F. Gulf of Maine cod
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Additional details and supporting information can be found in the Appendix of the GARM-III Report (NEFSC 2008).

1.0 Background

The area occupied by the Gulf of Maine Atlantic cod stock is shown in Figure F1. This stock was last assessed in 2005 at the August 2005 Groundfish Assessment Review Meeting (GARM II) (NEFSC 2005; Mayo and Col 2006). The methodology applied in the present default assessment is the same as in the 2005 and 2002 GARM assessments and the 2001 assessment as described in Mayo *et al.* (2002).

In the 2005 assessment, fully recruited fishing mortality (ages 4+) in 2004 was estimated to be 0.58. This was a result of a very high estimate of F on age 4. Spawning stock biomass was estimated to have increased from a low point of about 11,000 metric tons (mt) in 1997 and 1998 to about 25,000 mt in 2002 followed by a slight decline to 20,500 mt in 2004. The strength of several recent recruiting year classes (1999, 2000 and 2002) was estimated to be below average. The 2001 year class was estimated to be slightly above average and the 2003 year class appeared to be equivalent to the 1987 year class, the largest in the assessment series dating back to 1982. NEFSC spring and autumn research vessel bottom trawl survey indices for Gulf of Maine cod had declined to record low levels in the mid-1990s; indices from both surveys fluctuated at relatively low levels but had begun to increase in 2001 and 2002, continuing through 2004.

2.0 The Fishery

This section provides updated information on Gulf of Maine cod commercial landings, commercial discards, and recreational landings through 2007, and NEFSC and MADMF survey results through spring 2008.

Revised landings by stock were derived for the 1994-2007 period using the preferred allocation scheme reviewed at the GARMIII Data Meeting, October, 2007. Length and age samples associated with each allocated trip were also assigned to the corresponding stock. Both approaches required that landings at age be re-estimated from 1994 onward.

Commercial landings of Gulf of Maine cod declined to 1,380 mt in 1999, a 66 % decline from 1998 (Tables F1 and F2; Figure F2). Commercial landings have since increased to 4,280 mt in 2001, fluctuated between 3,500 and 3,800 mt between 2000 and 2005, declined to 3,028 mt in 2006 and increased to 3,989 mt in 2007. Gulf of Maine cod are caught by 2 primary gears: otter trawls and gillnets (Table F2). These two gear types account for over 90% of the catch with minor amounts coming from line trawls and handlines (hook gear). Otter trawls have generally taken over 50-70% of the catch and gillnets have taken about 30-40%. In recent years, the percentages have been about equal.

The number of commercial port samples for this stock declined from 89 in 1997 to 50 in 1998 to 10 in 1999 (Table F3). Port sampling has since improved, increasing to 74 samples in 2000 and over 300 samples per year since 2005; however a large part of this increase is due to acquisition of more 'Large' market category samples, many consisting of as few as 4-5 fish. Nevertheless, the number of fish sampled increased from a low of 733 in 1999 to over 10,000 per year since 2003. Sampling was not well distributed among quarters and market categories in

1999 and 2000, as only 1 biological sample was taken in the 3rd and 4th quarter of 1999, requiring substantial pooling over quarters. In 1999 and 2000 samples from each market category were pooled on an annual basis, but improved sampling beginning in 2001 allowed a return to the traditional quarterly or semi-annual pooling of samples within each market category. Landings from this fishery had been dominated by age 3 and 4 fish during the 1980s. Since then, however, the fishery has been dominated by age 4-6 fish, and the age structure of the landings appears to have expanded compared to the late 1990s (Table F4, Figure F4). Mean weights (kg) at age of the landed cod (Table F5) have remained relatively constant over time for ages up to age 5, but appear to have declined at ages 6 and older.

Commercial discards (Table F6, Figure F3) were re-estimated for the 1989-2007 period on a gear-quarter basis from NEFSC Observer Program data using SBRM methods incorporating cod discard/cod kept ratios. The revised estimates compare favorably with those presented at GARMII and indicate a substantial increase in the overall discard/kept ratio in 1999 compared to previous years (Table F6). Ratios calculated for years after 1999 were lower, but still remain substantially greater than the 1991-1998 ratios. Discards estimated from the Observer Program data have ranged from 97 mt in 1998 to 3,092 in 1990. These discard estimates were then used to generate the discards at age from 1999 to present (Table F7).

Recreational catches (Table F8) were re-estimated and partitioned by Gulf of Maine and Georges Bank stocks for the 1981-2007 period using revised MRFSS data and a revised site list (Steinbak and Thunberg, pers. comm.). The estimated recreational catch of Gulf of Maine cod (retained component only) has varied considerably over the past decade ranging from 337 mt in 1997 to 4,218 mt in 1981 (Table F8). The age composition and mean weights (kg) at age of the numbers of kept (A+B1) cod (Tables F9 and F10) were derived using available length measurements from the MRFSS database assigned to the Gulf of Maine area and a combination of age/length keys derived from commercial, survey (NEFSC and MADMF) and the cod industry-based survey (2004 and 2005 only). Recreational landings at age (Table F9) exhibit the same age structure as the commercial landings, with ages 4 and 5 always dominant and age 6 often replacing age 3 as the next most prevalent age.

Estimated numbers caught at age (including commercial and recreational landings and commercial discards (Table F11), estimated weight caught at age (Table F12), and weighted estimates of mean weights (kg) at age (Table F13) were derived from the various components. Most of the revisions occurred since 1994, but some differences are noted back to 1982 because of the changes in the estimates of recreational landings at age. The total catch at age in numbers was dominated by age 3 and 4 fish through 2001, with ages 4-6 predominating during the past 6 years. In terms of total weight at age, the fishery was dominated by age 3-5 fish through 2001, shifting thereafter to ages 4-6. The total catch at age reveals an increase in mean weights at age for ages 2, 3 and 4, no apparent trend for ages 4 and 5, and a decline for ages 6 and older (Table F13). The increase in mean weights at the younger ages reflects the trends in the recreational landings**.** See Appendix for a complete set of age composition tables (NEFSC 2008).

3.0 Research Vessel Surveys

NEFSC has conducted research vessel bottom trawl surveys off the northeast coast of the United States since 1963 (autumn) and 1968 (spring). The NOAA research vessels *Albatross IV* and *Delaware II* have been used exclusively during these surveys. Gear and door changes have occurred during the survey period. Vessel and door calibration coefficients have been applied to

the data as described below Table F14. The Commonwealth of Massachusetts has also conducted research vessel bottom trawl surveys during spring and autumn primarily in state waters in the southwest portion of the Gulf of Maine since 1978. These surveys are conducted in relatively shallow water and, as such do not provide an abundance index of the stock as a whole. However they do provide an abundance index of recruiting year classes.

Results (stratified mean number and weight [kg] per tow) from bottom trawl surveys conducted by NEFSC were updated through spring 2008 (Tables F14-16, Figures F5-F7) and MADMF survey indices were recalculated over the entire time period beginning in 1978 (Tables F17 - F18).

NEFSC research vessel bottom trawl survey abundance and biomass indices for Gulf of Maine cod remained relatively low through autumn 1999 and spring 2000 (Table F14; Figure F5). The autumn 1999 indices increased slightly from 1998, while the spring 2000 indices decreased slightly from 1999. However, biomass indices began to increase substantially in 2001 and spring 2002, but the large apparent increase evident in autumn 2002 resulted from a single large haul unduly influencing the stratified mean. Spring indices in 2003, 2004 and 2005 suggest a substantial decline in biomass since 2002 to levels evident during the mid-1990s. Autumn indices through 2004 suggest that biomass remains above the mid-1990s lows. Spring indices have increased since 2005, but the autumn indices have remained relatively low through 2007.

Recruitment indices for the 1994-1997 year classes derived from the NEFSC and Mass. DMF bottom trawl surveys are among the lowest in the respective series, although indices for the 1998 and 1999 year classes appear to be above the recent average. The 2000 year class appears to be extremely weak in all surveys. More recently, there are indications in both NEFSC and Mass. DMF surveys that the 2003 year class may be relatively strong compared those produced over the past decade. The 2005 year class also appears to be strong especially at ages 2 and 3 in the spring 2007 and 2008 NEFSC surveys, respectively (Figure F6). High indices at ages 0 and 1 in the Mass. DMF surveys also suggest improved recruitment (2003, 2005 and possibly 2006 year classes) (Table F18).

Maturity data collected on NEFSC spring surveys were also analyzed in order to construct a series of maturity at age moving windows over the assessment time period. This was accomplished to provide a smoother transition in the maturity schedule used to determine spawning stock biomass. A series of annual 3-year moving windows was employed in order to achieve a smooth transition across years.

4.0 Assessment

Input Data and Model Formulation

The present assessment represents more than a three-year update to the previous assessment (Mayo and Col 2006). As noted above, each component of the total catch at age has changed since the 2005 GARMII assessment. This required re-estimation of the landings at age from 1994 to present, the recreational catch at age from 1981 to present and the observer based discards since 1989.

The VPA formulation used in the previous assessment was evaluated and, based on a shift in the age of full recruitment from age 4 to age 5, the age 7 plus group formulation was discontinued in favor of an extended age range out to age 11 plus. Catch at age data were revised over the 1982 to present assessment time period to account for the data changes

described above. NEFSC survey abundance indices (stratified mean number per tow at age) were updated through spring 2008. Massachusetts DMF spring and autumn survey indices were recalculated over the entire period since 1978 due to slight changes in the strata boundaries that affected the stratified mean calculations. Differences were minor in most cases. The formulation in the present assessment is: catch at age from 1982-2007 out to age 11+, estimation of age 2-10 stock sizes in terminal year+1. Calibration included NEFSC spring and autumn age 2-8 indices, Massachusetts DMF spring ages 2-4 and autumn age 2 indices. As in recent VPAs, commercial CPUE indices were included only through 1993. This formulation of the present assessment addresses the recommendations of the GARMIII Model Selection Panel and the GARMIII Biological Reference Point Panel, and this base formulation was accepted by the GARMIII Assessment Review Panel as the final assessment.

Precision of the 2007 spawning stock biomass and fully recruited fishing mortality was estimated from 1,000 bootstrap replicates of the VPA. Retrospective analyses of terminal year estimates of stock sizes, fully recruited fishing mortality and SSB were also carried out.

Assessment Results

Fully recruited fishing mortality (ages 5-7) in 2007 is estimated at 0.46 (Table F20b; Figure F8), a substantial decrease since 2004 and 2005. Annual estimates of fully recruited fishing mortality are also given in Table F21. The 2004 year class is estimated to be equivalent to the 1998 year class (approximately 7-8 million fish), the 2003 year class (11 million fish) is about twice the long term average and the 2005 year class (24 million fish) is equivalent to the strong 1987 year class (Table F20a). The 2000 year class (1.2 million fish) is by far the lowest in the entire VPA series and the 2002 year class (1.7 million fish) is the second lowest.

Spawning stock biomass increased to 18,000 mt in 2001, but declined to 11,000 mt in 2005 as a result of the above average 1998 year class being removed from the population followed by subsequent poor recruiting year classes of 2000 and 2002 (Table F20c; Figure F9). Spawning stock biomass increased substantially to 19,000 mt in 2006 on the strength of the 2003 year class becoming partially mature, and further to 34,000 mt in 2007 on the combined strength of the 2003 year class (95% mature) and the partially mature 2005 year class (34% mature). The complete VPA output can be found in Appendix (NEFSC 2008).

VPA Diagnostics and Uncertainty

Extension of the age range out to 11+ resulted in a partial recruitment pattern that peaked at ages 5-7, followed by a reduction at ages 8 and 9 to about 70-80 percent of the maximum. Estimates of F at ages 8 and 9 were highly variable, however, especially during the 1990s. The calculation of F on the oldest true age (age 10) was evaluated for a series of ages ranging from ages 5-6 to ages 5-9. There were no discernable differences in the age 5-7 average F estimates, only minor differences in the estimates of F on age 10, and no appreciable differences in the estimates of SSB over time. An additional trial using ages 8 and 9 to estimate F on age 10 produced similar trends in SSB but highly variable estimates of F on age 10. Taking account of these results we elected to include as many ages as possible (ages 5-9) to calculate F on age 10. Further details and graphics of this analysis can be found in Appendix (NEFSC 2008).

The 2008 NLLS stock size estimates were relatively precise for ages less than 8, with CVs for these ages ranging from 26% (ages 4 and 5) to 44% (ages 2 and 7) (Table F22). However the CVs on ages 8-10 were considerably higher, ranging from 55% (age8) to 72% (age 10). The bootstrapped estimates of bias were relatively low for intermediate ages ranging from

3% (ages 4 and 5) to 6-7% (ages 3, 6 and 7). Bias was higher, ranging from 13% on age 8 and about 21% on ages 2, 9 and 10 (Table F23). Coefficients of Variation on the NEFSC survey Qs varied between 10 and 17% for ages 2-6, increasing to between 20 and 28% on ages 7 and 8. The CVs on the Mass. DMF spring survey Qs ranged from 9-15% while the Q on the Mass. DMF autumn survey was estimated to be about 30%.

An analysis was also carried out to determine the magnitude and trends in survey Qs by raising the Qs estimated by the VPA using survey swept area calculations. For Gulf of Maine cod, these raised values of Q ranged from about 10% at age 2 to about 50-60% at age 5 and leveling off at about 70-90% at ages 7-8. Further details and graphics of this analysis can be found in Appendix (NEFSC 2008). Residual patterns from the NEFSC and Mass. DMF survey data used to calibrate the VPA appear for the most part random, although there are some instances of 3-4 year blocks of positive and negative residuals (Figure F10).

A weak retrospective pattern is evident in the estimates of terminal F whereby fully recruited F alternates between over- and under-estimation in the terminal year (Figure F11). The same pattern is evident for SSB (Figure F12). A retrospective pattern is also evident for age 1 recruitment estimates whereby recruitment was well overestimated for the 2001 and 2003 year classes (Figure F13). The estimate of the size of the 2005 year class appears to not suffer the same fate, as it is supported by an additional year of data in the present assessment (Figure F13). The degree of retrospective change in the estimates of average F (ages 5-7), SSB and age 1 recruitment was computed by calculating a Mohn's average Rho based on the relative difference between terminal year estimates over the last 7 years of the assessment (2000 – 2006). The relative differences are as follows:

	Mohn's Average Rho		
Year	Avg F (Ages 5-7)	SSB	Recruits (Age 1)
2000	0.8828	-0.0170	0.9246
2001	0.2544	0.2032	-0.6116
2002	-0.2325	0.5366	1.8357
2003	-0.0181	0.1856	1.8471
2004	0.0925	0.1677	1.0833
2005	0.2243	0.0653	-0.2613
2006	-0.1045	0.2228	0.1340
Avg	0.1570	0.1949	0.7074

The relative differences are mostly positive during these years, although some negative values appear in the F and recruitment retrospective analyses. These results suggest about a 15-20% positive relative difference for average F and about a 70% positive relative difference for age 1 recruitment. The latter value is driven by 3 very high values in 2002, 2003 and 2004. Owing to relatively small magnitude of the retrospective pattern, no adjustment was made in the final assessment formulation.

The bootstrap analysis (Table F23) provides an 80% CI about the 2007 fully recruited F estimate (0.46) of 0.36 – 0.67 (Figure F 14) and an 80% CI about the 2007 SSB estimate (33,877 mt) of 29,133 mt – 41,747 mt (Figure F15).

5.0 Biological Reference Points

The existing biological reference points first developed by the Working Group on Re-Evaluation of Biological Reference Points for New England Groundfish (NEFSC 2002) are:

B_{MSY} 82,830 mt
F_{MSY} 0.225
MSY 16,600 mt

Two approaches for estimating biological reference points have been evaluated for this stock. The existing reference points are based on a parametric approach whereby spawning biomass and age 1 recruitment results obtained from the VPA were included in a model (SRFIT) that also included life history and fishery parameters using the Sissenwine-Shepherd approach (See Brodziak and Legault 2005). This approach was employed by the Working Group on Re-Evaluation of Biological Reference Points for New England Groundfish (NEFSC 2002). Because the updated relationship between stock and recruitment was weak, the GARMIII Biological Reference point Panel recommended against a parametric model in favor of a non-parametric approach . This helps ensure consistency between reference point estimation and projection methodology.

Non-Parametric Approach

In the non-parametric empirical approach, a yield and SSB per recruit analysis was conducted using catch and stock mean weights at age and maturity at age averaged over the 2003-2007 time period. Partial recruitment at age was derived from the average of the 2003-2007 time period Fs from the VPA results as:

Age 1: 0.0000, Age 2: 0.0021, Age 3: 0.1618, Age 4: 0.6821, Age 5: 0.9004 Age 6: 1.0000, Age 7: 0.8260, Age 8: 0.7326, Age 9: 0.7705, Ages 10 and 11: 0.7530.

Yield and SSB per recruit input and results are given in Table F24 and Figure F16. A proxy for F_{MSY} taken from this analysis is F40% MSP = 0.237. A stochastic projection program (AGEPRO) was used to project 100 year scenarios to obtain equilibrium SSB_{MSY} and MSY estimates based on the cumulative distribution function of age 1 recruits from the 1981-2005 year classes obtained from the current VPA. The initial conditions of 2008 stock size were based on the 1,000 bootstrap iterations performed by the VPA. Catch and stock mean weights at age, maturity at age and partial recruitment averaged over the 2003-2007 time period were the same as used in the yield and SSB per recruit analyses above. A constant F strategy was employed setting F at an F_{MSY} proxy F40% MSP (0.237) obtained from the SSB per recruit analysis. Results from this approach provide the following estimates:

SSB_{MSY} 58,248 mt
MSY 10,014 mt

6.0 Projections

The stochastic AGEPRO projection software was also used to conduct short-term projections of 2009 catches under 3 scenarios of F in 2009 ($F_{STATUS\ QUO}$, F_{MSY} and $F_{REBUILD}$).

The same initial conditions of stock size, mean weights, maturity and partial recruitment were used as in the long-term 100 year simulation used to derive SSB_{MSY} and MSY above. In each case F in 2008 was derived by assuming the 2008 catch will equal that of 2007.

$F_{REBUILD}$

$F_{REBUILD}$ was first estimated based on the current rebuilding plan for Gulf of Maine cod which required that the SSB be rebuilt to SSB_{MSY} by 2014, which is a 6-year time horizon beginning in 2009. Results from this projection suggest that the stock can almost reach the SSB_{MSY} target in 2009-2010 and then level off, remaining near the target through 2014, at $F_{REBUILD}$ (0.281) [slightly greater than the F40% proxy F_{MSY} (0.237)]. However, if F remains at 0.35 or greater, not only will SSB fail to rebuild by 2014, it will begin to decline after 2009. It should be recognized that these projections depend in large part on the estimated strength of the 2005 year class.

2009 Catch Estimates

Annual Catch estimates were determined for 2009 under the 3 scenarios of 2009 F as described above. Results are as follows: $F_{STATUS\ QUO}$: 19,191 mt, $F_{REBUILD}$: 12,591 mt, F_{MSY}: 10,798 mt. Further details are given in Table F25.

7.0 Summary

Stock Status

Fishing mortality in 2007 is estimated to be 0.46 (80% CI: 0.36 – 0.67) and current spawning stock biomass in 2007 is estimated to be 33,877 mt (80% CI: 29,133 mt – 41,747 mt). The set of biological reference points, based on the non-parametric SSB/R and AGEPRO projection approach, are as follows: F40% proxy F_{MSY} = 0.237, SSB_{MSY} = 58,248 mt and MSY = 10,014 mt.

Spawning stock biomass in 2007 is above ½ SSB_{MSY}, but F in 2007 is about twice the F_{MSY} level. Thus the stock is not overfished, but overfishing is occurring (Figure F17).

Sources of Uncertainty

High CVs (> 50%) on 2008 stock size estimates for ages > 7.
Bias on age 8-10 stock size estimates in 2008 ranges from 13% to 21%.
Bias on age 7-9 F estimates in 2007 ranges from 26% to 144%.
Estimates of F on ages >7 are highly variable during the 1990s.

Differences from Previous Assessment

Commercial and recreational landings at age revised from 1994 and 1982 to 2004, respectively.
Catch at age range extended from ages 7+ to ages 11+.
Includes ages 7-8 from NEFSC spring and autumn surveys in calibration.
Now estimating stock sizes on ages 2-10 vs. ages 2-6 in previous assessments.
Moderate dome in partial recruitment at ages 8 to 10.
Average F represented by ages 5-7 vs. ages 4-5.

8.0 Panel Discussion/Comments

Conclusions

The VPA assessment, with the modifications recommended by previous panels, was accepted by the Panel as Final, as the best available estimate of stock status, and as a sufficient basis for management advice

. The Panel particularly noted the extension of the catch at age to 11+ as recommended by both the GARM III 'models' and 'BRP' reviews to explore the possibility of the presence of a dome-shaped fishery partial recruitment. The previous panels had recommended that a flat-top PR be assumed unless there was compelling evidence otherwise. The current assessment provides evidence for a domed PR which peaks at ages 5 – 7 followed by a reduction at ages 8 and 9 to about 70 – 80% of the maximum. This pattern is not as steep as determined by the alternative ASPM assessment.

The Panel concluded that the retrospective pattern in this assessment was small and did not require an adjustment.

An alternative ASPM assessment resulted in higher estimated spawning biomass and lower fishing mortality rates although the overall temporal trend in these parameters was similar to that in the VPA. Improved statistical model fits resulted from steeply dome-shaped PR (compared to the VPA), domed survey catchability and increasing natural mortality (M) after age four. The Panel was concerned that increasing M after age four and the domed survey catchability did not have a clear biological basis. Consequently, the Panel could not accept this formulation as the basis for management advice. The examination of both models (VPA and ASPM) during the GARM III dramatically improved final assessment formulation. Comparing the two formulations, the Panel noted that the VPA may be underestimating current stock status.

The Panel noted that the BRPs were estimated as per the GARM III 'BRP' review and the projections are appropriate for estimating $F_{REBUILD}$.

Regarding uncertainties, it was noted that survival of released recreational cod is assumed to be 100%. This needs confirmation in future assessments.

Research Recommendations

As with Georges Bank cod, the Panel recommended that historical data be used to hindcast recruitments as far back in time as possible for use in the estimation of reference points and projections.

9.0 References

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10. Tables and Figures

Table F1. Commercial landings (metric tons, live) of Atlantic cod from the Gulf of Maine (NAFO Division 5Y), 1960 - 2007.[1]

	Gulf of Maine				
Year	USA	Canada	USSR	Other	Total
1960	3448	129	-	-	3577
1961	3216	18	-	-	3234
1962	2989	83	-	-	3072
1963	2595	3	133	-	2731
1964	3226	25	-	-	3251
1965	3780	148	-	-	3928
1966	4008	384	-	-	4392
1967	5676	297	-	-	5973
1968	6360	61	-	-	6421
1969	8157	59	-	268	8484
1970	7812	26	-	423	8261
1971	7380	119	-	163	7662
1972	6776	53	11	77	6917
1973	6069	68	-	9	6146
1974	7639	120	-	5	7764
1975	8903	86	-	26	9015
1976	10172	16	-	-	10188
1977	12426	-	-	-	12426
1978	12426	-	-	-	12426
1979	11680	-	-	-	11680
1980	13528	-	-	-	13528
1981	12534	-	-	-	12534
1982	13582	-	-	-	13582
1983	13981	-	-	-	13981
1984	10806	-	-	-	10806
1985	10693	-	-	-	10693
1986	9664	-	-	-	9664
1987	7527	-	-	-	7527
1988	7958	-	-	-	7958
1989	10397	-	-	-	10397
1990	15154	-	-	-	15154
1991	17781	-	-	-	17781
1992	10891	-	-	-	10891
1993	8287	-	-	-	8287
1994	7994	-	-	-	7994
1995	6536	-	-	-	6536
1996	6976	-	-	-	6976
1997	5420	-	-	-	5420
1998	4045	-	-	-	4045
1999	1380	-	-	-	1380
2000	3721	-	-	-	3721
2001	4280	-	-	-	4280
2002	3604	-	-	-	3604
2003	3851	-	-	-	3851
2004	3776	-	-	-	3776
2005	3525	-	-	-	3525
2006	3028	-	-	-	3028
2007	3989	-	-	-	3989

[1] USA 1960-1993 landings from NMFS, NEFSC Detailed Weighout Files and Canvass data.
[2] USA 1994-2007 landings from NMFS, NEFSC Detailed Weighout Files estimated by allocating landings on a trip basis from Vessel Trip Reports.

Table F2. USA commercial landings (metric tons, live) of Atlantic cod from the Gulf of Maine (Area 5Y), by gear type, 1965 - 2007.

	Landings (metric tons, live)						Percentage of Annual Landings					
Year	Otter Trawl	Sink Gill Net	Line Trawl	Handline	Other Gear	Total	Otter Trawl	Sink Gill Net	Line Trawl	Handline	Other Gear	Total
1965	2480	501	462	168	1	3612	68.7	13.9	12.8	4.6	-	100.0
1966	2549	830	308	150	4	3841	66.4	21.6	8.0	3.9	0.1	100.0
1967	4312	734	206	274	<1	5526	78.0	13.3	3.7	5.0	-	100.0
1968	4143	1377	213	339	4	6076	68.2	22.7	3.5	5.6	-	100.0
1969	6553	851	258	162	4	7828	83.7	10.9	3.3	2.1	-	100.0
1970	5967	951	407	178	9	7512	79.4	12.7	5.4	2.4	0.1	100.0
1971	5117	1043	927	98	8	7193	71.1	14.5	12.9	1.4	0.1	100.0
1972	4004	1492	1234	54	2	6786	59.0	22.0	18.2	0.8	-	100.0
1973	3542	1182	1305	23	9	6061	58.4	19.5	21.5	0.4	0.2	100.0
1974	5056	1412	904	36	17	7425	68.1	19.0	12.2	0.5	0.2	100.0
1975	6255	1480	920	12	8	8675	72.1	17.1	10.6	0.1	0.1	100.0
1976	6701	2511	621	4	41	9878	67.8	25.4	6.3	0.1	0.4	100.0
1977	8415	2872	534	6	166	11993	70.2	23.9	4.5	-	1.4	100.0
1978	7958	3438	393	10	91	11890	66.9	28.9	3.3	0.1	0.8	100.0
1979	7567	2900	334	19	167	10987	68.9	26.4	3.0	0.2	1.5	100.0
1980	8420	3733	251	48	61	12513	67.3	29.8	2.0	0.4	0.5	100.0
1981	7937	4102	276	23	45	12383	64.1	33.1	2.2	0.2	0.4	100.0
1982	9758	3453	188	46	34	13479	72.4	25.6	1.4	0.3	0.3	100.0
1983	9975	3744	77	4	67	13867	71.9	27.0	0.6	-	0.5	100.0
1984	6646	3985	22	3	69	10725	62.0	37.2	0.2	-	0.6	100.0
1985	7119	3090	55	6	326	10596	67.2	29.1	0.5	0.1	3.1	100.0
1986	6664	2692	56	12	180	9604	69.4	28.0	0.6	0.1	1.9	100.0
1987	4356	2994	70	13	68	7501	58.1	39.9	0.9	0.2	0.9	100.0
1988	4513	3308	68	27	22	7938	56.9	41.7	0.8	0.3	0.3	100.0
1989	6152	4000	72	36	119	10379	59.3	38.5	0.7	0.4	1.1	100.0
1990	10420	4343	126	20	186	15095	69.0	28.8	0.8	0.1	1.2	100.0
1991	13049	4158	212	59	266	17744	73.5	23.4	1.2	0.3	1.5	100.0
1992	7344	3081	359	94	14	10891	67.4	28.3	3.3	0.9	0.1	100.0
1993	4876	3130	236	16	29	8287	58.8	37.8	2.8	0.2	0.3	100.0
1994[1]	4368	3287	302	19	18	7994	54.6	41.1	3.8	0.2	0.2	100.0
1995	3309	2876	255	57	39	6536	50.6	44.0	3.9	0.9	0.6	100.0
1996	3901	2642	308	83	42	6976	55.9	37.9	4.4	1.2	0.6	100.0
1997	2891	2109	326	68	26	5420	53.3	38.9	6.0	1.3	0.5	100.0
1998	2277	1400	228	115	25	4045	56.3	34.6	5.6	2.8	0.6	100.0
1999	762	442	69	101	6	1380	55.2	32.0	5.0	7.3	0.4	100.0
2000	2025	1387	74	214	21	3721	54.4	37.3	2.0	5.8	0.6	100.0
2001	2375	1546	89	260	10	4280	55.5	36.1	2.1	6.1	0.2	100.0
2002	1903	1402	119	174	6	3604	52.8	38.9	3.3	4.8	0.2	100.0
2003	1912	1631	139	148	21	3851	49.6	42.4	3.6	3.8	0.5	100.0
2004	1612	1878	114	75	97	3776	42.7	49.7	3.0	2.0	2.6	100.0
2005	1448	1658	119	79	221	3525	41.1	47.0	3.4	2.2	6.3	100.0
2006	1329	1437	139	36	87	3028	43.9	47.5	4.6	1.2	2.9	100.0
2007	1495	2123	155	70	146	3989	37.5	53.2	3.9	1.8	3.7	100.0

1 Landings estimates revised since 1994

Table F3. USA sampling of commercial Atlantic cod landings from the Gulf of Maine cod stock (NAFO Division 5Y), 1982 - 2007.

Year	Number of Samples				Number of Samples, by Market Category & Quarter														No. Tons per Sample
	Length Samples		Age Samples		Scrod					Market					Large				
	No.	No. Fish Measured	No.	No. Fish Aged	Q1	Q2	Q3	Q4	3	Q1	Q2	Q3	Q4	3	Q1	Q2	Q3	Q4	3	
1982	48	3848	48	866	6	7	6	6	25	4	3	7	4	18	0	2	1	2	5	266
1983	71	5241	67	1348	14	10	10	4	38	4	10	6	2	22	1	3	5	2	11	197
1984	55	3925	55	1224	7	5	6	7	25	4	3	5	6	18	1	6	3	2	12	193
1985	69	5426	66	1546	5	6	7	5	23	8	6	7	4	25	7	5	3	6	21	155
1986	53	3970	51	1160	5	5	6	3	19	5	6	8	2	21	1	5	4	3	13	182
1987	43	3184	42	939	4	4	3	4	15	5	5	3	5	18	4	2	3	1	10	175
1988	34	2669	33	741	4	3	4	4	15	1	5	3	5	14	1	2	2	0	5	234
1989	32	2668	32	714	3	3	3	3	12	4	1	5	4	14	2	2	1	1	6	325
1990	39	2982	38	789	3	7	3	5	18	4	7	4	3	18	0	2	1	0	3	387
1991	56	4519	56	1152	2	10	4	3	19	5	11	11	3	30	0	3	3	1	7	318
1992	51	4086	51	1002	2	8	6	3	19	6	7	7	3	23	3	1	1	4	9	214
1993	23	1753	23	447	3	3	3	1	10	1	2	4	1	8	1	1	2	1	5	360
1994	29	2575	33	649	0	2	2	3	7	1	5	3	6	15	0	2	3	2	7	275
1995	31	2557	32	682	4	3	2	4	13	2	8	2	2	14	0	3	0	1	4	208
1996	71	6486	66	1380	5	4	7	9	25	6	9	11	11	37	1	2	3	3	9	97
1997	89	7559	80	1643	7	13	3	10	33	12	11	10	9	42	2	8	2	2	14	61
1998	50	4536	46	992	4	7	0	3	14	9	9	9	5	32	1	0	2	1	4	80
1999	10	733	10	195	5	0	0	0	5	2	1	1	0	4	1	0	0	0	1	137
2000	74	5737	74	1680	15	6	4	7	32	13	14	5	9	41	0	0	0	1	1	49
2001	109	6895	107	2436	4	4	4	7	19	4	9	8	15	36	2	15	18	19	54	38
2002	129	5263	124	2405	4	2	0	1	7	15	3	6	5	29	50	8	16	19	93	29
2003	248	11479	231	5630	5	1	17	8	31	14	8	25	19	66	50	34	34	33	151	15
2004	221	11031	162	3467	17	11	6	22	56	18	21	15	15	69	37	20	11	25	95	15
2005	364	10073	256	3486	23	29	33	16	101	13	15	20	19	67	20	41	68	63	192	9
2006	322	10735	255	4309	15	8	8	3	34	17	20	18	12	67	48	48	62	60	218	9
2007	376	10702	285	3907	10	6	11	8	35	7	14	18	17	56	43	73	104	60	280	11

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Table F4. Total commercial landings in numbers (000s) at age for Gulf of Maine cod.

	Total Commercial Landings in Numbers (000's) at Age								Revised LAA 1994+		Jul-08	
Year	1	2	3	4	5	6	7	8	9	10	11+	Total
1982	30	1380	1633	1143	633	69	91	61	41	4	33	5118
1983	0	866	2357	1058	638	422	47	61	23	9	15	5496
1984	4	446	1240	1500	437	194	74	19	15	11	17	3957
1985	0	407	1445	991	630	128	78	32	4	11	11	3737
1986	0	84	2164	813	250	177	39	24	20	4	8	3583
1987	2	216	595	1109	277	66	51	9	8	8	3	2344
1988	0	160	1443	953	406	43	9	17	1	2	1	3035
1989	0	337	1583	1454	449	81	35	6	3	5	7	3960
1990	0	205	3425	2064	430	157	27	30	10	15	17	6380
1991	0	344	934	4161	851	143	41	30	6	1	1	6512
1992	0	313	530	484	2018	202	62	7	12	3	0	3631
1993	0	76	1487	641	129	457	28	6	2	0	0	2825
1994	0	37	1094	1114	305	69	84	29	7	1	1	2742
1995	18	221	885	1035	222	27	14	18	1	2	0	2443
1996	0	69	513	1744	365	37	4	0	1	0	0	2734
1997	0	79	445	427	801	68	5	3	0	1	0	1829
1998	0	94	396	530	146	176	25	4	0	1	0	1373
1999	0	3	184	176	81	16	22	2	0	2	0	487
2000	0	102	256	501	122	69	11	5	0	0	0	1067
2001	0	46	484	323	212	68	39	6	9	1	0	1187
2002	0	2	115	439	172	106	43	12	4	4	0	898
2003	0	7	48	205	393	124	54	21	9	5	3	870
2004	0	1	156	133	226	178	54	28	15	8	2	799
2005	0	1	40	437	65	181	85	22	13	6	5	856
2006	0	1	120	192	307	22	66	31	11	6	5	761
2007	0	5	101	643	101	187	6	17	8	4	5	1077

Table F5. Total commercial landings mean weights (kg) at age for Gulf of Maine cod.

Total Commercial Landings Mean Weight (kg) at Age Year	1	2	3	4	5	6	7	8	9	10	11+	Average
1982	0.801	1.156	1.664	2.764	4.770	6.739	8.944	9.931	12.922	10.618	18.456	2.654
1983	0.000	1.164	1.660	2.475	3.778	5.962	5.808	10.522	10.089	10.898	17.813	2.544
1984	0.589	1.159	1.670	2.721	3.677	5.898	8.119	9.595	12.889	13.951	15.028	2.731
1985	0.000	1.260	1.746	2.840	4.466	5.525	7.901	11.218	11.420	13.386	14.523	2.861
1986	0.000	1.304	1.837	2.923	4.619	6.067	7.669	10.030	12.463	12.907	16.554	2.698
1987	1.028	1.313	1.684	3.283	4.831	6.824	8.878	10.023	13.752	14.738	14.596	3.212
1988	0.000	1.268	1.881	2.426	5.166	6.767	9.932	11.126	14.960	15.763	20.356	2.622
1989	0.000	1.247	1.776	2.993	3.864	4.872	9.267	11.938	14.806	18.196	21.521	2.626
1990	0.000	1.071	1.692	2.271	4.265	7.645	10.734	11.758	15.015	14.784	20.295	2.366
1991	0.000	1.130	1.568	2.512	4.136	7.309	9.642	12.322	15.547	24.328	21.885	2.731
1992	0.000	1.533	1.922	2.714	3.061	5.000	9.566	12.462	13.449	16.631		2.999
1993	0.000	1.293	1.889	2.513	4.356	6.174	9.999	13.869	17.544			2.933
1994	0.000	1.401	1.882	3.034	3.452	6.324	7.159	10.464	10.362	18.542	20.637	2.915
1995	0.274	1.388	1.854	2.774	5.138	5.837	10.760	11.510	18.893	20.064	20.347	2.675
1996	0.000	1.543	2.220	2.350	3.543	7.347	10.406	14.126	14.929	0.000	0.000	2.551
1997	0.000	1.777	2.242	3.090	3.171	4.880	8.409	11.560	14.726	15.814	21.874	2.964
1998	0.000	1.323	2.055	2.879	4.204	4.321	5.254	11.391	18.893	14.953	20.347	2.947
1999	0.000	1.483	1.809	2.511	3.691	5.712	7.311	10.081	0.000	13.402	0.000	2.837
2000	0.000	1.673	2.513	3.646	4.637	5.813	6.394	8.580	0.000	0.000	0.000	3.488
2001	0.000	1.843	2.491	3.365	4.880	6.359	7.451	8.733	8.789	12.414	24.418	3.605
2002	0.000	1.348	2.569	3.320	4.152	6.066	6.792	8.618	9.589	10.482	14.333	4.013
2003	0.000	1.810	2.415	3.179	4.183	5.343	7.247	8.480	10.295	11.771	12.638	4.426
2004	0.000	1.483	2.550	3.588	4.138	5.742	7.167	9.329	11.688	12.822	12.914	4.723
2005	0.000	1.876	2.185	3.018	4.467	4.622	6.226	7.736	10.355	13.331	14.098	4.120
2006	0.000	2.394	2.430	3.271	3.790	4.789	5.453	7.284	9.245	11.974	15.718	3.980
2007	0.000	1.945	2.493	3.241	3.961	4.827	6.243	6.839	9.625	11.369	14.255	3.703

Table F6. Discard estimates (weight, mt) and measures of precision (coefficient of variation) with a comparison of estimates derived for GARMII in 2005.

	Number of Trips	Otter Trawl	Shrimp Trawl	Gillnet	Total	d/k ratio	CV	2005 est.
1989	190	746.6	242.1	169.0	1157.8	0.111	32.3%	1545.0
1990	185	2505.6	349.0	238.0	3092.5	0.204	37.0%	3598.0
1991	935	774.6	94.9	143.4	1012.9	0.057	28.1%	1049.0
1992	1038	546.9	15.0	98.7	660.7	0.061	17.9%	603.0
1993	664	335.0	0.0	86.0	421.0	0.051	26.2%	329.0
1994	171	74.1	63.4	80.4	217.8	0.027	18.8%	239.0
1995	202	121.0	0.0	186.5	307.4	0.047	22.5%	426.0
1996	140	58.9	0.0	123.7	182.6	0.026	20.7%	199.0
1997	59	12.6	0.0	91.0	103.7	0.019	56.5%	179.0
1998	85	16.6		80.3	96.9	0.024	37.8%	154.0
1999	108	1170.3		1453.8	2624.2	1.902	25.1%	2630.0
2000	202	718.1		280.3	998.5	0.268	17.7%	1170.0
2001	192	667.6	0.0	708.6	1376.2	0.322	18.8%	1621.0
2002	311	943.1		594.9	1538.0	0.427	16.2%	1950.0
2003	608	930.3	0.0	293.8	1224.1	0.318	19.4%	1486.0
2004	1175	301.5	0.0	168.0	469.5	0.124	21.1%	575.0
2005	1262	157.0	0.0	112.1	269.0	0.076	9.5%	
2006	384	324.9	0.0	129.2	454.1	0.150	34.9%	
2007	381	327.3	0.0	188.4	515.7	0.129	12.8%	

Table F7. Total commercial discards in numbers (000s) at age for Gulf of Maine cod.

Total Commercial Discards in Numbers (000's) at Age — Revised Discards 1999+

Year	1	2	3	4	5	6	7	8	9	10	11+	Total
1999	0	6	350	335	155	31	43	4	0	3	0	925
2000	0	27	69	134	33	19	3	1	0	0	0	286
2001	0	15	155	104	68	22	12	2	3	0	0	382
2002	0	1	49	187	74	45	18	5	2	2	0	383
2003	0	2	15	65	125	39	17	7	3	2	1	277
2004	0	0	19	17	28	22	7	3	2	1	0	99
2005	0	0	3	33	5	14	6	2	1	0	0	65
2006	0	0	18	29	46	3	10	5	2	1	1	114
2007	0	1	13	83	13	24	1	2	1	1	1	139

Total Commercial Discards in Weight (Tons) at Age

Year	1	2	3	4	5	6	7	8	9	10	11+	Total
1999	0	8.229152	632.3211	840.8807	570.5593	175.6108	310.7809	44.92337	0	38.4042	0	2626.099
2000	0	45.69613	172.5082	490.2897	151.7367	107.5641	18.96529	12.59727	0	0	0	992.4665
2001	0	27.26515	387.2823	349.5529	332.4472	138.964	92.24515	16.02044	26.24963	3.653747	2.836484	1375.022
2002	0	0.894573	126.3784	621.6192	305.4864	275.5153	124.4507	44.46742	16.24992	18.99534	2.67322	1541.092
2003	0	4.041596	36.94529	207.3986	522.9986	210.9961	123.682	55.84634	30.87597	17.99572	13.4672	1223.025
2004	0	0.094445	49.38522	59.43709	116.1658	127.4585	48.25518	32.15067	21.24175	12.4877	3.384399	468.9256
2005	0	0.171457	6.598477	100.6273	22.12268	63.95506	40.40933	13.25934	10.42035	5.597503	5.891383	268.328
2006	0	0.362839	43.68574	94.059	174.4595	15.98146	53.74157	33.53138	15.2962	11.3954	11.77911	451.9766
2007	0	1.345042	32.46468	268.9374	51.85083	116.4489	5.086826	14.94985	10.0594	6.010341	8.426732	510.4338

Table F8. Recreational catch estimates for Gulf of Maine cod using revised site lists for partitioning total cod estimates into Gulf of Maine and GeorgesBank stocks.

	Gulf of Maine (me,ma,nh)			
	tot n	tot wt mt	n retain	wt retain mt
	a,b1,b2	ab1b2	a,b1	a,b1
	gm_totn lnd	tot wt mt	gm_lnded	ab1 mt
1981	2841.9	4523.3	2650.0	4218.0
1982	1943.9	3412.6	1849.2	3246.4
1983	1488.2	2110.3	1257.8	1783.7
1984	1107.5	1728.3	910.8	1421.3
1985	1833.5	2348.9	1633.9	2093.2
1986	1111.6	2059.8	990.1	1834.6
1987	2597.8	4308.1	2031.1	3368.3
1988	1448.7	2626.7	1272.3	2306.9
1989	1775.1	3763.5	1203.0	2550.5
1990	1727.1	3659.6	1254.5	2658.1
1991	1788.2	3711.7	1377.8	2859.9
1992	560.7	1097.4	321.6	629.5
1993	1517.8	2762.8	766.6	1395.3
1994	1272.2	2333.4	542.6	995.2
1995	1192.3	2116.8	509.6	904.8
1996	801.4	1816.3	350.6	794.6
1997	440.0	1060.0	139.8	336.7
1998	577.3	1585.3	194.3	533.5
1999	724.7	2338.6	248.9	803.2
2000	1443.8	4306.8	522.8	1559.5
2001	2330.3	6079.1	1018.3	2656.5
2002	1640.6	5050.7	551.4	1697.6
2003	1721.0	7095.2	613.0	2527.1
2004	1427.6	4897.2	531.9	1824.5
2005	1859.0	6237.5	584.2	1960.3
2006	932.4	3561.1	249.7	953.6
2007	1337.1	4470.4	307.0	1026.5

Table F9. Total recreational landings in numbers (000s) at age for Gulf of Maine cod.

	Total Recreational Landings in Numbers (000's) at Age						Revised Recr Catch 1982+					
Year	1	2	3	4	5	6	7	8	9	10	11+	Total
1982	41	601	787	279	114	8	7	5	0	0	0	1842
1983	11	458	561	131	49	31	3	4	2	3	4	1258
1984	21	356	342	137	33	14	4	0	0	1	1	908
1985	44	658	743	146	37	5	0	0	0	0	0	1634
1986	13	102	593	117	27	23	7	6	16	4	51	958
1987	94	674	726	397	69	25	33	5	6	2	0	2031
1988	2	389	685	164	23	6	2	1	0	0	0	1273
1989	4	183	698	262	39	12	6	0	0	0	0	1203
1990	0	49	701	392	93	20	0	0	0	0	0	1254
1991	0	94	407	750	80	16	6	0	2	0	0	1355
1992	0	25	57	48	170	17	3	0	0	0	0	322
1993	0	52	545	142	10	17	1	0	0	0	0	767
1994	1	17	394	103	26	2	1	0	0	0	0	543
1995	0	56	285	157	10	2	0	0	0	0	0	510
1996	0	21	117	193	19	0	0	0	0	0	0	351
1997	0	6	51	28	52	3	0	0	0	0	0	140
1998	0	14	87	64	13	16	1	0	0	0	0	194
1999	1	14	114	57	37	11	14	1	0	0	0	249
2000	0	72	209	192	36	11	2	0	0	0	0	523
2001	0	86	544	259	98	19	9	1	1	0	0	1018
2002	0	1	95	258	100	52	20	18	4	3	0	551
2003	0	7	55	172	248	68	33	13	9	4	3	611
2004	0	0	183	100	156	65	14	6	3	3	1	531
2005	0	6	92	344	25	70	29	8	5	2	2	584
2006	0	0	39	61	96	7	22	13	5	3	3	250
2007	0	2	41	182	26	43	1	4	3	2	2	307

Table F10. Total recreational landings mean weights (kg) at age for Gulf of Maine cod.

	Total Recreational Landings Mean Weight (kg) at Age											
Year	1	2	3	4	5	6	7	8	9	10	11+	Average
1982	0.531	1.009	1.526	2.423	4.431	5.686	6.100	7.050	10.522	12.655	16.456	1.700
1983	0.446	0.867	1.399	2.156	3.412	6.831	5.913	8.331	10.808	17.726	18.784	1.635
1984	0.459	0.849	1.408	2.460	3.428	4.476	6.755	6.618	5.621	16.868	17.991	1.510
1985	0.466	0.830	1.320	2.326	3.021	3.370	3.798	4.458	10.522	12.655	16.456	1.236
1986	0.399	0.968	1.646	2.641	4.014	5.740	11.181	13.651	14.756	13.780	20.055	3.240
1987	0.189	0.837	1.435	2.705	4.704	8.009	10.456	10.559	11.344	10.943	16.456	1.826
1988	0.318	0.838	1.434	2.104	3.881	3.669	6.773	7.109	10.522	12.655	16.456	1.405
1989	0.680	1.111	1.601	2.610	3.555	6.351	7.837	9.095	10.522	12.655	16.456	1.888
1990	0.421	1.141	1.656	2.453	3.830	5.508	7.176	8.160	10.522	12.655	16.456	2.107
1991	0.421	1.378	1.485	1.990	2.609	8.450	9.387	8.160	9.387	3.468	16.456	1.950
1992	0.421	1.810	2.205	3.030	3.323	4.827	7.781	2.515	10.522	12.655	16.456	3.087
1993	0.421	1.023	1.636	1.877	2.681	4.207	9.685	8.160	10.522	12.655	16.456	1.722
1994	0.131	1.342	1.601	2.182	2.086	4.300	8.623	8.476	9.095	12.655	16.456	1.755
1995	0.482	1.523	1.620	1.924	3.120	1.798	7.176	5.833	10.522	12.655	16.456	1.734
1996	0.582	1.542	1.808	1.952	2.387	8.127	12.664	12.664	12.664	12.655	16.456	1.915
1997	0.421	1.733	1.992	2.381	2.388	2.806	6.275	6.501	10.522	12.655	16.456	2.224
1998	0.456	1.718	2.151	2.570	3.332	3.140	3.288	6.735	10.522	12.655	16.456	2.423
1999	0.334	1.253	1.958	3.048	4.820	6.032	6.706	8.851	10.522	12.655	16.456	3.070
2000	0.421	1.521	1.929	2.688	3.543	4.898	3.419	4.826	10.522	12.655	16.456	2.334
2001	0.421	1.716	2.266	2.912	4.308	6.000	6.211	6.261	6.966	12.655	16.456	2.695
2002	0.421	1.381	2.265	3.147	3.716	5.357	6.422	14.256	11.036	10.987	16.456	3.890
2003	0.421	2.083	2.402	2.869	3.611	5.159	8.120	9.367	11.555	13.161	13.712	4.031
2004	0.421	1.459	2.140	2.681	2.849	3.780	5.664	9.757	12.265	13.369	14.001	2.960
2005	0.421	1.523	1.990	2.574	3.857	4.187	6.270	8.120	10.685	13.692	15.088	3.154
2006	0.421	2.053	2.409	3.222	3.610	5.054	5.727	8.514	10.601	12.556	15.562	4.217
2007	0.421	2.292	2.617	3.146	3.776	4.634	6.958	8.142	11.376	12.503	14.439	3.661

Table F11. Total catch in numbers (000s) at age for Gulf of Maine cod.

	Total Catch in Numbers (000's) at Age								Revised LAA 1994+			
Year	1	2	3	4	5	6	7	8	9	10	11+	Total
1982	71.4	1980.9	2420.3	1422.1	747.1	77.1	97.7	65.6	41.0	4.0	33.0	6960.1
1983	11.3	1324.4	2917.6	1189.0	687.2	452.6	50.0	65.4	25.2	11.8	19.4	6754.0
1984	24.7	801.5	1581.5	1636.5	470.1	207.6	78.4	19.3	15.0	11.6	18.4	4864.9
1985	44.3	1064.5	2187.8	1137.1	667.5	133.2	78.5	32.1	4.0	11.0	11.0	5371.0
1986	12.8	186.0	2756.8	929.6	277.0	199.9	45.7	30.2	35.6	8.0	59.5	4541.1
1987	96.3	889.6	1321.0	1505.8	346.4	91.5	83.7	13.9	13.6	10.3	3.0	4375.0
1988	2.4	549.1	2128.0	1117.1	428.8	49.3	11.2	17.9	1.0	2.0	1.0	4308.0
1989	3.8	519.5	2280.6	1715.7	488.0	92.8	41.2	6.4	3.0	5.0	7.0	5163.0
1990	0.0	253.6	4125.6	2455.9	523.3	176.6	27.0	30.0	10.0	15.0	17.0	7634.0
1991	0.0	438.5	1341.1	4910.7	930.6	158.8	46.8	30.0	7.9	1.3	1.0	7866.6
1992	0.0	338.3	587.1	531.9	2188.4	219.1	65.3	7.4	12.0	3.0	0.0	3952.5
1993	0.0	127.8	2031.8	783.0	139.4	473.8	29.2	6.0	2.0	0.0	0.0	3592.0
1994	0.9	54.0	1488.2	1216.6	330.9	71.0	85.7	29.5	6.7	0.6	1.2	3285.3
1995	18.1	277.0	1169.9	1192.0	232.5	28.6	13.9	18.4	0.8	1.6	0.2	2953.2
1996	0.0	90.0	630.7	1936.7	384.3	36.9	4.5	0.5	1.3	0.0	0.0	3085.0
1997	0.0	85.4	495.2	455.5	852.4	71.4	5.0	2.6	0.3	0.7	0.1	1968.6
1998	0.0	107.5	482.4	594.8	158.7	191.4	26.2	3.9	0.4	1.1	0.4	1566.7
1999	1.2	22.1	647.2	568.0	272.6	58.0	79.2	7.9	0.0	4.4	0.0	1660.7
2000	0.0	201.1	534.0	828.3	190.3	98.9	16.1	7.1	0.0	0.0	0.0	1875.8
2001	0.0	147.2	1183.5	685.5	378.0	109.1	59.8	8.9	13.3	1.2	0.5	2587.1
2002	0.0	3.0	259.5	884.3	346.0	203.5	81.0	35.5	9.5	9.4	0.6	1832.4
2003	0.0	16.4	118.6	442.9	766.1	231.4	103.3	39.9	21.7	9.9	7.4	1757.5
2004	0.0	0.9	357.8	249.9	409.6	266.0	74.6	36.9	19.3	11.3	3.5	1429.8
2005	0.0	7.5	134.1	813.8	95.2	265.3	120.9	32.5	19.2	8.1	8.3	1504.9
2006	0.0	1.6	177.4	281.3	449.3	32.5	97.2	48.0	18.2	10.8	8.8	1124.9
2007	0.0	7.9	154.8	907.5	140.4	253.8	8.5	23.3	12.6	6.7	7.5	1523.3

Table F12. Total catch in weight (mt) at age for Gulf of Maine cod.

Total Catch in Weight (Tons) at Age												
Year	1	2	3	4	5	6	7	8	9	10	11+	Total
1982	46.0	2201.2	3918.4	3836.2	3524.6	507.1	853.8	640.4	531.0	41.0	613.0	16712.7
1983	5.1	1406.6	4697.6	2901.4	2578.0	2726.9	288.7	679.9	250.6	151.8	350.8	16037.4
1984	12.5	817.8	2551.7	4415.8	1720.6	1206.0	633.0	188.0	193.3	162.9	275.9	12187.3
1985	20.6	1058.9	3503.3	3155.7	2927.2	722.6	616.9	363.7	51.0	141.0	152.0	12712.9
1986	5.1	208.7	4952.0	2682.8	1261.2	1203.5	371.5	327.1	482.7	109.0	1164.8	12768.4
1987	19.8	846.6	2042.5	4714.2	1666.2	654.9	796.9	139.7	180.0	134.7	40.0	11235.5
1988	0.8	529.1	3697.5	2656.3	2185.6	318.3	99.9	197.6	11.0	36.0	14.0	9746.0
1989	2.6	622.7	3928.2	5034.1	1875.8	399.7	371.9	70.7	43.0	87.0	163.0	12668.7
1990	0.0	274.4	6954.4	5648.2	2191.4	1307.9	290.0	354.0	153.0	214.0	350.0	17737.3
1991	0.0	518.2	2067.6	11946.7	3727.6	1178.3	453.8	369.0	111.3	33.0	17.0	20422.5
1992	0.0	525.8	1144.9	1458.3	6741.3	1093.5	619.8	89.0	161.0	49.0	0.0	11883.6
1993	0.0	152.0	3700.4	1877.6	588.9	2889.5	292.3	79.0	27.0	0.0	0.0	9606.6
1994	0.1	74.7	2690.0	3603.4	1107.2	446.1	615.4	307.9	69.6	10.7	25.8	8950.9
1995	5.0	392.0	2102.4	3172.9	1174.5	159.5	150.0	211.5	15.5	31.2	5.0	7419.3
1996	0.0	138.9	1351.8	4474.6	1339.8	271.3	46.4	7.4	19.8	0.0	0.0	7650.1
1997	0.0	151.5	1097.5	1387.3	2662.5	342.1	42.4	29.7	4.3	11.7	2.1	5731.3
1998	0.0	147.6	999.7	1692.7	656.2	808.3	135.8	43.7	6.9	16.4	7.4	4514.7
1999	0.4	29.6	1187.7	1457.0	1047.8	335.1	570.6	78.0	0.0	58.6	0.0	4769.2
2000	0.0	325.4	1219.7	2835.7	843.7	564.7	96.7	60.1	0.0	0.0	0.0	5939.0
2001	0.0	260.3	2825.3	2189.5	1788.6	687.0	434.5	74.5	115.3	15.0	11.7	8400.2
2002	0.0	4.1	637.8	2891.3	1392.9	1198.0	542.8	408.5	96.7	100.3	8.9	7285.6
2003	0.0	31.7	285.7	1354.5	3062.8	1223.8	776.7	349.1	235.5	121.3	97.4	7537.3
2004	0.0	1.3	837.4	805.6	1493.6	1398.9	514.1	347.1	227.5	146.6	46.0	5817.0
2005	0.0	11.8	276.1	2305.7	410.0	1196.1	754.4	255.0	199.9	108.7	118.9	5635.9
2006	0.0	3.6	430.1	917.2	1685.5	157.2	535.7	365.6	175.4	131.0	137.1	4536.1
2007	0.0	16.1	391.1	2924.0	551.3	1217.0	54.4	165.1	127.4	78.5	108.1	5627.8

Table F13. Total catch mean weights (kg) at age for Gulf of Maine cod.

	Total Catch Mean Weight (kg) at Age											
Year	1	2	3	4	5	6	7	8	9	10	11+	Average
1982	0.644	1.111	1.619	2.698	4.718	6.577	8.740	9.763	12.951	10.250	18.576	2.401
1983	0.446	1.062	1.610	2.440	3.751	6.025	5.775	10.391	9.951	12.855	18.125	2.375
1984	0.506	1.020	1.613	2.698	3.660	5.808	8.070	9.741	12.845	13.987	14.962	2.505
1985	0.466	0.995	1.601	2.775	4.385	5.424	7.859	11.312	12.750	12.818	13.818	2.367
1986	0.399	1.122	1.796	2.886	4.554	6.020	8.120	10.845	13.572	13.640	19.578	2.812
1987	0.206	0.952	1.546	3.131	4.811	7.161	9.521	10.053	13.195	13.132	13.333	2.568
1988	0.318	0.964	1.738	2.378	5.097	6.450	8.919	11.022	11.000	18.000	14.000	2.262
1989	0.680	1.199	1.722	2.934	3.844	4.309	9.018	11.034	14.333	17.400	23.286	2.454
1990	0.416	1.082	1.686	2.300	4.187	7.407	10.741	11.800	15.300	14.267	20.588	2.323
1991	0.416	1.182	1.542	2.433	4.006	7.421	9.689	12.300	14.003	25.672	17.000	2.596
1992	0.416	1.554	1.950	2.741	3.080	4.991	9.489	12.027	13.417	16.333	17.576	3.007
1993	0.416	1.189	1.821	2.398	4.225	6.099	10.022	13.167	13.500	14.785	17.576	2.674
1994	0.132	1.383	1.808	2.962	3.347	6.280	7.185	10.448	10.331	18.542	20.637	2.725
1995	0.274	1.415	1.797	2.662	5.051	5.578	10.760	11.492	18.893	20.064	20.347	2.512
1996	0.588	1.543	2.143	2.310	3.486	7.353	10.426	13.912	14.724	14.785	17.576	2.480
1997	0.416	1.774	2.216	3.046	3.124	4.791	8.405	11.547	14.726	15.814	21.874	2.911
1998	0.417	1.373	2.072	2.846	4.135	4.224	5.177	11.313	18.893	14.953	20.347	2.882
1999	0.334	1.341	1.835	2.565	3.843	5.773	7.201	9.915	12.870	13.402	17.576	2.872
2000	0.416	1.619	2.284	3.423	4.432	5.707	6.013	8.521	12.870	14.785	17.576	3.166
2001	0.416	1.768	2.387	3.194	4.732	6.296	7.266	8.351	8.643	12.414	24.418	3.247
2002	0.416	1.357	2.458	3.269	4.026	5.886	6.702	11.514	10.174	10.662	14.333	3.976
2003	0.416	1.929	2.409	3.058	3.998	5.289	7.522	8.760	10.834	12.269	13.074	4.289
2004	0.416	1.474	2.340	3.224	3.647	5.259	6.889	9.396	11.775	12.944	13.260	4.068
2005	0.416	1.574	2.058	2.833	4.307	4.509	6.239	7.835	10.440	13.428	14.382	3.745
2006	0.416	2.303	2.425	3.261	3.751	4.845	5.514	7.610	9.654	12.162	15.664	4.033
2007	0.416	2.027	2.526	3.222	3.927	4.794	6.362	7.075	10.106	11.721	14.314	3.695

Table F14. Standardized stratified mean catch per tow in numbers and weight (kg) for Atlantic cod from NEFSC offshore spring and autumn research vessel bottom trawl surveys in the Gulf of Maine (NEFSC strata 01260-01300 and 01360-01400), 1963 - 2008 [a,b,c].

	Spring		Autumn	
Year	no/tow (kg)	wt/tow (kg)	no/tow	wt/tow
1963	No Survey Conducted		5.914	17.95
1964	No Survey Conducted		4.015	22.799
1965	No Survey Conducted		4.5	12.005
1966	No Survey Conducted		3.784	12.916
1967	No Survey Conducted		2.56	9.225
1968	5.583	18.195	4.374	19.437
1969	3.247	13.194	2.758	15.368
1970	2.191	11.077	4.905	16.442
1971	1.429	6.996	4.361	16.527
1972	2.057	8.029	9.301	12.988
1973	7.525	18.807	4.452	8.758
1974	2.902	7.418	4.328	8.959
1975	2.512	6.039	6.143	8.619
1976	2.782	7.556	2.148	6.74
1977	3.872	8.541	3.073	10.199
1978	2.05	7.697	5.773	12.899
1979	3.993	8.363	3.142	13.927
1980	2.154	6.232	7.034	14.202
1981	4.831	10.65	2.349	7.533
1982	3.763	8.616	7.768	15.919
1983	3.912	10.962	2.786	8.416
1984	3.667	6.143	2.449	8.735
1985	2.517	7.645	2.821	8.264
1986	1.957	3.476	1.95	4.715
1987	1.083	1.976	2.996	3.394
1988	3.127	3.603	5.903	6.616
1989	2.112	2.424	4.553	4.535
1990	2.362	3.076	2.986	4.912
1991	2.393	2.891	1.252	2.781
1992	2.435	8.626	1.433	2.448
1993	2.507	5.875	1.232	1.002
1994	1.271	2.427	2.13	2.737
1995	1.93	2.431	2.008	3.665
1996	2.465	5.427	1.327	2.351
1997	2.192	5.615	0.872	1.872
1998	1.71	4.18	0.843	1.5
1999	2.301	5.089	1.807	3.505
2000	3.083	3.211	2.604	4.652
2001	2.147	6.216	1.98	7.325
2002	3.724	10.933	5.328	24.659
2003	3.677	9.495	2.529	5.993
2004	0.981	2.414	3.53	4.90
2005	1.765	2.703	1.338	2.87
2006	1.363	2.70	3.594	4.23
2007	12.393	15.81	1.992	2.71
2008	6.811	9.39		

[a] **Indices in all years have been recalculated and may differ slightly from those reported previously (e.g., Mayo *et al.* 2002) due to a better accounting of vessel effects in years when Albatross IV and Delaware II were used to conduct a portion of the same survey (e.g. 1979 and 1987).**

[b] **Spring surveys during 1973-1981 were conducted with a '41 Yankee' trawl; in all other years, spring surveys were conducted with a '36 Yankee' trawl. No adjustments have been made to the catch per tow data for these differences.**

[c] **During 1963-1984, BMV oval doors were used in the spring and autumn surveys; since 1985, Portuguese polyvalent doors have been used in both surveys. Adjustments have been made to the 1963-1984 catch per tow data to standardize these data to polyvalent door equivalents. Conversion coefficients of 1.56 (numbers) and 1.62 (weight) were used in the standardization (NEFSC 1991).**

[d] **In the Gulf of Maine, spring and autumn surveys were conducted primarily by R/V ALBATROSS IV. During several periods since 1979, however, surveys were conducted either entirely or in part by R/V DELAWARE II. Adjustments have been made to the R/V DELAWARE II catch per tow data to standardize these to R/V ALBATROSS IV equivalents. Conversion coefficients of 0.79 (number) and 0.67 (weight) were used in the standardization (NEFSC 1991).**

Table F15. Standardized [for both door and gear changes] stratified mean number per tow at age and standardized stratified mean weight (kg) per tow of Atlantic cod in NEFSC offshore spring research vessel bottom trawl surveys in the Gulf of Maine (Strata 26-30 and 36-40), 1968-2008. [a,b]

Year	Age Group															Totals				Standardized
[c,d,e]	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14+	0+	4+	5+	6+	Mean Wt/tow (Kg)
1968	0.128	0.613	1.234	1.407	0.846	0.538	0.207	0.129	0.111	0.059	0.165	-	-	-	-	5.438	2.056	1.211	0.673	18.20
1969	0.000	0.000	0.036	0.307	0.880	0.807	0.633	0.256	0.144	0.089	0.101	-	-	-	-	3.253	2.909	2.030	1.223	13.19
1970	0.000	0.159	0.124	0.053	0.091	0.271	0.465	0.611	0.094	0.059	0.098	0.100	0.042	0.012	0.012	2.191	1.855	1.764	1.494	11.08
1971	0.000	0.026	0.151	0.105	0.286	0.048	0.084	0.300	0.206	0.154	0.058	0.013	0.000	0.000	0.000	1.429	1.148	0.862	0.814	7.00
1972	0.000	0.371	0.135	0.521	0.195	0.181	0.044	0.124	0.093	0.229	0.056	0.056	0.034	0.000	0.017	2.057	1.030	0.835	0.653	8.03
1973	0.000	0.035	4.250	0.890	0.632	0.348	0.194	0.096	0.221	0.261	0.198	0.075	0.106	0.132	0.088	7.525	2.350	1.718	1.370	18.81
1974	0.000	0.475	0.103	1.503	0.172	0.235	0.075	0.028	0.057	0.033	0.045	0.043	0.081	0.000	0.051	2.902	0.820	0.648	0.413	7.42
1975	0.006	0.096	0.686	0.131	1.105	0.269	0.079	0.000	0.006	0.018	0.028	0.026	0.062	0.000	0.000	2.512	1.593	0.488	0.219	6.04
1976	0.000	0.051	0.265	1.104	0.137	0.902	0.090	0.095	0.027	0.000	0.011	0.000	0.074	0.027	0.000	2.782	1.362	1.225	0.323	7.56
1977	0.000	0.025	0.297	0.553	1.925	0.111	0.831	0.011	0.083	0.000	0.000	0.000	0.000	0.000	0.038	3.872	2.998	1.073	0.962	8.54
1978	0.000	0.048	0.110	0.308	0.351	0.744	0.095	0.252	0.013	0.107	0.000	0.022	0.000	0.000	0.000	2.050	1.584	1.233	0.488	7.70
1979	0.044	0.484	1.630	0.219	0.449	0.299	0.587	0.102	0.112	0.013	0.031	0.000	0.000	0.000	0.025	3.993	1.617	1.168	0.869	8.36
1980	0.070	0.037	0.423	0.492	0.138	0.238	0.304	0.317	0.000	0.122	0.014	0.000	0.000	0.000	0.000	2.155	1.133	0.994	0.756	6.23
1981	0.000	1.075	0.644	0.841	1.342	0.331	0.264	0.116	0.121	0.100	0.000	0.000	0.000	0.000	0.000	4.832	2.272	0.930	0.600	10.65
1982	0.014	0.359	1.007	0.476	0.655	0.988	0.087	0.112	0.000	0.026	0.039	0.000	0.000	0.000	0.000	3.763	1.907	1.251	0.264	8.62
1983	0.013	0.632	0.949	0.997	0.465	0.404	0.212	0.068	0.016	0.071	0.018	0.008	0.030	0.000	0.030	3.912	1.322	0.857	0.453	10.96
1984	0.000	0.151	1.312	1.023	0.823	0.212	0.047	0.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.667	1.182	0.359	0.147	6.14
1985	0.000	0.029	0.231	0.662	0.663	0.662	0.103	0.091	0.052	0.000	0.026	0.000	0.000	0.000	0.000	2.517	1.596	0.933	0.272	7.65
1986	0.000	0.537	0.248	0.754	0.237	0.091	0.035	0.038	0.000	0.000	0.000	0.000	0.018	0.000	0.000	1.957	0.419	0.182	0.090	3.48
1987	0.000	0.030	0.460	0.199	0.231	0.074	0.000	0.066	0.008	0.000	0.000	0.000	0.000	0.000	0.015	1.083	0.394	0.163	0.088	1.98
1988	0.029	0.717	0.923	0.823	0.218	0.254	0.092	0.065	0.000	0.007	0.000	0.000	0.000	0.000	0.000	3.127	0.635	0.417	0.163	3.60
1989	0.000	0.017	0.605	0.723	0.600	0.091	0.063	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.112	0.768	0.168	0.077	2.42
1990	0.000	0.000	0.208	1.365	0.637	0.102	0.032	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.362	0.789	0.152	0.050	3.08
1991	0.000	0.038	0.068	0.234	1.717	0.299	0.020	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.393	2.054	0.337	0.038	2.89
1992	0.000	0.050	0.226	0.242	0.282	1.328	0.226	0.069	0.000	0.012	0.000	0.000	0.000	0.000	0.000	2.435	1.917	1.635	0.307	8.63
1993	0.000	0.201	0.497	0.799	0.334	0.091	0.484	0.055	0.023	0.000	0.000	0.023	0.000	0.000	0.000	2.507	1.010	0.676	0.585	5.88
1994	0.000	0.015	0.316	0.388	0.215	0.094	0.049	0.127	0.027	0.022	0.018	0.000	0.000	0.000	0.000	1.271	0.553	0.338	0.244	2.43
1995	0.000	0.050	0.179	1.116	0.372	0.145	0.028	0.000	0.011	0.000	0.000	0.000	0.000	0.028	0.000	1.930	0.585	0.213	0.068	2.43
1996	0.000	0.057	0.022	0.593	1.331	0.403	0.059	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.465	1.793	0.463	0.059	5.43
1997	0.000	0.159	0.132	0.399	0.264	0.876	0.242	0.120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.192	1.502	1.238	0.362	5.62
1998	0.000	0.018	0.224	0.330	0.517	0.142	0.421	0.023	0.037	0.000	0.000	0.000	0.000	0.000	0.000	1.710	1.139	0.622	0.481	4.18
1999	0.000	0.166	0.344	0.713	0.345	0.315	0.134	0.273	0.000	0.000	0.000	0.000	0.000	0.011	0.000	2.301	1.078	0.733	0.418	5.09
2000	0.026	1.184	0.725	0.439	0.457	0.107	0.101	0.024	0.022	0.000	0.000	0.000	0.000	0.000	0.000	3.083	0.710	0.253	0.146	3.21
2001	0.000	0.029	0.323	0.716	0.497	0.354	0.064	0.098	0.055	0.000	0.011	0.000	0.000	0.000	0.000	2.146	1.078	0.581	0.227	6.22
2002	0.000	0.340	0.045	0.524	1.601	0.614	0.362	0.164	0.057	0.016	0.000	0.000	0.000	0.000	0.000	3.724	2.814	1.213	0.598	10.93
2003	0.000	0.069	0.831	0.063	0.708	1.089	0.395	0.321	0.103	0.073	0.027	0.000	0.000	0.000	0.000	3.677	2.715	2.007	0.918	9.50
2004	0.000	0.136	0.045	0.221	0.118	0.191	0.232	0.014	0.014	0.010	0.000	0.000	0.000	0.000	0.000	0.981	0.579	0.461	0.270	2.41
2005	0.000	0.020	0.726	0.101	0.608	0.015	0.145	0.130	0.014	0.000	0.000	0.000	0.000	0.000	0.000	1.765	0.917	0.309	0.294	2.70
2006	0.028	0.186	0.227	0.434	0.060	0.189	0.021	0.131	0.073	0.000	0.013	0.000	0.000	0.000	0.000	1.363	0.487	0.428	0.238	2.70
2007	0.000	0.092	3.480	2.890	4.346	0.538	0.944	0.065	0.038	0.000	0.000	0.000	0.000	0.000	0.000	12.393	5.931	1.585	1.047	15.81
2007	0.000	0.066	1.099	3.211	1.357	0.939	0.058	0.081	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.811	2.435	1.078	0.139	9.39

[a] Indices from 1970-2001 have been recalculated and may differ slightly from those reported previously (Mayo *et al.* 2002) due to slight modifications to the age-length keys and a better accounting of vessel effects in 1979 and 1987.
[b] Spring catch per tow at age indices for 1968-1969 were obtained by applying combined 1970-1981 age-length keys to stratified mean catch per tow at length distributions from each survey. Calculations were carried out only to age 10+.
[c] Spring surveys during 1973-1981 were accomplished with a '41 Yankee' trawl; in all other years, spring surveys were accomplished with a '36 Yankee' trawl. No adjustments have been made to the catch per tow data for these differences.
[d] During 1963-1984, BMV oval doors were used in the spring and autumn surveys; since 1985, Portuguese polyvalent doors have been used in both surveys. Adjustments have been made to the 1963-1984 catch per tow data to standardize these data to polyvalent door equivalents. Conversion coefficients of 1.56 (numbers) and 1.62 (weight) were used in this standardization (NESFC 1991).
[e] In the Gulf of Maine, spring surveys during 1980-1982, 1989-1991, 1994 and 2003, were conducted aboard R/V DELAWARE II; in all other years, the surveys were conducted aboard R/V ALBATROSS IV except in 1979 and 1987 when both vessels were deployed on portions of the survey. Adjustments have been made to the R/V DELAWARE II catch per tow data to standardize these to R/V ALBATROSS IV equivalents. Conversion coefficients of 0.79 (numbers) and 0.67 (weight) were used in this standardization (NEFSC 1991).

Table F16. Standardized [for both door and gear changes] stratified mean number per tow at age and standardized stratified mean weight (kg) per tow of Atlantic cod in NEFSC offshore autumn research vessel bottom trawl surveys in the Gulf of Maine (Strata 26-30 and 36-40), 1963-2007. [a,b]

Year	Age Group															Totals				Standardized Mean
Wt/tow [c,d]	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14+	0+	3+	4+	5+	(Kg)
1963	0.050	0.649	1.349	1.253	0.849	0.579	0.537	0.300	0.183	0.095	0.075	B	-	-	-	5.917	3.869	2.616	1.767	17.95
1964	0.000	0.092	0.122	0.417	0.856	0.853	0.783	0.373	0.237	0.114	0.101	-	-	-	-	4.003	3.789	3.318	2.462	22.80
1965	0.002	0.850	0.880	0.824	0.750	0.496	0.374	0.170	0.080	0.044	0.025	-	-	-	-	4.494	2.763	1.939	1.189	12.01
1966	0.170	0.204	0.640	0.697	0.718	0.558	0.441	0.192	0.078	0.048	0.036	-	-	-	-	3.783	2.769	2.072	1.354	12.92
1967	0.012	0.129	0.215	0.574	0.671	0.384	0.268	0.162	0.070	0.041	0.034	-	-	-	-	2.562	2.204	1.630	0.959	9.23
1968	0.012	0.036	0.179	0.719	1.256	0.973	0.627	0.261	0.156	0.072	0.095	-	-	-	-	4.387	4.159	3.440	2.184	19.44
1969	0.016	0.059	0.123	0.354	0.630	0.552	0.466	0.220	0.145	0.129	0.062	-	-	-	-	2.758	2.560	2.206	1.576	15.37
1970	0.802	0.883	0.260	0.538	0.329	0.486	0.425	0.811	0.132	0.094	0.036	0.037	0.073	0.000	0.000	4.905	2.960	2.422	2.093	16.44
1971	1.319	0.179	0.276	0.219	0.578	0.478	0.455	0.236	0.298	0.163	0.066	0.034	0.061	0.000	0.000	4.361	2.588	2.368	1.790	16.53
1972	0.031	5.578	1.215	1.528	0.233	0.090	0.140	0.070	0.138	0.262	0.000	0.000	0.000	0.000	0.016	9.301	2.477	0.949	0.716	12.99
1973	0.638	0.329	2.170	0.139	0.507	0.213	0.077	0.027	0.051	0.183	0.102	0.000	0.000	0.016	0.000	4.452	1.315	1.176	0.669	8.76
1974	0.283	1.134	0.266	1.876	0.167	0.274	0.051	0.046	0.036	0.033	0.033	0.098	0.000	0.000	0.033	4.328	2.646	0.770	0.603	8.96
1975	0.047	0.177	3.045	0.138	2.333	0.259	0.109	0.017	0.006	0.000	0.000	0.006	0.006	0.000	0.000	6.143	2.874	2.736	0.403	8.62
1976	0.000	0.230	0.221	0.633	0.077	0.773	0.052	0.132	0.000	0.000	0.031	0.000	0.000	0.000	0.000	2.148	1.697	1.064	0.988	6.74
1977	0.000	0.042	0.416	0.465	1.157	0.114	0.629	0.044	0.090	0.022	0.032	0.000	0.044	0.019	0.000	3.073	2.615	2.150	0.994	10.20
1978	0.248	1.373	0.378	1.135	0.658	1.426	0.109	0.310	0.005	0.083	0.007	0.013	0.000	0.028	0.000	5.773	3.773	2.638	1.980	12.90
1979	0.002	0.381	0.588	0.145	0.708	0.337	0.688	0.044	0.181	0.000	0.053	0.000	0.000	0.000	0.018	3.142	2.172	2.027	1.319	13.93
1980	0.027	1.321	2.520	1.780	0.492	0.194	0.360	0.207	0.036	0.025	0.000	0.036	0.000	0.014	0.022	7.034	3.165	1.385	0.894	14.20
1981	0.010	0.618	0.419	0.539	0.405	0.121	0.076	0.029	0.090	0.000	0.043	0.000	0.000	0.000	0.000	2.349	1.302	0.763	0.358	7.53
1982	0.000	0.843	3.353	2.275	1.089	0.209	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.769	3.573	1.298	0.209	15.92
1983	0.000	0.317	0.916	0.828	0.197	0.227	0.210	0.000	0.000	0.000	0.027	0.028	0.037	0.000	0.000	2.786	1.553	0.726	0.529	8.42
1984	0.022	0.432	0.426	0.631	0.387	0.214	0.163	0.079	0.000	0.030	0.000	0.000	0.030	0.035	0.000	2.449	1.569	0.938	0.551	8.74
1985	0.121	0.526	0.957	0.609	0.248	0.182	0.075	0.000	0.034	0.021	0.010	0.000	0.010	0.000	0.029	2.821	1.218	0.609	0.361	8.26
1986	0.000	0.392	0.401	0.657	0.342	0.073	0.041	0.000	0.011	0.034	0.000	0.000	0.000	0.000	0.000	1.950	1.157	0.501	0.159	4.72
1987	0.128	0.578	1.380	0.592	0.243	0.075	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.996	0.910	0.318	0.075	3.39
1988	0.000	1.938	2.313	0.990	0.443	0.099	0.065	0.033	0.011	0.011	0.000	0.000	0.000	0.000	0.000	5.903	1.652	0.662	0.219	6.62
1989	0.000	0.150	2.407	1.502	0.293	0.161	0.033	0.000	0.000	0.000	0.009	0.000	0.000	0.000	0.000	4.553	1.997	0.495	0.202	4.54
1990	0.006	0.045	0.187	1.829	0.598	0.259	0.052	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.986	2.748	0.919	0.321	4.91
1991	0.009	0.144	0.139	0.223	0.633	0.081	0.000	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.252	0.960	0.737	0.104	2.78
1992	0.059	0.291	0.446	0.140	0.036	0.350	0.104	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.433	0.638	0.498	0.462	2.45
1993	0.043	0.198	0.568	0.360	0.034	0.000	0.030	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.232	0.424	0.064	0.030	1.00
1994	0.032	0.207	0.883	0.826	0.085	0.051	0.000	0.045	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.130	1.008	0.182	0.096	2.74
1995	0.008	0.068	0.285	1.228	0.325	0.082	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.008	1.647	0.419	0.093	3.67
1996	0.029	0.124	0.383	0.188	0.542	0.062	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.327	0.792	0.604	0.062	2.35
1997	0.000	0.297	0.086	0.177	0.173	0.140	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.872	0.490	0.313	0.140	1.87
1998	0.050	0.097	0.320	0.115	0.192	0.039	0.031	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.843	0.376	0.262	0.069	1.50
1999	0.025	0.431	0.367	0.586	0.243	0.132	0.016	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.807	0.984	0.398	0.155	3.51
2000	0.008	0.533	0.984	0.394	0.507	0.134	0.010	0.000	0.011	0.023	0.000	0.000	0.000	0.000	0.000	2.604	1.079	0.686	0.178	4.65
2001	0.018	0.034	0.141	0.752	0.469	0.337	0.122	0.084	0.000	0.023	0.000	0.000	0.000	0.000	0.000	1.980	1.788	1.035	0.566	7.33
2002	0.000	0.269	0.081	0.364	2.797	1.096	0.627	0.051	0.043	0.000	0.000	0.000	0.000	0.000	0.000	5.328	4.979	4.615	1.818	24.66
2003	0.542	0.455	0.198	0.185	0.529	0.450	0.073	0.077	0.000	0.011	0.000	0.011	0.000	0.000	0.000	2.529	1.335	1.150	0.622	5.99
2004	1.380	0.651	0.168	0.581	0.231	0.253	0.168	0.068	0.011	0.010	0.011	0.000	0.000	0.000	0.000	3.533	1.334	0.753	0.522	4.90
2005	0.034	0.153	0.381	0.080	0.450	0.022	0.092	0.082	0.023	0.021	0.000	0.000	0.000	0.000	0.000	1.338	0.690	0.241	0.219	2.87
2006	0.064	1.251	0.580	1.033	0.248	0.286	0.034	0.050	0.030	0.006	0.014	0.000	0.000	0.000	0.000	3.594	0.666	0.418	0.133	4.23
2007	0.011	0.146	0.831	0.384	0.528	0.023	0.069	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.992	0.620	0.092	0.069	2.71

[a] Indices from 1970-2001 have been recalculated and may differ slightly from those reported previously (Mayo *et al.* 2002) due to slight modifications to the age-length keys and a better accounting of vessel effects in 1979.

[b] Autumn catch per tow at age indices for 1963-1969 were obtained by applying combined 1970-1981 age-length keys to stratified mean catch per tow at length distributions from each survey. Calculations were carried out only to age 10+.

[c] During 1963-1984, BMV oval doors were used in the spring and autumn surveys; since 1985, Portuguese polyvalent doors have been used in both surveys. Adjustments have been made to the 1963-1984 catch per tow data to standardize these data to polyvalent door equivalents. Conversion coefficients of 1.56 (numbers) and 1.62 (weight) were used in this standardization (NEFSC 1991).

[d] In the Gulf of Maine, autumn surveys during 1977-1978, 1980, 1989-1991 and 1993 were conducted aboard R/V DELAWARE II; in all other years, the surveys were conducted aboard R/V ALBATROSS IV except in 1979 when both vessels were deployed on portions of the survey. Adjustments have been made to the R/V DELAWARE II catch per tow data to standardize these to R/V ALBATROSS IV equivalents. Conversion coefficients of 0.79 (numbers) and 0.67 (weight) were used in this standardization (NEFSC 1991).

Table F17. Stratified mean number per tow and weight per tow (kg) of Atlantic cod in MADMF inshore spring and autumn research vessel bottom trawl surveys in the Gulf of Maine (Mass regions 4 and 5), 1978-2007

	Spring		Autumn	
Year	Mean No per Tow	Mean Wt per Tow	Mean No per Tow	Mean Wt per Tow
1978	47.89	11.05	156.06	1.51
1979	96.56	14.28	8.92	1.05
1980	65.98	14.51	12.53	1.28
1981	69.41	18.69	9.29	3.64
1982	25.84	12.16	6.12	0.66
1983	54.85	18.75	1.68	0.09
1984	10.33	7.24	10.55	0.13
1985	8.46	4.77	2.87	0.07
1986	24.09	7.84	2.75	0.25
1987	17.21	7.87	313.15	0.35
1988	22.24	7.70	8.87	0.37
1989	52.24	16.82	4.15	0.22
1990	32.41	15.88	12.71	0.76
1991	13.70	8.73	7.48	0.48
1992	16.92	8.77	27.50	0.27
1993	92.66	5.86	51.50	1.35
1994	15.96	3.89	49.00	2.00
1995	23.36	3.99	4.66	0.81
1996	12.96	3.15	7.01	0.08
1997	17.89	2.50	1.46	0.01
1998	27.57	3.25	4.33	0.36
1999	161.06	9.00	8.01	0.31
2000	50.77	20.60	0.68	0.27
2001	41.84	26.45	49.55	0.76
2002	24.34	11.16	3.30	3.99
2003	1120.37	10.98	122.28	1.85
2004	131.59	8.15	57.62	5.58
2005	193.26	10.40	40.35	0.21
2006	1077.03	9.18	7.50	1.94
2007	61.58	8.43	7.92	2.94

Table F18. Stratified mean number per tow at age of Atlantic cod in MADMF inshore spring research vessel bottom trawl surveys in the Gulf of Maine (Mass regions 4 and 5), 1978-2007

	Age Group																Totals			
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total	0+	1+	2+	3+
1978	31.43	6.33	2.59	3.61	2.00	1.76	0.07	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	47.89	47.87	16.44	10.11	7.52
1979	69.49	19.62	2.07	0.56	2.41	1.02	1.27	0.02	0.11	0.00	0.00	0.00	0.00	0.00	0.00	96.56	96.57	27.08	7.46	5.39
1980	9.03	42.81	10.45	1.80	0.22	0.89	0.40	0.35	0.00	0.04	0.00	0.00	0.00	0.00	0.00	65.98	65.99	56.96	14.15	3.70
1981	26.48	23.01	12.52	6.15	0.96	0.15	0.02	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	69.41	69.41	42.93	19.92	7.40
1982	1.71	13.29	7.17	2.41	0.87	0.22	0.08	0.04	0.05	0.00	0.00	0.00	0.00	0.00	0.00	25.84	25.84	24.13	10.84	3.67
1983	0.77	34.75	14.61	2.86	1.50	0.25	0.03	0.04	0.03	0.00	0.00	0.00	0.00	0.00	0.00	54.85	54.84	54.07	19.32	4.71
1984	0.26	1.96	5.15	2.07	0.70	0.05	0.05	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.33	10.32	10.06	8.10	2.95
1985	1.09	1.79	2.77	2.27	0.45	0.05	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.46	8.45	7.36	5.57	2.80
1986	1.14	9.26	11.68	1.23	0.68	0.07	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.09	24.09	22.95	13.69	2.01
1987	0.78	8.29	4.71	2.96	0.22	0.09	0.06	0.03	0.00	0.07	0.00	0.00	0.00	0.00	0.00	17.21	17.21	16.43	8.14	3.43
1988	1.88	10.05	6.35	2.45	1.45	0.01	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.24	22.25	20.37	10.32	3.97
1989	0.18	21.59	20.51	8.76	1.06	0.10	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	52.24	52.24	52.06	30.47	9.96
1990	4.92	4.63	5.45	14.75	2.31	0.31	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.41	32.41	27.49	22.86	17.41
1991	0.35	5.01	2.69	1.57	3.66	0.40	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.70	13.69	13.34	8.33	5.64
1992	1.51	4.50	5.13	3.67	0.75	1.26	0.09	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.92	16.93	15.42	10.92	5.79
1993	79.84	2.99	6.11	2.55	0.90	0.09	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	92.66	92.65	12.81	9.82	3.71
1994	4.63	4.79	4.07	1.75	0.49	0.16	0.01	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00	15.96	15.94	11.31	6.52	2.45
1995	12.03	5.83	1.92	2.76	0.78	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.36	23.37	11.34	5.51	3.59
1996	8.94	0.64	0.52	1.08	1.49	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.96	12.97	4.03	3.39	2.87
1997	12.47	2.88	0.98	0.93	0.17	0.42	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.89	17.90	5.43	2.55	1.57
1998	23.48	1.49	0.83	0.70	0.75	0.06	0.24	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.57	27.56	4.08	2.59	1.76
1999	143.00	11.68	2.39	2.31	0.78	0.64	0.07	0.18	0.01	0.00	0.00	0.00	0.00	0.00	0.00	161.06	161.06	18.06	6.38	3.99
2000	2.15	35.14	7.02	2.89	2.20	0.71	0.49	0.09	0.08	0.00	0.00	0.00	0.00	0.00	0.00	50.77	50.77	48.62	13.48	6.46
2001	25.99	0.08	4.50	4.97	3.52	2.07	0.42	0.26	0.03	0.00	0.00	0.00	0.00	0.00	0.00	41.84	41.84	15.85	15.77	11.27
2002	0.92	19.29	0.26	1.23	1.41	0.56	0.30	0.16	0.13	0.03	0.03	0.00	0.01	0.00	0.00	24.34	24.33	23.41	4.12	3.86
2003	1097.97	6.20	12.70	0.28	1.43	1.33	0.29	0.13	0.04	0.00	0.00	0.00	0.00	0.00	0.00	1120.37	1120.37	22.40	16.20	3.50
2004	116.15	9.21	1.56	2.58	0.46	0.90	0.64	0.04	0.04	0.01	0.00	0.00	0.00	0.00	0.00	131.59	131.59	15.44	6.23	4.67
2005	180.85	1.06	7.15	0.57	2.07	0.18	0.95	0.35	0.08	0.00	0.00	0.00	0.00	0.00	0.00	193.26	193.26	12.41	11.35	4.20
2006	1053.70	14.89	3.67	3.38	0.54	0.69	0.01	0.06	0.07	0.00	0.00	0.00	0.00	0.00	0.00	1077.03	1077.01	23.31	8.42	4.75
2007	49.35	4.37	3.36	1.84	1.75	0.32	0.54	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	61.58	61.58	12.23	7.86	4.50

Table F19. Stratified mean number per tow at age of Atlantic cod in MADMF inshore autumn research vessel bottom trawl surveys in the Gulf of Maine (Mass regions 4 and 5), 1978-2007

	Age Group															Totals				
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	total	0+	1+	2+	3+
1978	151.81	3.95	0.02	0.07	0.01	0.09	0.02	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	156.06	156.06	4.25	0.30	0.28
1979	5.72	2.93	0.20	0.00	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.92	8.92	3.20	0.27	0.07
1980	6.00	5.46	1.06	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.53	12.54	6.54	1.08	0.02
1981	1.45	6.20	1.25	0.36	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.29	9.28	7.83	1.63	0.38
1982	4.59	1.14	0.31	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.12	6.12	1.53	0.39	0.08
1983	1.27	0.28	0.10	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.68	1.68	0.41	0.13	0.03
1984	10.30	0.16	0.07	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.55	10.54	0.24	0.08	0.01
1985	2.65	0.19	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.87	2.87	0.22	0.03	0.01
1986	1.80	0.55	0.37	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.75	2.75	0.95	0.40	0.03
1987	311.72	1.40	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	313.15	313.14	1.42	0.02	0.00
1988	5.53	3.10	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.87	8.87	3.34	0.24	0.00
1989	3.94	0.02	0.10	0.07	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.15	4.15	0.21	0.19	0.09
1990	7.81	4.22	0.31	0.32	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.71	12.71	4.90	0.68	0.37
1991	5.04	2.00	0.36	0.02	0.05	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.48	7.49	2.45	0.45	0.09
1992	26.42	0.99	0.04	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.50	27.49	1.07	0.08	0.04
1993	49.43	1.53	0.36	0.17	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	51.50	51.51	2.08	0.55	0.19
1994	40.01	5.36	3.45	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.00	49.01	9.00	3.64	0.19
1995	2.93	0.80	0.41	0.49	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.66	4.65	1.72	0.92	0.51
1996	6.90	0.08	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.01	7.01	0.11	0.03	0.02
1997	1.43	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.46	1.46	0.03	0.00	0.00
1998	3.27	0.64	0.32	0.04	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.33	4.32	1.05	0.41	0.09
1999	7.33	0.59	0.07	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.01	8.00	0.67	0.08	0.01
2000	0.05	0.40	0.17	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.68	0.68	0.63	0.23	0.06
2001	49.19	0.01	0.13	0.13	0.04	0.05	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	49.55	49.56	0.37	0.36	0.23
2002	0.96	1.09	0.13	0.25	0.36	0.44	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.30	3.29	2.33	1.24	1.11
2003	120.17	1.60	0.14	0.05	0.20	0.11	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	122.28	122.28	2.11	0.51	0.37
2004	44.67	9.94	0.92	1.19	0.19	0.45	0.25	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57.62	57.62	12.95	3.01	2.09
2005	39.47	0.61	0.24	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.35	40.35	0.88	0.27	0.03
2006	2.08	4.35	0.42	0.48	0.06	0.08	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.50	7.50	5.42	1.07	0.65
2007	7.61	0.16	0.13	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.92	7.91	0.30	0.14	0.01

Table F20a. VPA estimates of population size for Gulf of Maine cod.

JAN-1 Population Numbers

AGE	1982	1983	1984	1985	1986
1	7857.	7929.	10674.	6679.	10260.
2	11123.	6368.	6481.	8717.	5428.
3	5520.	7314.	4015.	4581.	6174.
4	3128.	2329.	3348.	1856.	1771.
5	1767.	1274.	831.	1261.	491.
6	226.	771.	421.	255.	428.
7	260.	116.	222.	157.	88.
8	140.	124.	49.	111.	58.
9	71.	55.	42.	23.	62.
10	10.	21.	22.	21.	15.
11	79.	35.	36.	21.	113.
Total	30180.	26336.	26143.	23683.	24888.

AGE	1987	1988	1989	1990	1991
1	12744.	24612.	4254.	4135.	6975.
2	8388.	10347.	20148.	3480.	3386.
3	4276.	6063.	7974.	16026.	2620.
4	2560.	2306.	3038.	4465.	9388.
5	609.	734.	877.	935.	1434.
6	151.	185.	213.	276.	292.
7	170.	41.	107.	90.	66.
8	31.	63.	24.	50.	49.
9	20.	13.	35.	14.	14.
10	18.	4.	10.	26.	2.
11	5.	2.	13.	30.	2.
Total	28973.	44369.	36694.	29528.	24228.

AGE	1992	1993	1994	1995	1996
1	6340.	9123.	3180.	3805.	3545.
2	5711.	5191.	7469.	2603.	3099.
3	2375.	4369.	4134.	6066.	1880.
4	931.	1414.	1739.	2038.	3908.
5	3243.	281.	449.	323.	590.
6	332.	675.	104.	68.	54.
7	96.	73.	124.	21.	30.
8	12.	19.	34.	24.	5.
9	13.	3.	10.	1.	3.
10	4.	0.	1.	2.	0.
11	0.	0.	2.	0.	0
Total	19057.	21148.	17245.	14951.	13113.

Table F20a (continued).

JAN-1 Population Numbers

AGE	1997	1998	1999	2000	2001
1	5245.	4458.	7847.	4016.	1187.
2	2902.	4294.	3650.	6424.	3288.
3	2455.	2299.	3419.	2969.	5077.
4	969.	1562.	1446.	2213.	1947.
5	1447.	381.	741.	670.	1063.
6	135.	414.	168.	360.	376.
7	11.	46.	166.	85.	205.
8	20.	4.	14.	64.	55.
9	3.	14.	0.	4.	46.
10	1.	2.	11.	0.	4.
11	0.	1.	0.	0.	2.
Total	13190.	13477.	17462.	16805.	13250.

AGE	2002	2003	2004	2005	2006
1	4953.	1681.	10966.	6713.	23910.
2	972.	4055.	1377.	8979.	5496.
3	2559.	793.	3305.	1126.	7344.
4	3086.	1860.	542.	2382.	801.
5	974.	1726.	1122.	218.	1214.
6	528.	484.	720.	548.	92.
7	209.	248.	187.	349.	209.
8	114.	98.	110.	86.	176.
9	37.	61.	44.	56.	41.
10	25.	22.	30.	19.	29.
11	2.	16.	9.	19.	23.
Total	13459.	11046.	18414.	20495.	39336.

AGE	2007	2008
1	4808.	6105.
2	19576.	3937.
3	4498.	16020.
4	5852.	3543.
5	401.	3970.
6	587.	201.
7	46.	251.
8	83.	30.
9	101.	47.
10	17.	71.
11	21.	19.
Total	35992.	34196.

Table F20b. VPA estimates of instantaneous fishing mortality for Gulf of Maine cod.

Fishing Mortality Calculated

AGE	1982	1983	1984	1985	1986
1	0.0101	0.0016	0.0026	0.0074	0.0014
2	0.2192	0.2612	0.1470	0.1450	0.0386
3	0.6628	0.5814	0.5714	0.7503	0.6802
4	0.6981	0.8305	0.7769	1.1299	0.8676
5	0.6295	0.9064	0.9811	0.8800	0.9766
6	0.4723	1.0461	0.7862	0.8605	0.7259
7	0.5377	0.6505	0.4954	0.8028	0.8481
8	0.7294	0.8727	0.5657	0.3866	0.8646
9	1.0140	0.7010	0.4948	0.2139	1.0200
10	0.6088	0.9342	0.8265	0.8317	0.8523
11	0.6088	0.9342	0.8265	0.8317	0.8523

AGE	1987	1988	1989	1990	1991
1	0.0084	0.0001	0.0010	0.0000	0.0000
2	0.1247	0.0604	0.0289	0.0840	0.1545
3	0.4177	0.4909	0.3799	0.3348	0.8343
4	1.0499	0.7667	0.9783	0.9361	0.8630
5	0.9906	1.0384	0.9547	0.9634	1.2635
6	1.1023	0.3485	0.6584	1.2250	0.9179
7	0.7884	0.3576	0.5545	0.4021	1.5057
8	0.6852	0.3761	0.3568	1.0760	1.1140
9	1.4099	0.0904	0.0981	1.7050	0.9720
10	0.9568	0.7939	0.8422	0.9642	1.2033
11	0.9568	0.7939	0.8422	0.9642	1.2033

AGE	1992	1993	1994	1995	1996
1	0.0000	0.0000	0.0003	0.0053	0.0000
2	0.0677	0.0276	0.0080	0.1251	0.0326
3	0.3191	0.7214	0.5072	0.2397	0.4631
4	0.9977	0.9473	1.4838	1.0395	0.7934
5	1.3696	0.7941	1.6866	1.5888	1.2721
6	1.3085	1.4954	1.4035	0.6248	1.4090
7	1.4079	0.5791	1.4467	1.3241	0.1825
8	1.1311	0.4254	3.4380	1.9107	0.1292
9	8.8324	1.1807	1.2844	6.1427	0.6870
10	1.3641	1.1501	1.6321	1.3635	1.1851
11	1.3641	1.1501	1.6321	1.3635	1.1851

Table F20b (continued).

Fishing Mortality Calculated

AGE	1997	1998	1999	2000	2001
1	0.0000	0.0000	0.0002	0.0000	0.0000
2	0.0331	0.0281	0.0067	0.0352	0.0507
3	0.2522	0.2638	0.2347	0.2216	0.2979
4	0.7331	0.5461	0.5695	0.5337	0.4927
5	1.0524	0.6167	0.5220	0.3769	0.4994
6	0.8742	0.7161	0.4791	0.3620	0.3864
7	0.7168	0.9838	0.7526	0.2337	0.3888
8	0.1523	6.4333	0.9591	0.1311	0.1957
9	0.1066	0.0314	0.2164	0.0002	0.3866
10	1.0156	0.6873	0.5515	0.3465	0.4486
11	1.0156	0.6873	0.5515	0.3465	0.4486

AGE	2002	2003	2004	2005	2006
1	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0034	0.0045	0.0007	0.0009	0.0003
3	0.1189	0.1807	0.1274	0.1411	0.0271
4	0.3808	0.3053	0.7125	0.4741	0.4914
5	0.4985	0.6741	0.5164	0.6606	0.5260
6	0.5550	0.7507	0.5245	0.7653	0.4948
7	0.5582	0.6163	0.5806	0.4825	0.7225
8	0.4224	0.5975	0.4648	0.5426	0.3577
9	0.3310	0.4983	0.6597	0.4716	0.6789
10	0.5163	0.6793	0.5218	0.6406	0.5272
11	0.5163	0.6793	0.5218	0.6406	0.5272

AGE	2007
1	0.0000
2	0.0004
3	0.0388
4	0.1880
5	0.4892
6	0.6492
7	0.2288
8	0.3714
9	0.1484
10	0.4888
11	0.4888

Table F20c. VPA estimates of spawning stock biomass for Gulf of Maine cod.

Spawning Stock Biomass

AGE	1982	1983	1984	1985	1986
1	419.	158.	37.	19.	179.
2	3063.	1268.	866.	2102.	2226.
3	4035.	5238.	3928.	4797.	6913.
4	5361.	3431.	5870.	3147.	3186.
5	6169.	3270.	2040.	3621.	1435.
6	1406.	3307.	1669.	952.	1885.
7	1840.	618.	1377.	898.	492.
8	1160.	989.	326.	959.	446.
9	755.	469.	437.	239.	622.
10	96.	226.	223.	229.	168.
11	1283.	521.	449.	247.	1854.
Total	25587.	19494.	17223.	17211.	19406.

AGE	1987	1988	1989	1990	1991
1	35.	156.	155.	296.	145.
2	1910.	1854.	4192.	1452.	582.
3	4725.	6394.	7555.	15007.	1509.
4	4929.	3725.	5469.	6324.	12582.
5	1861.	2384.	2187.	2538.	3137.
6	696.	941.	864.	1128.	1311.
7	1089.	300.	719.	549.	420.
8	241.	587.	213.	420.	456.
9	182.	128.	424.	128.	148.
10	200.	52.	111.	310.	32.
11	58.	24.	262.	506.	21.
Total	15926.	16546.	22151.	28657.	20342.

AGE	1992	1993	1994	1995	1996
1	91.	121.	1.	0.	35.
2	834.	773.	1040.	160.	640.
3	1554.	3593.	4418.	8266.	2639.
4	1223.	2196.	3020.	3637.	6680.
5	6355.	786.	928.	927.	1406.
6	1131.	2183.	410.	256.	252.
7	607.	456.	623.	133.	213.
8	104.	193.	188.	153.	53.
9	38.	32.	93.	4.	32.
10	51.	0.	9.	26.	0.
11	0.	0.	24.	5.	0.
Total	11988.	10334.	10755.	13566.	11949.

Table F20c (continued).

Spawning Stock Biomass

AGE	1997	1998	1999	2000	2001
1	12.	60.	104.	110.	24.
2	456.	1125.	897.	1771.	757.
3	3326.	3345.	3634.	3438.	5603.
4	2098.	3361.	2727.	4467.	4030.
5	3155.	1180.	2129.	1990.	3654.
6	463.	1290.	735.	1519.	1784.
7	73.	189.	779.	468.	1198.
8	210.	14.	84.	473.	367.
9	45.	203.	0.	49.	357.
10	15.	31.	159.	0.	41.
11	3.	15.	0.	0.	33.
Total	9856.	10814.	11246.	14285.	17848.

AGE	2002	2003	2004	2005	2006
1	176.	54.	295.	34.	523.
2	289.	1334.	313.	773.	1665.
3	3440.	902.	3657.	630.	8704.
4	6729.	4079.	999.	3782.	1590.
5	2953.	5179.	2993.	632.	3366.
6	2408.	1889.	2810.	1855.	371.
7	1186.	1441.	982.	1767.	893.
8	939.	658.	826.	557.	1108.
9	314.	608.	389.	500.	307.
10	217.	211.	319.	204.	288.
11	21.	185.	111.	239.	326.
Total	18673.	16539.	13693.	10974.	19139.

AGE	2007
1	70.
2	5911.
3	7924.
4	14568.
5	1267.
6	2162.
7	237.
8	471.
9	836.
10	161.
11	271.
Total	33877.

Table F21. Average Fully recruited fishing mortality (F) for Gulf of Maine cod. The unweighted values in column 1 are used to indicate annual fishing mortality on this stock.

Average Fishing Mortality For Ages 5-7

Year	Average F	N Weighted	Biomass Wtd	Catch Wtd
1982	0.5465	0.6031	0.5896	0.6066
1983	0.8677	0.9426	0.9506	0.9488
1984	0.7543	0.8523	0.7919	0.8772
1985	0.8478	0.8698	0.8641	0.8702
1986	0.8502	0.8588	0.8383	0.8695
1987	0.9605	0.9719	0.9537	0.9778
1988	0.5815	0.8761	0.8204	0.9533
1989	0.7225	0.8662	0.8154	0.8839
1990	0.8635	0.9800	0.9711	1.0061
1991	1.2290	1.2161	1.1983	1.2252
1992	1.3620	1.3651	1.3643	1.3652
1993	0.9562	1.2385	1.2349	1.3016
1994	1.5123	1.5992	1.5540	1.6032
1995	1.1792	1.4161	1.3970	1.4752
1996	0.9545	1.2348	1.1860	1.2724
1997	0.8811	1.0350	1.0243	1.0369
1998	0.7722	0.6858	0.6925	0.6928
1999	0.5846	0.5508	0.5638	0.5605
2000	0.3242	0.3611	0.3550	0.3645
2001	0.4249	0.4598	0.4506	0.4648
2002	0.5373	0.5233	0.5298	0.5244
2003	0.6804	0.6834	0.6816	0.6848
2004	0.5405	0.5252	0.5285	0.5256
2005	0.6362	0.6564	0.6361	0.6736
2006	0.5811	0.5512	0.5613	0.5572
2007	0.4557	0.5685	0.5686	0.5845

Table F22. VPA model Diagnostics and Stock size estimates from the NLLS Solution for Gulf of Maine cod.

Levenburg-Marquardt Algorithm Completed 21 Iterations

Residual Sum of Squares = 279.707
Number of Residuals = 508
Number of Parameters = 9
Degrees of Freedom = 499
Mean Squared Residual = 0.560535
Standard Deviation = 0.748689
Number of Years = 26
Number of Ages = 11
First Year = 1982
Youngest Age = 1
Oldest True Age = 10
Number of Survey Indices Available = 25
Number of Survey Indices Used in Estimate = 23
VPA Classic Method - Auto Estimated Q's

Stock Numbers Predicted in Terminal Year Plus One (2008)

Age	Stock Predicted	Std. Error	CV
2	3936.752	0.173583E+04	0.440929E+00
3	16020.398	0.499998E+04	0.312101E+00
4	3542.738	0.930299E+03	0.262593E+00
5	3970.448	0.103469E+04	0.260597E+00
6	201.340	0.776978E+02	0.385903E+00
7	251.280	0.110401E+03	0.439357E+00
8	29.920	0.163265E+02	0.545679E+00
9	46.873	0.324104E+02	0.691456E+00
10	71.277	0.516470E+02	0.724592E+00

Catchability Values for Each Survey Used in Estimate

INDEX	Catchability	Std. Error	CV
1	0.639060E-04	0.988283E-05	0.154646E+00
2	0.131940E-03	0.141520E-04	0.107261E+00
3	0.225008E-03	0.228294E-04	0.101460E+00
4	0.293998E-03	0.386906E-04	0.131602E+00
5	0.382779E-03	0.641901E-04	0.167695E+00
6	0.566609E-03	0.109588E-03	0.193411E+00
7	0.511812E-03	0.139644E-03	0.272843E+00
8	0.533836E-04	0.687041E-05	0.128699E+00
9	0.113582E-03	0.128656E-04	0.113272E+00
10	0.223833E-03	0.225992E-04	0.100965E+00
11	0.370258E-03	0.463840E-04	0.125275E+00
12	0.478237E-03	0.565335E-04	0.118212E+00
13	0.451154E-03	0.836411E-04	0.185394E+00
14	0.566767E-03	0.129170E-03	0.227906E+00
15	0.710558E-03	0.107424E-03	0.151183E+00
16	0.544643E-03	0.474923E-04	0.871988E-01
17	0.453706E-03	0.562280E-04	0.123930E+00
19	0.122958E-03	0.367937E-04	0.299238E+00
21	0.245830E-05	0.690050E-06	0.280702E+00
22	0.140563E-04	0.164576E-05	0.117084E+00
23	0.231650E-04	0.128111E-05	0.553035E-01
24	0.229116E-04	0.123947E-05	0.540979E-01
25	0.218712E-04	0.246650E-05	0.112774E+00

Table F23. Bootstrap estimates of precision and bias on 2008 N and 2007 F estimates at age from the Gulf of Maine cod VPA.

Bootstrap Summary Report
 Number of Bootstrap Repetitions Requested = 1000
 Number of Bootstrap Repetitions Completed = 1000

Bootstrap Output Variable: Stock Estimates (2008)

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.
N 2	3937.	4778.	3549.	0.7428
N 3	16020.	17071.	6345.	0.3717
N 4	3543.	3648.	986.	0.2703
N 5	3970.	4078.	1050.	0.2575
N 6	201.	214.	80.	0.3741
N 7	251.	270.	126.	0.4652
N 8	30.	34.	19.	0.5717
N 9	47.	56.	45.	0.7909
N 10	71.	86.	70.	0.8079

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
N 2	841.	115.	21.3697	3095.	1.1466
N 3	1050.	203.	6.5570	14970.	0.4239
N 4	105.	31.	2.9687	3438.	0.2868
N 5	107.	33.	2.6968	3863.	0.2718
N 6	13.	3.	6.5231	188.	0.4263
N 7	19.	4.	7.4963	232.	0.5406
N 8	4.	1.	13.6268	26.	0.7521
N 9	9.	1.	20.1704	37.	1.1906
N 10	15.	2.	21.1718	56.	1.2418

Bootstrap Output Variable: Fishing Mortality (2007)

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.
AGE 1	0.0000	0.0000	0.000000	0.7193
AGE 2	0.0004	0.0005	0.000180	0.3776
AGE 3	0.0388	0.0403	0.010717	0.2657
AGE 4	0.1880	0.1940	0.047462	0.2446
AGE 5	0.4892	0.5077	0.151260	0.2979
AGE 6	0.6492	0.7011	0.268324	0.3827
AGE 7	0.2288	0.2890	0.246963	0.8546
AGE 8	0.3714	0.5913	0.645212	1.0911
AGE 9	0.1484	0.3630	0.603834	1.6637
AGE 10	0.4888	0.5279	0.202048	0.3827
AGE 11	0.4888	0.5279	0.202048	0.3827

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
AGE 1	0.000000	0.000000	25.9547	0.0000	1.2235
AGE 2	0.000031	0.000006	6.9738	0.0004	0.4343
AGE 3	0.001556	0.000342	4.0140	0.0372	0.2880
AGE 4	0.006058	0.001513	3.2227	0.1819	0.2609
AGE 5	0.018527	0.004819	3.7875	0.4706	0.3214
AGE 6	0.051977	0.008643	8.0070	0.5972	0.4493
AGE 7	0.060197	0.008039	26.3126	0.1686	1.4650
AGE 8	0.219925	0.021557	59.2126	0.1515	4.2591
AGE 9	0.214574	0.020266	144.6129	-0.0662	-9.1219
AGE 10	0.039139	0.006508	8.0070	0.4497	0.4493
AGE 11	0.039139	0.006508	8.0070	0.4497	0.4493

Table F24. Input data and F reference point estimates from yield and SSB per recruit analyses for Gulf of Maine cod.

Yield and SSB per Recruit Input Data

Age	Partial Recruitment	Sel on M	Mean Wts Stock	Mean Wts Catch	Mean Wts Sp Stock	Maturity
1	0	1	0.198	0.416	0.198	0.077
2	0.0021	1	0.877	1.862	0.877	0.272
3	0.1618	1	2.008	2.352	2.008	0.627
4	0.6821	1	2.698	3.12	2.698	0.883
5	0.9004	1	3.504	3.926	3.504	0.971
6	1	1	4.413	4.939	4.413	0.993
7	0.8264	1	5.791	6.505	5.791	0.999
8	0.7333	1	7.31	8.135	7.31	1
9	0.772	1	9.739	10.562	9.739	1
10	0.753	1	11.499	12.505	11.499	1
11+	0.753	1	14.139	14.139	14.139	1

Yield and SSB per Recruit Results

F	F	YpR	SSBpR	TBpR	Mean Age	Mean Gen	Exp Spws
Zero	0	0	21.31971	23.48204	5.14351	9.80601	2.50221
F0.1	0.2328	1.47453	8.63823	10.60663	3.54135	7.14426	1.58877
Fmax	0.5351	1.61796	4.58581	6.43139	2.85064	5.28891	1.09851
F40%	0.2372	1.48155	8.52856	10.49424	3.52445	7.10535	1.57786

Table F25. Projected catch and SSB in 2009 under 3 F scenarios in 2009 (Fsq, F_{MSY} and $F_{REBUILD}$), assuming catch in 2008 equals catch in 2007, for Gulf of Maine cod.

F2009 = Fstatus quo = F2007 = 0.456

	2007	2008	2009
F	0.456	0.203	0.456
SSB (mt)	33,877	46,433	56,619
Catch (mt)	5,628	5,628	19,191

F2009 = Frebuild = 0.281

	2007	2008	2009
F	0.456	0.203	0.281
SSB (mt)	33,877	46,433	57,797
Catch (mt)	5,628	5,628	12,591

F2009 = Fmsy = 0.237

	2007	2008	2009
F	0.456	0.203	0.237
SSB (mt)	33,877	46,433	58,091
Catch (mt)	5,628	5,628	10,798

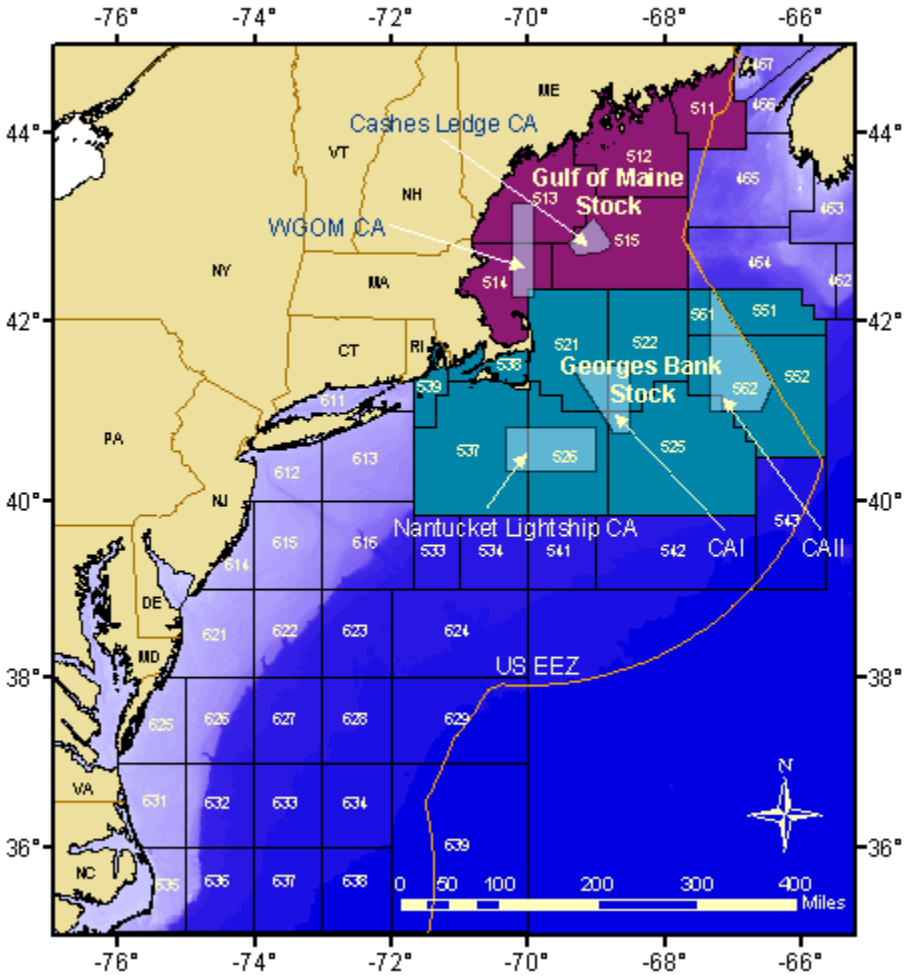

Figure 1.1. Statistical areas used to define the Gulf of Maine and Georges Bank cod stocks.

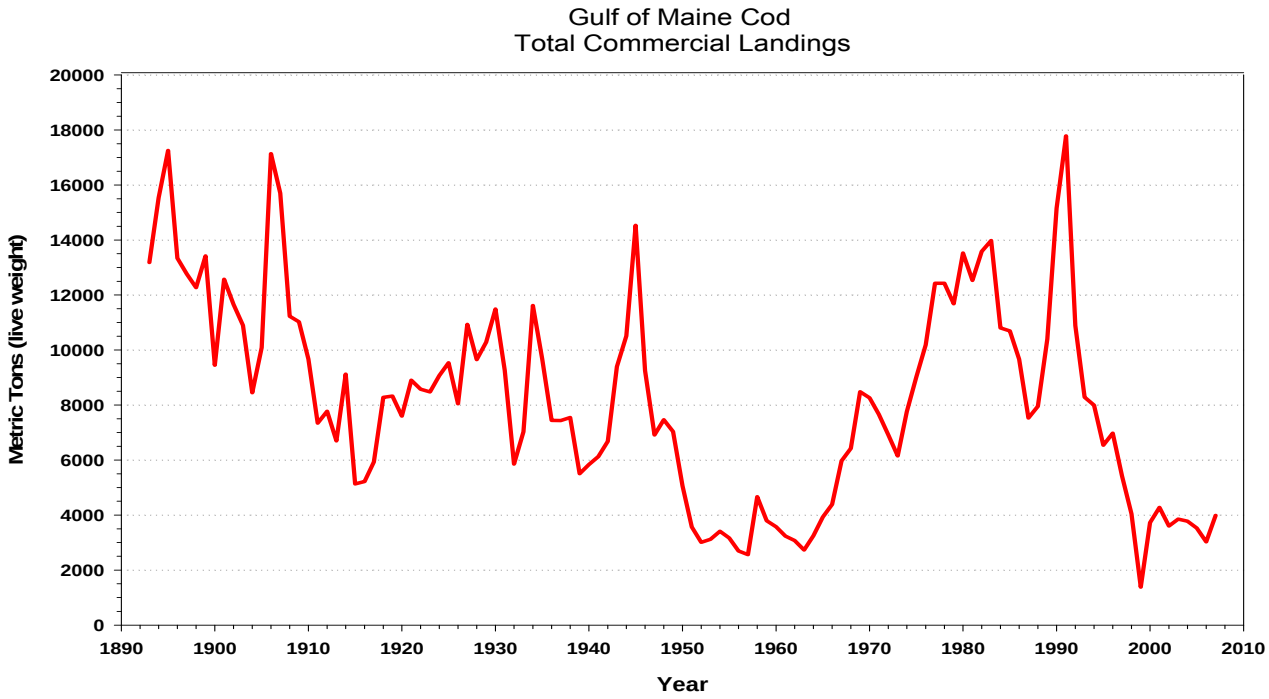

Figure F2. Total landings (mt) of Atlantic cod from the Gulf of Maine stock, 1893-2007.

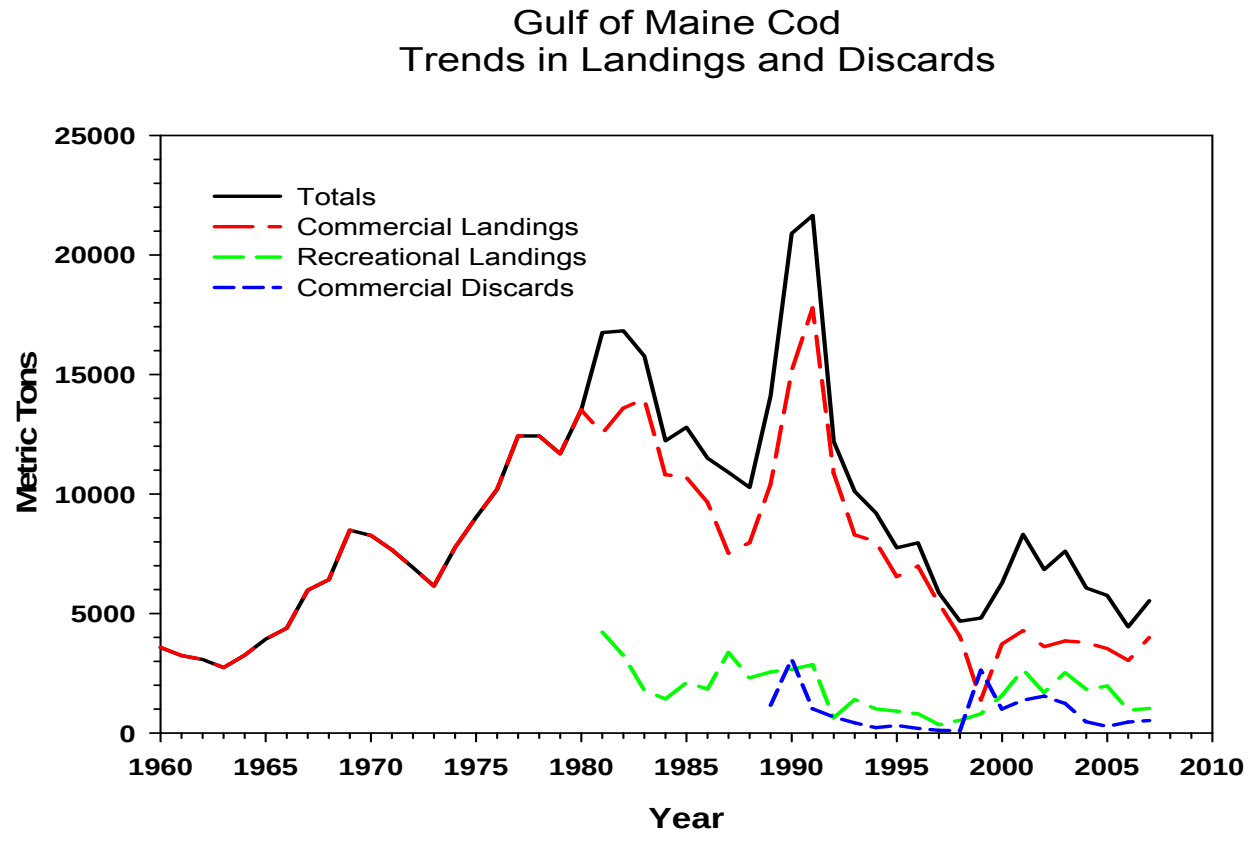

Figure F3. Commercial and recreational landings and commercial discards of Atlantic cod from the Gulf of Maine stock from 1960 to present.

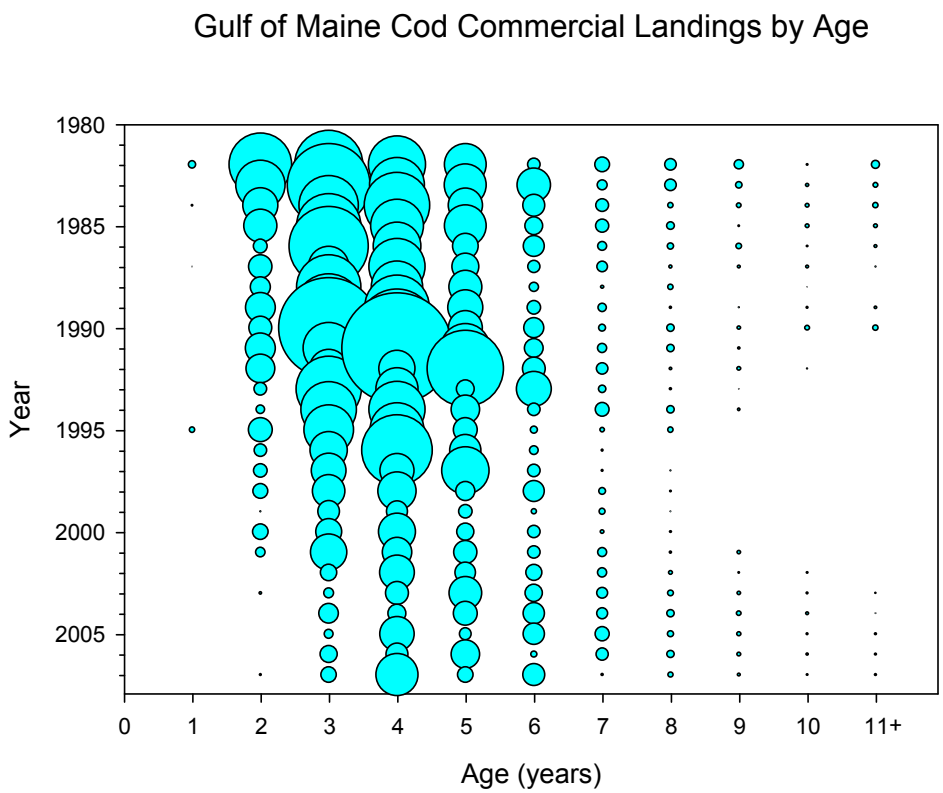

Figure F4. Age composition of total catch (commercial landings and discard and recreational landings) for Gulf of Maine cod.

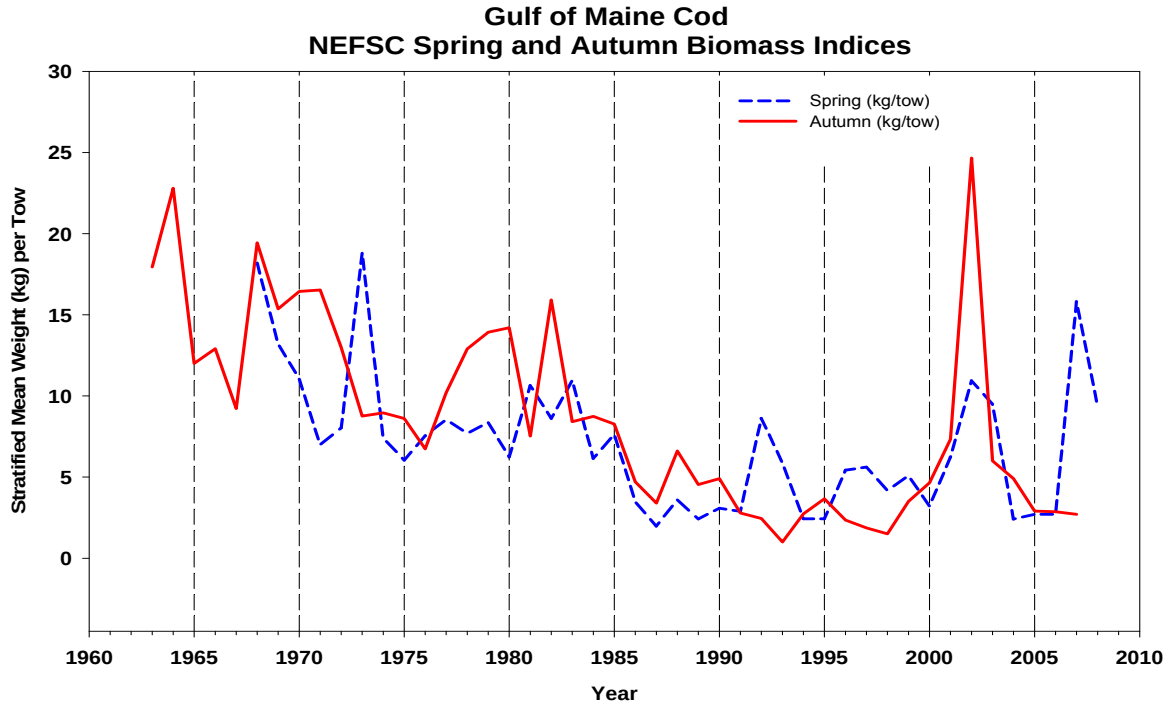

Figure F5. Trends in biomass (stratified mean weight, kg, per tow) of Atlantic cod in the Gulf of Maine based on NEFSC spring and autumn surveys, 1963-2008.

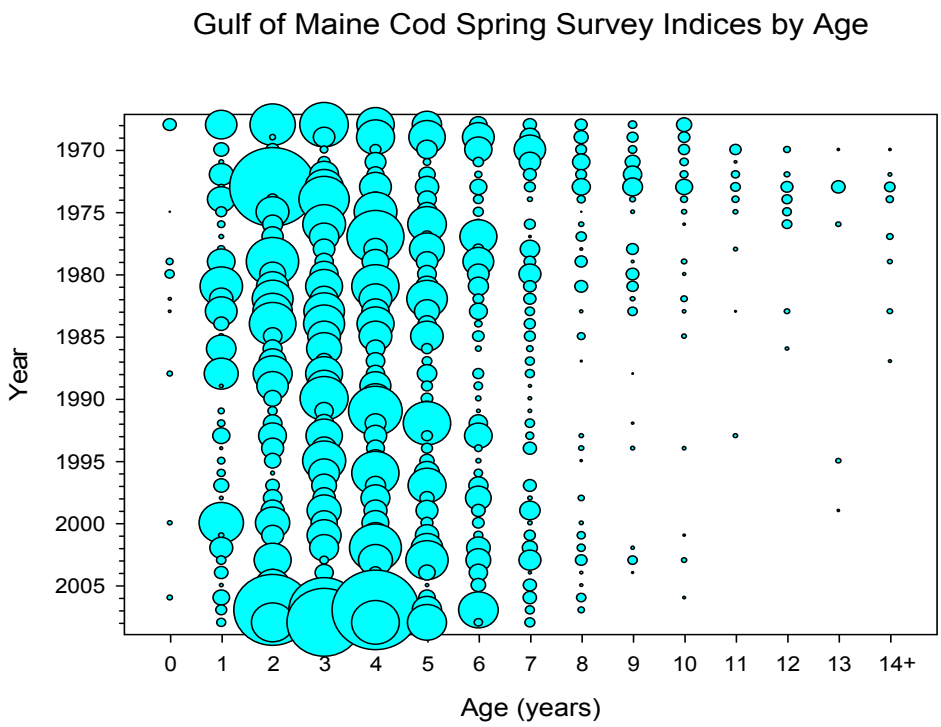

Figure F6. Relative abundance of Atlantic cod by age in the Gulf of Maine based on NEFSC spring bottom trawl surveys, 1970-2008.

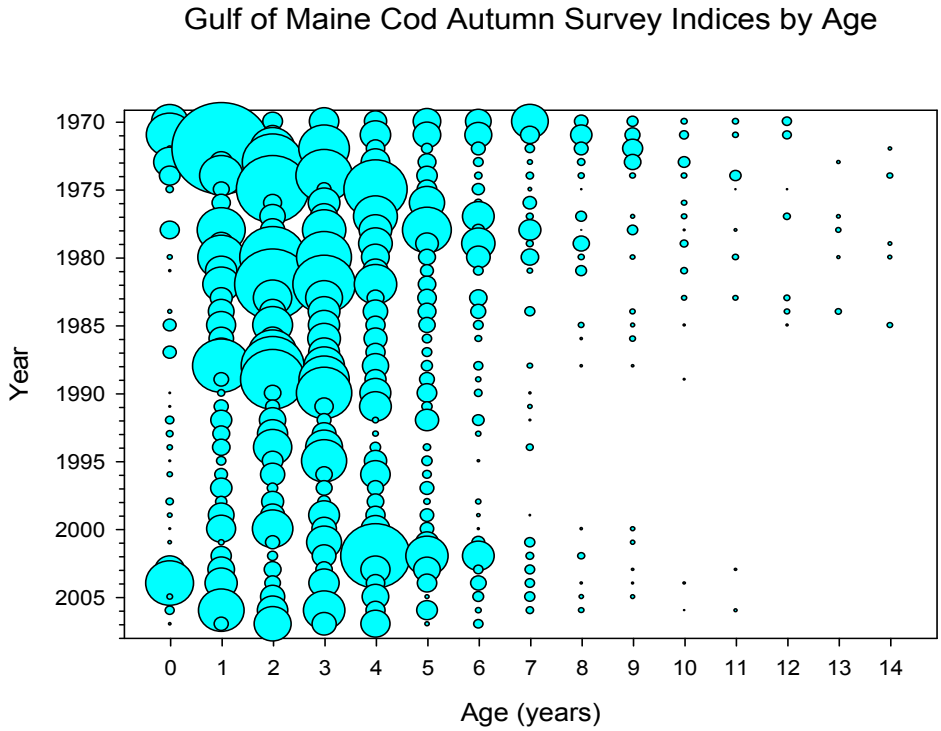

Figure F7. Relative abundance of Atlantic cod by age n the Gulf of Maine based on NEFSC autumn bottom trawl surveys, 1970-2007.

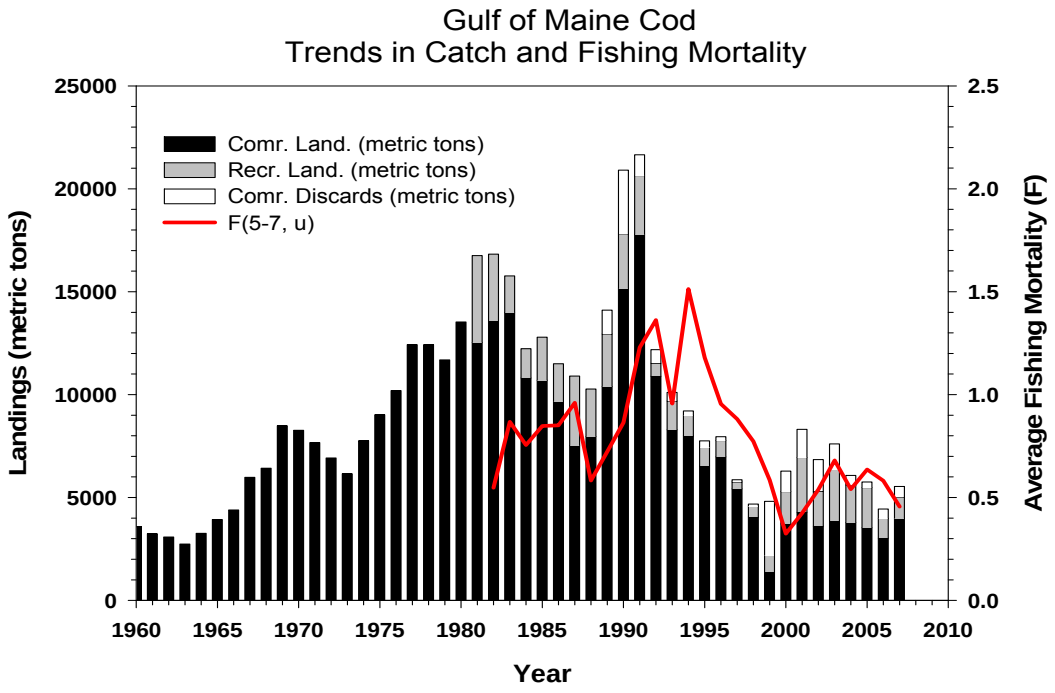

Figure F8. Trends in commercial and recreational landings and commercial discards compared to estimates of instantaneous fishing mortality (avg of ages 5-7) for Gulf of Maine cod.

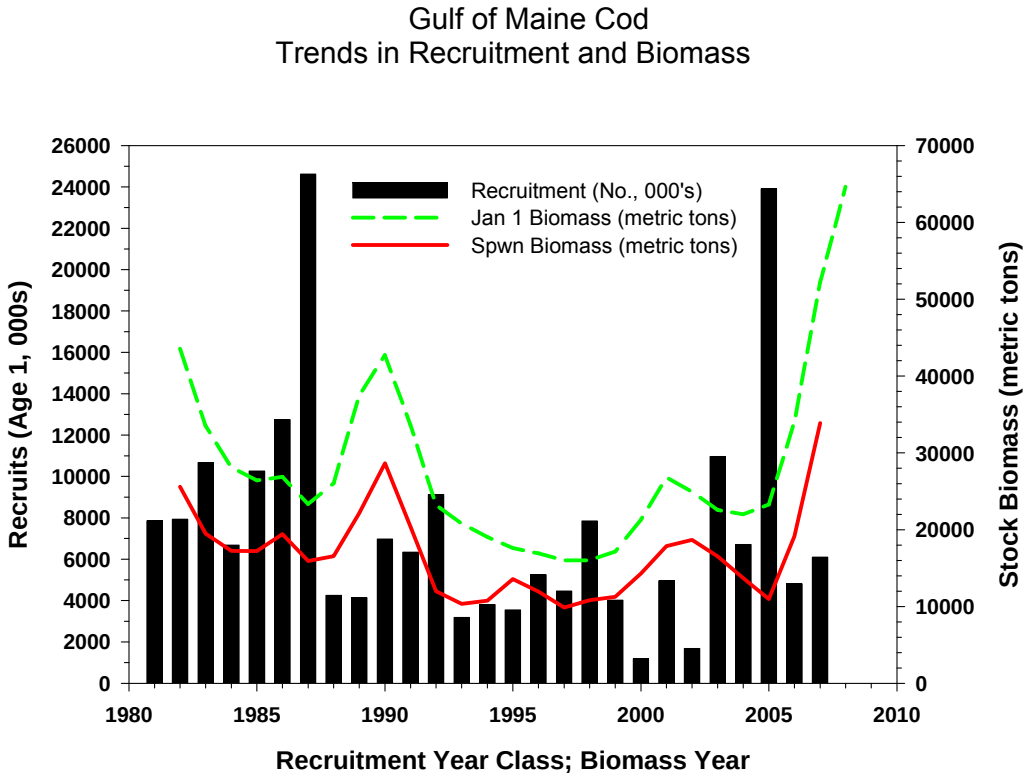

Figure F9. Trends in spawning stock biomass (SSB) and age 1 recruitment) for Gulf of Maine cod.

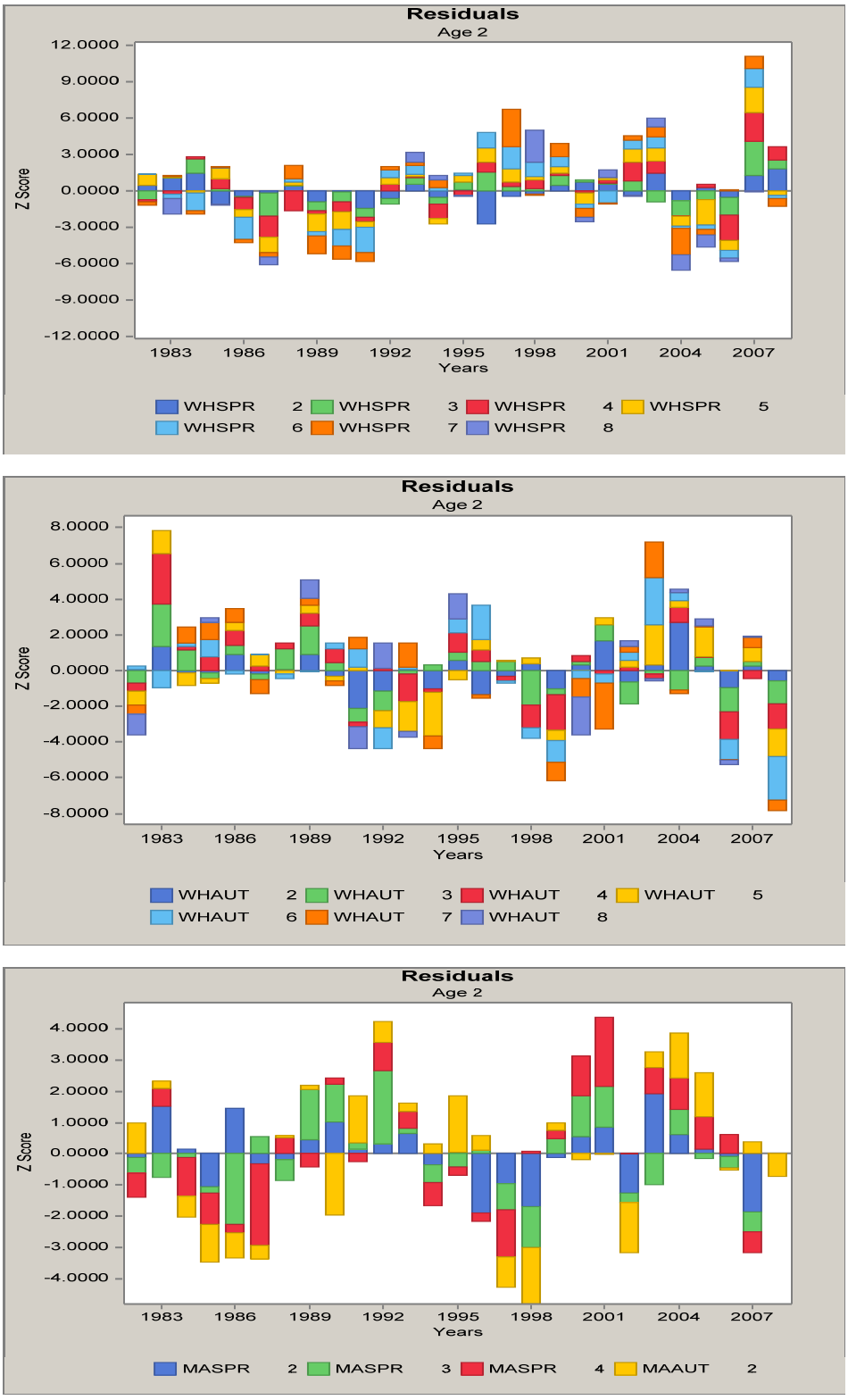

Figure F10. Residual patters for NEFSC spring (top), autumn (middle) and Massachusetts DMF (bottom) bottom trawl surveys for ages used to calibrate the Gulf of Maine cod VPA.

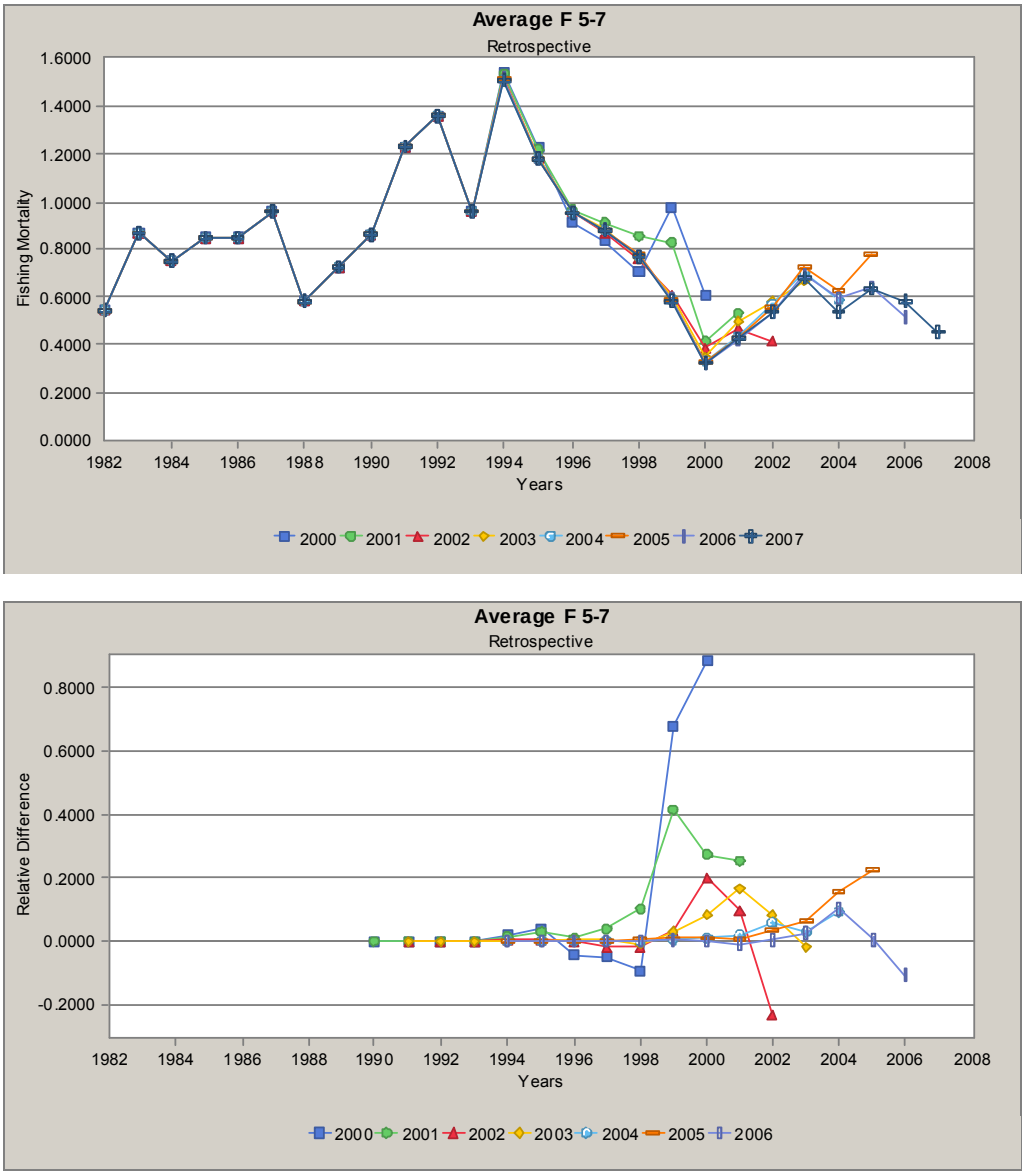

Figure F11. Retrospective plots (standard top, relative difference bottom) of average F (ages 5-7) for Gulf of Maine cod. Mohn's average Rho based on relative difference = 0.157.

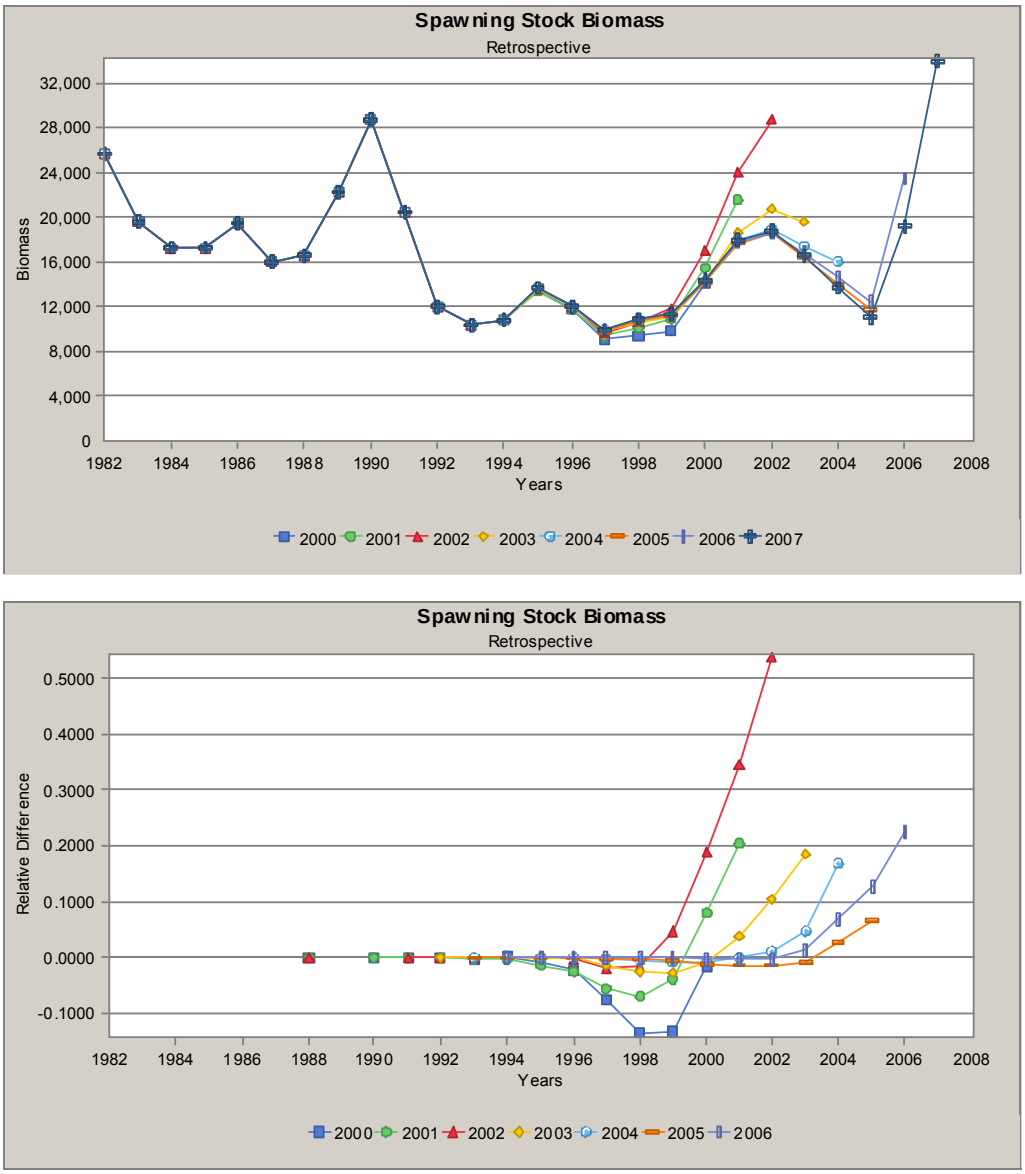

Figure F12. Retrospective plots (standard top, relative difference bottom) of spawning stock biomass for Gulf of Maine cod. Mohn's average Rho based on relative difference = 0.195.

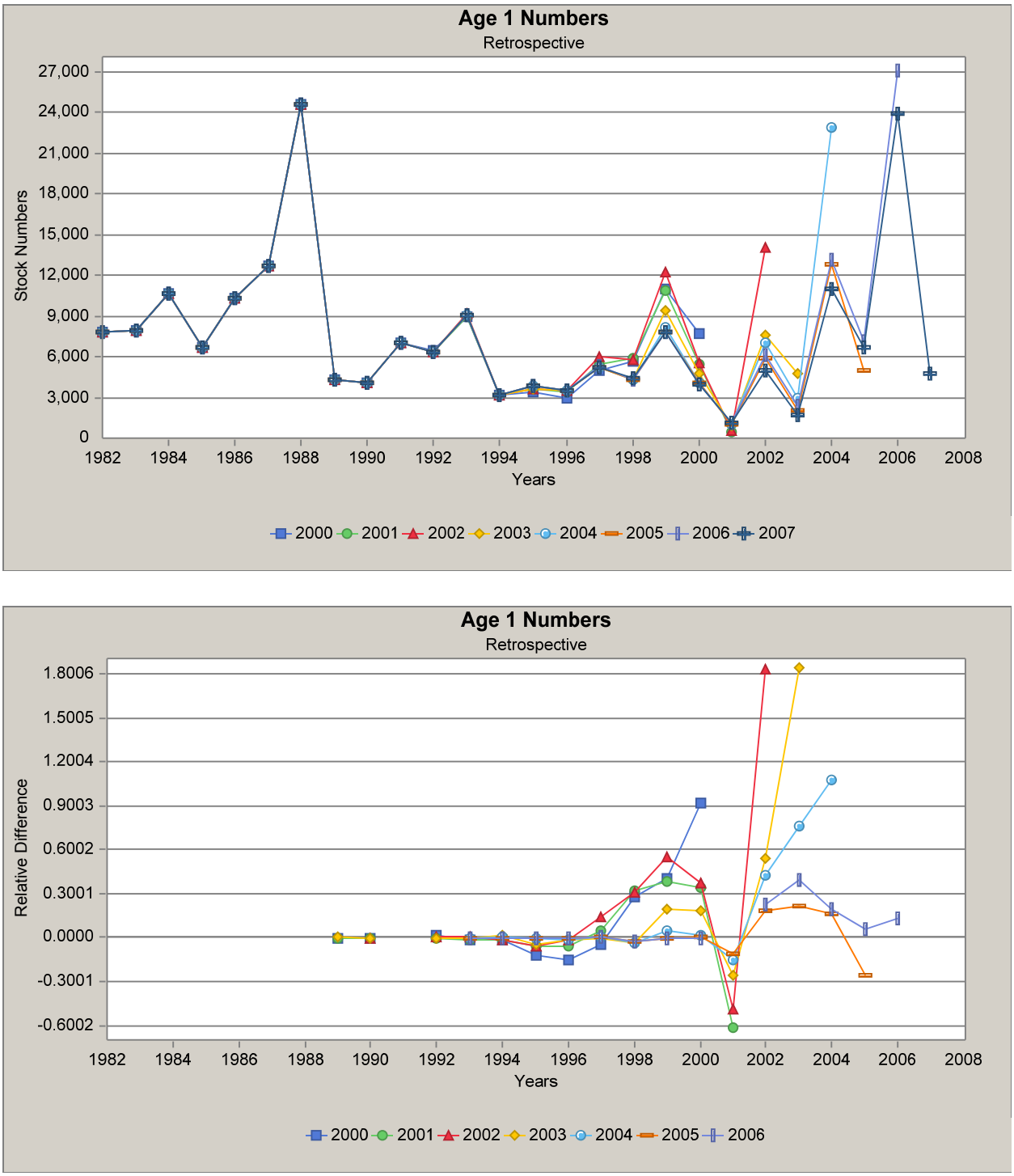

Figure F13. Retrospective plots (standard top, relative difference bottom) of age 1 recruitment for Gulf of Maine cod. Mohn's average Rho based on relative difference = 0.707.

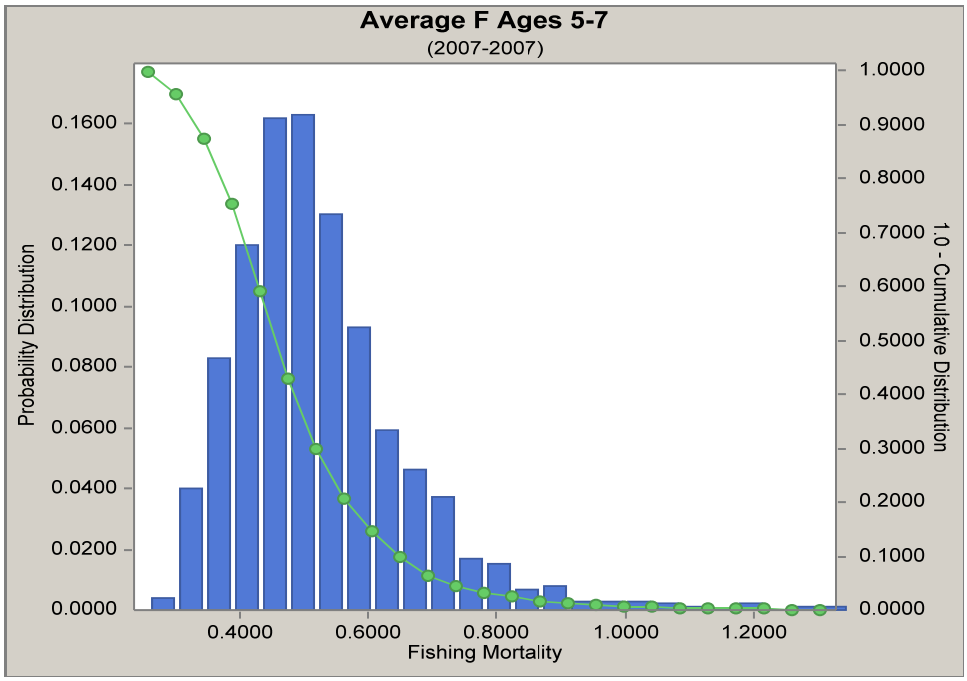

Figure F14. Distribution of estimates of 2007 average F (ages 5-7) based on 1000 bootstrap iterations for Gulf of Maine cod. The 10-90 percentile range is 0.36 – 0.67.

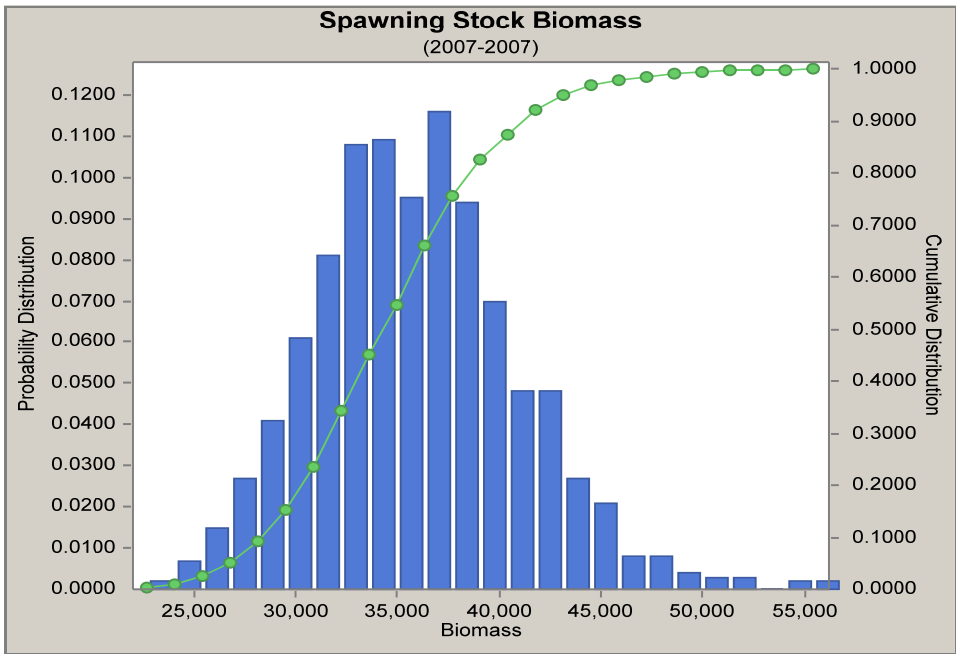

Figure F15. Distribution of estimates of 2007 spawning stock biomass based on 1000 bootstrap iterations for Gulf of Maine cod. The 10-90 percentile range is 29,133 mt – 41, 747 mt.

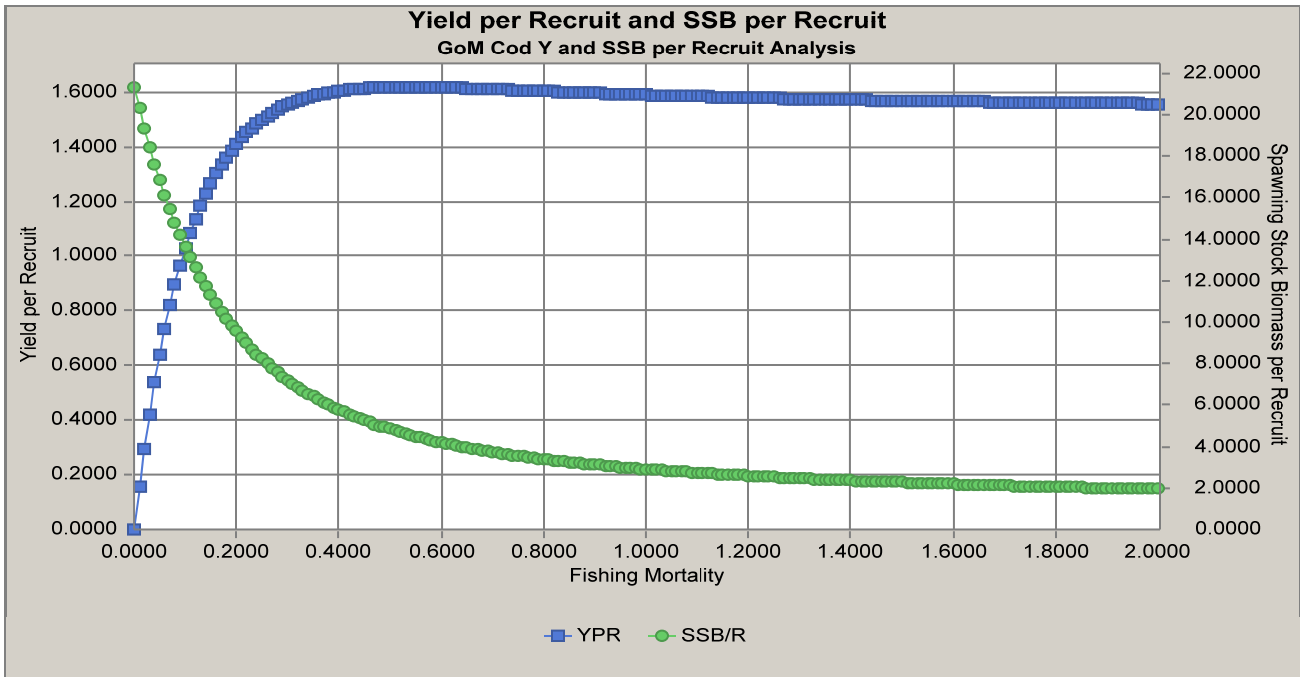

Figure F16. Yield and SSB per Recruit results for Gulf of Maine cod. Input data and output values are given in Table F23.

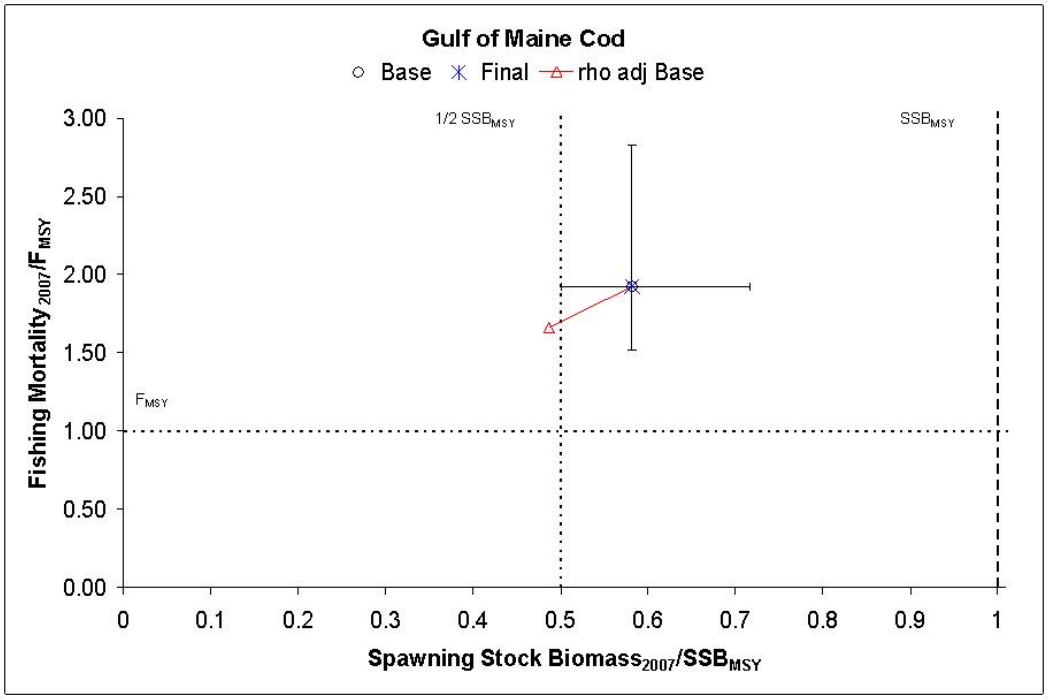

Figure F17. Status determination of Gulf of Maine cod in 2007.