

Cod (*Gadus morhua*) in Subarea 4, Division 7.d, and Subdivision 20 (North Sea, eastern English Channel, Skagerrak)

ICES advice on fishing opportunities

ICES advises that when the MSY approach is applied, catches in 2019 should be no more than 28 204 tonnes.

Stock development over time

Fishing mortality (F) has declined since 2000, but remains above F_{MSY} . Spawning-stock biomass (SSB) has increased from the historical low in 2006, but is still below $MSY B_{trigger}$. Recruitment since 1998 remains poor.

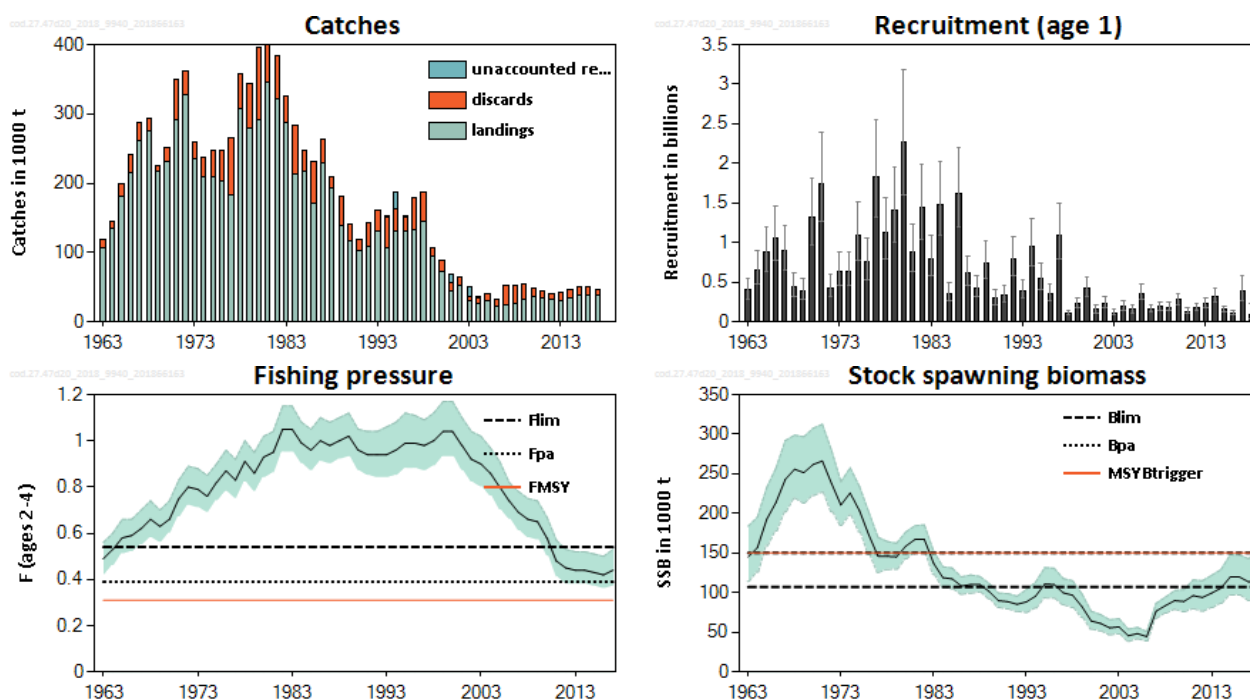


Figure 1 Cod in Subarea 4, Division 7.d, and Subdivision 20. Summary of the stock assessment. Catches are assessment estimates. Only positive unaccounted removals are plotted (see Table 10). Shaded areas (F, SSB) and error bars (R) indicate 95% confidence intervals.

Stock and exploitation status

ICES assesses that fishing pressure on the stock is above F_{MSY} and between F_{pa} and F_{lim} , and that spawning stock size is below $MSY B_{trigger}$ and between B_{pa} and B_{lim} .

Table 1 Cod in Subarea 4, Division 7.d, and Subdivision 20. State of the stock and fishery relative to reference points.

		Fishing pressure			Stock size					
		2015	2016	2017	2016	2017	2018			
Maximum sustainable yield	F_{MSY}	✘	✘	✘	Above	$MSY B_{trigger}$	✘	✘	✘	Below trigger
Precautionary approach	F_{pa}, F_{lim}	○	○	○	Increased risk	B_{pa}, B_{lim}	○	○	○	Increased risk
Management plan	F_{MGT}	—	—	—	Not applicable	B_{MGT}	—	—	—	Not applicable

Catch scenarios

Table 2 Cod in Subarea 4, Division 7.d, and Subdivision 20. Assumptions made for the interim year and in the forecast. All weights are in tonnes.

Variable	Value	Notes
F _{ages 2-4} (2018)	0.45	Average exploitation pattern (2015–2017) scaled to F _{ages 2-4} in 2017
SSB (2019)	116 380	Short-term forecast
R _{age 1} (2018)	99 387	Thousands; median recruitment assessment estimate in 2018
R _{age 1} (2019)	186 761	Thousands; median recruitment resampled from the years 1998–2017
Catch (2018)	49 278	Short-term forecast
Wanted catch (2018)	37 649	Assuming 2017 wanted catch fraction by age
Unwanted catch (2018)	11 629	Assuming 2017 unwanted catch fraction by age

Table 3 Cod in Subarea 4, Division 7.d, and Subdivision 20. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2019)	Wanted catch* (2019)	Unwanted catch* (2019)	F _{total} (2019)	F _{wanted} (2019)	F _{unwanted} (2019)	SSB (2020)	% SSB change **	% TAC change ***	% Advice change^
ICES advice basis										
MSY approach: F _{MSY} ×SSB(2019)/MSY B _{trigger}	28204	22331	5873	0.24	0.17	0.07	141896	22	-47	-47
Other scenarios^^^										
F = MAP^^ F _{MSY lower} ×SSB(2019)/MSY B _{trigger}	18759	14900	3859	0.154	0.109	0.045	152399	31	-65	-65
EU–Norway Management Strategy	42307	33357	8950	0.38	0.27	0.111	126249	8.5	-20	-20
F = 0	0	0	0	0	0	0	173375	49	-100	-100
F _{pa}	43081	33947	9134	0.39	0.28	0.113	125436	7.8	-18.5	-18.8
F _{lim}	56130	44231	11899	0.54	0.38	0.157	111247	-4.4	6.1	5.8
SSB (2020) = B _{lim}	60232	47418	12814	0.59	0.42	0.172	107000	-8.1	13.9	13.5
SSB (2020) = B _{pa}	20989	16647	4342	0.174	0.123	0.051	150000	29	-60	-60
SSB (2020) = MSY B _{trigger}	20989	16647	4342	0.174	0.123	0.051	150000	29	-60	-60
TAC (2018) – 20%	42307	33357	8950	0.38	0.27	0.111	126249	8.5	-20	-20
TAC (2018) – 15%	44951	35414	9537	0.41	0.29	0.119	123296	5.9	-15	-15.3
TAC (2018) – 10%	47596	37493	10103	0.44	0.31	0.127	120469	3.5	-10	-10.3
TAC (2018) – 5%	50240	39556	10684	0.47	0.33	0.137	117588	1.04	-5.0	-5.3
Constant TAC	52884	41655	11229	0.5	0.36	0.146	114646	-1.49	0	-0.33
TAC (2018) + 5%	55528	43760	11768	0.53	0.38	0.155	111869	-3.9	5.0	4.7
TAC (2018) + 10%	58172	45801	12371	0.56	0.4	0.164	109085	-6.3	10	9.6
TAC (2018) + 15%	60817	47895	12922	0.6	0.42	0.174	106397	-8.6	15	14.6
TAC (2018) + 20%	63460	49989	13471	0.63	0.45	0.185	103620	-11	20	19.6
F = F ₂₀₁₈	48422	38138	10284	0.45	0.32	0.131	119592	2.8	-8.4	-8.7
F = F _{MSY lower}	23669	18765	4904	0.198	0.140	0.058	147011	26	-55	-55
F = F _{MSY}	35358	27950	7408	0.31	0.22	0.090	133964	15.1	-33	-33
Mixed-fisheries scenarios – Mixed-fisheries considerations										
A: Max.	79465			0.888			83100	-29	50	50
B: Min.	26674			0.228			139421	20	-50	-50
C: COD	27947			0.241			138014	19	-47	-47
D: SQ effort	44956			0.417			119411	2.60	-15	-15
E: Value	46320			0.432			117937	1.34	-12.4	-12.7
F: Range ^{†‡}	27637			0.231			83100	-29	-48	-48

[†] Version 2: Mixed-fisheries range scenario revised.

[‡] Version 3: All mixed-fisheries scenarios updated as part of the ICES reopening process.

- * “Wanted” and “unwanted” catch are used to describe fish that would be landed and discarded in the absence of the EU landing obligation, based on discard rate estimates for 2017.
- ** SSB 2020 relative to SSB 2019.
- *** Catch in 2019 relative to TAC in 2018: North Sea (43 156 t) + Skagerrak (7995 t) + Eastern English Channel (1733 t) = 52 884 t.
- ^ Total catch 2019 relative to advice value 2018 (53 058 t).
- ^^ Proposed EU multiannual plan (MAP) for the North Sea (EU, 2016).
- ^^^ Other scenarios do not include $F_{MSY\ upper}$ because $SSB(2019) < MSY\ B_{trigger}$.

Mixed-fisheries assumptions (note: “fleet’s stock share” is used to describe the share of the fishing opportunities for each particular fleet, which has been calculated based on the single-stock advice for 2018 and the historical proportion of the stock landings taken by the fleet):

- A. Maximum scenario: Each fleet stops fishing when its last stock share is exhausted.
- B. Minimum scenario: Each fleet stops fishing when its first stock share is exhausted.
- C. COD: Each fleet stops fishing when its individual cod share is exhausted.
- D. SQ (*status quo*) effort scenario: The effort of each fleet in 2017 and 2018 is as in 2016.
- E. Value scenario: The effort of each fleet is equal to the weighted average of the efforts required to catch the fleet’s quota share of each of the stocks, where the weights are the relative catch values of each stock in the fleet’s portfolio.
- F. Range scenario: The potential for TAC mismatches in 2018 are minimized within the F_{MSY} range, for the demersal fish stocks for which such a range is available (cod.27.47d20, had.27.46a20, pok.27.3a46, ple.27.420, ple.27.7d, sol.27.4, sol.27.7d, whg.27.47d).

The change in advice (–47%) is due to a combination of: (a) a change in perception of stock size and recent recruitment with the addition of one extra year of data; (b) a reduction in the advised F below F_{MSY} because $SSB(2019)$ is below $MSY\ B_{trigger}$; and (c) an extremely low recruitment estimated for 2018 (the lowest in the time-series).

Basis of the advice

Table 4 Cod in Subarea 4, Division 7.d, and Subdivision 20. The basis of the advice.

Advice basis	ICES MSY approach
Management plan	<p>The EU–Norway management strategy was updated in December 2008. The EU has adopted a long-term plan with the same aims (EU management plan; EU, 2008). ICES evaluated the EU–Norway management strategy in 2009 and concluded that it was in accordance with the precautionary approach if implemented and enforced adequately. The management strategy was considered by ICES to switch from the recovery phase to the long-term phase in 2013. Changes to the stock assessment and reference points in 2015 and 2017 imply a need to re-evaluate the management strategy to ascertain if it can still be considered precautionary under the new stock perception. Until such an evaluation is conducted, the ICES advice is based on the MSY approach.</p> <p>An EU multiannual management plan (MAP) has been proposed for this stock (EU, 2016). This plan is not adopted by Norway; thus, it is not used as the basis of the advice for this shared stock. ICES was requested by the EC to provide advice based on the MSY approach and to include the MAP as a catch option.</p>

Quality of the assessment

The latest assessment results in a downscaling of SSB in recent years. This is partially caused by a lower than expected survey catch rate of the 2013 and 2016 year classes in IBTS Q1 2018 and, to a lesser extent, IBTS Q3 2017.

Maturity-at-age was re-estimated in 2017, which caused the observed downward revision in SSB in the 2017 assessment.

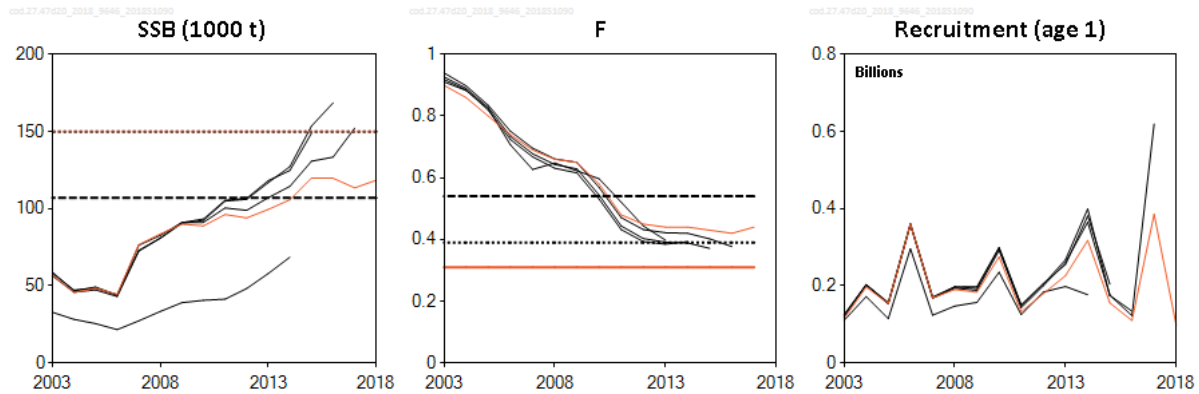


Figure 2 Cod in Subarea 4, Division 7.d, and Subdivision 20. Historical assessment results (final-year recruitment estimates included).

Issues relevant for the advice

The EU landing obligation was implemented from 1 January 2017 for several gears, including TR1, BT1, and fixed gears. From 2018, cod is fully under the EU landing obligation in Subarea 4 and Subdivision 20. The EU landing obligation does not apply to cod in Division 7.d in 2018. BMS landings of cod reported to ICES are currently much lower than the estimates of catches below MCRS (minimum conservation reference size) estimated by observer programmes.

Since the implementation of effort management (days-at-sea regulation), fishing mortality rates have been reduced and the stock size has increased from 2006. Furthermore, the decrease in F has led to an increase in the number of older fish in the population in recent years (Figure 3). The days-at-sea regulation was discontinued in 2017 for regulated gears apart from larger meshed beam trawls (BT2 and BT1), which resulted in an increase of the total effort in fisheries catching cod in 2017.

Cod is widely distributed throughout the North Sea, but there are indications of subpopulations inhabiting different regions of the North Sea (e.g. from genetic studies). The inferred limited degree of mixing suggests slow recolonization in areas where subpopulations are depleted. Figure 4 plots a cod biomass index by subregion (with subregions given in Figure 6), and highlights differing rates of change in this index. The figure shows a general decline in all areas prior to the mid-2000s and a general increase in all areas thereafter, apart from the southern area where cod has further declined. It is unclear what the reasons for the lack of recovery are in this area; further work is required to investigate climate change, biological, and fisheries effects. Recruitment has declined and remains low in all areas (Figure 5).

Mixed-fisheries considerations

Results from a North Sea mixed-fisheries analysis are presented in the ICES mixed-fisheries advice (ICES, 2018a). The analysis has been updated, taking into account latest changes made to the assessments and forecasts for stocks with reopened advice.[§]

After years of positive development, North Sea cod is again estimated to be the most limiting stock in the Greater North Sea mixed-fisheries model. For 2019, assuming a strictly implemented landing obligation (corresponding to the “Minimum” scenario), cod is estimated to constrain 24 out of 40 fleet segments. Whiting is the second most limiting stock, constraining twelve fleet segments. Conversely, in the “Maximum” scenario, saithe and both plaice stocks (North Sea and Eastern Channel) would be the least limiting for 17, 9, and 3 fleet segments, respectively. Finally, if Norway lobster were managed by separate TACs, Norway lobster in FU 7 would be the least limiting for seven fleet segments. (ICES, 2018b).

For those demersal fish stocks for which the F_{MSY} range is available, a “range” scenario is presented that minimizes the potential for TAC mismatches in 2019 within the F_{MSY} range. This scenario returns a fishing mortality by stock which, if

[§] Version 3: Text updated.

used for setting single-stock fishing opportunities for 2019, may reduce the gap between the most and the least restrictive TACs, thus reducing the potential for quota over- and undershoots. This “range” scenario suggests that the potential for mixed-fisheries mismatch would be lowered with a 2019 TAC in the lower part of the F_{MSY} range for North Sea plaice and North Sea saithe, and at the highest possible value for cod in accordance with the MSY approach and the MAP (EU multiannual plan).

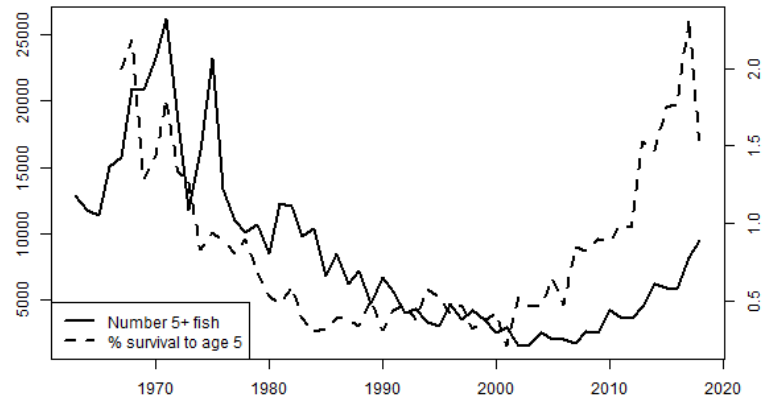


Figure 3 Cod in Subarea 4, Division 7.d, and Subdivision 20. Estimates of the number of 5-year-old and older cod in the population (solid line; thousands), and the percentage of 1-year-olds by number that have survived to age 5 in the given year (dashed line).

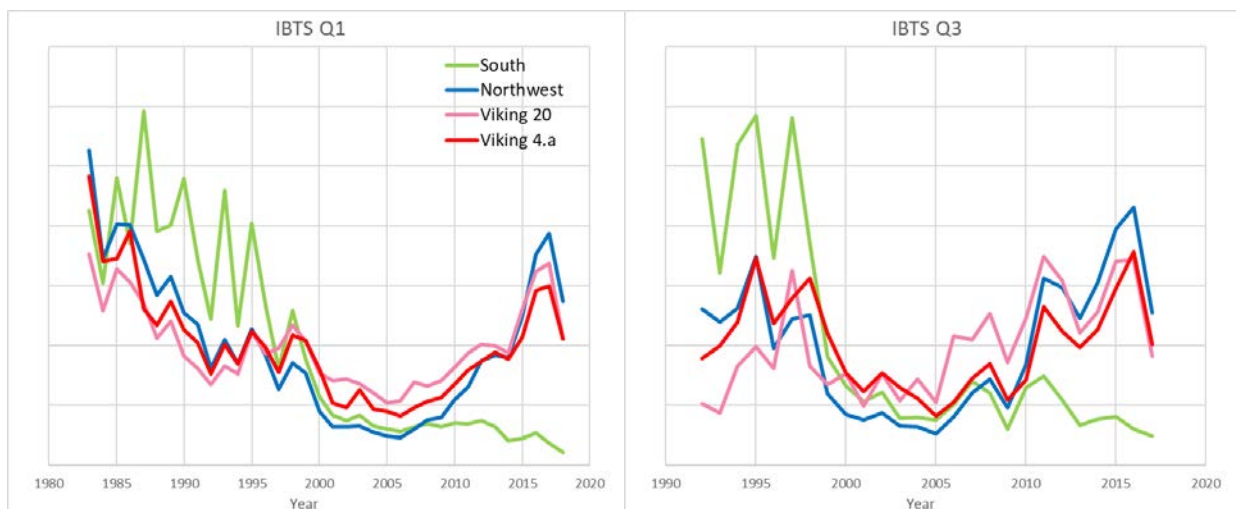


Figure 4 Cod in Subarea 4, Division 7.d, and Subdivision 20. Biomass indices by subregion (see Figure 6), based on the NS-IBTS Q1 and Q3 survey data. The biomass indices are derived by fitting a non-stationary Delta-GAM model (including ship effects) to numbers-at-age for the entire dataset and integrating the fitted abundance surface over each of the subareas to obtain indices-at-age by area. These are then multiplied by smoothed weight-at-age estimates and summed to get the biomass indices.

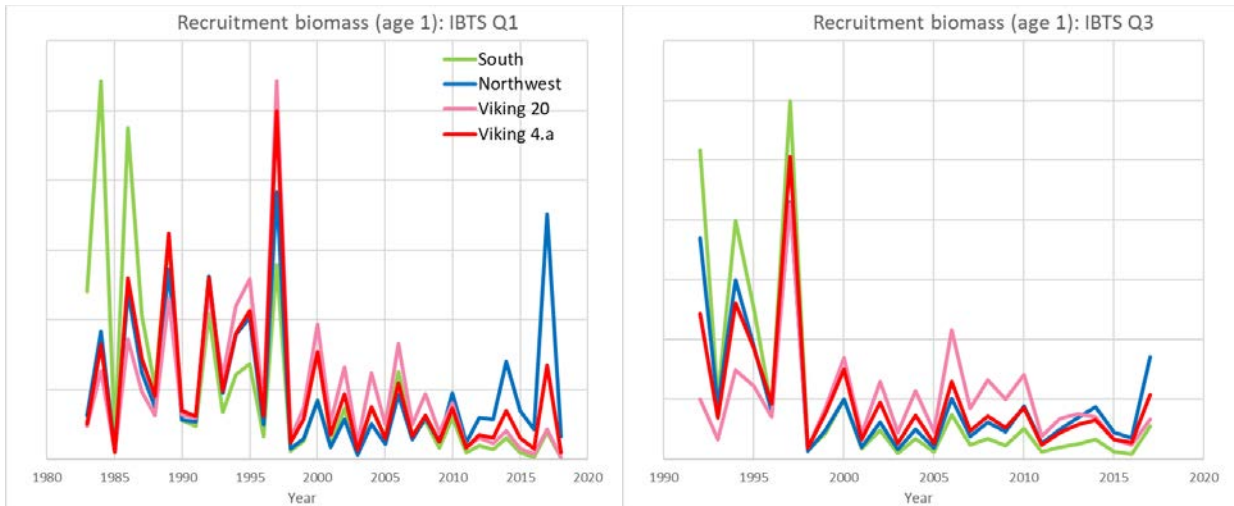


Figure 5 Cod in Subarea 4, Division 7.d, and Subdivision 20. Recruitment indices by subregion (see Figure 6), based on NS-IBTS Q1 and Q3 survey data.

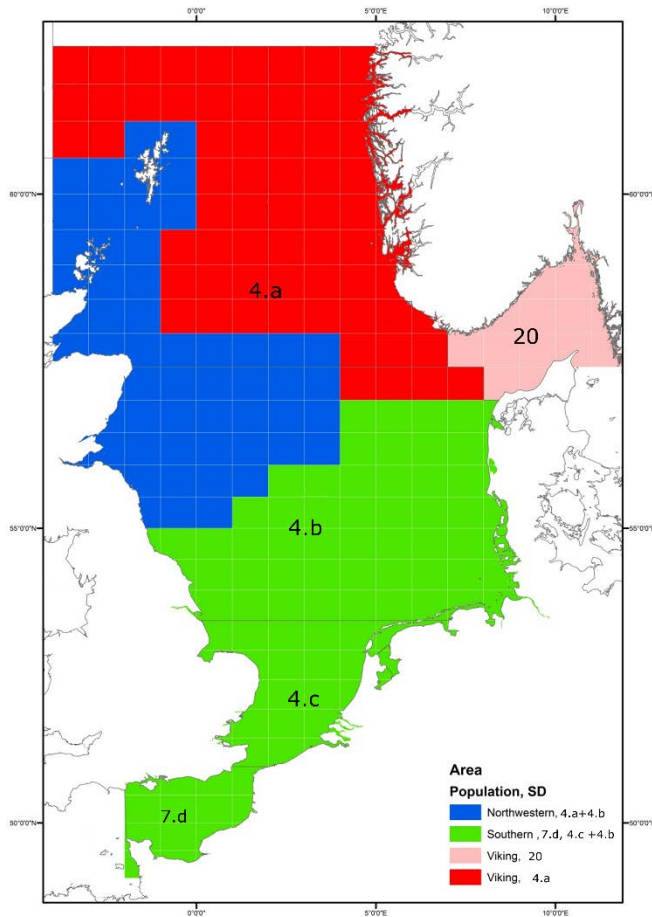


Figure 6 Cod in Subarea 4, Division 7.d, and Subdivision 20. Subregions used to derive area-specific biomass indices, based on NS-IBTS Q1 and Q3 survey data.

Reference points

Table 5 Cod in Subarea 4, Division 7.d, and Subdivision 20. Reference points, values, and their technical basis. All weights are in tonnes.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	150 000	B_{pa}	
	F_{MSY}	0.31	EQsim analysis based on the recruitment period 1988–2016	ICES (2017)
Precautionary approach	B_{lim}	107 000	SSB associated with the last above-average recruitment (1996 year class)	ICES (2017)
	B_{pa}	150 000	$B_{lim} \times \exp(1.645 \times 0.2) \approx 1.4 \times B_{lim}$	ICES (2017)
	F_{lim}	0.54	EQsim analysis based on the recruitment period 1998–2016	ICES (2017)
	F_{pa}	0.39	$F_{lim} \times \exp(-1.645 \times 0.2) \approx F_{lim} / 1.4$	ICES (2017)
EU–Norway Management Strategy	$SSB_{MS-lower}$	70 000	Former B_{lim}	EU (2008)
	$SSB_{MS-upper}$	150 000	Former B_{pa}	
	$F_{MS-lower}$	0.20	Fishing mortality when $SSB < SSB_{MS-lower}$	
	$F_{MS-upper}$	0.40	Fishing mortality when $SSB > SSB_{MS-upper}$	
Management Plan*	MAP MSY $B_{trigger}$	150 000	MSY $B_{trigger}$	
	MAP B_{lim}	107 000	B_{lim}	
	MAP F_{MSY}	0.31	F_{MSY}	
	MAP range F_{lower}	0.198	Consistent with ranges provided by ICES (2017), resulting in no more than 5% reduction in long-term yield compared with MSY	
	MAP range F_{upper}	0.46	Consistent with ranges provided by ICES (2017), resulting in no more than 5% reduction in long-term yield compared with MSY	

*Proposed EU multiannual plan (MAP) for the North Sea (EU, 2016).

Basis of the assessment

Table 6 Cod in Subarea 4, Division 7.d, and Subdivision 20. Basis of the assessment and advice.

ICES stock data category	1 (ICES, 2018c).
Assessment type	Age-based analytical assessment (SAM; ICES, 2018d) that uses catches in the model and in the forecast. Unaccounted removals were estimated for 1993–2005 (Nielsen and Berg, 2014).
Input data	Commercial catches (international landings and ages from catch sampling by métier), two survey indices (IBTS Q1, IBTS Q3) derived by a Delta–GAM approach, assuming a stationary spatial model with ship effect. Smoothed annually varying maturity data from IBTS Q1 (1978–2018). Annually varying natural mortalities from multispecies model (1974–2016).
Discards, BMS landings, and bycatch	Discards included (85% reported, 15% raised), data series from the main fleets (in 2017 covering 75% of the landings). Below minimum size (BMS) landings, where reported, are included with discards as unwanted catch in the assessment from 2016.
Indicators	NS-IBTS biomass indices by subregion.
Other information	Benchmarked in 2015 (ICES, 2015a; Annex 9 of ICES, 2015b). Reference points revised (ICES, 2017).
Working group	Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK)

Information from stakeholders

The amount and coverage of input data for the assessment has increased since 2012 through extended sampling programmes such as fully documented fishery (FDF) and the Scottish Industry–Science observer sampling scheme.

History of the advice, catch, and management

Table 7 Cod in Subarea 4, Division 7.d, and Subdivision 20. ICES advice, TAC, official landings ICES estimates of catch. All weights are in tonnes. Values of official landings and ICES landings for the period 1987 to 1996 are presented to the nearest thousand tonnes.

North Sea (Subarea 4)

Year	ICES advice	Predicted landings corresponding to advice	Predicted catch corresponding to advice	Agreed TAC	Official landings*	ICES landings**	ICES discards
1987	SSB recovery; TAC	100000–125000		175000	167000	182000	
1988	70% of F(86); TAC	148000		160000	142000	157000	
1989	Halt SSB decline; protect juveniles; TAC	124000		124000	110000	116000	
1990	80% of F (88); TAC	113000		105000	99000	105000	
1991	70% of effort (89)			100000	87000	89000	
1992	70% of effort (89)			100000	98000	97000	
1993	70% of effort (89)			101000	94000	105000	
1994	Significant effort reduction			102000	87000	95000	
1995	Significant effort reduction			120000	111000	120000	
1996	80% of F(94) = 0.7	141000		130000	107000	107000	
1997	80% of F(95) = 0.65	135000		115000	99423	102169	
1998	F(98) should not exceed F(96)	153000		140000	114324	122103	
1999	F = 0.60 to rebuild SSB	125000		132400	77566	78392	
2000	F less than 0.55	< 79000		81000	60881	59767	
2001	lowest possible catch	0		48600	41713	40973	
2002	lowest possible catch	0		49300	44526	42193	7235
2003	Closure	0		27300	25958	24083	2643
2004	Zero catch	0		27300	23806	22529	5026
2005	Zero catch	0		27300	22500	22855	5236
2006	Zero catch	0		23205	23119	21078	5236
2007	Zero catch	0		19957	20104	19056	22418
2008	Exploitation boundaries in relation to precautionary limits. Total removals < 22 000 t	< 22000		22152	22264	21657	20710
2009	Zero catch	0		28798	27500	27634	13542
2010	Management plan F (65% of F ₂₀₀₈)	< 40300 ***		33552	31657	30980	10122
2011	See scenarios	-		26842	27799	26675	6071
2012	Management plan F (45% of F ₂₀₀₈)	< 31800		26475	27641	26627	6533
2013	Management plan (TAC –20%)	< 25441		26475	26325	25315	8421
2014	Management plan long-term phase	< 28809		27799	29356	28550	7831
2015	Management plan long-term phase	< 26713		29189	32012	31244	9601
2016	MSY approach	≤ 40419	≤ 49259	33651	34192	33035	10538^
2017	MSY approach		≤ 47359	39220	34198	33109	7945^
2018	MSY approach		≤ 53058	43156			
2019	MSY approach		≤ 28204				

* Official landings for Norway include Norwegian fjords.

** Norwegian fjords not included from 2002 onwards.

*** From 2010 onwards, the advice is for Subarea 4 (North Sea), Division 7.d (Eastern English Channel), and Subdivision 20 (Skagerrak).

^ Since 2016 discards correspond to unwanted catch (including BMS landings).

Table 7 (cont.)

Skagerrak (Subdivision 20). Note: Values of official landings and ICES landings for the period 1987 to 1996 are presented to the nearest hundred tonnes.

Year	ICES advice	Predicted landings corresponding to advice	Predicted catch corresponding to advice	Agreed TAC*	Official landings	ICES landings*	ICES discards
1987	$F = F_{\max}$	< 21000		22500	19900	20900	
1988	Reduce F			21500	17000	16900	
1989	F at F_{med}	< 23000		20500	18700	19600	
1990	F at F_{med} ; TAC	21000		21000	17800	18600	
1991	TAC	15000		15000	12100	12400	
1992	70% of F(90)			15000	14000	14800	
1993	Precautionary TAC			15000	14700	15300	
1994	No long-term gain in increased F + precautionary TAC			15500	15100	13900	
1995	If required precautionary TAC; link to North Sea			20000	19800	12100	
1996	If required precautionary TAC; link to North Sea			23000	17900	16400	
1997	If required precautionary TAC; link to North Sea			16100	15736	14946	
1998	If required precautionary TAC; link to North Sea	21900		20000	15586	15331	
1999	$F = 0.60$ to rebuild SSB	17900		19000	11790	10974	
2000	F less than 0.55	< 11300		11600	9957	9277	
2001	lowest possible catch	0		7000	7729	7086	
2002	lowest possible catch	0		7100	7170	6854	4168
2003	Closure	0		3900	4483	3979	1225
2004	Zero catch	0		3900	4516	3914	3552
2005	Zero catch	0		3900	4375	3998	4573
2006	Zero catch	0		3315	3973	3258	6398
2007	Zero catch	0		2851	3751	3020	5946
2008	Exploitation boundaries in relation to precautionary limits. Total removals less than 22 000 t	< 22000		3165	3769	3393	2697
2009	Zero catch	0		4114	3983	3794	2910
2010	Management plan F (65% of F_{2008})	< 40300**		4793	4211	4057	2023
2011	See scenarios	-		3835	4117	3956	2050
2012	Management plan F (45% of F_{2008})	< 31800		3783	4392	4327	2054
2013	Management plan (TAC -20%)	< 25441		3783	4240	4154	1780
2014	Management plan long-term phase	< 28809		3972	4649	4687	2210
2015	Management plan long-term phase	< 26713		4171	4532	4563	2942
2016	MSY approach	≤ 40419	≤ 49259	4807	5007	4774	1704***
2017	MSY approach		≤ 47359	5744	4848	4715	777***
2018	MSY approach		≤ 53058	7995			
2019	MSY approach		≤ 28204				

* Norwegian fjords not included.

** From 2010 onwards, the advice is for Subarea 4 (North Sea), Division 7.d (Eastern Channel), and Subdivision 20 (Skagerrak).

*** Since 2016 discards correspond to unwanted catch (including BMS landings).

Table 7 (cont.)

Eastern Channel (Division 7.d). Note: Values of official landings and ICES landings for the period 1987 to 1996 are presented to the nearest hundred tonnes.

Year	ICES advice	Predicted landings corresponding to advice	Predicted catch corresponding to advice	Agreed TAC*	Official landings	ICES landings	ICES discards
1987	Not assessed	-		-	9400	14200	
1988	Precautionary TAC	-		-	10100	10700	
1989	No increase in F; TAC	10000**		-	NA	5500	
1990	No increase in F; TAC	9000**		-	NA	2800	
1991	Precautionary TAC	3000**		-	NA	1900	
1992	If required, precautionary TAC	5500**		-	2700	2700	
1993	If TAC required, consider SSB decline	-		-	2500	2400	
1994	Reduce F + precautionary TAC			-	2900	2900	
1995	Significant effort reduction; link to North Sea			-	4000	4000	
1996	Reference made to North Sea advice			-	3500	3500	
1997	No advice			-	7178	7043	
1998	Link to North Sea	4900		-	8665	8580	
1999	F = 0.60 to rebuild SSB	4000		-	629	6858	
2000	F less than 0.55	< 2500		-	3583	2325	
2001	lowest possible catch	0		-	2036	1573	
2002	lowest possible catch	0		-	1563	3139	507
2003	Closure	0		-	1941	2131	213
2004	Zero catch	0		-	974	1014	225
2005	Zero catch	0		-	1230	1259	278
2006	Zero catch	0		-	1481	1479	377
2007	Zero catch	0		-	2072	2147	2086
2008	Exploitation boundaries in relation to precautionary limits. Total removals less than 22 000 t	< 22000		-	1661	1629	1674
2009	Zero catch	0		1678	2023	1887	4513
2010	Management plan F (65% of F ₂₀₀₈)	< 40300***		1955	1836	1708	343
2011	See scenarios	-		1564	1311	1319	623
2012	Management plan F (45% of F ₂₀₀₈)	< 31800		1543	1064	1120	102
2013	Management plan (TAC -20%)	< 25441		1543	959	916	123
2014	Management plan long-term phase	< 28809		1620	1548	1436	624
2015	Management plan long-term phase	< 26713		1701	1434	1398	19
2016	MSY approach	≤ 40419	≤ 49259	1961	459	421	72^
2017	MSY approach		≤ 47359	2059	179	170	9^
2018	MSY approach		≤ 53058	1733			
2019	MSY approach		≤ 28204				

* Until 2008 this area was included in the TAC for Subarea 7 (except Division 7.a). From 2009 a separate TAC is set.

** Including Division 7.e.

*** From 2010 onwards, the advice is for Subarea 4 (North Sea), Division 7.d (Eastern Channel), and Subdivision 20 (Skagerrak).

^ Since 2016 discards correspond to unwanted catch (including BMS landings).

History of the catch and landings

Table 8 Cod in Subarea 4, Division 7.d, and Subdivision 20. Catch distribution by fleet in 2017 as estimated by ICES.

Catch (2017)	Wanted catch					Unwanted catch
	Demersal trawls and seines >100 mm 67%	Gillnets 12.5%	Demersal trawls 70–99 mm 5.4%	Beam trawls 2.5%	Other gears 12.3%	
46725 tonnes						8731 tonnes
	37994 tonnes					

Table 9 Cod in Subarea 4, Division 7.d, and Subdivision 20. History of commercial catch and landings; both the official and ICES estimated values are presented by area for each country participating in the fishery. All weights are in tonnes.

Subarea 4										
Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Belgium	5799	3882	3304	2470	2616	1482	1627	1722	1309	1009
Denmark	23002	19697	14000	8358	9022	4676	5889	6291	5105	3430
Faroe Islands	102	96	-	9	34	36	37	34	3	0
France	2934	.	1222	717	1777	620	294	664	354	659
Germany	8045	3386	1740	1810	2018	2048	2213	2648	2537	1899
Greenland	.	.	.	.	.	.	.	35	23	17
Netherlands	14676	9068	5995	3574	4707	2305	1726	1660	1585	1523
Norway	5823	7432	6410	4369	5217	4417	3223	2900	2749	3057
Poland	25	19	18	18	39	35	-	-	0	1
Sweden	540	625	640	661	463	252	240	319	309	387
UK (E/W/Ni)	17745	10344	6543	4087	3112	2213	1890	1270	1491	1588
UK (Scotland)	35633	23017	21009	15640	15416	7852	6650	4936	6857	6511
UK (combined)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Others	0	0	0	0	0	0	0	0	786	0
Danish industrial bycatch *	.	.	.	.	105	22	17	21	11	23
Norwegian industrial bycatch *	.	.	.	.	.	.	.	.	48	101
Total nominal catch	114324	77566	60881	41713	44526	25958	23806	22500	23119	20104
Unallocated landings	7779	826	-1114	-740	-2333	-1875	-1277	356	-2041	-1047
WG estimate of total landings	122103	78392	59767	40973	42193	24083	22529	22855	21078	19056
Agreed TAC	140000	132400	81000	48600	49300	27300	27300	27300	23205	19957

Division 7.d										
Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Belgium	239	172	110	93	51	54	47	51	80	84
Denmark	-	-	-	-	-	-	-	-	-	-
France	7788	.	3084	1677	1361	1730	810	986	1124	1743
Netherlands	19	3	4	17	6	36	14	9	9	59
UK (E/W/Ni)	618	454	385	249	145	121	103	184	267	174
UK (Scotland)	1	-	-	-	-	-	-	-	1	12
UK (combined)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total nominal catch	8665	629	3583	2036	1563	1941	974	1230	1481	2072
Unallocated landings	-85	6229	-1258	-463	1576	190	40	29	-2	75
WG estimate of total landings	8580	6858	2325	1573	3139	2131	1014	1259	1479	2147

Table 9 (contd).

Subdivision 20 **										
Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Denmark	12339	8681	7684	5900	5525	3067	3038	3019	2513	2246
Germany	54	54	54	32	83	49	99	86	84	67
Norway	1293	1146	926	762	645	825	856	759	628	681
Sweden	1900	1909	1293	1035	897	510	495	488	372	370
Others	-	-	-	-	-	27	24	21	373	385
Danish industrial bycatch *	97	62	99	687	20	5	4	2	3	2
Total nominal catch	15586	11790	9957	7729	7170	4483	4516	4375	3973	3751
Unallocated landings	-255	-816	-680	-643	-316	-504	-602	-376	-715	-731
WG estimate of total landings	15331	10974	9277	7086	6854	3979	3914	3998	3258	3020
Agreed TAC	20000	19000	11600	7000	7100	3900	3900	3900	3315	2851

Subarea 4, Division 7.d, and Subdivision 20 combined**										
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Total nominal	138575	89985	74421	51478	53260	32382	29296	28104	28573	25927
Unallocated	7439	6240	-3052	-1846	-1074	-2189	-1839	9	-2759	-1704
WG estimate of	146014	96225	71369	49632	52186	30193	27457	28113	25815	24223

* The Danish (up to 2001) and Norwegian industrial bycatch are not included in the (WG estimate of) total landings.

** Skagerrak/Kattegat split derived from national statistics.

. Magnitude not available. - Magnitude known to be nil. < 0.5 Magnitude less than half the unit used in the table.

n/a Not applicable.

Subarea 4 and Subdivision 20 landings not included in the assessment										
Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Danish industrial bycatch *	97	62	99	687	-	-	-	-	-	-
Norwegian industrial bycatch	.	.	.	.	.	.	.	.	48	101
Total	97	62	99	687	0	0	0	0	48	101

Subarea 4										
Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Belgium	894	946	666	653	862	1076	1257	1223	1103	696
Denmark	3831	4402	5686	4863	4803	4536	5457	6026	6697	6119
Faroe Islands	16	45	32	0	0	0	0	0	.	.
France	573	950	781	619	368	287	638	517	391	401
Germany	1736	2374	2844	2211	2385	1921	2257	2133	2083	1987
Greenland	17	11	0	0	0	0	0	0	2	1
Netherlands	1896	2649	2657	1928	1955	1344	1242	1403	1365	645
Norway	4128	4234	4496	4898	4601	4079	4600	5404	5592	5521
Poland	2	3	0	2	0	0	0	0	.	.
Sweden	439	378	363	315	472	332	401	415	370	387
UK (E/W/NI)	1546	2384	2553	2169	1630	2129	2963	.	.	.
UK (Scotland)	7185	9052	11567	10141	10565	10619	10517	.	.	.
UK (combined)	n/a	n/a	n/a	n/a	n/a	n/a	13480	14889	16583	18293
Others	0	0	0	0	0	0	0	0	0	0
Danish industrial bycatch	1	72	12	0	0	2	24	0	5	147
Norwegian industrial bycatch *	22	4	201	1	.	.	.	.	.	.
Total nominal catch	22264	27500	31657	27799	27641	26325	29356	32012	34192	34198
Unallocated landings	-607	134	-677	-1124	-1014	-1010	-806	-768	-1157	-1089
BMS landings	-	-	-	-	-	-	-	-	-	1
WG estimate of total landings	21657	27634	30980	26675	26627	25315	28550	31244	33035	33109
Agreed TAC	22152	28798	33552	26842	26475	26475	27799	29189	33651	39220

Table 9 (contd).

Division 7.d										
Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Belgium	154	73	57	56	40	53	72	78	38	17
Denmark	.	.	.	.	.	.	.	.	.	.
France	1326	1779	1606	1078	885	768	1270	1142	279	92
Netherlands	30	35	45	51	40	38	50	52	40	22
UK (E/W/NI)	144	133	127	125	99	100	156	.	.	.
UK (Scotland)	7	3	1	1	0	0	0	.	.	.
UK (combined)	n/a	n/a	n/a	n/a	n/a	n/a	156	162	101	48
Total nominal catch	1661	2023	1836	1311	1064	959	1548	1434	459	179
Unallocated landings	-32	-136	-128	8	56	-43	-112	-36	-38	-9
WG estimate of total landings	1629	1887	1708	1319	1120	916	1436	1398	421	170
Agreed TAC		1678	1955	1564	1543	1543	1620	1701	1961	2059

Subdivision 20 **										
Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Denmark	2553	3024	3286	3118	3178	3033	3430	3344	3695	3663
Germany	52	55	56	60	78	69	84	87	94	63
Norway	779	440	375	421	615	575	533	500	549	486
Sweden	365	459	458	518	520	529	570	571	643	559
Others	13	2	26	0	0	33	28	26	25	37
Danish industrial bycatch	7	2	10	0	1	1	5	5	0	40
Total nominal catch	3769	3983	4211	4117	4392	4240	4649	4532	5007	4848
Unallocated landings	-376	-188	-154	-161	-65	-85	38	31	-233	-133
BMS landings	-	-	-	-	-	-	-	-	-	1
WG estimate of total landings	3393	3794	4057	3956	4327	4154	4687	4563	4774	4715
Agreed TAC	3165	4114	4793	3835	3783	3783	3972	4171	4807	5744

Subarea 4, Division 7.d and Subdivision 20 combined										
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total nominal catch	27694	33506	37705	33227	33097	31524	35553	37978	39657	39225
Unallocated landings	-1015	-190	-959	-1277	-1024	-1138	-880	-773	-1427	-1231
BMS landings										2
WG estimate of total landings	26679	33315	36746	31950	32074	30386	34673	37205	38230	37994

* The Norwegian industrial bycatch is not included in the (WG estimate of) total landings.

** Skagerrak/Kattegat split derived from national statistics prior to 2017.

*** WG estimates of total landings do not include BMS landings.

. Magnitude not available. - Magnitude known to be nil. < 0.5 Magnitude less than half the unit used in the table.

Subarea 4 and Subdivision 20 landings not included in the assessment										
Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Norwegian industrial bycatch *	22	4	201	1	.	.	.	.	.	.
Total	22	4	201	1	0	0	0	0	0	0

Summary of the assessment

Table 10 Cod in Subarea 4, Division 7.d, and Subdivision 20. Assessment summary. Weights are in tonnes. Highs and lows are 95% confidence intervals. Catches (wanted and unwanted) and unaccounted removals are assessment estimates.

Year	Recruitment			SSB			F			Wanted catch	Unwanted catch	Unaccounted removals
	Age 1	Low	High	SSB	Low	High	Ages 2–4	Low	High			
	thousands			tonnes								
1963	398864	289535	549476	145056	114396	183934	0.49	0.42	0.56	107430	10847	0
1964	651351	473524	895960	157003	126165	195380	0.53	0.46	0.60	134769	9449	0
1965	874233	637821	1198275	192537	159332	232663	0.58	0.51	0.66	181361	16807	0
1966	1062544	776067	1454771	213818	177765	257183	0.59	0.52	0.66	215189	26091	0
1967	890549	650148	1219843	242898	202125	291894	0.62	0.55	0.70	260373	26136	0
1968	448728	326969	615830	255832	219047	298795	0.66	0.58	0.74	275773	16681	0
1969	392556	284087	542441	251522	213202	296728	0.63	0.56	0.70	216360	9424	0
1970	1321591	962787	1814110	261751	222799	307513	0.66	0.60	0.74	232054	19859	0
1971	1734814	1258515	2391374	266191	226760	312478	0.75	0.67	0.83	292020	58017	0
1972	428894	310617	592209	237657	202254	279256	0.80	0.72	0.89	327803	34046	0
1973	635387	460324	877028	210703	185078	239875	0.79	0.71	0.88	234526	25206	0
1974	631387	456634	873017	225799	197922	257601	0.76	0.69	0.85	209859	27104	0
1975	1085420	778290	1513751	203488	176897	234076	0.82	0.74	0.90	209922	37671	0
1976	752472	535390	1057572	173152	148538	201844	0.87	0.78	0.96	202162	45542	0
1977	1832441	1312566	2558226	146146	125714	169898	0.83	0.75	0.92	183453	82031	0
1978	1121065	799291	1572378	145892	129326	164581	0.91	0.82	1.00	307773	48985	0
1979	1400592	1002243	1957266	145125	129715	162367	0.86	0.78	0.95	278783	64566	0
1980	2261414	1609560	3177261	158705	142629	176594	0.93	0.84	1.02	291866	104684	0
1981	876555	625986	1227423	167149	151389	184549	0.95	0.86	1.04	345144	54320	0
1982	1439757	1038977	1995138	167389	150999	185559	1.05	0.95	1.15	321748	62777	0
1983	800367	587331	1090675	136979	123166	152341	1.05	0.95	1.15	288183	37468	0
1984	1481585	1088119	2017329	119012	106746	132688	0.99	0.90	1.08	212301	71033	0
1985	358913	260702	494121	117385	105134	131064	0.96	0.87	1.05	217803	29104	0
1986	1625467	1197681	2206050	108388	98046	119821	1.00	0.91	1.10	170475	61119	0
1987	617457	456733	834739	110237	99353	122313	0.98	0.90	1.08	229202	33415	0
1988	426224	314860	576976	110178	100818	120407	1.00	0.92	1.10	193235	14945	0
1989	745534	548269	1013774	101541	92366	111628	1.02	0.93	1.12	139531	41591	0
1990	295322	218878	398465	89913	81318	99416	0.96	0.87	1.05	116636	23863	0
1991	339399	252176	456792	88668	79517	98872	0.94	0.85	1.04	102857	16145	0
1992	792194	588326	1066706	85350	76304	95469	0.94	0.84	1.04	109586	32620	0
1993	394504	295530	526625	88375	75168	103903	0.94	0.84	1.06	131155	28888	-12417
1994	955384	703812	1296879	95545	80601	113260	0.96	0.85	1.08	106816	43321	1722
1995	547278	406514	736786	110842	93376	131576	0.99	0.88	1.12	131086	31863	24080
1996	351284	262552	470004	110348	93005	130925	0.99	0.88	1.11	131082	21009	1029
1997	1089999	795354	1493796	99750	84553	117677	0.98	0.87	1.09	132921	45101	-25504
1998	111936	82845	151243	96772	81382	115072	1.00	0.89	1.12	145364	41167	-52062
1999	229672	172285	306175	82354	68841	98519	1.04	0.93	1.17	94675	12943	-16960
2000	422524	317091	563014	64321	54088	76489	1.04	0.93	1.17	72967	16092	-10279
2001	154024	115180	205968	61256	51786	72457	0.98	0.87	1.10	44424	11364	12031
2002	233307	175304	310502	55558	46982	65700	0.92	0.82	1.04	53283	11192	-11163
2003	115009	85932	153924	56871	48072	67281	0.90	0.80	1.02	31050	4611	14756
2004	196468	149532	258136	45670	38670	53936	0.86	0.76	0.97	27272	7481	1890
2005	154259	115848	205407	48389	41744	56091	0.80	0.70	0.91	29829	11339	-3323
2006	359929	275636	469998	44507	39031	50752	0.74	0.66	0.82	22506	9090	0
2007	168870	129567	220096	76643	67842	86586	0.69	0.61	0.78	23937	29014	0
2008	190204	145843	248057	83653	74197	94314	0.66	0.58	0.75	26944	25136	0
2009	183318	140233	239642	89933	78842	102583	0.65	0.57	0.74	32995	21216	0
2010	274919	209519	360733	88828	75989	103836	0.58	0.50	0.67	36089	12390	0
2011	132904	101506	174013	96198	79729	116068	0.48	0.41	0.57	34227	10349	0

Year	Recruitment			SSB			F			Wanted catch	Unwanted catch	Unaccounted removals
	Age 1	Low	High	SSB	Low	High	Ages 2–4	Low	High			
	thousands			tonnes								
2012	179434	137538	234092	93960	76751	115029	0.45	0.38	0.53	32571	7602	0
2013	226194	173181	295435	99494	81167	121960	0.44	0.38	0.52	30884	10838	0
2014	317568	242921	415153	105714	86598	129050	0.44	0.38	0.52	34886	10993	0
2015	155316	118799	203058	119893	97172	147926	0.43	0.37	0.51	38139	13199	0
2016	109912	82134	147083	119699	97197	147411	0.42	0.36	0.50	38589	12544*	0
2017	385593	259272	573460	113502	90267	142718	0.44	0.37	0.53	37629	9079*	0
2018	97383**	40347	235049	118387	90333	155154						

* Unwanted catch values include discards and BMS landings from 2016 onwards.

** Recruitment in 2018 is the assessment estimate. The value given in Table 2 is the median from a normal distribution of the assessment estimate required for stochastic projections.

Sources and references

EU. 2008. COUNCIL REGULATION (EC) No. 1342/2008 of 18 December 2008 establishing a long-term plan for cod stocks and the fisheries exploiting those stocks and repealing Regulation (EC) No. 423/2004. Official Journal of the European Union, L 348: 20–33. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:348:0020:0033:EN:PDF>.

EU. 2016. Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on establishing a multi-annual plan for demersal stocks in the North Sea and the fisheries exploiting those stocks and repealing Council Regulation (EC) 676/2007 and Council Regulation (EC) 1342/2008. COM(2016) 493 final. 23 pp. https://eur-lex.europa.eu/resource.html?uri=cellar:9aa2aaae-5956-11e6-89bd-01aa75ed71a1.0008.02/DOC_1&format=PDF.

ICES. 2015a. Report of the Benchmark Workshop on North Sea Stocks (WKNSEA), 2–6 February 2015, Copenhagen, Denmark. ICES CM 2015/ACOM:32. 253 pp.

ICES. 2015b. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 28 April–7 May 2015, ICES Headquarters, Copenhagen, Denmark. ICES CM 2015/ACOM:13. 1229 pp.

ICES. 2017. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 26 April–5 May 2017, ICES Headquarters, Copenhagen, Denmark. ICES CM 2017/ACOM:21. 1077 pp.

ICES. 2018a. Mixed-fisheries advice for Subarea 4, Division 7.d, and Subdivision 3.a.20 (North Sea, eastern English Channel, Skagerrak). In Report of the ICES Advisory Committee, 2018. ICES Advice 2018, mix-ns. 16 pp. <https://doi.org/10.17895/ices.pub.4612>.

ICES. 2018b. Report of the Working Group on Mixed-Fisheries Advice (WGMIXFISH-ADVICE), 21–26 May 2018, ICES Headquarters, Copenhagen, Denmark. ICES CM 2018/ACOM:19. In preparation.

ICES. 2018c. Advice basis. In Report of the ICES Advisory Committee, 2018. ICES Advice 2018, Book 1, Section 1.2. <https://doi.org/10.17895/ices.pub.4503>.

ICES. 2018d. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 24 April–3 May 2018, Ostend, Belgium. ICES CM 2018/ACOM:22. In preparation.

Nielsen, A., and Berg, C. W. 2014. Estimation of time-varying selectivity in stock assessments using state–space models. Fisheries Research, 158: 96–101.