Contents

5 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 50 m 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 275 m 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, 2022a) the recreational fishery was included in the assessment for the first time.

Type of assessment

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

ICES advice applicable to 2021 and 2022

ICES advised on the basis of precautionary approaches that there should be no directed fisheries, and bycatch and discards should be minimized in 2021 and 2022. Advice since 2020 was applied based on the on the 2 over 3 rule for category 3.

ICES advice applicable to 2023

ICES advised on the basis of the MSY and precautionary approach that there should be zero catches in 2023 as SSB will be below B_{lim} in 2023 and 2024.

5.1 General

Stock description and management units

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

Management applicable to 2021

TACs and quotas set for 2021

	TAC	Landed
Belgium	3	2.8
France	7	0
Ireland	104	41.8
The Netherlands	1	0
United Kingdom	91	88.7
EU (total)	115	44.6
Total	206	133.3

Management of this cod fishery is by TAC, days-at-sea limits and technical measures. Technical regulations in force in the Irish Sea, including those associated with the cod recovery plan since 2000, are described in Section 5.2.

Quota uptake in 2021 was considerably below the officially set TAC of 206 tonnes.

Table 1. Fishing opportunities (TAC) for 2022 for cod in 27.7.a.

Species:	Cod *Gadus morhua*		Zone: 7a (COD/07A.)
Belgium	3	(1)	Precautionary TAC Article 7(1) of this Regulation applies
France	7	(1)	
Ireland	104	(1)	
Netherlands	1	(1)	
Union	115	(1)	
United Kingdom	91	(1)	
TAC	206	(1)	

(1) Exclusively for bycatches. No directed fisheries are permitted under this quota.

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021R1239.

Fishery in 2021

Landings in accordance with TAC were below the TAC, however, the TAC in 2021 was considerably higher than the ICES advised value of 74 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 2021 were 133 tonnes after this re-allocation and total catches in the area were 184 t.

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
2015	39
2016	40
2017	19
2018	20
2019	37
2020	71
2021	52

The majority of landings in 2021 was taken by the *Nephrops* fleet, followed by the midwater demersal fleet. Landings and discards by métier and country can be seen in Table 8. Total uptake of cod TAC was 65%.

A Fishery–Science Partnership Survey (FSP) was repeated in the western Irish Sea in spring 2021 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.

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.

Landings

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

1. 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.
2. 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.
3. 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.
4. 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.
5. 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.
6. 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* catches. However, no cod were found in the provided self samples.

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.

Discards data

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

Biological data

Natural mortality

Natural mortality has been revised in WKNSCS (ICES, 2022a). M-at-age was calculated from tagging data following calculated following (Pollock, Hoenig *et al.*, 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 for a description of the surveys and survey data.

Survey	Ages	Years
FSP SURVEY (B7897)	2–6	2004–2021 (EXCLUDING 2014)
NIGFS-WIBTS-Q4 (G7655)	0	1995–2021
NIGFS-WIBTS-Q1 (G7144)	1–4	1995–2021

5.2 Historical stock development

The advice is based on the newly benchmarked assessment (WKNSCS, ICES 2022a).

Deviations from Stock Annex

During the benchmark process kept and assumed dead (i.e. 35% of released fish) removals from the recreational fishery were included in the assessment. There was considerable discussion regarding the introduction of the recreational fishery, which was in the range of 30 tonnes for each of the available data year 2017–2020. The benchmark agreed and reviewed a) a model excluding the recreational data due to issues with uncertainty of data and insufficient information of a selectivity pattern and b) combine the recreational removals with the total commercial catches, using the same selectivity pattern. With a view on a possible increase of the recreational component over the next few years with decreasing commercial fishing pressure, the benchmark decided that it would be beneficial to go for approach b to enable the incorporation of future recreational removals. The differences in SSB, F_{bar} and general perception of the stock were negligible.

In preparation for the working-group it became apparent that the values estimated for the recreational fleet ahead of the benchmark contained a data error and are now indeed estimated at approximately 120–150 tonnes for each of the year 2017–2021, similar levels to the commercial catches.

There are high uncertainties around the recreational removals and the values largely diverge from the benchmarked values.

The benchmark had agreed on a model excluding the recreational catches and passed the model as fit to benchmark and considered the inclusion of the recreational data only as a way to include them in times of increase in relation to commercial catches. In light of the data error the WGCSE working group therefore decided in this instance to exclude all recreational removals from the model.

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 6 and Table 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 11 and Figure 12) as well as the individual residuals. Further 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 F_{bar} at 0.09 and -0.14 respectively (Figure 13).

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

Final assessment: long-term trends

5.3 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 2002–2019 (Final year-2), which encompasses the block where recruitment is supposedly reduced.

Table 3. Short-term forecast assumptions.

Variable	Value	Notes
$F_{ages\ 2\text{–}4}$ (2022)	0.038	$F_{sq} = F_{average(2018\text{–}2021)}$ *
SSB (2023)	4842	Short-term forecast fishing at f_{sq}; in tonnes.
$R_{age\ 0}$ (2022 and 2023)	17 989	Geometric Mean (2002–2019); in thousands
Total catch (2022)	165	Fishing at F_{sq}; in tonnes
Projected landings (2022) ((2022)((20(2022(2020)	159	Assuming average landing patterns (2019–2021); in tonnes
Projected discards (2022)	6	Assuming average discard patterns (2019–2021); in tonnes

*** F in 2020 was assumed to be unrepresentative due to the COVID-19 disruption and hence F_{sq} was calculated as $F_{average}$ (2018–2021) excluding 2020.**

Table 4 shows the catch scenarios, in particular the zero catch advice and the scaled MSY advices due to SSB being below $MSY_{Btrigger}$ and unable to reach B_{lim} even under a no-catch scenario. The newly introduced F_{ECO} (ICES, 2022a) 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 0.19.

Table 4. Catch scenarios for 2023; all weights are in tonnes.

Basis	Total catch (2023)	Projected landings (2023)	Projected discards (2023)	F_{total} (2023)	$F_{projected\ landings}$ (2023)	$F_{projected\ discards}$ (2023)	SSB (2024)	% SSB change *	% TAC change ^	% Advice change^^
ICES advice basis										
MSY approach: F = 0	0	0	0	0	0	0	5410	11.7	-100	-100
Other scenarios										
F_{MSY} × SSB (2023)/MSY $B_{trigger}$	403	382	21	0.093	0.090	0.0036	4988	3.0	96	440
$F_{MSY\ lower}$ × SSB (2023) / MSY $B_{trigger}$	308	292	16	0.071	0.068	0.0027	5087	5.1	50	320
F = $F_{MSY\ lower}$	704	667	37	0.168	0.162	0.0065	4677	-3.4	240	850
F = F_{MSY}	908	861	48	0.22	0.21	0.0086	4466	-7.8	340	1130
F = F_{pa}	1011	958	53	0.25	0.24	0.0097	4362	-9.9	390	1270
F = $F_{MSY\ upper}$	1093	1035	58	0.27	0.26	0.0106	4278	-11.7	430	1380
F = F_{2022}	170	161	9	0.038	0.037	0.00148	5232	8.0	-17.5	130
F = F_{lim}	1612	1526	86	0.43	0.41	0.0166	3754	-22	680	2100
F=F_{ECO}	788	747	41	0.19	0.183	0.0074	4589	-5.2	280	960
F_{ECO}× SSB (2023) / MSY $B_{trigger}$	347	329	18	0.080	0.077	0.0031	5047	4.2	68	370
SSB (2024) = SSB (2023)	544	516	28	0.128	0.123	0.0049	4842	0	160	640
SSB (2024) = B_{lim} **										

*** SSB 2024 relative to SSB 2023.**

**** The B_{lim} option was left blank because B_{lim} cannot be achieved in 2024, even with zero catches.**

^ Total TAC in 2023 relative to the TAC in 2022 (206 tonnes).

^^ Total Advice in 2023 relative to advice in 2022 (74 tonnes).

5.4 Biological reference points

New reference points were defined at WKNSCS (ICES, 2022a). The newly introduced F_{ECO} (ICES, 2022a) 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, 2022a). In case of cod in 7.a 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

(Is) in the advice year compared with previous years. The status of the indicator determines the placement of the FECO reference point within F_{MSY} ranges (ICES, 2019; 2020); for 2023 FECO is at 0.19, estimated as F_{MSY} lower + ((F_{MSY} upper–F_{MSY} lower)*Is).

Table 5. Biological reference points.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	11 538	B_{pa}	ICES, 2022a
	F_{MSY}	0.222	Median point estimates of (F_{MSY}) EqSim with combined SR	ICES, 2022a
	$F_{MSY\ lower}$	0.168	Median lower estimates of (F_{MSY}) EqSim with combined SR	ICES, 2022a
	$F_{MSY\ upper}$	0.273	Median upper point estimates of (F_{MSY}) EqSim with combined SR	ICES, 2022a
	F_{ECO}	0.19	Ecosystem Indicator (I_S); $F_{ECO} = F_{MSY\ lower} + ((F_{MSY\ upper} - F_{MSY\ lower})*I_s)$	ICES, 2022a
Precautionary approach	B_{lim}	8303	Lowest SSB with above-average recruitment	ICES, 2022a
	B_{pa}	11 538	B_{lim} combined with the assessment error	ICES, 2022a
	F_{lim}	0.43	F with 50% probability of SSB less than B_{lim}	ICES, 2022a
	F_{pa}	0.25	F_{P05}; the F that leads to SSB > B_{lim} with 95% probability	ICES, 2022a

5.5 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 (WGCSE 2009).

5.6 Uncertainties and bias in assessment

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 Q 4 groundfish survey only attributes to the recruitment at age 0.

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 (ICES, 2021). 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.

5.7 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 since 2020. Since 2022 the stock is being assessed using an MSY approach; however, low SSB and the incapability of reaching B_{lim} by 2024 even under with zero catches lead to a zero catch advice for 2023.

5.8 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 7.a and 7.e–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.

5.9 References

Armstrong, M. J., Gerritsen, H. D., Allen, M., McCurdy, W. J. and Peel, J. A. D. 2004. Variability in maturity and growth in a heavily exploited stock: cod (*Gadus morhua* L.) in the Irish Sea. ICES J. Mar. Sci., 61, 98–112.

Bendall, V. O., Ó´Cuaig, M., Schon, P-J., Hetherington, S., Armstrong, M., Graham, N., Righton, D. 2009. Spatio-temporal dynamics of Atlantic cod (*Gadus morhua*) in the Irish and Celtic Sea: results from a collaborative tagging programme. ICES Document CM 2009/J: 06. 35 pp.

Carvalho, F.,Winker, H. Courtney, D., Kapur, M., Kell, L., Cardinale, M., Schirripa, M., Kitakado, T., Yemane, D., Piner, K.R., Maunder, M.N., Taylor, I., Wetzel, C.R., Doering, K., Johnson, K.F.,Methot, R.D. 2021. A cookbook for using model diagnostics in integrated stock assessments. Fisheries Research 240.

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: 1–17. http://data.europa.eu/eli/reg/2019/472/oj

Hoenig, J. M., *et al*. 1998. "Multiyear tagging studies incorporating fishing effort data." Canadian Journal of Fisheries and Aquatic Sciences **55**(6): 1466–1476.

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. 165 pp.

ICES. 2019. Working Group on Multispecies Assessment Methods (WGSAM). ICES Scientific Reports. 1:91. 320 pp. http://doi.org/10.17895/ices.pub.5758.

ICES. 2020. Workshop on an Ecosystem Based Approach to Fishery Management for the Irish Sea (WKIrish6; outputs from 2019 meeting). ICES Scientific Reports. 2:4. 32 pp. http://doi.org/10.17895/ices.pub.5551.

ICES. 2021a. Advice on fishing opportunities. *In* Report of the ICES Advisory Committee, 2021. ICES Advice 2021, section 1.1.1. https://doi.org/10.17895/ices.advice.7720.

ICES. 2022a. Benchmark Report WKNSCS (WKNSCS). Draft report. ICES Scientific Reports.

Pollock, K. H., *et al*. 1989. Estimation of fishing and natural mortality when a tagging study is combined with a creel survey or port sampling, North Carolina State University. Dept. of Statistics.

Table 6. Official landings (t) 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	Nether-lands	Spain	UK (England Wales, & NI)	UK (Isle of Man)	UK (Scotland)	Total	Landings in rectan-gles 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	Nether-lands	Spain	UK (England Wales, & NI)	UK (Isle of Man)	UK (Scotland)	Total	Landings in rectan-gles 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	76	-	-	95	< 1	< 1	252	71	181	25
2021*	3	0	93	-	-	89	<1	<1	184	52	133	4

*** 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

b)

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	UK	Ireland	France	Belgium	Netherlands	Total
Landings	41	38	0.2	5	0	84
TAC	42	97	5	2	0	146
% uptake	98%	39%	4%	250%	0%	

2018	UK	Ireland	France	Belgium	Netherlands	Total
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%

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	**UK**	**Ireland**	**France**	**Belgium**	**Netherlands**	**Total**
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	**UK**	**Ireland**	**France**	**Belgium**	**Netherlands**	**Total**
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%

Table 8. Landings and discard proportions by métier.

Catch (2021)	Landings				
137 tonnes	otter trawls		midwater trawl	beam trawls	other gear types
	Nephrops directed 33%	demersal fish directed 37%	18.7%	9.4%	1%
	133 tonnes				
	Discards				
	otter trawls		midwater trawl	beam trawls	other gear types
	77% *Nephrops* directed	<1% demersal fish directed	<1%	22%	1%
	4 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
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

Year	0	1	2	3	4	5	6+
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
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

Year	0	1	2	3	4	5	6+
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
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

***Excluded from assessment as very low sampling.**

Table 10. Mean weights-at-age in the landings (used for whole stock and catch). *wean weight at age in landings only available for Q1, hence considerably lower than previous years and only used for forecast.

	0	1	2	3	4	5	6+
1968	0.1	0.61	1.66	3.33	5.09	6.19	6.86
1969	0.1	0.61	1.66	3.33	5.09	6.19	7.26
1970	0.1	0.61	1.66	3.33	5.09	6.19	7.17
1971	0.1	0.61	1.66	3.33	5.09	6.19	7.12
1972	0.1	0.61	1.66	3.33	5.09	6.19	7.28
1973	0.1	0.61	1.66	3.33	5.09	6.19	7.16
1974	0.1	0.61	1.66	3.33	5.09	6.19	7.34
1975	0.1	0.61	1.66	3.33	5.09	6.19	7.05
1976	0.1	0.61	1.66	3.33	5.09	6.19	7.13
1977	0.1	0.61	1.66	3.33	5.09	6.19	7.63
1978	0.1	0.61	1.66	3.33	5.09	6.19	7.19
1979	0.1	0.61	1.66	3.33	5.09	6.19	7.48
1980	0.1	0.61	1.66	3.33	5.09	6.19	6.87
1981	0.1	0.61	1.66	3.33	5.09	6.19	7.55
1982	0.1	1.01	1.52	3.49	5.57	7.59	9.11
1983	0.1	1	1.84	3.99	5.96	7.97	9.97
1984	0.1	0.68	1.81	3.81	5.87	7.48	10.05
1985	0.1	0.78	2.02	4.24	5.83	7.5	9.04
1986	0.1	0.81	1.83	3.86	5.86	7.39	8.78

	0	1	2	3	4	5	6+
1987	0.1	0.71	2.16	3.91	6.41	7.82	10.32
1988	0.1	0.61	1.56	3.76	5.67	8.02	9.88
1989	0.1	0.94	1.85	3.22	5.41	6.57	9.47
1990	0.1	0.84	1.94	3.57	5.28	7.53	9.4
1991	0.1	0.86	1.64	3.54	5.42	6.39	9.11
1992	0.1	0.81	1.96	3.99	5.98	6.92	8.67
1993	0.1	0.85	1.71	3.67	5.68	7.37	10.17
1994	0.1	0.8	1.92	3.61	6.08	7.68	8.57
1995	0.1	0.9	1.84	4.00	5.79	8.45	9.14
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

	0	1	2	3	4	5	6+
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	0.22	1.29	3.67	5.23	7.85	9.54
2021	0.1	0.187	1.831	4.164	6.485	8.64	7.25

Table 11. Estimates of numbers discarded (a) and the discarded proportions (b) from 1968–2021. 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, 2017a) 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
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

Year	0	1	2	3	4	5	6+
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
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

Year	0	1	2	3	4	5	6+
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
2020*	NA						
2021	0	10.6	6.1	0	0	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
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

Year	0	1	2	3	4	5	6+
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
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

Year	0	1	2	3	4	5	6+
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
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

NA= not available.

***Data for are unavailable due to restricted discard sampling.**

Table 12. Maturity ogive updated for 2021. Prior to 1995 maturity was considered constant.

Year	1	2	3+
1996	0	0.27	1
1997	0	0.275415	1
1998	0	0.339514	1
1999	0	0.402555	1
2000	0	0.464725	1
2001	0	0.526111	1
2002	0	0.585231	1
2003	0	0.623356	1
2004	0	0.65373	1
2005	0	0.676757	1
2006	0	0.691103	1
2007	0	0.697111	1
2008	0	0.700228	1
2009	0	0.704985	1
2010	0	0.707035	1
2011	0	0.704413	1
2012	0	0.700372	1
2013	0	0.702394	1

Year	1	2	3+
2014	0	0.708485	1
2015	0	0.716712	1
2016	0	0.726138	1
2017	0	0.735987	1
2018	0	0.745951	1
2019	0	0.756372	1
2020	0	0.74887	1
2021	0	0.75601	1

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

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

year	c.v.	1	2	3	4
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

Northern Irish Groundfish Quarter 4

year	c.v.	0
1995	0.54163	6.66
1996	0.430336	12.519
1997	0.720571	2.345
1998	0.914513	0.047
1999	0.637233	6.734
2000	0.785349	6.212
2001	0.830289	4.863
2002	0.895678	0.123
2003	0.707142	6.746
2004	0.939137	3.663
2005	0.805428	8.144
2006	0.871324	1.16
2007	1.277817	0.067
2008	1.422627	0.185
2009	0.938364	5.356
2010	1.332794	2.779
2011	0.919446	0.084
2012	1.256171	1.924
2013	0.933411	11.208
2014	0.792604	0.121
2015	0.872952	2.244
2016	1.063181	0.149
2017	0.815541	4.291
2018	1.419523	0.685
2019	1.266571	0.072
2020	1.386682	0.072
2021	1.610235	0.335

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

Q1 groundfish survey CPUE and SD used in the assessment.

Year	CPUE	SD
1995	0.955344	0.214285
1996	1.728974	0.313405
1997	1.391875	0.217769
1998	1.435543	0.198929
1999	1.597456	0.255936
2000	1.023321	0.146161
2001	1.491194	0.224681
2002	2.619399	0.964573
2003	1.696543	0.235312
2004	0.764752	0.139312
2005	0.890243	0.267329
2006	0.508091	0.07914
2007	0.46498	0.104631
2008	0.501744	0.098636
2009	0.494051	0.141257
2010	0.71933	0.129658
2011	1.204889	0.364965
2012	1.017556	0.179033
2013	1.074564	0.205801
2014	1.089111	0.274391
2015	1.785167	0.26655
2016	1.374257	0.246976
2017	1.029783	0.30429
2018	0.631522	0.11959
2019	0.816597	0.221725
2020	0.492889	0.177333
2021	0.476304	0.122131

Table 14. Assessment summary.

Year	Recruitment age 0			SSB			Landings	Discards	Fishing mortality ages 2–4		
	Value	High	Low	Value	High	Low			Value	High	Low
1968	184549	250405	118693	46341	57748	34934	8541	1285	0.108	0.156	0.059
1969	248327	326531	170123	41512	52782	30242	7991	1898	0.26	0.31	0.196
1970	384744	489996	279492	36819	47717	25921	6426	708	0.28	0.33	0.24
1971	139637	192753	86521	36214	47328	25101	9246	363	0.22	0.28	0.162
1972	358296	451004	265588	41664	54267	29061	9234	1546	0.26	0.33	0.194
1973	89533	127165	51901	46927	61667	32188	11819	1222	0.26	0.35	0.166
1974	286027	363839	208215	39749	52783	26715	10251	1749	0.34	0.42	0.25
1975	95891	133523	58259	40510	53818	27201	9863	857	0.32	0.42	0.23
1976	152041	202217	101865	31895	43028	20762	10247	381	0.33	0.44	0.23
1977	156311	207075	105547	31257	42762	19752	8054	201	0.36	0.46	0.25
1978	292095	365791	218399	24799	34579	15019	5662	0	0.33	0.40	0.25
1979	325000	401048	248952	24541	33713	15368	7548	0	0.25	0.34	0.162
1980	183575	236103	131047	28154	36916	19393	10599	0	0.30	0.39	0.22
1981	87444	119000	55888	36538	46259	26816	13958	0	0.35	0.44	0.25

Year	Recruitment age 0			SSB			Landings	Discards	Fishing mortality ages 2–4		
	Value	High	Low	Value	High	Low			Value	High	Low
1982	121906	159342	84470	40865	51841	29889	13381	313	0.40	0.51	0.29
1983	176541	222405	130677	34460	45201	23719	10015	372	0.44	0.54	0.33
1984	163766	208454	119078	24049	32437	15660	8383	2	0.40	0.51	0.29
1985	125242	163658	86826	23371	30800	15943	10483	61	0.40	0.51	0.28
1986	314979	375151	254807	23174	30112	16236	9852	154	0.45	0.57	0.34
1987	148276	186496	110056	23944	31059	16830	12894	128	0.47	0.59	0.34
1988	75658	99374	51942	22126	27614	16638	14168	109	0.57	0.70	0.45
1989	87599	112687	62511	23577	28751	18403	12751	202	0.65	0.80	0.51
1990	103824	129696	77952	17093	21719	12468	7379	159	0.70	0.83	0.57
1991	159860	190436	129284	12099	15725	8473	7095	163	0.56	0.73	0.40
1992	36349	49324	23374	11486	14857	8115	7735	98	0.69	0.83	0.55
1993	79041	96308	61773	12087	14948	9225	7555	155	0.65	0.79	0.52
1994	73406	88048	58765	12400	15497	9303	5402	142	0.66	0.79	0.53
1995	79988	94120	65857	8234	10704	5765	4587	166	0.59	0.70	0.48
1996	114682	131577	97787	8845	10942	6747	4964	140	0.54	0.65	0.42

Year	Recruitment age 0			SSB			Landings	Discards	Fishing mortality ages 2–4		
	Value	High	Low	Value	High	Low			Value	High	Low
1997	29215	36741	21689	10256	12274	8237	5859	120	0.61	0.73	0.50
1998	10300	14239	6360	10136	11963	8309	5318	29	0.65	0.76	0.54
1999	85980	104796	67164	9471	11412	7531	4784	159	0.61	0.85	0.36
2000	40830	51473	30187	4321	6015	2628	1274	699	0.95	1.10	0.80
2001	45489	56269	34709	6527	8477	4576	2252	64	0.50	0.58	0.42
2002	11180	15022	7339	7807	10276	5337	2695	46	0.32	0.43	0.22
2003	23209	28893	17525	8965	11846	6084	1285	215	0.42	0.49	0.35
2004	11475	14611	8339	8052	10737	5367	1072	254	0.26	0.32	0.191
2005	15620	19403	11838	7094	9270	4919	910	204	0.25	0.32	0.187
2006	19634	24181	15086	4255	5747	2764	840	185	0.26	0.35	0.171
2007	6406	8504	4309	3072	4473	1671	702	145	0.34	0.41	0.26
2008	16137	20684	11590	3544	4851	2236	662	61	0.28	0.36	0.21
2009	39400	50454	28345	2840	3916	1764	466	88	0.28	0.34	0.21
2010	25608	33506	17709	3242	4420	2064	464	386	0.25	0.31	0.183
2011	21342	28437	14247	4322	5757	2888	365	48	0.23	0.25	0.20

Year	Recruitment age 0			SSB			Landings	Discards	Fishing mortality ages 2–4		
	Value	High	Low	Value	High	Low			Value	High	Low
2012	28200	37549	18850	5617	7499	3736	198	678	0.089	0.139	0.039
2013	47279	62332	32226	7466	10053	4879	206	152	0.188	0.21	0.171
2014	16662	22699	10625	9363	12538	6188	213	184	0.064	0.079	0.050
2015	26831	35220	18442	8841	12036	5646	161	147	0.055	0.066	0.044
2016	7164	9888	4439	8313	11116	5511	82	60	0.041	0.047	0.036
2017	18842	24703	12982	9270	12328	6213	84	59	0.023	0.028	0.0175
2018	17867	23590	12144	8196	10862	5531	215	42	0.022	0.033	0.0100
2019	13315	17999	8630	7336	9727	4945	295	7	0.049	0.063	0.035
2020	9468	14388	4549	5345	8206	2483	181	25	0.059	0.070	0.048
2021	17562	46962	0	6014	7994	4034	133	4	0.045	0.053	0.037
2022	17989*			5029							

***Geometric Mean 2002 to 2019.**

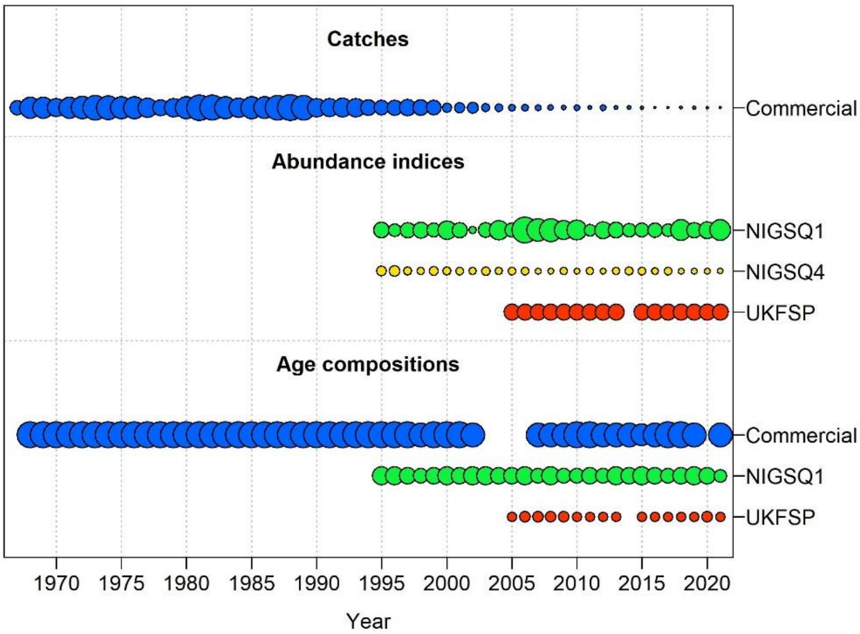

Figure 1. Available data.

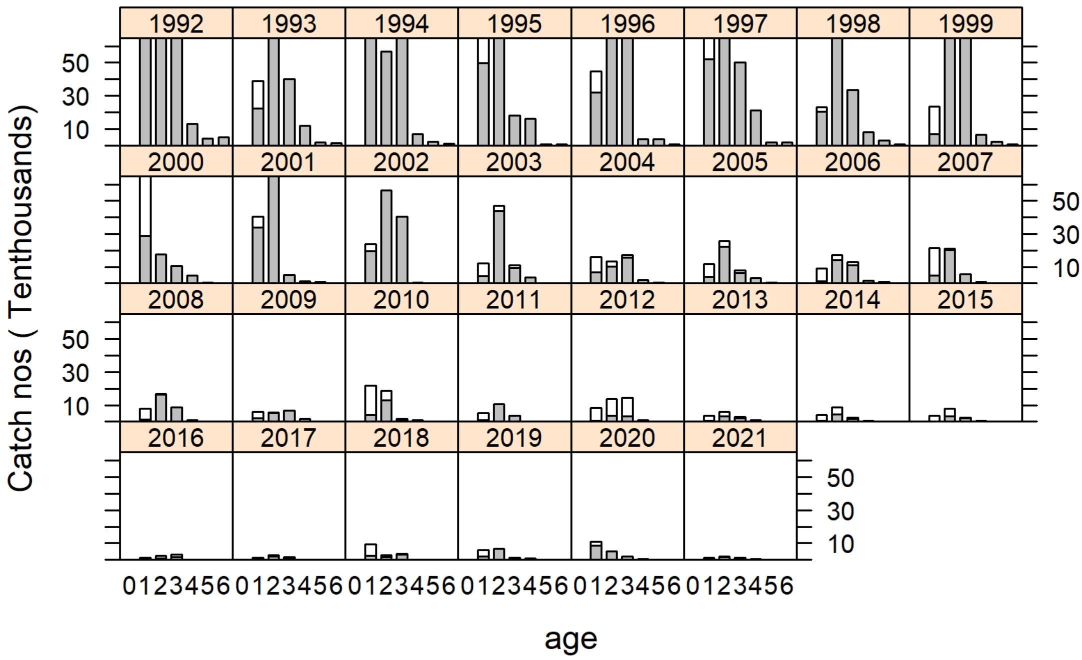

Figure 2. Landings and discards-at-age. Landings are shaded in grey, discards in white.

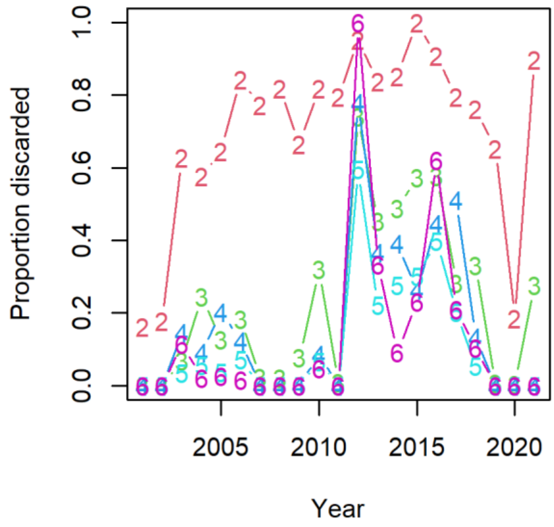

Figure 3. Proportion discarded-at-age. Ages 1 and 0 not displayed.

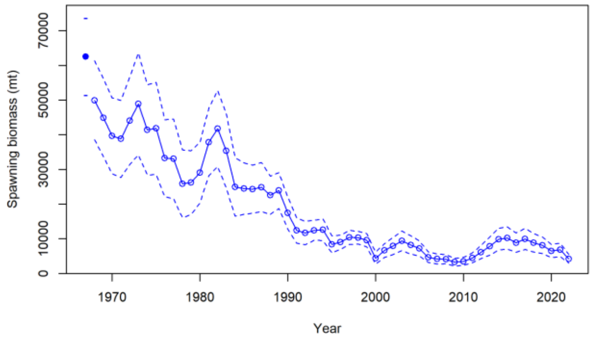

Figure 4. SSB with 95% confidence interval.

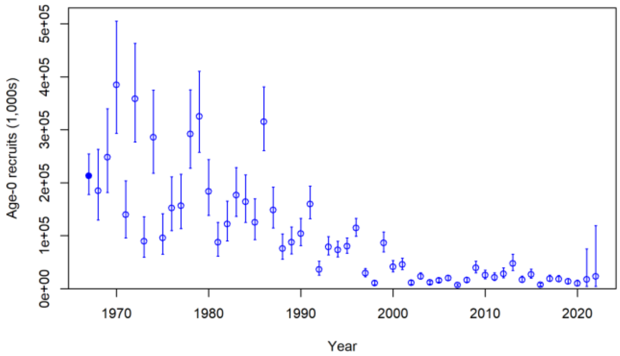

Figure 5. Recruitment with 95% confidence level. Recruitment in the figure for 2022 is model estimated and not the same as in the forecast.

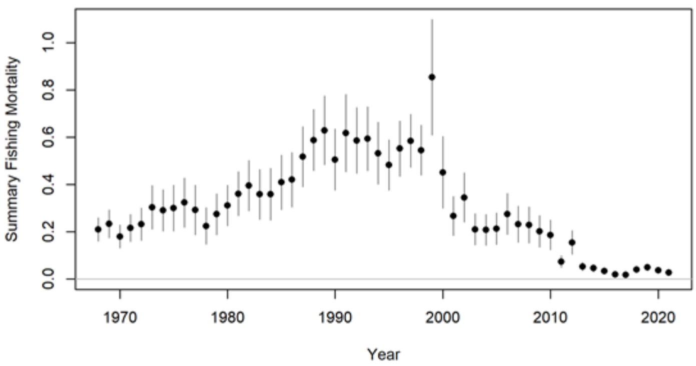

Figure 6. Age compositions for commercial data and surveys.

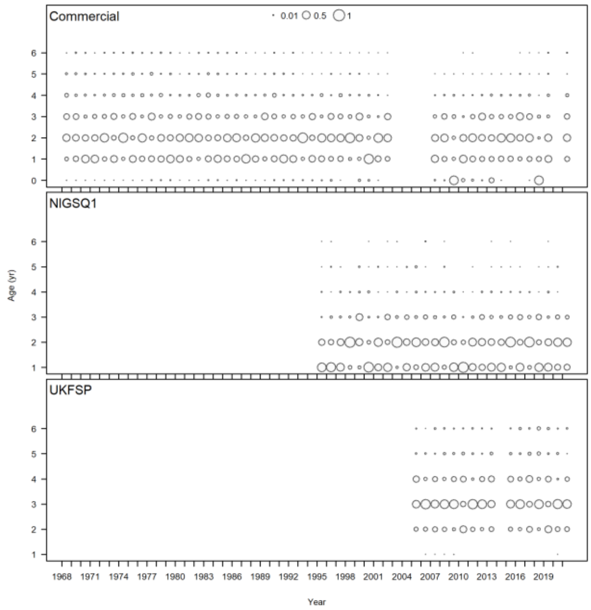

Figure 7. Residuals at-age.

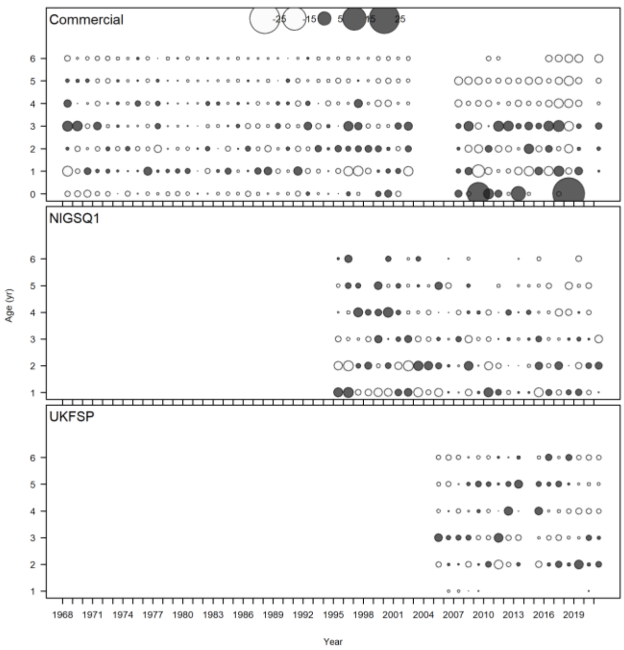

Figure 8. Log CPUE fit NIGFS Q1.

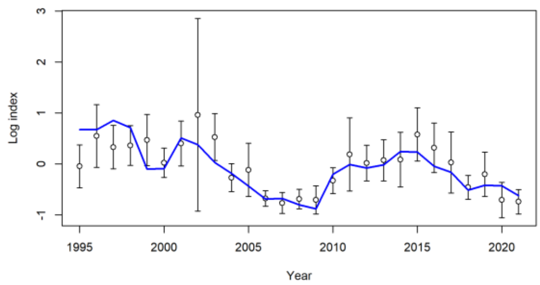

Figure 9. Log index fit NIGFS Q4.

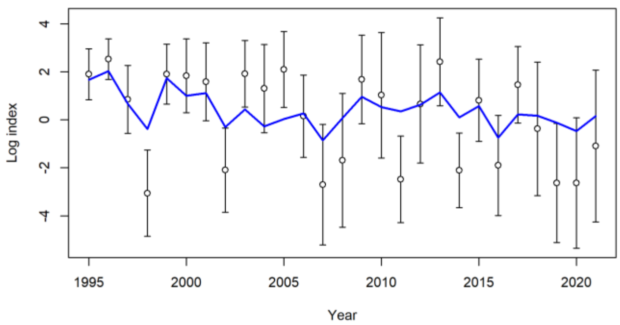

Figure 10. Log index fit UKFSP survey.

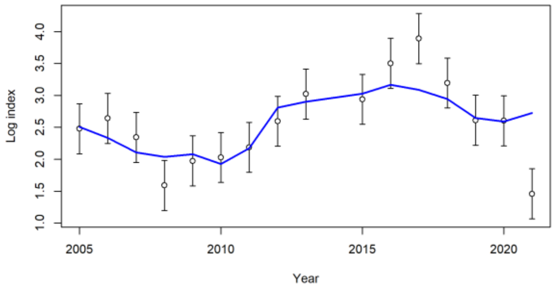

Figure 11. Results for runs tests for the three indices included and RMSE with fitted LOESS smoother.

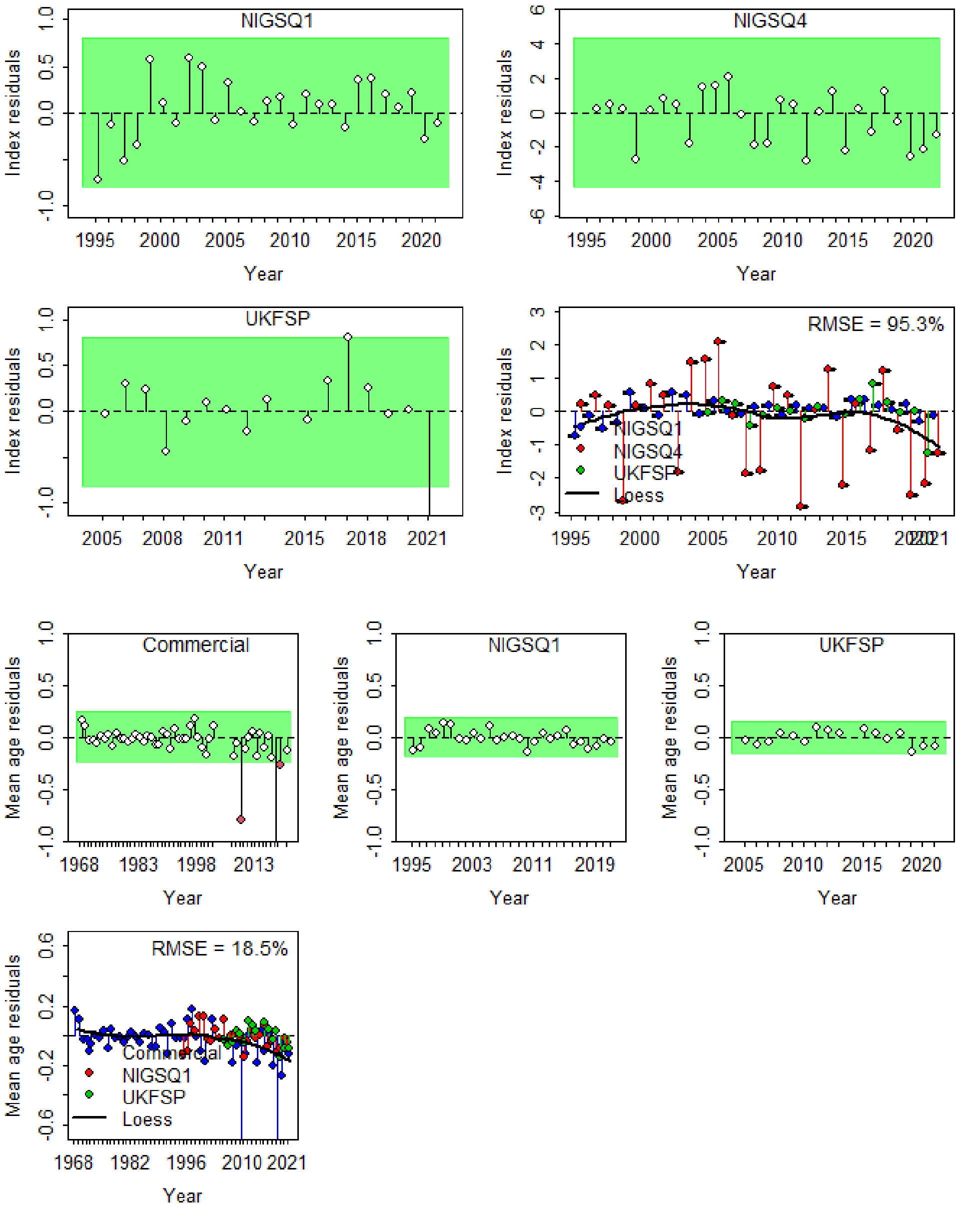

Figure 12. Mean age residual fits for total catches, NIGFSQ1 and UKFSP surveys, NIGFSQ4 survey only includes age 0 recruits and is therefore excluded.

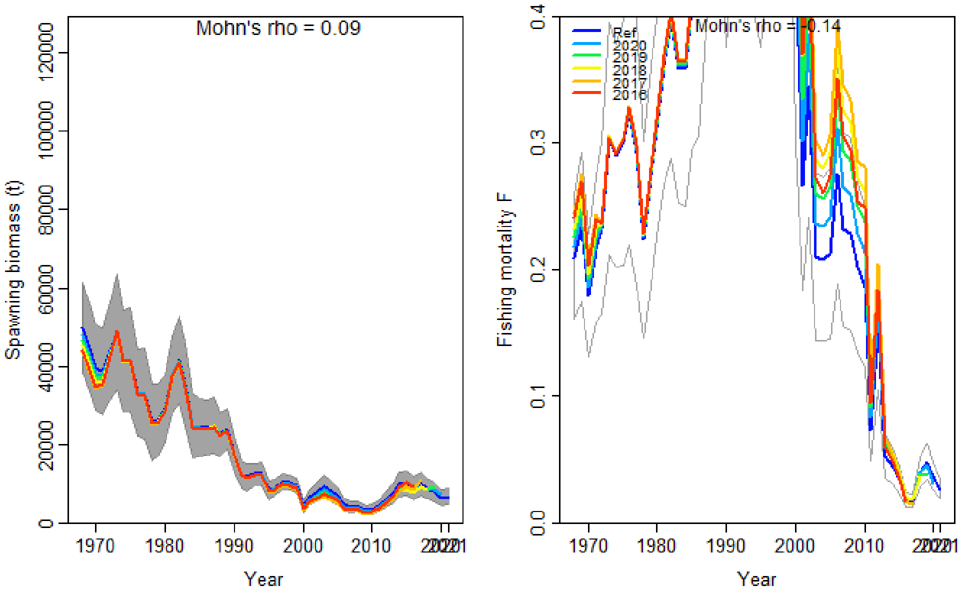

Figure 13. Mohns Rho for SSB and F_{bar}.