

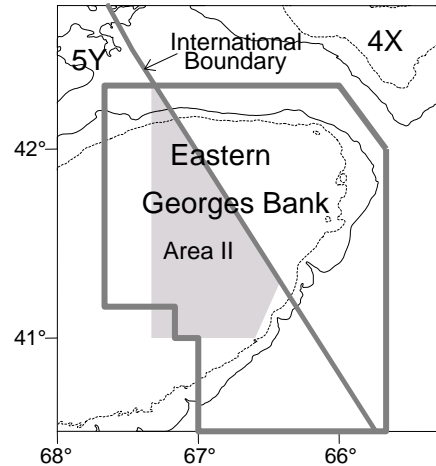


Transboundary Resources Assessment Committee

Status Report 2012/03

**EASTERN  
GEORGES BANK  
HADDOCK**

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



*Summary*

- Combined Canada and USA catches in 2011 were 12,655 mt.
- Adult biomass decreased to 62,200 mt in 2005 and subsequently increased to 172,700 mt in 2009. At the beginning of 2012, adult biomass had decreased to 70,700 mt.
- The current estimate for the outstanding 2010 year class is 589 million age 1 fish, which would make it the largest cohort in the assessment time series. The preliminary estimate for the 2011 year class is 105 million age 1 fish. Except for the strong 2000 and 2011 year classes and the exceptional 2003 and 2010 year classes, recruitment has fluctuated between 2.1 and 29.4 million since 1990.
- Fishing mortality was below  $F_{ref} = 0.26$  during 1995 to 2003, above or near  $F_{ref}$  in 2004 to 2006, but has subsequently been below  $F_{ref}$  and was 0.14 in 2011.
- This stock exhibits positive features such as an expanding age structure, broad spatial distribution, and has produced 2 exceptional and 2 strong year classes in the last 12 years. However, fish condition has been below the series average since 2003, similar to the trends in condition observed in Eastern Georges Bank cod and Georges Bank yellowtail flounder.
- Assuming a 2012 catch equal to the 16,000 mt total quota, a combined Canada/USA catch of 10,400 mt in 2013 results in a neutral risk (50%) that the 2012 fishing mortality rate would exceed  $F_{ref} = 0.26$ . Due to the entry of the 2010 year class into the 3+ group in 2013 and its subsequent growth, the estimated probability that the adult biomass will decline from 2013 to 2014 is virtually 0% at any of the catch scenarios considered. Adult biomass is projected to be 306,200 mt (a record-high) at the beginning of 2014.



**Catches and Biomass (thousands mt); Recruits (millions)**

		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Avg <sup>1</sup>	Min <sup>1</sup>	Max <sup>1</sup>
<b>Canada<sup>8</sup></b>	<b>Quota</b>	6.9	9.9	15.4	14.5	12.7	15.0	18.9	17.6	12.5	9.1			
	<b>Landed</b>	6.8	9.7	14.5	12.0	11.9	14.8	17.6	16.6	11.2		5.7	0.5	17.6
	<b>Discard</b>	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.0	0.0		0.1	0.0	0.2
<b>USA<sup>8</sup></b>	<b>Quota<sup>2</sup></b>		5.1	7.6	7.5	6.3	8.1	11.1	12.0	9.5	6.9			
	<b>Catch<sup>2</sup></b>		1.1	0.6	0.7	0.3	1.6	1.6	1.8	1.1				
	<b>Landed</b>	1.7	1.8	0.6	0.3	0.3	1.1	2.2	2.2	1.3		2.1	0.0	9.1
	<b>Discard</b>	0.1	0.2	0.1	0.3	0.3	0.1	0.1	0.0	0.1		0.6	0.0	7.6
<b>Total<sup>8</sup></b>	<b>Quota<sup>3</sup></b>		15.0	23.0	22.0	19.0	23.0	30.0	29.6	22.0	16.0			
	<b>Catch<sup>3,4</sup></b>		10.9	15.1	12.7	12.3	17.1	17.6	18.4	12.3				
	<b>Catch</b>	8.6	11.9	15.3	12.6	12.5	16.0	19.9	18.8	12.7		8.3	2.1	23.3
	<b>Adult Biomass<sup>5</sup></b>	86.4	81.6	62.2	130.9	160.7	162.2	172.7	136.6	99.0	70.7	50.5 <sup>6</sup>	4.9 <sup>6</sup>	172.7 <sup>6</sup>
	<b>Age 1 Recruits</b>	2.7	328.0	5.9	18.8	5.8	7.8	4.3	4.9	588.9	104.9	36.3 <sup>6</sup>	0.2 <sup>6</sup>	588.9 <sup>6</sup>
	<b>Fishing mortality<sup>7</sup></b>	0.19	0.27	0.25	0.25	0.13	0.08	0.12	0.15	0.14		0.29	0.08	0.57
	<b>Exploitation Rate<sup>7</sup></b>	16%	22%	20%	20%	11%	7%	11%	13%	12%		22%	7%	40%

<sup>1</sup>1969 – 2011

<sup>2</sup>for fishing year from May 1<sup>st</sup> – April 30<sup>th</sup>

<sup>3</sup>for Canadian calendar year and USA fishing year May 1<sup>st</sup> – April 30<sup>th</sup>

<sup>4</sup>sum of Canadian Landed, Canadian Discard, and USA Catch (includes discards)

<sup>5</sup>January 1<sup>st</sup> ages 3+

<sup>6</sup>1931 – 1955, 1969 – 2012

<sup>7</sup>ages 4-8 for 1969 – 2002; ages 5-8 for 2003 – 2011

<sup>8</sup> unless otherwise noted, all values reported are for calendar year

***Fishery***

Under restrictive management measures, **combined Canada/USA catches** declined from 6,504 mt in 1991 to a low of 2,150 mt in 1995, varied between about 3,000 mt and 4,000 mt until 1999, and increased to 15,256 mt in 2005 (Figure 1). Combined catches then decreased to 12,508 mt in 2007 but increased to 19,856 in 2009 and then decreased to 12,655 mt in 2011.

The **Canadian catch** in 2011 decreased to 11,247 mt from 16,592 mt in 2010. The weight of all Canadian landings was monitored at dockside. Compliance with mandatory retention is thought to be high, so discards in the groundfish fishery are considered to be negligible. Discards of haddock by the Canadian sea scallop fishery ranged between 29 mt and 186 mt since 1969 and were 15 mt in 2011.

**USA catches** in 2011 decreased to 1,409 mt from 2,201 mt in 2010. Landings were 1,322 mt and discards were estimated to be 87 mt, primarily from the large mesh otter trawl fishery, but discards also occurred in the longline fleet. Landings are reported by dealers, and discards are estimated from at-sea observer data.

The **combined Canada/USA fishery catch** (landings + discards) in 2011 was dominated by the 2003 year class (age 8) by numbers and weight. Both the Canadian and the USA fisheries were adequately sampled to determine length composition of the catch.

## *Harvest Strategy and Reference Points*

The Transboundary Management Guidance Committee (TMGC) has adopted a strategy to maintain a low to neutral risk of exceeding the fishing mortality reference,  $F_{\text{ref}} = 0.26$  (established in 2002 by the TMGC). 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) that used fishery catch statistics and sampling for size and age composition of the catch for 1969 to 2011 (including discards). The VPA was calibrated to trends in abundance from three bottom trawl survey series: NMFS spring, NMFS fall and DFO. Data to approximate the age composition of the catch during 1931 to 1955 were used to reconstruct a population analysis of eastern Georges Bank haddock suitable for comparison of productivity to recent years. Retrospective analyses were conducted to detect any tendency to consistently overestimate or underestimate fishing mortality, biomass and recruitment relative to the terminal year estimates. The current stock assessment does not display a retrospective bias.

Improved **recruitment** since 1990, lower exploitation, and reduced capture of small fish in the fisheries allowed the **adult population biomass** (ages 3+) to increase from near an historical low of 10,400 mt in 1993 to 86,400 mt in 2003 (Figure 2). Adult biomass decreased to 62,200 mt in 2005 and subsequently increased to 172,700 mt in 2009, higher than the 1931-1955 maximum biomass of about 90,000 mt. At the beginning of 2012, the adult biomass had decreased to 70,700 mt (80% confidence interval: 60,000 mt – 83,700 mt). The tripling of the adult biomass after 2005 was due to the exceptional 2003 year class, currently estimated at 328 million age 1 fish. The current estimate for the outstanding 2010 year class is 589 million age 1 fish, which would make it the largest cohort in the assessment time series: 1931-1955 and 1969-2011. The preliminary estimate for the 2011 year class is 105 million age 1 fish. Except for the strong 2000 and 2011 year classes and the exceptional 2003 and 2010 year classes, recruitment has fluctuated between 2.1 and 29.4 million since 1990.

**Fishing mortality** (population weighted for ages 4-8) fluctuated between 0.26 and 0.47 during the 1980s, and markedly increased in 1992 and 1993 to about 0.5, the highest observed. From 2003 to the present, the age at full recruitment to the fishery has been at age 5 (rather than age 4, previously) due to a decline in size at age of haddock. Fishing mortality (population weighted for ages 4-8 prior to 2003 and ages 5-8 for 2003-2011) was below  $F_{\text{ref}} = 0.26$  during 1995 to 2003, above or near  $F_{\text{ref}}$  in 2004 to 2006, but has subsequently been below  $F_{\text{ref}}$  and was 0.14 in 2011 (80% confidence interval: 0.11 – 0.15, Figure 1).

## *Productivity*

Recruitment, as well as age structure, spatial distribution and fish growth reflect changes in the productive potential. Recruitment, while highly variable, has generally been higher when adult biomass has been above 40,000 mt, which has been the case since 2001 (Figure 3). The **population age structure** displays a broad representation of age groups, reflecting improving recruitment and lower exploitation since 1995. The **spatial distribution** patterns observed during

the most recent bottom trawl surveys were similar to the average patterns over the previous ten years. There has been a general decline in weights at age since the late 1990s. The 2003 year class appears to have reached its maximum growth potential. Fish condition as measured by Fulton's K derived from the DFO survey exhibits a declining trend since about 2001 and declined to its lowest value in 2011. Except in 2009, the condition factor of haddock has been below the series average since 2003, similar to the trends in condition observed in Eastern Georges Bank cod and Georges Bank yellowtail flounder.

***Outlook***

This outlook is provided in terms of consequences with respect to the harvest reference points for alternative catch quotas in 2013. Uncertainty about current biomass generates uncertainty in forecast results, which is expressed here as the probability of exceeding  $F_{ref}=0.26$  and change in adult biomass from 2013 to 2014. 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 most recent 3-year survey and fishery average weights at age were used as inputs. Fishery partial recruitment (PR) was based on the 2003 to 2011 year population weighted average. This resulted in a PR on the age 9+ group of 0.3, which differs from what was used last year (when a value of 1.0 was used despite the VPA PR being 0.3). No growth was assumed for the 2003 year class from ages 9 to 11. The 2003 year class values were used for the 2010 year class for weights and partial recruitment. Assuming a 2012 catch equal to the 16,000 mt total quota, a combined Canada/USA catch of 10,400 mt in 2013 results in a neutral risk (50%) that the 2013 fishing mortality rate would exceed  $F_{ref} = 0.26$  (Figure 4). The 9+ age group (34%), of which the 2003 year class is the main component, and the 2010 year class (44%) are expected to constitute the majority of the 2013 catch biomass. A catch of 9,300 mt in 2013 results in a low risk (25%) that the 2013 fishing mortality rate will exceed  $F_{ref}$ . A catch of 11,900 mt in 2013 results in a high risk (75%) that the 2013 fishing mortality rate will exceed  $F_{ref}$ . Due to the entry of the 2010 year class into the 3+ group in 2013 and its subsequent increase in weight, the estimated probability that the adult biomass will decline from 2013 to 2014 is virtually 0% at any of the catch scenarios considered. Adult biomass is projected to be 306,200 mt (a record-high) at the beginning of 2014.

<b>Probability of exceeding <math>F_{ref}</math></b>	<b>25%</b>	<b>50%</b>	<b>75%</b>
2013 catch	9,300 mt	10,400 mt	11,900 mt

***Special Considerations***

Although the fishing mortality reference is based on a PR of 1 for older ages, the benchmark model indicates a PR of 0.3 for the 9+ age group. Several corroborating factors influenced the decision to use the lower PR produced by the model, e.g. the predicted versus observed 2011 catch at age supports the use of the lower PR.

Last year, the PR on ages 9+ was set equal to 1.0 for projections. This year, it has been set at 0.3 to match the VPA estimated PR. If this reduced PR for ages 9+ occurs in 2012 and the quota is caught, then the fishing mortality rate would be expected to be above  $F_{ref} = 0.26$ .

In 2013, the 2010 year class will be mostly below the current minimum size regulation used by the US, which could lead to significant discarding. This is not expected to be an issue in the Canadian fishery due to the different gear types and management measures.

***Source Documents***

O'Brien, L., and T. Worcester, editors. 2012. Proceedings of the Transboundary Resources Assessment Committee (TRAC): Eastern Georges Bank Cod and Haddock, and Georges Bank Yellowtail Flounder: Report of Meeting held 26-29 June 2012. TRAC Proceedings 2012/01.

Van Eeckhaute, L., E. Brooks, and S.C. Hansen. 2012. Assessment of Haddock on Eastern Georges Bank for 2012. TRAC Reference Document 2012/01.

***Correct Citation***

TRAC. 2012. Eastern Georges Bank Haddock. TRAC Status Report 2012/03.

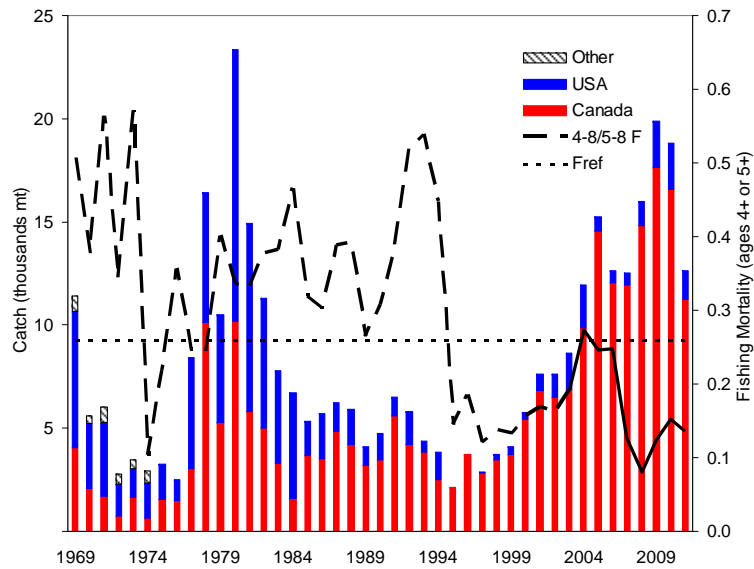


Figure 1. Catches (bars) and fishing mortality (line); (F=4-8 for 1969-2002 and 5-8 for 2003-2011).

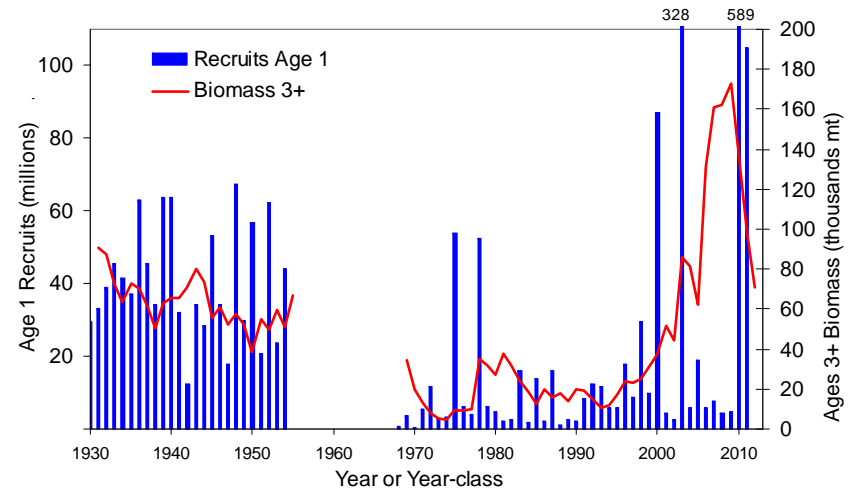


Figure 2. Biomass (line) and recruitment (bars).

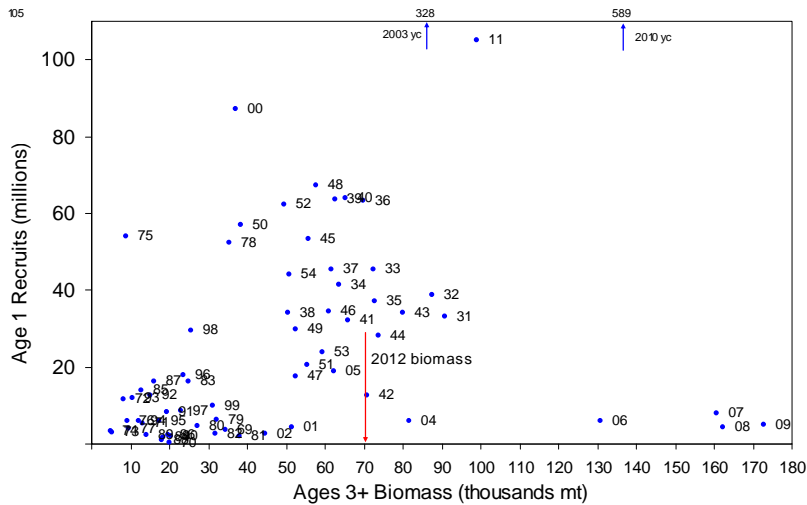


Figure 3. Stock recruitment patterns.

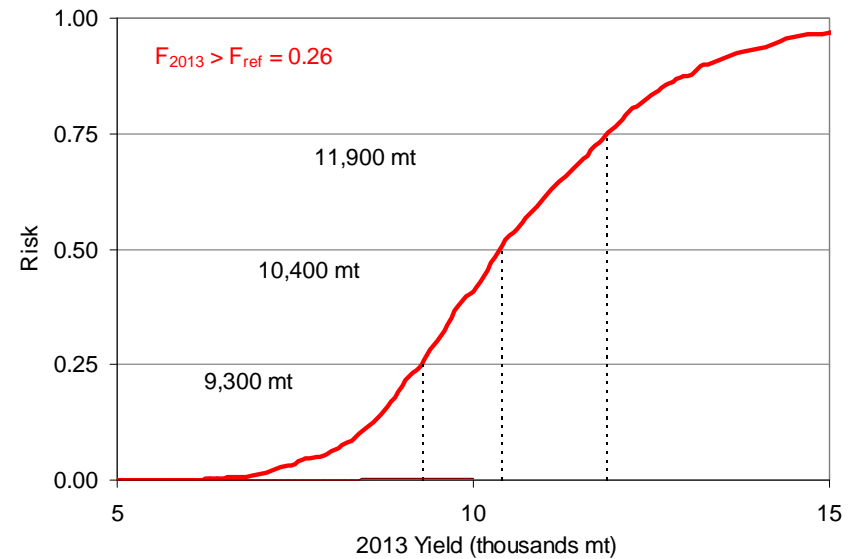


Figure 4. Projection risks.