

Cod (*Gadus morhua*) in NAFO Subarea 1, inshore (West Greenland cod)

ICES advice on fishing opportunities

Please note: The present advice replaces the catch advice given for 2018 (in June 2017) and it provides the catch advice for 2019.*

ICES advises that when the MSY approach is applied, catches in 2018 should be no more than 8858 tonnes.

ICES advises that when the MSY approach is applied, catches in 2019 should be no more than 6806 tonnes.

Stock development over time

The spawning-stock biomass (SSB) of West Greenland inshore cod has in the past decade increased to a level not seen for more than three decades. Fishing mortality (F) has decreased over the past decade, but remains above F_{MSY} . Recent recruitment has gradually decreased from a decade of high values, and is currently close to historically low levels.

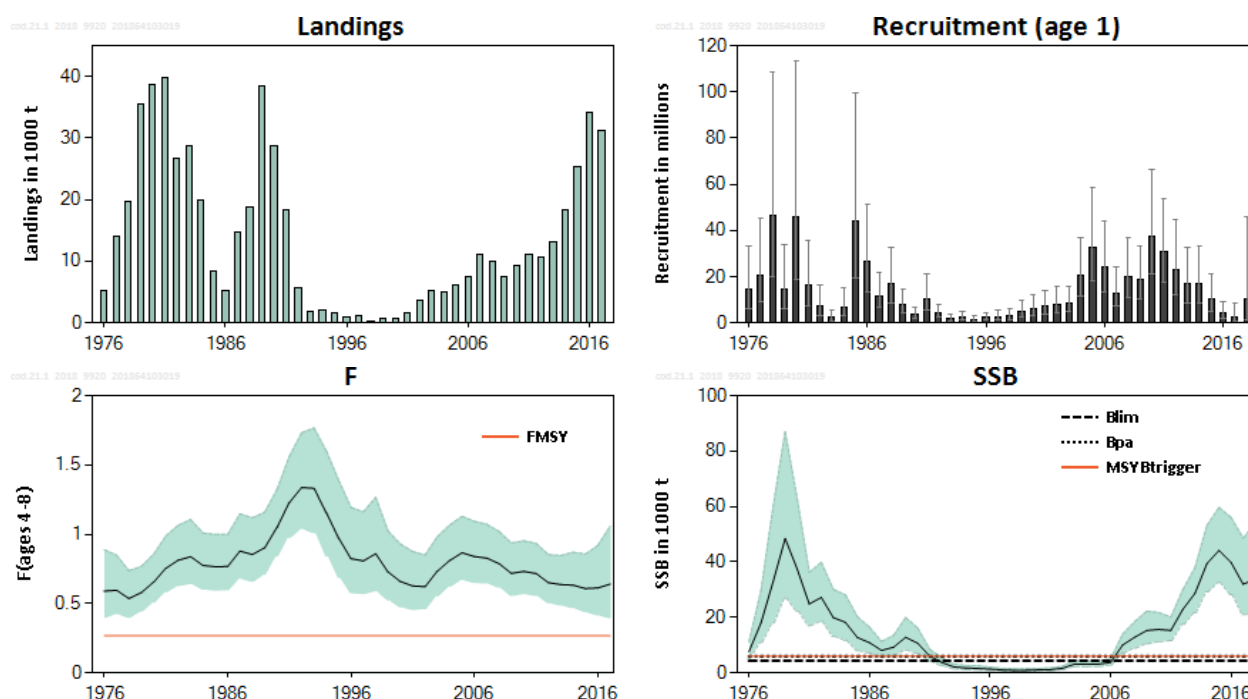


Figure 1 Cod in NAFO Subarea 1, inshore. Summary of the stock assessment with 95% confidence intervals. The recruitment estimate for 2018 is a survey estimate and not estimated by the model.

Stock and exploitation status

ICES assesses that fishing pressure on the stock is above F_{MSY} but below F_{pa} and F_{lim} . The spawning stock size is above $MSY B_{trigger}$, B_{pa} , and B_{lim} .

* In January 2018 an Inter-benchmark protocol was conducted, IBPGreenlandCod, and the assessment type and data category for this stock changed following this benchmark (ICES, 2018a). Updated catch advice for 2018 was requested based on the new assessment. The new assessment results in a 37% decrease relative to the previously released catch advice for 2018 (ICES, 2017).

Table 1 Cod in NAFO Subarea 1, inshore. State of the stock and fishery relative to reference points.

		Fishing pressure				Stock size		
		2014	2015	2016		2016	2017	2018
Maximum sustainable yield	F_{MSY}	✗	✗	✗ Above		$MSY B_{trigger}$	✓	✓ Above trigger
Precautionary approach	$F_{pa, F_{lim}}$	?	?	? Unknown		$B_{pa, B_{lim}}$	✓	✓ Full reproductive capacity
Management plan	F_{MGT}	—	—	— Not applicable		B_{MGT}	—	— Not applicable

Catch scenarios

Table 2 Cod in NAFO Subarea 1, inshore. Assumptions made for the interim year and in the forecast for the 2018 advice. All weights are in tonnes, recruitment in thousands.

Variable	Value	Notes
$F_{ages\ 4-8}$ (2017)	0.64	Estimated by the assessment.
SSB (2018)	33 818	Estimated by the assessment.
$R_{age\ 1}$ (2018)	10 583	Estimated by the assessment.
Total catch (2017)	16 934	Estimated catch from the assessment, $F_{ages\ 4-8}$ (2017) = 0.64.

Table 3 Cod in NAFO Subarea 1, inshore. Annual catch scenarios for the 2018 advice. All weights are in tonnes.

Rationale	Catch (2018)	F (2018)	SSB (2019)	%SSB change *	%TAC change **	% advice change ***
ICES advice basis						
MSY approach: F_{MSY}	8 858	0.27	35251	4%	-76%	-28%
Other scenarios						
$F = F_{2017}$ (status quo)	17 143	0.64	25470	-25%	-53%	38%

* SSB_{2019} relative to SSB_{2018} .

** Advice value for 2018, from this updated assessment, relative to the TAC for 2017.

*** Advice value for 2018, from this updated assessment, relative to the advice value for 2017.

Following a 2018 benchmark (ICES, 2018a) the assessment model changed for this stock. The new assessment changed the perception of the stock and therefore also the advice. This advice is an update of the previous advice for 2018 (ICES, 2017).

Table 4 Cod in NAFO Subarea 1, inshore. Assumptions made for the interim year and in the forecast for the 2019 advice. All weights are in tonnes, recruitment in thousands.

Variable	Value	Notes
$F_{ages\ 4-8}$ (2018)	0.66	$F_{ages\ 4-8}$ (2018) = $F_{ages\ 4-8}$ (2017)
SSB (2019)	25014	Fishing at F_{sq}
$R_{age\ 1}$ (2019)	11810	Assuming random walk recruitment drawn from the full time-series (1973–2017)
Total catch (2018)	17143	Based on $F_{ages\ 4-8}$ (2018) = 0.66

Table 5 Cod in NAFO Subarea 1, inshore. Annual catch scenarios for the 2019 advice. All weights are in tonnes.

Rationale	Catch (2019)	F (2019)	SSB (2020)	% SSB change *	% TAC change **	% advice change ***
ICES advice basis						
MSY approach: F_{MSY}	6806	0.27	25898	4.0%	-81%	-23%
Other scenarios						
$F = 0$	0	0	34002	36%	-100%	-100%
$F = F_{2018}$ (<i>status quo</i>)	13049	0.64	19206	-25%	-64%	47%
$SSB_{2020} = B_{lim}$	27079	5.0	4346	-83%	-26%	206%
$SSB_{2020} = B_{pa} = MSY B_{trigger}$	25335	3.3	6000	-76%	-31%	186%

* SSB_{2020} relative to SSB_{2019} .

** Advice value for 2019 relative to the advice value for 2018, from this updated assessment.

*** Advice value for 2019 relative to the TAC in 2018, from this updated assessment.

Basis of the advice

Table 6 Cod in NAFO Subarea 1, inshore. The basis of the advice.

Advice basis	MSY approach
Management plan	There is no management plan.

Quality of the assessment

The stock was benchmarked in 2018 (ICES, 2018a). Input data and the assessment model were changed, reference points were defined, and uncertainty estimates are now available to assess the quality of the assessment. This is an improved assessment, but stock mixing in both survey and catches adds uncertainty to the assessment.

The catches in the assessment are estimated and show large discrepancies, especially when the reported landings are high (Figure 2). The input landings include a mixture of stocks in addition to the West Greenland inshore stocks and this is likely to be the cause of the discrepancy.

This stock has not previously been assessed analytically, and there are no comparable historical assessment results.

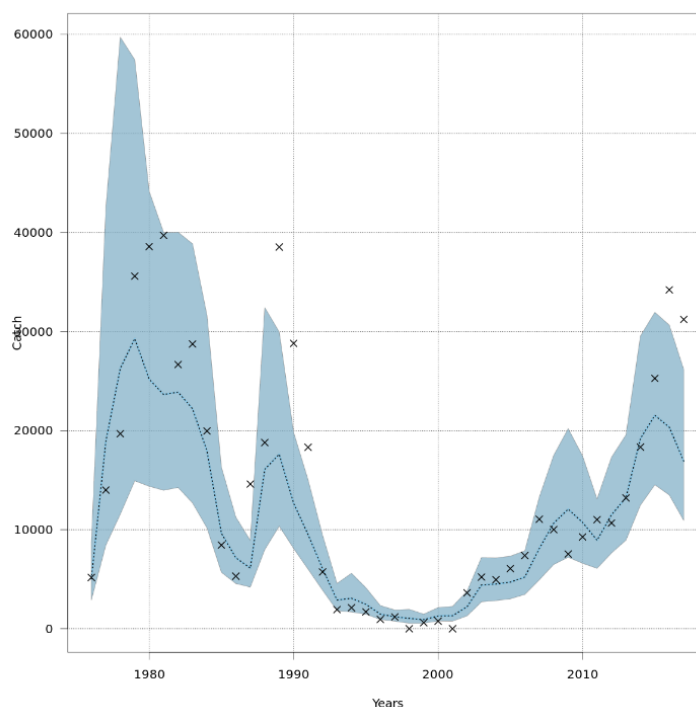


Figure 2 Cod in NAFO Subarea 1, inshore. Observed catches (tonnes) from the inshore area (crosses) and the model estimate of catches (dotted line). The model estimates are shown with 95% confidence intervals.

Issues relevant for the advice

Four cod stocks mix in the West Greenland inshore area, especially in the coastal zone (Storr-Paulsen *et al.*, 2004). The proportional contribution of each stock is highly uncertain.

Catches in the area include cod from the West Greenland offshore stock, a stock that is in a depleted condition and for which the current ICES advice is zero catch. Attempts should be made to minimize catches of West Greenland offshore cod. Current results suggest this could be achieved by restricting fishing in areas with relatively high proportions of West Greenland offshore cod (Henriksen, 2015; ICES, 2018a).

Because of the discrepancy between catches and the model estimate in the intermediate year, ICES has assumed that F_{2018} will equal F_{2017} . Based on this assumption the estimated catches in 2018 are 17 143 t, which is in contrast to the expected catches of 36 500 t (TAC) in the area.

Reference points

Table 7 Cod in NAFO Subarea 1, inshore. Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	5983 t	Assumed at B_{pa}	ICES (2018a)
	F_{MSY}	0.27	Stochastic simulations with segmented regression and a Beverton–Holt stock–recruitment curve from 1973 to 2017.	ICES (2018a)
Precautionary approach	B_{lim}	4346 t	Breakpoint in segmented regression	ICES (2018a)
	B_{pa}	5983 t	$B_{lim} \times e^{1.645\sigma}$, $\sigma = 0.194$	ICES (2018a)
	F_{lim}	-	Not defined	
	F_{pa}	-	Not defined	
Management plan	SSB_{mgt}	-	-	
	F_{mgt}	-	-	

Basis of the assessment

Table 8 Cod in NAFO Subarea 1, inshore. Basis of the assessment and advice.

ICES stock data category	1 (ICES, 2016)
Assessment type	Age-based analytical assessment (SAM; ICES, 2018b) that uses catches in the model and in the forecast.
Input data	Catch-at-age and age-disaggregated survey indices (July, gillnet since 1985)
Discards and bycatch	Discarding is considered negligible.
Indicators	None
Other information	Benchmarked in 2018 (ICES, 2018a)
Working group	North-Western Working Group (NWWG)

Information from stakeholders

There is no additional available information.

History of the advice, catch, and management

Table 9 Cod in NAFO Subarea 1, inshore. ICES advice, TACs, and catch. All weights are in tonnes.

Year	ICES advice	Catch corresponding to advice	Agreed TAC*	ICES catch*
2012			15000	10672
2013	Mean catch in recent 10 years	8000	13500	13202
2014	20% increase in catch (relative to 3-year average)	< 12379	18500	18331
2015	Same basis as 2014	< 12379	27500	25272
2016	Same advice as in 2014	< 12379	35400	34204
2017	Precautionary approach (same advice value as for 2014–2016)	< 12379	36500	31220
2018	MSY approach	< 8858**	36500	
2019	MSY approach	≤ 6806		

* Catches include cod from other stocks.

** This is the updated advice for 2018. The original advice value for 2018 was 13 952 tonnes ([ICES, 2017](#)).

History of the catch and landings

Table 10 Cod in NAFO Subarea 1, inshore. Catch distribution by fleet in 2017 as estimated by ICES. All weights are in tonnes.

Catch (2017)	Landings				Discards
31220	Poundnet 69%	Longline 9%	Gillnet 14%	Hooks 8%	Discarding is negligible
	31220				

Table 11 Historical catches of cod in NAFO Subarea 1, inshore. All weights are in tonnes.

Year	NAFO divisions							Total West Greenland	ICES Division 14.b
	1A	1B	1C	1D	1E	1F	Unknown NAFO division		
1911				19				19	
1912				5				5	
1913				66				66	
1914				60				60	
1915		47	6	45				98	
1916		66	24	103				193	
1917		67	28	59				154	
1918		106	26	140		169		441	
1919		39	37	140	148	137		501	
1920		117	32	187	23	95		454	
1921		116	92	97	7	196		508	
1922		82	178	144	40	158		602	
1923		120	116	147	0	307		690	
1924		131	223	221	1	267		843	
1925		122	371	318	45	168		1024	
1926		97	785	673	170	499		2224	
1927		282	974	982	305	1027		3570	
1928		426	888	1153	497	1199		4163	
1929		1479	1572	1335	642	2052		7080	
1930	137	2208	2326	1681	994	2312		9658	
1931	315	1905	2026	1520	835	2453		9054	
1932	358	1713	2130	1042	731	3258		9232	
1933	304	1799	1743	1148	948	2296		8238	
1934	451	2080	1473	652	921	3591		9168	
1935	524	1870	1277	769	670	2466		7576	
1936	329	2039	1199	705	717	2185		7174	

Year	NAFO divisions							Total West Greenland	ICES Division 14.b
	1A	1B	1C	1D	1E	1F	Unknown NAFO division		
1937	135	1982	1433	854	496	2061		6961	
1938	258	1743	1406	703	347	1035		5492	
1939	416	2256	1732	896	431	1430		7161	
1940	482	2478	1600	1061	646	1759		8026	
1941	636	3229	1473	823	593	1868		8622	
1942	879	3831	2249	1332	1003	2733		12027	
1943	1507	5056	2016	1240	1134	2073		13026	
1944	1795	4322	2355	1547	1198	2168		13385	
1945	1585	4987	2844	1207	1474	2192		14289	
1946	1889	5210	2871	1438	1139	2715		15262	
1947	1573	5261	3323	2096	1658	4118		18029	
1948	1130	5660	3756	1657	1652	4820		18675	
1949	1403	4580	3666	2110	2151	3140		17050	
1950	1657	6358	4140	2357	2278	4383		21173	
1951	1277	5322	3324	2571	2101	3605		18200	
1952	646	4443	2906	2437	2216	4078		16726	
1953	1092	5030	3662	5513	3093	4261		22651	
1954	950	6164	3118	3275	1773	3418		18698	
1955	591	5523	3225	4061	2773	3614		19787	
1956	475	5373	3175	5127	3292	3586		21028	
1957	277	6146	3282	5257	4380	5251		24593	
1958	19	6178	3724	5456	3975	6450		25802	
1959	237	6404	5590	5009	3767	6570		27577	
1960	188	6741	6230	3614	3626	6610		27009	
1961	601	6569	6726	4178	6182	9709		33965	
1962	315	7809	6269	3824	5638	11525		35380	
1963	295	4877	3178	2804	3078	9037		23269	
1964	275	3311	2447	8766	2206	4981		21986	
1965	325	5209	4818	6046	2477	5447		24322	
1966	483	8738	5669	7022	2335	4799		29046	
1967	310	5658	6248	6747	2429	6132		27524	
1968	142	1669	2738	6123	2837	7207		20716	
1969	57	1767	4287	7540	2017	5568		21236	
1970	136	1469	2219	3661	2424	5654		15563	
1971	255	1807	2011	3802	1698	3933		13506	
1972	263	1855	3328	3973	1533	3696		14648	
1973	158	1362	1225	3682	1614	1581		9622	
1974	454	926	1449	2588	1628	1593		8638	
1975	216	1038	1930	1269	964	1140		6557	
1976	204	644	1224	904	1367	831		5174	
1977	216	580	2505	2946	3521	4231		13999	
1978	348	1587	3244	2614	4642	7244		19679	
1979	433	1768	2201	6378	9609	15201		35590	
1980	719	2303	2269	7781	10647	14852		38571	
1981	281	2810	3599	6119	7711	11505	7678	39703	
1982	206	2448	3176	7186	4536	3621	5491	26664	
1983	148	2803	3640	7430	5016	2500	7205	28742	
1984	175	3908	1889	5414	1149	1333	6090	19958	
1985	149	2936	957	1976	1178	1245		8441	
1986	76	1038	255	1209	1456	1268		5302	
1987	77	2366	423	6407	3602	1326	403	14604	

Year	NAFO divisions							Total West Greenland	ICES Division 14.b
	1A	1B	1C	1D	1E	1F	Unknown NAFO division		
1988	333	6294	1342	2992	3346	4484		18791	
1989	634	8491	5671	8212	10845	4676		38529	
1990	476	9857	1482	9826	1917	5241		28799	
1991	876	8641	917	2782	1089	4007		18312	
1992	695	2710	563	1070	239	450		5727	
1993	333	327	168	970	19	109		1926	
1994	209	332	589	914	11	62		2117	
1995	53	521	710	332	4	81		1701	
1996	41	211	471	164	11	46		944	
1997	18	446	198	99	13	130	282	1186	
1998	9	118	79	78	0	38		322	
1999	68	142	55	336	8	4		613	
2000	154	266	0	332	0	12		764	
2001	117	1183	245	54	0	81		1680	
2002	263	1803	505	214	24	813		3622	
2003	1109	1522	334	274	3	479	1494	5215	
2004	535	1316	242	116	47	84	2608	4948	
2005	650	2351	1137	1162	278	382	83	6043	
2006	922	1682	577	943	630	1461	1173	7388	
2007	416	2547	1195	1842	659	4391		11050	42
2008	870	3066	1539	3172	225	1133		10005	6
2009	325	1288	1189	2009	1142	1581		7534	2
2010	559	2990	1607	1795	1458	859		9268	2
2011	567	2364	2850	2905	1274	1047		11007	0
2012	546	1376	2061	4375	1989	325		10672	0.02
2013	1506	2552	2784	4711	1450	198		13202	35
2014	3084	6142	3710	4629	684	82		18331	38
2015	4088	7912	6426	6613	117	115		25272	50
2016	5929	11466	11270	5279	87	173		34204	39
2017	5797	11110	10060	4066	56	131		31220	82

Summary of the assessment

Table 12 Cod in NAFO Subarea 1, inshore. Assessment summary. Weights are in tonnes.

Year	Recruitment Age 1	High	Low	SSB	High	Low	Landings	F Ages 4–8	High	Low
	thousands				tonnes		tonnes			
1976	14541	33341	6342	7623	11169	5203	5174	0.59	0.89	0.39
1977	20562	44953	9405	18096	29730	11014	13999	0.60	0.85	0.42
1978	46657	108425	20077	32839	59778	18040	19679	0.54	0.74	0.39
1979	14390	34087	6075	48478	86940	27031	35590	0.58	0.77	0.44
1980	46041	113156	18734	37436	62746	22336	38571	0.66	0.86	0.50
1981	16387	35622	7538	24861	36279	17037	39703	0.76	0.99	0.58
1982	7435	16601	3330	27215	39859	18582	26664	0.81	1.06	0.62
1983	2276	5639	919	19945	30148	13195	28742	0.84	1.11	0.64
1984	6857	14835	3169	18237	28150	11815	19958	0.78	1.01	0.60
1985	43850	99399	19344	12754	20220	8045	8441	0.77	1.00	0.59
1986	26331	51436	13480	10888	16483	7192	5302	0.77	1.00	0.59
1987	11810	21685	6432	8111	11340	5801	14604	0.88	1.15	0.67
1988	16956	32713	8789	9255	13517	6337	18791	0.85	1.12	0.65
1989	7785	14552	4165	12859	19981	8276	38529	0.90	1.16	0.70
1990	3412	6723	1731	10666	16188	7027	28799	1.05	1.32	0.83
1991	10583	21231	5275	6041	8484	4301	18312	1.23	1.56	0.97

Year	Recruitment Age 1	High	Low	SSB	High	Low	Landings	F Ages 4–8	High	Low
	thousands			tonnes			tonnes			
1992	4105	7710	2186	3773	5466	2604	5727	1.34	1.73	1.03
1993	1869	3748	932	2152	3152	1469	1926	1.33	1.77	1.00
1994	2474	4867	1258	1788	2713	1178	2117	1.16	1.60	0.83
1995	1511	2948	775	1617	2578	1015	1701	0.97	1.39	0.68
1996	2231	4305	1157	1352	2085	876	944	0.82	1.19	0.57
1997	2724	5255	1412	1078	1663	698	1186	0.81	1.16	0.56
1998	2901	5923	1421	924	1547	551	322	0.86	1.27	0.58
1999	4639	9666	2226	955	1564	583	613	0.73	1.02	0.52
2000	6213	12344	3127	1097	1682	716	764	0.66	0.93	0.47
2001	7110	13674	3697	1179	1756	792	1680	0.63	0.88	0.45
2002	8178	15475	4322	1672	2398	1165	3622	0.62	0.85	0.46
2003	8574	15857	4636	3159	4504	2216	5215	0.73	0.98	0.55
2004	20789	37045	11666	3078	4245	2232	4948	0.81	1.07	0.62
2005	32520	58456	18091	3186	4356	2330	6043	0.87	1.13	0.66
2006	24397	44154	13480	3764	5012	2826	7388	0.84	1.09	0.64
2007	13013	24025	7049	10013	13958	7183	11050	0.83	1.07	0.64
2008	20211	36807	11098	12868	18485	8957	10005	0.79	1.02	0.61
2009	18640	33267	10444	15294	22276	10500	7534	0.72	0.94	0.55
2010	37494	66128	21259	15657	21762	11265	9268	0.73	0.95	0.56
2011	30791	53972	17566	15311	20111	11657	11007	0.72	0.93	0.55
2012	23194	44359	12127	22929	30019	17513	10672	0.65	0.85	0.50
2013	16654	32517	8529	28697	37925	21714	13202	0.64	0.85	0.48
2014	16700	33373	8357	39442	53228	29227	18331	0.63	0.87	0.46
2015	10313	21074	5047	44148	59666	32665	25272	0.61	0.86	0.43
2016	4151	9187	1876	39802	56051	28263	34204	0.61	0.92	0.41
2017	2429	8722	677	31982	48622	21036	31220	0.64	1.06	0.39
2018	10583	46041	1511	33818	53933	21123				

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