ICES
CIEM

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

ICES stock advice

ICES advises that when the Iceland management plan is applied, catches in the fishing year 2017/2018 should be no more than 257 572 tonnes.

Stock development over time

The spawning-stock biomass (SSB) of Icelandic cod is increasing and is higher than has been observed over the last four decades. Fishing mortality (F) has declined significantly in the last decade and is presently at a historical low. Year classes are estimated to have been relatively stable since 1988, but with the mean around the lower values observed in the period 1955 to 1985.
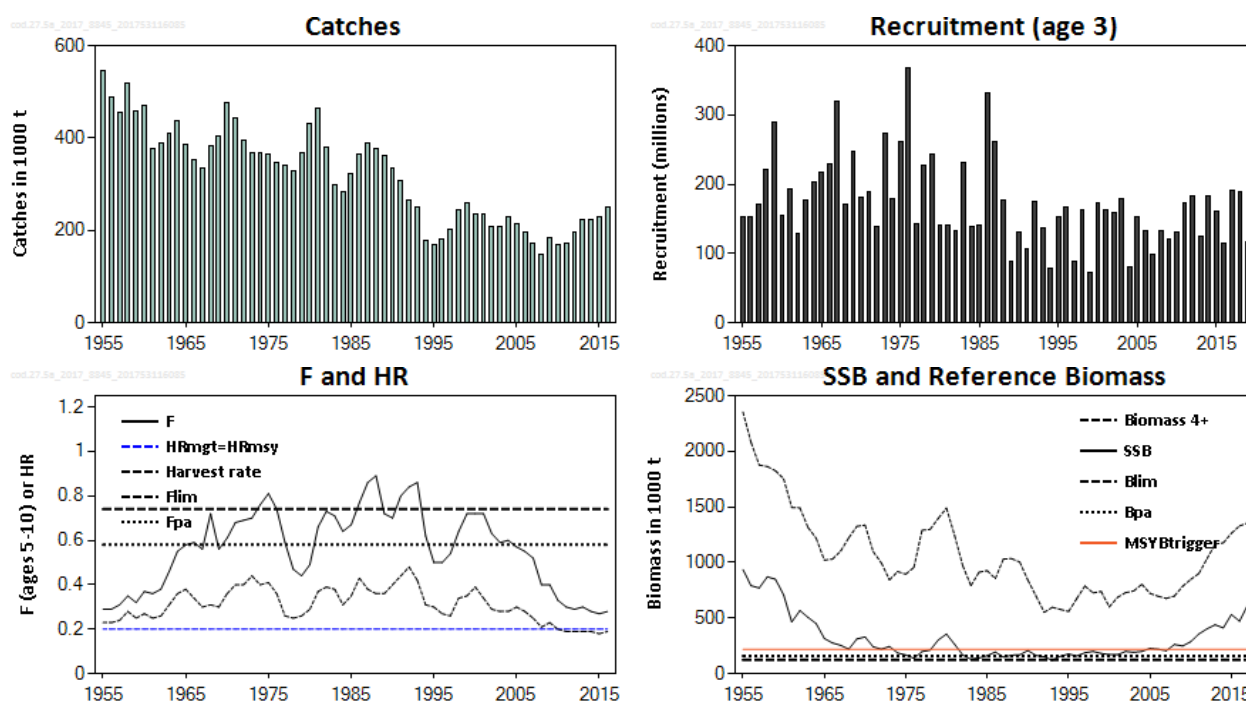
Figure 1   Cod in Division 5.a. Summary of the stock assessment. Harvest rates are calculated based on biomass age 4+. All biomass reference points refer to SSB levels. $HR_{MGT} = HR_{MSY}$ and MGT $B_{trigger}$ = MSY $B_{trigger}$; therefore, the horizontal lines displaying these points in the graph overlap.

Stock and exploitation status

Table 1   Cod in Division 5.a. State of the stock and fishery relative to reference points. The expected range of realized harvest rate (HR) following the management plan (HR_{MGT}) can be found in the North-Western Working Group report (ICES, 2017).

		Fishing pressure				Stock size			
		2014	2015	2016			2015	2016	2017
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 options

Table 2   Cod in Division 5.a. The basis for the catch options.

Variable	Value	Source	Notes
Fages 5–10 (2017)	0.26	ICES (2017)	TAC constraint
SSB (2018)	649356	ICES (2017)	(in tonnes)
B4+ (2018)	1444190	ICES (2017)	(in tonnes)
Rage3 (2017)	190932	ICES (2017)	From the assessment (in thousands)
Rage3 (2018)	188040	ICES (2017)	From the assessment (in thousands)
Rage3 (2019)	117273	ICES (2017)	From the assessment (in thousands)
Total catch (2017)	251000	ICES (2017)	(in tonnes) Estimated catch until the end of the fishing year (31.08.2017) and estimated catch in the first four months of the next fishing year (01.09–31.12.2017)
Landings (2017)	251000	ICES (2017)	(in tonnes)
Discards (2017)	-	ICES (2017)	Negligible

Table 3   Cod in Division 5.a. Annual catch options. All weights are in tonnes.

Rationale	Catch (2017/18)	F (2018)	SSB (2019)	Biomass of age 4+ (2019)	%SSB change*	% TAC change**
Management plan ***	257572	0.26	669000	1524000	3%	6%

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

** Catch in 2017/18 relative to $TAC_{2016/17}$ (244 000 t)

** Because SSB_{2017} is bigger than MGT $B_{trigger}$, the TAC for 2017/18 is calculated as $(0.2 \times B_{4+,2017} + TAC_{2016/17}) / 2$.
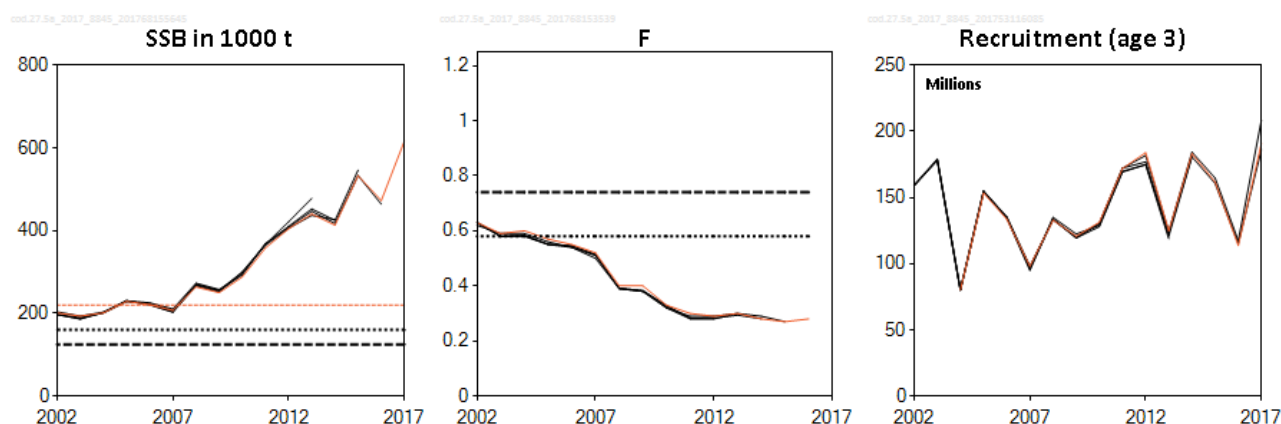
Basis of the advice

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

Advice basis	Management plan
Management plan	The Icelandic Ministry of Industries and Innovation's fisheries management plan for Icelandic cod (MII, 2015). In 2015, the plan was extended until 2020. The plan, aimed 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 (September 1 of year Y to August 31 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.

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.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	220000 t	Trigger point in HCR considered consistent with ICES MSY framework	ICES (2010)
	HR_{MSY}	20%	Stochastic HCR evaluation. Percentage of age 4+ biomass.	ICES (2010)
Precautionary approach	B_{lim}	125000 t	B_{loss}	ICES (2010)
	B_{pa}	160000 t	$B_{pa} = B_{lim} \times \exp(1.645\sigma_B)$, $\sigma_B = 0.15$	ICES (2016a)
	F_{lim}	0.74	Equilibrium F, which will maintain the stock above B_{lim} with a 50% probability.	ICES (2016a)
	F_{pa}	0.58	5% probability that true F has been above F_{lim}. $F_{pa} = F_{lim} \times \exp(-1.645\sigma_F)$ and $\sigma_F = 0.15$.	ICES (2016a)
Management plan	MGT $B_{trigger}$	220000 t	The 5th percentile on the distribution of SSB when the TAC is based on HR_{MGT}	ICES (2009)
	HR_{MGT}	20%	Percentage of age 4+ biomass. Leads to long-term MSY.	ICES (2009)

Basis of the assessment

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

ICES stock data category	1 (ICES, 2016).
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
Input data	Catch-at-age and age-structured spring and autumn survey indices
Discards and bycatch	Discarding is considered negligible and is not included.
Indicators	None
Other information	Immigration has been taken into account.
Working group	North-Western Working Group (NWWG)

Information from stakeholders

There is no available information.

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 [#]	Predicted catch corresp. 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 Fmax	< 124000	160000^	171000	183302
2009/2010	Apply Fmax	< 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		
2017/2018	Management plan	257572			

* Calendar year.
** Amended catch rule.
^ Initial TAC set to 130 according to the catch rule, raised to 160 in January 2009.
^^ Set according to the catch rule.
[#] The catch rule prior to 2010/2011 is different from the one was used since then (0.25 vs. 0.20 multiplier).

History of the catch and landings

Table 8   Cod in Division 5.a. Catch distribution by fleet in 2016 as estimated by ICES.

Catch (2016)	Landings					Discards
251 134 t	Bottom trawl 45%	Longline 35%	Gillnet 8%	Danish seine 6%	Hooks 6%	Negligible
	251 134 t					

Summary of the assessment

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

Year	Recruitment	Stock size		Catch	Fishing pressure	
	Age 3	SSB	Biomass age 4+		$F_{Ages\ 5–10}$	Harvest rate age 4+
	(thousands)	(tonnes)	(tonnes)	(tonnes)	per year	per year
1955	151968	936957	2354550	545250	0.29	0.23
1956	152779	791479	2079670	486909	0.29	0.23
1957	170645	771545	1876560	455182	0.31	0.24
1958	220745	871819	1863510	517359	0.35	0.28
1959	289220	849812	1825050	459081	0.32	0.25
1960	154235	707616	1752670	470121	0.37	0.27
1961	192814	466533	1495590	377291	0.36	0.25
1962	128753	568226	1491700	388985	0.38	0.26
1963	177361	507238	1314700	408800	0.46	0.31
1964	203993	450537	1218020	437012	0.55	0.36
1965	216324	317427	1021880	387106	0.58	0.38
1966	229143	277117	1031020	353357	0.59	0.34
1967	320294	256385	1102490	335721	0.56	0.3
1968	171920	221564	1222650	381770	0.72	0.31
1969	247519	313646	1325510	403205	0.56	0.3
1970	180519	331062	1336830	475077	0.61	0.36
1971	188666	242547	1097930	444248	0.68	0.4
1972	139274	221848	997062	395166	0.69	0.4
1973	273152	245538	843945	369205	0.7	0.44
1974	179021	187230	918545	368133	0.76	0.4
1975	260861	168577	895774	364754	0.81	0.41
1976	367736	138864	955975	346253	0.74	0.36
1977	143333	199152	1290500	340086	0.59	0.26
1978	227611	212854	1298840	329602	0.47	0.25
1979	243306	304741	1398130	366462	0.44	0.26
1980	140214	357419	1490310	432237	0.49	0.29
1981	140176	264788	1242870	465032	0.66	0.37
1982	132046	168127	971395	380068	0.73	0.39
1983	231686	131064	792556	298049	0.71	0.38
1984	139487	142138	913317	282022	0.64	0.31
1985	141016	162773	927603	323428	0.67	0.35
1986	331006	195326	855467	364797	0.77	0.43
1987	261644	149477	1032960	389915	0.86	0.38
1988	176183	167110	1035360	377554	0.89	0.36
1989	89375	170219	1004410	363125	0.72	0.36
1990	131288	208954	841679	335316	0.7	0.4
1991	107619	164827	699390	307759	0.8	0.44
1992	175207	152750	552524	264834	0.84	0.48
1993	136037	121603	597698	250704	0.86	0.42
1994	78841	157885	578481	178138	0.62	0.31
1995	152168	178346	560464	168592	0.5	0.3
1996	166131	160307	675467	180701	0.5	0.27
1997	89382	189355	788688	203112	0.54	0.26
1998	162305	201252	727708	243987	0.64	0.34
1999	71551	182945	739798	260147	0.72	0.35
2000	171958	172963	601354	235092	0.72	0.39
2001	162627	171565	686565	236705	0.72	0.34
2002	158887	201024	729368	209537	0.63	0.29

Year	Recruitment	Stock size		Catch	Fishing pressure	
	Age 3	SSB	Biomass age 4+		$F_{Ages\ 5–10}$	Harvest rate age 4+
	(thousands)	(tonnes)	(tonnes)	(tonnes)	per year	per year
2003	178428	193265	744541	207246	0.59	0.28
2004	80256	201184	804839	228337	0.6	0.28
2005	153340	228840	722745	213865	0.57	0.3
2006	133720	220981	696877	197247	0.55	0.28
2007	98168	207098	677413	171646	0.52	0.25
2008	132945	263861	698956	147668	0.4	0.21
2009	120777	250112	786507	183302	0.4	0.23
2010	131366	288159	847814	170009	0.33	0.2
2011	171966	358182	901929	172207	0.3	0.19
2012	183932	404550	1033820	196177	0.29	0.19
2013	124929	440439	1166220	223594	0.3	0.19
2014	183145	413113	1176950	221990	0.28	0.19
2015	161815	532915	1263480	230229	0.27	0.18
2016	113762	472782	1329700	251134	0.28	0.19
2017	190932	616906	1355719			
2018	188040					
2019	117273					

Sources and references

MII. 2015. Icelandic Ministry of Industries and Innovation's fisheries management plan for Icelandic cod. http://www.fisheries.is/main-species/cod/management_plan/nr/349.

ICES. 2009. Report of the Ad hoc Group on Icelandic Cod HCR Evaluation (AGICOD), 24–26 November 2009 ICES, Copenhagen, Denmark. ICES CM 2009\ACOM:56. 89 pp.

ICES. 2010. Report of the ICES Advisory Committee, 2010. ICES Advice 2010, Book 2.

ICES. 2016. Advice basis. *In* Report of the ICES Advisory Committee, 2016. ICES Advice 2016, Book 1, Section 1.2.

ICES. 2017. Report of the North-Western Working Group (NWWG), 27 April–4 May, 2017, ICES Headquarters, Copenhagen. ICES CM 2017/ACOM:08.