5.3.6 Cod (*Gadus morhua*) in Division 7.a (Irish Sea)

ICES stock advice

ICES advises that when the MSY approach is applied, there should be zero catch in 2017.

Stock development over time

Fishing mortality has been declining in recent years and is uncertain, but remains well above F_{MSY}. The spawning-stock biomass has increased since 2010, although it still remains below B_{lim}. Recruitment has been low since the mid-1990s.

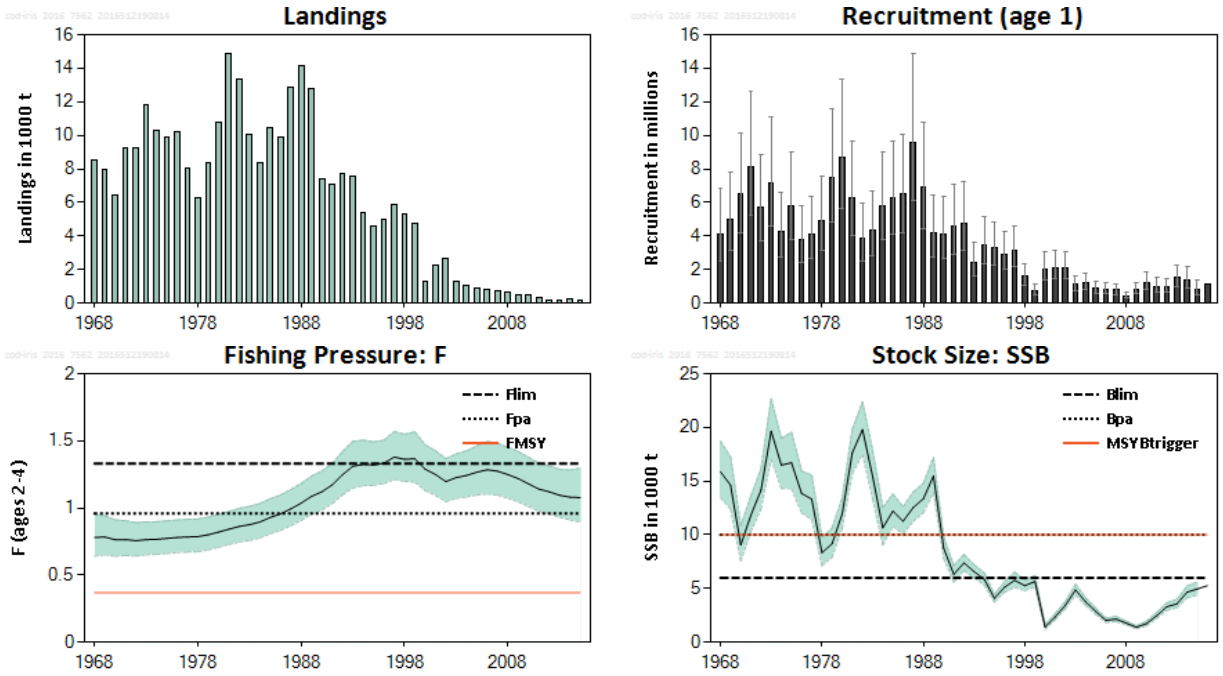

Figure 5.3.6.1 Cod (*Gadus morhua*) in Division 7.a. Summary of stock assessment (weights in thousand tonnes).

Stock and exploitation status

Table 5.3.6.1 Cod (*Gadus morhua*) in Division 7.a. State of the stock and fishery relative to reference points.

	Fishing pressure					Stock size				
		2013	2014	2015			2014	2015	2016	
Maximum sustainable yield	F_{MSY}	✗	✗	✗	Above	MSY $B_{trigger}$	✗	✗	✗	Below trigger
Precautionary approach	F_{pa}, F_{lim}	o	o	o	Increased risk	B_{pa}, B_{lim}	✗	✗	✗	Reduced reproductive capacity
Management plan	F_{MGT}	?	?	?	Not applicable	SSB_{MGT}	?	?	?	Not applicable

Catch options

When a stock is below B_{lim} the ICES advice is to bring the stock above B_{lim} in the short term. The short-term forecast carried out for this stock indicates that assuming $F_{2016} = F_{2015}$ and negligible removals in 2017, the stock would only be at B_{lim}. Given the uncertainties in the assessment, zero catch is advised for 2017 and no catch options are provided for 2017.

Basis of the advice

Table 5.3.6.2 Cod (*Gadus morhua*) in Division 7.a. The basis of the advice.

Advice basis	MSY approach.
Management plan	A long-term plan was agreed by the EU in 2008 (Council Regulation (EC) 1342/2008; EU, 2008), resulting in TACs of 285 t in 2013 and 228 t in 2014. ICES (2009, 2010) evaluated the plan and does not consider the management plan to be in accordance with the precautionary approach.

Quality of the assessment

The model estimates of total removals continue to be substantially higher than the reported landings, despite more accurate catch reporting. In the last two years model estimates of total removals have been more than 20 fold higher than that reported in the fishery. The assessment model is sensitive to changes in information sources and has difficulties in fitting the latest survey results.

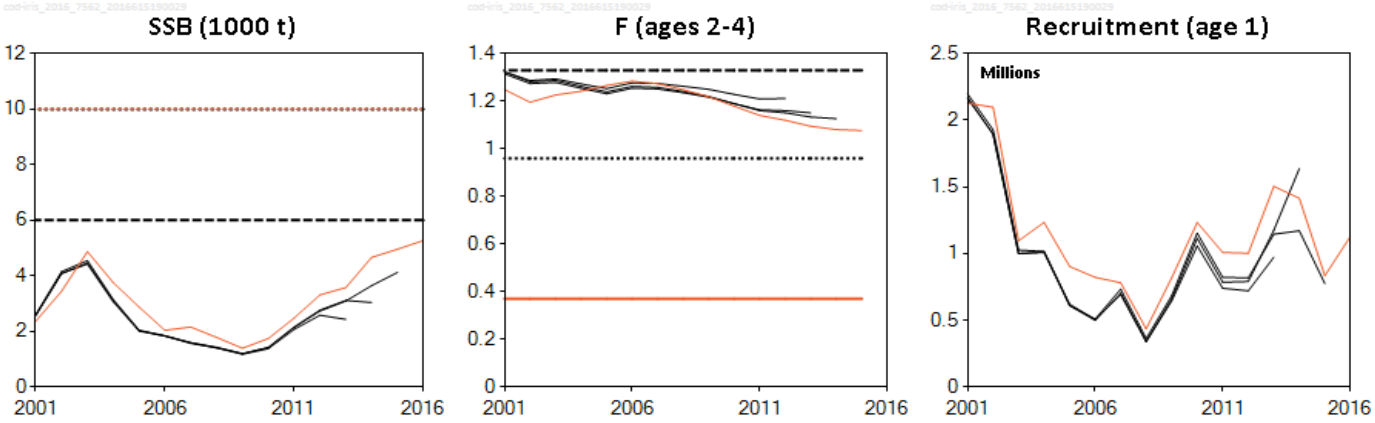

Figure 5.3.6.2 Cod (*Gadus morhua*) in Division 7.a. Historical assessment results (final-year recruitment estimates included).

Issues relevant for the advice

No catch options are provided because removals in the forecast cannot presently be partitioned in a way that could provide an estimate of fishing opportunities.

Reference points

Table 5.3.6.3 Cod (*Gadus morhua*) in Division 7.a. Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	10 000 t	MSY $B_{trigger}$ = B_{pa}	ICES (1998)
	F_{MSY}	0.37	Segmented regression with B_{loss}, the lowest observed spawning-stock biomass (Eqsim).	ICES (2016a)
Precautionary approach	B_{lim}	6 000 t	B_{lim} = B_{loss}, the lowest observed spawning stock estimated in previous assessments	ICES (1998)
	B_{pa}	10 000 t	High probability (95%) of maintaining SSB above B_{lim}	ICES (1998)
	F_{lim}	1.33	Based on simulated recruitment to median biomass at B_{lim}	ICES (2016b)
	F_{pa}	0.96	$F_{lim} \times \exp(-1.645 \times \sigma)$; $\sigma = 0.2$	ICES (2016b)
Management plan	SSB_{MGT}	B_{pa} and B_{lim}		EU (2008)
	F_{MGT}	0.4		EU (2008)

Basis of the assessment

Table 5.3.6.4 Cod (*Gadus morhua*) in Division 7.a. The basis of the assessment.

ICES stock data category	1 (ICES, 2016c)
Assessment type	Analytical assessment (SAM)
Input data	Commercial landings; nine survey indices (NIGFS-WIBTS-Q1, NIGFS-WIBTS-Q4, ScoGFS-WIBTS-Q1, ScoGFS-WIBTS-Q4, NIMIK, 2 UK-FSP (Eastern and Western Irish Sea), IS-AEPM, UK(E&W)-BTS-Q3); maturity-at-age constant in all years; maturity-at-age 2 changed in the last years according to Armstrong *et al.* (2004); fixed natural mortality.
Discards and bycatch	Used to provide advice, but not included in the assessment. Discard information available since 2007.
Indicators	None
Other information	This stock was benchmarked in 2012 (WKROUND; ICES, 2012). A new benchmark is planned for 2017.
Working group	Working Group for the Celtic Seas Ecoregion (WGCSE)

Information from stakeholders

The UK Fisheries–Science Partnership (FSP) surveys of the Irish Sea cod spawning grounds in spring 2015, carried out using commercial trawlers, indicated a widespread distribution of cod, mostly at high density with some localized aggregations. The time-series of SSB indices (Figure 5.3.6.4) show a downward trend during 2004–2010, with an increase since 2010.

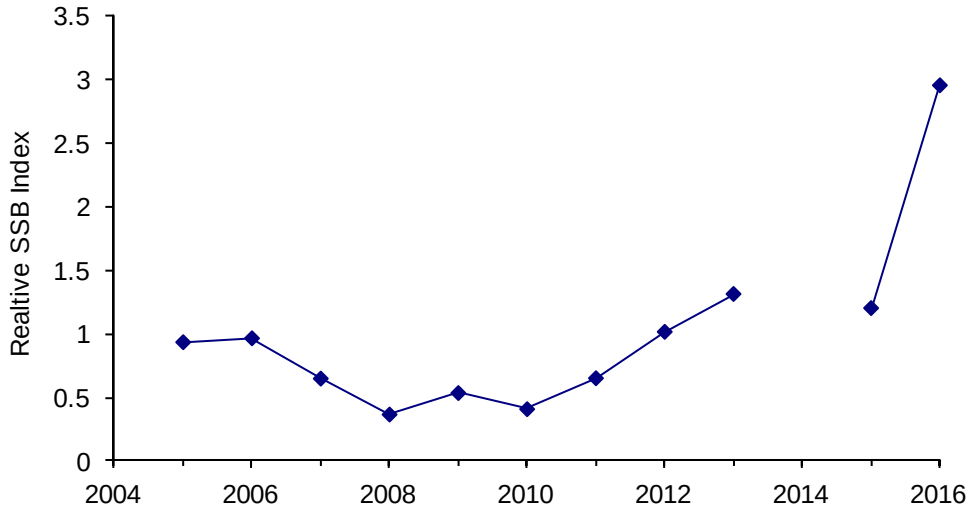

Figure 5.3.6.3 Cod (*Gadus morhua*) in Division 7.a. Relative SSB from the UK-Fisheries Science Partnership (FSP) survey

History of the advice, catch, and management

Table 5.3.6.5 Cod (*Gadus morhua*) in Division 7.a. History of ICES advice, the agreed TAC, and ICES estimates of landings and discards. Weights are in thousand tonnes.

Year	ICES advice / single-stock exploitation boundaries since 2004	Predicted catch corresponding to advice	Agreed TAC	Official landings	ICES landings	ICES discards
1987	No increase in F; interaction with *Nephrops*	10.3	15.0	13.2	12.9	
1988	No increase in F; interaction with *Nephrops*	10.1	15.0	15.8	14.2	
1989	No increase in F	13.4	15.0	11.3	12.8	
1990	F at F_{med}; TAC	15.3	15.3	9.9	7.4	
1991	Stop SSB decline; TAC	6.0	10.0	7.0	7.1**	
1992	20% of F(90) ~ 10 000 t	10.0	10.0	7.4	7.7**	
1993	F_{med} ~ 10 200 t	10.2	11.0	5.9	7.6**	
1994	60% reduction in F	3.7	6.2	4.5	5.4**	
1995	50% reduction in F	3.9	5.8	4.5	4.6**	
1996	30% reduction in F	5.4	6.2	5.30	4.96**	
1997	30% reduction in F	5.9	6.2	4.44	5.86**	
1998	No increase in F	6.2	7.1	4.96	5.31**	
1999	Reduce F below F_{pa}	4.9	5.5	2.96	4.78**	
2000	Lowest possible F	0	2.1	1.42	1.27^	
2001	Lowest possible F	0	2.1	2.03	2.25^	
2002	Establish recovery plan	-	3.2	2.7	2.69^	
2003	Closure of all fisheries for cod	-	1.95	1.5	1.28^	
2004	Zero catch	0	2.15	1.1	1.07^	
2005	Zero catch	0	2.15	0.97	0.91^	
2006	Zero catch	0	1.828	0.95	0.84^	
2007	Zero catch	0	1.462	1.12	0.70^	0.15
2008	Zero catch	0	1.199	1.22	0.66^	0.06
2009	Zero catch	0	0.899	0.75	0.47^	0.06
2010	Zero catch	0	0.674	0.59	0.46^	0.38
2011	Zero catch	0	0.506	0.48	0.37^	0.04
2012	Zero catch	0	0.380	0.33	0.20^	0.66
2013	No directed fisheries, minimize bycatch and discards	0	0.285	0.28	0.21^	0.12
2014	No directed fisheries, minimize bycatch and discards	0	0.228	0.23	0.21	0.15
2015	No directed fisheries, minimize bycatch and discards	0	0.182	0.20	0.16	0.22*
2016	No directed fisheries, minimize bycatch and discards	0	0.146			
2017	MSY approach	0				

* Preliminary.

** Includes sample-based estimates of landings into three ports.

^ As reported to the working group.

History of catch and landings

Table 5.3.6.6 Cod (*Gadus morhua*) in Division 7.a. Catch distribution by fleet in 2015 as estimated by ICES.

Catch (2015)	Estimated landings					
385 tonnes	otter trawls		Scottish seines	mid-water trawl	Beam trawl	other gear-types
	27% *Nephrops* directed	38% demersal fish directed	2%	3%	21%	9%
	161 tonnes					
	Estimated discards					
	otter trawls		Scottish seines	mid-water trawl	Beam trawl	other gear types
	39% *Nephrops* directed	31% demersal fish directed	< 1%	1%	19%	10%
	224 tonnes					

Table 5.3.6.7 Cod (*Gadus morhua*) in Division 7.a. History of commercial landings and discards; the official and ICES estimates of landings. Weights are in tonnes. n/a = not available.

Year	Belgium	France	Ireland	Netherlands	Spain	UK (England, Wales, & NI)	UK (Isle of Man)	UK (Scotland)	Total	Unallocated	ICES estimates	Discards
1996	142	148	2476	25	-	2359	27	126	5303	−339	4964**	
1997	183	268	1492	29	-	2370	19	80	4441	1418	5859**	
1998	316	269	1739	20	-	2517	34	67	4962	356	5318**	
1999	150	n/a	966	5	-	1665	9	80	2875	1909	4784**	
2000	60	53	455	1	-	799	11	38	1417	−143	1274^	
2001	283	74	751	-	-	885	1	32	2026	226	2252^	
2002	318	116	1111	-	-	1134	7	29	2715	−20	2695^	
2003	183	151	594	-	14	505	7	23	1477	−192	1285^	
2004	104	29	380	-	-	646	5	15	1179	−107	1072^	
2005	115	35	220	-	-	594	n/a	3	967	−57	910^	
2006	60	18**	275	-	-	5892	n/a	6	948	−108	840^	
2007	67	17**	608	-	-	423	n/a	2	1117	−415	702^	148
2008	26	3	618**	-	-	5432	22	12	1224	−563	661^	62
2009	19	12	323**	-	-	3872	12	12	754	−286	468^	60
2010	21	1	289	-	-	282	1	-	594	−130	464^	377
2011	36	3	275	-	-	169	1	-	485	−117	368	43
2012	23	1	193	-	-	109	< 1	-	326	−128	198	658
2013	13	< 1	160			107	< 1	-	281	−75	206	118
2014	9	< 1	148	-	-	79	< 1	-	236	−33	213	149
2015*	12	< 1	137	-	-	50	< 1	-	199	−38	161	224

* Preliminary.

** Includes sample-based estimates of landings into three ports.

^ As reported to the working group.

Summary of the assessment

Table 5.3.6.8 Cod (*Gadus morhua*) in Division 7.a. Assessment summary (weights in tonnes). Removals are the estimated total removals in 2003 onwards in excess of removals ensuing from the assumed natural mortality rate. Recent mortality values are poorly estimated because of unaccounted mortality.

Year	Recruitment Age 1 thousands	High	Low	SSB tonnes	High	Low	Landings tonnes	Mean F Ages 2–4	High	Low
1968	4119	6877	2467	15875	18722	13461	8541	0.781	0.952	0.64
1969	4972	7779	3177	14621	17239	12400	7991	0.783	0.942	0.651
1970	6551	10160	4223	9052	10840	7558	6426	0.764	0.911	0.64
1971	8126	12613	5235	11830	13606	10286	9246	0.765	0.905	0.646
1972	5728	8865	3702	14159	16143	12418	9234	0.756	0.891	0.642
1973	7142	11059	4613	19653	22663	17043	11819	0.764	0.897	0.651
1974	4245	6568	2744	16491	18988	14323	10251	0.767	0.897	0.655
1975	5805	8989	3748	16711	19542	14289	9863	0.773	0.904	0.661
1976	3756	5819	2424	13855	15934	12047	10247	0.78	0.91	0.669
1977	4121	6369	2667	13322	15561	11406	8054	0.784	0.915	0.672
1978	4890	7560	3163	8330	9746	7120	6271	0.787	0.918	0.675
1979	7509	11596	4863	9167	10630	7906	8371	0.801	0.931	0.688
1980	8661	13382	5606	11942	13432	10617	10776	0.82	0.952	0.707
1981	6240	9627	4044	17643	19827	15700	14907	0.842	0.974	0.727
1982	3826	5940	2464	19791	22375	17506	13381	0.863	0.997	0.746
1983	4338	6692	2812	15429	17831	13351	10015	0.876	1.012	0.758
1984	5828	8987	3780	10650	12545	9041	8383	0.896	1.033	0.776
1985	6285	9684	4079	12207	13801	10798	10483	0.929	1.068	0.808
1986	6508	10025	4225	11268	12608	10070	9852	0.956	1.097	0.833
1987	9560	14878	6142	12539	13985	11242	12894	0.993	1.137	0.868
1988	6922	10755	4455	13354	14806	12045	14168	1.036	1.183	0.908
1989	4189	6449	2720	15477	17180	13943	12751	1.086	1.238	0.953
1990	4125	6352	2679	8750	9820	7797	7379	1.121	1.275	0.985
1991	4557	7074	2936	6314	7128	5593	7095	1.172	1.331	1.032
1992	4744	7216	3119	7386	8173	6674	7735	1.249	1.421	1.098
1993	2405	3596	1608	6577	7219	5991	7555	1.311	1.495	1.149
1994	3458	5121	2335	5859	6460	5314	5402	1.325	1.505	1.166
1995	3298	4859	2239	4088	4478	3731	4587	1.321	1.492	1.169
1996	2925	4294	1992	5119	5625	4658	4964	1.334	1.505	1.182
1997	3150	4589	2162	5768	6527	5096	5859	1.379	1.569	1.213
1998	1593	2325	1091	5267	5777	4802	5318	1.362	1.549	1.198
1999	742	1099	501	5659	6218	5150	4784	1.367	1.567	1.192
2000	2058	3054	1387	1411	1661	1199	1274	1.288	1.47	1.129
2001	2129	3144	1441	2363	2669	2092	2252	1.249	1.426	1.094
2002	2099	3066	1436	3439	3802	3111	2695	1.196	1.367	1.047
2003	1096	1612	745	4869	5395	4394	1285	1.226	1.402	1.072
2004	1234	1808	842	3754	4137	3407	1072	1.242	1.426	1.082
2005	903	1333	612	2869	3170	2597	910	1.266	1.463	1.097
2006	822	1230	549	2034	2248	1841	840	1.285	1.495	1.104
2007	780	1149	530	2153	2401	1931	702	1.274	1.482	1.096
2008	435	646	293	1779	1969	1608	662	1.249	1.452	1.074
2009	818	1210	553	1389	1545	1248	466	1.219	1.421	1.046
2010	1232	1851	820	1737	1967	1534	464	1.179	1.377	1.01
2011	1008	1509	674	2477	2775	2212	365	1.14	1.333	0.975
2012	1002	1495	672	3309	3677	2977	198	1.12	1.312	0.956
2013	1504	2246	1007	3575	4001	3194	206	1.095	1.289	0.93

Year	Recruitment Age 1 thousands	High	Low	SSB tonnes	High	Low	Landings tonnes	Mean F Ages 2–4	High	Low
2014	1414	2150	930	4659	5240	4143	213	1.081	1.282	0.912
2015	833	1374	506	4957	5606	4384	161	1.077	1.297	0.894
2016	1127			5270						
Average	**3690**	**5752**	**2438**	**8494**	**9744**	**7526**	**6216**	**1.057**	**1.222**	**0.914**

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