

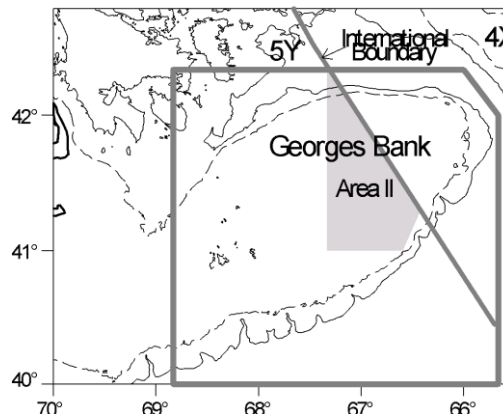


Transboundary Resources Assessment Committee

Status Report 2023/02

GEORGES BANK YELLOWTAIL FLOUNDER

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



SUMMARY

- Combined Canada and US catches in 2022 were 15 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 2023 National Marine Fisheries Service (NMFS) spring survey estimates were not available due to vessel delays and changes in sampling protocol (only day-time tows). For the sake of completeness and comparability with previous Transboundary Resources Assessment Committee (TRAC) Status Reports (TSRs), a number of tables and figures that could not be updated due to these missing data are included in the Appendix.
- The average survey biomass for 2023 using the Miller et al (2021) method was 917 mt. The biomass estimate is below the bounds of the Limiter approach (lower limit: 1,000 mt; upper limit 7,300-8,500 mt). If biomass is below the lower limit a linear decrease in fishing mortality rate (F) is used to determine catch advice. The result of the Limiter in 2023 produces catch advice of 168 mt.
- The Limiter approach was designed to have three independent surveys serve as the basis for average biomass for a year. Since 2020, only two surveys have been available each year for this estimation and uncertainty around the average survey biomass estimate has increased. Further investigation of the validity of the Limiter approach when one or more surveys are missing within a year, should be conducted. Given the continued uncertainty caused by the missing surveys and its influence on the applicability of the Limiter, the TRAC reviewers suggested that the quota not exceed 200 mt. The TRAC recommends continued low exploitation to allow for the possibility of rebuilding.



FISHERY

Total catches of Georges Bank Yellowtail Flounder peaked at about 21,000 mt in both 1969 and 1970 (Figure 1). The combined Canada/United States of America (USA) catch increased from 1995 through 2001, averaged 6,300 mt during 2002–2004, but declined to 15 mt in 2022 (Table 1) due in part to restrictive management measures.

The 2022 **Canadian catch** of 4 mt was 5% of the 78 mt quota, with landings less than 1 mt and estimated discards of 3 mt from the sea scallop dredge fishery.

USA catches in calendar year 2022 were 11 mt, with landings less than 1 mt and discards of 10 mt. The USA landings in calendar year 2022 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 2022 were 11% of the 122 mt quota.

Table 1. Catches (mt)

		2017	2018	2019	2020	2021	2022	2023	Avg ¹	Min ¹	Max ¹
Canada ²	Quota	93	87	34	42	45	78				
	Landed	<1	<1	<1	<1	<1	<1		387	<1	2,913
	Discard	2	3	4	6	4	3		380	2	815
USA ²	Quota ³	207	213	106	120	80	122				
	Catch ³	84	40	5	8	48	11 ⁴				
	Landed	35	32	3	5	<1	<1 ⁴		3,414	<1	15,899
	Discard	57	11	2	56	47	10 ⁴		469	2	3,021
Total ²	Quota ⁵	300	300	140	162	125	200	168			
	Catch ⁵	87	42	9	14	30	14				
	Catch ⁶	95	45	8	68	51	15 ⁴		4,678	8	17,211

¹1973 – 2022

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 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). There is no clear trend in the catch curve

analyses (Sinclair Z; 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. 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 approach¹. 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 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 2023, vessel delays and changes in sampling protocol prevented the spring NMFS survey analyses from being completed in time so catch advice for 2023 from both approaches was computed using only the 2022 NMFS fall and 2023 DFO surveys.

During the 2014 Benchmark, considerations were provided as reasons to decrease, maintain, or increase the quota. As 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: survey biomass remains low for both available surveys (NMFS fall and DFO); recent recruitment continues to be below average; and the abundance of age 6+ fish in both available surveys remains low. 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.

During 2012 to 2022, the catch has averaged 29% 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.

¹ 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.

At the 2020 TRAC meeting, the missing 2020 NMFS spring survey was shown to have no 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%. Adjusted survey values have been used at the previous three TRAC meetings to inform catch advice. No adjustment was made in 2023 because, on average, removing the NMFS spring survey in previous years did not affect previous biomass estimates based on analyses with data from 2010-2019 (Figure A4).

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>.

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) that incorporates tow-specific area swept and an exploitation rate of 7% results in catch of 64 mt for 2024 (Table 2).

The average survey biomass for (the 2022 NMFS fall and 2023 spring DFO) 2023 was 917 mt, which is below the lower limit set for the Limiter (lower limit: 1,000 mt; upper limit: 7,300 to 8,500 mt). TMGC agreed that if biomass falls below the lower limit a linear decrease in F will be used to produce catch advice. The resulting catch advice from this approach is 168 mt (Table 3; Figure 6).

The Limiter Approach was designed to use the results from three surveys. The absence of one or more surveys increases uncertainty around the average survey biomass estimate. The continued absence of surveys requires reinvestigation by TRAC of the assumptions of the Limiter approach. Missing surveys starting in 2020 have prevented the ability to update the effect of missing surveys on average biomass. Given the continued uncertainty caused by the missing surveys and its influence on the applicability of the Limiter, the TRAC reviewers suggested that the quota not exceed 200 mt. The TRAC recommends continued low exploitation to allow for the possibility of rebuilding.

Table 2. Survey biomass with the Miller et al. (2021) approach 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 2023 quota would be implemented in 2024). NA=data not available for assessment. X=missing surveys.

Year	Biomass (mt)				Example Quota (mt) at 7% Exploitation Rate
	DFO	Spring	Fall (year-1)	Average	
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

Year	Biomass (mt)				Example Quota (mt) at 7% Exploitation Rate
	DFO	Spring	Fall (year-1)	Average	
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	X	3,608	2,006	140
2021	446	4,804	X	2,625	184
2022	NA	929	2,070	1,500	105
2023	506	NA	1,327	917	64

Table 3. Recent quotas and catches by year and associated exploitation rates (computed by dividing by the average survey biomass in Table 2). A dash (-) indicates not applicable. VPA=Virtual Population Analysis.

Year	Quota (mt)	Catch (mt)	Quota/Avg	Catch/Avg	Approach
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%	Limiter
2022	200	15	13%	1%	Limiter
2023	168	-	18%	-	Limiter
Mean	553	226	10% ¹	3%	-

¹ 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 the 2023NMFS spring survey (due to vessel delays and changes in survey protocols).
- The 2023 NMFS spring survey only sampled during daylight hours. Yellowtail catch rates in the NMFS surveys can vary by day/night. Analyses will need to be conducted in the future to determine whether data from this survey are appropriate to use in the future.
- The Limiter Approach was designed to have three surveys and the absence of surveys increases uncertainty around the average survey biomass estimate. Further investigation of the validity of the Limiter Approach when one or more surveys are missing within a year, should be conducted.
- Missing surveys starting in 2020 have prevented the ability to update the effect of missing surveys on average biomass.
- In 2023, the average survey biomass is below the lower bound of the Limiter approach.
- 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.
- The USA Yellowtail Research Track is underway and due to be completed in 2024.

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. (<https://repository.library.noaa.gov/view/noaa/26476>)

CORRECT CITATION

TRAC. 2023. Georges Bank Yellowtail Flounder. TRAC Status Report 2023/02.

FIGURES

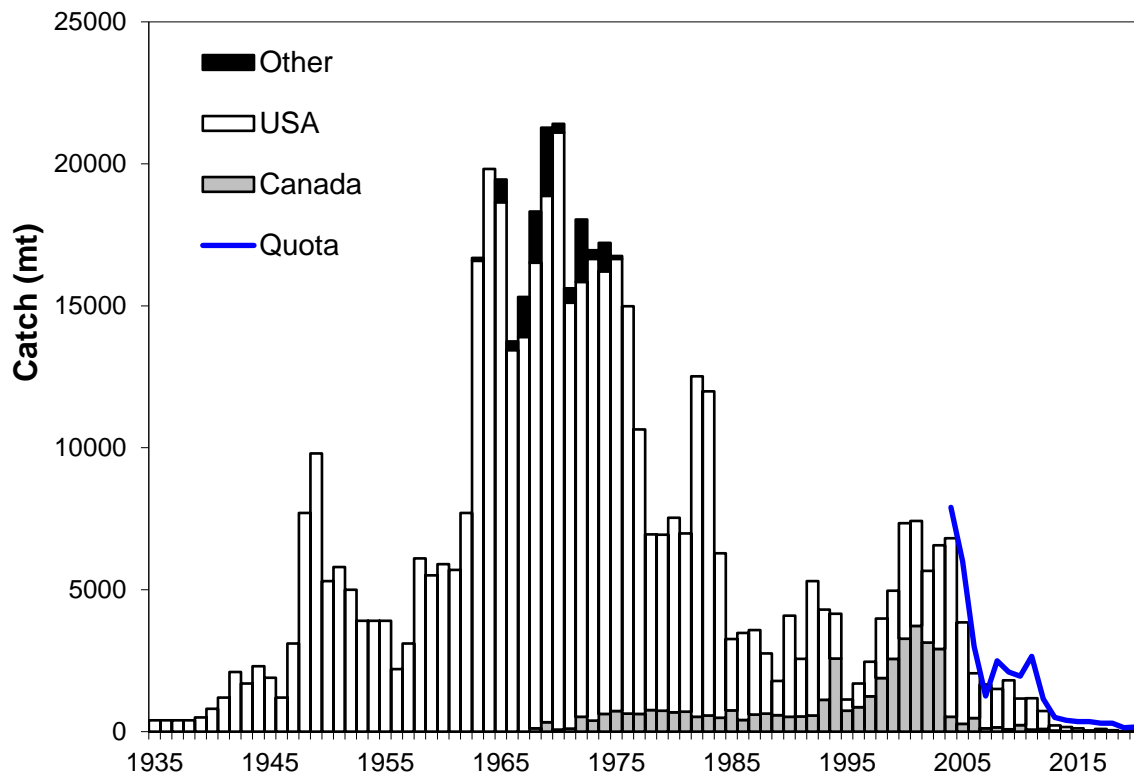


Figure 1. Catches and quota for Georges Bank Yellowtail Flounder, 1935 to 2023.

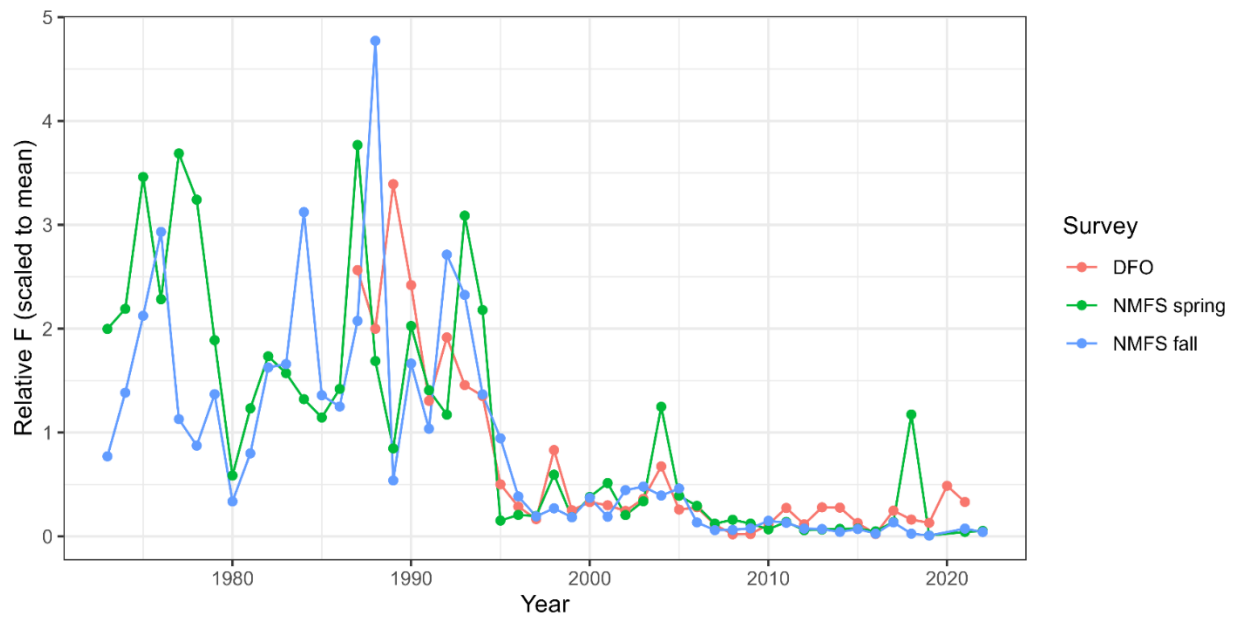


Figure 2. Relative F (catch in mt divided by survey catch in kg per tow) scaled to the mean value during 1987–2007 for the three surveys. Please see note in **State of the Resource** about recent low survey catches. Note the 2020 National Marine Fisheries Service (NMFS) spring and fall surveys were not conducted due to Covid-19 restrictions. The DFO 2022 survey data are not available due to a change in vessel and an absence of conversion factor. The NMFS spring survey data are not available in 2023 due to vessel delays.

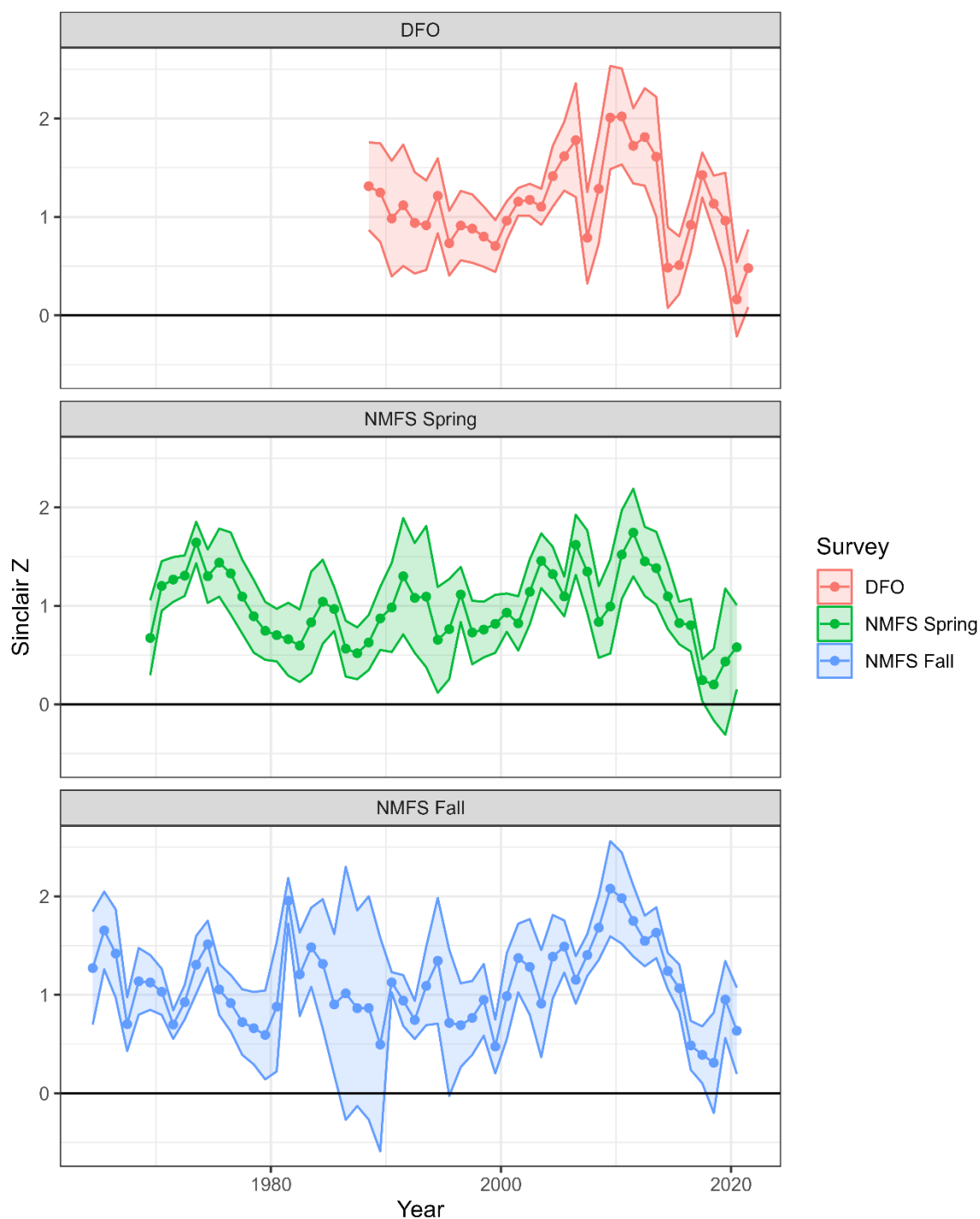


Figure 3. Total mortality (Z) from the three surveys using the Sinclair method with a four-year moving window for ages 3 to 8. Please see note in **State of the Resource** about recent survey catches. Note the 2020 National Marine Fisheries Service (NMFS) spring and fall surveys were not conducted due to Covid-19 restrictions. The Fisheries and Oceans Canada 2022 survey data are not available due to a change in vessel and an absence of conversion factor. The NMFS spring survey data are not available in 2023 due to vessel delays and changes in sampling protocol.

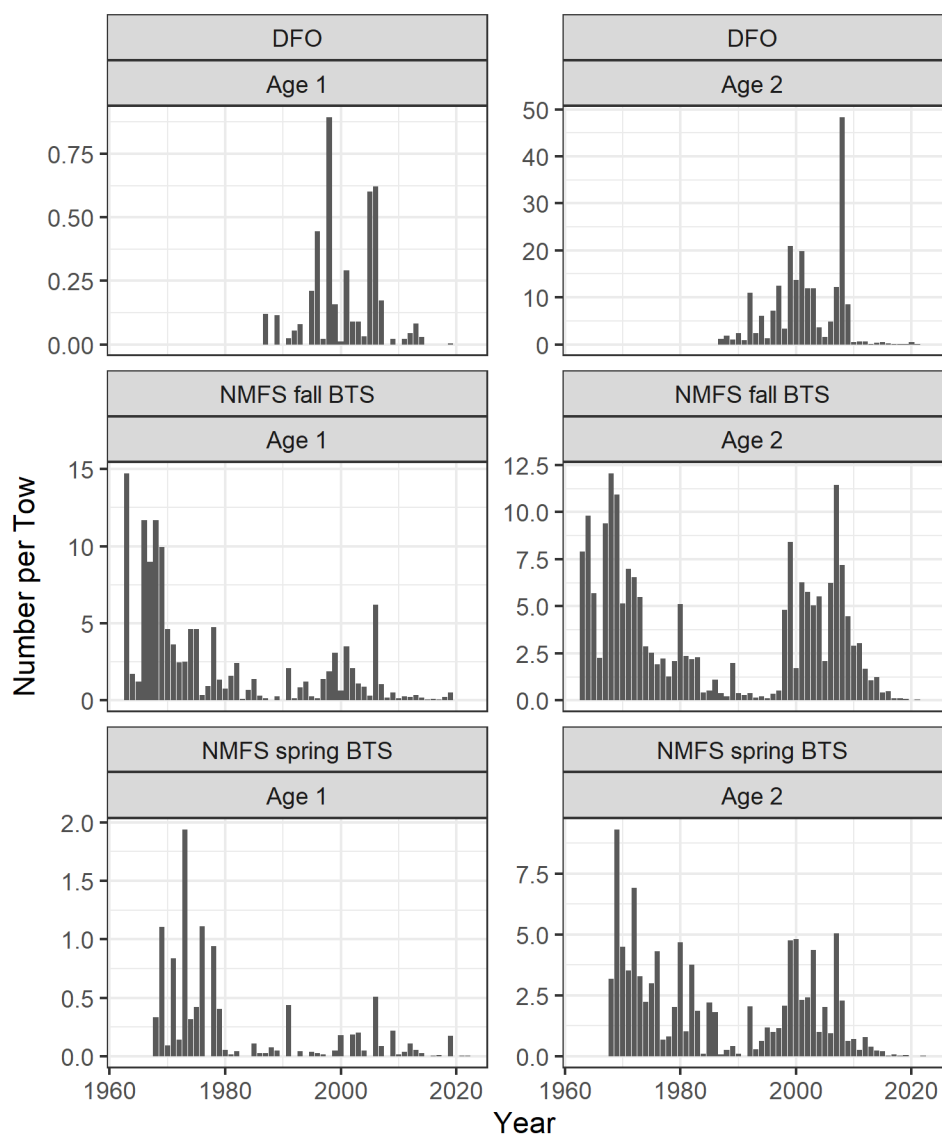


Figure 4. Estimates of recruitment (age 1 has many zeros, so age 2 also shown) from the three bottom trawl surveys. Note the 2020 National Marine Fisheries Service (NMFS) spring and fall surveys were not conducted due to Covid-19 restrictions. The Fisheries and Oceans Canada 2022 survey data are not available due to a change in vessel and an absence of conversion factor. The NMFS spring survey data are not available in 2023 due to vessel delays and changes in sampling protocol.

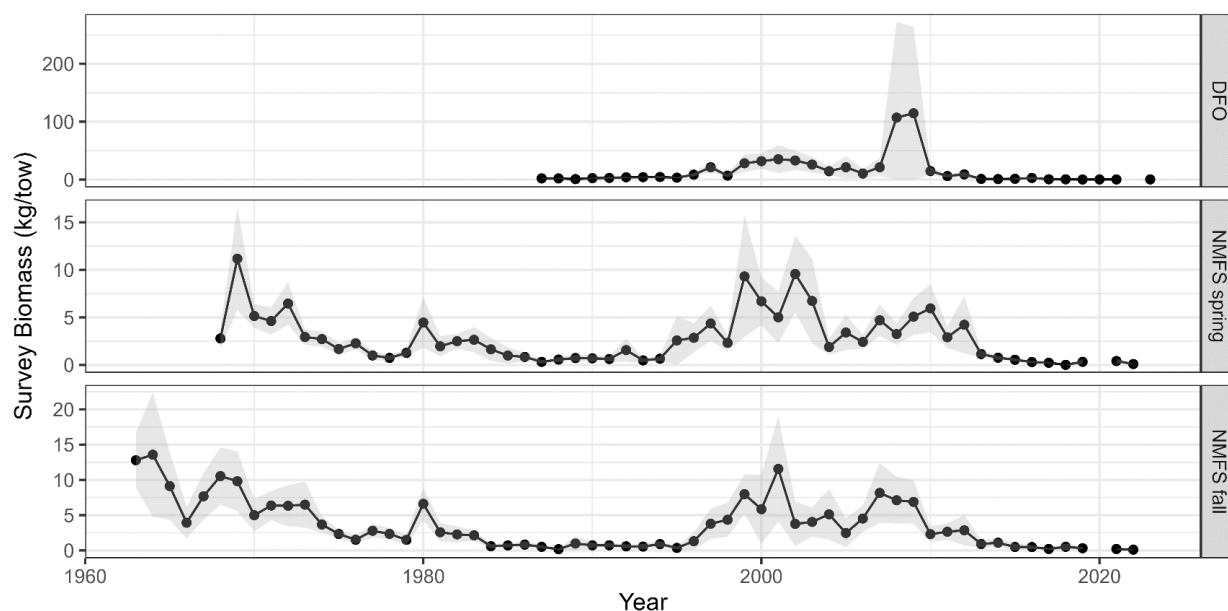


Figure 5. Bottom trawl survey catch rates (in biomass) for Georges Bank Yellowtail Flounder (filled circles) with 90% confidence intervals (gray area). Note that the amount of Georges Bank area covered in the Fisheries and Oceans Canada (DFO) and National Marine Fisheries Service (NMFS) surveys differs 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. The NMFS spring survey data are not available in 2023 due to vessel delays and changes in sampling protocol.

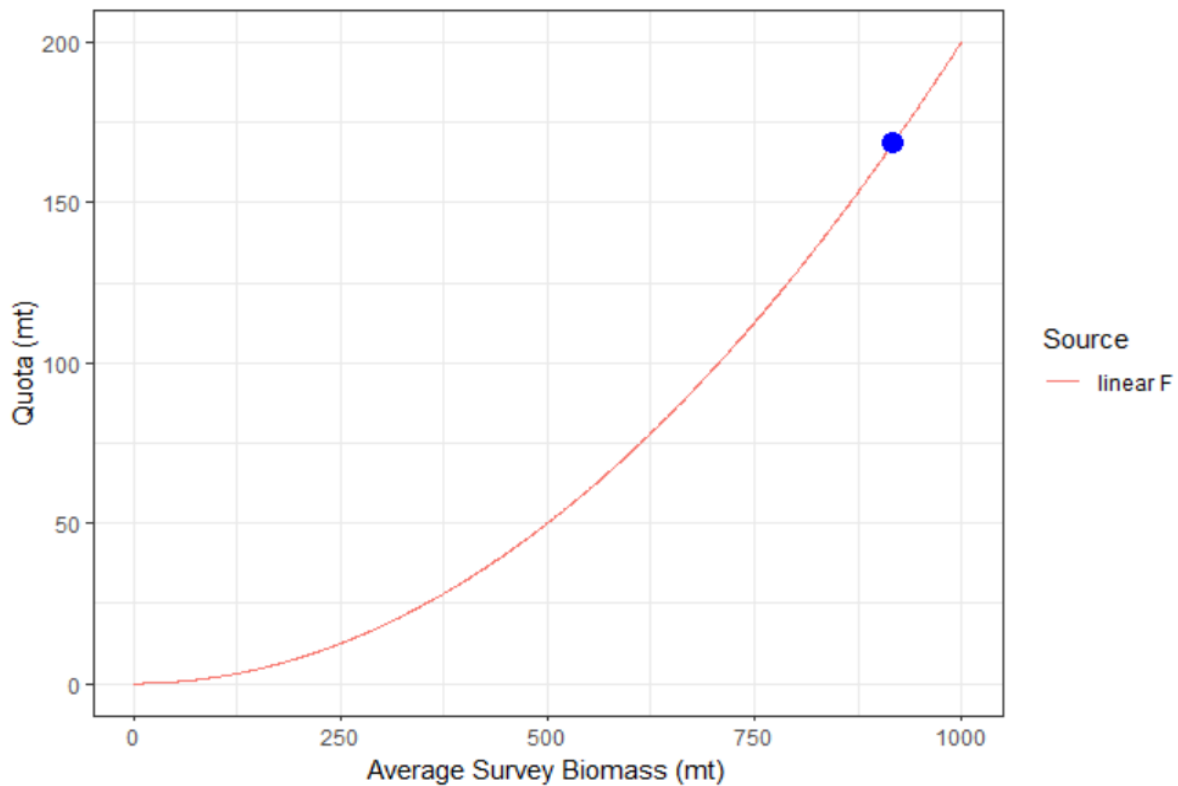


Figure 6. Linear decrease in F used to produce catch advice when average survey biomass is below the lower bound of the Limiter (200 mt). The blue dot represents where the average survey biomass (917 mt) from 2023 falls on the linear decrease, which equates to a catch advice of 168 mt. The National Marine Fisheries Service spring survey data are not available in 2023 due to vessel delays and changes in sampling protocol.

APPENDIX

Table A1. Annual USA and Canadian catch and quota (mt) of Georges Bank Yellowtail Flounder. A dash (-) indicates not applicable.

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	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	-	-	-

GB Yellowtail Flounder**TRAC Status Report 2023/02**

Year	USA Landings	USA Discards	Canada Landings	Canada Discards	Other Landings	Total Catch	USA Quota	Canada Quota	Total Quota
1977	9444	567	44	584	0	10639	-	-	-
1978	4519	1669	69	687	0	6944	-	-	-
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	57	<1	6	0	68	120	42	162
2021	1	46	<1	4	0	51	80	45	125
2022	<1	10	1	3	0	15	78	122	200

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	-	-	-

Year	Age											
	1	2	3	4	5	6	7	8	9	10	11	12
2019	0.088	0.232	0.404	0.506	0.642	0.619	0.817	0.804	1.148	-	1.048	-
2020	0.148	0.238	0.294	0.337	0.449	0.399	0.803	0.609	0.790	0.790	1.125	1.045
2021	0.109	0.275	0.424	0.436	0.502	0.543	-	0.580	0.659	0.702	-	-
2022	0.167	0.359	0.396	0.468	0.496	0.447	0.650	0.591	0.728	-	0.933	-

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

Year	Numbers at Age						Biomass (kg/tow)	CV(B)
	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6+		
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	0.22	0.305
2022	-	-	-	-	-	-	-	-
2023	0.000	0.012	0.039	0.062	0.235	0.178	0.004	0.000

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

Year	Numbers at Age						Biomass	CV(B)
	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6+	B(kg/tow)	
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
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

Year	Numbers at Age						Biomass	CV(B)
	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6+	B(kg/tow)	
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
2023	-	-	-	-	-	-	-	-

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

Year	Numbers at Age						Biomass	CV(B)
	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6+	B(kg/tow)	
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

Year	Numbers at Age						Biomass	CV(B)
	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6+	B(kg/tow)	
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	0.203	0.315
2022	0.047	0.028	0.000	0.152	0.033	0.028	0.105	0.508

Table A6. Catch for 2024 associated with the full range of exploitation rates from the 2014 Benchmark and using the Miller et al. (2021) survey values.

Terminal year	
Exploitation rate	Catch advice (mt)
2%	18
3%	28
4%	37
5%	46
6%	55
7%	64
8%	73
9%	83
10%	92
11%	101
12%	110
13%	119
14%	128
15%	138
16%	147
17%	156
18%	165
19%	174
20%	183
21%	193
22%	202

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				Catch
	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

Year	Biomass				Catch
	DFO	Spring	Fall (year-1)	Average	
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
2023	506	NA	1,327	917	55

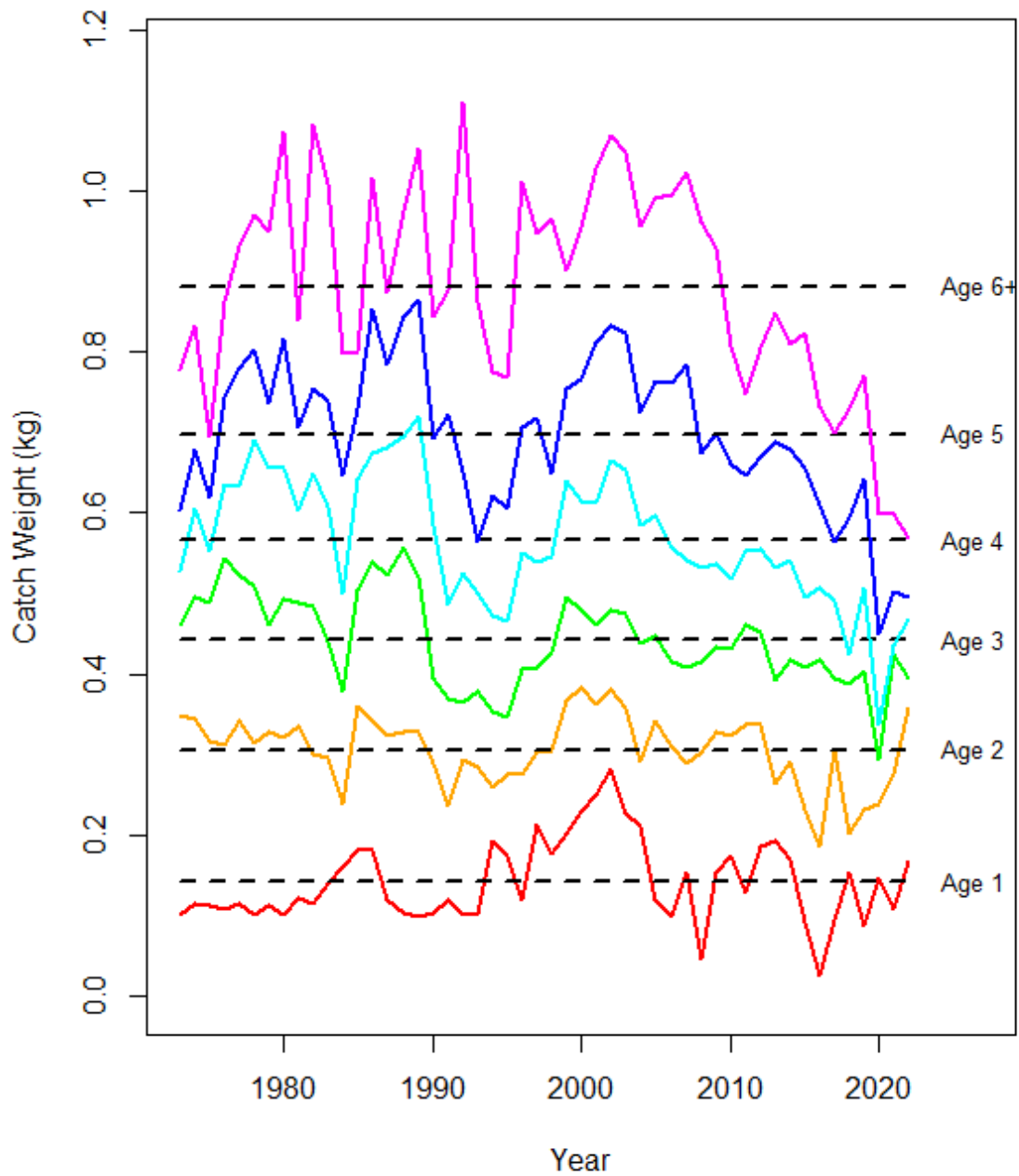


Figure A1. Trends in mean weight at age from the Georges Bank Yellowtail Flounder fishery (Canada and USA combined, including discards). Dashed lines denote average of time series.

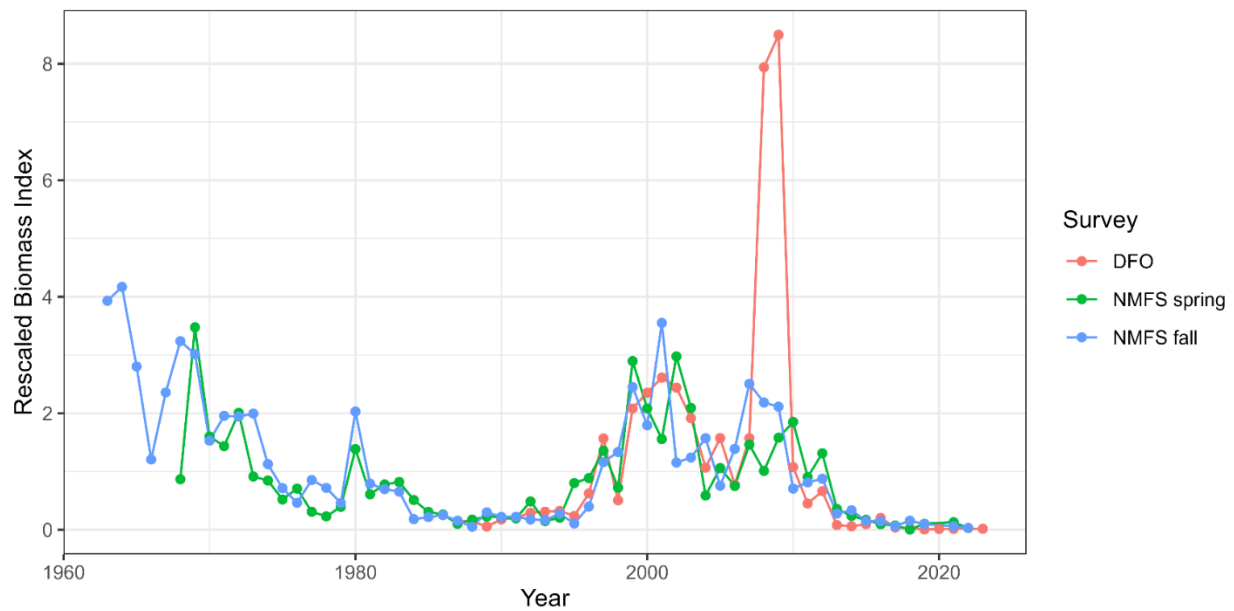


Figure A2. Fisheries and Oceans Canada (DFO), National Marine Fisheries Service spring, and NMFS fall survey biomass indices for Yellowtail Flounder on Georges Bank rescaled to their respective means for years 1987–2007. Note the 2020 NMFS spring and fall surveys were not conducted due to Covid-19. The 2022 DFO survey data are not available due to a change in vessel and an absence of conversion factor. The 2023 NMFS spring survey data are not available due to vessel delays and changes in sampling protocol.

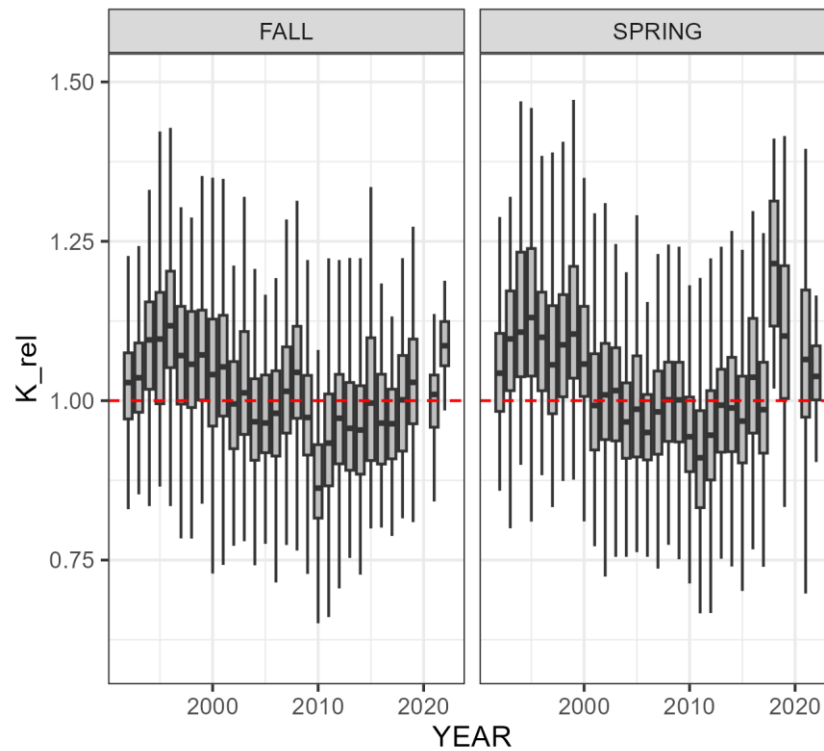


Figure A3. Condition factor (Fulton's K) of Georges Bank Yellowtail Flounder from the National Marine Fisheries Service (NMFS) fall and spring surveys. Note the 2020 NMFS spring and fall surveys were not conducted due to Covid-19 restrictions. The 2023 NMFS spring survey data are not available due to vessel delays and changes in sampling protocol.

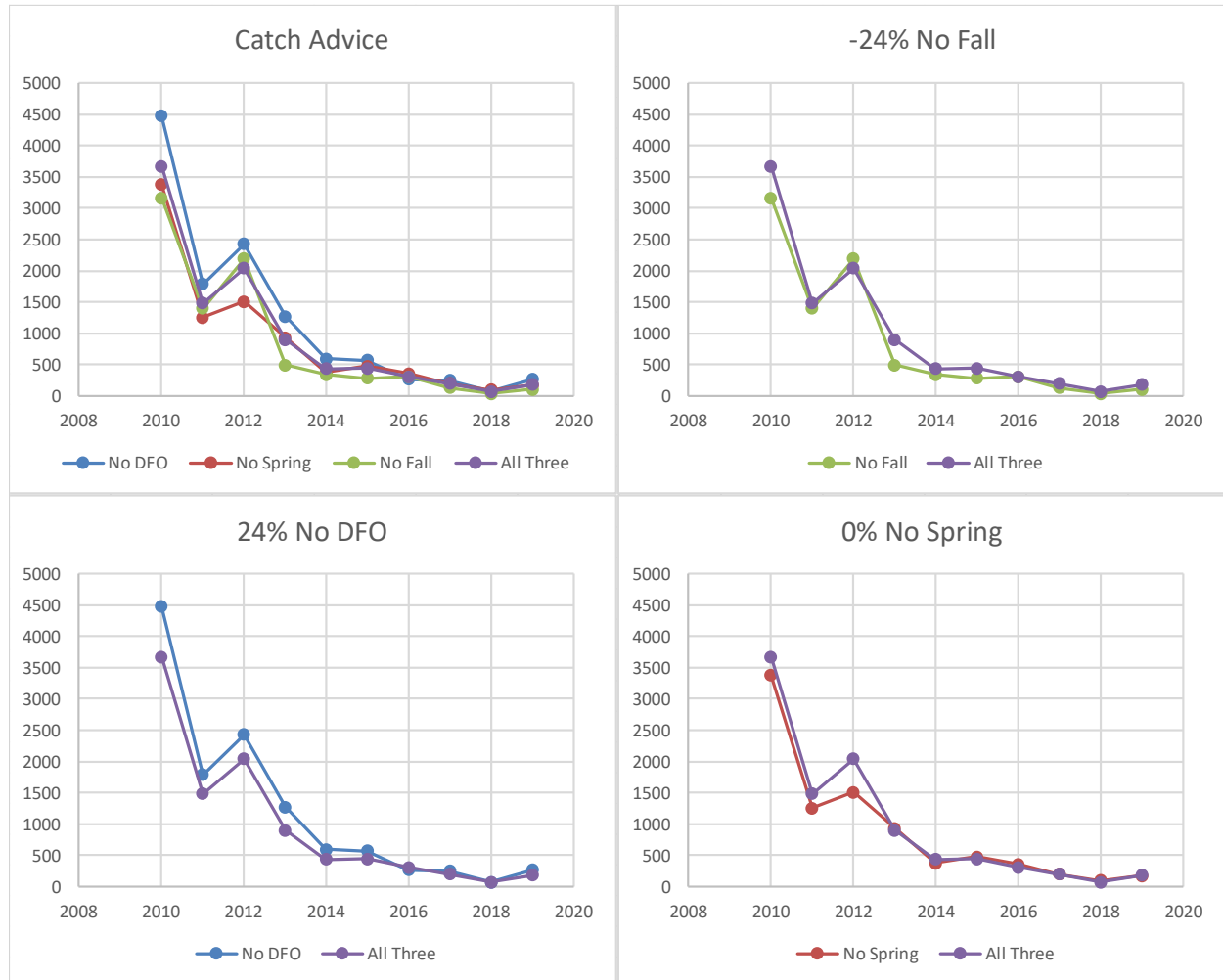


Figure A4. Scenario analyses where one of the three surveys was removed from the calculation of catch compared to the situation with all three surveys. The percentiles at the top of the figures refer to the average relative difference $(2 \text{ surveys} - \text{all } 3) / \text{all } 3$.

MANAGEMENT TABLE

Table A7. The table below was kindly initiated by Tom Nies (New England Fisheries Management Council). It summarizes the performance of the management system, the Transboundary Resources Assessment Committee (TRAC) advice, the Transboundary Management Guidance Committee (TMGC) quota decisions, 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 ⁽²⁾ /Compared to Risk Analysis	Actual Result ⁽³⁾
		Amount	Rationale	Amount	Rationale		
1999 ⁴	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

² All catches are calendar-year catches

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

⁴ Prior to implementation of USA/CAN Understanding

TRAC	Catch Year	TRAC Analysis/Recommendation		TMGC Decision		Actual Catch ⁽²⁾ /Compared to Risk Analysis	Actual Result ⁽³⁾
		Amount	Rationale	Amount	Rationale		
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
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	$F \sim 0.09$ 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

TRAC	Catch Year	TRAC Analysis/Recommendation		TMGC Decision		Actual Catch ⁽²⁾ /Compared to Risk Analysis	Actual Result ⁽³⁾
		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	$F=0.13$ 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 change in biomass from five projections	500 mt	Trade-off risk of $F > F_{ref}$ and biomass increase among 5 sensitivity analyses	218 mt	$F=0.32$ (0.78 rho adjusted) 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 ⁽²⁾ /Compared to Risk Analysis	Actual Result ⁽³⁾
		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 ⁽²⁾ /Compared to Risk Analysis	Actual Result ⁽³⁾
		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	Constant catch advice from the Limiter	200 mt	Balance Yellowtail Flounder stock conditions and the utilization of other species	15 mt	Now Avg survey B decreased 49% 22–23 (note 2023 survey B based on only two surveys due to vessel delays)
2022	2023	168 mt	Linear F decrease from the lower bound of the Limiter				