

## Cod (*Gadus morhua*) in subareas 1 and 2 (Norwegian coastal waters cod)

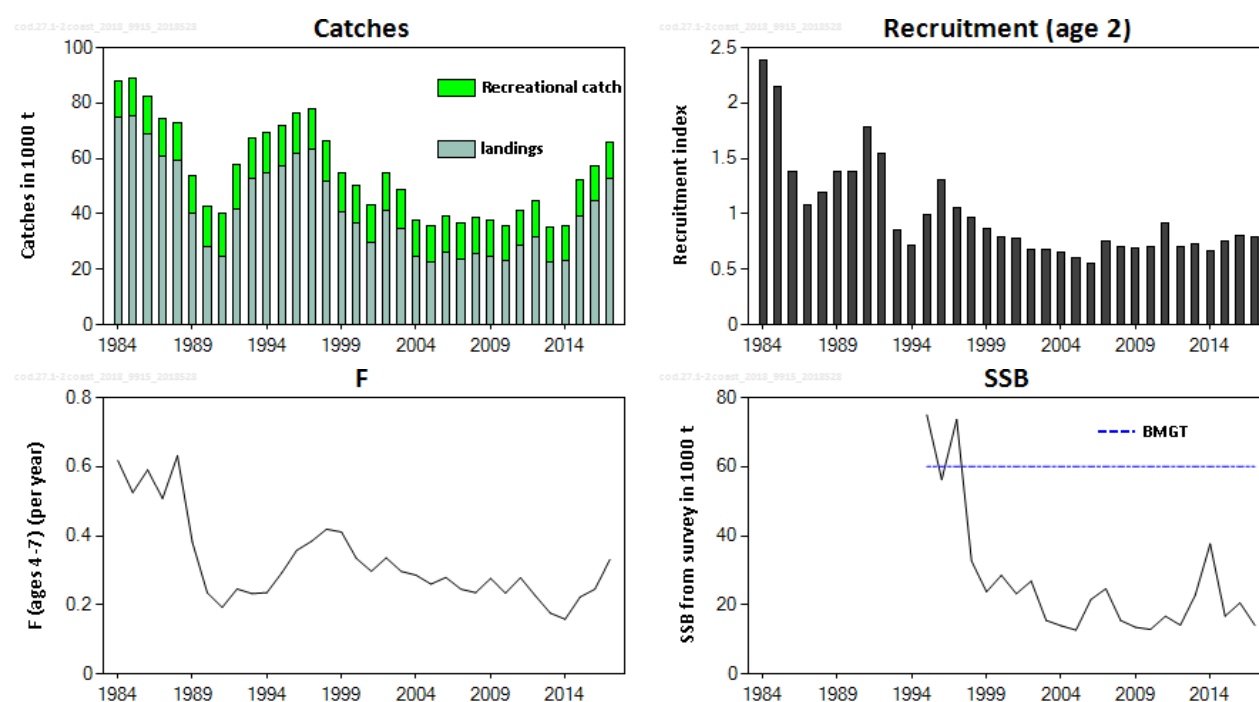
### ICES advice on fishing opportunities

ICES strongly recommends the development of a new rebuilding plan for Norwegian coastal cod. Until such a plan is in operation, ICES will continue to provide advice based upon the existing rebuilding plan.

The rebuilding plan is based on the autumn survey results, the latest of which will be available in December 2018. If the 2018 SSB index is below the 2017 index, application of the rebuilding plan implies that the regulations should ensure that catches in 2019 are consistent with no less than 75% reduction in  $F$  relative to the 2009 value. If the 2018 SSB index is above the 2017 index, then the required reduction in  $F$  remains at 60% relative to the 2009 value.

### Stock development over time

The survey estimate in 2017 is well below the rebuilding biomass set in the Norwegian rebuilding plan. Both SSB and recruitment have been stable overall in the last two decades. Fishing pressure ( $F$ ) increased in 2015, 2016, and 2017, after a declining trend over the period 2000–2014.



**Figure 1** Cod in subareas 1 and 2 (Norwegian coastal waters cod). Summary of the stock assessment. Catches (recreational catches are fixed from 2009 at 12 700 tonnes), the relative recruitment index (long-term average = 1) and  $F$  estimate from the exploratory virtual population analysis (VPA) assessment, and the survey spawning-stock biomass (SSB) index (including the rebuilding biomass of 60 000 tonnes in the rebuilding plan).

### Stock and exploitation status

ICES cannot assess the stock and exploitation status relative to MSY and PA reference points because the reference points are undefined.

**Table 1** Cod in subareas 1 and 2 (Norwegian coastal waters cod). State of the stock and fishery relative to reference points.

		Fishing pressure				Stock size				
		2015	2016	2017		2015	2016	2017		
Maximum Sustainable Yield	$F_{MSY}$	?	?	?	Undefined	$MSY B_{Trigger}$	?	?	?	Undefined
Precautionary Approach	$F_{pa}, F_{lim}$	?	?	?	Undefined	$B_{pa}, B_{lim}$	?	?	?	Undefined
Management plan	$F_{MGT}$	?	?	?	Undefined	$B_{MGT}$	✗	✗	✗	Below
Qualitative evaluation	-	↗	↗	↗	Increasing	-	↘	↗	↘	Decreasing

## Catch scenarios

The rebuilding plan was put into operation in 2011. The plan specifies the following reductions in fishing mortality:

**Table 2** Cod in subareas 1 and 2 (Norwegian coastal waters cod). Action steps according to the rebuilding plan of 2011.

Action step*	1	2	3	4	5	6 and later
Reduction of F relative to $F_{2009}$	15%	30%	45%	60%	75%	Keep F at or below 0.1

\* A new step is initiated when the most recent survey index for SSB is lower than the index in the previous year (and at the same time the most recent estimate of F is above 0.10).

The spawning-stock biomass (SSB) index in the 2010 survey was below the index in the 2009 survey. Step 1 was thus initiated in 2011. This means that the regulation in 2011 was aimed at a 15% reduction of F relative to  $F_{2009}$ . The 2011 survey gave a higher SSB index than in 2010, allowing the regulation for step 1 to continue in 2012. The 2012 survey resulted in a lower SSB index compared to 2011; accordingly step 2 was set in motion in 2013, with regulations aiming for an F at least 30% below  $F_{2009}$ . The 2013 and 2014 surveys provided an increased SSB index, allowing for the existing regulations to be continued in 2014 and 2015 (still step 2). The lower survey result in 2015 implied that step 3 (45% reduced F compared to 2009) should have been introduced in 2016. The 45% reduction in F also applied to 2017, since the survey in 2016 gave a higher SSB estimate than in the previous year. The SSB index in 2017 was lower than the index in 2016 so the plan moved to step 4: no less than a 60% reduction in F for 2018 relative to the 2009 value.

If the 2018 SSB index is below the 2017 index, application of the rebuilding plan implies that the regulations should ensure that catches in 2019 are consistent with no less than 75% reduction in F relative to the 2009 value. If the 2018 SSB index is above the 2017 index, then the required reduction in F remains at 60% relative to the 2009 value.

## Basis of the advice

**Table 3** Cod in subareas 1 and 2 (Norwegian coastal waters cod). The basis of the advice.

Advice basis	Rebuilding plan
Management plan	<p>Norwegian rebuilding plan for coastal cod (ICES, 2010).</p> <p>The rebuilding plan, as communicated to ICES by the Norwegian Ministry of Fisheries and Coastal Affairs, states:</p> <p><i>"The overarching aim is to rebuild the stock complex to full reproductive capacity, as well as to give sufficient protection to local stock components. Until a biologically founded rebuilding target is defined, the stock complex will only be regarded as restored when the survey index of spawning stock in two successive years is observed to be above 60 000 tons*. Importantly, this rebuilding target will be redefined on the basis of relevant scientific information. Such information could, for instance, include a reliable stock assessment, as well as an estimate of the spawning stock corresponding to full reproductive capacity.</i></p> <p><i>Given that the survey index for SSB does not increase, the regulations will aim to reduce <math>F^{**}</math> by at least 15 per cent annually compared to the <math>F</math> estimated for 2009. If, however, the latest survey index of SSB is higher than the preceding one – or if the estimated <math>F</math> for the latest catch year is less than 0.1 – the regulations will be unchanged.</i></p> <p><i>Special regulatory measures for local stock components will be viewed in the context of scientific advice. A system with stricter regulations inside fjords than outside fjords is currently in operation, and this particular system is likely to be continued in the future.</i></p> <p><i>The management regime employed is aiming for improved ecosystem monitoring in order to understand and possibly enhance the survival of coastal cod. Potential predators are – among others – cormorants, seals and saithe.</i></p> <p><i>When the rebuilding target is reached, a thorough management plan is essential. In this regard, the aim will be to keep full reproductive capacity and high long-term yield."</i></p>

\*Average survey index in the years 1995–1998.

\*\*Ages 4–7.

## Quality of the assessment

The assessment is rather uncertain. The reasons for this include (a) uncertainty in the catch split between Northeast Arctic cod and coastal cod, where coastal cod is the minor fraction of the overall cod catch, (b) highly uncertain data for the recreational catch, (c) uncertainty regarding stock identity among coastal cod substocks, and (d) the survey is considered uncertain since it does not cover the shallow parts of the stock distribution area.

## Issues relevant for the advice

ICES evaluation of the Norwegian rebuilding plan in 2010 (ICES, 2010) stated: *"Based on simulations, ICES conclude that the plan, if fully implemented, is expected to lead to significant rebuilding. Nonetheless, accounting for realistic uncertainties in the catches, surveys, and the assessment model, a rather long rebuilding period is required even if fishing mortality is markedly reduced within the next several years. Whereas not fully quantifiable, the needed reductions in fishing mortality will require accompanying reductions in the catches. ICES consider the proposed rule to be provisionally consistent with the Precautionary Approach"*.

The rebuilding plan has now been in operation for eight years. The plan implies that the fishing mortality in 2018 should be at least 60% lower than the 2009 value. The 2017 data indicate increasing fishing mortality, and the estimated catch in 2017 is well above the catch in 2009. The regulations have therefore not been sufficient to constrain the coastal cod catches in 2015, 2016, and 2017, and the most recent estimate of  $F$  is above the  $F$  in 2009.

ICES strongly recommends the development of a new rebuilding plan. Until such a plan is in operation, ICES will continue to provide advice based upon the existing rebuilding plan.

## Reference points

**Table 4** Cod in subareas 1 and 2 (Norwegian coastal waters cod). Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger\_proxy}$	Not defined		
	$F_{MSY\_proxy}$	Not defined		
Precautionary approach	$B_{lim}$	Not defined		
	$B_{pa}$	Not defined		
	$F_{lim}$	Not defined		
	$F_{pa}$	Not defined		
Management plan	SSB <sub>mgt</sub>	60 000 t	Rebuilding target (1995–1998 average survey SSB)	ICES (2010)
	$F_{mgt}$	Not defined		

## Basis of the assessment

**Table 5** Cod in subareas 1 and 2 (Norwegian coastal waters cod). Basis of the assessment and advice.

ICES stock data category	3 ( <a href="#">ICES, 2016</a> )
Assessment type	Based on survey SSB index and estimates of F from an exploratory VPA assessment (ICES, 2018).
Input data	Catch-at-age and an acoustic survey; commercial catches (landings, age and length frequencies from catch sampling); one survey index (coastal survey, NOcoast-Aco-4Q); annual maturity data from surveys; natural mortalities assumed, $M = 0.2$ . Estimated recreational catch considered to be highly uncertain.
Discards and bycatch	Discarding is considered to be negligible. Bycatch is included.
Indicators	None
Other information	Last benchmarked in 2015 (WKARCT; ICES, 2015)
Working group	<a href="#">Arctic Fisheries Working Group (AFWG)</a>

## Information from stakeholders

There is no additional available information.

## History of the advice, catch, and management

**Table 6** Cod in subareas 1 and 2 (Norwegian coastal waters cod). ICES advice, TAC, and catches. All weights are in tonnes.

Year	ICES advice	Predicted catch corresponding to advice	Agreed TAC*	ICES estimates of commercial catches**
1987	Not assessed		40000	60972
1988	Not assessed		40000	59294
1989	No advice		40000	40285
1990	No advice		40000	28127
1991	Included in TAC for subareas 1 and 2		40000	24822
1992	Shot forecast included in TAC for 1 and 2		40000	41690
1993	Shot forecast included in TAC for 1 and 2		40000	52557
1994	No advice		40000	54562
1995	No advice		40000	57207
1996	No advice		40000	61776
1997	No advice		40000	63319
1998	No advice		40000	51572
1999	No advice		40000	40732
2000	No advice		40000	36715
2001	Reduce F considerably	22000	40000	29699
2002	Catches should be reduced by the same proportion as for Northeast Arctic cod	13000	40000	40994
2003	Reduce F considerably	8000	40000	34635
2004	A recovery plan	0	20000	24547
2005	A recovery plan	0	21000	22432

Year	ICES advice	Predicted catch corresponding to advice	Agreed TAC*	ICES estimates of commercial catches**
2006	A recovery plan	0	21000	26134
2007	A recovery plan	0	21000	23841
2008	A recovery plan	0	21000	25777
2009	Zero catch and a recovery plan	0	21000	24821
2010	Zero catch and a recovery plan	0	21000	22925
2011	Same advice as last year	0	21000	28594
2012	Rebuilding plan, action dependent on autumn survey	-	21000	31907
2013	Rebuilding plan, action dependent on autumn survey	-	21000	22464
2014	Rebuilding plan, action dependent on autumn survey	-	21000	23169
2015	Rebuilding plan, action dependent on autumn survey	-	21000	39455
2016	Rebuilding plan, action dependent on autumn survey	-	21000	44610
2017	Rebuilding plan, action dependent on autumn survey	-	21000	52887
2018	Rebuilding plan, action dependent on autumn survey	-	21000	
2019	Rebuilding plan, action dependent on autumn survey	-		

\* These TACs have been added to the Norwegian TAC of Northeast Arctic cod.

\*\* Estimated according to otolith type.

## History of the catch and landings

**Table 7** Cod in subareas 1 and 2 (Norwegian coastal waters cod). Catch distribution by fleet in 2017 as estimated by ICES.

Catch (2017 )	Commercial landings				Recreational catch estimates (unreported catches)	Discards
65587 tonnes	38% gillnets	35% Danish seine	25% longline/handline	2% bottom trawl	12700 tonnes*	Discarding is assumed to be negligible
	52887 tonnes					

\* Estimated in 2009 and assumed at the same value since.

## Summary of the assessment

**Table 8** Cod in subareas 1 and 2 (Norwegian coastal waters cod). Assessment summary. Weights are in tonnes.

Year	Relative recruitment Age 2 (compared to long-term mean)	Survey SSB	Commercial catch	Recreational catch	F Ages 4–7
1984	2.39		74824	13300	0.62
1985	2.15		75451	13400	0.52
1986	1.38		68905	13500	0.59
1987	1.08		60972	13500	0.51
1988	1.20		59294	13600	0.63
1989	1.39		40285	13700	0.38
1990	1.38		28127	14500	0.24
1991	1.79		24822	15300	0.193
1992	1.54		41690	16100	0.25
1993	0.85		52557	14800	0.23
1994	0.72		54562	14700	0.24
1995	1.00	74992	57207	14700	0.29
1996	1.31	56237	61776	14500	0.36
1997	1.06	73660	63319	14500	0.38
1998	0.97	32691	51572	14600	0.42
1999	0.87	23771	40732	13900	0.41
2000	0.80	28579	36715	13600	0.33
2001	0.78	23230	29699	13400	0.30
2002	0.67	26885	40994	13600	0.34
2003	0.68	15521	34635	13900	0.30
2004	0.65	13959	24547	13400	0.29
2005	0.60	12709	22432	13200	0.26
2006	0.56	21546	26134	13000	0.28
2007	0.75	24689	23841	13000	0.25
2008	0.71	15493	25777	12800	0.24
2009	0.69	13508	24821	12700	0.28
2010	0.70	12901	22925	12700	0.23
2011	0.91	16725	28594	12700	0.28
2012	0.70	14143	31907	12700	0.23
2013	0.73	22856	22464	12700	0.176
2014	0.67	37659	23169	12700	0.158
2015	0.75	16763	39455	12700	0.22
2016	0.80	20597	44610	12700	0.25
2017	0.79	14078	52887	12700	0.33

## Sources and references

ICES. 2010. Request by the Norwegian ministry of fisheries and coastal affairs: Evaluation of a rebuilding plan for coastal cod. *In* Report of the ICES Advisory Committee, 2010. ICES Advice 2010, Book 3, Section 3.3.3.1. 3 pp.

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