

## Contents

5	Cod ( <i>Gadus morhua</i> ) in divisions 7.e-k (eastern English Channel and southern Celtic Seas) .....	126
5.1	Stock description and management units .....	126
5.1.1	Management applicable in 2022 and 2023 .....	126
5.1.2	Fishery .....	127
5.1.3	Information from the industry .....	128
5.2	Data .....	128
5.2.1	InterCatch procedure .....	128
5.2.2	Catches .....	128
5.2.3	Discards .....	129
5.2.4	Biological .....	130
5.2.5	Surveys and commercial tuning fleet .....	130
5.3	Stock assessment .....	131
5.3.1	Final update assessment (SAM) .....	131
5.3.2	State of the stock .....	132
5.4	Short-term projections .....	132
5.5	Medium-term projection .....	132
5.6	Biological reference points .....	133
5.7	Management plans .....	133
5.8	Uncertainties and bias in assessment and forecast .....	133
5.9	Recommendations for future developments .....	133
5.10	Management considerations .....	134
5.11	References .....	134
5.12	Tables .....	135
5.13	Figures .....	161





## 5 Cod (*Gadus 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 replaced 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 <i>Gadus morhua</i>	Zone:	7b, 7c, 7e-k, 8, 9 and 10; Union waters of CECAF 34.1.1 (COD/7XAD34)
Belgium	14	(1)	Analytical TAC
France	231	(1)	Article 8 of this Regulation applies
Ireland	336	(1)	Article 3 of Regulation (EC) No 847/96 shall not apply
Netherlands	0	(1)	Article 4 of Regulation (EC) No 847/96 shall not apply
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: <b>Cod</b> <i>Gadus morhua</i>	Zone: 7b, 7c, 7e-k, 8, 9 and 10; Union waters of CEEAF 34.1.1 (COD/7XAD34)	
Belgium	14 <sup>(1)</sup>	Analytical TAC
France	230 <sup>(1)</sup>	Article 8 of this Regulation applies
Ireland	335 <sup>(1)</sup>	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 <sup>(1)</sup>	
Union	579 <sup>(1)</sup>	
United Kingdom	65 <sup>(1)</sup>	
TAC	644 <sup>(1)</sup>	
<sup>(1)</sup> 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 métier and quarter, regardless of area and country. Unsampled BMS landings and Log-book Registered Discards are filled in using discards data employing as much as possible the same métier and quarter, regardless of area and country.

Low SSB, low recruitment, (selective device (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.

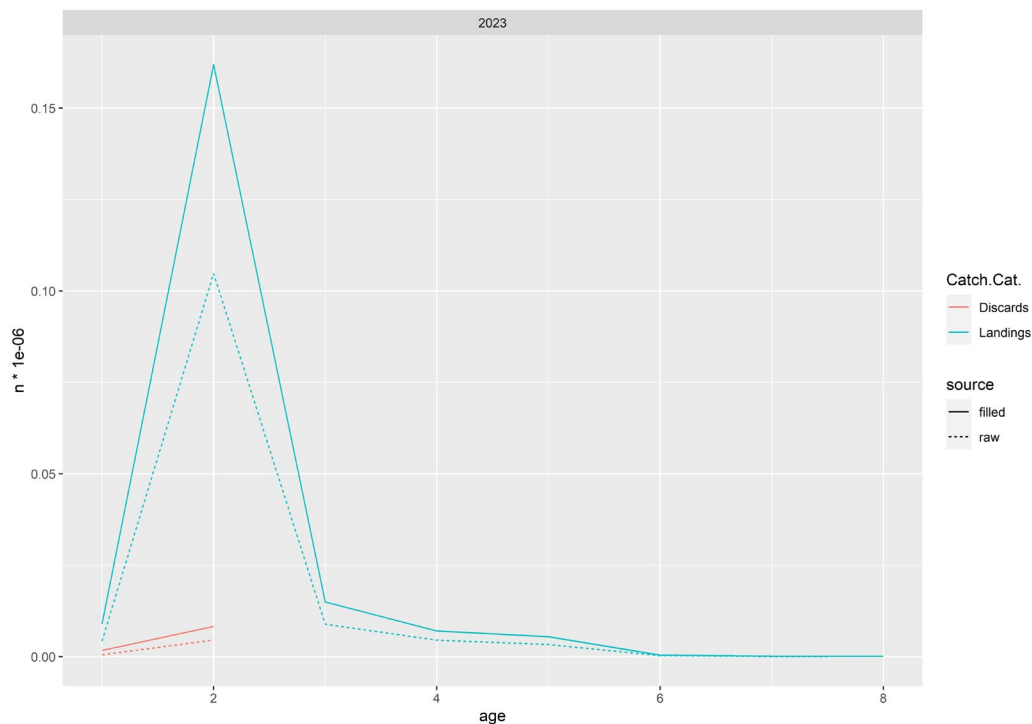
It is noticeable that this stock has always been composed of few age classes, even though Celtic Sea cod can live up to ten years (Table 5.2, Figure 5.10). While the catch are mainly composed of age 2 and 3 since 2000's, the strong year classes (2009, 2014) has contributed strongly to the catch at older 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 dataserries 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 WKCELTIC 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  $F_{bar(2-5)}$ , 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  $F_{MSY} \times SSB_{2024}/MSY$ ) and 60 tonnes (at  $F_{MSY} \times SSB_{2024}/MSY$ ), 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  $SSB \geq B_{lim}$  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**

YEAR	Beam_trawl_27.7ek		Trawl_27.7ek		Trawl_27.7e	
	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	<b>1</b>
-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
itransfIRARdist_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**

Frame-work	Reference point	Value	Technical basis	Source
MSY ap- proach	MSY $B_{trigger}$	5800	$B_{pa}$ ; in tonnes	ICES (2020)
	$F_{MSY}$	0.29	Segmented regression with $B_{lim}$ (EqSim).	ICES (2020)
Precau- tionary approach	$B_{lim}$	4200	$B_{loss}$ , lowest observed SSB from which there has been some recovery (2005).	ICES (2020)
	$B_{pa}$	5800	$B_{lim} \times 1.4$ ; 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 $SSB \geq B_{lim}$ with 95% probability	ICES (2020)
Manage- ment 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:me- dian	fbar:low	fbar:high	rec:me- dian	rec:low	rec:high	ssb:me- dian	ssb:low	ssb:high	catch:me- dian	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:me dian	fbar:lo w	fbar:high	rec:me dian	rec:lo w	rec:high	ssb:me dian	ssb:lo w	ssb:high	catch:me dian	catch:lo w	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	0.000	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:me dian	fbar:lo w	fbar:high	rec:me dian	rec:lo w	rec:high	ssb:me dian	ssb:lo w	ssb:high	catch:me dian	catch:lo w	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:me dian	fbar:lo w	fbar:high	rec:me dian	rec:lo w	rec:high	ssb:me dian	ssb:lo w	ssb:high	catch:me dian	catch:lo w	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:me dian	fbar:lo w	fbar:hig h	rec:me dian	rec:lo w	rec:hig h	ssb:me dian	ssb:lo w	ssb:hig h	catch:me dian	catch:lo w	catch:hig h
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:me dian	fbar:lo w	fbar:hig h	rec:me dian	rec:lo w	rec:hig h	ssb:me dian	ssb:lo w	ssb:hig h	catch:me dian	catch:lo w	catch:hig h
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:me dian	fbar:lo w	fbar:hig h	rec:me dian	rec:lo w	rec:hig h	ssb:me dian	ssb:lo w	ssb:hig h	catch:me dian	catch:lo w	catch:hig h
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:me dian	fbar:lo w	fbar:hig h	rec:me dian	rec:lo w	rec:hig h	ssb:me dian	ssb:lo w	ssb:hig h	catch:me dian	catch:lo w	catch:hig h
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:me dian	fbar:lo w	fbar:hig h	rec:me dian	rec:lo w	rec:hig h	ssb:me dian	ssb:lo w	ssb:hig h	catch:me dian	catch:lo w	catch:hig h
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 <sub>total</sub> (2025)	SSB (2026)	% SSB change*	% TAC change **	Probabil-ity of SSB (2026) <Blim(%)	% Advice change ^
ICES advice basis							
MSY approach: F = 0	0	0	2040	202	-100	91	
Other scenarios							
F <sub>MSY</sub> × SSB <sub>2025</sub> /MSY B <sub>trigger</sub>	42	0.034	1976	192	-93	92	
EU MAP***: F <sub>MSY lower</sub> × SSB <sub>2025</sub> /MSY B <sub>trigger</sub>	25	0.020	1998	196	-96	92	
EU MAP***: F <sub>MSY upper</sub> × SSB <sub>2025</sub> /MSY B <sub>trigger</sub>	60	0.048	1946	188	-91	93	
F = F <sub>MSY</sub>	324	0.290	1556	130	-50	97	
F = F <sub>MSY lower</sub>	201	0.170	1740	157	-69	95	
F = F <sub>MSY upper</sub>	436	0.410	1393	106	-32	98	
F = F <sub>lim</sub>	909	1.130	733	8	41	100	
F = F <sub>pa</sub>	707	0.770	1005	49	10	100	
SSB <sub>2026</sub> = SSB <sub>2025</sub>	953	1.221	676	0	48	100	
F = F <sub>2024</sub>	739	0.821	961	42	15	99	
SSB <sub>2026</sub> = B <sub>lim</sub> ****							
SSB <sub>2026</sub> = B <sub>pa</sub> = MSY B <sub>trigger</sub> ****							

**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

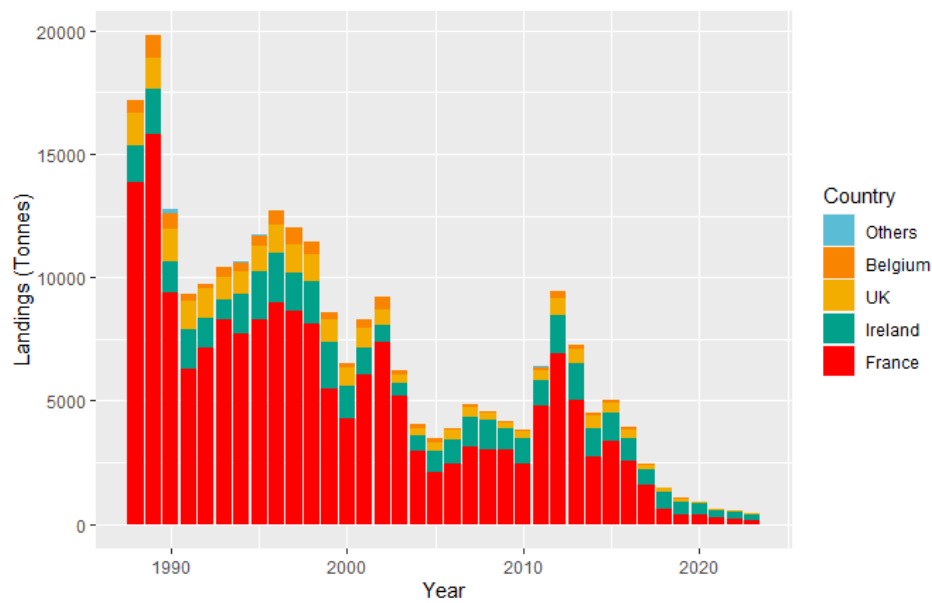


Figure 5.1. Cod in Divisions 7e-k. Historical landings (in Tonnes) by country. Revised at WKCETIC 2020

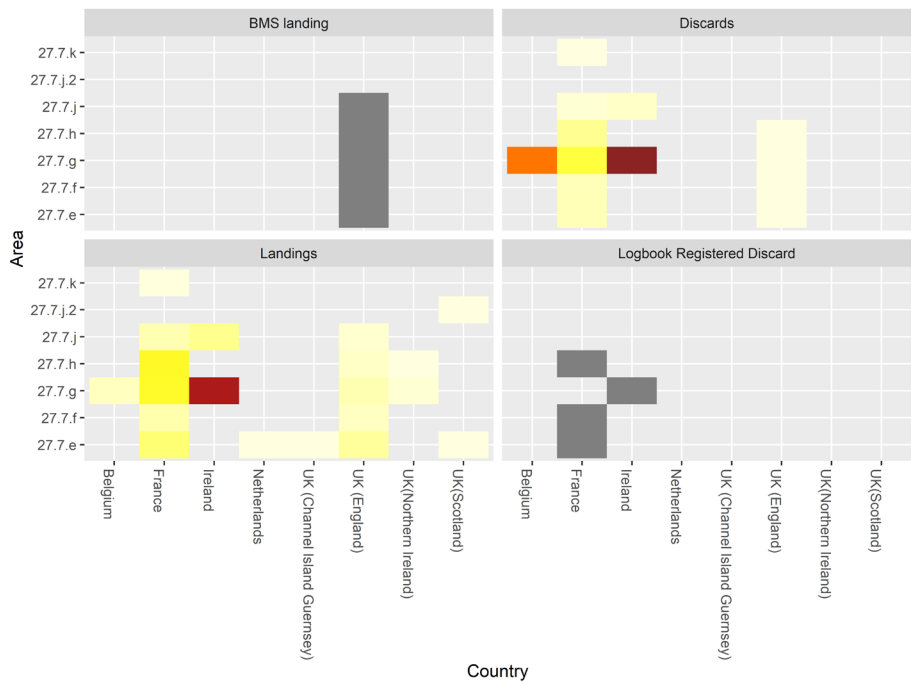


Figure 5.2. Cod in Divisions 7e-k. Catches volume in Tonnes (i.e.landings and discards) by area and country in 2023.

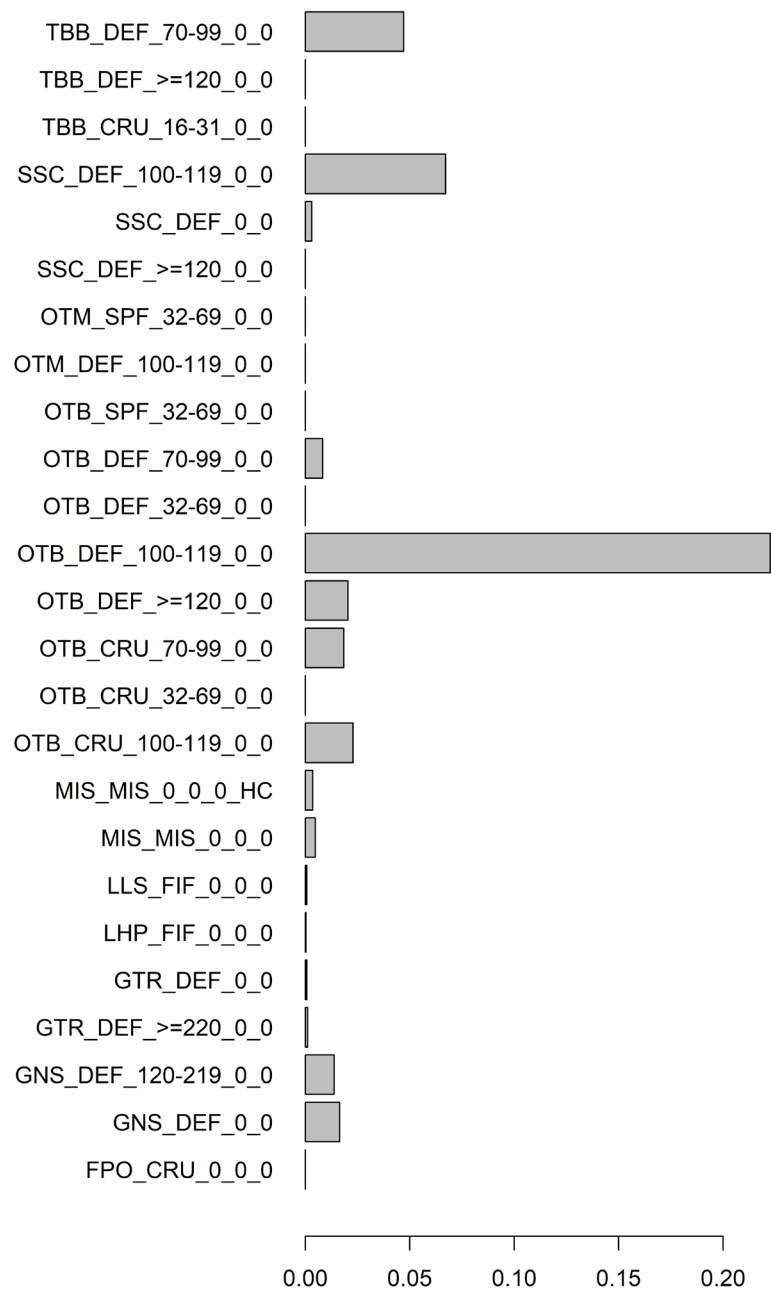


Figure 5.3. Cod in Divisions 7e-k. Proportion of landings per métier (Level 6) in 2023



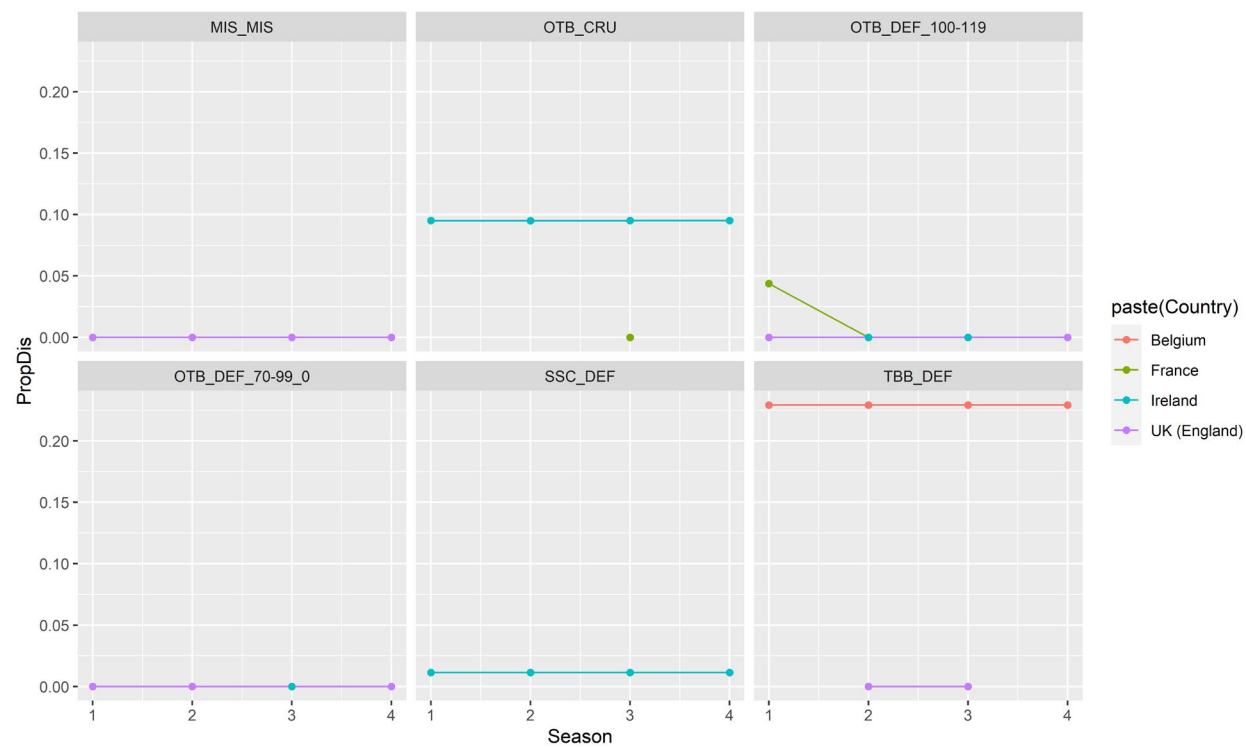


Figure 5.4. Cod in Divisions 7e-k. Discard proportion per fleet and season in 2023.

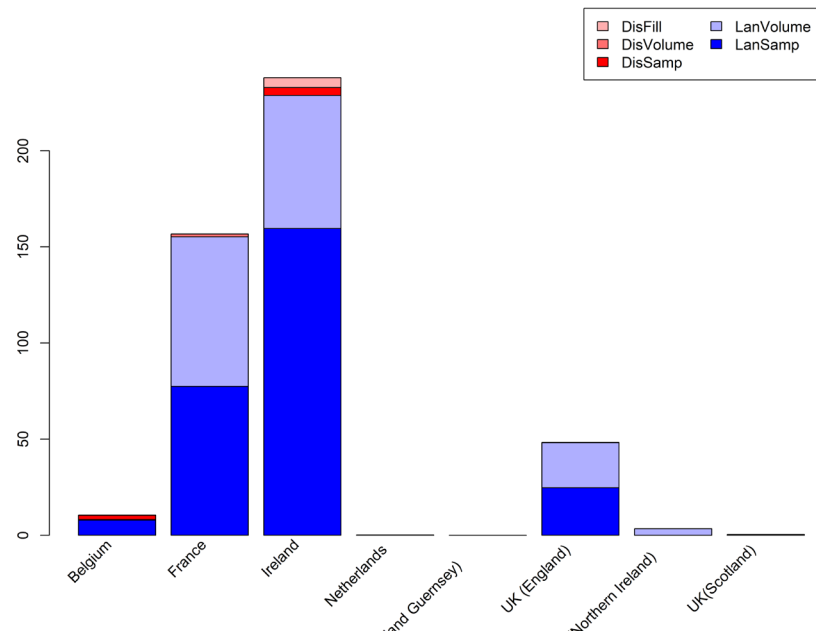


Figure 5.5. Cod in Divisions 7e-k. Allocation procedure in 2023.

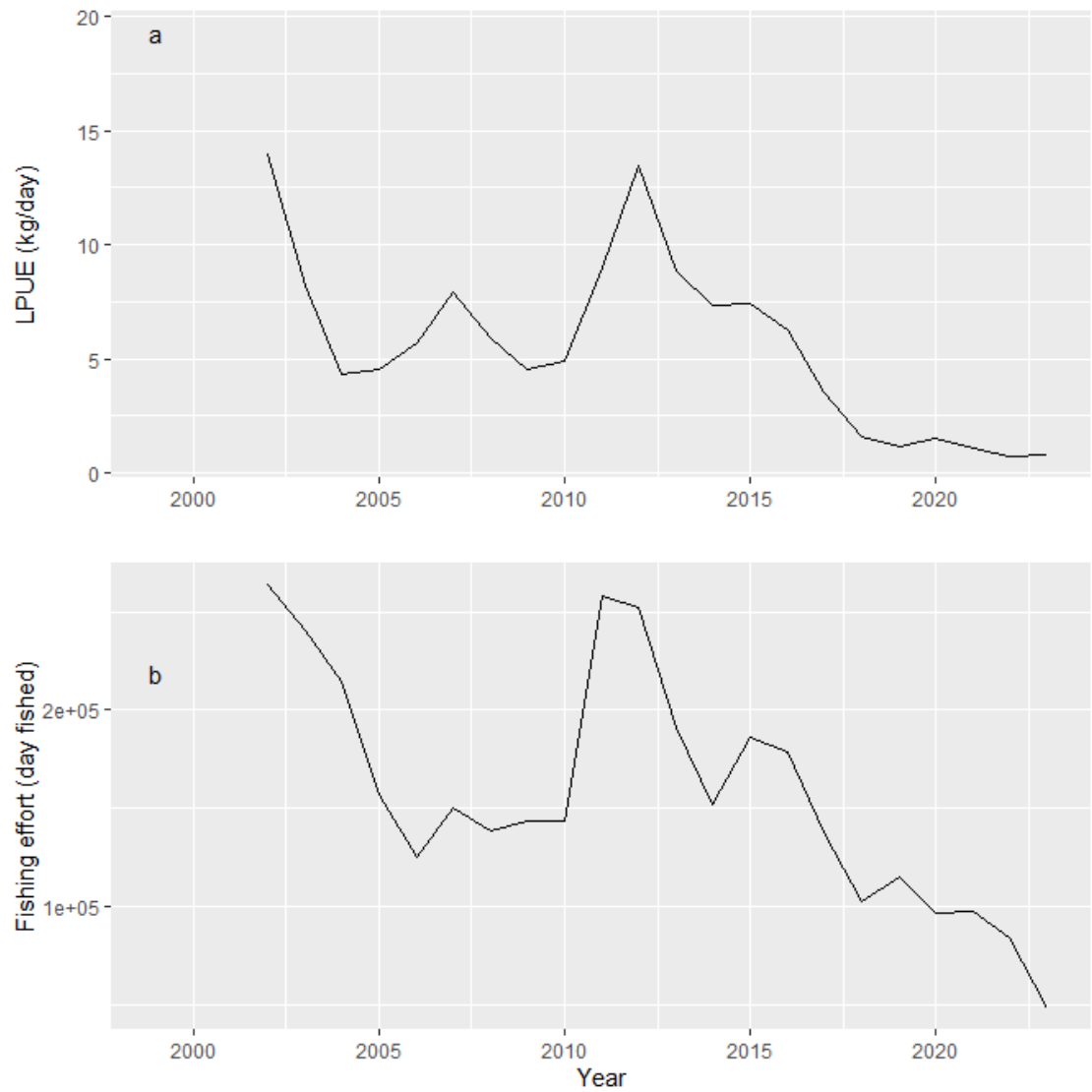


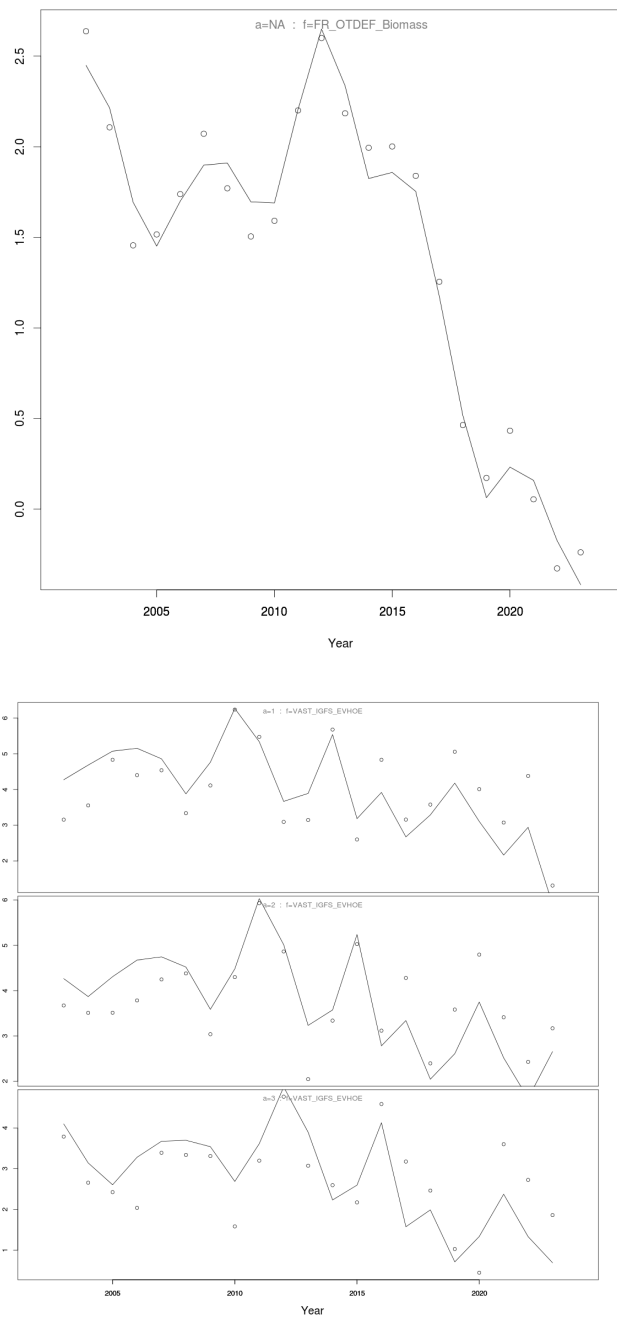
Figure 5.6a. Cod in Divisions 7e-k. Time series of (a) LPUE and (b) fishing effort for the French fleets. Units: LPUE in kg/day and fishing effort in days fished.



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

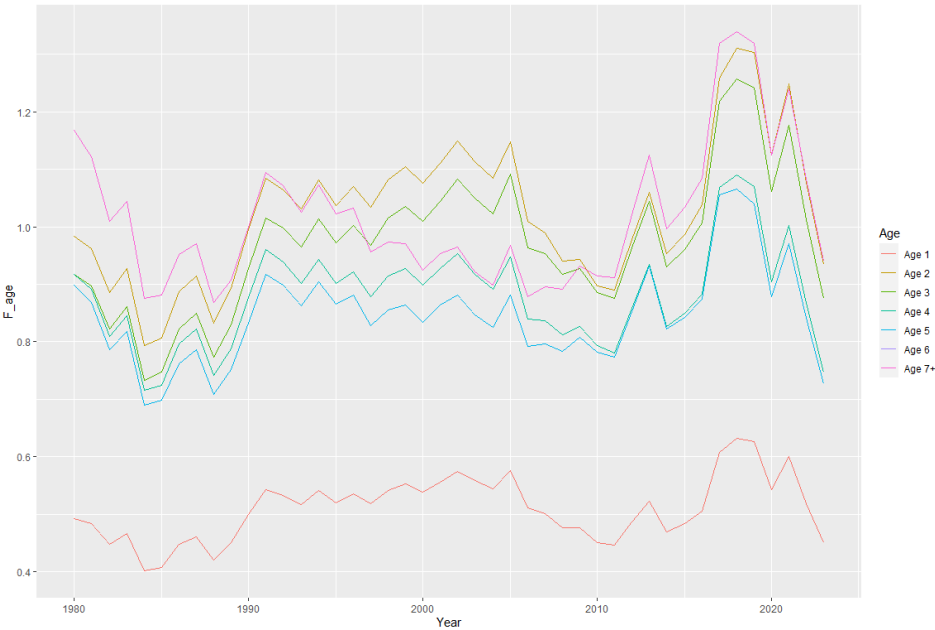
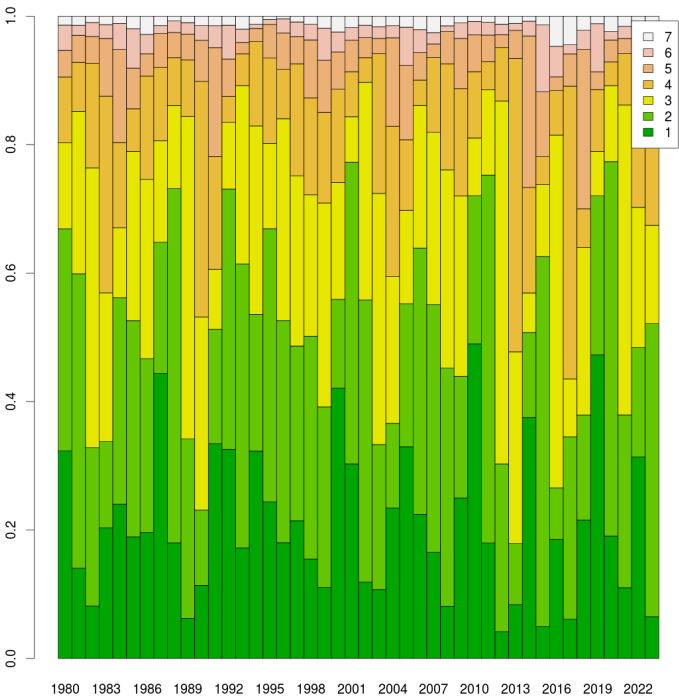


Figure 5.9. Cod in Divisions 7e-k.Fishing mortality at age.



stockassessment.org, Cod\_7e\_k\_2024\_preliminary, r18192, gt: e38ae2b4890

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

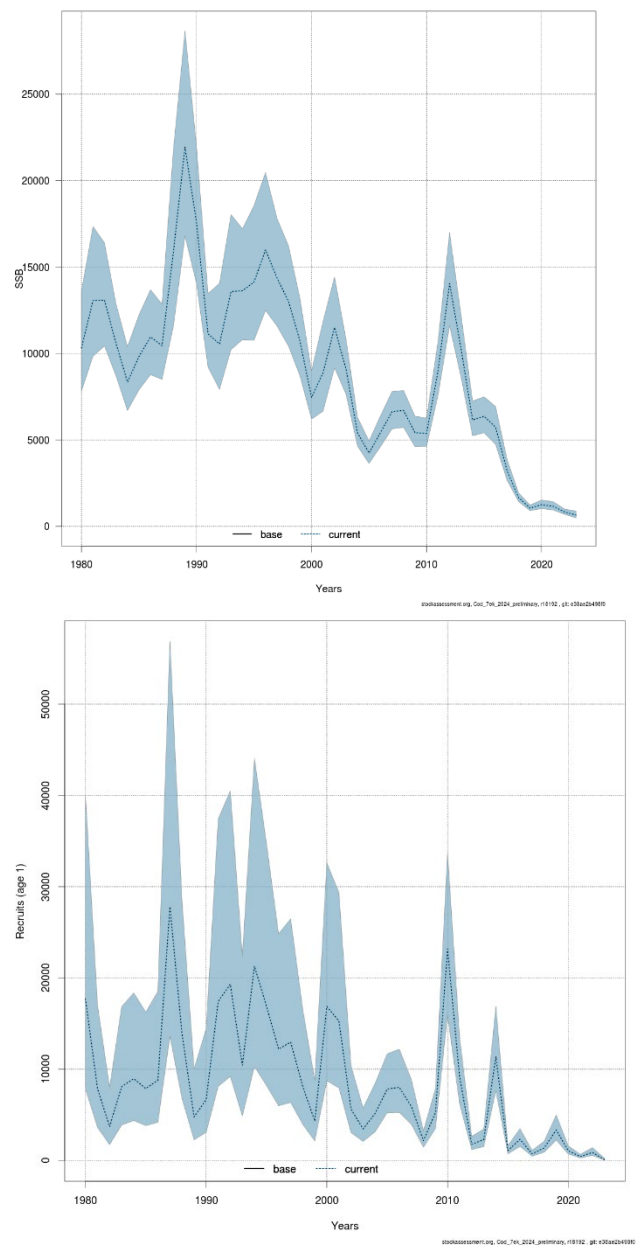


Figure 5.11. Cod in Divisions 7e-k. Final SAM outputs. SSB , R and F estimates.



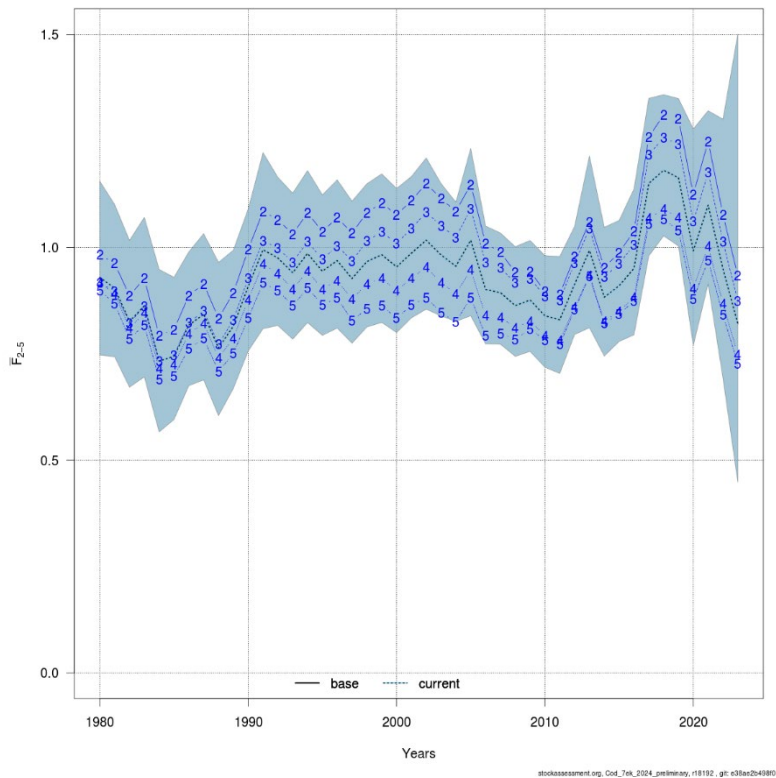


Figure 5.11. continued Cod in Divisions 7e-k. Final SAM outputs. SSB , R and F estimates.

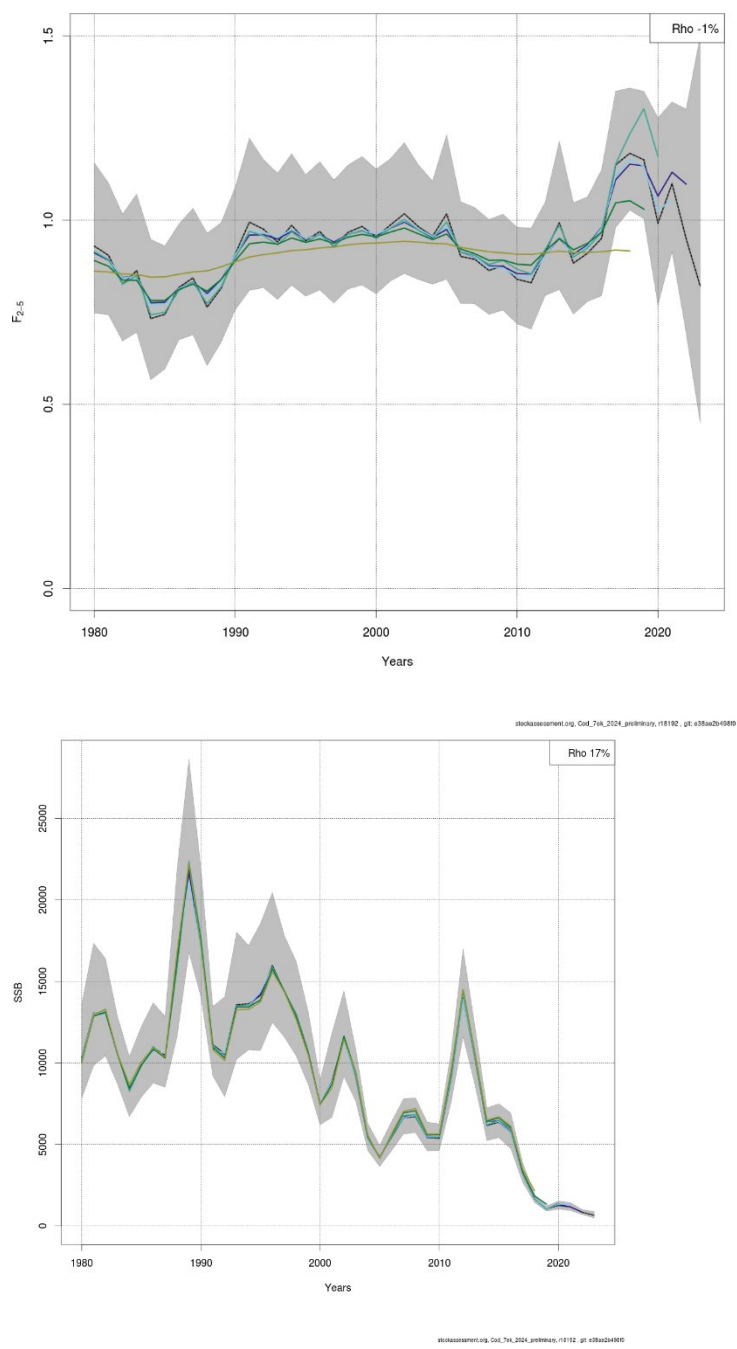


Figure 5.12a. continued. Cod in Divisions 7e-k. Final SAM. Retrospective plots

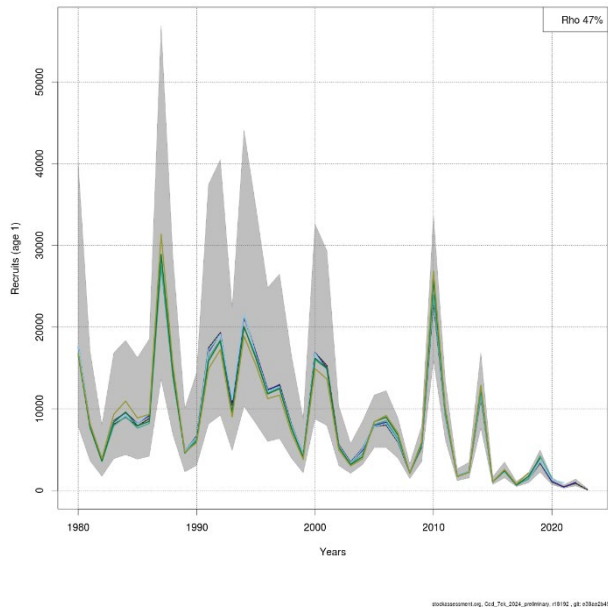
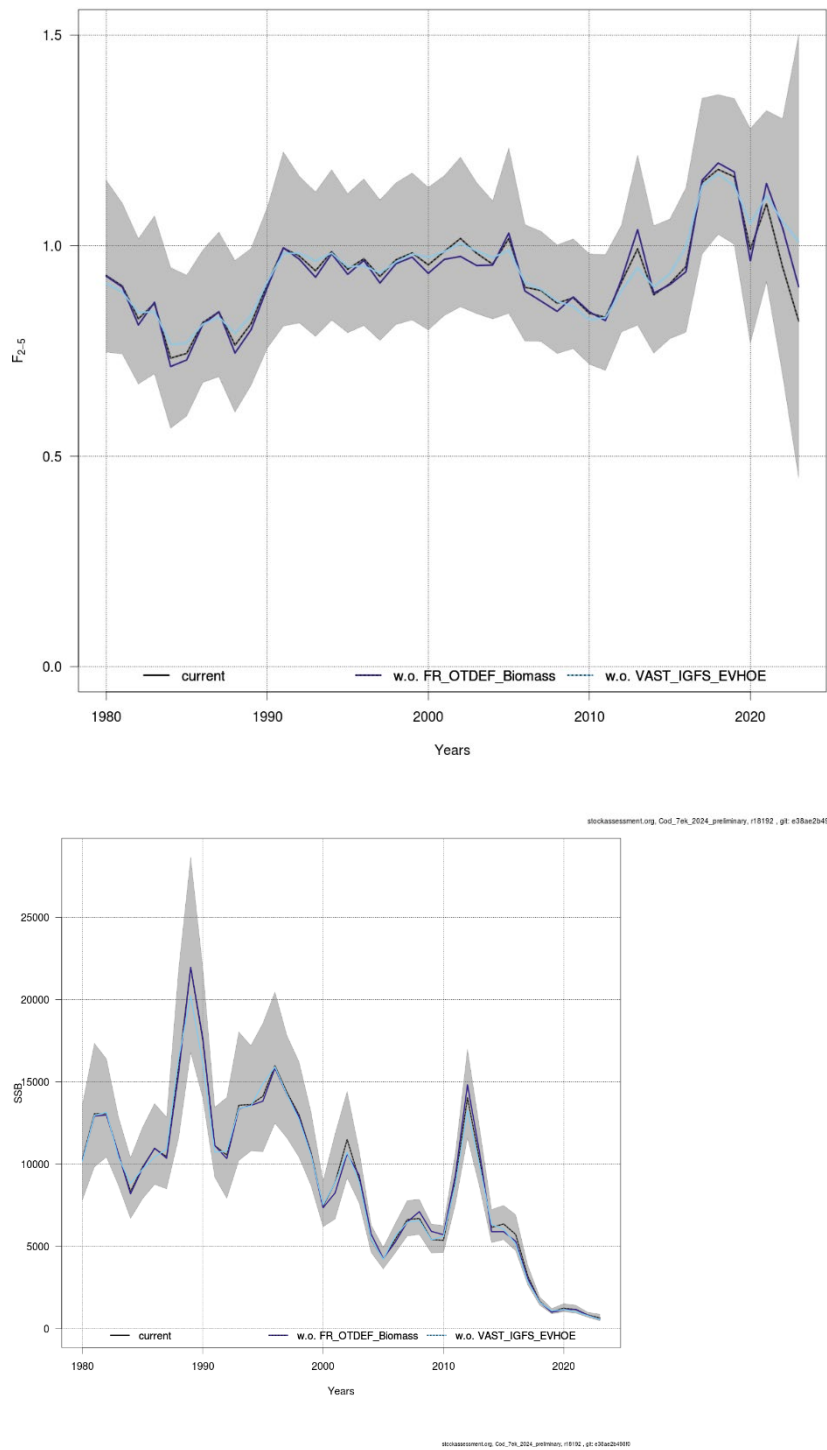
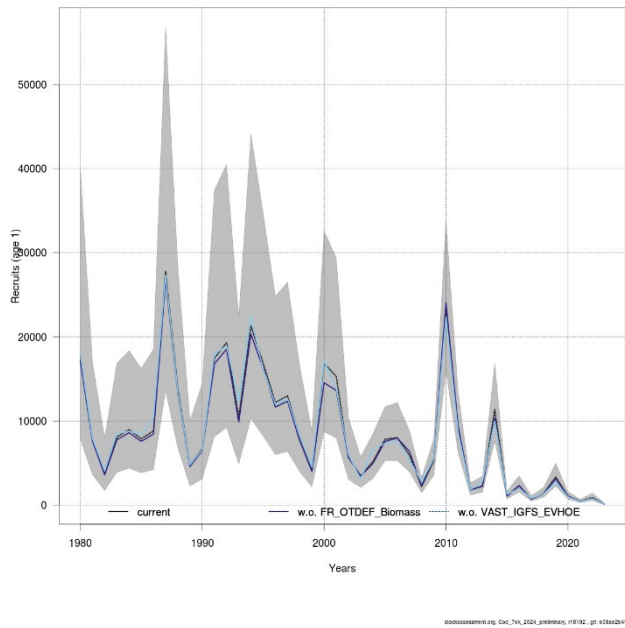


Figure 5.12a. continued. Cod in Divisions 7e-k. Final SAM. Retrospective plots



**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)**

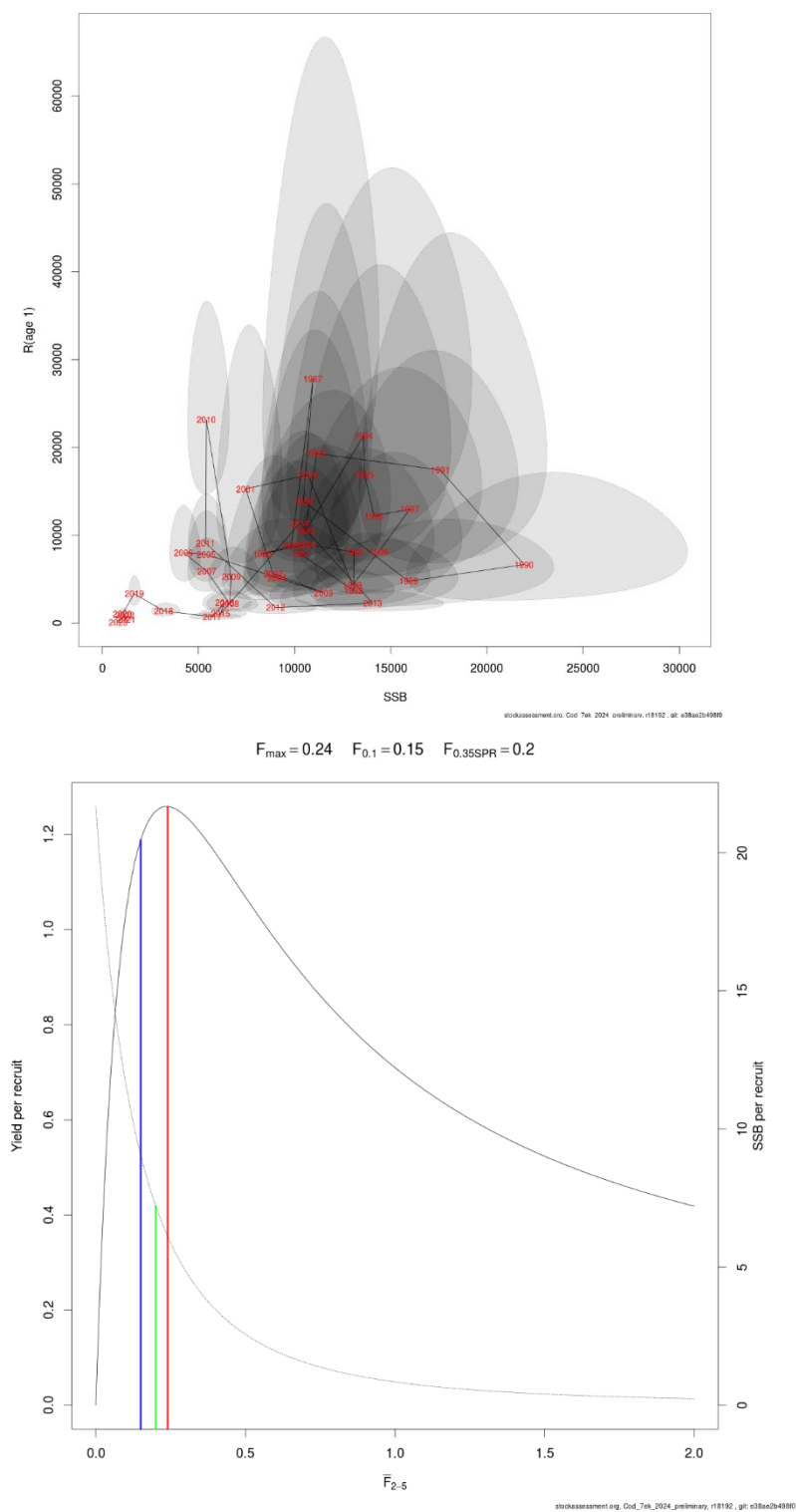


Figure 5.13. Cod in Divisions 7e-k. Stock\_recruitment plots and yield per recruits information.

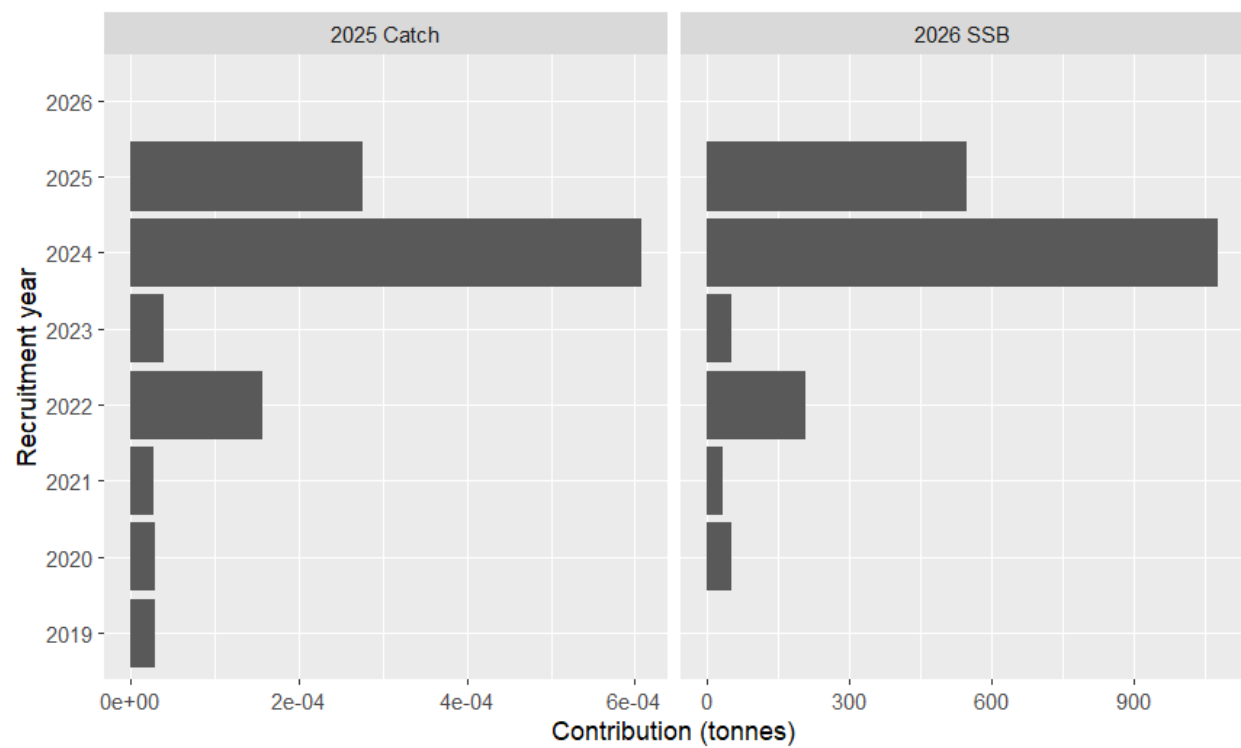


Figure 5.14. Cod in Divisions 7e-k. Forecast (a) catch in 2025 and (b) SSB in 2026.