

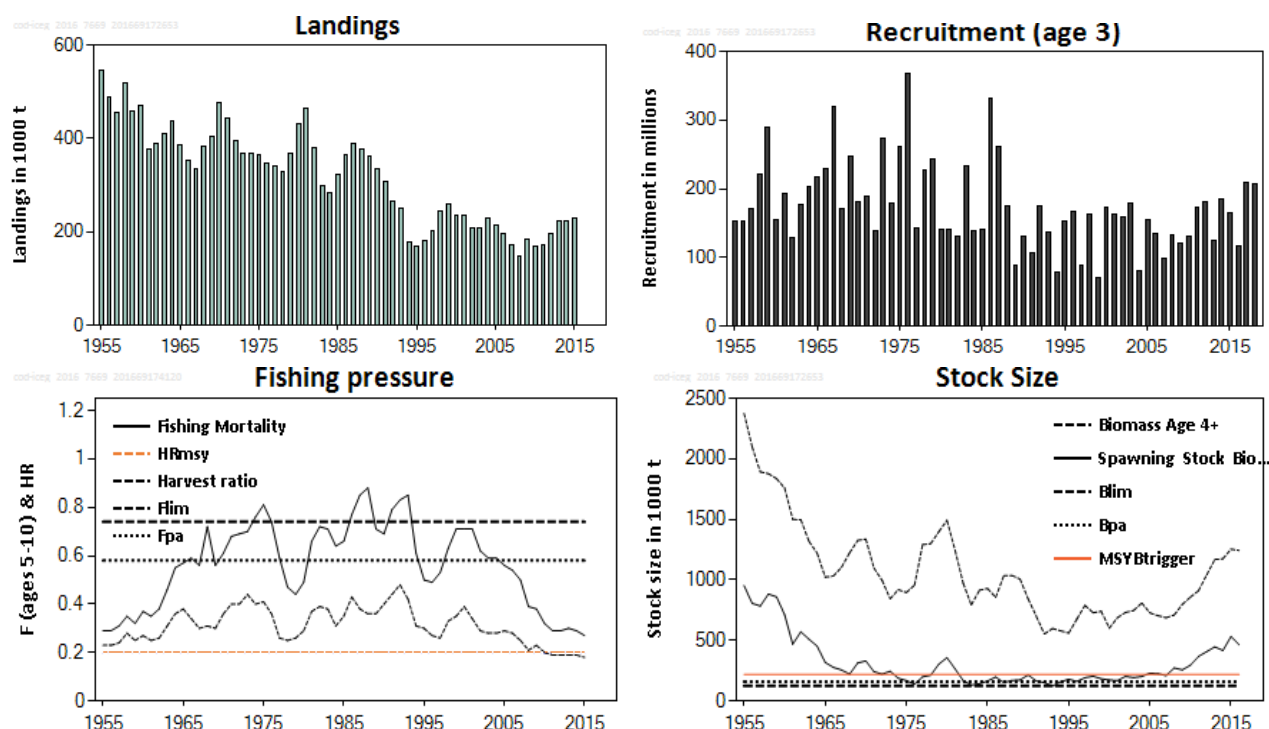
## 2.3.2 Cod (*Gadus morhua*) in Division 5.a (Iceland grounds)

### ICES stock advice

ICES advises that when the Icelandic management plan is applied, catches in the fishing year 2016/2017 should be no more than 244 000 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. Year classes 2014 and 2015 are estimated to be above the long-term average.



**Figure 2.3.2.1** 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 2.3.2.1** 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, 2016a).

		Fishing pressure			Stock size		
		2013	2014	2015	2014	2015	2016
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 2.3.2.2** Cod in Division 5.a. The basis for the catch options.

Variable	Value	Source	Notes
F <sub>ages 5–10</sub> (2016)	0.30	ICES (2016a)	TAC constraint
SSB (2017)	481 kt	ICES (2016a)	
B <sub>4+</sub> (2017)	1191 kt	ICES (2016a)	
R <sub>age3</sub> (2016)	117 million	ICES (2016a)	From the assessment
R <sub>age3</sub> (2017)	208 million	ICES (2016a)	From the assessment
R <sub>age3</sub> (2018)	208 million	ICES (2016a)	From the assessment
Total catch (2016)	246 kt	ICES (2016a)	Estimated catch until the end of the fishing season (31.08.2016) and estimated catch in the first four months of the next fishing season (01.09–31.12.2016).
Discards (2016)	-	ICES (2016a)	Negligible

**Table 2.3.2.3** Cod in Division 5.a. The catch options. Weights in thousand tonnes.

Rationale	Landings (2016/17)	Basis	F (2017)	SSB (2018)	Biomass of age 4+ (2018)	%SSB change*	% TAC change
Management plan	244	Harvest control rule (HCR) in the Management Plan **	0.30	492	1266	2%	2%

\* SSB<sub>2018</sub> relative to SSB<sub>2017</sub>.

\*\* Because SSB<sub>2016</sub> is bigger than MGT B<sub>trigger</sub>, the TAC for 2016/17 is calculated as  $(0.2 \times B_{4+,2016} + TAC_{2015/16}) / 2$ .

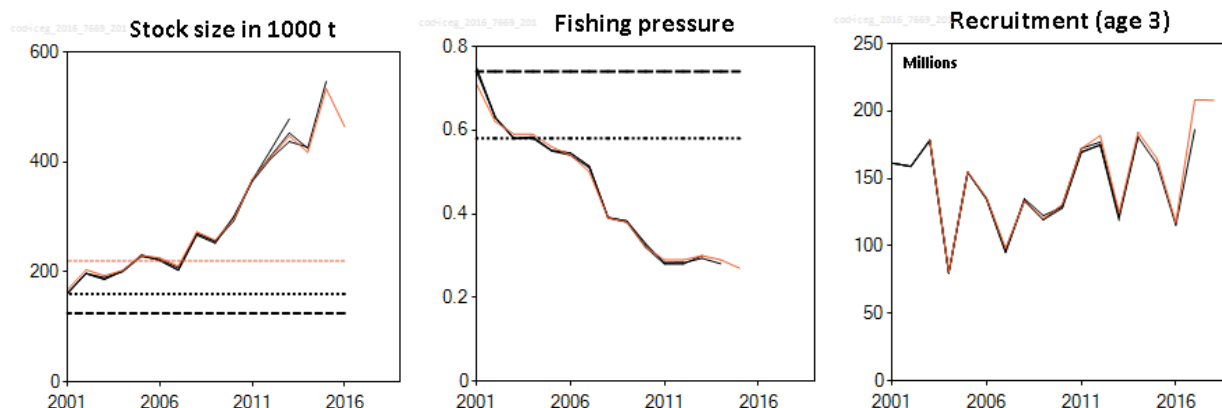
## Basis of the advice

**Table 2.3.2.4** Cod in Division 5.a. The basis of the advice.

Advice basis	Management plan
Management plan	<p>The Icelandic Ministry of Industries and Innovation's fisheries management plan for Icelandic cod (<a href="#">MII, 2015</a>).</p> <p>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:</p> $TAC_{Y/Y+1} = \frac{\min\left(\frac{SSB_Y}{MGT B_{trigger}}, 1\right) 0.2 B_{4+,Y} + TAC_{Y-1/Y}}{2}$ <p>where B<sub>4+,Y</sub> is the biomass of cod aged 4 and older in year Y, and MGT B<sub>trigger</sub> = 220 000 tonnes.</p>

## Quality of the assessment

This assessment is considered consistent.



**Figure 2.3.2.2** Cod in Division 5.a. Historical assessment results (final-year recruitment estimates included).

### Issues relevant for the advice

There is no information to present for this stock.

### Reference points

**Table 2.3.2.5** Cod in Division 5.a. Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{\text{trigger}}$	220 000 t	Trigger point in HCR considered consistent with ICES MSY framework.	ICES (2010)
	$HR_{\text{MSY}}$	20%	Stochastic HCR evaluation. Percentage of age 4+ biomass.	ICES (2010)
Precautionary approach	$B_{\text{lim}}$	125 000 t	$B_{\text{loss}}$	ICES (2010)
	$B_{\text{pa}}$	160 000 t	$B_{\text{pa}} = B_{\text{lim}} \times \exp(1.645\sigma_B)$ , $\sigma_B = 0.15$	ICES (2016a)
	$F_{\text{lim}}$	0.74	Equilibrium $F$ which will maintain the stock above $B_{\text{lim}}$ with a 50% probability.	ICES (2016a)
	$F_{\text{pa}}$	0.58	5% probability that true $F$ has been above $F_{\text{lim}}$ . $F_{\text{pa}} = F_{\text{lim}} \times \exp(-1.645\sigma_F)$ and $\sigma_F = 0.15$ .	ICES (2016a)
Management plan	MGT $B_{\text{trigger}}$	220 000 t	The 5th percentile on the distribution of SSB when the TAC is based on $HR_{\text{MGT}}$ .	ICES (2009)
	$HR_{\text{MGT}}$	20%	Percentage of age 4+ biomass. Leads to long-term MSY.	ICES (2009)

### Basis of the assessment

**Table 2.3.2.6** Cod in Division 5.a. The basis of the assessment.

ICES stock data category	1 ( <a href="#">ICES, 2016b</a> )
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	Landings-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 ( <a href="#">NWWG</a> )

### Information from stakeholders

There is no available information.

### History of the advice, catch, and management

**Table 2.3.2.7** Cod in Division 5.a. History of ICES advice, the agreed TAC, and ICES estimates of landings by national fishing year (September to August the following year). Weights are in thousand tonnes.

Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC <sup>#</sup>	ICES landings for the fishing year	ICES landings for the calendar year
1988*	National advice	300	350		378
1989*	National advice	300	325		356
1990*	National advice	250	300		335
1991*	National advice	240	245		309
1991/1992	National advice	250	265	274	274
1992/1993	Reduce F by 40%	154	205	241	241
1993/1994	Reduce F by 40%	150	165	197	197
1994/1995	Reduce F by 50%	130	155	165	169
1995/1996	Apply catch rule	155	155	170	182
1996/1997	Apply catch rule	186	186	202	203
1997/1998	Apply catch rule	218	218	227	243
1998/1999	Apply catch rule	250	250	254	260
1999/2000	Apply catch rule	247	250	257	236
2000/2001	Apply catch rule	203	220**	221	238
2001/2002	Apply catch rule	164	190**	219	210
2002/2003	Apply catch rule	183	179**	202	207
2003/2004	Apply catch rule	210	209	227	228
2004/2005	Apply catch rule	205	205	217	214
2005/2006	Apply catch rule	198	198	207	197
2006/2007	Apply catch rule	187	193	191	172
2007/2008	Apply catch rule	152	130	143	148
2008/2009	Apply $F_{\max}$	< 124	160 <sup>^</sup>	171	183
2009/2010	Apply $F_{\max}$	< 135	150 <sup>^^</sup>	170	170
2010/2011	Apply catch rule	160	160	167	172
2011/2012	Apply catch rule	177	177	185	196
2012/2013	Apply catch rule	196	196	213	224
2013/2014	Apply catch rule	215	215	226	222
2014/2015	Apply catch rule	218	218	223	230
2015/2016	Apply catch rule	239	239		
2016/2017	Management plan	244			

\* Calendar year.

\*\* Amended catch rule.

<sup>^</sup> Initial TAC set to 130 according to the catch rule, raised to 160 in January 2009.

<sup>^^</sup> Set according to the catch rule.

<sup>#</sup> The catch rule prior to 2010/2011 is different from the one was used since then (0.25 vs. 0.20 multiplier).

### History of catch and landings

**Table 2.3.2.8** Cod in Division 5.a. Catch distribution by fleet in 2015 as estimated by ICES.

Total catch (2015)	Commercial landings					Commercial discards
230 kt	45% bottom trawl	35% longline	8% gillnet	6% Danish seine	6% hooks	Negligible
	230 kt					

## Summary of the assessment

**Table 2.3.2.9** Cod in Division 5.a. Assessment summary.

Year	Recruitment	Stock size		Landings	Fishing pressure	
	Age 3	SSB	Biomass age 4+		F <sub>Ages 5–10</sub>	Harvest rate age 4+
	(millions)	(kilotonnes)	(kilotonnes)	(kilotonnes)	Year–1	Year–1
1955	152.016	953.278	2375.036	545.25	0.288	0.23
1956	152.792	806.298	2098.032	486.909	0.288	0.23
1957	170.639	785.078	1892.57	455.182	0.309	0.24
1958	220.984	883.799	1877.055	517.359	0.352	0.28
1959	289.373	859.929	1836.372	459.081	0.321	0.25
1960	154.337	712.439	1758.278	470.121	0.37	0.27
1961	193.074	469.374	1500.279	377.291	0.354	0.25
1962	128.938	571.614	1495.842	388.985	0.382	0.26
1963	177.51	510.186	1318.431	408.8	0.457	0.31
1964	203.898	453.246	1221.569	437.012	0.547	0.36
1965	216.388	318.588	1023.463	387.106	0.575	0.38
1966	229.16	277.969	1032.152	353.357	0.588	0.34
1967	320.303	257.009	1103.398	335.721	0.56	0.30
1968	171.801	221.959	1223.332	381.77	0.72	0.31
1969	247.395	314.034	1326.003	403.205	0.557	0.30
1970	180.418	331.527	1337.314	475.077	0.61	0.36
1971	188.597	242.925	1098.217	444.248	0.683	0.40
1972	139.216	222.252	997.449	395.166	0.692	0.40
1973	273.174	245.944	844.349	369.205	0.703	0.44
1974	178.982	187.669	919.1	368.133	0.762	0.40
1975	260.861	169.023	896.324	364.754	0.806	0.41
1976	367.683	139.357	956.675	346.253	0.742	0.36
1977	143.32	199.795	1291.284	340.086	0.587	0.26
1978	227.589	213.472	1299.594	329.602	0.473	0.25
1979	243.438	305.369	1398.864	366.462	0.443	0.26
1980	140.028	358.371	1491.73	432.237	0.489	0.29
1981	140.305	265.714	1243.885	465.032	0.658	0.37
1982	131.676	169.082	972.541	380.068	0.724	0.39
1983	232.626	132.004	793.208	298.049	0.708	0.38
1984	139.027	143.098	915.231	282.022	0.635	0.31
1985	140.638	165.594	928.907	323.428	0.663	0.35
1986	331.207	197.834	856.099	364.797	0.768	0.43
1987	261.938	152.472	1034.126	389.915	0.854	0.38
1988	175.76	169.571	1037.275	377.554	0.883	0.36
1989	89.215	174.449	1006.952	363.125	0.71	0.36
1990	130.949	215.606	843.546	335.316	0.692	0.40
1991	107.033	165.986	700.65	307.759	0.791	0.44
1992	175.343	152.494	553.176	264.834	0.833	0.48
1993	135.945	123.097	598.878	250.704	0.853	0.42
1994	78.225	158.854	580.018	178.138	0.612	0.31
1995	152.067	179.591	561.283	168.592	0.497	0.30
1996	166.349	161.85	676.22	180.701	0.495	0.27
1997	89.332	192.442	789.809	203.112	0.531	0.26
1998	162.422	204.859	729.154	243.987	0.631	0.33
1999	71.254	183.618	741.204	260.147	0.712	0.35
2000	172.49	173.878	602.062	235.092	0.714	0.39
2001	163.252	167.932	687.981	236.705	0.71	0.34
2002	159.586	203.796	731.859	209.537	0.619	0.29
2003	179.232	193.407	748.012	207.246	0.587	0.28

Year	Recruitment	Stock size		Landings	Fishing pressure	
	Age 3	SSB	Biomass age 4+		F <sub>Ages 5–10</sub>	Harvest rate age 4+
	(millions)	(kilotonnes)	(kilotonnes)		Year–1	Year–1
2004	80.593	202.944	809.603	228.337	0.594	0.28
2005	154.973	230.364	728.167	213.865	0.557	0.29
2006	135.56	225.566	704.547	197.247	0.537	0.28
2007	98.209	210.642	687.892	171.646	0.499	0.25
2008	133.187	273.051	710.846	147.668	0.389	0.21
2009	120.241	257.608	798.076	183.302	0.381	0.23
2010	130.644	295.656	858.715	170.009	0.318	0.20
2011	172.196	368.713	911.068	172.207	0.289	0.19
2012	181.809	408.345	1042.222	196.177	0.287	0.19
2013	124.534	447.024	1169.133	223.594	0.299	0.19
2014	184.339	417.504	1175.369	221.99	0.285	0.19
2015	164.774	533.186	1253.847	230.225	0.273	0.18
2016	117.45	464.02	1240.7			
2017	208.38					
2018	207.996					

### Sources and references

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