

3.3.4 Cod (*Gadus morhua*) in Subareas I and II (Northeast Arctic)

ICES stock advice

ICES advises that when the Joint Russian–Norwegian Fisheries Commission management plan is applied, TAC in 2016 should be set at 805 000 t. All catches are assumed to be landed. Bycatch of coastal cod and *Sebastes norvegicus* should be kept as low as possible.

Stock development over time

The spawning-stock biomass (SSB) has been above $MSY B_{trigger}$ since 2002. The total stock biomass (TSB) reached a peak in 2013 and is still close to this. Fishing mortality (F) was reduced from well above F_{lim} in 1997 to below F_{MSY} in 2007. Since 2012 fishing mortality shows an increasing trend and is above F_{MSY} in 2014. Surveys indicate that year classes 2010–2014 are slightly above the long-term average.

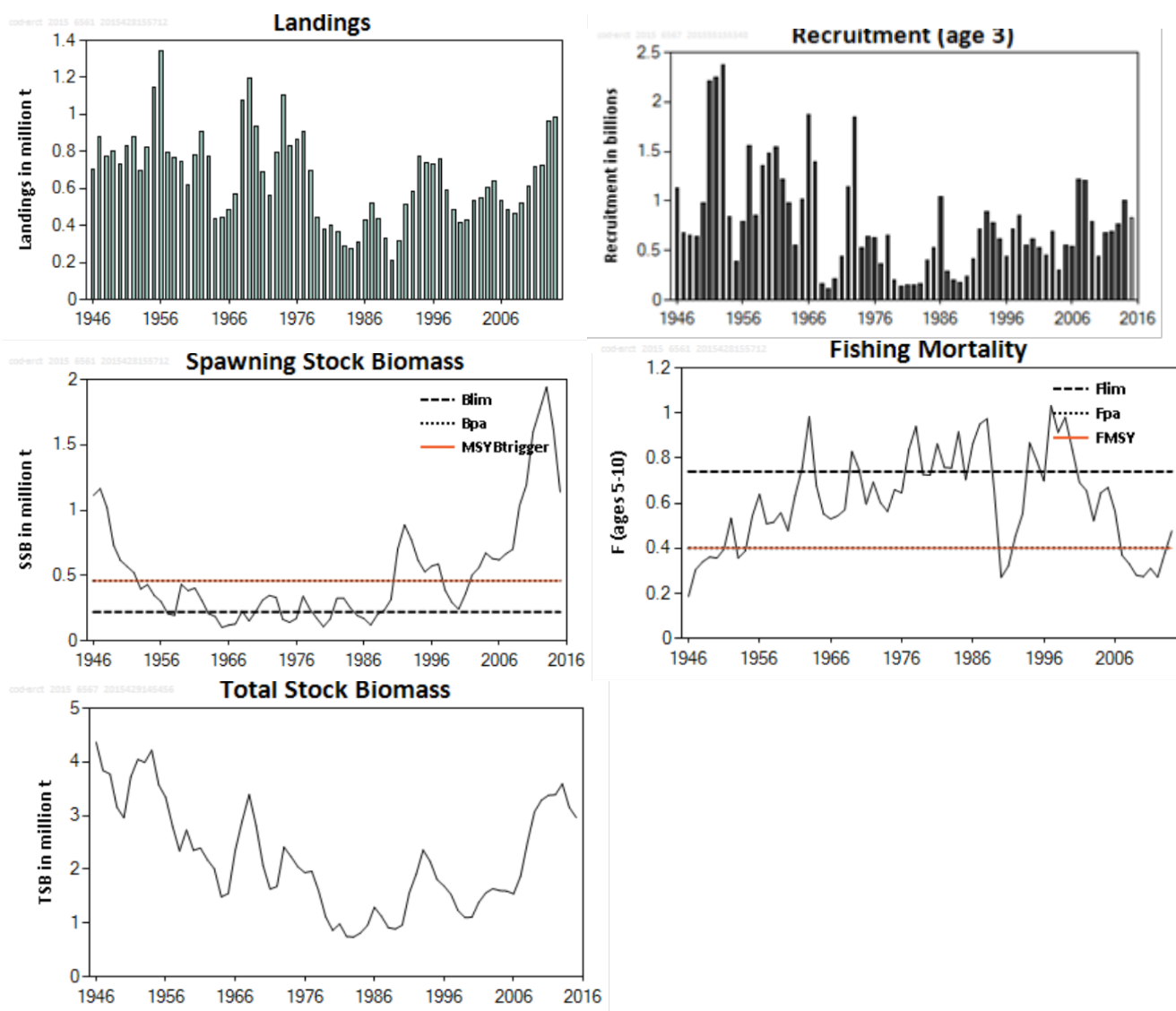


Figure 3.3.4.1 Cod in Subareas I and II. Landings, recruitment, SSB, F, and TSB. Time-series used in the assessment (B_{pa} equal to $MSY B_{trigger}$, F_{pa} equal to F_{MSY}).

Stock and exploitation status

Table 3.3.4.1 Cod in Subareas I and II. State of the stock and fishery, relative to reference points.

		Fishing pressure			Stock size			
		2012	2013	2014	2013	2014	2015	
Maximum Sustainable Yield	F_{MSY}	✓	✓	✗ Above F_{MSY}	MSY	✓	✓	✓ Above trigger
Precautionary approach	F_{pa} , F_{lim}	✓	✓	○ Increased risk	$B_{trigger}$	✓	✓	✓ Full reproductive capacity
Management Plan	F_{MGT}	✓	✓	✗ Above target	B_{pa} , B_{lim}	✓	✓	✓ Above trigger
					SSB _{MGT}	✓	✓	✓ Above trigger

Catch options

Table 3.3.4.2 Cod in Subareas I and II. The basis for the catch options.

Variable	Value	Source	Notes
F 5–10 (2015)	0.48	ICES, 2015c	F <i>status quo</i> (F_{sq})
SSB (2016)	1 063 kt	ICES, 2015c	
R_{age3} (2015)	824 million	ICES, 2015c	Model estimate
Total catch (2015)	884 kt	ICES, 2015c	TAC is 894 kt in 2015

Table 3.3.4.3 Cod in Subareas I and II. The catch options. Weights in thousand tonnes.

Rationale	Catches (2016)	Basis	F (2016)	SSB (2017)	%SSB change*	%TAC change**
Management plan ***	805	F_{MP}	0.45	1 039	-2	-10
MSY approach	725	F_{MSY}	0.40	1 097	+3	-19
Zero catch	0	0	0	1 661	+56	-100
<i>Status quo</i>	837	F_{sq}	0.48	1 016	-4	-6

* SSB 2017 relative to SSB 2016.

** Catch 2016 relative to TAC 2015.

*** Catch decided by limit of -10% change compared to TAC 2015.

Basis of the advice

Table 3.3.4.4 Cod in Subareas I and II. The basis of the advice.

Advice basis	Management plan.
Management plan	<p>Joint Russian–Norwegian Fisheries Commission management plan.</p> <p>At the 38th meeting of the Joint Russian–Norwegian Fisheries Commission (JRNFC) in November 2009, the previously used management plan was amended (marked in bold) and currently states:</p> <p><i>“The Parties agreed that the management strategies for cod and haddock should take into account the following:</i></p> <p><i>conditions for high long-term yield from the stocks</i></p> <p><i>achievement of year-to-year stability in TACs</i></p> <p><i>full utilization of all available information on stock development</i></p> <p><i>On this basis, the Parties determined the following decision rules for setting the annual fishing quota (TAC) for Northeast Arctic cod (NEA cod):</i></p> <p><i>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.</i></p>

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 TAC.”¹

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).

Quality of the assessment

With the recent expansion of the cod distribution it is likely that the coverage in the ecosystem survey (Eco-NoRu-Q3 (Btr)) has been incomplete in 2014, in particular for the older ages. This incomplete coverage was mainly due to a wider distribution of ice than usual. The 2014 index from this survey has been excluded from the assessment.

Norwegian sampling of commercial catches is believed to be less precise because of the termination of a Norwegian port sampling programme in mid-2009. The poor sampling caused problems in estimating Norwegian catches for the oldest ages in 2010 and 2011. The sampling has improved somewhat in 2012–2014, but there is still a lack of samples from certain gear/area/season combinations. Sampling from Norwegian trawl catches was also very poor in the third quarter of 2014.

Russian sampling of commercial catches has decreased in recent years, and the sampling in 2014 was at the same level as in 2012–2013.

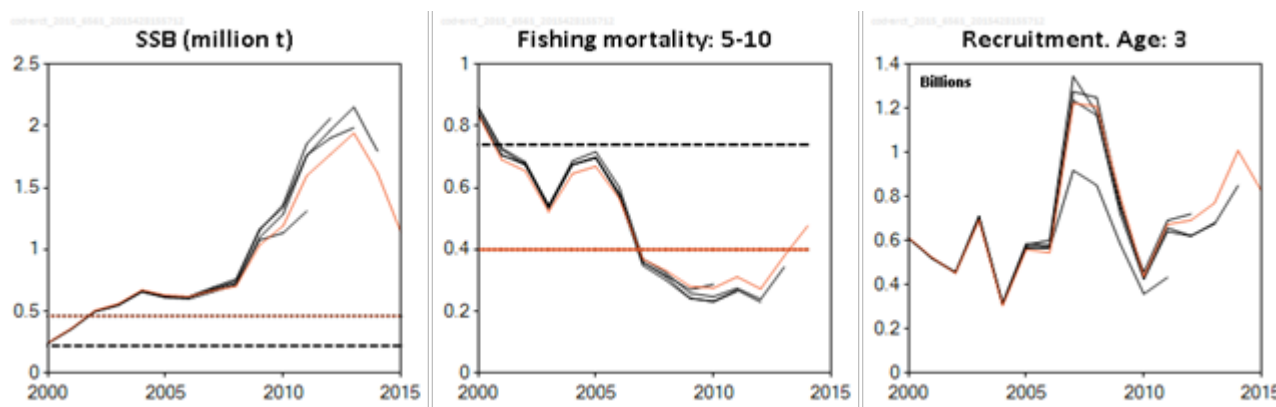


Figure 3.3.4.2 Cod in Subareas I and II. Historical assessment results (final-year recruitment estimates included).

Issues relevant for the advice

Due to the uncertainty in catch at age estimation from poor sampling coverage, it is recommended to increase Russian sampling to pre-2012 levels. There remains a lack of samples from several Norwegian gear/area/season combinations. ICES recommends a redistribution of port sampling effort for Norway.

Bycatch of *Sebastes norvegicus* should be kept as low as possible because of the low stock status of this stock. It should be noted that the fish currently in and those entering the fishery are from a period of poor recruitment, and that the stock would need to be stabilized before any safe catch limits can be defined. The current catches of *Sebastes norvegicus* as bycatch in fisheries targeting Northeast Atlantic (NEA) cod constitutes a considerable part of the total *Sebastes norvegicus* catch, and is far above any sustainable catch level.

Bycatch of coastal cod should be kept as low as possible in order to obtain the reductions in fishing mortality implied by the coastal cod rebuilding plan.

Reference points

Table 3.3.4.5 Cod in Subareas I and II. Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	460 000 t	B_{pa} , and trigger point in HCR.	ICES (2003)
	F_{MSY}	0.40	Long-term simulations.	ICES (2005)
Precautionary approach	B_{lim}	220 000 t	Change point regression.	ICES (2003)
	B_{pa}	460 000 t	The lowest SSB estimate having >90% probability of remaining above B_{lim} .	ICES (2003)
	F_{lim}	0.74	F corresponding to an equilibrium stock = B_{lim} .	ICES (2003)
	F_{pa}	0.40	The highest F estimate having >90% probability of remaining below F_{lim} .	ICES (2003)
Management plan	SSB_{MGT}	460 000 t	B_{pa} , TAC linearly reduced from F_{pa} at $SSB = B_{pa}$ to zero at $SSB = 0$.	
	F_{MGT}	0.40	F_{pa} , average TAC for the coming three years based on F_{pa} .	

Basis of the assessment

Table 3.3.4.6 Cod in Subareas I and II. The basis of the assessment.

ICES stock data category	1 (ICES, 2015c).
Assessment type	Age-based analytical assessment (XSA) with cannibalism estimated. Catches are used in the model and in the forecast. Note that to follow WKARCT, cannibalism is also estimated for the period 1946–1983; previously it was included only from 1984 to the present. Thus historical recruitment and total stock biomass figures have changed since last year.
Input data	Commercial catches (international landings, ages and length frequencies from catch sampling); three survey indices (Joint bottom trawl survey Barents Sea, Feb–Mar (BS-NoRu-Q1 (BTr)); Joint acoustic survey Barents Sea and Lofoten, Feb–Mar (BS-NoRu-Q1 (Aco)); Russian bottom trawl survey, October–December (RU-BTr-Q4)); Joint Ecosystem survey (Eco-NoRu-Q3 (Btr)); annual maturity data from the three surveys; natural mortalities from annual stomach sampling.
Discards and bycatch	Discarding is considered negligible.
Indicators	None.
Other information	Last benchmarked in January 2015 (WKARCT; ICES, 2015a).
Working group	Arctic Fisheries Working Group (AFWG).

Information from stakeholders

The Norwegian reference fleets provide information on catch composition.

History of advice, catch, and management

Table 3.3.4.7 Cod in Subareas I and II. History of ICES advice, the agreed TAC, and ICES estimates of landings. Weights in thousand tonnes.

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 1987, revised advice May 1988)	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		538	67
2007	Take into account coastal cod and redfish bycatches. F_{pa}	309	424		487	41
2008	Take into account coastal cod and redfish bycatches. Apply catch rule.	409	430		464	15
2009	Take into account coastal cod and redfish bycatches. Apply catch rule.	473	525		523	0
2010	Take into account coastal cod and redfish bycatches. Apply catch rule.	577.5	607		610	0
2011	Take into account coastal cod and redfish bycatches. Apply catch rule.	703	703		720	0
2012	Take into account coastal cod and redfish bycatches. Apply catch rule.	751	751		728	0
2013	Take into account coastal cod and <i>S. marinus</i> bycatches. Apply catch rule.	940	1000		966	0
2014	Take into account coastal cod and <i>S. marinus</i> bycatches. Apply catch rule.	993	993		986	0
2015	Take into account coastal cod and <i>S. norvegicus</i> bycatches. Apply catch rule.	894	894			
2016	Take into account coastal cod and <i>S. norvegicus</i> bycatches. Apply catch rule.	805				

History of catch and landings

Table 3.3.4.8 Cod in Subareas I and II. Catch distribution by fleet in 2014 as estimated by ICES.

Total catch (2014)	Commercial landings		Commercial discards
	70% demersal trawls	30% other gear types	
986 kt	986 kt		Discards are considered to be negligible

Table 3.3.4.9 Cod in Subareas I and II. History of commercial catch and landings, both official and ICES estimated values are presented by area for each country participating in the fishery. 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**		Others	Total all countries
1961	3934	13755	3921	8129	268377	-	158113	325780		1212	783221
1962	3109	20482	1532	6503	225615	-	175020	476760		245	909266
1963	-	18318	129	4223	205056	108	129779	417964		-	775577
1964	-	8634	297	3202	149878	-	94549	180550		585	437695
1965	-	526	91	3670	197085	-	89962	152780		816	444930
1966	-	2967	228	4284	203792	-	103012	169300		121	483704
1967	-	664	45	3632	218910	-	87008	262340		6	572605
1968	-	-	225	1073	255611	-	140387	676758		-	1074084
1969	29374	-	5907	5543	305241	7856	231066	612215		133	1197226
1970	26265	44245	12413	9451	377606	5153	181481	276632		-	933246
1971	5877	34772	4998	9726	407044	1512	80102	144802		215	689048
1972	1393	8915	1300	3405	394181	892	58382	96653		166	565287
1973	1916	17028	4684	16751	285184	843	78808	387196		276	792686
1974	5717	46028	4860	78507	287276	9898	90894	540801		38453	1102434
1975	11309	28734	9981	30037	277099	7435	101843	343580		19368	829377
1976	11511	20941	8946	24369	344502	6986	89061	343057		18090	867463
1977	9167	15414	3463	12763	388982	1084	86781	369876		17771	905301
1978	9092	9394	3029	5434	363088	566	35449	267138		5525	698715
1979	6320	3046	547	2513	294821	15	17991	105846		9439	440538
1980	9981	1705	233	1921	232242	3	10366	115194		8789	380434
						Spain					
1981	12825	3106	298	2228	277818	14500	5262	83000		-	399037
1982	11998	761	302	1717	287525	14515	6601	40311		-	363730
1983	11106	126	473	1243	234000	14229	5840	22975		-	289992
1984	10674	11	686	1010	230743	8608	3663	22256		-	277651
1985	13418	23	1019	4395	211065	7846	3335	62489		4330	307920
1986	18667	591	1543	10092	232096	5497	7581	150541		3505	430113
1987	15036	1	986	7035	268004	16223	10957	202314		2515	523071
1988	15329	2551	605	2803	223412	10905	8107	169365		1862	434939
1989	15625	3231	326	3291	158684	7802	7056	134593		1273	332481
1990	9584	592	169	1437	88737	7950	3412	74609		510	187000
1991	8981	975	Greenland	2613	126226	3677	3981	119427***		3278	269158
1992	11663	2	3337	3911	168460	6217	6120	182315	Iceland	1209	383234
1993	17435	3572	5389	5887	221051	8800	11336	244860	9374	3907	531611
1994	22826	1962	6882	8283	318395	14929	15579	291925	36737	28568	746086
1995	22262	4912	7462	7428	319987	15505	16329	296158	34214	15742	739999
1996	17758	5352	6529	8326	319158	15871	16061	305317	23005	14851	732228
1997	20076	5353	6426	6680	357825	17130	18066	313344	4200	13303	762403
1998	14290	1197	6388	3841	284647	14212	14294	244115	1423	8217	592624
1999	13700	2137	4093	3019	223390	8994	11315	210379	1985	5898	484910
2000	13350	2621	5787	3513	192860	8695	9165	166202	7562	5115	414870
2001	12500	2681	5727	4524	188431	9196	8698	183572	5917	5225	426471
2002	15693	2934	6419	4517	202559	8414	8977	184072	5975	5484	445045
2003	19427	2921	7026	4732	191977	7924	8711	182160	5963	6149	436990

2004	19226	3621	8196	6187	212117	11285	14004	201525	7201	6082	489445
2005	16273	3491	8135	5848	207825	9349	10744	200077	5874	7660	475276
2006	16327	4376	8164	3837	201987	9219	10594	203782	5972	6271	470527
2007	14788	3190	5951	4619	199809	9496	9298	186229	7316	5101	445796
2008	15812	3149	5617	4955	196598	9658	8287	190225	7535	7336	449171
2009	16905	3908	4977	8585	224298	12013	8632	229291	7380	7442	523431
2010	15977	4499	6584	8442	264701	12657	9091	267547	11299	9185	609983
2011	13429	1173	7155	4621	331535	13291	8210	310326	12734	17354 [^]	719829
2012~	17523	2841	8520	8500	315739	12814	11166	329943	9536	11081	727663
2013	13833	7858	7885	8010	438734	15042	12536	432314	14734	15263	966209
2014*	33298	8149	10864	6225	431846	16378	14762	433479	18205	13243	986449

* Provisional figures.

** USSR prior to 1991.

*** Includes Baltic countries.

[^] Includes unspecified EU catches.

~ Revised figures.

Summary of the assessment

Table 3.3.4.10 Cod in Subareas I and II. Assessment summary (weights in tonnes).

Year	Recruitment (age 3)	SSB	TSB	Landings	Mean F Ages 5–10
	thousands	tonnes	tonnes	tonnes	
1946	1 126 514	1 112 945	4 367 668	706 000	0.186
1947	678 224	1 165 171	3 839 613	882 017	0.304
1948	649 597	1 019 217	3 775 604	774 295	0.34
1949	638 062	729 919	3 156 987	800 122	0.362
1950	979 309	615 385	2 960 071	731 982	0.357
1951	2 210 700	568 882	3 722 971	827 180	0.396
1952	2 250 119	520 807	4 046 139	876 795	0.534
1953	2 378 899	396 626	3 992 058	695 546	0.357
1954	847 379	429 821	4 216 295	826 021	0.388
1955	396 197	347 080	3 572 939	1 147 841	0.543
1956	792 842	299 937	3 342 003	1 343 068	0.639
1957	1 558 705	207 909	2 799 741	792 557	0.508
1958	850 121	195 444	2 342 825	769 313	0.516
1959	1 354 956	432 708	2 732 448	744 607	0.558
1960	1 486 994	384 350	2 354 866	622 042	0.478
1961	1 542 917	404 333	2 395 452	783 221	0.634
1962	1 224 235	311 751	2 176 183	909 266	0.756
1963	977 411	209 201	2 008 686	776 337	0.984
1964	547 510	186 570	1 487 644	437 695	0.678
1965	1 013 702	102 315	1 550 917	444 930	0.553
1966	1 871 746	120 751	2 353 618	483 711	0.53
1967	1 389 823	129 784	2 902 009	572 605	0.544
1968	169 828	227 278	3 391 704	1 074 084	0.57
1969	115 958	151 870	2 808 070	1 197 226	0.829
1970	220 225	224 507	2 069 435	933 246	0.749
1971	443 681	311 666	1 631 740	689 048	0.596
1972	1 146 800	347 229	1 682 401	565 254	0.693
1973	1 849 455	332 913	2 414 550	792 685	0.602
1974	533 786	164 491	2 241 204	1 102 433	0.563
1975	642 257	142 042	2 048 293	829 377	0.659
1976	632 264	171 238	1 939 090	867 463	0.646
1977	365 657	341 409	1 963 956	905 301	0.838
1978	659 096	241 536	1 588 144	698 715	0.94
1979	200 063	174 698	1 115 016	440 538	0.726
1980	137 736	108 253	863 861	380 434	0.724
1981	150 880	166 925	983 662	399 038	0.863

Year	Recruitment (age 3)	SSB	TSB	Landings	Mean F Ages 5–10
	thousands	tonnes	tonnes	tonnes	
1982	151 830	326 133	750 875	363 730	0.758
1983	167 340	327 184	738 874	289 992	0.756
1984	397 854	251 086	817 605	277 651	0.916
1985	523 672	193 855	957 511	307 920	0.704
1986	1 038 709	170 729	1 294 412	430 113	0.865
1987	286 365	121 243	1 126 279	523 071	0.951
1988	204 645	202 589	915 459	434 939	0.974
1989	172 780	234 716	890 360	332 481	0.66
1990	242 762	316 418	962 680	212 000	0.271
1991	411 745	704 747	1 561 702	319 158	0.321
1992	721 292	887 567	1 912 315	513 234	0.455
1993	894 864	775 193	2 359 878	581 611	0.553
1994	783 479	614 891	2 149 025	771 086	0.868
1995	616 080	528 861	1 808 805	739 999	0.788
1996	440 434	571 882	1 690 365	732 228	0.698
1997	718 518	589 016	1 534 212	762 403	1.032
1998	848 805	386 726	1 233 030	592 624	0.914
1999	552 549	294 333	1 105 696	484 910	0.981
2000	614 338	242 609	1 109 136	414 868	0.836
2001	524 419	359 805	1 388 974	426 471	0.691
2002	452 088	505 188	1 561 970	535 045	0.655
2003	692 921	560 820	1 639 660	551 990	0.522
2004	304 824	672 496	1 605 931	606 445	0.646
2005	558 953	628 909	1 596 776	641 276	0.67
2006	545 571	619 531	1 544 846	537 642	0.564
2007	1 223 377	666 542	1 873 552	486 883	0.368
2008	1 209 828	701 456	2 511 991	464 171	0.331
2009	798 034	1 035 858	3 071 831	523 430	0.28
2010	437 472	1 191 948	3 289 421	609 983	0.275
2011	674 247	1 598 899	3 378 814	719 830	0.311
2012	692 819	1 769 707	3 389 314	727 663	0.272
2013	770 458	1 943 036	3 590 870	966 209	0.379
2014	1 008 678	1 620 217	3 152 139	986 449	0.477
2015	824 000	1 139 000	2 963 000		
Average	779 134	510 716	2 204 502	662 167	0.607

Sources and references

ICES. 2003. Report of the Study Group on Biological Reference Points for Northeast Arctic Cod, 13–17 January 2003, Svanhovd, Norway. ICES CM 2003/ACFM:11. 39 pp.

ICES. 2005. Report of the Arctic Fisheries Working Group (AFWG), 19–28 April 2005, Murmansk, Russia. ICES CM 2005/ACFM:20. 564 pp.

ICES. 2014a. Advice basis. *In* Report of the ICES Advisory Committee, 2014. ICES Advice 2014, Book 1, Section 1.2.

ICES. 2014b. Report of the Arctic Fisheries Working Group (AFWG), 23–29 April 2014, Lisbon, Portugal. ICES CM 2014/ACOM:05.

ICES. 2015a. Report of the Benchmark Workshop on Arctic Stocks (WKARCT), 26–30 January 2015, ICES Headquarters, Denmark. ICES CM 2015/ACOM:31. 126 pp.

ICES. 2015b. Report of the Arctic Fisheries Working Group (AFWG), 23–29 April 2015, Hamburg, Germany. ICES CM 2015/ACOM:05.

ICES. 2015c. Advice basis. *In* Report of the ICES Advisory Committee, 2015. ICES Advice 2015, Book 1. In preparation.