

ECOREGION Baltic Sea
STOCK Cod in Subdivision 22-24

Advice summary for 2011

Management Objective (s)	Landings in 2011
Transition to an MSY approach with caution at low stock size	Less than 18.2 kt
Cautiously avoid impaired recruitment (Precautionary Approach)	n/a
Cautiously avoid impaired recruitment and achieve other objective(s) of a management plan (e.g., catch stability)	Less than 18.8 kt

Stock status

Fishing mortality	2007	2008	2009
F_{MSY}	above	above	above
F_{PA}/F_{lim}	Not available		
Spawning Stock Biomass (SSB)	2008	2009	2010
$MSY B_{trigger}$	below	above	above
B_{PA}	below	above	above

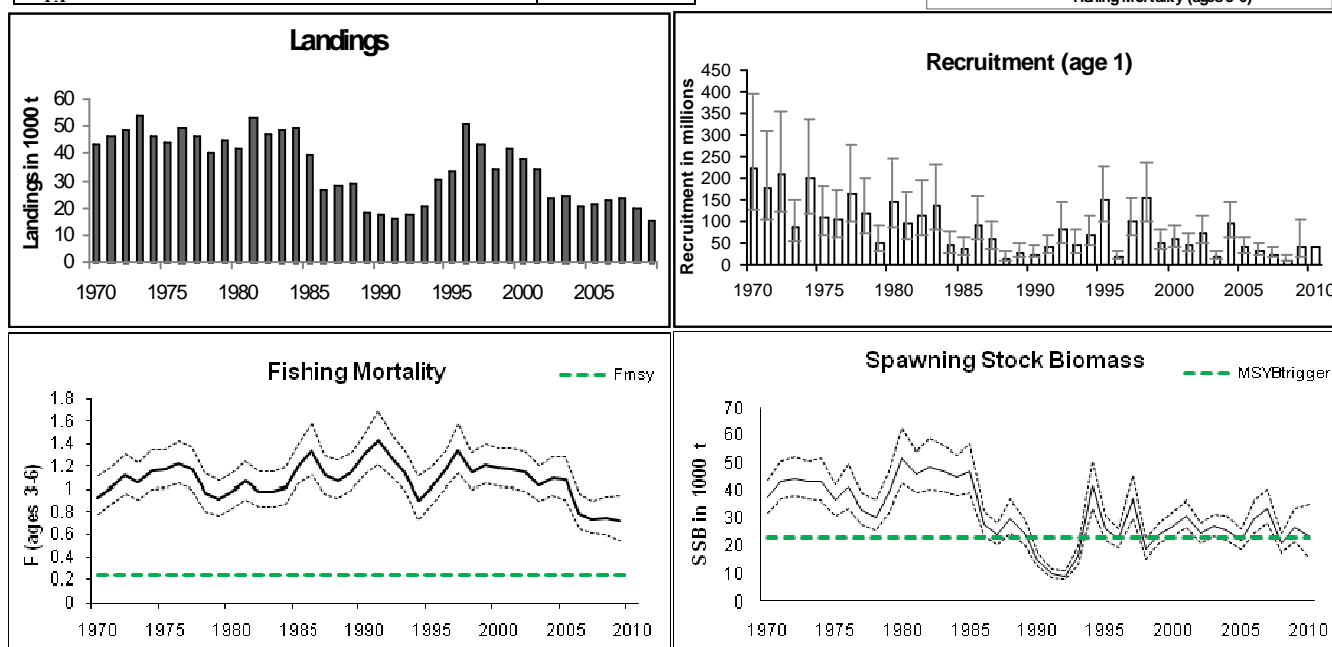
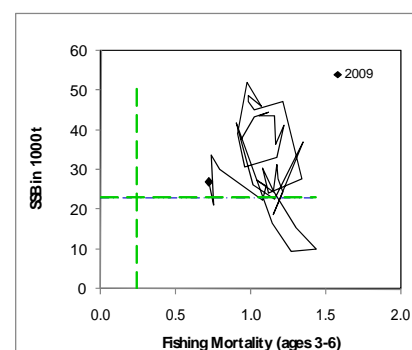


Figure 8.4.1.1 Cod in Subdivision 22-24. Summary of stock assessment (weights in '000 tonnes). Top right: SSB and F over the years. 2010 in recruitment is estimated. Recruitment, F mortalities and SSB have uncertainty boundaries in the plot.

SSB has in recent years been fluctuating around B_{pa} . F has been decreasing since the late 1990s to around 0.7 in recent years. The 2 latest year classes have been close to the average of the last 10 years, but the year classes 2004 – 2007 were weak.

Management plan

A management plan was agreed for cod in the western Baltic Sea in September 2007 by the EC (EC [1098/2007](#)). This plan aims for a reduction in F by 10% each year. ICES has evaluated the management plan in 2009 and considered it to be in accordance with the precautionary approach.

Biology

There is a mixture of stock between the Eastern and Western Baltic stock especially in SD 24. The degree of mixing has not been quantified. At present three main spawning sites are considered for this stock in the Sound (SD 23), in the Western Baltic (SD 22) and in the Arkona Basin (SD 24). At present the Eastern Baltic stock is increasing. There are indications for movement of juvenile cod from the western Baltic to the east, but also of adult cod moving the other way.

The fisheries

The main part is taken by trawlers but also gillnetters and to a minor extent long liners and Danish seine is part of the fishery. Bycatch consists mainly of flatfish.

Catch by fleet	Total catch (2009) 16.2 kt where 15.3 kt landings (70 % trawlers, 30% gillnetters), 0.9 kt discards,
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Effects of the fisheries on the ecosystem

Cod is the main predator on sprat and herring, and due to the low cod density, there is limited predation mortality on these stocks.

Quality considerations

Good recruitment data is lacking. Not all removals are considered in the assessment. Discarding is not fully quantified, but the problem may be significant in years when strong year classes enter the fishery. In 2010 problems with age reading arose in younger age groups of cod.

Cod in Subdivisions 22 - 24

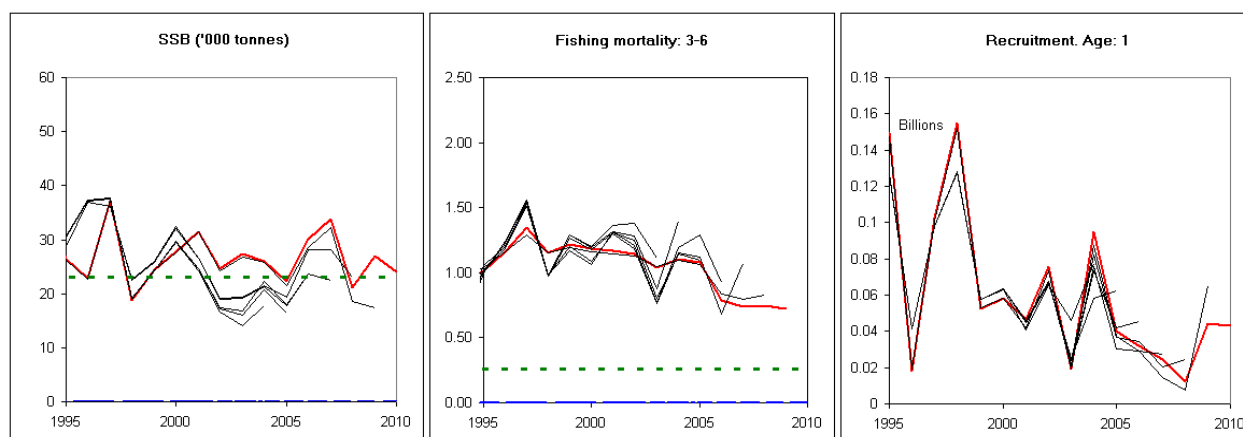


Figure 8.4.1.2 Cod in Subdivisions 22-24. Historic performance of the assessment. Left-hand panel: SSB in '000 t, mid-panel: F, and right-hand panel: Recruitment (age 1).

The season and area coverage of discard sampling requires improvement.

Scientific basis

Assessment type	analytical (SAM – State-space-Assessment Model)
Input data	3 survey indices (KASU-1Q, KASU-4Q, Solea- 4Q) 1 commercial CPUE index (Danish trawlers)
Discards and by-catch	Included in the assessment (since 1970)
Indicators	None
Other information	benchmark done in 2009
Working group report	WGBFAS

8.4.1

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Reference points

	Type	Value	Technical basis
MSY	MSY $B_{trigger}$	23 000 t	B_{pa} (23 000 t)
Approach	F_{MSY}	0.24	F_{max} (WGBFAS 2010)
Precautionary Approach	B_{lim}	not defined	
	B_{pa}	23 000 t	MBAL
	F_{lim}	not defined	
	F_{pa}	not defined	

(changed in 2010)

Yield and spawning biomass per Recruit F -reference points (2010):

	Fish Mort	Yield/R	SSB/R
	Ages 3-6		
Average last 3 years	0.73	0.29	0.2
F_{max}	0.24	0.34	1.28
$F_{0.1}$	0.16	0.33	1.80
$F_{35\%SPR}$	0.20	0.34	1.51
F_{med}	0.72	0.26	0.34

F_{msy} is based on F_{max} (0.24), as F_{max} has a well define top (Figure 8.4.1.4).

Outlook for 2011

Basis: F_{sq} (2007–09)=0.725 (scaled to final year) ; SSB (2011) = 24.6 kt; R (2010)= 43.4 (mill.); HC landings (2010) = 17.7 kt; Discards (2010) = 2.1 kt;

Rationale	Human Consumption (2011)	Basis	F Total (2011)	F (HC) (2011)	Catch Total (2011)	Discards (2011)	SSB (2012)	%SSB change ¹⁾	% TAC change ²⁾
MSY framework	8.1	$F=F_{max}$	0.24	0.23	9.0	0.9	38.2	55%	-54
MSY transition	18.2	$0.8 * F_{sq} + 0.2 * F_{msy}$	0.63	0.60	20.3	2.1	29.0	18%	+3%
Management plan	18.8	$F_{sq} * 0.9$	0.65	0.63	21.0	2.2	28.4	16%	+6%
Zero catch	0	$F = 0$	0	0	0	0	45.1	83%	-100%
<i>Status quo</i>	7.4	$F_{sq} * 0.3$	0.22	0.21	8.2	0.8	38.8	58%	-58%
	13.6	$F_{sq} * 0.6$	0.44	0.42	15.1	1.5	33.1	34%	-23%
	17.1	$F_{sq} * 0.8$	0.58	0.56	19.1	2.0	29.8	21%	-3%
	18.8	$F_{sq} * 0.9$	0.65	0.63	21.0	2.2	28.4	16%	+6%
	20.3	$F_{sq} * 1.0$	0.73	0.7	22.7	3.2	27.0	10%	15%
	21.7	$F_{sq} * 1.1$	0.80	0.77	24.3	2.6	25.7	4%	23%
	25.7	$F_{sq} * 1.4$	1.02	0.97	28.8	3.2	22.3	-9%	45%
	29.0	$F_{sq} * 1.7$	1.23	1.18	32.6	3.5	19.6	-20%	64%

Units: '000 tonnes.

¹⁾ SSB 2012 relative to SSB 2011.

²⁾ Human Consumption landings 2011 relative to TAC 2010.

MSY approach

Following the ICES MSY framework implies fishing mortality to be reduced to 0.24, resulting in landings of 8.1 kt in 2011. This is expected to lead to an SSB of 38.2 kt in 2012. Following the transition scheme towards the ICES MSY framework implies fishing mortality to be reduced to 0.63, resulting in landings of 18.2 kt in 2011. This is expected to lead to an SSB of 29.0 kt in 2012.

PA approach

As there is no F_{pa} defined for this stock the catch corresponding to the PA approach cannot be calculated.

Management plan

Following the agreed EU management plan implies an F reduction of 10% which is expected to lead to a TAC of 18.8 kt and F at 0.65 in 2011.

Additional considerations

The fishery is largely based on recruiting year classes. The two last year classes have been estimated to be close to the average of the last 10 years.

Management plan evaluations

ICES evaluated the EC management plan in March 2009 and concluded that the plan is in accordance with the precautionary approach. In its evaluation, ICES assumed that the annual effort reduction is fully achieved. Under the evaluations, F is assumed to decrease in line with the annual 10% effort reduction. The evaluation of the plan is most sensitive to assumptions about implementation error, and the effectiveness of effort limitations.

In the past, F has not been reduced as much as anticipated by the management plan indicating that effort limitations are not effectively limiting the fishery.

Factors affecting the fisheries and the stock

Regulations and their effects

The EC Council Regulation for the Baltic TAC and quota 2009 involves reductions in the effort (10% in terms of number of fishing days per year, which results in 201 days maximum in 2009) and a regulation of TACs for Western Baltic cod ($\pm 15\%$) following the agreed management plan (EC REG 1098/2007).

The cod fisheries in the Western Baltic are also regulated by a seasonal closure in order to protect spawning aggregations of cod, from 1st to 30th of April in 2009 and 2010. The TAC was nearly taken in 2009 (94%).

A 'Bacoma' codend with a 120-mm mesh was introduced by IBSFC in 2001 in parallel to an increase in diamond mesh size to 130 mm in traditional codends. The expected effect of introducing the Bacoma 120-mm exit window was nullified by compensatory measures in the industry. This was to some extent explained by the mismatch between the selectivity of the 120-mm Bacoma trawl and the minimum landing size. In October 2003, the regulation was changed to a 110-mm Bacoma window. This was expected to enhance the compliance and to be in better accordance with the minimum landing size, which was changed from 35 to 38 cm in the same year. 1st of January 2010 the Bacoma 120 mm was re-introduced along with an extended Bacoma window (5.5 m), to further decrease discard and the minimum landing size was kept at 38 cm.

From 1st January 2009 a small area ("the triangle") in SD 23 (The Sound) was closed for all fisheries in February and March where there traditionally has been a large directed cod fishery. This has implied a reduction of the cod catch in SD 23 with more than 60% compared to the last 5 years (table 8.4.1.2)

In Denmark, annual quota shares for individual vessels were introduced on 1 January 2007 according to which fishers are allocated a yearly share of the Danish quota. Fishers can subsequently fish, trade, exchange, or pool their share with other fishers. This could potentially affect the efficiency of the vessels, but a change in efficiency has not been found.

Scientific basis

Data and methods

The assessment includes catch data, supplemented with one commercial CPUE index and three survey indices. 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 was adopted at the Benchmark workshop in 2009.

Discard data have been available since 1996 and are used in the assessment as yearly proportions discarded per age-group. For years prior to 1996, an average proportion discarded per age-group estimated for 1996–2003 is applied. The season and area coverage of discard sampling requires improvement. A relationship between *year class* strength and discard rates cannot be estimated from the available data. Due to recent changes in technical regulations, e.g. the increase of minimum landing size, introduction of BACOMA 110 and varying closures, discard rates may have varied additionally.

Uncertainties in assessment and forecast

The assessment has shown a retrospective pattern with a consistent overestimation of F and underestimation of SSB. Although the SAM model shows the same retrospective pattern as XSA the magnitude of the overestimation of F is less in the SAM model, and stays within the confidence intervals.

Comparison with previous assessment and advice:

The SSB estimates have been revised upwards by 12% compared to last year's assessment, and the fishing mortality estimates were revised downwards by 10% for 2008. This reflects the uncertainty of the assessment with the overestimation of F.

The basis for the advice is the same as last year but extended by MSY considerations.

Sources

ICES. 2010. Report of the Baltic Fisheries Assessment Working Group. ICES Headquarters, 15–22 April 2010. ICES CM 2010/ACOM:10.

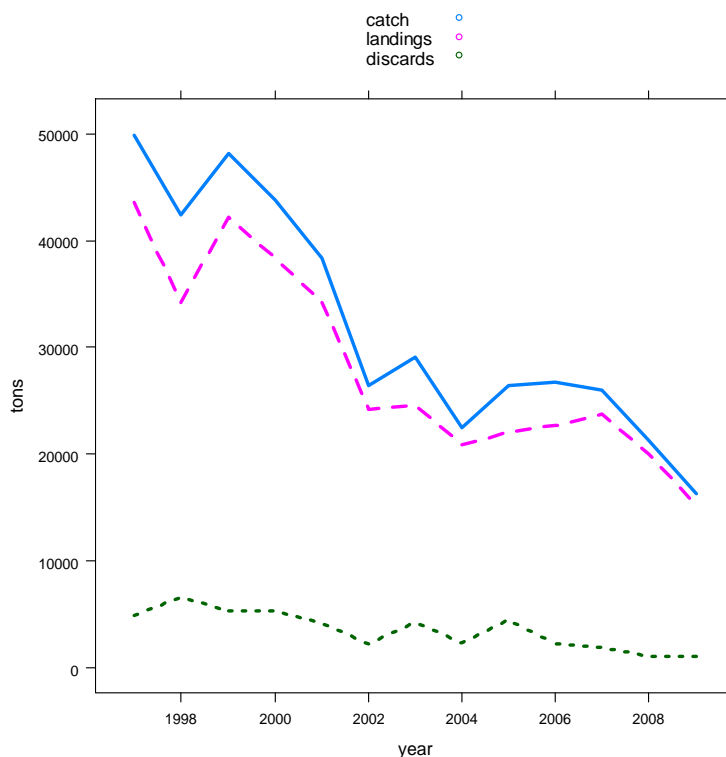


Figure 8.4.1.3 Cod in Subdivisions 22-24. Landings, discards and catches in tons.

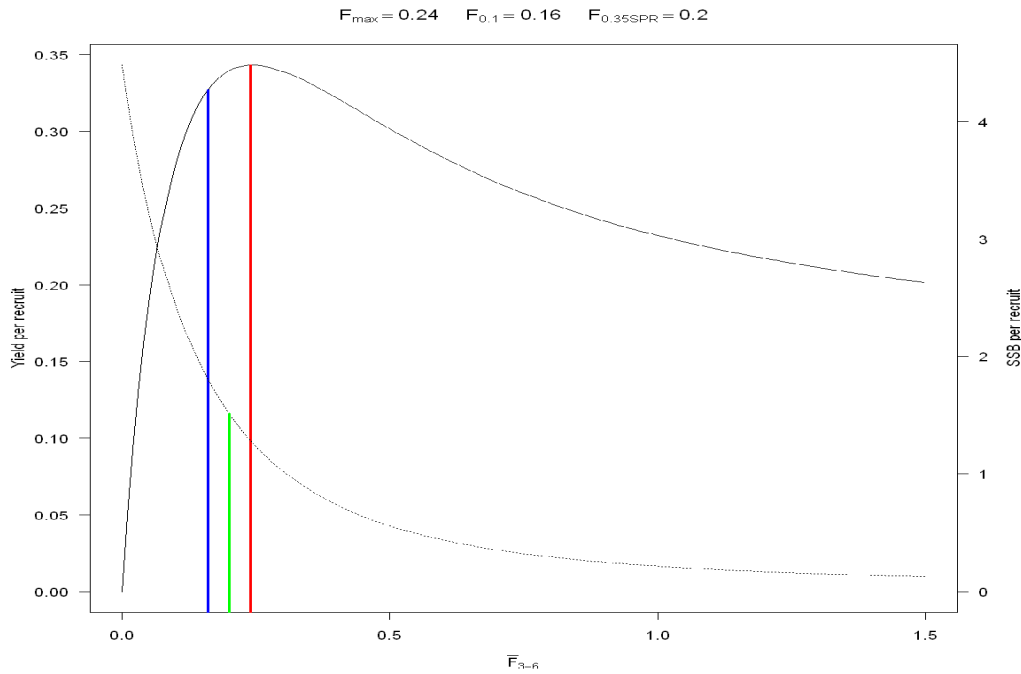


Figure 8.4.1.4 Cod in Area SD2224. Yield and SSB per recruit plots. The vertical lines represent biological reference points.

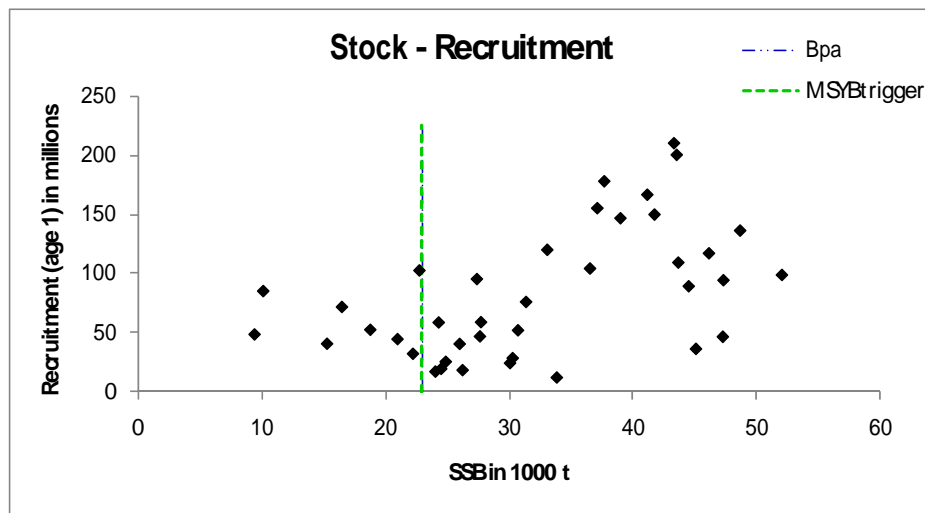


Figure 8.4.1.5 Cod Subdivisions 22-24. Stock and recruitment plot.

Table 8.4.1.1 Cod in Subdivision 22-24. Single stock exploitation boundaries (advice), management and landings.

Year	ICES Advice	Predicted landings Corresp to advice	Agreed TAC ¹	ICES Landings (22–24)	ICES Landings (22–32)
1987	TAC	9		29	236
1988	TAC	16		29	223
1989	TAC	14	220	19	198
1990	TAC	8	210	18	171
1991	TAC	11	171	17	140
1992	Substantial reduction in F	-	100	18	73 ²
1993	F at lowest possible level	-	40	21	66 ²
1994	TAC	22	60	31	124 ²
1995	30% reduction in fishing effort from 1994 level	-	120	34	142 ²
1996	30% reduction in fishing effort from 1994 level	-	165	51	173
1997	Fishing effort should not be allowed to increase above the level of recent years	-	180	44	132
1998	20% reduction in F from 1996	35	160	34	102
1999	At or below F_{sq} with 50% probability	38	126	42	115
2000	Reduce F by 20%	44.6	105	38	128
2001	Reduce F by 20%	48.6	105	34	126
2002	Reduce F to below 1.0	36.3	76	24	92
2003	Reduce F to below 1.0	22.6–28.8 ³	75	25	94
2004	Reduce F to below 1.0	< 29.6	29.6	21	*
2005	Reduce F to below 0.92	< 23.4	24.7	22	*
2006	Management plan	< 28.4	28.4	23	*
2007	Keep SSB at B_{pa}	< 20.5	26.7	24	*
2008	Rebuild SSB to B_{pa}	< 13.5	19.2	20	*
2009	Rebuild SSB to B_{pa}	< 13.7	16.3	15.3	
2010	Management plan	<17.7	17.7		
2011	See scenarios	-			

Weights in '000 t.

¹ Included in TAC for total Baltic, until and including 2003.

² The reported landings in 1992–1995 are known to be incorrect due to incomplete reporting.

³ Two options based on implementation of the adopted mesh regulation.

* Separate management for western and eastern Baltic cod since 2004.

Table 8.4.1.2 Cod in Subdivisions 22-24. Landings ('000 tonnes) by country and area

Year	Denmark		Finland	German Dem. Rep. ²	Germany, FRG	Estonia		Latvia	Poland Sweden			Total						
	23	22+24	24	22+24	22+24	22	24	24	24	23	24	22	23	24	Unalloc.	22+24	22+24 + Unalloc.	22-24+ Unalloc.
1965		19,457		9,705	13,350						2,182	27,867		17,007		44,874	44,874	44,874
1966		20,500		8,393	11,448						2,110	27,864		14,587		42,451	42,451	42,451
1967		19,181		10,007	12,884						1,996	28,875		15,193		44,068	44,068	44,068
1968		22,593		12,360	14,815						2,113	32,911		18,970		51,881	51,881	51,881
1969		20,602		7,519	12,717						1,413	29,082		13,169		42,251	42,251	42,251
1970		20,085		7,996	14,589						1,289	31,363		12,596		43,959	43,959	43,959
1971		23,715		8,007	13,482						1,419	32,119		14,504		46,623	46,623	46,623
1972		25,645		9,665	12,313						1,277	32,808		16,092		48,900	48,900	48,900
1973		30,595		8,374	13,733						1,655	38,237		16,120		54,357	54,357	54,357
1974		25,782		8,459	10,393						1,937	31,326		15,245		46,571	46,571	46,571
1975		23,481		6,042	12,912						1,932	31,867		12,500		44,367	44,367	44,367
1976	712	29,446		4,582	12,893						1,800	33,368	712	15,353		48,721	48,721	49,433
1977	1,166	27,939		3,448	11,686					550	1,516	29,510	1,716	15,079		44,589	44,589	46,305
1978	1,177	19,168		7,085	10,852					600	1,730	24,232	1,777	14,603		38,835	38,835	40,612
1979	2,029	23,325		7,594	9,598					700	1,800	26,027	2,729	16,290		42,317	42,317	45,046
1980	2,425	23,400		5,580	6,657					1,300	2,610	22,881	3,725	15,366		38,247	38,247	41,972
1981	1,473	22,654		11,659	11,260					900	5,700	26,340	2,373	24,933		51,273	51,273	53,646
1982	1,638	19,138		10,615	8,060					140	7,933	20,971	1,778	24,775		45,746	45,746	47,524
1983	1,257	21,961		9,097	9,260					120	6,910	24,478	1,377	22,750		47,228	47,228	48,605
1984	1,703	21,909		8,093	11,548					228	6,014	27,058	1,931	20,506		47,564	47,564	49,495
1985	1,076	23,024		5,378	5,523					263	4,895	22,063	1,339	16,757		38,820	38,820	40,159
1986	748	16,195		2,998	2,902					227	3,622	11,975	975	13,742		25,717	25,717	26,692
1987	1,503	13,460		4,896	4,256					137	4,314	12,105	1,640	14,821		26,926	26,926	28,566
1988	1,121	13,185		4,632	4,217					155	5,849	9,680	1,276	18,203		27,883	27,883	29,159
1989	636	8,059		2,144	2,498					192	4,987	5,738	828	11,950		17,688	17,688	18,516
1990	722	8,584		1,629	3,054					120	3,671	5,361	842	11,577		16,938	16,938	17,780
1991	1,431	9,383			2,879					232	2,768	7,184	1,663	7,846		15,030	15,030	16,693
1992	2,449	9,946			3,656					290	1,655	9,887	2,739	5,370		15,257	15,257	17,996
1993	1,001	8,666			4,084					274	1,675	7,296	1,275	7,129	5,528	14,425	19,953	21,228
1994	1,073	13,831			4,023					555	3,711	8,229	1,628	13,336	7,502	21,565	29,067	30,695
1995	2,547	18,762	132		9,196			15		611	2,632	16,936	3,158	13,801		30,737	30,737	33,895
1996	2,999	27,946	50		12,018		50	32		1,032	4,418	21,417	4,031	23,097	2,300	44,514	46,814	50,845
1997	1,886	28,887	11		9,269		6		263	777	2,525	21,966	2,663	18,995		40,961	40,961	43,624
1998	2,467	19,192	13		9,722		8	13	623	607	1,571	15,093	3,074	16,049		31,142	31,142	34,216
1999	2,839	23,074	116		13,224		10	25	660	682	1,525	20,409	3,521	18,225		38,634	38,634	42,155
2000	2,451	19,876	171		11,572		5	84	926	698	2,564	18,934	3,149	16,264		35,198	35,198	38,347
2001	2,124	17,446	191		10,579		40	46	646	693	2,479	14,976	2,817	16,451		31,427	31,427	34,244
2002	2,055	11,657	191		7,322			71	782	354	1,727	11,968	2,409	9,781		21,749	21,749	24,158
2003	1,373	13,275	59		6,775			124	568	551	1,899	9,573	1,925	13,127		22,700	22,700	24,624
2004	1,927	11,386			4,651			221	538	393	1,727	9,091	2,320	9,430	13	18,521	18,534	20,854
2005	1,902	9,867	2		7,002	72	67	476	1,093	720	835	8,729	2,621	10,686	9	19,415	19,424	22,045
2006	1,899	9,761	242		7,516		91	586	801		1,855	9,979	1,914	10,858		20,837	20,837	22,751
2007	2,169	8,975	220		6,802		69	273	2,371	534	2,322	7,840	2,713	13,183		21,023	21,023	23,736
2008	1,612	8,582	159		5,489		134	30	1,361	525	2,189	5,687	2,139	12,256		17,943	17,943	20,082
2009	567	7,871			4,020		194	23	529	269	1,817	3,451	839	11,000		14,451	14,451	15,290

¹ Provisional data. ² Includes landings from Oct.-Dec. 1990 of Fed.Rep.Germany.

Table 8.4.1.3 Cod in Subdivisions 22-24. Summary of stock assessment (weights in tonnes). Recruits (age 1, in '000'), Low= lower confidence limit, High = higher confidence limit. F36=Fbar 3-6 years.

Table 2.3.21. Estimated recruitment, total stock biomass (TBS), spawning stock biomass (SSB), and average fishing mortality for ages 3 to 6 (F36).

Year	Recruits	Low	High	TBS	Low	High	SSB	Low	High	F36	Low	High
1970	225483	128713	395007	104715	86086	127375	37722	32165	44239	0.932	0.776	1.12
1971	177726	102015	309626	113550	94489	136457	43347	36963	50835	1.022	0.875	1.194
1972	209819	123767	355699	109207	91470	130384	44534	37880	52357	1.115	0.954	1.303
1973	89143	53121	149594	105662	88257	126500	43565	37149	51088	1.055	0.908	1.226
1974	199985	118565	337318	96664	81047	115291	43695	36765	51933	1.158	1	1.341
1975	109098	65133	182740	93620	77459	113153	36571	31362	42645	1.168	1.01	1.35
1976	104089	62243	174068	93807	77890	112978	41192	33927	50013	1.223	1.048	1.427
1977	166375	99256	278881	80017	67240	95223	33124	28075	39080	1.171	0.996	1.377
1978	119850	71445	201052	85991	70626	104698	30761	26096	36260	0.961	0.81	1.141
1979	51896	30603	88004	87553	72675	105478	39027	32426	46971	0.909	0.764	1.082
1980	146532	87565	245207	82785	69748	98259	52052	43104	62858	0.976	0.837	1.138
1981	98617	58375	166601	89322	74728	106765	46166	39190	54384	1.066	0.91	1.248
1982	116891	69593	196335	87553	73758	103928	48679	40358	58715	0.984	0.839	1.154
1983	136080	80618	229698	86595	73190	102455	47287	39852	56109	0.982	0.838	1.15
1984	46490	27695	78042	79539	66821	94677	45116	38312	53129	1.018	0.872	1.189
1985	36243	21569	60899	70757	60032	83396	47335	39426	56830	1.215	1.052	1.404
1986	94183	56269	157645	44578	38182	52046	27778	23530	32793	1.341	1.13	1.59
1987	58806	35037	98700	56050	45410	69184	24101	20434	28426	1.115	0.958	1.298
1988	17069	10121	28786	48825	40434	58958	30333	24775	37139	1.075	0.921	1.256
1989	28453	16735	48376	37049	31322	43823	24934	20687	30053	1.15	0.997	1.325
1990	25387	15083	42732	31132	26317	36828	15357	13089	18016	1.301	1.134	1.492
1991	40579	24208	68022	19821	16987	23128	10209	8706	11971	1.434	1.215	1.692
1992	85050	50591	142983	22203	18244	27022	9510	8081	11191	1.271	1.1	1.469
1993	48485	28207	83338	38754	31424	47794	16559	13678	20048	1.142	0.981	1.33
1994	71611	44991	113980	59042	48977	71175	41773	34106	51162	0.905	0.734	1.116
1995	149642	98121	228214	59576	50783	69890	26291	22190	31151	1.012	0.863	1.187
1996	18337	11592	29009	72766	60974	86838	22811	19547	26620	1.16	1.011	1.332
1997	102437	67364	155771	63959	53151	76965	37160	30253	45645	1.345	1.146	1.58
1998	154972	100831	238184	60658	51243	71801	18852	15821	22465	1.149	0.995	1.326
1999	52418	34353	79982	61759	52033	73304	24367	20953	28338	1.215	1.054	1.4
2000	58513	38490	88951	50818	43525	59332	27695	23523	32606	1.184	1.027	1.365
2001	46770	29818	73360	48630	41819	56551	31414	26865	36733	1.172	1.01	1.36
2002	75887	49989	115202	40498	34893	47002	24563	21115	28574	1.148	0.987	1.336
2003	19417	12551	30039	44135	37401	52081	27447	23642	31864	1.036	0.89	1.207
2004	95225	62117	145979	44046	37385	51895	26056	21860	31057	1.101	0.95	1.277
2005	40457	26591	61553	45433	38178	54067	22292	18922	26263	1.078	0.907	1.281
2006	32145	20685	49953	48485	40657	57819	30122	25022	36261	0.789	0.646	0.964
2007	24222	14991	39136	51380	43696	60415	33894	28563	40221	0.739	0.607	0.9
2008	12064	7383	19713	35668	30235	42077	21045	17737	24969	0.748	0.6	0.931
2009	44489	19246	102839	42873	34437	53375	26930	21413	33869	0.72	0.547	0.949
2010	43088	10979	169102	41982	28356	62156	23957	16200	35427			