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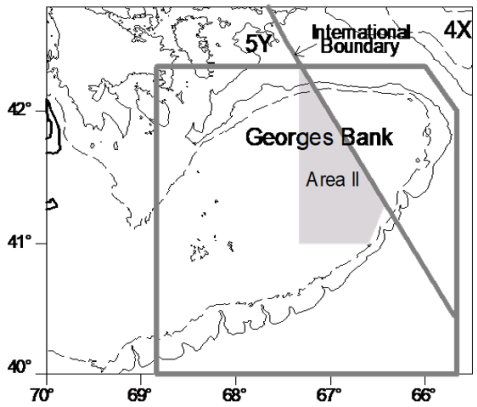
NOAA FISHERIES NATIONAL MARINE FISHERIES SERVICE

Transboundary Resources Assessment Committee

Status Report 2021/03

GEORGES BANK YELLOWTAIL FLOUNDER

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



Summary

- Combined Canada and USA catches in 2020 were 14 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.
- Miller et al. (2021) presented a new method to estimate National Marine Fisheries Service (NMFS) spring and fall expanded survey biomass accounting for catchability at length and day/night effects. These NMFS spring and fall expanded survey values were lower than previously used values, requiring a modification of the historical exploitation rate from 6% to 7%.
- Application of the Empirical Approach with new Miller et al. (2021) data and an exploitation rate of 7% results in catch advice of 184 mt for 2022. Adjusting for the missing NMFS fall survey results in catch advice of 243 mt for 2022. The Empirical Approach was not recommended by TRAC.
- The TRAC recommends changing the approach for setting the catch advice from the Empirical Approach to constant catch advice. The constant catch advice would remain until the average survey biomass fell outside the limits set by the Transboundary Management Guidance Committee (TMGC).
- The TRAC recommends setting the constant catch advice at 200 mt as long as the average survey biomass remains between the bounds selected by TMGC. The TRAC recommends the lower limit survey biomass of 1,000 mt and a range between 7,300–8,500 mt for the upper survey biomass limit. The average survey biomass for 2021 was 2,625 mt, which is between the limits. The average survey biomass for 2021 adjusted for the missing NMFS fall survey was 3,471 mt. Thus, the constant catch advice of 200 mt is recommended.

- There was no 2020 NMFS spring or fall survey due to the COVID-19 pandemic. 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.

Fishery

Total catches of Georges Bank Yellowtail Flounder peaked at about 21,000 mt in both 1969 and 1970 (Figure A1). The combined Canada/USA catch increased from 1995 through 2001, averaged 6,300 mt during 2002–2004, but declined to 14 mt in 2020 (Table 1) due in part to restrictive management measures.

The 2020 **Canadian catch** of 6 mt was 15% of the 42 mt quota, with landings of < 1 mt and estimated discards of 6 mt from the sea scallop dredge fishery.

USA catches in calendar year 2020 were 8 mt, with landings of 5 mt and discards of 2 mt. The USA landings in calendar year 2020 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 2020 were 6% of the 120 mt quota.

Table 1. Catches (mt)

		2017	2018	2019	2020	2021	Avg[1]	Min[1]	Max[1]
Canada[2]	**Quota**	93	87	34	42	45			
	Landed	< 1	< 1	< 1	< 1		397	1	2,913
	Discard	2	3	4	6		393	2	815
USA[2]	**Quota[3]**	207	213	106	120	80			
	Catch[3]	84	40	5	8[4]				
	Landed	35	32	3	5[4]		3,556	3	15,899
	Discard	57	11	2	2[4]		487	2	3,021
Total[2]	**Quota[5]**	300	300	140	162	125			
	Catch[5]	87	42	9	14[4]				
	Catch[6]	95	45	8	14[4]		4,869	8	17,211

[1] 1973 – 2020
[2] unless otherwise noted, all values reported are for calendar year
[3] for fishing year May 1 – April 30
[4] preliminary estimate
[5] for Canadian calendar year and USA fishing year May 1 – April 30
[6] sum of Canadian landed, Canadian discard, and USA catch (includes discards)

Harvest Strategy and Reference Points

The 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. Due to the lack of an assessment model, an estimate of fishing mortality rate can no longer be calculated. Status determination relative to reference points is not possible because reference points have not been defined.

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 A2) but catch curve analyses (Sinclair Z) indicate

conflicting information with one survey high Z but declining and the other survey low Z but increasing (Figure A3). 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 A4) 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 regarding the Empirical Approach and a Limiter Approach. 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. Both the Empirical and Limiter approaches rely on average estimates of biomass from the Fisheries and Oceans Canada (DFO) survey, NMFS spring, and NMFS fall surveys (Figure A5). 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 2020, the NMFS spring and fall surveys on Georges Bank were not conducted due to the Covid-19 restrictions. Catch advice for 2022 from both approaches was computed using only the 2021 DFO and 2021 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 are positive signals: the relative F continues to be low; both available surveys increased; and survey total mortality decreased to low values in one of the available surveys. The negative signals are: the two available surveys were the third (DFO) and sixth (NMFS spring) 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.

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. These NMFS spring and fall expanded survey values were lower than previously used values that had used survey catchability of 0.31 for all three surveys. The values presented in the Tables 2 and 3 reflect these new estimates, but maintain the survey catchability of 0.31 for the DFO survey. The previous approach values are shown in the Appendix for comparison. Importantly, the change of survey values required a modification of the historical exploitation rate from 6% to 7%. This exploitation rate is based on the 2010–2017 period using quota divided by the average survey biomass to measure the exploitation rate. The TRAC considered the possibility of changing the exploitation rate to reflect an average of all available years and to use catch instead of quota in the calculation of exploitation rate. The TRAC chose to continue in the manner used previously.

During 2010 to 2020, 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. This year, 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 32% increase in average survey biomass and catch advice. The TRAC presents both the adjusted and non-adjusted values for comparison purposes to account for the missing 2020 NMFS fall survey.

Application of the Empirical Approach with new Miller et al. (2021) data and an exploitation rate of 7% results in catch advice of 184 mt for 2022. Adjusting for the missing NMFS fall survey results in catch advice of 243 mt for 2022. 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 1.32 which is derived from 1/(1 - 0.24).

The TMGC held an intersessional meeting on April 22, 2021, to discuss an alternative approach to management for this stock. Specifically, catch advice would be constant as long as the average survey biomass fell within a specified range. A sub-group of the TMGC met on May 13, 2021, and provided multiple options for the constant catch advice and average survey biomass limits. A final decision regarding whether to use this approach for 2022 catch advice was not made prior to the TRAC meeting. The 2021 average survey biomass, both unadjusted and adjusted for the missing 2020 NMFS fall survey, was shown to be within all of the proposed limits. The TRAC recommends changing the approach for setting the catch advice from the Empirical Approach to constant catch advice. The constant catch advice would remain until the average survey biomass fell outside the limits set by the TMGC.

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 online.

For the TMGC's consideration, the TRAC recommends setting the constant catch advice at 200 mt as long as the average survey biomass remains between the limits selected by TMGC. The TMGC used the time series of 2014–2020 and the uncertainty associated with the average survey biomass to determine the limits based on 75% or 90% probabilities. The lower survey biomass limit recommended by TRAC of 1,000 mt reflects the desire to avoid the potential for increased exploitation rates if the average survey biomass falls below the time series low of 947 mt in 2018. The upper survey biomass limit recommended by TRAC, a range between 7,300–8,500 mt, relied on the TMGC proposal using the Limiter Approach, adjusting for the use of Miller et al. (2021) survey values. The average survey biomass for 2021 was 2,625 mt, which is between the limits. The average survey biomass for 2021 adjusted for the missing NMFS fall survey was 3,471 mt. Thus, the constant catch advice of 200 mt is recommended. The TRAC notes that other options for setting the limits and constant catch advice are possible. Discussions during the TRAC noted that an exploitation rate of 27.5% corresponds to the Empirical Benchmark new estimate of natural mortality of 0.4 and setting fishing mortality equal to natural mortality. The TRAC recommends that if the point estimate of the average survey

biomass falls outside the limits that the catch advice reverts to the Empirical Approach with application of a 7% exploitation rate immediately.

Table 2. Survey biomass from the three bottom trawl surveys, an arithmetic average of these biomasses, and catch advice for an exploitation rate of 7%. Catch advice is implemented in the following year (e.g., the row of 2021 catch advice would be implemented in 2022).

	Biomass (mt)				
Year	**DFO**	**Spring**	**Fall (year-1)**	**Average**	**Catch Advice (mt)**
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

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	14	8%	1%	Empirical
2021	125		5%		Empirical
Mean	699	342	9%[1]	2%	

[1] The average Quota/Avg for years 2010–2017 is 7%.

Special Considerations

- The US commercial fishery data processing system is undergoing a change. The new system is called the Catch Accounting and Monitoring System (CAMS). Due to delays in implementation, the 2020 US commercial fishery data could not be processed in time for this meeting. The data presented in this report was kindly provided by Dan Caless (NMFS, Greater Atlantic Regional Fisheries Office). Since the age composition of the Canadian fishery catch relies on the US ages, it was also not available for this meeting. The full 2020 fishery catch data should be available at next year's meeting.
- Results from the most recent surveys are considered valid for use in the empirical approach despite the lack of a NMFS fall 2020 survey due to Covid-19 restrictions.
- The new values from Miller et al. (2021) for the NMFS spring and fall expanded survey biomass are considered a scientific advancement over previous approaches. The TRAC recognizes the cooperative research guided by the Northeast Trawl Advisory Panel that led to these new estimates. The use of the new approach in the future may require some new workflows to ensure the information is available for TRAC meetings.
- Results from three US scallop research set aside funded surveys were presented this year. While none of them can be used directly in the Empirical or Limiter approaches due to limited spatial coverage, all three surveys confirmed the strong downward trend and current low abundance of Yellowtail Flounder on Georges Bank.
- While the NMFS surveys were adjusted for catchability based on the Miller et al. (2021) analysis, 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/XX. (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.

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.

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.

Correct Citation

TRAC. 2021. Georges Bank Yellowtail Flounder. TRAC Status Report 2021/XX.

APPENDIX – FIGURES AND TABLES

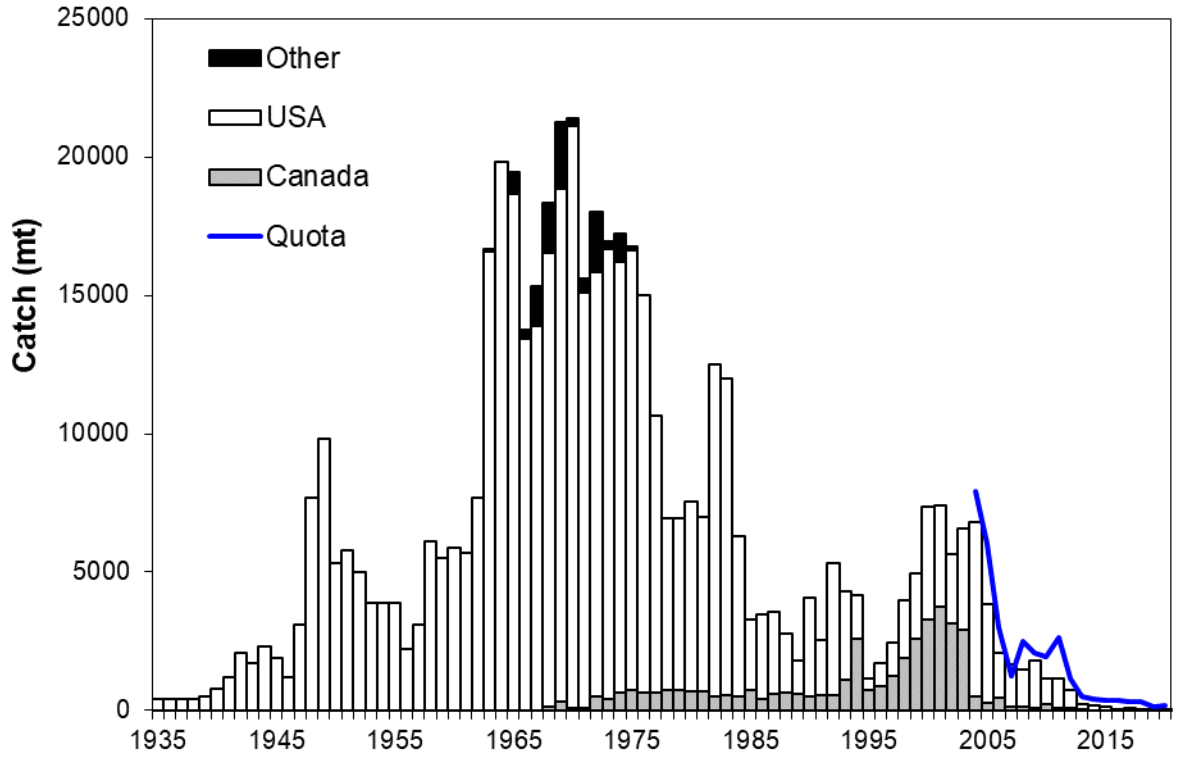


Figure A1. Catches and quota for Georges Bank Yellowtail Flounder.

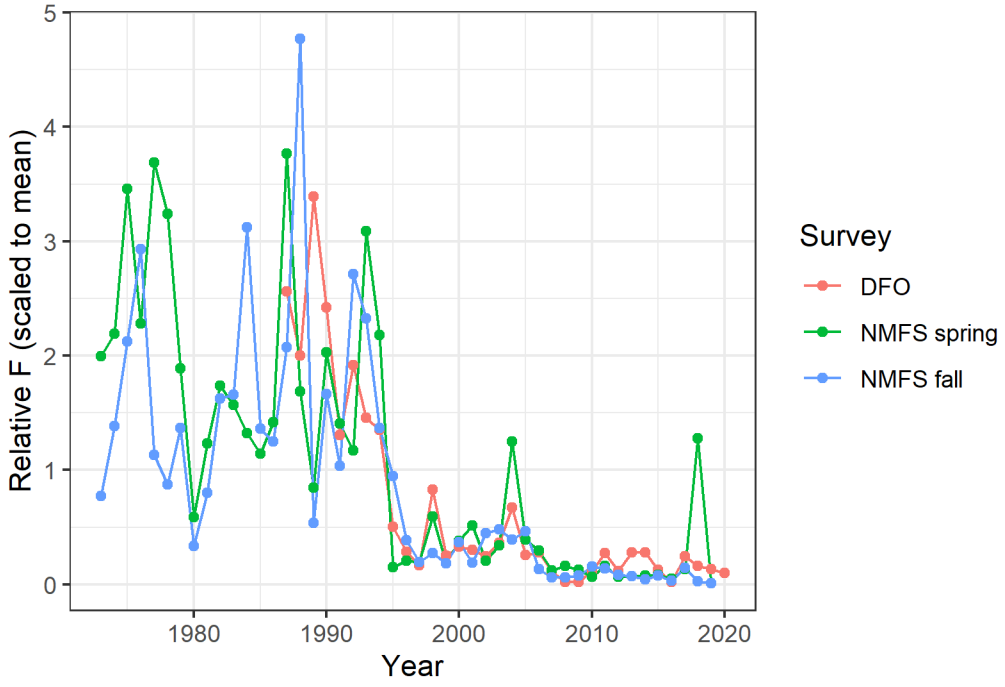


Figure A2. Relative F (catch in mt divided by survey catch in kg per tow) scaled to the mean value during 1987–2007 for the three surveys. Please see note in State of the Resource about recent low survey catches. Note the 2020 NMFS spring and fall surveys were not conducted due to Covid-19 restrictions.

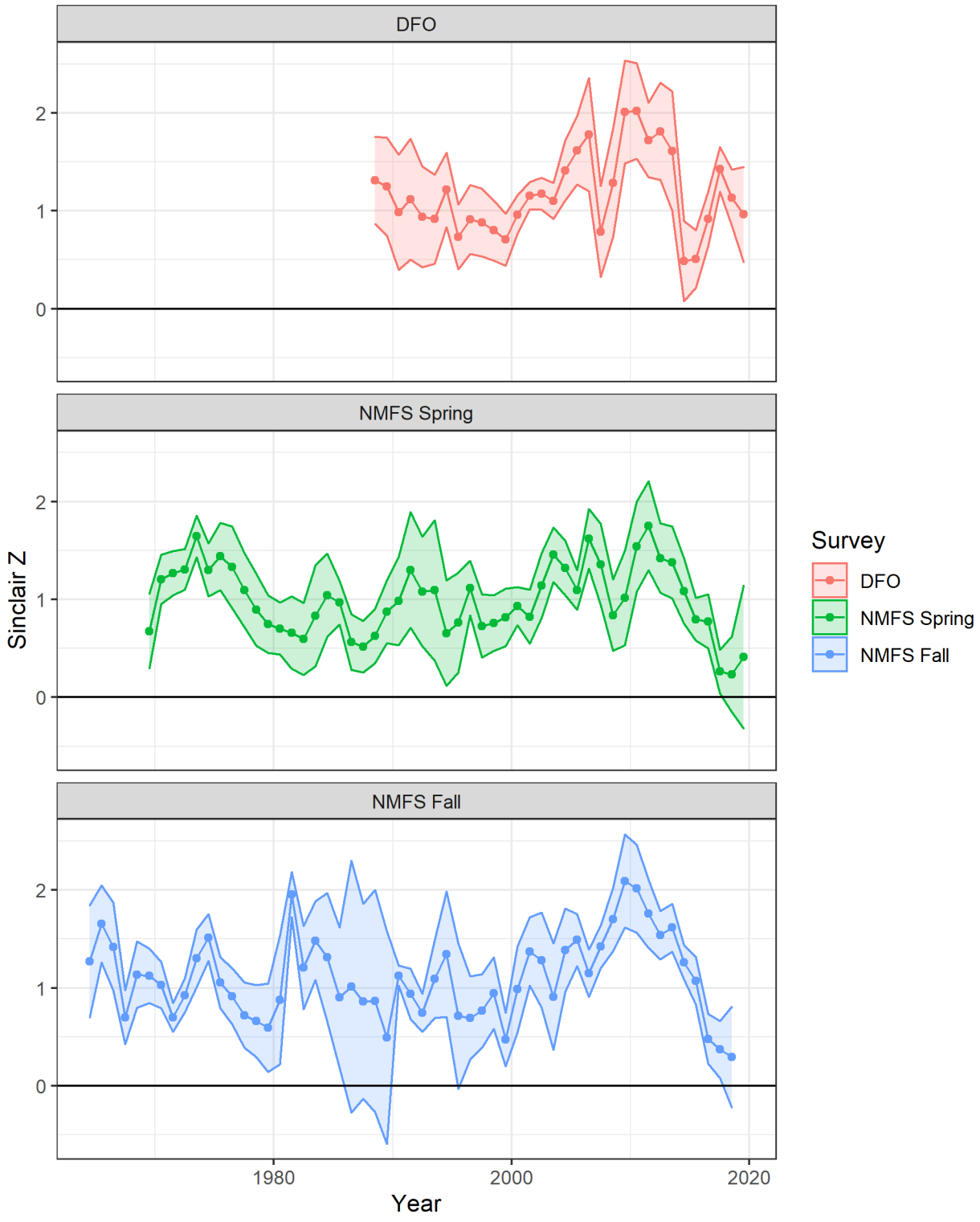


Figure A3. Total mortality (Z) from the three surveys using the Sinclair method with a four-year moving window for ages 3 to 8. Please see note in State of the Resource about recent survey catches.

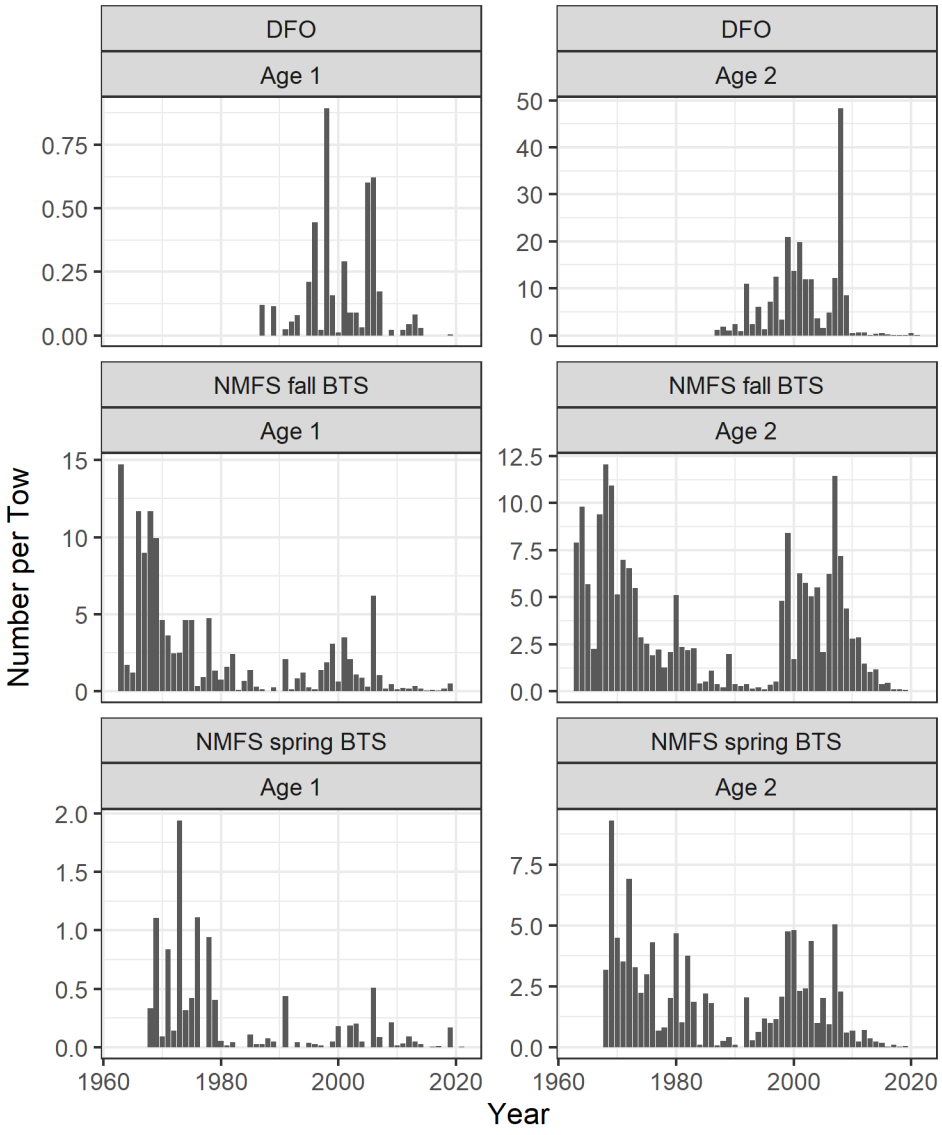


Figure A4. Estimates of recruitment (age 1 has many zeros, so age 2 also shown) from the three bottom trawl surveys. Note the 2020 NMFS spring and fall surveys were not conducted due to Covid-19 restrictions.

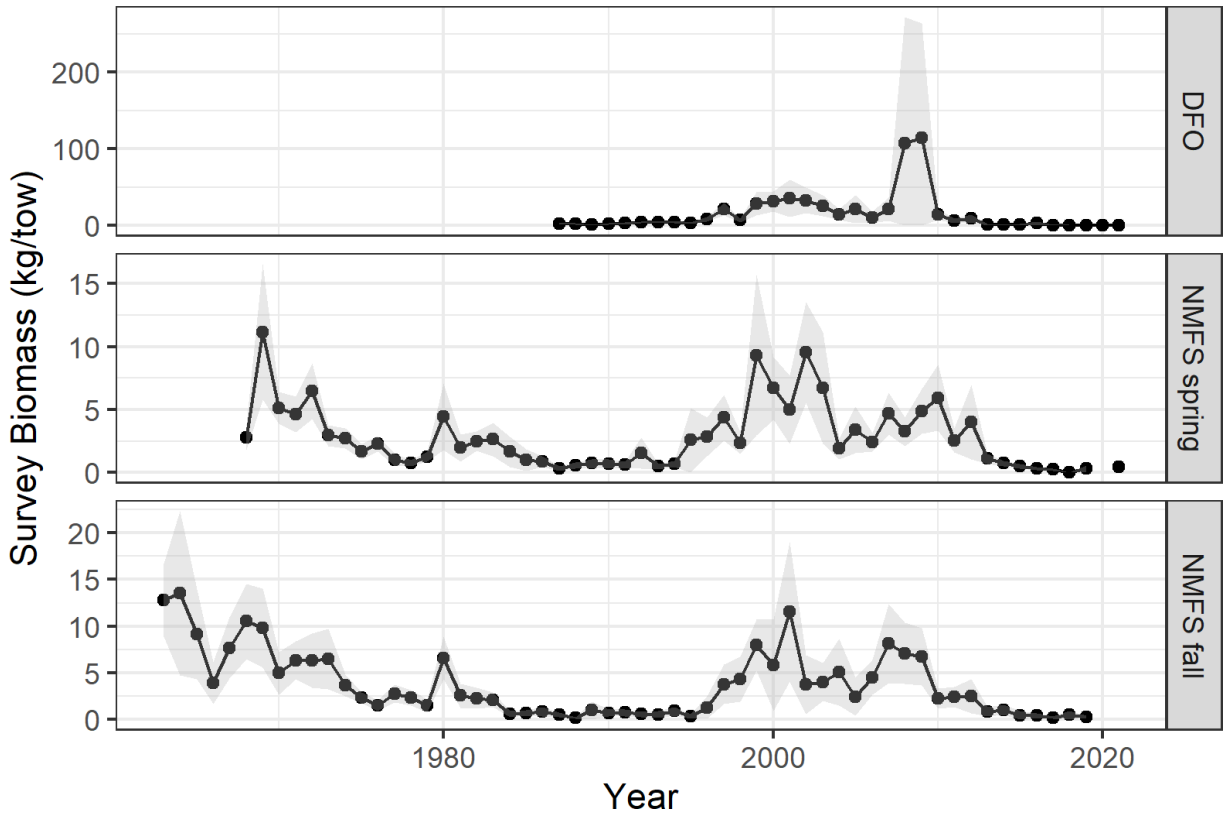


Figure A5. Bottom trawl survey catch rates (in biomass) for Georges Bank Yellowtail Flounder (filled circles) with 90% confidence intervals (gray area). Note that the amount of Georges Bank area covered in the DFO and NMFS surveys differs and that the NMFS surveys have been standardized to Albatross units. Note the 2020 NMFS spring and fall surveys were not conducted due to Covid-19 restrictions.

Table A1. Annual catch and quota (mt) of Georges Bank Yellowtail Flounder.

Year	US Landings	US Discards	Canada Landings	Canada Discards	Other Landings	Total Catch	US 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	1200			
1942	1575	525	0	0	0	2100			
1943	1275	425	0	0	0	1700			
1944	1725	575	0	0	0	2300			
1945	1425	475	0	0	0	1900			
1946	900	300	0	0	0	1200			
1947	2325	775	0	0	0	3100			
1948	5775	1925	0	0	0	7700			
1949	7350	2450	0	0	0	9800			
1950	3975	1325	0	0	0	5300			
1951	4350	1450	0	0	0	5800			
1952	3750	1250	0	0	0	5000			
1953	2925	975	0	0	0	3900			
1954	2925	975	0	0	0	3900			
1955	2925	975	0	0	0	3900			
1956	1650	550	0	0	0	2200			
1957	2325	775	0	0	0	3100			
1958	4575	1525	0	0	0	6100			
1959	4125	1375	0	0	0	5500			
1960	4425	1475	0	0	0	5900			
1961	4275	1425	0	0	0	5700			
1962	5775	1925	0	0	0	7700			
1963	10990	5600	0	0	100	16690			
1964	14914	4900	0	0	0	19814			
1965	14248	4400	0	0	800	19448			
1966	11341	2100	0	0	300	13741			
1967	8407	5500	0	0	1400	15307			
1968	12799	3600	122	0	1800	18321			
1969	15944	2600	327	0	2400	21271			
1970	15506	5533	71	0	300	21410			
1971	11878	3127	105	0	500	15610			
1972	14157	1159	8	515	2200	18039			
1973	15899	364	12	378	300	16953			
1974	14607	980	5	619	1000	17211			
1975	13205	2715	8	722	100	16750			
1976	11336	3021	12	619	0	14988			
1977	9444	567	44	584	0	10639			
1978	4519	1669	69	687	0	6944			

Table A1. Continued.

Year	US Landings	US Discards	Canada Landings	Canada Discards	Other Landings	Total Catch	US Quota	Canada Quota	Total Quota
1979	5475	720	19	722	0	6935			
1980	6481	382	92	584	0	7539			
1981	6182	95	15	687	0	6979			
1982	10621	1376	22	502	0	12520			
1983	11350	72	106	460	0	11989			
1984	5763	28	8	481	0	6280			
1985	2477	43	25	722	0	3267			
1986	3041	19	57	357	0	3474			
1987	2742	233	69	536	0	3580			
1988	1866	252	56	584	0	2759			
1989	1134	73	40	536	0	1783			
1990	2751	818	25	495	0	4089			
1991	1784	246	81	454	0	2564			
1992	2859	1873	65	502	0	5299			
1993	2089	1089	682	440	0	4300			
1994	1431	148	2139	440	0	4158			
1995	360	43	464	268	0	1135			
1996	743	96	472	388	0	1700			
1997	888	327	810	438	0	2464			
1998	1619	482	1175	708	0	3985			
1999	1818	577	1971	597	0	4963			
2000	3373	694	2859	415	0	7341			
2001	3613	78	2913	815	0	7419			
2002	2476	53	2642	493	0	5663			
2003	3236	410	2107	809	0	6562			
2004	5837	460	96	422	0	6815	6000	1900	7900
2005	3161	414	30	247	0	3852	4260	1740	6000
2006	1196	384	25	452	0	2057	2070	930	3000
2007	1058	493	17	97	0	1664	900	350	1250
2008	937	409	41	112	0	1499	1950	550	2500
2009	959	759	5	84	0	1806	1617	483	2100
2010	654	289	17	210	0	1170	1200	756	1956
2011	904	192	22	53	0	1171	1458	1192	2650
2012	443	188	46	48	0	725	564	586	1150
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	2	<1	6	0	14	120	42	162

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

	Age											
Year	**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	-	-	-	-	-	-	-	-	-	-	-	-

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.

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	0.000	0.009	0.381	0.318	0.032	0.016	0.220	0.305

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 CV for the biomass estimates.

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	NA	NA	NA	NA	NA	NA	NA	NA
2021	0.005	0.000	0.732	0.424	0.079	0.085	0.425	0.375

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 CV for the biomass estimates.

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	NA	NA	NA	NA	NA	NA	NA	NA

Table A6. Catch advice for 2022 associated with the full range of exploitation rates from the 2014 Benchmark using the Miller et al. (2021) survey values.

Exploitation Rate	Catch Advice (mt)
2%	53
3%	79
4%	105
5%	131
6%	158
7%	184
8%	210
9%	236
10%	263
11%	289
12%	315
13%	341
14%	368
15%	394
16%	420

Table A7. Survey biomass from the three bottom trawl surveys, an arithmetic average of these biomasses, and catch advice for an exploitation rate of 6%. Catch advice is implemented in the following year (e.g., the row of 2021 catch advice 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.

	Biomass (mt)				
Year	DFO	Spring	Fall (year-1)	Average	Catch Advice (mt)
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

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	14	8%	1%	Empirical
2021	125		5%		Empirical
Mean	699	342	8%[1]	2%	

[1] The average Quota/Avg for years 2010–2017 is 6%.

Table A9. Comparison of average survey biomass between use of the Miller et al. (2021) 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	52439	60565	-13%
2011	21120	23262	-9%
2012	29164	31559	-8%
2013	12823	15404	-17%
2014	6213	7015	-11%
2015	6309	7064	-11%
2016	4403	4997	-12%
2017	2757	3118	-12%
2018	947	1126	-16%
2019	2562	3322	-23%
2020	2006	2077	-3%
2021	2625	2679	-2%
		mean	-11%

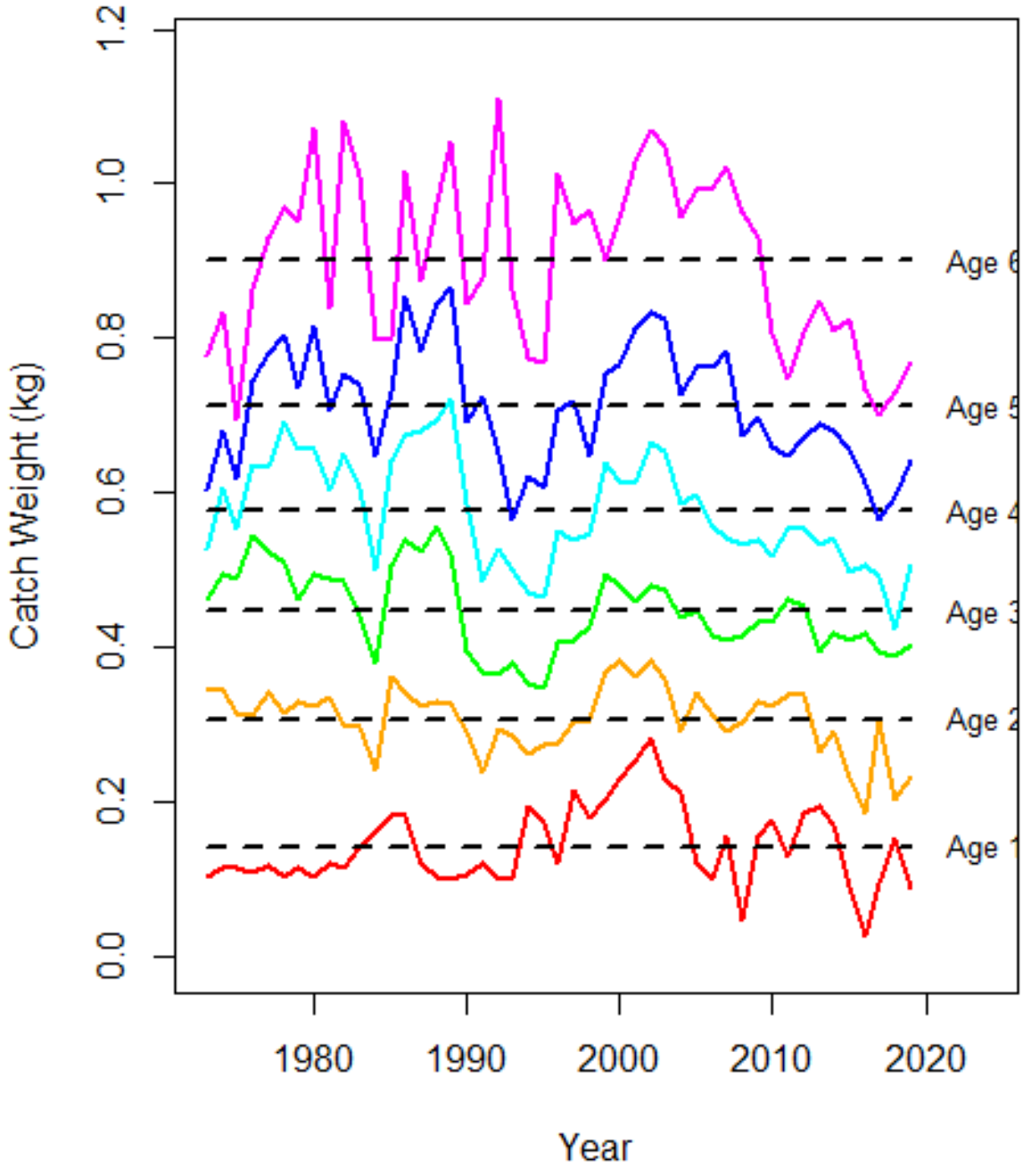


Figure A1. Trends in mean weight at age from the Georges Bank Yellowtail Flounder fishery (Canada and US combined, including discards). Dashed lines denote average of time series. Note 2020 data not available for this meeting (see Special Considerations).

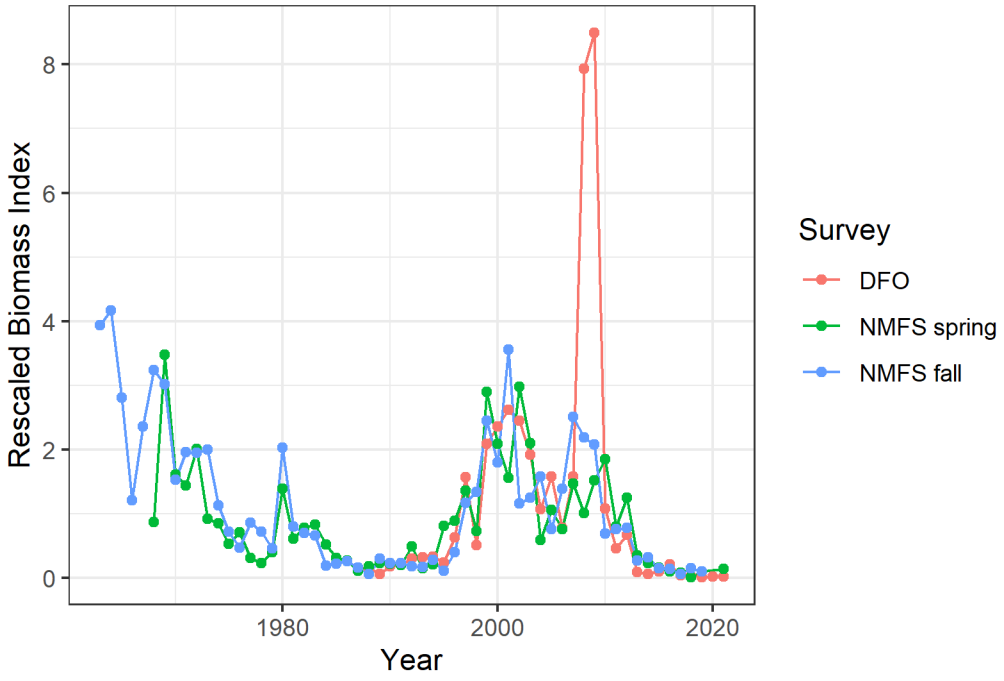


Figure A2. Three survey biomass indices (DFO, NMFS spring, and NMFS fall) for Yellowtail Flounder on Georges Bank rescaled to their respective means for years 1987–2007. Note the 2020 NMFS spring and fall surveys were not conducted due to Covid-19.

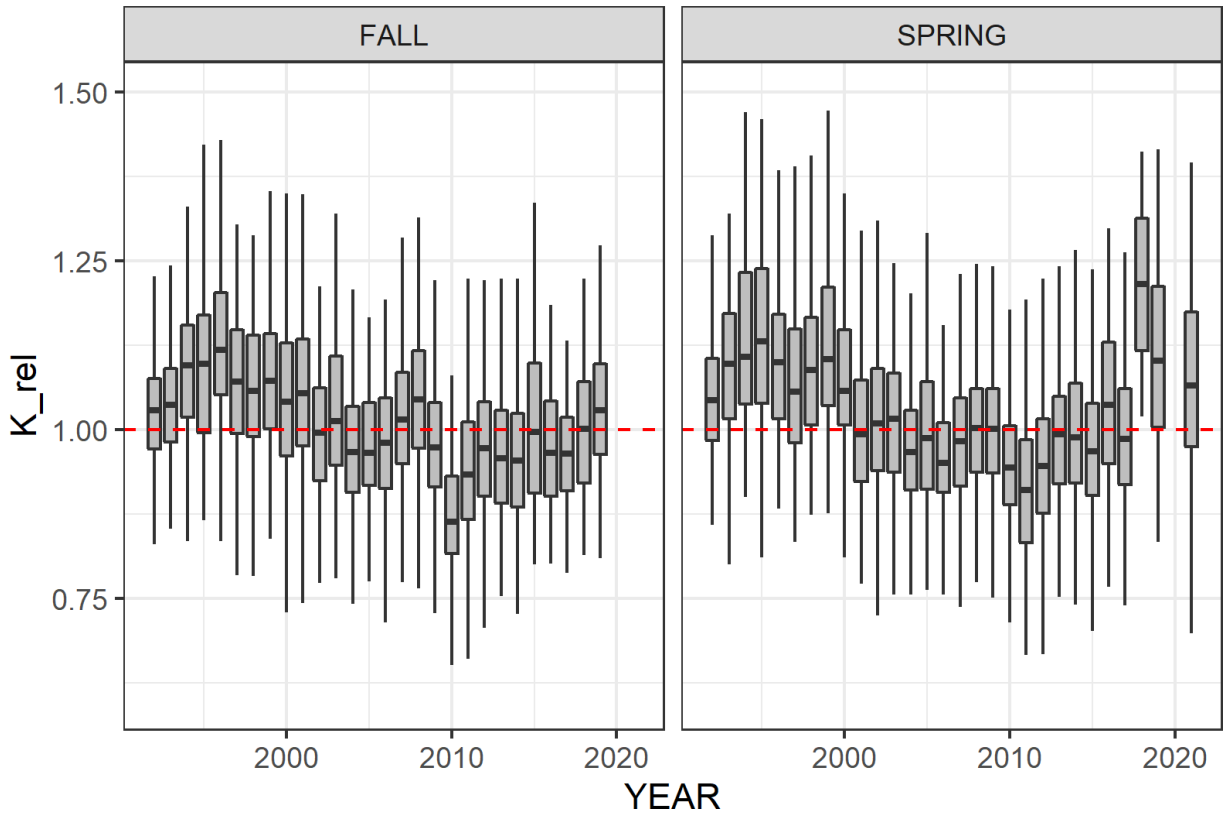


Figure A3. Condition factor (Fulton's K) of Georges Bank Yellowtail Flounder from the NMFS fall and spring surveys. Note the 2020 NMFS spring and fall surveys were not conducted due to Covid-19.

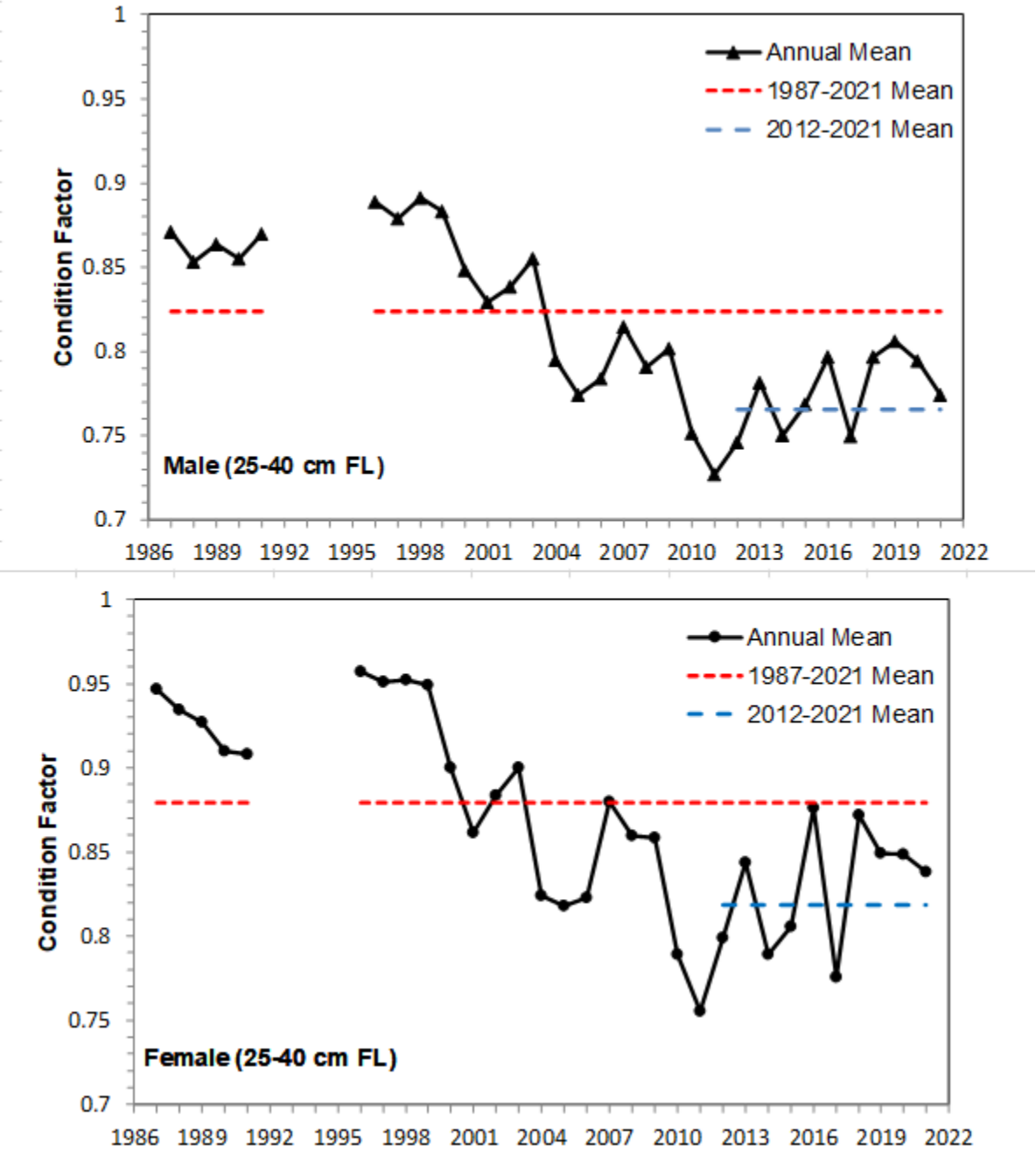


Figure A4. Condition factor (Fulton's K) for male and female Yellowtail Flounder in the DFO survey.

Figure A5. Scenario analyses where one of the three surveys was removed from the calculation of catch advice 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

Table A7. The Management Table below was kindly initiated by Tom Nies (NEFMC). It summarizes the performance of the management system. It reports the TRAC advice, 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[1]/Compared to Risk Analysis	Actual Result[2]
		Amount	**Rationale**	**Amount**	**Rationale**		
1999[3]	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	
Transition to TMGC process in following year; note catch year differs from TRAC year in following lines							
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	*F above 1.0* 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	*F = 1.37* *Age 3+ biomass decreased 5% 05–06* Now NA
2005	2006	(1) 4,200 (2) 2,100 (3) 3,000–3,500	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	*F = 0.89* *Age 3+ biomass increased 41% 06–07* Now NA

[1] All catches are calendar-year catches

[2] Values in italics are assessment results in year immediately following the catch year; values in normal font are results from this assessment

[3] Prior to implementation of US/CAN Understanding

TRAC	Catch Year	TRAC Analysis/Recommendation		TMGC Decision		Actual Catch[(1)]/Compared to Risk Analysis	Actual Result[(2)]
		Amount	**Rationale**	**Amount**	**Rationale**		
2006	2007	1,250 mt	Neutral risk of exceeding Fref; 66% increase in SSB from 2007 to 2008	1,250 mt (revised after US objections to a 1,500 mt TAC)	Neutral risk of exceeding Fref	1,664 mt About 75 percent probability of exceeding Fref	*F = 0.29* *Age 3+ biomass increased 211% 07–08* 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	*F~0.09* *Age 3+ biomass increased between 35%–52%* 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	*F=0.15* *Age 3+ biomass increased 11%* Now NA
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	*F=0.13* *3+ Biomass increased 6% 10–11* 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	*F=0.31* *Age 3+ biomass decreased 5% 11–12* 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	*F=0.32* *Age 3+ biomass decreased 6% 12–13* Now Avg survey B decreased 50% 12–13
2012	2013	(1) 200–500 mt	(1) trade-off between risk of overfishing and	500 mt	Trade-off risk of F>Fref and biomass increase	218 mt	*F=0.32 (0.78 rho adjusted)*

TRAC	Catch Year	TRAC Analysis/Recommendation		TMGC Decision		Actual Catch(1)/Compared to Risk Analysis	Actual Result(2)
		Amount	Rationale	Amount	Rationale		
			change in biomass from five projections		among 5 sensitivity analyses		Now Avg survey B decreased 55% 13–14
2013	2014	(1) 200 mt (2) 500 mt	(1) F < Fref (2) B increase	400 mt	Reduction from 2013 quota, allow rebuilding	159 mt	Now Avg survey B increased 0% 14–15
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	(3) 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	(4) 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	(5) 199 mt	Exploitation rate 6%	162 mt	Balance Yellowtail Flounder stock conditions and the utilization of other species	14 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[(1)]/Compared to Risk Analysis	Actual Result[(2)]
		Amount	Rationale	Amount	Rationale		
2020	2021	(6) 125 mt	Exploitation rate 6%	125 mt	Balance Yellowtail Flounder stock conditions and the utilization of other species		