

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

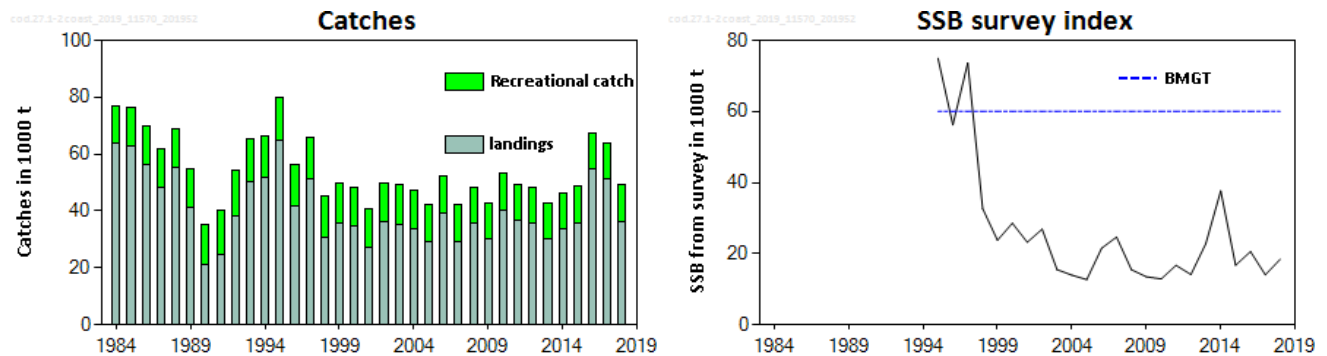
### ICES advice on fishing opportunities

ICES strongly recommends the development of a new management plan for Norwegian coastal cod. For 2020, 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 2019. If the 2019 SSB index is below the 2018 index, application of the rebuilding plan implies that the regulations should ensure that catches in 2020 are consistent with no less than 75% reduction in F relative to the 2009 value. If the 2019 SSB index is above the 2018 index, then the required reduction in F remains at 60% relative to the 2009 value.

### Stock development over time

The 2018 SSB estimate from the survey is well below the rebuilding biomass target set in the Norwegian rebuilding plan. SSB has been fluctuating without trend in the last two decades.



**Figure 1** Cod in subareas 1 and 2 (Norwegian coastal waters cod). Catches (recreational catches are fixed from 2009 at 12 700 tonnes) and the survey spawning-stock biomass (SSB) index (including the rebuilding biomass target 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					
		2016	2017	2018	2016	2017	2018			
Maximum sustainable yield	$F_{MSY}$	?	?	?	Undefined	$MSY B_{trigger}$	?	?	?	Undefined
Precautionary approach	$F_{pa} F_{lim}$	?	?	?	Undefined	$B_{pa} B_{lim}$	?	?	?	Undefined
Management plan	$F_{MGT}$	—	—	—	Not applicable	$B_{MGT}$	✗	✗	✗	Below
Qualitative evaluation	-	↗	↗	↘	Decreasing	-	↗	↘	↗	Increasing

## 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).

If the 2019 SSB index is below the 2018 index, application of the rebuilding plan implies that the regulations should ensure that catches in 2020 are consistent with no less than 75% reduction in F relative to the 2009 value. If the 2019 SSB index is above the 2018 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 F estimated for 2009. If, however, the latest survey index of SSB is higher than the preceding one – or if the estimated F 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 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) several different coastal cod sub-stocks may exist with different dynamics, 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 concludes 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. Whilst 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".

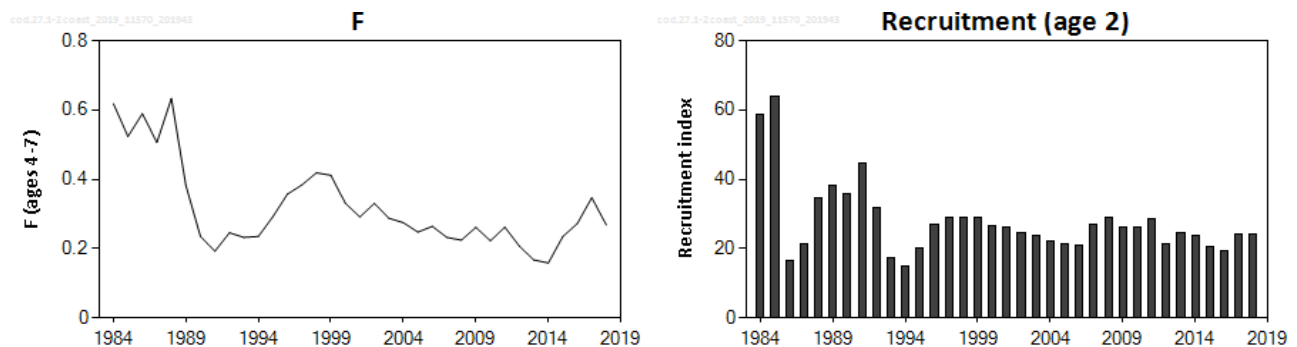
The rebuilding plan has now been in operation for eight years (Table 4). The plan implies that the fishing mortality in 2019 should be at least 60% lower than the 2009 value. An exploratory assessment has been conducted to provide estimates of F and recruitment (Figure 2). This indicates recent fishing mortality is above the 2009 level and recruitment has been stable in the last two decades. The estimated catch in 2018 is well above both the catch in 2009 and the TAC for 2018.

**Table 4** Cod in subareas 1 and 2 (Norwegian coastal waters cod). Application of the Norwegian rebuilding plan for coastal cod (ICES, 2010) since 2010.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
SSB survey compared to previous year	↘	↗	↘	↗	↗	↘	↗	↘	↗	-
Rebuilding plan action step *	-	Step 1	Step 1	Step 2	Step 2	Step 2	Step 3	Step 3	Step 4	Step 4
Management regulation for the action step **	-	Reduce F by ≥ 15%	Reduce F by ≥ 15%	Reduce F by ≥ 30%	Reduce F by ≥ 30%	Reduce F by ≥ 30%	Reduce F by ≥ 45%	Reduce F by ≥ 45%	Reduce F by ≥ 60%	Reduce F by ≥ 60%

\* Based on the survey trend in the previous year.  
 \*\* Reduction in F compared to F in 2009.

Despite management actions, the management plan has not led to significantly reduced catches. A new plan is therefore required, with regulations better targeted to areas and seasons where catches of coastal cod are high. Since these areas vary over time, the spatial management needs to be dynamic. In order to support such improved management, improved techniques for identifying areas with high bycatches of coastal cod have been developed and are now being used. Furthermore, improved knowledge of stock structure and improved assessment methodology better able to handle the spatial variability would be required to support this management.



**Figure 2** Cod in subareas 1 and 2 (Norwegian coastal waters cod). F (left) and recruitment (right) estimates from the exploratory virtual population analysis (VPA) assessment.

## 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 $B_{trigger}$	Not defined		
	$F_{MSY}$	Not defined		
Precautionary approach	$B_{lim}$	Not defined		
	$B_{pa}$	Not defined		
	$F_{lim}$	Not defined		
	$F_{pa}$	Not defined		
Management plan	$SSB_{mgt}$	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 (ICES, 2018).
Assessment type	Based on survey SSB index (ICES, 2019).
Input data	Survey index (coastal survey, NOcoast-Aco-4Q); commercial catches (landings); estimated recreational catch (fixed at 12 700 tonnes since 2009).
Discards and bycatch	Discarding is considered to be negligible. Bycatch is included.
Indicators	Estimates of F and recruitment from an exploratory VPA assessment (Catch-at-age (age and length frequencies from catch sampling) and an acoustic survey; coastal survey; annual maturity data from surveys; natural mortalities assumed, $M = 0.2$ ).
Other information	Last benchmarked in 2015 (WKARCT; ICES, 2015).
Working group	Arctic Fisheries Working Group (AFWG).

## 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	Catch corresponding to advice	Agreed TAC *	ICES estimates of commercial catches **	ICES estimates of recreational catch	ICES estimates of total catch
1987	Not assessed		40000	48274	13500	61774
1988	Not assessed		40000	55065	13600	68665
1989	No advice		40000	41242	13700	54942
1990	No advice		40000	20920	14500	35420
1991	Included in TAC for subareas 1 and 2		40000	24837	15300	40137
1992	Short-term forecast included in TAC for subareas 1 and 2		40000	38195	16100	54295
1993	Short-term forecast included in TAC for subareas 1 and 2		40000	50420	14800	65220
1994	No advice		40000	51664	14700	66364
1995	No advice		40000	64964	14700	79664
1996	No advice		40000	41672	14500	56172
1997	No advice		40000	51123	14500	65623
1998	No advice		40000	30472	14600	45072
1999	No advice		40000	35805	13900	49705
2000	No advice		40000	34815	13600	48415
2001	Reduce F considerably	22000	40000	27253	13400	40653
2002	Catches should be reduced by the same proportion as for Northeast Arctic cod	13000	40000	36405	13600	50005

Year	ICES advice	Catch corresponding to advice	Agreed TAC *	ICES estimates of commercial catches **	ICES estimates of recreational catch	ICES estimates of total catch
2003	Reduce F considerably	8000	40000	35381	13900	49281
2004	A recovery plan	0	20000	33650	13400	47050
2005	A recovery plan	0	21000	29255	13200	42455
2006	A recovery plan	0	21000	39343	13000	52343
2007	A recovery plan	0	21000	29227	13000	42227
2008	A recovery plan	0	21000	35552	12800	48352
2009	Zero catch and a recovery plan	0	21000	29987	12700	42687
2010	Zero catch and a recovery plan	0	21000	40397	12700	53097
2011	Same advice as last year	0	21000	36714	12700	49414
2012	Rebuilding plan, action dependent on autumn survey	-	21000	35540	12700	48240
2013	Rebuilding plan, action dependent on autumn survey	-	21000	30144	12700	42844
2014	Rebuilding plan, action dependent on autumn survey	-	21000	33660	12700	46360
2015	Rebuilding plan, action dependent on autumn survey	-	21000	35843	12700	48543
2016	Rebuilding plan, action dependent on autumn survey	-	21000	54767	12700	67467
2017	Rebuilding plan, action dependent on autumn survey	-	21000	51053	12700	63753
2018	Rebuilding plan, action dependent on autumn survey	-	21000	36375	12700	49075
2019	Rebuilding plan, action dependent on autumn survey	-	21000			
2020	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 2018 as estimated by ICES.

Catch (2018)	Commercial landings				Recreational catch estimate	Discards
	36% gillnets	31% Danish seine	19% longline/handline	14% bottom trawl		
49 075 tonnes	36 375 tonnes				12 700 tonnes*	Discarding is assumed to be negligible

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

### Summary of the assessment

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

Year	SSB survey	Recreational catch	Commercial catch	Total catch
1984		13300	63818	77118
1985		13400	62954	76354
1986		13500	56107	69607
1987		13500	48274	61774
1988		13600	55065	68665
1989		13700	41242	54942
1990		14500	20920	35420
1991		15300	24837	40137
1992		16100	38195	54295
1993		14800	50420	65220
1994		14700	51664	66364

Year	SSB survey	Recreational catch	Commercial catch	Total catch
1995	74992	14700	64964	79664
1996	56237	14500	41672	56172
1997	73660	14500	51123	65623
1998	32691	14600	30472	45072
1999	23771	13900	35805	49705
2000	28579	13600	34815	48415
2001	23230	13400	27253	40653
2002	26885	13600	36405	50005
2003	15521	13900	35381	49281
2004	13959	13400	33650	47050
2005	12709	13200	29255	42455
2006	21546	13000	39343	52343
2007	24689	13000	29227	42227
2008	15493	12800	35552	48352
2009	13508	12700	29987	42687
2010	12901	12700	40397	53097
2011	16725	12700	36714	49414
2012	14143	12700	35540	48240
2013	22856	12700	30144	42844
2014	37659	12700	33660	46360
2015	16763	12700	35843	48543
2016	20597	12700	54767	67467
2017	14078	12700	51053	63753
2018	18423	12700	36375	49075

### Sources and references

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