

6.4 Stock Summaries

6.4.1 Cod in the Kattegat

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Fishing mortality in relation to agreed target	Comment
Unknown	Unknown	Unknown	NA	There is no assessment to compare with the established reference points, but the stock is likely to be around the limit biomass reference point.

The assessment is indicative of trends only. The SSB trend indicates a fivefold decrease since 1970 and SSB has been at a historically low level since the early 2000s. The estimates of fishing mortality do not indicate a major decline in F in the past five years. The recruitment has steadily declined since 1970 and has in recent years been the lowest in the time-series.

Management objectives

The European Commission has enacted a Council Regulation (EC) No. 423/2004 which establishes measures for the recovery of cod stocks, including cod in the Kattegat. The recovery plan requires annual predictions of spawning-stock size and fishing mortality which are not available for this stock, given that the assessment is only indicative of stock trends. The European Commission has adopted a proposal in April 2008 to amend the EU cod recovery plan (COM(2008) 162 final).

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}	1.0	The spawning stock has declined steadily since the early 1970s at fishing mortality rates averaging $F = 1.0$. F_{lim} is tentatively set equal to $F = 1.0$.
	F_{pa}	0.6	$F_{lim} * \exp(-1.645 * 0.3)$.
Targets	F_v	not defined	

(unchanged since 1998)

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

According to the recovery plan the TAC for 2009 shall be set at a level consistent with an increase in SSB of more than 30%. The available information does not allow for reliable catch forecasts.

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. There should therefore be no catches of this stock in 2009.

Conclusion on exploitation boundaries

Based on the current perception of the stock abundance and recruitment, there should be no catches of this stock in 2009.

Short-term implications

Due to uncertainty in the recent estimates of catches and stock size, reliable predictions cannot be made.

Management considerations

The present management measures are not effective in regulating catches of this stock. Fishery-independent information indicates that removals from the stock are substantially higher than reported landings and that the mismatch between TAC/official landings and the total removals has increased in the most recent years.

The assessment does not indicate a major decline in fishing mortality in the latest five years, although the TAC has been reduced to a third during 2003–2007. This suggests that the management measures have likely not been effective in terms of achieving a major reduction in fishing mortality.

Discarding (high-grading) of marketable cod occurs. The available discard estimates indicate high numbers of discards of 1- and 2-year-old cod. Discarding in recent years related to changes in technical measures cannot be evaluated due to insufficient discard survey coverage.

The decline of the cod stock in the Kattegat seems associated with the disappearance of separate spawning aggregations/sub-populations. This raises concern for the reproductive capacity of this stock and the ability of the stock to rebuild.

To achieve a zero catch of cod, bycatches in all fisheries should be avoided. Cod in the Kattegat is at present mainly caught as bycatch in fisheries targeting other species. Measures that could reduce cod catches with lower impact on catches of other species include:

- closed areas (i.e. the major spawning areas in the southern part of the Kattegat);
- closed seasons or effort restrictions in periods of high catch rates, such as the regulation implemented in 2008 with one fishing day counting as 2.5 days in the period from 1 February to 30 April;
- introduction of more selective trawls with low catchability on cod. Ongoing selectivity experiments indicate that new designs of escape windows can possibly improve the selectivity for cod. Usage of species-sorting grid in the *Nephrops* fishery has been shown to reduce bycatch of cod and other fin-fishes;
- removing directed fisheries on cod as an exploitation option in the border area between the Kattegat and Øresund (ICES square 41G2).

When implementing these types of measures, a dedicated sampling programme is needed for ICES to be able to evaluate their effects.

Management plan evaluations

The EU recovery plan requires a reliable assessment; this is not available because of the poor quality of the catch data. Under the present situation with poor data and poor control, ICES cannot calculate a TAC according to the management plan.

Factors affecting the fisheries and the stock

Regulations and their effects

The TAC has been implemented through half-monthly quotas for individual vessels in Denmark until 2007. This system is still in place in Sweden, but here it has not been mandatory. Ration sizes have been very low in recent years, leading to increased discarding of marketable cod and an increased incentive for misreporting. In Denmark, annual quota shares for individual vessels were introduced in 2007; the effect of this change on fisheries can only be evaluated in the forthcoming years.

Since 2004, the use of trawl with codend mesh sizes less than 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 fishers were allocated extra fishing days if using an exit-window with square-meshes at a minimum 120 mm; since 1 February 2008, the usage of the exit-window in trawls has been made mandatory. These changes can be expected to reduce discarding of undersized cod. The Danish minimum landing size was reduced to 30 cm in February 2008, which is expected to reduce discarding as well.

The EU cod recovery plan, agreed upon in 2004, aimed at reducing fishing mortality for this stock by means of reduced TACs, technical measures, and increased control effort. While official landings have been reduced along with the reduction of TACs, fishing mortality has remained at a high level.

In 2008, a new effort restriction was implemented (EC No. 40/2008) to limit the cod fishery in the periods with the highest catches and catch rates: when fishing in the Kattegat, one day present in the area during the period 1 February–

30 April 2008 counts as 2.5 fishing days. Preliminary information indicates that a substantial reduction in fishing effort in the Kattegat in February–March in 2008 compared to previous years is a consequence of the new regulation. The potential effect of this regulation in terms of reducing the fishing mortality on cod can only be evaluated in the coming years.

Impacts of the environment on the fish stock

An analysis of the possible long-term effect of environment and climate change on this stock are likely to be smaller than the impact of fishing mortality. 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

Catch data and six scientific survey data time-series are available for the assessment of this stock. Due to incomplete catch data in recent years, assessment methods that rely on accurate catch data in the entire time-series cannot be used. The perception of stock trends for cod in the Kattegat are therefore based on models assuming uncertain catches for 2003–2007, consequently relying more on fishery-independent survey information. Two different models were applied that allow estimating the total removals from the stock and thus the potential bias in the catch-at-age data in recent years, based on survey information. These methods included the assessment model applied for North Sea cod (B-Adapt) and a newly developed stochastic state–space model. Both models assume a similar age structure of reported and unallocated catches and gave consistent results for development in SSB and recruitment (Figure 6.4.1.2).

Information from the fishing industry

The fishers' perception of the stock development indicates an increase in stock size in the most recent years, especially in the abundance of larger fish. The assessment output indicates a minor increase in stock size, albeit with high uncertainty, and it does not show an overall improvement in the state of the stock. The perception of an increased abundance of larger fish could be caused by the relatively stronger 2003 year class being at age 4 in 2007.

Uncertainties in assessment and forecast

There are large uncertainties regarding the amount of total removals in the most recent period, therefore this assessment is considered indicative for trends only. It cannot be used as a basis for a catch forecast.

No discard data are included in the assessment due to lack of sampling coverage. Information on relative changes in recent discards cannot be separated from the overall bias in removals. The influence of the trends in discarding on the historical part of the time-series is unknown.

Tagging studies (Svedäng *et al.*, 2006) suggest that the Kattegat may function as a nursery area for North Sea cod, and that return migrations to the North Sea are common. There is some indication 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 adds uncertainty to the assessment and could contribute to the estimate of stock removals in the latest years.

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 2009.

Sources of information

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.

Report of the Baltic Fisheries Assessment Working Group. Copenhagen, 8–17 April 2008 (ICES CM 2008/ACOM:06).

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.

Year	ICES Advice	Single-stock exploitation boundaries	Predicted catch corresp. to advice	Predicted catch corresp. to single-stock exploitation boundaries	Agreed TAC	ICES landings
1987	Reduction in F		< 13.0		15.5	11.5
1988	Reduction in F		< 15.0		15.0	5.5
1989	TAC		10.0		12.5	8.6
1990	TAC		7.0		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		7.0	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	2.0
2004	No fishery		0		1.363	1.4
2005	No fishery	No fishery	0	0	1.0	1.1
2006	No fishery	No fishery	0	0	0.85	0.9
2007	No fishery	No fishery	0	0	0.731	0.6
2008	No catch	No catch	0	0	0.673	
2009	No catch	No catch	0	0		

Weights in '000 t.

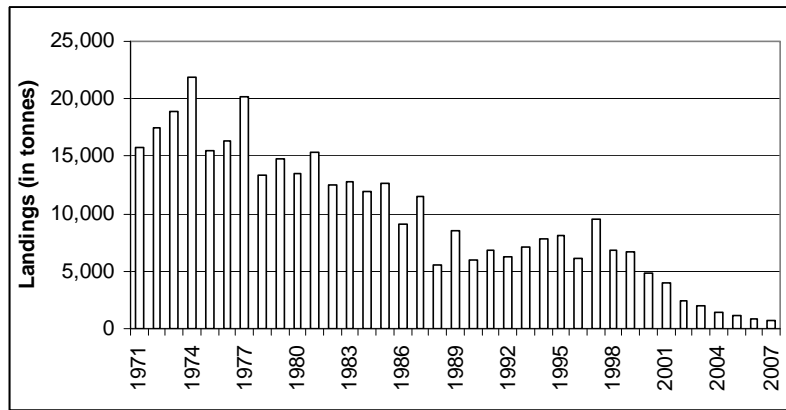


Figure 6.4.1.1 Cod in the Kattegat: Reported landings in tonnes in 1971–2007.

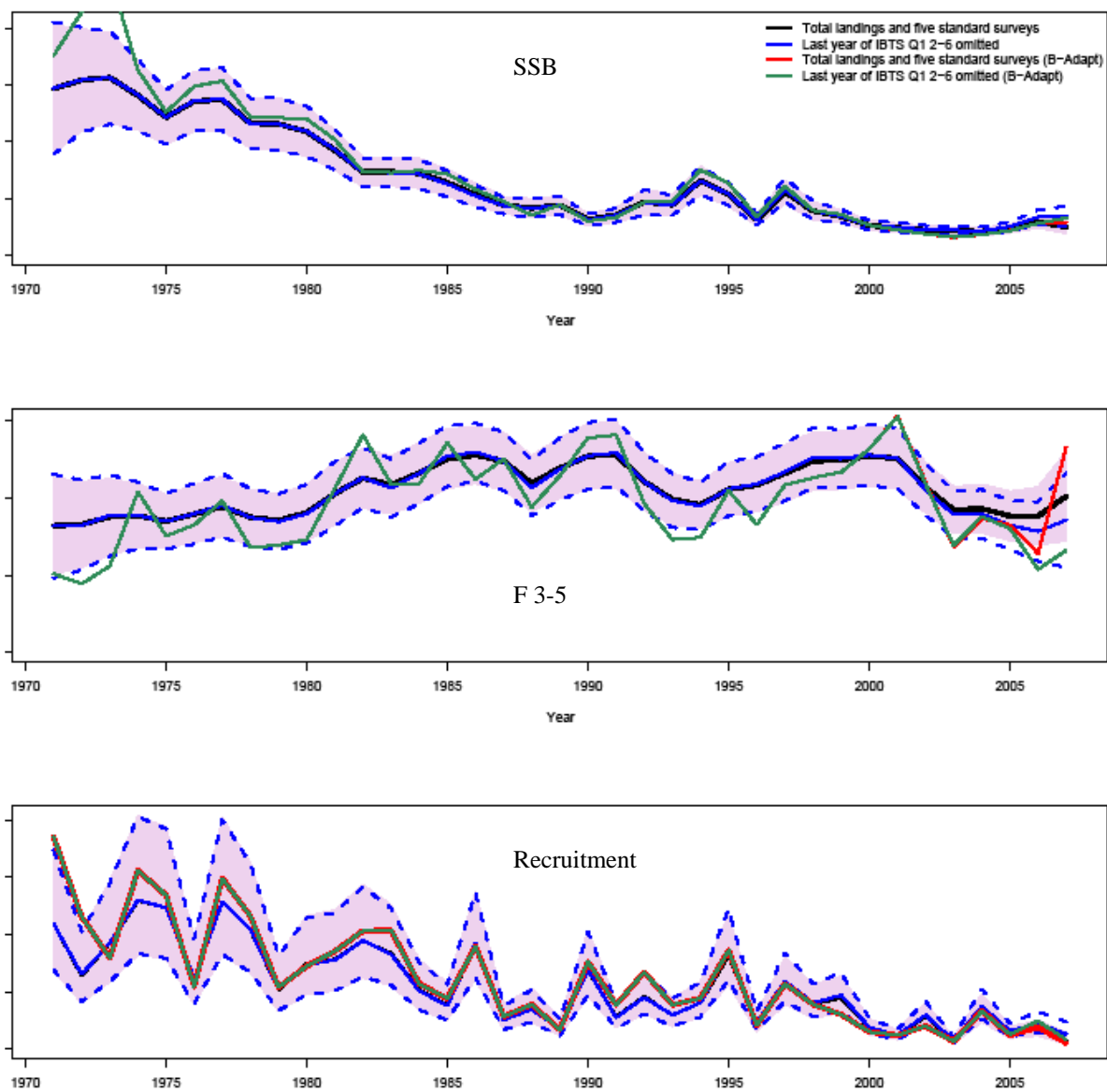


Figure 6.4.1.2 Cod in the Kattegat. Trends in SSB, F (3–5), and Recruitment (age 1) from the stochastic state-space model (black and blue lines, including 95% confidence intervals) compared to the estimates from B-Adapt (red and green lines, including and excluding the latest year’s data from the IBTS 1st quarter survey, respectively).

Table 6.4.1.1 Cod in the Kattegat. Reported landings (in tonnes) in 1971–2007.

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

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 pollack⁷ the catch reported to the EU exceeds the catch reported to the WG (presented in the table) by 40%