

ECOREGION Barents Sea and Norwegian Sea
STOCK Cod in Subareas I and II (Northeast Arctic cod)

Advice for 2012

ICES advises on the basis of the Joint Russian–Norwegian Fisheries Commission management plan that catches in 2012 should be no more than 751 000 t. Coastal cod and redfish bycatches should be kept as low as possible.

Stock status

F (Fishing Mortality)			
	2008	2009	2010
MSY (F_{MSY})	?	?	?
Precautionary approach (F_{pa}, F_{lim})	✓	✓	✓
Management plan (F_{MP})	✓	✓	✓
			Undefined
			Harvested sustainably
			Below target
SSB (Spawning Stock Biomass)			
	2009	2010	2011
MSY ($B_{trigger}$)	?	?	?
Precautionary approach (B_{pa}, B_{lim})	✓	✓	✓
Management plan (SSB_{MP})	✓	✓	✓
			Undefined
			Full reproductive capacity
			Above trigger

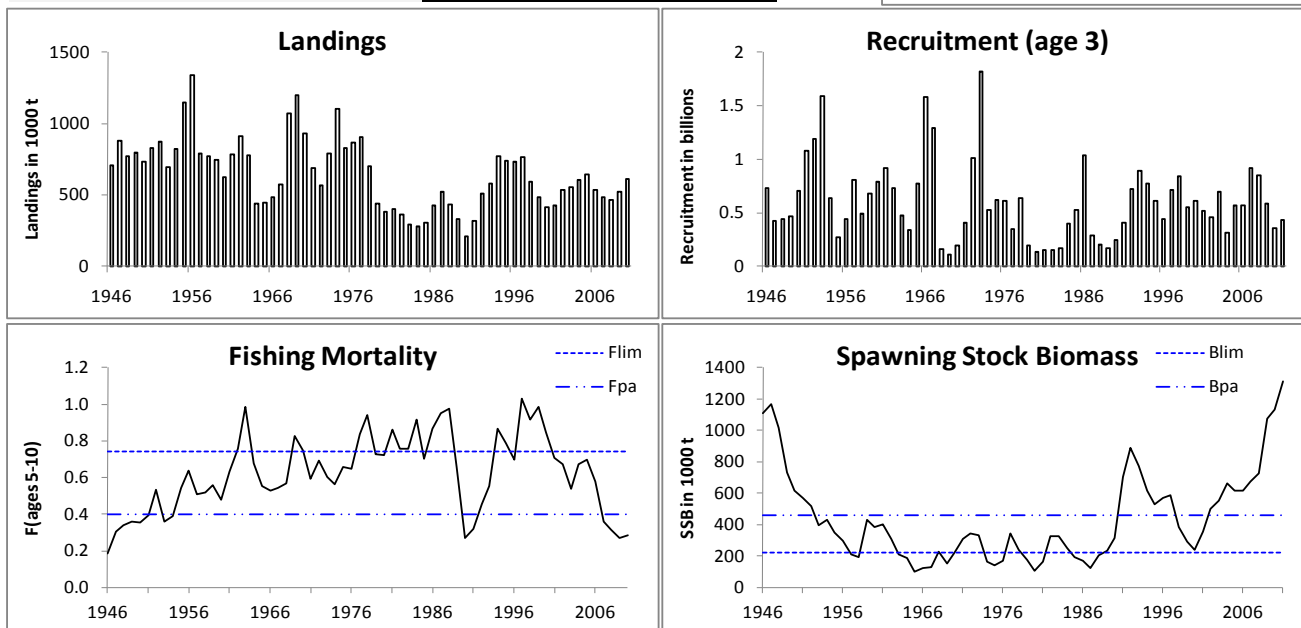
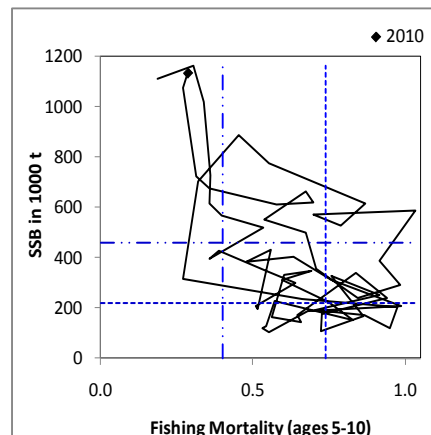


Figure 3.4.1.1 Cod in Subareas I and II. Summary of stock assessment (weights in '000 tonnes). Top right: SSB and F over the years.

The SSB has been above B_{pa} since 2002 and is now near its record high. Fishing mortality was reduced from well above F_{lim} in 1997 to below F_{pa} in 2007 and is now close to its lowest value. Surveys indicate that cod recruitment will be below average in 2011 and will be average in 2012–2013.

Management plans

A management plan has been implemented since 2004 (Annex 3.4.1) with the objectives of maintaining high long-term yield, year-to-year stability, and full utilization of all available information on stock dynamics. The plan was evaluated in 2010 and ICES considers it to be in accordance with the precautionary approach but it has not been evaluated against the MSY framework. At the 2010 meeting of the Joint Russian–Norwegian Fisheries Commission it was agreed that the plan will be in force until 2015.

Environmental influence on the stock

Among the factors influencing cod growth and recruitment are water temperature, food supply, and cod population abundance. Environmental drivers were used in estimating recruitment and temperature was used for estimating cod cannibalism. Changes in growth, maturity, and cod cannibalism are linked to the abundance of capelin. This linkage appears to be less pronounced in the recent period compared to the 1980s and 1990s. Capelin abundance is at present intermediate.

The fisheries

Cod is a target species caught in a mixed fishery together with haddock and saithe. In coastal areas, Northeast Arctic cod and coastal cod are caught in the same fishery during parts of the year. Redfish (both *S. mentella* and *S. marinus*) are caught as bycatch in the cod fishery. TAC regulations are in place. Unreported catches have decreased in the recent years and were close to zero in 2009 and 2010. Discarding is illegal in Norway and Russia. Data on discarding are scarce, but attempts to obtain better quantification continue. The fisheries are controlled by inspections at sea and when landing fish, by a requirement to report to catch control points when entering and leaving the EEZs, and by VMS satellite tracking for some fleets.

Catch by fleet Total catch (2010) = 610 kt (70% demersal trawls, 30% other gear types).

Effects of the fisheries on the ecosystem

Fisheries of cod in the Barents Sea do not only influence the targeted stock. Due to strong species interactions fisheries removal of cod, which is an important predator in the ecosystem, influences the abundance of prey stocks such as capelin.

Quality considerations

The uncertainties in this assessment relate both to catch and survey data. Unreported catches (IUU) and incomplete spatial coverage in surveys has been a problem in some years, but do not affect the data collected in 2009–2010. The biological sampling from some vessel groups decreased considerably and may have become critically low after the termination of the Norwegian harbour sampling program in mid-2009, e.g. for handline in quarter 1 and for gillnet in quarters 2–4 in 2010.

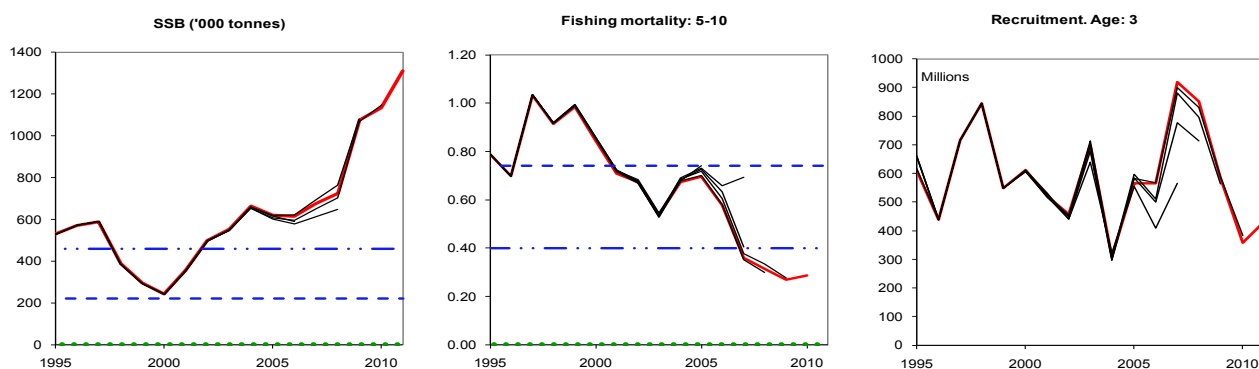


Figure 3.4.1.2 Cod in Subareas I and II. Historical performance of the assessment (final year estimates included).

Scientific basis

Assessment type	Age-based analytical assessment (XSA).
Input data	3 survey indices: Joint bottom trawl survey Barents Sea Feb–Mar (BS-NoRu-Q1 (BTr)); Joint acoustic survey Barents Sea+Lofoten Feb–Mar (BS-NoRu-Q1 (Aco)); Russian bottom trawl survey Oct–Dec (RU-BTr-Q4)
Discards and bycatch	1 commercial cpue index; data from the Russian trawl fisheries. Discards are not accounted for. Bycatch of juvenile cod is unknown.
Indicators	None.
Other information	None.
Working group report	AFWG

3.4.1

ECOREGION Barents Sea and Norwegian Sea
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Reference points

	<i>Type</i>	<i>Value</i>	<i>Technical basis</i>
Management	SSB _{MP}	460 000 t	B _{pa} , TAC linearly reduced from F _{pa} at SSB = B _{pa} to 0 at SSB equal to zero.
Plan	F _{MP}	0.4	F _{pa} , average TAC for the coming 3 years based on F _{pa} .
MSY Approach	MSY B _{trigger}	Undefined	
	F _{MSY}	Undefined	
Precautionary Approach	B _{lim}	220 000 t	change point regression.
	B _{pa}	460 000 t	the lowest SSB estimate having >90% probability of remaining above
	F _{lim}	0.74	F corresponding to an equilibrium stock = B _{lim} .
	F _{pa}	0.40	the highest F estimate having >90% probability of remaining below F _{lim} .

(unchanged since 2011)

Yield and spawning biomass per Recruit F-reference points (2011):

	Fish Mort Ages 5–10	Yield/R	SSB/R
Average last 3 years	0.29	1.08	2.64
F _{max} *	-	-	-
F _{0.1}	0.12	0.99	6.19
F _{med}	0.72	0.98	0.68

* F_{max} is poorly defined.

Outlook for 2012

Basis: F₂₀₁₁ = F₂₀₁₀ = 0.29; SSB (2012) = 1551; R (2011) = 433 million; Landings (2011) = 628

Rationale	Landings (2012)	Basis	F (2012)	SSB (2013)	%SSB change ¹⁾	%TAC change ²⁾
Management plan ³⁾	751	F _{MP}	0.35	1446	-7	+7
Precautionary approach	834	F _{pa}	0.40	1373	-11	+19
Zero catch	0	0*F _{sq}	0	2123	+37	-100
<i>Status quo</i>	631	F _{sq}	0.29	1552	0	-10

Units: '000 tonnes.

¹⁾ SSB 2013 relative to SSB 2012.

²⁾ Catch 2012 relative to TAC 2011.

³⁾ Forecast based on catch equal to average catch in 2012–2014, corresponding to F=0.40.

Management plan

In accordance with the adopted management plan the catch in 2012 should be equal to the average predicted catch in 2012–2014 with target F = 0.40, corresponding to landings of 751 000 t in 2012 and implying an F = 0.35 in 2012. This is expected to keep SSB above B_{pa} in 2013 and close to the historical high.

Stochastic simulations show that the F=0.40 currently used in the management plan provides high long-term yield.

PA approach

Fishing at F_{pa} (= 0.40) corresponds to landings of no more than 834 000 t in 2012. This is expected to keep SSB above B_{pa} in 2013 and close to the historical high.

Additional considerations

Management considerations

The estimates of unreported landings by the Joint Norwegian–Russian analysis group were reduced considerably compared to the period 2006–2008. For 2009 and 2010, the estimate of unreported landings is close to zero.

Management plan

The plan aims to maintain F at $F_{pa} = 0.40$ and restrict between-year TAC change to $\pm 10\%$ unless SSB falls below B_{pa} , in which case the target F should be reduced.

The management plan was amended in 2009 by adding a new condition: “If the TAC, by following such a rule, corresponds to a fishing mortality (F) lower than 0.30 the TAC should be increased to a level corresponding to a fishing mortality of 0.30”, when SSB is above B_{pa} .

Regulations and their effects

In addition to quotas, the fisheries are regulated by mesh size limitations, a minimum catching size, a maximum bycatch of undersized fish, maximum bycatch of non-target species, closure of areas with high densities of juveniles, and other seasonal and area restrictions. The total effects of these regulations have not been evaluated.

Since January 1997, sorting grids have been mandatory for the trawl fisheries in most of the Barents Sea and Svalbard area. From 2011 onwards, the minimum mesh size for bottom trawl fisheries for cod and haddock is 130 mm for the entire Barents Sea (before 2011 the minimum mesh size was 135 mm in the Norwegian EEZ and 125 mm in the Russian EEZ). This change is expected to have a minor impact on the total exploitation pattern for this stock, thus a recent average exploitation pattern is used in the predictions.

A real-time closure system has been in force along the Norwegian coast and in the Barents Sea since 1984, aimed at protecting juvenile fish. Based on scientific research data and mapping of areas by hired fishing vessels, fishing is prohibited in areas where the proportion by number of undersized cod, haddock, and saithe combined has been observed by inspectors to exceed 15% (the size limits vary by species). The time of notice before a closure of an area comes into force is 2–4 hours for national vessels and 7 days for foreign vessels. Before or parallel to a closure, the Coast Guard requests vessels not to fish in an area where too many small fish have been observed during their inspections. A closed area is not opened until it is documented by trial fishing to contain less than 15% undersized fish. A preliminary evaluation of the effectiveness of the system up to 1998 showed a clear decrease in the discarding of small cod and haddock.

From 1 January 2011, the technical regulations for the demersal fisheries were harmonized so that they are now the same in the Norwegian and Russian EEZs. The minimum size is now 44 cm for cod (previously 47 in the Norwegian and 42 cm in the Russian EEZ). The maximum allowable percentage of fish below the minimum size is 15% by number of cod, haddock, and saithe combined in the Norwegian EEZ, and 15% by number of cod and haddock combined in the Russian EEZ. Previously, the maximum percentage was 15% for each species (cod and haddock) in the Russian EEZ. The effect of these changes is expected to be small as long as the fishing mortality is kept low such as the agreed harvest control rule implies.

Information from fishing industry

Several Norwegian oceanic and coastal fishing vessels provide regular sampling data for length and age. These data are used for estimating catch-at-age for the corresponding fleets. Russian fishing vessels with observers onboard provide similar information on catch length distribution and sample fish to receive data on length–age matrices.

Data issues

The analytical assessment is based on catch-at-age data, using one commercial cpue series and three survey series. Estimates of cod cannibalism are included in the natural mortality. The estimates of IUU catch was available to ICES for the years 2002–2008 and used in the assessment. Since 2008, the recruitment predictions have included information on environmental drivers (ice coverage, temperature and oxygen saturation at the Kola section, air temperature at the Murmansk coast, and capelin biomass).

Comparison with previous assessment and advice

Compared to last year's assessment, the current assessment estimates of SSB in 2010 and the F in 2009 are very similar. The basis of the advice is the same as last year.

Sources

ICES. 2011. Report of the Arctic Fisheries Working Group, 28 April–4 May 2011. ICES CM 2011/ACOM:05.

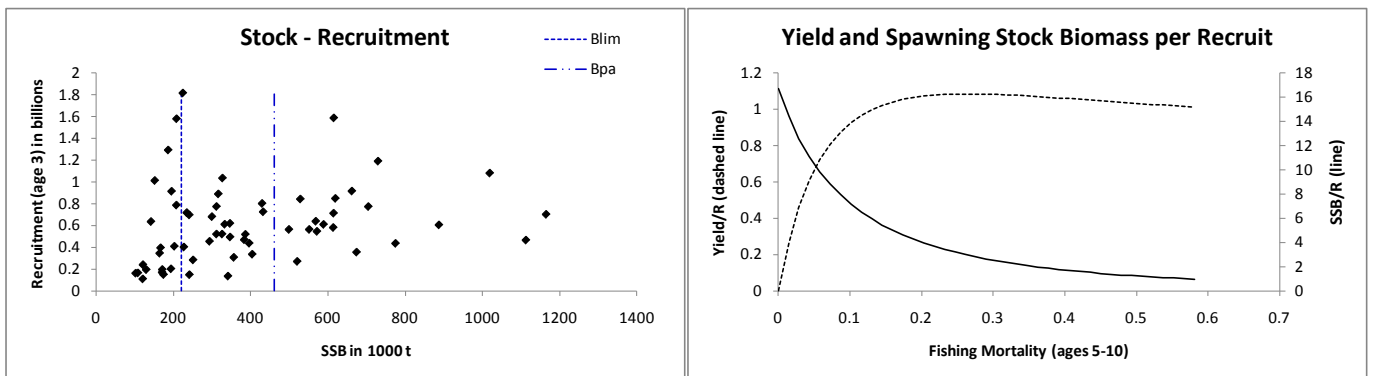


Figure 3.4.1.3 Cod in Subareas I and II (Northeast Arctic cod). Stock–recruitment plot and yield-per-recruit analysis.

Table 3.4.1.1 Cod in Subareas I and II (Northeast Arctic cod). ICES advice, management, and landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings	ICES landings	Unreported landings (included in ICES landings)
1987	Gradual reduction in F	595	560	552	523	
1988	F = 0.51; TAC (Advice November 87, revised advice May 88)	530 (320–360)	590 451	459	435	
1989	Large reduction in F	335	300	348	332	
1990	F at F_{low} ; TAC	172	160	210	212	25
1991	F at F_{low} ; TAC	215	215	294	319	50
1992	Within safe biological limits	250	356	421	513	130
1993	Healthy stock	256	500	575	582	50
1994	No long-term gains in increased F	649	700	795	771	25
1995	No long-term gains in increased F	681	700	763	740	
1996	No long-term gains in increased F	746	700	759	732	
1997	Well below F_{med}	< 993	850	792	762	
1998	F less than F_{med}	514	654	615	593	
1999	Reduce F to below F_{pa}	360	480	506	485	
2000	Increase B above B_{pa} in 2001	110	390		415	
2001	High prob. of $SSB > B_{pa}$ in 2003	263	395		426	
2002	Reduce F to well below 0.25	181	395		535	90
2003	Reduce F to below F_{pa}	305	395		552	115
2004	Reduce F to below F_{pa}	398	486		606	117
2005	Take into account coastal cod and redfish by- catches. Apply catch rule.	485	485		641	166
2006	Take into account coastal cod and redfish by- catches. Apply amended catch rule	471	471		538	67
2007	Take into account coastal cod and redfish by- catches. F_{pa}	309	424		487	41
2008	Take into account coastal cod and redfish by- catches. Apply catch rule	409	430		464	15
2009	Take into account coastal cod and redfish by- catches. Apply catch rule	473	525		523	0
2010	Take into account coastal cod and redfish by- catches. Apply catch rule	577.5	607		610	0
2011	Take into account coastal cod and redfish by- catches. Apply catch rule	703	703			
2012	Take into account coastal cod and redfish by- catches. Apply catch rule.	751				

Weights in '000 tonnes.

Table 3.4.1.2 Cod in Subareas I and II (Northeast Arctic cod). Total landings (t) by fishing areas.

Year	Faroe Islands	France	German Dem. Rep.	Fed. Rep. Germany	Norway	Poland	United Kingdom	Russia ²		Others	Total all countries
1961	3 934	13 755	3 921	8 129	268 377	-	158 113	325 780		1 212	783 221
1962	3 109	20 482	1 532	6 503	225 615	-	175 020	476 760		245	909 266
1963	-	18 318	129	4 223	205 056	108	129 779	417 964		-	775 577
1964	-	8 634	297	3 202	149 878	-	94 549	180 550		585	437 695
1965	-	526	91	3 670	197 085	-	89 962	152 780		816	444 930
1966	-	2 967	228	4 284	203 792	-	103 012	169 300		121	483 704
1967	-	664	45	3 632	218 910	-	87 008	262 340		6	572 605
1968	-	-	225	1 073	255 611	-	140 387	676 758		-	1 074 084
1969	29 374	-	5 907	5 543	305 241	7 856	231 066	612 215		133	1 197 226
1970	26 265	44 245	12 413	9 451	377 606	5 153	181 481	276 632		-	933 246
1971	5 877	34 772	4 998	9 726	407 044	1 512	80 102	144 802		215	689 048
1972	1 393	8 915	1 300	3 405	394 181	892	58 382	96 653		166	565 287
1973	1 916	17 028	4 684	16 751	285 184	843	78 808	387 196		276	792 686
1974	5 717	46 028	4 860	78 507	287 276	9 898	90 894	540 801		38 453	1 102 434
1975	11 309	28 734	9 981	30 037	277 099	7 435	101 843	343 580		19 368	829 377
1976	11 511	20 941	8 946	24 369	344 502	6 986	89 061	343 057		18 090	867 463
1977	9 167	15 414	3 463	12 763	388 982	1 084	86 781	369 876		17 771	905 301
1978	9 092	9 394	3 029	5 434	363 088	566	35 449	267 138		5 525	698 715
1979	6 320	3 046	547	2 513	294 821	15	17 991	105 846		9 439	440 538
1980	9 981	1 705	233	1 921	232 242	3	10 366	115 194		8 789	380 434
							Spain				
1981	12 825	3 106	298	2 228	277 818	14 500	5 262	83 000		-	399 037
1982	11 998	761	302	1 717	287 525	14 515	6 601	40 311		-	363 730
1983	11 106	126	473	1 243	234 000	14 229	5 840	22 975		-	289 992
1984	10 674	11	686	1 010	230 743	8 608	3 663	22 256		-	277 651
1985	13 418	23	1 019	4 395	211 065	7 846	3 335	62 489		4 330	307 920
1986	18 667	591	1 543	10 092	232 096	5 497	7 581	150 541		3 505	430 113
1987	15 036	1	986	7 035	268 004	16 223	10 957	202 314		2 515	523 071
1988	15 329	2 551	605	2 803	223 412	10 905	8 107	169 365		1 862	434 939
1989	15 625	3 231	326	3 291	158 684	7 802	7 056	134 593		1 273	332 481
1990	9 584	592	169	1 437	88 737	7 950	3 412	74 609		510	187 000
1991	8 981	975	Greenland	2 613	126 226	3 677	3 981	119 427	³	3 278	269 158
1992	11 663	2	3 337	3 911	168 460	6 217	6 120	182 315	Iceland	1 209	383 234
1993	17 435	3 572	5 389	5 887	221 051	8 800	11 336	244 860	9 374	3 907	531 611
1994	22 826	1 962	6 882	8 283	318 395	14 929	15 579	291 925	36 737	28 568	746 086
1995	22 262	4 912	7 462	7 428	319 987	15 505	16 329	296 158	34 214	15 742	739 999
1996	17 758	5 352	6 529	8 326	319 158	15 871	16 061	305 317	23 005	14 851	732 228
1997	20 076	5 353	6 426	6 680	357 825	17 130	18 066	313 344	4 200	13 303	762 403
1998	14 290	1 197	6 388	3 841	284 647	14 212	14 294	244 115	1 423	8 217	592 624
1999	13 700	2 137	4 093	3 019	223 390	8 994	11 315	210 379	1 985	5 898	484 910
2000	13 350	2 621	5 787	3 513	192 860	8 695	9 165	166 202	7 562	5 115	414 870
2001	12 500	2 681	5 727	4 524	188 431	9 196	8 698	183 572	5 917	5 225	426 471
2002	15 693	2 934	6 419	4 517	202 559	8 414	8 977	184 072	5 975	5 484	445 045
2003	19 427	2 921	7 026	4 732	191 977	7 924	8 711	182 160	5 963	6 149	436 990
2004	19 226	3 621	8 196	6 187	212 117	11 285	14 004	201 525	7 201	6 082	489 445
2005	16 273	3 491	8 135	5 848	207 825	9 349	10 744	200 077	5 874	7 660	475 276
2006	16 327	4 376	8 164	3 837	201 987	9 219	10 594	203 782	5 972	6 271	470 527
2007	14 788	3 190	5951	4619	199 809	9 496	9298	186 229	7316	5 101	445 796
2008	15 812	3 149	5 617	4 955	196 598	9 658	8 287	190 225	7 535	7 336	449 171
2009	16 905	3 908	4 977	8 585	224 298	12 013	8 632	229 291	7 380	7 442	523 431
2010 ¹	15 977	4 499	6 584	8 442	264 701	12 657	9 091	267 547	11 299	9 185	609 983
¹ Provisional figures.											
² USSR prior to 1991.											
³ Includes Baltic countries.											

Table 3.4.1.3 Cod in Subareas I and II (Northeast Arctic cod). Summary of the assessment. Landings include unreported landings.

Year	Recruitment Age 3 thousands	SSB tonnes	Landings tonnes	Mean F Ages 5- 10	Year	Recruitment Age 3 thousands	SSB tonnes	Landings tonnes	Mean F Ages 5-10
1946	728139	1112776	706000	0.1857	1990	242751	316419	212000	0.2710
1947	425311	1165059	882017	0.3047	1991	411739	704748	319158	0.3210
1948	442592	1019114	774295	0.3398	1992	720703	887567	513234	0.4550
1949	468348	729879	800122	0.3619	1993	892370	775174	581611	0.5528
1950	704908	615339	731982	0.3566	1994	776251	614799	771086	0.8678
1951	1083753	568705	827180	0.3966	1995	608066	528780	739999	0.7879
1952	1193111	520599	876795	0.5348	1996	438359	571732	732228	0.6985
1953	1590377	396417	695546	0.3572	1997	715454	588888	762403	1.0330
1954	641584	429694	826021	0.3879	1998	845476	386431	592624	0.9151
1955	272778	346919	1147841	0.5437	1999	548551	293666	484910	0.9842
1956	439602	299823	1343068	0.6401	2000	612599	241243	414868	0.8448
1957	804781	207840	792557	0.5089	2001	521360	356449	426471	0.7071
1958	496824	195377	769313	0.5169	2002	457346	499231	535045	0.6743
1959	683690	432489	744607	0.5596	2003	699345	551716	551990	0.5368
1960	789653	383479	622042	0.4789	2004	309769	662161	606445	0.6744
1961	916842	404228	783221	0.6348	2005	566089	619438	641276	0.6970
1962	728338	311678	909266	0.7576	2006	566293	613874	537642	0.5778
1963	472064	208207	776337	0.9866	2007	918598	674305	486883	0.3587
1964	338678	186570	437695	0.6789	2008	851328	725543	464171	0.3145
1965	776941	102315	444930	0.5533	2009	583950	1076703	523430	0.2698
1966	1582560	120722	483711	0.5302	2010	357904	1134247	609983	0.2868
1967	1295416	129784	572605	0.5439	2011	433000	1310681		
1968	164955	227215	1074084	0.5704	Average	603664	438690	650605	0.6242
1969	112039	151870	1197226	0.8292					
1970	197105	224482	933246	0.7493					
1971	404774	311662	689048	0.5956					
1972	1015319	346511	565254	0.6928					
1973	1818949	332913	792685	0.6020					
1974	523916	164491	1102433	0.5633					
1975	621616	142028	829377	0.6595					
1976	613942	171238	867463	0.6457					
1977	348054	341385	905301	0.8379					
1978	638490	241536	698715	0.9406					
1979	198490	174699	440538	0.7264					
1980	137735	108253	380434	0.7241					
1981	150868	166926	399038	0.8632					
1982	151830	326133	363730	0.7583					
1983	166831	327181	289992	0.7560					
1984	397831	251087	277651	0.9161					
1985	523674	193856	307920	0.7038					
1986	1038010	170729	430113	0.8649					
1987	286372	121243	523071	0.9510					
1988	204645	202589	434939	0.9743					
1989	172783	234717	332481	0.6602					

Annex 3.4.1 Northeast Arctic Cod Management Agreement

At the 38th meeting of the Joint Russian–Norwegian Fisheries Commission (JRNC) in November 2009, the previously used management plan was amended (marked in bold) and currently states:

“The Parties agreed that the management strategies for cod and haddock should take into account the following:

*conditions for high long-term yield from the stocks
achievement of year-to-year stability in TACs
full utilization of all available information on stock development*

On this basis, the Parties determined the following decision rules for setting the annual fishing quota (TAC) for Northeast Arctic cod (NEA cod):

estimate the average TAC level for the coming 3 years based on F_{pa} . TAC for the next year will be set to this level as a starting value for the 3-year period.

*the year after, the TAC calculation for the next 3 years is repeated based on the updated information about the stock development, however the TAC should not be changed by more than +/- 10% compared with the previous year's TAC. **If the TAC, by following such a rule, corresponds to a fishing mortality (F) lower than 0.30 the TAC should be increased to a level corresponding to a fishing mortality of 0.30.***

if the spawning stock falls below B_{pa} , the procedure for establishing TAC should be based on a fishing mortality that is linearly reduced from F_{pa} at B_{pa} , to $F=0$ at SSB equal to zero. At SSB-levels below B_{pa} in any of the operational years (current year, a year before and 3 years of prediction) there should be no limitations on the year-to-year variations in TAC¹.

At the 39th Session of the Joint Russian–Norwegian Fisheries Commission in October 2010 it was agreed that the current management plan should be used ‘for five more years’ before it is evaluated.

¹ This quotation is taken from Annex 14 in the Protocol of the 38th session of the Joint Russian–Norwegian Fisheries Commission and translated from Norwegian to English. For an accurate interpretation, please consult the text in the official languages of the Commission (Norwegian and Russian).