










Cod in Division 3M**Advice June 2019 for 2020****Recommendation for 2020**

Scientific Council notes that the strong year classes of 2009 to 2011 are dominant in the current *SSB*. Subsequent recruitments are much lower, therefore substantial declines in stock size are occurring and expected to continue in the near future under any fishing scenario.

Yields during 2020 of either 8 531 tonnes ($\frac{3}{4} F_{lim}$) or 5 619 tonnes ($F_{2016-2018}$) result in a very low probability of *SSB* being below B_{lim} in 2021 and a low probability of F exceeding F_{lim} . However, under both of these scenarios, the probability $SSB < B_{lim}$ in 2022 is high ($\geq 20\%$).

Management objectives

A management strategy evaluation process has been initiated for this stock by the Commission and Scientific Council but has not yet been finalized. At this moment Convention General Principles are applied.

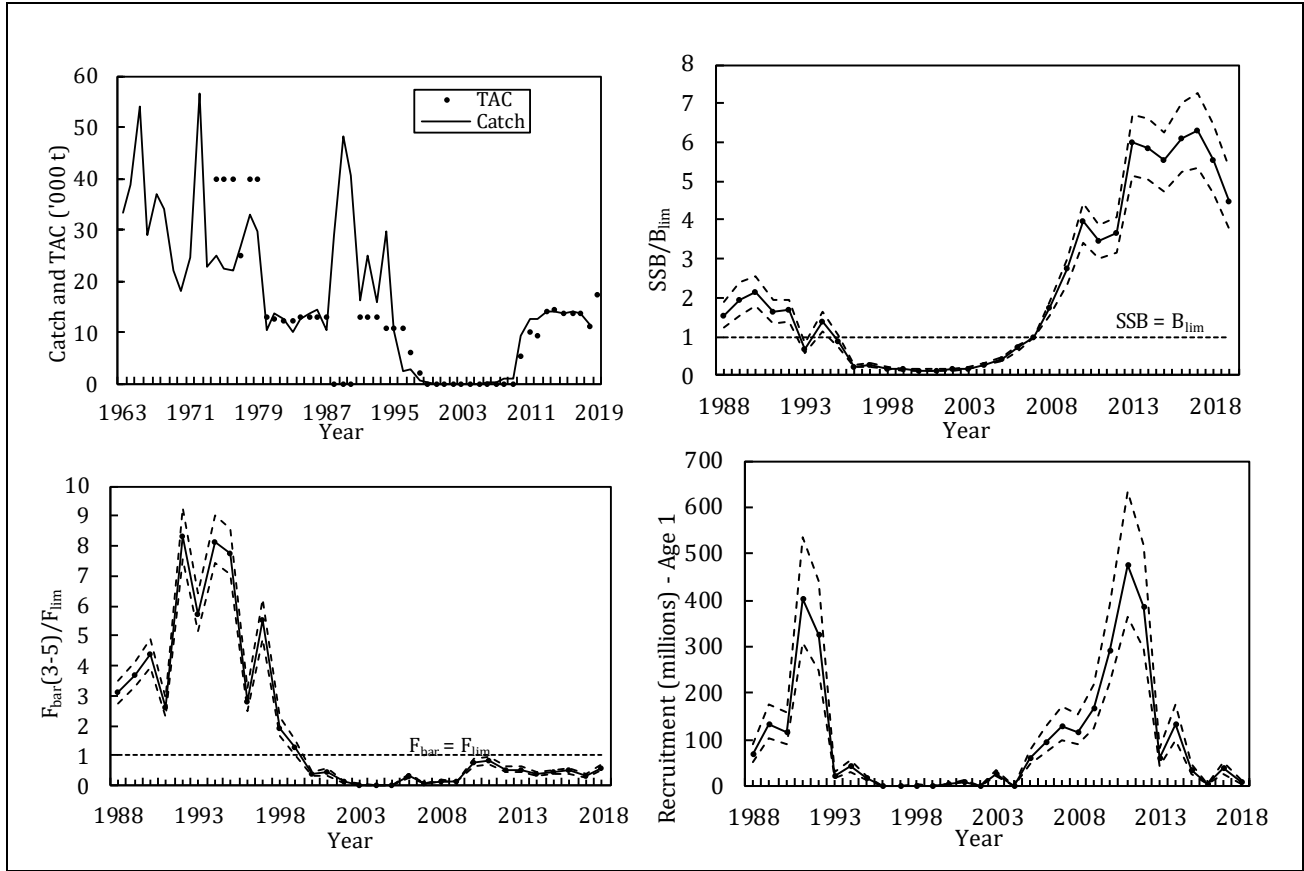
<i>Convention General Principles</i>	<i>Status</i>	<i>Comment/consideration</i>	
Restore to or maintain at B_{msy}		Stock well above B_{lim} . B_{msy} is unknown	 OK
Eliminate overfishing		$F < F_{lim}$	 Intermediate
Apply Precautionary Approach		F_{lim} and B_{lim} defined, HCR in development	 Not accomplished
Minimise harmful impacts on living marine resources and ecosystems		VME closures in effect, no specific measures	 Unknown
Preserve marine biodiversity		Cannot be evaluated	

Management unit

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

Stock status

Current *SSB* is estimated to be well above B_{lim} (15 177 t) although it is expected to decline rapidly in the near future due to poor recruitment since 2015. F increased in 2010 with the re-opening of the fishery but it has remained below F_{lim} (0.167).



Reference points

$B_{lim} = SSB_{2007}$: Median = 15 177 t of spawning biomass (Scientific Council, 2019).

$F_{lim} = F_{30\%SPR}$: Median = 0.167 (Scientific Council, 2019)

Projections

	B		SSB		Yield
Median and 80% CI					
$F_{bar}=F_{lim}$ (median=0.167)					
2019	76891	(67817 - 86311)	69015	(60552 - 78262)	17500
2020	43969	(36989 - 51393)	38538	(32067 - 45573)	10876
2021	26256	(20590 - 32652)	22083	(17017 - 27722)	6275
2022	15086	(10689 - 20149)	12350	(8454 - 16718)	
$F_{bar}=3/4F_{lim}$ (median=0.125)					
2019	76891	(67817 - 86311)	69015	(60552 - 78262)	17500
2020	43969	(36989 - 51393)	38538	(32067 - 45573)	8531
2021	28637	(22958 - 34999)	24368	(19275 - 29993)	5405
2022	17653	(13236 - 22793)	14842	(10933 - 19242)	
$F_{bar}=F_{2016-2018}$ (median=0.079)					
2019	76891	(67817 - 86311)	69015	(60552 - 78262)	17500
2020	43969	(36989 - 51393)	38538	(32067 - 45573)	5619
2021	31634	(25964 - 37966)	27230	(22125 - 32840)	3953
2022	21241	(16828 - 26434)	18302	(14356 - 22736)	



	Yield			P(B < B _{lim})				P(F > F _{lim})			P(B ₂₂ > B ₁₉)
	2019	2020	2021	2019	2020	2021	2022	2019	2020	2021	
F _{lim} = 0.167	17500	10876	6275	<1%	<1%	5%	78%	20%	50%	50%	<1%
3/4F _{lim} = 0.125	17500	8531	5405	<1%	<1%	1%	55%	20%	3%	9%	<1%
F ₁₆₋₁₈ = 0.079	17500	5619	3953	<1%	<1%	<1%	20%	20%	<1%	<1%	<1%

Although advice is given only for 2020, projection results are shown to 2022 to illustrate the medium term implications.

The results indicate that under all scenarios, total biomass and *SSB* during the projected years will decrease sharply. The probability of *SSB* being below *B_{lim}* in 2021 is very low ($\leq 5\%$) in all cases. In 2022, due to rapid stock declines, the risk of being below *B_{lim}* is quite high (20-78%). The probability of *SSB* in 2022 being above that in 2019 is $<1\%$.

Under $\frac{3}{4}$ *F_{lim}* the probability of *F* exceeding *F_{lim}* is less than 10% in 2020 and 2021.

Assessment

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

Timing of the next full assessment of this stock will be subject to the timelines of the ongoing MSE process.

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. Recent studies indicate strong trophic interactions between these species in the Flemish Cap.

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.

Recent catch estimates and TACs ('000 t) are as follows:

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
TAC	5.5	10.0	9.3	14.1	14.5	13.8	13.9	13.9	11.1	17.5
STATLANT 21	5.2	10.0	9.1	13.5	14.4	12.8	13.8	13.9	10.5	
STACFIS	9.3	12.8	12.8	14.0	14.3	13.8	14.0	13.9	11.5	

Effects of the fishery on the ecosystem

General impacts of fishing gear on the ecosystem should be considered. A large area of Div. 3M has been closed to protect sponge, seapens and other coral.

Special comments

Given the rapid declines projected for this stock, an additional projection was conducted assuming no removals ($F=0$). The results show that even with no fishing, the total biomass and *SSB* during the projected years will decrease sharply. The probability of *SSB* in 2022 being above *SSB* in 2019 is $<1\%$. Further, the probability that *SSB* in 2022 is below *B_{lim}* is $<1\%$.

Sources of information

SCS Doc. 18/18, 19/06, 19/07, 19/09, 19/10, 19/11 and SCR Doc. 19/21, 19/26.