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Update of Allocation Shares for Canada and the USA of the Transboundary Resources of Atlantic Cod, Haddock, and Yellowtail Flounder on Georges Bank Through Fishing Year 2017

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ABSTRACT

The development of consistent management by Canada and the United States of America (USA) for the transboundary resources of Atlantic Cod, Haddock, and Yellowtail Flounder on Georges Bank led to a sharing allocation agreement by the Transboundary Management Guidance Committee (TMGC). For Atlantic Cod and Haddock, the agreement is limited to the eastern Georges Bank management unit (Fisheries and Oceans Canada (DFO) Statistical Unit Areas 5Zj and 5Zm; USA Statistical Areas 551, 552, 561, and 562). The management unit for Yellowtail Flounder encompasses the entire Georges Bank east of the Great South Channel (DFO Statistical Unit Areas 5Zh, 5Zj, 5Zm, and 5Zn; USA Statistical Areas 522, 525, 551, 552, 561, and 562). Two principles are incorporated in the sharing formulae: 1) historical utilization based on reported landings during 1967 through 1994; 2) temporal changes in resource distributions determined from the DFO and USA National Marine Fisheries Service (NMFS) survey results that are updated annually. From 2010 onward, utilization will account for 10% and distribution for 90% of the allocation. This report uses the 2016 DFO and NMFS survey results to update the calculation for the 2018 fishing year allocations. In 2017, the TRAC will evaluate potential impacts of the delayed start of the 2016 NMFS spring survey for each stock.

The resource distributions in 2016 were: 26% USA, 74% Canada, for Atlantic Cod; 38% USA, 62% Canada, for Haddock; and 68% USA, 32% Canada for Yellowtail Flounder. The 2018 fishing year allocations (calendar year for Canada; May 1, 2018, to April 30, 2019, for the USA), updated with the 2016 resource distributions, resulted in shares for Atlantic Cod of 27% USA, 73% Canada, for Haddock of 39% USA, 61% Canada, and for Yellowtail Flounder of 71% USA, 29% Canada.

RÉSUMÉ

INTRODUCTION

The designation of units for management entails a compromise between the biological realities of stock structure and the practical convenience of analysis and policy making (Gulland 1980). For Yellowtail Flounder, Canada and the United States of America (USA) use a common management unit (for Canada the Fisheries and Oceans Canada (DFO) Statistical Unit Areas 5Zh, 5Zj, 5Zm, and 5Zn; for the USA the USA Statistical Areas 522, 525, 551, 552, 561, and 562) encompassing the entire bank east of the Great South Channel (Figure 1), referred to hereafter as Georges Bank. For Atlantic Cod and Haddock, Canada uses only the eastern portion of Georges Bank, while the USA employs a management unit comprising all of Georges Bank and extending south and west of Cape Cod. The Transboundary Management Guidance Committee (TMGC) agreed that, for the purpose of developing a sharing formula for Atlantic Cod and Haddock, the management unit would be limited to the eastern portion of Georges Bank (Figure 1; DFO Statistical Unit Areas 5Zj and 5Zm; USA Statistical Areas 551, 552, 561, and 562), referred to as eastern Georges Bank.

Consistent fisheries management advice utilizing an allocation sharing arrangement for eastern Georges Bank was provided for the first time in the 2003 TMGC Guidance Document (TMGC 2003) for application to the 2004 fishing year quotas, and subsequently in the 2005 to 2016 TMGC Guidance Documents for application to the 2006 to 2017 fishing year quotas, respectively (TMGC 2015). The analyses are based on calendar year data. The fishing year for Canadian fisheries starts on January 1st and ends on December 31st, whereas the fishing year for USA fisheries starts on May 1st and ends on April 30th the following year.

Principles of resource sharing for transboundary stocks include consideration of access to resources occurring or produced within national boundaries and historical participation in exploitation of the resources (Gavaris and Murawski 2004). The former has emerged from the effective property rights associated with Exclusive Economic Zones as well as the distribution of stocks occurring in areas under national jurisdiction (UN 1995). The latter recognizes traditional involvement and investment in the development of a fishery. Both principles were incorporated in the TMGC sharing proposal, but historical participation gradually was down-weighted so that after an eight year phase-in period the annual allocation would be based primarily on resource distribution (90%).

Details for calculating the national allocations for Canada and the USA were described by Murawski and Gavaris (2004). The approach incorporates both resource utilization and resource distributions relative to the Canada/USA east coast maritime boundary. Results for fishing years 2005 to 2016 have been reported annually, most recently by Busawon and Brooks (2016). This report uses the 2016 DFO and USA National Marine Fisheries Service (NMFS) survey results to estimate the 2018 fishing year allocations.

DATA AND METHODS

FORMULA

The TMGC agreed approach for calculating the respective country shares (TMGC 2002), which takes into historical utilization and adapts to shifts in resource distribution, is as follows:

$$\%share_{year,country} = (\alpha_{year} \times \%utilization_{year,country}) + (\beta_{year} \times \%resource\ distribution_{year,country})$$

where α_{year} = percentage weighting for utilization in year
β_{year} = percentage weighting for resource distribution in year
$\alpha_{year} + \beta_{year} = 100\%$

The initial sharing formula was based on the weighting of country utilization by 40% and resource distribution from surveys by 60%. Thereafter, the percentage weighting was changed in 5% annual increments until the weightings reached 10% country utilization from landings and 90% resource distribution from surveys. This sharing agreement was implemented in 2003, with the end of the transition to a 90:10 resource distribution-to-utilization weighting in the 2010 fishing year.

RESOURCE UTILIZATION

Historical participation in exploitation of these resources was assessed for the three species using landings records (Table 1). The TMGC agreed to use the percentage of the total landings by country from 1967 to 1994 (inclusive), as the measure of country utilization.

RESOURCE DISTRIBUTION

Resource distribution patterns were determined from three research vessel bottom trawl survey time series conducted by the DFO and NMFS (DFO winter (February 2016), NMFS Spring (May 2016) and NMFS Fall (October 2016)). Surveys of Georges Bank have been conducted by DFO since 1986 (February), and by NMFS each fall (October) since 1963 and each spring (April) since 1968. Each of the three surveys cover Canadian and USA waters on both sides of the Hague line (Figure 2). Further details about DFO and USA Northeast Fisheries Science Center (NEFSC) vessels and calibrations can be found in Gross et al. (2014).

Swept area biomass, considered a relative index of abundance, was computed for each species in each stratum (Table 2, Figure 2) and apportioned to USA and Canadian sectors in each year. DFO survey sampling strata were revised in 1987 to incorporate the international boundary. Thus, only results since 1987 have been used from this survey. Since both the DFO and NMFS survey designs are based on randomization within strata, the data were post-stratified to Canadian and USA zones within the existing survey strata.

Estimates of biomass indices were calculated for each stratum or stratum section unless no observations occurred within a stratum (Tables 2 to 11). Prior to 2005, on the few occasions where no observations were available in a stratum section, density and distribution patterns from adjacent areas and years were used as substitute values. The magnitude of these derived values was generally small and did not influence results. When such values are combined over surveys, they have only a minor effect on the annual aggregate biomass index estimates within the transboundary management units. In recent years, missing observations have been assumed to be zero, as derived values did not influence results when adjusted prior to 2005 (Tables 3 to 10).The swept area biomasses for each groundfish species were summed individually to derive the biomass index on the Canadian and USA side for each management unit. Age- and size-specific distribution patterns were not considered while developing the biomass indices.

The biomass index estimate derived from each survey represents a synoptic snapshot of resource distribution at a specific time during a year. Combining the results of multiple surveys requires an understanding of seasonal movement patterns and how much of the biological year each survey represents. For Atlantic Cod, the DFO and the NMFS spring surveys in each year were averaged to characterize the distribution during the winter-spring period. This result was averaged with the NMFS fall survey distribution percentage, thereby giving equal weight to the winter-spring and summer-fall periods. Prior to initiation of the DFO survey in 1987, the NMFS spring survey was used alone to characterize the winter-spring period. For Haddock and Yellowtail Flounder, the results from all three surveys in each year were averaged to represent the annual distribution pattern. Prior to 1987, only the NMFS spring and fall surveys were averaged for these two species.

A robust locally-weighted regression algorithm (Cleveland 1979), referred to as LOESS, was adopted for removing both unpredictable fluctuations and sampling variation from survey observations. A 30% smoothing parameter was chosen as it reflected current trends, was responsive to changes, and provided the most appropriate results for contemporary resource sharing. The recommended default of two robustness iterations also was adopted (Cleveland 1979). Resource distributions are updated annually by incorporating data from the latest survey (i.e. 2016) and dropping data from the earliest survey used in the previous year (i.e. 1983) so that a 33-year window is maintained. After the surveys were combined, the LOESS smoother was applied to the 1984 to 2016 survey data. The fixed resource utilization (10% weighting) and the 2016 resource distributions (90% weighting) were applied to the agreed sharing formula to determine national allocation shares of each of the three transboundary groundfish species for the upcoming fishing year (i.e. 2018), which is two years ahead of the survey data that is used (i.e. 2016).

RESULTS AND CONCLUSIONS

The country utilization aspect of the sharing formula, based on each country's landings during the period of 1967 to 1994 (Table 1), resulted in the following percentage weightings for utilization:

Stock	Canada	USA
Eastern Georges Bank Atlantic Cod	60%	40%
Eastern Georges Bank Haddock	55%	45%
Georges Bank Yellowtail Flounder	2%	98%

The 2010 fishing year marked the end of transition to a 90/10 weighting of resource distribution and country utilization. Historical utilization now accounts for only 10% of the sharing formula.

The biomass indices were updated with the 2016 survey values for each species for the DFO survey and NMFS spring and fall surveys (Tables 3 to 11; Figures 3, 4, and 5). During the 2016 NMFS fall survey, no tows occurred in the US waters for the portion of stratum 22 that lies within the eastern Georges Bank area (Table 2), resulting in a missing value for that strata for Cod and Haddock. In the analysis for TRAC in 2016, minor differences were found in the resource distribution of cod, haddock and yellowtail in 2012, 2013 and 2014, which were due to a difference in a tow that was either present in the previous analysis and absent in the next year's, or vice versa. Tables 3 to 15 were updated to incorporate values from the 2016 re-analysis, and resulted in minimal change (1% to 3%) in allocation shares for these years (Busawon and Brooks, 2016; Table 15).

The resource distribution, by country, for each survey and for the combined surveys, and the results from the smoothing algorithm for the most recent 33-year time period were determined for Atlantic Cod, Haddock, and Yellowtail Flounder (Tables 12, 13, and 14, respectively; Figure 6). The smoothed percentages for the time series differ from those previously calculated, due to dropping the earliest year of survey data (1983) and the incorporation of the next recent year of survey data (2016) in the smoothing algorithm. The resulting smoothed resource distributions for eastern Georges Bank in 2016 were, for cod: 74% Canada, 26% USA; for Haddock: 62% Canada, 38% USA; and for Yellowtail Flounder: 32% Canada, 68% USA (Table 15, Figure 6).

The 2016 smoothed resource distributions and the fixed resource utilization were applied to the agreed sharing formula and result in shares for the 2018 fishing year (calendar year for Canada; May 1, 2018 to April 30, 2019 for the USA) for Atlantic Cod of 27% USA, 73% Canada; for Haddock of 39% USA, 61% Canada; and for Yellowtail Flounder of 71% USA, 29% Canada (Table 15).

In 2017, TRAC will assess any impact of the delay in the start of the NEFSC 2016 spring research bottom trawl survey on the biomass distribution of the three species. Analyses will include standard comparisons of the current biomass distribution relative to historical distributions, as well as trends in common spatial statistics (e.g. weighted mean location of the population with variance; see Adams WP 2017-09).

REFERENCES

Adams, C. Spatial patterns in the spring and fall NEFSC surveys for Eastern Georges Bank cod, Eastern Georges Bank haddock and Georges Bank yellowtail flounder. TRAC Ref. Doc. 2017/09.

Busawon, D.S., and E. Brooks. 2016. Update of Allocation Shares for Canada and the USA of the Transboundary Resources of Atlantic Cod, Haddock, and Yellowtail Flounder on Georges Bank through Fishing Year 2017. TRAC Ref. Doc. 2016/xx: 28p.

Cleveland, W.S. 1979. Robust Locally Weighted Regression and Smoothing Scatterplots. J. Amer. Statist. Assoc. 74: 829-836.

Gavaris, S., and S.A. Murawski. 2004. The Role and Determination of Residence Proportions for Fisheries Resources Across Political Boundaries: The Georges Bank Example; pp. 261- 278. In: A.I.L. Payne, C.M. O'Brien, and S.I. Rogers [eds.]. Management of Shared Fish Stocks. Blackwell. Oxford, UK.

Gross, W.E., L. O'Brien, H.H. Stone, and L. Van Eeckhaute. 2014. Update of Allocation Shares for Canada and the USA of the Transboundary Resources of Atlantic Cod, Haddock, and Yellowtail Flounder on Georges Bank through Fishing Year 2015. TRAC Ref. Doc. 2014/04: 27p.

Gulland, J.A. 1980. Some Problems of the Management of Shared Stocks. FAO Fish. Tech. Pap. 206.

Murawski, S.A., and S. Gavaris. 2004. Computation of Allocation Shares for Canada and the USA of the Transboundary Resources of Atlantic Cod, Haddock and Yellowtail Flounder on Georges Bank. TRAC Ref. Doc. 2004/05: 25 p.

TMGC. 2003. Transboundary Management Guidance Document. Guidance Doc. 2003/01: 7 p.

TMGC. 2002. Development of a Sharing Allocation Proposal for Transboundary Resources of Cod, Haddock and Yellowtail Flounder on Georges Bank. DFO Maritimes Region, Fisheries Management Regional Report 2002/01: 59 p.

TMGC. 2014. Transboundary Management Guidance Committee. Guidance Doc. 2014/01: 11 p.

TRAC. 2014. Update of Allocation Shares for Canada and the USA of the Transboundary Resources of Atlantic Cod, Haddock, and Yellowtail Flounder on Georges Bank through Fishing Year 2015. TRAC Reference Doc. 2015/04: 30 p.

UN. 1995. United Nations Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks. Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks. U.N. Doc. A/Conf./164/37.

Table 1. Annual landings (mt) of Atlantic Cod, Haddock, and Yellowtail Flounder from the transboundary management units on Georges Bank from 1967 to 1994. The TMGC agreed to use the percentage of total landings by country from this time period as the measure of country utilization

Year	Atlantic Cod			Haddock			Yellowtail Flounder		
	Canada	USA	Total	Canada	USA	Total	Canada	USA	Total
1967	8188	3115	11303	12999	11999	24998	133	8407	8540
1968	9055	3244	12299	9195	7646	16841	122	12799	12921
1969	5876	3676	9552	3941	6621	10562	327	15944	16271
1970	2580	3211	5791	1970	3154	5124	70	15505	15575
1971	2950	4389	7339	1610	3533	5143	102	11878	11980
1972	2535	2708	5243	609	1551	2160	8	14157	14165
1973	3222	3064	6286	1565	1396	2961	12	15899	15911
1974	1370	3792	5162	462	955	1417	5	14607	14612
1975	1833	3108	4941	1353	1705	3058	8	13205	13213
1976	2320	2037	4357	1362	974	2336	11	11336	11347
1977	6156	4256	10412	2871	2428	5299	38	9444	9482
1978	8777	5502	14279	9968	4724	14692	56	4519	4575
1979	5979	6408	12387	5080	5212	10292	17	5475	5492
1980	8065	6418	14483	10017	5615	15632	81	6481	6562
1981	8498	8092	16590	5658	9075	14733	12	6182	6194
1982	17825	8565	26390	4872	6280	11152	18	10634	10652
1983	12131	8573	20704	3208	4453	7661	43	11350	11393
1984	5761	10551	16312	1463	5120	6583	4	5764	5768
1985	10442	6641	17083	3484	1684	5168	3	2477	2480
1986	8411	5697	14108	3415	2201	5616	27	3041	3068
1987	11844	4793	16637	4703	1418	6121	56	2743	2799
1988	12740	7645	20385	5941	1694	7635	47	1866	1913
1989	7895	6182	14077	3060	785	3845	32	1134	1166
1990	14364	6414	20778	3340	1188	4528	13	2751	2764
1991	13459	6353	19812	5423	931	6354	25	1784	1809
1992	11673	5080	16753	4090	1629	5719	15	2859	2874
1993	8524	4027	12551	3725	424	4149	675	2089	2764
1994	5278	1229	6507	2412	32	2444	2139	1589	3728
Total 1967-94	217751	144770	362521	117796	94427	212223	4099	215919	220018
Percentage 1967-94	60%	40%	100%	55%	45%	100%	2%	98%	100%

Table 2. Strata (or strata section) areas (in square nautical miles) used in the calculation of biomass indices. The designation 'eGB' denotes the eastern Georges Bank management unit used for Cod and Haddock. The designation '~eGB' denotes the portion of the stratum not in the eastern Georges Bank management unit.

DFO/NMFS Strata	Canada	USA(eGB)	USA(~eGB)
DFO 5Z1	795	0	0
5Z2	1252	0	0
5Z3	0	1504	791
5Z4	0	1350	1729
NMFS 13	0	0	2374
14	0	0	656
15	0	0	230
16	1553	1427	0
17	284	76	0
18	127	45	0
19	0	1059	1395
20	0	335	886
21	210	78	136
22	125	106	223

Table 3. Atlantic Cod biomass (mt) index by strata sections of eastern Georges Bank (see Figure 2) from the NMFS spring survey. Light shaded cells represent missing values calculated from adjacent strata sections. Dark shaded cells were recently updated with revised survey data. Cells with "-" represent missing values assumed to be zero while "0" represents observed zeros. Only the 33 year moving average data are shown.

Year	USA 16	CAN 16	USA 17	CAN 17	USA 18	CAN 18	USA 19	USA 20	USA 21	CAN 21	USA 22	CAN 22	USA total	CAN total
1984	1532	1527	78	239	0	0	793	4797	0	250	301	223	7500	2240
1985	1142	9618	29	57	0	159	2886	3032	-	1239	-	675	7088	11747
1986	1504	5622	103	45	0	13	2824	298	23	1712	-	425	4751	7817
1987	1430	3370	0	497	0	23	549	804	74	305	-	250	2856	4444
1988	1236	4560	0	334	-	42	1403	243	60	1229	0	269	2942	6432
1989	583	4630	0	33	-	9	1875	550	0	250	-	0	3008	4923
1990	1128	4693	0	519	-	146	475	449	57	108	-	603	2110	6068
1991	559	3512	-	178	-	157	1920	154	115	617	-	36	2748	4499
1992	0	2116	-	293	-	9	491	316	55	639	-	1240	862	4296
1993	749	695	-	1322	-	0	2229	472	-	134	-	229	3451	2380
1994	143	0	0	21	0	-	96	43	36	658	-	73	318	752
1995	350	7548	-	63	0	-	302	503	-	265	-	150	1154	8026
1996	1161	1545	-	221	-	0	1211	74	358	1653	0	0	2803	3419
1997	756	1561	11	107	0	28	471	0	116	176	-	343	1355	2214
1998	235	6238	0	187	-	72	0	-	110	5408	186	263	531	12168
1999	1053	2482	0	13	-	0	337	667	0	338	495	25	2552	2858
2000	1458	3281	0	11	0	-	967	1513	27	302	-	96	3965	3691
2001	191	1795	-	59	-	0	275	166	207	155	-	340	839	2349
2002	1341	2243	0	23	-	46	318	-	0	477	0	64	1659	2851
2003	478	3194	25	50	-	0	387	61	242	318	149	131	1342	3694
2004	309	2252	-	12	-	119	252	2462	119	11393	-	0	3142	13776
2005	1235	1599	0	266	0	-	0	64	-	697	121	151	1420	2713
2006	3162	511	0	457	-	0	524	277	509	1011	-	0	4472	1979
2007	2287	1759	15	128	0	0	398	237	452	260	-	82	3388	2229
2008	1488	1669	0	18	0	0	368	300	6	788	0	345	2162	2820
2009	1024	2673	7	0	0	100	535	47	256	3045	37	0	1906	5817
2010	541	1070	0	410	0	125	667	461	941	1010	94	198	2704	2813
2011	474	1573	0	133	0	74	56	0	0	460	0	196	530	2436
2012	1075	3504	6	182	0	0	646	1412	-	695	-	146	3139	4528
2013	40	1158	0	54	0	77	740	1312	-	7808	61	239	2153	9335
2014	0	1304	0	93	0	0	1214	1773	40	202	-	45	3027	1644
2015	411	394	0	284	0	422	106	462	-	411	-	113	979	1624
2016	24	2867	0	0	0	13	83	146	0	935	0	20	253	3835

Table 4. Atlantic Cod biomass (mt) index by strata sections of eastern Georges Bank (see Figure 2) from the NMFS fall survey. Shaded cells represent missing values calculated from adjacent strata sections. Dark shaded cells were recently updated with revised survey data. Cells with "-" represent missing values assumed to be zero while "0" represents observed zeros. Only the 33 year moving average data are shown.

Year	USA 16	CAN 16	USA 17	CAN 17	USA 18	CAN 18	USA 19	USA 20	USA 21	CAN 21	USA 22	CAN 22	USA total	CAN total
1984	0	3745	-	495	0	838	0	244	-	345	0	-	244	5423
1985	0	1926	-	189	0	85	0	1	9	98	-	16	10	2313
1986	138	722	-	217	0	102	0	0	710	147	0	0	848	1187
1987	0	1359	-	52	-	260	0	0	166	294	51	41	217	2006
1988	0	2154	-	251	-	610	2	6	-	385	30	1400	38	4799
1989	0	2329	-	216	0	-	0	7	3	893	23	13	33	3451
1990	12	2647	0	285	-	27	0	0	-	1014	-	16	12	3989
1991	0	118	-	109	0	-	-	0	0	88	0	7	0	322
1992	57	643	0	704	-	0	0	35	13	380	-	57	105	1784
1993	0	92	-	188	-	0	0	0	-	54	-	26	0	361
1994	0	56	-	157	-	201	0	0	7	1583	-	0	7	1997
1995	0	23	-	127	-	71	0	67	28	1171	0	-	95	1392
1996	0	652	-	311	-	48	0	-	66	181	-	93	66	1284
1997	0	0	-	57	-	0	0	0	-	1285	-	0	0	1342
1998	0	1031	-	31	-	170	0	0	-	769	-	-	0	2001
1999	0	58	-	154	-	56	0	0	-	465	22	15	22	748
2000	0	269	-	226	-	48	0	0	0	234	0	0	0	778
2001	40	423	-	431	-	0	0	0	0	288	-	9	40	1151
2002	0	2955	0	366	-	34	207	0	0	7312	61	16	268	10684
2003	0	133	-	0	-	0	135	0	0	405	-	23	135	561
2004	0	5982	0	485	0	50	0	0	41	731	61	0	102	7247
2005	0	486	0	445	0	40	0	77	32	366	0	102	109	1440
2006	59	1781	0	0	0	0	0	-	-	190	-	0	59	1972
2007	0	149	0	34	-	0	47	47	4	214	-	21	98	418
2008	0	368	0	131	0	73	0	0	0	108	0	23	0	704
2009	0	834	0	16	0	0	0	332	0	724	24	31	356	1605
2010	0	457	0	0	0	47	0	0	0	480	45	0	45	984
2011	0	3317	0	77	0	160	0	0	112	93	0	0	112	3647
2012	0	120	0	0	0	158	0	0	0	622	171	0	171	900
2013	0	2745	0	110	0	12	25	98	-	551	-	0	123	3419
2014	0	631	0	0	0	0	0	122	-	972	-	36	122	1639
2015	0	3751	0	665	0	41	0	515	0	897	-	74	515	5427
2016	0	0	0	52	0	47	214	2951	0	2287	-	0	3165	2387

Table 5. Atlantic Cod biomass (mt) index by strata and strata sections of eastern Georges Bank (see Figure 2) from the DFO survey.

Year	CAN 5Z1	CAN 5Z2	USA 5Z3	USA 5Z4	USA total	CAN total
1987	1555	5826	1345	98	1443	7381
1988	1894	12927	3856	775	4631	14821
1989	2040	8664	2766	1076	3842	10704
1990	1708	48900	4622	1435	6057	50608
1991	2204	17398	3820	1646	5467	19601
1992	2087	7602	4005	887	4892	9689
1993	719	9427	3875	2524	6399	10146
1994	817	11821	455	47	502	12638
1995	919	3277	3368	553	3921	4197
1996	1090	22489	3927	4667	8594	23579
1997	377	7336	2095	1196	3290	7714
1998	332	4091	551	32	583	4423
1999	211	6880	1206	880	2086	7092
2000	228	21947	9281	842	10123	22174
2001	1499	15563	257	718	975	17062
2002	2298	17043	309	683	992	19341
2003	720	3571	1130	797	1927	4291
2004	685	4248	699	29	728	4933
2005	1597	7306	192	17105	17298	8903
2006	127	8469	2652	1299	3951	8595
2007	836	8930	911	552	1462	9766
2008	5880	6603	327	848	1175	12483
2009	2195	20917	0	54	54	23113
2010	218	8694	16963	477	17440	8913
2011	3702	4031	543	161	704	7733
2012	444	1311	504	203	708	1755
2013	7079	1538	1819	677	2496	8617
2014	586	1483	122	218	340	2069
2015	482	2785	225	102	327	3267
2016	693	2342	600	20	620	3036

Table 6. Haddock biomass (mt) index by strata sections of eastern Georges Bank (see Figure 2) from the NMFS spring survey. Light shaded cells represent missing values calculated from adjacent strata sections. Dark shaded cells were recently updated with revised survey data. Cells with "-" represent missing values assumed to be zero while "0" represents observed zeros. Only the 33 year moving average data are shown.

Year	USA 16	CAN 16	USA 17	CAN 17	USA 18	CAN 18	USA 19	USA 20	USA 21	CAN 21	USA 22	CAN 22	USA total	CAN total
1984	3539	4784	8	168	0	0	1497	-	2	154	120	170	5166	5276
1985	1793	8819	14	99	0	18	167	0	-	3696	-	54	1974	12686
1986	1210	6880	0	21	0	0	367	0	0	1297	-	0	1578	8197
1987	245	7607	0	101	0	17	0	1005	-	63	-	69	1250	7856
1988	3085	2097	0	13	-	0	169	0	0	310	0	0	3255	2419
1989	5778	2961	28	146	-	79	123	0	0	751	-	256	5929	4193
1990	1612	8848	0	64	-	-	0	0	33	1305	-	21	1645	10238
1991	1012	6001	-	37	-	0	0	0	0	28	-	0	1012	6067
1992	442	1530	-	80	-	0	93	0	-	376	-	0	536	1986
1993	266	3234	-	439	-	0	0	0	-	387	-	154	266	4214
1994	2	801	11	1	0	-	0	-	6	5644	-	0	19	6446
1995	2297	578	42	60	0	-	778	0	2	3356	-	888	3119	4881
1996	3720	1021	23	32	-	0	8581	0	8	972	31	0	12362	2026
1997	218	1884	10	28	0	11	0	0	45	1239	-	74	273	3237
1998	574	6600	3	84	-	5	0	-	282	227	0	108	859	7024
1999	6267	3485	0	1598	-	0	0	74	42	366	37	38	6420	5487
2000	4238	3712	0	220	0	-	198	668	522	151	-	55	5626	4138
2001	297	1537	-	446	-	0	71	0	1215	4339	-	15	1583	6337
2002	13973	9781	0	332	-	15	8094	-	0	897	93	78	22161	11103
2003	2149	14472	2	77	-	0	699	291	1123	1438	19	46	4282	16034
2004	25198	27752	-	978	-	75	3503	28736	715	669	-	3	58152	29477
2005	1575	3031	680	948	0	-	4991	144	-	3945	132	484	7522	8408
2006	11166	8302	5	323	-	97	758	3059	143	4140	-	40	15131	12901
2007	9617	23430	7	64	0	90	19906	12979	295	795	-	124	42804	24502
2008	40456	5465	2	135	0	164	87	1869	484	151	0	204	42898	6120
2009	22760	4635	88	245	0	37	1061	1502	6546	6224	0	19	31957	11159
2010	11191	11361	92	85	0	147	12458	2895	1364	2968	36	109	28037	14670
2011	5332	6871	17	859	0	157	515	0	364	2642	0	740	6228	11270
2012	28213	15155	15	2039	1	315	3285	2483	-	3635	-	101	33997	21245
2013	5291	13149	0	557	0	294	5952	5047	-	18415	123	326	16413	32741
2014	3228	7953	133	2523	0	496	14247	21918	701	2405	-	1230	40227	14607
2015	13773	6688	367	941	59	753	54810	13065	-	5685	-	699	82074	14766
2016	24635	29393	9	326	0	1106	4735	11066	1009	6696	936	178	42390	37699

Table 7. Haddock biomass (mt) index by strata sections of eastern Georges Bank (see Figure 2) from the NMFS fall survey. Light shaded cells represent missing values calculated from adjacent strata sections. Dark shaded cells were recently updated with revised survey data. Cells with "-" represent missing values assumed to be zero while "0" represents observed zeros. Only the 33 year moving average data are shown.

Year	USA 16	CAN 16	USA 17	CAN 17	USA 18	CAN 18	USA 19	USA 20	USA 21	CAN 21	USA 22	CAN 22	USA total	CAN total
1984	0	308	-	1603	0	455	0	0	-	71	152	194	152	2632
1985	497	590	-	739	0	395	0	0	7	453	-	18	504	2195
1986	0	2368	-	1383	0	465	0	0	16	2079	0	26	16	6321
1987	7	8	-	320	-	140	8	7	0	205	0	239	22	911
1988	50	1134	-	366	-	1588	0	0	-	1724	0	413	50	5224
1989	4	528	-	987	2	1114	0	8	6	1331	46	296	66	4257
1990	51	29	0	1396	-	401	0	0	-	885	-	132	51	2842
1991	20	92	-	561	0	0	-	0	8	0	0	178	28	831
1992	171	292	0	585	-	173	0	8	0	6	-	21	179	1077
1993	0	443	-	217	-	0	0	0	-	4103	-	83	0	4846
1994	0	0	-	284	-	347	0	0	0	1162	-	0	0	1793
1995	4	5214	-	843	-	1373	0	0	0	6575	0	-	4	14005
1996	10	2057	-	1138	-	639	0	-	1	179	-	0	10	4012
1997	0	4	-	133	-	0	2	5	8	6012	-	0	15	6149
1998	7	3409	-	285	-	471	0	37	7	2241	-	-	51	6406
1999	0	151	-	113	-	2021	0	0	-	13900	0	0	0	16184
2000	100	1646	-	365	-	1351	0	0	0	9432	0	0	100	12795
2001	1013	1471	-	2264	-	395	0	0	0	21540	-	491	1013	26161
2002	314	21420	8	591	-	201	0	144	0	19620	206	223	671	42054
2003	2736	3312	-	331	-	95	342	219	123	6453	-	0	3420	10191
2004	3275	24845	746	1115	0	693	0	5	1766	8248	223	1181	6014	36083
2005	5647	13381	2	1071	0	98	3	120	585	5617	2650	11761	9009	31927
2006	2088	20548	0	837	0	571	0	-	-	4502	-	7275	2088	33732
2007	203	2560	6	788	-	39	0	0	11208	2860	-	15315	11417	21561
2008	89	2578	2	4246	0	775	0	0	0	8005	0	7470	91	23074
2009	11958	14743	0	2070	0	0	12254	304	240	3999	188	36	24944	20848
2010	2936	14967	50	1554	1	1087	0	0	2677	2604	697	707	6361	20919
2011	9122	29552	1606	2549	1	2355	166	0	1178	1096	0	443	12073	35995
2012	564	21501	0	798	0	680	0	0	784	29443	736	7528	2084	59950
2013	61804	27768	676	1060	89	447	22938	6321	-	3769	-	7276	91828	40320
2014	28032	24214	5450	7395	75	2543	16	4393	-	5710	-	6441	37966	46303
2015	15406	63954	4	10087	0	1252	186527	14234	12602	6342	-	257	228773	81892
2016	4249	75958	0	5347	0	1871	2751	3418	5738	20514	-	519	16156	104209

Table 8. Haddock biomass (mt) index by strata and strata sections of eastern Georges Bank (see Figure 2) from the DFO survey.

Year	CAN 5Z1	CAN 5Z2	USA 5Z3	USA 5Z4	USA total	CAN total
1987	2661	12956	375	99	475	15617
1988	1350	16559	8305	96	8401	17909
1989	982	9377	641	198	839	10359
1990	3943	15963	3424	4155	7579	19907
1991	3084	13597	7383	3260	10643	16680
1992	3544	10403	5953	576	6530	13946
1993	2064	2367	110	2411	2521	4432
1994	8871	9968	19	90	108	18839
1995	2244	18041	336	0	336	20285
1996	4947	16985	440	839	1279	21933
1997	1853	11022	1298	179	1476	12875
1998	15844	29323	89	11	99	45167
1999	14775	15221	506	319	825	29996
2000	4682	41522	11048	158	11206	46205
2001	9471	43754	2022	513	2535	53225
2002	5695	28569	3391	11863	15254	34264
2003	1583	89462	4334	27407	31741	91045
2004	21198	71574	5479	1796	7274	92772
2005	9638	39589	1931	5209	7140	49226
2006	5445	53525	35052	6285	41337	58970
2007	9705	43079	3811	5009	8820	52784
2008	35446	47657	34798	6063	40861	83102
2009	29750	41728	0[1]	82	82	71478
2010	1137	44993	5148	19991	25139	46130
2011	12095	32436	4114	10518	14632	44530
2012	4365	29550	25010	18497	43508	33915
2013	21809	50425	60218	31062	91281	72235
2014	26210	40788	1423	909	2332	66997
2015	5630	28722	150689	47854	198542	34352
2016	6344	160556	66166	4793	70959	166900

Table 9. Yellowtail Flounder biomass (mt) index by strata and strata sections of Georges Bank (see Figure 2) from the NMFS spring survey. Cells with "-" represent missing values assumed to be zero while "0" represents observed zeros. shaded cells were recently updated with revised survey data. Only the 33 year moving average data is shown.

Year	USA 13	USA 14	USA 15	USA 16	CAN 16	USA 17	CAN 17	USA 18	CAN 18	USA 19	USA 20	USA 21	CAN 21	USA total	CAN total
1984	135	0	0	342	747	-	0	0	0	265	201	16	0	960	747
1985	127	0	0	200	473	0	0	0	3	131	55	0	0	512	475
1986	190	0	0	68	584	0	0	0	0	71	0	9	20	338	604
1987	66	0	0	114	102	0	0	0	0	71	0	2	0	253	102
1988	193	0	0	183	146	0	0	-	0	46	6	40	0	467	146
1989	179	0	0	115	322	0	0	-	0	65	2	2	3	363	324
1990	545	0	0	30	117	0	7	-	-	37	0	0	0	612	124
1991	233	0	0	139	286	-	0	-	0	7	0	0	0	380	286
1992	295	0	0	178	1200	-	9	-	0	169	45	0	25	688	1233
1993	84	0	0	83	349	-	8	-	0	49	0	0	6	217	363
1994	103	0	0	127	383	0	0	0	-	70	0	55	37	356	419
1995	298	0	0	439	1854	-	0	0	-	41	12	4	44	794	1898
1996	103	0	0	1020	1724	-	9	-	0	229	120	13	23	1485	1756
1997	95	0	0	432	3631	0	0	3	0	35	59	2	0	626	3631
1998	704	0	0	910	676	0	0	-	0	38	65	19	302	1737	978
1999	768	0	0	2571	6830	0	0	-	0	5	67	36	3	3448	6833
2000	681	0	0	2003	4927	0	6	0	-	180	33	61	0	2956	4933
2001	61	0	0	2486	2389	-	8	-	0	101	20	240	17	2908	2413
2002	66	0	0	3656	3876	0	0	-	0	663	8	4	3150	4397	7026
2003	173	0	0	895	6384	0	28	-	0	21	0	14	-	1103	6412
2004	261	0	-	535	1219	-	0	-	0	74	16	0	62	886	1281
2005	216	0	0	2094	1025	0	0	0	-	44	0	0	33	2354	1058
2006	93	5	0	1258	1051	0	0	-	0	87	58	2	2	1504	1053
2007	372	382	3	733	3271	0	6	0	0	38	81	89	0	1699	3277
2008	234	0	0	968	1241	44	969	0	0	92	22	28	29	1388	2238
2009	1338	0	0	4298	5566	61	116	0	0	380	24	69	104	6171	5786
2010	573	974	0	4059	6352	0	6	1	0	2491	80	3	39	8182	6397
2011	3238	110	0	1821	251	7	0	0	0	368	89	6	0	5640	251
2012	1637	0	0	4763	817	0	7	0	1	1098	424	14	111	7936	936
2013	133	0	0	665	1151	6	28	0	0	138	54	6	175	1002	1354
2014	360	0	0	498	299	0	0	0	0	563	0	102	0	1523	299
2015	395	0	0	295	166	0	40	0	0	128	187	11	37	1016	243
2016	68	0	0	89	92	0	0	0	0	60	25	0	6	242	98

Table 10. Yellowtail Flounder biomass (mt) index by strata and strata sections of Georges Bank (see Figure 2) from the NMFS fall survey. Cells with "-" represent missing values assumed to be zero while "0" represents observed zeros. Shaded were recently updated with revised survey data. Only the 33 year moving average data are shown.

Year	USA 13	USA 14	USA 15	USA 16	CAN 16	USA 17	CAN 17	USA 18	CAN 18	USA 19	USA 20	USA 21	CAN 21	USA total	CAN total
1984	304	0	0	201	85	-	5	0	0	31	0	45	17	581	108
1985	141	0	0	405	171	-	4	0	0	0	0	0	38	547	212
1986	208	0	0	438	155	-	0	0	0	8	2	4	0	659	155
1987	69	0	0	193	267	-	0	-	0	16	0	0	0	278	267
1988	18	0	0	121	60	-	0	-	0	0	4	0	13	144	73
1989	794	0	0	202	83	-	0	0	-	9	21	0	0	1026	83
1990	388	0	0	282	76	0	0	-	0	32	0	0	0	702	76
1991	90	0	0	661	99	-	0	3	-	0	0	25	0	779	99
1992	177	0	0	9	419	0	0	-	0	16	22	0	0	224	419
1993	47	0	0	24	327	-	12	-	0	0	7	18	0	96	339
1994	113	0	0	105	755	-	18	-	0	11	0	118	19	347	792
1995	47	0	0	80	214	-	0	-	0	3	10	71	0	211	214
1996	90	0	0	1494	284	-	0	-	0	0	0	10	0	1593	284
1997	232	0	0	1808	1999	-	0	-	0	38	0	37	3	2115	2003
1998	818	0	0	592	2364	-	3	-	0	0	20	5	0	1435	2367
1999	770	0	0	2935	3962	-	191	-	0	224	114	157	0	4200	4154
2000	171	0	0	5580	1097	-	4	-	0	60	22	144	20	5978	1121
2001	641	0	0	7877	2139	-	13	-	0	177	47	111	0	8853	2153
2002	161	0	0	1784	1861	0	7	-	0	5	10	214	75	2174	1943
2003	92	0	0	2825	1613	-	0	-	0	158	0	43	3	3119	1616
2004	161	0	0	5915	78	0	0	0	0	172	12	67	121	6327	198
2005	145	0	0	1133	1260	0	7	0	0	41	29	56	9	1404	1276
2006	1475	0	-	2909	294	0	45	1	0	25	3	16	37	4429	376
2007	274	0	0	5739	753	3	0	0	0	52	6	114	115	6188	868
2008	852	0	0	3090	3654	0	0	0	0	0	0	31	58	3973	3712
2009	4209	0	0	10518	785	0	45	0	0	1180	151	161	136	16219	966
2010	1497	4	0	2371	1579	18	74	4	0	61	0	20	39	3975	1692
2011	2139	0	3	2511	880	14	0	0	0	63	0	13	841	4742	1721
2012	49	0	0	4888	400	0	0	0	0	29	0	617	49	5583	449
2013	164	0	0	1255	542	0	0	0	0	260	114	0	28	1793	570
2014	392	0	0	1478	762	0	0	0	0	0	5	0	3	1875	765
2015	0	0	0	180	1016	0	0	0	0	28	0	0	34	208	1050
2016	68	0	0	211	57	0	0	0	0	3	3	4	139	289	196

Table 11. Yellowtail Flounder biomass (mt) index by strata of Georges Bank (see Figure 2) from the DFO survey.

Year	CAN 5Z1	CAN 5Z2	USA 5Z3	USA 5Z4	USA total	CAN total
1987	69	750	102	343	445	819
1988	30	253	136	816	952	283
1989	29	111	50	281	331	140
1990	39	358	129	1053	1181	397
1991	57	444	262	996	1258	501
1992	119	432	327	1599	1925	550
1993	59	1634	178	771	949	1693
1994	91	501	745	1417	2162	591
1995	35	785	487	719	1206	820
1996	35	2799	1229	1241	2470	2833
1997	868	2464	2431	7529	9960	3332
1998	93	2484	613	1102	1715	2577
1999	190	6616	408	10452	10860	6806
2000	2019	5526	6430	5974	12404	7545
2001	443	4995	963	15757	16720	5438
2002	66	5052	5854	9727	15581	5118
2003	48	5739	75	10387	10462	5786
2004	84	5637	63	3271	3334	5720
2005	51	1028	392	11886	12278	1079
2006	35	776	962	4805	5767	812
2007	196	2959	102	10088	10189	3155
2008	64491	1656	262	910	1172	66147
2009	70851	1077	45	72	117	71927
2010	5332	3226	178	402	580	8558
2011	1	477	800	2552	3351	479
2012	89	1121	385	4055	4440	1210
2013	212	252	77	157	234	464
2014	79	98	79	257	336	177
2015	40	108	80	595	675	147
2016	20	235	31	1441	1473	255

Table 12. Resource distribution for eastern Georges Bank Atlantic Cod on the Canadian and USA sides of the international boundary for the NMFS and DFO surveys, the distribution resulting from combining the surveys, and the smoothed resource distribution. The combined distribution was obtained by averaging the NMFS spring and DFO surveys to represent winter-spring and subsequently averaging with NMFS fall which represented summer-fall. Shaded cells were recently updated with revised survey data. Open box highlights current year results. Only the 33 year moving average data are shown. Number in parentheses reflect original values, before revisions were applied.

Year	NMFS fall		NMFS spring		DFO		Combined surveys		Smoothed	
	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA
1984	96	4	23	77	-	-	59	41	69	31
1985	100	0	62	38	-	-	81	19	71	29
1986	58	42	62	38	-	-	60	40	74	26
1987	90	10	61	39	84	16	81	19	78	22
1988	99	1	69	31	76	24	86	14	82	18
1989	99	1	62	38	74	26	83	17	85	15
1990	100	0	74	26	89	11	91	9	85	15
1991	100	0	62	38	78	22	85	15	85	15
1992	94	6	83	17	66	34	85	15	85	15
1993	100	0	41	59	61	39	76	24	84	16
1994	100	0	70	30	96	4	91	9	83	17
1995	94	6	87	13	52	48	82	18	83	17
1996	95	5	55	45	73	27	80	20	84	16
1997	100	0	62	38	70	30	83	17	84	16
1998	100	0	96	4	88	12	96	4	84	16
1999	97	3	53	47	77	23	81	19	85	15
2000	100	0	48	52	69	31	79	21	82	18
2001	97	3	74	26	95	5	90	10	86	14
2002	98	2	63	37	95	5	88	12	88	12
2003	81	19	73	27	69	31	76	24	82	18
2004	99	1	81	19	87	13	91	9	86	14
2005	93	7	66	34	34	66	71	29	79	21
2006	97	3	31	69	69	31	73	27	74	26
2007	81	19	40	60	87	13	72	28	71	29
2008	100	0	57	43	91	9	87	13	77	23
2009	82	18	75	25	100	0	85	15	83	17
2010	96	4	51	49	34	66	69	31	78	22
2011	97	3	82	18	92	8	92	8	87	13
2012	84	16	59	41	71	29	75	25	81 (80)	19 (20)
2013	97	3	81	19	78	22	88	12	84 (83)	16 (17)
2014	93	7	35	65	86	14	77	23	81 (80)	19 (20)
2015	91	9	62	38	91	9	84	16	82	18
2016	43	57	94	6	83	17	66	34	**74**	**26**

Table 13. Resource distribution for eastern Georges Bank Haddock on the Canadian and USA sides of the international boundary for the NMFS and DFO surveys, the distribution resulting from combining the surveys, and the smoothed resource distribution. The combined distribution was obtained by averaging over all surveys. Open box highlights current year results. Shaded cells were recently updated with revised survey data. Only the 33 year moving average data are shown. Number in parentheses reflect original values, before revisions were applied.

Year	NMFS fall		NMFS spring		DFO		Combined surveys		Smoothed	
	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA
1984	95	5	51	49	-	-	73	27	82	18
1985	81	19	87	13	-	-	84	16	84	16
1986	100	0	84	16	-	-	92	8	84	16
1987	98	2	86	14	97	3	94	6	84	16
1988	99	1	43	57	68	32	70	30	83	17
1989	98	2	41	59	93	7	77	23	81	19
1990	98	2	86	14	72	28	86	14	80	20
1991	97	3	86	14	61	39	81	19	82	18
1992	86	14	79	21	68	32	78	22	84	16
1993	100	0	94	6	64	36	86	14	86	14
1994	100	0	100	0	99	1	100	0	86	14
1995	100	0	61	39	98	2	86	14	88	12
1996	100	0	14	86	94	6	69	31	89	11
1997	100	0	92	8	90	10	94	6	87	13
1998	99	1	89	11	100	0	96	4	86	14
1999	100	0	46	54	97	3	81	19	85	15
2000	99	1	42	58	80	20	74	26	80	20
2001	96	4	80	20	95	5	91	9	84	16
2002	98	2	33	67	69	31	67	33	74	26
2003	75	25	79	21	74	26	76	24	73	27
2004	86	14	34	66	93	7	71	29	71	29
2005	78	22	53	47	87	13	73	27	71	29
2006	94	6	46	54	59	41	66	34	68	32
2007	65	35	36	64	86	14	62	38	64	36
2008	100	0	12	88	67	33	60	40	60	40
2009	46	54	26	74	100	0	57	43	57	43
2010	77	23	34	66	65	35	59	41	57	43
2011	75	25	64	36	75	25	72	28	63	37
2012	97	3	38	62	44	56	60	40	63 (62)	37 (38)
2013	31	69	67	33	44	56	47	53	55 (52)	45 (48)
2014	55	45	27	73	97	3	59	41	57 (59)	43 (41)
2015	26	74	15	85	15	85	19	81	39	61
2016	87	13	47	53	70	30	68	32	**62**	**38**

Table 14. Resource distribution for Georges Bank Yellowtail Flounder on the Canadian and USA sides of the international boundary for the NMFS and DFO surveys, the distribution resulting from combining the surveys, and the smoothed resource distribution. The combined distribution was obtained by averaging over all surveys. Shaded cells were recently updated with revised survey data. Open box highlights current year results. Only the 33 year moving average data are shown. Number in parentheses reflect original values, before revisions were applied.

Year	NMFS fall		NMFS spring		DFO		Combined surveys		Smoothed	
	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA
1984	16	84	44	56			30	70	32	68
1985	28	72	48	52			38	62	36	64
1986	19	81	64	36			42	58	37	63
1987	49	51	29	71	65	35	48	52	35	65
1988	34	66	24	76	23	77	27	73	32	68
1989	7	93	47	53	30	70	28	72	30	70
1990	10	90	17	83	25	75	17	83	31	69
1991	11	89	43	57	28	72	28	72	36	64
1992	65	35	64	36	22	78	51	49	42	58
1993	78	22	63	37	64	36	68	32	47	53
1994	70	30	54	46	21	79	48	52	50	50
1995	50	50	71	29	40	60	54	46	51	49
1996	15	85	54	46	53	47	41	59	50	50
1997	49	51	85	15	25	75	53	47	50	50
1998	62	38	36	64	60	40	53	47	48	52
1999	50	50	66	34	39	61	52	48	46	54
2000	16	84	63	37	38	62	39	61	46	54
2001	20	80	45	55	25	75	30	70	36	64
2002	47	53	62	38	25	75	44	56	38	62
2003	34	66	85	15	36	64	52	48	44	56
2004	3	97	59	41	63	37	42	58	44	56
2005	48	52	31	69	8	92	29	71	37	63
2006	8	92	41	59	12	88	20	80	27	73
2007	12	88	66	34	24	76	34	66	27	73
2008	48	52	62	38	98	2	69	31	40	60
2009	6	94	48	52	100	0	51	49	50	50
2010	30	70	44	56	94	6	56	44	56	44
2011	27	73	4	96	13	87	14	86	63	37
2012	7	93	11	89	21	79	13	87	19 (20)	81 (80)
2013	24	76	57	43	67	33	49	51	33 (34)	67 (66)
2014	29	71	16	84	35	65	27	73	28 (27)	72 (73)
2015	83	17	19	81	18	82	40	60	34	66
2016	40	60	29	71	15	85	28	72	**32**	**68**

Table 15. (a) Resource utilization and (b) smoothed distribution of eastern Georges Bank Atlantic Cod and Haddock, and Georges Bank Yellowtail Flounder (Ytl) and the weightings used in the USA/Canada allocation sharing formula. Allocation shares are updated annually based on resource distribution. Values are in percentage. Number in parentheses reflect original values, before revisions were applied.

a)

Country	Resource Utilization		
	Cod	Haddock	Ytl
USA	40	45	98
Canada	60	55	2

b)

Country	Survey Year	Resource Distribution			Fishing Year	Weighting		Allocation Shares		
		Cod	Had	Ytl		Utilization	Distribution	Cod	Had	Ytl
USA	2000	18	20	54	2002	40	60	27	30	72
Canada	2000	82	80	46	2002	40	60	73	70	28
USA	2001	14	16	64	2003	40	60	24	28	78
Canada	2001	86	84	36	2003	40	60	76	72	22
USA	2002	12	26	62	2004	40	60	23	34	76
Canada	2002	88	74	38	2004	40	60	77	66	24
USA	2003	18	27	56	2005	35	65	26	33	71
Canada	2003	82	73	44	2005	35	65	74	67	29
USA	2004	14	29	56	2006	30	70	22	34	69
Canada	2004	86	71	44	2006	30	70	78	66	31
USA	2005	21	29	63	2007	25	75	26	33	72
Canada	2005	79	71	37	2007	25	75	74	67	28
USA	2006	26	32	73	2008	20	80	29	35	78
Canada	2006	74	68	27	2008	20	80	71	65	22
USA	2007	29	36	73	2009	15	85	31	37	77
Canada	2007	71	64	27	2009	15	85	69	63	23
USA	2008	23	40	60	2010	10	90	25	40.5	64
Canada	2008	77	60	40	2010	10	90	75	59.5	36
USA	2009	17	43	50	2011	10	90	19	43	55
Canada	2009	83	57	50	2011	10	90	81	57	45
USA	2010	22	43	44	2012	10	90	24	43	49
Canada	2010	78	57	56	2012	10	90	76	57	51
USA	2011	13	37	37	2013	10	90	16	38	43
Canada	2011	87	63	63	2013	10	90	84	62	57
USA	2012	19(20)	37(38)	81(80)	2014	10	90	21(22)	38(39)	83(82)
Canada	2012	81(80)	63(62)	19(20)	2014	10	90	79(78)	62(61)	17(18)
USA	2013	16(17)	45(48)	67(66)	2015	10	90	18(19)	45(48)	70(69)
Canada	2013	84(83)	55(52)	33(34)	2015	10	90	82(81)	55(52)	30(31)
USA	2014	19(20)	43(41)	72(73)	2016	10	90	21(22)	43(41)	75(76)
Canada	2014	81(80)	57(59)	28(27)	2016	10	90	79(78)	57(59)	25(24)
USA	2015	18	61	66	2017	10	90	20	59	69
Canada	2015	82	39	34	2017	10	90	80	41	31
USA	2016	26	38	68	2018	10	90	27	39	71
Canada	2016	74	62	32	2018	10	90	73	61	29

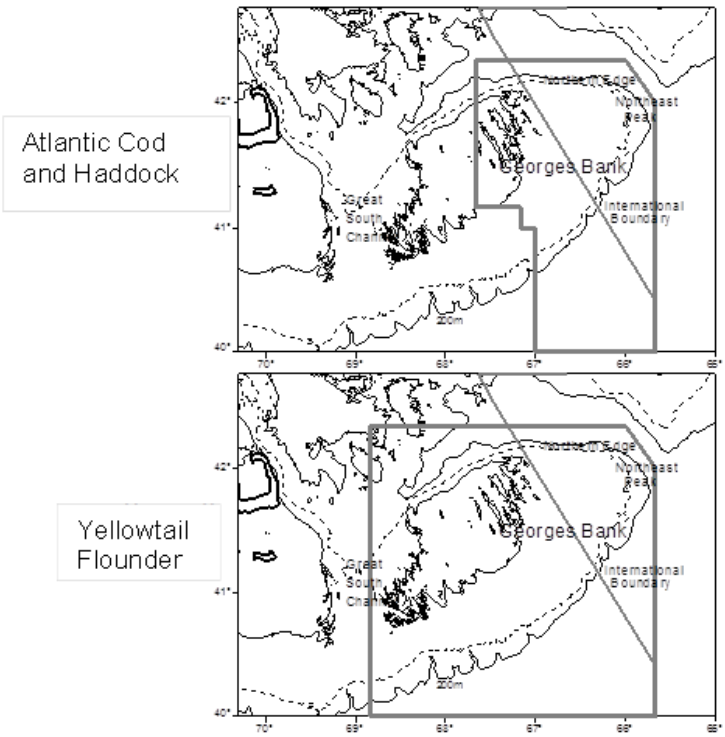

Figure 1. The management areas for Atlantic Cod, Haddock (upper panel), and Yellowtail Flounder (lower panel) on Georges Bank (thick grey line), including the Canada/USA boundary line (thin grey line) across which resource distribution was determined.

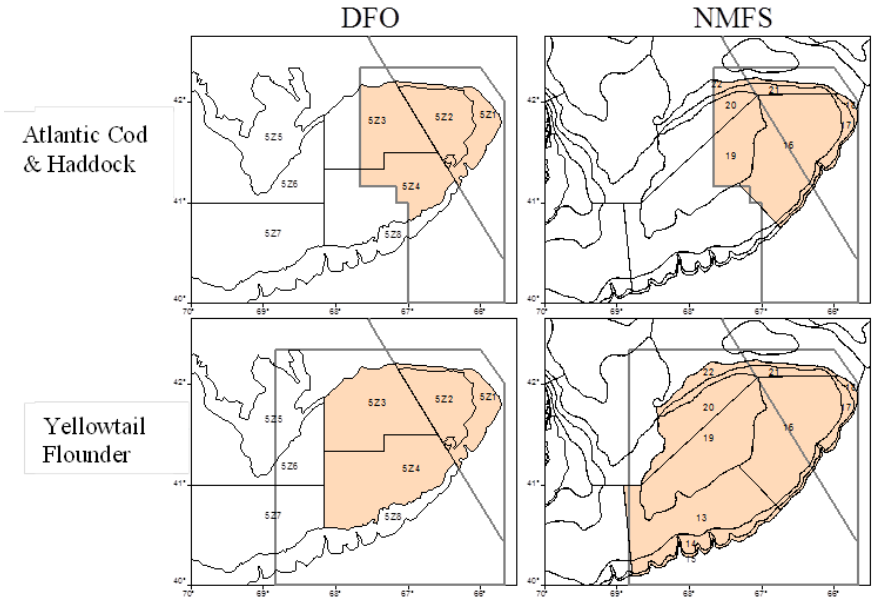

Figure 2. DFO and NMFS survey strata used to develop biomass indices on either side of the Canada/USA boundary for eastern Georges Bank Atlantic Cod and Haddock (upper panels) and Georges Bank Yellowtail Flounder (lower panels) in relation to the management unit borders. Strata boundaries (thin black lines) with strata labels are shown. The shaded area represents the strata and strata sections that were used to approximate the respective management units (thick grey lines).

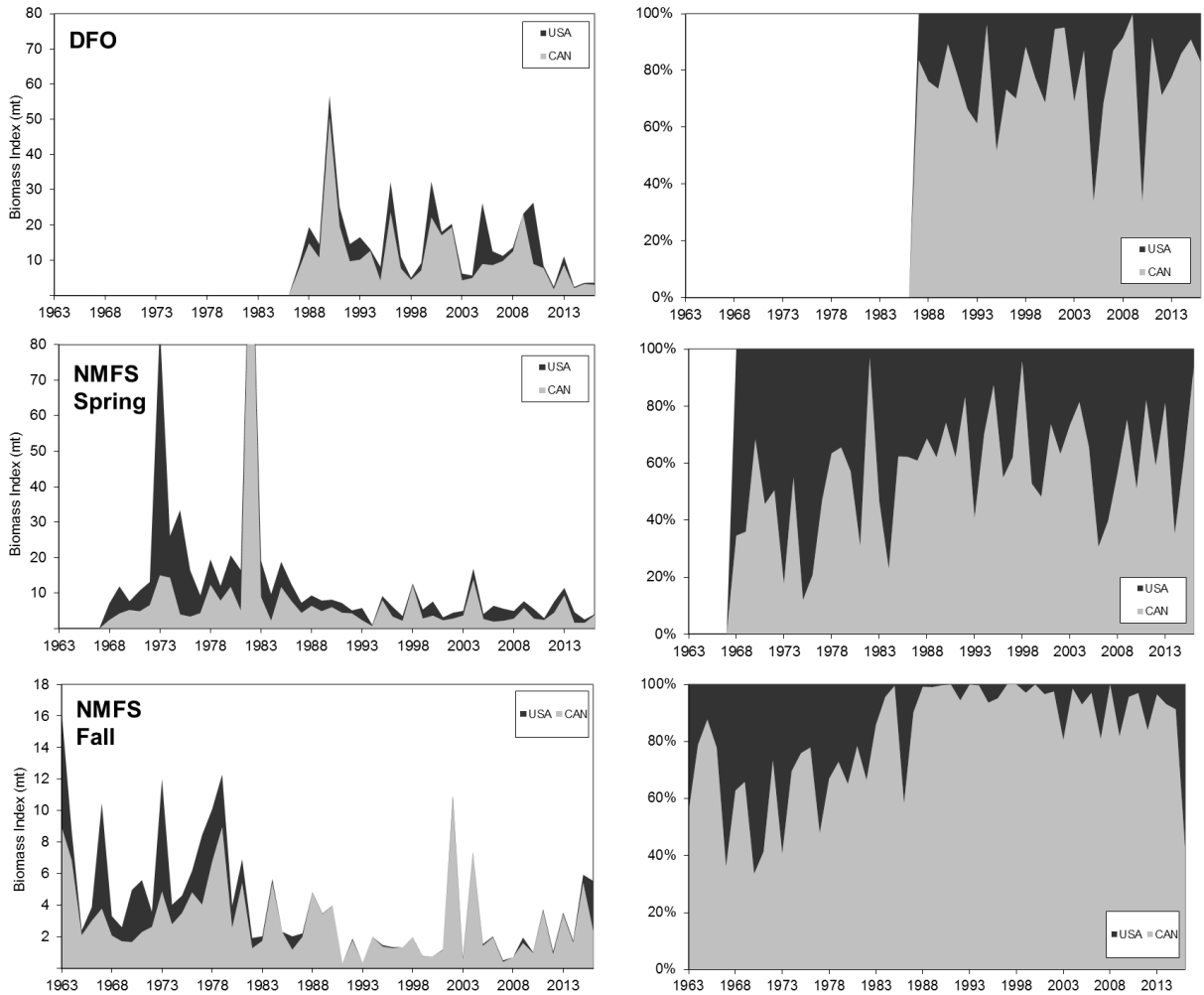

Figure 3. Relative indices of biomass and percentage resource distribution in relation to the international boundary for Atlantic Cod on eastern Georges Bank.

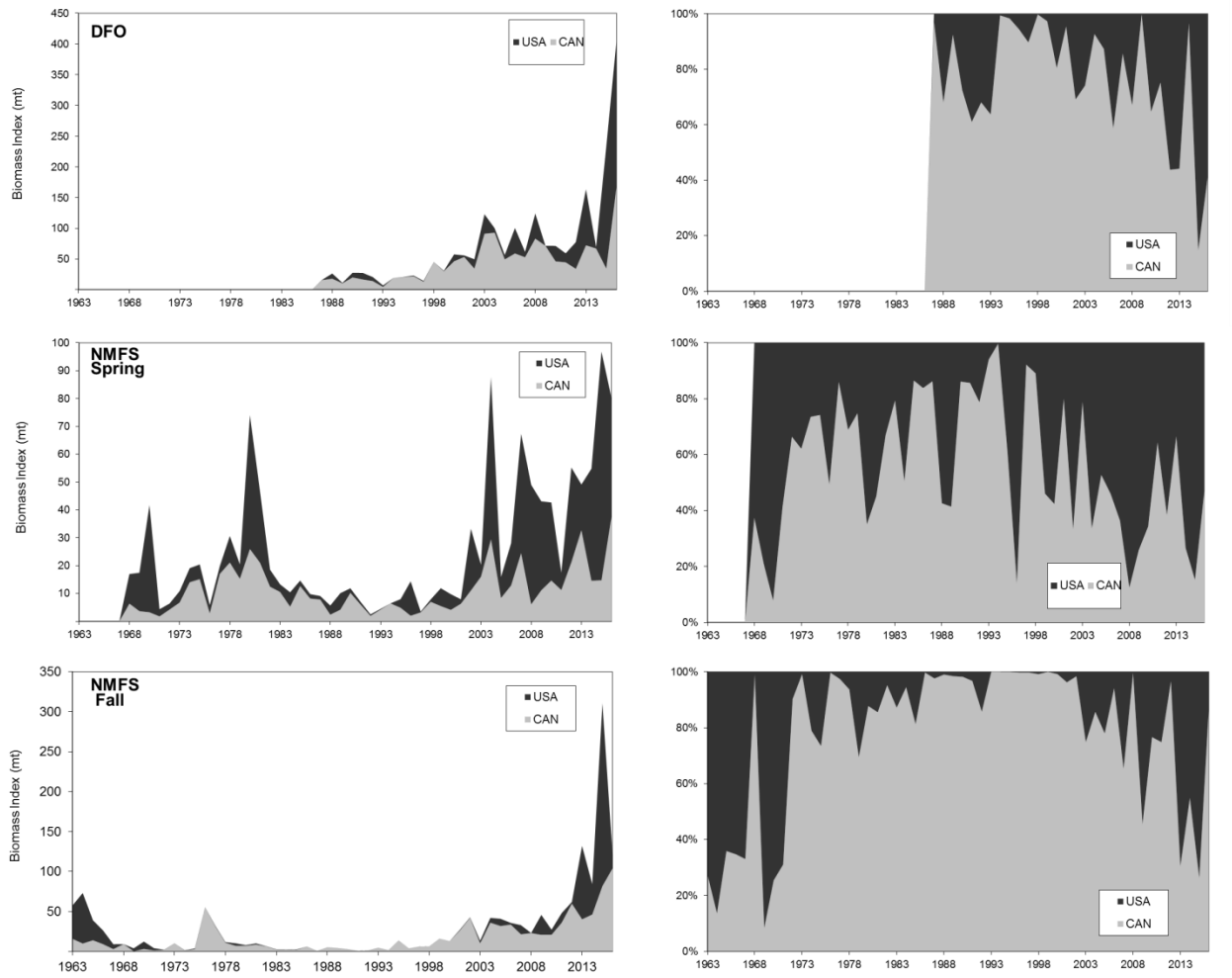

Figure 4. Relative indices of biomass and percentage resource distribution in relation to the international boundary for Haddock on eastern Georges Bank.

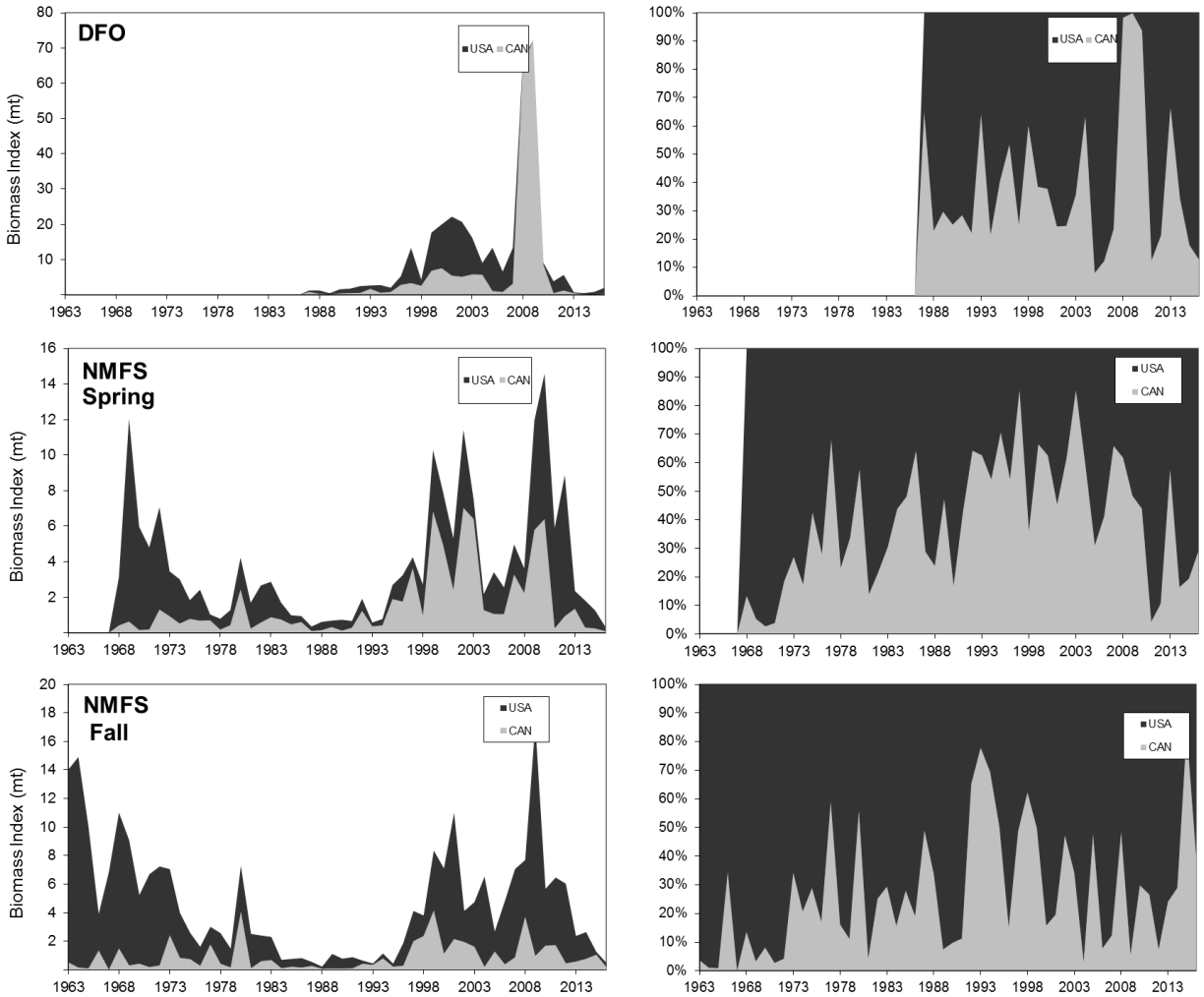

Figure 5. Relative indices of biomass and percentage resource distribution in relation to the international boundary for Yellowtail Flounder on Georges Bank.

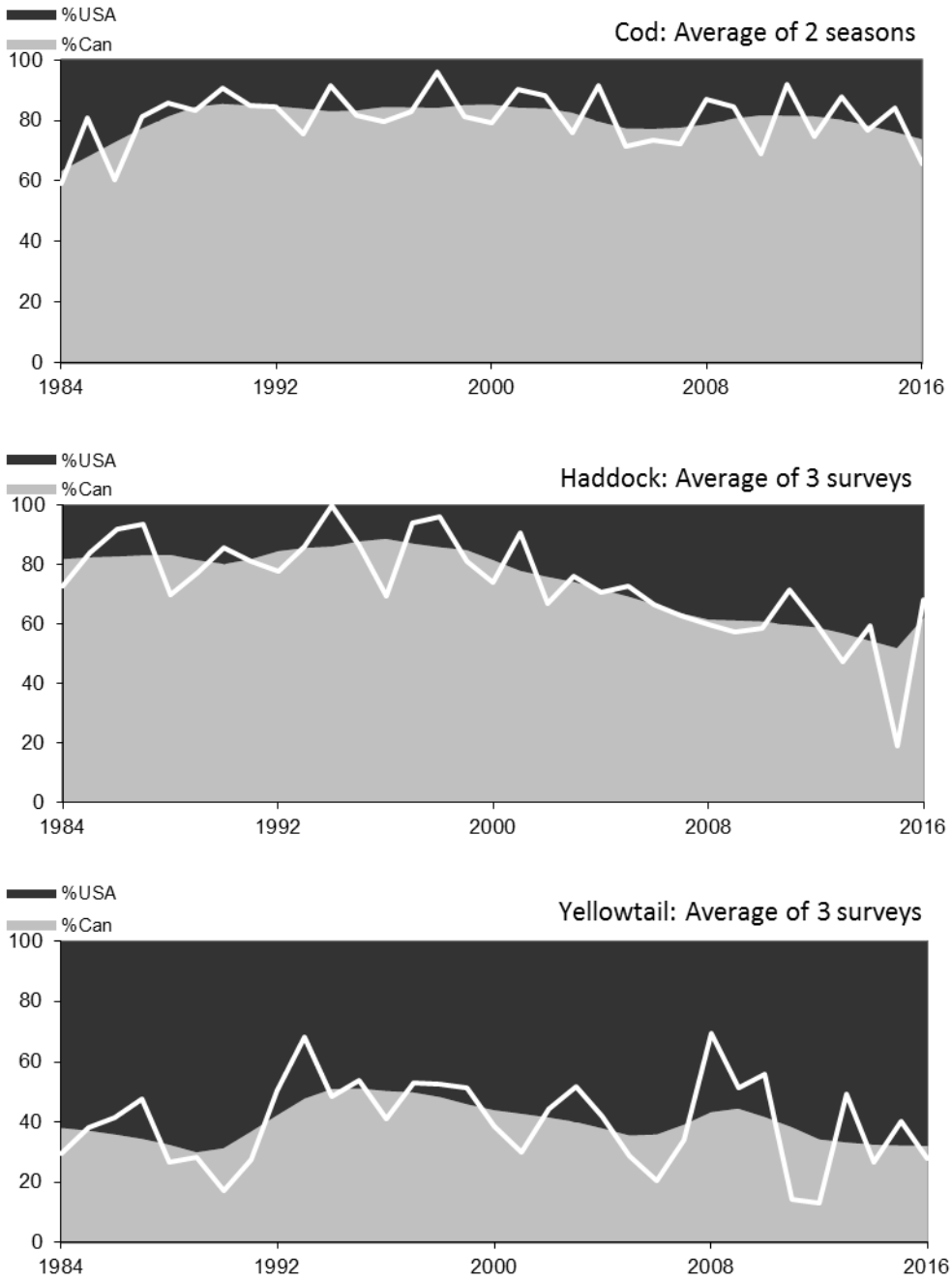

Figure 6. Observed annual percentage (white line) and smoothed trends of proportion of eastern Georges Bank Atlantic Cod (upper panel), eastern Georges Bank Haddock (middle panel), and Georges Bank Yellowtail Flounder (bottom panel) on the Canadian side of the international boundary.