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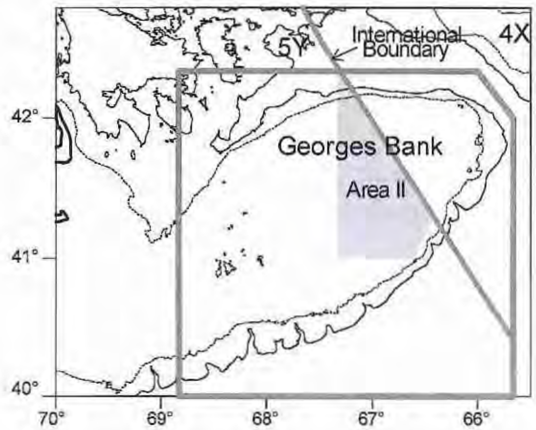
NOAA FISHERIES
NATIONAL MARINE FISHERIES SERVICE

Transboundary Resources Assessment Committee

Status Report 2012/01 (Revised)

GEORGES BANK YELLOWTAIL FLOUNDER

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



Summary

- Combined Canada and USA catches in 2011 were 1,169 mt.
- The Split Series VPA, which splits the survey indices between 1994 and 1995, was used as the basis for status determination reflected in the bullets below, but a range of sensitivity analyses were considered when providing catch advice.
- Adult population biomass (age 3+) increased from a low of 2,100 mt in 1995 to 10,900 mt in 2003, declined to about 2,500 mt in 2006 and 2007, increased to 4,500 mt in 2011, and was 4,300 mt at the beginning of 2012. Spawning stock biomass in 2011 was estimated to be 4,600 mt.
- During 1973-2011, recruitment averaged 19.5 million fish at age 1; however, it has been below this average since 2002. The 2009 and 2010 year classes are estimated at 3.1 million and 3.0 million, respectively, the lowest values in the time series.
- 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 1.94, and then declined to 0.31 in 2011. The fishing mortality rate has been above the reference point of $F_{ref} = 0.25$ for the entire assessment time series.
- If the retrospective pattern observed in this assessment continues, the 2011 fishing mortality rate estimate is expected to increase from 0.31 to 0.62, while the 2011 spawning stock biomass estimate is expected to decrease from 4,600 mt to 1,700 mt in future assessments.

Ce document est disponible sur l'Internet à : This document is available on the Internet at :
http://www.mar.dfo-mpo.gc.ca/science/TRAC/trac.html

Canada

July 2012
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- Given the increased magnitude of the retrospective bias in the Split Series VPA, five sensitivity analyses were performed to address the retrospective bias in characterizing the uncertainty and risk in the catch advice.

- To achieve both a high probability that F in 2013 will be less than F_{ref} and that adult biomass will increase, a 2013 quota of approximately 200 mt would be required. A quota of 400-500 mt implies that either F will be below F_{ref} in 2013 in only one of the five sensitivity analyses or the adult biomass will increase from 2013 to 2014 for the other four. Thus, a 2013 quota of 400-500 mt has both positive and negative aspects.

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

		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Avg[1]	Min[1]	Max[1]
Canada[9]	**Quota**	2.3	1.9	1.7	0.9	0.4	0.6	0.5	0.8[8]	1.2	0.6			
	Landed	2.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		0.5	<0.1	2.9
	Discard	0.8	0.4	0.2	0.5	0.1	0.1	0.1	0.2	<0.1		0.5	0.1	0.8
USA[9]	**Quota[2]**		6.0	4.3	2.1	0.9	1.9	1.6	1.2[8]	1.5	0.6			
	Catch[2]		5.9	3.8	1.9	1.0	1.6	1.8	1.1	1.1				
	Landed	3.2	5.8	3.2	1.2	1.1	0.7	1.0	0.7	0.9		4.4	0.4	15.9
	Discard	0.4	0.5	0.4	0.4	0.5	0.4	0.7	0.3	0.2		0.6	<0.1	3.0
Total[9]	**Quota[3]**		7.9	6.0	3.0	1.3	2.5	2.1	2.0[8]	2.7	1.2			
	Catch[3,4]		6.4	4.1	2.5	1.1	1.7	1.9	1.3	1.1				
	Catch	6.6	6.8	3.9	2.1	1.7	1.3	1.8	1.2	1.2		6.0	1.1	17.2
	Adult Biomass[5]	10.9	8.5	4.0	2.5	2.5	3.4	3.9	4.2	4.5	4.3	6.9[6]	2.0[6]	26.2[6]
	SSB	10.0	5.4	3.2	2.4	2.9	3.7	4.2	4.4	4.6		6.8	2.2	22.2
	Age 1 Recruits	10.6	6.9	8.8	10.8	7.4	8.2	6.9	3.1	3.0		19.5	3.0	70.6
	Fishing mortality[7]	0.61	1.94	1.39	1.52	1.00	0.51	0.67	0.49	0.31		1.02	0.31	1.94
	Exploitation Rate[7]	42%	80%	70%	73%	58%	37%	45%	35%	24%		59%	24%	80%

[1]1973 – 2011
[2]for fishing year May 1 – April 30
[3]for Canadian calendar year and USA fishing year May 1 – April 30
[4]sum of Canadian Landed, Canadian Discard, and USA Catch (includes discards)
[5]January 1st ages 3+
[6]1973 – 2012
[7]ages 4+ for calendar year
[8]quotas not jointly determined; established individually by each country
[9] unless otherwise noted, all values reported are for calendar year

Fishery

Total catches of Georges Bank yellowtail flounder peaked at about 21,000 mt in both 1969 and 1970 (Figure 1). The combined Canada/USA catch increased from 1995 through 2001, averaged 6,300 mt during 2002-2004, but declined to 1,169 mt in 2011 due to restrictive management measures.

The 2011 **Canadian catch** of 72 mt was well below the Canadian quota of 1,192 mt, with landings of only 22 mt and estimated discards of 50 mt. The majority of landings were incidental to cod and haddock fishing. Discards were due to the sea scallop dredge fishery.

USA catches in 2011 were 1,096 mt, with landings of 904 mt and discards of 192 mt. The USA landings in 2011 were predominantly from the trawl fishery while discards came from both the trawl and sea scallop dredge fisheries. Preliminary estimates of the USA catches for fishing year 2011-2012 were 86% of the 1,458 mt quota.

Ages 3-5 accounted for most of the **combined Canada/USA fishery** catch in 2011. Both the Canadian and 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, $F_{ref} = 0.25$ (established during the 2005 TRAC benchmark). 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 1973 to 2011. The VPA was calibrated to trends in abundance from three bottom trawl survey series (NMFS spring, NMFS fall, and DFO) and a recruitment index from the NMFS summer sea scallop survey. The VPA formulation down-weights the DFO surveys in 2008 and 2009 to account for the higher uncertainty in these years due to large tows, as previously recommended by TRAC. This formulation is denoted Split Series and is most similar to the Major Change model of the benchmark assessment. 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 exhibits retrospective bias in spawning stock biomass (SSB) and fishing mortality rate (F) that results in decreases in SSB and increases in F compared to the results of last year's assessment.

Given the increased magnitude of the retrospective bias in the Split Series VPA, five sensitivity analyses were performed to address the retrospective bias in characterizing the uncertainty and risk in the catch advice. The current perception of the stock is different from last year primarily because of the effects of this retrospective bias. If the retrospective bias continues to persist, the state of the resource will be more pessimistic than described below.

All the results presented for adult biomass, recruitment, and fishing mortality rate below are for the Split Series VPA.

Adult population biomass (age 3+) increased from a low of 2,100 mt in 1995 to 10,900 mt in 2003, declined to about 2,500 mt in 2006 and 2007, increased to 4,500 mt in 2011, and was 4,300 mt at the beginning of 2012. Total population biomass (age 1+) shows a similar broad trend as observed from the three groundfish surveys (Figure 2). Spawning stock biomass in 2011 was estimated to be 4,600 mt (80% confidence interval: 3,800-5,700 mt) (Figure 3).

During 1973-2011, **recruitment** averaged 19.5 million fish at age 1; however, it has been below this average since 2002 (Figure 3). The 2009 and 2010 year classes are estimated at 3.1 million and 3.0 million, respectively, the lowest values in the time series.

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 1.94, and then declined to 0.31 in 2011 (80% confidence interval: 0.24-0.40). The fishing mortality rate has been above the reference point of $F_{ref} = 0.25$ for the entire assessment time series (Figure 1).

If the retrospective pattern observed in this assessment continues, the 2011 fishing mortality rate estimate is expected to increase from 0.31 to 0.62, while the 2011 spawning stock biomass estimate is expected to decrease from 4,600 mt to 1,700 mt in future assessments. These changes are based on the retrospective rho adjustments used in the projections.

Productivity

Age structure, spatial distribution, and fish growth typically 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 and poor recent recruitment. **Spatial distribution patterns** from the three groundfish surveys generally follow historical averages. **Growth** has been variable without strong trends, but weights at length in recent years have trended down. Truncated age structure and lower condition factor (weights at length) 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 2013. Uncertainty about current biomass generates uncertainty in forecast results, which is expressed here as the probability of exceeding $F_{ref} = 0.25$ 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, the possibility that the model may not reflect stock dynamics closely enough, and/or retrospective bias.

Projections were made using 2009-2011 average fishery partial recruitment and the 2009-2011 survey and fishery average weights at age from the Split Series benchmark model as inputs. The abundance of the 2011 year class (age 1 in 2012) was set as the geometric mean of the previous ten years. A number of sensitivity analyses were performed that address in various ways the retrospective bias observed in the Split Series results (Figure 4).

The Split Series formulation was approved at the last benchmark assessment and is used to estimate current stock size and fishing mortality. In recent years, catches based on this model have not reduced fishing mortality below F_{ref} and have not had the expected effect on age 3+ biomass or SSB. If the 2013 catch quota is set based on this model, this pattern of failing to achieve management objectives seems likely to continue given the model's retrospective pattern. TRAC recommends not basing 2013 catches on these unadjusted model projection results.

In order to meet management objectives ($F<F_{ref}$ and reduce F when stock condition is poor to promote rebuilding), the 2013 quota should be set below the level suggested by the Split Series model. To determine the appropriate quota level, 5 sensitivity analyses were conducted:

1. Split Series rho adjusted
2. Single Series rho adjusted
3. Catch multiplied by 5 for years 2005-2011
4. Natural mortality multiplied by 4.5 for years 2005-2011
5. Catch multiplied by 3.5 and natural mortality multiplied by 2.5 for years 2005-2011.

The latter three sensitivity analyses were chosen to minimize retrospective bias. However, it was agreed that the magnitudes of the changes in these scenarios were too great to be regarded as plausible explanations for the patterns in the data. The changes were therefore assumed to alias unknown mechanisms in a similar manner to the Split Series change in survey catchability. If the adjustments adequately alias the currently unknown mechanism(s), the broadly consistent results across the approaches all support the proposed catch advice.

The results from the five different sensitivity analyses are therefore used as the basis for the catch advice. Results for alternative catch options are shown in Figure 4 (and in the text table below for two of these catch options). Under the Split Series model, a 2013 quota of 500 mt is expected to have a low probability of exceeding F_{ref} and is expected to generate an increase in age 3+ biomass (29%) from 2013 to 2014. Both the Split Series and Single Series models have strong retrospective bias that prevent their use in catch advice projections (shown in grey font in the text table below).

Under the remaining five sensitivity analyses, to achieve both a high probability that F in 2013 will be less than F_{ref} and that adult biomass will increase, a 2013 quota of approximately 200 mt would be required. A quota of 400-500 mt implies that either F will be below F_{ref} in 2013 in only one (adjSi) of the five sensitivity analyses or the adult biomass will increase from 2013 to 2014 for the other four (but not adjSi). Thus, a 2013 quota of 400-500 mt has both positive and negative aspects. Due to the assumption used for the 2011 year class in the projections, the increase in adult biomass will be optimistic if the 2011 year class is as poor as the recent year classes.

	[illegible]	adjSp	[illegible]	adjSi	Cmults	Mmults	M&C
200 mt quota							
$P(F>F_{ref})$	[illegible]	0.56	[illegible]	0.00	0.03	0.02	0.25
F2013	[illegible]	0.27	[illegible]	0.06	0.15	0.15	0.21
deltaB	[illegible]	55%	[illegible]	10%	70%	91%	72%
B2013	[illegible]	881	[illegible]	3441	7497	1931	4270
P(B inc)	[illegible]	1.00	[illegible]	1.00	1.00	1.00	1.00
P(B inc 10%)	[illegible]	1.00	[illegible]	0.55	1.00	1.00	1.00
500 mt quota							
$P(F>F_{ref})$	[illegible]	1.00	[illegible]	0.04	0.98	0.98	1.00
F2013	[illegible]	0.80	[illegible]	0.16	0.42	0.39	0.61
deltaB	[illegible]	22%	[illegible]	1%	50%	81%	51%
B2013	[illegible]	881	[illegible]	3441	7497	1931	4270
P(B inc)	[illegible]	1.00	[illegible]	0.76	1.00	1.00	1.00
P(B inc 10%)	[illegible]	1.00	[illegible]	0.00	1.00	1.00	1.00

In the USA, there is a requirement to provide rebuilding projections when stocks are overfished. The current rebuilding scenario for Georges Bank yellowtail flounder requires solving for a value of F (F_{reb50}) that, when applied in years 2013 onwards, results in a 50% probability that SSB is greater than SSB_{msy} (43,200 mt) in year 2032. This is so far into the future that no rebuilding projections were considered.

Special Considerations

The correction of an error in the 2011 DFO survey catch at age accounts for much of the change in the estimated size of the 2009 year class in the current VPA relative to that estimated in last year's assessment.

Source Documents

Gavaris, S., R. O'Boyle, and W. Overholtz, editors. 2005. 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.

Legault, C.M., L. Alade, H.H. Stone, and W.E. Gross. 2012. Stock Assessment of Georges Bank Yellowtail Flounder for 2012. TRAC Reference Document 2012/02.

Legault, C., L. Alade, H. Stone, S. Gavaris, and C. Waters. 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/] (Accessed July 2012).

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.

Correct Citation

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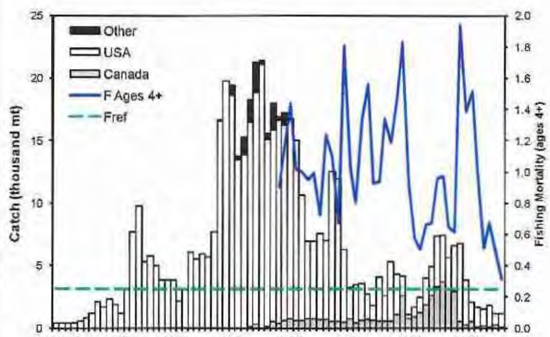


Figure 1. Catches and fishing mortality.

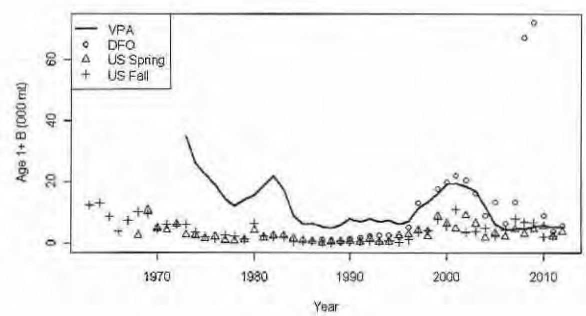


Figure 2. Ages 1+ biomasses.

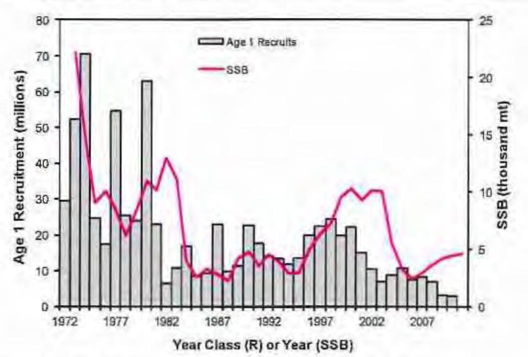
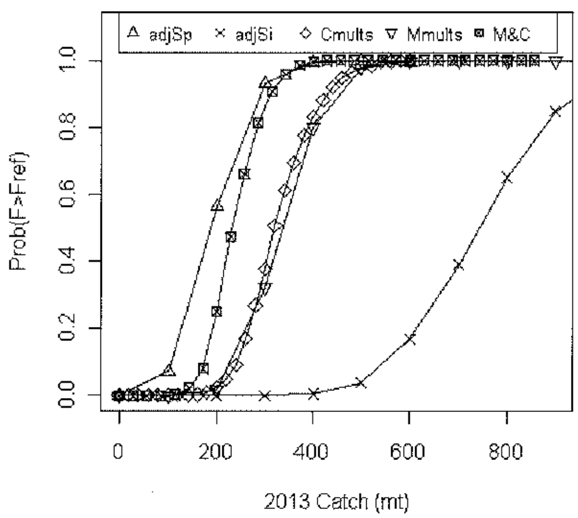


Figure 3. Recruitment and spawning stock biomass.



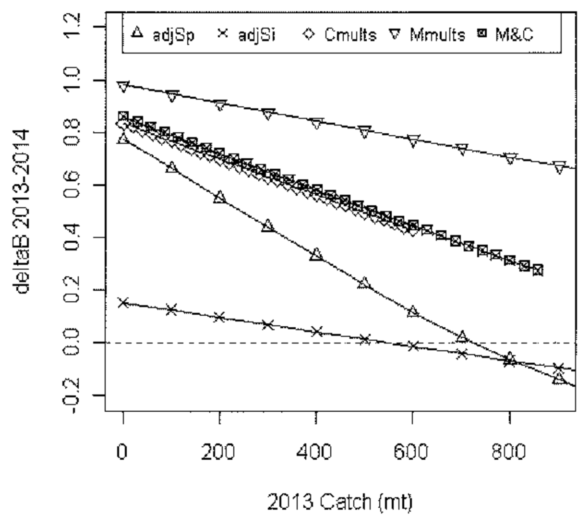


Figure 4. Risk of exceeding F_{ref}=0.25 and relative change in median adult biomass.