

Cod in Division 3M

Advice June 2023 for 2024











Recommendation for 2024

Catches up to $3/4 F_{lim}$ are projected to result in a very low probability ($\leq 10\%$) of the stock going below B_{lim} and of fishing mortality exceeding F_{lim} in 2024. All fishing scenarios with fishing mortality less than $2/3 F_{lim}$ are projected to promote growth in SSB.

SC therefore advises that exploitation should not exceed $2/3 F_{lim}$ in 2024.

Management objectives

No explicit management plan or management objectives have been defined by the Commission. Convention General Principles are applied (NAFO GC Doc. 07-04).

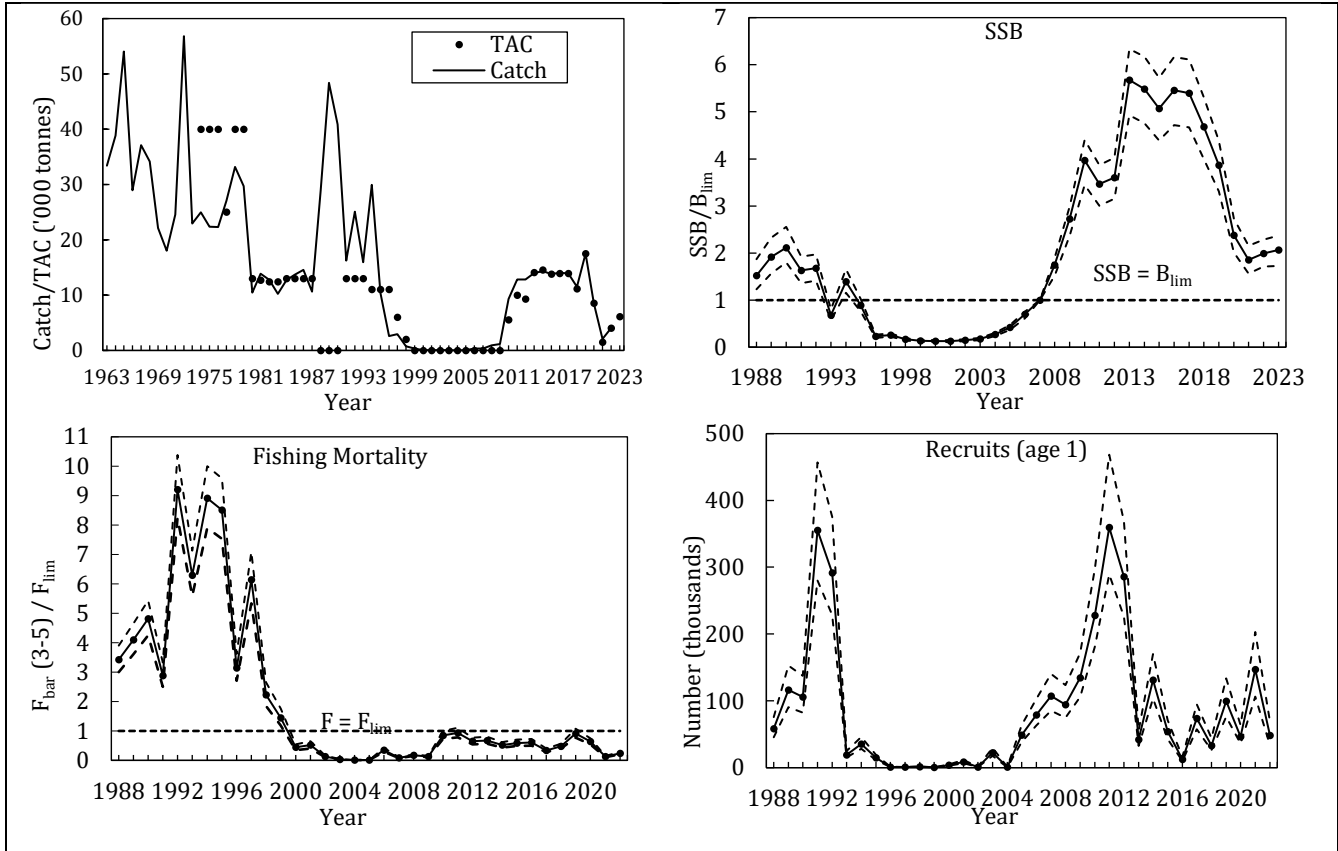
Convention Principle	Status	Comment	
Restore to or maintain at B_{msy}		B_{msy} undefined, $B > B_{lim}$	 OK
Eliminate Overfishing (Stock)		$F < F_{lim}$	 Intermediate
Eliminate Overfishing (Ecosystem)		Total EPU catches $< 2TCI$	 Not accomplished
Apply Precautionary Approach		B_{lim} and F_{lim} defined	 Unknown
Minimize harmful impacts on living marine resources and ecosystems		Directed fishery, VME closures in effect, effectiveness of bycatch regulations uncertain	
Preserve marine biodiversity		Cannot be evaluated	

Management unit

The cod stock in Flemish Cap (NAFO Div. 3M) is considered to be a distinct population.

Stock status

SSB declined rapidly since 2017 but has remained stable during the last 3 years and is estimated to be above B_{lim} . Since 2013, recruitment has varied at intermediate levels, much lower than those observed in 2011-2012. Fishing mortality has remained below F_{lim} since the fishery reopened in 2010. F has generally decreased since 2019 and in 2022 is below F_{lim} with a high probability.



Reference points

$B_{lim} = SSB_{2007}$: Median = 14 755 tons of spawning biomass (Scientific Council, 2023).
 $F_{lim} = F_{30\%SPR}$: Median = 0.157 (Scientific Council, 2023).



Projections

Stochastic projections of the stock dynamics from 2023 to the start of 2025 were conducted. F_{bar} is the mean of the F at ages 3-5 and is used as the indicator of overall fishing mortality; F_{sq} is the status quo F , calculated as the mean of the last three years F_{bar} (2020-2022).

Table 1.

	B		SSB		Yield
Median and 80% CI					
$F_{bar} = 0$					
2023	53812	(47944 - 61013)	27709	(24790 - 30794)	6100
2024	58438	(51161 - 68867)	30747	(27207 - 34601)	0
2025	65890	(56510 - 78568)	39660	(34924 - 44681)	
$F_{bar} = F_{sq}$ (median = 0.053)					
2023	53812	(47944 - 61013)	27709	(24790 - 30794)	6100
2024	58438	(51161 - 68867)	30747	(27207 - 34601)	6509
2025	59324	(50003 - 72050)	33696	(29110 - 38825)	
$F_{bar} = F_{2023}$ (median = 0.058)					
2023	53812	(47944 - 61013)	27709	(24790 - 30794)	6100
2024	58438	(51161 - 68867)	30747	(27207 - 34601)	7079
2025	58752	(49433 - 71480)	33199	(28505 - 38167)	
$F_{bar} = 1/2F_{lim}$ (median = 0.078)					
2023	53812	(47944 - 61013)	27709	(24790 - 30794)	6100
2024	58438	(51161 - 68867)	30747	(27207 - 34601)	9176
2025	56673	(47350 - 69385)	31352	(26697 - 36365)	
$F_{bar} = 2/3F_{lim}$ (median = 0.104)					
2023	53812	(47944 - 61013)	27709	(24790 - 30794)	6100
2024	58438	(51161 - 68867)	30747	(27207 - 34601)	11708
2025	54177	(44843 - 66893)	29127	(24423 - 34096)	
$F_{bar} = 3/4F_{lim}$ (median = 0.117)					
2023	53812	(47944 - 61013)	27709	(24790 - 30794)	6100
2024	58438	(51161 - 68867)	30747	(27207 - 34601)	12903
2025	53003	(43651 - 65719)	28064	(23409 - 33003)	
$F_{bar} = F_{lim}$ (median = 0.157)					
2023	53812	(47944 - 61013)	27709	(24790 - 30794)	6100
2024	58438	(51161 - 68867)	30747	(27207 - 34601)	16163
2025	49790	(40459 - 62527)	25247	(20608 - 30117)	



Table 2.

	Yield		P(SSB < SSBlim)			P(F > Flim)		P(SSB ₂₅ > SSB ₂₃)
	2023	2024	2023	2024	2025	2023	2024	
F=0	6100	0	<1%	<1%	<1%	<1%	<1%	100%
Fsq = 0.053	6100	6509	<1%	<1%	<1%	<1%	<1%	100%
F2023 = 0.058	6100	7079	<1%	<1%	<1%	<1%	<1%	100%
1/2Flim = 0.078	6100	9176	<1%	<1%	<1%	<1%	<1%	94%
2/3Flim = 0.104	6100	11708	<1%	<1%	<1%	<1%	<1%	72%
3/4Flim = 0.117	6100	12903	<1%	<1%	<1%	<1%	2%	52%
Flim = 0.157	6100	16163	<1%	<1%	<1%	<1%	50%	14%

The results indicate that the total biomass and SSB are likely to increase or remain stable by the start of 2025 in all scenarios except with $F=F_{lim}$. The probability of SSB being below B_{lim} is very low ($\leq 1\%$) in all the scenarios. The probability of SSB in 2025 being above that in 2023 ranges between 14% and 100%, depending on the scenario (Tables 1 and 2).

Under all scenarios except $F=F_{lim}$, the probability of F_{bar} exceeding F_{lim} is less than or equal to 2% in 2024.

Assessment

A Bayesian SCAA model, introduced at the 2018 benchmark, was used as the basis for the assessment of this stock with data from 1988 to 2022.

The next full assessment for this stock will be in 2024.

Human impact

Mainly fishery related mortality. Other sources (e.g., pollution, shipping, oil-industry) are undocumented.

Biological and environmental interactions

Redfish, shrimp and smaller cod are important prey items for cod. There are strong trophic interactions between these species in the Flemish Cap.

The Flemish Cap (3M) Ecosystem Production Unit (EPU) has not experienced sustained reductions in overall productivity observed in other EPUs. With the exception of a short-lived increase in 2005-2009, total EPU biomass has remained fairly stable over time despite the changes in individual stocks.

Ecosystem sustainability of catches

The impact of bottom fishing activities on VMEs in the NRA was last assessed in 2021. The risk of Significant Adverse Impacts (SAIs) on sponge and large gorgonian VMEs was assessed to be low, while this risk for sea pen VMEs has been assessed as intermediate. The risks of SAIs on small gorgonian, black coral, bryozoan and sea squirt VMEs were assessed as high. A number of areas in the Flemish Cap (3M) EPU have been closed to bottom fishing to protect VMEs.

3M cod is included in the piscivores guild of the Flemish Cap (3M) Ecosystem Production Unit (EPU). Other NAFO managed stocks in this guild and EPU are 3M redfish and 2+3KLMNOPs Greenland halibut. The Catch/TCI is below the 2TCI ecosystem reference point (3M Piscivore $Catch_{2022}/TCI=0.98$) indicating a low risk of ecosystem overfishing.

Fishery

Cod is caught in directed trawl and longline fisheries and as bycatch in the directed redfish fishery by trawlers. The fishery is regulated by quota. New technical regulations were introduced in 2021, in particular a closure of the directed fishery in the first quarter as well as sorting grids to protect juveniles.

Recent catch estimates and TACs ('000 tonnes) are as follows:

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
TAC	14.5	13.8	13.9	13.9	11.1	17.5	8.5	1.5	4.0	6.1
STATLANT 21	14.4	12.8	13.8	13.9	10.5	13.0	8.5	2.6	NA*	
STACFIS	14.3	13.8	14.0	13.9	11.5	17.5	8.5	2.1	4.0	

*STATLANT 21a data for 2022 were not yet available at the time of writing

Sources of information

SCS Doc. 23/05REV, 23/06, 23/08, 23/13 and SCR Doc. 23/03, 23/04 and 23/09.