ECOREGION North Sea
STOCK Cod in Division IIIa East (Kattegat)

Advice for 2013

ICES advises on the basis of precautionary considerations that there should be no directed fisheries and bycatch and discards should be minimised.

Stock status

F (Fishing Mortality)	2009	2010	2011	
MSY (F_{MSY})	?	?	?	Unknown
Precautionary approach (F_{pa},F_{lim})	?	?	?	Unknown

SSB (Spawning Stock Biomass)	2010	2011	2012	
MSY ($B_{trigger}$)	?	?	?	Undefined
Precautionary approach (B_{pa},B_{lim})	✗	✗	✗	Reduced reproductive capacity
Management plan (SSB_{MP})	✗	✗	✗	Below limit

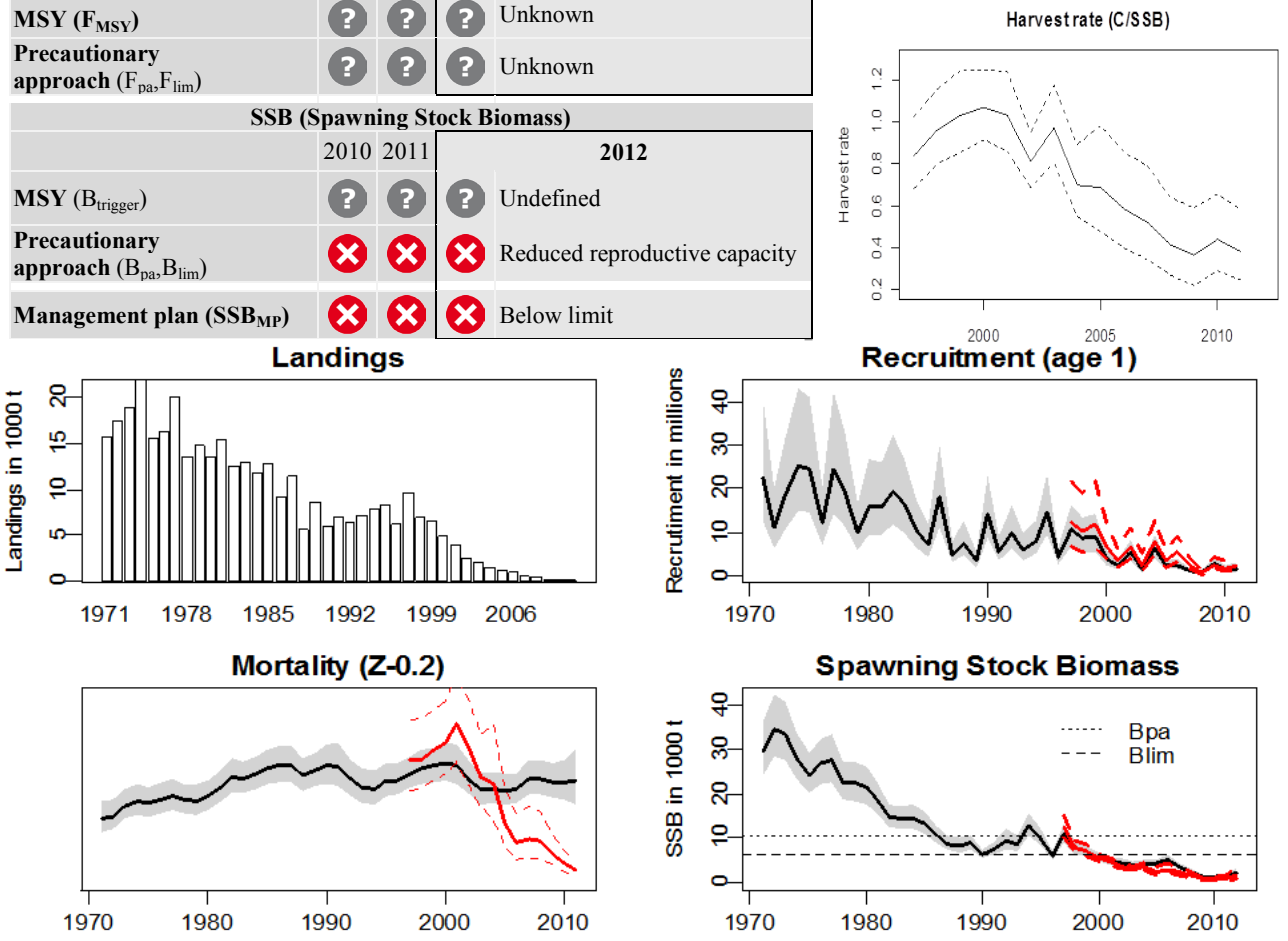

Figure 6.4.1.1 Cod in Division IIIa East (Kattegat). Summary of stock assessment (weights in '000 tonnes) represented by: Black line: reported landings and estimating total removals within model; Red line: reported landings and discards from observer data. Shaded area and dashed lines represent 95% confidence intervals for the two runs, respectively. Top right: Estimated harvest rate (catch divided by SSB) based on reported landings and estimates of discards.

Spawning stock biomass has been at a historically lowest level since 2000. Recruitment in recent years has been among the lowest in the time series. Current level of fishing mortality is unknown due to a pronounced difference between the catch data (landings plus discards estimated from observer data) and the total removals from the stock estimated within the model based on survey data. The harvest rate based on available catch data shows a decline from 2000 to 2009, and a stable level in 2009-2011.

Management plans

A multi-annual plan has been agreed by the EU in 2008 ((EC) No.1342/2008). At present situation, when the cod stock and the landings are very low, the implementation of management plan is focused on fishing effort and cod avoidance measures. ICES evaluated this plan in 2009 and concluded it was in accordance with the precautionary approach if

implemented and enforced adequately; however, this evaluation is not expected to be realistic in a situation of high unaccounted removals as estimated by the present assessment model.

Biology

Existence of separate stock units influences population dynamics in the Kattegat. In addition to local stock units, which are spawning in the Kattegat, there is a significant transportation of cod larvae/ juveniles from the North Sea and Sound into the Kattegat. Return migration to the North Sea / Sound is believed to occur at ages 2-3. An increasing proportion of fish originating from other stocks due to the decline of the Kattegat cod could thus seriously affect estimations of population parameters and bias the mortality estimates.

Environmental influence on the 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.

The fisheries

Kattegat cod are mainly caught by trawls and Danish seines. Bycatch of cod is taken in the *Nephrops* and sole fishery. Cod represented less than 1% of the total revenue of the Danish fishery in the Kattegat in 2010 (and less than 1.5% of the revenue from demersal fisheries alone). Discarding of young cod and possibly also high-grading of marketable cod takes place. The use of Swedish sorting grid has increased in recent years and SELTRA trawl has been made mandatory in Danish fisheries in the Kattegat from 2011. However, a total estimate of discards for the entire fleet shows an increase in 2009-2011. The harvest rate (catch/SSB) is estimated stable in 2009-2011.

Catch distribution	Total landings (2011) 145 t; estimated discards (2011) 216 t. Total removals from the stock were estimated at 1521 t (95% confidence intervals 1036-2234 t), which is likely due to a combination of fisheries and biological issues (e.g. migration).

Effects of the fisheries on the ecosystem

The fish community in the Kattegat has changed profoundly over the last 100 years. Due to fishing, some species such as halibut, haddock, ling and pollack are no longer present or are now extremely rare, and the size composition of species such as cod, and plaice have all decreased during the 20th century.

Quality considerations

In recent years, reported landings and the discard estimates based on observer trips do not represent total removals from the stock. At present, the relative proportion of unallocated removals due to fishing and biology driven factors cannot be specified. Therefore, current level of fishing mortality cannot be reliably estimated. The discard data indicate a relatively high fishing mortality on young ages (1-2). The 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.

Scientific basis

Assessment type	Age based analytical assessment (stochastic state-space model SAM)
Input data	4 bottom trawl survey indices (IBTS-Q1; IBTS-Q3; Havfisken-Q1; Havfisken-Q4)
Discards and by-catch	Discards included in one of the assessment runs
Indicators	Data from joint Swedish-Danish fishermen-scientists survey
Other information	Benchmark done in WKROUND (2009)
Working group report	WGBFAS

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Reference points

	Type	*Value*	*Technical basis*
Management Plan	SSB_{MP}	6400	B_{lim}
	F_{MP}	0.4	Same as for other cod stocks
MSY Approach	MSY $B_{trigger}$	Not defined	
	F_{MSY}	Not defined	
Precautionary Approach	B_{lim}	6400 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	

(unchanged since: 2011)

Outlook for 2013

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

Management plan

According to the long-term management plan, the fishing mortality in 2013 shall be reduced by 25 % compared with the fishing mortality rate in 2011, unless the target 0.4 is reached. The current level of fishing mortality on cod in the Kattegat cannot be reliably estimated. According to Article 9 in the management plan, TAC and effort should be reduced by 25 % in cases when it is advised that the catches of cod should be reduced to the lowest possible level.

At present situation, where the cod landings are very low compared to the available estimates of discards and estimated unallocated removals from the stock, TAC is not effectively regulating total removals from the stock. The Articles 11 and 13 in the management, which allow Member States to avoid reductions in effort by introducing measures to avoid catching cod (closed areas, selective gears) have resulted in changes in fisheries. Evaluation of effectiveness of these measures for cod recovery and possible improvements is currently ongoing within EU STECF and bilaterally by Sweden and Denmark.

ICES evaluated this plan in 2009 and concluded it was in accordance with the precautionary approach if implemented and enforced adequately; however, this evaluation is not expected to be realistic in a situation of high unaccounted removals as estimated by the present assessment model.

Precautionary considerations

The stock size is considered to be far below B_{lim}, while the exploitation status is uncertain. Therefore, there should be no directed fisheries and bycatch and discards should be minimised.

Additional considerations

Even though a management plan has been in place since 2005, the stock biomass has remained very low. Total removals in the last 3 years have been estimated at 1000-1500 t, whereas the fisheries catch (reported landings plus the estimates of discards) is estimated at about 300-400 t. No information is available on the nature of the unallocated removals. Potential sources of fishery-based unallocated removals are unaccounted discarding of young ages and possibly also high-grading of marketable cod. The discard data from observers trips indicates an increase in discards since 2009. The discard data indicates relatively high fishing mortality on young ages (1-2). Furthermore, migration of cod to other areas and unaccounted catches in recreational fisheries may contribute to the discrepancy between the catch data and the estimates of total removals.

Management plan evaluations

At present, the TAC does not control the catch from the stock. Therefore, the implementation of management plan is focused on fishing effort and cod avoidance measures. Evaluation of effectiveness of these measures for cod recovery and possible improvements is currently ongoing within EU STECF and bilaterally by Sweden and Denmark.

Regulations and their effects

Besides TAC regulation, fishing in Kattegat are restricted by effort limitations. The system was first introduced in the first cod recovery plan (EC No. 423/2004). Effort was limited by allowed number of fishing days for individual fishing vessels. In 2009, following the introduction of the new management plan (EC No. 1342/2008) for North Sea (incl. Kattegat) cod a new effort system was introduced. In this system each Member State is given amounts of kWdays for different gear groups. The amount of kWdays for gear groups catching cod will be subject to yearly cuts as long as the cod stock is below reference points in the management plan. Derogation can however be obtained from the kWdays system if the catches in a certain part of the fleet can be shown to consist of less than 1.5% cod (article 11(2)(b)) or avoid cuts (or part of cuts) if they introduce highly selective gear and cod avoidance plans (article 13).

Fisheries in Kattegat are dominantly operated with trawls and seines with mesh sizes 90-99 mm (TR2) (80% of total effort in 2010). All Danish and German effort in gear category TR2 in 2010 operated under article 13. It is mandatory in Danish fisheries to use a SELTRA trawl with 180 mm panel during the first three quarters of a year. Sweden operate partly under the derogation of article 11 by using a sorting grid (63% of the effort deployed by this country in this gear category in 2010 (STECF, 2011).

In 2009, as a part of the attempts to rebuild of the cod stock in Kattegat, Denmark and Sweden, introduced protected areas on historically important spawning grounds in South East Kattegat. The protected zone consists of three different areas in which the fisheries are either completely forbidden or limited to certain selective gears (Swedish grid and Danish SELTRA 300 trawl) during all or different periods of a year.

Data and methods

Reported landings, discard estimates from observer trips and data from four scientific surveys were available for the assessment of this stock. The assessment is based on 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 for selected years, by scaling of catches. The stock estimates for these years consequently rely more on survey information.

The model estimates significant unallocated removals from the stock between 2003 and 2011, which is not explained by discard data alone. At present, the relative proportion of unallocated removals due to fishing and biology driven factors (migration patterns) cannot be specified. Therefore, both runs with estimating total removals within the model and the run relying on available catch data as representing total removal from the stock are presented.

Information from the fishing industry

In December 2008-2011, extensive joint Swedish-Danish cod surveys in Kattegat were conducted by fisheries research institutes in Denmark and Sweden in collaboration with the fishing industry. The data from these surveys were used to provide an independent estimate of biomass of adult cod in the Kattegat. The results were in line with the estimates from the assessment.

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 2003–2011, which cannot be explained by available discard data. 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.,* 2007) and the same issue may apply for migration to and from the Western Baltic. 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.

In the assessment using the estimates of discards, fishing mortality shows different trends by age, with relatively high values for young age-groups. The estimate of overall harvest rate (catch/SSB) is showing a decline until 2009 and stable values for 2009-2011. However, similarly to the F estimates, the estimate of the harvest rates relies on the catch data, while discards of cod in the Kattegat are likely underestimated.

Concerning SSB, the estimates are considered imprecise, however both the assessment with discards and with estimating total removals within the model indicate historically lowest SSB in recent years (in the range of 950 and 1700 tonnes in 2011). The level of SSB estimated from the assessment is in line with the independent estimates of cod biomass based on data from the joint Swedish-Danish fishermen-scientist survey.

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. The basis for the advice is similar to last year.

Sources

ICES. 2011. Report of the Baltic Fisheries Assessment Working Group, 12–19 April, ICES Headquarters, Copenhagen. 2011 ICES CM 2011/ACOM:10.

ICES. 2012. Report of the Baltic Fisheries Assessment Working Group, 12–19 April, ICES Headquarters, Copenhagen. 2012 ICES CM 2012/ACOM:13.

STECF. 2011. Report of the SGMOS-10-05 Working Group on Fishing Effort Regimes Regarding Annexes IIA, IIB and IIC of TAC & Quota Regulations, Celtic Sea and Bay of Biscay. 27 September–1 October 2010, Edinburgh, Scotland.

Svedäng, H., Righton, D. and Jonsson, P. 2007. Migratory behaviour of Atlantic cod *Gadus morhua*: natal homing is the prime stock-separating mechanism. Marine Ecology Progress Series, 345: 1–12..

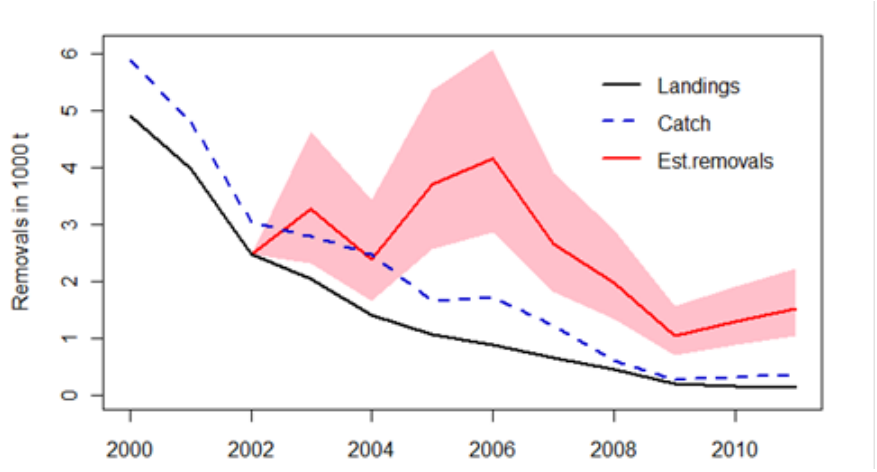

Figure 6.4.1.2 Cod in Division IIIa East (Kattegat). Total removals from the stock estimated by SAM model, compared to reported landings and total catches (landings plus discard data). Shaded area is the 95% confidence interval around the estimated removals.

Table 6.4.1.1 Cod in Division IIIa East (Kattegat). ICES 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 = Fpa = 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	0.197
2010	No catch	0	0.379	0.155
2011	No directed fisheries, minimise by-catches	0	0.190	0.145
2012	No directed fisheries, minimise by-catch and discards	0	0.133	
2013	No directed fisheries, minimise by-catch and discards	0		

Weights in ‘000 t.

Table 6.4.1.2 Cod in Division IIIa East (Kattegat). Officially reported landings (in tonnes).

Year	Kattegat			Total
	Denmark	Sweden	Germany[1]	
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 [2]
1995	3789	2704	71	8164 [3]
1996	4028	2334	64	6126 [4]
1997	6099	3303	58	9460 [5]
1998	4207	2509	38	6835
1999	4029	2540	39	6608
2000	3285	1568	45	4897
2001	2752	1191	16	3960
2002	1726	744	3	2470
2003	1441	603 [7]	1	2045
2004	827	575	1	1403
2005	608	336	10	1070 [6]
2006	540	315	21	876
2007	390	247	7	645
2008	296	152	1	449
2009	134	62	0.3	197
2010	117	38	0.3	155
2011	102	42	1.4	145

[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%

Table 6.4.1.3 Cod in Division IIIa East (Kattegat). Reported landings and estimated discards (from observer data), and the total fisheries catch (sum of landings and discards, in tons). Total removals (shown as a mean value and the 95% confidence intervals) from 2003 onwards is estimated from SAM model based on survey information, and represent the removals from the stock in excess to the reported landings and assumed natural mortality.

Year	Landings	Discards	Catch	Estimated total removals
2000	4897	992	5889	
2001	3960	823	4783	
2002	2470	577	3047	
2003	2045	750	2795	3272 (2311-4622)
2004	1403	1063	2466	2385 (1656-3437)
2005	1070	575	1645	3692 (2557-5350)
2006	876	849	1725	4161 (2856-6062)
2007	645	577	1222	2664 (1825-3896)
2008	449	165	614	1968 (1334-2898)
2009	197	77	274	1050 (702-1573)
2010	155	167	322	1287 (874-1895)
2011	145	216	361	1521 (1037-2234)

Annex 5.4.1 – management plan

The European Commission has enacted a Council Regulation ((EC) No. 1342/2008) which establishes measures for the recovery and long term management of cod stocks. The stated objective of the plan is to ensure the sustainable exploitation of the cod stocks on the basis of maximum sustainable yield while maintaining a fishing mortality of 0.4. Articles 7 – 9, describing aspects of the plan relevant for Kattegat cod, are reproduced below:

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.