

Cod (*Gadus morhua*) in Subdivision 21 (Kattegat)

ICES stock advice

ICES advises that when the precautionary approach is applied, catches in 2018 should be no more than 772 tonnes.

Stock development over time

The assessment is indicative of trends only, and shows that spawning-stock biomass (SSB) has increased since 2009 from a historical low level. The mortality has decreased since 2008. While recruitment in 2013 was the highest in the time-series, recruitment in 2016 is the lowest in the time-series.

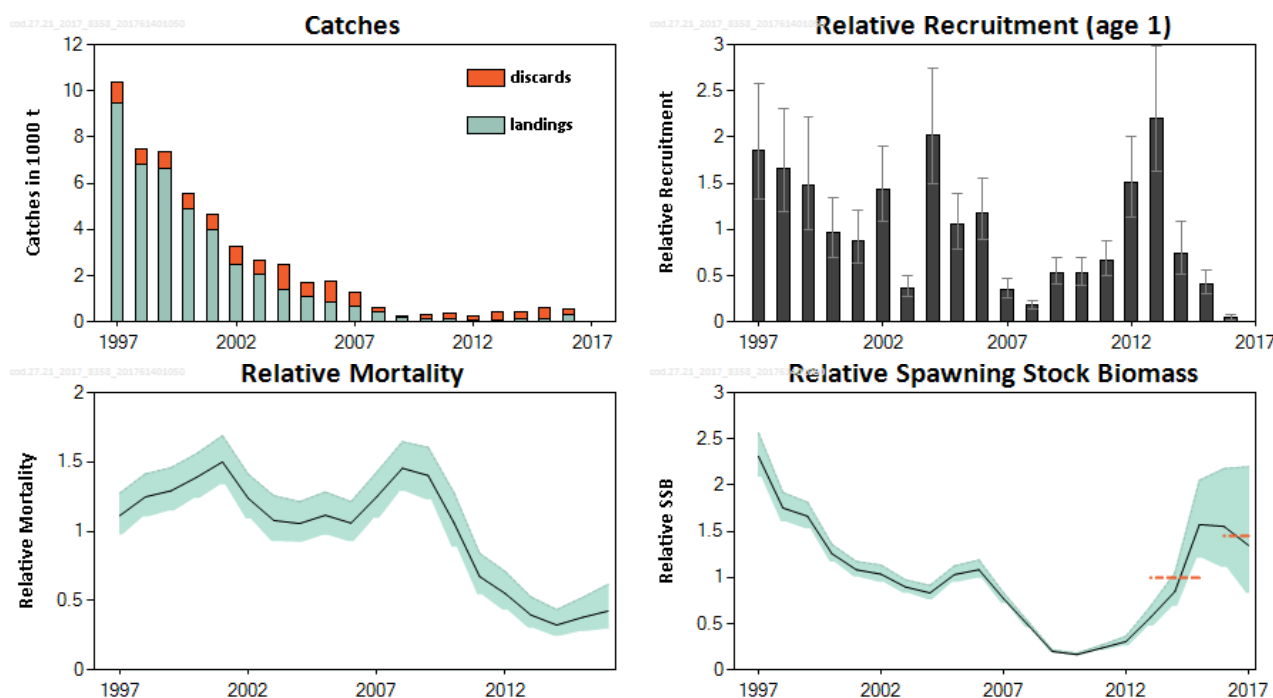


Figure 1 Cod in Subdivision 21. Summary of the stock assessment. Catches (weights in thousand tonnes). Recruitment, mortality, and SSB are relative in relation to the average of the time-series. Bottom right panel: relative SSB, regarded as an indicator of the recent development of the stock. The dashed lines in the relative SSB plot indicate the average values of the respective years. Relative recruitment, mortality, and SSB have confidence intervals (95%) in the plot.

Stock and exploitation status

Table 1 Cod in Subdivision 21. 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}	?	?	?	Undefined	?	?	?	Undefined
Precautionary approach	F_{pa} , F_{lim}	?	?	?	Undefined	?	?	?	Undefined
Management plan	F_{MGT}	-	-	-	Not applicable	-	-	-	Not applicable
Qualitative evaluation	-	↘	↗	↗	Increasing	↗	→	↘	Decreasing

Catch options

The ICES framework for category 3 stocks was applied (ICES, 2012a). The SSB trends from the assessment are used as the index of stock development. The advice is based on a comparison of the two latest index values (index A) with the three preceding values (index B), multiplied by the recent catch advice.

The index is estimated to have increased by more than 20%; thus, the uncertainty cap was applied in estimating the catch advice. The stock status relative to candidate reference points is unknown. Considering that the SSB has increased over several years, and F has decreased significantly in the last decade (WKBALT; ICES, 2017x), no additional precautionary buffer has been applied. An average discard rate of the latest three years was used for the catch advice.

Table 2 Cod in Subdivision 21. The basis for the catch options.*

Index A (2016, 2017)		1.44
Index B (2015, 2014, 2013)		0.99
Index ratio (A/B)		1.45
Uncertainty cap	Applied	1.2
Recent advised catch for 2017		643 t
Discard rate (average 2014–2016)		0.67
Precautionary buffer	Not applied	-
Catch advice**		772 t
Landings corresponding to the catch advice		254 t

* The figures in the table are rounded. Calculations were done with unrounded inputs and computed values may not match exactly when calculated using the rounded figures in the table.

** [recent advised catch] × [uncertainty cap].

Basis of the advice

Table 3 Cod in Subdivision 21. The basis of the advice.

Advice basis	Precautionary approach.
Management plan	A multi-annual plan was agreed by the EU in 2008 (EU, 2008). ICES evaluated this plan in 2009 and concluded that it was in accordance with the precautionary approach if implemented and enforced adequately; however, this evaluation is not expected to be realistic in the present situation where high unaccounted removals have been estimated by the assessment model. Therefore, the management plan is not used as basis for the advice.

Quality of the assessment

In recent years, reported landings and the discard estimates, based on observer trips, did not represent the total removals from the stock. Historically, unreported catches have been considered to be an issue for this stock and have been estimated as part of the unaccounted removals within the assessment model. WKBALT (ICES, 2017a) concluded that unaccounted removals estimated in the model include inflow of recruits from the North Sea cod and their return migration when they become mature, as well as possibly increased natural mortality from seal predation. WKBALT (ICES, 2017a) also concluded the catch data to be of reasonable quality from 2011 onwards.

This year's advice is based on an assessment indicative of trends. The current absolute level of mortality is still unknown because of a pronounced difference between the catch data (landings plus discards) and the total removals from the stock estimated within the model.

Issues relevant for the advice

The recent increase in SSB should be interpreted in the light of a much higher SSB during the seventies (ICES, 2012b).

ICES is not using the management plan as basis for the advice because it is unknown whether the plan is applicable in the current situation of high unaccounted removals, which are a result of stock mixing, migration, and mortality (ICES, 2017a).

Cod is mainly taken as bycatch in the *Nephrops* fishery. The rate of discarding has been high, but stable in the years 2013–2015. However, in 2016 the discard rate decreased. Therefore, the average discard rate of the three latest years was used for the catch advice.

Reduced fishing mortality of juvenile cod could improve the potential long-term yield from this stock.

Reference points

No reference points are defined for this stock. An attempt was made this year to calculate MSY proxy reference points for the stock. However, there were concerns on the quality of the input data for the analysis and further investigation is needed (ICES, 2017b).

Basis of the assessment

Table 4 Cod in Subdivision 21. Basis of assessment and advice.

ICES stock data category	3 (ICES, 2016).
Assessment type	Age-based analytical assessment (SAM), considered indicative of trends only (ICES, 2017b).
Input data	Commercial catches (international landings, ages and length frequencies from catch sampling); four bottom trawl survey indices (IBTS-Q1; IBTS-Q3; Havfisker-Q1: cod survey; and annual maturity data from survey (IBTS-Q1); Natural mortalities fixed at 0.2.
Discards and bycatch	Included in the assessment, data series from the majority of the fleets (covering 87% of the landings).
Indicators	None.
Other information	Benchmarked in 2017 (ICES, 2017a).
Working group	Baltic Fisheries Assessment Working Group (WGBFAS)

Information from stakeholders

There is no additional available information for this stock.

History of the advice, catch, and management

Table 5 Cod in Subdivision 21. ICES advice and official landings. All weights are in tonnes.

Year	ICES advice	Predicted landings corresp. to advice	Predicted catch corresp. to advice	Agreed TAC	Landings (ICES estimates)	Catch * (ICES estimates)
1987	Reduction in F	< 13000		15500	11491	
1988	Reduction in F	< 15000		15000	5527	
1989	TAC	10000		12500	8590	
1990	TAC	7000		8500	5936	
1991	TAC	6300		6650	6834	
1992	30% reduction in fishing effort	-		6650	6271	
1993	Limit fishing effort to 70% of 1991 effort	-		6800	7170	
1994	Reduction in catch from 1991–1992	< 6300–6800		6700	7802	
1995	Precautionary TAC based on recent catches	6000–7000		6700	8164	
1996	30% reduction in fishing effort from 1994 level	-		7700	6126	
1997	Fishing effort should not exceed 70% of the 1994 level	-		8500	9460	10341
1998	Fishing effort should not exceed 70% of the 1994 level	-		7500	6835	7499
1999	F = 0.6	4500		6300	6608	7372
2000	At least 40% reduction in F	6400		7000	4897	5550
2001	F = F _{pa} = 0.6	4700		6200	3960	4617
2002	No fishery	0		2800	2470	3290
2003	No fishery	0		2300	2045	2661
2004	No fishery	0		1363	1403	2488
2005	No fishery	0		1000	1070	1964
2006	No fishery	0		850	876	1738
2007	No fishery	0		731	645	1269
2008	No catch	0		673	449	605
2009	No catch	0		505	197	264
2010	No catch	0		379	155	325
2011	No directed fisheries, minimize bycatches	0		190	145	356
2012	No directed fisheries, minimize bycatch and discards	0		133	94	251
2013	No directed fisheries, minimize bycatch and discards	0		100	92	447
2014	Same advice as for 2013	0		100	108	456
2015	Same advice as last year	0		100	103	584
2016	Precautionary approach (increase recent landings by no more than 20%)	≤ 130	≤ 536	370	299	521
2017	Precautionary approach (increase recent catch advice by no more than 20%)	≤ 129	≤ 643	525		
2018	Precautionary approach (increase recent catch advice by no more than 20%)	≤ 254	≤ 772			

* The discard rates for 2000 to 2015 were changed in 2017 (ICES, 2017a).

History of the catch and landings

Table 6 Cod in Subdivision 21. Catch distribution by fleet in 2016 as estimated by ICES.

Catch (2016)	Landings		Discards
	Active gears 87%	Passive gears 13%	
521 t	299 t		222 t

Table 7 Cod in Subdivision 21. History of commercial catch and landings; both the official and ICES estimated values are presented for each country participating in the fishery. All weights are in tonnes.

Year	Denmark	Sweden	Germany*	Total landings	Discards	Catch
1971	11748	3962	22	15732		
1972	13451	3957	34	17442		
1973	14913	3850	74	18837		
1974	17043	4717	120	21880		
1975	11749	3642	94	15485		
1976	12986	3242	47	16275		
1977	16668	3400	51	20119		
1978	10293	2893	204	13390		
1979	11045	3763	22	14830		
1980	9265	4206	38	13509		
1981	10693	4380	284	15337		
1982	9320	3087	58	12465		
1983	9149	3625	54	12828		
1984	7590	4091	205	11886		
1985	9052	3640	14	12706		
1986	6930	2054	112	9096		
1987	9396	2006	89	11491		
1988	4054	1359	114	5527		
1989	7056	1483	51	8590		
1990	4715	1186	35	5936		
1991	4664	2006	104	6834		
1992	3406	2771	94	6271		
1993	4464	2549	157	7170		
1994	3968	2836	98	7802**		
1995	3789	2704	71	8164***		
1996	4028	2334	64	6126^		
1997	6099	3303	58	9460^^	881	10341
1998	4207	2509	38	6835	664	7499
1999	4029	2540	39	6608	764	7372
2000##	3285	1568	45	4897	653##	5550
2001##	2752	1191	16	3960	657##	4617
2002##	1726	744	3	2470	820##	3290
2003##	1441	603#	1	2045	616##	2661
2004##	827	575	1	1403	1086##	2489
2005##	608	336	10	1070^^^	624##	1694
2006##	540	315	21	876	862##	1738
2007##	390	247	7	645	624##	1269
2008##	296	152	1	449	156##	605

Year	Denmark	Sweden	Germany*	Total landings	Discards	Catch
2009 ^{##}	134	62	0.3	197	67 ^{##}	264
2010 ^{##}	117	38	0.3	155	170 ^{##}	325
2011 ^{##}	102	42	1.4	145	211 ^{##}	356
2012 ^{##}	63	31	0.0	94	157 ^{##}	251
2013 ^{##}	60	32	0.0	92	355 ^{##}	447
2014 ^{##}	75	32	0.0	108	348 ^{##}	456
2015 ^{##}	65	38	0.0	103	481 ^{##}	584
2016	185	114	0.0	299	222 ^{##}	521

* Landings statistics incompletely split on the Kattegat and Skagerrak.

** Including 900 t reported in Skagerrak.

*** Including 1600 t misreported by area.

^ Excluding 300 t taken in subdivisions 22–24.

^^ Including 1700 t reported in Subdivision 23.

^^^ Including 116 t reported as pollack.

The catch reported to the EU exceeds the catch reported to the WG (shown in the table) by 40%.

The discard rates for 2000 to 2015 were revised in 2017 (ICES, 2017a).

Summary of the assessment

Table 8 Cod in Subdivision 21. Assessment summary. Weights are in tonnes. High and low refers to 95% confidence limits.

Year	Relative						Landings	Discards	Relative		
	Recruitment Age 1	High	Low	SSB	High	Low			Mortality (Z-0.2) Ages 3–5 *	High	Low
1997	1.86	2.6	1.33	2.31	2.6	2.1	9461	881	1.11	1.27	0.97
1998	1.66	2.3	1.19	1.75	1.92	1.60	6835	664	1.25	1.41	1.10
1999	1.48	2.2	0.99	1.66	1.81	1.53	6608	764	1.29	1.46	1.14
2000	0.97	1.34	0.70	1.26	1.36	1.16	4897	653	1.39	1.56	1.24
2001	0.87	1.21	0.63	1.08	1.17	1.00	3960	657	1.50	1.69	1.33
2002	1.43	1.90	1.08	1.04	1.13	0.95	2470	820	1.24	1.41	1.09
2003	0.36	0.50	0.27	0.90	0.98	0.83	2045	616	1.08	1.26	0.92
2004	2.0	2.7	1.49	0.83	0.91	0.76	1402	1086	1.06	1.21	0.92
2005	1.05	1.39	0.79	1.03	1.13	0.95	1070	624	1.12	1.28	0.97
2006	1.17	1.55	0.88	1.08	1.19	0.99	876	862	1.06	1.21	0.92
2007	0.34	0.46	0.25	0.77	0.84	0.72	645	624	1.25	1.43	1.09
2008	0.178	0.23	0.136	0.49	0.53	0.45	449	156	1.45	1.65	1.29
2009	0.53	0.70	0.40	0.199	0.22	0.183	197	67	1.40	1.61	1.23
2010	0.53	0.70	0.40	0.166	0.183	0.150	155	170	1.06	1.28	0.88
2011	0.66	0.88	0.50	0.24	0.27	0.21	145	211	0.67	0.84	0.54
2012	1.50	2.0	1.13	0.31	0.36	0.26	94	157	0.55	0.71	0.43
2013	2.2	3.0	1.63	0.57	0.69	0.47	92	355	0.40	0.53	0.30
2014	0.75	1.08	0.52	0.85	1.05	0.69	108	348	0.32	0.44	0.24
2015	0.41	0.56	0.30	1.57	2.1	1.21	103	481	0.38	0.52	0.28
2016	0.040	0.070	0.023	1.55	2.2	1.11	299	222	0.42	0.62	0.29
2017				1.35	2.2	0.83					

* Includes unaccounted removals.

Sources and references

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