



## Transboundary Management Guidance Committee

### Guidance Document 2011/01

The Transboundary Management Guidance Committee (TMGC), established in 2000, is a government – industry committee comprised of representatives from Canada and the United States. The Committee’s purpose is to develop guidance in the form of harvest strategies, resource sharing and management processes for Canadian and US management authorities for the cod, haddock and yellowtail flounder transboundary resources on Georges Bank. This document is a summary of the basis of the TMGC’s guidance to both countries for the 2012 fishing year. Pertinent reference documents and consultations used in the TMGC deliberations are listed at the end of this document.

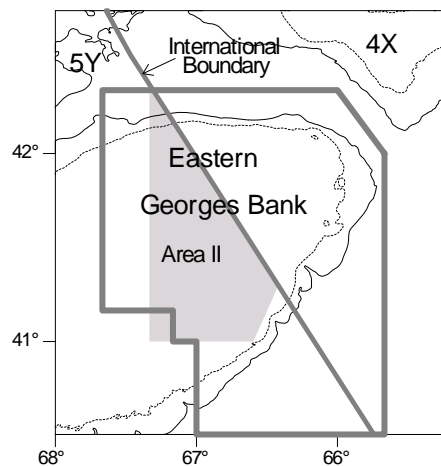
Since inception, the TMGC has successfully coordinated management of three transboundary groundfish resources. Annual harvest levels have been established, consistent with the legal and policy requirements of both countries. The benefits of this approach are worth noting: fishing mortality rates for the three management units considered by the TMGC have been reduced to low levels, Eastern Georges Bank haddock has been at record high abundance and Georges Bank yellowtail flounder biomass has increased since 2006.

In January of 2011, the International Fisheries Clarification Act (Act) was signed into law in the U.S. The Act recognizes the U.S./Canada Transboundary Resources Sharing Understanding, and provides the US with flexibility in the rebuilding period and catch level requirements for Georges Bank yellowtail flounder under the Magnuson-Stevens Fishery Conservation and Management Act.

### Eastern Georges Bank Cod [5Zjm; 551, 552, 561, 562]

#### Guidance

The TMGC concluded, after considering both models, that the most appropriate combined Canada/USA TAC for Eastern Georges Bank cod for the 2012 fishing year is 675 mt. In keeping with the harvest strategy for this stock, TMGC sought to decrease fishing mortality and promote stock rebuilding. A 2012 TAC of 675 mt is advised and corresponds to a low to neutral risk of exceeding  $F_{ref}$  of 0.18. Under both model formulations a catch at this level is expected to result in a low to neutral probability of biomass decrease. The recommended low catch level was intended to both reduce risk of exceeding  $F_{ref}$  and consider the retrospective pattern. The annual allocation shares between countries for 2012 are based on a combination of historical catches (10% weighting) and resource distribution based on trawl surveys (90% weighting). Combining these factors entitles the USA to 24% and Canada to 76% of the TAC, resulting in a national quota of 162 mt for the USA and 513 mt for Canada.



**Harvest Strategy & Reference Points**

The strategy is 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.

**Fishery Exploitation**

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

		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Avg <sup>1</sup>	Min <sup>1</sup>	Max <sup>1</sup>
Canada	Quota	1.2	1.3	1.0	0.7	1.3	1.4	1.6	1.2	1.0	0.9			
	Catch	1.4	1.5	1.3	0.9	1.4	1.2	1.5	1.2	0.8				
	Landed	1.3	1.3	1.1	0.6	1.1	1.1	1.4	1.0	0.7		5.9	0.6	17.8
	Discard	0.1	0.2	0.1	0.2	0.3	0.1	0.1	0.2	0.1		0.1	<0.1	0.5
USA	Quota <sup>2</sup>			0.3	0.3	0.4	0.5	0.7	0.5	0.3	0.2			
	Catch <sup>2</sup>			0.2	0.2	0.3	0.3	0.5	0.5	0.3				
	Landed	1.7	1.9	1.0	0.2	0.1	0.2	0.2	0.4	0.4		3.8	0.1	10.6
	Discard	<0.1	0.1	0.1	0.3	0.1	0.4	<0.1	0.2	0.1		0.1	<0.1	0.4
Total	Quota			1.3	1.0	1.7	1.9	2.3	1.7	1.3	1.1			
	Catch <sup>3,4</sup>			1.5	1.1	1.7	1.5	2.0	1.7	1.1				
	Catch	3.1	3.5	2.3	1.3	1.7	1.8	1.8	1.8	1.3		10.0	1.3	26.5
<b>From "split M 0.2" model</b>														
	Adult Biomass <sup>5</sup>	7.9	5.9	5.1	3.1	4.2	3.9	3.6	4.2	3.9	3.3	22.1	3.1	59.2
	Age 1 Recruits	1.6	0.5	2.8	0.5	1.0	1.6	1.0	0.9	0.8		5.4	0.5	23.6
	Fishing mortality <sup>6</sup>	0.48	0.80	0.85	0.43	0.69	0.49	0.53	0.54	0.41		0.6	0.3	1.3
	Exploitation Rate <sup>6</sup>	35%	50%	53%	32%	45%	36%	38%	38%	31%		39%	26%	67%
<b>From "split M 0.5" model</b>														
	Adult Biomass <sup>5</sup>	10.1	7.4	6.7	4.2	6.2	6.3	6.0	7.0	6.1	5.1	24.1	4.2	59.2
	Age 1 Recruits	1.9	0.7	4.1	0.6	1.3	1.9	1.2	1.1	1.0		5.6	0.6	23.8
	Fishing mortality <sup>6</sup>	0.37	0.59	0.58	0.31	0.43	0.28	0.26	0.27	0.25		0.5	0.2	1.1
	Exploitation Rate <sup>7</sup>	27%	40%	41%	23%	28%	18%	21%	25%	24%		33%	18%	60%
	Exploitation Rate <sup>8</sup>	32%	43%	46%	35%	37%	34%	27%	20%	11%		35%	11%	60%

<sup>1</sup>1978 – 2010

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

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

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

<sup>5</sup>Jan 1 ages 3+

<sup>6</sup>ages 4-9

<sup>7</sup>ages 4-5

<sup>8</sup>ages 6-9

Combined Canada/USA catches averaged 17,208 mt between 1978 and 1992, peaking at 26,464 mt in 1982. Catches declined to 1,683 mt in 1995, then fluctuated at about 3,000 mt until 2004, subsequently declining. Catches in 2010 were 1,326 mt, including 211 mt of discards.

Two model formulations were used for development of management advice. It is anticipated that this practice will continue until the progression of the 2003 year class through older ages has been documented, providing information on natural mortality at ages 6 and older. These model formulations are 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.

Fishing mortality (population weighted average of ages 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. F in 2010 was estimated to be 0.41 (80% confidence interval: 0.34-0.58) from the “split M 0.2” model and 0.25 (80% confidence interval: 0.21-0.34) from the “split M 0.5” model. F has been consistently above  $F_{ref} = 0.18$

Both assessment models exhibit a retrospective pattern in which perceptions of fishing mortality were revised upward. If the retrospective pattern persists, the F in 2010 will be 39% higher than estimated above for both models.

### ***State of Resource***

Since 1995 adult population biomass (ages 3+) from the “split M 0.2” model has fluctuated between 3,100 mt and 10,100 mt. Biomass was 3,288 mt (80% confidence interval: 2,769 mt – 4,217 mt) at the beginning of 2011. Since 1995 adult population biomass from the “split M 0.5” model has fluctuated between 4,200 mt and 12,600 mt. Biomass was 5,088 mt (80% confidence interval: 4,274 mt – 6,291 mt) at the beginning of 2011. In both models, the increase since 2005 was largely due to recruitment and 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. The 2011 biomass estimates are the second lowest in the time series according to both models.

Both assessment models exhibit a retrospective pattern in which estimates of stock size would be revised downward. Accounting for the retrospective inconsistency would adjust the terminal year biomass downward by 50 to 60% in both models.

### ***Productivity***

Recruitment at age 1 has been low in recent years. Since 2000, the 2003 year class (2.8 million fish – “split M 0.2” model and 4.1 million fish - “split M 0.5” model) was the highest recruitment observed by either model, but was less than half of the average (about 10 million) during 1978-1990, when the productivity was considered to be higher. The 2002 and 2004 year classes were the lowest on record in both models. The 2006 year class at age 1 at 1.6 million from the “split M 0.2” model and at 1.9 million from the “split M 0.5” model was close to half the strength of the 2003 year class. Initial indications were that the 2007, 2008, and 2009 year classes were similar in strength to the 2000 year class, which was only about 10% of the 1978-1990 average recruitment in both models. The current biomass is well below 30,000 mt where recruitment has historically been poor. Recruitment indices from the bottom trawl surveys for the 2010 year class were higher than those for recent year classes although they were not estimated in the VPA. The population age structure displays a very low proportion of ages 7+ compared to the 1980s. The declines in length and weight at age from the early 1990s have hampered biomass rebuilding. Resource productivity is currently very poor due to low recent recruitment and low weights at age compared to the 1980s.

**2012 Catch Risk Assessment**

Model Risk Level	"split M 0.2"			"split M 0.5"		
	25% (risk averse)	50% (risk neutral)	75% (risk prone)	25% (risk averse)	50% (risk neutral)	75% (risk prone)
Risk Factor:	Catch (mt) in 2012 for the indicated risk factors					
F <sub>ref</sub> in 2012 will be exceeded	525	600	700	825	925	1,025
4+ biomass in 2012 will be lower than the 2011 biomass	1,050	1,350	1,650	500	900	1,350
4+ biomass in 2012 will not increase by 10%	700	1,000	1,350	-	300	850
4+ biomass in 2012 will not increase by 20%	350	650	1,050	-	-	350

Note: In some cases, no level of catch will result in the indicated increase in biomass.

As indicated in the above table, for the “split M 0.2” model a combined Canada/USA catch of about 600 mt in 2012 will result in a neutral risk (50%) that the fishing mortality rate in 2012 will exceed F<sub>ref</sub> whereas a catch of 1,350 mt will result in a neutral risk (50%) that the 2013 biomass (ages 4+) will be lower than the 2012 biomass.

For the “split M 0.5” model a combined Canada/USA catch of about 925 mt in 2012 will result in a neutral risk (50%) that the fishing mortality rate in 2012 will exceed F<sub>ref</sub> whereas a catch of 900 mt will result in a neutral risk (50%) that the 2013 biomass (ages 4+) will be lower than the 2012 biomass.

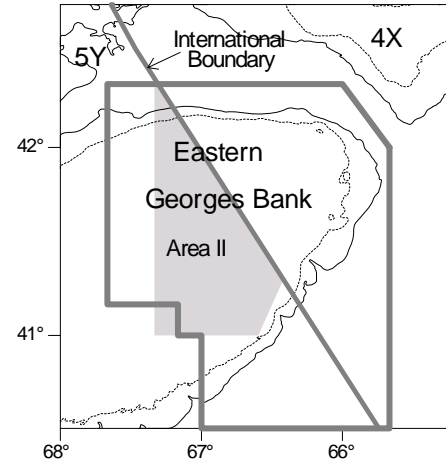
**Special Considerations**

There is no strong evidence to determine which of the two benchmark methods provides a better scientific basis for fishery management. The range of stock status estimates and projections from the two models reflects the substantial uncertainty in the assessment. If the magnitude of the retrospective pattern was accounted for, short term projections for catch would be decreased for both models. The inability to identify the plausible mechanisms responsible for the retrospective bias causes increased uncertainty in this assessment. Despite these uncertainties, all assessment results indicate that low catches are needed to promote rebuilding and/or prevent further decline.

## Eastern Georges Bank Haddock [5Zjm; 551, 552, 561, 562]

### Guidance

The TMGC concluded that the most appropriate combined Canada/USA TAC for Eastern Georges Bank haddock for the 2012 fishing year is 16,000 mt, representing a neutral risk (50%) of exceeding  $F_{ref}$  of 0.26. This is a reduction from the previous TAC to account for the expected decrease in stock size as the exceptional 2003 year class moves through the fishery. The stock size is expected to again increase beginning in 2013 as the 2010 year class recruits. However, if the 2010 year class turns out to be much smaller than currently estimated (i.e., half the size), some decrease in adult biomass in 2013 compared to 2011 is likely to result. The annual allocation shares between countries for 2012 are based on a combination of historical catches (10% weighting) and resource distribution based on trawl surveys (90% weighting). Combining these factors entitles the USA to 43% and Canada to 57% of the TAC, resulting in a national quota of 6,880 mt for the USA and 9,120 mt for Canada.



### Harvest Strategy & Reference Points

The strategy is to maintain a low to neutral risk of exceeding the fishing mortality limit reference,  $F_{ref}=0.26$ . When stock conditions are poor, fishing mortality rates should be further reduced to promote rebuilding.

### Fishery Exploitation

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

		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Avg <sup>1</sup>	Min <sup>1</sup>	Max <sup>1</sup>
<b>Canada</b>	<b>Quota</b>	6.7	6.9	9.9	15.4	14.5	12.7	15.0	18.9	17.6	12.5			
	<b>Landed</b>	6.5	6.8	9.7	14.5	12.0	11.9	14.8	17.6	16.6		5.5	0.5	17.6
	<b>Discard</b>	<0.1	0.1	0.1	<0.1	0.1	0.1	<0.1	0.1	<0.1		0.1	<0.1	<0.1
<b>USA</b>	<b>Quota<sup>2</sup></b>			5.1	7.6	7.5	6.3	8.1	11.1	12.0	9.5			
	<b>Catch<sup>2</sup></b>			1.1	0.6	0.7	0.3	1.6	1.6	1.8				
	<b>Landed</b>	1.1	1.7	1.8	0.6	0.3	0.3	1.1	2.2	2.2		2.1	<0.1	9.1
	<b>Discard</b>	<0.1	0.1	0.2	0.1	0.3	0.3	0.1	0.1	<0.1		0.6	<0.1	7.6
<b>Total</b>	<b>Quota<sup>3</sup></b>			15.0	23.0	22.0	19.0	23.0	30.0	29.6	22.0			
	<b>Catch<sup>3,4</sup></b>			10.9	15.1	12.7	12.3	17.1	17.6	18.4				
	<b>Catch</b>	7.6	8.6	11.9	15.3	12.6	12.5	16.0	19.9	18.8		8.2	2.1	23.3
	<b>Adult Biomass<sup>5</sup></b>	43.6	83.6	78.7	59.7	122.5	149.5	152.6	162.8	129.4	93.4	49.2 <sup>6</sup>	4.9 <sup>6</sup>	162.8 <sup>6</sup>
	<b>Age 1 Recruits</b>	4.1	2.6	304.4	6.1	23.6	6.4	9.8	5.1	5.9	557.1	34.5 <sup>6</sup>	0.2 <sup>6</sup>	557.1 <sup>6</sup>
	<b>Fishing mortality<sup>7</sup></b>	0.16	0.19	0.27	0.25	0.25	0.12	0.09	0.13	0.15		0.28	0.09	0.58
	<b>Exploitation Rate<sup>7</sup></b>	14%	16%	21%	20%	20%	10%	7%	11%	13%		22%	7%	40%

<sup>1</sup>1969 - 2010

<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 – 2011

<sup>7</sup>ages 4+ for 1969 - 2002; ages 5+ for 2003 - 2010

Combined Canada/USA catches declined from 6,504 mt in 1991 to a low of 2,150 mt in 1995, fluctuated about 3,000 mt to 4,000 mt until 1999, and increased to 19,856 mt in 2009. Combined catches were 18,794 mt in 2010.

Fishing mortality for fully recruited ages fluctuated between 0.2 and 0.4 during the 1980s, and markedly increased in 1992 and 1993 to about 0.5, the highest observed. Fishing mortality was below  $F_{ref} = 0.26$  during 1995 to 2003, fluctuated around  $F_{ref}$  during 2004 to 2006, but declined since then and was 0.15 in 2010.

***State of Resource***

Adult population biomass (ages 3+) increased from near an historical low of 10,300 mt in 1993 to 83,600 mt in 2003. Adult biomass subsequently decreased to 59,700 mt in 2005, but increased to 162,800 mt in 2009, the highest in the assessment time series (1931-1955 and 1969-2010). The tripling of the biomass after 2005 was due to recruitment and growth of the exceptional 2003 year class. In 2011 the adult biomass decreased to 93,400 mt commensurate with the 2003 year class reaching its highest biomass in 2009.

***Productivity***

Recruitment improved in the 1990s and the 2003 year class is currently estimated at 304 million. Except for the strong 2000 year class and the exceptional 2003 year class, recruitment has fluctuated without trend about an average of 9 million since 1990. The preliminary estimate for the 2010 year class is 557 million age 1 fish which would make it the largest in the assessment time series. There has been a general decline in weights at age since the late 1990s. This stock exhibits some positive features such as an expanding age structure, broad spatial distribution and has produced 2 exceptional year classes in the last 8 years.

***2012 and 2013 Catch Risk Assessment***

<b>Risk of exceeding <math>F_{ref}</math></b>	25% (risk averse)	50% (risk neutral)	75% (risk prone)
<b>2012 Catch (mt)</b>	13,900 mt	16,000 mt	17,800 mt
<b>2013 Catch (mt)</b>	13,700 mt	15,700 mt	18,100 mt

A combined Canada/USA catch of 16,000 mt results in a neutral risk (50%) of exceeding  $F_{ref}=0.26$ . The 9+ age group, of which the 2003 year class will be the main component, is expected to constitute 72% of the 2012 catch biomass. Due to the entry of the 2010 year class into the 3+ group in 2013, the estimated probability that the adult biomass will decline from 2012 to 2013 is virtually 0%.

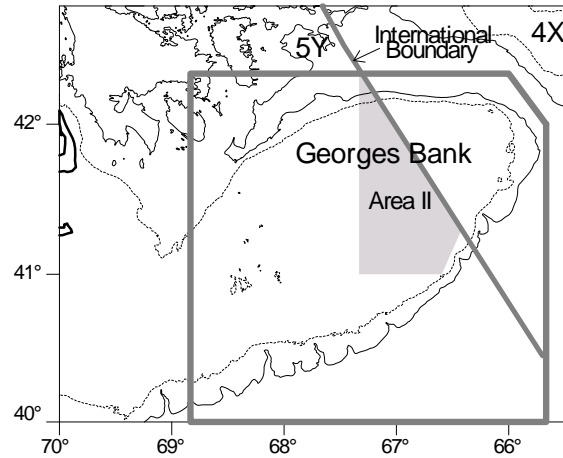
***Special Considerations***

The 2003 year class will enter the 9+ age group in 2012. The projected catch will be highly influenced by the partial recruitment assumption used for the 9+ age group. A value of 1 was used for ages 9+ partial recruitment. Next year's assessment will provide more information on partial recruitment on ages 9+.

## Georges Bank Yellowtail Flounder [5Zhjmn; 522,525, 551, 552, 561, 562]

### Guidance

The TMGC concluded that the most appropriate combined Canada/USA TAC for Georges Bank yellowtail for the 2012 fishing year is 900 mt. The re-emergence of the retrospective pattern led the TMGC to consider sensitivity analyses consistent with the TRAC advice. A 2012 TAC of 900 mt is less than the low probability catch of exceeding  $F_{ref}$  from the approved model (Split Series). With this catch, biomass is expected to increase. The annual allocation shares between countries for 2012 are based on a combination of historical catches (10% weighting) and resource distribution based on trawl surveys (90% weighting). Combining these factors entitles the USA to 49% and Canada to 51% of the TAC, resulting in a national quota of 441 mt for the USA and 459 mt for Canada.



### Harvest Strategy & Reference Points

The strategy is to maintain a low to neutral risk of exceeding the fishing mortality limit reference,  $F_{ref}=0.25$ . When stock conditions are poor, fishing mortality rates should be further reduced to promote rebuilding.

### Fishery Exploitation

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

		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Avg <sup>1</sup>	Min <sup>1</sup>	Max <sup>1</sup>
Canada	Quota	2.9	2.3	1.9	1.7	0.9	0.4	0.6	0.5	0.8 <sup>8</sup>	1.2			
	Landed	2.6	2.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		0.5	<0.1	2.9
	Discard	0.5	0.8	0.4	0.2	0.5	0.1	0.1	0.1	0.2		0.5	0.1	0.8
USA	Quota <sup>2</sup>			6.0	4.3	2.1	0.9	1.9	1.6	1.2 <sup>8</sup>	1.5			
	Catch <sup>2</sup>			5.9	3.8	1.9	1.0	1.6	1.8	1.1				
	Landed	2.5	3.2	5.8	3.2	1.2	1.1	1.0	1.0	0.7		4.4	0.4	15.9
	Discard	0.1	0.4	0.5	0.4	0.4	0.5	0.4	0.8	0.3		0.6	<0.1	3.0
Total	Quota <sup>3</sup>			7.9	6.0	3.0	1.3	2.5	2.1	2.0 <sup>8</sup>	2.7			
	Catch <sup>3,4</sup>			6.4	4.1	2.5	1.1	1.7	1.9	1.3				
	Catch	5.7	6.6	6.8	3.9	2.1	1.7	1.5	1.8	1.2		6.1	1.1	17.2
	Adult Biomass <sup>5</sup>	9.1	10.9	8.6	4.1	2.7	3.3	5.6	8.7	8.7	9.3	7.4 <sup>6</sup>	2.0 <sup>6</sup>	26.2 <sup>6</sup>
	SSB	10.1	10.1	5.5	3.3	2.9	4.4	7.1	9.3	8.8		7.2	2.2	22.2
	Age 1 Recruits	15.2	10.7	7.4	11.6	16.8	17.2	8.0	4.7	0.9		20.3	0.9	70.6
	Fishing mortality <sup>7</sup>	0.65	0.61	1.93	1.35	1.35	0.72	0.28	0.27	0.13		1.00	0.13	1.93
	Exploitation Rate <sup>7</sup>	44%	42%	80%	69%	69%	47%	22%	22%	11%		58%	11%	80%

<sup>1</sup>1973 – 2010

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

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

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

<sup>5</sup>Jan-1 age 3+

<sup>6</sup>1973 - 2011

<sup>7</sup>age 4+ for calendar year

<sup>8</sup>quotas not jointly determined; established individually by each country

Total catches of Georges Bank yellowtail flounder peaked at about 21,000 mt in both 1969 and 1970. The combined Canada/USA catch increased from 1995 through 2001, averaged 6,300 mt during 2002-2004, but declined to 1,160 mt in 2010.

The current stock assessment exhibits a retrospective pattern in SSB and F which results in decreases in SSB and increases in F compared to the results of last year's assessment. In light of this, two additional approaches were considered to address the retrospective pattern. Firstly, since the Split Series VPA no longer eliminates the retrospective, a rho adjustment was applied to this model. Secondly, a rho adjustment was applied to the Single Series VPA (formerly known as the Base Case formulation during the 2005 benchmark assessment, but not used in recent years). The Split Series with the rho adjustment applies two approaches in combination (splitting the survey time series and applying a rho adjustment) to address the retrospective pattern, whereas the Single Series with the rho adjustment applies a single adjustment with a larger rho.

Fishing mortality for fully recruited ages 4+ was close to or above 1.0 between 1973 and 1995, fluctuated between 0.51 and 0.97 during 1996-2003, increased in 2004 to 1.93, and then declined to about 0.27 in both 2008 and 2009, and 0.13 in 2010, below the reference point of  $F_{ref} = 0.25$ . Although quotas had been set to bring F below  $F_{ref}$ , the retrospective pattern re-emergence resulted in F estimates above  $F_{ref}$ .

### ***State of Resource***

Adult population biomass (age 3+) increased from a low of 2,100 mt in 1995 to 10,900 mt in 2003, declined to about 2,700 mt in 2006, and increased to 9,300 mt at the beginning of 2011. Spawning stock biomass in 2010 was estimated to be 8,800 mt.

The perception of the stock has changed from last year to this year primarily due to the retrospective pattern. If the retrospective pattern persists the state of the resource will be more pessimistic.

### ***Productivity***

During 1973-2010 recruitment averaged 20.3 million fish at age 1 but has been below this average since 2002. The 2005 and 2006 year classes are estimated at 16.8 million and 17.2 million, respectively. The 2007 and 2008 year classes are well below average, and the 2009 year class is currently estimated to be the lowest in the time series. The 2005 year class had been estimated as strong in previous assessments, but is now estimated as below average. Truncated age structure and lower weights at age indicate current resource productivity is lower than historical levels.

Projections were made for the Split Series benchmark model, Single Series rho adjusted model, and the Split Series rho adjusted model. Results from all three models are given in the tables below.



**2012 Catch Risk Assessment**

<b>Risk of exceeding <math>F_{ref}</math></b>	25% (risk averse)	50% (risk neutral)	75% (risk prone)
Split Series	1,400 mt	1,700 mt	1,900 mt
Split Series rho adjusted	600 mt	750 mt	900 mt
Single Series rho adjusted	1,400 mt	1,700 mt	1,900 mt

For the Split Series model, a combined Canada/USA catch of about 1,700 mt in 2012 would result in a neutral risk (~50%) that the fishing mortality rate will exceed  $F_{ref}$ . Catches of 1,400 mt and 1,900 mt in 2012 would result in 25% and 75% risk that fishing mortality rate will exceed  $F_{ref}$ , respectively.

**Anticipated Biomass Changes**

For the Split Series model, a catch in 2012 of 2,300 mt will result in no change in median biomass from 2012 to 2013, while catches in 2012 of 1,500 mt and 700 mt will result in 10% and 20% increases in median biomass from 2012 to 2013, respectively.

2012 Catch (mt)	Split Series	Split Series rho adjusted	Single Series rho adjusted
600	+22%	+25%	0%
750	+20%	+20%	-2%
900	+18%	+16%	-3%
1,400	+12%	+1%	-9%
1,700	+8%	-8%	-13%
1,900	+5%	-14%	-15%

**Special Considerations**

Although the Split Series VPA is used for management advice, the mechanisms for the large changes in survey catchability are not easily explained. These changes in survey catchability, most appropriately thought of as aliasing an unknown mechanism that produces a better fitting model, cause an additional source of uncertainty which should be considered when setting the 2012 quota. This uncertainty indicates lower catch advice than the projections from the Split Series VPA.

Alternative projection assumptions were explored to examine the sensitivity of catch advice. The population abundance at age in 2011 was adjusted to account for the retrospective pattern by adjusting all ages by the same amount based on the SSB retrospective rho. This Split Series rho adjusted projection formulation resulted in much lower 2012 catch advice for a given probability of exceeding  $F_{ref}$  than the unadjusted Split Series projections. Another alternative projection used the Single Series VPA formulation (which was most similar to the benchmark Base Case formulation) and adjusted that population abundance at age in 2011 to account for the much larger retrospective pattern in SSB. This Single Series rho adjusted projection formulation resulted in nearly identical 2012 catch advice for a given probability of exceeding  $F_{ref}$  as the unadjusted Split Series projections. However, the Single Series rho adjusted projection formulation predicts decreases in median adult biomass from 2012 to 2013

under catches that are predicted to produce increases in this median biomass under the Split Series projections.

The TSR stated, “*in light of the implications of the alternative models, if managers wish to base the 2012 catch on consideration of both  $F_{ref}$  and a desire to maintain stock biomass, a catch in the range of 900-1,400 mt is indicated*”.

The assessment indicates that rebuilding by the current US end date of 2016 is not possible. The rebuilding strategy may be revised again by May 2012 by the New England Fishery Management Council.

### **Source Documents**

Van Eeckhaute L and O’Brien L . 2011. Update of allocation shares for Canada and the USA of the transboundary resources of Atlantic cod, haddock and yellowtail flounder on Georges Bank through fishing year 2012. TRAC Reference Document 2011/xx (in prep).

TRAC. 2011. Eastern Georges Bank cod. TRAC Status Report 2011/02.

TRAC. 2011. Eastern Georges Bank haddock. TRAC Status Report 2011/03.

TRAC. 2011. Georges Bank yellowtail flounder. TRAC Status Report 2011/01.

### **Consultations**

TRAC Pre-Assessment Industry/Science meeting in Canada, Yarmouth, Nova Scotia, June 2, 2011.

TRAC Pre-Assessment Industry/Science meeting in the USA, Gloucester, Massachusetts, June 2, 2011

Transboundary Resources Assessment Committee (TRAC), St. Andrews, New Brunswick, 21-24 June 2011.

Transboundary Management Guidance Committee public consultation in Canada, Yarmouth, Nova Scotia, 16 Aug 2011.