

6.4 Stock Summaries

6.4.1 Cod in Division IIIa East (Kattegat)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to high long-term yield	Fishing mortality in relation to agreed target	Comment
Reduced reproductive capacity	Unknown	Unknown	Unknown	

Based on the most recent estimates of SSB (in 2009) ICES classifies the stock as suffering reduced reproductive capacity. The SSB trend indicates a fivefold decrease since 1970 and SSB has been at a historically low level since the early 2000s. Current level of fishing mortality is unknown. Recruitment in recent years has been the lowest in the time series.

Management objectives

In 2004, the European Commission enacted a Council Regulation (EC) No. 423/2004 which established measures for the recovery of cod stocks, including cod in the Kattegat. Council Regulation (EC) No 1342/2008 of 18 December 2008 (see Annex 6.4.1) established a long-term plan for cod stocks and the fisheries exploiting those stocks, repealing Regulation (EC) No 423/2004.

The long term management plan requires implementation through Article 9 due to the current inability to estimate F. An exploratory evaluation (see section below) that assumed no bias in the TAC implementation shows that SSB will recover before 2015 to within precautionary limits; however, this evaluation is not expected to be realistic in a situation where unaccounted removals may be up to five times the TAC. In these circumstances ICES considers that a TAC constraint alone (under Article 9) is not precautionary.

Reference points

	Type	Value	Technical basis
Precautionary approach	B _{lim}	6 400 t	lowest observed SSB before the late 1990s.
	B _{pa}	10 500 t	B _{lim} *exp(1.645*0.3).
	F _{lim}	Not defined	
	F _{pa}	Not defined	
Targets	F _{mgt}	0.4	EU management plan EC 1342/08

(unchanged since 2009)

Single-stock exploitation boundaries

Considering the options below, ICES advises on the basis of Exploitation boundaries in relation to precautionary considerations that there should be no catches of this stock in 2010.

Exploitation boundaries in relation to existing management plans

According to the long-term management plan, the fishing mortality in 2010 shall be reduced by 25 % compared with the fishing mortality rate in 2009, unless the target 0.4 is reached. The current level of fishing mortality on cod in the Kattegat cannot be reliably estimated.

Where it is advised that the catches of cod should be reduced to the lowest possible level, the TACs shall be set according to a 25 % reduction compared to the TAC in the previous year, that corresponds to a TAC at 379 tonnes in 2010.

Exploitation boundaries in relation to precautionary considerations

Taking into account the current perception of the stock abundance and recruitment, fishing at any level will involve a risk of the stock remaining depleted.

Short-term implications

Due to uncertainty in the recent estimates, especially concerning fishing mortality, reliable predictions cannot be made.

Management considerations

Even though a management plan has been in place since 2005, the stock biomass has continued to decline. Total removals in the last 3 years have been estimated up to 5 times higher than the reported catches. No information is available on the nature of the unallocated removals but this information is essential to managers in order to take the appropriate management measures. Potential sources of unallocated removals are discarding of young ages and possibly also high-grading of marketable cod. Furthermore, migration of cod to other areas and not counted catches in recreational fisheries may explain the discrepancy between the reported catches and the estimates of total removals.

Management plan evaluations

ICES has conducted exploratory evaluation of the long-term management plan for cod in the Kattegat as specified by Council Regulation (EC) No 1342/2008 of 18 December 2008. The results showed that the present low TAC and the 20% TAC constraint in the long-term plan will allow a steep increase of SSB to above B_{pa} even though scenario recruitment is assumed to be at a low level. This conclusion is based on no bias in the TAC implementation, which is not expected to be realistic. Due to uncertainties related to the historical and future bias in catch reporting and the extend of inflow of recruits from the North Sea stock and their homing at age 2-3 it is not possible to quantify the effect on the SSB of the local Kattegat stock spawning in the area.

Factors affecting the fisheries and the stock

Regulations and their effects

Cod in Kattegat are mainly taken by trawls, Danish seines and gill-nets,

Since 2004, the use of trawl with codend mesh sizes below 90 mm in the *Nephrops* fisheries has only been permitted if the trawl was equipped with a separator grid. This has resulted in a substantial decline of effort for this gear category. In 2007, Danish fishermen were allocated extra fishing days if using an exit-window with square-meshes at a minimum 120 mm; since 1st February 2008, the usage of the exit-window in trawls has been made mandatory. The Danish minimum landing size was reduced to 30 cm in Feb. 2008. In 2008, due to effort restrictions imposed between 1 February and 30 April the usage of trawls equipped with species sorting grid (which allows most cod to escape from the trawl) increased considerably, as this type of trawl is not effort regulated. These changes can be expected to have reduced discard of undersized cod, the effect can however not be evaluated due to uncertain discard estimates. Changes in fishing pattern in 2008 are believed to have reduced Swedish discards in 2008.

Spatial and temporal fishing area closures were implemented in the Kattegat in January 2009 in order to reduce fishing mortality on cod. The effects of the spatial restrictions on cod recovery will be evaluated in three years time after the implementation.

Impacts of the environment on the fish stock

An analysis of the possible effect of environment and climate change on this stock has shown that fishing mortality has been the major driver of the long-term dynamics of the stock (Cardinale and Svedäng, 2004).

Scientific basis

Data and methods

Reported landings and data from four scientific surveys were available for the assessment of this stock. Discard data are not used in the assessment. The assessment is based on the recently developed stochastic state-space model (SAM) that provides statistically sound estimates of uncertainty in the model results. The model allows estimating potential additional removals from the stock, not represented by reported landings. The stock estimates for these years consequently rely more on survey information.

The model estimates significant unallocated removals from the stock between 2003 and 2008. At present, the relative proportion of unallocated removals due to fishing and biology driven factors (migration patterns) cannot be specified. Therefore, both runs with and without estimating unallocated removals are presented (Fig. 6.4.1.2). Estimates of F in either runs are not considered reliable.

Information from the fishing industry

In December 2008, an extensive joint Swedish-Danish cod survey in Kattegat was conducted as collaboration between the fishing industry and fisheries research institutes of Denmark and Sweden. The data from this survey were used to provide an independent estimate of biomass of adult cod in the Kattegat (WKROUND 2009). The results were in line with the estimates from assessment, indicating low SSB (below 2000 tonnes).

Uncertainties in assessment and forecast

In recent years, reported landings appeared not to represent total removals from the stock. Significant bias in removals was estimated for 2003-2008. At present, the relative proportion of unallocated removals due to fishing and biology driven factors cannot be specified. Recent tagging studies suggest that the Kattegat may function as a nursery area for North Sea cod, and that return migration to the North Sea are common (Svedäng *et al.* 2006). There are some indications that the proportion of recruits of North Sea origin has increased in recent years. The migration of this stock component out of the area at an older age could contribute to the estimate of unallocated removals in the latest years. Because of these uncertainties, the current level of fishing mortality cannot be reliably estimated.

Concerning SSB, the estimates are considered imprecise, however both the assessment with and without estimating unallocated removals indicate historically lowest SSB in recent years (in the range of 1413 and 3406 tonnes in 2008). The level of SSB estimated from assessment is in line with the independent estimates of cod biomass based on data from the joint Swedish-Danish fishermen-scientist survey conducted in 2008. In benchmark assessment 2009, the estimates of SSB showed also to be robust for uncertainties concerning natural mortality and discards of young fish. The assessment cannot be used as a basis for forecast.

Comparison with previous assessment and advice

The overall perception of the state of the stock is unchanged compared to last year. Therefore, the advice is similar to last year, i.e. there should be no catch on this stock in 2010.

Sources of information

Report of the Baltic Fisheries Assessment Working Group. Copenhagen, 22-28 April 2009 (ICES CM 2009/ACOM:07).

Cardinale, M., and Svedäng, H. 2004. Modelling recruitment and abundance of Atlantic cod, *Gadus morhua*, in the eastern Skagerrak-Kattegat (North Sea): evidence of severe depletion due to a prolonged period of high fishing pressure. *Fisheries Research*, 69: 263–282.

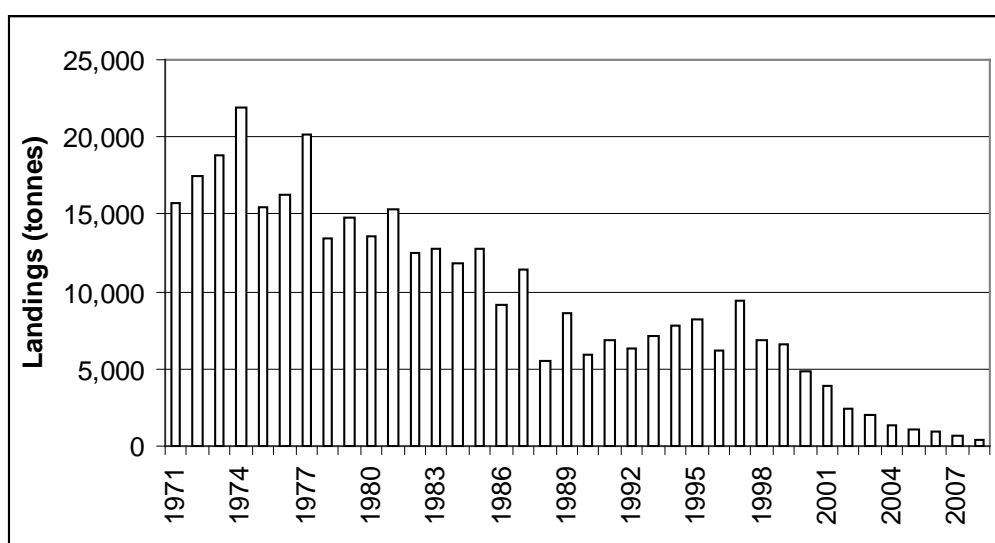
Svedäng, H., Righton, D., and Jonsson, P. 2006. Return migrations of Atlantic cod (*Gadus morhua* L.) to the North Sea evidenced by archival tagging of cod off the eastern Skagerrak coast. ICES CM 2006/Q:06.

WKROUND 2009. Report of the Benchmark and Data Compilation Workshop for Roundfish January 16–23 2009 Copenhagen, Denmark (ICES CM 2009/ACOM:32)

Table 6.4.1.1 Cod in the Kattegat. Single stock exploitation boundaries (advice), management and landings.

Year	ICES Advice / 2005 onwards: Single-stock exploitation boundaries	Predicted catch corresp. to advice	Agreed TAC	ICES landings
1987	Reduction in F	< 13.0	15.5	11.5
1988	Reduction in F	< 15.0	15	5.5
1989	TAC	10	12.5	8.6
1990	TAC	7	8.5	5.9
1991	TAC	6.3	6.65	6.8
1992	30% reduction in fishing effort	-	6.65	6.3
1993	Limit fishing effort to 70% of 1991 effort	-	6.8	7.2
1994	Reduction in catch from 1991–1992	< 6.3–6.8	6.7	7.8
1995	Precautionary TAC based on recent catches	6–7	6.7	8.2
1996	30% Reduction in fishing effort from 1994 level	-	7.7	6.1
1997	Fishing effort should not exceed 70% of the 1994 level	-	8.5	9.5
1998	Fishing effort should not exceed 70% of the 1994 level	-	7.5	6.8
1999	F = 0.6	4.5	6.3	6.6
2000	At least 40% reduction in F	6.4	7	4.9
2001	F = F _{pa} = 0.6	4.7	6.2	3.9
2002	No fishery	0	2.8	2.3
2003	No fishery	0	2.3	2
2004	No fishery	0	1.363	1.4
2005	No fishery	0	1	1.1
2006	No fishery	0	0.85	0.9
2007	No fishery	0	0.731	0.6
2008	No catch	0	0.673	0.45
2009	No catch	0	0.505	
2010	No catch	0		

Weights in '000 t.

**Figure 6.4.1.1** Cod in the Kattegat: Reported landings in tonnes in 1971–2008.

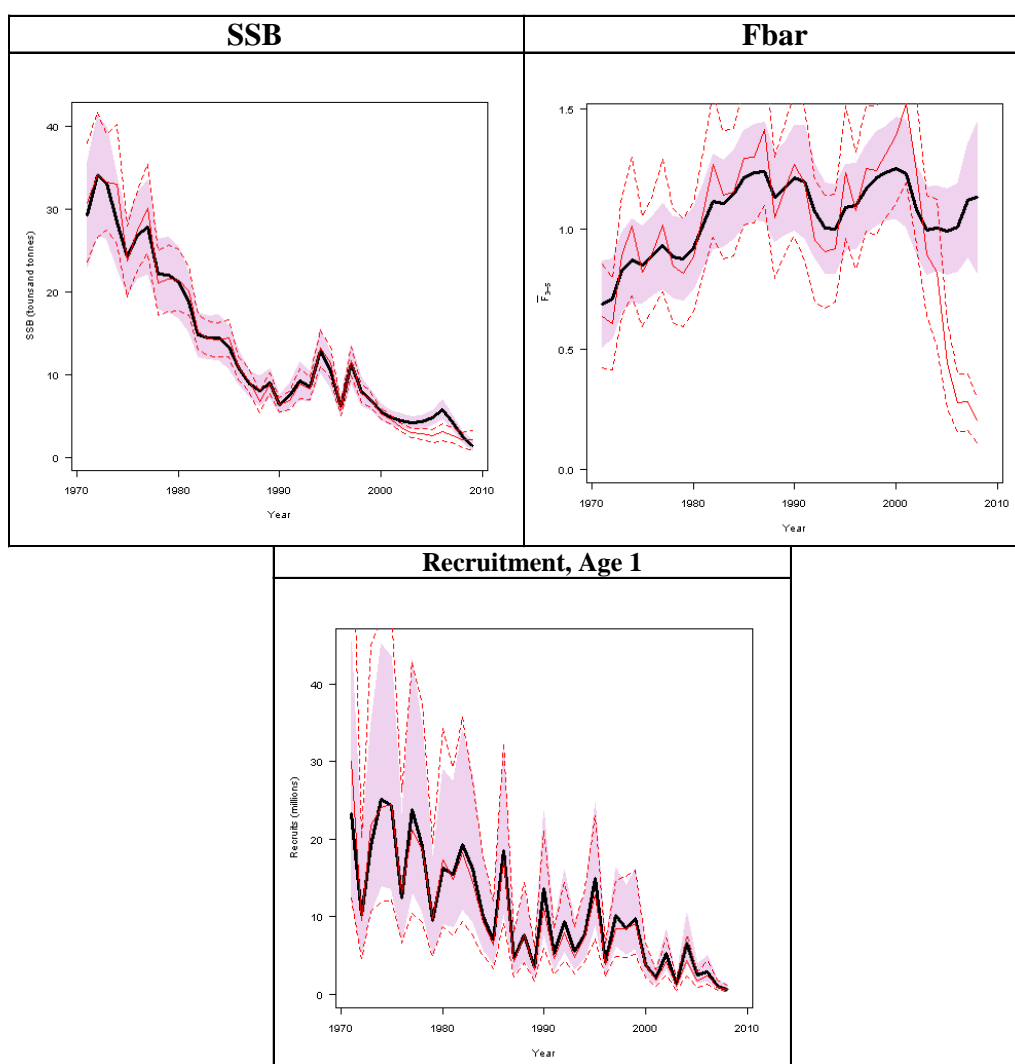


Figure 6.4.1.2 Cod in the Kattegat. Mean SSB (t) , Fbar and recruitment (Age 1, millions) from the runs with (black line) and without (red line) estimating unallocated removals. The latest estimate for SSB shown in the figure refers to the beginning of 2009. For Fbar and recruitment, the latest estimate is for 2008. Shaded area and broken lines represent 95% confidence intervals for the runs with and without estimating unallocated removals, respectively. Estimates of F in either runs are not considered reliable.

Table 6.4.1.2 Cod in the Kattegat. Estimated scaling factors for removals from the stock (average and 95% confidence intervals, indicated as Low and High)

Year	Catch multiplier	Low	High
2003	1.61	1.14	2.27
2004	1.77	1.23	2.56
2005	3.67	2.53	5.33
2006	5.27	3.58	7.74
2007	4.66	3.13	6.92
2008	4.51	3.02	6.70

Table 6.4.1.2 Cod in the Kattegat. Reported landings (in tonnes) in 1971–2008.

Year	Kattegat			Total
	Denmark	Sweden	Germany ¹	
1971	11,748	3,962	22	15,732
1972	13,451	3,957	34	17,442
1973	14,913	3,850	74	18,837
1974	17,043	4,717	120	21,880
1975	11,749	3,642	94	15,485
1976	12,986	3,242	47	16,275
1977	16,668	3,400	51	20,119
1978	10,293	2,893	204	13,390
1979	11,045	3,763	22	14,830
1980	9,265	4,206	38	13,509
1981	10,693	4,380	284	15,337
1982	9,320	3,087	58	12,465
1983	9,149	3,625	54	12,828
1984	7,590	4,091	205	11,886
1985	9,052	3,640	14	12,706
1986	6,930	2,054	112	9,096
1987	9,396	2,006	89	11,491
1988	4,054	1,359	114	5,527
1989	7,056	1,483	51	8,590
1990	4,715	1,186	35	5,936
1991	4,664	2,006	104	6,834
1992	3,406	2,771	94	6,271
1993	4,464	2,549	157	7,170
1994	3,968	2,836	98	7,802 ²
1995	3,789	2,704	71	8,164 ³
1996	4,028	2,334	64	6,126 ⁴
1997	6,099	3,303	58	9,460 ⁵
1998	4,207	2,509	38	6,835
1999	4,029	2,540	39	6,608
2000	3,285	1,568	45	4,897
2001	2,752	1,191	16	3,960
2002	1,726	744	3	2,470
2003	1,441	603 ⁷	1	2,045
2004	827	575	1	1,403
2005	608	336	10	1,070 ⁶
2006	540	315	21	876
2007	390	247	7	645
2008	296	152	1	449

¹ Landings statistics incompletely split on the Kattegat and Skagerrak.

² Including 900 t reported in Skagerrak.

³ Including 1.600 t misreported by area.

⁴ Excluding 300 t taken in Sub-divisions 22–24.

⁵ Including 1.700t reported in Sub-division 23.

⁶ Including 116 t reported as pollack

⁷ the catch reported to the EU exceeds the catch reported to the WG (shown in the table) by 40%

Annex 6.4.1

In December 2008 the European Council agreed on a new cod management plan implementing the new system of effort management and a target fishing mortality of 0.4 (EC 1342/2008). The HCR for setting TAC for the Kattegat cod stock are as follows:

Article 6

The minimum spawning biomass level and the precautionary spawning biomass level for each of the cod stocks shall be as follows:

<i>Cod in the Kattegat</i>	<i>Minimum spawning biomass Levels in tonnes</i>	<i>6 400</i>
	<i>Precautionary spawning biomass Levels in tonnes</i>	<i>10 500</i>

Article 7

Procedure for setting TACs for cod stocks in the Kattegat the west of Scotland and the Irish Sea

1. Each year, the Council shall decide on the TAC for the following year for each of the cod stocks in the Kattegat, the west of Scotland and the Irish Sea. The TAC shall be calculated by deducting the following quantities from the total removals of cod that are forecast by STECF as corresponding to the fishing mortality rates referred to in paragraphs 2 and 3:

- (a) a quantity of fish equivalent to the expected discards of cod from the stock concerned;*
- (b) as appropriate a quantity corresponding to other sources of cod mortality caused by fishing to be fixed on the basis of a proposal from the Commission.*

2. The TAC shall, based on the advice of STECF, satisfy all of the following conditions:

- (a) if the size of the stock on 1 January of the year of application of the TAC is predicted by STECF to be below the minimum spawning biomass level established in Article 6, the fishing mortality rate shall be reduced by 25 % in the year of application of the TAC as compared with the fishing mortality rate in the previous year;*
- (b) if the size of the stock on 1 January of the year of application of the TAC is predicted by STECF to be below the precautionary spawning biomass level set out in Article 6 and above or equal to the minimum spawning biomass level established in Article 6, the fishing mortality rate shall be reduced by 15 % in the year of application of the TAC as compared with the fishing mortality rate in the previous year; and*
- (c) if the size of the stock on 1 January of the year of application of the TAC is predicted by STECF to be above or equal to the precautionary spawning biomass level set out in Article 6, the fishing mortality rate shall be reduced by 10 % in the year of application of the TAC as compared with the fishing mortality rate in the previous year.*

3. If the application of paragraph 2(b) and (c) would, based on the advice of STECF, result in a fishing mortality rate lower than the fishing mortality rate specified in Article 5(2), the Council shall set the TAC at a level resulting in a fishing mortality rate as specified in that Article.

4. When giving its advice in accordance with paragraphs 2 and 3, STECF shall assume that in the year prior to the year of application of the TAC the stock is fished with an adjustment in fishing mortality equal to the reduction in maximum allowable fishing effort that applies in that year.

5. Notwithstanding paragraph 2(a), (b) and (c) and paragraph 3, the Council shall not set the TAC at a level that is more than 20 % below or above the TAC established in the previous year.

Article 9: Procedure for setting TACs in poor data conditions

Where, due to lack of sufficiently accurate and representative information, STECF is not able to give advice allowing the Council to set the TACs in accordance with Articles 7 or 8, the Council shall decide as follows:

- (a) where STECF advises that the catches of cod should be reduced to the lowest possible level, the TACs shall be set according to a 25 % reduction compared to the TAC in the previous year;*
- (b) in all other cases the TACs shall be set according to a 15 % reduction compared to the TAC in the previous year, unless STECF advises that this is not appropriate.*

Article 10: Adaptation of measures

- 1. When the target fishing mortality rate in Article 5(2) has been reached or in the event that STECF advises that this target, or the minimum and precautionary spawning biomass levels in Article 6 or the levels of fishing mortality rates given in Article 7(2) are no longer appropriate in order to maintain a low risk of stock depletion and a maximum sustainable yield, the Council shall decide on new values for these levels.*
- 2. In the event that STECF advises that any of the cod stocks is failing to recover properly, the Council shall take a decision which:*
 - (a) sets the TAC for the relevant stock at a level lower than that provided for in Articles 7, 8 and 9;*
 - (b) sets the maximum allowable fishing effort at a level lower than that provided for in Article 12;*
 - (c) establishes associated conditions as appropriate.*