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NOAA FISHERIES NATIONAL MARINE FISHERIES SERVICE

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Transboundary Resources Assessment Committee

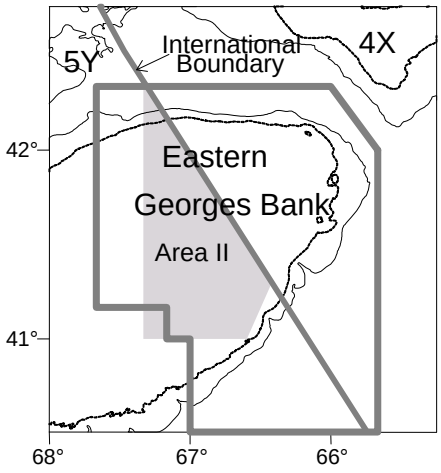
Status Report 2009/01

EASTERN

GEORGES BANK

COD

[5Zjm; 551,552,561,562]



Summary

- Combined Canada/USA catches were 1,782 mt, including 161 mt of discards in the 2008 calendar year.
- Adult population biomass (ages 3+) declined from about 50,000 mt in 1990 to below 10,000 mt in 1995. Biomass subsequently fluctuated between 6,000 and 13,000 mt before decreasing in 2005 to about 3,800 mt in the "split M 0.2" model and 6,000 mt in the "split M 0.5" model. It increased at the beginning of 2009 to 8,700 mt in the "split M 0.2" model and 12,000 mt in the "split M 0.5" model.
- Fishing mortality (F) in 2008 was estimated to be 0.25 from the "split M 0.2" model and 0.17 from the "split M 0.5" model. Both models show recent reductions in F; however, F has been above the F_{ref}=0.18 in the past.
- Recruitment at Age 1 of the 2003 year class (4.4 million from "split M 0.2" model and 5.8 million from "split M 0.5" model) is the highest since the 1990 year class but is still lower than the pre-1990 average (10 million from both models). The 2002 and 2004 year classes are the lowest on record. The 2005 and 2006 year classes are close to the post-1990 average. Initial indications are that the 2007 year class is weak.
- Resource productivity is currently poor due to low recent recruitment and low weights-at-age.
- Assuming a 2009 catch equal to the 1,700 mt total quota, a combined Canada/USA catch of about 1,300 mt ("split M 0.2" model) and 1,700 mt ("split M 0.5" model) in 2010 will result in a neutral risk (50%) that the fishing mortality rate in 2010 will exceed F_{ref}. A catch of 1,800 mt ("split M 0.2" model) and 900 mt ("split M 0.5" model) will result in a neutral risk (50%) that the 2011 adult biomass (ages 4+) will be lower than 2010. A catch of about 1,000 mt ("split M 0.2" model) will result in a neutral risk (50%) and 500 mt ("split M 0.5" model) will have high risk (75%) of adult biomass in 2011 will not increase by 10% from 2010.

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http://www.mar.dfo-mpo.gc.ca/science/TRAC/trac.html

Catches, Biomass (thousands mt); Recruits (millions)

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Avg[1]	Min[1]	Max[1]
Canada	Quota	1.6	2.1	1.2	1.3	1.0	0.7	1.3	1.4	1.6	1.2			
	Landed	1.6	2.1	1.3	1.3	1.1	0.6	1.1	1.1	1.4		6.2	0.6	17.8
	Discard	0.1	0.1	0.1	0.2	0.1	0.2	0.3	0.1	0.1		0.1	0.0	0.5
USA	Quota[2]					0.3	0.3	0.4	0.5	0.7	0.5			
	Catch[2]					0.2	0.2	0.3	0.3	0.7				
	Landed	0.8	1.5	1.7	1.9	1.0	0.2	0.1	0.2	0.2		3.8	0.1	10.6
	Discard	0.0	0.2	0.0	0.1	0.1	0.2	0.1	0.3	0.0		0.1	0.0	0.3
Total	Quota					1.3	1.0	1.7	1.9	2.3	1.7			
	Catch	2.4	4.0	3.1	3.5	2.3	1.3	1.7	1.8	1.8		10.3	1.3	26.5
From "split M 0.2" model														
	Adult Biomass[3]	7.9	10.2	8.1	6.3	5.9	3.8	6.2	6.6	7.4	8.7	24.9[4]	3. 8[4]	60.4[4]
	Age 1 Recruits	1.5	1.2	1.8	0.6	4.4	0.6	1.8	1.5	1.0		5.7	0.6	23.6
	Fishing mortality[5]	0.38	0.64	0.45	0.74	0.68	0.33	0.48	0.26	0.25		0.56	0.25	1.29
	Exploitation Rate[5]	29%	43%	33%	48%	45%	26%	35%	21%	20%		38%	20%	67%
From "split M 0.5" model														
	Adult Biomass[3]	10.4	13.5	11.2	8.8	8.9	6.0	9.1	9.8	10.3	12.0	26.4[4]	6.0[4]	60.4[4]
	Age 1 Recruits	1.7	1.5	2.5	0.7	5.8	0.8	2.2	1.9	1.2		6.0	0.7	23.7
	Fishing mortality[5]	0.27	0.44	0.32	0.49	0.40	0.20	0.28	0.18	0.17		0.46	0.17	1.06
	Exploitation Rate[6]	22%	31%	23%	35%	30%	15%	24%	14%	14%		32%	14%	59%
	Exploitation Rate[7]	21%	32%	25%	33%	32%	21%	18%	14%	12%		29%	12%	53%

[1]1978 – 2008
[2]for fishing year from May 1 – April 30
[3]Jan 1 ages 3+
[4]1978 – 2009
[5]ages 4-9
[6]ages 4-5
[7]ages 6-9

Fishery

Combined Canada/USA catches averaged 17,508 mt between 1978 and 1992, peaked at 26,463 mt in 1982, and declined to 1,684 mt in 1995. Catches fluctuated around 3,000 mt until 2004, and subsequently declined again. Catches in 2008 were 1,782 mt, including 161 mt of discards (Figure 1).

Canadian catches increased to 1,529 mt in 2008 from 1,222 mt in 2007. Since 1995, with reduction in cod quotas, the fishery has reduced targeting for cod through changes in fishing practices. All 2008 landings were subject to dockside monitoring, and at sea observers monitored close to 38% by weight of the mobile gear fleet landings and 21% by weight of the fixed gear landings. Discards were estimated at 6 mt from mobile gear fleet and 97mt from the fixed gear fleet. Since 1996 the Canadian scallop fishery has not been permitted to land cod. Estimated discards of cod by the Canadian scallop fishery were 36 mt in 2008.

USA catches decreased to 253 mt in 2008 from 557 mt in 2007. Since December 1994, a year-round closure of Area II has been in effect, with the exception of a Special Access Program for yellowtail flounder in 2004. Minimum mesh size limits were increased in 1994, 1999 and 2002. Limits on sea days and trip limits have also been implemented. Quotas were introduced in May 2004. Eastern Georges bank was not open until August 1, 2008. Estimated discards of cod for 2008 were 22 mt, predominantly from the groundfish fishery.

The combined Canada/USA 2008 **fishery age composition** was dominated by the 2003 year class at Age 5 (47% by number), followed by the 2005 year classes at Age 3 (23% by number) and the 2004 year class at Age 4 (11% by number). The 2001 year class at Age 7 still contributes to the catch (6% by number). Discards at age from the USA groundfish and scallop fishery (1989 to 2008), the Canadian groundfish fishery (1995 to 2008) and the Canadian scallop fishery (1978 to 2008) were included in the assessment when identified.

Harvest Strategy and Reference Points

The Transboundary Management Guidance Committee has adopted a strategy to maintain a low to neutral risk of exceeding the fishing mortality limit reference, $F_{ref} = 0.18$. When stock conditions are poor, fishing mortality rates should be further reduced to promote rebuilding.

State of Resource

Evaluation of the state of the resource was based on results from an age structured analytical assessment (Virtual Population Analysis, VPA), which used fishery catch statistics and sampling for size and age composition of the catch for 1978 to 2008 (including discards). The VPA was calibrated to trends in abundance from three bottom trawl survey series: NMFS spring, NMFS fall and DFO.

Two VPA model formulations were established during the benchmark assessment meeting in 2009. These model formulations will be referred to as the "split M 0.2" and "split M 0.5"model. The survey abundance indices were split in 1993-1994 for both model formulations. Natural mortality (M) was fixed at 0.2 for all the ages in all years for the "split M 0.2" model and was fixed at 0.5 for ages 6+ in years after 1994 for the "split M 0.5" model. It was recommended at the benchmark meeting to consider both model formulations until the fate of the 2003 year class has been documented and thus provides information on natural mortality.

Retrospective analyses were conducted to detect any tendency to consistently overestimate or underestimate fishing mortality, biomass or recruitment relative to the terminal year estimates. There was no persistent retrospective pattern but there was a tendency to initially overestimate 3+ biomass in some recent years.

From the "split M 0.2" model**, adult population biomass** (ages 3+) declined substantially from 48,400 mt in 1990 to 6,700 mt in 1995. Biomass subsequently fluctuated between 5,900 and 10,200 mt before decreasing to 3,800 mt in 2005 and increasing again to 8,700 mt (80% confidence interval: 7,595mt-11,279mt) at the beginning of 2009(Figure 2). From the "split M 0.5" model, **adult population biomass** declined substantially from 49,100 mt in 1990 to 8,500 mt in 1995. Biomass subsequently fluctuated between 8,400 and 13,500 mt before decreasing to 6,000 mt in 2005 and increasing again to 12,000 mt (80% confidence interval: 10,417mt-15,245mt) at the beginning of 2009(Figure 2). The increase in 2006 was largely due to recruitment of the 2003 year class, and the increases in 2007, 2008 and 2009 were due to growth of the 2003 year class. Lower weights-at-age in the population in recent years and generally poor recruitment have contributed to the lack of sustained rebuilding, although improvement in size at some ages has been seen in the 2008 fishery and 2009 DFO survey.

Recruitment at Age 1 of the 2003 year class (4.4 million from "split M 0.2" model and 5.8 million from "split M 0.5" model) is the highest since the 1990 year class but is still lower than the pre-1990 average (10 million from both models). The 2002 and 2004 year classes are the lowest on record. The 2005 and 2006 year classes are close to the post-1990 average (2 million from "split M 0.2" model and 2.4 million from "split M 0.5" model). Initial indications are that the 2007 year class is weak. Recruitment, while highly variable, has generally been higher when adult biomass has been above 30,000 mt (Figure 3). The current biomass is below 30,000 mt and recruitment is poor.

Fishing mortality (population weighted average of age groups 4-9) was high prior to 1994. F declined in 1995 to 0.36 for the "split M 0.2" model and to 0.24 for the "split M 0.5" model due to restrictive management measures and then fluctuated. F in 2008 was estimated to be 0.25 (80% confidence interval: 0.19-0.33) from the "split M 0.2" model and 0.17 (80% confidence interval: 0.14-0.22) from the "split M 0.5" model. Both models show recent reductions in F; however, F has been above the F_{ref}=0.18 in the past (Figure 1).

Productivity

Recruitment, age structure, fish growth and spatial distribution reflect changes in the productive potential. Although there is high **recruitment** variability at any given biomass, the recruit per spawner has not increased when the biomass has been low. This hampers stock rebuilding. In both absolute numbers and percent composition, the **population age structure** displays a very low proportion of ages 7+ compared to the 1980s. Average weight at length, used to reflect condition, has been stable, but declines in length and weight at age have hampered biomass rebuilding. There is some improvement in **size at age** in the 2008 fishery and the 2009 DFO survey for some ages. The **spatial distribution** patterns observed during the most recent bottom trawl surveys showed that adult cod were distributed in a similar manner to the average over the past decade. Resource productivity is currently poor due to low recent recruitment and low weights at age compared to the 1980s.

Outlook

This outlook is provided in terms of consequences with respect to the harvest reference points for alternative catch quotas in 2010. Uncertainty about current biomass generates uncertainty in forecast results, which is expressed here as the risk of exceeding F_{ref} =0.18. The risk calculations assist in evaluating the consequences of alternative catch quotas by providing a general measure of the uncertainties. However, they are dependent on the data and model assumptions and do not include uncertainty due to variations in weight at age, partial recruitment to the fishery, natural mortality, systematic errors in data reporting or the possibility that the model may not reflect stock dynamics closely enough.

For **projections**, the 2006-2008 average values were assumed for the fishery weight at age, the 2004-2008 average values were assumed for the partial recruitment pattern in 2009-2010, and the 2007-2009 survey average values were assumed for beginning of year population weight at age in 2010-2011. Catch in 2009 was assumed to be equal to the 1,700 mt quota. Projections are provided from each of the model results.

A. "split M 0.2" model

A combined Canada/USA catch of about 1,300 mt in 2010 will result in a neutral risk (50%) that the fishing mortality rate in 2010 will exceed F_{ref} whereas a catch of 1,800 mt will result in a neutral risk (50%) that the 2011 adult biomass (4+) will be lower than the 2010 adult biomass (Figure 4). A catch of about 1,000 mt will result in a neutral risk (50%) that 2011 adult biomass will not increase by 10%

B. "split M 0.5" model

A combined Canada/USA catch of about 1,700 mt in 2010 will result in a neutral risk (50%) that the fishing mortality rate in 2010 will exceed F_{ref} whereas a catch of 900 mt will result in a neutral risk (50%) that the 2011 adult biomass will be lower than the 2010 adult biomass (Figure 4). A catch of about 500 mt will have a high risk (75%) that 2011 adult biomass will not increase by 10%.

While management measures have resulted in decreased exploitation rate since 1995, adult biomass has fluctuated without any appreciable rebuilding. The continuing poor recruitment since the early 1990s is an important factor for this lower productivity. The 2003 year class made a substantial contribution to the fishery and population biomass, and it is projected to continue to be an important component in the fishery catch biomass in 2009-2010 (around one third of the catch) and population biomass in 2010-2011. With the passing of the 2003 year class through the population, rebuilding will not occur without improved recruitment.

Special Considerations

Cod and haddock are often caught together in groundfish fisheries, although they are not necessarily caught in proportion to their relative abundance because their catchabilities to the fisheries differ. Due to the higher haddock quota, discarding of cod may be high and should be monitored. Modifications to fishing gear and practices, with enhanced monitoring, may mitigate these concerns.

Mechanisms that explain changes in either survey catchability or natural mortality could not be established. Possible differences in vertical structure of cod aggregations in relation to changes in abundance could cause changes in catchability. Changes in natural mortality could be aliasing 'missing' catch, particularly during the regulatory and reporting changes of the mid 1990s. It could also be aliasing emigration or imperfect designation of the boundaries for this component, though an excess of larger/older fish is not apparent in adjacent cod components.

Source Documents

TRAC. 2009. L. O'Brien and T. Worcester, editors. 2009. Proceedings of the Transboundary Resources Assessment Committee (TRAC); 8-12 June 2009. TRAC Proceedings 2009/01.

Wang, Y., L. O'Brien, S. Gavaris, and B. Hatt. 2009. Assessment of Eastern Georges Bank Atlantic Cod for 2009. TRAC Reference Document 2009/01.

Correct Citation

TRAC. 2009. Eastern Georges Bank Cod. TRAC Status Report 2009/01.

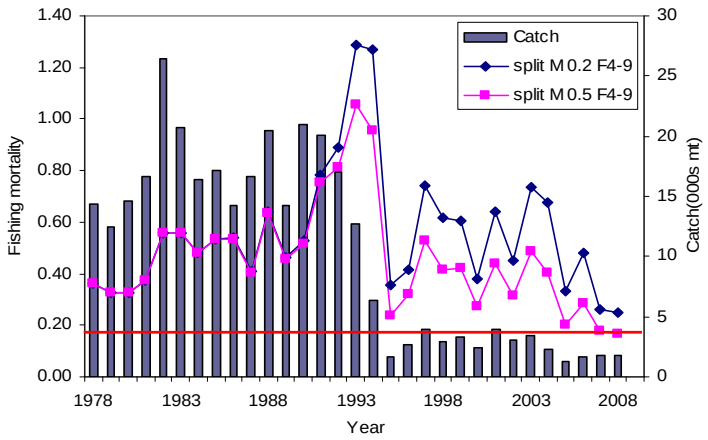

Figure 1. Catches and fishing mortality.

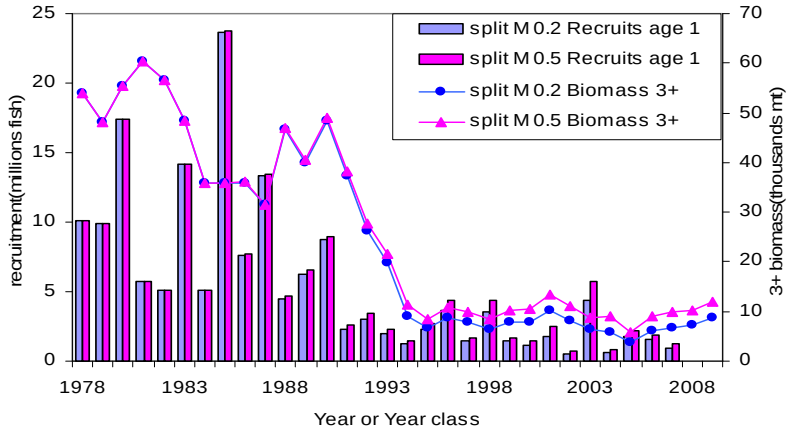

Figure 2. Biomass and recruitment.

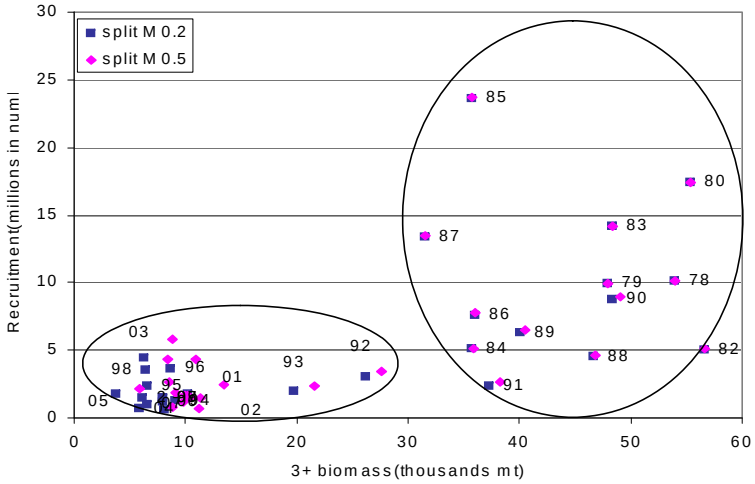

Figure 3. Stock recruitment patterns.

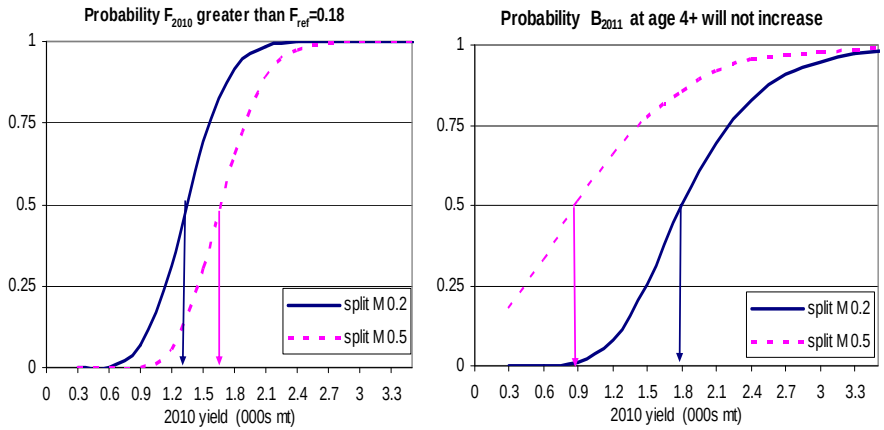

Figure 4. Projection and risks.