B. Georges Bank Haddock by Jon Brodziak, Michele Traver and Laurel Col

1.0 Background

The Georges Bank haddock stock was last assessed at the Groundfish Assessment Review Meeting in 2002. Based on that assessment, the stock was overfished and was not experiencing overfishing. Spawning biomass in 2001 was 74,400 mt, roughly 30% of B_{MSY}. Fishing mortality in 2001 was F=0.22, roughly 85% of F_{MSY}. Spawning biomass in 2001 was over 6-fold greater than the near-record low of 11,400 mt in 1993. In this report, we update the Georges Bank haddock assessment using updated fishery data for 1972-2001 along with fishery data for 2002-2004 and research survey data for 2002-2005. Updated estimates of spawning biomass and fishing mortality are used to determine stock status. Sensitivity analyses of 2002 assessment results to updated VPA software and updated fishery and biological data are conducted.

2.0 Assessment for 2005

2.1 2001-2004 Catches

For this assessment, US haddock landings for 2001-2004 were prorated into Georges Bank and Gulf of Maine stock components using a standard algorithm (Figure B1). Total catches of Georges Bank haddock increased from a low of 2,351 mt in 1995 to 17,584 mt in 2004 (Table B1, Figure B2). Revised prorated US Georges Bank haddock landings totaled 4,631 mt in 2001, a 0.1% decrease from the value reported in the last assessment (Brodziak et al. 2002). US landings in 2004 were 7,179 mt, a 55% increase over 2001 landings (Table B2). Canadian landings totaled 9,745 mt in 2004, a 44% increase over 2001 landings. US discards of Georges Bank haddock during 2001-2004 were estimated using at-sea observer sampling data. Quarterly US discards for the western and eastern Georges Bank haddock substocks (Figure 1) were estimated for otter trawl, longline (hook), gillnet, and other (all other gears that caught some haddock) fishing gears using reported landings and observed discard to kept ratios similar to previous assessments (Brown and Munroe 2000). US discards of western Georges Bank haddock increased from about 100 mt during 2001-2003 to over 400 mt in 2004 (Table B3.1). US discards of eastern Georges Bank haddock increased from about 50 mt during 2001-2003 to over 150 mt in 2004 (Table B3.2). Estimates of discards of eastern Georges Bank haddock in the Canadian sea scallop fishery during 1972-2004 (Van Eeckhaute and Brodziak 2005) were also included in the updated fishery catch data. Canadian discards ranged from a high of 186 mt in 1985 to a low of 29 mt in 2000 and have remained below 100 mt since 1998.

Total catch numbers at age of Georges Bank haddock were estimated using available fishery length and age composition data. The Canadian catch at age of eastern Georges Bank haddock during 1972-2004 was taken from the most recent TRAC assessment of this substock (Van Eeckhaute and Brodziak 2005). The US catch at age of western and eastern Georges Bank haddock during 2001-2004 was estimated using fishery length and age-length composition data collected by port sampling and at-sea observers, along with research survey age-length composition data to characterize sublegal discards.

US commercial fishery length sampling intensity for western Georges Bank haddock averaged over 200 lengths/100 mt during 2001, 2003 and 2004, but was only 124 lengths/100 mt in 2002

(Table B4.1) while age sampling averaged about 50 ages/100 mt during 2001-2004. Sampling intensity for eastern Georges Bank haddock during 2001-2004 was similar to that for western Georges Bank (Table B4.2), although there were some quarters where no length samples were available. Fisheries in both management areas primarily use similar otter trawl gear (Tables B3.1 and B3.2) and observed fishery length selectivity is similar. As a result, US commercial length frequency data for eastern Georges Bank haddock were augmented with length composition data from US statistical areas 521, 522 and 525 during 2001-2002 and areas 522, and 525 during 2003-2004. US discard length composition data for western and eastern Georges Bank were taken from domestic at-sea observer data.

Annual US catch at age of western and eastern Georges Bank haddock during 2001-2004 were computed for landings and discards (Tables B5.1 and B5.2) using quarterly age-length keys applied to large and scrod market categories. For eastern Georges Bank haddock, there were few age-length composition data in some quarters (Table B4.2). As a result, Canadian commercial fishery age-length keys from eastern Georges Bank were used to augment US age-length composition data for quarters 2, 3, and 4, while the Canadian spring survey age-length key was used for quarter 1. Canadian catch at age during 2001-2004 (Table B5.3) was derived using quarterly age-length composition and length composition data and were taken from the most recent TRAC assessment (Van Eeckhaute and Brodziak 2005). Mean weights at age of US western and eastern Georges Bank haddock catches were computed for landings and discards (Table B6). US fishery catch-at-age data were combined with Canadian fishery catch-at-age data were to compute total catch at age of Georges Bank haddock (Table B7). Similarly, mean weight-at-age data for western and eastern Georges Bank haddock (Table B6) were averaged to compute the mean weights at age of Georges Bank haddock during 2001-2004 (Table B8).

2.2 Survey Indices

NEFSC spring survey and autumn survey indices (Table B9, Figure B3) were computed using standardized research survey data (Table B10). Number per tow at age indices for the NEFSC spring (Table B11) and autumn (Table B12) surveys were computed using survey-specific age-length keys.

Canadian winter survey indices in 2001-2004 (Table B13) were taken from the most recent TRAC assessment (Van Eeckhaute and Brodziak 2005). Analyses of female proportion mature at age during 2001-2004 were updated from the 2002 assessment to compute recent spawning biomass (Table B14).

3.0 Assessment Results

3.1 VPA Results

An updated VPA analysis for Georges Bank haddock was conducted. The VPA formulation was identical to that used for the 2002 GARM assessment (Table B15, Figure B4). The updated VPA included updated research survey indices collected during 2001-2005. VPA diagnostics indicated a good overall fit to the survey data with the lowest mean squared residual observed in the last 7 assessments (Table B15). Coefficients of variation of numbers at age estimates for ages 1-8 in the terminal year plus one ranged from 58% at age-1 to 23% at age-6. Maximal coefficients of

variation of catchability ranging from 0.15 (NEFSC fall survey) to 0.51 (NEFSC spring survey Yankee 41 net, 1972-81 across surveys.

VPA results indicate that total stock size increased 4-fold from 163.7 million in 2001 to 869.1 million in 2004 (Table B16). Spawning biomass also increased by 22% from 96.0 thousand mt in 2001 to 116.8 thousand mt in 2004 (Table B17, Figure B5.1). Fishing mortality (age-6 and average F on ages 4-7, unweighted) increased from 2001 to 2004 (Tables B18 and B19, Figure B5.2). Average F was 0.18 in 2001 and increased to 0.24 in 2004 (+39%). Results indicate that the 1998 (47 million) and 2000 (91 million) year classes are strong, while the 2003 year class appears to be exceptionally strong (789 million) and may be the largest ever observed (Figure B5.3). Bootstrap analysis indicates that estimates of spawning biomass and average F in 2004 are relatively precise with coefficients of variation of 13-16% (Table B20, Figure B6). Retrospective analysis suggests a minor pattern of overestimation of F and underestimation of spawning biomass (Figure B7).

3.2 Sensitivity Analyses

3.2.1 Effect of updated VPA software on 2002 VPA results

The NEFSC VPA software was enhanced to include more options for estimation of stock size and F in 2004. The old software (FACT) was compared to the new software (GARM) using the 2002 VPA input data for Georges Bank haddock from the 2002 GARM. Results of this comparison showed that there were minimal differences in estimates of numbers-at-age in the terminal year plus one, fishing mortality at age in the terminal year, average F, and spawning biomass (Table B21). Overall, the software changes had no significant impact on VPA results.

3.2.2 Effect of updated VPA software and fishery and biological data on 2002 VPA results

The input data for the Georges Bank haddock VPA was revised in this assessment to include Canadian scallop fishery discards in the catch at age for 1972-2004, US discard-at-age estimates for 2001-2004, updated proration of 2001 US haddock landings to stock area, revised mean weight-at-age data in 2001, and revised female percent mature at age in 2001. The effect of using the revised data with the GARM VPA software was compared to the effect of using the old data with the FACT VPA software (Table B21). The use of the new data moderately increased the estimates of stock size at age and spawning (Table B21) but had no discernable effect on estimates of fishing mortality. Overall, this showed that the primary effect of using the new data was to increase stock size to account for increases in catch at age due to the inclusion of additional estimates of fishery discards.

4.0 Sources of Uncertainty

- Increased quarterly sampling of US landings from eastern Georges Bank haddock would improve estimates of US catch-at-age data.
- Proration of landings are based on preliminary logbook data and are subject to change.

5.0 Summary Stock Status

5.1 Biological Reference Points

For Georges Bank haddock, spawning biomass (B_{MSY}) and the fishing mortality to produce MSY (F_{MSY}) are B_{MSY} = 250,300 mt and F_{MSY} = 0.263 (NEFSC 2002). The overfished threshold ($B_{THRESHOLD}$) for Georges Bank haddock is $B_{THRESHOLD}$ = ½ B_{MSY} = 125,200 mt. The overfishing threshold ($F_{THRESHOLD}$) for Georges Bank haddock is $F_{THRESHOLD} = F_{MSY}$ = 0.26.

5.2 Stock Status in 2004

In 2004, spawning biomass was 116,800 mt (93% of $B_{THRESHOLD}$ and 47% of B_{MSY}). Therefore, the Georges Bank haddock stock was overfished in 2004 (Figure B8). In 2004, the fishing mortality was 0.24 (92% of $F_{THRESHOLD}$). Therefore, overfishing was not occurring on the Georges Bank haddock stock in 2004 (Figure B9).

5.3 Comparison with Projected Amendment 13 Rebuilding Trajectory

The projected Amendment 13 rebuilding trajectory for Georges Bank haddock was compared to VPA estimates of spawning biomass and fishing mortality in 2004. For this stock, an adaptive rebuilding plan was adopted in which $F_{REBUILD}=F_{MSY}=0.26$ during 2004-2008. Median spawning biomass on the rebuilding trajectory was projected to be 129.8 kt in 2004. For comparison, the 80% confidence interval based on bootstrapping was (0.21, 0.31) and the $F_{REBUILD}$ value for 2004 falls within the probable range of the VPA estimate of F_{2004}. Similarly, the 80% confidence interval for SSB_{2004} was (97.9, 138.8) kt and the $SSB_{REBUILD}$ in 2004 falls within the probable range of the VPA estimate of SSB_{2004}. Overall, this suggests that current estimates of F and SSB are consistent with projected values on the rebuilding trajectory.

6.0 GARM Comments

The Panel noted that the 2003 year-class appears to be the highest recruitment on record, at an estimated value of 789 million age-1 fish. The size of 2003 year-class is still uncertain since the fish have not yet recruited to the fishery. The magnitude and growth pattern of the 2003 year-class appears to be very similar to the historically large 1963 year-class, which was also the slowest growing year class in the time series.

The Panel discussed the estimation of discards during 2001-2004 using at-sea observer data. It was noted that on the order of 2-5% of haddock landings were observed in this period. The Panel considered the discard estimates to be appropriate for inclusion in the catch at age given recent increases in recruitment.

The Panel discussed how haddock catch at age estimates were derived during 2001-2004 using length-weight relationships, length frequency data, and age-length keys. The Panel concluded that the estimation methods were reasonable.

The Panel discussed whether it was consistent for F to increase from 0.16 in 2003 to 0.24 in 2004 even though population size (age-1+) increased from 2003 to 2004. It was apparent that the increase in the average F for fully recruited ages 4-7 was due to both increases in catch, as well as inclusion of the comparatively weak 1997, 1999, and 2001 year classes in the catch. In 2004, more fish of ages 6-7 were harvested leading to increases in F on ages 6-7. The Panel noted that ages 6-7 may have been targeted by the fishery. In particular, the 2004 Fs on ages 6 and 7 were 0.3 and 0.44, 3-fold higher than the Fs on ages 4 and 5.

The Panel discussed the decreasing trends in fishery mean weights at age. Possible mechanisms for the observed decreases were density-dependence, increased discarding or environmental impacts on fish growth. In 2001-2004, mean weights at age decreased significantly, especially in 2004. The Panel noted that haddock abundance during 2001-2004 was the highest since the 1960s and that this high abundance may have reduced average food ration per capita. After reviewing comparing short-term and long-term mean weights at age in the NEFSC spring and fall surveys and the DFO winter survey, the Panel concluded that significant decreases in mean weights at age were also apparent in all three surveys. This suggested that the observed decreases in fishery mean weights at age represented a broad-scale, population-wide pattern.

The Panel also discussed whether the length-weight relationship for Georges Bank haddock had changed in recent years. In particular, the Panel was interested in whether the decline in mean weights at age was due to a change in average length at age or due to a change in the length-weight relationship. After reviewing available data, the Panel concluded that the decrease in mean weights at age was primarily due to a decline in lengths at age although there were some minor decreases in average weight at length during 2001-2004. It was also noted that there was no clear relationship between water temperature anomalies in recent years and the observed decline in mean weights.

Sources of Uncertainty

Increased quarterly sampling of US landings from eastern Georges Bank haddock would improve estimates of the US catch at age.

The proration of US haddock landings is based on preliminary logbook data and are subject to change.

The size of 2003 year-class is estimated to be very large but still subject to uncertainty since the fish have not yet recruited to the fishery. If the slow growth of this year class persists, it may delay recruitment of the 2003 year-class to the landings and result in a prolonged exposure to discarding.

Projection Advice

Recent trends in mean weights indicate that a short-term average is appropriate for projections. The Panel recommends the use of the recent 3-year average (2002-2004) mean weights at age for the entire Georges Bank stock.

The Panel agreed that it was reasonable to use the existing Georges Bank haddock 2-state stock-recruitment model, including the 2002-2004 estimates of recruitment.

The panel reviewed both long and short term (2001-2004) partial recruitment patterns for the Georges Bank haddock projections. The panel concluded that the short term partial recruitment pattern was more appropriate due to recent changes in growth and mesh size.

Research Recommendation

Investigate how best to compute the average F on fully-recruited age classes, in light of possible changing targeting of fully recruited age classes.

7.0 References

Brodziak, J., M. Thompson, and R. Brown. 2002. Georges Bank haddock. In NEFSC, *Assessment of 20 northeast groundfish stocks through 2001*, pp. 36-59. *NEFSC Ref. Doc.* 02-16, 509 p. Available at: http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0216/

Brown, R. W., and N. J. Munroe. 2000. Stock assessment of Georges Bank haddock, 1931-1999. Northeast Fisheries Science Center Ref. Doc. 00-12, NEFSC, Woods Hole, MA 02543.

Northeast Fisheries Science Center [NEFSC]. 2002. Final Report of the Working Group on Re-Evaluation of Biological Reference Points for New England Groundfish. NEFSC Reference Document 02-04, Woods Hole, MA, 02543.

Van Eeckhaute, L., and J. Brodziak. 2005. In review. Assessment of eastern Georges Bank haddock. Transboundary Resource Assessment Committee Research Document.

Table B1. Georges Bank haddock catch biomass (mt), 1960-2004

Year	USA	Canada	USSR	Spain	Other	Total
1960	40800	77	0	0	0	40877
1961	46384	266	0	0	0	46650
1962	49409	3461	1134	0	0	54004
1963	44150	8379	2317	0	0	54846
1964	46512	11625	5483	2	464	64086
1965	52823	14889	81882	10	758	150362
1966	52918	18292	48409	1111	544	121274
1967	34728	13040	2316	1355	30	51469
1968	25469	9323	1397	3014	1720	40923
1969	16456	3990	65	1201	540	22252
1970	8415	1978	103	782	22	11300
1971	7306	1630	374	1310	242	10862
1972	3869	742	137	1098	20	5866
1973	2777	1661	602	386	3	5429
1974	2396	622	109	764	559	4450
1975	3989	1544	8	61	4	5606
1976	2904	1521	4	46	9	4484
1977	7934	3060	0	0	0	10994
1978	12160	10356	0	0	0	22516
1979	14279	5368	0	0	0	19647
1980	17470	10168	0	0	0	27638
1981	19176	5835	0	0	0	25011
1982	12625	5002	0	0	0	17627
1983	8682	3327	0	0	0	12009
1984	8807	1587	0	0	0	10394
1985	4273	3670	0	0	0	7943
1986	3339	3507	0	0	0	6846
1987	2156	4841	0	0	0	6997
1988	2492	4197	0	0	0	6689
1989	1430	3197	0	0	0	4627
1990	2001	3468	0	0	0	5469
1991	1395	5563	0	0	0	6958
1992	2005	4191	0	0	0	6196
1993	687	3841	0	0	0	4528
1994	218	2525	0	0	0	2743
1995	218	2133	0	0	0	2351
1996	313	3695	0	0	0	4008
1997	888	2682	0	0	0	3570
1998	1841	3473	0	0	0	5314
1999	2775	3729	0	0	0	6504
2000	3366	5431	0	0	0	8797
2001	4754	6751	0	0	0	11505
2002	6477	6517	0	0	0	12994
2003	5703	6873	0	0	0	12576
2004	7746	9838	0	0	0	17584
Average 1960-2004	13256	5064	3208	248	109	21884
Average 1980-1999	4640	4032	0	0	0	8671
Average 2000-2004	5609	7082	0	0	0	12691

Table B2. USA and Canadian commercial landings (mt) of Georges Bank haddock by major gear, 1964-2004.

	United States				Canada			
Year	Otter Trawl	Longline	Other	Total	Otter Trawl	Longline	Other	Total
1964	45617	742	153	46512	11624	1	0	11625
1965	52034	716	73	52823	14862	22	5	14889
1966	51686	1127	105	52918	17905	63	324	18292
1967	33825	814	89	34728	12923	96	21	13040
1968	24930	495	44	25469	9201	111	11	9323
1969	15494	950	12	16456	3955	22	13	3990
1970	7979	430	6	8415	1900	76	2	1978
1971	7004	300	2	7306	1475	154	1	1630
1972	3674	190	5	3869	411	198	0	609
1973	2675	100	2	2777	1461	102	0	1358
1974	2308	80	8	2396	374	87	1	462
1975	3839	143	7	3989	1247	111	0	1358
1976	2840	51	13	2904	1192	154	15	1361
1977	7842	36	56	7934	2814	94	1	2909
1978	11962	63	135	12160	9716	171	292	10179
1979	14138	30	111	14279	4907	274	1	5182
1980	17170	30	270	17470	9510	590	1	10101
1981	19031	3	142	19176	4644	1015	0	5659
1982	12484	2	139	12625	4222	709	0	4931
1983	8588	35	59	8682	2396	813	3	3212
1984	8661	79	67	8807	624	838	1	1463
1985	4194	43	36	4273	2745	626	41	3484
1986	3298	24	17	3339	2734	594	35	3415
1987	2124	21	11	2156	3521	1046	89	4703
1988	2408	32	52	2492	3183	695	97	4046
1989	1356	24	50	1430	1976	977	106	3060
1990	1949	15	37	2001	2411	853	76	3340
1991	1340	28	27	1395	4028	1309	119	5456
1992	1974	17	14	2005	2583	1384	90	4058
1993	659	16	12	687	2489	1143	96	3727
1994	175	33	10	218	1597	714	100	2411
1995	144	59	15	218	1647	390	28	2065
1996	210	63	40	313	2689	947	26	3663
1997	754	76	58	888	1991	722	36	2749
1998	1692	55	94	1841	2422	921	27	3371
1999	2605	27	143	2775	2760	887	33	3680
1999	2605	27	143	2775	2760	887	33	3680
1999	2605	27	143	2775	2760	887	33	3680
2000	3217	31	118	3366	4146	1186	71	5402
2001	4443	49	139	4631	5112	1633	29	6774
2002	6081	40	209	6330	4954	1521	12	6488
2003	5353	160	52	5564	4985	1776	14	6775
2004	6596	474	110	7179	7744	2000	1	9745

Table B3.1 Western Georges Bank haddock catch (mt) with discards based on observer data, 2001-2004

WGB 2001

			QTR 1				QTR 2				QTR 3				QTR 4		
	D/K Ratio	Annual Landings (mt)	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch
HOOK	0.12	49.28	4.59	0.54	5.13	0.12	2.92	0.34	3.26	0.12	38.60	4.56	43.16	0.12	3.17	0.37	3.54
OTTER TRAWL	0.01	3835.88	1332.44	18.31	1350.75	0.03	887.42	28.48	915.90	0.01	1050.58	14.11	1064.69	0.03	565.44	15.02	580.46
GILLNET	0.01	137.07	70.78	0.73	71.51	0.00	33.16	0.00	33.16	0.06	18.79	1.11	19.90	0.02	14.34	0.31	14.65
OTHER		0.05		0.00	0.00			0.00	0.00			0.00	0.00	0.13	0.05	0.01	0.06
Totals by QTR			1407.81	19.58	1427.39		923.50	28.82	952.32		1107.97	19.77	1127.74		583.00	15.71	598.71
Total Landings	4022																
Total Discards	84																
Total DK Ratio	2%																
Total Catch 2001	4106																

WGB 2002

			QTR 1				QTR 2				QTR 3				QTR 4		
	D/K Ratio	Annual Landings (mt)	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch
HOOK	0.12	39.54	11.81	1.39	13.20	0.12	2.67	0.32	2.99	0.07	19.30	1.29	20.59	0.19	5.76	1.07	6.83
OTTER TRAWL	0.04	5166.02	1405.93	49.88	1455.81	0.01	1718.57	15.90	1734.47	0.01	1336.95	13.64	1350.59	0.02	704.57	15.23	719.80
GILLNET	0.01	203.86	70.37	0.57	70.94	0.00	52.67	0.14	52.81	0.17	73.06	12.18	85.24	0.01	7.76	0.05	7.81
OTHER	0.13	4.17	0.02	0.00	0.02	0.13	3.91	0.52	4.43	0.13	0.09	0.01	0.10	0.13	0.15	0.02	0.17
Totals by QTR			1488.13	51.85	1539.98		1777.82	16.87	1794.69		1429.40	27.11	1456.51		718.24	16.37	734.61
Total Landings	5414																
Total Discards	112																
Total DK Ratio	2%																
Total Catch 2002	5526																

WGB 2003

			QTR 1				QTR 2				QTR 3				QTR 4		
	D/K Ratio	Annual Landings (mt)	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch
HOOK	0.24	159.72	8.67	2.05	10.72	0.12	1.16	0.14	1.30	0.12	31.10	3.67	34.77	0.12	118.79	14.03	132.82
OTTER TRAWL	0.01	3789.61	1354.12	18.82	1372.94	0.01	1354.20	17.88	1372.08	0.02	511.16	7.82	518.98	0.01	570.13	6.56	576.69
GILLNET	0.00	47.87	3.44	0.00	3.44	0.11	8.51	0.91	9.42	0.10	26.31	2.58	28.89	0.06	9.61	0.62	10.23
OTHER	0.13	3.71	0.03	0.00	0.03	0.13	3.31	0.44	3.75	0.13	0.36	0.05	0.41	0.13	0.01	0.00	0.01
Totals by QTR			1366.26	20.88	1387.14		1367.18	19.36	1386.54		568.93	14.12	583.05		698.54	21.20	719.74
Total Landings	4001																
Total Discards	76																
Total DK Ratio	2%																
Total Catch 2003	4076																

WGB 2004

			QTR 1				QTR 2				QTR 3				QTR 4		
	D/K Ratio	Annual Landings (mt)	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch
HOOK	0.01	472.46	44.82	0.64	45.46	0.01	2.65	0.04	2.69	0.01	64.17	0.71	64.88	0.01	360.82	5.23	366.05
OTTER TRAWL	0.12	4801.31	1380.47	164.69	1545.16	0.04	1484.08	55.21	1539.29	0.12	934.64	109.82	1044.46	0.06	1002.12	57.61	1059.73
GILLNET	0.09	25.69	2.58	0.22	2.80	0.06	6.23	0.38	6.61	0.03	14.50	0.41	14.91	0.14	2.38	0.33	2.71
OTHER	0.21	84.22	0.01	0.00	0.01	0.21	47.31	10.07	57.38	0.13	36.90	4.85	41.75			0.00	0.00
Totals by QTR			1427.88	165.56	1593.44		1540.27	65.69	1605.96		1050.21	115.79	1166.00		1365.32	63.17	1428.49
Total Landings	5384																
Total Discards	410																
Total DK Ratio	8%																
Total Catch 2004	5794																

Table B3.2 Eastern Georges Bank haddock catch (mt) with discards based on observer data, 2001-2004

EGB 2001			QTR 1				QTR 2				QTR 3				QTR 4		
	D/K Ratio	Annual Landings (mt)	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch
HOOK				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00
OTTER TRAWL	0.03	606.60	172.30	4.34	176.64	0.10	308.10	31.58	339.68	0.03	57.21	1.57	58.78	0.03	68.99	2.03	71.02
GILLNET	0.02	1.83	0.92	0.02	0.94	0.02	0.91	0.02	0.93			0.00	0.00			0.00	0.00
OTHER				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00
Totals by QTR			173.22	4.35	177.57		309.01	31.60	340.61		57.21	1.57	58.78		68.99	2.03	71.02
Total Landings	608																
Total Discards	40																
Total DK Ratio	7%																
Total Catch 2001	648																

EGB 2002			QTR 1				QTR 2				QTR 3				QTR 4		
	D/K Ratio	Annual Landings (mt)	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch
HOOK				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00
OTTER TRAWL	0.07	914.84	165.14	11.92	177.06	0.04	573.08	20.32	593.40	0.02	98.81	1.80	100.61	0.01	77.81	0.81	78.62
GILLNET				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00
OTHER		1.20		0.00	0.00	0.12	1.17	0.14	1.31	0.12	0.03	0.00	0.03			0.00	0.00
Totals by QTR			165.14	11.92	177.06		574.25	20.45	594.70		98.84	1.80	100.64		77.81	0.81	78.62
Total Landings	916																
Total Discards	35																
Total DK Ratio	4%																
Total Catch 2002	951																

EGB 2003			QTR 1				QTR 2				QTR 3				QTR 4		
	D/K Ratio	Annual Landings (mt)	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch
HOOK				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00
OTTER TRAWL	0.03	1563.40	179.41	4.66	184.07	0.04	1041.06	42.16	1083.22	0.04	92.09	3.54	95.63	0.05	250.84	13.04	263.88
GILLNET				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00
OTHER				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00
Totals by QTR			179.41	4.66	184.07		1041.06	42.16	1083.22		92.09	3.54	95.63		250.84	13.04	263.88
Total Landings	1563																
Total Discards	63																
Total DK Ratio	4%																
Total Catch 2003	1627																

EGB 2004			QTR 1				QTR 2				QTR 3				QTR 4		
	D/K Ratio	Annual Landings (mt)	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch	D/K Ratio	Landings	Discards	Total Catch
HOOK		1.11		0.00	0.00			0.00	0.00			0.00	0.00	0.01	1.11	0.02	1.13
OTTER TRAWL	0.04	1794.26	265.84	11.11	276.95	0.09	1195.85	109.47	1305.32	0.11	309.01	34.28	343.29	0.04	23.56	0.99	24.55
GILLNET	0.05	0.40	0.32	0.01	0.33	0.05	0.08	0.00	0.08			0.00	0.00			0.00	0.00
OTHER				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00
Totals by QTR			266.16	11.12	277.28		1195.93	109.47	1305.40		309.01	34.28	343.29		24.67	1.00	25.67
Total Landings	1796																
Total Discards	156																
Total DK Ratio	9%																
Total Catch 2004	1952																

Table B4.1 USA landings and sampling intensity of western Georges Bank haddock by quarter and market category, 2001-2004

2001 Market Category Landings (mt)				
Qtr	Large	Scrod	Uncl	Total
1	978	355	74	1408
2	655	249	20	924
3	611	493	4	1108
4	297	284	2	583
Total	2541	1381	100	4022

Qtr	Lengths per 100 mt			
1	75	97	0	173
2	123	91	0	214
3	211	122	0	334
4	313	120	0	433
Wt Avg	158	106	0	264

Qtr	Ages per 100 mt			
1	25	39	0	64
2	49	28	0	77
3	73	35	0	108
4	103	38	0	141
Wt Avg	55	35	0	90

2002 Market Category Landings (mt)				
Qtr	Large	Scrod	Uncl	Total
1	1037	438	14	1488
2	1074	594	110	1778
3	978	419	32	1429
4	446	264	8	718
Total	3534	1715	164	5414

Qtr	Lengths per 100 mt			
1	38	45	0	82
2	18	26	0	44
3	101	99	0	200
4	139	122	0	261
Wt Avg	61	63	0	124

Qtr	Ages per 100 mt			
1	17	15	0	33
2	6	12	0	17
3	33	26	0	59
4	39	42	0	82
Wt Avg	21	20	0	41

2003 Market Category Landings (mt)				
Qtr	Large	Scrod	Uncl	Total
1	895	457	15	1366
2	773	555	40	1367
3	337	225	7	569
4	394	267	38	699
Total	2398	1503	100	4001

Qtr	Lengths per 100 mt			
1	62	65	0	127
2	116	77	0	192
3	241	126	0	367
4	245	101	0	346
Wt Avg	138	84	0	222

Qtr	Ages per 100 mt			
1	17	21	0	38
2	29	27	0	57
3	79	37	0	116
4	71	30	0	101
Wt Avg	39	27	0	67

2004 Market Category Landings (mt)				
Qtr	Large	Scrod	Uncl	Total
1	837	548	43	1428
2	570	883	87	1540
3	363	523	163	1050
4	486	780	99	1365
Total	2256	2735	393	5384

Qtr	Lengths per 100 mt			
1	120	73	0	193
2	119	20	0	139
3	205	97	0	302
4	242	131	0	373
Wt Avg	167	77	0	245

Qtr	Ages per 100 mt			
1	36	24	0	59
2	15	3	0	18
3	36	17	0	53
4	34	16	0	50
Wt Avg	29	15	0	44

Table B4.2 USA landings and sampling intensity of eastern Georges Bank haddock by quarter and market category, 2001-2004

2001 Market Category Landings (mt)				
Qtr	Large	Scrod	Uncl	Total
1	61	110	3	173
2	162	144	2	309
3	38	19		57
4	47	22		69
Total	309	295	5	608

Qtr	Lengths per 100 mt			
1	337	68	0	405
2	186	39	0	225
3	0	281	0	281
4	0	0	0	0
Wt Avg	190	65	0	256

Qtr	Ages per 100 mt			
1	111	23	0	134
2	51	17	0	68
3	0	132	0	132
4	0	0	0	0
Wt Avg	58	28	0	85

2002 Market Category Landings (mt)				
Qtr	Large	Scrod	Uncl	Total
1	96	68	1	165
2	279	281	14	574
3	56	43	0	99
4	51	24	2	78
Total	482	416	18	916

Qtr	Lengths per 100 mt			
1	94	0	0	94
2	92	47	0	139
3	275	0	0	275
4	0	0	0	0
Wt Avg	105	29	0	134

Qtr	Ages per 100 mt			
1	47	0	0	47
2	27	18	0	45
3	66	0	0	66
4	0	0	0	0
Wt Avg	33	11	0	44

2003 Market Category Landings (mt)				
Qtr	Large	Scrod	Uncl	Total
1	82	96	0	179
2	493	540	8	1041
3	50	37	6	92
4	26	222	3	251
Total	652	894	17	1563

Qtr	Lengths per 100 mt			
1	119	0	0	119
2	128	53	0	182
3	219	0	0	219
4	427	43	0	470
Wt Avg	180	42	0	223

Qtr	Ages per 100 mt			
1	43	0	0	43
2	36	14	0	50
3	84	0	0	84
4	95	12	0	107
Wt Avg	49	12	0	60

2004 Market Category Landings (mt)				
Qtr	Large	Scrod	Uncl	Total
1	71	193	3	266
2	233	960	3	1196
3	65	238	6	309
4	4	21		25
Total	372	1411	12	1796

Qtr	Lengths per 100 mt			
1	147	0	0	147
2	138	37	0	174
3	339	97	0	437
4	0	0	0	0
Wt Avg	172	41	0	213

Qtr	Ages per 100 mt			
1	35	0	0	35
2	33	9	0	41
3	59	27	0	86
4	0	0	0	0
Wt Avg	37	11	0	48

Table B5.1 Catch at age of western Georges Bank Haddock, 2001-2004

2001 WGB Catch at age (thousands of fish)

	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Age-8	Age-9+	Total
Landings at age 2001	0.0	58.4	479.2	287.3	369.8	299.2	181.5	93.8	56.2	1825.6
Discards at age 2001	4.3	7.1	23.9	13.3	7.8	4.9	2.9	1.1	0.6	65.9
Catch at age 2001	4.3	65.5	503.1	300.6	377.6	304.1	184.4	94.9	56.8	1891.5

2002 WGB Catch at age (thousands of fish)

	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Age-8	Age-9+	Total
Landings at age 2002	0.0	2.2	70.8	925.0	430.1	351.5	195.0	139.0	219.1	2332.8
Discards at age 2002	1.0	46.6	18.3	42.1	7.4	3.5	0.9	0.8	1.3	121.9
Catch at age 2002	1.0	48.8	89.1	967.1	437.5	355.0	195.9	139.8	220.4	2454.7

2003 WGB Catch at age (thousands of fish)

	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Age-8	Age-9+	Total
Landings at age 2003	0.0	0.8	82.6	144.9	926.4	178.6	246.3	93.0	144.7	1817.1
Discards at age 2003	1.1	4.1	28.8	6.1	20.3	2.1	2.4	0.9	1.7	67.4
Catch at age 2003	1.1	4.9	111.4	151.0	946.7	180.7	248.7	93.9	146.4	1884.5

2004 WGB Catch at age (thousands of fish)

	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Age-8	Age-9+	Total
Landings at age 2004	0.0	0.2	23.3	760.6	212.7	1202.7	178.4	125.9	136.5	2640.6
Discards at age 2004	375.1	19.3	34.4	206.8	22.5	58.2	10.3	2.1	3.0	731.6
Catch at age 2004	375.1	19.5	57.7	967.4	235.2	1260.9	188.7	128.0	139.5	3372.2

Table B5.2 USA catch at age of eastern Georges Bank Haddock, 2001-2004

2001 US EGB Catch at age (thousands of fish)

	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Age-8	Age-9+	Total
Landings at age 2001	0.0	0.7	71.0	35.2	68.9	29.5	20.2	26.3	40.4	292.2
Discards at age 2001	1.0	3.3	10.4	3.5	4.0	1.4	1.1	1.3	2.1	28.1
Catch at age 2001	1.0	4.0	81.4	38.7	72.9	30.9	21.3	27.6	42.5	320.3

2002 US EGB Catch at age (thousands of fish)

	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Age-8	Age-9+	Total
Landings at age 2002	0.0	5.4	12.5	176.3	52.7	75.0	26.5	22.1	60.3	430.8
Discards at age 2002	0.1	48.0	12.4	10.0	1.1	0.8	0.1	0.2	0.1	72.8
Catch at age 2002	0.1	53.4	24.9	186.3	53.8	75.8	26.6	22.3	60.4	503.6

2003 US EGB Catch at age (thousands of fish)

	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Age-8	Age-9+	Total
Landings at age 2003	0.0	0.0	94.8	46.6	295.8	77.4	105.2	43.2	91.5	754.5
Discards at age 2003	3.8	2.8	35.5	7.1	11.6	2.6	2.0	0.6	1.3	67.3
Catch at age 2003	3.8	2.8	130.3	53.7	307.4	80.0	107.2	43.8	92.8	821.8

2004 US EGB Catch at age (thousands of fish)

	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Age-8	Age-9+	Total
Landings at age 2004	0.0	0.0	1.3	340.3	152.0	246.7	104.3	94.7	74.5	1013.8
Discards at age 2004	165.6	15.0	24.5	67.9	24.8	17.4	6.7	0.9	0.7	323.5
Catch at age 2004	165.6	15.0	25.8	408.2	176.8	264.1	111.0	95.6	75.2	1337.3

Table B5.3 Canadian catch at age of eastern Georges Bank haddock (thousands of fish), 2001-2004

Year	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Age-8	Age-9+	Total
2001	26	63	1639	486	758	224	178	198	151	3724
2002	1	304	197	1676	316	581	83	84	218	3459
2003	1	6	1675	227	1153	339	363	63	134	3961
2004	178	3	37	3186	410	1216	401	322	185	5939

Table B6 Mean weights at age of western and eastern Georges Bank haddock landings and discards, 2001-2004

Mean weights at age (kg) of western Georges Bank haddock landings, 2001-2004

Year	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Age-8	Age-9+
2001	0.25	1.34	1.47	1.80	2.29	2.68	3.11	3.18	3.76
2002	0.35	1.19	1.39	1.75	1.99	2.71	3.35	3.49	3.38
2003	0.32	1.05	1.35	1.73	1.88	2.37	2.77	3.35	3.30
2004	0.16	0.95	1.25	1.59	1.92	2.07	2.34	3.02	3.28

Mean weights at age (kg) of USA eastern Georges Bank haddock landings, 2001-2004

Year	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Age-8	Age-9+
2001	0.25	1.13	1.29	1.60	2.04	2.34	2.19	2.74	3.31
2002	0.35	1.07	1.18	1.56	1.74	2.44	2.97	3.10	3.31
2003	0.32	1.05	1.31	1.52	1.83	1.99	2.54	2.89	3.09
2004	0.16	0.95	1.05	1.40	1.52	1.84	1.96	2.39	2.73

Mean weights at age (kg) of western Georges Bank haddock discards 2001-2004

Year	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Age-8	Age-9+
2001	0.18	0.64	1.06	1.33	1.78	1.95	2.73	1.85	3.45
2002	0.23	0.58	0.77	1.12	1.33	1.93	2.09	1.73	2.65
2003	0.21	0.50	0.90	1.09	1.48	1.86	2.47	2.98	2.27
2004	0.12	0.37	0.84	1.17	1.18	1.61	1.59	2.08	2.61

Mean weights at age (kg) of eastern Georges Bank haddock discards 2001-2004

Year	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Age-8	Age-9+
2001	0.18	0.64	1.06	1.33	1.78	1.95	2.73	1.85	3.19
2002	0.23	0.58	0.77	1.12	1.33	1.93	2.09	1.73	2.58
2003	0.21	0.50	0.90	1.09	1.48	1.86	2.47	2.98	2.42
2004	0.12	0.37	0.84	1.17	1.18	1.61	1.59	2.08	2.45

Mean weights at age (kg) of Canadian eastern Georges Bank haddock landings, 2001-2004

Year	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Age-8	Age-9+
2001	0.39	1.10	1.47	1.76	2.11	2.37	2.19	2.52	3.31
2002	0.41	1.01	1.42	1.76	1.94	2.34	2.66	2.38	3.31
2003	0.48	0.76	1.38	1.59	1.85	1.89	2.34	2.84	3.09
2004	0.48	0.59	1.10	1.51	1.64	1.88	2.00	2.28	2.73

Table B7 Georges Bank haddock catch at age (thousands of fish), 1963-2004

Year	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Age-8	Age-9+	Total
1963	2910	4047	7418	11152	8198	2205	1405	721	1096	39152
1964	10101	15935	4554	4776	8722	5794	2082	1028	1332	54324
1965	9601	125818	44496	5356	4391	6690	3772	1094	1366	202584
1966	114	6843	100810	19167	2768	2591	2332	1268	867	136760
1967	1150	168	2891	20667	10338	1209	993	917	698	39031
1968	8	2994	709	1921	14519	3499	667	453	842	25612
1969	2	11	1698	448	654	5954	1574	225	570	11136
1970	46	158	16	570	186	214	2308	746	464	4708
1971	1	1375	223	40	289	246	285	1469	928	4856
1972	160	2	460	83	33	123	80	68	1265	2273
1973	2607	2113	3	393	54	31	78	15	455	5750
1974	48	4481	682	2	73	2	2	55	258	5602
1975	199	1069	1928	388	4	43	4	4	91	3731
1976	149	491	570	913	224	0	24	4	116	2491
1977	1	19858	190	689	522	362	4	40	113	21778
1978	1	767	14509	307	571	521	140	14	68	16899
1979	1	26	1742	7238	530	414	318	97	46	10413
1980	8	31170	349	980	6087	597	549	154	81	39976
1981	1	1755	11076	837	944	2590	333	159	95	17791
1982	1	1174	1645	3761	394	573	1127	107	111	8893
1983	0	216	821	697	2261	275	188	808	77	5343
1984	0	94	301	736	402	1500	237	270	550	4090
1985	0	2464	563	199	472	233	539	80	156	4706
1986	6	55	2848	226	148	175	152	270	61	3941
1987	0	2035	132	1645	124	74	91	108	138	4348
1988	4	53	2439	137	953	152	56	65	108	3969
1989	0	1302	89	904	147	369	47	29	46	2933
1990	2	11	1480	176	889	100	181	47	45	2932
1991	6	456	93	2186	104	417	74	157	73	3565
1992	7	252	327	135	1560	113	330	28	96	2848
1993	7	297	359	307	107	676	39	163	78	2031
1994	1	281	846	178	68	72	157	45	45	1693
1995	9	92	615	471	62	32	8	58	19	1367
1996	5	54	577	958	470	69	22	5	8	2169
1997	30	178	290	768	556	216	19	16	40	2114
1998	1	203	423	511	705	536	151	22	42	2594
1999	1	40	1070	587	502	514	338	144	41	3235
2000	0	392	620	1583	558	497	362	246	86	4263
2001	31	133	2223	826	1209	559	383	321	251	5935
2002	2	406	311	2829	808	1012	306	246	498	6418
2003	6	14	1916	432	2407	600	719	201	373	6668
2004	719	38	121	4561	822	2741	701	546	400	10648
Average 1963-2004	665	5460	5106	2399	1782	1062	552	298	336	17656
Average 1980-1999	5	2109	1317	820	848	464	232	137	95	6027
Average 2000-2004	152	196	1038	2046	1161	1082	494	312	322	6786

Table B8 Georges Bank haddock mean catch weights at age (kg), 1963-2004

Year	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Age-8	Age-9+
1963	0.57	0.87	1.18	1.47	1.68	2.15	2.35	3.04	3.10
1964	0.50	0.83	1.12	1.43	1.64	2.01	2.40	2.64	2.97
1965	0.58	0.69	1.03	1.35	1.67	1.99	2.26	2.66	3.11
1966	0.58	0.73	0.89	1.26	1.70	2.07	2.28	2.87	3.18
1967	0.66	0.70	0.95	1.18	1.42	2.05	2.31	2.66	3.10
1968	0.59	0.81	1.05	1.32	1.57	2.10	2.32	2.62	2.86
1969	0.52	0.78	1.10	1.69	1.75	1.99	2.52	2.99	3.63
1970	0.71	1.27	1.22	1.93	2.19	2.39	2.58	3.23	3.75
1971	0.67	1.03	1.31	1.74	2.39	2.81	2.92	3.10	3.72
1972	0.62	1.03	1.74	2.04	2.42	2.92	3.06	3.44	3.66
1973	0.60	1.03	1.58	2.13	2.41	3.29	3.42	3.86	3.94
1974	0.72	1.06	1.82	2.32	2.83	3.76	4.05	3.92	4.26
1975	0.62	0.98	1.63	2.21	2.20	2.94	4.00	4.05	4.33
1976	0.50	0.99	1.39	1.99	2.66	3.08	3.69	4.67	4.94
1977	0.53	1.07	1.44	2.17	2.73	3.21	4.15	4.00	4.99
1978	0.53	0.94	1.50	2.04	2.79	3.19	3.37	3.61	5.11
1979	0.53	1.00	1.28	2.02	2.51	3.14	3.78	3.79	4.87
1980	0.55	0.94	1.21	1.73	2.17	2.82	3.60	3.56	3.87
1981	0.39	0.87	1.24	1.83	2.30	2.72	3.71	4.04	4.44
1982	0.22	0.97	1.45	1.88	2.37	2.76	3.24	3.96	4.09
1983	0.33	1.02	1.37	1.83	2.21	2.65	3.25	3.36	4.27
1984	0.33	0.92	1.32	1.83	2.20	2.67	2.96	3.41	3.72
1985	0.33	0.99	1.39	1.98	2.46	2.72	3.06	3.72	3.80
1986	0.45	0.94	1.36	1.83	2.56	2.83	2.96	3.46	3.78
1987	0.43	0.83	1.43	2.00	2.25	2.63	3.02	3.77	4.29
1988	0.42	0.98	1.34	1.68	2.06	2.45	2.97	3.49	3.96
1989	0.53	0.89	1.48	1.79	2.21	2.57	3.24	3.56	3.82
1990	0.64	0.97	1.48	1.78	2.12	2.55	2.81	2.99	4.16
1991	0.58	1.20	1.31	1.82	2.18	2.65	2.85	3.05	4.34
1992	0.54	1.18	1.64	1.77	2.19	2.52	2.97	3.37	4.27
1993	0.66	1.17	1.73	2.17	2.12	2.63	2.65	3.12	4.01
1994	0.45	1.09	1.64	2.21	2.63	2.73	2.90	3.78	4.55
1995	0.43	0.97	1.49	2.03	2.54	2.82	3.28	3.09	3.98
1996	0.46	1.10	1.50	1.84	2.33	2.54	3.42	3.52	3.71
1997	0.42	1.00	1.69	1.89	2.21	2.55	3.14	3.38	3.66
1998	0.51	0.97	1.49	1.92	2.33	2.69	3.03	3.04	4.07
1999	0.68	1.10	1.53	1.83	2.11	2.34	2.70	2.97	3.68
2000	0.66	1.13	1.46	1.89	2.25	2.37	2.73	2.99	3.30
2001	0.36	1.17	1.46	1.75	2.16	2.53	2.63	2.73	3.41
2002	0.30	0.91	1.34	1.73	1.95	2.47	3.13	3.07	3.34
2003	0.26	0.65	1.36	1.61	1.85	2.05	2.52	3.09	3.17
2004	0.21	0.39	1.00	1.50	1.67	1.95	2.07	2.47	2.91
Average 1963-2004	0.50	0.96	1.38	1.82	2.19	2.60	3.01	3.34	3.86
Average 1980-1999	0.47	1.00	1.45	1.88	2.28	2.64	3.09	3.43	4.02
Average 2000-2004	0.36	0.85	1.32	1.70	1.98	2.27	2.62	2.87	3.23

Table B10 Conversion factors used to adjust for changes in door type and survey vessel in the NMFS surveys during 1968-2005.

		Spring		Fall	
Year	Door	Vessel	Conversion	Vessel	Conversion
1968	BMV	Albatross IV	1.49	Albatross IV	1.49
1969	BMV	Albatross IV	1.49	Albatross IV	1.49
1970	BMV	Albatross IV	1.49	Albatross IV	1.49
1971	BMV	Albatross IV	1.49	Albatross IV	1.49
1972	BMV	Albatross IV	1.49	Albatross IV	1.49
1973	BMV	Albatross IV	1.49	Albatross IV	1.49
1974	BMV	Albatross IV	1.49	Albatross IV	1.49
1975	BMV	Albatross IV	1.49	Albatross IV	1.49
1976	BMV	Albatross IV	1.49	Albatross IV	1.49
1977	BMV	Albatross IV	1.49	Delaware II	1.2218
1978	BMV	Albatross IV	1.49	Delaware II	1.2218
1979	BMV	Albatross IV	1.49	Delaware II	1.2218
1980	BMV	Albatross IV	1.49	Delaware II	1.2218
1981	BMV	Delaware II	1.2218	Delaware II	1.2218
1982	BMV	Delaware II	1.2218	Albatross IV	1.49
1983	BMV	Albatross IV	1.49	Albatross IV	1.49
1984	BMV	Albatross IV	1.49	Albatross IV	1.49
1985	Polyvalent	Albatross IV	1	Albatross IV	1
1986	Polyvalent	Albatross IV	1	Albatross IV	1
1987	Polyvalent	Albatross IV	1	Albatross IV	1
1988	Polyvalent	Albatross IV	1	Albatross IV	1
1989	Polyvalent	Delaware II	0.82	Delaware II	0.82
1990	Polyvalent	Delaware II	0.82	Delaware II	0.82
1991	Polyvalent	Delaware II	0.82	Delaware II	0.82
1992	Polyvalent	Albatross IV	1	Albatross IV	1
1993	Polyvalent	Albatross IV	1	Delaware II	0.82
1994	Polyvalent	Delaware II	0.82	Albatross IV	1
1995	Polyvalent	Albatross IV	1	Albatross IV	1
1996	Polyvalent	Albatross IV	1	Albatross IV	1
1997	Polyvalent	Albatross IV	1	Albatross IV	1
1998	Polyvalent	Albatross IV	1	Albatross IV	1
1999	Polyvalent	Albatross IV	1	Albatross IV	1
2000	Polyvalent	Albatross IV	1	Albatross IV	1
2001	Polyvalent	Albatross IV	1	Albatross IV	1
2002	Polyvalent	Albatross IV	1	Albatross IV	1
2003	Polyvalent	Delaware II	0.82	Delaware II	0.82
2004	Polyvalent	Albatross IV	1	Albatross IV	1
2005	Polyvalent	Albatross IV	1		

Table B11 Georges Bank haddock NEFSC spring survey number at age indices, 1968-2005

Year	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Age-8	Age-9+
1968	0.40	2.83	0.46	0.70	6.72	1.68	0.25	0.45	0.34
1969	0.00	0.07	0.58	0.25	0.42	4.23	1.03	0.28	0.46
1970	0.67	0.25	0.00	0.33	0.46	0.46	2.00	0.98	0.85
1971	0.00	1.16	0.25	0.00	0.12	0.12	0.09	0.82	0.22
1972	4.02	0.09	0.61	0.12	0.03	0.04	0.13	0.03	1.30
1973	30.68	4.84	0.00	0.54	0.09	0.00	0.18	0.01	1.28
1974	2.13	13.29	2.86	0.00	0.24	0.00	0.01	0.10	0.37
1975	0.94	0.97	3.32	0.63	0.00	0.13	0.09	0.01	0.15
1976	80.79	0.30	0.60	0.92	0.43	0.00	0.04	0.00	0.10
1977	0.61	33.41	0.42	1.22	0.60	0.45	0.00	0.04	0.12
1978	0.07	0.97	15.93	0.36	0.94	0.82	0.16	0.06	0.10
1979	36.12	1.58	1.13	5.71	0.33	0.16	0.37	0.06	0.04
1980	5.20	46.70	0.51	1.04	4.87	0.67	0.37	0.46	0.24
1981	3.30	3.29	19.49	2.19	0.76	1.78	0.24	0.11	0.05
1982	0.76	1.53	0.94	4.07	0.42	0.28	0.61	0.00	0.00
1983	0.43	0.55	0.58	0.22	2.41	0.01	0.04	1.16	0.18
1984	2.09	1.18	0.64	0.63	0.58	0.72	0.07	0.04	0.30
1985	0.00	4.96	0.76	0.40	0.87	0.34	1.17	0.10	0.25
1986	2.49	0.18	2.06	0.24	0.11	0.21	0.12	0.33	0.11
1987	0.00	3.62	0.06	0.81	0.08	0.10	0.05	0.22	0.01
1988	1.55	0.04	0.99	0.13	0.32	0.12	0.11	0.12	0.00
1989	0.02	3.49	0.45	0.71	0.14	0.41	0.06	0.05	0.01
1990	0.86	0.00	5.72	0.33	0.58	0.06	0.13	0.00	0.01
1991	0.54	1.07	0.24	1.85	0.09	0.10	0.02	0.04	0.02
1992	0.40	0.18	0.11	0.07	0.33	0.03	0.03	0.03	0.00
1993	1.17	0.65	0.18	0.14	0.12	0.37	0.06	0.02	0.02
1994	0.70	2.68	1.00	0.15	0.10	0.07	0.16	0.02	0.05
1995	0.50	1.29	2.32	0.91	0.17	0.11	0.03	0.18	0.11
1996	1.09	4.59	8.86	5.21	2.62	0.35	0.07	0.07	0.00
1997	1.79	1.02	3.35	3.66	2.01	0.89	0.13	0.07	0.00
1998	0.82	2.95	1.25	1.06	0.85	0.21	0.06	0.01	0.06
1999	10.21	2.03	2.14	0.72	0.64	0.51	0.20	0.20	0.02
2000	1.83	2.37	4.10	2.01	1.11	1.11	1.01	0.48	0.13
2001	10.01	0.86	2.44	0.83	0.30	0.21	0.12	0.08	0.07
2002	0.18	19.25	6.72	3.22	1.09	0.48	0.61	0.17	0.53
2003	0.01	0.25	5.45	1.21	4.85	0.96	1.14	0.86	0.89
2004	112.14	1.85	1.20	9.06	2.18	2.67	0.43	0.96	0.42
2005	0.80	53.34	0.16	0.38	3.35	0.45	1.01	0.19	0.08
Average 1968-2005	8.30	5.78	2.58	1.37	1.09	0.56	0.33	0.23	0.23
Average 1980-1999	1.70	4.10	2.58	1.23	0.90	0.37	0.19	0.16	0.07
Average 2000-2005	20.83	12.99	3.34	2.79	2.15	0.98	0.72	0.46	0.35

Table B12 Georges Bank haddock NEFSC autumn survey number at age indices, 1963-2004

Year	Age-0	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Age-8	Age-9+
1963	83.93	25.39	9.22	6.81	8.34	5.95	2.04	1.68	1.18	0.46
1964	2.37	112.87	63.74	5.83	1.79	3.81	1.56	0.69	0.25	0.33
1965	0.33	10.16	77.39	9.70	1.07	0.80	0.91	0.80	0.25	0.27
1966	6.14	0.95	2.89	18.39	3.35	0.52	0.49	0.33	0.12	0.07
1967	0.03	6.72	0.36	1.00	6.76	1.62	0.49	0.21	0.33	0.18
1968	0.09	0.06	0.95	0.13	0.33	3.86	1.27	0.27	0.16	0.39
1969	0.39	0.03	0.00	0.28	0.13	0.16	1.52	0.51	0.09	0.27
1970	0.04	4.13	0.21	0.01	0.28	0.27	0.51	1.37	0.48	0.40
1971	2.43	0.00	0.31	0.07	0.01	0.22	0.03	0.09	0.75	0.28
1972	6.75	2.52	0.00	0.52	0.09	0.00	0.09	0.06	0.03	1.30
1973	3.23	9.00	1.61	0.00	0.19	0.04	0.00	0.07	0.01	0.72
1974	0.75	1.77	0.98	0.31	0.00	0.01	0.00	0.00	0.00	0.22
1975	23.48	0.63	0.72	4.86	0.92	0.00	0.03	0.00	0.01	0.30
1976	4.32	64.17	0.52	0.54	0.82	0.30	0.00	0.04	0.10	0.25
1977	0.13	2.14	18.73	0.56	0.57	0.64	0.34	0.04	0.01	0.09
1978	13.22	0.84	1.04	9.27	0.18	0.26	0.45	0.01	0.00	0.01
1979	1.32	45.57	0.04	0.90	3.81	0.26	0.28	0.05	0.01	0.00
1980	11.68	2.71	12.72	0.45	0.18	1.70	0.48	0.46	0.09	0.06
1981	0.38	6.13	2.08	3.70	0.21	0.42	0.53	0.00	0.00	0.01
1982	1.36	0.00	1.33	0.34	1.40	0.13	0.07	0.21	0.01	0.10
1983	5.80	0.24	0.21	0.27	0.30	0.94	0.12	0.00	0.10	0.01
1984	0.03	3.32	0.88	0.24	0.28	0.06	0.45	0.00	0.00	0.12
1985	11.35	0.65	1.53	0.22	0.05	0.10	0.07	0.17	0.00	0.05
1986	0.00	5.11	0.09	1.21	0.06	0.13	0.13	0.02	0.03	0.03
1987	1.80	0.00	0.79	0.10	0.77	0.06	0.06	0.02	0.02	0.00
1988	0.07	3.02	0.18	1.30	0.12	0.40	0.12	0.11	0.00	0.03
1989	0.47	0.05	2.71	0.20	0.66	0.09	0.13	0.02	0.02	0.00
1990	0.77	0.67	0.02	1.19	0.05	0.17	0.04	0.00	0.00	0.00
1991	2.16	0.21	0.24	0.05	0.22	0.02	0.02	0.00	0.00	0.02
1992	2.85	2.08	0.23	0.24	0.00	0.47	0.02	0.08	0.03	0.06
1993	1.52	4.04	2.01	0.30	0.00	0.06	0.15	0.02	0.00	0.00
1994	0.91	0.77	0.81	0.67	0.12	0.05	0.02	0.17	0.06	0.00
1995	2.27	7.14	4.90	2.32	0.38	0.01	0.00	0.07	0.02	0.00
1996	1.31	0.54	0.93	1.04	0.49	0.14	0.01	0.01	0.00	0.01
1997	0.32	2.47	1.47	0.75	0.55	0.33	0.13	0.00	0.07	0.08
1998	4.32	2.79	2.47	0.72	0.41	0.18	0.16	0.02	0.00	0.01
1999	1.82	0.84	3.37	8.05	3.52	2.32	0.82	1.32	0.75	0.31
2000	4.14	2.82	5.48	3.10	1.10	0.66	0.13	0.27	0.09	0.19
2001	0.85	8.77	1.68	7.44	2.12	1.16	0.36	0.22	0.13	0.01
2002	0.12	1.91	22.27	5.45	8.54	1.87	0.62	0.53	0.68	0.10
2003	154.54	0.07	0.45	8.55	1.77	3.36	0.29	0.28	0.00	0.22
2004	1.63	163.65	0.22	0.84	13.62	1.18	4.54	0.50	0.67	0.15
Average 1963-2004	8.61	12.07	5.90	2.57	1.56	0.83	0.46	0.26	0.16	0.17
Average 1980-1999	2.56	2.14	1.95	1.17	0.49	0.39	0.18	0.14	0.06	0.05
Average 2000-2004	32.26	35.45	6.02	5.08	5.43	1.65	1.19	0.36	0.31	0.13

Table B13 Georges Bank haddock DFO winter survey number at age indices, 1986-2004

Year	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Age-8
1986	4.06	0.22	6.05	1.07	0.19	0.29	0.34	0.37
1987	0.03	3.04	0.69	2.51	0.67	0.08	0.30	0.10
1988	1.47	0.05	8.53	0.17	2.85	0.18	0.17	0.11
1989	0.03	5.34	0.72	2.12	0.19	0.42	0.03	0.03
1990	0.93	0.11	9.87	0.13	3.36	0.23	1.09	0.13
1991	0.75	1.67	0.14	8.99	0.11	1.60	0.09	0.44
1992	3.30	2.95	1.13	0.17	3.82	0.03	1.06	0.04
1993	3.96	2.16	0.55	0.45	0.04	1.28	0.02	0.32
1994	3.32	11.52	4.08	0.42	0.24	0.02	0.70	0.01
1995	1.94	2.62	4.30	2.22	0.56	0.03	0.00	0.48
1996	6.11	2.89	4.84	5.04	2.92	0.26	0.24	0.04
1997	1.74	1.16	0.99	2.34	2.37	1.70	0.23	0.09
1998	2.41	8.18	3.08	2.57	3.76	3.67	1.98	0.24
1999	19.75	3.41	7.16	2.21	1.40	1.35	1.26	0.33
2000	18.33	68.60	9.32	8.91	2.11	1.55	1.94	1.14
2001	22.28	2.83	10.88	3.09	4.13	1.29	1.15	1.41
2002	1.98	31.70	6.65	15.36	4.32	5.32	1.59	1.32
2003	1.37	2.55	69.32	5.14	13.24	2.94	2.69	1.21
2004	147.70	0.41	1.99	39.57	3.94	7.38	1.24	0.73
Average 1986-2004	12.71	7.97	7.91	5.39	2.64	1.56	0.85	0.45
Average 1986-1999	3.56	3.24	3.72	2.17	1.61	0.80	0.54	0.20
Average 2000-2004	38.33	21.22	19.63	14.41	5.55	3.69	1.72	1.16

Table B14 Percentage maturity of female Georges Bank haddock at age, 1963-2001.

	Age				
Year	1	2	3	4	Source
1963-1967	0	0	78	100	Clark (1959)
1968 - 1972	0	28	76	100	Livingstone (pers. comm., March 1980) as cited in Clark et al. (1982)
1973 - 1976	0	34	92	100	Livingstone (pers. comm., March 1980) as cited in Clark et al. (1982)
1977	0	61	100	100	Overholtz (1987)
1978	0	26	99	100	Overholtz (1987)
1979	0	8	71	100	Overholtz (1987)
1980	0	41	100	100	Overholtz (1987)
1981	0	52	94	100	Overholtz (1987)
1982	0	31	67	100	Overholtz (1987)
1983	0	11	39	100	Overholtz (1987)
1984	12	33	94	100	O'Brien (pers. comm.)
1985 - 1987	39	73	92	98	Brown et al. (2000)
1988 - 1990	3	33	89	99	Brown et al. (2000)
1991 - 1992	5	72	99	100	Brown et al. (2000)
1993 - 1994	7	30	71	94	Brown et al. (2000)
1995 - 1997	2	34	93	100	Brown et al. (2000)
1998 - 2000	4	49	95	100	Brown et al. (2000)
2001-2004	1	60	95	99	Current Assessment

Table B15 Georges Bank haddock virtual population analysis (VPA) run descriptions including a summary of accepted VPA formulations from the previous six stock assessments and current assessment.

VPA Run #	SARC-24	SARC-27	NDWG-1999	TRAC-2000	TRAC-2001	GARM 2002	GARM 2005
Terminal Year of Catch at Age	1996	1997	1998	1999	2000	2001	2004
Ages Estimated	1-8	1-8	1-8	1-8	1-8	1-8	1-8
Tuning Indices							
US Spring 1-8	Yes	Yes	Yes	Yes	Yes	Yes	Yes
US Spring 1973-1981 (Yankee 41 years) separate index	No	Yes	Yes	Yes	Yes	Yes	Yes
Canada Spring 1-8	Yes	Yes	Yes	Yes	Yes	Yes	Yes
US Autumn 0-5 Lagged	Yes	Yes	Yes	Yes	Yes	Yes	Yes
US Autumn 6-8 Lagged	Yes	No	No	No	No	No	No
Terminal Year US Spring Indices	No	No	Yes	No	No	Yes	Yes
Discards							
Post 1993 Discard Estimates Included	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Diagnostics							
Sum of Squares	398.66	338.16	352.20	375.25	386.81	404.75	433.31
Mean squared residuals	0.725	0.696	0.683	0.708	0.701	0.695	0.647
CV n1	0.62	0.61	0.49	0.61	0.61	0.50	0.58
CV n2	0.40	0.39	0.35	0.39	0.39	0.35	0.37
CV n3	0.31	0.31	0.29	0.31	0.31	0.29	0.3
CV n4	0.29	0.27	0.27	0.29	0.28	0.27	0.26
CV n5	0.27	0.27	0.25	0.27	0.28	0.26	0.25
CV n6	0.26	0.25	0.26	0.26	0.25	0.26	0.23
CV n7	0.33	0.27	0.25	0.30	0.27	0.28	0.3
CV n8	0.34	0.31	0.27	0.29	0.30	0.31	0.34
Max CV q (US Spring)	0.17	N/A	N/A	N/A	N/A	N/A	N/A
Max CV q (US Spring - Yankee 36)	N/A	0.21	0.19	0.20	0.19	0.18	0.2
Max CV q (US Spring - Yankee 41)	N/A	0.34	0.34	0.35	0.34	0.34	0.51
Max CV q (Canadian Spring)	0.26	0.25	0.24	0.23	0.23	0.22	0.24
Max CV q (US Autumn)	0.17	0.15	0.15	0.15	0.14	0.14	0.15

Table B16. VPA estimates of Georges Bank haddock beginning year stock numbers at age, 1963-2005

AGE	1963	1964	1965	1966	1967
1	189461.	462186.	32366.	4090.	14686.
2	31983.	152489.	369285.	17883.	3246.
3	32327.	22539.	110482.	189565.	8515.
4	44770.	19798.	14357.	50644.	65418.
5	28469.	26634.	11917.	6958.	24302.
6	9017.	15949.	13985.	5824.	3220.
7	5326.	5401.	7868.	5480.	2453.
8	2757.	3099.	2558.	3075.	2401.
9	4190.	4055.	3741.	2956.	3026.
Total	348300.	712151.	566560.	286474.	127267.

AGE	1968	1969	1970	1971	1972
1	482.	1045.	4696.	317.	8610.
2	10987.	388.	853.	3803.	259.
3	2506.	6307.	307.	557.	1882.
4	4380.	1415.	3639.	237.	256.
5	35021.	1869.	757.	2466.	158.
6	10654.	15687.	944.	452.	1758.
7	1553.	5585.	7513.	581.	151.
8	1120.	676.	3159.	4080.	221.
9	2995.	2208.	1647.	2848.	3524.
Total	69698.	35179.	23516.	15342.	16820.

AGE	1973	1974	1975	1976	1977
1	19727.	10615.	7856.	105602.	14031.
2	6905.	13802.	8648.	6253.	86324.
3	210.	3757.	7282.	6116.	4677.
4	1127.	169.	2463.	4230.	4493.
5	135.	571.	137.	1667.	2643.
6	100.	62.	402.	108.	1163.
7	1329.	55.	49.	290.	89.
8	53.	1017.	43.	37.	216.
9	1873.	1154.	1496.	1174.	883.
Total	31459.	31202.	28374.	125476.	114518.

AGE	1978	1979	1980	1981	1982
1	6179.	83910.	10592.	7402.	2510.
2	11487.	5058.	68693.	8665.	6060.
3	52825.	8713.	4118.	28399.	5515.
4	3658.	30221.	5566.	3057.	13337.
5	3058.	2718.	18238.	3674.	1751.
6	1694.	1989.	1748.	9474.	2161.
7	628.	919.	1256.	896.	5431.
8	69.	388.	468.	538.	435.
9	762.	607.	686.	733.	812.
Total	80359.	134522.	111364.	62838.	38011.

Table B16 Continued.

AGE	1983	1984	1985	1986	1987
1	3207.	17565.	1844.	15267.	1995.
2	2054.	2626.	14380.	1510.	12494.
3	3905.	1487.	2065.	9555.	1187.
4	3039.	2459.	947.	1185.	5267.
5	7543.	1862.	1353.	596.	767.
6	1079.	4146.	1163.	684.	355.
7	1254.	637.	2051.	742.	403.
8	3432.	857.	309.	1195.	471.
9	825.	2690.	2168.	1816.	2168.
Total	26339.	34329.	26280.	32551.	25107.

AGE	1988	1989	1990	1991	1992
1	17052.	1112.	2841.	2552.	10401.
2	1633.	13957.	911.	2324.	2084.
3	8397.	1289.	10253.	735.	1493.
4	853.	4685.	976.	7062.	519.
5	2836.	575.	3023.	640.	3821.
6	516.	1468.	338.	1677.	431.
7	224.	285.	871.	187.	998.
8	248.	133.	191.	550.	87.
9	1939.	1634.	1379.	1202.	1228.
Total	33698.	25140.	20782.	16930.	21061.

AGE	1993	1994	1995	1996	1997
1	15415.	16091.	12443.	12222.	25106.
2	8509.	12614.	13173.	10179.	10002.
3	1479.	6698.	10074.	10702.	8284.
4	928.	888.	4722.	7694.	8241.
5	304.	485.	567.	3442.	5435.
6	1733.	153.	336.	409.	2395.
7	251.	814.	61.	245.	273.
8	522.	170.	525.	42.	181.
9	965.	1000.	877.	1079.	905.
Total	30105.	38915.	42778.	46013.	60822.

AGE	1998	1999	2000	2001	2002
1	13722.	46906.	18902.	90863.	5359.
2	20528.	11233.	38400.	15474.	74364.
3	8028.	16623.	9161.	31085.	12549.
4	6521.	6191.	12644.	6941.	23445.
5	6055.	4878.	4540.	8926.	4938.
6	3949.	4322.	3542.	3215.	6219.
7	1766.	2750.	3075.	2452.	2129.
8	206.	1309.	1947.	2191.	1663.
9	839.	798.	1558.	2571.	3384.
Total	61612.	95011.	93769.	163717.	134049.

Table B16 Continued.

AGE	2003	2004	2005
1	1335.	788886.	9879.
2	4386.	1088.	645236.
3	60518.	3578.	857.
4	9993.	47817.	2821.
5	16646.	7792.	35037.
6	3316.	11460.	5638.
7	4180.	2175.	6920.
8	1467.	2776.	1153.
9	3461.	3517.	4301.
Total	105302.	869090.	711840.

Table B17. VPA estimates of Georges Bank haddock spawning stock biomass (mt), 1963-2004

AGE	1963	1964	1965	1966	1967
1	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.
3	23910.	15503.	65562.	88804.	4684.
4	54720.	22653.	14729.	48018.	57345.
5	37829.	35203.	15397.	8693.	26450.
6	16142.	24562.	19988.	8724.	5009.
7	10314.	10178.	13259.	9497.	4410.
8	6440.	6559.	5254.	6415.	4914.
9	11355.	10249.	9744.	8115.	8294.
Total	160710.	124907.	143932.	178266.	111107.

AGE	1968	1969	1970	1971	1972
1	0.	0.	0.	0.	0.
2	1958.	69.	175.	764.	57.
3	1415.	3943.	214.	449.	1685.
4	3964.	1612.	4810.	312.	357.
5	38997.	2395.	1280.	4866.	290.
6	15654.	23067.	1710.	853.	4331.
7	2751.	11142.	14614.	1205.	341.
8	2266.	1511.	7955.	9685.	602.
9	7431.	7015.	5357.	9025.	10831.
Total	74435.	50755.	36114.	27160.	18494.

AGE	1973	1974	1975	1976	1977
1	0.	0.	0.	0.	0.
2	1611.	3190.	2265.	1549.	18428.
3	234.	4259.	7688.	6080.	4254.
4	1830.	307.	4480.	6773.	7088.
5	247.	1283.	291.	3695.	5511.
6	243.	177.	1068.	268.	2913.
7	3928.	187.	177.	887.	297.
8	157.	3489.	160.	146.	745.
9	6495.	4357.	6054.	5358.	4034.
Total	14745.	17249.	22184.	24755.	43270.

AGE	1978	1979	1980	1981	1982
1	0.	0.	0.	0.	0.
2	2497.	1154.	12829.	1767.	1102.
3	47145.	6921.	3405.	20558.	4323.
4	5820.	46365.	7466.	3957.	17658.
5	6757.	5507.	32417.	6418.	3231.
6	4290.	5249.	3935.	20028.	4751.
7	1830.	2695.	3417.	2419.	14374.
8	238.	1217.	1459.	1769.	1466.
9	3611.	2750.	2437.	2978.	3034.
Total	72188.	71859.	67365.	59894.	49941.

Table B17 Continued.

AGE	1983	1984	1985	1986	1987
1	0.	382.	82.	1155.	130.
2	296.	450.	4824.	515.	4493.
3	3248.	1449.	1849.	8693.	1153.
4	4380.	3353.	1336.	1661.	7292.
5	13238.	3321.	2421.	1180.	1409.
6	2371.	8446.	2543.	1582.	822.
7	3415.	1489.	5122.	1879.	1043.
8	9997.	2443.	899.	3446.	1391.
9	3263.	8934.	7677.	6469.	8690.
Total	40208.	30266.	26753.	26579.	26423.

AGE	1988	1989	1990	1991	1992
1	1123.	100.	126.	99.	361.
2	650.	5135.	347.	1022.	885.
3	6965.	1318.	10077.	714.	1748.
4	1174.	6373.	1411.	9833.	684.
5	4883.	970.	5082.	1143.	6249.
6	1044.	2964.	692.	3488.	883.
7	549.	727.	2085.	416.	2378.
8	704.	383.	522.	1394.	229.
9	7190.	5892.	5407.	4874.	4872.
Total	24281.	23862.	25749.	22983.	18289.

AGE	1993	1994	1995	1996	1997
1	525.	326.	63.	72.	130.
2	1907.	3036.	2796.	2256.	2171.
3	1317.	6040.	11293.	11339.	9992.
4	1399.	1458.	7958.	11669.	12838.
5	495.	1057.	1239.	6820.	10121.
6	3438.	292.	844.	939.	5400.
7	588.	2014.	166.	706.	718.
8	1360.	470.	1447.	131.	570.
9	3599.	4271.	3303.	3801.	3109.
Total	14629.	18963.	29109.	37732.	45049.

AGE	1998	1999	2000	2001	2002
1	91.	468.	180.	194.	11.
2	4202.	2722.	10855.	7775.	24190.
3	8609.	17742.	10200.	35383.	14099.
4	10915.	9445.	19705.	10113.	33897.
5	11690.	9058.	8455.	16478.	8265.
6	8798.	9273.	7229.	6916.	13008.
7	4550.	6791.	7143.	5555.	5451.
8	587.	3618.	5066.	5446.	4295.
9	3201.	2754.	4813.	8107.	10280.
Total	52642.	61872.	73646.	95968.	113496.

Table B17 Continued.

AGE	2003	2004
1	3.	1058.
2	1111.	196.
3	60302.	2578.
4	13651.	62496.
5	27202.	11785.
6	5961.	19229.
7	9422.	3821.
8	4165.	6196.
9	10100.	9430.
Total	131916.	116787.

Table B18. VPA estimates of Georges Bank haddock fishing mortality at age, 1963-2004

AGE	1963	1964	1965	1966	1967
1	0.0171	0.0244	0.3933	0.0312	0.0902
2	0.1500	0.1222	0.4668	0.5420	0.0587
3	0.2903	0.2510	0.5800	0.8639	0.4648
4	0.3194	0.3076	0.5243	0.5343	0.4248
5	0.3794	0.4442	0.5160	0.5706	0.6246
6	0.3125	0.5066	0.7370	0.6646	0.5288
7	0.3416	0.5473	0.7393	0.6250	0.5840
8	0.3382	0.4514	0.6292	0.5986	0.5406
9	0.3382	0.4458	0.5099	0.3879	0.2921

AGE	1968	1969	1970	1971	1972
1	0.0185	0.0021	0.0109	0.0035	0.0207
2	0.3551	0.0318	0.2275	0.5035	0.0086
3	0.3715	0.3500	0.0591	0.5761	0.3127
4	0.6515	0.4260	0.1891	0.2051	0.4378
5	0.6031	0.4828	0.3145	0.1381	0.2576
6	0.4458	0.5362	0.2862	0.8949	0.0801
7	0.6327	0.3697	0.4105	0.7651	0.8527
8	0.5833	0.4537	0.3000	0.5008	0.4070
9	0.3686	0.3331	0.3695	0.4414	0.4987

AGE	1973	1974	1975	1976	1977
1	0.1572	0.0050	0.0283	0.0016	0.0001
2	0.4085	0.4395	0.1463	0.0904	0.2911
3	0.0164	0.2224	0.3432	0.1084	0.0457
4	0.4808	0.0138	0.1902	0.2705	0.1849
5	0.5727	0.1509	0.0336	0.1600	0.2448
6	0.4079	0.0378	0.1266	0.0001	0.4170
7	0.0672	0.0434	0.0961	0.0952	0.0524
8	0.3822	0.0614	0.1117	0.1314	0.2248
9	0.3103	0.2822	0.0694	0.1153	0.1512

AGE	1978	1979	1980	1981	1982
1	0.0002	0.0001	0.0008	0.0001	0.0004
2	0.0764	0.0057	0.6833	0.2518	0.2393
3	0.3585	0.2481	0.0980	0.5558	0.3959
4	0.0971	0.3050	0.2152	0.3571	0.3699
5	0.2299	0.2412	0.4549	0.3310	0.2837
6	0.4112	0.2595	0.4685	0.3565	0.3440
7	0.2812	0.4760	0.6482	0.5227	0.2588
8	0.2549	0.3204	0.4467	0.3918	0.3141
9	0.1026	0.0880	0.1401	0.1534	0.1626

Table B18 Continued.

AGE	1983	1984	1985	1986	1987
1	0.0001	0.0001	0.0001	0.0004	0.0001
2	0.1231	0.0403	0.2087	0.0408	0.1974
3	0.2626	0.2512	0.3555	0.3956	0.1302
4	0.2901	0.3975	0.2621	0.2353	0.4190
5	0.3984	0.2706	0.4812	0.3179	0.1967
6	0.3275	0.5039	0.2493	0.3301	0.2618
7	0.1801	0.5219	0.3398	0.2549	0.2844
8	0.2990	0.4235	0.3331	0.2846	0.2905
9	0.1081	0.2542	0.0824	0.0376	0.0726

AGE	1988	1989	1990	1991	1992
1	0.0003	0.0001	0.0008	0.0026	0.0008
2	0.0366	0.1084	0.0138	0.2427	0.1430
3	0.3834	0.0787	0.1729	0.1492	0.2751
4	0.1945	0.2383	0.2212	0.4143	0.3357
5	0.4584	0.3303	0.3891	0.1961	0.5906
6	0.3916	0.3227	0.3930	0.3187	0.3407
7	0.3229	0.2017	0.2596	0.5688	0.4493
8	0.3419	0.2733	0.3157	0.3745	0.4291
9	0.0636	0.0318	0.0367	0.0695	0.0901

AGE	1993	1994	1995	1996	1997
1	0.0005	0.0001	0.0008	0.0005	0.0013
2	0.0393	0.0248	0.0077	0.0059	0.0198
3	0.3099	0.1496	0.0696	0.0613	0.0394
4	0.4491	0.2482	0.1163	0.1475	0.1083
5	0.4856	0.1686	0.1275	0.1627	0.1196
6	0.5560	0.7245	0.1128	0.2056	0.1045
7	0.1875	0.2388	0.1653	0.1050	0.0804
8	0.4196	0.3450	0.1305	0.1552	0.1032
9	0.0933	0.0504	0.0235	0.0082	0.0503

AGE	1998	1999	2000	2001	2002
1	0.0001	0.0001	0.0001	0.0004	0.0004
2	0.0110	0.0039	0.0113	0.0095	0.0060
3	0.0598	0.0736	0.0775	0.0821	0.0277
4	0.0903	0.1102	0.1483	0.1403	0.1425
5	0.1372	0.1202	0.1453	0.1613	0.1982
6	0.1619	0.1403	0.1675	0.2122	0.1972
7	0.0992	0.1452	0.1389	0.1887	0.1721
8	0.1221	0.1290	0.1500	0.1757	0.1775
9	0.0565	0.0586	0.0624	0.1137	0.1768

Table B18 Continued.

AGE	2003	2004
1	0.0051	0.0010
2	0.0035	0.0388
3	0.0355	0.0379
4	0.0488	0.1110
5	0.1732	0.1235
6	0.2216	0.3045
7	0.2095	0.4352
8	0.1633	0.2436
9	0.1264	0.1336

Table B19. VPA estimates of Georges Bank haddock average fishing mortality for ages 4-7, 1963-2004

Average Fishing Mortality For Ages 4- 7

Year	Average F	N Weighted	Biomass Wtd	Catch Wtd
1963	0.3382	0.3395	0.3396	0.3415
1964	0.4514	0.4272	0.4404	0.4406
1965	0.6292	0.6192	0.6373	0.6330
1966	0.5986	0.5562	0.5657	0.5585
1967	0.5406	0.4833	0.4967	0.4956
1968	0.5833	0.5756	0.5687	0.5819
1969	0.4537	0.4879	0.4811	0.4961
1970	0.3000	0.3330	0.3500	0.3584
1971	0.5008	0.3315	0.3592	0.5655
1972	0.4070	0.1819	0.1744	0.3853
1973	0.3822	0.2785	0.2320	0.4274
1974	0.0614	0.1087	0.1096	0.1413
1975	0.1117	0.1733	0.1690	0.1816
1976	0.1314	0.2285	0.2170	0.2455
1977	0.2248	0.2346	0.2480	0.2576
1978	0.2549	0.2137	0.2385	0.2694
1979	0.3204	0.3021	0.3033	0.3052
1980	0.4467	0.4151	0.4349	0.4402
1981	0.3918	0.3598	0.3644	0.3633
1982	0.3141	0.3342	0.3206	0.3402
1983	0.2990	0.3458	0.3406	0.3586
1984	0.4235	0.4287	0.4395	0.4455
1985	0.3331	0.3421	0.3421	0.3607
1986	0.2846	0.2754	0.2806	0.2807
1987	0.2905	0.3777	0.3664	0.3923
1988	0.3419	0.3930	0.4007	0.4168
1989	0.2733	0.2620	0.2668	0.2676
1990	0.3157	0.3363	0.3358	0.3500
1991	0.3745	0.3859	0.3810	0.3959
1992	0.4291	0.5246	0.5211	0.5395
1993	0.4196	0.4897	0.4905	0.5075
1994	0.3450	0.2596	0.2594	0.3061
1995	0.1305	0.1178	0.1182	0.1181
1996	0.1552	0.1530	0.1539	0.1542
1997	0.1032	0.1110	0.1108	0.1114
1998	0.1221	0.1221	0.1244	0.1285
1999	0.1290	0.1254	0.1278	0.1268
2000	0.1500	0.1494	0.1494	0.1498
2001	0.1757	0.1653	0.1689	0.1686
2002	0.1775	0.1610	0.1645	0.1646
2003	0.1633	0.1460	0.1550	0.1736
2004	0.2436	0.1546	0.1654	0.1980

Table B20. Bootstrap analyses of VPA estimates of Georges Bank haddock 2005 stock size at age (000s), 2004 fishing mortality at age, 2004 average fishing mortality for ages 4-7, and 2005 January 1st, 2004 mean, and 2004 spawning biomass (mt)

Number of Bootstrap Repetitions Requested = 1000
Number of Bootstrap Repetitions Completed = 1000
Bootstrap Output Variable: Stock Estimates (2005)

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.
N 1	9879.	11928.	8374.	0.7020
N 2	645236.	669643.	226845.	0.3388
N 3	857.	892.	313.	0.3508
N 4	2821.	2879.	745.	0.2588
N 5	35037.	35659.	8156.	0.2287
N 6	5638.	5756.	1296.	0.2252
N 7	6920.	7230.	2155.	0.2980
N 8	1153.	1190.	416.	0.3496

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
N 1	2050.	273.	20.7478	7829.	1.0695
N 2	24407.	7215.	3.7827	620828.	0.3654
N 3	35.	10.	4.1217	821.	0.3810
N 4	58.	24.	2.0669	2762.	0.2697
N 5	623.	259.	1.7771	34414.	0.2370
N 6	118.	41.	2.0902	5521.	0.2348
N 7	311.	69.	4.4928	6609.	0.3260
N 8	38.	13.	3.2651	1115.	0.3732

	LOWER 80. % CI	UPPER 80. % CI
N 1	4074.	22316.
N 2	372811.	1000000.
N 3	540.	1280.
N 4	1982.	3882.
N 5	25379.	46652.
N 6	4212.	7452.
N 7	4689.	9987.
N 8	673.	1738.

Table B20 Continued.

Bootstrap Output Variable: Fishing Mortality at Age (2004)

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.
AGE 1	0.0010	0.0011	0.000489	0.4380
AGE 2	0.0388	0.0757	0.345088	4.5602
AGE 3	0.0379	0.0397	0.010666	0.2687
AGE 4	0.1110	0.1146	0.026292	0.2295
AGE 5	0.1235	0.1266	0.026893	0.2124
AGE 6	0.3045	0.3130	0.081932	0.2618
AGE 7	0.4352	0.4625	0.145436	0.3145
AGE 8	0.2436	0.2542	0.042497	0.1672
AGE 9	0.1336	0.1368	0.019333	0.1413

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
AGE 1	0.000111	0.000016	11.0555	0.0009	0.5469
AGE 2	0.036913	0.010975	95.2357	0.0018	186.8730
AGE 3	0.001784	0.000342	4.7077	0.0361	0.2953
AGE 4	0.003586	0.000839	3.2305	0.1074	0.2448
AGE 5	0.003092	0.000856	2.5032	0.1204	0.2233
AGE 6	0.008465	0.002605	2.7796	0.2961	0.2767
AGE 7	0.027329	0.004680	6.2801	0.4078	0.3566
AGE 8	0.010618	0.001385	4.3596	0.2329	0.1824
AGE 9	0.003256	0.000620	2.4374	0.1303	0.1484

	LOWER 80. % CI	UPPER 80. % CI
AGE 1	0.000649	0.001740
AGE 2	0.026040	0.060798
AGE 3	0.027659	0.053442
AGE 4	0.084460	0.149963
AGE 5	0.094689	0.161942
AGE 6	0.220269	0.421159
AGE 7	0.308434	0.654753
AGE 8	0.206285	0.308014
AGE 9	0.114521	0.161721

Table B20 Continued.

Bootstrap Output Variable: Average F (2004) AGES 4 - 7

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.
AVG F	0.2436	0.2542	0.042497	0.1672
N WTD	0.1546	0.1561	0.025912	0.1660
B WTD	0.1654	0.1665	0.026543	0.1594
C WTD	0.1980	0.2050	0.031608	0.1542

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
AVG F	0.010618	0.001385	4.3596	0.2329	0.1824
N WTD	0.001450	0.000821	0.9380	0.1532	0.1692
B WTD	0.001138	0.000840	0.6883	0.1642	0.1616
C WTD	0.006940	0.001023	3.5050	0.1911	0.1654

	LOWER 80. % CI	UPPER 80. % CI
AVG F	0.206285	0.308014
N WTD	0.125718	0.191840
B WTD	0.134996	0.202197
C WTD	0.166422	0.245121

Table B20. Bootstrap analyses of VPA estimates of Georges Bank haddock 2005 stock size at age (000s), 2004 fishing mortality at age, 2004 average fishing mortality for ages 4-7, and 2005 January 1st, 2004 mean, and 2004 spawning biomass (mt)

Number of Bootstrap Repetitions Requested = 1000
Number of Bootstrap Repetitions Completed = 1000
Bootstrap Output Variable: Stock Estimates (2005)

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.
N 1	9879.	12419.	8412.	0.6773
N 2	645236.	690848.	287594.	0.4163
N 3	857.	898.	303.	0.3378
N 4	2821.	2929.	775.	0.2645
N 5	35037.	35948.	8240.	0.2292
N 6	5638.	5780.	1313.	0.2272
N 7	6920.	7271.	2085.	0.2868
N 8	1153.	1193.	407.	0.3412

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
N 1	2540.	278.	25.7141	7339.	1.1462
N 2	45612.	9208.	7.0691	599623.	0.4796
N 3	41.	10.	4.8172	815.	0.3720
N 4	108.	25.	3.8291	2713.	0.2855
N 5	911.	262.	2.6000	34126.	0.2415
N 6	141.	42.	2.5085	5497.	0.2389
N 7	352.	67.	5.0846	6568.	0.3175
N 8	40.	13.	3.5057	1112.	0.3660

	LOWER 80. % CI	UPPER 80. % CI
N 1	3907.	22838.
N 2	362798.	1096168.
N 3	549.	1297.
N 4	2005.	3914.
N 5	25680.	46706.
N 6	4172.	7456.
N 7	4760.	9924.
N 8	722.	1711.

Table B21. Comparative Results from ADAPT/VPA runs incorporating software and data updates since the 2002 GARM.

	GARM/FACT	GARM/NFT	Updated Data/NFT [1]
Terminal Year	2001	2001	2001
RSS	404.747	397.378	397.886
N t+1 age 1 (cv)	4450 (0.50)	4449 (0.48)	4527 (0.48)
N t+1 age 2 (cv)	61500 (0.35)	61423 (0.34)	62483 (0.34)
N t+1 age 3 (cv)	11700 (0.29)	11741 (0.28)	11944 (0.28)
N t+1 age 4 (cv)	19400 (0.27)	19471 (0.26)	19793 (0.26)
N t+1 age 5 (cv)	5173 (0.26)	5262 (0.25)	5351 (0.25)
N t+1 age 6 (cv)	4330 (0.26)	4224 (0.27)	4311 (0.27)
N t+1 age 7 (cv)	1740 (0.28)	1772 (0.27)	1812 (0.27)
N t+1 age 8 (cv)	1020 (0.31)	1229 (0.28)	1259 (0.28)
F age 1	0.00	0.00	0.00
F age 2	0.01	0.01	0.01
F age 3	0.10	0.09	0.10
F age 4	0.13	0.13	0.13
F age 5	0.22	0.23	0.23
F age 6	0.25	0.25	0.25
F age 7	0.29	0.24	0.24
F age 8	0.22	0.21	0.21
F (ages 4-7)	0.21	0.21	0.21
SSB (mt)	**74429**	**77719**	**82315**

[1] Revised data includes revised catch biomass and catch-at-age data for 1972-2001 which includes Canadian sea scallop fishery discards and updated catch proration, mean weights-at-age, discard, and female percent mature at age data for 2001.

Figure B1. Western and eastern Georges Bank haddock management units.

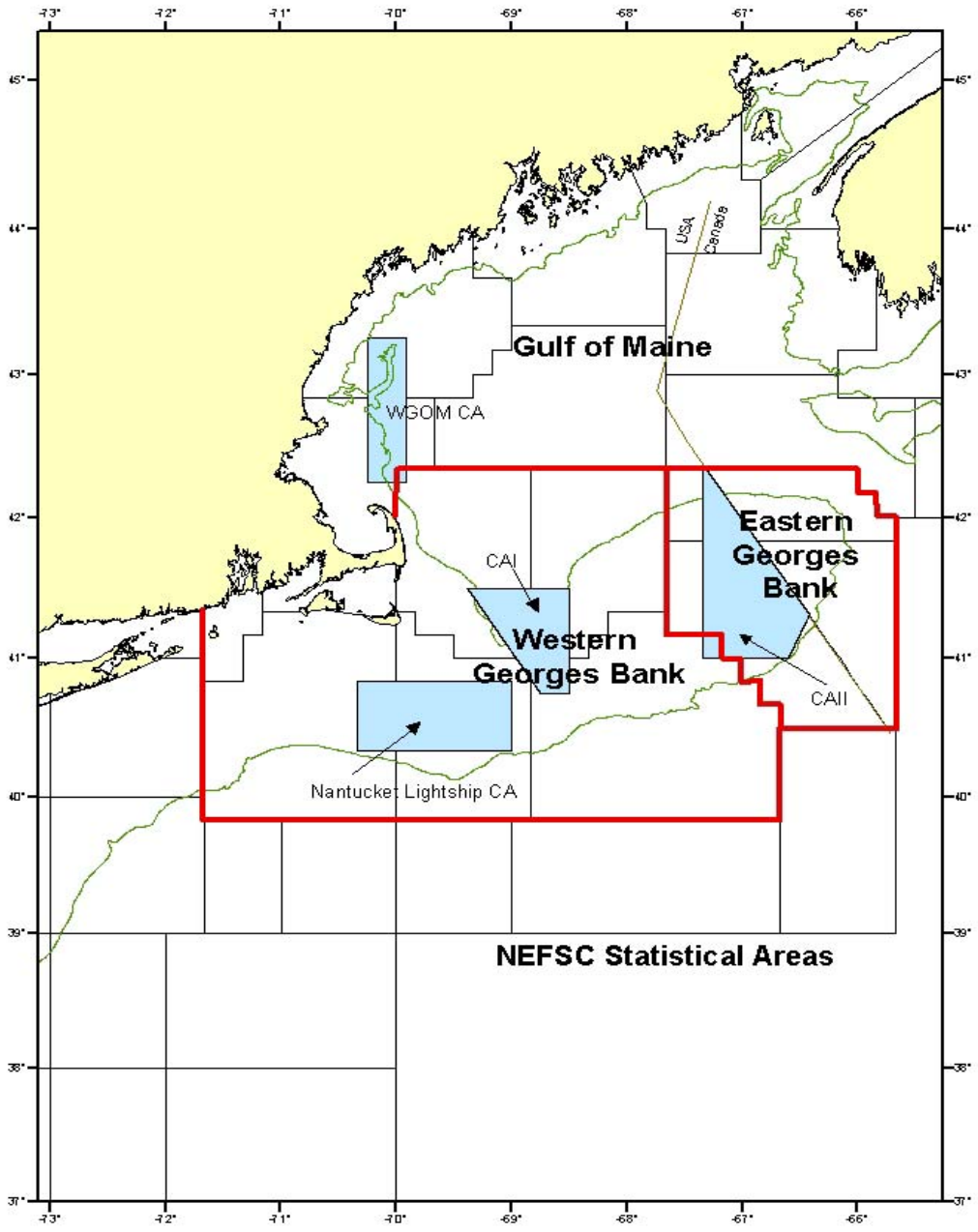


Figure B2. Total commercial catch (thousand mt) of haddock from Georges Bank and south, 1904-2004.

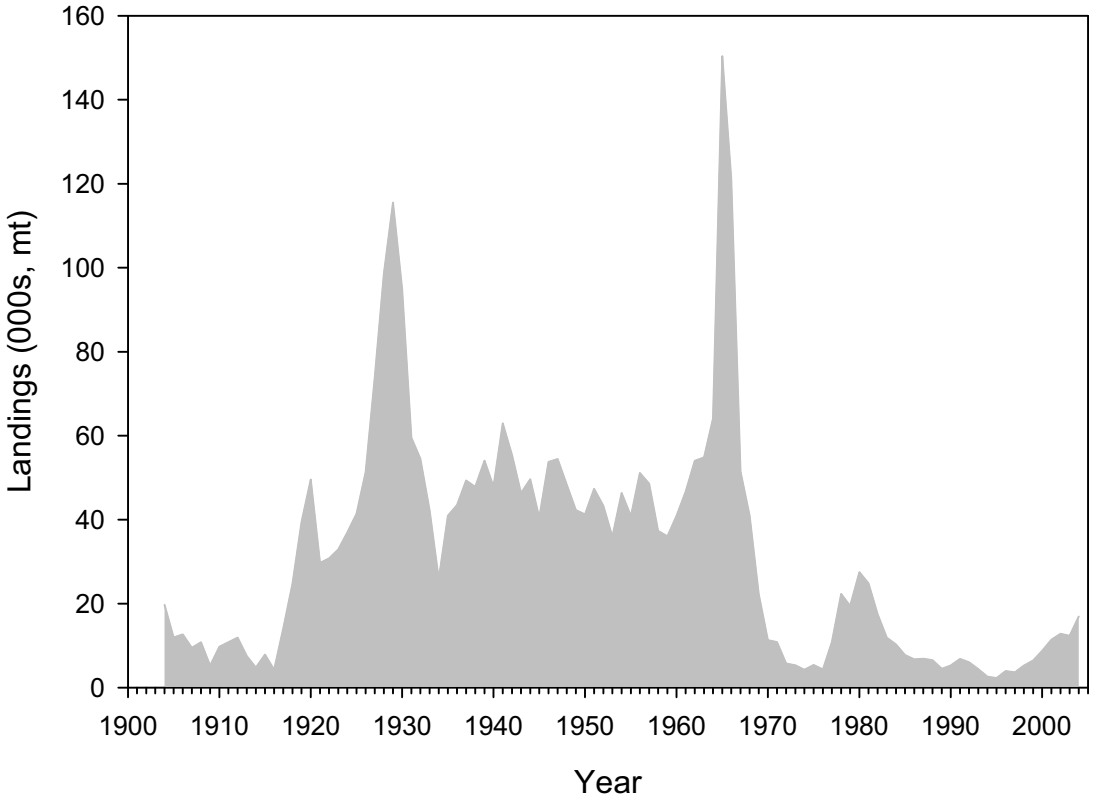


Figure B3. Georges Bank haddock research survey indices, 1963-2005.

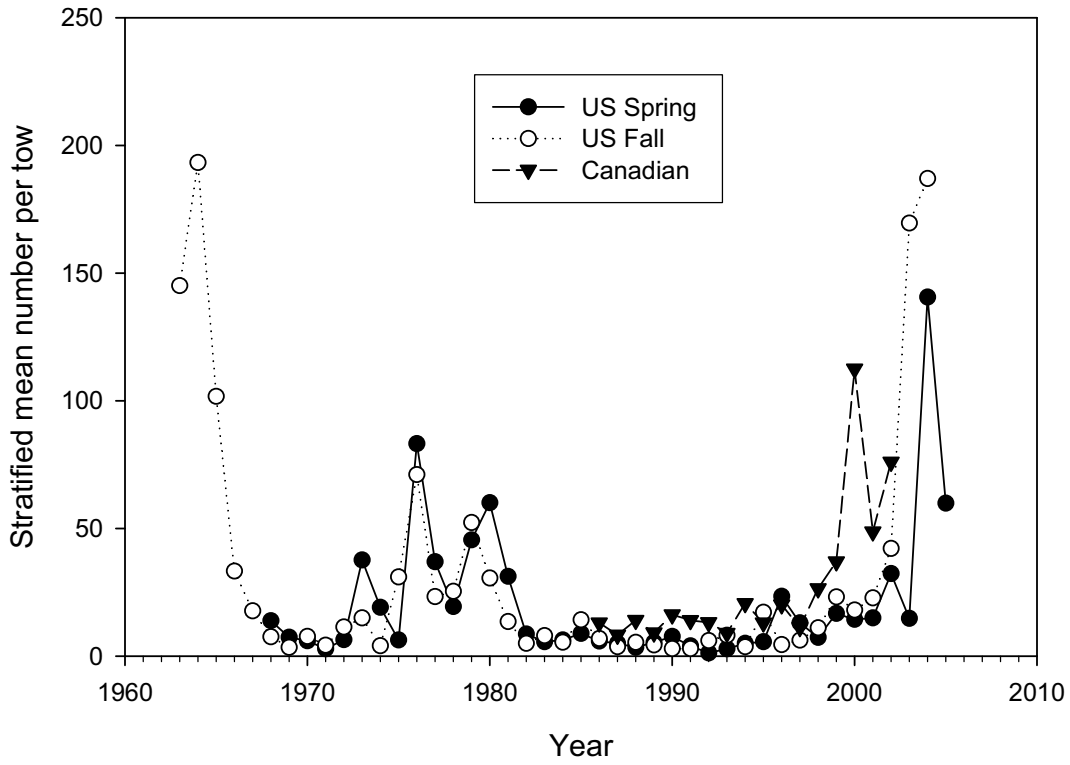


Figure B4. Georges Bank haddock VPA tuning residuals, age-2 through age-8 by survey.

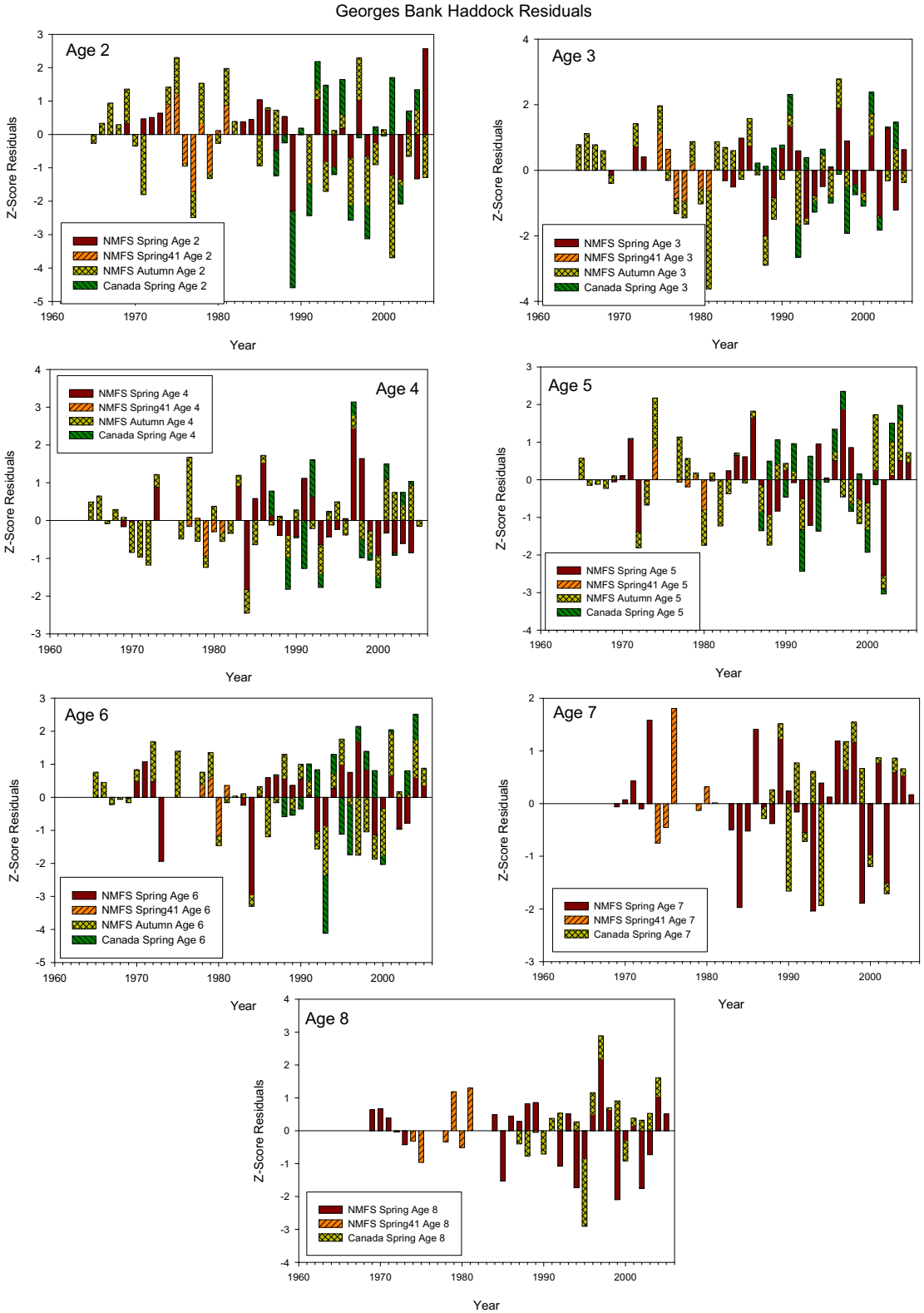


Figure B5.1 VPA estimates of Georges Bank haddock spawning biomass, 1963-2004

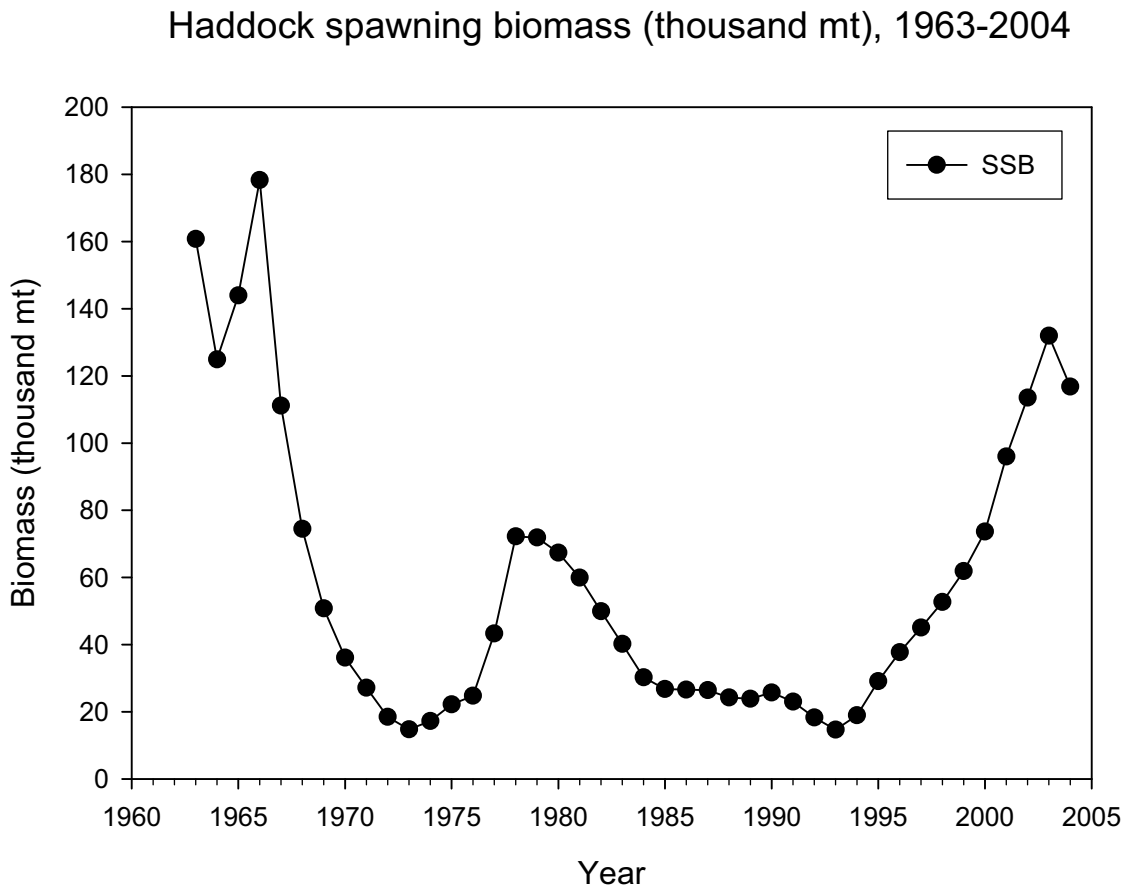


Figure B5.2 VPA estimates of Georges Bank haddock fishing mortality, 1963-2004

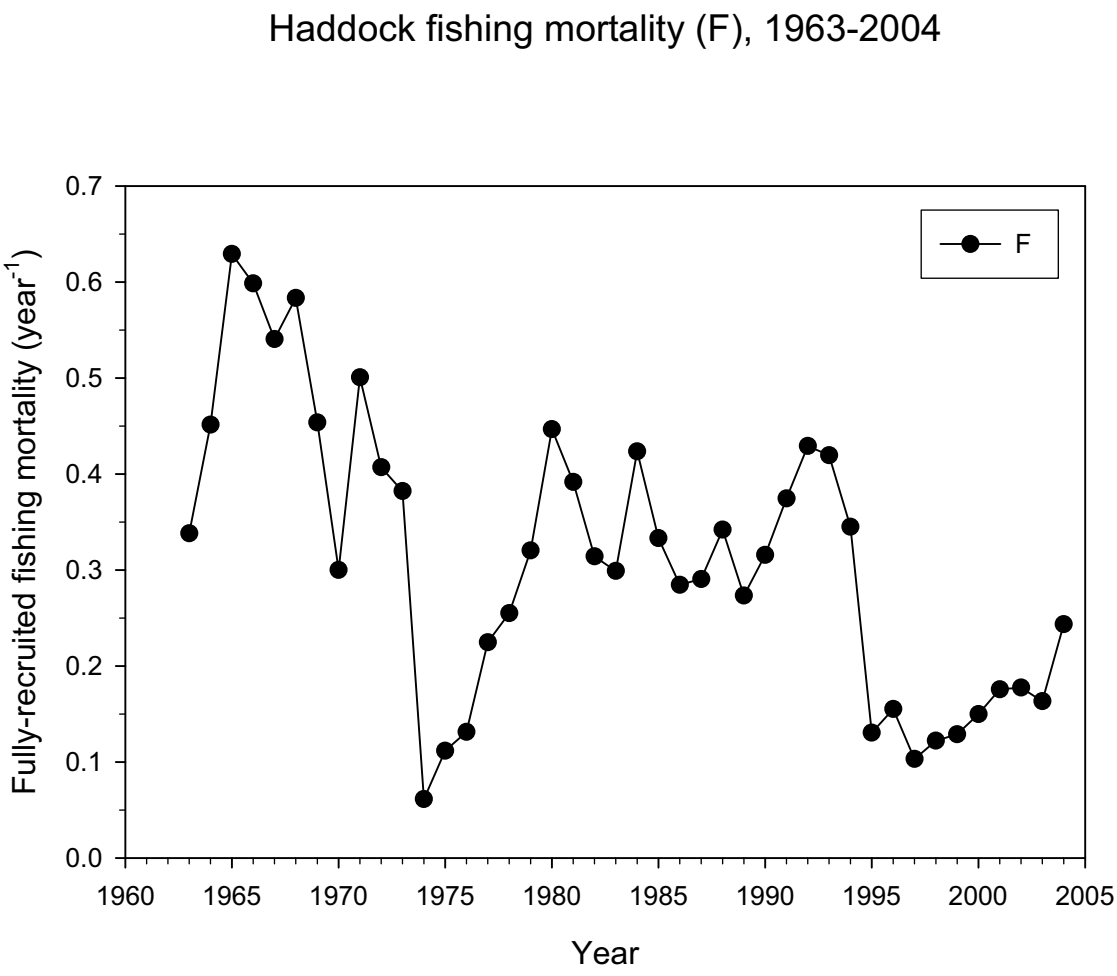


Figure B5.3 VPA estimates of Georges Bank haddock recruitment, 1963-2005

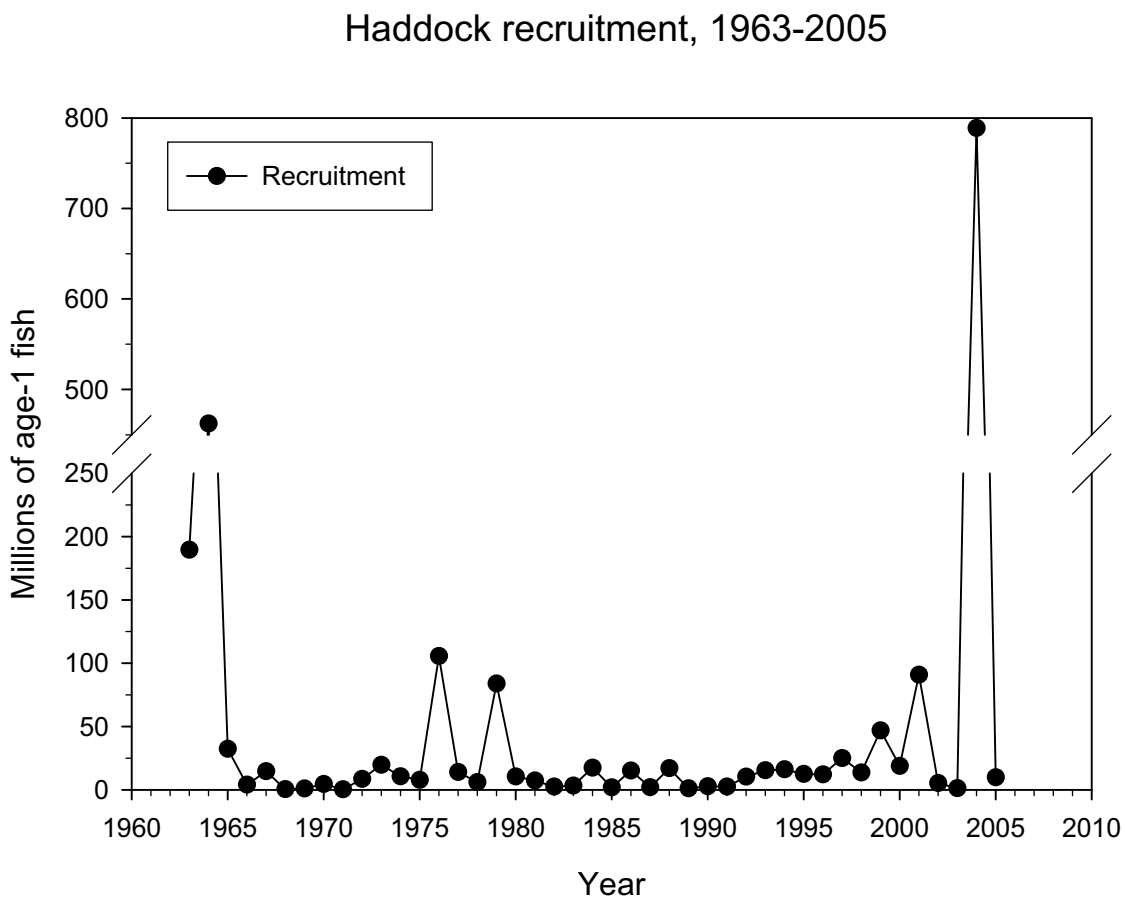
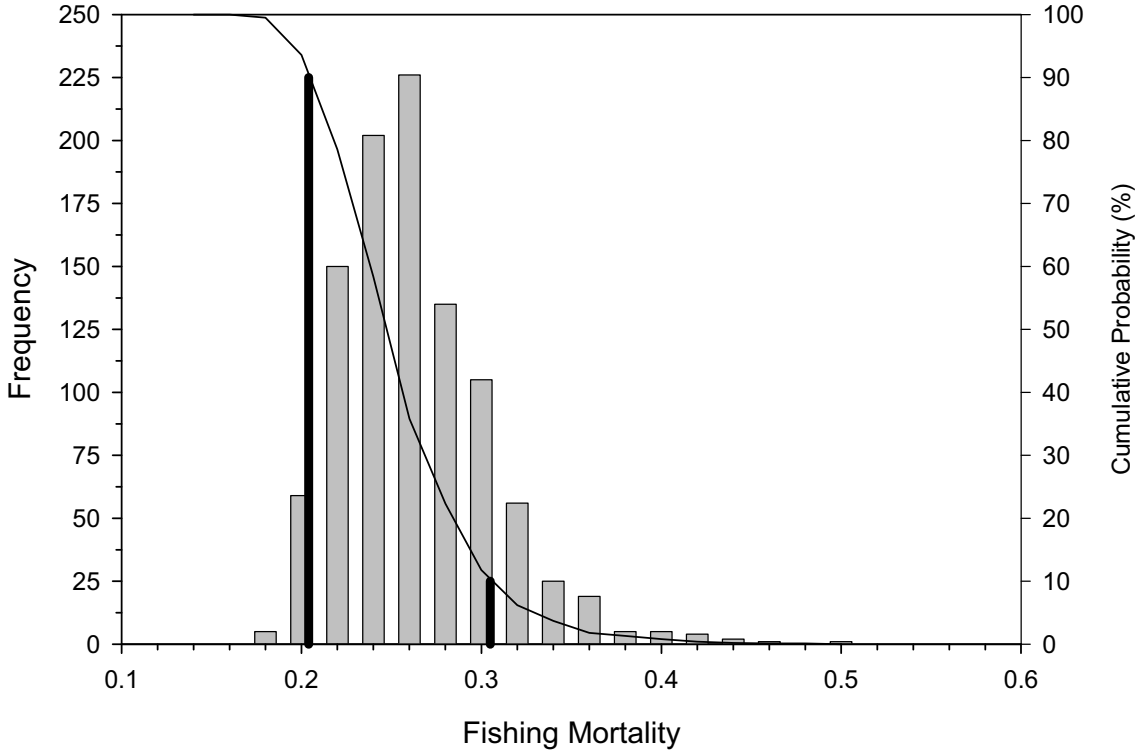
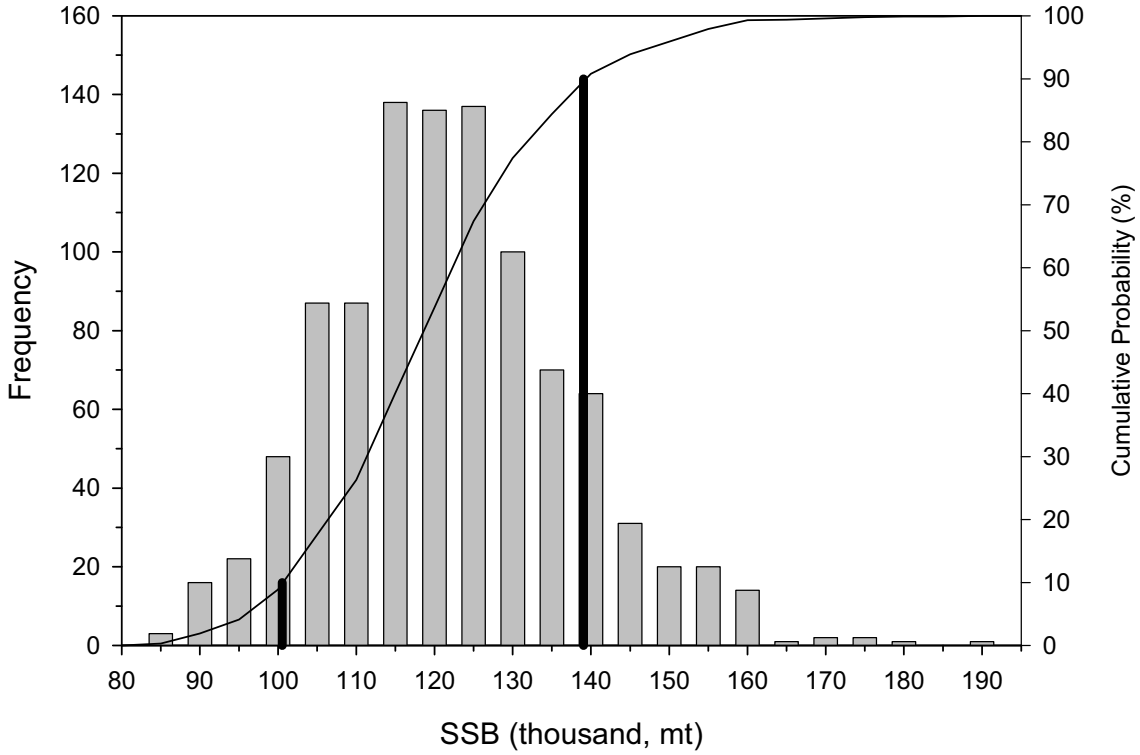


Figure B6. Precision of 2004 estimates of fishing mortality and spawning biomass.



Precision of the estimated fully recruited F in 2004 based on 1000 bootstrap realizations of the VPA for Georges Bank Haddock.



Precision of the estimated spawning stock biomass in 2004 based on 1000 bootstrap realizations of the VPA for Georges Bank Haddock.

Figure B7.1 Retrospective analysis of VPA estimates of Georges Bank haddock spawning biomass 1999-2004.

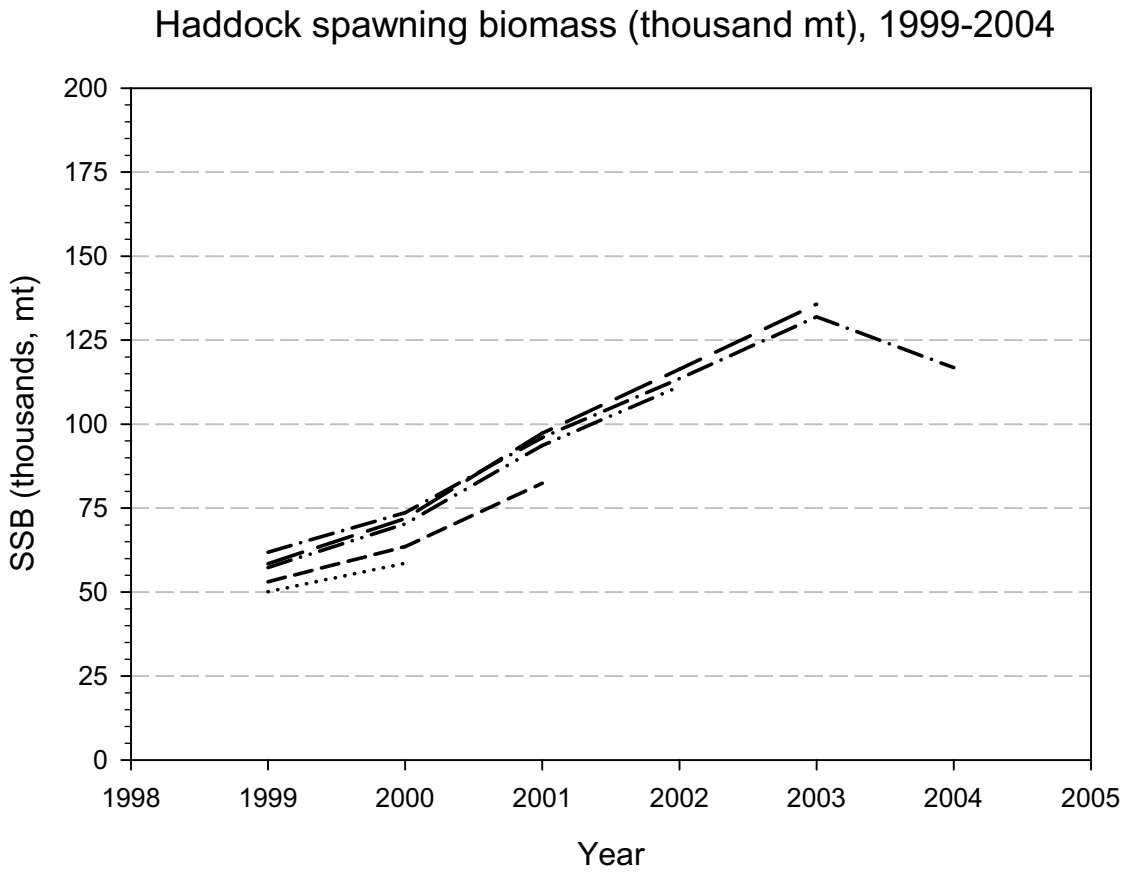


Figure B7.2 Retrospective analysis of VPA estimates of Georges Bank haddock fishing mortality, 1999-2004.

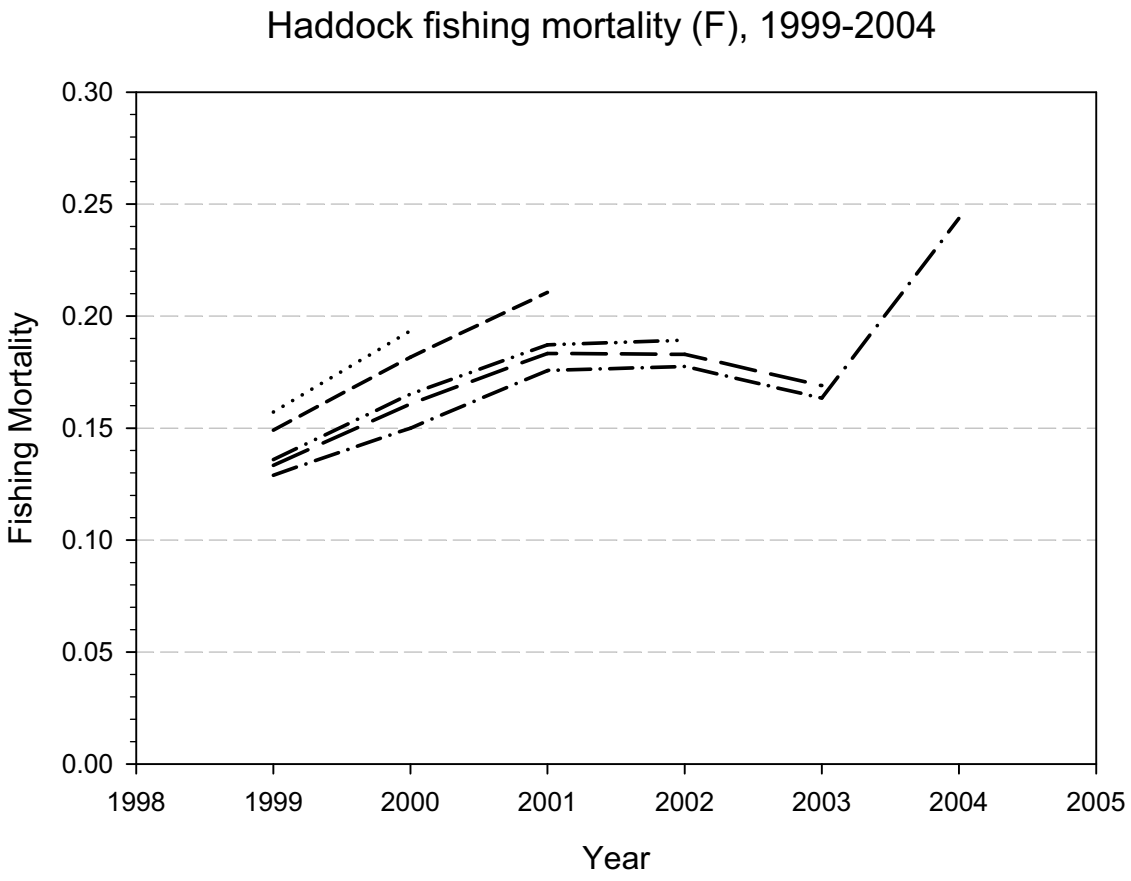


Figure B7.3 Retrospective analysis of VPA estimates of Georges Bank haddock recruitment,1999-2004.

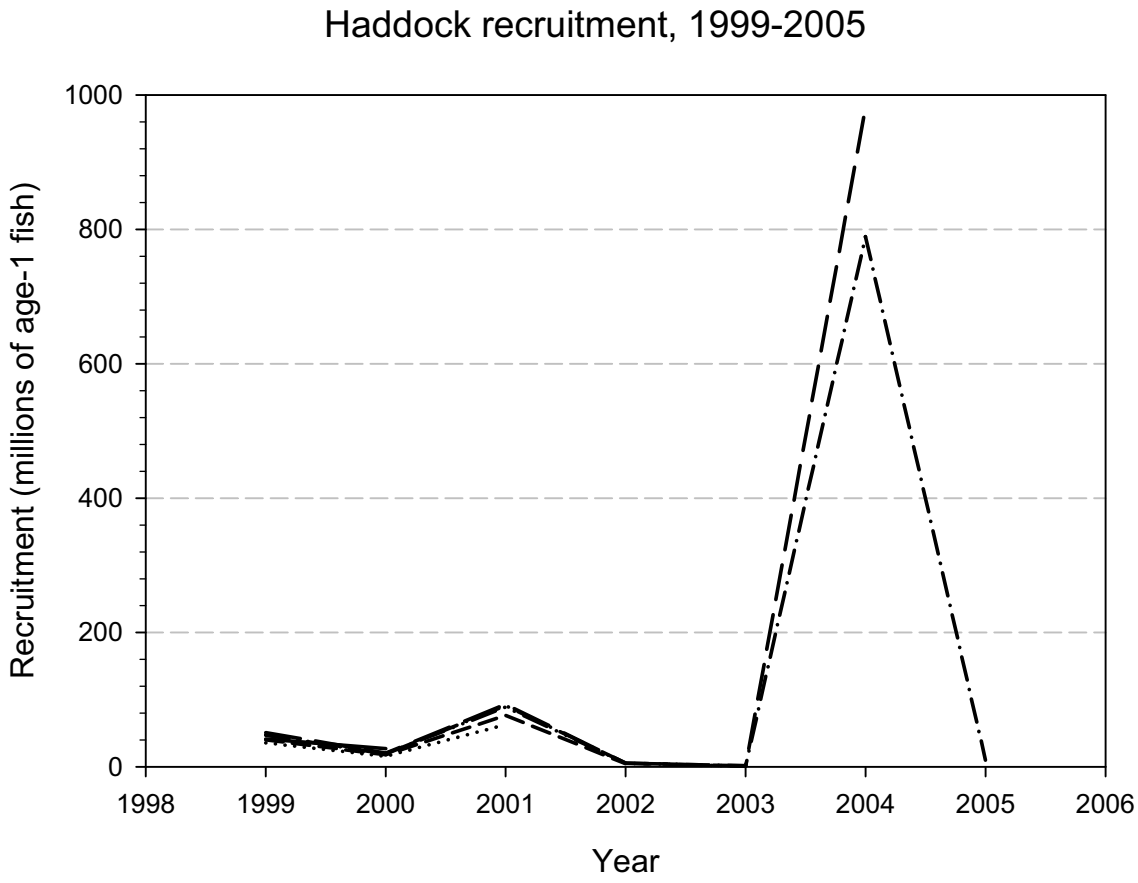


Figure B8. Trends in spawning stock biomass (line) and recruitment (bars) for Georges Bank haddock from 1931-2004.

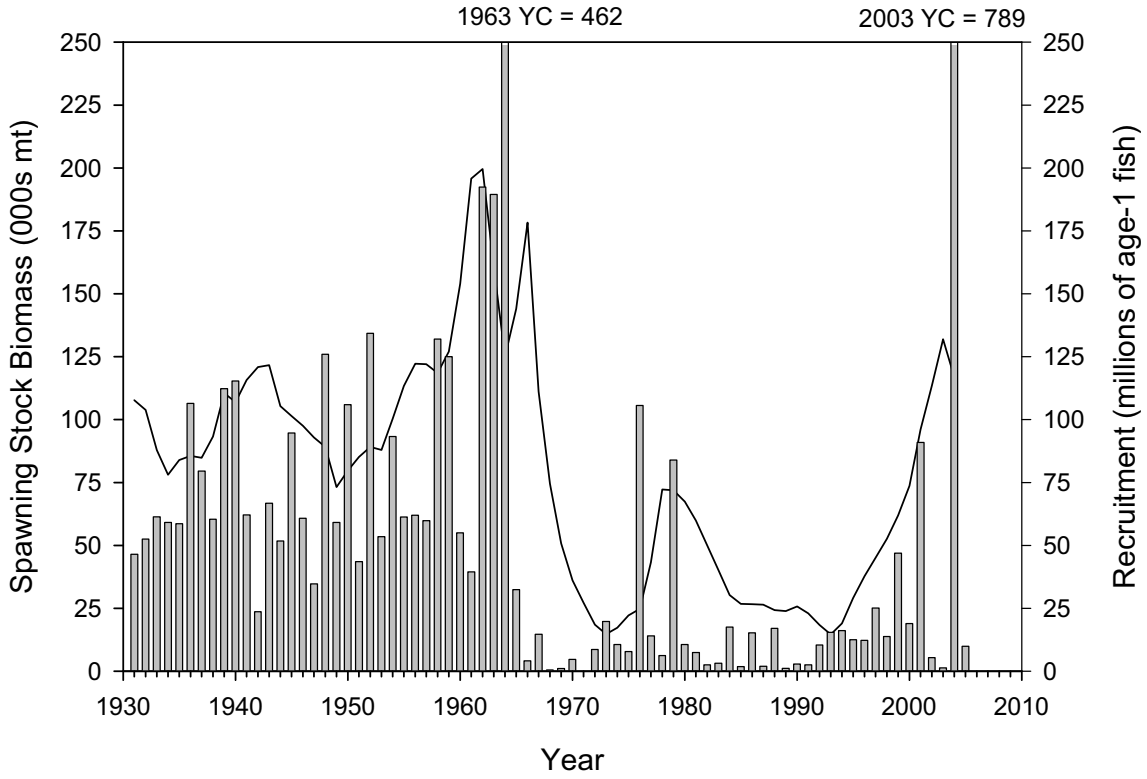


Figure B9. Trends in commercial landings (thousand mt, live weight) and fishing mortality (unweighted mean, ages 4-7) for Georges Bank haddock from 1931-2004.