

3.4 Stock summaries

3.4.1 Northeast Arctic cod

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits/management plan	Fishing mortality in relation to highest yield	Fishing mortality in relation to agreed target	Comment
Full reproductive capacity	Increased risk	Overexploited	Above target	Lack of enforcement of the management plan has resulted in exploitation above the level intended by the management plan.

Based on the most recent estimates of SSB and fishing mortality, ICES classifies the stock as having full reproductive capacity and at risk of being harvested unsustainably. The SSB has been above B_{pa} since 2002. Fishing mortality was reduced significantly over the years 1999–2003 but has since then increased to a level below F_{lim} in 2004–2006. Surveys indicate that recent year classes are below average.

Management objectives

A management plan has existed for this stock 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 aims to maintain target F at $F_{pa} = 0.40$ and minimize between-year TAC change to +/- 10%, unless SSB falls below B_{pa} in which case the management targets should change.

In 2006, ICES has evaluated these decision rules for cod and a management plan based upon them is in accordance with the precautionary approach when the SSB is above B_{lim} and a low level of implementation error is assumed.

Further evaluations made in 2007 concluded that the risk for SSB to drop below B_{lim} is low within a plausible range of conditions. Therefore, ICES considers the management plan to be in accordance with the precautionary approach. If conditions change to outside the assumed range (with respect to biological conditions, assessment quality, or implementation error), the management plan may have to be revised. In particular, overfishing of the TACs derived from the management plan at levels that have been observed in the recent past is likely to lead to that situation.

Reference points

	Type	Value	Technical basis
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 B_{lim}
	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}
Target	F_{pa}	0.40	

(unchanged since: 2003)

Yield and spawning biomass per Recruit

F-reference points:

	Fish Mort Ages 5-10	Yield/R	SSB/R
Average last 3 years	0.69	1.16	1.06
Fmax	0.28	1.29	3.96
F0.1	0.15	1.19	7.54
Fmed	0.94	1.09	0.65

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

The agreed management plan implies catches of 409 000 t in 2008. This catch projection includes all catches and therefore the TAC must account for all unreported catches.

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential, and considering ecosystem effects

The current fishing mortality is estimated to be at 0.69 and is above the level that would lead to high long-term yields (indicated to be in the F range of 0.25–0.50). Catches corresponding to high long-term yield for 2008 are in the order of 220 000–403 000 t.

Exploitation boundaries in relation to precautionary limits

The agreed management plan has been found to be consistent with the precautionary approach and is therefore the basis for the advice.

If conditions change to outside the assumed range (with respect to biological conditions, assessment quality, or implementation error), the management plan may have to be revised. In particular, overfishing of the TACs derived from the management plan at levels that have been observed in the recent past is likely to lead to that situation.

Short-term implications

Outlook for 2008:

For the forecast the F in 2007 is set equal to the recent 3-year average.

Basis: $F(2007) = F_{2004-2006} = 0.69$; $SSB(2008) = 531$; $catch(2007) = 530$.

Rationale	TAC (2008)	Basis	F (2008)	SSB (2009)	%SSB change ¹⁾	% TAC change ²⁾
Zero catch	0	F=0	0	956	+80%	-100%
<i>Status quo</i>	520	$F_{2004-2006}$	0.69	520	-2%	+22%
High long-term yield	220-403	Simulations (F=0.25–0.5)				
Agreed management Plan	409	TAC(man. Plan)	0.51	608	+15%	-4%
Precautionary Limits	334	F_{pa}	0.40	669	+26%	-21%

Weights in '000 t. Shaded scenarios are not considered consistent with the precautionary approach.

¹⁾ SSB 2009 relative to SSB 2008.

²⁾ TAC 2008 relative to TAC 2007.

Management considerations

Concerns about under-reporting of catches in recent years continue. Two sets of estimates of non-reported landings (IUU) for the period 2002–2006 were available, ranging from 90 000–166 000 t and 22 000–41 000 t in recent years. ICES concluded that the description of the methodology used to estimate IUU catches in one of the series was insufficient to form the basis for scientific advice. Therefore the series with 90 000–166 000 unallocated catches was taken forward in the calculations. This was the same method as used last year. The estimates of unreported catches for 2006 amount to around 25% of the official catches. Unreported landings will reduce the effect of management measures and will undermine the intended objectives of the harvest control rule. Therefore it is important that management agencies ensure that all catches are counted against the TAC.

Management plan evaluations

The recent high amount of unreported catch has been considered in an additional evaluation of the existing HCR. Under these conditions, it is doubtful whether the HCR can protect the stock and future fisheries. Actions are needed to stop the unreported fishing.

Factors affecting the fisheries and the stock

Regulations and their effects

TAC regulations are in place but there is non-compliance, resulting in a significant amount of unreported catches. The estimation of unreported catches must be resolved and the most accurate estimates made available to ICES. The main mechanism used for avoiding quota control seems to be trans-shipping of fish from the Barents Sea.

Discarding of cod, haddock, and saithe is thought to be significant in some periods although 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 of the trawler fleet at sea, i.e. by a requirement to report to catch control points when entering and leaving the EEZs, VMS satellite tracking for some fleets, and by inspections of all fishing vessels when landing the fish. Keeping a detailed fishing logbook on-board is mandatory for most vessels, and large parts of the fleet report to the authorities on a daily basis. 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 effects of these regulations have not been evaluated.

Changes in fishing technology and fishing patterns

Since January 1997, sorting grids have been mandatory for the trawl fisheries in most of the Barents Sea and Svalbard area.

The environment

The Northeast Arctic cod is characterized by significant year-to-year variations in the growth rate. In some years the mean weight of fish at the same age may differ by a factor of 2 or 3. Among the factors influencing cod growth are water temperature, food supply, and cod population abundance.

Northeast Arctic cod is an important predator on other species in the ecosystem, notably capelin. The management of Arctic cod will therefore have implications on the dynamics of these stocks. Changes in growth, maturity, and 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. In recent years, maturation, growth, and cannibalism have been fairly stable in spite of the variation in capelin stock.

Scientific basis

Data and methods

Analytical assessment is based on catch-at-age data, using one commercial cpue series and three survey series. The total effect of the discarding is still unclear and requires more work before it can be included in the assessments. Estimates of cannibalism are included in the natural mortality. Two series of catch were made available to ICES, based on two series of IUU. The methods used to determine one of the series were unclear and thus the series was not used by ICES.

Uncertainties in assessment and forecast

Uncertainties in the total catch are large. All survey series used had incomplete spatial coverage in the last year. Adjustments to the survey time-series were made to account for this. However, this increases the uncertainty in the assessment. Obstacles preventing complete spatial coverage should be removed by allowing research vessels unlimited access to the entire Barents Sea.

Environmental conditions

The population dynamic parameters vary with the environment as described above. Recent changes in the environment have been taken into account by using the recent three-year average for maturation and cannibalism (since 1984), and by prediction of weight-at-age.

Comparison with previous assessment and advice

The current assessment estimates the SSB 3% higher for 2005 and mean F in 2005 is 0.01 lower (figure 3.4.1.3). Advice is based on the management plan whereas last year it was based on precautionary limits.

Source of information

Year	ICES Advice	Single-stock exploitation boundaries	Predicted catch corresp. to advice	Predicted catch corresp. to single-stock exploitation boundaries	Agreed TAC	Official landings	ACFM landings	Unreported landings (included in ACFM 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 bycatches	Apply catch rule	485		485		641	166
2006	Take into account coastal cod and redfish bycatches	Apply amended catch rule	471		471		596	127
2007	Take into account coastal cod and redfish bycatches	F_{pa}	309		424			
2008	Take into account coastal cod and redfish bycatches	Apply catch rule	409					

Weights in '000 tonnes

Unreported landings 2002 – 2006 corrected according to table 3.4.1.1

North-East Arctic cod (Subareas I and II)

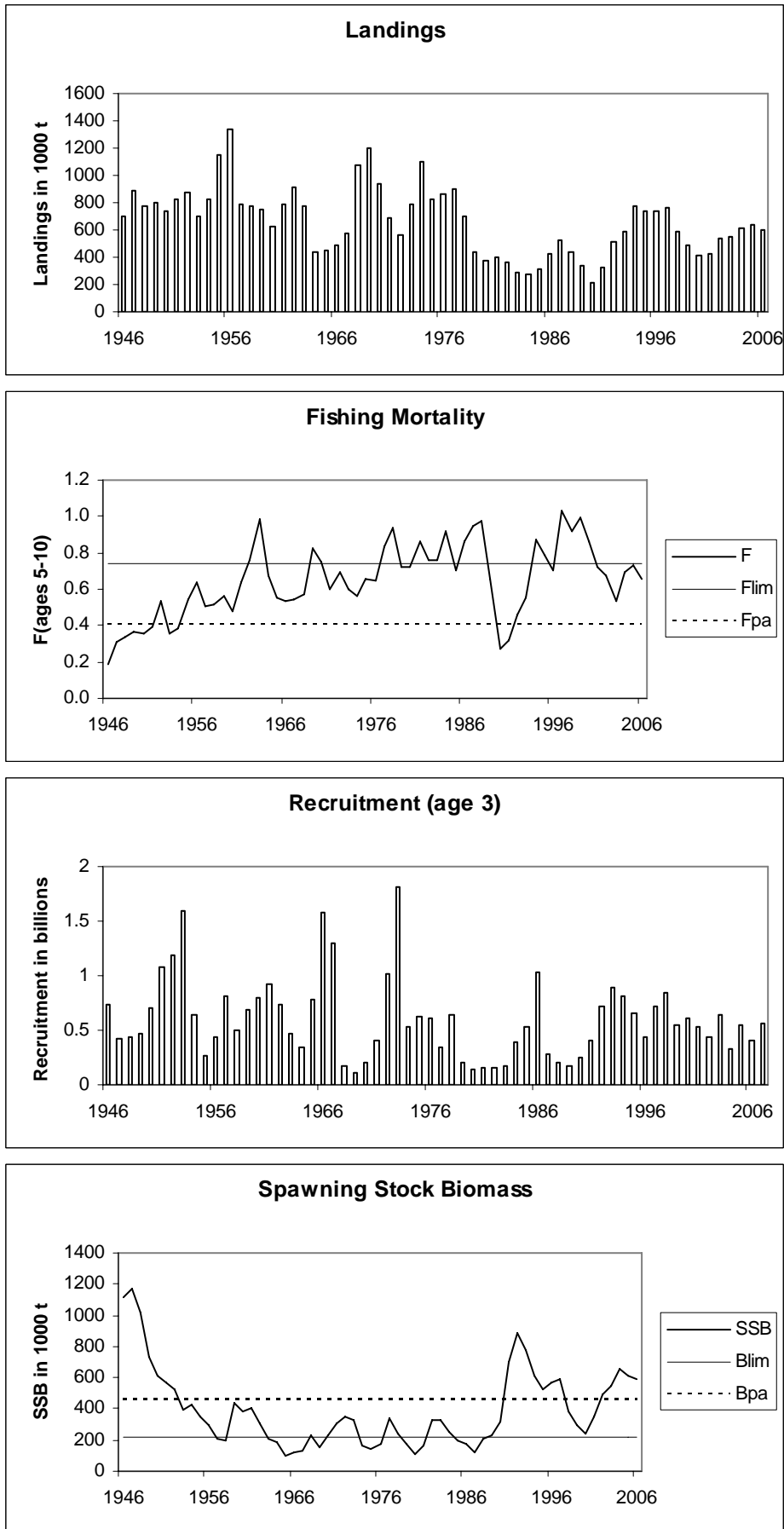


Figure 3.4.1.1 North-East Arctic cod (Subareas I and II). Landings, Fishing Mortality, Recruitment and SSB.

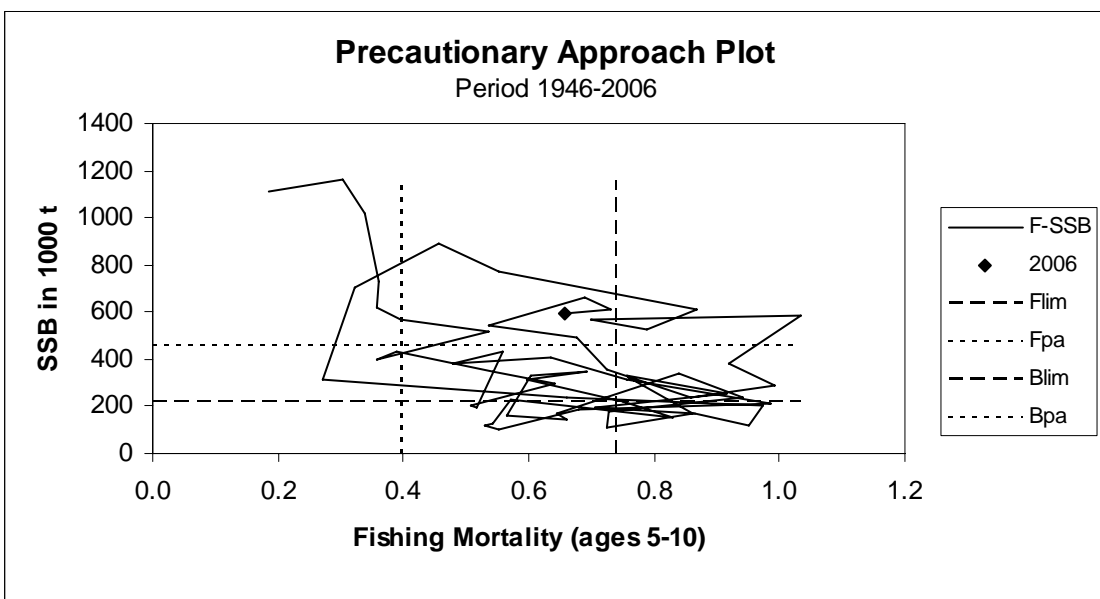
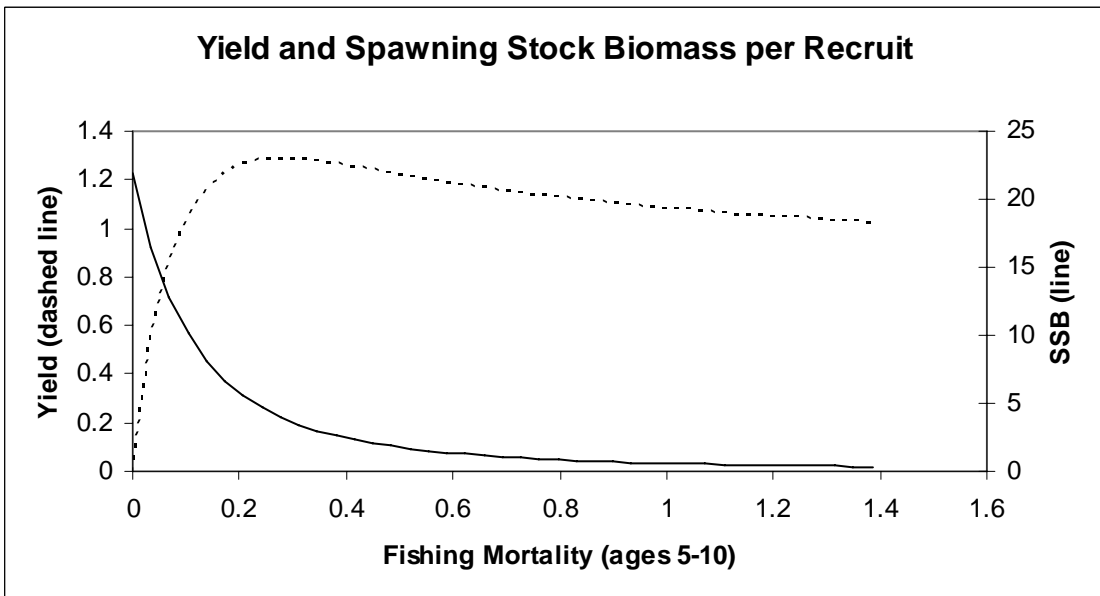
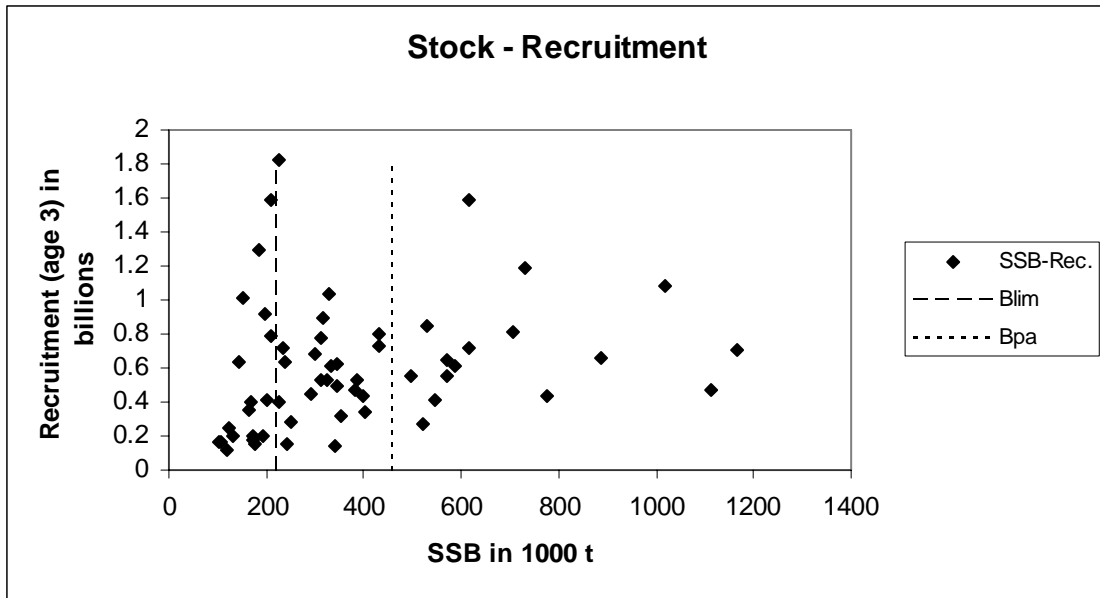


Figure 3.4.1.2 North-East Arctic cod (Subareas I and II). Stock and Recruitment, Yield and Precautionary Approach.

North-East Arctic cod (Sub-areas I and II)

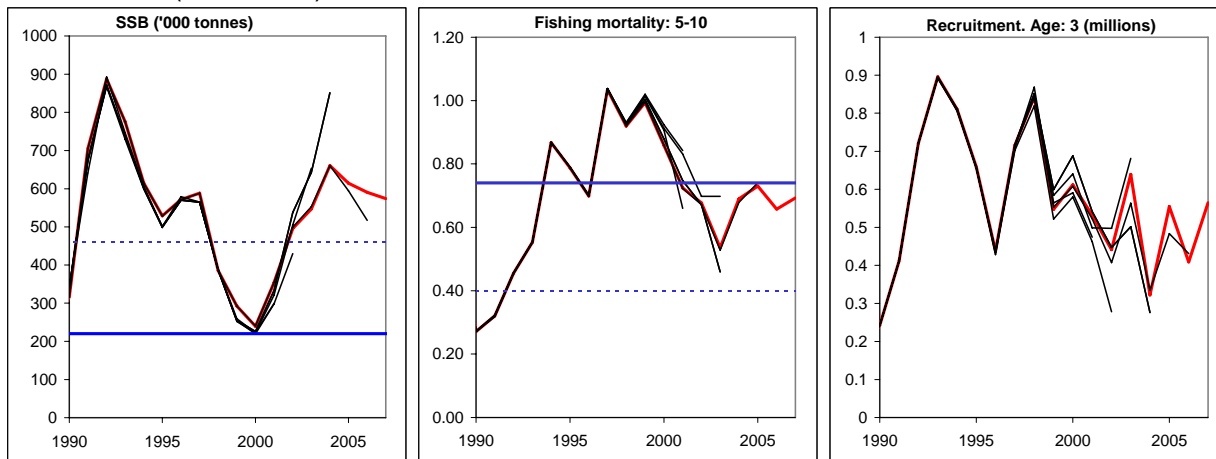


Figure 3.4.1.3 Northeast Arctic cod (Subareas I and II). Historical performance of the assessments.

Table 3.4.1.1 Northeast Arctic COD. Total catch (t) by fishing areas and unreported catch.
(Data provided by Working Group members.)

Year	Subarea I	Division IIa	Division IIb	Unreported catches	Total catch
1961	409 694	153 019	220 508		783 221
1962	548 621	139 848	220 797		909 266
1963	547 469	117 100	111 768		776 337
1964	206 883	104 698	126 114		437 695
1965	241 489	100 011	103 430		444 983
1966	292 253	134 805	56 653		483 711
1967	322 798	128 747	121 060		572 605
1968	642 452	162 472	269 254		1 074 084
1969	679 373	255 599	262 254		1 197 226
1970	603 855	243 835	85 556		933 246
1971	312 505	319 623	56 920		689 048
1972	197 015	335 257	32 982		565 254
1973	492 716	211 762	88 207		792 685
1974	723 489	124 214	254 730		1 102 433
1975	561 701	120 276	147 400		829 377
1976	526 685	237 245	103 533		867 463
1977	538 231	257 073	109 997		905 301
1978	418 265	263 157	17 293		698 715
1979	195 166	235 449	9 923		440 538
1980	168 671	199 313	12 450		380 434
1981	137 033	245 167	16 837		399 037
1982	96 576	236 125	31 029		363 730
1983	64 803	200 279	24 910		289 992
1984	54 317	197 573	25 761		277 651
1985	112 605	173 559	21 756		307 920
1986	157 631	202 688	69 794		430 113
1987	146 106	245 387	131 578		523 071
1988	166 649	209 930	58 360		434 939
1989	164 512	149 360	18 609		332 481
1990	62 272	99 465	25 263	25 000	212 000
1991	70 970	156 966	41 222	50 000	319 158
1992	124 219	172 532	86 483	130 000	513 234
1993	195 771	269 383	66 457	50 000	581 611
1994	353 425	306 417	86 244	25 000	771 086
1995	251 448	317 585	170 966		739 999
1996	278 364	297 237	156 627		732 228
1997	273 376	326 689	162 338		762 403
1998	250 815	257 398	84 411		592 624
1999	159 021	216 898	108 991		484 910
2000	137 197	204 167	73 506		414 870
2001	142 628	185 890	97 953		426 471
2002	184 789	189 013	71 242	90 000	535045
2003	163 109	222 052	51 829	115 000	551990
2004	177 888	219 261	92 296	117 000	606445
2005	159 573	194 644	121 059	166 000	641276
2006 ¹	159 851	204 603	104 743	127 000	596197

¹ Provisional figures.

Table 3.4.1.2 North-East Arctic COD. Nominal catch (t) by countries

(Sub-area I and Divisions IIa and IIb combined, data provided by Working Group members.)

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 ¹	16 480	3 834	8 164	3 769	201 185	9 219	10 594	203 775	5 915 6 261	469 197

¹ Provisional figures.² USSR prior to 1991.³ Includes Baltic countries.

Table 3.4.1.3

North-East Arctic cod (Sub-areas I and II)

Year	Recruitment Age 3 thousands	SSB tonnes	Landings tonnes	Mean F Ages 5-10
1946	728139	1112776	706000	0.1857
1947	425311	1165059	882017	0.3047
1948	442592	1019114	774295	0.3398
1949	468348	729879	800122	0.3619
1950	704908	615339	731982	0.3566
1951	1083753	568705	827180	0.3966
1952	1193111	520599	876795	0.5348
1953	1590377	396417	695546	0.3572
1954	641584	429694	826021	0.3879
1955	272778	346919	1147841	0.5437
1956	439602	299823	1343068	0.6401
1957	804781	207840	792557	0.5089
1958	496824	195377	769313	0.5169
1959	683690	432489	744607	0.5596
1960	789653	383479	622042	0.4789
1961	916842	404228	783221	0.6348
1962	728338	311678	909266	0.7576
1963	472064	208207	776337	0.9866
1964	338678	186570	437695	0.6789
1965	776941	102315	444930	0.5533
1966	1582560	120722	483711	0.5302
1967	1295416	129784	572605	0.5439
1968	164955	227215	1074084	0.5704
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	1037294	170729	430113	0.8649
1987	286233	121243	523071	0.9510
1988	204644	202589	434939	0.9743
1989	172781	234716	332481	0.6602
1990	242749	316417	212000	0.2710
1991	411727	704743	319158	0.3210
1992	720977	887558	513234	0.4550
1993	896132	775169	581611	0.5528
1994	810730	614856	771086	0.8678
1995	659269	528745	739999	0.7881
1996	437438	571465	732228	0.6989
1997	715534	588322	762403	1.0347
1998	843569	385508	592624	0.9192
1999	547506	292298	484910	0.9937
2000	611503	239848	414868	0.8585
2001	531705	353956	426471	0.7242
2002	441520	495634	535045	0.6771
2003	638975	547018	551990	0.5357
2004	322496	660389	606445	0.6899
2005	554414	614399	641276	0.7301
2006	408987	590631	596197	0.6575
2007	565000			0.6925
Average	598772	393225	660056	0.6486

Annex 3.4.1 Northeast Arctic Cod Management Agreement

At the 33rd meeting of the Joint Russian–Norwegian Fisheries Commission (JRNC) in November 2004, the following decision was made:

“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 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 TAC.

The Parties agreed on similar decision rules for haddock, based on F_{pa} and B_{pa} for haddock, and with a fluctuation in TAC from year to year of no more than +/-25% (due to larger stock fluctuations).¹”

¹ This quotation is taken from point 5.1 in the Protocol of the 33rd session of The Joint Norwegian–Russian Fishery 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).