



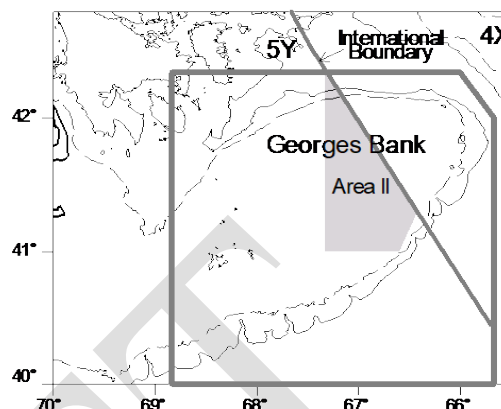
## Transboundary Resources Assessment Committee

Status Report 2022/XX

# GEORGES BANK YELLOWTAIL FLOUNDER

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

**DRAFT**



## Summary

- Combined Canada and USA catches in 2021 were 51 mt.
- The declining trend in survey biomass to low levels, despite reductions in catch to historical low amounts, indicates a poor state of the resource.
- Stock biomass is low and productivity is poor.
- The Transboundary Resource Assessment Committee (TRAC) recommends continued low exploitation to allow for the possibility of rebuilding.
- The new USA commercial fishery data processing system (Catch Accounting and Monitoring System [CAMS]) was used to produce USA landings estimates for 2020 and 2021.
- Fall and spring National Marine Fisheries Service (NMFS) survey estimates were updated to account for tow-specific area swept. Updated estimates were not meaningfully different than previous estimates.
- 2022 Fisheries and Oceans Canada (DFO) survey estimates were not available due to the use of a new survey vessel and an absence of a calibration factor. For the sake of completeness and comparability with previous TRAC Status Reports (TSRs), a number of tables and figures that could not be updated due to this missing data are included in the Appendix.
- The average survey biomass for 2022, using the adjustment from Miller et al. (2021), was 1,500 mt. The average survey biomass for 2022 adjusted for the missing DFO survey was 1,211 mt. Both estimates are between the survey bounds of the Limiter Approach (lower limit: 1,000 mt; upper limit 7,300-8,500 mt). Thus, TRAC recommends the constant catch advice of 200 mt.



## 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 51 mt in 2021 (Table 1) due in part to restrictive management measures.

The 2021 **Canadian catch** of 4 mt was 9% of the 45 mt quota, with landings of less than 1 mt and estimated discards of 4 mt from the sea scallop dredge fishery.

**USA catches** in calendar year 2021 were 47 mt, with landings of 1 mt and discards of 46 mt. The USA landings in calendar year 2021 were predominantly from the trawl fishery, while discards were predominantly from the scallop dredge fishery. Preliminary estimates of the USA catches (landings plus discards) for fishing year 2021 were 38% of the 80 mt quota.

Table 1. Catches (mt)

		2016	2017	2018	2019	2020	2021	2022	Avg <sup>1</sup>	Min <sup>1</sup>	Max <sup>1</sup>
Canada <sup>2</sup>	Quota	85	93	87	34	42	45	78			
	Landed	1	<1	<1	<1	<1	<1		395	<1	2,913
	Discard	10	2	3	4	6	4		385	2	815
USA <sup>2</sup>	Quota <sup>3</sup>	269	207	213	106	120	80	122			
	Catch <sup>3</sup>	26	84	40	5	8	48 <sup>4</sup>				
	Landed	26	35	32	3	5	<1 <sup>4</sup>		3,484	3	15,899
	Discard	7	57	11	2	56	47 <sup>4</sup>		479	2	3,021
Total <sup>2</sup>	Quota <sup>5</sup>	354	300	300	140	162	125	200			
	Catch <sup>5</sup>	36	87	42	9	14	30 <sup>4</sup>				
	Catch <sup>6</sup>	44	95	45	8	68	51 <sup>4</sup>		5,877	8	17,211

<sup>1</sup>1973 – 2021

<sup>2</sup> unless otherwise noted, all values reported are for calendar year

<sup>3</sup> for fishing year May 1 – April 30

<sup>4</sup> preliminary estimate

<sup>5</sup> for Canadian calendar year and USA fishing year May 1 – April 30

<sup>6</sup> sum of Canadian landed, Canadian discard, and USA catch (includes discards)

## 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 limit reference,  $F_{ref} = 0.25$  (established in 2002 by the TMGC). When stock conditions are poor, fishing mortality rates should be further reduced to promote rebuilding. However, due to the lack of an assessment model, an estimate of fishing mortality rate cannot be calculated. Status determination relative to reference points is not possible because reference points have not been defined for the Empirical or Limiter approaches.

## State of Resource

The declining trend in survey biomass to low levels, despite reductions in catch to historical low amounts, indicates a poor state of the resource. Recent catch is low relative to the biomass estimated from the surveys (relative  $F$ ; Figure 2), but catch curve analyses (Sinclair  $Z$ ) indicate conflicting information between USA and Canadian surveys (Figure 3). However, the low

catches in the survey in recent years make interpretation of the current relative F and survey Z difficult. Fishing does not appear to be a major driver of stock status currently.

## Productivity

Recruitment, spatial distribution, and fish growth typically reflect changes in the productive potential. Recent recruitment has generally been below average (Figure 4) and age structure is truncated (i.e., both fewer young fish and fewer old fish). Recent spatial distribution patterns from the bottom trawl surveys generally follow the ten-year average, although low survey catches make these comparisons difficult. Growth, as measured by length-at-age in the surveys, has been variable without trend, and condition (weight at length) has been average or poor recently, although low survey catches makes interpreting these trends difficult. Stock biomass is low and productivity is poor.

## Outlook and TRAC Advice

This outlook is provided in terms of agreements reached through a series of meetings of the TRAC and TMGC regarding the Empirical Approach and a Limiter Approach<sup>1</sup>. Both the Empirical and Limiter approaches rely on average estimates of biomass from the Fisheries and Oceans Canada (DFO) survey, National Marine Fisheries Service (NMFS) spring, and NMFS fall surveys (Figure 5). The Empirical Approach applies an exploitation rate to this average to generate catch advice. The Limiter Approach sets constant catch advice as long as the average survey biomass remains within predetermined limits.

In 2021, Miller et al. (2021) presented a new method to estimate NMFS spring and fall expanded survey biomass accounting for catchability-at-length and day/night effects. This method was further revised in 2022 to account for the tow-specific area swept. In 2022, the DFO survey was conducted with a new vessel. Conversion factors between the old and new vessel are not currently available so catch advice for 2023 from both approaches was computed using only the 2021 NMFS fall and 2022 NMFS spring surveys.

During the 2014 Benchmark, considerations were provided as reasons to decrease or to maintain or increase the quota. Like in 2014, findings this year show both positive and negative signals. The following is a positive signal: the relative F continues to be low. The negative signals are: both available surveys decreased; the two available surveys (NMFS fall and NMFS spring) were the second lowest surveys in their respective time series; recent recruitment continues to be below average; and the abundance of age 6+ fish in both available surveys decreased. Three independent surveys, funded by USA Atlantic Sea Scallop Research Set-Aside program, were updated with additional data and showed similar trends to the relative abundance estimates produced by the DFO and NMFS surveys.

USA landings estimates for 2020 and 2021 are from the newly implemented Catch Accounting and Monitoring System (CAMS). In addition, USA discard estimates for 2020 have been revised since the 2021 TRAC meeting. Observed trips in 2020 were processed and an updated discard estimate was calculated. As a result, scallop dredge fleet discard estimates for 2020 were higher than prior estimates reported in the 2021 TRAC meeting. However, observer coverage was low in the scallop fleet in semester two, resulting in high coefficients of variation (Figure 6).

---

<sup>1</sup> The Empirical Approach derives from the 2014 Georges Bank Yellowtail Flounder Diagnostic and Empirical Approach Benchmark, a subsequent TRAC meeting in 2014, and an intersessional TRAC conference call in June 2017. The Limiter Approach was developed during the 2020 TRAC meeting and subsequently enhanced during TMGC intersessional meetings. At the November 2021 intersessional meeting of the TMGC the group recommended use of the Limiter Approach for catch advice in 2023.

NMFS survey estimates were adapted to account for tow-specific area swept; these revised estimates were similar to previous estimates. Revised tow-specific area swept estimates were incorporated into Miller et al. (2021) estimates used to expand biomass estimates.

During 2011 to 2021, the catch has averaged 32% of the quota, ranging from 6% to 63%. The TRAC recognizes that catch has been well below the quota in recent years and expects this to continue in the future if current management measures continue and there is not a significant change in stock abundance or distribution. The TRAC recommends continued low exploitation to allow for the possibility of rebuilding.

At the 2020 TRAC meeting, the missing 2020 NMFS spring survey was shown to have little impact on the average survey biomass by examining previous years with and without the NMFS spring survey. At the 2021 TRAC meeting, the missing 2020 NMFS fall survey was shown to have a larger impact. Adjusting for the mean relative difference between the ten years with and without the NMFS fall survey leads to a 24% increase in average survey biomass and catch advice. At the same meeting and using the same methods, it was estimated that if the DFO survey was missing, average survey biomass and catch advice would decrease by 24%. The TRAC presents both the adjusted and non-adjusted values for comparison purposes to account for the missing 2022 DFO survey.

Prior to the application of the Limiter Approach, the Empirical Approach was used to provide catch advice. Application of the Empirical Approach, with the Miller et al. (2021) adjustment that incorporates tow-specific area swept and an exploitation rate of 7%, results in catch of 105 mt for 2023. Adjusting for the missing DFO survey results in a reduced catch of 85 mt for 2023. This adjustment is based on a comparison between the average survey biomass estimated with all three surveys compared to estimates using only the DFO and NMFS spring survey, which showed an average relative difference of 24%. The adjustment factor is 0.807, which is derived from  $1/(1 + 0.24)$ .

Low catches and poor condition of the stock, along with a desire to stop chasing survey noise, led to the development of the Limiter Approach, a tool to help make the decisions regarding the constant catch advice and average survey biomass limits. This tool is an R Shiny app available at <https://github.com/cmlegault/limiter>.

The catch advice for 2023 was based on the Limiter Approach. The average survey biomass for 2022 was 1,500 mt, which is between the limits (lower limit: 1,000 mt; upper limit 7,300–8,500 mt). The average survey biomass for 2022 adjusted for the missing DFO survey was 1,211 mt, which is between the limits. Thus, TRAC recommends the constant catch advice of 200 mt.

*Table 2. Survey biomass with the Miller et al. (2021) adjustment from the three bottom trawl surveys, an arithmetic average of these biomasses, and example quota associated with an exploitation rate of 7%. Quota is implemented in the following year (e.g., the row of 2022 quota would be implemented in 2023).*

Year	Biomass (mt)				Example Quota (mt) at 7% Exploitation Rate
	DFO	Spring	Fall (year-1)	Average	
2010	29,452	60,877	66,989	52,439	3,671
2011	12,344	27,500	23,517	21,120	1,478
2012	18,113	44,532	24,846	29,164	2,041
2013	2,249	11,879	24,340	12,823	898
2014	1,654	8,040	8,946	6,213	435
2015	2,650	5,312	10,964	6,309	442
2016	5,569	3,063	4,578	4,403	308
2017	1,104	2,558	4,610	2,757	193
2018	812	139	1,891	947	66
2019	182	2,776	4,728	2,562	179
2020	404	NA	3,608	2,006	140
2021	446	4,804	NA	2,625	184
2022	NA	929	2,070	1,500	105

*Table 3. Recent quotas and catches by year and associated exploitation rates (computed by dividing by the average survey biomass in Table 2). (VPA = Virtual Population Analysis.)*

Year	Quota (mt)	Catch (mt)	Quota/Avg	Catch/Avg	Model Type
2010	1,956	1,170	4%	2%	VPA
2011	2,650	1,171	13%	6%	VPA
2012	1,150	725	4%	2%	VPA
2013	500	218	4%	2%	VPA
2014	400	159	6%	3%	VPA
2015	354	118	6%	2%	Empirical
2016	354	44	8%	1%	Empirical
2017	300	95	11%	3%	Empirical
2018	300	45	32%	5%	Empirical
2019	140	8	5%	0%	Empirical
2020	162	68	8%	3%	Empirical
2021	125	49	5%	2%	Empirical
2022	200		13%		Empirical
Mean	699	342	9% <sup>1</sup>	5%	

<sup>1</sup> The average Quota/Avg for years 2010–2017 is 7%.

## Special Considerations

- Results from the most recent surveys are considered valid for use in the Empirical Approach despite the lack of a DFO 2022 survey (due to an absence of a catchability conversion factor to account for changes in survey vessel).
- Updated USA catch-at-age data were not available this year due to the transition to CAMS. These estimates are expected to be available for next year.
- Discard estimates in 2020 are uncertain due to lower observer coverage in semester two for the USA scallop dredge fleet.
- In 2022, the average survey biomass is near the lower bound of the Limiter Approach.
- While the NMFS surveys were adjusted for catchability based on Miller et al. (2021), the DFO survey was not adjusted since it uses a different gear configuration. It is possible that the DFO survey catchability estimate could be adjusted with further analysis.

## Source Documents

- Clark, K. and E. N. Brooks, editors. 2017. Proceedings of the Transboundary Resources Assessment Committee (TRAC): Eastern Georges Bank Cod and Haddock, and Georges Bank Yellowtail Flounder: Report of Meeting held 11–14 July 2017. TRAC Proceedings 2017/01. (not yet publicly available)
- McIntyre, T. and T. Trinko-Lake, editors. 2021. Proceedings of the Transboundary Resources Assessment Committee: Report of Meeting held 12–14 July 2021. TRAC Proceedings 2021/01. (not yet publicly available)
- Miller, T.J., D.E. Richardson, A.W. Jones, and P.J. Politis. 2021. Relative efficiency of a chain sweep and the rockhopper sweep used for the NEFSC bottom trawl survey and biomass estimates for Georges Bank Yellowtail Flounder. TRAC Ref. Doc. 2021/02. (not yet publicly available)
- O'Brien, L., and K. Clark, editors. 2014. Proceedings of the Transboundary Resources Assessment Committee for Georges Bank Yellowtail Flounder Diagnostic and Empirical Approach Benchmark: Report of Meeting held 14–18 April 2014. TRAC Proceedings 2014/01. (<https://repository.library.noaa.gov/view/noaa/26476>)

## Correct Citation

TRAC. 2022. Georges Bank Yellowtail Flounder. TRAC Status Report 2022/XX.

### Figures

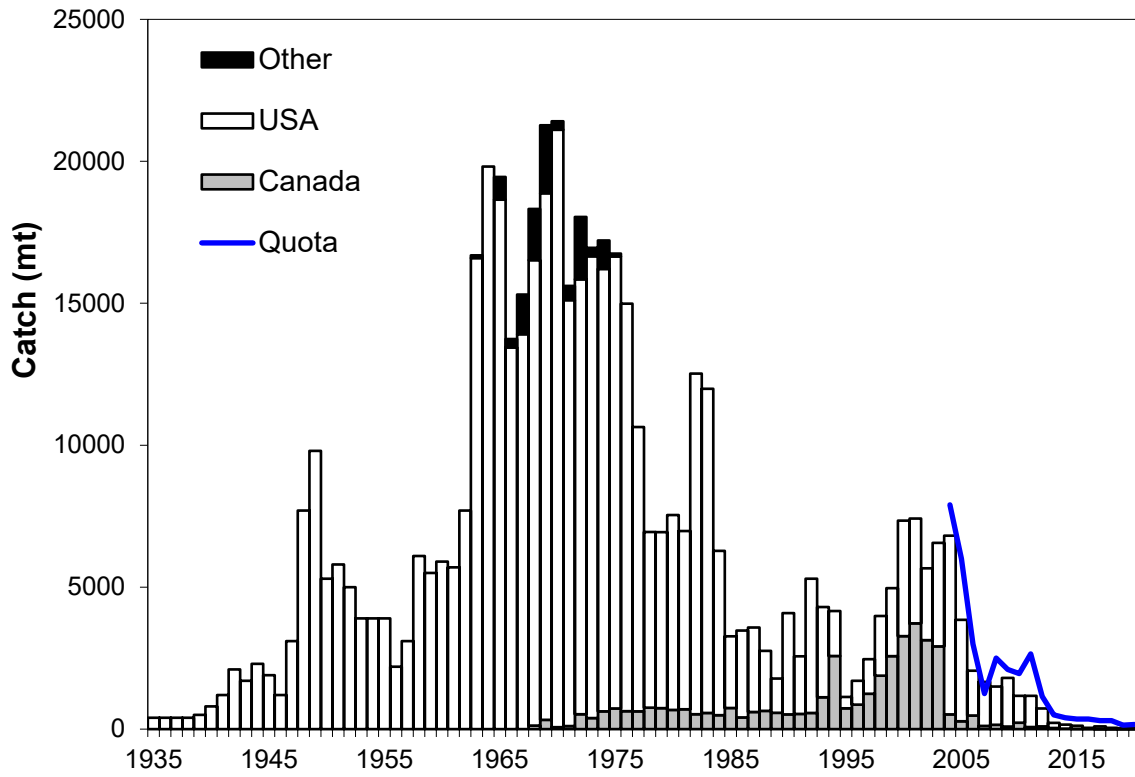


Figure 1. Catches and quota for Georges Bank Yellowtail Flounder, 1935 to 2021.

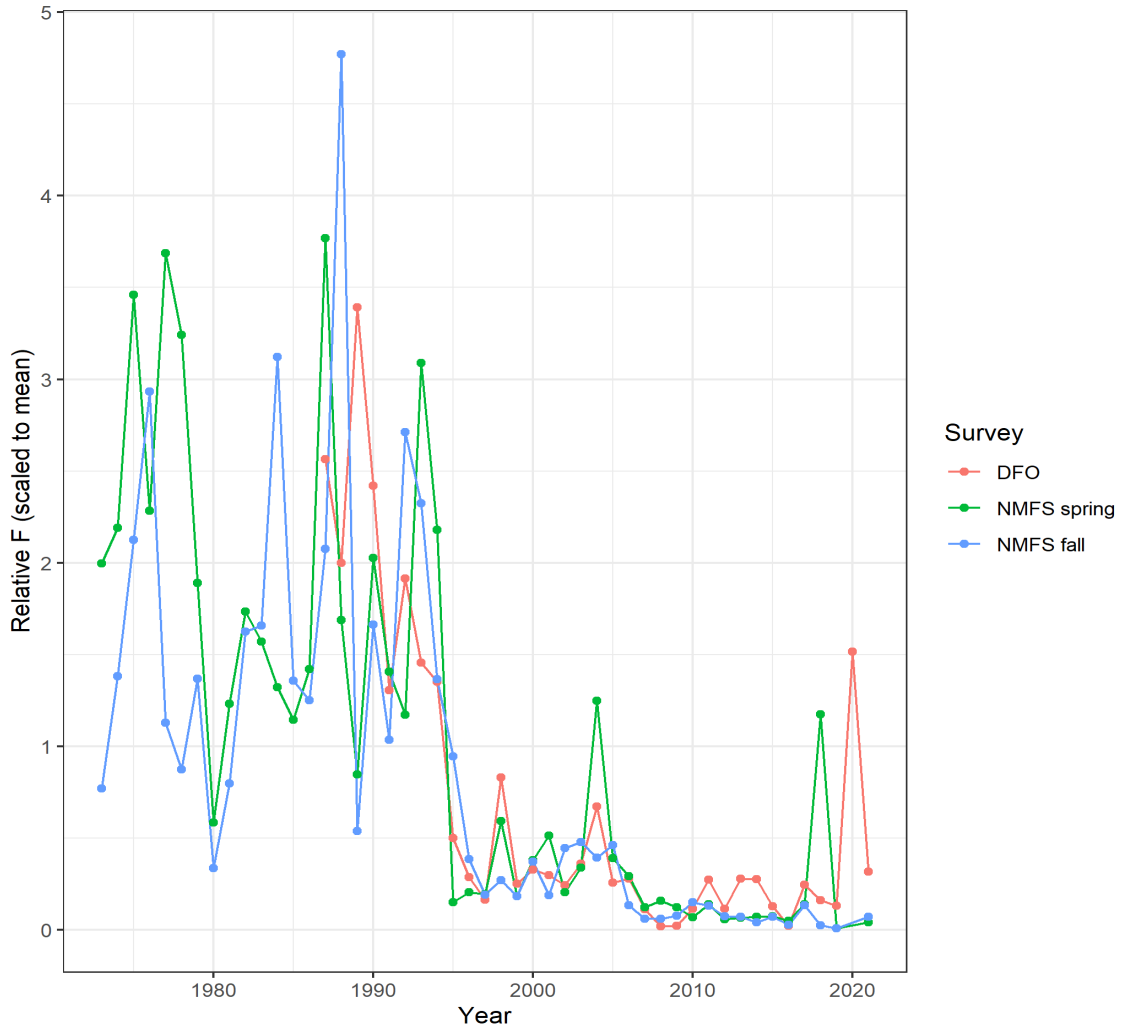


Figure 2. Relative F (catch in mt divided by survey catch in kg per tow) scaled to the mean value during 1987–2007 for the three surveys. Please see note in State of the Resource about recent low survey catches. Note the 2020 National Marine Fisheries Service (NMFS) spring and fall surveys were not conducted due to COVID-19 restrictions. The Fisheries and Oceans Canada (DFO) 2022 survey data are not available due to a change in vessel and an absence of conversion factor.



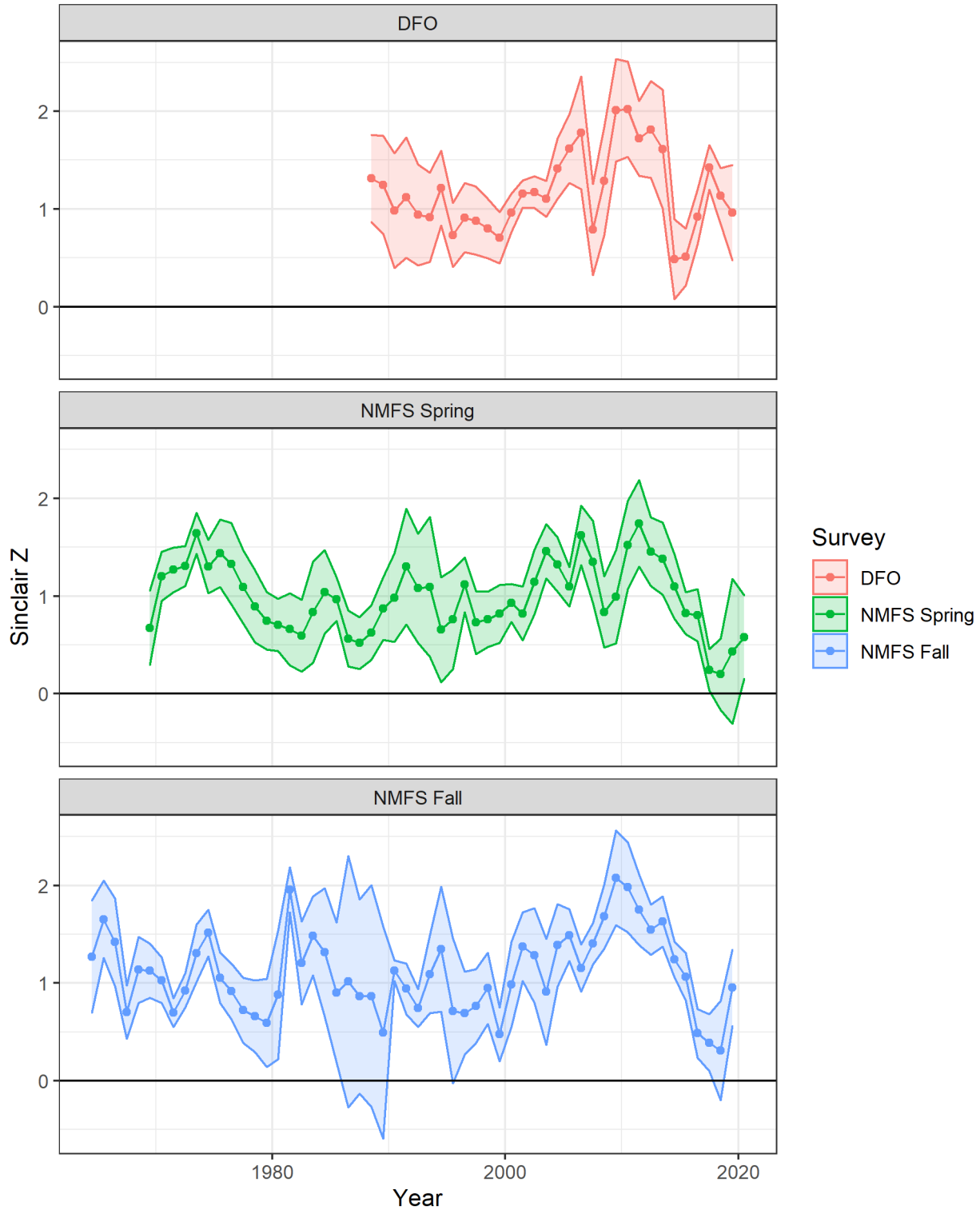


Figure 3. Total mortality (Z) from the three surveys using the Sinclair method with a four-year moving window for ages 3 to 8. Please see note in State of the Resource about recent survey catches. Note the 2020 National Marine Fisheries Service (NMFS) spring and fall surveys were not conducted due to COVID-19 restrictions. The Fisheries and Oceans Canada (DFO) 2022 survey data are not available due to a change in vessel and an absence of conversion factor.

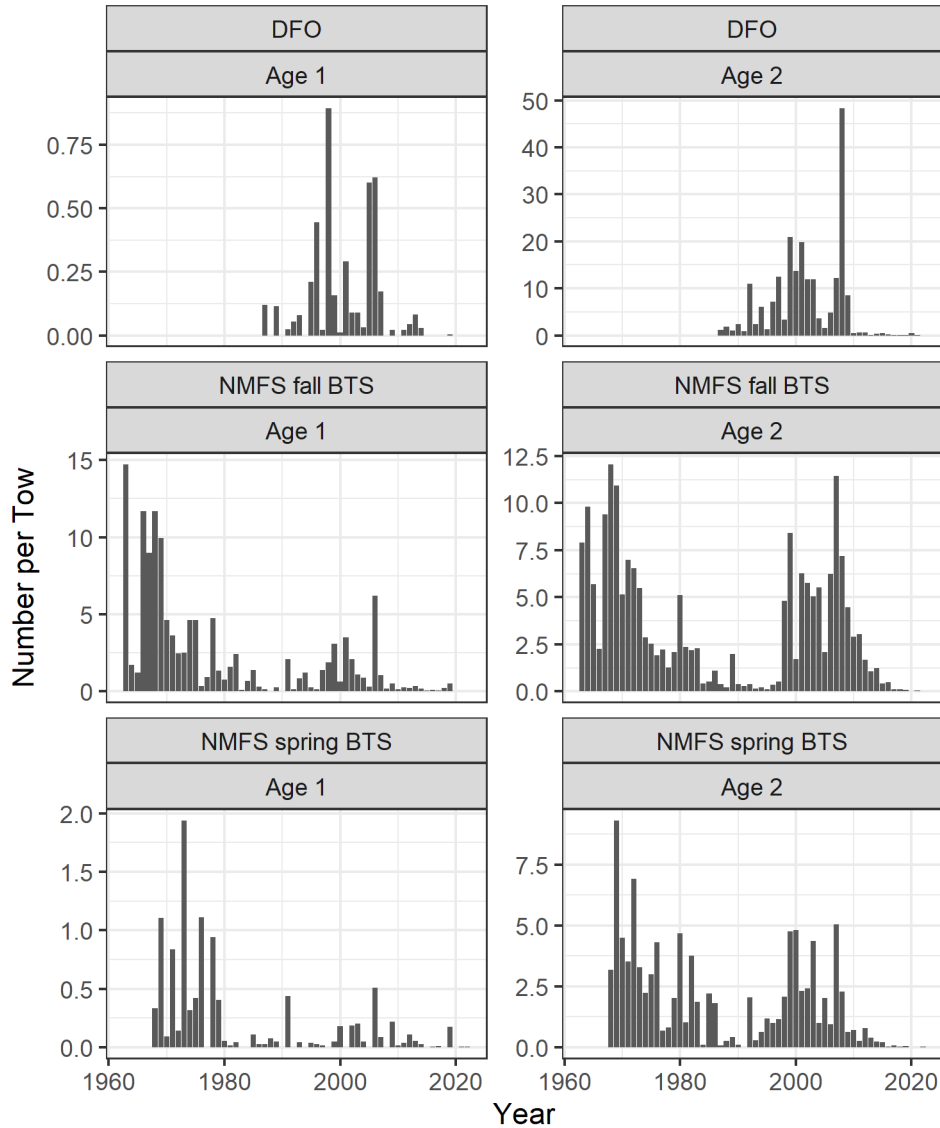


Figure 4. Estimates of recruitment (age 1 has many zeros, so age 2 also shown) from the three bottom trawl surveys. Note the 2020 National Marine Fisheries Service (NMFS) spring and fall surveys were not conducted due to COVID-19 restrictions. The Fisheries and Oceans Canada (DFO) 2022 survey data are not available due to a change in vessel and an absence of conversion factor.

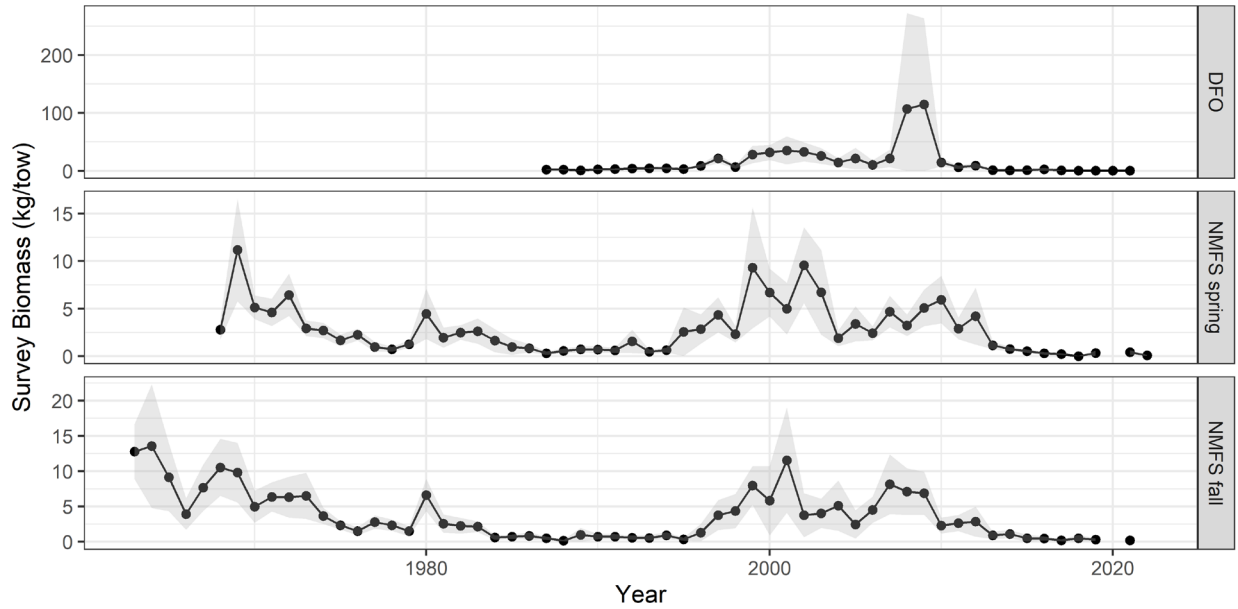


Figure 5. Bottom trawl survey catch rates (in biomass) for Georges Bank Yellowtail Flounder (filled circles) with 90% confidence intervals (gray area). Note that the amount of Georges Bank area covered in the Fisheries and Oceans Canada (DFO) and National Marine Fisheries Service (NMFS) surveys differs and that the NMFS surveys have been standardized to Albatross units. Note the 2020 NMFS spring and fall surveys were not conducted due to COVID-19 restrictions. The DFO 2022 survey data are not available due to a change in vessel and an absence of conversion factor.

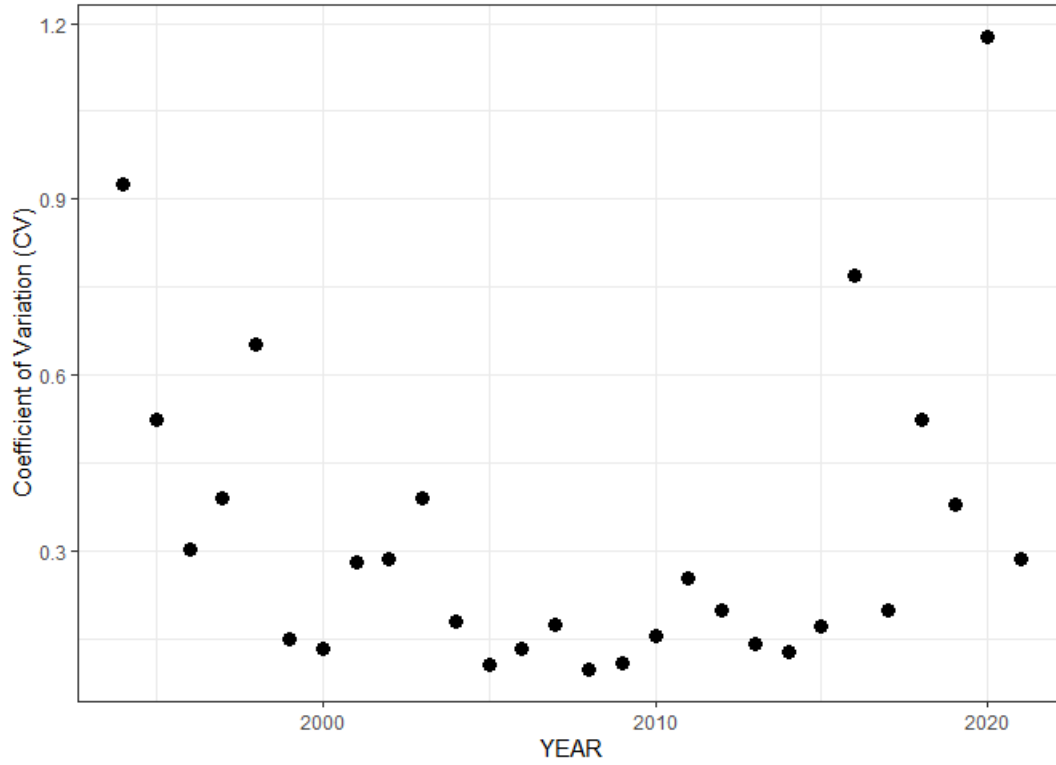


Figure 6. Coefficients of variation for USA discard estimates of Georges Bank Yellowtail Flounder. Note the high value for 2020 due to limited observer coverage in the scallop dredge fleet as a result of COVID-19.

APPENDIX

Additional Figures and Tables

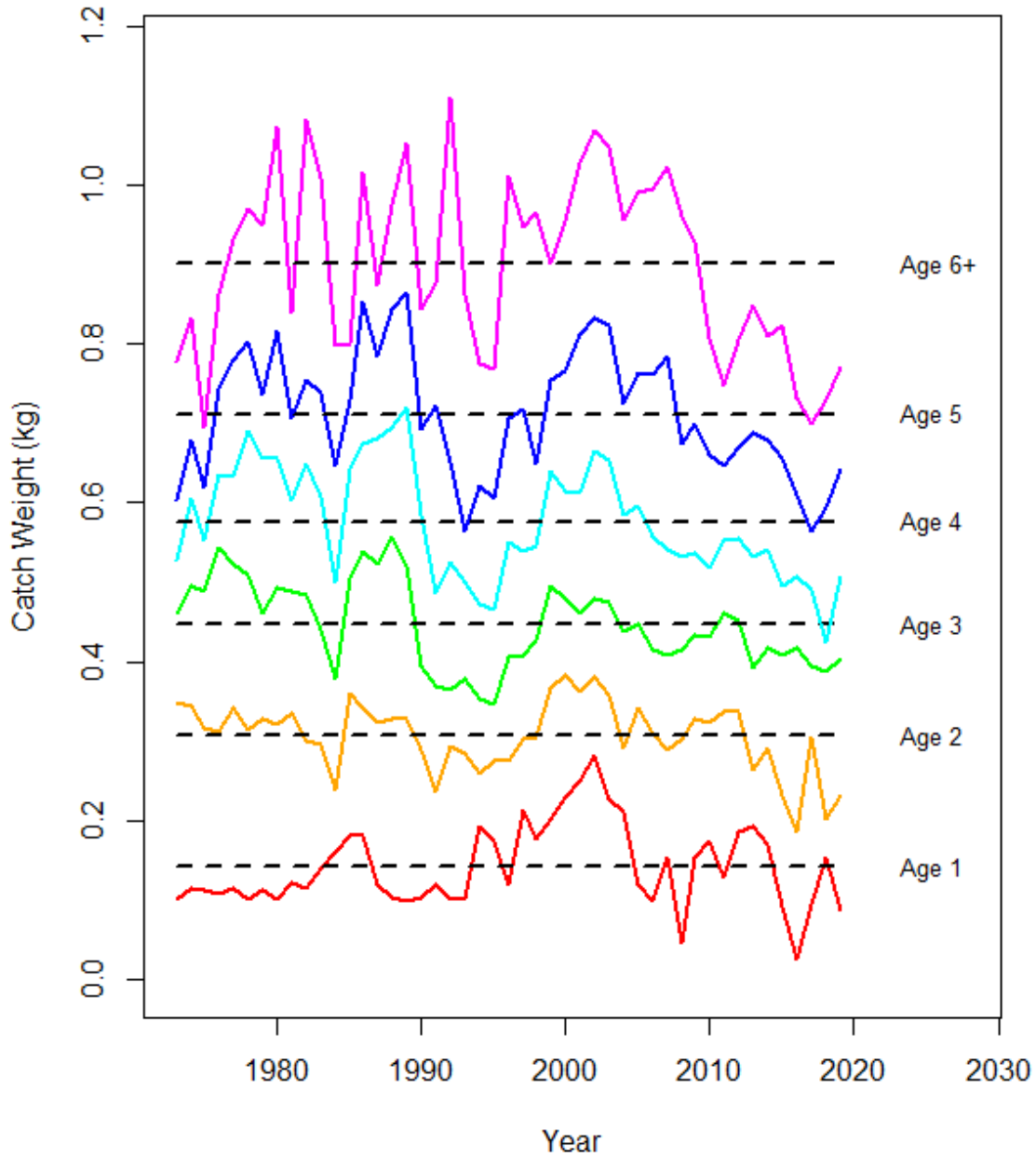


Figure A1. Trends in mean weight at age from the Georges Bank Yellowtail Flounder fishery (Canada and USA combined, including discards). Dashed lines denote average of time series. Note 2020 and 2021 data not available for this meeting (see Special Considerations).

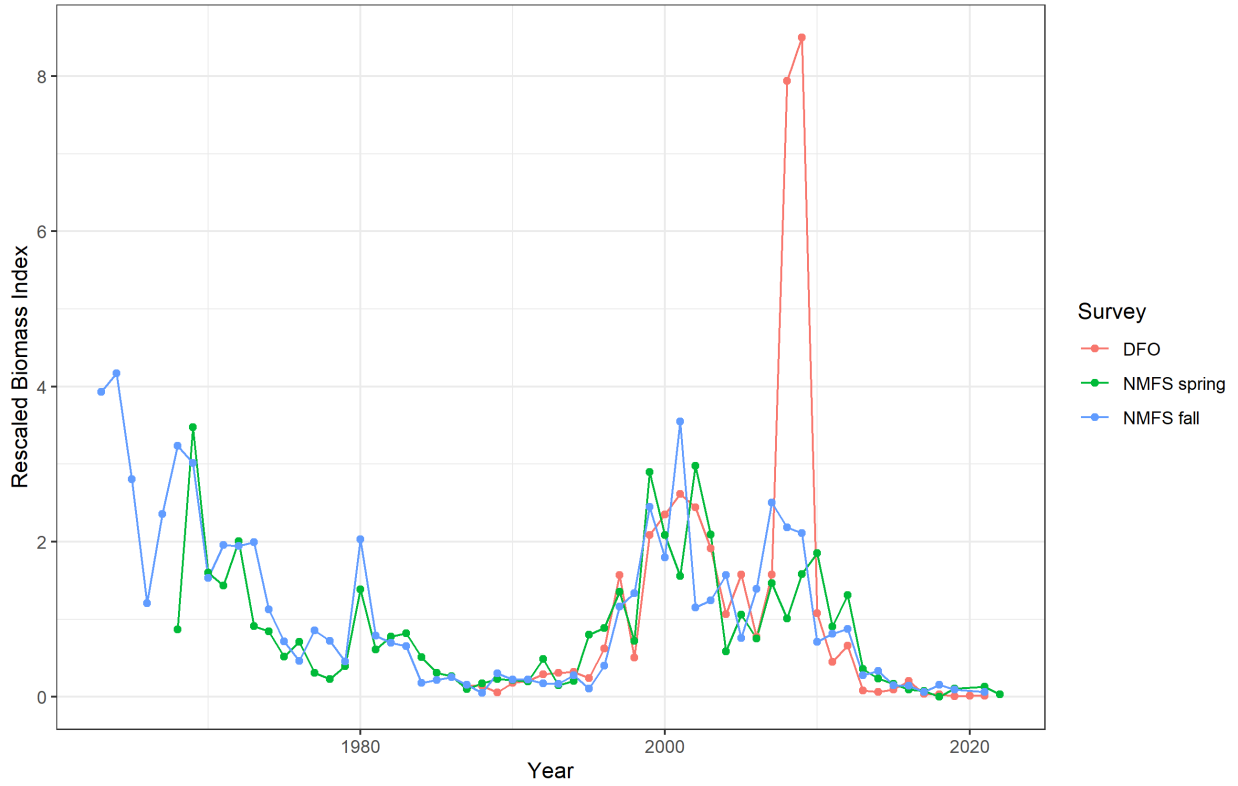


Figure A2. Three survey biomass indices (Fisheries and Oceans Canada [DFO], National Marine Fisheries Service [NMFS] spring, and NMFS fall) for Yellowtail Flounder on Georges Bank rescaled to their respective means for years 1987–2007. Note the 2020 NMFS spring and fall surveys were not conducted due to COVID-19. The DFO 2022 survey data are not available due to a change in vessel and an absence of conversion factor.

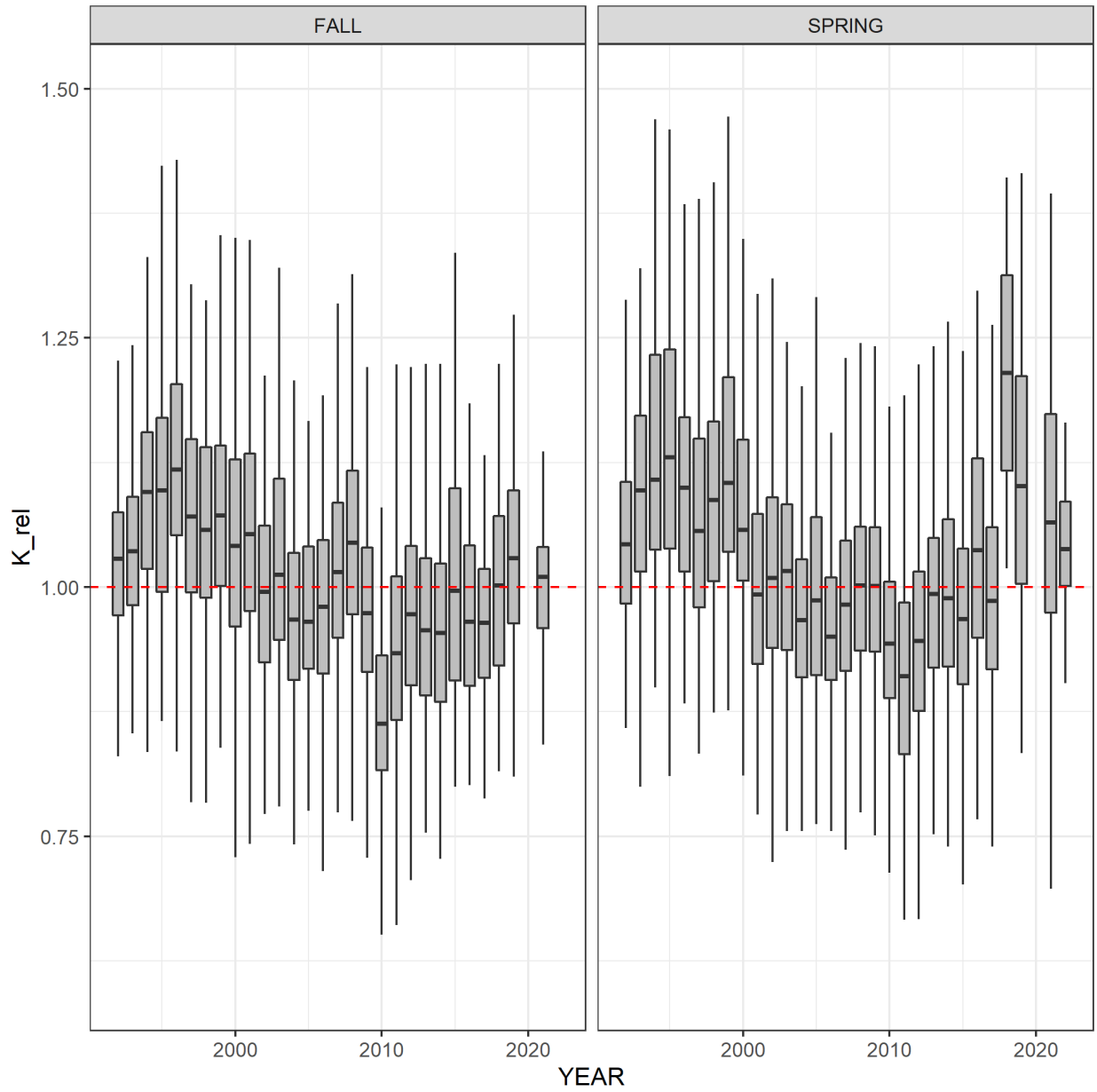


Figure A3. Condition factor (Fulton's  $K$ ) of Georges Bank Yellowtail Flounder from the National Marine Fisheries Service (NMFS) fall and spring surveys. Note the 2020 NMFS spring and fall surveys were not conducted due to COVID-19.

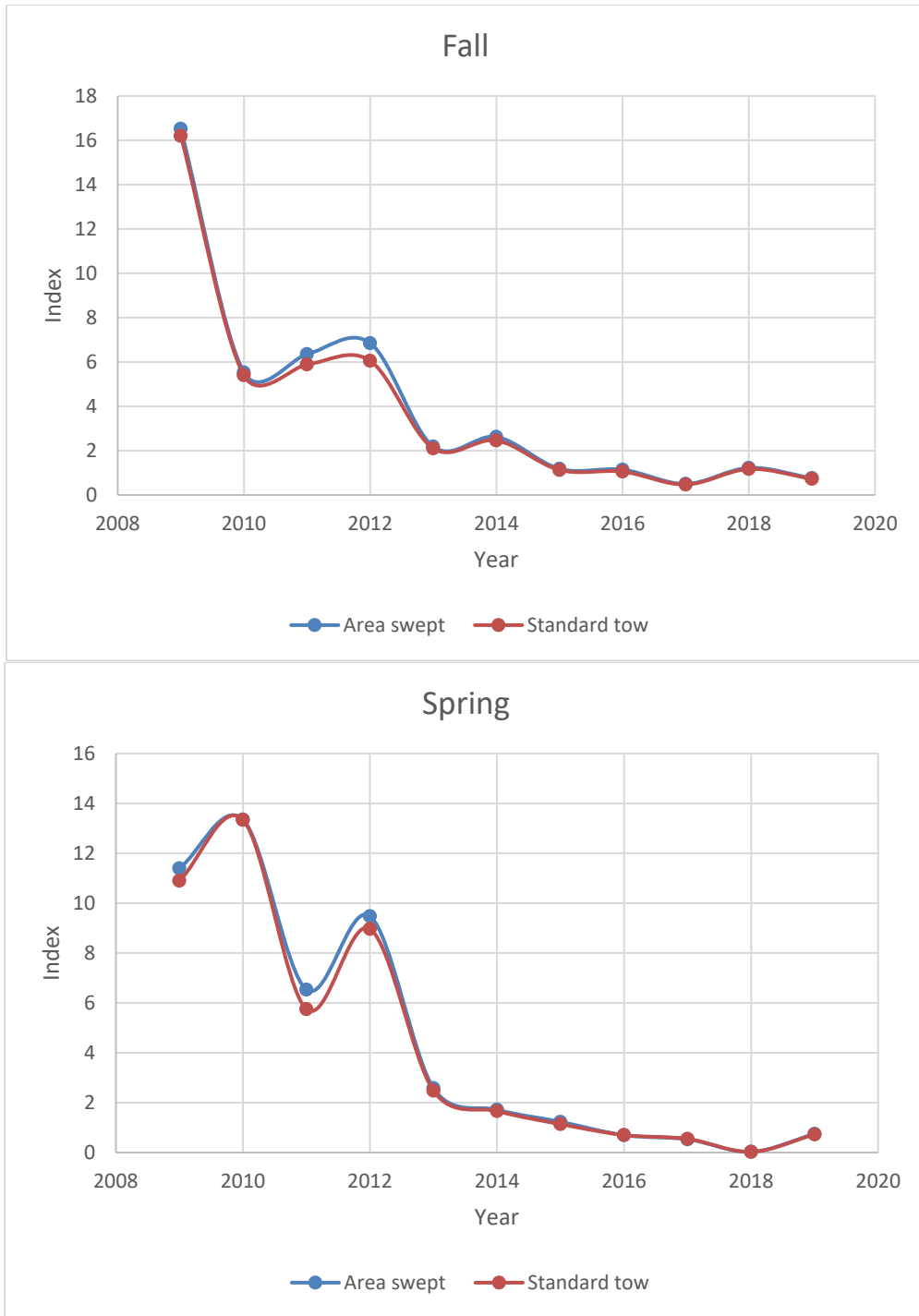


Figure A4. For Georges Bank Yellowtail Flounder, comparison of relative abundance biomass estimates using standard tow and tow-specific area swept approach.



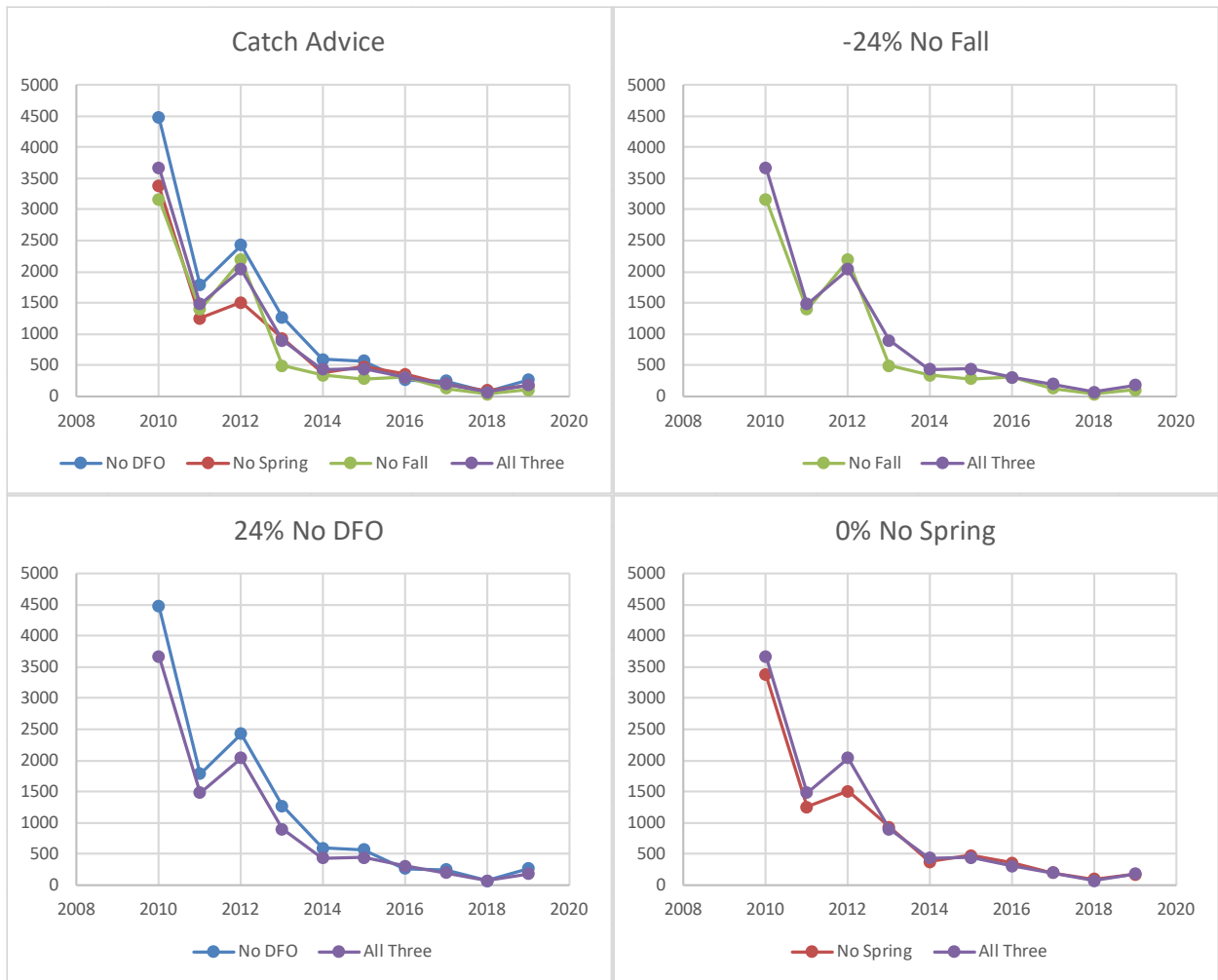


Figure A5. Scenario analyses where one of the three surveys was removed from the calculation of catch compared to the situation with all three surveys. The percentiles at the top of the figures refer to the average relative difference (2 surveys – all 3)/all 3.

Table A1. Annual USA and Canadian catch (landings and discards) and quota (mt) of Georges Bank Yellowtail Flounder.

Year	USA Landings	USA Discards	Canada Landings	Canada Discards	Other Landings	Total Catch	USA Quota	Canada Quota	Total Quota
1935	300	100	0	0	0	400			
1936	300	100	0	0	0	400			
1937	300	100	0	0	0	400			
1938	300	100	0	0	0	400			
1939	375	125	0	0	0	500			
1940	600	200	0	0	0	800			
1941	900	300	0	0	0	1,200			
1942	1,575	525	0	0	0	2,100			
1943	1,275	425	0	0	0	1,700			
1944	1,725	575	0	0	0	2,300			
1945	1,425	475	0	0	0	1,900			
1946	900	300	0	0	0	1,200			
1947	2,325	775	0	0	0	3,100			
1948	5,775	1,925	0	0	0	7,700			
1949	7,350	2,450	0	0	0	9,800			
1950	3,975	1,325	0	0	0	5,300			
1951	4,350	1,450	0	0	0	5,800			
1952	3,750	1,250	0	0	0	5,000			
1953	2,925	975	0	0	0	3,900			
1954	2,925	975	0	0	0	3,900			
1955	2,925	975	0	0	0	3,900			
1956	1,650	550	0	0	0	2,200			
1957	2,325	775	0	0	0	3,100			
1958	4,575	1,525	0	0	0	6,100			
1959	4,125	1,375	0	0	0	5,500			
1960	4,425	1,475	0	0	0	5,900			
1961	4,275	1,425	0	0	0	5,700			
1962	5,775	1,925	0	0	0	7,700			
1963	10,990	5,600	0	0	100	16,690			
1964	14,914	4,900	0	0	0	19,814			
1965	14,248	4,400	0	0	800	19,448			
1966	11,341	2,100	0	0	300	13,741			
1967	8,407	5,500	0	0	1,400	15,307			
1968	12,799	3,600	122	0	1,800	18,321			
1969	15,944	2,600	327	0	2,400	21,271			
1970	15,506	5,533	71	0	300	21,410			
1971	11,878	3,127	105	0	500	15,610			
1972	14,157	1,159	8	515	2,200	18,039			
1973	15,899	364	12	378	300	16,953			
1974	14,607	980	5	619	1,000	17,211			
1975	13,205	2,715	8	722	100	16,750			
1976	11,336	3,021	12	619	0	14,988			
1977	9,444	567	44	584	0	10,639			
1978	4,519	1,669	69	687	0	6,944			

Table A1. Continued.

Year	USA Landings	USA Discards	Canada Landings	Canada Discards	Other Landings	Total Catch	USA Quota	Canada Quota	Total Quota
1979	5,475	720	19	722	0	6,935			
1980	6,481	382	92	584	0	7,539			
1981	6,182	95	15	687	0	6,979			
1982	10,621	1,376	22	502	0	12,520			
1983	11,350	72	106	460	0	11,989			
1984	5,763	28	8	481	0	6,280			
1985	2,477	43	25	722	0	3,267			
1986	3,041	19	57	357	0	3,474			
1987	2,742	233	69	536	0	3,580			
1988	1,866	252	56	584	0	2,759			
1989	1,134	73	40	536	0	1,783			
1990	2,751	818	25	495	0	4,089			
1991	1,784	246	81	454	0	2,564			
1992	2,859	1,873	65	502	0	5,299			
1993	2,089	1,089	682	440	0	4,300			
1994	1,431	148	2,139	440	0	4,158			
1995	360	43	464	268	0	1,135			
1996	743	96	472	388	0	1,700			
1997	888	327	810	438	0	2,464			
1998	1,619	482	1,175	708	0	3,985			
1999	1,818	577	1,971	597	0	4,963			
2000	3,373	694	2,859	415	0	7,341			
2001	3,613	78	2,913	815	0	7,419			
2002	2,476	53	2,642	493	0	5,663			
2003	3,236	410	2,107	809	0	6,562			
2004	5,837	460	96	422	0	6,815	6,000	1,900	7,900
2005	3,161	414	30	247	0	3,852	4,260	1,740	6,000
2006	1,196	384	25	452	0	2,057	2,070	930	3,000
2007	1,058	493	17	97	0	1,664	900	350	1,250
2008	937	409	41	112	0	1,499	1,950	550	2,500
2009	959	759	5	84	0	1,806	1,617	483	2,100
2010	654	289	17	210	0	1,170	1,200	756	1,956
2011	904	192	22	53	0	1,171	1,458	1,192	2,650
2012	443	188	46	48	0	725	564	586	1,150
2013	130	49	1	39	0	218	215	285	500
2014	70	74	1	14	0	159	328	72	400
2015	63	41	3	11	0	118	248	106	354
2016	26	7	1	10	0	44	269	85	354
2017	35	57	<1	2	0	95	207	93	300
2018	32	11	<1	3	0	45	213	87	300
2019	3	2	<1	4	0	8	106	34	140
2020	5	57	<1	6	0	68	120	42	162
2021	1	46	<1	4	0	51	80	45	125

Table A2. Mean weight-at-age (kg) for the total catch of USA and Canadian landings and discards, for Georges Bank Yellowtail Flounder. A dash (-) indicates no data available.

Year	Age											
	1	2	3	4	5	6	7	8	9	10	11	12
1973	0.101	0.348	0.462	0.527	0.603	0.690	1.063	1.131	1.275	1.389	1.170	-
1974	0.115	0.344	0.496	0.607	0.678	0.723	0.904	1.245	1.090	-	1.496	1.496
1975	0.113	0.316	0.489	0.554	0.619	0.690	0.691	0.654	1.052	0.812	-	-
1976	0.108	0.312	0.544	0.635	0.744	0.813	0.854	0.881	1.132	1.363	1.923	-
1977	0.116	0.342	0.524	0.633	0.780	0.860	1.026	1.008	0.866	0.913	-	-
1978	0.102	0.314	0.510	0.690	0.803	0.903	0.947	1.008	1.227	1.581	0.916	-
1979	0.114	0.329	0.462	0.656	0.736	0.844	0.995	0.906	1.357	1.734	1.911	-
1980	0.101	0.322	0.493	0.656	0.816	1.048	1.208	1.206	1.239	-	-	-
1981	0.122	0.335	0.489	0.604	0.707	0.821	0.844	1.599	1.104	-	-	-
1982	0.115	0.301	0.485	0.650	0.754	1.065	1.037	1.361	-	-	-	-
1983	0.140	0.296	0.441	0.607	0.740	0.964	1.005	1.304	1.239	-	-	-
1984	0.162	0.239	0.379	0.500	0.647	0.743	0.944	1.032	-	-	-	-
1985	0.181	0.361	0.505	0.642	0.729	0.808	0.728	-	-	-	-	-
1986	0.181	0.341	0.540	0.674	0.854	0.976	0.950	1.250	-	1.686	-	-
1987	0.121	0.324	0.524	0.680	0.784	0.993	0.838	0.771	0.809	-	-	-
1988	0.103	0.328	0.557	0.696	0.844	1.042	0.865	1.385	-	-	-	-
1989	0.100	0.327	0.520	0.720	0.866	0.970	1.172	1.128	-	-	-	-
1990	0.105	0.290	0.395	0.585	0.693	0.787	1.057	-	-	-	-	-
1991	0.121	0.237	0.369	0.486	0.723	0.850	1.306	-	-	-	-	-
1992	0.101	0.293	0.365	0.526	0.651	1.098	1.125	1.303	1.303	-	-	-
1993	0.100	0.285	0.379	0.501	0.564	0.843	1.130	1.044	-	-	-	-
1994	0.193	0.260	0.353	0.472	0.621	0.780	0.678	1.148	-	-	-	-
1995	0.174	0.275	0.347	0.465	0.607	0.720	0.916	0.532	-	-	-	-
1996	0.119	0.276	0.407	0.552	0.707	0.918	1.031	1.216	-	-	-	-
1997	0.214	0.302	0.408	0.538	0.718	1.039	0.827	1.136	1.113	-	-	-
1998	0.178	0.305	0.428	0.546	0.649	0.936	1.063	1.195	-	1.442	-	-
1999	0.202	0.368	0.495	0.640	0.755	0.870	1.078	1.292	1.822	-	-	-
2000	0.229	0.383	0.480	0.615	0.766	0.934	1.023	1.023	1.296	-	-	-
2001	0.251	0.362	0.460	0.612	0.812	1.011	1.024	1.278	1.552	-	-	-
2002	0.282	0.381	0.480	0.665	0.833	0.985	1.100	1.286	1.389	1.483	-	-
2003	0.228	0.359	0.474	0.653	0.824	0.957	1.033	1.144	1.267	1.418	1.505	-
2004	0.211	0.292	0.438	0.585	0.726	0.883	1.002	1.192	1.222	1.305	1.421	-
2005	0.119	0.341	0.447	0.597	0.763	0.965	0.993	1.198	1.578	1.578	-	-
2006	0.100	0.311	0.415	0.557	0.761	0.917	1.066	1.186	1.263	1.225	1.599	-
2007	0.154	0.290	0.409	0.541	0.784	0.968	1.108	1.766	-	-	-	-
2008	0.047	0.302	0.415	0.533	0.675	0.882	1.130	-	-	-	-	-
2009	0.155	0.328	0.434	0.538	0.699	0.879	1.050	1.328	-	-	-	-
2010	0.175	0.323	0.432	0.519	0.661	0.777	0.997	1.176	-	-	-	-
2011	0.128	0.337	0.461	0.553	0.646	0.739	0.811	0.851	-	-	-	-
2012	0.185	0.338	0.452	0.555	0.671	0.792	0.935	0.798	-	-	-	-
2013	0.193	0.263	0.393	0.533	0.689	0.825	1.002	1.183	-	-	-	-
2014	0.171	0.292	0.417	0.541	0.679	0.799	0.883	0.814	0.864	-	-	-
2015	0.091	0.233	0.408	0.496	0.656	0.800	0.890	0.893	-	-	-	-
2016	0.025	0.186	0.418	0.507	0.611	0.650	0.862	0.952	-	-	-	-
2017	0.094	0.306	0.395	0.490	0.564	0.644	0.732	0.778	0.799	0.830	-	-
2018	0.154	0.202	0.388	0.425	0.594	0.667	0.767	0.771	1.088	-	-	-
2019	0.088	0.232	0.404	0.506	0.642	0.619	0.817	0.804	1.148	-	1.048	-
2020	-	-	-	-	-	-	-	-	-	-	-	-
2021	-	-	-	-	-	-	-	-	-	-	-	-

Table A3. DFO survey indices of abundance for Georges Bank Yellowtail Flounder in both numbers and kg per tow, along with the coefficient of variation (CV) for the biomass estimates. A dash (-) indicates no data available.

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6+	B(kg/tow)	CV(B)
1987	0.120	1.194	1.970	0.492	0.087	0.049	1.987	0.274
1988	0.000	1.776	1.275	0.610	0.278	0.024	1.964	0.217
1989	0.114	1.027	0.609	0.294	0.066	0.022	0.748	0.257
1990	0.000	2.387	3.628	0.914	0.209	0.014	2.405	0.222
1991	0.024	0.858	1.186	3.759	0.525	0.014	2.796	0.330
1992	0.055	11.039	3.677	0.990	0.350	0.030	3.937	0.163
1993	0.079	2.431	4.085	4.076	0.887	0.130	4.201	0.151
1994	0.000	6.056	3.464	3.006	0.781	0.207	4.378	0.228
1995	0.210	1.251	4.353	2.546	0.647	0.101	3.223	0.201
1996	0.446	7.142	9.174	5.406	1.155	0.123	8.433	0.223
1997	0.022	12.482	13.902	16.369	4.044	0.670	21.138	0.233
1998	0.893	3.330	4.907	4.334	1.988	0.558	6.826	0.244
1999	0.159	20.861	20.834	7.669	5.350	2.200	28.093	0.325
2000	0.011	13.765	27.442	19.243	5.069	3.689	31.723	0.253
2001	0.291	19.896	42.124	13.307	4.581	2.397	35.236	0.416
2002	0.088	11.962	31.015	12.234	5.553	2.833	32.916	0.305
2003	0.089	11.889	24.618	11.086	3.421	1.988	25.839	0.317
2004	0.033	3.599	16.260	9.205	2.273	1.416	14.397	0.313
2005	0.600	1.602	27.959	20.564	5.696	1.565	21.240	0.530
2006	0.623	4.893	18.600	6.572	0.820	0.238	10.462	0.444
2007	0.173	12.159	27.708	12.799	2.288	0.248	21.219	0.435
2008	0.000	48.315	170.363	57.119	8.059	0.055	107.052	0.939
2009	0.021	8.540	137.957	116.966	19.900	4.764	114.566	0.791
2010	0.000	0.489	9.392	20.943	3.533	1.279	14.532	0.294
2011	0.022	0.651	6.093	8.205	1.701	0.327	6.091	0.294
2012	0.044	0.644	8.243	11.423	3.096	0.453	8.937	0.356
2013	0.081	0.129	0.831	1.254	0.604	0.140	1.109	0.328
2014	0.030	0.395	0.741	0.960	0.471	0.018	0.816	0.337
2015	0.000	0.467	1.112	1.659	0.747	0.093	1.308	0.367
2016	0.000	0.218	3.151	2.104	1.257	0.657	2.748	0.608
2017	0.000	0.014	0.185	0.435	0.437	0.388	0.545	0.469
2018	0.000	0.006	0.263	0.194	0.315	0.223	0.401	0.378
2019	0.005	0.053	0.029	0.045	0.005	0.092	0.090	0.381
2020	0.000	0.453	0.266	0.059	0.025	0.065	0.199	0.333
2021	0	0.009	0.381	0.318	0.032	0.016	0.22	0.305
2022	-	-	-	-	-	-	-	-

Table A4. NMFS spring survey indices of abundance for Georges Bank Yellowtail Flounder in both numbers and kg per tow in *Albatross* units, along with the coefficient of variation (CV) for the biomass estimates. A dash (-) indicates no data available

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6+	B(kg/tow)	CV(B)
1968	0.335	3.176	3.580	0.304	0.073	0.310	2.791	0.214
1969	1.108	9.313	11.121	3.175	1.345	0.699	11.170	0.291
1970	0.093	4.485	6.030	2.422	0.570	0.311	5.146	0.146
1971	0.835	3.516	4.813	3.300	0.780	0.320	4.619	0.198
1972	0.141	6.923	7.050	3.705	1.127	0.239	6.455	0.214
1973	1.940	3.281	2.379	1.068	0.412	0.217	2.939	0.174
1974	0.317	2.234	1.850	1.262	0.347	0.282	2.720	0.186
1975	0.422	3.006	0.834	0.271	0.208	0.089	1.676	0.224
1976	1.112	4.315	1.253	0.312	0.197	0.112	2.273	0.162
1977	0.000	0.674	1.131	0.396	0.063	0.013	0.999	0.312
1978	0.940	0.802	0.510	0.220	0.027	0.008	0.742	0.197
1979	0.406	2.016	0.407	0.338	0.061	0.092	1.271	0.209
1980	0.057	4.666	5.787	0.475	0.057	0.036	4.456	0.350
1981	0.017	1.020	1.777	0.720	0.213	0.059	1.960	0.322
1982	0.045	3.767	1.130	1.022	0.458	0.091	2.500	0.190
1983	0.000	1.865	2.728	0.530	0.123	0.245	2.642	0.294
1984	0.000	0.093	0.831	0.863	0.896	0.183	1.646	0.428
1985	0.110	2.199	0.262	0.282	0.148	0.000	0.988	0.501
1986	0.027	1.806	0.291	0.056	0.137	0.055	0.847	0.298
1987	0.027	0.076	0.137	0.133	0.053	0.055	0.329	0.365
1988	0.078	0.275	0.366	0.242	0.199	0.027	0.566	0.257
1989	0.047	0.424	0.739	0.290	0.061	0.045	0.729	0.270
1990	0.000	0.110	1.063	0.369	0.163	0.057	0.699	0.312
1991	0.435	0.000	0.254	0.685	0.263	0.021	0.631	0.247
1992	0.000	2.048	1.897	0.641	0.165	0.017	1.566	0.470
1993	0.046	0.290	0.501	0.317	0.027	0.000	0.482	0.263
1994	0.000	0.621	0.633	0.354	0.145	0.040	0.660	0.223
1995	0.040	1.179	4.812	1.485	0.640	0.010	2.579	0.631
1996	0.025	0.987	2.626	2.701	0.610	0.058	2.853	0.320
1997	0.019	1.169	3.733	4.080	0.703	0.134	4.359	0.257
1998	0.000	2.081	1.053	1.157	0.760	0.350	2.324	0.234
1999	0.050	4.746	10.819	2.721	1.623	0.779	9.307	0.433

Table A4. Continued.

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6+	B(kg/tow)	CV(B)
2000	0.183	4.819	7.666	2.914	0.813	0.524	6.696	0.221
2001	0.000	2.315	6.563	2.411	0.484	0.453	5.006	0.329
2002	0.188	2.412	12.334	4.078	1.741	0.871	9.563	0.250
2003	0.202	4.370	6.764	2.876	0.442	0.862	6.722	0.405
2004	0.049	0.986	2.179	0.735	0.255	0.217	1.891	0.261
2005	0.000	2.013	5.080	2.404	0.270	0.115	3.407	0.325
2006	0.509	0.935	3.523	2.177	0.317	0.082	2.420	0.182
2007	0.090	5.048	6.263	2.846	0.556	0.129	4.701	0.217
2008	0.000	2.274	5.071	1.732	0.310	0.027	3.247	0.218
2009	0.211	0.600	7.446	4.653	1.002	0.191	4.856	0.223
2010	0.017	0.694	5.412	8.451	2.721	0.654	5.944	0.267
2011	0.031	0.243	3.331	3.735	0.964	0.108	2.561	0.226
2012	0.095	0.718	4.178	5.745	1.411	0.200	3.995	0.455
2013	0.048	0.376	1.006	1.401	0.657	0.124	1.104	0.218
2014	0.027	0.234	0.679	0.682	0.367	0.196	0.740	0.175
2015	0.000	0.183	0.513	0.420	0.368	0.049	0.507	0.189
2016	0.006	0.022	0.233	0.283	0.072	0.133	0.312	0.252
2017	0.012	0.095	0.070	0.109	0.180	0.177	0.244	0.212
2018	0.000	0.022	0.000	0.000	0.000	0.013	0.012	0.632
2019	0.171	0.062	0.086	0.060	0.038	0.372	0.323	0.516
2020	-	-	-	-	-	-	-	-
2021	0.005	0.00	0.732	0.424	0.079	0.085	0.425	0.375
2022	0.005	0.019	0.051	0.095	0.041	0.061	0.099	0.384

Table A5. NMFS fall survey indices of abundance for Georges Bank Yellowtail Flounder in both numbers and kg per tow in Albatross units, along with the coefficient of variation (CV) for the biomass estimates. A dash (-) indicates no data available

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6+	B(kg/tow)	CV(B)
1963	14.722	7.896	11.227	1.859	0.495	0.549	12.788	0.187
1964	1.722	9.806	7.312	5.967	2.714	0.488	13.567	0.378
1965	1.197	5.705	5.988	3.532	1.573	0.334	9.120	0.326
1966	11.663	2.251	1.685	0.898	0.101	0.000	3.928	0.335
1967	8.985	9.407	2.727	1.037	0.342	0.103	7.670	0.270
1968	11.671	12.057	5.758	0.745	0.965	0.058	10.536	0.229
1969	9.949	10.923	5.217	1.811	0.337	0.461	9.807	0.250
1970	4.610	5.132	3.144	1.952	0.452	0.080	4.979	0.287
1971	3.627	6.976	4.914	2.250	0.498	0.298	6.365	0.209
1972	2.462	6.525	4.824	2.094	0.610	0.342	6.328	0.273
1973	2.494	5.498	5.104	2.944	1.217	0.618	6.490	0.311
1974	4.623	2.864	1.516	1.060	0.458	0.379	3.669	0.179
1975	4.625	2.511	0.877	0.572	0.334	0.063	2.326	0.164
1976	0.344	1.920	0.474	0.117	0.122	0.100	1.508	0.233
1977	0.934	2.212	1.621	0.617	0.105	0.126	2.781	0.192
1978	4.760	1.281	0.780	0.411	0.136	0.036	2.343	0.204
1979	1.321	2.069	0.261	0.120	0.138	0.112	1.494	0.294
1980	0.766	5.120	6.091	0.682	0.219	0.258	6.607	0.210
1981	1.595	2.349	1.641	0.588	0.079	0.054	2.576	0.322
1982	2.425	2.184	1.590	0.423	0.089	0.000	2.270	0.290
1983	0.109	2.284	1.915	0.511	0.031	0.049	2.131	0.222
1984	0.661	0.400	0.306	0.243	0.075	0.063	0.593	0.305
1985	1.377	0.516	0.171	0.051	0.081	0.000	0.709	0.266
1986	0.282	1.108	0.349	0.074	0.000	0.000	0.820	0.371
1987	0.129	0.373	0.396	0.053	0.080	0.000	0.509	0.280
1988	0.019	0.213	0.107	0.027	0.000	0.000	0.171	0.325
1989	0.248	1.993	0.773	0.079	0.056	0.000	0.977	0.582
1990	0.000	0.370	1.473	0.294	0.000	0.000	0.725	0.323
1991	2.101	0.275	0.439	0.358	0.000	0.000	0.730	0.293
1992	0.151	0.396	0.712	0.162	0.144	0.027	0.576	0.287
1993	0.839	0.139	0.586	0.536	0.000	0.022	0.546	0.426
1994	1.195	0.221	0.983	0.713	0.263	0.057	0.897	0.311
1995	0.276	0.119	0.346	0.275	0.046	0.013	0.354	0.359
1996	0.149	0.352	1.869	0.447	0.075	0.000	1.303	0.570
1997	1.393	0.533	3.442	2.090	1.071	0.082	3.781	0.344
1998	1.900	4.817	4.202	1.190	0.298	0.074	4.347	0.347
1999	3.090	8.423	5.727	1.433	1.437	0.261	7.973	0.215



Table A5. Continued.

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6+	B(kg/tow)	CV(B)
2000	0.629	1.697	4.814	2.421	0.948	0.827	5.838	0.482
2001	3.518	6.268	8.092	2.601	1.718	2.048	11.553	0.381
2002	2.093	5.751	2.127	0.594	0.277	0.055	3.754	0.517
2003	1.077	5.031	2.809	0.565	0.100	0.191	4.038	0.316
2004	0.876	5.508	5.010	2.107	0.924	0.176	5.117	0.436
2005	0.313	2.095	3.763	0.614	0.185	0.000	2.463	0.492
2006	6.194	6.251	3.664	1.167	0.255	0.046	4.521	0.247
2007	1.058	11.447	7.866	1.998	0.383	0.094	8.151	0.309
2008	0.168	7.174	9.883	1.033	0.000	0.000	7.109	0.291
2009	0.477	4.382	12.202	2.219	0.631	0.064	6.744	0.269
2010	0.125	2.811	4.507	0.781	0.298	0.000	2.247	0.283
2011	0.237	2.865	3.897	1.106	0.145	0.010	2.452	0.264
2012	0.195	1.475	3.658	1.586	0.441	0.014	2.520	0.459
2013	0.332	1.028	0.940	0.537	0.116	0.044	0.875	0.369
2014	0.163	1.177	1.123	0.647	0.146	0.084	1.024	0.334
2015	0.031	0.394	0.589	0.303	0.069	0.020	0.469	0.619
2016	0.077	0.460	0.553	0.258	0.085	0.044	0.439	0.361
2017	0.047	0.105	0.142	0.172	0.042	0.097	0.196	0.355
2018	0.197	0.113	0.344	0.438	0.247	0.190	0.488	0.596
2019	0.491	0.067	0.056	0.084	0.020	0.308	0.303	0.267
2020	-	-	-	-	-	-	-	-
2021	0.009	0.036	0.368	0.161	0.01	0.041	0.009	0.036

Table A6. Catch for 2023 associated with the full range of exploitation rates from the 2014 Benchmark adjusting for the missing DFO survey and using the Miller et al. (2021) adjusted survey values.

Terminal Year	
Exploitation Rate	Catch (mt)
2%	24
3%	36
4%	48
5%	61
6%	73
7%	85
8%	97
9%	109
10%	121
11%	133
12%	145
13%	157
14%	169
15%	182
16%	194
16.5%	200

Table A7. Survey biomass from the three bottom trawl surveys, an arithmetic average of these biomasses, and quota associated with an exploitation rate of 6%. Quota is implemented in the following year (e.g., the row of 2021 catch would be implemented in 2022). Note these values use the previously accepted survey catchability of 0.31 for all three surveys and are shown for comparative purposes only.

Year	Biomass (mt)				Catch (mt)
	DFO	Spring	Fall (year-1)	Average	
2010	29,452	68,752	83,490	60,565	3,634
2011	12,344	29,621	27,821	23,262	1,396
2012	18,113	46,209	30,354	31,559	1,894
2013	2,249	12,766	31,199	15,404	924
2014	1,654	8,564	10,828	7,015	421
2015	2,650	5,861	12,682	7,064	424
2016	5,569	3,610	5,811	4,997	300
2017	1,104	2,819	5,432	3,118	187
2018	812	143	2,424	1,126	68
2019	182	3,735	6,047	3,322	199
2020	404	NA	3,749	2,077	125
2021	446	4,912	NA	2,679	161
2022	NA	1145	2507	1,826	110

Table A8. Recent quotas and catches by year and associated exploitation rates (computed by dividing by the average survey biomass in Table 2). (VPA = Virtual Population Analysis.) Note these values use the previously accepted survey catchability of 0.31 for all three surveys and are shown for comparative purposes only.

Year	Quota (mt)	Catch (mt)	Quota/Avg	Catch/Avg	Model Type
2010	1,956	1,170	3%	2%	VPA
2011	2,650	1,171	11%	5%	VPA
2012	1,150	725	4%	2%	VPA
2013	500	218	3%	1%	VPA
2014	400	159	6%	2%	VPA
2015	354	118	5%	2%	Empirical
2016	354	44	7%	1%	Empirical
2017	300	95	10%	3%	Empirical
2018	300	45	27%	4%	Empirical
2019	140	8	4%	0%	Empirical
2020	162	68	8%	2%	Empirical
2021	125	51	5%	2%	Empirical
2022	200		11%		Empirical
Mean	699	342	8% <sup>1</sup>	2%	

<sup>1</sup> The average Quota/Avg for years 2010–2017 is 6%.

Table A9. Comparison of average survey biomass (mt) between use of the Miller et al. (2021) adjusted values for the NMFS spring and fall surveys and the previous assumption that survey catchability( $q$ ) was 0.31 for all three surveys.

Year	Miller	q = 0.31	rel diff
2010	52,439	60,565	-13%
2011	21,120	23,262	-9%
2012	29,164	31,559	-8%
2013	12,823	15,404	-17%
2014	6,213	7,015	-11%
2015	6,309	7,064	-11%
2016	4,403	4,997	-12%
2017	2,757	3,118	-12%
2018	947	1,126	-16%
2019	2,562	3,322	-23%
2020	2,006	2,077	-3%
2021	2,625	2,679	-2%
2022	1,500	1,826	-18%
		<b>mean</b>	<b>-12%</b>

Table A10. The Management Table below was kindly initiated by Tom Nies (Northeast Fisheries Management Council). It summarizes the performance of the management system by reporting on the annual TRAC advice, the TMGC quota decision, actual catch, and realized stock conditions for Georges Bank Yellowtail Flounder. VPA=Virtual Population Analysis; SPM=Surplus Production Model.

TRAC	Catch Year	TRAC Analysis/Recommendation		TMGC Decision		Actual Catch <sup>(2)</sup> /Compared to Risk Analysis	Actual Result <sup>(3)</sup>
		Amount	Rationale	Amount	Rationale		
1999 <sup>4</sup>	1999	(1) 4,383 mt (2) 6,836 mt	Neutral risk of exceeding Fref (1)VPA (2)SPM	NA	NA	4,963 mt/ 50% risk of exceeding Fref (VPA)	
2000	2000	7,800 mt	Neutral risk of exceeding Fref	NA	NA	7,341 mt/About 30% risk of exceeding Fref	
2001	2001	9,200 mt	Neutral risk of exceeding Fref	NA	NA	7,419 mt/Less than 10% risk of exceeding Fref	
2002	2002	10,300 mt	Neutral risk of exceeding Fref	NA	NA	5,663 mt/Less than 1% risk of exceeding Fref	
<i>Transition to TMGC process in following year; note catch year differs from TRAC year in following lines</i>							
2003	2004		No confidence in projections; status quo catch may be appropriate	7,900 mt	Neutral risk of exceeding Fref, biomass stable; recent catches between 6,100–7,800 mt	6,815 mt	<i>F above 1.0</i>  Now NA
2004	2005	4,000 mt	Deterministic; other models give higher catch but less than 2004 quota	6,000 mt	Moving towards Fref	3,852 mt	<i>F = 1.37</i> <i>Age 3+ biomass decreased 5% 05–06</i>  Now NA

<sup>2</sup> All catches are calendar-year catches

<sup>3</sup> Values in italics are assessment results in year immediately following the catch year; values in normal font are results from this assessment

<sup>4</sup> Prior to implementation of US/CAN Understanding

TRAC	Catch Year	TRAC Analysis/Recommendation		TMGC Decision		Actual Catch <sup>(2)</sup> /Compared to Risk Analysis	Actual Result <sup>(3)</sup>
		Amount	Rationale	Amount	Rationale		
2005	2006	(1) 4,200 (2) 2,100  (3) 3,000–3,500 mt	Neutral risk of exceeding F ref (1-base case; 2 – major change) (3) Low risk of not achieving 20% biomass increase	3,000 mt	Base case TAC adjusted for retrospective pattern, result is similar to major change TAC (projections redone at TMGC)	2,057 mt/ (1) Less than 10% risk of exceeding Fref (2) Neutral risk of exceeding Fref	<i>F = 0.89</i> <i>Age 3+ biomass increased 41% 06–07</i>  Now NA
2006	2007	1,250 mt	Neutral risk of exceeding Fref; 66% increase in SSB from 2007 to 2008	1,250 mt (revised after USA objections to a 1,500 mt TAC)	Neutral risk of exceeding Fref	1,664 mt About 75 percent probability of exceeding Fref	<i>F = 0.29</i> <i>Age 3+ biomass increased 211% 07–08</i>  Now NA
2007	2008	3,500 mt	Neutral risk of exceeding Fref; 16% increase in age 3+ biomass from 2008 to 2009	2,500 mt	Expect F=0.17, less than neutral risk of exceeding Fref	1,499 mt No risk plot; expected less than median risk of exceeding Fref	<i>F~0.09</i> <i>Age 3+ biomass increased between 35%–52%</i>  Now NA
2008	2009	(1) 4,600 mt  2) 2,100 mt	(1) Neutral risk of exceeding Fref; 9% increase from 2009–2010 (2) U.S. rebuilding plan	2,100 mt	U.S. rebuilding requirements; expect F=0.11; no risk of exceeding Fref	1,806 mt No risk of exceeding Fref	<i>F=0.15</i> <i>Age 3+ biomass increased 11%</i>  Now NA

TRAC	Catch Year	TRAC Analysis/Recommendation		TMGC Decision		Actual Catch <sup>(2)</sup> /Compared to Risk Analysis	Actual Result <sup>(3)</sup>
		Amount	Rationale	Amount	Rationale		
2009	2010	(1) 5,000–7,000 mt  (2) 450–2,600 mt	(1) Neutral risk of exceeding Fref under two model formulations (2) U.S. rebuilding requirements	No agreement. Individual TACs total 1,975 mt	No agreement	1,170 mt No risk of exceeding Fref About 15% increase in median biomass expected	<i>F=0.13</i> <i>3+ Biomass increased 6% 10–11</i>  Now Avg survey B decreased 62% 10–11
2010	2011	(1) 3,400 mt	(1) Neutral risk of exceeding Fref; no change in age 3+ biomass	2,650 mt	Low probability of exceeding Fref; expected 5% increase in biomass from 11 to 12	1,171 mt No risk of exceeding Fref About 15% increase in biomass expected	<i>F=0.31</i> <i>Age 3+ biomass decreased 5% 11–12</i>  Now Avg survey B increased 35% 11–12
2011	2012	(1) 900–1,400 mt	(1) trade-off between risk of overfishing and change in biomass from three projections	1,150 mt	Low probability of exceeding Fref; expected increase in biomass from 12 to 13	725 mt	<i>F=0.32</i> <i>Age 3+ biomass decreased 6% 12–13</i>  Now Avg survey B decreased 50% 12–13
2012	2013	(1) 200–500 mt	(1) trade-off between risk of overfishing and change in biomass from five projections	500 mt	Trade-off risk of $F > F_{ref}$ and biomass increase among 5 sensitivity analyses	218 mt	<i>F=0.32 (0.78 rho adjusted)</i>  Now Avg survey B decreased 55% 13–14
2013	2014	(1) 200 mt (2) 500 mt	(1) $F < F_{ref}$ (2) B increase	400 mt	Reduction from 2013 quota, allow rebuilding	159 mt	Now Avg survey B increased 0% 14–15

TRAC	Catch Year	TRAC Analysis/Recommendation		TMGC Decision		Actual Catch <sup>(2)</sup> /Compared to Risk Analysis	Actual Result <sup>(3)</sup>
		Amount	Rationale	Amount	Rationale		
2014	2015	(1) 45–354 mt (2) 400 mt	(1) constant exploitation rate 2%–16% (2) constant quota	354 mt	One year quota at 16% exploitation rate, reduction from 2014 quota	118 mt	Now Avg survey B decreased 31% 15–16
2015	2016	(1) 45–359 mt (2) 354 mt	(1) constant exploitation rate 2%–16% (2) constant quota	354 mt	Constant quota (and essentially no change in surveys)	44 mt	Now Avg survey B decreased 36% 16–17
2016	2017	31–245 mt	Constant exploitation rate 2%–16%	300 mt	Decline in surveys and low inter-annual changes in quota	95 mt	Now Avg survey B decreased 64% 17–18
2017	2018	62–187 mt	Constant exploitation rate 2%–6%	300 mt	Balance Yellowtail Flounder stock conditions and the utilization of other species	45 mt	Now Avg survey B increased 195% 18–19
2018	2019	68 mt	Exploitation rate 6%	140 mt	Balance Yellowtail Flounder stock conditions and the utilization of other species	8 mt	Now Avg survey B decreased 37% 19–20 (note 2020 survey B based on only two surveys due to Covid-19)
2019	2020	199 mt	Exploitation rate 6%	162 mt	Balance Yellowtail Flounder stock conditions and the utilization of other species	63 mt	Now Avg survey B increased 29% 20–21 (note 2021 survey B based on only two surveys due to Covid-19)



TRAC	Catch Year	TRAC Analysis/Recommendation		TMGC Decision		Actual Catch <sup>(2)</sup> /Compared to Risk Analysis	Actual Result <sup>(3)</sup>
		Amount	Rationale	Amount	Rationale		
2020	2021	125 mt	Exploitation rate 7%	125 mt	Balance Yellowtail Flounder stock conditions and the utilization of other species	51 mt	Now Avg survey B decreased 43% 21–22 (note 2022 survey B based on only two surveys due to new survey vessel)
2021	2022	200 mt					