

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

ICES stock advice

ICES advises that when the MSY approach is applied, catches in 2018 should be no more than 59 888 tonnes.

Stock development over time

Fishing mortality (F) has declined since year 2000, but is estimated to be above F_{MSY} . Spawning–stock biomass (SSB) has increased from the historical low in 2006 to above $MSY B_{trigger}$ in 2017. There are indications of increased recruitment in 2017.

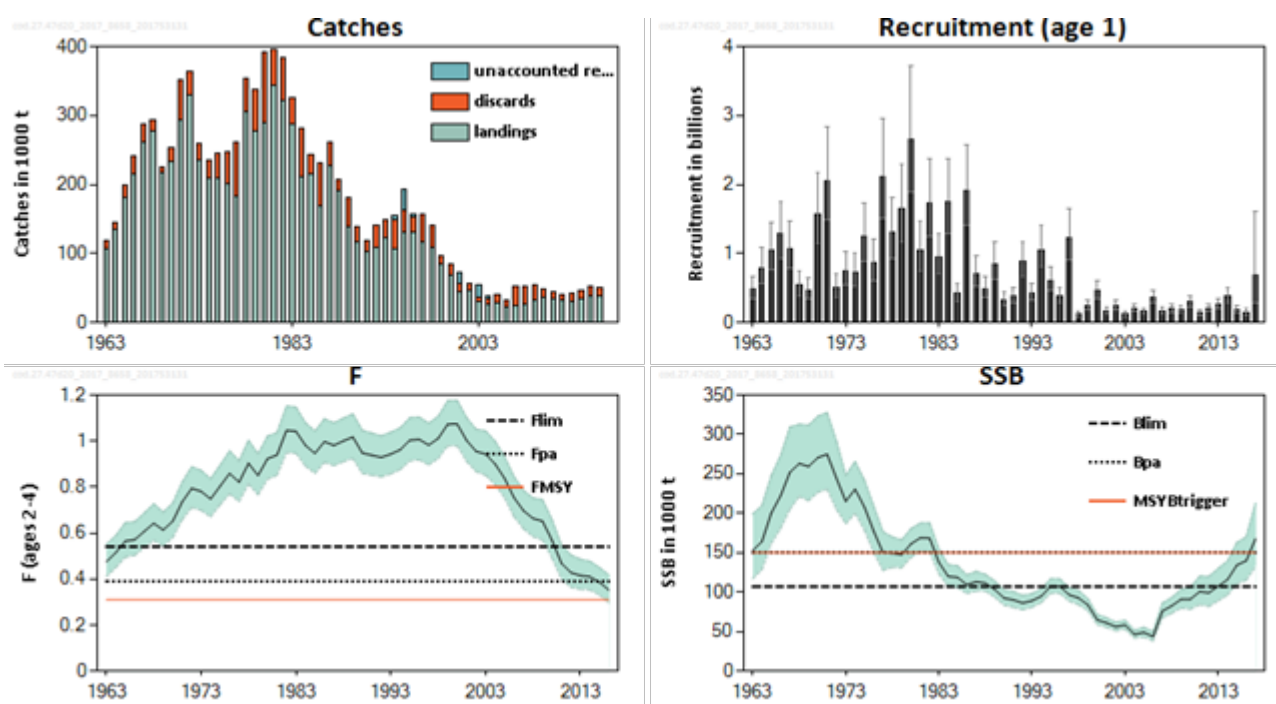


Figure 1 Cod in Subarea 4, Division 7.d, and Subdivision 20. Summary of the stock assessment. Catches are assessment estimates. Shaded areas (F, SSB) and error bars (R) indicate point-wise 95% confidence intervals.

Stock and exploitation status

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			
		2014	2015	2016	2015	2016	2017	
Maximum sustainable yield	F_{MSY}	✘	✘	✘	MSY	✘	✘	✓ Above trigger
Precautionary approach	F_{pa} , F_{lim}	○	✓	✓	B_{pa} , B_{lim}	○	○	✓ Full reproductive capacity
Management plan	F_{MGT}	—	—	—	B_{MGT}	—	—	— Not applicable

Catch options

Table 2 Cod in Subarea 4, Division 7.d, and Subdivision 20. The basis for the catch options.

Variable	Value	Source	Notes
$F_{\text{ages 2-4}}$ (2017)	0.35	ICES (2017a)	$F_{\text{ages 2-4}}$ (2016), assuming effort similar to 2016.
SSB (2018)	204267	ICES (2017a)	Tonnes; short-term forecast.
$R_{\text{age 1}}$ (2017)	692194	ICES (2017a)	Thousands; median recruitment estimate in 2017.
$R_{\text{age 1}}$ (2018)	198216	ICES (2017a)	Thousands; median recruitment, resampled from the years 1998–2016.
Catch (2017)	55207	ICES (2017a)	Tonnes; short-term forecast.
Landings (2017)	41939	ICES (2017a)	Tonnes; assuming 2016 landings fraction by age.
Discards (2017)	13268	ICES (2017a)	Tonnes; assuming 2016 discards fraction by age.

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

Basis	Total catch (2018)	Wanted catch* (2018)	Unwanted catch* (2018)	F_{total} (2018)	F_{wanted} (2018)	F_{unwanted} (2018)	SSB (2019)	% SSB change **	% TAC change ***
ICES advice basis									
MSY approach: F_{MSY}	59888	41309	18579	0.31	0.20	0.108	216473	6.0	-12.2
Other options									
EU–Norway Management Strategy (MS) with previous reference points	74748	51393	23355	0.40	0.26	0.139	202395	-0.92	9.3
EU–Norway MS with new reference points	74748	51393	23355	0.40	0.26	0.139	202395	-0.92	9.3
$F = 0$	0.0	0.0	0.0	0.0	0.0	0.0	275777	35	-100
F_{pa}	73133	50297	22836	0.39	0.25	0.135	203811	-0.22	7.0
F_{lim}	95963	65753	30210	0.54	0.35	0.188	182048	-10.9	40
SSB (2019) = B_{lim}	178836	119859	58977	1.29	0.84	0.45	107000	-48	155
SSB (2019) = B_{pa}	130185	88465	41720	0.80	0.52	0.28	150000	-27	88
SSB (2019) = MSY B_{trigger}	130185	88465	41720	0.80	0.52	0.28	150000	-27	88
TAC (2017) – 20%	55135	37168	17517	0.28	0.182	0.097	220655	8.0	-20
TAC (2017) – 15%	58613	39970	18643	0.30	0.195	0.104	217094	6.3	-15.0
TAC (2017) – 10%	62089	42321	19768	0.32	0.21	0.111	213494	4.5	-10.0
TAC (2017) – 5%	65567	44672	20895	0.34	0.22	0.118	210182	2.9	-5.0
Constant TAC	69046	47023	22023	0.36	0.24	0.125	206804	1.24	0.0
TAC (2017) + 5%	72530	49374	23156	0.38	0.25	0.132	203532	-0.36	5.0
TAC (2017) + 10%	76018	51725	24293	0.40	0.26	0.140	200116	-2.0	10.0
TAC (2017) + 15%	79508	54076	25423	0.42	0.28	0.148	196951	-3.6	15.0
TAC (2017) + 20%	83010	56428	26582	0.45	0.29	0.155	193442	-5.3	20
$F = F_{2017}$	66900	46061	20839	0.35	0.23	0.123	209849	2.7	-2.0

Basis	Total catch (2018)	Wanted catch* (2018)	Unwanted catch* (2018)	F _{total} (2018)	F _{wanted} (2018)	F _{unwanted} (2018)	SSB (2019)	% SSB change **	% TAC change ***
Mixed fisheries options									
A: Max.	180241			1.44			91380	-55	
B: Min.	47378			0.25			215196	5.4	
C: HAD	60863			0.32			214510	5.0	
E: POK	79380			0.53			156291	-23	
E: SQ effort	70421			0.41			187234	-8.3	
F: Value	63548			0.35			199183	-2.5	
G: Range	63282			0.33			213162	4.4	

* "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 2016.

** SSB 2019 relative to SSB 2018.

*** Wanted catch in 2018 relative to TAC in 2017: North Sea (39 220 t) + Skagerrak (5744 t) + Eastern English Channel (2059 t) = 47 023 t.

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. HAD: Each fleet stops fishing when its individual haddock share is exhausted.

D. POK: Each fleet stops fishing when its individual saithe share is exhausted.

E. SQ (*status quo*) effort scenario: The effort of each fleet in 2017 and 2018 is as in 2016.

F. 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.

G. Range scenario: where the potential for TAC mismatches in 2018 are minimized within the FMSY 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).

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	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.

Quality of the assessment

Catch data have been provided to ICES since 2012 through programmes such as Fully Documented Fisheries (FDF), and increased coverage by the Scottish industry/science observer sampling scheme.

The benchmark in 2015 introduced annually varying maturity estimates to the assessment (ICES, 2015a). Maturity-at-age was re-estimated in 2017 to produce a time-series of maturity estimates that are consistently calculated over time and corrected for errors. The re-estimated maturities caused a re-scaling of the SSB, to an extent that necessitated the re-calculation of reference points.

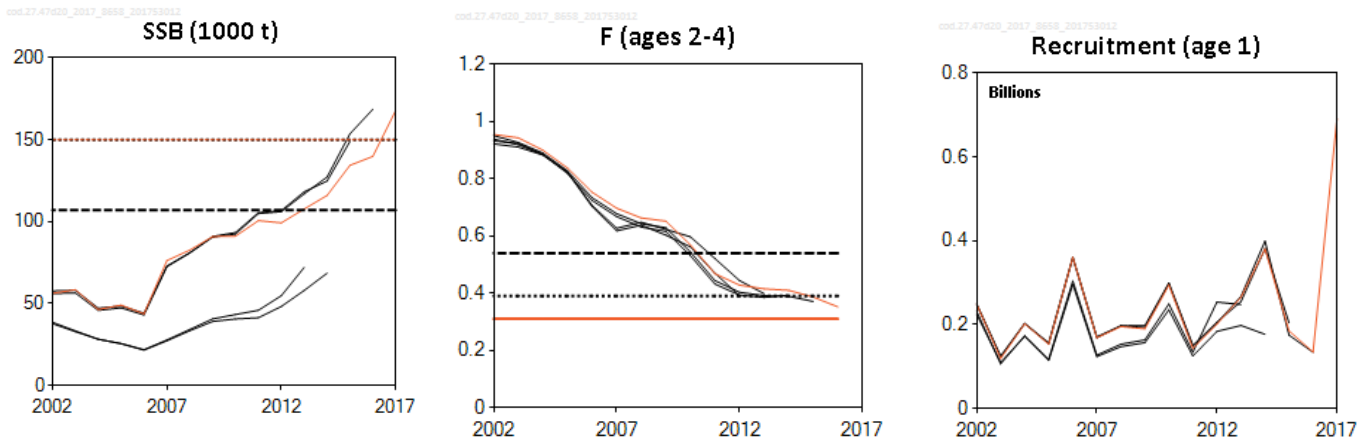


Figure 2 Cod in Subarea 4, Division 7.d, and Subdivision 20. Historical assessment results (final-year recruitment estimates included).

Issues relevant for the advice

ICES previously provided advice on the F_{MSY} range for this stock in 2015 (ICES, 2015b). F_{MSY} was revised in 2017 and the F_{MSY} range was updated as follows:

Description	Value	Source
F_{MSY} lower	0.198	ICES (2017a)
F_{MSY} upper	0.46	ICES (2017a)

The EU landing obligation was implemented from 1 January 2017 for several gears, including TR1, BT1, and fixed gears.

Since the implementation of effort management (days-at-sea regulation), fishing mortality rates have been reduced and the stock 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).

There are indications from the IBTS Q1 survey that recruitment in 2017 is substantially higher than the low level observed since 1998. Therefore, the forecast uses the assessment estimate of recruitment in 2017 rather than assuming the continuation of the recent period of low recruitment. The 2017 recruitment remains to be confirmed by the IBTS Q3 survey and a reopening of the advice may be triggered in October.

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. 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, but there are indications of increased recruitment in the northern North Sea (Figure 5).

Results from a North Sea mixed-fisheries analysis are presented in ICES (2017c). For 2018, assuming a strictly implemented discard ban (corresponding to the “Minimum” scenario), whiting would be the most limiting stock, being estimated to constrain 24 out of 42 fleet segments. Haddock is the second most limiting stock, constraining eight fleet segments. Additionally, if Norway lobster (*Nephrops*) was managed by separate TACs for the individual functional units (FUs), Norway lobster in FU 6 would be considered the most limiting stock for ten fleet segments. Conversely, in the “Maximum” scenario, saithe and Eastern Channel plaice would be least limiting for 20 and 11 fleet segments, respectively. Finally, if Norway lobster was managed by separate TACs, Norway lobster in FUs 7, 5, 33, and 4.non-FU would be the least limiting for nine, two, one, and two fleet segments, respectively. 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 2018 within the F_{MSY} range. This scenario returns a fishing mortality by stock which, if used for setting single-stock fishing opportunities for 2018, may

reduce the gap between the most and the least restrictive TACs, thus reducing the potential for quota over- and undershoot. This “range” scenario suggests that the potential for mixed-fisheries mismatch would be lowered with a 2018 TAC in the lower part of the F_{MSY} range for Eastern English Channel plaice and saithe, and in the upper part of the range for cod and North Sea plaice.

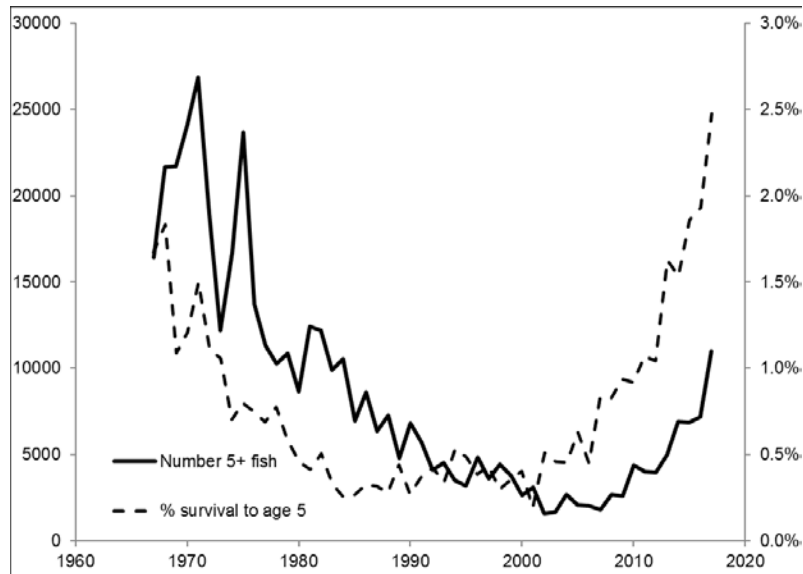


Figure 3 Cod in Subarea 4, Division 7.d, and Subdivision 20. Estimates of the number of 5-year-old and older cod in the population (solid line; thousands), and the percentage of 1-year-olds by number that have survived to age 5 in the given year (dashed line).

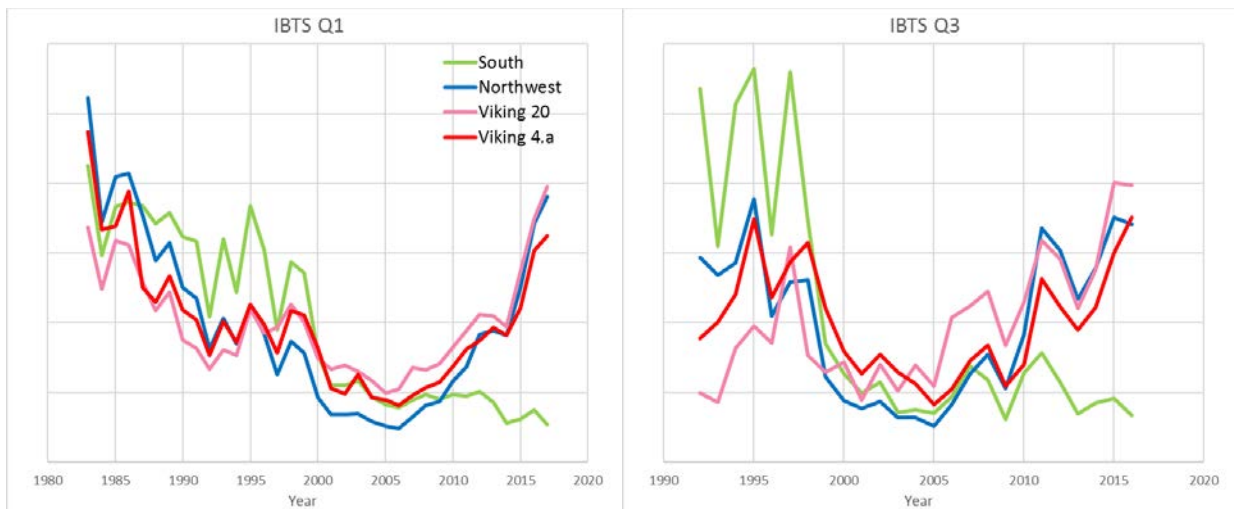


Figure 4 Cod in Subarea 4, Division 7.d, and Subdivision 20. Biomass indices by subregion (see Figure 6), based on the NS IBTS Q1 and Q3 survey data. The biomass indices are derived by fitting a non-stationary Delta-GAM model (including ship effects) to numbers-at-age for the entire dataset and integrating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

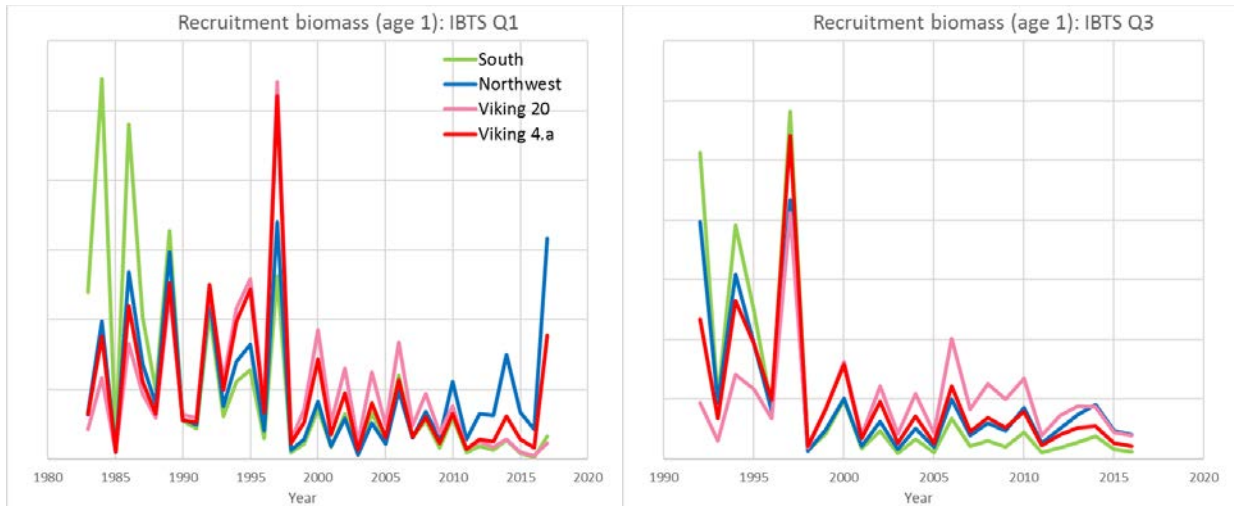


Figure 5 Cod in Subarea 4, Division 7.d, and Subdivision 20. Recruitment indices by subregion (see Figure 6), based on NS IBTS Q1 and Q3 survey data.

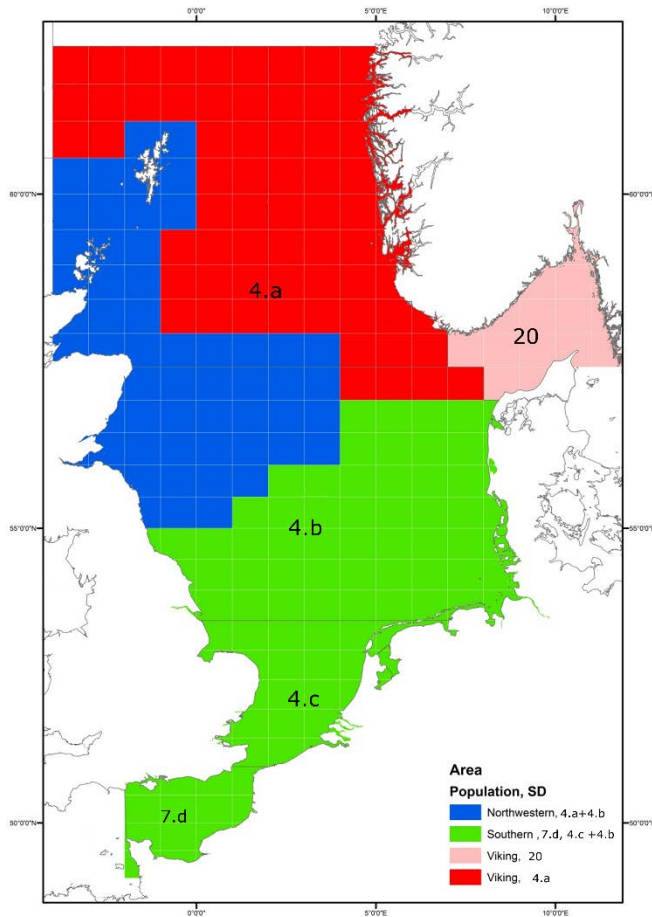


Figure 6 Cod in Subarea 4, Division 7.d, and Subdivision 20. Subregions used to derive area-specific biomass indices, based on NS IBTS Q1 and Q3 survey data.

Reference points

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

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	150000 t	B_{pa}	ICES (2017a)
	F_{MSY}	0.31	EQsim analysis based on recruitment period 1988–2016	
Precautionary approach	B_{lim}	107000 t	SSB associated with the last above-average recruitment (1996 year class)	ICES (2017a)
	B_{pa}	150000 t	$B_{lim} \times \exp(1.645 \times 0.2) \approx 1.4 \times B_{lim}$	ICES (2017a)
	F_{lim}	0.54	EQsim analysis based on recruitment period 1988–2016	ICES (2017a)
	F_{pa}	0.39	$F_{lim} \times \exp(-1.645 \times 0.2) \approx F_{lim} / 1.4$	ICES (2017a)
EU–Norway Management Strategy	$SSB_{MS-lower}$	70000 t	Former B_{lim}	EU (2008)
	$SSB_{MS-upper}$	150000 t	Former B_{pa}	
	$F_{MS-lower}$	0.20	Fishing mortality when $SSB < SSB_{MS-lower}$	
	$F_{MS-upper}$	0.40	Fishing mortality when $SSB > SSB_{MS-upper}$	

Basis of the assessment

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

ICES stock data category	1 (ICES, 2016a).
Assessment type	Age-based analytical assessment (SAM; ICES, 2017a) 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, ages and length frequencies 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 (1978–2017). Annually varying natural mortalities from multispecies model (1974–2013).
Discards, BMS landings, and bycatch	Discards included (80% reported, 20% raised), data series from the main fleets (in 2016 covering 72% 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, 2015c). Reference points revised (ICES, 2017a).
Working group	Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK)

Information from stakeholders

There is no additional available information.

History of the advice, catch, and management

Table 7 Cod in Subarea 4, Division 7.d, and Subdivision 20. ICES advice and official landings. 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	BMS reported to ICES
1987	SSB recovery; TAC	100000–125000		175000	167000	182000		
1988	70% of F(86); TAC	148000		160000	142000	157000		
1989	Halt SSB decline; protect	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	29346	28550	7831	
2015	Management plan long-term phase	< 26713		29189	31959	31244	9601	
2016	MSY approach	≤ 40419	≤ 49259	33651	34192	33035	10528	10
2017	MSY approach	≤ 39651	≤ 47359	39220				
2018	MSY approach	≤ 41309	≤ 59888					

* 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).

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	BMS reported to ICES
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	4644	4687	2210	
2015	Management plan long-term phase	< 26713		4171	4536	4563	2942	
2016	MSY approach	≤ 40419	≤ 49259	4807	5007	4774	1704	0
2017	MSY approach	≤ 39651	≤ 47359	5744				
2018	MSY approach	≤ 41309	≤ 59888					

* Norwegian fjords not included.

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

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	BMS reported to ICES
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	1387	1398	19	
2016	MSY approach	≤ 40419	≤ 49259	1961	459	421	72	0
2017	MSY approach	≤ 39651	≤ 47359	2059				
2018	MSY approach	≤ 41309	≤ 59888					

* 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).

History of the catch and landings

Table 8 Cod in Subarea 4, Division 7.d, and Subdivision 20. Catch distribution by fleet in 2016 as estimated by ICES.

Catch (2016)	Wanted catch					Unwanted catch	
	Demersal trawls and seines >100 mm 71%	Gillnets 12.6%	Demersal trawls 70–99 mm 5.0%	Beam trawls 4.1%	Other gears 7.0%	Discards	BMS landings
50544 tonnes	38230 tonnes					12304 tonnes	10 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	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Belgium	4642	5799	3882	3304	2470	2616	1482	1627	1722	1309
Denmark	21870	23002	19697	14000	8358	9022	4676	5889	6291	5105
Faroe Islands	40	102	96	-	9	34	36	37	34	3
France	3451	2934	.	1222	717	1777	620	294	664	354
Germany	5179	8045	3386	1740	1810	2018	2048	2213	2648	2537
Greenland	.	.	.	.	.	.	.	.	35	23
Netherlands	11807	14676	9068	5995	3574	4707	2305	1726	1660	1585
Norway	5814	5823	7432	6410	4369	5217	4417	3223	2900	2749
Poland	31	25	19	18	18	39	35	-	-	0
Sweden	832	540	625	640	661	463	252	240	319	309
UK (E/W/Nl)	13413	17745	10344	6543	4087	3112	2213	1890	1270	1491
UK (Scotland)	32344	35633	23017	21009	15640	15416	7852	6650	4936	6857
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	0	786
Danish industrial bycatch *	.	.	.	.	.	105	22	17	21	11
Norwegian industrial bycatch *	.	.	.	.	.	.	.	.	.	48
Total nominal catch	99423	114324	77566	60881	41713	44526	25958	23806	22500	23119
Unallocated landings	2746	7779	826	-1114	-740	-2333	-1875	-1277	356	-2041
WG estimate of total landings	102169	122103	78392	59767	40973	42193	24083	22529	22855	21078
Agreed TAC	115000	140000	132400	81000	48600	49300	27300	27300	27300	23205

Division 7.d										
Country	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Belgium	310	239	172	110	93	51	54	47	51	80
Denmark	-	-	-	-	-	-	-	-	-	-
France	6387	7788	.	3084	1677	1361	1730	810	986	1124
Netherlands	-	19	3	4	17	6	36	14	9	9
UK (E/W/Nl)	478	618	454	385	249	145	121	103	184	267
UK (Scotland)	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
Total nominal catch	7178	8665	629	3583	2036	1563	1941	974	1230	1481
Unallocated landings	-135	-85	6229	-1258	-463	1576	190	40	29	-2
WG estimate of total landings	7043	8580	6858	2325	1573	3139	1231	1014	1259	1479

Subdivision 20 **										
Country	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Denmark	12159	12339	8681	7684	5900	5525	3067	3038	3019	2513
Germany	81	54	54	54	32	83	49	99	86	84
Norway	1323	1293	1146	926	762	645	825	856	759	628
Sweden	2173	1900	1909	1293	1035	897	510	495	488	372
Others	-	-	-	-	-	-	27	24	21	373
Danish industrial bycatch *	205	97	62	99	687	20	5	4	2	3
Total nominal catch	15736	15586	11790	9957	7729	7170	4483	4516	4375	3973
Unallocated landings	-790	-255	-816	-680	-643	-316	-504	-602	-376	-715
WG estimate of total landings	14946	15331	10974	9277	7086	6854	3979	3914	3998	3258
Agreed TAC	16100	20000	19000	11600	7000	7100	3900	3900	3900	3315

Subarea 4 Divisions 7.d and Subdivision 20 combined										
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total nominal catch	122337	138575	89985	74421	51478	53260	32382	29296	28104	28573
Unallocated landings	1821	7439	6240	-3052	-1846	-1074	-2189	-1839	9	-2759
WG estimate of total landings	124158	146014	96225	71369	49632	52186	30193	27457	28113	25815

* 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	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Danish industrial bycatch *	205	97	62	99	687	-	-	-	-	-
Norwegian industrial bycatch	.	.	.	.	.	.	.	.	.	48
Total	205	97	62	99	687	0	0	0	0	48

Table 9 (contd).

Subarea 4										
Country	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Belgium	1009	894	946	666	653	862	1076	1257	1187	1103
Denmark	3430	3831	4402	5686	4863	4803	4536	5457	6026	6697
Faroe Islands	0	16	45	32	0	0	0	0	.	.
France	659	573	950	781	619	368	287	638	521	391
Germany	1899	1736	2374	2844	2211	2385	1921	2257	2133	2083
Greenland	17	17	11	0	0	0	0	0	.	2
Netherlands	1523	1896	2649	2657	1928	1955	1344	1242	1349	1365
Norway	3057	4128	4234	4496	4898	4601	4079	4590	5486	5592
Poland	1	2	3	0	2	0	0	0	.	.
Sweden	387	439	378	363	315	472	332	401	417	370
UK (E/W/Ni)	1588	1546	2384	2553	2169	1630	2129	2963	.	.
UK (Scotland)	6511	7185	9052	11567	10141	10565	10619	10517	.	.
UK (combined)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	13480	14839	16583
Others	0	0	0	0	0	0	0	0	0	0
Danish industrial bycatch	23	1	72	12	0	0	2	24	0	5
Norwegian industrial bycatch *	101	22	4	201	1	.	.	.	.	.
Total nominal catch	20104	22264	27500	31657	27799	27641	26325	29346	31959	34192
Unallocated landings	-1047	-607	134	-677	-1124	-1014	-1010	-796	-715	-1157
WG estimate of total landings	19056	21657	27634	30980	26675	26627	25315	28550	31244	33035
Agreed TAC	19957	22152	28798	33552	26842	26475	26475	27799	29189	33651

Division 7.d										
Country	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Belgium	84	154	73	57	56	40	53	72	79	38
Denmark	.	.	.	.	.	.	.	.	.	.
France	1743	1326	1779	1606	1078	885	768	1270	1100	279
Netherlands	59	30	35	45	51	40	38	50	47	40
UK (E/W/Ni)	174	144	133	127	125	99	100	156	.	.
UK (Scotland)	12	7	3	1	1	0	0	0	.	.
UK (combined)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	156	161	101
Total nominal catch	2072	1661	2023	1836	1311	1064	959	1548	1387	459
Unallocated landings	75	-32	-136	-128	8	56	-43	-112	11	-38
WG estimate of total landings	2147	1629	1887	1708	1319	1120	916	1436	1398	421
Agreed TAC			1678	1955	1564	1543	1543	1620	1701	1961

Subdivision 20 **										
Country	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Denmark	2246	2553	3024	3286	3118	3178	3033	3430	3344	3695
Germany	67	52	55	56	60	78	69	84	87	94
Norway	681	779	440	375	421	615	575	528	499	549
Sweden	370	365	459	458	518	520	529	570	576	643
Others	385	13	2	26	0	0	33	28	24	25
Danish industrial by-catch	2	7	2	10	0	1	1	5	5	0
Total nominal catch	3751	3769	3983	4211	4117	4392	4240	4644	4536	5007
Unallocated landings	-731	-376	-188	-154	-161	-65	-85	43	28	-233
WG estimate of total landings	3020	3393	3794	4057	3956	4327	4154	4687	4563	4774
Agreed TAC	2851	3165	4114	4793	3835	3783	3783	3972	4171	4807

Subarea 4, Division 7.d and Subdivision 20 combined										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total nominal catch	25927	27694	33506	37705	33227	33097	31524	35538	37882	39657
Unallocated landings	-1704	-1015	-190	-959	-1277	-1024	-1138	-865	-676	-1427
WG estimate of total landings	24223	26679	33315	36746	31950	32074	30386	34673	37205	38230

* The Norwegian industrial bycatch are not included in the (WG estimate of) total landings.
 ** Skagerrak/Kattegat split derived from national statistics.
 *** 2016 WG estimates of total landings do not include BMS landings.

Subarea 4 and Subdivision 20 landings not included in the assessment										
Country	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Norwegian industrial bycatch *	101	22	4	201	1	.	.	.	.	.
Total	101	22	4	201	1	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 point-wise 95% confidence intervals.

Year	Recruitment (age 1) thousands	High	Low	SSB	High	Low	Wanted catch	Unwanted catch*	Unaccounted removals	F ages 2-4	High	Low
1963	483110	668145	349319	152665	199016	117109	107581	10982		0.48	0.55	0.41
1964	788589	1088618	571249	164226	209798	128553	134996	9673		0.52	0.59	0.45
1965	1053891	1449139	766446	200186	247657	161814	181498	17187		0.57	0.65	0.50
1966	1278247	1755668	930651	222348	273370	180849	215130	26450		0.57	0.65	0.50
1967	1074107	1475755	781773	251954	309298	205241	260928	26689		0.61	0.69	0.54
1968	537132	739478	390155	263024	312750	221204	276509	17021		0.64	0.73	0.57
1969	469771	650854	339069	259367	311550	215924	216425	9541		0.61	0.69	0.54
1970	1572221	2163029	1142786	270493	323041	226492	232582	20054		0.65	0.73	0.58
1971	2053385	2834851	1487340	274855	327704	230529	293021	58454		0.74	0.82	0.66
1972	505347	698381	365668	244263	291352	204784	329062	34303		0.79	0.89	0.71
1973	741181	1023645	536660	215130	247995	186622	234451	24860		0.78	0.87	0.70
1974	725053	1003054	524101	230499	265837	199858	209609	26134		0.75	0.84	0.67
1975	1246687	1738268	894124	207939	241912	178737	208772	36316		0.80	0.90	0.72
1976	861129	1208850	613429	177194	209031	150206	201995	44312		0.86	0.96	0.77
1977	2115919	2953082	1516082	150091	176504	127632	182408	78669		0.82	0.91	0.74
1978	1298863	1819296	927307	149492	169913	131526	305285	47954		0.90	1.00	0.81
1979	1639661	2288896	1174579	147561	166234	130986	276509	62007		0.85	0.94	0.77
1980	2655119	3723148	1893467	161135	180416	143915	290396	101620		0.92	1.02	0.83
1981	1043405	1458968	746208	168890	187499	152127	342833	53370		0.94	1.04	0.85
1982	1723728	2379783	1248533	168384	187789	150984	321579	63007		1.05	1.15	0.95
1983	946002	1285425	696205	137861	154352	123131	287506	37123		1.04	1.15	0.95
1984	1744537	2366636	1285965	119970	134760	106804	210871	69633		0.98	1.08	0.89
1985	416649	574652	302090	118777	133539	105647	215777	28368		0.95	1.04	0.86
1986	1901208	2574124	1404202	109426	121860	98260	169736	60476		1.00	1.10	0.91
1987	714258	964032	529199	113210	126327	101455	227977	33157		0.98	1.08	0.89
1988	485046	655701	358807	111413	122423	101393	191760	14694		1.00	1.10	0.91
1989	853414	1159385	628191	103363	114207	93549	138968	41357		1.02	1.12	0.92
1990	328733	442856	244019	92503	102682	83334	116192	23482		0.95	1.05	0.86
1991	377755	505943	282044	90219	100851	80708	102642	15845		0.94	1.03	0.85
1992	883812	1175660	664414	86250	95809	77644	109426	32273		0.93	1.02	0.84
1993	430198	564311	327958	89054	98089	80852	130651	28319	-9746	0.94	1.04	0.86
1994	1056001	1401032	795941	94940	103908	86746	106101	42665	5431	0.96	1.06	0.88
1995	604405	797120	458282	107474	117087	98649	130947	31842	29270	1.00	1.10	0.91
1996	382697	502304	291571	107259	116787	98508	131426	21159	4933	1.01	1.10	0.92
1997	1218340	1639103	905588	96568	105415	88463	133926	46866	-23309	0.98	1.08	0.90
1998	121176	161348	91006	92689	102022	84209	146983	41985	-48413	1.01	1.11	0.92
1999	248699	325651	189932	83784	91787	76479	94781	13085	-11649	1.07	1.18	0.98
2000	456343	598056	348210	64926	71597	58876	73272	16670	-6076	1.07	1.18	0.98

Year	Recruitment (age 1) thousands	High	Low	SSB	High	Low	Wanted catch	Unwanted catch*	Unaccounted removals	F ages 2–4	High	Low
2001	162592	213788	123656	61145	67491	55396	44747	11577	14935	1.00	1.10	0.91
2002	248699	326152	189639	56162	61855	50994	53486	11480	-8380	0.96	1.05	0.87
2003	119253	157320	90396	58454	64289	53149	31104	4688	17932	0.94	1.04	0.85
2004	202197	264633	154492	46397	51536	41772	27316	7595	4050	0.90	1.00	0.81
2005	153430	203471	115696	49021	55518	43284	29863	11377	-1592	0.84	0.93	0.75
2006	360411	471126	275714	43739	50061	38216	22697	9256		0.75	0.85	0.67
2007	168721	219687	129578	76191	86164	67373	24077	29319		0.70	0.79	0.62
2008	195243	254694	149669	82619	93213	73230	27092	25387		0.66	0.75	0.58
2009	190042	247850	145717	90853	103520	79736	33223	21627		0.65	0.75	0.57
2010	294490	386265	224520	91126	106045	78306	36279	12655		0.57	0.66	0.49
2011	143631	187865	109811	100609	120292	84147	34441	10489		0.47	0.55	0.40
2012	201189	262194	154378	99211	120074	81972	32696	7637		0.43	0.50	0.36
2013	265136	346057	203138	107689	130187	89078	30853	10872		0.43	0.49	0.36
2014	380408	498391	290355	115960	139583	96335	34752	11049		0.41	0.48	0.35
2015	184979	246363	138890	134323	162941	110731	38139	13317		0.39	0.45	0.33
2016	134592	193567	93584	139804	169982	114984	38330	12352		0.35	0.42	0.30
2017	692194	1599321	285667	167711	212535	132341						

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

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