



## Transboundary Resources Assessment Committee

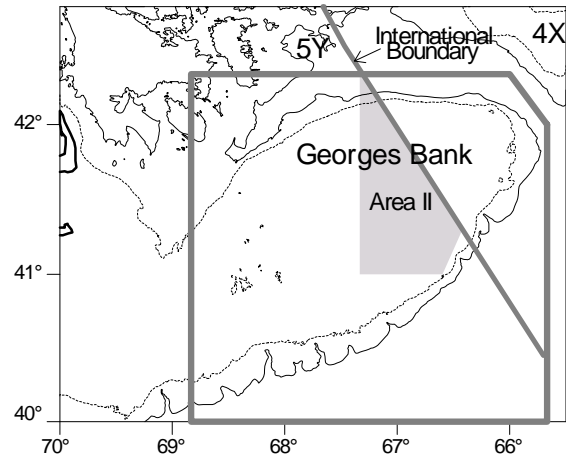
Status Report 2008/03

### GEORGES BANK

### YELLOWTAIL

### FLOUNDER

[5Zhjmn;  
522,525,551,552,561,562]



#### Summary

- Combined Canada and USA catches in 2007 were 1,686 mt.
- Adult biomass (age 3+) increased from a low of 2,100 mt in 1995 to 11,000 mt in 2003, declined to 3,900 mt in 2006, and increased to 15,900 mt at the beginning of 2008. Spawning stock biomass in 2007 was estimated to be 9,500 mt.
- During 1998-2001 recruitment averaged 22.3 million fish at age 1 but has since been below 20 million fish, with the exception of the above average 2005 year-class estimated at 49.4 million, the strongest year class since the 1980 cohort.
- 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 1.82, and then declined to 0.89 in 2006 and 0.29 in 2007.
- Truncated age structure in the surveys and changes in distribution indicate current resource productivity is lower than historical levels.
- Assuming a 2008 catch equal to the 2,500 mt quota, a combined Canada/USA catch of about 4,600 mt in 2009 would result in a neutral risk (~50%) that the fishing mortality rate in 2009 will exceed  $F_{ref}$  ( $F=0.25$ ). Fishing at  $F_{ref}$  in 2009 will generate a 9% increase in median age 3+ biomass from 20,500 mt in 2009 to 22,300 mt in 2010.



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

		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Avg <sup>1</sup>	Min <sup>1</sup>	Max <sup>1</sup>
Canada	Quota	2.0	3.0	3.4	2.9	2.3	1.9	1.7	0.9	0.4	0.6			
	Landed	2.0	2.9	2.9	2.6	2.1	0.1	<0.1	<0.1	<0.1		0.6	<0.1	2.9
	Discard	0.6	0.4	0.8	0.5	0.8	0.4	0.3	0.6	0.1		0.5	0.1	0.8
USA	Quota <sup>5</sup>						6.0	4.3	2.1	0.9	1.9			
	Catch <sup>5</sup>						5.9	3.8	1.9	1.0				
	Landed	1.8	3.4	3.6	2.5	3.2	5.8	3.2	1.2	1.1		4.9	0.4	15.9
	Discard	0.5	0.4	0.3	0.2	0.4	0.5	0.5	0.4	0.5		0.6	<0.1	3.0
Total	Quota <sup>6</sup>						7.9	6.0	3.0	1.3	2.5			
	Catch <sup>6,7</sup>						6.4	4.1	2.5	1.1				
	Catch	4.9	7.1	7.7	5.9	6.5	6.9	3.9	2.2	1.7		6.7	1.1	17.2
	Adult Biomass <sup>3</sup>	8.0	10.2	10.4	9.2	11.0	8.8	4.5	3.9	5.1	15.9	7.6 <sup>2</sup>	2.0 <sup>2</sup>	26.2 <sup>2</sup>
	SSB	9.6	10.3	9.3	10.2	10.2	5.9	4.2	4.4	9.5		7.4	2.2	22.2
	Age 1 Recruits	24.6	19.9	22.3	15.5	11.8	10.5	14.4	49.4	18.4		22.9	6.6	70.6
	Fishing mortality <sup>4</sup>	0.67	0.96	0.97	0.64	0.60	1.82	1.16	0.89	0.29		1.03	0.29	1.83
	Exploitation Rate <sup>4</sup>	45%	57%	57%	43%	41%	78%	63%	54%	23%		57%	23%	78%

<sup>1</sup>1973 – 2007<sup>2</sup>1973 - 2008<sup>3</sup>Jan-1 age 3+<sup>4</sup>age 4+ for calendar year<sup>5</sup>for fishing year May 1 – April 30<sup>6</sup>for Canadian calendar year and USA fishing year May 1 – April 30<sup>7</sup>sum of Canadian Landed, Canadian Discard, and USA Catch (includes discards)**Fishery**

**Total catches** of Georges Bank yellowtail flounder peaked at 21,000 mt in 1969 and 1970. Prior to the mid-1990s, the USA fishery accounted for most of the annual catches. The combined Canada/USA catch increased from 1995 through 2001, averaged 6,400 mt during 2002-2004, but declined to 1,686 mt in 2007 (Figure 1).

The 2007 **Canadian catch** of 122 mt was well below the Canadian quota of 350 mt, with landings of only 17 mt and estimated discards of 105 mt. There was no directed Canadian fishery in 2007, landings were incidental to cod and haddock fishing. Discards were due to the sea scallop dredge fishery.

**USA catches** in 2007 were 1,564 mt, with landings of 1,061 mt and discards of 503 mt. The USA landings in 2007 were predominantly from the trawl fishery while discards came from both the trawl and scallop dredge fisheries. The USA catches for fishing year 2007-2008 were 980 mt, above the quota of 900 mt.

Ages 2-4 accounted for most of the **combined Canada/USA fishery** catch in 2007 by number, with few age 1 fish caught due to mesh regulations. Both the Canadian and particularly the USA fisheries were well sampled to determine length composition of the catch.

### *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,  $F_{ref} = 0.25$ . When stock conditions are poor, fishing mortality rates should be further reduced to promote rebuilding. A review of production from this resource indicated that  $F_{ref} = 0.25$  remains appropriate.

### *State of Resource*

The state of the resource was based on survey observations and the range of results from plausible age structured analytical assessments (VPA) that used fishery catch statistics and sampling for size and age composition of the catch for 1973 to 2007. The VPAs were calibrated to trends in abundance from three bottom trawl survey series (NMFS spring, NMFS fall and DFO spring) and a recruitment index from the NMFS summer sea scallop survey. Two VPA formulations were examined based on recommendations from the 2005 benchmark assessment review: 1) Base Case, the same formulation as used in the 2004 assessment, and 2) Major Change. Splitting each of the survey time series into two sets (i.e., 1973-1994 and 1995-2008) is the only difference between the Base Case and the Major Change VPAs. The Major Change VPA shows unexpected large increases in survey catchability since the mid 1990s that are not understood.

The Base Case VPA and Major Change VPA were compared using retrospective patterns and agreement with survey biomass trends. Retrospective analyses were used to detect any patterns to consistently overestimate or underestimate fishing mortality, biomass, and recruitment relative to the terminal year estimates. The Base Case VPA continues to display a retrospective pattern, updating population biomass estimates to lower values than previously determined and compromising interpretation of results. The Major Change VPA does not exhibit an appreciable retrospective pattern; updates are both above and below previously estimated values (range 25% decrease to 57% increase in the last five years). Trends in age 3+ biomass from the Base Case VPA do not follow the pattern of reduced abundance in the most recent years relative to the late 1990s and early 2000s as indicated by all three bottom trawl surveys (Figures 2-3), and therefore the Base Case model results are not recommended as the basis for management advice. The Major Change VPA results better reflect the recent trends observed in all three trawl surveys (Figures 2 and 3) and is thus recommended as the basis for management advice.

**Adult population biomass** (age 3+), based on the Major Change VPA results, increased from a low of 2,100 mt in 1995 to 11,000 mt in 2003, declined to 3,900 mt in 2006, and increased to 15,900 mt at the beginning of 2008 (80% Confidence Interval: 12,000-22,100 mt), the highest adult biomass since 1983 (Figure 3). Spawning stock biomass in 2007 was estimated to be 9,500 mt (80% Confidence Interval: 7,700-12,300 mt; Figure 4).

During 1998-2001 **recruitment** averaged 22.3 million fish at age 1 but has since been below 20 million fish, with the exception of the above average 2005 year-class estimated at 49.4 million, the strongest year class since the 1980 cohort (Figure 4).

**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 1.82, and then declined to 0.89 in 2006 and 0.29 in 2007 (80% Confidence Interval: 0.22-0.38) (Figure 1). Fishing mortality was well above the reference point of  $F_{ref} = 0.25$  for the entire time series except in 2007.

### *Productivity*

Age structure, spatial distribution, and fish growth reflect changes in the productive potential. In both absolute numbers and percent composition, the **population age structure** estimated by the VPA displays a truncated pattern with few old fish. **Spatial distribution patterns** in recent surveys show yellowtail were caught in fewer strata relative to previous years. Truncated age structure in the bottom trawl surveys and changes in distribution indicate current resource productivity is lower than historical levels.

### *Outlook*

This outlook is provided in terms of consequences with respect to the harvest reference points for alternative catch quotas in 2009. Uncertainty about standing stock generates uncertainty in forecast results which is expressed here as the risk of exceeding  $F_{ref} = 0.25$ . 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.

Due to changes in fishery partial recruitment patterns over time and increasing trends in both survey and fishery weights at age, average values from 2003-2007 were used in the projections. Assuming a catch in 2008 equal to the 2,500 mt total TAC, a combined Canada/USA catch of about 4,600 mt in 2009 would result in a neutral risk (~50%) that the fishing mortality rate in 2009 will exceed  $F_{ref}$  (Figure 5). Fishing at  $F_{ref}$  in 2009 will generate a 9% increase in median age 3+ biomass from 20,500 mt in 2009 to 22,300 mt in 2010. The 2005 year-class is expected to account for 60% of the 2009 catch, 58% of the 2009 age 3+ biomass, and 45% of the 2010 age 3+ biomass.

In the USA, there is a requirement to furnish rebuilding projections when stocks are overfished. The rebuilding scenario for Georges Bank yellowtail flounder requires solving for a value of  $F$  ( $F_{reb75}$ ) which when applied in years 2009-2014 results in a 75% probability that SSB in 2014 is greater than SSB<sub>msy</sub> (43,200 mt). Using the same starting conditions as in the TRAC projection described above, the  $F_{reb75}$  was found through iterative search to be 0.107, resulting in a median 2009 catch of 2,100 mt, well below the  $F_{ref}$  projection described above. For comparison, applying  $F_{ref} = 0.25$  in years 2009-2014 results in median 2014 SSB of 39,000 mt compared to the median 2014 SSB of 53,200 mt from the  $F_{reb75}$  scenario.

### *Special Considerations*

There was a single tow on the 2008 DFO survey which captured over 7.5 mt of yellowtail flounder, well beyond the previous maximum catch of less than one mt. This resulted in substantial increase of abundance for all ages from 2 to 5, inconsistent with stock dynamics and indicative that the tow results were outliers. Management advice was based on an assessment that excluded the 2008 DFO survey results. However, sensitivity analyses were conducted which included the 2008 DFO survey, both with and without the large tow. Not surprisingly, results from these analyses indicated that both biomass and recruitment were higher with the large tow included. However, whether the large tow is included or excluded, the sensitivity analyses generate a higher  $F$  for ages 4-5, a somewhat counter-intuitive result, but explainable by the age composition of the fish caught in the large tow. While the 2008 DFO survey results are outliers, their influence on stock status, when included in the sensitivity analysis, was mitigated by the other data. For example, the estimate of the dominant 2005 year class at age 3 in 2008 from the sensitivity analysis with the large tow was 36.1 million compared to 31.7 million used for management advice.

In the past, realized fishing mortality rates have been higher than the target  $F$  used to set the annual quotas. For example in 2005, a catch of 2,100 mt in 2006 was projected to produce a fishing mortality well below 0.25 using the Base Case model and 0.25 using the Major Change model; however, the observed catch of 2,200 mt is now estimated to have generated an  $F$  in 2006 of 0.49 (Base Case model) and 0.89 (Major Change model). In contrast, when set in 2006 using the Major Change model, the 2007 TAC of 1,250 mt was expected to result in an  $F$  of 0.25; the observed catch of 1,686 mt resulted in an  $F$  in 2007 of 0.29. Furthermore, the forecast of age 3+ biomass in 2009 from the previous and current assessments, both of which used the Major Change model, are in general agreement.

Although the Major Change VPA is recommended for management decisions, the mechanisms for the large changes in survey catchability are not easily explained. These changes in survey catchability are most appropriately thought of as an aliasing of an unknown mechanism that produces a better fitting model. The inability to plausibly explain these survey catchability changes causes increased uncertainty in this assessment relative to other assessments. However, the Major Change VPA results more closely reflect the recent trend in abundance observed in all three surveys and is the preferred model from which to make management decisions.

### *Source Documents*

Legault C, Alade L, Stone H, Gavaris S, Waters C. 2008. C. Georges Bank Yellowtail Flounder. *In* Northeast Fisheries Science Center. 2008. Assessment of 19 Northeast groundfish stocks through 2007: A report of the 3rd Groundfish Assessment Review Meeting (GARM III), Northeast Fisheries Science Center, Woods Hole, Massachusetts, August 4-8, 2008. Northeast Fish Sci Cent Ref Doc. 08-15. [available at <http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0815/> once finalized]

TRAC. 2005. Gavaris S, O'Boyle R, Overholtz W, editors. Proceedings of the Transboundary Resources Assessment Committee (TRAC): Benchmark review of stock assessment models for the Georges Bank yellowtail flounder stock; 25 – 26 January 2005 and 26 – 29 April 2005. TRAC Proceedings 2005/01: 65p.

TRAC. 2008. Worcester T, O'Brien L, editors. Proceedings of the Transboundary Resources Assessment Committee (TRAC); 24–26 June and 12-13 August 2008. TRAC Proceedings 2008/(in prep.).

***Correct Citation***

TRAC. 2008. Georges Bank Yellowtail Flounder. TRAC Status Report 2008/03.

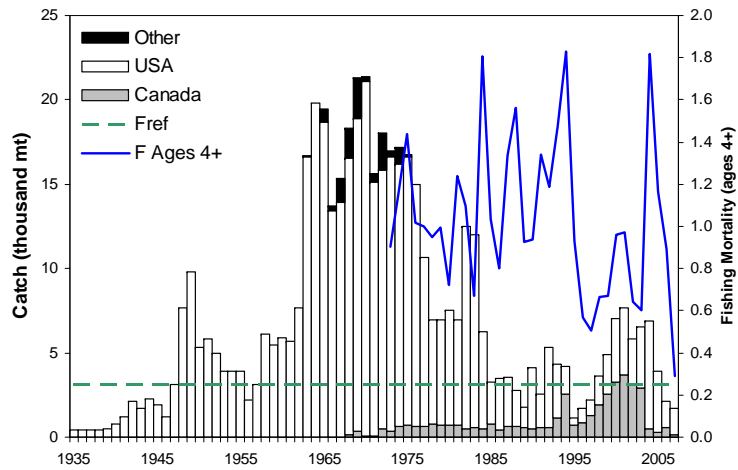


Figure 1. Catches and fishing mortality.

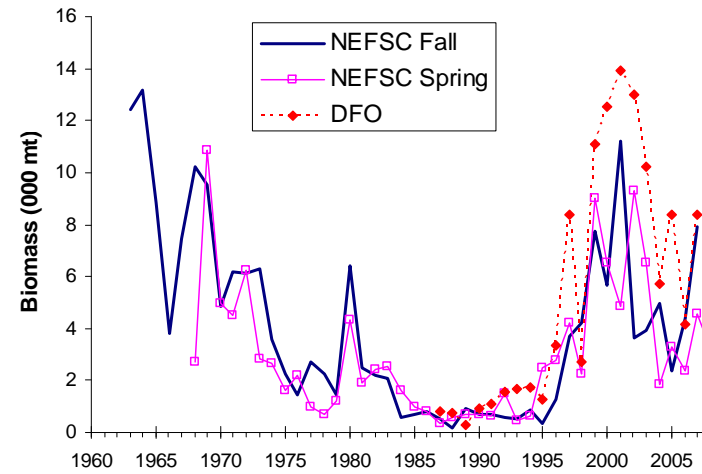


Figure 2. Survey biomass indices (minimum swept area).

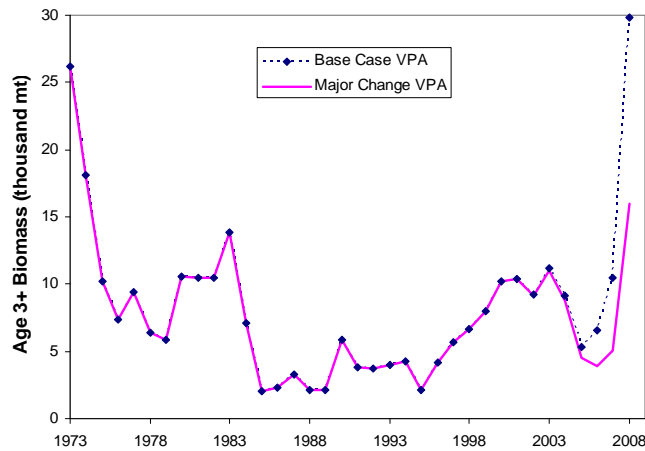


Figure 3. Ages 3+ biomasses.

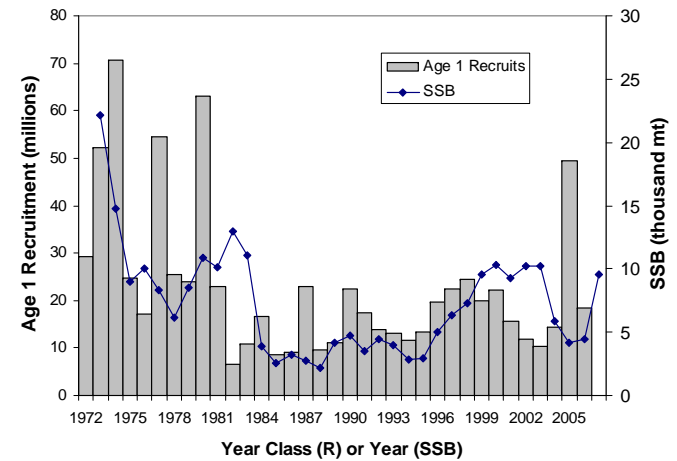


Figure 4. Recruitment and spawning stock biomass.

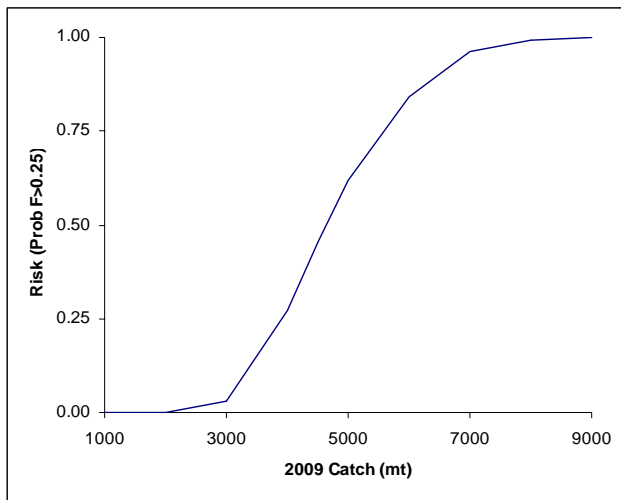


Figure 5. Risk of F exceeding  $F_{ref}=0.25$  for a range of 2009 catch.