

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 2020 should be no more than 10 457 tonnes.

Stock development over time

Fishing mortality (F) has increased since 2016, and is above F_{lim} in 2018. Spawning-stock biomass (SSB) has decreased since 2015 and is now below B_{lim} . Recruitment since 1998 remains poor.

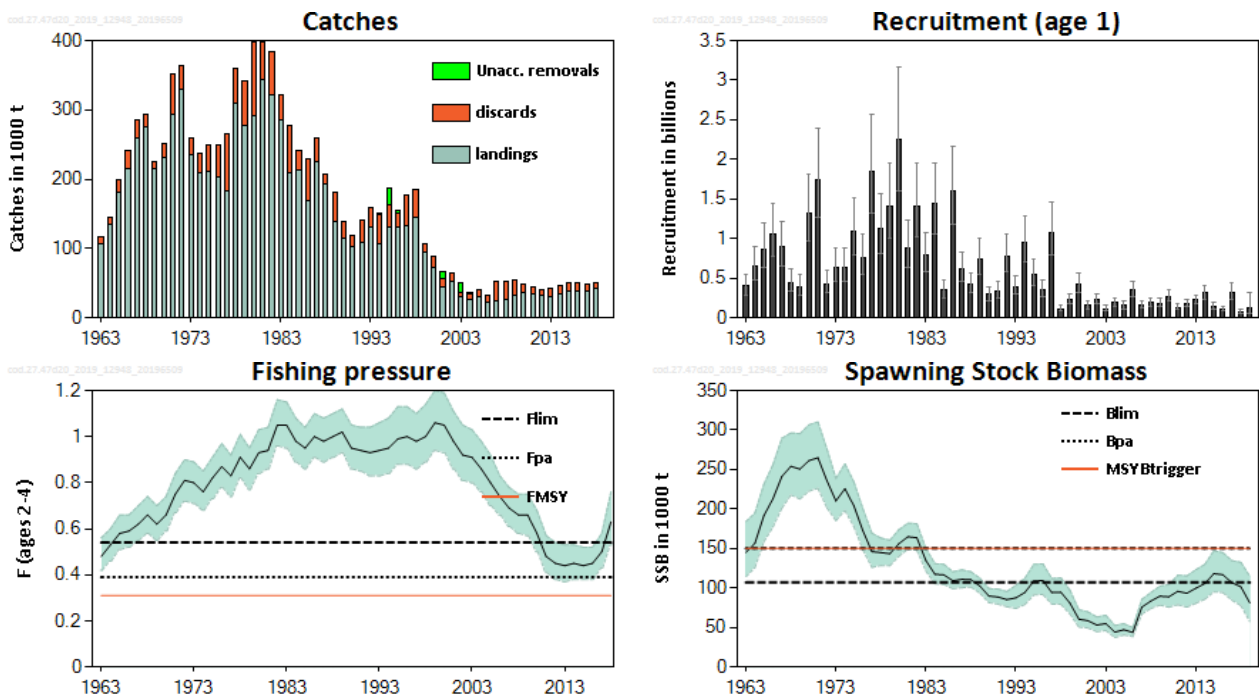


Figure 1 Cod in Subarea 4, Division 7.d, and Subdivision 20. Summary of the stock assessment. Catches are assessment estimates. Only positive unaccounted removals are plotted (see Table 10). Shaded areas (F, SSB) and error bars (R) indicate 95% confidence intervals.

Stock and exploitation status

ICES assesses that fishing pressure on the stock is above F_{MSY} , F_{pa} and F_{lim} ; spawning stock size is below $MSY B_{trigger}$, 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		
		2016	2017	2018	2017	2018	2019
Maximum sustainable yield	F_{MSY}	✘	✘	✘	MSY	✘	✘
Precautionary approach	F_{pa}, F_{lim}	○	○	✘	B_{pa}, B_{lim}	✘	✘
Management plan	F_{MGT}	—	—	—	B_{MGT}	—	—
							Below trigger
							Reduced reproductive capacity
							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, recruitment is in thousands.

Variable	Value	Notes
F _{ages 2-4} (2019)	0.49	Average exploitation pattern (2016–2018) with median total catch in 2019 set equal to the TAC in 2019
SSB (2020)	81 755	Short-term forecast
R _{age 1} (2019)	136 231	Median recruitment estimated from the assessment in 2019
R _{age 1} (2020)	183 333	Median recruitment resampled from the years 1998–2018
Total catch (2019)	35 358	Median catch based on TAC in 2019
Wanted catch (2019)	30 271	Assuming 2018 wanted catch fraction by age
Unwanted catch (2019)	5 087	Assuming 2018 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 (t).

Basis	Total catch (2020)	Wanted catch* (2020)	Unwanted catch* (2020)	F _{total} (2020)	F _{wanted} (2020)	F _{unwanted} (2020)	SSB (2021)	% SSB change **	% TAC change ***	% Advice change^
ICES advice basis										
MSY approach: SSB (2021) = B _{lim}	10457	8613	1844	0.131	0.101	0.030	107000	31	-70	-63
Other scenarios^^^										
MSY approach: F _{MSY} × SSB(2020) / MSY B _{trigger}	13289	10933	2356	0.169	0.130	0.039	104036	27	-62	-53
F = MAP^^ F _{MSY-lower} × SSB(2020) / MSY B _{trigger}	8699	7178	1521	0.108	0.083	0.025	108827	33	-75	-69
F = 0	0	0	0	0.00	0.00	0.00	118230	45	-100	-100
F _{pa}	28056	22944	5112	0.39	0.30	0.090	88516	8.3	-21	-0.52
F _{lim}	36634	29848	6786	0.54	0.42	0.124	79709	-2.5	3.6	30
SSB (2021) = B _{lim}	10457	8613	1844	0.131	0.101	0.030	107000	31	-70	-63
SSB (2021) = B _{pa}	0	0	0	0.00	0.00	0.00	118230	45	-100	-100
SSB (2021) = MSY B _{trigger}	0	0	0	0.00	0.00	0.00	118230	45	-100	-100
TAC (2019) – 20%	28286	23131	5155	0.39	0.30	0.091	88253	7.9	-20.0	0.29
TAC (2019) – 15%	30053	24574	5479	0.42	0.33	0.098	86409	5.7	-15.0	6.6
TAC (2019) – 10%	31821	25985	5836	0.45	0.35	0.104	84513	3.4	-10.0	12.8
TAC (2019) – 5%	33589	27374	6215	0.48	0.37	0.112	82710	1.17	-5.0	19.1
Constant TAC	35357	28803	6554	0.52	0.40	0.119	80950	-0.98	0.00	25
TAC (2019) + 5%	37125	30254	6871	0.55	0.42	0.126	79208	-3.1	5.0	32
TAC (2019) + 10%	38893	31690	7203	0.58	0.45	0.135	77422	-5.3	10.0	38
TAC (2019) + 15%	40661	33107	7554	0.62	0.48	0.142	75386	-7.8	15.0	44
TAC (2019) + 20%	42428	34494	7934	0.65	0.50	0.150	73575	-10.0	20.0	50
F = F ₂₀₁₉	33714	27472	6242	0.49	0.38	0.112	82598	1.03	-4.6	19.5
F = F _{MSY lower}	15374	12646	2728	0.198	0.152	0.046	101873	25	-57	-45
F = F _{MSY}	23024	18870	4154	0.31	0.24	0.071	93892	14.8	-35	-18.4

* “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 2018.

** SSB 2021 relative to SSB 2020.

*** Catch in 2020 relative to TAC in 2019: North Sea (29 437 t) + Skagerrak (4 205 t) + Eastern English Channel (1 715 t) = 35 357 t.

^ Total catch 2020 relative to advice value 2019 (28 204 t).

^^ EU multiannual plan (MAP) for the North Sea (EU, 2018)

^^^ Other scenarios do not include F_{MSY upper} because SSB(2020) < MSY B_{trigger}.

The reason behind the change in advice (-63%) is a combination of the following: a downward revision of SSB in recent years with the addition of one extra year of data, the recruitment estimate for 2019 being substantially below the value assumed last year, and the need for a large reduction in F to recover the stock to B_{lim} by 2021 because the stock is below B_{lim}.

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	An EU multiannual management plan (MAP) has been agreed by the EU for this stock (EU, 2018). This plan is not adopted by Norway, thus 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 catch scenarios for the MAP. EU–Norway have requested an evaluation of multiple management strategies (ICES 2019b), which are currently under consideration.

Quality of the assessment

In recent years (since 2017), assessments resulted in a downscaling of SSB and upward revision of F. This is caused by lower catch rates of older fish in the IBTS surveys, compared to the commercial catches. The reason for this discrepancy is not understood and might include a number of possible ecological and anthropogenic drivers. If the recent observed retrospective pattern continues, then the current forecast may be too optimistic.

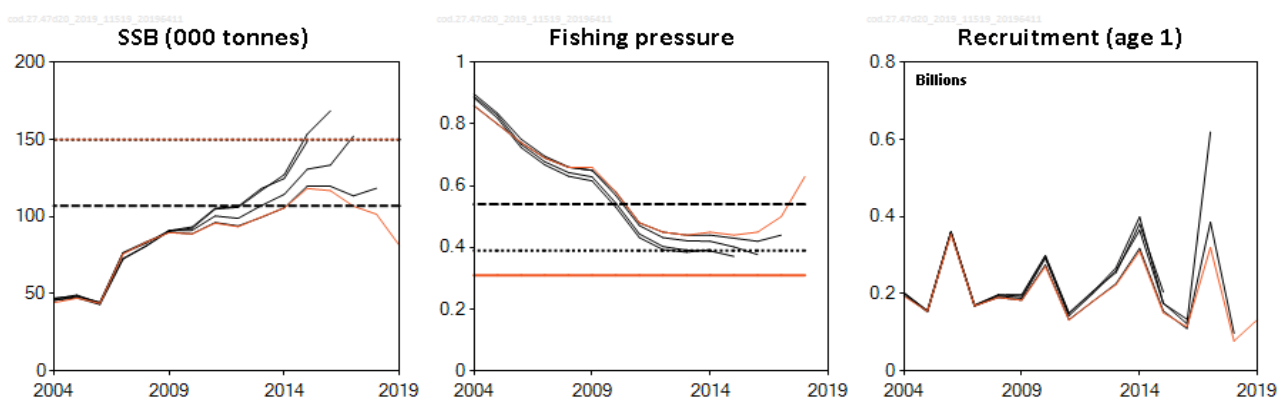


Figure 2 Cod in Subarea 4, Division 7.d, and Subdivision 20. Historical assessment results (final-year recruitment estimates included). Maturity-at-age was re-estimated in 2017, which caused the observed downward revision in SSB in the 2017 assessment.

Issues relevant for the advice

The catch scenarios presented assume that the TAC is taken in 2019, which implies that management measures in place are sufficient to ensure that catches remain at or below the TAC. This TAC may become restrictive in some areas, because the TAC in 2019 is 33% lower than in 2018. This assumption gives a lower F than assuming status quo for the intermediate year.

The EU landing obligation was implemented from 1 January 2017 for several gears, including otter trawlers with >100mm mesh (TR1), beam trawlers >120 mm (BT1), and fixed gears. From 2018, cod is fully under the EU landing obligation in Subarea 4 and Subdivision 20. The EU landing obligation did not apply to cod in Division 7.d in 2018. BMS landings of cod reported to ICES are currently negligible, and are much lower than the estimates of catches below MCRS (Minimum Conservation Reference Size) estimated by observer programmes.

It is uncertain if and to what extent the discontinuation of the days-at-sea regulation in 2017, which was part of the cod recovery plan, has an impact on the recent decline of the cod stock.

The decrease in F in the 2000s had led to an increase in the number of older fish in the population, but this trend appears to have reversed in recent years, with poorer survival to the older ages now evident (Figure 3).

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 peaking in 2016–2017 in all areas thereafter, with the exception of the southern area where cod has further declined. There has been a subsequent decrease in all areas, and it is unclear what the reasons are for this; further work is required to investigate climate change, biological, and fisheries effects. Recruitment has declined and remains low in all areas (Figure 5).

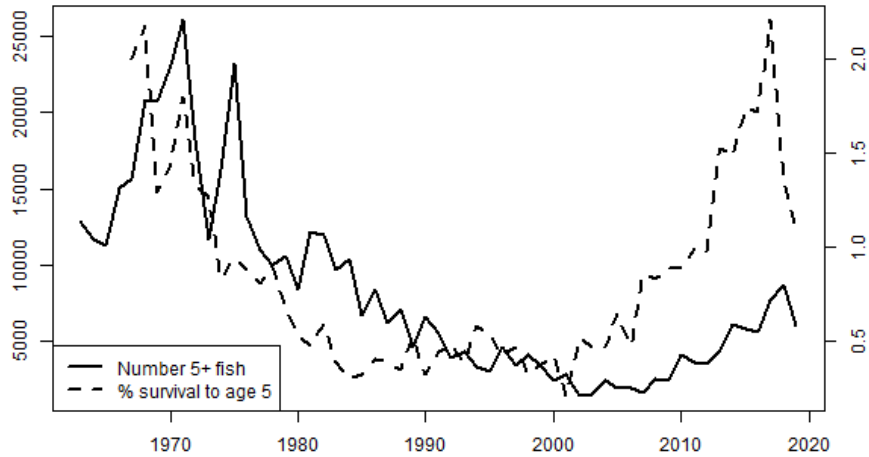


Figure 3 Cod in Subarea 4, Division 7.d, and Subdivision 20. Estimates of the number of 5-year-old and older cod in the population (solid line; thousands), and the percentage of 1-year-olds by number that have survived to age 5 in the given year (dashed line).

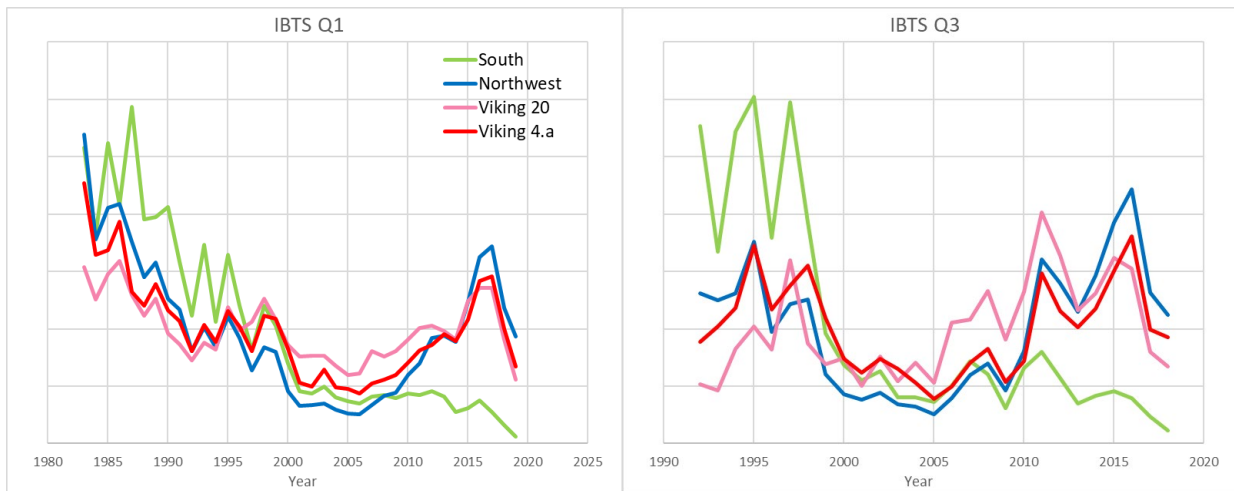


Figure 4 Cod in Subarea 4, Division 7.d, and Subdivision 20. Biomass indices by subregion (see Figure 6), based on the NS IBTS Q1 and Q3 survey data. The biomass indices are derived by fitting a non-stationary Delta-GAM model (including ship effects) to numbers-at-age for the entire dataset, and integrating 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.

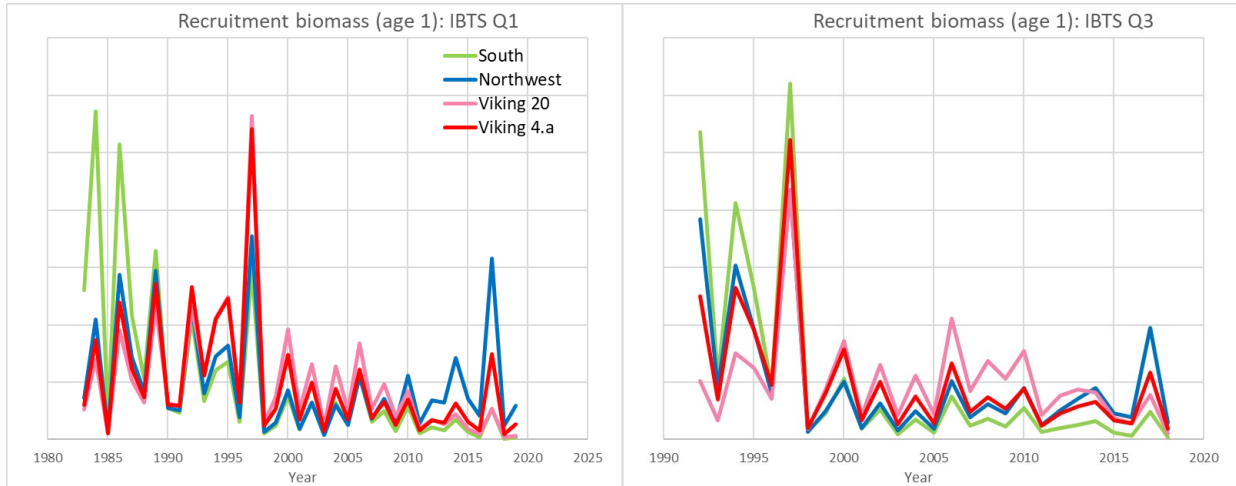


Figure 5 Cod in Subarea 4, Division 7.d, and Subdivision 20. Recruitment indices by subregion (see Figure 6), based on NS IBTS Q1 and Q3 survey data.

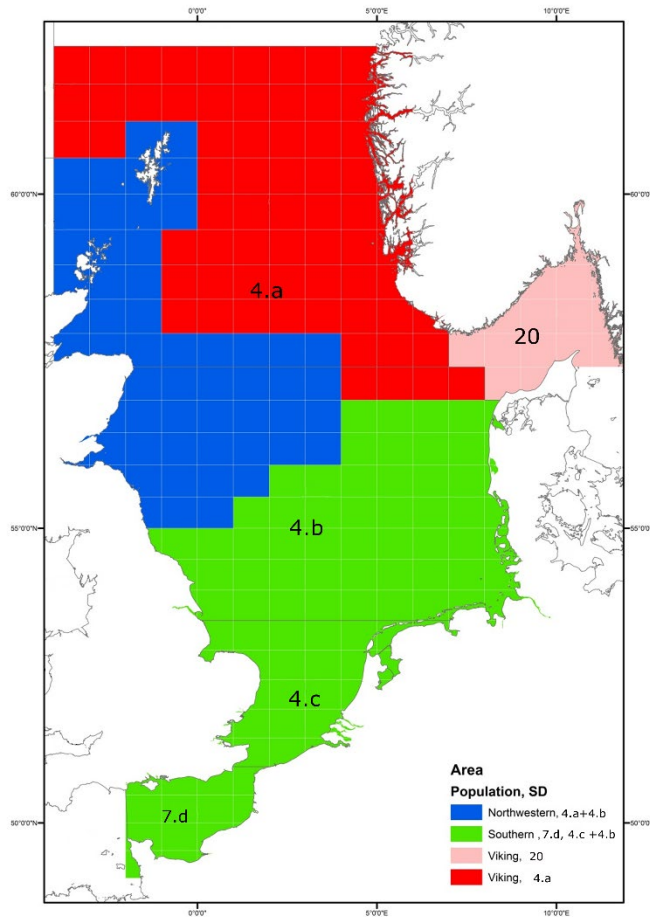


Figure 6 Cod in Subarea 4, Division 7.d, and Subdivision 20. Subregions used to derive area-specific biomass indices, based on NS IBTS Q1 and Q3 survey data.

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}	ICES (2017)
	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 Management Plan (MAP) EU (2018)	MAP MSY $B_{trigger}$	150 000	MSY $B_{trigger}$	ICES (2017)
	MAP B_{lim}	107 000	B_{lim}	ICES (2017)
	MAP F_{MSY}	0.31	F_{MSY}	ICES (2017)
	MAP range F_{lower}	0.198–0.31	Consistent with ranges provided by ICES (2017), resulting in no more than 5% reduction in long-term yield compared with MSY	ICES (2017)
	MAP range F_{upper}	0.31–0.46	Consistent with ranges provided by ICES (2017), resulting in no more than 5% reduction in long-term yield compared with MSY	ICES (2017)

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, 2018)
Assessment type	Age-based analytical assessment (SAM; ICES, 2019a) 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 (1978–2019). Annually varying natural mortalities from multispecies model (1974–2016).
Discards, BMS landings, and bycatch	Discards included (78% reported, 22% raised), data series from the main fleets (in 2018 covering 76% 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 number of samples used to derive the input data for the assessment has increased since 2012, through extended sampling programs such as 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, and ICES estimates of landings and discards. 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	Landings corresponding to advice	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	20102	19056	22418
2008	Exploitation boundaries in relation to precautionary limits. Total removals < 22 000 t	< 22000		22152	22262	21657	20710
2009	Zero catch	0		28798	27497	27634	13542
2010	Management plan F (65% of F ₂₀₀₈)	< 40300 ***		33552	31657	30980	10122
2011	See scenarios	-		26842	27800	26675	6071
2012	Management plan F (45% of F ₂₀₀₈)	< 31800		26475	27640	26627	6533
2013	Management plan (TAC –20%)	< 25441		26475	26324	25315	8421
2014	Management plan long-term phase	< 28809		27799	29356	28550	7831
2015	Management plan long-term phase	< 26713		29189	32011	31244	9601
2016	MSY approach	≤ 40419	≤ 49259	33651	34265	33035	10538^
2017	MSY approach		≤ 47359	39220	34198	33109	7945^
2018	MSY approach		≤ 53058	43156	35789	35064	7036^
2019	MSY approach		≤ 28204	29437			
2020	MSY approach		≤ 10457				

* 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	Landings corresponding to advice	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	3972	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	3982	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	4391	4327	2054
2013	Management plan (TAC –20%)	< 25441		3783	4240	4154	1780
2014	Management plan long-term phase	< 28809		3972	4650	4687	2210
2015	Management plan long-term phase	< 26713		4171	4533	4563	2942
2016	MSY approach	≤ 40419	≤ 49259	4807	5006	4774	1704***
2017	MSY approach		≤ 47359	5744	4848	4715	777***
2018	MSY approach		≤ 53058	7995	5327	5484	951***
2019	MSY approach		≤ 28204	4205			
2020	MSY approach		≤ 10457				

* 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	Landings corresponding to advice	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	-	-	1480	1479	377
2007	Zero catch	0	-	-	2073	2147	2086
2008	Exploitation boundaries in relation to precautionary limits. Total removals less than 22 000 t	< 22000	-	-	1662	1629	1674
2009	Zero catch	0	1678	1678	2023	1887	4513
2010	Management plan F (65% of F ₂₀₀₈)	< 40300***	1955	1955	1836	1708	343
2011	See scenarios	-	1564	1564	1311	1319	623
2012	Management plan F (45% of F ₂₀₀₈)	< 31800	1543	1543	1064	1120	102
2013	Management plan (TAC -20%)	< 25441	1543	1543	959	916	123
2014	Management plan long-term phase	< 28809	1620	1620	1548	1436	624
2015	Management plan long-term phase	< 26713	1701	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	92	84	< 1 ^
2019	MSY approach		≤ 28204	1715			
2020	MSY approach		≤ 10457				

* 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 2018 as estimated by ICES.

Catch (2018)	Wanted catch					Unwanted catch
48 620 tonnes	Demersal trawls and seines >100 mm 75%	Gillnets 10.7%	Demersal trawls 70–99 mm 6.7%	Beam trawls 2.5%	Other gears 4.6%	7 988 tonnes
	40 633 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	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Belgium	1627	1722	1309	1008	894	946	666	653	862	1075	1258	1223	1103	696	818
Denmark	5889	6291	5105	3430	3831	4402	5686	4863	4803	4536	5457	6026	6713	6119	5489
Faroe Islands	37	34	3	-	16	45	32	-	-	-	-	-	-	.	.
France	294	664	354	659	573	950	782	619	369	287	637	517	391	401	583
Germany	2213	2648	2537	1899	1736	2374	2844	2211	2385	1921	2257	2133	2083	1987	1506
Greenland	.	35	23	17	17	11	-	-	-	-	-	-	2	1	.
Netherlands	1726	1660	1585	1523	1896	2649	2657	1928	1955	1344	1242	1403	1365	645	513
Norway	3223	2900	2749	3057	4128	4234	4495	4898	4601	4080	4600	5404	5627	5521	5553
Poland	-	-	-	1	2	3	-	2	-	-	-	-	-	.	.
Sweden	240	319	309	386	439	378	362	316	471	332	401	415	373	387	274
UK (E/W/NI)	1890	1270	1491	1587	1546	2383	2553	2169	1629	2129	2962	.	.	.	.
UK (Scotland)	6650	4936	6857	6511	7185	9052	11567	10141	10565	10619	10517	.	.	.	.
UK (combined)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	13479	14889	16603	18293	21054
Others	0	0	786	0	0	0	0	0	0	0	0	0	0	0	0
Danish industrial bycatch	17	21	11	23	1	72	12	0	0	2	24	0	5	147	0
Norwegian industrial bycatch *	.	.	48	101	22	4	201	1	.	.	.	.	.	.	.
Total nominal catch	23806	22500	23119	20102	22262	27497	31657	27800	27640	26324	29355	32011	34265	34198	35789
Unallocated landings	-1277	356	-2041	-1046	-605	136	-677	-1125	-1013	-1009	-805	-767	-1230	-1089	-725
Official BMS landings	-	-	-	-	-	-	-	-	-	-	-	-	-	1	8
ICES estimate of total landings	22529	22855	21078	19056	21657	27634	30980	26675	26627	25315	28550	31244	33035	33109	35064
Agreed TAC	27300	27300	23205	19957	22152	28798	33552	26842	26475	26475	27799	29189	33651	39220	43156

Division 7.d															
Country	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Belgium	47	51	80	84	154	73	57	56	40	53	72	78	39	17	8
Denmark	-	-	-	-	-	-	-	-	-	-	-	-	-	.	.
France	810	986	1124	1743	1326	1779	1606	1078	885	768	1270	1142	279	92	35
Netherlands	14	9	9	59	30	35	45	51	40	38	50	52	40	22	10
UK (E/W/NI)	103	184	267	174	144	133	127	125	99	100	156	.	.	.	.
UK (Scotland)	-	-	1	12	7	3	1	1	-	-	-	.	.	.	.
UK (combined)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	156	162	102	48	39
Total nominal catch	974	1230	1480	2073	1662	2023	1836	1311	1064	959	1548	1434	459	179	92
Unallocated landings	40	29	-2	74	-33	-135	-128	8	56	-43	-112	-36	-38	-9	-8
ICES estimate of total landings	1014	1259	1479	2147	1629	1887	1708	1319	1120	916	1436	1398	421	170	84
Agreed TAC	n/a	n/a	n/a	n/a	n/a	1678	1955	1564	1543	1543	1620	1701	1961	2059	1733

Subdivision 20 **															
Country	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Denmark	3038	3019	2513	2246	2553	3024	3286	3118	3178	3033	3430	3344	3696	3663	4220
Germany	99	86	84	67	52	55	56	60	78	69	84	87	94	63	86
Norway	856	759	628	681	779	440	375	421	615	575	533	500	551	486	288
Sweden	495	488	372	370	365	459	458	518	520	529	570	571	641	559	668
Others	24	21	373	385	13	2	26	0	0	33	28	26	25	37	58
Danish industrial by-catch	4	2	3	2	7	2	10	0	1	1	5	5	0	40	7
Total nominal catch	4516	4375	3972	3751	3769	3982	4211	4117	4391	4240	4650	4533	5006	4848	5327
Unallocated landings	-602	-376	-715	-731	-376	-188	-154	-161	-64	-86	37	31	-232	-133	157
Official BMS landings	-	-	-	-	-	-	-	-	-	-	-	-	-	1	4
ICES estimate of total landings	3914	3998	3258	3020	3393	3794	4057	3956	4327	4154	4687	4563	4774	4715	5484
Agreed TAC	3900	3900	3315	2851	3165	4114	4793	3835	3783	3783	3972	4171	4807	5744	7995

Subarea 4 Division 7.d and Subdivision 20 combined															
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total nominal catch	29296	28104	28572	25926	27693	33502	37704	33228	33095	31523	35554	37978	39730	39225	41208
Unallocated landings	-1839	9	-2757	-1703	-1014	-187	-958	-1277	-1022	-1137	-880	-773	-1500	-1231	-576
Official BMS landings	-	-	-	-	-	.	.	.	.	.	.	.	.	2	12
ICES estimate of total landings	27457	28113	25815	24223	26679	33315	36746	31950	32074	30386	34673	37205	38230	37994	40633

Subarea 4 and Subdivision 20 landings not included in the assessment															
Country	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Norwegian industrial bycatch *	.	.	48	101	22	4	201	1	.	.	.	.	.	.	.
Total	0	0	48	101	22	4	201	1	0	0	0	0	0	0	0

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

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

. Magnitude not available. - Magnitude known to be nil. < 0.5 Magnitude less than half the unit used in the table. n/a Not applicable.

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 (Age 1)			SSB			F (Ages 2–4)			Wanted catch	Unwanted catch	Unaccounted removals
	Age 1	Low	High	SSB	Low	High	Ages 2–4	Low	High			
	thousands			tonnes								
1963	397633	289452	546246	145016	114233	184094	0.48	0.42	0.56	106802	10719	0
1964	650569	474239	892462	156610	125894	194820	0.53	0.46	0.60	134541	9404	0
1965	871808	637817	1191641	191632	158680	231427	0.58	0.51	0.66	181440	16875	0
1966	1059734	776140	1446950	212893	177118	255894	0.59	0.52	0.66	214641	26042	0
1967	891641	652622	1218200	241337	201148	289556	0.62	0.55	0.70	260099	26159	0
1968	448190	327485	613387	254072	217826	296349	0.66	0.58	0.74	276249	16732	0
1969	391338	284048	539153	250569	212605	295312	0.62	0.55	0.70	215608	9310	0
1970	1319269	963442	1806514	261239	222613	306567	0.66	0.59	0.74	231405	19725	0
1971	1740206	1265171	2393604	264919	226254	310193	0.75	0.67	0.84	292551	58471	0
1972	431806	313383	594980	235866	201568	276000	0.81	0.72	0.90	329398	34472	0
1973	635677	461558	875483	210206	185143	238663	0.80	0.71	0.89	234730	25399	0
1974	632510	458498	872562	225745	198174	257152	0.76	0.68	0.85	209328	27122	0
1975	1092931	784945	1521759	204016	177746	234169	0.82	0.73	0.91	210468	38112	0
1976	755228	538030	1060107	172409	148352	200367	0.87	0.78	0.97	203274	46227	0
1977	1842843	1322444	2568027	146131	126087	169360	0.83	0.74	0.92	183236	82627	0
1978	1122754	802406	1570995	144837	128523	163222	0.91	0.82	1.01	310333	49582	0
1979	1399884	1003940	1951983	143438	128208	160476	0.86	0.77	0.95	277586	64419	0
1980	2254006	1607701	3160129	156049	140130	173776	0.93	0.84	1.03	292052	104803	0
1981	877285	627775	1225964	164850	149267	182060	0.94	0.86	1.04	343649	54211	0
1982	1414554	1022443	1957042	163662	147630	181435	1.05	0.96	1.16	321947	62074	0
1983	784294	576545	1066903	134944	121409	149988	1.05	0.95	1.15	284695	36719	0
1984	1436937	1057232	1953013	117444	105418	130843	0.98	0.89	1.08	209600	68632	0

Year	Recruitment (Age 1)			SSB			F (Ages 2–4)			Wanted catch	Unwanted catch	Unaccounted removals
	Age 1	Low	High	SSB	Low	High	Ages 2–4	Low	High			
	thousands			tonnes								
1985	350975	255833	481500	116664	104638	130072	0.95	0.86	1.04	213480	28170	0
1986	1597931	1178693	2166285	109218	99003	120487	1.00	0.91	1.10	169122	59997	0
1987	609972	451901	823335	111058	100317	122949	0.98	0.89	1.08	226071	32765	0
1988	421805	312043	570175	110518	101316	120555	1.00	0.91	1.10	192261	14755	0
1989	733346	540067	995795	102521	93470	112448	1.02	0.93	1.12	139028	41026	0
1990	294268	218401	396489	89916	81462	99247	0.95	0.86	1.05	115602	23536	0
1991	341888	254386	459490	88679	79620	98769	0.94	0.85	1.04	102648	16189	0
1992	780266	580038	1049612	85356	76286	95505	0.93	0.83	1.04	109507	32121	0
1993	395474	295868	528613	87538	74114	103394	0.94	0.83	1.06	130320	28669	-12318
1994	951238	700253	1292182	94324	79183	112360	0.95	0.84	1.08	106797	42976	1575
1995	544657	404465	733440	108795	91139	129872	0.99	0.88	1.13	130907	31673	25126
1996	350372	261637	469202	109556	91857	130666	1.00	0.88	1.13	130737	20821	2500
1997	1072352	785294	1464342	94290	79441	111916	0.98	0.86	1.10	132011	44032	-24467
1998	112966	83595	152657	94704	79340	113043	1.00	0.89	1.14	144621	40842	-51385
1999	227641	170628	303702	80941	67247	97423	1.06	0.94	1.20	94599	12859	-16044
2000	416935	312638	556026	60530	50558	72469	1.05	0.93	1.19	72758	15925	-10102
2001	152852	114297	204413	58733	49404	69825	0.98	0.86	1.11	44357	11319	11287
2002	229713	172403	306073	53225	44761	63289	0.92	0.81	1.05	53200	11095	-11602
2003	113961	85151	152518	55002	46209	65469	0.91	0.80	1.03	31016	4592	14288
2004	193972	147609	254899	44228	37218	52558	0.86	0.76	0.98	27264	7458	1541
2005	154826	116268	206172	47151	40551	54825	0.80	0.70	0.92	29804	11361	-3522
2006	354524	271669	462648	43808	38428	49943	0.74	0.66	0.83	22489	9043	0
2007	168447	129247	219536	75783	67081	85614	0.69	0.61	0.78	23857	28827	0
2008	190527	146093	248477	83490	74002	94195	0.66	0.58	0.75	26928	25159	0
2009	183333	140260	239634	89598	78440	102343	0.66	0.57	0.75	33077	21300	0

Year	Recruitment (Age 1)			SSB			F (Ages 2–4)			Wanted catch	Unwanted catch	Unaccounted removals
	Age 1	Low	High	SSB	Low	High	Ages 2–4	Low	High			
	thousands			tonnes								
2010	270365	206170	354548	88837	75725	104219	0.58	0.50	0.68	36076	12325	0
2011	131827	100694	172587	95767	78893	116250	0.48	0.41	0.57	33937	10120	0
2012	179746	137773	234505	93437	75738	115272	0.45	0.38	0.54	32442	7503	0
2013	223389	171141	291588	99704	80722	123150	0.44	0.37	0.53	30819	10721	0
2014	310228	237456	405302	105637	85875	129946	0.45	0.38	0.53	34791	10818	0
2015	150660	115523	196482	118237	94999	147159	0.44	0.38	0.52	37958	12941	0
2016	114185	87473	149055	116859	94287	144835	0.45	0.38	0.52	38690	12532 *	0
2017	320063	234487	436870	106745	84593	134697	0.50	0.43	0.58	38500	9252 *	0
2018	77677	53035	113770	101582	77818	132603	0.63	0.53	0.76	41418	9118 *	0
2019	133583 **	57128	312360	81224	57451	114834						

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

** Recruitment in 2019 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.2018. Regulation (EU) 2018/973 of the European Parliament and of the council of 4 July 2018 establishing a multiannual plan for demersal stocks in the North Sea and the fisheries exploiting those stocks, specifying details of the implementation of the landing obligation in the North Sea and repealing Council Regulations (EC) No 676/2007 and (EC) No 1342/2008. Official Journal of the European Union, L 179: 1–13. <http://data.europa.eu/eli/reg/2018/973/oj>
- 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. <https://doi.org/10.17895/ices.pub.5324>
- 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. <https://doi.org/10.17895/ices.pub.5325>
- 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. <https://doi.org/10.17895/ices.pub.5323>
- ICES. 2018. 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. 2019. Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK). ICES Scientific Reports. 1:7. <http://doi.org/10.17895/ices.pub.5402>
- ICES. 2019b. EU and Norway request concerning the long-term management strategy of cod, saithe, and whiting, and of North Sea autumn-spawning herring. In Report of the ICES Advisory Committee, 2019. ICES Advice 2019, sr.2019.06, <https://doi.org/10.17895/ices.advice.4895>
- Nielsen, A. and Berg, C. W. 2014. Estimation of time-varying selectivity in stock assessments using state–space models. Fisheries Research, 158: 96–101. <https://doi.org/10.1016/j.fishres.2014.01.014>

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