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Comité d'évaluation des ressources transfrontalières

Document de référence 2014/04

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TRAC

Transboundary Resources Assessment Committee

Reference Document 2014/04

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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 2015

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ABSTRACT

The development of consistent management by Canada and the USA for the transboundary resources of Atlantic Cod, Haddock, and Yellowtail Flounder on Georges Bank led to a sharing allocation agreement. For Atlantic Cod and Haddock, the agreement is limited to the eastern Georges Bank management unit (Department of Fisheries and Oceans (DFO) Statistical Unit Areas 5Zj and 5Zm; United States of America (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 formula to account for both historical utilization, based on reported landings during 1967 through 1994, and temporal changes in resource distributions, determined from National Marine Fisheries Service (NMFS) and DFO survey results that are updated annually. From 2010 onward, utilization has accounted for 10% and distribution for 90% of the allocation. This report uses the 2013 DFO and NMFS survey results to update the calculation for the 2015 fishing year allocations.

The resource distributions in 2013 were: 17% USA, 83% Canada, for Atlantic Cod; 48% USA, 52% Canada, for Haddock; and 67% USA, 33% Canada for Yellowtail Flounder. The 2015 fishing year allocations (calendar year for Canada; May 1, 2015, to April 30, 2016, for the USA), updated with the 2013 resource distributions, resulted in shares for Atlantic Cod of 19% USA, 81% Canada, for Haddock of 48% USA, 52% Canada, and for Yellowtail Flounder of 70% USA, 30% Canada.

RÉSUMÉ

Soucieux de gérer de manière cohérente les stocks transfrontaliers de morue franche, d'aiglefin et de limande à queue jaune du banc Georges, le Canada et les États-Unis ont conclu une entente de partage de la ressource. Pour la morue franche et l'aiglefin, l'entente se limite à l'unité de gestion de l'est du banc Georges (unités statistiques 5Zj et 5Zm de Pêches et Océans Canada [MPO] et unités statistiques 551, 552, 561 et 562 des États-Unis). L'unité de gestion de la limande à queue jaune comprend quant à elle toute la partie du banc Georges située à l'est du Grand chenal Sud (unités statistiques 5Zh, 5Zj, 5Zm et 5Zn du MPO et unités statistiques 522, 525, 551, 552, 561 et 562 des États-Unis). Deux principes ont été intégrés à la formule de calcul des parts afin de tenir compte à la fois de l'utilisation historique de la ressource, d'après les débarquements déclarés de 1967 à 1994, et des changements temporels dans la répartition de la ressource, d'après les résultats des relevés du National Marine Fisheries Service (NMFS) et du MPO, qui sont mis à jour chaque année. À compter de 2010, l'utilisation de la ressource comptera pour 10 % et la répartition pour 90 % dans le calcul des parts. Ce rapport utilise les résultats des relevés du NMFS et du MPO de 2013 pour calculer les parts pour la saison de pêche de 2015.

En 2013, la ressource était répartie à raison de 17 % pour les États-Unis et 83 % pour le Canada pour la morue franche, de 48 % pour les États-Unis et 52 % pour le Canada pour l'aiglefin et de 67 % pour les États-Unis et 33 % pour le Canada pour la limande à queue jaune. Les parts pour l'année de pêche de 2015 (année civile pour le Canada et période du 1er mai 2015 au 30 avril 2016 pour les États-Unis), calculées en tenant compte de la répartition de la ressource en 2013, ont été établies à raison de 19 % pour les États-Unis et 81 % pour le Canada pour la morue franche, de 48 % pour les États-Unis et 52 % pour le Canada pour l'aiglefin et de 70 % pour les États-Unis et 30 % pour le Canada pour la limande à queue jaune.

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 Department of Fisheries and Oceans Canada (DFO) Statistical Unit Areas 5Zh, 5Zj, 5Zm, and 5Zn; for 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, the USA employs a management unit comprising all of Georges Bank and extending south and west of Cape Cod, while Canada uses only the eastern portion of Georges Bank. 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.

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 USA/Canada east coast maritime boundary. Results for fishing years 2006 to 2013 have been reported annually (Stone *et al.* 2013). This report uses the 2013 USA National Marine Fisheries Service (NMFS) and DFO survey results to estimate the 2015 fishing year allocations.

DATA AND METHODS

FORMULA

The TMGC (TMGC 2002) agreed approach for calculating the respective country shares that takes into consideration 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 resource distribution from surveys by 60% and country utilization by 40%. Thereafter, the percentage weighting was changed in 5% annual increments until the weightings reached 90% resource distribution from surveys and 10% country utilization from landings. This agreement was implemented in 2003, with the end of the transition to a 90/10 weighting in the 2010 fishing year according to the following schedule:

Year	2003	2004	2005	2006	2007	2008	2009	2010
Weighting	60/40	60/40	65/35	70/30	75/25	80/20	85/15	90/10

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 from 1967 to1994, inclusive, by country, 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 NMFS and DFO. Surveys of Georges Bank have been conducted by NMFS each fall (October) since 1963 and each spring (April) since 1968, and by DFO since 1986 (February).

Before 2009, two vessels (the former National Oceanic and Atmospheric Administration (NOAA) ships *Albatross IV* and *Delaware II*) were used to conduct NMFS surveys and a trawl door change occurred in 1985. Vessel and door conversion factors, derived from comparative fishing experiments (Forrester *et al.* 1997), were applied to the survey results to make the series consistent. Additionally, two different trawl nets were used on the NMFS spring surveys, a modified Yankee 41 from 1973 to 1981 and a Yankee 36 in all other years, but no conversion factors are available.

Starting in 2009, NMFS surveys were conducted by the NOAA ship *Henry B. Bigelow*, using a different net (3-bridle, 4 seam) and revised protocols. Given that the allocation is based on proportions of biomass distribution within a survey, the use of biomass-based conversion coefficients is not necessary, *i.e*. proportions would not change if survey indices were calibrated by a constant. As the conversion coefficients are length based, differences in fishing power between the vessels could potentially affect biomass estimates if there were large disparities in length composition on each side of the Hague Line. However, when length frequencies from the two jurisdictions were compared for the 2009 surveys, the differences were minor and application of a length-weight relationship to the length frequencies produced negligible differences in biomass.

The Canadian Coast Guard Ship (CCGS) *Alfred Needler* is the standard vessel used for the DFO Georges Bank survey, but, due to unavailability of the *Alfred Needler*, the CCGS *Wilfred Templeman*, a sister ship to the *Alfred Needler*, has been used in several years; 1993, 2004, 2007, and 2008. No conversion factors are available for the *Wilfred Templeman*. However, this vessel is considered to be similar in fishing strength to the *Alfred Needler*.

Swept area biomass, considered a relative index of abundance, was computed for each species in each stratum and apportioned to USA and Canadian sectors in each year (see Figure 2 for strata and “strata sections” on each side of the international boundary, and Table 2 for their areas). 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 NMFS and DFO survey designs are based on randomization within strata, the data were post-stratified to USA and Canadian zones within the existing survey strata.

Estimates of biomass indices were calculated for entire strata and for strata sections unless no observations occurred within a stratum (Tables 3 to 11). 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 unduly. 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. The swept area biomasses for each groundfish species were summed individually to derive the biomass index on the USA and Canadian side for each management unit. Age and size specific distribution patterns were ignored 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 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.

A robust locally weighted regression algorithm (Cleveland 1979), referred to as LOESS, was adopted for removing both unpredictable fluctuations and sampling variation from the 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 (Cleveland 1979) of two robustness iterations also was adopted. Resource distributions are updated annually by incorporating data from the latest surveys and dropping data from the earliest survey used in the previous year (2013 and 1980, respectively, in this case) so that a 33-year window is maintained. After the surveys were combined, the LOESS smoother was applied to the 1981 to 2013 survey data. The fixed resource utilization (10% weighting) and the 2013 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 fishing year two years beyond the latest survey data (2015).

RESULTS

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

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

The biomass indices were updated for each species with 2013 values for the NMFS spring and fall surveys and the DFO survey (Tables 3 to 11; Figures 3, 4, and 5). For 2013 surveys, it was not necessary to derive any values for missing values. The biomass of Atlantic Cod in 2013 was highest on the Canadian side for all three surveys. This pattern is similar to 2011 and 2012, but it differed from 2010 when the DFO survey found very high biomass on the USA side and the NMFS spring survey detected approximately equal biomass on each side. Haddock

biomass in 2013 was highest in USA waters for all surveys, particularly the NMFS fall and DFO surveys. This is in contrast to 2011 when Haddock biomass was highest in Canadian waters for all three surveys. For Yellowtail Flounder, biomass in 2013 was highest on the Canadian side for the NMFS spring and DFO surveys, and it was highest on the USA side for the NMFS fall survey. This is a change from 2012 when all three surveys found higher biomass in USA waters.

The resource distributions for the three surveys, for the combined surveys, and the results from the smoothing algorithm for the most recent 33-year time period, with the terminal year being 2013, were determined for Atlantic Cod, Haddock, and Yellowtail Flounder (Tables 12, 13, and 14, respectively; Figure 6). The smoothed percentages for 2013 differ from those previously presented (Murawski and Gavaris 2004; Stone *et al.* 2013), due to dropping the earliest year of survey data and the incorporation of the next recent year of survey data in the smoothing algorithm. The resulting smoothed resource distributions for eastern Georges Bank in 2013 were, for cod: 83% Canada, 17% USA; for Haddock: 52% Canada, 48% USA; and for Yellowtail Flounder: 33% Canada, 67% USA (Table 15, Figure 6).

The 2013 smoothed resource distributions and the fixed resource utilization were applied to the agreed sharing formula and result in shares for the 2015 fishing year (calendar year for Canada; May 1, 2015, to April 30, 2016, for the USA) for Atlantic Cod of 19% USA, 81% Canada; for Haddock of 48% USA, 52% Canada; and for Yellowtail Flounder of 70% USA, 30% Canada (Table 15).

The abundance of Atlantic Cod declined in the mid 1980s and the biomass index in USA waters declined markedly, particularly in the NMFS fall survey (Figure 3). Most of the Atlantic Cod biomass during the NMFS spring surveys (Table 3) and the DFO surveys (Table 5) was located on the top of Georges Bank in shallower depths (in DFO survey stratum 5Z2 and NMFS survey strata 16, 19, and 20, although, 19 and 20 were more important in the 1970s and early 1980s and have now declined in importance). The deeper slope strata have always been more important for Atlantic Cod in the NMFS fall survey than in the spring surveys (Table 4), but, after the late 1980s, these strata (particularly the deeper water on the Canadian side of NMFS survey strata 21 and 17, with high variability for stratum 17) became even more important as biomass shifted away from the top of the Bank (shift is also evident for the 2013 DFO survey where much of the cod biomass is in stratum 5Z1). Exceptions occurred in the 2011 and 2013 NMFS fall surveys when most of the cod occurred in Canadian waters on top of the bank (stratum 16). The percentage of Atlantic Cod in Canadian waters during the NMFS spring and DFO surveys generally has been lower than the percentage during the NMFS fall surveys although there have been a few exceptions in recent years. This difference has become more pronounced since the mid 1980s (Table 12, Figure 3).

Haddock abundance is near historic highs. It peaked during the early 1960s and again in the late 1970s, increased during the late 1990s, and rose to very high levels in the 2000s (Figure 4). The biomass index in USA waters was exceptionally high during the 1960s, and, coincident with the increase in Haddock abundance in recent years, the percentage in USA waters in the NMFS surveys, especially in the spring, has increased. As with Atlantic Cod, Haddock biomass is concentrated on top of the bank during both the NMFS spring and DFO surveys (Tables 6 and 8). However, in the 2013 there were also significant increases in biomass in the deeper strata, 19 and 5Z1 and 5Z3 for the NMFS spring and DFO surveys, respectively. Since the 1970s, Haddock biomass in the fall NMFS surveys has been concentrated in the deeper slope strata in Canadian waters. Stratum 19, entirely in USA waters, was important only in the early part of the fall series (Table 7). However, in 2013 it contained approximately 17% of the biomass estimate. The percentage of Haddock on each side of the Canada/USA boundary from the DFO survey is generally somewhat intermediate between the NMFS fall and NMFS spring

survey results (Table 13, Figure 4). For the first time, the percentage of Haddock was higher in USA waters for the NMFS fall survey (70%, Table 13).

Yellowtail Flounder survey abundance is approaching historic lows. It was high in the 1960s, declined and remained low during the 1970s and 1980s, increased during the 1990s, declined again, and then increased to 1960s levels in 2009 (Figure 5). The biomass index in USA waters was highest during the 1960s. In all three survey series (Tables 9 to 11), Yellowtail Flounder biomass has been highest on the southern flank of the Bank at the shallower depths in NMFS survey strata 13 and 16 and in DFO survey strata 5Z2 and 5Z4. NMFS survey stratum 19, a shallow depth stratum near the middle of the bank, was important during the 1960s only. A change in distribution occurred in 2008 and 2009, during the DFO survey, due to large catches in Canadian waters and the substantial decrease in catches on the USA side in those years. While the large yellowtail catches in 2008 and 2009 had an appreciable influence on the overall abundance index for the stock (Table 11, Figure 5), their impact on the estimated biomass distribution was less (Van Eeckhaute and O'Brien 2010). Averaging the 2008 and 2009 DFO surveys with the NMFS spring and fall surveys and subjecting the result to the smoothing algorithm produced no change in the Yellowtail Flounder allocation, whether the large tows were included or not. Such fluctuations have been observed in the past and the averaging/smoothing algorithm appears to handle them adequately (Figure 6). In 2011 and 2012, the distribution of yellowtail from the DFO survey shifted from Canadian (strata 5Z1/5Z2) to USA waters (strata 5Z4), whereas in 2013 more biomass was detected in Canadian strata (Table 11).

The percentage of biomass of eastern Georges Bank cod in Canadian waters, as indicated by the combined smoothed results, progressively increased from about 60% in the late 1970s to approximately 80% in the late 1980s, fluctuated between 83% and 85% until 2003, declined to 77% in 2006, and then increased again to 87% in 2011 (Table 12, Figure 6). In 2013 the percentage in Canadian waters was 83%. The percentage of biomass of eastern Georges Bank Haddock in Canadian waters fluctuated around 80% from the late 1970s and 1980s to almost 90% in the mid 1990s, and, with the large increase in biomass, has subsequently declined to 53% in 2013 (Table 13, Figure 6). The percentage of Georges Bank Yellowtail Flounder biomass in Canadian waters was at a low of 18% in 1979, gradually increased through the 1980s and most of the 1990s to about 50%, declined to 35% in 2005/2006, and then increased to 63% in 2011 (Table 14, Figure 6). In 2012, the percentage of Yellowtail Flounder biomass in Canadian waters dropped sharply to 20%, and in 2013 it was 32%.

DISCUSSION

Consistent fisheries management advice utilizing the allocation sharing arrangement 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 2004 to 2013 TMGC Guidance Documents for application to the 2005 to 2014 fishing year quotas, respectively (TMGC 2013). However, in 2009, due to the inability of TMGC to come to an agreement on the Yellowtail Flounder quota, the Yellowtail Flounder allocation sharing arrangement for 2010 was not adhered to. The enactment of the International Fisheries Agreement Clarification Act by the USA in January 2011, which allows the USA more flexibility in negotiating quotas in TMCG, should facilitate adherence to the sharing arrangement. It is recognized that the analyses are based on calendar year data but that the fishing year for USA fisheries starts May 1st and ends April 30th. The fishing year for Canadian fisheries starts January 1st and ends December 31st.

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TABLES

Table 1. Annual landings (mt) of Atlantic Cod, Haddock, and Yellowtail Flounder from the transboundary management units on Georges Bank.

	Atlantic Cod			Haddock			Yellowtail Flounder		
Year	Canada	USA	Total	Canada	USA	Total	Canada	USA	Total
1967	8,188	3,115	11,303	12,999	11,999	24,998	133	8,407	8,540
1968	9,055	3,244	12,299	9,195	7,646	16,841	122	12,799	12,921
1969	5,876	3,676	9,552	3,941	6,621	10,562	327	15,944	16,271
1970	2,580	3,211	5,791	1,970	3,154	5,124	70	15,505	15,575
1971	2,950	4,389	7,339	1,610	3,533	5,143	102	11,878	11,980
1972	2,535	2,708	5,243	609	1,551	2,160	8	14,157	14,165
1973	3,222	3,064	6,286	1,565	1,396	2,961	12	15,899	15,911
1974	1,370	3,792	5,162	462	955	1,417	5	14,607	14,612
1975	1,833	3,108	4,941	1,353	1,705	3,058	8	13,205	13,213
1976	2,320	2,037	4,357	1,362	974	2,336	11	11,336	11,347
1977	6,156	4,256	10,412	2,871	2,428	5,299	38	9,444	9,482
1978	8,777	5,502	14,279	9,968	4,724	14,692	56	4,519	4,575
1979	5,979	6,408	12,387	5,080	5,212	10,292	17	5,475	5,492
1980	8,065	6,418	14,483	10,017	5,615	15,632	81	6,481	6,562
1981	8,498	8,092	16,590	5,658	9,075	14,733	12	6,182	6,194
1982	17,825	8,565	26,390	4,872	6,280	11,152	18	10,634	10,652
1983	12,131	8,573	20,704	3,208	4,453	7,661	43	11,350	11,393
1984	5,761	10,551	16,312	1,463	5,120	6,583	4	5,764	5,768
1985	10,442	6,641	17,083	3,484	1,684	5,168	3	2,477	2,480
1986	8,411	5,697	14,108	3,415	2,201	5,616	27	3,041	3,068
1987	11,844	4,793	16,637	4,703	1,418	6,121	56	2,743	2,799
1988	12,740	7,645	20,385	5,941	1,694	7,635	47	1,866	1,913
1989	7,895	6,182	14,077	3,060	785	3,845	32	1,134	1,166
1990	14,364	6,414	20,778	3,340	1,188	4,528	13	2,751	2,764
1991	13,459	6,353	19,812	5,423	931	6,354	25	1,784	1,809
1992	11,673	5,080	16,753	4,090	1,629	5,719	15	2,859	2,874
1993	8,524	4,027	12,551	3,725	424	4,149	675	2,089	2,764
1994	5,278	1,229	6,507	2,412	32	2,444	2,139	1,589	3,728
1995	1,099	638	1,737	2,062	22	2,084	470	410	880
1996	1,921	757	2,678	3,666	35	3,701	472	777	1,249
1997	2,919	551	3,470	2,749	47	2,796	809	969	1,778
1998	1,893	828	2,721	3,362	311	3,673	1,175	1,836	3,011
1999	1,818	1,151	2,969	3,679	355	4,034	1,992	2,066	4,058
2000	1,572	662	2,234	5,402	188	5,590	2,860	3,678	6,538
Total 1967-94	217,751	144,770	362,521	117,796	94,427	212,223	4,099	215,919	220,018
Percentage 1967-94	60%	40%	-	56%	45%	-	2%	98%	-

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. Shaded cells represent missing values calculated from adjacent strata sections. Cells with "-" represent missing values assumed to be zero while "0" represents observed zeros.

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
1968	1,543	2,053	-	313	-	16	2,762	0	335	70	0	-	4,640	2,451
1969	1,876	4,015	0	264	0	0	2,413	2,882	452	0	-	0	7,623	4,278
1970	948	4,877	0	375	0	28	520	809	164	0	-	0	2,441	5,280
1971	3,071	4,267	0	258	0	0	2,376	383	0	365	-	0	5,830	4,890
1972	1,322	5,875	0	69	0	0	3,749	1,378	68	669	-	32	6,518	6,645
1973	16,082	13,420	-	136	0	195	6,119	47,331	275	1,004	405	279	70,212	15,035
1974	8,700	13,169	0	230	-	32	2,681	260	92	872	0	68	11,733	14,370
1975	2,515	3,220	0	370	-	12	6,365	20,482	20	287	-	119	29,382	4,008
1976	2,017	2,302	-	567	-	5	4,949	5,985	81	527	0	-	13,032	3,402
1977	694	2,118	0	218	0	0	2,073	1,872	227	2,055	100	0	4,966	4,391
1978	3,959	6,849	25	627	0	9	2,584	407	-	2,262	155	2,627	7,129	12,375
1979	2,044	5,988	0	405	-	94	436	751	711	1,357	206	42	4,148	7,885
1980	6,542	10,355	83	460	-	123	995	981	152	655	112	212	8,865	11,805
1981	4,839	1,927	103	894	-	-	2,235	3,654	489	821	72	1,495	11,391	5,137
1982	476	123,809	27	146	222	286	460	2,591	-	483	196	993	3,972	125,717
1983	549	7,246	246	784	0	93	0	8,737	619	588	106	253	10,258	8,963
1984	1,532	1,527	78	239	0	0	793	4,797	0	250	301	223	7,500	2,240
1985	1,142	9,618	29	57	0	159	2,886	3,032	-	1,239	-	675	7,088	11,747
1986	1,504	5,622	103	45	0	13	2,824	298	23	1,712	-	425	4,751	7,817
1987	1,430	3,370	0	497	0	23	549	804	74	305	-	250	2,856	4,444
1988	1,236	4,560	0	334	-	42	1,403	243	60	1,229	0	269	2,942	6,432
1989	583	4,630	0	33	-	9	1,875	550	0	250	-	0	3,008	4,923
1990	1,128	4,693	0	519	-	146	475	449	57	108	-	603	2,110	6,068
1991	559	3,512	-	178	-	157	1,920	154	115	617	-	36	2,748	4,499
1992	0	2,116	-	293	-	9	491	316	55	639	-	1,240	862	4,296
1993	749	695	-	1,322	-	0	2,229	472	-	134	-	229	3,451	2,380
1994	143	0	0	21	0	-	96	43	36	658	-	73	318	752
1995	350	7,548	-	63	0	-	302	503	-	265	-	150	1,154	8,026
1996	1,161	1,545	-	221	-	0	1,211	74	358	1,653	0	0	2,803	3,419
1997	756	1,561	11	107	0	28	471	0	116	176	-	343	1,355	2,214
1998	235	6,238	0	187	-	72	0	-	110	5,408	186	263	531	12,168
1999	1,053	2,482	0	13	-	0	337	667	0	338	495	25	2,552	2,858
2000	1,458	3,281	0	11	0	-	967	1,513	27	302	-	96	3,965	3,691
2001	191	1,795	-	59	-	0	275	166	207	155	-	340	839	2,349
2002	1,341	2,243	0	23	-	46	318	-	0	477	0	64	1,659	2,851
2003	478	3,194	25	50	-	0	387	61	242	318	149	131	1,342	3,694
2004	309	2,252	-	12	-	119	252	2,462	119	11,393	-	0	3,142	13,776
2005	1,235	1,599	0	266	0	-	0	64	-	697	121	151	1,420	2,713
2006	3,162	511	0	457	-	0	524	277	509	1,011	-	0	4,472	1,979
2007	2,287	1,759	15	128	0	0	398	237	452	260	-	82	3,388	2,229
2008	1,488	1,669	0	18	0	0	368	300	6	788	0	345	2,162	2,820

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
2009	1,024	2,673	7	0	0	100	535	47	256	3,045	37	0	1,906	5,817
2010	541	1,070	0	410	0	125	667	461	941	1,010	94	198	2,704	2,813
2011	474	1,573	0	133	0	74	56	0	0	460	0	196	530	2,436
2012	1,075	3,504	6	182	0	0	646	1,412	0	695	0	146	3,139	4,528
2013	701	1,211	0	0	0	77	740	1,312	-	7,808	61	239	2,814	9,335

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. Cells with "-" represent missing values assumed to be zero while "0" represents observed zeros.

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	CAN Total
1963	385	6,654	0	0	0	-	3,851	2,806	245	2,313	0	-	7,287	8,968
1964	0	5,453	0	230	0	0	1,089	750	-	1,180	-	0	1,840	6,864
1965	0	1,328	-	32	0	42	0	125	143	386	27	322	295	2,110
1966	0	1,414	0	68	0	779	386	467	6	480	0	280	859	3,021
1967	1,799	1,421	0	1,661	0	228	2,876	1,908	98	386	-	96	6,682	3,793
1968	0	226	0	445	-	134	515	640	81	432	-	849	1,236	2,087
1969	23	495	0	104	-	37	309	516	45	316	0	772	893	1,723
1970	0	461	0	0	-	249	1,445	1,718	143	679	-	286	3,306	1,674
1971	19	1,439	0	744	0	0	1,089	2,165	11	131	-	0	3,285	2,314
1972	815	2,016	-	314	0	0	0	0	138	310	0	-	953	2,639
1973	54	3,215	0	572	0	149	1,944	5,096	33	949	-	-	7,128	4,886
1974	0	601	0	0	0	46	0	1,227	0	2,160	0	0	1,227	2,807
1975	0	2,742	-	323	0	182	0	1,094	18	255	0	10	1,112	3,513
1976	79	3,547	0	21	0	36	51	1,150	87	1,148	0	71	1,367	4,824
1977	165	1,770	0	475	0	322	602	2,963	423	1,353	253	129	4,407	4,050
1978	0	4,898	0	345	0	213	1,684	303	1,105	744	242	557	3,333	6,756
1979	1,084	7,191	0	225	-	747	914	1,141	157	754	40	40	3,336	8,957
1980	0	784	0	1,049	0	34	529	805	11	536	39	182	1,385	2,585
1981	65	3,498	31	1,156	0	36	713	588	80	701	18	41	1,495	5,431
1982	0	382	-	250	-	0	0	491	11	655	146	0	648	1,286
1983	0	352	-	74	0	36	0	255	15	1,289	18	-	288	1,751
1984	0	3,745	-	495	0	838	0	244	-	345	0	-	244	5,423
1985	0	1,926	-	189	0	85	0	1	9	98	-	16	10	2,313
1986	138	722	-	217	0	102	0	0	710	147	0	0	848	1,187
1987	0	1,359	-	52	-	260	0	0	166	294	51	41	217	2,006
1988	0	2,154	-	251	-	610	2	6	-	385	30	1,400	38	4,799
1989	0	2,329	-	216	0	-	0	7	3	893	23	13	33	3,451
1990	12	2,647	0	285	-	27	0	0	-	1,014	-	16	12	3,989
1991	0	118	-	109	0	-	-	0	0	88	0	7	0	322
1992	57	643	0	704	-	0	0	35	13	380	-	57	105	1,784
1993	0	92	-	188	-	0	0	0	-	54	-	26	0	361
1994	0	56	-	157	-	201	0	0	7	1,583	-	0	7	1,997
1995	0	23	-	127	-	71	0	67	28	1,171	0	-	95	1,392
1996	0	652	-	311	-	48	0	-	66	181	-	93	66	1,284
1997	0	0	-	57	-	0	0	0	-	1,285	-	0	0	1,342
1998	0	1,031	-	31	-	170	0	0	-	769	-	-	0	2,001
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	1,151
2002	0	2,955	0	366	-	34	207	0	0	7,312	61	16	268	10,684
2003	0	133	-	0	-	0	135	0	0	405	-	23	135	561
2004	0	5,982	0	485	0	50	0	0	41	731	61	0	102	7,247
2005	0	486	0	445	0	40	0	77	32	366	0	102	109	1,440

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	CAN Total
2006	59	1,781	0	0	0	0	0	-	-	190	-	0	59	1,972
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	1,605
2010	0	457	0	0	0	47	0	0	0	480	45	0	45	984
2011	0	3,317	0	77	0	160	0	0	112	93	0	0	112	3,647
2012	0	120	0	0	0	0	0	0	0	622	171	0	171	741
2013	0	2,745	0	110	0	25	25	98	-	551	-	0	123	3,431

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	1,555	5,826	1,345	98	1,443	7,381
1988	1,894	12,927	3,856	775	4,631	14,821
1989	2,040	8,664	2,766	1,076	3,842	10,704
1990	1,708	48,900	4,622	1,435	6,057	50,608
1991	2,204	17,398	3,820	1,646	5,467	19,601
1992	2,087	7,602	4,005	887	4,892	9,689
1993	719	9,427	3,875	2,524	6,399	10,146
1994	817	11,821	455	47	502	12,638
1995	919	3,277	3,368	553	3,921	4,197
1996	1,090	22,489	3,927	4,667	8,594	23,579
1997	377	7,336	2,095	1,196	3,290	7,714
1998	332	4,091	551	32	583	4,423
1999	211	6,880	1,206	880	2,086	7,092
2000	228	21,947	9,281	842	10,123	22,174
2001	1,499	15,563	257	718	975	17,062
2002	2,298	17,043	309	683	992	19,341
2003	720	3,571	1,130	797	1,927	4,291
2004	685	4,248	699	29	728	4,933
2005	1,597	7,306	192	17,105	17,298	8,903
2006	127	8,469	2,652	1,299	3,951	8,595
2007	836	8,930	911	552	1,462	9,766
2008	5,880	6,603	327	848	1,175	12,483
2009	2,195	20,917	0[1]	54	54	23,113
2010	218	8,694	16,963	477	17,440	8,913
2011	3,702	4,031	543	161	704	7,733
2012	444	1,311	504	203	708	1,755
2013	7,079	1,538	1,819	677	2,496	8,617

[1]No cod were caught in 7 tows in this stratum section.

Table 6. Haddock biomass (mt) index by strata sections of eastern Georges Bank (see Figure 2) from the NMFS spring survey. Shaded cells represent missing values calculated from adjacent strata sections. Cells with "-" represent missing values assumed to be zero while "0" represents observed zeros.

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
1968	4,767	5,197	-	856	-	84	4,637	1,012	-	29	226	203	10,642	6,367
1969	11,660	2,342	0	1,141	0	0	1,914	71	0	44	152	137	13,797	3,664
1970	36,753	2,583	0	448	0	0	1,381	120	201	73	18	159	38,474	3,263
1971	1,102	469	0	194	3	0	1,215	0	240	38	-	1,097	2,561	1,798
1972	1,017	3,843	0	20	0	0	856	0	278	393	-	0	2,151	4,256
1973	2,320	5,270	-	113	0	0	1,546	207	42	86	0	1,284	4,116	6,752
1974	718	13,765	0	77	-	6	4,334	0	-	194	0	-	5,052	14,042
1975	4,047	7,002	0	59	-	0	1,203	0	24	8,076	-	34	5,273	15,171
1976	1,955	1,802	-	229	-	0	1,003	-	2	856	0	-	2,961	2,887
1977	323	3,283	0	43	0	0	1,165	1,242	41	13,720	0	0	2,771	17,046
1978	6,884	11,740	6	56	0	24	2,520	0	121	9,148	-	151	9,531	21,119
1979	3,715	12,218	10	84	-	0	1,049	0	103	987	260	2,005	5,137	15,294
1980	21,009	6,764	13	263	-	67	26,933	-	0	18,795	82	96	48,036	25,985
1981	12,286	15,870	2	44	-	-	9,096	3,890	-	4,215	370	944	25,642	21,073
1982	3,830	8,719	131	348	0	11	1,200	859	-	2,342	91	1,029	6,112	12,450
1983	1,487	5,525	21	668	0	0	0	708	61	3,999	464	368	2,741	10,559
1984	3,539	4,784	8	168	0	0	1,497	-	2	154	120	170	5,166	5,276
1985	1,793	8,819	14	99	0	18	167	0	-	3,696	-	54	1,974	12,686
1986	1,210	6,880	0	21	0	0	367	0	0	1,297	-	0	1,578	8,197
1987	245	7,607	0	101	0	17	0	1,005	-	63	-	69	1,250	7,856
1988	3,085	2,097	0	13	-	0	169	0	0	310	0	0	3,255	2,419
1989	5,778	2,961	28	146	-	79	123	0	0	751	-	256	5,929	4,193
1990	1,612	8,848	0	64	-	-	0	0	33	1,305	-	21	1,645	10,238
1991	1,012	6,001	-	37	-	0	0	0	0	28	-	0	1,012	6,067
1992	442	1,530	-	80	-	0	93	0	-	376	-	0	536	1,986
1993	266	3,234	-	439	-	0	0	0	-	387	-	154	266	4,214
1994	2	801	11	1	0	-	0	-	6	5,644	-	0	19	6,446
1995	2,297	578	42	60	0	-	778	0	2	3,356	-	888	3,119	4,881
1996	3,720	1,021	23	32	-	0	8,581	0	8	972	31	0	12,362	2,026
1997	218	1,884	10	28	0	11	0	0	45	1,239	-	74	273	3,237
1998	574	6,600	3	84	-	5	0	-	282	227	0	108	859	7,024
1999	6,267	3,485	0	1,598	-	0	0	74	42	366	37	38	6,420	5,487
2000	4,238	3,712	0	220	0	-	198	668	522	151	-	55	5,626	4,138
2001	297	1,537	-	446	-	0	71	0	1,215	4,339	-	15	1,583	6,337
2002	13,973	9,781	0	332	-	15	8,094	-	0	897	93	78	22,161	11,103
2003	2,149	14,472	2	77	-	0	699	291	1,123	1,438	19	46	4,282	16,034
2004	25,198	27,752	-	978	-	75	3,503	28,736	715	669	-	3	58,152	29,477
2005	1,575	3,031	680	948	0	-	4,991	144	-	3,945	132	484	7,522	8,408
2006	11,166	8,302	5	323	-	97	758	3,059	143	4,140	-	40	15,131	12,901
2007	9,617	23,430	7	64	0	90	19,906	12,979	295	795	-	124	42,804	24,502
2008	40,456	5,465	2	135	0	164	87	1,869	484	151	0	204	42,898	6,120
2009	22,760	4,635	88	245	0	37	1,061	1,502	6,546	6,224	0	19	31,957	11,159
2010	11,191	11,361	92	85	0	147	12,458	2,895	1,364	2,968	36	109	28,037	14,670
2011	5,332	6,871	17	859	0	157	515	0	364	2,642	0	740	6,228	11,270

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
2012	28,213	15,155	15	2,039	1	315	3,285	2,483	-	3,635	-	101	33,996	21,245
2013	24,543	14,231	0	557	0	294	5,952	5,047	-	18,415	123	326	35,664	33,823

Table 7. Haddock 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. Cells with "-" represent missing values assumed to be zero while "0" represents observed zeros.

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
1963	12,153	8,911	0	1,892	0	2,127	27,496	1,401	541	2,689	240	194	41,832	15,814
1964	26,324	5,986	227	851	0	957	25,601	9,150	1,531	2,158	442	34	63,275	9,986
1965	6,109	8,981	-	773	0	687	16,273	2,064	112	2,492	498	1,114	25,056	14,047
1966	2,640	8,170	26	142	0	287	11,825	1,985	6	308	618	210	17,100	9,115
1967	1,372	1,700	0	448	22	304	2,377	425	1,884	193	-	360	6,080	3,005
1968	0	8,032	0	129	-	377	0	71	21	0	-	651	92	9,188
1969	599	0	0	146	-	0	1,107	1,927	-	86	0	102	3,633	333
1970	27	743	8	555	-	542	9,156	0	32	1,035	-	274	9,223	3,149
1971	244	361	0	356	0	57	2,463	0	112	29	-	470	2,819	1,272
1972	151	1,143	-	685	0	43	0	0	0	0	72	204	223	2,076
1973	83	9,296	0	811	0	26	0	0	-	36	-	-	83	10,169
1974	0	586	0	99	0	35	0	-	0	560	341	0	341	1,279
1975	560	747	-	1,322	0	226	0	425	-	0	37	540	1,022	2,835
1976	0	44,340	0	375	0	307	0	-	-	9,637	152	724	152	55,381
1977	4	2,886	0	623	0	510	88	0	482	24,478	253	3,131	827	31,628
1978	133	1,848	0	6,727	0	1,074	475	9	0	872	120	490	737	11,010
1979	2,561	2,193	5	143	-	871	0	2	-	730	575	3,233	3,143	7,171
1980	5	1,228	0	4,167	0	394	647	44	228	363	51	850	974	7,002
1981	647	4,886	213	2,349	0	348	5	20	266	570	316	552	1,467	8,705
1982	162	1,919	-	2,889	-	1,423	0	0	26	60	128	14	316	6,305
1983	95	334	-	1,061	0	506	0	0	-	197	262	333	357	2,431
1984	0	308	-	1,603	0	455	0	0	-	71	152	194	152	2,632
1985	497	590	-	739	0	395	0	0	7	453	-	18	504	2,195
1986	0	2,368	-	1,383	0	465	0	0	16	2,079	0	26	16	6,321
1987	7	8	-	320	-	140	8	7	0	205	0	239	22	911
1988	50	1,134	-	366	-	1,588	0	0	-	1,724	0	413	50	5,224
1989	4	528	-	987	2	1,114	0	8	6	1,331	46	296	66	4,257
1990	51	29	0	1,396	-	401	0	0	-	885	-	132	51	2,842
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	1,077
1993	0	443	-	217	-	0	0	0	-	4,103	-	83	0	4,846
1994	0	0	-	284	-	347	0	0	0	1,162	-	0	0	1,793
1995	4	5,214	-	843	-	1,373	0	0	0	6,575	0	-	4	14,005
1996	10	2,057	-	1,138	-	639	0	-	1	179	-	0	10	4,012
1997	0	4	-	133	-	0	2	5	8	6,012	-	0	15	6,149
1998	7	3,409	-	285	-	471	0	37	7	2,241	-	-	51	6,406
1999	0	151	-	113	-	2,021	0	0	-	13,900	0	0	0	16,184
2000	100	1,646	-	365	-	1,351	0	0	0	9,432	0	0	100	12,795

Table 7. (Continued.)

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
2001	1,013	1,471	-	2,264	-	395	0	0	0	21,540	-	491	1,013	26,161
2002	314	21,420	8	591	-	201	0	144	0	19,620	206	223	671	42,054
2003	2,736	3,312	-	331	-	95	342	219	123	6,453	-	0	3,420	10,191
2004	3,275	24,845	746	1,115	0	693	0	5	1,766	8,248	223	1,181	6,014	36,083
2005	5,647	13,381	2	1,071	0	98	3	120	585	5,617	2,650	11,761	9,009	31,927
2006	2,088	20,548	0	837	0	571	0	-	-	4,502	-	7,275	2,088	33,732
2007	203	2,560	6	788	-	39	0	0	11,208	2,860	-	15,315	11,417	21,561
2008	89	2,578	2	4,246	0	775	0	0	0	8,005	0	7,470	91	23,074
2009	11,958	14,743	0	2,070	0	0	12,254	304	240	3,999	188	36	24,944	20,848
2010	2,936	14,967	50	1,554	1	1,087	0	0	2,677	2,604	697	707	6,361	20,919
2011	9,122	29,552	1,606	2,549	1	2,355	166	0	1,178	1,096	0	443	12,073	35,995
2012	564	21,464	0	798	0	0	0	0	784	29,443	736	7,528	2,083	59,233
2013	61,804	27,768	676	1,060	89	894	22,938	6,321	-	3,769	-	7,276	91,829	40,766

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	2,661	12,956	375	99	475	15,617
1988	1,350	16,559	8,305	96	8,401	17,909
1989	982	9,377	641	198	839	10,359
1990	3,943	15,963	3,424	4,155	7,579	19,907
1991	3,084	13,597	7,383	3,260	10,643	16,680
1992	3,544	10,403	5,953	576	6,530	13,946
1993	2,064	2,367	110	2,411	2,521	4,432
1994	8,871	9,968	19	90	108	18,839
1995	2,244	18,041	336	0	336	20,285
1996	4,947	16,985	440	839	1,279	21,933
1997	1,853	11,022	1,298	179	1,476	12,875
1998	15,844	29,323	89	11	99	45,167
1999	14,775	15,221	506	319	825	29,996
2000	4,682	41,522	11,048	158	11,206	46,205
2001	9,471	43,754	2,022	513	2,535	53,225
2002	5,695	28,569	3,391	11,863	15,254	34,264
2003	1,583	89,462	4,334	27,407	31,741	91,045
2004	21,198	71,574	5,479	1,796	7,274	92,772
2005	9,638	39,589	1,931	5,209	7,140	49,226
2006	5,445	53,525	35,052	6,285	41,337	58,970
2007	9,705	43,079	3,811	5,009	8,820	52,784
2008	35,446	47,657	34,798	6,063	40,861	83,102
2009	29,750	41,728	0[1]	82	82	71,478
2010	1,137	44,993	5,148	19,991	25,139	46,130
2011	12,095	32,436	4,114	10,518	14,632	44,530
2012	4,365	29,550	25,010	18,497	43,508	33,915
2013	21,809	50,425	60,218	31,062	91,281	72,235

[1]No Haddock were caught in 7 tows in this stratum section.

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.

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
1968	326	0	0	1,228	413	-	0	-	0	1,052	99	0	0	2,705	413
1969	2,239	0	0	1,524	633	22	0	0	0	7,425	107	100	0	11,416	633
1970	2,975	0	0	773	156	29	0	0	0	1,359	653	17	0	5,806	156
1971	2,114	29	0	1,146	183	0	0	0	0	1,284	0	49	0	4,622	183
1972	2,056	10	0	1,505	1,307	0	0	0	0	1,979	214	0	0	5,764	1,307
1973	1,204	6	0	862	611	-	5	0	0	367	83	5	317	2,528	932
1974	782	0	0	623	522	0	0	-	0	870	214	0	0	2,488	522
1975	258	17	0	344	781	0	0	-	0	349	89	0	-	1,057	781
1976	835	0	0	375	674	-	6	-	0	430	107	2	0	1,748	680
1977	152	7	0	124	666	0	0	0	0	30	20	0	37	332	703
1978	224	7	0	119	180	0	3	0	0	159	90	7	0	607	182
1979	312	0	0	193	422	5	9	-	0	315	20	5	0	849	432
1980	933	0	0	387	2,300	0	131	-	2	389	81	2	4	1,793	2,437
1981	211	9	0	1,035	137	0	25	-	-	185	19	0	73	1,459	235
1982	1,202	0	3	175	563	0	10	0	4	694	0	10	0	2,084	578
1983	355	13	0	431	799	0	73	0	3	1,023	161	16	-	1,999	875
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	1,200	-	9	-	0	169	45	0	25	688	1,233
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	1,854	-	0	0	-	41	12	4	44	794	1,898
1996	103	0	0	1,020	1,724	-	9	-	0	229	120	13	23	1,485	1,756
1997	95	0	0	432	3,631	0	0	3	0	35	59	2	0	626	3,631
1998	704	0	0	910	676	0	0	-	0	38	65	19	302	1,737	978
1999	768	0	0	2,571	6,830	0	0	-	0	5	67	36	3	3,448	6,833
2000	681	0	0	2,003	4,927	0	6	0	-	180	33	61	0	2,956	4,933
2001	61	0	0	2,486	2,389	-	8	-	0	101	20	240	17	2,908	2,413
2002	66	0	0	3,656	3,876	0	0	-	0	663	8	4	3,150	4,397	7,026
2003	173	0	0	895	6,384	0	28	-	0	21	0	14	-	1,103	6,412
2004	261	0	-	535	1,219	-	0	-	0	74	16	0	62	886	1,281
2005	216	0	0	2,094	1,025	0	0	0	-	44	0	0	33	2,354	1,058
2006	93	5	0	1,258	1,051	0	0	-	0	87	58	2	2	1,504	1,053
2007	372	382	3	733	3,271	0	6	0	0	38	81	89	0	1,699	3,277
2008	234	0	0	968	1,241	44	969	0	0	92	22	28	29	1,388	2,238
2009	1,338	0	0	4,298	5,566	61	116	0	0	380	24	69	104	6,171	5,786
2010	573	974	0	4,059	6,352	0	6	1	0	2,491	80	3	39	8,182	6,397
2011	3,238	110	0	1,821	251	7	0	0	0	368	89	6	0	5,640	251

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
2012	1,637	0	0	4,763	817	0	7	0	1	1,098	424	14	111	7,937	936
2013	129	0	0	752	1,219	6	28	0	0	0	64	6	175	957	1,421

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.

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
1963	6,254	153	15	1,741	477	84	41	5	-	2,136	3,102	13	0	13,502	518
1964	10,125	60	0	1,102	114	26	33	0	0	3,324	113	0	7	14,751	154
1965	6,677	24	0	247	80	-	17	0	0	1,451	1,419	62	0	9,879	97
1966	669	0	0	164	1,336	5	5	0	0	1,351	353	25	4	2,566	1,345
1967	1,622	10	23	2,359	0	119	0	0	0	2,202	495	0	0	6,830	0
1968	2,864	0	0	2,143	1,491	9	0	-	0	4,178	323	5	0	9,521	1,491
1969	2,927	0	0	1,859	298	86	0	-	0	3,738	156	7	0	8,773	298
1970	1,519	0	0	632	424	75	0	-	0	2,206	318	62	0	4,812	424
1971	3,359	19	9	1,766	179	0	0	3	4	1,222	0	137	0	6,514	183
1972	4,504	29	0	1,827	306	-	0	0	0	339	0	232	0	6,930	306
1973	1,867	0	0	2,225	2,377	5	0	0	0	178	13	349	36	4,638	2,414
1974	2,286	0	0	749	825	0	0	0	0	126	0	0	0	3,160	825
1975	770	19	0	936	747	-	0	0	0	80	36	0	0	1,842	747
1976	128	0	0	1,070	167	0	75	0	0	17	63	55	34	1,333	276
1977	139	123	0	712	1,765	0	7	0	-	109	91	60	0	1,235	1,772
1978	1,129	0	0	838	336	0	78	0	0	151	31	1	0	2,151	414
1979	479	0	0	739	156	0	5	-	0	9	45	48	4	1,320	165
1980	40	14	0	1,975	3,869	8	26	0	0	970	93	110	173	3,211	4,068
1981	941	0	0	1,250	106	0	0	0	0	190	0	22	0	2,403	106
1982	1,512	0	0	110	603	-	0	-	0	105	23	42	0	1,792	603
1983	753	0	0	731	676	-	0	0	0	0	0	141	0	1,625	676
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	1,026	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	1,494	284	-	0	-	0	0	0	10	0	1,593	284
1997	232	0	0	1,808	1,999	-	0	-	0	38	0	37	3	2,115	2,003
1998	818	0	0	592	2,364	-	3	-	0	0	20	5	0	1,435	2,367
1999	770	0	0	2,935	3,962	-	191	-	0	224	114	157	0	4,200	4,154
2000	171	0	0	5,580	1,097	-	4	-	0	60	22	144	20	5,978	1,121

Table 10. (Continued.)

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
2001	641	0	0	7,877	2,139	-	13	-	0	177	47	111	0	8,853	2,153
2002	161	0	0	1,784	1,861	0	7	-	0	5	10	214	75	2,174	1,943
2003	92	0	0	2,825	1,613	-	0	-	0	158	0	43	3	3,119	1,616
2004	161	0	0	5,915	78	0	0	0	0	172	12	67	121	6,327	198
2005	145	0	0	1,133	1,260	0	7	0	0	41	29	56	9	1,404	1,276
2006	1,475	0		2,909	294	0	45	1	0	25	3	16	37	4,429	376
2007	274	0	0	5,739	753	3	0	0	0	52	6	114	115	6,188	868
2008	852	0	0	3,090	3,654	0	0	0	0	0	0	31	58	3,973	3,712
2009	4,209	0	0	10,518	785	0	45	0	-	1,180	151	161	136	16,219	966
2010	1,497	4	0	2,371	1,579	18	74	4	0	61	0	20	39	3,975	1,692
2011	2,139	0	3	2,511	880	14	0	0	0	63	0	13	841	4,742	1,721
2012	49	0	0	4,888	389	0	0	0	-	29	0	617	49	5,583	438
2013	164	0	0	1,255	542	0	0	0	0	260	114	0	28	1,793	570

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	1,053	1,181	397
1991	57	444	262	996	1,258	501
1992	119	432	327	1,599	1,925	550
1993	59	1,634	178	771	949	1,693
1994	91	501	745	1,417	2,162	591
1995	35	785	487	719	1,206	820
1996	35	2,799	1,229	1,241	2,470	2,833
1997	868	2,464	2,431	7,529	9,960	3,332
1998	93	2,484	613	1,102	1,715	2,577
1999	190	6,616	408	10,452	10,860	6,806
2000	2,019	5,526	6,430	5,974	12,404	7,545
2001	443	4,995	963	15,757	16,720	5,438
2002	66	5,052	5,854	9,727	15,581	5,118
2003	48	5,739	75	10,387	10,462	5,786
2004	84	5,637	63	3,271	3,334	5,720
2005	51	1,028	392	11,886	12,278	1,079
2006	35	776	962	4,805	5,767	812
2007	196	2,959	102	10,088	10,189	3,155
2008	64,491	1,656	262	910	1,172	66,147
2009	70,851	1,077	45	72	117	71,927
2010	5,332	3,226	178	402	580	8,558
2011	1	477	800	2,552	3,351	479
2012	89	1,121	385	4,055	4,440	1,210
2013	212	252	77	157	234	464

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. Open box highlights current year results.

	NMFS Fall		NMFS Spring		DFO		Combined Surveys		Smoothed	
Year	**%CAN**	**%USA**	**%CAN**	**%USA**	**%CAN**	**%USA**	**%CAN**	**%USA**	**%CAN**	**%USA**
1979	73	27	66	34	-	-	69	31	64	36
1980	65	35	57	43	-	-	61	39	65	35
1981	78	22	31	69	-	-	55	45	65	35
1982	67	33	97	3	-	-	82	18	66	34
1983	86	14	47	53	-	-	66	34	67	33
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	85	15
2001	97	3	74	26	95	5	90	10	84	16
2002	98	2	63	37	95	5	88	12	84	16
2003	81	19	73	27	69	31	76	24	83	17
2004	99	1	81	19	87	13	91	9	80	20
2005	93	7	66	34	34	66	71	29	78	22
2006	97	3	31	69	69	31	73	27	77	23
2007	81	19	40	60	87	13	72	28	78	22
2008	100	0	57	43	91	9	87	13	79	21
2009	82	18	75	25	100	0	85	15	80	20
2010	96	4	51	49	34	66	69	31	81	19
2011	97	3	82	18	92	8	92	8	82	18
2012	81	19	59	41	71	29	73	27	82	18
2013	97	3	77	23	78	22	86	14	**83**	**17**

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.

	NMFS Fall		NMFS Spring		DFO		Combined Surveys		Smoothed	
Year	**%CAN**	**%USA**	**%CAN**	**%USA**	**%CAN**	**%USA**	**%CAN**	**%USA**	**%CAN**	**%USA**
1979	70	30	75	25	-	-	72	28	66	34
1980	88	12	35	65	-	-	61	39	69	31
1981	86	14	45	55	-	-	65	35	72	28
1982	95	5	67	33	-	-	81	19	74	26
1983	87	13	79	21	-	-	83	17	78	22
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	81	19
2001	96	4	80	20	95	5	91	9	78	22
2002	98	2	33	67	69	31	67	33	76	24
2003	75	25	79	21	74	26	76	24	74	26
2004	86	14	34	66	93	7	71	29	72	28
2005	78	22	53	47	87	13	73	27	69	31
2006	94	6	46	54	59	41	66	34	67	33
2007	65	35	36	64	86	14	62	38	64	36
2008	100	0	12	88	67	33	60	40	61	39
2009	46	54	26	74	100	0	57	43	61	39
2010	77	23	34	66	65	35	59	41	59	41
2011	75	25	64	36	75	25	72	28	57	43
2012	97	3	38	62	44	56	60	40	55	45
2013	31	69	49	51	44	56	41	59	**52**	**48**

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. Open box highlights current year results.

	NMFS Fall		NMFS Spring		DFO		Combined Surveys		Smoothed	
Year	**%CAN**	**%USA**	**%CAN**	**%USA**	**%CAN**	**%USA**	**%CAN**	**%USA**	**%CAN**	**%USA**
1979	11	89	34	66	-	-	22	78	18	82
1980	56	44	58	42	-	-	57	43	20	80
1981	4	96	14	86	-	-	9	91	23	77
1982	25	75	22	78	-	-	23	77	25	75
1983	29	71	30	70	-	-	30	70	27	73
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	44	56
2001	20	80	45	55	25	75	30	70	43	57
2002	47	53	62	38	25	75	44	56	42	58
2003	34	66	85	15	36	64	52	48	40	60
2004	3	97	59	41	63	37	42	58	38	62
2005	48	52	31	69	8	92	29	71	35	65
2006	8	92	41	59	12	88	20	80	35	65
2007	12	88	66	34	24	76	34	66	38	62
2008	48	52	62	38	98	2	69	31	42	58
2009	6	94	48	52	100	0	51	49	44	56
2010	28	72	44	56	94	6	55	45	41	59
2011	27	73	4	96	13	87	14	86	39	61
2012	8	92	11	89	21	79	13	87	**37**	**63**
2013	24	76	57	43	67	33	49	51	**34**	**66**

Table 15. Resource (a) 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 Canada/USA allocation sharing formula. Allocation shares are updated annually based on resource distribution.

a)

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

b)

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

FIGURES

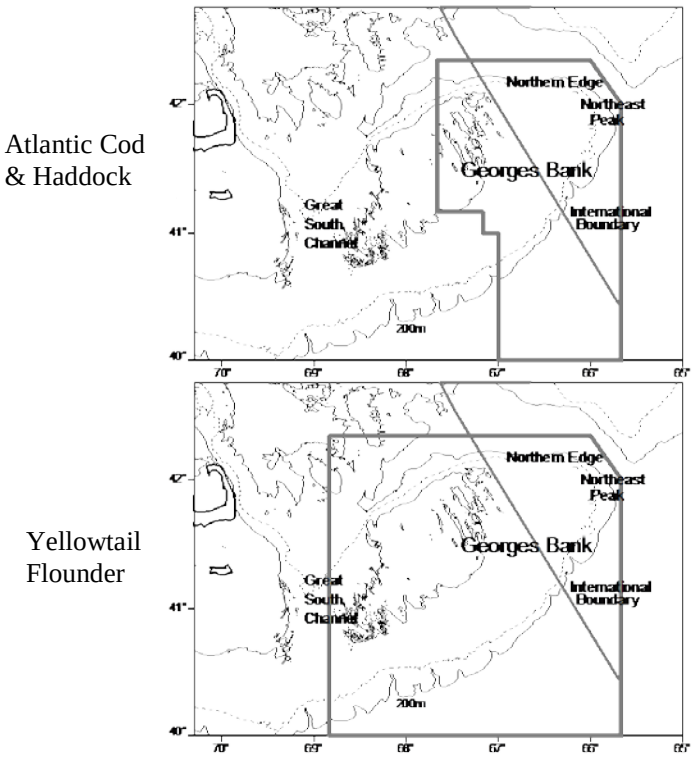

Figure 1. The management areas for Atlantic Cod, Haddock (upper panel), and Yellowtail Flounder (lower panel) on Georges Bank and the Canada/USA boundary line across which resource distribution was determined.

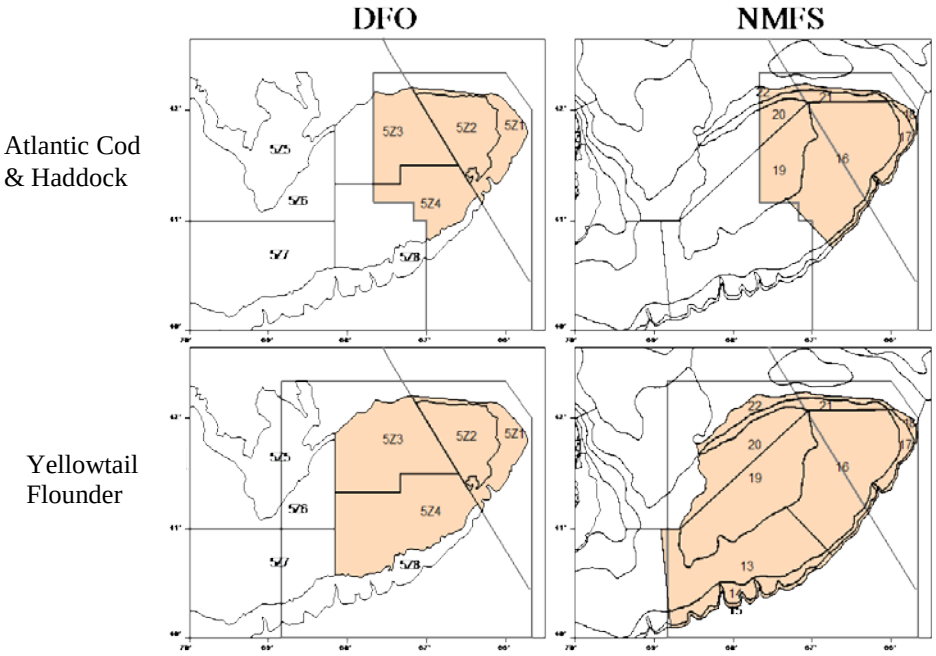

Figure 2. DFO and NMFS survey strata used to develop biomass indices on either side of the Canada/USA boundary for eastern Georges Bank Atlantic Cod and Haddock (upper panels) and Georges Bank Yellowtail Flounder (lower panels) in relation to the management unit borders. Strata boundaries

(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).

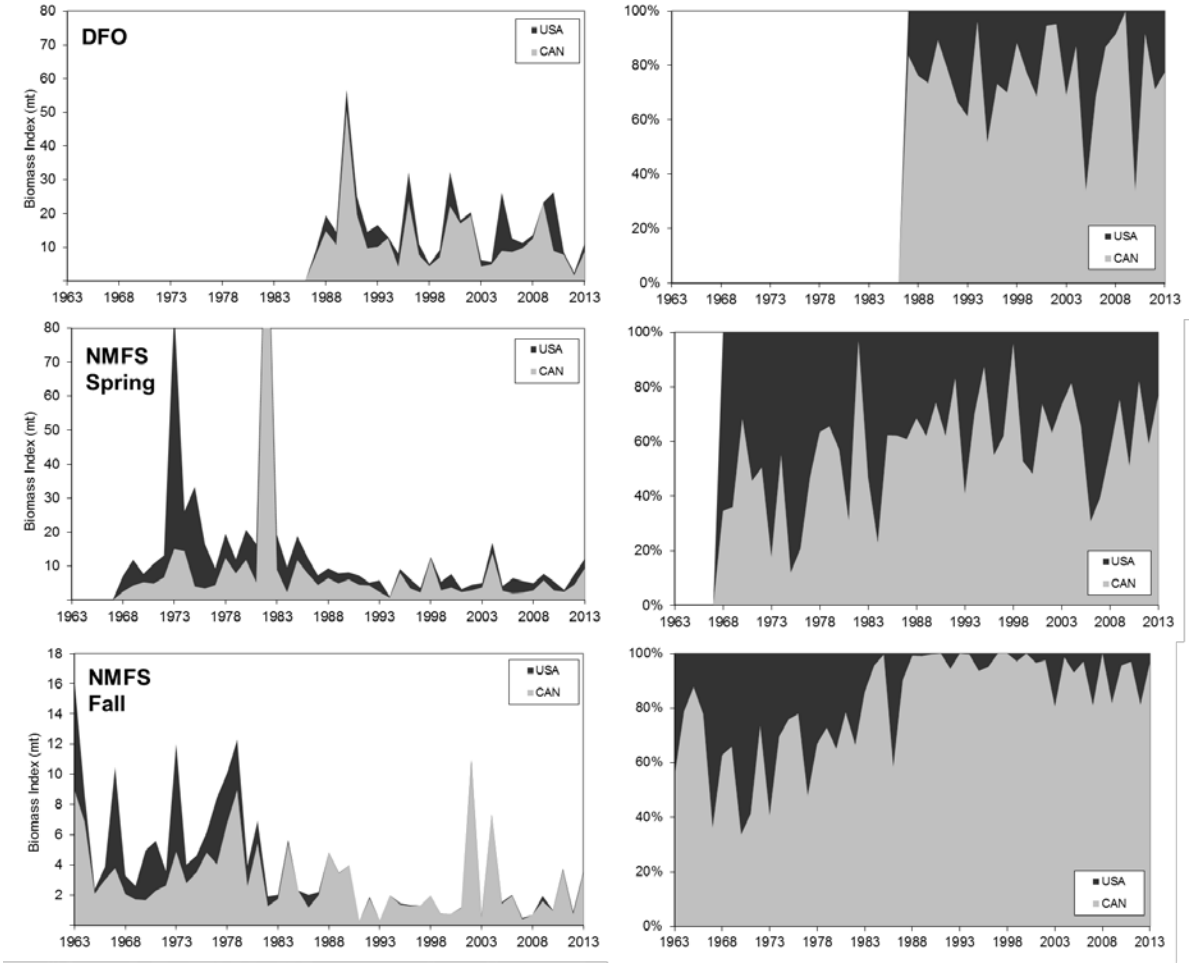

Figure 3. Relative indices of biomass and percentage resource distribution in relation to the international boundary for Atlantic Cod on eastern Georges Bank.

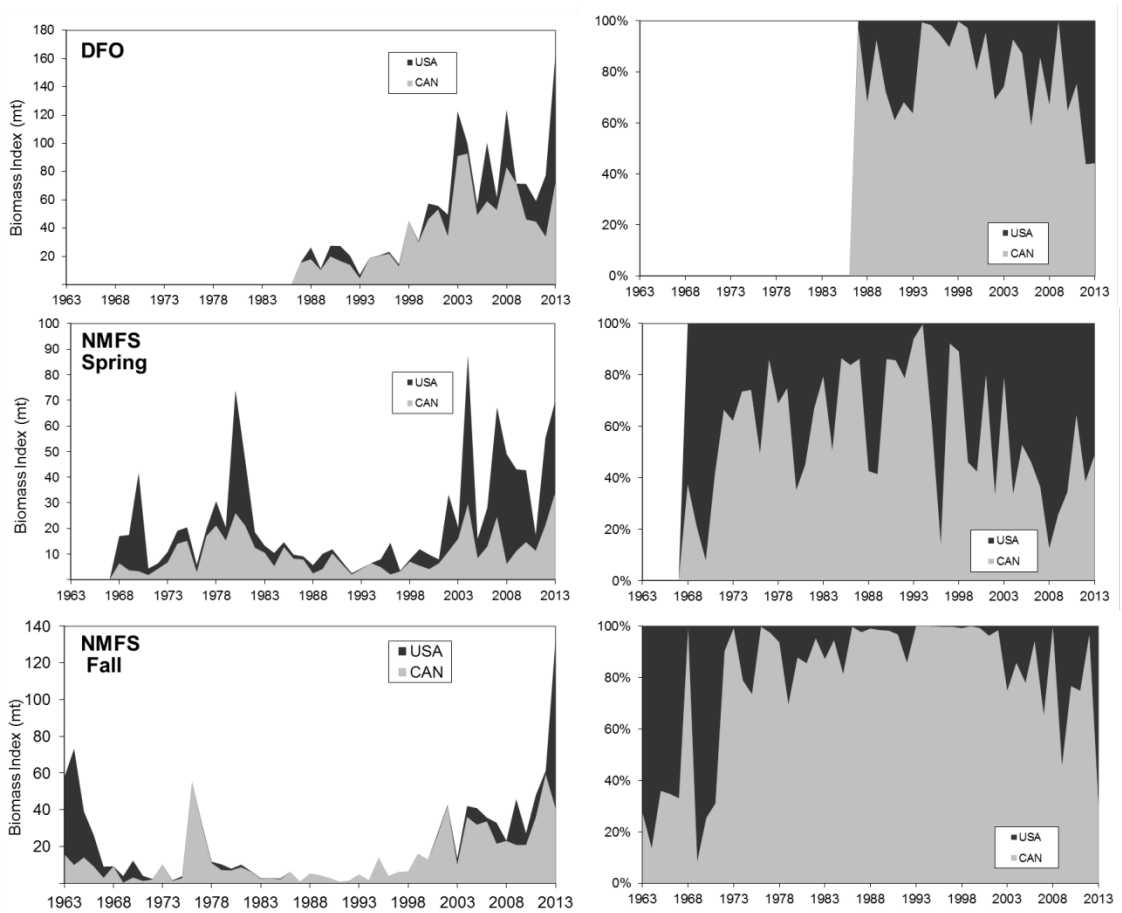

Figure 4. Relative indices of biomass and percentage resource distribution in relation to the international boundary for Haddock on eastern Georges Bank.

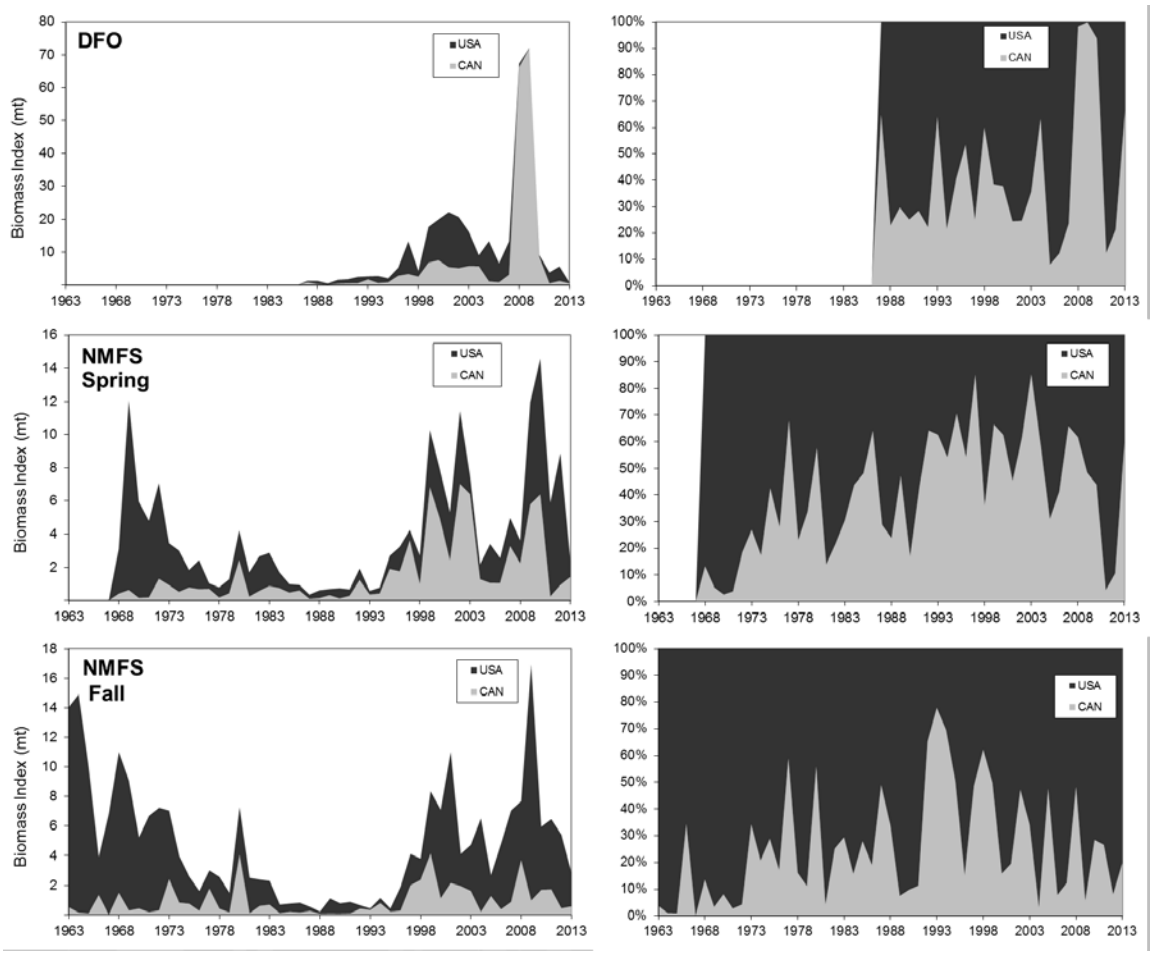

Figure 5. Relative indices of biomass and percentage resource distribution in relation to the international boundary for Yellowtail Flounder on Georges Bank.

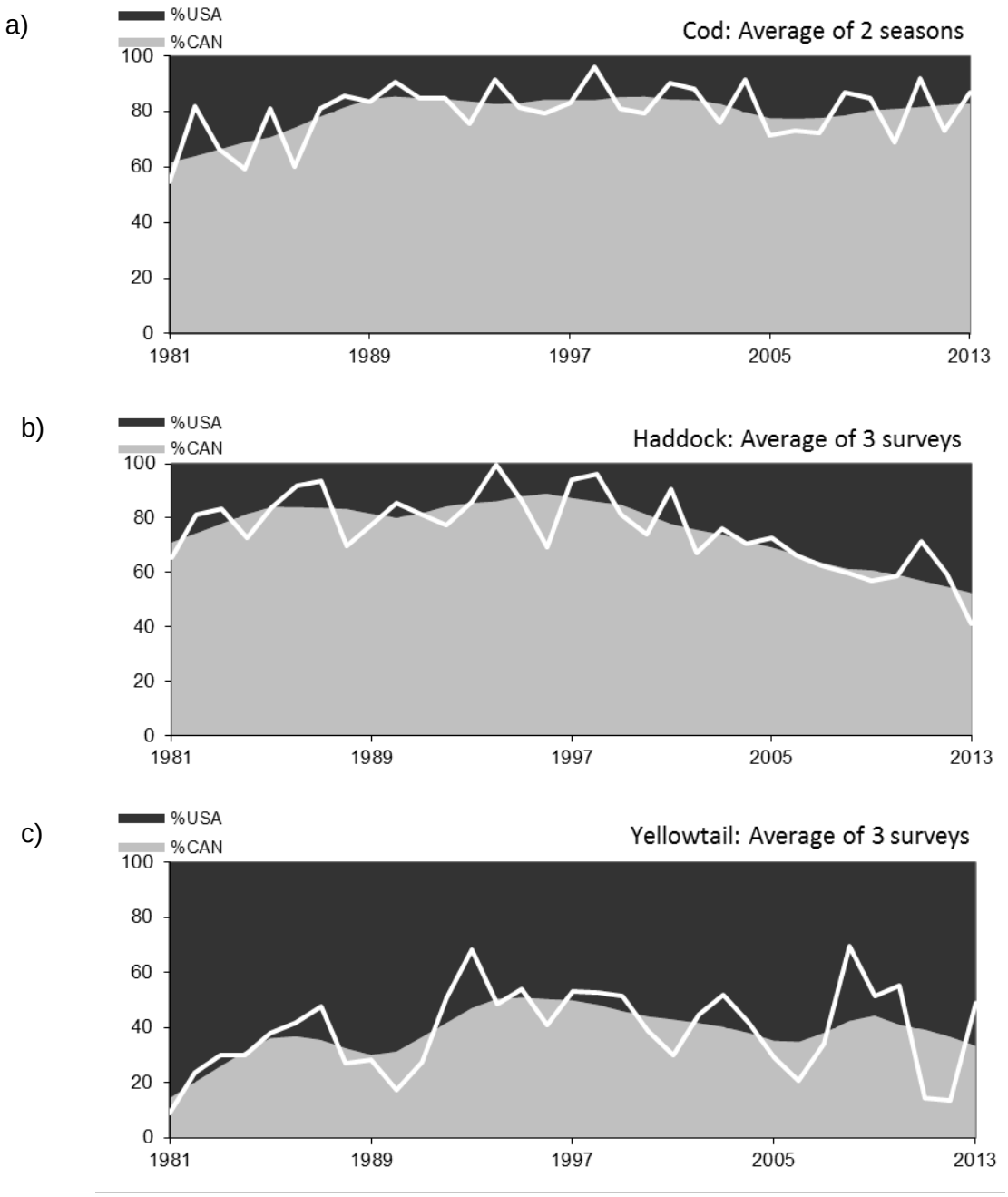

Figure 1. Observed annual percentage (white line) and smoothed trends of proportion of a) eastern Georges Bank Atlantic Cod, b) eastern Georges Bank Haddock, and c) Georges Bank Yellowtail Flounder on the Canadian side of the international boundary.