

G. Gulf of Maine-Georges Bank Acadian Redfish

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Background

The most recent stock assessment of Gulf of Maine-Georges Bank Acadian redfish was completed and reviewed at the 2008 Groundfish Assessment Review Meeting (GARM III) (NEFSC 2008). The assessment was based on an ASAP (ASAP 2008) model configuration which incorporates information on the age composition of the landings, size and age composition of the population, and trends in relative abundance derived from research vessel survey biomass indices.

Based on the most recent assessment, estimates of redfish population biomass have been increasing in recent years. The increase in biomass estimates is produced by corresponding increases in both the NEFSC spring and autumn survey biomass indices which rose substantially during the mid-1990s and remained relatively high through 2007. The rapid increase in abundance and biomass was attributed to strong recruitment for some cohorts in the early-1990s coupled with extremely low fishing mortality. At GARM III, the stock was found to not be overfished and overfishing was not occurring. Estimated spawning biomass in 2007 after an adjustment for retrospective pattern (172,342 mt) was approximately 64% of the spawning biomass reference point, SSB(50%MSP) = 271,000 mt. The estimated fishing mortality in 2007 (0.007) was approximately 18% of overfishing reference point, F(50%MSP) = 0.0377.

Updated data

For this update, we include the catch, discard and survey data from 2008-2010, but no age composition data have been updated. Landings have continued to rise gradually since 2007 and 2010 landings were the largest since 1987 (Table G1, Figure GG1). Between 1964 and the early 1990s nearly all redfish were landed by trawl gear. Since then trawl gear is still by far the primary component, but catches by gillnet gear have also become important (Table G2).

We estimated discards for 2008-2010 using the same methodology as at GARM III (Wigley et al. 2006) and the estimates have stayed relatively constant since 2007 (Table G1, Figure GG2). Similar, to the landings, discards are primarily associated with trawl gear, but some also occur in gillnet gear (Table G3). The precision has improved in recent years primarily due to increased observer effort (Tables G3 and G4).

The NEFSC fall and spring survey indices using the calibration factors (1.456, CV = 0.09 for number/tow and 1.191, CV = 0.11 for kg/tow) in Miller et al. (2010) for years 2009-2010 continue to climb (Tables G5 and G6, Figures G3 and G4).

Assessment model

We use the same parameterization of the final assessment model (ASAP 2008) from GARM III, but upon re-examining the data inputs and model specification, we determined that there was a mismatch between the survey indices and survey age composition. We used biomass indices, but

the age composition information was in terms of abundance (numbers). We revise the indices to correct this issue (base model), and there was negligible effect of this change in data on the scale and trend of estimated spawning biomass and fishing mortalities (Figure GG5).

Because of the lack of age composition information since 2007, we considered a parameterization that also included a ramping down of the CV specified on recruitment deviations analogous to the ramp up at the beginning of the availability of age composition information (alternate model). The assumed CVs for recruitments in 2008-2010 (0.66, 0.52, and 0.38) mirrored the assumed values in the ramp up prior to the first age composition data in 1969. The results of the alternate model for spawning biomass and fishing mortality were also very similar in scale and trend to the GARM III results and to the base model results (Figure GG5).

Despite the increase in data for the base and alternate models relative to GARM III, the maximized objective function is less for the newer fits (Table G7). This appears to be primarily due to improvements in the fits to age composition data for the fishery and surveys.

The primary difference between the GARM III results and those from the current base and alternate models is the estimated selectivities for the surveys (Figure GG6). The reason for this change is likely due to the change in assumption of the proportions at age from representing biomass to representing numbers. Because the proportion of numbers at age will be greater than proportion of biomass at age for younger fish, estimated selectivity was higher at GARM III under the biomass assumption. Note, that the estimated selectivity for the fishery changed little because there was no mismatch in these data and corresponding model configuration. Both the base and alternate models tend to estimate fishing mortality slightly less and spawning biomass slightly greater than GARM III. The large changes in and poorer precision of some fishing mortality estimates in the 1990s are due to greater uncertainty in total removals for those years which is a result of poor precision of discard estimates (Table G8).

Estimated annual recruitment, numbers at age, and fishing mortality at age are provided for both the base and alternative models (Tables 9-12).

Retrospective results and diagnostics

The retrospective pattern of both the base and alternate model fits as measured by Mohn's Rho were substantially less for spawning biomass and fishing mortality than the corresponding results at GARM III, but the retrospective pattern in recruitment was substantially greater (Figure GG7, Table G13).

There was generally little variation in residuals for the total catch data and the few large residuals were substantially reduced in absolute magnitude for the base and alternative models relative to the GARM III results (Figure GG8). The variability in residuals for the spring and fall indices was also reduced for the current base and alternative models relative to the GARM III results (Figure GG9). There was increased size of the negative residuals for the plus group for the age composition of the catch, but there was a reduction in the absolute magnitude of residuals for many of the younger age classes (Figure GG10). Differences in the age composition residuals for

the spring and fall surveys between the GARM III and current results were less apparent (Figures 11 and 12).

Updated Reference Points and Stock Status

We re-estimated the F(50%MSP) reference point using the yield-per-recruit software (YPR 2007) with the updated estimates of fishery selectivity from both the base and alternative model results. All other inputs remained the same as at the last assessment due to unavailable biological information in 2008-2010 (Table G14). The F(50%MSP) reference point was unchanged due to a negligible difference in estimated fishery selectivity between the GARM III and current results (Table G15). We used AgePro (AGEPRO 2005) to re-estimate the SSB(50%MSP) reference point which included the information in the yield-per-recruit analysis along with updated recruitment estimates between 1969 and 2010 (see Table G8) and 10 random draws of numbers-at-age in 2010 from both the base and alternative model results. We projected 300 years with catch in 2011 equal to that in 2010 and fishing mortality in 2012-2309 equal to the reference point (F(50%MSP)). The results are based on 1000 stochastic projections of every numbers-at-age vector. The reported median equilibrium SSB(50%MSP) and Yield(50%MSP) was the average of the median respective values in last 100 years of the projections (Table G15). The SSB(50%MSP) and Yield(50%MSP) from both the base and alternative models alternative models were less than those determined at GARM III.

We also considered whether the current spawning biomass and fishing mortalities should be adjusted for retrospective pattern to determine stock status. For the base model,

$$SSB_{adjusted}(2010) = SSB(2010)/(1+0.036) = 302379\text{mt}$$

and

$$F_{adjusted}(2010) = F(2007)/(1-0.035) = 0.0062.$$

For the alternate model,

$$SSB_{adjusted}(2010) = SSB(2010)/(1+0.047) = 300777\text{mt}$$

and

$$F_{adjusted}(2010) = F(2007)/(1-0.045) = 0.0062.$$

The estimated spawning biomass and fishing mortalities for 2010 adjusted for retrospective pattern are within the 80% confidence intervals of the unadjusted values (Figure GG13). Using the rational at GARM III, the retrospective pattern is not severe enough to consider for stock status and projections.

The estimated fishing mortalities for 2010 from the base and alternative models 2010 were 84% less than the new (or GARM III) F(50%MSP) reference point (Table G15). The estimated

spawning biomasses in 2010 from the base and alternative models are 24% and 32% greater than the respective new SSB(50%MSP) reference point. In either case, these results would indicate that the stock is not overfished nor is overfishing occurring. These results would also indicate that the Gulf of Maine-Georges Bank Acadian redfish stock is rebuilt. The same conclusions would be drawn from the current spawning biomass and fishing mortality estimates adjusted for retrospective patterns.

Short-term Projections

The same inputs used for the SSB(50%MSP) estimation were used for the short-term projection scenarios. These results are based on 100 random numbers-at-age vectors in 2010 and we performed 1000 stochastic projections per numbers-at-age vector through 2015. In 3 different scenarios, fishing mortality in 2012-2015 was assumed equal to status quo, the reference point (F(50%MSP)), or 75% of the reference point (for acceptable biological catch).

The differences between the base and alternative models in median catch or spawning biomass in years 2012-2015 under a given fishing mortality rate scenario are small (Tables 16-19). If fishing at status quo median catch increases to approximately 2700 mt in 2015. At 0.75F(50%MSP) median catch increases to approximately 12000 mt and at F(50%MSP) to approximately 15000 mt. Median SSB at status quo, 0.75F(50%MSP) and F(50%MSP) is approximately, 440,000-450,000 mt, 410,000-420,000 mt, and 400,000-410,000 mt, respectively.

Summary

There is little difference in the diagnostics, results, or stock status for the base and alternative models. Because the alternative model treats variance of recruitment in recent years without age information consistent to the years preceding age composition information, it may be preferable.

Conclusions

Status of Stock

SSB in 2010 is estimated to be 314,780 mt.

F in 2010 is estimated to be 0.006.

Revised estimates of the biological reference points are:

SSB_{MSY} proxy= 238,000 mt,

F_{MSY} proxy = 0.04, and

MSY proxy= 8891.

Based on these results, the stock of Gulf of Maine-Georges Bank Acadian redfish is not overfished and overfishing is not occurring. The stock is above the biomass target.

The results are based on the same model used in GARM-III (NEFSC 2008, CRD#08-15), but includes a decrease in assumed variability in recruitment from the stock-recruitment relationship

in years 2008-2010. A strong retrospective pattern was present in the GARM III assessment, but not in this assessment. Thus, no retrospective adjustment was applied.

The updated biological reference points are based on the following updates: estimates of fishery selectivity and annual recruitment from updated and revised model results. All other inputs remained the same as at the last assessment due to unavailable biological information in 2008-2010.

Acadian Redfish. Summary of Assessment Information

Acadian Redfish	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Avg	Min	Max	YrRange
Landings (mt)	360	368	361	398	564	499	787	1193	1461	1646	10456	7	55892	1913-2010
Discards (mt)	368	126	203	125	101	149	373	180	206	206	241	30	1514	1989-2010
Catch(mt)	728	494	564	523	665	648	1160	1373	1667	1852	10510	7	55892	1913-2010
Recruits (000's)	48904	98871	32443	74048	84812	67654	223820	81644	66353	55434	43724	824.61	223820	1913-2010
F	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.08	0.00	0.36	1913-2010
SSB (mt)	114580	133270	152880	173530	195270	217900	241090	264670	289090	314780	289873	14202	670180	1913-2010

Reviewer Comments

The work that is presented is accepted by the Review Panel for determining stock status and providing catch advice.

The assessment was revised in two ways. An inconsistency in the currency of aggregate survey indices and survey age compositions was corrected so that they are now both expressed in terms of abundance rather than biomass. Age data were not available for years since the 2008 GARM, so variation in recruitment was decreased for years 2008-2010, similar to variation in recruitment assumed for the historic periods when age composition data were unavailable.

The revised assessment was considered to be an improvement by the Review Panel. Estimates of survey selectivity were much more realistic, presumably from the corrected currency of age distributions. Anomalous spikes in annual estimates of fishing mortality from the 2008 GARM assessment were reduced (1991) or removed (1996), and the model estimated total catch much better in those years.

The previous assessment had a considerable retrospective pattern, so retrospective adjustments were used for status determination and catch projections by the 2008 GARM. However, the retrospective pattern in the updated assessment was substantially reduced (e.g., now only 4% inconsistency in fishing mortality and spawning biomass). A retrospective adjustment is no longer needed according to the criteria developed by the 2008 GARM.

Some uncertainties remain in the assessment. The seasonal difference in survey selectivities is not well understood. Given the interest in developing a targeted fishery for redfish with smaller mesh, there is a need to collect age samples from the commercial fishery to inform possible changes in selectivity.

References

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Table G1. Nominal redfish catches (metric tons) and estimated discards for the Gulf of Maine-Georges Bank Acadian redfish fishery.

Year	Nominal Catch (Metric tons)			Estimated		Total	
	USA	Others	Total	Discards (mt)	CV	Removals (mt)	CV
1913	7		7			7	
1914	30		30			30	
1915	40		40			40	
1916	53		53			53	
1917	82		82			82	
1918	73		73			73	
1919	25		25			25	
1920	31		31			31	
1921	13		13			13	
1922	9		9			9	
1923	7		7			7	
1924	40		40			40	
1925	25		25			25	
1926	30		30			30	
1927	30		30			30	
1928	57		57			57	
1929	34		34			34	
1930	54		54			54	
1931	108		108			108	
1932	60		60			60	
1933	120		120			120	
1934	519		519			519	
1935	7549		7549			7549	
1936	23162		23162			23162	
1937	14823		14823			14823	
1938	20640		20640			20640	
1939	25406		25406			25406	
1940	26762		26762			26762	
1941	50796		50796			50796	
1942	55892		55892			55892	
1943	48348		48348			48348	
1944	50439		50439			50439	
1945	37912		37912			37912	
1946	42423		42423			42423	
1947	40160		40160			40160	
1948	43631		43631			43631	
1949	30743		30743			30743	
1950	34307		34307			34307	
1951	30077		30077			30077	
1952	21377		21377			21377	
1953	16791		16791			16791	
1954	12988		12988			12988	
1955	13914		13914			13914	
1956	14388		14388			14388	
1957	18490		18490			18490	
1958	16043	4	16047			16047	
1959	15521		15521			15521	
1960	11373	2	11375			11375	
1961	14040	61	14101			14101	
1962	12541	1593	14134			14134	

1963	8871	1175	10046		10046	
1964	7812	501	8313		8313	
1965	6986	1071	8057		8057	
1966	7204	1365	8569		8569	
1967	10442	422	10864		10864	
1968	6578	199	6777		6777	
1969	12041	414	12455		12455	
1970	15534	1207	16741		16741	
1971	16267	3767	20034		20034	
1972	13157	5938	19095		19095	
1973	11954	5406	17360		17360	
1974	8677	1794	10471		10471	
1975	9075	1497	10572		10572	
1976	10131	565	10696		10696	
1977	13012	211	13223		13223	
1978	13991	92	14083		14083	
1979	14722	33	14755		14755	
1980	10085	98	10183		10183	
1981	7896	19	7915		7915	
1982	6735	168	6903		6903	
1983	5215	113	5328		5328	
1984	4722	71	4793		4793	
1985	4164	118	4282		4282	
1986	2790	139	2929		2929	
1987	1859	35	1894		1894	
1988	1076	101	1177		1177	
1989	628	9	637	32	0.62	0.03
1990	588	13	601	38	0.49	0.03
1991	525		525	1514	0.74	0.55
1992	849		849	129	0.30	0.04
1993	800		800	246	0.53	0.13
1994	440		440	106	2.60	0.51
1995	440		440	191	0.47	0.14
1996	322		322	367	0.37	0.20
1997	251		251	181	0.44	0.18
1998	320		320	266	0.97	0.44
1999	353		353	30	0.51	0.04
2000	319		319	169	0.48	0.17
2001	360		360	368	0.33	0.17
2002	368		368	126	0.37	0.10
2003	361		361	203	0.19	0.07
2004	398		398	125	0.18	0.04
2005	564		564	101	0.15	0.02
2006	499		499	149	0.24	0.06
2007	787		787	373	0.34	0.11
2008	1193		1193	180	0.17	0.02
2009	1461		1461	206	0.25	0.03
2010	1646		1646	206	0.16	0.02

Table G2. Proportion of redfish landed by two main gear categories in 1964-2010.

Year	Otter trawl	Gillnet
1964	1	0
1965	1	0
1966	1	0
1967	1	0
1968	1	0
1969	1	0
1970	1	0
1971	1	0
1972	1	0
1973	1	0
1974	1	0
1975	1	0
1976	1	0
1977	1	0
1978	1	0
1979	1	0
1980	0.99	0
1981	1	0
1982	0.99	0
1983	0.99	0.01
1984	0.99	0.01
1985	0.99	0.01
1986	0.99	0.01
1987	0.98	0.02
1988	0.96	0.04
1989	0.93	0.06
1990	0.94	0.06
1991	0.9	0.1
1992	0.94	0.06
1993	0.95	0.05
1994	0.92	0.07
1995	0.92	0.07
1996	0.91	0.08
1997	0.9	0.09
1998	0.87	0.09
1999	0.83	0.16
2000	0.8	0.2
2001	0.83	0.17
2002	0.89	0.11
2003	0.86	0.13
2004	0.82	0.14
2005	0.81	0.1
2006	0.88	0.1
2007	0.89	0.11
2008	0.89	0.11
2009	0.92	0.06
2010	0.95	0.04

Table G3. Estimated redfish discards (mt) by two main gear categories in 2008-2010 with associated CVs.

Year	Otter Trawl	CV	Gillnet	CV
1989	33.9	0.59	0	0
1990	38.38	0.48	0	0
1991	1543.2	0.75	0	0
1992	129.91	0.3	0	0
1993	253.6	0.52	0	0
1994	125.68	2.1	3.36	0.84
1995	196.06	0.47	4.26	0.4
1996	426.13	0.38	6.71	0.45
1997	175.7	0.45	3.52	0.58

1998	248.04	1.05	11.82	0.65
1999	29.6	0.52	6.41	0.55
2000	164.95	0.49	3.81	0.44
2001	360.42	0.34	3.2	0.67
2002	128.85	0.36	0.12	0.71
2003	203.8	0.19	5.83	0.53
2004	115.86	0.2	6.46	0.27
2005	93.95	0.16	4.48	0.25
2006	147.99	0.23	10.19	0.31
2007	335.92	0.37	40.53	0.58
2008	156.42	0.19	23.82	0.32
2009	198.28	0.26	7.83	0.39
2010	200.84	0.16	5.41	0.34

Table G4. Number of observed trips on vessels in two main gear categories in 2008-2010.

Year	Otter Trawl	Gillnet
1989	232	213
1990	140	156
1991	299	957
1992	226	1187
1993	139	770
1994	203	862
1995	291	697
1996	229	575
1997	188	702
1998	162	707
1999	188	280
2000	269	317
2001	378	229
2002	588	217
2003	649	620
2004	1197	1504
2005	2013	1242
2006	976	360
2007	1153	453
2008	1161	387
2009	1616	536
2010	2044	2366

Table G5. Estimated numbers and biomass per tow of Gulf of Main-Georges Bank Acadian redfish for offshore strata 24, 26-30, 36-40 in the spring NEFSC bottom trawl survey.

Year	Numbers/tow	CV	Biomass (kg)/tow	CV
1968	45.18	0.45	17.09	0.34
1969	46.43	0.26	19.69	0.29
1970	54.72	0.67	18.93	0.53
1971	157.23	0.28	71.56	0.30
1972	101.22	0.51	44.36	0.50
1973	44.35	0.31	25.30	0.32
1974	34.31	0.59	18.84	0.66
1975	38.93	0.32	17.61	0.35
1976	62.22	0.49	26.19	0.54
1977	25.06	0.26	11.59	0.26
1978	23.98	0.20	12.17	0.20
1979	61.41	0.32	32.21	0.33
1980	29.81	0.34	20.34	0.34
1981	33.04	0.69	18.31	0.69
1982	16.96	0.39	9.41	0.37

1983	9.85	0.36	6.07	0.41
1984	4.96	0.32	2.68	0.33
1985	11.72	0.39	6.61	0.40
1986	5.27	0.27	3.22	0.32
1987	24.50	0.80	12.93	0.84
1988	8.09	0.49	3.27	0.47
1989	7.81	0.28	2.98	0.36
1990	12.34	0.36	6.81	0.43
1991	9.47	0.32	4.26	0.38
1992	37.86	0.41	10.67	0.41
1993	35.50	0.45	17.50	0.50
1994	16.14	0.58	3.92	0.63
1995	7.23	0.32	1.92	0.40
1996	28.74	0.46	11.89	0.64
1997	212.02	0.77	34.04	0.71
1998	34.67	0.33	7.84	0.33
1999	76.05	0.33	19.02	0.29
2000	180.09	0.55	56.01	0.58
2001	101.61	0.46	37.97	0.54
2002	225.18	0.68	61.21	0.63
2003	109.15	0.41	33.34	0.43
2004	152.30	0.38	55.67	0.43
2005	145.34	0.53	46.26	0.53
2006	34.70	0.35	10.33	0.34
2007	122.25	0.33	35.10	0.35
2008	125.16	0.45	46.01	0.42
2009	171.54	0.58	59.92	0.72
2010	116.53	0.25	29.41	0.32

Table G6. Estimated numbers and biomass per tow of Gulf of Main-Georges Bank Acadian redfish for offshore strata 24, 26-30, 36-40 in the autumn NEFSC bottom trawl survey.

Year	Numbers/tow	CV	Biomass (kg)/tow	CV
1963	87.34	NA	24.11	NA
1964	116.26	0.68	53.64	0.75
1965	57.00	0.23	13.20	0.37
1966	93.84	0.34	29.27	0.45
1967	100.59	0.34	24.37	0.37
1968	143.45	0.41	40.43	0.43
1969	71.23	0.24	23.76	0.26
1970	93.98	0.23	32.96	0.19
1971	48.00	0.19	23.42	0.22
1972	55.57	0.17	24.63	0.19
1973	39.16	0.16	17.03	0.18
1974	48.30	0.22	24.16	0.30
1975	74.84	0.22	39.95	0.29
1976	28.85	0.31	15.29	0.39
1977	40.39	0.19	17.25	0.15
1978	45.21	0.17	20.74	0.16
1979	28.89	0.21	15.98	0.21
1980	20.58	0.28	12.63	0.31
1981	20.36	0.32	12.24	0.32
1982	9.18	0.46	3.48	0.27
1983	10.04	0.21	4.12	0.23
1984	7.77	0.42	3.93	0.38
1985	13.01	0.32	5.69	0.31
1986	26.05	0.39	8.01	0.34
1987	13.72	0.41	5.46	0.32
1988	12.43	0.41	6.33	0.57
1989	20.25	0.29	6.81	0.30
1990	35.53	0.34	12.16	0.33
1991	19.06	0.34	8.36	0.45
1992	22.37	0.26	8.09	0.29
1993	35.62	0.31	11.20	0.33
1994	20.86	0.32	5.94	0.43
1995	33.22	0.25	4.65	0.24
1996	169.64	0.35	30.63	0.33
1997	65.02	0.30	18.94	0.39
1998	116.95	0.42	31.72	0.45
1999	82.48	0.23	22.86	0.24
2000	104.43	0.27	26.16	0.29
2001	89.62	0.23	28.17	0.25
2002	185.19	0.31	41.88	0.33
2003	250.94	0.47	65.49	0.49
2004	127.29	NA	36.63	NA
2005	166.07	0.21	46.95	0.23
2006	183.43	0.31	50.22	0.30
2007	170.03	0.23	50.39	0.25
2008	219.43	0.25	62.28	0.24
2009	221.24	0.26	41.31	0.23
2010	283.61	0.24	81.48	0.28

Table G7. Objective function components for the GARM III and current base and alternative models.

	GARM III	Base	Alternative
Objective Function Components			
Catch (landings + discards)	433.8	429.5	429.5
Autumn survey index	513.5	564.1	564
Spring survey index	471.3	533.8	533.8
Landings age composition	893.2	859.3	860.9
Survey age composition	2034.9	1934.6	1934.5
Catch selectivity penalties	110.2	32.9	32.9
Survey selectivity penalties	6.2	15.1	15.2
Initial numbers-at-age penalty	265.0	265.8	265.9
Recruitment deviations	1104.2	1140.4	1138.9
Other	15.2	14.9	13.8
Total	5847.5	5790.2	5789.4

Table G8. Annual estimates of spawning biomass (mt), recruitment (1000s), and fully selected fishing mortality from base and alternative models.

Year	Base Model				Alternate Model							
	Spawning Biomass at Year + 0.4	CV	Recruitment on January 1	CV	Full Fishing Mortality	CV	Spawning Biomass at Year + 0.4	Recruitment on January 1	CV	Full Fishing Mortality	CV	
1913	662580	0.02	52882	0.02	1.10E-05	0.02	663930	0.02	52992	0.02	1.10E-05	0.02
1914	662570	0.02	54103	0.1	4.52E-05	0.02	663920	0.02	54248	0.1	4.51E-05	0.02
1915	662550	0.02	54115	0.1	6.10E-05	0.02	663900	0.02	54259	0.1	6.09E-05	0.02
1916	662540	0.02	54128	0.1	8.06E-05	0.02	663890	0.02	54271	0.1	8.05E-05	0.02
1917	662520	0.02	54141	0.1	0.000125	0.02	663880	0.02	54282	0.1	0.000125	0.02
1918	662540	0.02	54154	0.1	0.000111	0.02	663900	0.02	54293	0.1	0.000111	0.02
1919	662640	0.02	54167	0.1	3.76E-05	0.02	664000	0.02	54305	0.1	3.75E-05	0.02
1920	662820	0.02	54182	0.1	4.65E-05	0.02	664190	0.02	54319	0.1	4.64E-05	0.02
1921	663070	0.02	54198	0.1	1.90E-05	0.02	664450	0.02	54334	0.1	1.90E-05	0.02
1922	663400	0.01	54215	0.1	1.30E-05	0.02	664780	0.01	54350	0.1	1.30E-05	0.02
1923	663780	0.01	54233	0.1	1.05E-05	0.02	665170	0.01	54366	0.1	1.05E-05	0.02
1924	664190	0.01	54251	0.1	6.01E-05	0.02	665600	0.01	54384	0.1	6.00E-05	0.02
1925	664630	0.01	54269	0.1	3.74E-05	0.02	666040	0.01	54401	0.1	3.74E-05	0.02
1926	665090	0.01	54286	0.1	4.49E-05	0.02	666520	0.01	54418	0.1	4.49E-05	0.02
1927	665580	0.01	54302	0.1	4.54E-05	0.02	667010	0.01	54435	0.1	4.53E-05	0.02
1928	666060	0.01	54318	0.1	8.61E-05	0.02	667510	0.01	54450	0.1	8.59E-05	0.02
1929	666550	0.01	54332	0.1	5.10E-05	0.02	668010	0.01	54465	0.1	5.09E-05	0.02
1930	667040	0.01	54344	0.1	8.10E-05	0.02	668520	0.01	54477	0.1	8.08E-05	0.02
1931	667510	0.01	54355	0.1	0.000162	0.02	668990	0.01	54489	0.1	0.000162	0.02
1932	667960	0.01	54366	0.1	9.01E-05	0.02	669450	0.01	54501	0.1	8.99E-05	0.02
1933	668410	0.01	54375	0.1	0.00018	0.02	669910	0.01	54511	0.1	0.00018	0.02
1934	668670	0.01	54383	0.1	0.00078	0.02	670180	0.01	54521	0.1	0.000778	0.02
1935	665910	0.01	54387	0.1	0.011399	0.02	667430	0.01	54525	0.1	0.011374	0.02
1936	652860	0.01	54341	0.1	0.035758	0.02	654390	0.01	54479	0.1	0.035676	0.02
1937	634290	0.01	54128	0.1	0.023533	0.02	635830	0.01	54259	0.1	0.023477	0.02
1938	618520	0.01	53812	0.1	0.03364	0.02	620060	0.01	53932	0.1	0.033558	0.02
1939	597800	0.01	53522	0.1	0.042889	0.02	599350	0.01	53632	0.1	0.042779	0.02
1940	574220	0.01	53115	0.1	0.047062	0.02	575780	0.01	53211	0.1	0.046936	0.02
1941	540550	0.01	52610	0.1	0.095322	0.02	542100	0.01	52690	0.1	0.095051	0.02
1942	491740	0.01	51831	0.1	0.11557	0.02	493300	0.01	51885	0.1	0.1152	0.02
1943	444130	0.02	50573	0.1	0.11072	0.02	445700	0.02	50588	0.1	0.11033	0.02
1944	400820	0.02	49120	0.1	0.12827	0.02	402390	0.02	49092	0.1	0.12777	0.02
1945	362530	0.02	47518	0.1	0.10648	0.02	364090	0.02	47450	0.1	0.10603	0.02
1946	330250	0.02	45405	0.1	0.13114	0.02	331810	0.02	45302	0.1	0.13052	0.02
1947	297200	0.02	44942	0.1	0.13811	0.02	298740	0.02	44804	0.1	0.13738	0.02
1948	264610	0.02	44397	0.09	0.16904	0.02	266140	0.02	44223	0.09	0.16806	0.02
1949	236100	0.02	41308	0.09	0.1332	0.03	237600	0.02	41112	0.09	0.13234	0.03
1950	213670	0.02	39554	0.09	0.16475	0.03	215140	0.02	39337	0.09	0.16359	0.03
1951	191390	0.03	38280	0.09	0.16134	0.03	192820	0.03	38057	0.09	0.16011	0.03
1952	175290	0.03	35300	0.09	0.12487	0.03	176680	0.03	35087	0.09	0.12387	0.03
1953	166080	0.03	41473	0.08	0.10329	0.03	167410	0.03	41221	0.08	0.10245	0.03
1954	161150	0.03	37968	0.08	0.082158	0.03	162420	0.03	37742	0.08	0.081499	0.03
1955	158170	0.03	41594	0.07	0.089652	0.03	159370	0.02	41362	0.07	0.08896	0.03
1956	154590	0.02	35533	0.07	0.094868	0.03	155710	0.02	35341	0.07	0.094169	0.03
1957	149130	0.02	37441	0.07	0.12686	0.03	150160	0.02	37251	0.07	0.12596	0.03
1958	142320	0.02	39770	0.06	0.1153	0.03	143270	0.02	39586	0.06	0.11452	0.03
1959	137060	0.02	33227	0.06	0.11594	0.03	137920	0.02	33072	0.06	0.1152	0.03
1960	133780	0.02	41050	0.06	0.086917	0.02	134550	0.02	40885	0.06	0.086409	0.02
1961	131800	0.02	30906	0.06	0.10954	0.02	132490	0.02	30771	0.06	0.10897	0.02
1962	128310	0.02	45377	0.05	0.1128	0.02	128920	0.02	45224	0.05	0.11227	0.02
1963	126410	0.02	28534	0.06	0.081051	0.02	126940	0.02	28413	0.06	0.080716	0.02
1964	127550	0.02	51839	0.04	0.06647	0.02	128000	0.02	51696	0.04	0.066237	0.02
1965	129940	0.02	33475	0.06	0.063159	0.02	130320	0.02	33451	0.06	0.062979	0.02
1966	132460	0.01	18424	0.07	0.065888	0.02	132760	0.01	18422	0.07	0.065739	0.02

1967	133890	0.01	4641.3	0.14	0.082745	0.02	134120	0.01	4648.1	0.14	0.082605	0.02
1968	135490	0.01	3368.5	0.16	0.050766	0.02	135660	0.01	3377.1	0.16	0.050706	0.02
1969	136810	0.01	1583.8	0.21	0.092069	0.02	136930	0.01	1592.5	0.21	0.092003	0.02
1970	132270	0.01	1861.9	0.19	0.12728	0.01	132340	0.01	1870.3	0.19	0.12723	0.01
1971	122400	0.01	1928.2	0.18	0.16495	0.01	122430	0.01	1936.2	0.18	0.16493	0.01
1972	109220	0.01	116820	0.03	0.17486	0.01	109220	0.01	116870	0.03	0.17488	0.01
1973	95710	0.01	4428.8	0.11	0.18171	0.01	95692	0.01	4436.8	0.11	0.18175	0.01
1974	85247	0.01	2103.8	0.16	0.12432	0.02	85218	0.01	2110	0.16	0.12437	0.02
1975	78615	0.01	1315.1	0.18	0.14077	0.02	78580	0.01	1320.2	0.18	0.14084	0.02
1976	72581	0.01	1285.5	0.18	0.15605	0.02	72544	0.01	1290.3	0.18	0.15614	0.02
1977	66264	0.01	820.39	0.22	0.20456	0.02	66227	0.01	824.61	0.22	0.20471	0.02
1978	58267	0.02	1039.5	0.19	0.25333	0.03	58233	0.02	1044	0.19	0.25352	0.03
1979	48732	0.02	25785	0.06	0.31999	0.03	48702	0.02	25813	0.06	0.32024	0.03
1980	39745	0.02	1013.2	0.2	0.24985	0.02	39718	0.02	1018	0.2	0.25001	0.02
1981	33123	0.03	1911	0.17	0.23808	0.03	33099	0.03	1917.8	0.17	0.23825	0.03
1982	27550	0.03	9500.5	0.11	0.25759	0.04	27529	0.03	9523.2	0.11	0.25781	0.04
1983	23027	0.04	12340	0.11	0.24158	0.04	23009	0.04	12372	0.11	0.2418	0.04
1984	19645	0.05	3439.5	0.16	0.25162	0.05	19629	0.05	3452.5	0.16	0.25186	0.05
1985	16818	0.07	5378.7	0.15	0.27208	0.07	16807	0.07	5398.2	0.15	0.27233	0.07
1986	14884	0.08	16672	0.12	0.21406	0.08	14876	0.08	16724	0.12	0.21424	0.08
1987	14205	0.09	16242	0.12	0.13654	0.09	14202	0.09	16281	0.12	0.1366	0.09
1988	14540	0.1	11361	0.13	0.083929	0.1	14543	0.1	11381	0.13	0.083938	0.1
1989	15718	0.1	13623	0.13	0.045612	0.11	15727	0.1	13647	0.13	0.045601	0.11
1990	17546	0.1	14397	0.14	0.038828	0.11	17562	0.1	14427	0.14	0.038802	0.11
1991	17752	0.08	19098	0.14	0.34947	0.41	17739	0.08	19141	0.14	0.35538	0.41
1992	17364	0.1	78928	0.09	0.060243	0.11	17311	0.1	79058	0.09	0.060463	0.11
1993	20017	0.1	108000	0.09	0.058798	0.16	19967	0.1	108210	0.09	0.058992	0.16
1994	23870	0.09	50890	0.12	0.032967	0.56	23825	0.09	51030	0.12	0.033111	0.56
1995	29730	0.09	52050	0.12	0.02495	0.17	29694	0.09	52223	0.12	0.025	0.17
1996	38046	0.08	38094	0.15	0.021724	0.22	38026	0.08	38258	0.15	0.021754	0.22
1997	49208	0.08	33675	0.16	0.009919	0.2	49211	0.08	33852	0.16	0.009925	0.2
1998	63100	0.08	42288	0.16	0.010353	0.44	63134	0.08	42535	0.16	0.010357	0.44
1999	79031	0.08	53667	0.16	0.005201	0.09	79104	0.08	54015	0.16	0.005198	0.09
2000	96381	0.08	125390	0.13	0.005205	0.18	96502	0.08	126160	0.13	0.005201	0.18
2001	114410	0.08	48483	0.19	0.006332	0.19	114580	0.08	48904	0.19	0.006324	0.19
2002	133020	0.08	98070	0.17	0.003722	0.12	133270	0.08	98871	0.17	0.003716	0.12
2003	152550	0.08	31953	0.31	0.003746	0.1	152880	0.08	32443	0.31	0.003739	0.1
2004	173090	0.08	73038	0.29	0.003074	0.09	173530	0.08	74048	0.29	0.003067	0.09
2005	194690	0.08	83018	0.4	0.003466	0.08	195270	0.08	84812	0.4	0.003457	0.08
2006	217160	0.08	65041	0.56	0.003044	0.09	217900	0.08	67654	0.55	0.003034	0.09
2007	240150	0.08	215320	0.53	0.004907	0.13	241090	0.08	223820	0.53	0.00489	0.13
2008	263470	0.08	100110	0.68	0.005247	0.08	264670	0.08	81644	0.59	0.005226	0.08
2009	287600	0.08	104380	0.69	0.005878	0.08	289090	0.08	66353	0.49	0.00585	0.08
2010	313140	0.08	107940	0.69	0.006007	0.08	314780	0.08	55434	0.37	0.005974	0.08

Table G9. Estimated numbers at age (1000s) on January 1 from base model.

year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16	Age 17	Age 18	Age 19	Age 20	Age 21	Age 22	Age 23	Age 24	Age 25	Age 26
1913	52882.1	50293.4	47840.4	45070.1	43287.5	41176.1	39167.5	37256.9	35449.5	33710.6	32066.1	30901.8	29013.8	27598.5	26252.2	24971.5	23753.4	22594.6	21492.5	20444	19446.7	18498.1	17595.7	16737.4	15920.9	310439
1914	54102.7	50303	47840.6	45070.2	43287.7	41176.2	39167.7	37257	35449.6	33710.7	32066.1	30901.9	29013.9	27598.5	26252.2	24971.6	23753.4	22594.7	21492.5	20444	19446.7	18498.1	17595.7	16737.4	15920.9	310439
1915	54115.1	51464	47849.7	45070.3	43287.7	41176	39167	37256.3	35448.8	33709.6	32065.1	30900.9	29013	27597.6	26251.3	24970.7	23752.6	22593.9	21491.7	20443.3	19446.1	18497.5	17595.1	16736.8	15920.4	310430
1916	54127.7	51475.9	48954	45151.9	43287.7	41175.8	39166.4	37255.3	35437.7	33708.4	32063.6	30994.4	29011.6	27596.3	26250.1	24969.5	23751.4	22592.8	21490.7	20442.3	19445.1	18496.6	17594.3	16736	15919.6	310415
1917	54140.6	51487.8	48965.3	45656.4	43295.9	41175.8	39165.8	37254.3	35436.2	33706.7	32061.8	30997.4	29009.6	27594.4	26248.3	24967.8	23749.8	22591.2	21489.2	20440.9	19443.8	18495.3	17593.1	16734.8	15918.5	310394
1918	54153.6	51500	48976.6	45677	43295	41182.9	39164.6	37252.6	35434.1	33703.8	32058.4	30943	29006.4	27591.4	26245.4	24965	23747.2	22588.7	21486.8	20438.6	19441.6	18493.2	17591.1	16732.9	15916.7	310359
1919	54167.1	51512.4	48988.2	45687.8	43205.2	41233.4	39171.8	37251.8	35432.9	33702.2	32056.5	30941.9	29003.9	27588.7	26242.8	24962	23744.8	22586.5	21484.7	20436.6	19439.6	18491.3	17589.3	16731.3	15915.1	310329
1920	54181.9	51525.3	49000.1	46989.9	44151.6	42143.9	40077.6	37260.5	35434	33703.5	32057.3	30941.9	29003.7	27588.3	26242.2	24962	23744.3	22585.9	21484.1	20436.1	19439.2	18490.9	17588.9	16730.8	15914.7	310321
1921	54198.1	51539.4	49012.4	46610.2	43226.2	41233.8	40087.4	38121.9	35442	33704.3	32058.3	30942	29003.5	27587.9	26241.6	24961.2	23743.5	22585.2	21483.4	20435.4	19438.5	18490.2	17588.2	16730.3	15914.1	310311
1922	54215.8	49025.7	46622	43237	41175.9	38131.9	36094.2	34509.7	32164.3	30597.9	28159.4	30942.4	29004.8	27588.4	26241.9	24961.3	23743.4	22585.1	21483.3	20435.3	19438.4	18490.1	17588.1	16730.1	15914	310309
1923	54232.8	51571	49040.4	46634.7	43248	41174.5	38141.6	36281.1	34509.4	33718.1	32068.3	30949.5	29006.6	27589.8	26242.6	24961.2	23743.6	22586	21483.3	20435.3	19438.4	18490	17588.1	16730.1	15914	310309
1924	54246.8	51583.9	49058.5	46648.3	43250.3	41174.7	38151.4	36284.5	34510.9	33728.1	32070.4	30951.4	29011.7	27594.1	26244.5	24961.3	23744.1	22585.4	21483.4	20434.3	19438.5	18489.2	17588.1	16730.1	15914	310309
1925	54260.8	51594.9	49071.8	46663.3	43254.3	41175.8	38152.4	36285.4	34512.9	33730.5	32071.5	30952.4	29012.6	27595.2	26244.5	24961.3	23744.2	22585.7	21483.2	20434.3	19438.4	18489.2	17588.1	16730.1	15914	310309
1926	54268.6	51604.9	49085.8	46673.3	43257.3	41176.9	38153.4	36286.4	34514.9	33731.5	32072.5	30953.4	29013.7	27596.3	26245.3	24961.3	23744.2	22585.7	21483.2	20434.3	19438.4	18489.2	17588.1	16730.1	15914	310309
1927	54302.3	51618.1	49104.2	46689.9	43261.8	41177.2	38154.2	36287.5	34515.7	33732.7	32073.5	30954.3	29014.7	27597.4	26245.3	24961.3	23744.2	22585.7	21483.2	20434.3	19438.4	18489.2	17588.1	16730.1	15914	310309
1928	54317.5	51635.9	49119.6	46693.9	43272	41178.1	38155.2	36288.4	34516.8	33733.1	32074.1	30955.2	29015.1	27598.5	26245.4	24961.3	23745	22585.7	21483.2	20434.3	19438.4	18489	17588.1	16730.1	15914	310309
1929	54332	51668.3	49134.6	46723.9	43274.9	41179	38156.2	36289.5	34517.5	33734.1	32075.1	30956.2	29015.9	27599.5	26245.3	24961.3	23745	22585.7	21483.2	20434.3	19438.4	18489	17588.1	16730.1	15914	310309
1930	54343.8	51682.3	49148.4	46738.2	43276	41179.4	38157.2	36290.5	34518.6	33735.1	32076.1	30957.1	29016.1	27599.5	26245.4	24961.3	23746	22585.7	21483.2	20434.3	19438.4	18489	17588.1	16730.1	15914	310309
1931	54354.9	51693.4	49161.5	46751.3	43276.5	41179.5	38158.2	36291.5	34519.6	33736.1	32077.1	30958.1	29017	27599.5	26245.4	24961.3	23747	22585.7	21483.2	20434.3	19438.4	18489	17588.1	16730.1	15914	310309
1932	54366.1	51703.9	49172.1	46763.6	43278.4	41180.8	38159.2	36292.5	34520.6	33737.1	32078.1	30959.1	29017.9	27599.5	26245.4	24961.3	23748	22585.7	21483.2	20434.3	19438.4	18489	17588.1	16730.1	15914	310309
1933	54375.1	51714.6	49182.1	46773.8	43279.2	41182.0	38160.2	36293.5	34521.7	33738.1	32079.1	30959.9	29018	27599.5	26245.4	24961.3	23749	22585.7	21483.2	20434.3	19438.4	18489	17588.1	16730.1	15914	310309
1934	54383.2	51723.4	49192.2	46783.2	43281	41182.9	38161.2	36294.5	34522.6	33737.2	32079.8	30960.1	29019	27599.5	26245.4	24961.3	23750	22585.7	21483.2	20434.3	19438.4	18489	17588.1	16730.1	15914	310309
1935	54387.1	51730.2	49199.6	46792	43282.1	41183.1	38162.1	36295.8	34523.6	33737.1	32080.4	30961.7	29019.8	27599.5	26245.4	24961.3	23751	22585.7	21483.2	20434.3	19438.4	18489	17588.1	16730.1	15914	310309
1936	54413.1	51729.3	49194.4	46784.2	43286.9	41183.4	38163.9	36297.5	34524.1	33738.1	32080.4	30962	29019.8	27599.5	26245.4	24961.3	23752	22585.7	21483.2	20434.3	19438.4	18489	17588.1	16730.1	15914	310309
1937	54428	51741.7	49201.2	46787.2	43287.3	41184.1	38164.2	36298.3	34525.1	33739.2	32081.5	30963	29020	27599.5	26245.4	24961.3	23753	22585.7	21483.2	20434.3	19438.4	18489	17588.1	16730.1	15914	310309
1938	53812	51466.2	49111.5	46728.7	43283.1	41184.7	38165.2	36298.9	34526.4	33738.6	32082.4	30964	29020.7	27599.5	26245.4	24961.3	23754	22585.7	21483.2	20434.3	19438.4	18489	17588.1	16730.1	15914	310309
1939	53521.7	51564.6	49182.4	46740.7	43283.1	41190.7	38166.2	36300.8	34527.5	33740.7	32083.1	30965	29021	27599.5	26245.4	24961.3	23755	22585.7	21483.2	20434.3	19438.4	18489	17588.1	16730.1	15914	310309
1940	53404.7	51578.1	49193.4	46746.3	43286.9	41190.7	38167.2	36301.8	34528.4	33741.7	32084.1	30966	29022	27599.5	26245.4	24961.3	23756	22585.7	21483.2	20434.3	19438.4	18489	17588.1	16730.1	15914	310309
1941	53447.8	51593.4	49204.4	46751.3	43287.3	41192.1	38168.2	36303.5	34530.1	33742.6	32085.4	30967	29023	27599.5	26245.4	24961.3	23757	22585.7	21483.2	20434.3	19438.4	18489	17588.1	16730.1	15914	310309
1942	53464.7	51604.9	49214.2	46757.2	43287.3	41193.7	38169.2	36304.5	34531.5	33743.6	32086.5	30968	29024	27599.5	26245.4	24961.3	23758	22585.7	21483.2	20434.3	19438.4	18489	17588.1	16730.1	15914	310309
1943	53481.2	51621.2	49224.7	46764.1	43287.3	41195.1	38170.2	36305.5	34532.4	33745.9	32087.4	30969	29025	27599.5	26245.4	24961.3	23759	22585.7	21483.2	20434.3	19438.4	18489	17588.1	16730.1	15914	310309
1944	53491.9	51632.9	49234.7	46771.2	43287.3	41196.6	38171.2	36306.5	34533.3	33750.4	32088.5	30970	29026	27599.5	26245.4	24961.3	23760	22585.7	21483.2	20434.3	19438.4	18489	17588.1	16730.1	15914	310309
1945	53507.9	51643.5	49245.7	46776.1	43287.3	41197.1	38172.2	36307.5	34534.2	33751.5	32089.5	30971	29027	27599.5	26245.4	24961.3	23761	22585.7	21483.2	20434.3	19438.4	18489	17588.1	16730.1	15914	310309
1946	53521.7	51653.9	49256.7	46781.2	43287.3	41197.6	38173.2	36308.5	34535.1	33752.6	32090.5	30972	29028	27599.5												

1997	33674.9	36222.3	47051.9	43719.9	58807.1	60805.2	13712.6	9630.55	8393.94	6316.71	7676.99	6486.92	1853.41	1027.34	2967.54	1919.42	310.146	127.794	2486.08	74.8638	43.5497	50.7513	38.0695	44.2471	69.9259	2353.79
1998	4228.7	32026.8	34447.8	44743.2	41564.3	83565	57498.3	12959.7	9093.82	7905.75	7230.5	6109.65	1745.62	967.587	2794.95	1807.79	292.108	120.361	2341.49	70.5098	41.0169	47.9997	35.8554	41.6737	2282.76	
1999	5275.7	4064.5	34447.8	44743.2	41564.3	3200.1	3200.1	3200.1	3200.1	3200.1	3200.1	3200.1	1244.3	520.4	1244.3	1244.3	263.1	123.2	263.1	123.2	58.623	45.4508	42.2334	35.7575	34.7575	41.7575
2000	12538.8	40405.2	38251.7	28967.4	31150.4	40403.8	37355.9	74880.9	51478.2	11576.5	8101.44	1040.02	1300.01	6441.46	5442.92	1555.13	861.997	2489.95	1610.51	260.231	107.227	208.97	12.9152	36.5408	42.2334	2102.71
2001	48483.4	119362	48549.9	36380.2	27546.5	29588.8	38314.1	35442.1	76064.4	48713.3	10954.8	7666.32	6664.75	5015.43	6095.49	5150.59	1471.6	815.7	2356.21	1534.01	246.255	197.94	59.4415	44.5782	2030.08	
2002	98069.6	46113.5	113429	46172.9	34953.5	26157.5	28039.6	36295.4	33555.9	67077.4	46015.1	10354.7	7264.6	6299.69	4740.72	5761.62	4863.47	1391	771.02	2237.15	1440.33	232.766	95.9098	1865.82	56.1856	1951.56
2003	31952.8	92380.4	43860.7	107884	43911.7	3287.2	2482.6	26607.5	34430.2	31800.8	63568.9	43636.7	9813.14	6867.38	5970.19	4492.76	5460.26	4613.83	1318.24	730.693	2110.66	1365.19	220.592	90.8933	1768.23	1902.74
2004	73038.2	30392.4	88723.4	41716.7	10260.1	41272.7	31199.7	23558.2	25239.7	32628.6	30136.7	60242.6	41353.3	9299.65	6508.03	5657.79	4257.66	5174.54	1372.4	1249.26	692.458	2000.22	1293.75	209.049	86.1372	3478.87
2005	83018	69472.2	28908.1	84388.2	39675.3	97514.4	39619.4	29618.7	23583.5	23935	30942	28579	57128.6	39215.8	8818.95	6171.63	5365.34	4037.59	4907.07	4146.39	1184.69	656.665	1896.83	1226.88	198.243	3380.73
2006	65041.4	78942.4	66078.7	27495.2	80256.7	37704.4	9256.9	37602.1	28101.9	21194.3	22688.9	29311.3	51454.4	37174.1	8359.82	5890.33	5086.01	3827.38	4651.6	3930.52	1123.01	622.477	1798.07	1163	3392.65	
2007	215319	61865.8	75107.8	62850	2614.9	76278.7	35800.4	8787.9	35687.7	26650.1	20099.3	21516.8	27815.8	5269.51	51536.7	5255.7	7927.94	5548.09	4823.26	3695.6	4411.29	372.746	1064.99	590.319	1705.18	4320.3
2008	100115	204800	58842	71433.8	59768.2	24840.9	72346.4	33945.7	83288.8	33781	25226.3	19025.5	20367.2	26329.7	24318.9	48612.9	33370.2	7504.37	5251.67	4565.57	3435.73	4175.61	3528.32	1008.09	558.781	5703.56
2009	104385	95223.1	194788	55963	67929.7	56771.3	23555.5	68583.1	32164.9	78812.1	31965.3	23870.4	18002.9	19272.5	24914.5	23011.8	46000	31576.6	7101.02	4969.4	4320.17	3251.07	3951.17	3338.67	953.91	5925.75
2010	107942	99283.4	90566.7	185254	53215.9	64512.5	53813.5	22231	6495.4	30416.9	74529.1	30228.1	22573.2	17024.5	23560.5	21761.2	43500.1	29860.5	6715.11	4699.34	4085.39	3074.39	3736.45	3157.23	6505.78	

Table G10. Estimated numbers at age (1000s) on January 1 from alternate model.

year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16	Age 17	Age 18	Age 19	Age 20	Age 21	Age 22	Age 23	Age 24	Age 25	Age 26
1913	52992.3	50397.4	47939.4	45601.2	43377.1	42163.1	39248.6	37334	35512.8	33780.3	32132.4	30564.9	29079.3	27655.6	26306.5	25023.2	23806.2	22641.4	21537	20486.4	19487	18536.4	17632.2	16772.1	15953.9	311056
1914	54248.5	50407.8	47939.5	45601.4	43377.2	42161.4	39248.7	37334.1	35512.9	33780.4	32132.5	30565	29079.3	27655.6	26306.5	25023.2	23806.2	22641.4	21537	20486.4	19487	18536.4	17632.2	16772.1	15953.9	311058
1915	54259.5	51602.7	47949.3	45601.4	43377.3	42162.1	39248	37334.3	35512.1	33779.4	32131.5	30564	29079.3	27654.7	26305.7	25022.4	23801.8	22640.7	21536.2	20485.7	19486.4	18535.8	17631.6	16771.5	15953.4	311049
1916	54270.6	51613.2	49086	45610.7	43377.3	42161	39247	37332.4	35511.1	33778.1	32130	30562	29071.6	27654.3	26304.4	25021.2	23806.0	22639.6	21535.2	20484.7	19485.4	18534.9	17630.7	16770.7	15952.6	311036
1917	54281.9	51623.7	49095.9	46619.1	43386.1	42160.8	39248.6	37331.3	35509.6	33776.4	32128.2	30560.5	29069.7	27651.5	26306.2	25019.5	23801.5	22638.6	21533.7	20482.3	19484	18533.6	17629.5	16769.5	15951.5	311016
1918	54293.4	51634.4	49105.8	46701.3	43441.4	42167.8	39245.6	37329.7	35507.4	33773.5	32125.1	30557.4	29060.6	27648.5	26299.7	25016.7	23796.3	22635.5	21531.3	20480.9	19481.8	18531.5	17627.5	16767.6	15949.7	310982
1919	54304.5	51643.5	49116.1	46710.7	44247	39253.4	37328.9	35506.2	33771.9	32122.8	30555	29063.9	27648.5	26297.1	25014.3	23794	22632.3	21529.1	20478.9	19487	18529.6	17625.7	16765.9	15948.1	310953	
1920	54318.9	51656.9	49126.5	46720.5	44232.5	40185.7	37338.1	35507.3	33773.3	32123.7	30555	29063.7	27645.4	26296.5	25013.7	23794.3	22632.7	21528.6	20478.4	19479.4	18529.2	17625.3	16765.5	15947.6	310946	
1921	54333.8	51669.6	49137.5	46730.5	44441.8	42165	39246.4	37224.6	35515.9	33774.1	32124.6	30556.5	29063.5	27645	26295.9	25012.9	23792.6	22631.9	21527.9	20477.7	19478.7	18528.5	17624.7	16764.9	15947.1	310937
1922	54349.7	51683.9	49147.9	46741	44451.4	42274.2	39233.6	36359.9	33783.1	32123.6	30559.4	29064.8	27645.5	26296.2	25013.7	23792.5	22631.8	21527.8	20477.6	19478.6	18528.4	17624.5	16764.8	15947	310935	
1923	54366.5	51699	49163.2	46752.6	44461.4	42283.3	39221.2	36368.6	33784.2	32124.6	30559.1	29066.7	27646.9	26296.9	25013.4	23792.8	22631.9	21527.8	20477.6	19478.6	18528.4	17624.5	16764.8	15946.9	310936	
1924	54383.8	51715	49177.6	46765.3	44472.4	42292.9	39230.9	36368.7	33784.2	32124.7	30559.1	29066.7	27646.9	26296.5	25013.7	23792.8	22631.9	21527.9	20477.7	19478.7	18528.5	17624.5	16764.8	15947	310934	
1925	54394.0	51783.4	49184.6	46779.8	44491.5	42302.8	39245.4	36362.5	33784.2	32125.9	30559.6	29067.4	27647.6	26296.5	25013.7	23792.8	22631.9	21527.9	20477.7	19478.7	18528.5	17624.5	16764.8	15946.9	310935	
1926	54397.8	51855.9	49193.8	46786.1	44507.5	42301.7	39240.5	36378.1	33789.4	32126.9	30559.4	29067.4	27647.6	26296.5	25013.7	23792.8	22631.9	21527.9	20477.7	19478.7	18528.5	17624.5	16764.8	15946.9	310934	
1927	54258.7	51886.4	49286	46861	44523	42302.7	39239.1	36376.5	33787.6	32126.9	30559	29067.4	27648.6	26299.7	25012.0	23791.4	22631.8	21527.9	20477.7	19478.7	18528.5	17624.5	16764.8	15946.9	310933	
1928	53919.1	51590.6	49296.2	46847.8	44516.2	42307.9	39239.7	36390.1	33789.8	32123.7	30557.3	29067.4	27648.5	26296.5	25012.0	23791.4	22631.8	21527.9	20477.7	19478.7	18528.5	17624.5	16764.8	15946.9	310932	
1929	53631.6	49210.4	46703.6	46785.8	44478.3	42304.9	39234.3	36356.9	33767.9	32123.7	30557.3	29067.4	27646.5	26296.5	25012.0	23791.4	22631.8	21527.9	20477.7	19478.7	18528.5	17624.5	16764.8	15946.9	310931	
1930	53211	50974.4	48721.9	46822.6	44461.4	42306.2	39231.8	36359.4	33779.8	32123.7	30557.3	29067.4	27646.5	26296.5	25012.0	23791.4	22631.8	21527.9	20477.7	19478.7	18528.5	17624.5	16764.8	15946.9	310930	
1931	53251																									

1981	1917.81	963.955	23087.7	880.953	652.729	907.18	751.165	952.444	1599.18	32288.1	413.931	319.522	219.978	376.958	422.32	1379.99	2080.05	2734.04	1296.61	1795.93	1080.54	1280.89	913.515	957.394	781.243	5370.99
1982	9525.19	1816.42	911.925	21798.6	526.741	581.59	748.65	611.823	759.513	1198.71	24202.3	310.272	239.505	164.89	282.558	316.635	1824.41	1559.15	2049.37	971.908	1345.5	509.793	960.118	684.747	717.637	4611.56
1983	1.11E-06	9.71E-07	1.04E-06																							
1984	3452.54	11.71E-07	8529.14	1623.52	807.366	18189.6	603.377	383.5	478.841	359.176	116.994	658.123	1320.77	170.348	131.495	90.5291	155.132	173.842	567.919	856.016	1125.16	533.605	738.72	444.599	527.132	3301.82
1985	5398.2	1.2691.6	11081.6	8049.49	1520.56	716.691	14889.6	487.11	304.329	354.073	265.589	308.341	486.641	982.46	125.962	97.3235	66.9406	114.711	128.545	419.941	632.971	331.986	394.567	546.237	238.153	2831.37
1986	16723.9	5109.65	3090.31	10451.7	7539.55	1342.32	579.549	11861.3	378.762	220.473	356.511	192.407	223.38	352.55	7118.12	91.3538	70.4046	48.955	83.1028	93.1252	304.229	458.56	602.738	285.847	395.725	2389.3
1987	16281.2	15846.6	4836.53	2919.9	8821.91	6762.25	1123.64	479.481	968.2	290.808	169.276	196.946	147.728	171.508	270.684	5465.2	70.6635	54.0834	37.2243	63.8052	71.5064	233.583	352.076	462.774	219.47	2061.53
1988	11381	15448.8	15026.4	4581.03	2756.11	8999.06	5929.26	977.848	412.234	7899.23	241.305	140.461	163.42	122.581	142.313	224.606	4534.88	58.1369	44.877	30.896	52.9439	59.3292	193.821	292.144	383.998	1892.71
1989	13646.9	10809.5	14667	14256.1	4336.91	2561.99	8142.26	5340.01	874.124	360.558	6987.74	211.056	122.853	142.935	107.215	124.473	196.451	3966.41	50.8491	39.2514	27.023	46.3071	51.8919	169.524	255.222	1991.31
1990	14476.8	12970.6	10271.5	13931.8	13525.8	4074.08	237.66	7518.5	4910.98	747.427	327.685	6350.64	191.814	111.652	129.903	97.4395	113.125	178.539	3604.78	46.213	35.6727	24.5592	42.0851	47.1607	154.668	2041.98
1991	19140.6	13713.6	12327	9758.73	13232.5	12729.8	3786.78	2199.69	6949.33	4493.68	726.922	299.84	5811.01	175.515	102.165	118.865	89.1597	103.512	163.368	3298.47	42.2862	32.6415	23.4724	38.509	43.1534	2009.45
1992	79058.4	18090.2	12938.4	11596.1	9097.55	11409.5	9796.55	2857.75	1608.44	4633.28	2996.04	484.657	199.911	3874.34	117.02	68.1159	79.2499	59.4449	69.0139	108.922	2199.17	28.1932	21.7629	14.9829	25.6749	1368.52
1993	108214	75120.3	17184	12284.2	10992.8	8511.42	10468.5	8958.91	2599.39	1440.23	4148.73	2682.71	433.971	179.004	3469.16	104.782	60.9923	70.9619	53.2282	61.7964	97.5306	1969.18	25.2447	19.4869	13.416	1248.39
1994	51029.9	102826	71359.7	16315.8	11646	10288.8	7815.46	9582.6	8157.86	2330.98	1291.51	370.333	2405.69	388.158	160.52	3110.93	93.9618	54.6941	63.6342	47.7317	55.4152	87.4594	1765.84	22.6379	17.4747	11.3151
1995	52222.8	48512	97736.6	67809.1	15491	10977.8	9595.62	7276.61	8984.57	7507.26	2145.08	1188.51	3423.63	213.84	358.122	147.718	2862.83	86.4683	50.3322	58.5593	43.9251	50.9958	80.4844	1625.01	20.8325	1057.35
1996	38257.9	46953.4	46119.5	92897.3	64410.4	14634.7	10232.4	8980.21	6794.82	8251.88	6964.82	1990.08	1102.63	3176.25	2053.87	332.246	137.044	2655.97	80.2204	46.6953	54.328	40.7512	47.311	74.6688	1507.59	1000.28
1997	36382.1	36377.7	47208.1	43840.4	88257.6	60904.5	13741.5	9846.46	8047.99	6780.52	6482.57	1852.29	1026.28	2956.32	1911.66	309.241	137.555	247.07	74.6659	43.4622	50.5663	37.7926	44.0352	69.4988	2334.22	
1998	42534.6	32193.5	34959.6	44891.8	41678.8	83724.9	57592.3	1297.1	9110.72	7916.87	5956.49	5233.78	1761.05	1744.55	966.598	2784.37	1800.47	291.254	120.136	2328.28	70.323	40.9342	47.6252	35.7234	41.4739	2266.91
1999	54015.3	40452.6	30617.8	32897.7	42677.3	39533.6	7915.12	54415.2	12259.4	8577.09	7453.16	5607.61	6810.09	5747.9	1642.37	909.975	2621.28	1695.01	274.195	113.1	2191.91	66.204	38.5366	44.8357	33.631	2170.35
2000	126162	51376.1	38475.1	21919.9	31284.1	40538	37489.1	75036.5	51562.5	11601	8116.48	7052.91	5306.47	6444.37	5439.23	1554.17	861.107	2480.52	1603.99	259.47	107.026	2074.2	62.6487	36.4671	42.4279	2085.62
2001	48904	11998	48864.6	36592.7	27695.1	59715.9	38441.6	35540.1	71102.7	4879.3	10978	6780.59	6674.14	5021.48	6098.27	5141.11	1470.7	814.861	2347.3	1517.85	245.535	101.278	1962.8	59.2842	34.5086	2013.77
2002	98870.9	46513.6	114129	46472.3	34795.6	26953.5	28160.2	36416.4	33649	67208.6	46121.1	10376.8	7259.5	6308.61	4746.47	5764.29	4865.22	1390.16	770.234	2218.75	1437.42	232.088	95.7314	1855.31	56.0374	1936.1
2003	23443.3	90402.6	44241.3	108550	44196.5	33064.8	24957.5	26722.1	43454.52	31892.8	63693.7	43709.1	9834.08	6880.26	5978.68	4498.24	5462.83	4610.78	1317.45	729.952	2102.71	1359.68	219.95	90.7248	1758.28	1887.95
2004	74047.7	30859	38484.4	42078.7	103234	41979.7	13182.2	23682.6	25348.6	32737.8	30207.2	60361.2	41422.2	9319.55	6520.29	5665.88	4262.89	5177.01	4369.54	1248.52	691.761	1992.69	1288.55	208.442	85.9781	3455.46
2005	84811.7	70432.4	29351.9	85077.8	40019.5	98116.5	39876.6	29792.1	22476.5	31045.8	28658.8	32741.5	8837.89	6183.3	5373.05	4042.57	4909.45	4147.31	1184	656.008	1889.71	1221.95	197.669	3358.4		
2006	67653.5	80670.3	66992.1	27917.4	80912.6	38031.7	93139.1	37846.5	28266.7	21306.5	2278.72	29429.8	27167	54261.9	37326.6	8377.85	5861.44	5093.36	3832.14	4653.89	3928.02	112.37	621.861	1791.34	1158.34	3370.96
2007	22823	64350.5	76730.6	26551.2	76902.4	36111.4	88421.7	35919.9	2606.06	20206	21610.2	27909.7	25763.8	51849.2	35313.3	7945.11	5558.68	4808.28	3634.62	4413.51	3725.12	1064.39	389.74	1698.81	4295.36	
2008	81644.3	21286	61025.2	72977.2	60594.4	25224.4	72988.8	34241	38305.8	34001.4	25374.9	19126.7	20456	26419	24387.7	48710.7	33427.2	7520.76	5261.79	4572.29	3440.01	4177.78	3526.16	1007.54	558.242	5674.02
2009	66353.5	77655.1	20247	58210.7	69395.7	57556.5	23917.9	6945.8	32443.5	79302.7	32174.6	24011.5	18099.1	19356.9	24999.5	30774.4	46093.5	31631.2	7116.68	4979.08	43263.63	32525.26	9353.31	3336.71	953.409	3897.41
2010	55433.5	63110.7	73857.8	192569	55353.3	65907	54558.8	22664.7	65489.3	30682.9	74995	30426.9	22707.2	17116	18305.5	23641.6	43589.8	29913	6730.1	4708.62	4091.61	3078.44	3738.57	3155.46	6478.69	

1939	0.000778	0.000989	0.001343	0.002435	0.011781	0.025598	0.02795	0.031761	0.042889	0.042889
1940	0.000854	0.001085	0.001474	0.002672	0.012927	0.028089	0.030669	0.03485	0.047061	0.047062
1941	0.001729	0.002198	0.002986	0.005412	0.026184	0.056893	0.06212	0.070589	0.095322	0.095322
1942	0.002097	0.002665	0.00362	0.006562	0.031745	0.068975	0.075312	0.08558	0.115565	0.115565
1943	0.002009	0.002553	0.003468	0.006287	0.030413	0.066083	0.072154	0.081991	0.110719	0.110719
1944	0.002327	0.002958	0.004018	0.007283	0.035236	0.076561	0.083594	0.094991	0.128274	0.128274
1945	0.001932	0.002455	0.003335	0.006046	0.02925	0.063556	0.069394	0.078855	0.106485	0.106485
1946	0.002379	0.003024	0.004108	0.007446	0.036022	0.078269	0.085459	0.09711	0.131136	0.131136
1947	0.002506	0.003184	0.004326	0.007842	0.037936	0.082429	0.090001	0.102271	0.138106	0.138106
1948	0.003067	0.003898	0.005295	0.009598	0.046435	0.100894	0.110163	0.125183	0.169044	0.169045
1949	0.002417	0.003071	0.004172	0.007563	0.036587	0.079498	0.086801	0.098635	0.133195	0.133196
1950	0.002989	0.003799	0.00516	0.009354	0.045254	0.098329	0.107362	0.121999	0.164746	0.164746
1951	0.002927	0.00372	0.005054	0.009161	0.044319	0.096298	0.105145	0.11948	0.161344	0.161344
1952	0.002266	0.002879	0.003911	0.00709	0.034301	0.074531	0.081378	0.092472	0.124873	0.124873
1953	0.001874	0.002382	0.003235	0.005865	0.028373	0.06165	0.067314	0.076491	0.103292	0.103293
1954	0.001491	0.001894	0.002573	0.004665	0.022568	0.049036	0.053541	0.06084	0.082158	0.082158
1955	0.001627	0.002067	0.002808	0.00509	0.024626	0.053509	0.058424	0.06639	0.089652	0.089652
1956	0.001721	0.002187	0.002972	0.005387	0.026059	0.056622	0.061824	0.070253	0.094868	0.094868
1957	0.002302	0.002925	0.003973	0.007203	0.034846	0.075714	0.08267	0.093941	0.126856	0.126856
1958	0.002092	0.002659	0.003612	0.006547	0.031673	0.068819	0.075141	0.085386	0.115303	0.115304
1959	0.002103	0.002673	0.003631	0.006583	0.031846	0.069196	0.075553	0.085854	0.115935	0.115935
1960	0.001577	0.002004	0.002722	0.004935	0.023875	0.051877	0.056642	0.064365	0.086917	0.086917
1961	0.001987	0.002526	0.003431	0.00622	0.03009	0.065381	0.071387	0.081119	0.109542	0.109542
1962	0.002047	0.002601	0.003533	0.006405	0.030986	0.067327	0.073512	0.083534	0.112804	0.112804
1963	0.001471	0.001869	0.002539	0.004602	0.022264	0.048376	0.05282	0.060021	0.081051	0.081051
1964	0.001206	0.001533	0.002082	0.003774	0.018259	0.039672	0.043317	0.049223	0.066469	0.066469
1965	0.001146	0.001456	0.001978	0.003586	0.017349	0.037696	0.041159	0.046771	0.063159	0.063159
1966	0.001195	0.001519	0.002064	0.003741	0.018099	0.039325	0.042938	0.048792	0.065887	0.065888
1967	0.001501	0.001908	0.002592	0.004698	0.022729	0.049387	0.053924	0.061275	0.082745	0.082745
1968	0.000921	0.001171	0.00159	0.002883	0.013945	0.0303	0.033084	0.037594	0.050766	0.050767
1969	0.00167	0.002123	0.002884	0.005228	0.02529	0.054952	0.06	0.06818	0.092069	0.092069
1970	0.002309	0.002935	0.003987	0.007227	0.034962	0.075966	0.082945	0.094253	0.127278	0.127278
1971	0.002993	0.003803	0.005167	0.009366	0.04531	0.098451	0.107495	0.12215	0.16495	0.16495
1972	0.003172	0.004032	0.005477	0.009928	0.048032	0.104364	0.113952	0.129487	0.174858	0.174858
1973	0.003297	0.00419	0.005692	0.010317	0.049913	0.108452	0.118415	0.134559	0.181707	0.181707
1974	0.002256	0.002866	0.003894	0.007059	0.034149	0.074199	0.081015	0.09206	0.124317	0.124317
1975	0.002554	0.003246	0.004409	0.007993	0.038668	0.084019	0.091738	0.104245	0.140771	0.140771
1976	0.002831	0.003598	0.004888	0.00886	0.042864	0.093137	0.101693	0.115557	0.156046	0.156046
1977	0.003711	0.004717	0.006407	0.011615	0.05619	0.12209	0.133306	0.15148	0.204556	0.204557
1978	0.004596	0.005841	0.007935	0.014384	0.069588	0.151203	0.165093	0.187601	0.253334	0.253334
1979	0.005806	0.007378	0.010023	0.018169	0.087897	0.190985	0.20853	0.236961	0.319988	0.319988
1980	0.004533	0.005761	0.007826	0.014187	0.068631	0.149123	0.162823	0.185021	0.24985	0.24985
1981	0.004319	0.00549	0.007457	0.013518	0.065397	0.142096	0.15515	0.176302	0.238076	0.238076
1982	0.004674	0.00594	0.008069	0.014626	0.070758	0.153745	0.167869	0.190755	0.257593	0.257593
1983	0.004383	0.00557	0.007567	0.013717	0.066358	0.144185	0.157431	0.178894	0.241576	0.241576
1984	0.004565	0.005802	0.007882	0.014287	0.069119	0.150182	0.163979	0.186335	0.251624	0.251625
1985	0.004936	0.006274	0.008522	0.015449	0.074737	0.162391	0.177309	0.201483	0.272079	0.272079

1986	0.003884	0.004936	0.006705	0.012155	0.058801	0.127764	0.139501	0.15852	0.214063	0.214063
1987	0.002477	0.003148	0.004277	0.007753	0.037507	0.081497	0.088984	0.101115	0.136544	0.136544
1988	0.001523	0.001935	0.002629	0.004766	0.023054	0.050093	0.054695	0.062152	0.083929	0.083929
1989	0.000828	0.001052	0.001429	0.00259	0.012529	0.027224	0.029724	0.033777	0.045612	0.045612
1990	0.000704	0.000895	0.001216	0.002205	0.010666	0.023174	0.025303	0.028753	0.038828	0.038828
1991	0.00634	0.008058	0.010946	0.019843	0.05995	0.208581	0.227742	0.258792	0.349469	0.349469
1992	0.001093	0.001389	0.001887	0.003421	0.016548	0.035956	0.039259	0.044612	0.060243	0.060243
1993	0.001067	0.001356	0.001842	0.003339	0.016151	0.035094	0.038318	0.043542	0.058798	0.058799
1994	0.000598	0.00076	0.001033	0.001872	0.009056	0.019677	0.021484	0.024413	0.032967	0.032967
1995	0.000453	0.000575	0.000781	0.001417	0.006853	0.014891	0.016259	0.018476	0.02495	0.02495
1996	0.000394	0.000501	0.00068	0.001233	0.005967	0.012966	0.014157	0.016087	0.021724	0.021724
1997	0.00018	0.000229	0.000311	0.000563	0.002725	0.00592	0.006464	0.007345	0.009919	0.009919
1998	0.000188	0.000239	0.000324	0.000588	0.002844	0.006179	0.006747	0.007667	0.010353	0.010353
1999	9.44E-05	0.00012	0.000163	0.000295	0.001429	0.003104	0.003389	0.003851	0.005201	0.005201
2000	9.44E-05	0.00012	0.000163	0.000296	0.00143	0.003107	0.003392	0.003855	0.005205	0.005205
2001	0.000115	0.000146	0.000198	0.00036	0.001739	0.003779	0.004126	0.004689	0.006332	0.006332
2002	6.75E-05	8.58E-05	0.000117	0.000211	0.001022	0.002221	0.002425	0.002756	0.003722	0.003722
2003	6.80E-05	8.64E-05	0.000117	0.000213	0.001029	0.002236	0.002441	0.002774	0.003746	0.003746
2004	5.58E-05	7.09E-05	9.63E-05	0.000175	0.000844	0.001835	0.002003	0.002276	0.003074	0.003074
2005	6.29E-05	7.99E-05	0.000109	0.000197	0.000952	0.002069	0.002259	0.002567	0.003466	0.003466
2006	5.52E-05	7.02E-05	9.53E-05	0.000173	0.000836	0.001817	0.001984	0.002254	0.003044	0.003044
2007	8.90E-05	0.000113	0.000154	0.000279	0.001348	0.002929	0.003198	0.003634	0.004907	0.004907
2008	9.52E-05	0.000121	0.000164	0.000298	0.001441	0.003132	0.00342	0.003886	0.005247	0.005247
2009	0.000107	0.000136	0.000184	0.000334	0.001615	0.003508	0.00383	0.004353	0.005878	0.005878
2010	0.000109	0.000139	0.000188	0.000341	0.00165	0.003585	0.003915	0.004448	0.006007	0.006007

Table G12. Estimated fishing mortality at age for ages 1-10 from alternate model. Fishing mortalities for ages greater than 10 are equal to the last column.

year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10
1913	1.98E-07	2.52E-07	3.43E-07	6.21E-07	3.01E-06	6.53E-06	7.13E-06	8.11E-06	1.10E-05	1.10E-05
1914	8.17E-07	1.04E-06	1.41E-06	2.56E-06	1.24E-05	2.69E-05	2.94E-05	3.34E-05	4.51E-05	4.51E-05
1915	1.10E-06	1.40E-06	1.90E-06	3.45E-06	1.67E-05	3.63E-05	3.96E-05	4.51E-05	6.09E-05	6.09E-05
1916	1.46E-06	1.85E-06	2.52E-06	4.56E-06	2.21E-05	4.80E-05	5.24E-05	5.96E-05	8.05E-05	8.05E-05
1917	2.26E-06	2.87E-06	3.90E-06	7.08E-06	3.43E-05	7.44E-05	8.13E-05	9.24E-05	0.000125	0.000125
1918	2.00E-06	2.54E-06	3.46E-06	6.26E-06	3.03E-05	6.59E-05	7.19E-05	8.17E-05	0.00011	0.00011
1919	6.80E-07	8.64E-07	1.17E-06	2.13E-06	1.03E-05	2.24E-05	2.44E-05	2.78E-05	3.75E-05	3.75E-05
1920	8.41E-07	1.07E-06	1.45E-06	2.63E-06	1.27E-05	2.77E-05	3.02E-05	3.43E-05	4.64E-05	4.64E-05
1921	3.44E-07	4.37E-07	5.93E-07	1.08E-06	5.20E-06	1.13E-05	1.24E-05	1.40E-05	1.90E-05	1.90E-05
1922	2.36E-07	2.99E-07	4.07E-07	7.37E-07	3.57E-06	7.75E-06	8.47E-06	9.62E-06	1.30E-05	1.30E-05
1923	1.89E-07	2.41E-07	3.27E-07	5.93E-07	2.87E-06	6.23E-06	6.81E-06	7.74E-06	1.05E-05	1.05E-05
1924	1.09E-06	1.38E-06	1.88E-06	3.40E-06	1.65E-05	3.58E-05	3.91E-05	4.44E-05	6.00E-05	6.00E-05
1925	6.77E-07	8.60E-07	1.17E-06	2.12E-06	1.03E-05	2.23E-05	2.43E-05	2.77E-05	3.74E-05	3.74E-05
1926	8.13E-07	1.03E-06	1.40E-06	2.54E-06	1.23E-05	2.67E-05	2.92E-05	3.32E-05	4.49E-05	4.49E-05
1927	8.20E-07	1.04E-06	1.42E-06	2.57E-06	1.24E-05	2.70E-05	2.95E-05	3.35E-05	4.53E-05	4.53E-05
1928	1.56E-06	1.98E-06	2.69E-06	4.87E-06	2.36E-05	5.12E-05	5.59E-05	6.36E-05	8.59E-05	8.59E-05
1929	9.22E-07	1.17E-06	1.59E-06	2.89E-06	1.40E-05	3.04E-05	3.32E-05	3.77E-05	5.09E-05	5.09E-05

1930	1.46E-06	1.86E-06	2.53E-06	4.59E-06	2.22E-05	4.82E-05	5.27E-05	5.98E-05	8.08E-05	8.08E-05
1931	2.93E-06	3.72E-06	5.06E-06	9.17E-06	4.44E-05	9.64E-05	0.000105	0.00012	0.000162	0.000162
1932	1.63E-06	2.07E-06	2.81E-06	5.10E-06	2.47E-05	5.36E-05	5.86E-05	6.66E-05	8.99E-05	8.99E-05
1933	3.26E-06	4.14E-06	5.62E-06	1.02E-05	4.93E-05	0.000107	0.000117	0.000133	0.00018	0.00018
1934	1.41E-05	1.79E-05	2.43E-05	4.41E-05	0.000214	0.000464	0.000507	0.000576	0.000778	0.000778
1935	0.000206	0.000262	0.000356	0.000645	0.003122	0.006782	0.007408	0.008419	0.011374	0.011374
1936	0.000647	0.000822	0.001116	0.002024	0.009792	0.021274	0.023237	0.026408	0.035676	0.035676
1937	0.000425	0.000541	0.000734	0.001332	0.006444	0.013999	0.015292	0.017378	0.023477	0.023477
1938	0.000608	0.000773	0.00105	0.001903	0.009211	0.020011	0.021858	0.02484	0.033558	0.033558
1939	0.000775	0.000985	0.001338	0.002426	0.011742	0.02551	0.027864	0.031666	0.042779	0.04278
1940	0.000851	0.001081	0.001468	0.002662	0.012883	0.027988	0.030571	0.034742	0.046936	0.046936
1941	0.001722	0.002189	0.002974	0.005391	0.02609	0.056679	0.061911	0.070357	0.095051	0.095051
1942	0.002088	0.002653	0.003604	0.006534	0.031621	0.068695	0.075036	0.085273	0.115201	0.115201
1943	0.001999	0.002541	0.003452	0.006258	0.030284	0.065791	0.071864	0.081668	0.110331	0.110331
1944	0.002315	0.002943	0.003997	0.007247	0.035072	0.076193	0.083225	0.09458	0.127774	0.127775
1945	0.001921	0.002442	0.003317	0.006014	0.029102	0.063224	0.069059	0.078481	0.106026	0.106026
1946	0.002365	0.003006	0.004083	0.007403	0.035825	0.077828	0.085011	0.096609	0.130516	0.130516
1947	0.00249	0.003164	0.004298	0.007792	0.037709	0.081922	0.089484	0.101692	0.137382	0.137383
1948	0.003045	0.003871	0.005258	0.009532	0.046129	0.100213	0.109463	0.124397	0.168056	0.168057
1949	0.002398	0.003048	0.00414	0.007506	0.036324	0.078913	0.086197	0.097956	0.132336	0.132336
1950	0.002965	0.003768	0.005118	0.009279	0.044903	0.09755	0.106554	0.121091	0.16359	0.163591
1951	0.002901	0.003688	0.005009	0.009082	0.043948	0.095475	0.104288	0.118516	0.160111	0.160111
1952	0.002245	0.002853	0.003875	0.007026	0.033999	0.073862	0.08068	0.091687	0.123866	0.123867
1953	0.001857	0.00236	0.003205	0.005811	0.028121	0.061091	0.06673	0.075833	0.102449	0.102449
1954	0.001477	0.001877	0.00255	0.004623	0.02237	0.048598	0.053084	0.060326	0.081499	0.081499
1955	0.001612	0.002049	0.002783	0.005046	0.024418	0.053047	0.057944	0.065849	0.08896	0.08896
1956	0.001706	0.002169	0.002946	0.005341	0.025848	0.056153	0.061336	0.069704	0.094168	0.094169
1957	0.002283	0.002901	0.003941	0.007144	0.034573	0.07511	0.082042	0.093235	0.125958	0.125958
1958	0.002075	0.002638	0.003583	0.006496	0.031435	0.068291	0.074594	0.084771	0.114523	0.114523
1959	0.002088	0.002653	0.003604	0.006534	0.03162	0.068693	0.075033	0.08527	0.115197	0.115197
1960	0.001566	0.00199	0.002703	0.004901	0.023718	0.051526	0.056282	0.063961	0.086409	0.086409
1961	0.001975	0.00251	0.003409	0.006181	0.029909	0.064977	0.070974	0.080657	0.108966	0.108966
1962	0.002035	0.002586	0.003512	0.006368	0.030816	0.066948	0.073127	0.083103	0.11227	0.11227
1963	0.001463	0.001859	0.002525	0.004578	0.022155	0.048131	0.052574	0.059747	0.080716	0.080716
1964	0.0012	0.001526	0.002072	0.003757	0.018181	0.039497	0.043143	0.049029	0.066237	0.066237
1965	0.001141	0.001451	0.00197	0.003572	0.017287	0.037555	0.041021	0.046617	0.062979	0.062979
1966	0.001191	0.001514	0.002057	0.003729	0.018044	0.039201	0.042819	0.048661	0.065739	0.06574
1967	0.001497	0.001903	0.002584	0.004685	0.022674	0.049258	0.053805	0.061145	0.082605	0.082605
1968	0.000919	0.001168	0.001586	0.002876	0.013918	0.030237	0.033027	0.037533	0.050706	0.050707
1969	0.001667	0.002119	0.002878	0.005218	0.025253	0.054862	0.059926	0.068102	0.092003	0.092003
1970	0.002306	0.00293	0.00398	0.007217	0.034922	0.075868	0.08287	0.094176	0.127229	0.12723
1971	0.002989	0.003799	0.00516	0.009355	0.045271	0.09835	0.107427	0.122083	0.164931	0.164931
1972	0.003169	0.004028	0.005471	0.009919	0.048001	0.104279	0.113904	0.129444	0.174876	0.174876
1973	0.003294	0.004186	0.005686	0.010309	0.049888	0.108381	0.118384	0.134535	0.181753	0.181754
1974	0.002254	0.002864	0.003891	0.007054	0.034137	0.07416	0.081005	0.092057	0.124366	0.124366
1975	0.002552	0.003244	0.004406	0.007989	0.038659	0.083986	0.091738	0.104254	0.140844	0.140844
1976	0.00283	0.003596	0.004885	0.008857	0.042859	0.093109	0.101703	0.115578	0.156143	0.156143

1977	0.00371	0.004715	0.006404	0.011611	0.056188	0.122067	0.133334	0.151524	0.204705	0.204705
1978	0.004594	0.005839	0.007932	0.01438	0.069587	0.151176	0.16513	0.187658	0.253521	0.253521
1979	0.005803	0.007376	0.010019	0.018165	0.087902	0.190963	0.208589	0.237047	0.320244	0.320244
1980	0.004531	0.005758	0.007822	0.014181	0.068625	0.149085	0.162845	0.185062	0.250014	0.250014
1981	0.004317	0.005487	0.007454	0.013514	0.065396	0.14207	0.155183	0.176355	0.23825	0.23825
1982	0.004672	0.005938	0.008066	0.014623	0.070764	0.153732	0.167922	0.190831	0.257808	0.257808
1983	0.004382	0.005569	0.007565	0.013715	0.066369	0.144185	0.157494	0.17898	0.241797	0.241798
1984	0.004564	0.005801	0.00788	0.014286	0.069133	0.150189	0.164051	0.186432	0.251865	0.251865
1985	0.004935	0.006272	0.00852	0.015447	0.074751	0.162394	0.177383	0.201584	0.272334	0.272334
1986	0.003882	0.004934	0.006703	0.012152	0.058806	0.127754	0.139546	0.158584	0.214242	0.214243
1987	0.002475	0.003146	0.004274	0.007748	0.037495	0.081457	0.088975	0.101114	0.136602	0.136602
1988	0.001521	0.001933	0.002626	0.004761	0.02304	0.050053	0.054673	0.062131	0.083938	0.083938
1989	0.000826	0.00105	0.001427	0.002587	0.012517	0.027192	0.029702	0.033754	0.045601	0.045601
1990	0.000703	0.000894	0.001214	0.002201	0.010651	0.023138	0.025273	0.028721	0.038802	0.038802
1991	0.00644	0.008185	0.011118	0.020157	0.097546	0.211915	0.231474	0.263054	0.355379	0.355379
1992	0.001096	0.001393	0.001892	0.003429	0.016596	0.036054	0.039382	0.044755	0.060463	0.060463
1993	0.001069	0.001359	0.001846	0.003346	0.016192	0.035177	0.038424	0.043666	0.058991	0.058992
1994	0.0006	0.000763	0.001036	0.001878	0.009088	0.019744	0.021567	0.024509	0.033111	0.033111
1995	0.000453	0.000576	0.000782	0.001418	0.006862	0.014908	0.016284	0.018505	0.025	0.025
1996	0.000394	0.000501	0.000681	0.001234	0.005971	0.012972	0.014169	0.016103	0.021754	0.021754
1997	0.00018	0.000229	0.000311	0.000563	0.002724	0.005918	0.006465	0.007347	0.009925	0.009925
1998	0.000188	0.000239	0.000324	0.000587	0.002843	0.006176	0.006746	0.007666	0.010357	0.010357
1999	9.42E-05	0.00012	0.000163	0.000295	0.001427	0.0031	0.003386	0.003848	0.005198	0.005198
2000	9.42E-05	0.00012	0.000163	0.000295	0.001427	0.003101	0.003387	0.00385	0.005201	0.005201
2001	0.000115	0.000146	0.000198	0.000359	0.001736	0.003771	0.004119	0.004681	0.006324	0.006324
2002	6.73E-05	8.56E-05	0.000116	0.000211	0.00102	0.002216	0.00242	0.00275	0.003716	0.003716
2003	6.78E-05	8.61E-05	0.000117	0.000212	0.001026	0.002229	0.002435	0.002767	0.003739	0.003739
2004	5.56E-05	7.06E-05	9.59E-05	0.000174	0.000842	0.001829	0.001998	0.00227	0.003067	0.003067
2005	6.26E-05	7.96E-05	0.000108	0.000196	0.000949	0.002061	0.002252	0.002559	0.003457	0.003457
2006	5.50E-05	6.99E-05	9.49E-05	0.000172	0.000833	0.001809	0.001976	0.002246	0.003034	0.003034
2007	8.86E-05	0.000113	0.000153	0.000277	0.001342	0.002916	0.003185	0.003619	0.00489	0.00489
2008	9.47E-05	0.00012	0.000163	0.000296	0.001434	0.003116	0.003404	0.003868	0.005226	0.005226
2009	0.000106	0.000135	0.000183	0.000332	0.001606	0.003489	0.003811	0.00433	0.00585	0.00585
2010	0.000108	0.000138	0.000187	0.000339	0.00164	0.003562	0.003891	0.004422	0.005974	0.005974

Table G13. Mohn's Rho as a measure of retrospective pattern for SSB, recruitment and fishing mortality.

	SSB	Rec	F
Base	0.036	0.753	-0.035
Alternate	0.047	0.742	-0.045

Table G14. Inputs for yield-per-recruit analysis.

	Age	Age	Age	v	Age																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
M	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
Weight	0	0.02	0.05	0.1	0.16	0.23	0.3	0.37	0.45	0.51	0.58	0.64	0.7	0.75	0.79	0.83	0.87	0.9	0.93	0.96	0.98	1	1.01	1.03	1.04	1.05
Maturity	0.14	0.2	0.29	0.39	0.51	0.62	0.73	0.81	0.87	0.91	0.94	0.96	0.98	0.99	0.99	0.99	1	1	1	1	1	1	1	1	1	1
GARM III selectivity	0.03	0.03	0.03	0.05	0.23	0.53	0.63	0.84	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Base selectivity	0.02	0.02	0.03	0.06	0.27	0.6	0.65	0.74	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Alternative selectivity	0.02	0.02	0.03	0.06	0.27	0.6	0.65	0.74	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table G15. Spawning biomass and fishing mortality estimates (and standard errors in parentheses) for 2010. Spawning biomass-per-recruit and fishing mortality at 50% maximum spawning potential (MSP) as estimated using a spawning biomass- and yield-per-recruit analysis (fishery selectivity inputs are estimates from the ASAP model fits). AGEPRO estimates of median spawning biomass and yield at F(50%MSP) with 80% intervals in parentheses. Spawning biomass and fishing mortality for 2007 for the base (final) model adjusted for retrospective pattern are also given.

	2008 Assessment	2011 Base Model	2011 Alternate Model
SSB(2007)	234609mt	240151mt	241090mt
SSB _{adjusted} (2007)	172342mt		
F(2007)	0.0051	0.0049	0.0049
F _{adjusted} (2007)	0.0068		
SSB(2010)		313140mt	314780mt
SSB _{adjusted} (2010)		302379mt	300777mt
F(2010)		0.0060	0.0060
F _{adjusted} (2010)		0.0062	0.0062
SSB-per-recruit(50%MSP)	6.2021kg	6.1987kg	6.1991kg
F(50%MSP)	0.0377	0.0377	0.0377
SSB(50%MSP)	271,000mt	253,000mt (196,000-316,000mt)	238,000mt (185,000-298,000mt)
Yield(50%MSP)	10,139mt	9,437mt (7284-11826mt)	8,891mt (6880-11167mt)

Table G16. Projected SSB (mt) through 2015 based on base model.

Fishing Scenario	Percentile	2012	2013	2014	2015
Status Quo	90%	421961.6	454235.3	490963.5	527603.9
	50%	364550.3	392072.2	422523.3	448485.4
	10%	333722.5	359021.8	381348.9	402613.8
0.75 F(50%MSP)	90%	418478.5	441539.3	467922.4	495106.6
	50%	361503.2	381076.8	402824.3	419563.8
	10%	330995.2	348947.2	363409	376156
F(50%MSP)	90%	417013.3	436279	458570.8	482017.2
	50%	360217.8	376555.9	394792.5	407962.6
	10%	329848	344771.5	356083.9	365502.5

Table G17. Projected total catch (mt) through 2015 based on base model.

Fishing Scenario	Percentile	2012	2013	2014	2015
Status Quo	90%	2504.393	2709.891	2912.762	3194.582
	50%	2171.006	2331.604	2515.164	2728.476
	10%	1956.692	2146.429	2276.942	2432.405
0.75 F(50%MSP)	90%	11665.41	12367.95	13033.35	14071.51
	50%	10111.41	10638.67	11270.08	11968.51
	10%	9114.659	9793.779	10188.1	10671.25
F(50%MSP)	90%	15485.27	16277	17009.88	18243.58
	50%	13421.81	13999.6	14717.92	15495.61
	10%	12099.52	12887.79	13296.49	13811.71

Table G18. Projected SSB (mt) through 2015 based on alternate model.

Fishing Scenario	Percentile	2012	2013	2014	2015
Status Quo	90%	411274.2	446586.1	479963.9	517586.2
	50%	371234.8	396693.3	420077.3	442748.1
	10%	342124.5	368012	389880.6	406753.1
0.75 F(50%MSP)	90%	407996.8	433780.6	458553.9	484512.9
	50%	368118.5	385319	400139.5	413680.4
	10%	339254.1	357485.9	371141.6	379421.5
F(50%MSP)	90%	406620.1	428485.9	449816.4	470930.5
	50%	366809.7	380614.9	392014.8	402006
	10%	338047.6	353130.3	363507	368443.7

Table G19. Projected total catch (mt) through 2015 based on alternate model.

Fishing Scenario	Percentile	2012	2013	2014	2015
Status Quo	90%	2426.664	2651.579	2822.826	3137.663
	50%	2196.601	2355.483	2507.482	2672.113
	10%	2019.35	2183.433	2326.522	2438.151
0.75 F(50%MSP)	90%	11364.28	12164.43	12686.85	13885.06
	50%	10286.84	10804.5	11279.54	11786.27
	10%	9456.702	10020.32	10464.03	10735.77
F(50%MSP)	90%	15084.7	16006.99	16550.44	17972.43
	50%	13654.5	14217.01	14720.14	15254.17
	10%	12552.57	13187.58	13656.1	13885.2

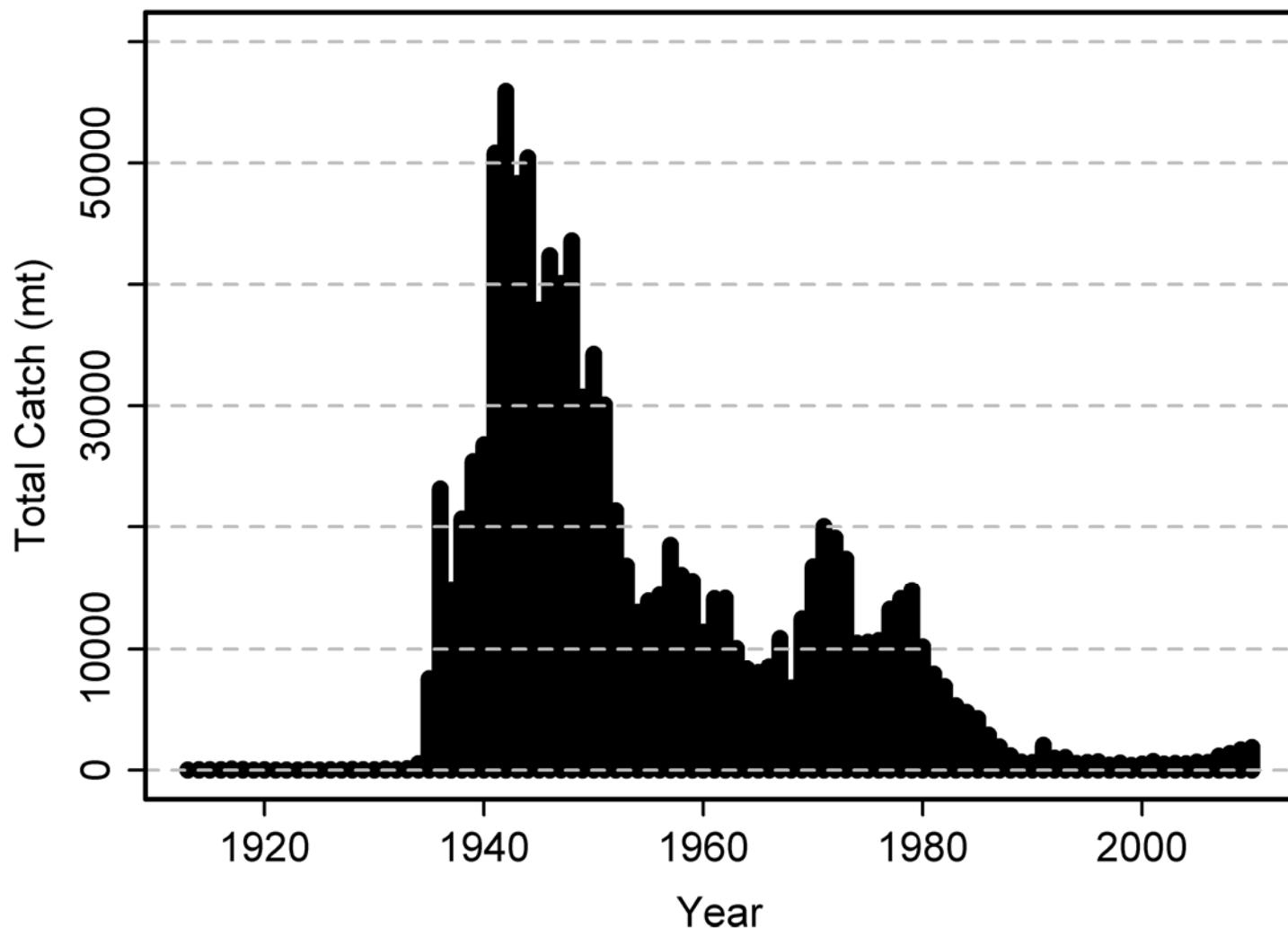


Figure GG1. Annual total catch (mt) of Gulf of Maine-Georges Bank Acadian redfish between 1913-2010.

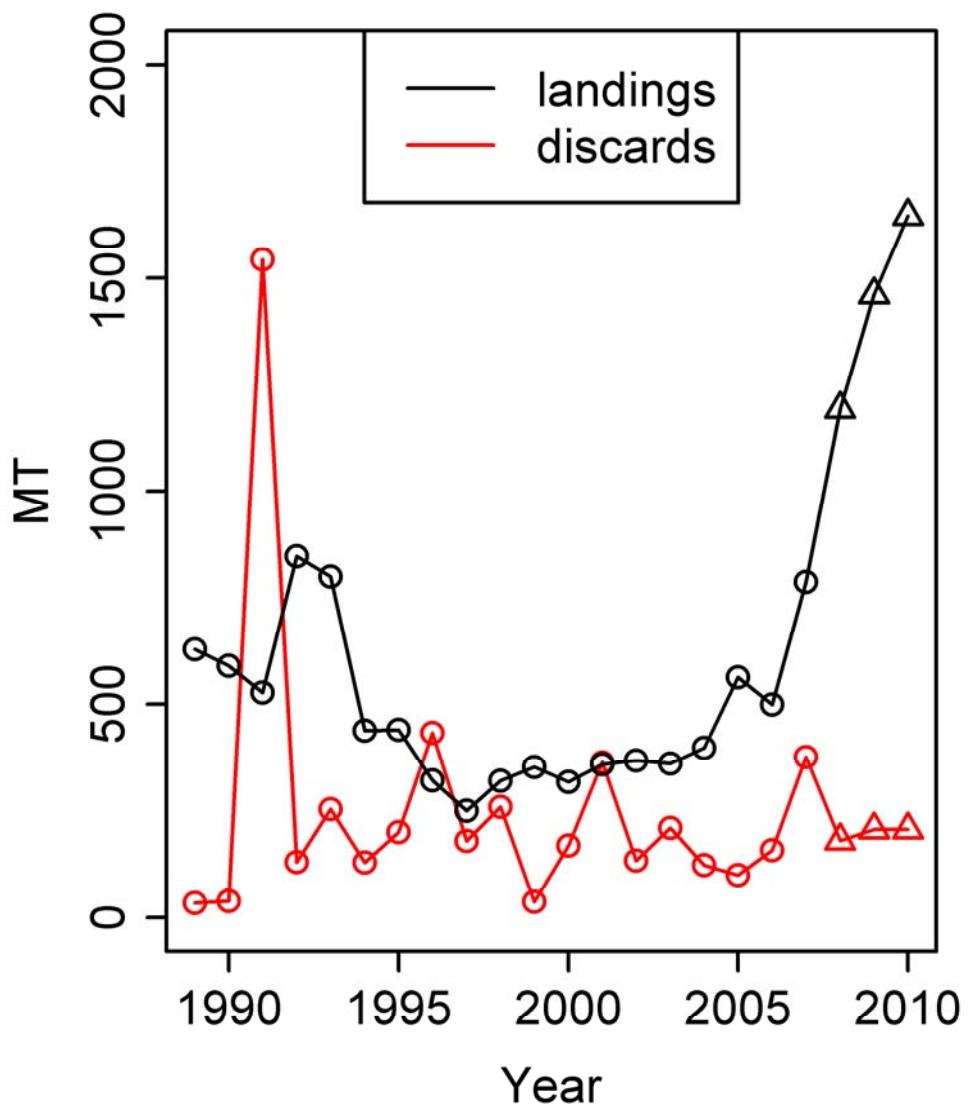


Figure GG2. Annual landings (mt) and estimated discards of Gulf of Maine-Georges Bank Acadian redfish between 1989-2010. Updated data since previous assessment are triangles.

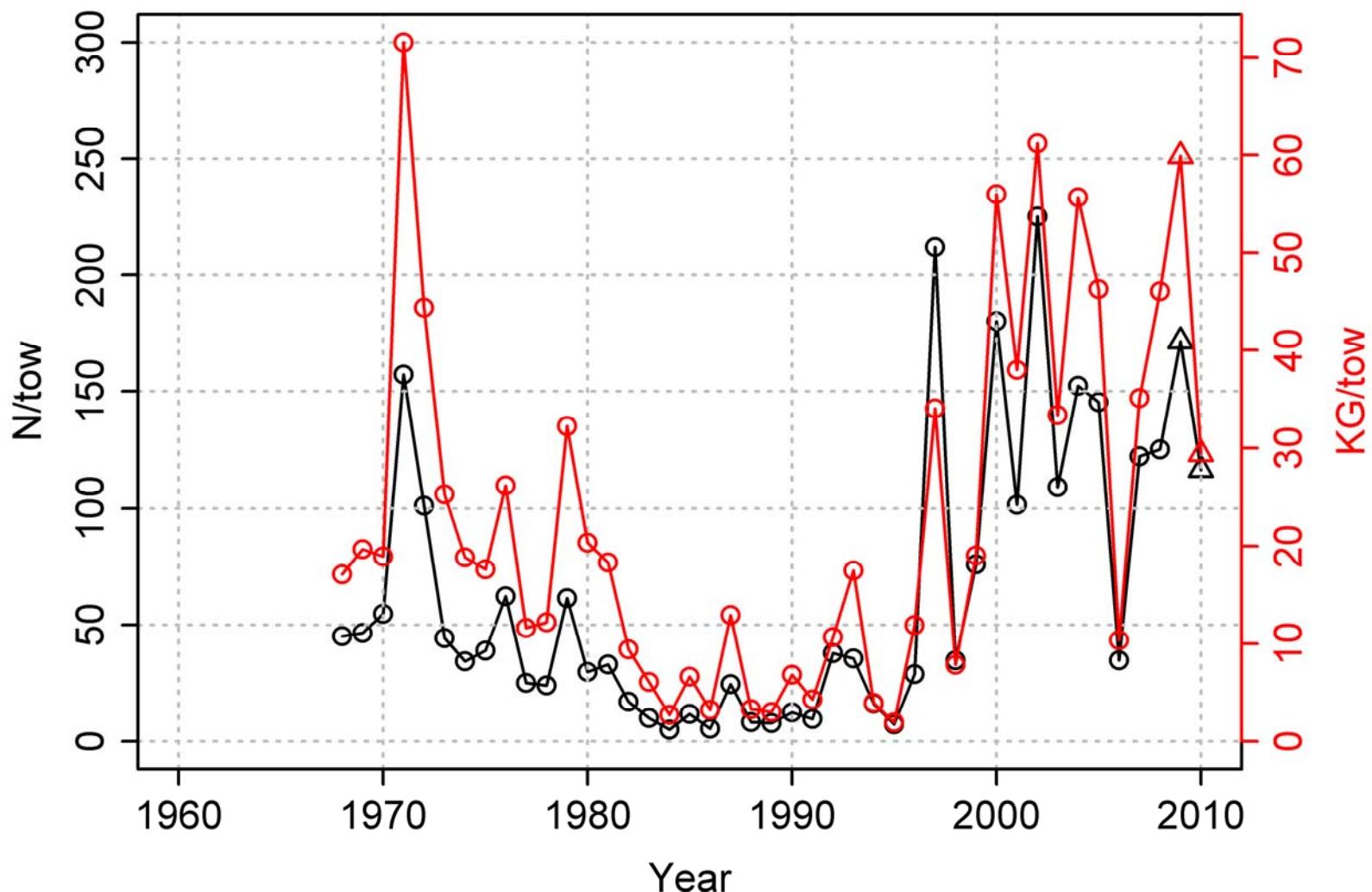


Figure G3. Estimated numbers- (black) and kg-per-tow (red) for Gulf of Maine-Georges Bank Acadian redfish in the NEFSC spring survey covering offshore strata 24, 26-30, 36-40. Triangles represent values calibrated to Albatross IV units.

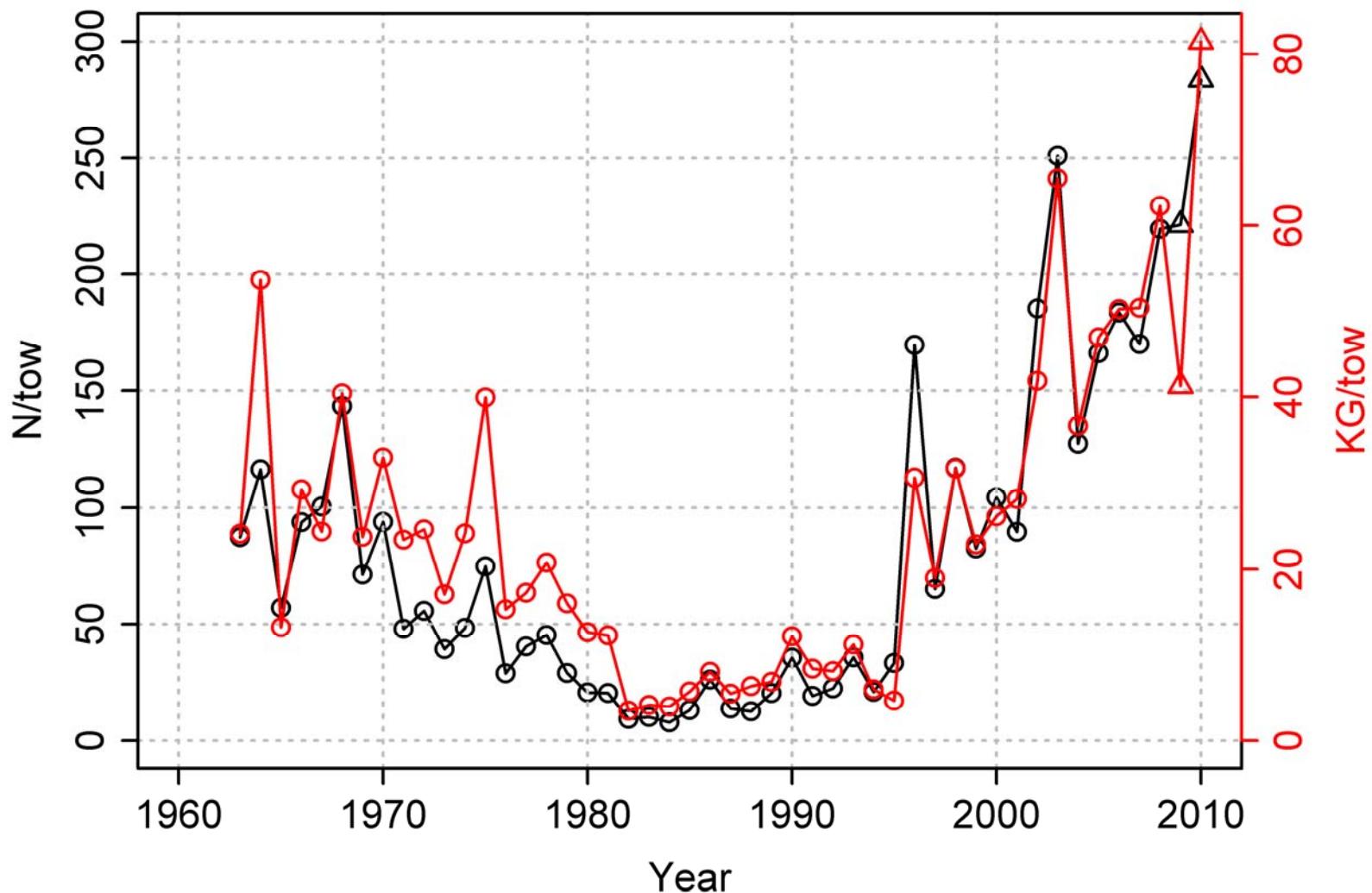


Figure G4. Estimated numbers- (black) and kg-per-tow (red) for Gulf of Maine-Georges Bank Acadian redfish in the NEFSC fall survey covering offshore strata 24, 26-30, 36-40. Triangles represent values calibrated to Albatross IV units.

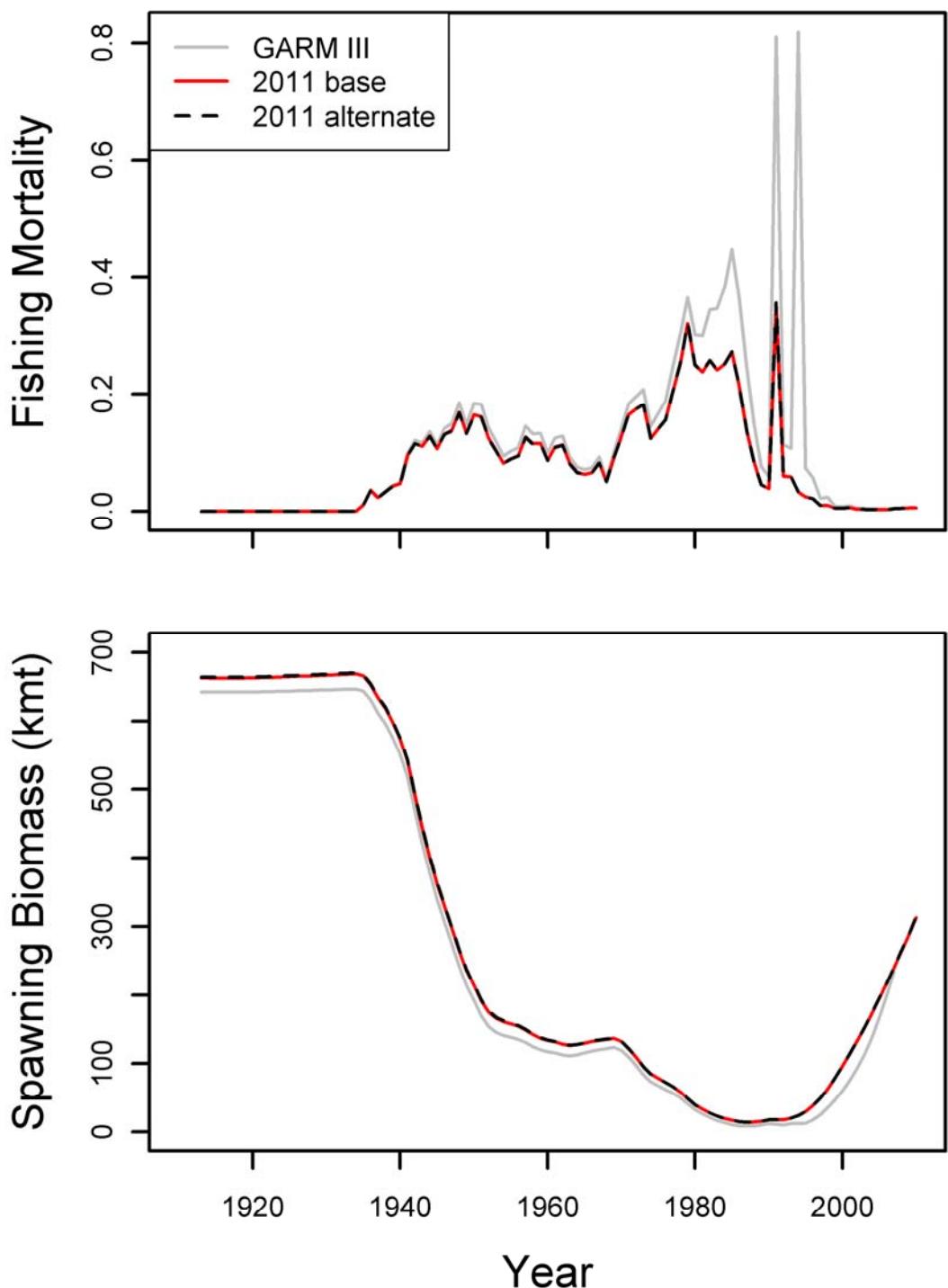


Figure G5. Estimated annual fishing mortality (top) and spawning biomass from the last assessment (gray), 2011 base model (red), , and also the 2011 alternate model (black dashed).

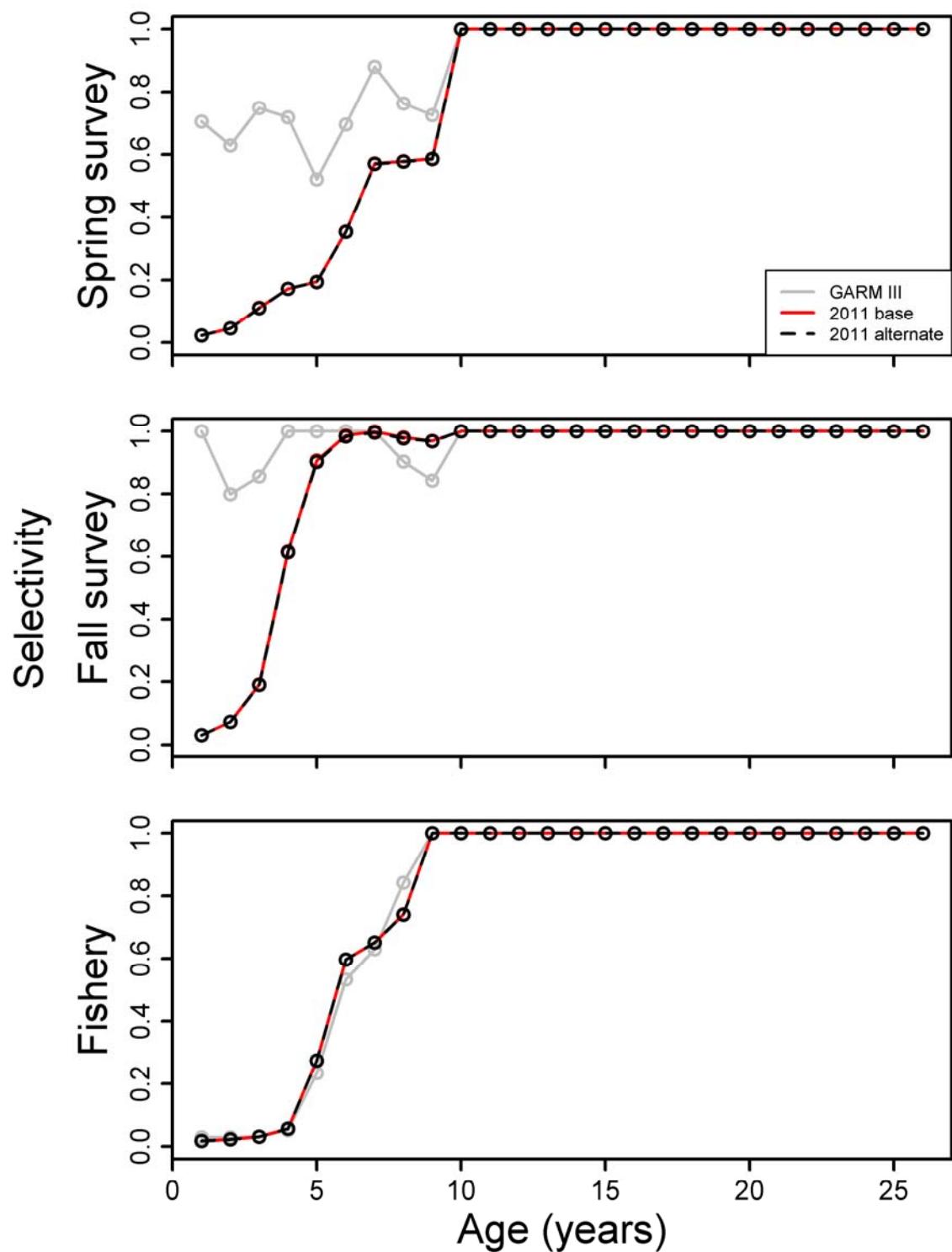


Figure G6. Estimated selectivity from the last assessment (gray), base model (red), and alternate model (black dashed).

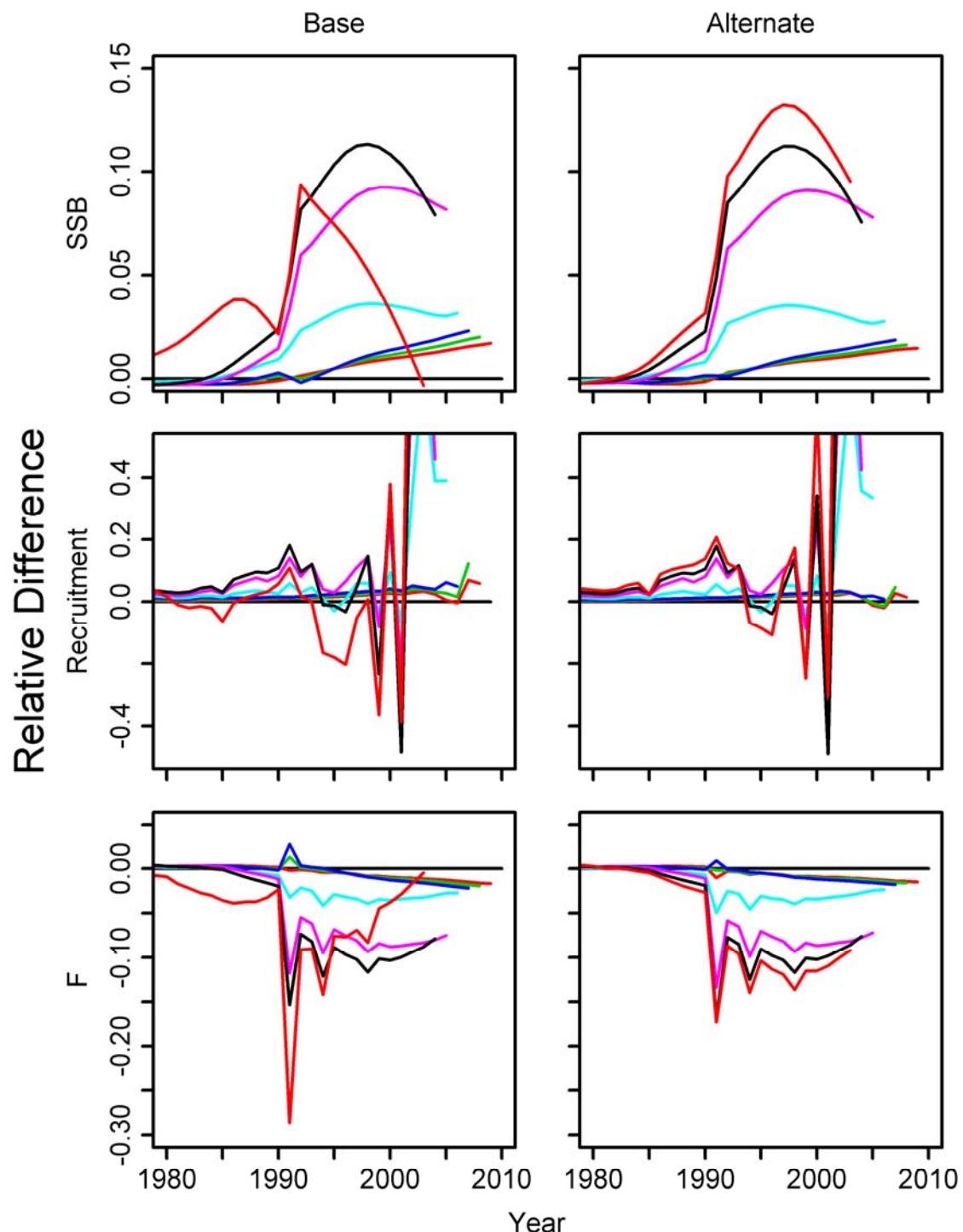


Figure G7. Retrospective patterns of relative differences in spawning biomass (top), recruitment (middle) and fishing mortality (bottom) from the base model (left) and alternate model (right).

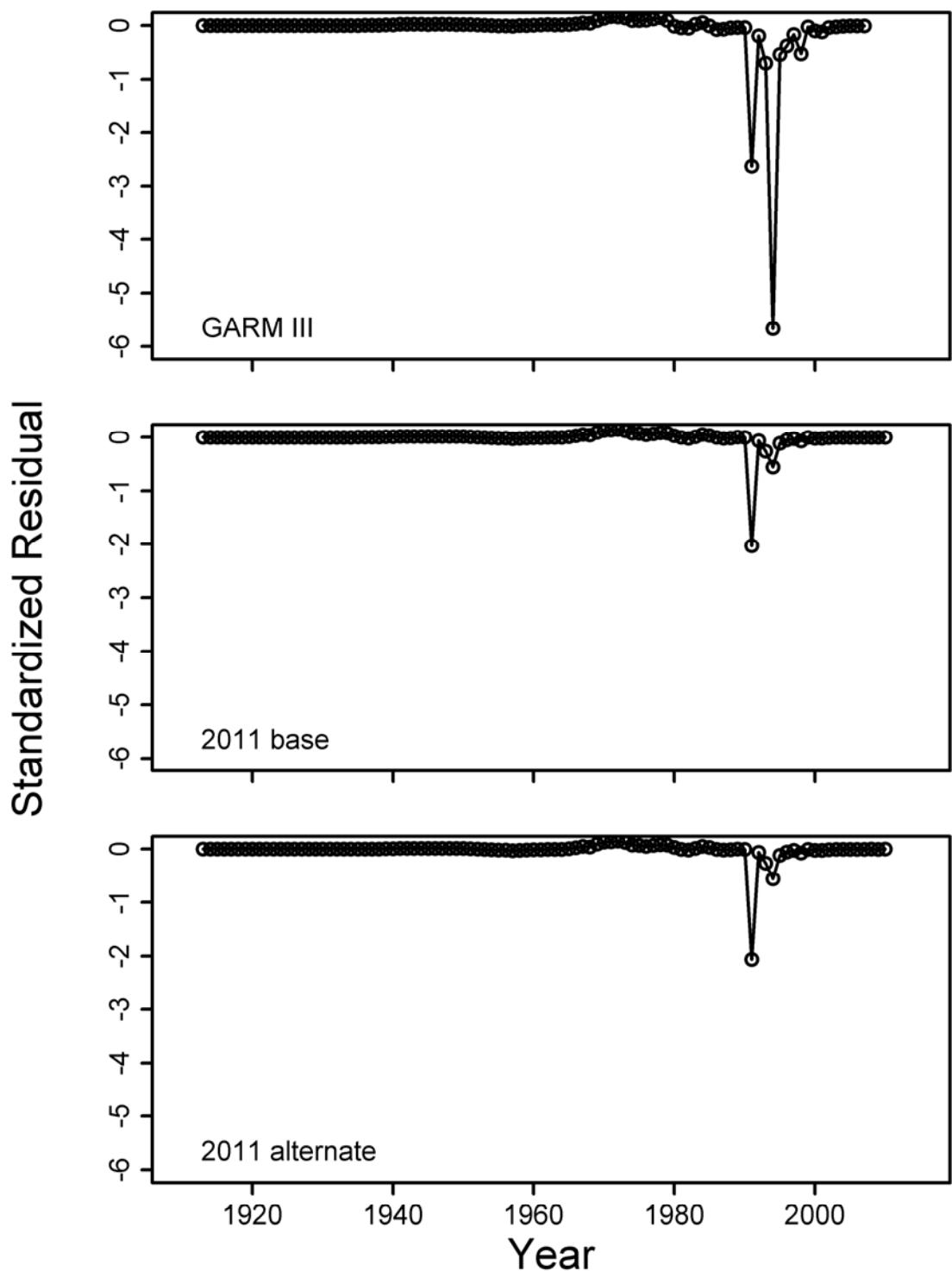


Figure G8. Standardized residuals for total catch from GARM III, base and alternative models.

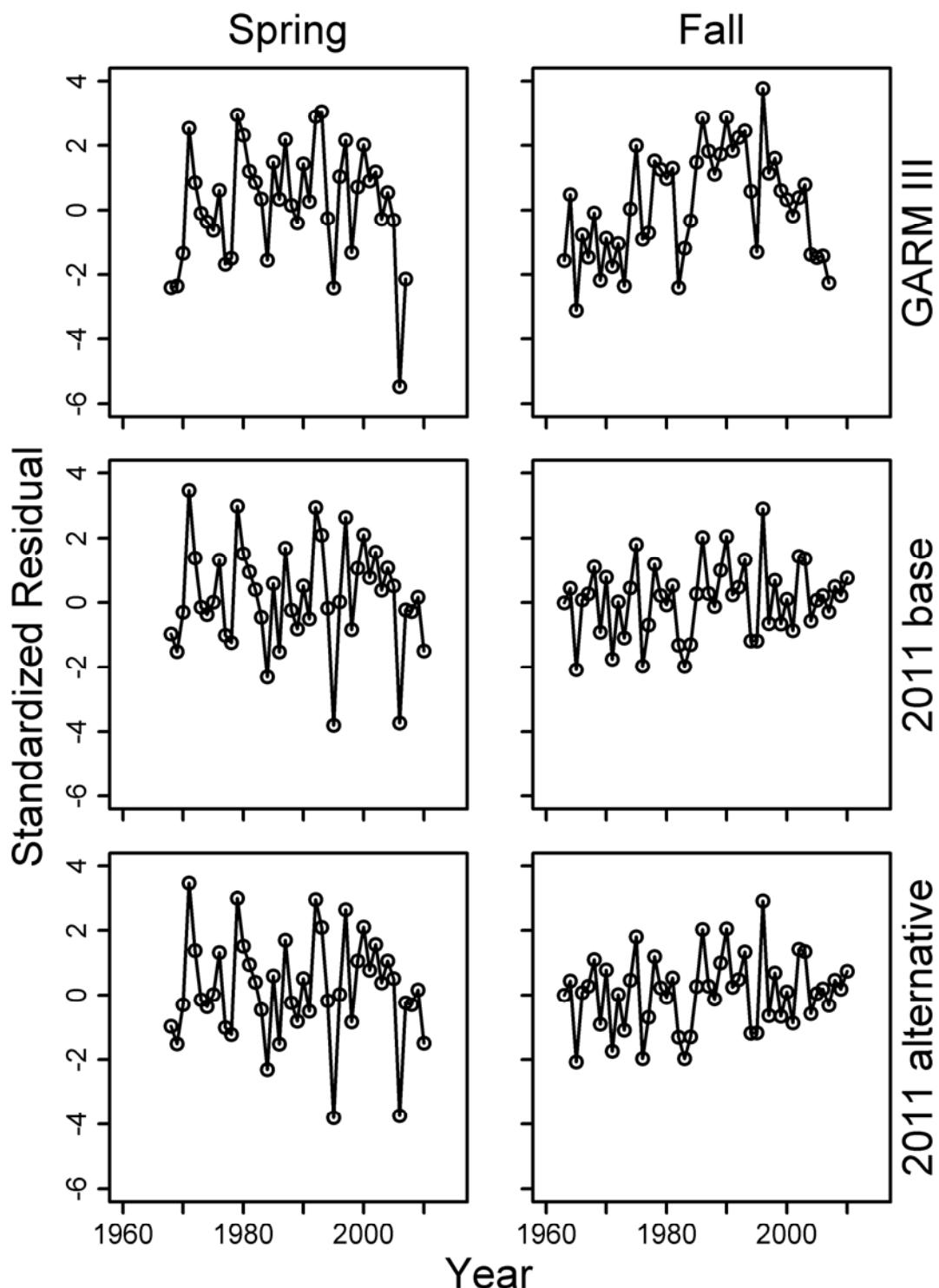


Figure G9. Standardized residuals for NEFSC spring and fall abundance indices from GARM III, base and alternative models.

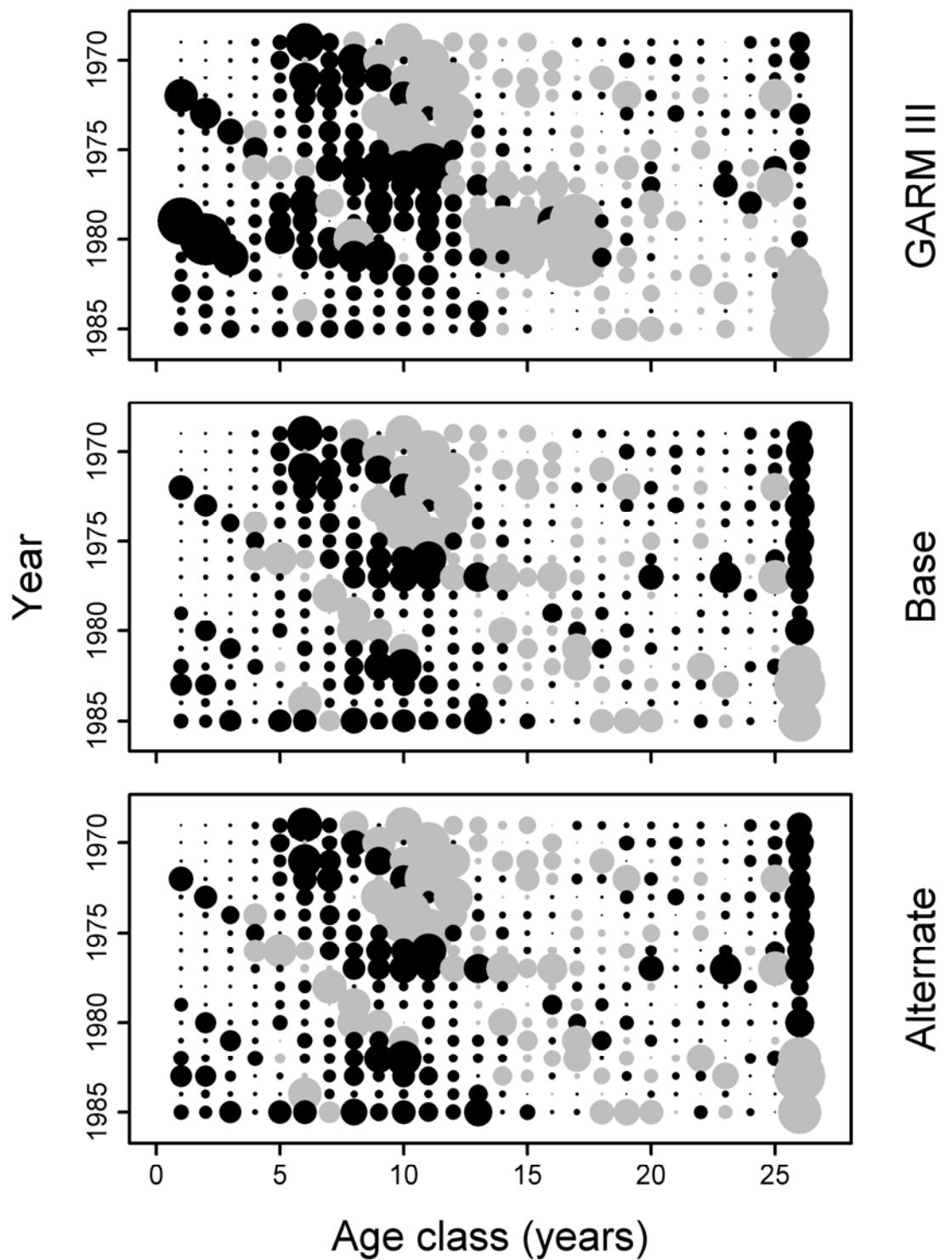


Figure G10. Pearson residuals for age composition of catch from GARM III, base and alternative models. Grey represents positive residuals and black represent negative residuals.

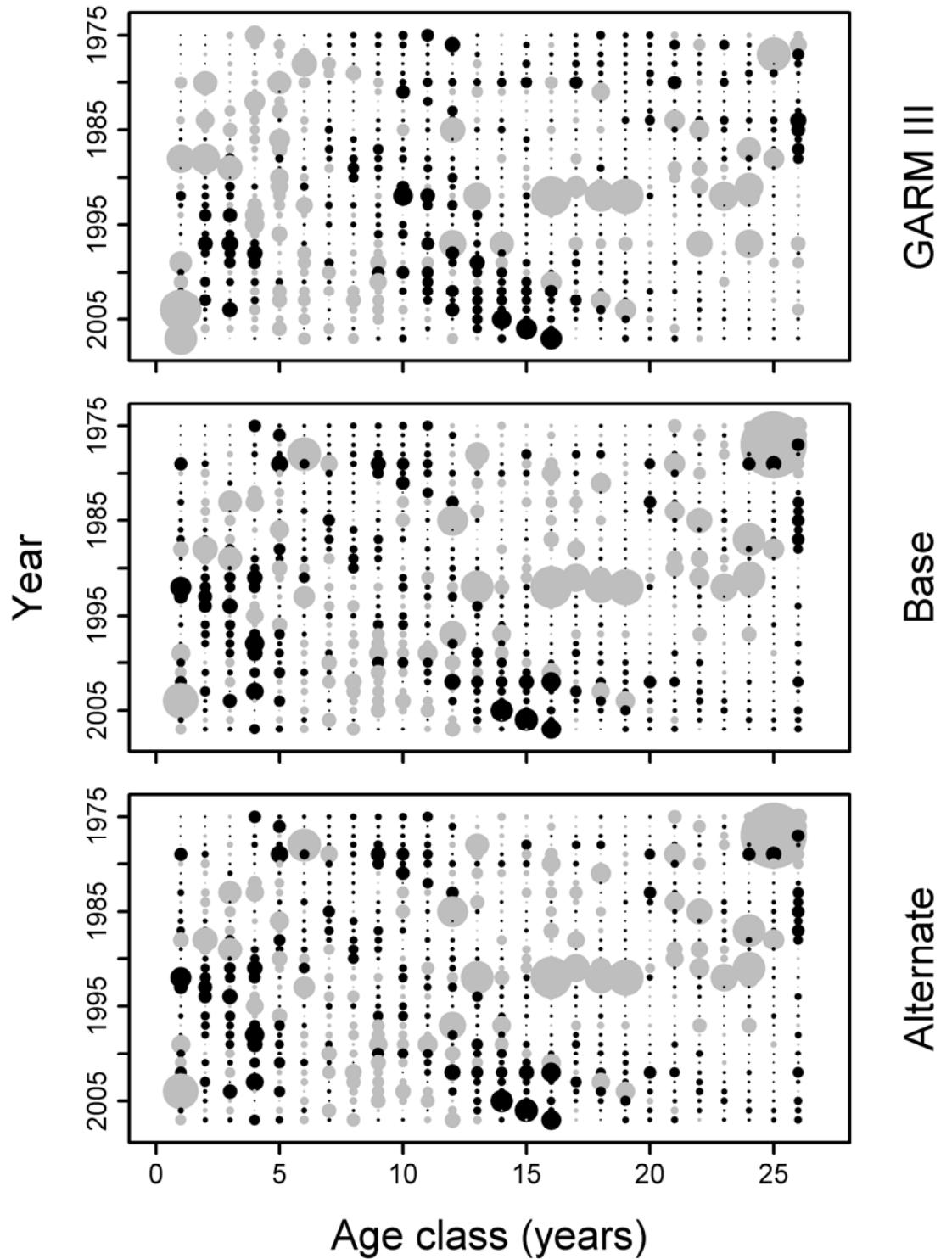


Figure G11. Pearson residuals for age composition of NEFSC fall survey from GARM III, base and alternative models. Grey represents positive residuals and black represent negative residuals.

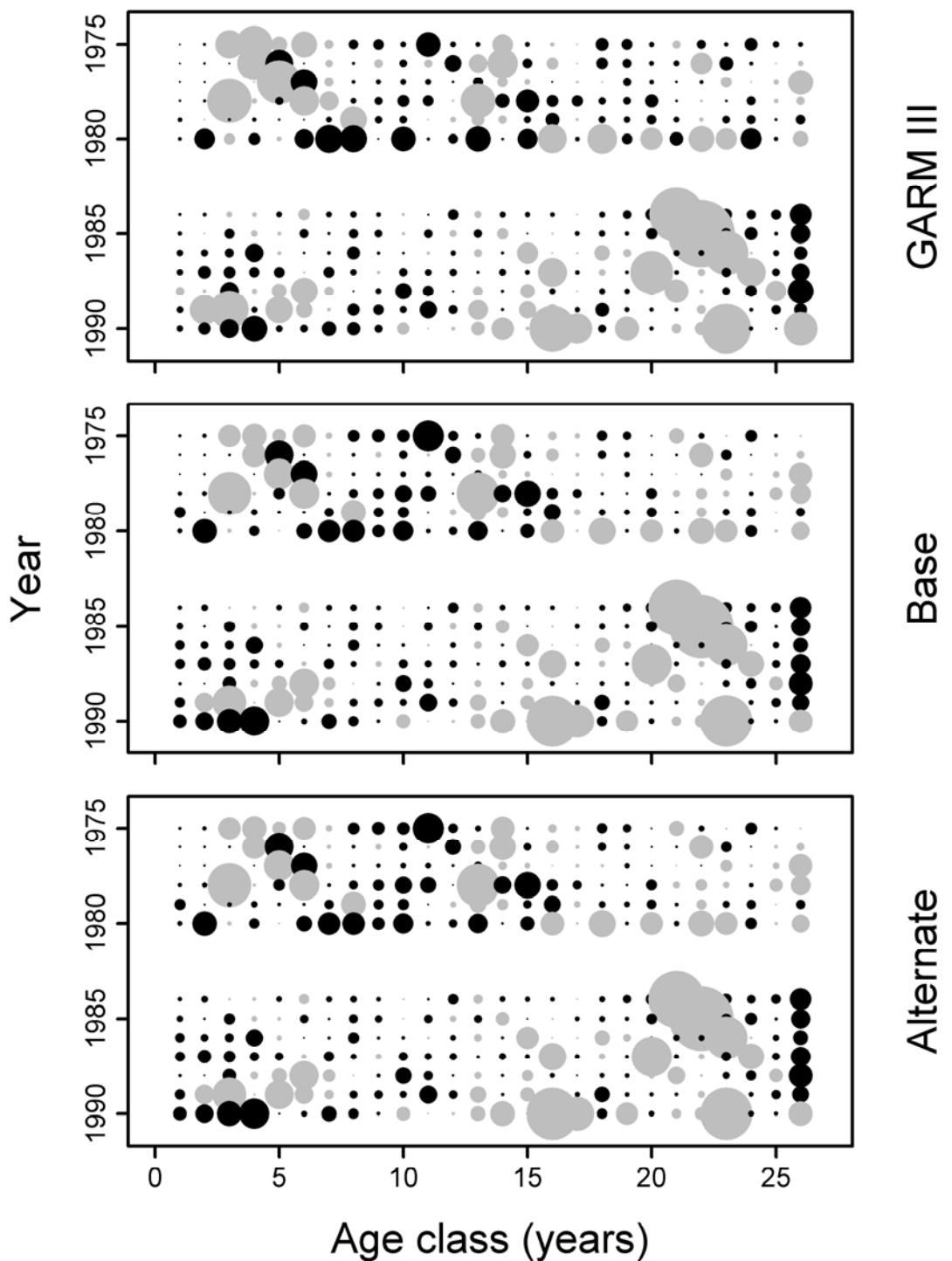


Figure G12. Pearson residuals for age composition of NEFSC spring survey from GARM III, base and alternative models. Grey represents positive residuals and black represent negative residuals.

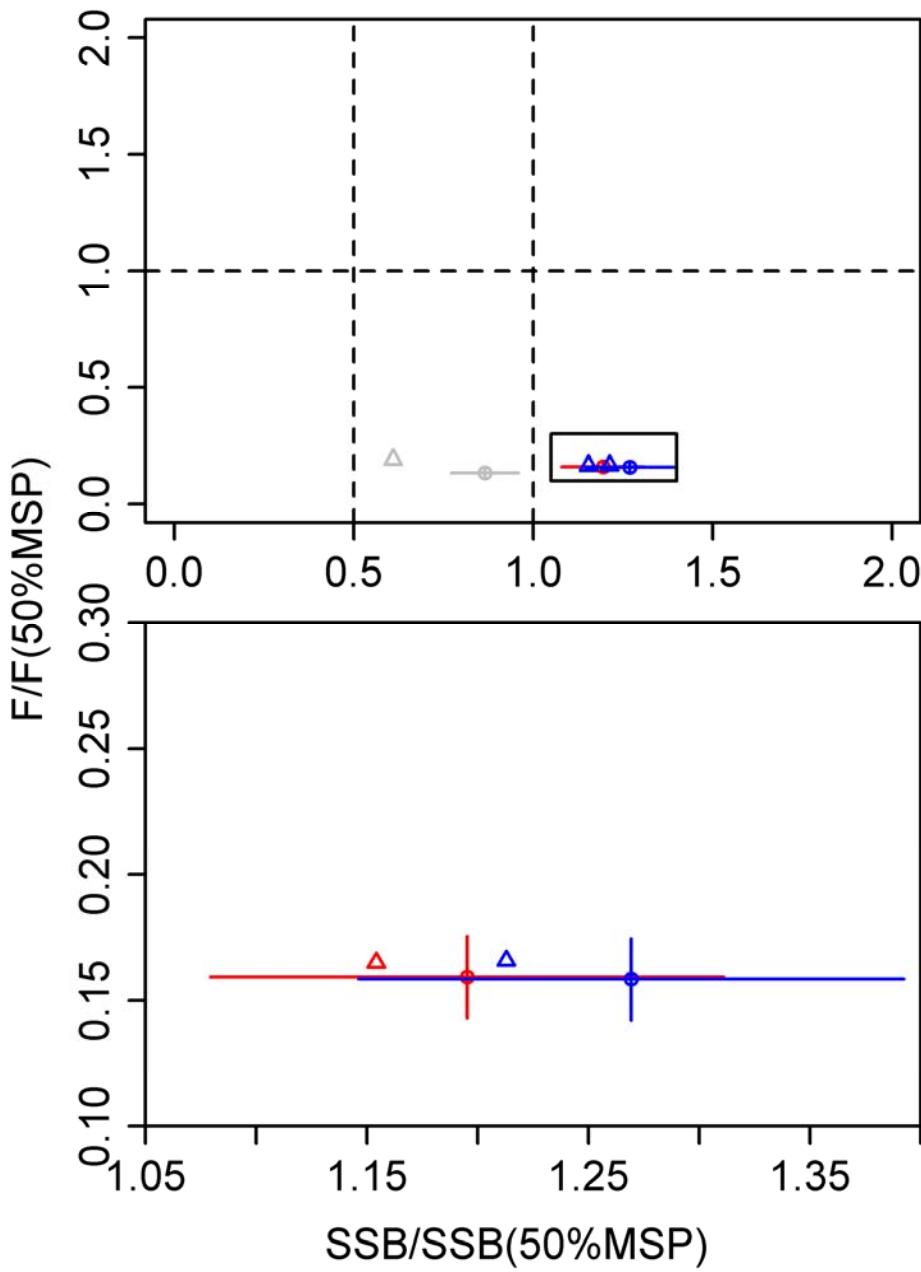


Figure G13. Stock status in 2010 based on unadjusted (circle) or retrospective-adjusted (triangle) base model (red) or alternate model (blue). Vertical and horizontal bars around status points are 80% confidence intervals based on ASAP provided standard errors. Vertical and horizontal dashed lines represent thresholds for rebuilding, overfished, and overfishing definitions.