Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Division 3M Advice June 2021 for 2022 – 2024

Recommendation for 2022 and 2023

SC advises that catches do not exceed $F_{0.1}$ level, given the life history of the stock. This corresponds to a TAC of 10 933 t in 2022 and 11 171 t in 2023.

Management objectives

No explicit management plan or management objectives defined by Fisheries Commission. Convention General Principles are applied.

Convention objectives	*Status*	*Comment/consideration*
Restore to or maintain at B_{msy}	○	B_{msy} unknown. Stock above historical average level
Eliminate overfishing	●	F_{msy} unknown. Catch at a low level over past 25 years.
Apply Precautionary Approach	●	Candidate yield per recruit reference points available and used, but need to be confirmed.
Minimise harmful impacts on living marine resources and ecosystems	●	VME closures in effect, no specific measures, low bycatch reported.
Preserve marine biodiversity	○	Cannot be evaluated

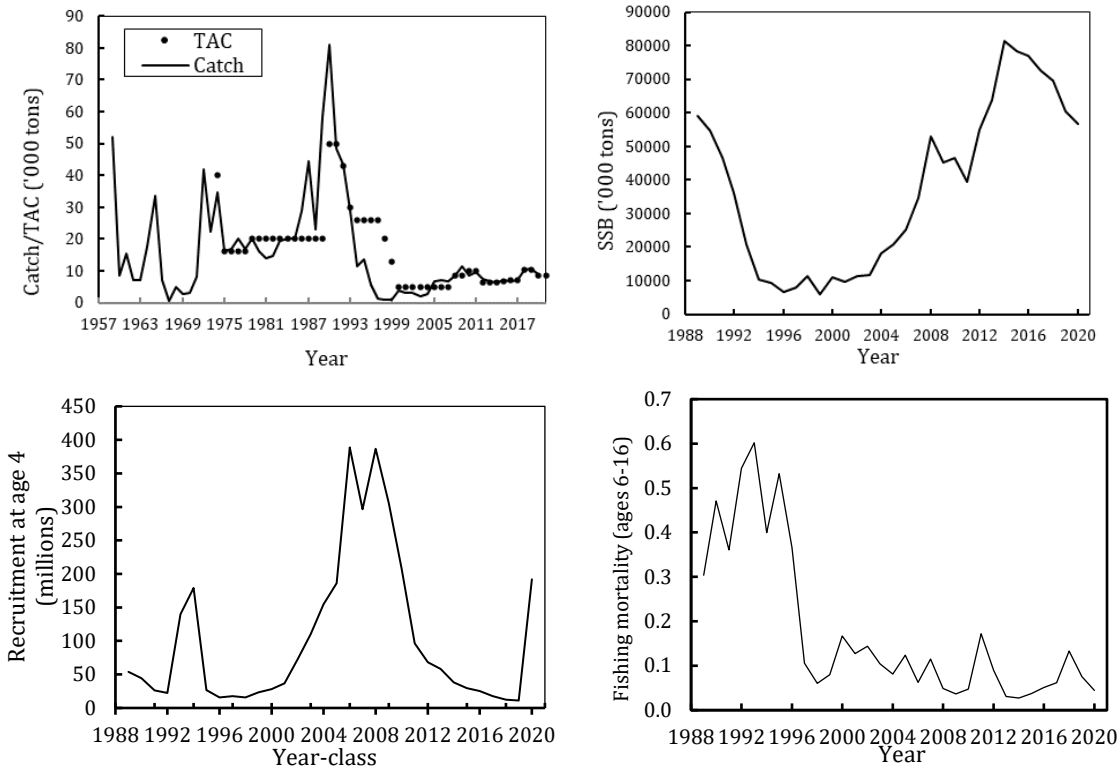
● OK
● Intermediate
● Not accomplished
○ Unknown

Management unit

Catches of redfish in Div. 3M include three species of the genus *Sebastes; S. mentella, S. norvegicus* (=*S. marinus*) and *S. fasciatus*. For management purposes, they are considered as one stock. The assessment and advice are based on data for only two species (*S. mentella* & *S. fasciatus*), labeled as beaked redfish. The TAC advice is adjusted to reflect all three species on the Flemish Cap, based upon the relative species distribution in recent surveys.

Stock status

SSB has declined continuously from its highest level in 2014. After an extended period of declining recruitment, the recruitment estimate for 2020 is high but associated with high uncertainty, and its magnitude needs to be confirmed in future assessments. Fishing mortality remains relatively low compared to the 1980s and 1990s.



Reference points

No reference points have been adopted.

Assessment

Input data comes from the EU Flemish Cap bottom trawl survey and the fishery. A quantitative model (XSA) introduced in 2003 was used. Increased natural mortality was assumed from 2006 to 2010, but natural mortality was low (more typical of redfish) in other years. There is no evidence that natural mortality has increased recently from the level of 0.1 adopted in the 2017 assessment, and therefore, the 2021 XSA assessment was run with average M from 2015 onwards kept at 0.1.

The next full assessment of this stock will be in 2023.

Projections

Short term (2022-2024) stochastic projections were carried out for female spawning stock biomass (SSB) and catch, under most recent level of natural mortality and considering five options for fishing mortality ($F_{0.1}$, F=M, $F_{statusquo}$, 1.25 TAC and 0.75 TAC). Projections assume that redfish catches (all species) in 2021 are equal to the redfish TAC ($F_{statusquo}$ is defined as the corresponding F). Recruitment entering in 2021 to 2023 is given by the geometric mean of the most recent recruitments (age 4 XSA, 2017-2019).

In all projection scenarios, the SSB is projected to decline, and to be at around the average for the assessment time-series (since the late 1980s) by 2024.

***F0.1* =0.0669**

	SSB Median and 80% CI	Yield	TAC
$2021_{deterministic}$	54264	8271	8448
2022	49021 (45226 - 54929)	10704	10933
2023	43311 (39721 - 48611)	10937	11171
2024	38147 (34488 - 43820)		

***F=M* =0.1**

	SSB Median and 80% CI	Yield	TAC
$2021_{deterministic}$	54264	8271	8448
2022	49021 (45226 - 54929)	15506	15837
2023	40898 (37522 - 45931)	14898	15217
2024	34029 (30695 - 39319)		

***FsqTAC* = 0.0558**

	SSB Median and 80% CI	Yield	TAC
$2021_{deterministic}$	54264	8271	8448
2022	49021 (45226 - 54929)	9027	9220
2023	44164 (40476 - 49546)	9415	9616
2024	39674 (35891 - 45447)		

1.25 TAC (*F* = 0.0644)

	SSB Median and 80% CI	Yield	TAC
$2021_{deterministic}$	54264	8271	8448
2022	49021 (45226 - 54929)	10339	10560
2023	43497 (39888 - 48815)	10610	10837
2024	38481 (34787 - 44163)		

0.75 TAC (*F*=0.0376)

	SSB Median and 80% CI	Yield	TAC
$2021_{deterministic}$	54264	8271	8448
2022	49021 (45226 - 54929)	6204	6337
2023	45578 (41810 - 51106)	6697	6840
2024	42303 (38374 - 48389)		

average beaked redfish proportion in the 2019-2020 3M redfish catch 0.979

	F0.1	F=M	Fsq	1.25 TAC	0.75 TAC
$P(SSB_{2022}>SSB_{2021})$	<10%	<10%	<10%	<10%	<10%
$P(SSB_{2023}>SSB_{2021})$	<10%	<10%	<10%	<10%	<10%
$P(SSB_{2024}>SSB_{2021})$	<10%	<10%	<10%	<10%	<10%

Human impact

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

Biology and Environmental Interactions

Since 2004 a rapid increase was observed on survey biomass both of golden (*Sebastes norvegicus*) and Acadian (*Sebastes fasciatus*) redfish stocks. Due to their shallower depth distributions, these two redfish species overlap with cod to an extent greater than deep sea redfish (*Sebastes mentella*). Since 2006, the cod stock started to

recover, while those two redfish stocks declined sharply. Redfish is an important component in the diet of cod, especially in those years when successful recruitment events were observed in redfish stocks.

Fishery

Redfish is caught in directed bottom trawl fisheries at intermediate depths (300-700m), but also as bycatch in fisheries directed for cod and Greenland halibut. The fishery in NAFO Div. 3M is regulated by minimum mesh size and quota.

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

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
TAC	6.5	6.5	6.5	6.7	7.0	7.0	10.5	10.5	8.6	8.4
STATLANT 21	5.4	6.8	6.4	6.9	6.6	7.1	10.5	10.4	8.6	
STACFIS Total catch [1]	6.2	7.8	7.4	6.9	6.6	7.1	10.5	10.6	8.8	
STACFIS Catch [2]	6.3	5.2	4.6	5.2	6.2	6.9	10.3	10.2	8.7	

[1] STACFIS total catch on 2011-2014 based on the average 2006-2010 bias.
[2] STACFIS beaked redfish catch estimate, based on beaked redfish proportions on observed catch.

Effects of the fishery on the ecosystem

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

Sources of information: SCR Doc. 21/034 SCS Doc. 21/05, 06, 09,13