Redfish in Division 3M

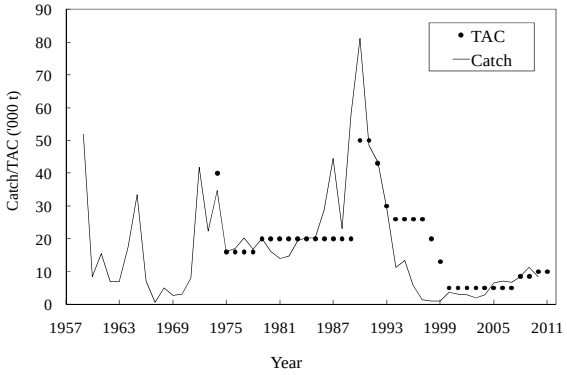
Background: There are 3 species of redfish, which are commercially fished on Flemish Cap: deep-water redfish *(Sebastes mentella*), golden redfish (*Sebastes marinus*) and Acadian redfish (*Sebastes fasciatus*). The present assessment evaluates the status of the Div. 3M beaked redfish stock, regarded as a management unit composed of two populations from two very similar species (*Sebastes mentella* and *Sebastes fasciatus*). The reason for this approach is that evidence indicates this is the dominant redfish group on Flemish Cap.

Fishery and Catches: The redfish fishery in Div. 3M increased from 20 000 t in 1985 to 81 000 t in 1990, falling continuously since then until 1998-1999, when a minimum catch around 1 100 t was recorded mostly as by-catch of the Greenland halibut fishery. An increase of the fishing effort directed to Div. 3M redfish is observed during the first years of the present decade, pursued by EU-Portugal and Russia fleets. A new golden redfish fishery occurred on the Flemish Cap bank from September 2005 onwards on shallower depths above 300m, basically pursued by Portuguese bottom trawl and Russia pelagic trawl. Furthermore, the reopening of the Flemish Cap cod fishery in 2010 also contributed to the actual level of redfish catch of 8 500 t.

This new reality implied a revision of catch estimates, in order to split 2005-2010 redfish catch from the major fleets on Div. 3M into golden and beaked redfish catches.

	Catch ('000 tons)			TAC ('000 tons)	
Year	STACFIS		21A	Recommended	Agreed
2008	8.5[1]	4.3[2]	7.9	5	5
2009	11.3[1]	3.7[2]	8.7	8.5	8.7
2010	8.5[1]	5.4[2]	8.5[3]	10.0	10.0
2011				10.0	10.0

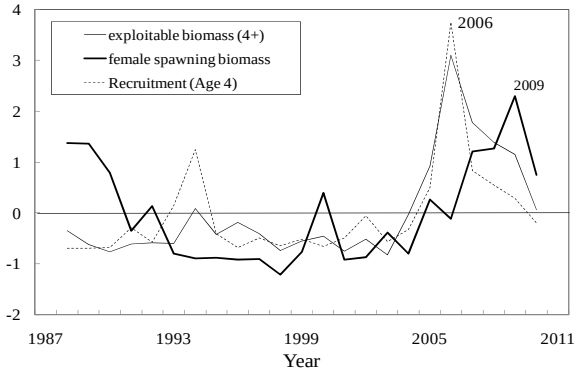
[1] Estimated total redfish catch
[2] Estimated beaked redfish catch
[3] Provisional.



Data: Catch-at-age data were available from 1989-2010, including by-catch information from the shrimp fishery from 1993-2004.

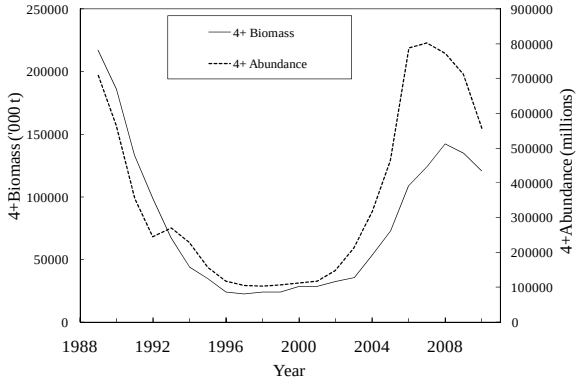
There are three bottom trawl survey series providing biomass indices as well as length and age data for the Flemish Cap redfish stocks; Russia (1983-93, 1995-96 and 2001-2002), EU (1988-2010) and Canada (1979-85 and 1996). The Russian survey was complemented with an acoustic estimate of the redfish pelagic component for the 1988-92 period.

Assessment: Survey bottom biomass, female spawning biomass and recruitment were calculated from 1988-2010 EU surveys.

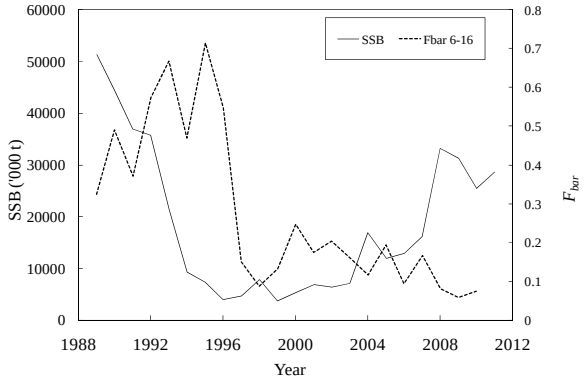


A virtual population (XSA) was carried out for 1989-2010. In order to adjust the model to the recent declines observed on survey exploitable and spawning biomass, that can only be explained by an increase in mortality other than fishing mortality, a sensitivity analysis was carried out, allowing an increase of natural mortality (*M*) from 0.1 to 1.0.

Taking into account the results of the sensitivity analysis the assessment was accepted with a natural mortality level at 0.4 for ages 4-6 through 2006-2010, and ages 7+ on 2009 and 2011. The assessment was considered reliable for projections.

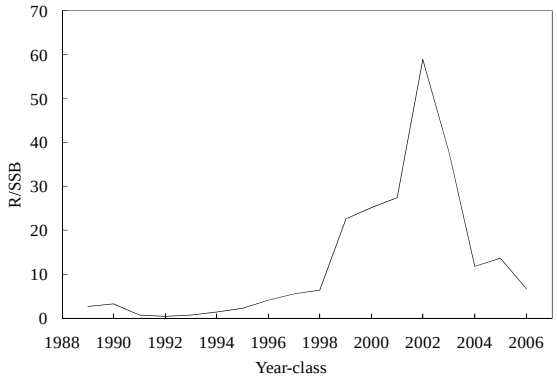


Biomass: Experienced a steep decline from the 1989 until 1996. The exploitable stock was kept at a low level until the early 2000's, basically dependent on the survival and growth of the existing cohorts. Above average year classes coupled with high survival rates allowed a rapid growth of biomass and abundance since 2003 and sustained the stock at a high level on 2007-2008. However the stock decreased on the last couple of years for causes other than fishing and, despite the stock size being still above average level, there are no signs that the present decline rate is slowing down.



Spawning stock biomass: The continuous increase observed since 2000 was halted at 2008. Female spawning biomass drop from 2009 to 2010, but is still well above average. A marginal increase is expected in 2011 due to the individual growth of the female survivors from the abundant 2000-2002 year classes, now dominating the spawning biomass.

Fishing Mortality: Fishing mortality was at a high level until 1996 and dropped to a low level since 1997.



Recruitment: Increased from 1998 year class till 2002 year class, which gave the age 4 historical high, and declined afterwards as fast as it went up. Recruitment is on 2010 just below average.

State of the Stock: Scientific Council concluded that the declines of stock abundance and biomass, observed since 2008, were extended to the survey female spawning component in 2009-2010. These declines could not be explained by a commercial catch that has been chronically small for more than a decade. The assessment results can only reflect the declines foreseen by the EU survey if natural mortality is allowed to suffer an important increase since 2006.

Short term projections: Short term (2013) stochastic projections were obtained for female spawning stock biomass (SSB) and yield for $F = 0$, F *status quo* = 0.072 and $F_{0.1} = 1.98$.

Results of the SSB and yield short term projections under the three F scenarios are tabulated bellow for 5%, 50% and 95% probability levels:

Female spawning biomass			
F = 0	2012	2013	2014
p5	23152	21838	19437
p50	26650	25030	22228
p95	30842	29035	25853
$F_{status\ quo}$=0.072	2012	2013	2014
p5	23152	20492	17088
p50	26650	23505	19590
p95	30842	27287	22875
$F_{0.1}$=1.976	2012	2013	2014
p5	23152	4861	1337
p50	26650	5708	1657
p95	30842	6873	2090

Yield		
F = 0	2012	2013
p5		
p50		
p95		
$F_{status\ quo}$=0.072	2012	2013
p5	2904	2519
p50	3279	2894
p95	3772	3430
$F_{0.1}$=1.976	2012	2013
p5	42499	10914
p50	48469	14295
p95	56542	23830

Between 2011 and 2014 the female spawning stock biomass (SSB) is expected to record a decrease under no fishing mortality or under *F status quo* within 22-31%. With the actual $F_{0.1}$ a short term reduction of the SSB in the order of 94% is expected, along with catches much higher than the correspondent SSB.

Under these circumstances fishing at $F_{0.1}$ is not a management option. Between 2011 and 2014 the female spawning stock biomass (SSB) is expected to decrease either under no fishing mortality or under *F status quo.*

Recommendation: In order to sustain the female spawning stock biomass on the short term fishing mortality should be kept at its present low level. This would correspond to an expected average 2012-2013 beaked redfish catch under *F status quo* of 3 087 t. Catch for all redfish species combined in Div. 3M in 2012 and 2013 should not exceed 6 500 t.

Reference Points: No updated information on biological reference points was available.

Special Comments: Scientific Council expressed its concern not only for the uncertainty around the actual level of natural mortality but also for the lack of research regarding the possible causes responsible for the severe decline of the stock from 2006 onwards.

$F_{0.1}$ will always be dependent on the magnitude of the underlying natural mortality. In the actual yield per recruit analysis the adopted high level of natural mortality lead to a very high $F_{0.1}$.

The next assessment will be in 2013.

Sources of Information: SCR Doc. 11/21, 26; SCS Doc. 11/4, 5,7,11.