

Cod (*Gadus morhua*) in subareas 1 and 2 (Northeast Arctic)

ICES advice on fishing opportunities

ICES advises that when the Joint Norwegian–Russian Fisheries Commission management plan is applied, catches in 2021 should be no more than 885 600 tonnes.

Note: This advice sheet is abbreviated due to the Covid-19 disruption. The previous advice issued for 2020 is attached as Annex 1.

Stock development over time

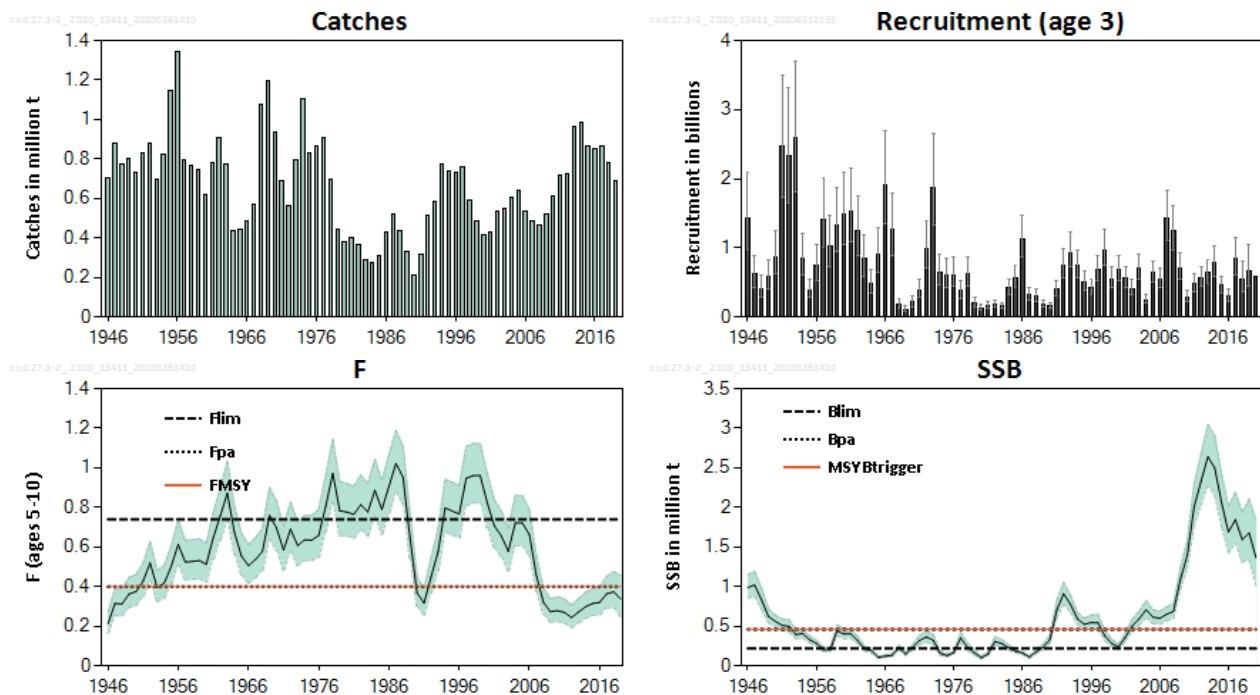


Figure 1 Cod in subareas 1 and 2 (Northeast Arctic). Catch, recruitment, F, and SSB. Confidence intervals (95%) are indicated in the plots for recruitment, F, and SSB. For this stock, F_{MGT} ranges from 0.40 to 0.60 and there are three SSB_{MGT} values (460 000 tonnes, 920 000 and 1 380 000 tonnes) which are not shown.

Stock and exploitation status

Table 1 Cod in subareas 1 and 2 (Northeast Arctic). State of the stock and the fishery relative to reference points.

	Fishing pressure			Stock size						
	2017	2018	2019	2018	2019	2020				
Maximum sustainable yield	F_{MSY}	✓	✓	✓	Below	MSY $B_{trigger}$	✓	✓	✓	Above trigger
Precautionary approach	F_{pa}, F_{lim}	✓	✓	✓	Harvested sustainably	B_{pa}, B_{lim}	✓	✓	✓	Full reproductive capacity
Management plan	F_{MGT}	✓	✓	✓	Below	B_{MGT}	✓	✓	✓	Above

Catch scenarios

Table 2 Cod in subareas 1 and 2 (Northeast Arctic). Assumptions made for the interim year and in the forecast.

Variable	Value	Notes
F _{ages 5-10} (2020)	0.34	F status quo (F _{sq} = F ₂₀₁₉); exploitation pattern from average of the last three years
SSB (2021)	1 373 132 tonnes	Based on fishing at F _{sq}
R _{age 3} (2020)	583 000 thousands	Recruitment model estimate
R _{age 3} (2021)	635 000 thousands	Recruitment model estimate
R _{age 3} (2022)	512 000 thousands	Recruitment model estimate
Total catch (2020)	674 200 tonnes	Fishing at F _{sq}

Table 3 Cod in subareas 1 and 2 (Northeast Arctic). Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2021)	F _{total} (2021)	SSB (2022)	% SSB change *	% TAC change **	% Advice change ***
ICES advice basis						
Management plan ^	885600	0.47	1171141	-15	+20	+28
Other scenarios						
MSY approach: F _{MSY}	774860	0.40	1257564	-8	+5	+12
Management plan applied to 2020 advice^^	827606	0.43	1216341	-11	+12	+20
F = 0	0	0	1898191	+38	-100	-100
F = F ₂₀₂₀	673954	0.3381	1337566	-3	-9	-2
F _{pa}	774860	0.40	1257564	-8	+5	+12
F _{lim}	1236791	0.74	907720	-34	+68	+79

* SSB 2022 relative to SSB 2021.

** Advice value for 2021 relative to TAC 2020 (738000 tonnes).

*** Advice value for 2021 relative to the advice value for 2020 (689672 tonnes).

^ Since SSB in 2021 is between $2 \times B_{pa} = 920000$ tonnes and $3 \times B_{pa} = 1380000$ tonnes, $F = 0.4 \times (1 + 0.5 \times (1373 - 920)/460) = 0.597$ is used in the 3-year prediction, giving catches of 1059716, 866192, and 745559 tonnes in 2021, 2022, and 2023, respectively. The average of this is 890489 tonnes. According to the harvest control rule (HCR), the maximum increase in TAC is limited by 20%, giving a catch of 885600 tonnes, which corresponds to an F of 0.47 in 2021.

^^ Applying the 20% limitation to the 2020 advice and not to the 2020 TAC.

The advice this year is higher than the one given last year, mostly due to an upwards revision of age groups 5–10 in this year’s assessment. These age groups make up most of the catches in the prediction.

Quality of the assessment

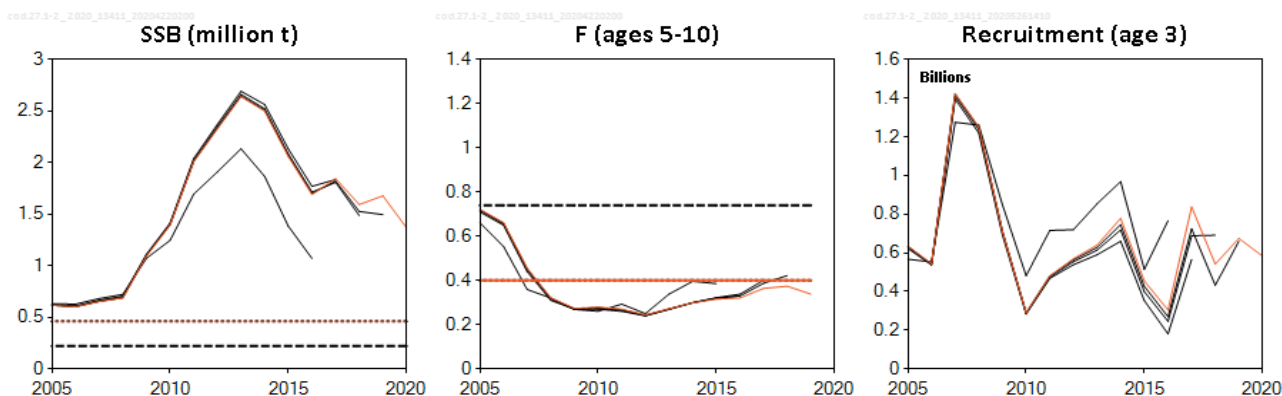


Figure 2 Cod in subareas 1 and 2 (Northeast Arctic). Historical assessment results. The 2016 assessment, prior to the benchmark in 2017, is based on a different assessment model.

History of the advice, catch, and management

Table 4 Cod in subareas 1 and 2 (Northeast Arctic). ICES advice, agreed TACs, the official and unreported landings, and ICES catches. All weights are in tonnes.

Year	ICES advice	Catch corresponding to advice	Agreed TAC	Official catches	Unreported landings (included in ICES catches)	ICES catches
1987	Gradual reduction in F	595000	560000	552000		523071
1988	F = 0.51; TAC (Advice November 1987, revised advice May 1988)	530000 (320000–360000)	590000 (451000)	459000		434939
1989	Large reduction in F	335000	300000	348000		332481
1990	F at F_{low} ; TAC	172000	160000	210000	25000	212000
1991	F at F_{low} ; TAC	215000	215000	294000	50000	319158
1992	Within safe biological limits	250000	356000	421000	130000	513234
1993	Healthy stock	256000	500000	575000	50000	581611
1994	No long-term gains in increased F	649000	700000	795000	25000	771086
1995	No long-term gains in increased F	681000	700000	763000		739999
1996	No long-term gains in increased F	746000	700000	759000		732228
1997	Well below F_{med}	< 993000	850000	792000		762403
1998	F less than F_{med}	514000	654000	615000		592624
1999	Reduce F to below F_{pa}	360000	480000	506000		484910
2000	Increase B above B_{pa} in 2001	110000	390000			414870
2001	High probability of $SSB > B_{pa}$ in 2003	263000	395000			426471
2002	Reduce F to well below 0.25	181000	395000		90000	535045
2003	Reduce F to below F_{pa}	305000	395000		115000	551990
2004	Reduce F to below F_{pa}	398000	486000		117000	606445
2005	Take into account coastal cod and redfish bycatches. Apply catch rule.	485000	485000		166000	641276
2006	Take into account coastal cod and redfish bycatches. Apply amended catch rule.	471000	471000		67100	537642
2007	Take into account coastal cod and redfish bycatches. F_{pa}	309000	424000		41087	486883
2008	Take into account coastal cod and redfish bycatches. Apply catch rule.	409000	430000		15000	464171
2009	Take into account coastal cod and redfish bycatches. Apply catch rule.	473000	525000		0	523431
2010	Take into account coastal cod and redfish bycatches. Apply catch rule.	577500	607000		0	609983
2011	Take into account coastal cod and redfish bycatches. Apply catch rule.	703000	703000		0	719829
2012	Take into account coastal cod and redfish bycatches. Apply catch rule.	751000	751000		0	727663
2013	Take into account coastal cod and <i>S. marinus</i> ^^ bycatches. Apply catch rule.	940000	1000000		0	966209
2014	Take into account coastal cod and <i>S. marinus</i> ^^ bycatches. Apply catch rule.	993000	993000		0	986449

Year	ICES advice	Catch corresponding to advice	Agreed TAC	Official catches	Unreported landings (included in ICES catches)	ICES catches
2015	Take into account coastal cod and <i>S. norvegicus</i> bycatches. Apply catch rule.	894000	894000		0	864384
2016	Take into account coastal cod and <i>S. norvegicus</i> bycatches. Apply catch rule.	805000	894000		0	849422
2017	Take into account coastal cod and <i>S. norvegicus</i> bycatches. Apply management plan.	≤ 805000	890000 ^		0	868276
2018	Take into account coastal cod and <i>S. norvegicus</i> bycatches. Apply management plan.	712000	775000		0	778627
2019	Take into account coastal cod and <i>S. norvegicus</i> bycatches. Apply management plan.	674678	725000		0	692609
2020	Apply management plan	≤ 689672	738000			
2021	Apply management plan	≤ 885600				

^ The 2017 TAC was set according to the new management plan agreed by JNRF in October 2016.

^^ Until 2014 this species was named *Sebastes marinus*, thereafter *Sebastes norvegicus*.

Table 5 Cod in subareas 1 and 2 (Northeast Arctic). Catches inside and outside the NEAFC Regulatory Area (RA) as estimated by ICES.

Year	Inside the NEAFC RA (tonnes)	Outside the NEAFC RA (tonnes)	Total catches (tonnes)	Proportion inside the NEAFC RA (%)
2017	1224	867052	868276	0.14%
2018	1726	776901	778627	0.22%
2019	1094	691515	692609	0.16%

Summary of the assessment

Table 6 Cod in subareas 1 and 2 (Northeast Arctic). Assessment summary. High and low refer to 95% confidence bounds. Weights are in tonnes.

Year	Recruitment			Spawning-stock biomass			Total catch	Fishing mortality		
	Recruitment (Age 3)	High	Low	SSB	High	Low		F (ages 5–10)	High	Low
	thousands			tonnes			tonnes			
1946	1423343	2100554	964463	990609	1150256	853120	706000	0.21	0.27	0.166
1947	617235	890382	427882	1021068	1192210	874494	882017	0.32	0.39	0.25
1948	404564	597798	273792	837031	985149	711183	774295	0.31	0.39	0.25
1949	576298	825156	402492	624864	721652	541058	800122	0.36	0.45	0.30
1950	875549	1246386	615047	562163	642582	491808	731982	0.38	0.46	0.31
1951	2469380	3506080	1739218	511069	590260	442503	827180	0.43	0.52	0.35
1952	2328260	3305949	1639709	498837	582336	427311	876795	0.52	0.63	0.43
1953	2588386	3691480	1814921	395700	460298	340168	695546	0.40	0.48	0.33
1954	850213	1204269	600250	409262	470877	355708	826021	0.42	0.51	0.34
1955	388395	550553	273999	331294	377548	290706	1147841	0.50	0.61	0.42
1956	743782	1052438	525648	284209	324154	249186	1343068	0.61	0.74	0.51
1957	1416452	2001691	1002321	206967	236487	181133	792557	0.53	0.64	0.43
1958	1032979	1459754	730976	204255	235592	177087	769313	0.53	0.64	0.44
1959	1326289	1875643	937834	442905	519121	377879	744607	0.53	0.64	0.44
1960	1481044	2095569	1046728	402781	473415	342685	622042	0.51	0.62	0.42
1961	1528761	2153563	1085229	405816	470624	349933	783221	0.65	0.77	0.54
1962	1250787	1756778	890532	319994	371317	275765	909266	0.76	0.90	0.64
1963	839041	1185072	594048	214337	249207	184345	776337	0.87	1.03	0.74
1964	482566	687621	338661	192205	224277	164719	437695	0.68	0.81	0.56
1965	904964	1281380	639124	106572	123434	92013	444930	0.56	0.67	0.46
1966	1901765	2700780	1339135	121928	141343	105179	483711	0.51	0.61	0.42
1967	1264851	1795547	891009	133496	155529	114584	572605	0.54	0.65	0.45
1968	186263	262970	131931	228850	263065	199085	1074084	0.58	0.70	0.48

Year	Recruitment			Spawning-stock biomass			Total catch	Fishing mortality		
	Recruitment (Age 3)	High	Low	SSB	High	Low		F (ages 5–10)	High	Low
	thousands			tonnes				tonnes		
1969	110972	157318	78279	151247	175617	130258	1197226	0.76	0.90	0.64
1970	213425	301223	151217	230661	269961	197081	933246	0.70	0.83	0.58
1971	388223	548370	274846	319457	383875	265849	689048	0.59	0.71	0.48
1972	992240	1395943	705287	365215	444895	299806	565254	0.69	0.83	0.58
1973	1870935	2644876	1323463	324433	396599	265399	792685	0.61	0.73	0.51
1974	642931	901295	458630	159570	193448	131624	1102433	0.64	0.76	0.53
1975	598946	839317	427415	130495	149110	114203	829377	0.64	0.76	0.53
1976	612521	859406	436560	167868	193899	145331	867463	0.66	0.79	0.55
1977	374504	520959	269221	352518	424426	292792	905301	0.81	0.96	0.68
1978	625994	869790	450533	234876	290287	190042	698715	0.97	1.14	0.83
1979	209854	289486	152128	165182	202907	134471	440538	0.78	0.93	0.66
1980	129779	176968	95173	102563	122118	86139	380434	0.78	0.92	0.66
1981	160267	216090	118865	151331	176662	129633	399038	0.77	0.91	0.65
1982	176481	233915	133149	309233	368826	259269	363730	0.81	0.96	0.69
1983	157359	208302	118875	280971	333245	236896	289992	0.78	0.92	0.66
1984	415597	544191	317390	227446	263939	195998	277651	0.89	1.04	0.75
1985	564693	738775	431631	187581	217374	161871	307920	0.79	0.94	0.67
1986	1123445	1473307	856664	162605	187430	141068	430113	0.91	1.06	0.77
1987	330792	433151	252622	110373	127635	95445	523071	1.02	1.19	0.88
1988	300608	394961	228796	179294	209705	153293	434939	0.95	1.11	0.82
1989	190122	248402	145515	234927	275029	200672	332481	0.65	0.77	0.54
1990	156070	207264	117520	332203	393106	280736	212000	0.37	0.45	0.30
1991	398889	521675	305002	706951	829500	602508	319158	0.32	0.39	0.26
1992	744428	976376	567582	909485	1054425	784469	513234	0.45	0.55	0.37
1993	935483	1222848	715648	777317	895019	675094	581611	0.58	0.69	0.48
1994	738692	970493	562255	592996	675603	520490	771086	0.80	0.94	0.68
1995	503553	658814	384882	524650	601541	457587	739999	0.78	0.93	0.66
1996	416490	547961	316563	547659	640193	468500	732228	0.77	0.91	0.65
1997	679661	887396	520555	544858	649983	456736	762403	0.95	1.11	0.81
1998	969301	1269385	740157	377941	450954	316749	592624	0.96	1.12	0.82
1999	550901	719923	421562	282913	335359	238669	484910	0.96	1.12	0.82
2000	678770	889079	518208	239293	275205	208066	414868	0.82	0.97	0.70
2001	557105	729600	425392	364097	422441	313811	426471	0.71	0.84	0.60
2002	413451	540370	316341	507144	590392	435635	535045	0.66	0.78	0.55
2003	698613	906602	538339	596107	692756	512942	551990	0.58	0.70	0.48
2004	249125	317952	195197	709766	825923	609944	606445	0.72	0.86	0.61
2005	635063	811017	497283	614977	711271	531719	641276	0.72	0.86	0.61
2006	541999	695574	422331	601333	689002	524820	537642	0.66	0.79	0.56
2007	1423088	1823263	1110744	651662	745992	569260	486883	0.46	0.55	0.37
2008	1250005	1609604	970743	687443	786045	601209	464171	0.32	0.39	0.26
2009	708305	921482	544444	1095497	1242579	965824	523430	0.27	0.34	0.22
2010	288945	377755	221014	1396260	1586126	1229122	609983	0.28	0.35	0.22
2011	480333	633726	364069	2011119	2295822	1761722	719830	0.27	0.34	0.22
2012	569721	735307	441424	2328107	2672658	2027974	727663	0.24	0.31	0.194
2013	640235	831812	492782	2639228	3046562	2286356	966209	0.27	0.34	0.22
2014	777674	1024031	590584	2499243	2908432	2147624	986449	0.30	0.37	0.24
2015	454913	593029	348964	2059938	2420472	1753106	864384	0.32	0.39	0.26
2016	303634	407868	226038	1689689	2012735	1418492	849422	0.32	0.40	0.26
2017	836999	1143457	612675	1845399	2191815	1553734	868276	0.36	0.45	0.29
2018	541513	804341	364568	1593377	1941732	1307518	778627	0.37	0.48	0.29
2019	674702	1042267	436763	1677851	2104714	1337562	692609	0.34	0.46	0.25
2020	583000*			1367961	1839549	1017269				

* Recruitment model estimate.

Sources and references

ICES. 2020. Arctic Fisheries Working Group (AFWG). ICES Scientific Reports. 2:52. <http://doi.org/10.17895/ices.pub.6050>

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