Cod (*Gadus morhua*) in Division 5.a (Iceland grounds)

ICES advice on fishing opportunities

ICES advises that when the Iceland management plan is applied, catches in the fishing year 2019/2020 should be no more than 272 411 tonnes.

Stock development over time

The spawning-stock biomass (SSB) shows an increasing trend and is well above MSY $B_{trigger}$. Fishing pressure (F) has declined in the last two decades and is currently at a historical low and close to HR_{MSY}. Recruitment (R) has been relatively stable since 1988.

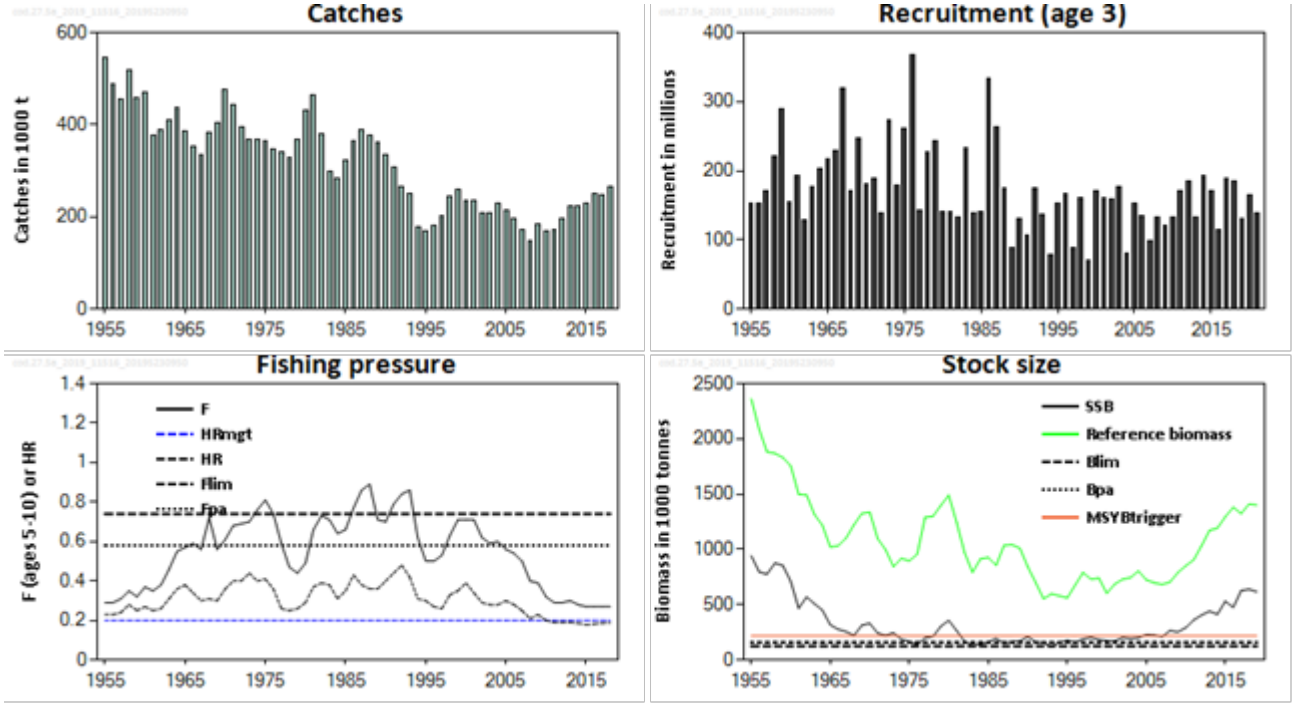

Figure 1 Cod in Division 5.a. Summary of the stock assessment. Harvest rates are calculated based on biomass age 4+. All biomass reference points refer to SSB levels (SSB is shown as a black line). $HR_{MGT} = HR_{MSY}$ and MGT $B_{trigger}$ = MSY $B_{trigger}$.

Stock and exploitation status

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

Table 1 Cod in Division 5.a. State of the stock and fishery relative to reference points.

	Fishing pressure				Stock size			
		2016	2017	2018		2017	2018	2019
Maximum sustainable yield	HR_{MSY}	✓	✓	✓ Below	MSY $B_{trigger}$	✓	✓	✓ Above trigger
Precautionary approach	F_{pa},F_{lim}	✓	✓	✓ Harvested sustainably	B_{pa},B_{lim}	✓	✓	✓ Full reproductive capacity
Management plan	HR_{MGT}	✓	✓	✓ Within expected range	MGT $B_{trigger}$	✓	✓	✓ Above

Catch scenarios

Table 2 Cod in Division 5.a. Assumptions made for the interim year and in the forecast. All weights are in tonnes.

Variable	Value	Notes
$F_{ages\ 5–10}$ (2019)	0.28	TAC constraint.
SSB (2020)	629 399	
B4+ (2020)	1 364 745	
$R_{age\ 3}$ (2019)	130 687	From the assessment (thousands).
$R_{age\ 3}$ (2020)	164 930	From the assessment (thousands).
$R_{age\ 3}$ (2021)	139 117	From the assessment (thousands).
Total catch (2019)	264 000	Estimated catch until the end of the fishing year (31 August 2019) and estimated catch of the first four months of the fishing year (1 September–31 December 2019).

Table 3 Cod in Division 5.a. Annual catch scenarios. All weights are in tonnes (t).

Rationale	Catch (2019/2020)	F (2020)	SSB (2021)	Biomass age 4+ (2021)	% SSB change *	% TAC change **	% advice change ***
Management plan	272 411	0.30	630 918	1 359 822	0	3	3

* SSB_{2021} relative to SSB_{2020}.
** Catch in 2019/2020 relative to $TAC_{2018/19}$ (264 437 tonnes). Because SSB_{2019} is bigger than MGT $B_{trigger}$, the TAC for 2019/2020 is calculated as $(0.2 \times B_{4+,2019} + TAC_{2018/19}) / 2$.
*** Advice value for 2019/2020 relative to the advice value for 2018/2019.

The advice for this year is similar to that of last year.

Basis of the advice

Table 4 Cod in Division 5.a. The basis of the advice.

Advice basis	Management plan (MII, 2015)
Management plan	The Icelandic Ministry of Industries and Innovation has a fisheries management plan for Icelandic cod (MII, 2015). In 2015, the plan was extended until 2020. The plan, which aims at providing maximum sustainable yield, has been evaluated by ICES and is considered to be precautionary. According to the management plan, the TAC for the fishing year Y/Y+1 (1 September of year Y to 31 August of year Y+1) is calculated as follows: $$TAC_{Y/Y+1} = \frac{\min\left(\frac{SSB_Y}{MGT\ B_{trigger}}, 1\right) 0.2\ B_{4+,Y} + TAC_{Y-1/Y}}{2}$$ where $B_{4+,Y}$ is the biomass of cod aged 4 and older in year Y and MGT $B_{trigger}$ = 220 000 tonnes. The expected range of realized harvest rate (HR) following the management plan (HR_{MGT}) can be found in the North-Western Working Group (NWWG) report (ICES, 2019).

Quality of the assessment

This assessment is considered consistent.

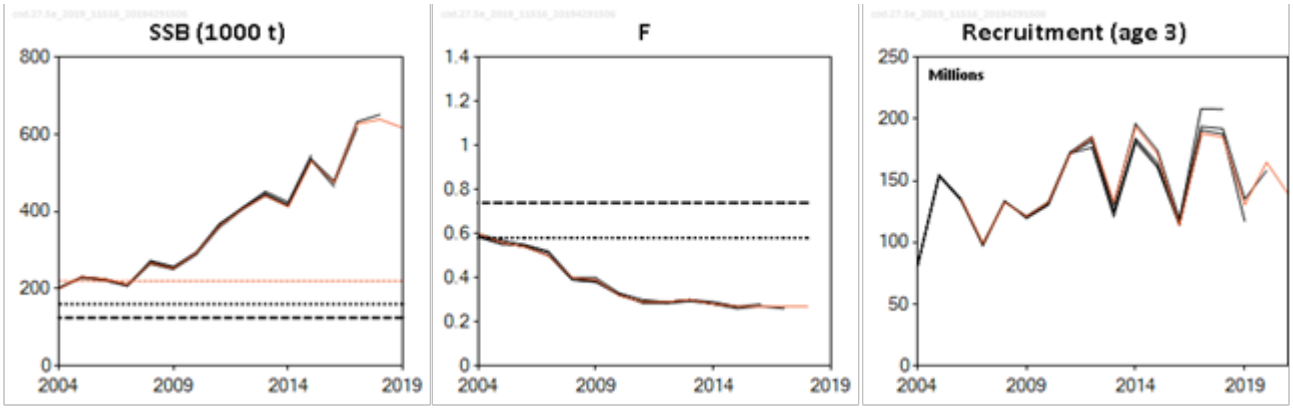

Figure 2 Cod in Division 5.a. Historical assessment results.

Issues relevant for the advice

There is no information to present for this stock.

Reference points

Table 5 Cod in Division 5.a. Reference points, values, and their technical basis. All weights are in tonnes.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	220 000	The trigger point in HCR that is considered consistent with the ICES MSY framework.	ICES (2010a)
	HR_{MSY}	20%	Stochastic HCR evaluation. Percentage of age 4+ biomass.	ICES (2010a)
Precautionary approach	B_{lim}	125 000	B_{loss}	ICES (2010a)
	B_{pa}	160 000	$B_{pa} = B_{lim} \times \exp(1.645\sigma_B)$; $\sigma_B = 0.15$.	ICES (2016)
	F_{lim}	0.74	The equilibrium F that will maintain the stock above B_{lim} with a 50% probability.	ICES (2016)
	F_{pa}	0.58	5% probability that true F has been above F_{lim}. $F_{pa} = F_{lim} \times \exp(-1.645\sigma_F)$; $\sigma_F = 0.15$.	ICES (2016)
Management plan	MGT $B_{trigger}$	220 000	The fifth percentile on the distribution of SSB when the TAC is based on HR_{MGT}.	ICES (2010b)
	HR_{MGT}	20%	Percentage of age 4+ biomass. Leads to long-term MSY.	ICES (2010b)

Basis of the assessment

Table 6 Cod in Division 5.a. Basis of the assessment and advice.

ICES stock data category	1 (ICES, 2018).
Assessment type	A forward-based statistical catch-at-age model that is implemented in the AD model builder, using catches in the model and in the forecast (ICES, 2019).
Input data	Catch-at-age and age-structured Icelandic spring (IS-SMB) and autumn (IS-SMH) survey indices (ages 1–10).
Discards and bycatch	Discarding is considered negligible and is not included.
Indicators	None.
Other information	None.
Working group	North-Western Working Group (NWWG).

Information from stakeholders

There is no additional available information for this stock.

History of the advice, catch, and management

Table 7 Cod in Division 5.a. ICES advice and official landings. All weights are in tonnes.

Year	ICES advice	Catch corresponding to advice	Agreed TAC	ICES catch for the fishing year	ICES catch for the calendar year
1988*	National advice	300000	350000		377554
1989*	National advice	300000	325000		363125
1990*	National advice	250000	300000		335316
1991*	National advice	240000	245000		307759
1991/1992	National advice	250000	265000	274000	264834
1992/1993	Reduce F by 40%	154000	205000	241000	250704
1993/1994	Reduce F by 40%	150000	165000	197000	178138
1994/1995	Reduce F by 50%	130000	155000	165000	168592
1995/1996	Apply catch rule #	155000	155000	170000	180701
1996/1997	Apply catch rule	186000	186000	202000	203112
1997/1998	Apply catch rule	218000	218000	227000	243987
1998/1999	Apply catch rule	250000	250000	254000	260147
1999/2000	Apply catch rule	247000	250000	257000	235092
2000/2001	Apply catch rule	203000	220000**	221000	236705
2001/2002	Apply catch rule	164000	190000**	219000	209537
2002/2003	Apply catch rule	183000	179000**	202000	207246
2003/2004	Apply catch rule	210000	209000	227000	228337
2004/2005	Apply catch rule	205000	205000	217000	213865
2005/2006	Apply catch rule	198000	198000	207000	197247
2006/2007	Apply catch rule	187000	193000	191000	171646
2007/2008	Apply catch rule	152000	130000	143000	147668
2008/2009	Apply F_{max}	< 124000	160000^	171000	183302
2009/2010	Apply F_{max}	< 135000	150000^^	170000	170009
2010/2011	Apply catch rule	160000	160000	167000	172207
2011/2012	Apply catch rule	177000	177000	185000	196177
2012/2013	Apply catch rule	196000	196000	213000	223594
2013/2014	Apply catch rule	215000	215000	226000	221990
2014/2015	Apply catch rule	218000	218000	223000	230229
2015/2016	Apply catch rule	239000	239000	249000	251134
2016/2017	Management plan	244000	244000	237644	243990
2017/2018	Management plan	257572	257572	270217	264992
2018/2019	Management plan	264437	264437		
2019/2020	Management plan	≤ 272411			

* Calendar year.
** Amended catch rule.
^ Initial TAC set to 130 000 tonnes according to the catch rule, raised to 160 000 tonnes in January 2009.
^^ Set according to the catch rule.

History of the catch and landings

Table 8 Cod in Division 5.a. Catch distribution by fleet in 2018 as estimated by ICES. All weights are in tonnes.

Catch (2018)	Landings					Discards
264 992	Bottom trawl 51%	Longline 30%	Gillnet 7%	Demersal seine 6%	Hooks 6%	Discarding is considered negligible
	264 992					

Summary of the assessment

Table 9 Cod in Division 5.a. Assessment summary. Weights are in tonnes. Recruitment in thousands.

Year	Recruitment Age 3	Stock size		Fishing pressure		Catch
		SSB	Reference biomass Ages 4+	F (ages 5−10)	Harvest rate	
1955	152005	941965	2360936	0.29	0.23	545250
1956	152803	796300	2085804	0.29	0.23	486909
1957	170634	776248	1882293	0.31	0.24	455182
1958	220681	876319	1868633	0.35	0.28	517359
1959	288961	854810	1830749	0.32	0.25	459081
1960	154365	709896	1754823	0.37	0.27	470121
1961	192863	467785	1497332	0.35	0.25	377291
1962	128928	569580	1493069	0.38	0.26	388985
1963	177463	508276	1315971	0.46	0.31	408800
1964	203974	451490	1219227	0.55	0.36	437012
1965	216329	317830	1022381	0.57	0.38	387106
1966	229131	277489	1031512	0.59	0.34	353357
1967	320055	256712	1102967	0.56	0.3	335721
1968	171858	221770	1222748	0.72	0.31	381770
1969	247416	313747	1325327	0.56	0.3	403205
1970	180464	331145	1336512	0.61	0.36	475077
1971	188615	242594	1097719	0.68	0.4	444248
1972	139272	221857	996907	0.69	0.4	395166
1973	273089	245599	843880	0.70	0.44	369205
1974	178989	187381	918604	0.76	0.4	368133
1975	260845	168763	895921	0.81	0.41	364754
1976	367581	139078	956188	0.74	0.36	346253
1977	143319	199435	1290607	0.59	0.26	340086
1978	227421	213114	1298934	0.47	0.25	329602
1979	243430	304938	1397844	0.44	0.26	366462
1980	140078	357768	1490591	0.49	0.29	432237
1981	140111	265122	1242908	0.66	0.37	465032
1982	131915	168483	971458	0.73	0.39	380068
1983	232263	131401	792469	0.71	0.38	298049
1984	139195	142412	914040	0.64	0.31	282022
1985	141056	163109	927820	0.66	0.35	323428
1986	333672	195661	855763	0.77	0.43	364797
1987	263665	149880	1037480	0.86	0.38	389915
1988	175666	168298	1042644	0.89	0.36	377554
1989	88908	171915	1010943	0.71	0.36	363125
1990	131118	210218	843395	0.70	0.4	335316
1991	107213	165842	700289	0.79	0.44	307759
1992	175465	153655	552973	0.84	0.48	264834
1993	136224	122366	598808	0.86	0.42	250704
1994	78731	158780	580055	0.62	0.31	178138
1995	152783	179320	561847	0.50	0.3	168592
1996	166026	161363	677772	0.50	0.27	180701
1997	89189	190558	790862	0.53	0.26	203112
1998	161848	202417	729585	0.63	0.33	243987

Year	Recruitment Age 3	Stock size		Fishing pressure		Catch
		SSB	Reference biomass Ages 4+	F (ages 5–10)	Harvest rate	
1999	71293	184328	741033	0.71	0.35	260147
2000	171341	174499	602618	0.71	0.39	235092
2001	161790	172743	686589	0.71	0.34	236702
2002	158707	201393	729720	0.62	0.29	209551
2003	177715	193823	744894	0.59	0.28	207246
2004	80439	199369	805305	0.60	0.28	228342
2005	153616	230986	724583	0.56	0.3	213867
2006	135258	224822	698154	0.54	0.28	197258
2007	99180	210121	682481	0.50	0.25	171659
2008	132425	266410	704737	0.40	0.21	147672
2009	121003	252783	790864	0.39	0.23	183322
2010	132437	293186	851942	0.32	0.2	170023
2011	171743	362235	906301	0.29	0.19	172209
2012	185172	406692	1036006	0.29	0.189	196180
2013	132724	440925	1171792	0.30	0.191	223592
2014	193725	412888	1192758	0.28	0.186	222010
2015	171882	530987	1295337	0.27	0.178	230239
2016	113936	475265	1381067	0.27	0.182	251146
2017	188357	627486	1323989	0.27	0.187	247860
2018	185447	639312	1409502	0.27	0.188	264992
2019	130687	617019	1401925			
2020	164930					
2021	139117					

Sources and references

ICES. 2010a. Iceland and Greenland. Report of the ICES Advisory Committee, 2010. ICES Advice 2010, Book 2. 114 pp. https://doi.org/10.17895/ices.advice.4910.

ICES. 2010b. Report of the Ad hoc Group on Icelandic Cod HCR Evaluation (AGICOD), 24–26 November 2009, ICES Headquarters, Copenhagen, Denmark. ICES CM 2009\ACOM:56. 89 pp. https://doi.org/10.17895/ices.pub.5279.

ICES. 2016. Report of the North-Western Working Group (NWWG), 27 April–4 May, 2016, ICES Headquarters, Copenhagen, Denmark. ICES CM 2016/ACOM:08. 703 pp. https://doi.org/10.17895/ices.pub.5280.

ICES. 2018. Advice basis. *In* Report of the ICES Advisory Committee, 2018. ICES Advice 2018, Book 1, Section 1.2. https://doi.org/10.17895/ices.pub.4503.

ICES. 2019. North-Western Working Group. ICES Scientific Reports. 1:14. 620 pp. http://doi.org/10.17895/ices.pub.5298.

MII. 2015. Icelandic Ministry of Industries and Innovation's fisheries management plan for Icelandic cod.

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