

**Ten-Year Projections of Landings,
Spawning Stock Biomass,
and Recruitment
for Five New England
Groundfish Stocks**

by

**William J. Overholtz, Steven A. Murawski,
Paul J. Rago, Wendy L. Gabriel,
Mark Terceiro, and Jon K.T. Brodziak**

April 1999

A Report of the 24th Northeast Regional Stock Assessment Workshop

**Ten-Year Projections of Landings,
Spawning Stock Biomass, and Recruitment
for Five New England Groundfish Stocks**

by

**William J. Overholtz, Steven A. Murawski, Paul J. Rago,
Wendy L. Gabriel, Mark Terceiro, and Jon K.T. Brodziak**

National Marine Fisheries Serv., 166 Water St., Woods Hole, MA 02543-1026

**U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Region
Northeast Fisheries Science Center
Woods Hole, Massachusetts**

April 1999

Northeast Fisheries Science Center Reference Documents

This series is an informal report series designed to assure the long-term documentation and to enable the timely transmission of research results emanating from various Center laboratories. The reports in this series receive internal scientific review but no technical or copy editing. The National Marine Fisheries Service does not endorse any proprietary material, process, or product mentioned in these reports. To obtain additional copies of reports in this series, contact the senior Center author of the desired report. Refer to the title page of the desired report for the senior Center author's name and mailing address.

This report's publication history is as follows: manuscript submitted for review--June 10, 1997; manuscript accepted through technical review--April 8, 1999; manuscript accepted through policy review--April 16, 1999; and camera-ready copy submitted for publication--April 21, 1999. This report may be cited as:

Overholtz, W.J.; Murawski, S.A.; Rago, P.J.; Gabriel, W.L.; Terceiro, M.; Brodziak, J.K.T. 1999. Ten-year projections of landings, spawning stock biomass, and recruitment for five New England groundfish stocks. *Northeast Fish. Sci. Cent. Ref. Doc.* 99-05; 74 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

TABLE of CONTENTS

ABSTRACT.....	v
INTRODUCTION.....	1
PROJECTION METHODOLOGY.....	2
STOCK RESULTS.....	6
Georges Bank Cod.....	7
Georges Bank Haddock.....	7
Georges Bank Yellowtail.....	8
Gulf of Maine Cod.....	9
Southern New England Yellowtail.....	9
ADDITIONAL HADDOCK ANALYSES.....	10
SUMMARY.....	12
ACKNOWLEDGMENTS.....	13
REFERENCES CITED.....	14
TABLES.....	15
FIGURES.....	48

ABSTRACT

Projections for a 10-year horizon (1997-2006) for five New England groundfish stocks indicate that if current fishing mortality trends continue, the threshold spawning stock biomass targets for Georges Bank cod, and the Georges Bank and Southern New England yellowtail flounder stocks could be met in the medium-term. The probability of recovery for the Georges Bank haddock stock to the 80,000 mt threshold level was estimated at $P=0.38$, 0.52 , and 0.68 for fishing rates of $F_{0.1}$, F_{96} , and $F=0.1$, respectively. Ten-year projections for this stock indicate that the threshold could be reached in 2006 for F_{96} and in 2003 for $F=0.1$. Results for the Gulf of Maine cod stock, indicate that if the stock were fished at the $F_{\max}=0.29$ target, SSB would recover to about 50,000 mt by 2006. If the current fishing mortality trend continues for this stock the SSB will continue to decline.

Results from this study indicate that significant improvement in landings, spawning stock biomass, and recruitment trends are possible if current (1996) levels of fishing mortality on the Georges Bank stocks and on Southern New England yellowtail flounder are maintained for the foreseeable future. The Gulf of Maine cod stock is currently overfished and at a low level of biomass. A major reduction in fishing mortality would be required to improve the status of this stock and begin rebuilding SSB.

Introduction:

Amendment 7 to the Multispecies Fishery Management Plan (FMP) became effective on May 1, 1996. This FMP is promulgated by the New England Fishery Management Council and includes the 13 major groundfish stocks found off the New England coast. Analyses supporting the plan include a series of 10-year projections for Georges Bank cod, Georges Bank haddock, Georges Bank yellowtail flounder, Gulf of Maine cod, and Southern New England yellowtail flounder. These projections are used to assess the probabilities of rebuilding spawning stock biomass to minimum threshold levels established for each stock (Table 1) and the economic consequences of different rebuilding strategies. These threshold values were determined from historic stock-recruitment data for the groundfish stocks and were assumed to be minimum acceptable stock sizes; they were not management target levels (NEFMC 1996). No threshold value for the Gulf of Maine cod stock was established due to the shortness of the spawning biomass and recruitment time series (NEFMC 1996).

The starting year for the 10-year projections conducted in support of Amendment 7 was 1994, except for Southern New England yellowtail flounder which began in 1993, and Georges Bank haddock which began in 1995. At the time these first projections were completed, the five stocks were overfished (F levels exceeding F-replacement targets) and spawning stock biomass levels were low. The prognosis was that fishing rates would have to be reduced

dramatically in order for stock recovery to occur for these five important groundfish resources. Results from the 10-year projections indicated that if fishing mortality were reduced to $F_{0.1}$ (the rebuilding fishing mortality rate target in Amendment 7), it would be possible for both yellowtail flounder stocks, as well as Georges Bank cod, to reach the established SSB thresholds within the 10 year time frame. The 10-year assessment for Georges Bank haddock suggested that recovery to the threshold would require a fishing rate below $F_{0.1}$. A fishing rate of $F=0.1$ produced an average SSB of 85,000 mt in year 10 with probability $P=0.43$ (NEFMC 1996).

Results from the 1997 stock assessments for the five groundfish stocks (NEFSC 1997) suggest that with the exception of Gulf of Maine cod, fishing rates have declined substantially to below $F_{0.1}$ levels, and spawning stock biomasses are generally increasing or have stabilized. Since fishing mortality appears to have declined dramatically in 1995 and 1996 for these stocks, 10-year projections were revised to reassess the medium-term prognoses for rebuilding these stocks.

Projection Methodology:

The 10-year forecasts began on Jan 1, 1997 for each stock. Starting stock sizes for each 10-year projection were obtained from Virtual Population Analyses (VPA) tuned with unweighted non-linear least squares methods (ADAPT: Gavaris 1988; Conser and

Powers 1990). ADAPT results were resampled, utilizing residuals of observed-predicted survey abundance indices, to produce an input matrix of 200 bootstrap starting stock size vectors at age for each stock. Natural mortality rates used in the analyses were assumed to equal $M=0.2$, the same values used in the assessments. Mean weight at age, partial recruitments, and maturity schedules were the same as used in the new assessments, generally means of 1994-1996 values. For Southern New England and Georges Bank yellowtail flounder, discard fractions at age were estimated from ratio of discards to landings for 1994-1996 and used to estimate discards in the 10-year scenarios as a constant fraction of landings.

Time series of stock recruitment data for each of the groundfish stocks were assembled (Figures 1-5A). A Beverton-Holt stock recruitment relationship was used to estimate recruitment for a given level of SSB for each of the five stocks. Variability in the predicted recruitment of these stocks was assumed to follow a log normal process (Hilborn and Walters 1992). Nonlinear regression was used to estimate the parameters of the Beverton and Holt model as:

$$R = \frac{a * SSB}{b + SSB} * e^w$$

where the error term w is assumed to be distributed $\sim N(0, s^2)$.

The stock-recruitment equation was structured according to Hilborn and Walters (1992) and fitted with a Gauss-Newton

iterative search algorithm (SAS 1990) following methods developed in Brodziak (1994). The estimated parameters for these stock recruitment model fits are presented in Table 2. The a and b parameters from these estimations are in general agreement with previous results used in Amendment 7 (NEFMC 1996). Any differences are due to the addition of several years of new data to each series and some slight changes in stock and recruitment estimates for some years in the ADAPT tuning process.

Projections (Brodziak and Rago 1996) using the fitted Beverton-Holt stock-recruitment relationships were accomplished in the following manner: (1) each of the bootstrap realizations of initial (1997) stock size from ADAPT were used separately as the starting point for a 10-year projection sequence (2) recruitment for each year of the projection was computed using the fitted S/R relationship and the projected SSB. A total of 100 ten-year projections were made for each initial vector of stock size (3) two different fishing strategies ($F_{0.1}$ and F_{96} =fishing rate in 1996) were evaluated for each stock. A third strategy, $F=0.1$ was evaluated for Georges Bank haddock, as well as a no fishing strategy ($F=0.00$) for Gulf of Maine cod..

The Beverton-Holt equation with multiplicative lognormal error, has the potential to generate recruitment values that are outside the range of the available empirical data series (Brodziak 1994). Therefore, as in the previous 10-year projection analyses (Brodziak 1994; Rago and Brodziak 1994), recruitment was constrained to values within the observed time-

series for each stock. This was accomplished by using a threshold SSB level, below which only R/SSB values that were within the 80% CI of the empirical distribution were allowed. If the SSB level was greater than the observed minimum SSB, then the R/SSB value was allowed within the range $R/SSB_{\min}$ to $R/SSB_{\max}$ for the empirical R/SSB distribution. Values for these constraints from the empirical stock-recruitment series are presented in Table 3.

In the case of the Gulf of Maine cod, recent R/SSB and spawning stock biomass levels are low and declining, and the fishing rate in 1996 was far above biological reference points. Projections at low spawning stock sizes may be overly optimistic if survival rates (measured as R/SSB) are non stationary (e.g., declining with stock size or in recent time), and short-term prospects for resource recovery are low due to declining SSB and high fishing rates. Therefore, a more conservative medium-term projection was used for this stock. The upper constraint on R/SSB was set to the long-term median value for the series (0.3 recruits/kg SSB), and the lower R/SSB constraint was set to 0.00. The constraints were applied when SSB was below the observed minimum SSB of 8,800 mt. These revised constraints were used for three medium-term projections for Gulf of Maine cod: $F_{96}=1.04$, $F_{\max}=0.29$, and $F=0.0$.

Residuals from the nonlinear estimations for the five stocks were inspected for time trends in differences between observed and predicted recruitment (Figures 1-5B). There appear to be no

observable trends in residuals for these stocks although patterning does occur in some cases. Autocorrelation plots (ACF's) were also used to test for any serial auto correlation for lags of one to six years (Figure 1-5C). No significant autocorrelations were found, except for the Southern New England yellowtail flounder stock at a lag of one year.

The maximum recruitment values the parameter a for each stock, are presented in Table 4. Maximum recruitment values ranged from 7,868 thousand fish for Gulf of Maine cod to 61,806 thousand fish for Georges Bank yellowtail flounder (Table 4). The residuals from the model fits were tested for the assumption of lognormality (Table 4). In all cases the assumption of lognormal residual patterns for the five groundfish stock could not be rejected at the 0.05 level.

Stock Results:

Landings, spawning stock biomass and recruitment were projected for 10 years for each stock. Fishing mortality rates of $F_{0.1}$ and F_{96} were used in the analyses. Additional fishing rate scenarios of $F=0.1$ was produced for the Georges Bank haddock stock and $F=0.0$ for Gulf of Maine cod. Because 100 individual projections were made for each run, probabilities associated with achieving the defined SSB thresholds could be calculated, as well a percentiles of SSB, recruitment, and landings for each year in the projection.

Georges Bank cod

Total landings from this stock follow a similar pattern of increase for both the $F_{0.1}$ and F_{96} fishing rates since the values are virtually identical (0.17 vs 0.18) graphically, therefore only the $F_{0.1}$ results are presented (Table 5). Projected median landings increase from roughly 7,700 mt in 1997 to about 29,000 mt in 2006 at $F_{0.1}$ for this stock (Table 6; Figure 1D). Median SSB increases from 47,460 mt in 1997 to about 200,000 mt in 2006 under an $F_{0.1}$ strategy (Table 6; Figure 1D). The median projected recruitment improves continuously over the 10-year period if this stock were fished at $F_{0.1}$ (Table 6; Figure 1D). The probability that SSB exceeds the 70,000 mt threshold increases steadily from $P=0.09$ in 1998 to $P>0.99$ by 2002 and beyond (Table 6; Figure 1E).

Georges Bank haddock

Projected median landings increase from roughly 7,900 mt in 1997 to about 12,900 mt in 2006 at $F_{0.1}$ (0.26) for this stock; increase from 5,600 mt in 1997 to about 11,600 mt in 2006 at F_{96} (0.18); and increase from 3,200 mt in 1997 to 8,600 mt in 2006 at $F=0.1$ (Table 7; Figure 2D). Median SSB increases slowly from 39,000 mt in 1997 to about 65,000 mt in 2006 under an $F_{0.1}$ fishery; increases from 40,000 mt in 1997 to 82,000 mt in 2006 at F_{96} ; and increases from 40,600 mt in 1997 to 104,700 mt in 2006

for $F=0.1$ (Table 7; Figure 2D). Median recruitment continues to improve over the 10-year period if this stock were fished at $F_{0.1}$; with improved recruitment trends for the F_{96} and $F=0.1$ strategies (Table 7; Figure 2D). The median spawning stock biomass stock increases to slightly above the threshold of 80,000 mt in 2006 under the F_{96} ($F=0.18$) fishing rate and by 2003 under the $F=0.1$ scenario (Table 7). The probability of reaching the threshold in 2006 improves from $P=0.22$ in the Amendment 7, 10-year projection, to $P=0.38-0.68$ under the $F_{0.1}$, F_{96} , and $F=0.1$ strategies, respectively (Figure 2E). Under the $F_{0.1}$ scenario, the probability of exceeding the biomass threshold of 80,000 mt increases from zero in 1998 to $P=0.38$ by 2006. For F_{96} , the annual probability of SSB exceeding the threshold increases from zero in 1998 to $P=0.52$ by 2006. If F is reduced to 0.10, the annual probability of SSB exceeding the threshold increases from zero in 1998 to $P=0.68$ by 2006 (Figure 2E). The improvement in the probability of attaining the minimum threshold is due to a more rapid reduction in F as compared with Amendment 7 scenarios and improved SSB starting conditions.

Georges Bank yellowtail flounder

Median projected landings increase from 2,700 mt in 1997 to about 8,400 mt in 2006 at $F_{0.1}$ (0.25); and increase from 1,100 mt in 1997 to about 5,500 mt in 2006 at F_{96} (0.10) (Table 8; Figure 3D). Median SSB increases from 14,600 mt in 1997 to about 46,200

mt in 2006 under an $F_{0.1}$ fishery and increases from 15,400 mt in 1997 to 71,600 mt in 2006 at F_{96} (Table 8; Figure 3D). Median recruitment improves over the 10-year period if this stock is fished at $F_{0.1}$ and even more so at the F_{96} level (Table 8; Figure 3D). For all years of the medium-term simulations there is a $P=1.0$ probability that SSB exceeds the 10,000 mt threshold.

Gulf of Maine cod

Median projected landings decline from about 5,800 mt to 1,400 mt from 1997-2006 at the current fishing rate of $F_{96}=1.04$ for this stock; they increase from 2,200 mt in 1997 to about 11,000 mt in 2006 at F_{max} (0.29) (Table 9; Figure 4D). Median SSB declines from about 6,800 mt in 1997 to 2,000 mt in 2006 for $F_{96}=1.04$, increases from 7,600 mt in 1997 to about 44,000 mt in 2006 under an F_{max} strategy, and would increase from 7,900 mt to 120,000 mt during 1997-2006 for a no fishing strategy ($F=0.0$) (Table 9; Figure 4D). Median recruitment remains extremely poor if F remains at the F_{96} level, improves over the 10-year period if this stock were fished at F_{max} and shows additional improvement for $F=0.00$ (Table 9; Figure 4D).

Southern New England yellowtail flounder

Median projected landings increase from about 700 mt in 1997

to about 7,200 mt in 2006 at $F_{0.1}$ (0.27); they increase from 325 mt in 1997 to about 4,900 mt in 2006 at F_{96} (0.12) (Table 10; Figure 5D). Median SSB increases from 5,100 mt in 1997 to about 40,700 mt in 2006 under an $F_{0.1}$ scenario and from 5,300 mt in 1997 to 57,100 mt in 2006 at $F_{96}=0.12$ (Table 10; Figure 5D). Median recruitment improves over the 10-year period if this stock is fished at $F_{0.1}$; recruitment would be even higher at the F_{96} level (Table 10; Figure 5D). Under an $F_{0.1}$ scenario, the probability of exceeding the biomass threshold increases from $P=0.27$ in 1998 to $P>.99$ by 2004. For F_{96} , the annual probability of SSB exceeding the 10,000 mt threshold increases from $P=0.34$ in 1998 to $P>0.99$ by 2002 (Table 10; Figure 5E).

Additional Georges Bank haddock analyses

The historic stock-recruitment data for the Georges Bank haddock stock spans the period from 1931-1995. Attempts to fit stock-recruitment relationships to the full data series have not been successful however, because of problems with model significance, convergence, and residual patterns. A non-linear regression approach was used in the previous (Brodziak 1994) and the current analyses, but model convergence was not obtained for the Beverton-Holt model. Parameters from a non-linear Ricker model produce extremely large estimates of management parameters (e.g. the stock size that yields maximum recruitment, $S_{max}=1mmt$).

The data appear to center around two historical time

horizons, pre-ICNAF and post-ICNAF, defining periods of relatively high (1931-1967) and low (1968-1995) spawning stock biomasses, respectively (Figure 6). A divisive cluster analysis of SSB and recruitment data, with two clusters, produces distinct regions of high and low stock size (Figure 7). The 75% probability ellipse regions from these data suggest a high SSB cluster from roughly 70,000 mt to 110,000 mt of SSB and a low stock cluster less than 70,000 m (Figure 7). Similarly, by examining the recruitment data on a log scale the distinct nature of the two time periods is also apparent (Figure 8).

Non-parametric methods (e.g. probability transition matrices) have been successfully applied to these data and used to provide a long-term perspective on this stock (Overholtz et al. 1986). This approach entailed dividing the S-R information into regions based on natural cut points in the empirical data (Figure 9). Results from the 10-year projections on this stock at the F_{96} and $F=0.1$ fishing mortality levels suggest that SSB could increase to the threshold (80,000 mt) and beyond, under both scenarios (albeit with different probabilities). Therefore, ten-year projections as provided herein are consistent with those using the full 1931-1995 time series, even though data for the earlier time period were not used to fit the B-H model. If a long-term perspective on this stock were required (beyond 10 years), then a different approach incorporating the full historic stock-recruitment series, 1931-1995, would be required.

Summary

Medium and long-term projections utilizing stock-recruitment models or non-parametric approaches can provide valuable strategic advice on optimal harvest policies, stock recovery strategies, and economic benefits for fish stocks (Hilborn and Walters 1992). Results from these approaches are generally comparative in nature and are not intended to provide point estimates of management reference values or targets (Overholtz et al. 1995).

Projections over a 10-year horizon for five groundfish stocks indicate that if current (i.e. 1996) fishing mortality trends continue, the threshold spawning stock biomass targets for Georges Bank cod, and the Georges Bank and Southern New England yellowtail flounder stocks could be met in the medium-term (within ten years). The probability of recovery within ten years for the Georges Bank haddock stock to the 80,000 mt threshold level was estimated at $P=0.38$, 0.52 , and 0.68 for fishing rates of $F_{0.1}$, F_{96} , and $F=0.1$, respectively. Ten-year projections for this stock indicate that the threshold could be reached in 2006 for F_{96} and in 2003 for $F=0.1$. The New England Fishery Management Council provided no threshold SSB target for the Gulf of Maine cod stock, but the 10-year projection under the management $F_{\max}=0.29$ target would promote SSB recovery to about 50,000 mt by 2006. If the current fishing mortality trend continues for this stock, the SSB will remain at historically low

levels.

Significant improvement in landings, spawning stock biomass, and recruitment trends are possible if current (1996) levels of fishing mortality on the Georges Bank stocks and on Southern New England yellowtail flounder are maintained for the foreseeable future. The Gulf of Maine cod stock is currently overfished and at a low level of biomass. Unless the fishing rate on this stock is reduced dramatically, the stock will likely decline even further.

Acknowledgments

We acknowledge the assistance of the SARC committee in reviewing the results of this analysis.

References Cited

- Brodziak, J.K.T., and P.J. Rago. 1996. AGEPRO USER'S GUIDE. National Marine Fisheries Service. Northeast Fisheries Science Center. MS. 44 pp.
- Brodziak, J.K.T. 1994. Amendment 7 stock recruitment models for groundfish. Northeast Fisheries Science Center MS. 12pp.
- Conser, R.J., and J.E. Powers. 1990. Extension of the ADAPT VPA tuning method designed to facilitate assessment work on tuna and swordfish stocks. ICCAT Collected Volume Scientific Papers. 32:461-467.
- Gavaris, S. 1988. An adaptive framework for the estimation of population size. CAFSAC Research Document 88/29.
- Hilborn, R., and C.J. Walters. 1992. Quantitative Fisheries Stock Assessment: Choice, Dynamics, and Uncertainty. Chapman and Hall. New York. 570 pp.
- New England Fishery Management Council (NEFMC). 1996. Amendment 7 to the Northeast Multispecies Fishery management Plan Volume II Appendix VII 47 pp.
- NEFSC. 1997. 24th Northeast Regional Stock Assessment Workshop. Stock assessment Review Committee (SARC) Consensus summary Of Assessments. Northeast Fisheries Science Center Reference Document 97-12.290 pp.
- Overholtz, W.J., M.P. Sissenwine, and S.H. Clark. 1986. Recruitment variability and its implication for managing and rebuilding the Georges Bank haddock (*Melanogrammus aeglefinus*) stock. Canadian Journal Of Fisheries and Aquatic Sciences. 43:748-753.
- Overholtz, W.J., S.F. Edwards, and J.K.T. Brodziak. 1995. Effort control in the New England groundfish fishery: a bioeconomic perspective. Canadian Journal of Fisheries and Aquatic Sciences. 52:1944-1957.
- Rago, P., and J.K.T. Brodziak. 1994. Stock recruitment relationships and rebuilding targets for cod and yellowtail flounder. Northeast Fisheries Science Center MS. 17pp.
- SAS. 1990. The NLIN Procedure. SAS/STAT Users's Guide, Version 6, Fourth Edition, Volume 2. SAS Institute INC.

Table 1. Spawning stock biomass threshold levels for Georges Bank cod, haddock, and yellowtail flounder, and Southern New England yellowtail flounder, established by the New England Fishery Management Council.

STOCK	SSB Theshold (mt)
Georges Bank cod	70,000
Georges Bank haddock	80,000
Georges Bank yellowtail	10,000
Gulf of Maine cod	N/A
Southern New England yellowtail	10,000

Table 2. Estimated parameters¹ and variance (S^2) with series duration for the five groundfish stocks for a Beverton-Holt model fit with nonlinear regression.

Stock	a	b	S^2	Time-Series
Georges Bank cod	37745.13477	95826.72456	0.239801	1978-1995
Georges Bank haddock	17105.55857	39738.40459	1.8728415	1968-1995
Georges Bank yellowtail	50089.70202	10737.07716	0.4203756	1973-1995
Gulf of Maine cod	5593.837237	2542.61787	0.6822985	1982-1995
SNE yellowtail	21851.34499	1421.76952	1.1776888	1973-1995

1 $R = [a \cdot SSB / b + SSB] \cdot e^w$, where $w \sim N(0, S^2)$.

Table 3. Values for observed minimum spawning stock biomass (SSB_{min}) , minimum recruitment per spawner biomass (R/SSB_{min}), lower limit of the 80% confidence limit on recruitment per spawner biomass (R/SSB_{10}), upper limit of the 80% confidence limit on recruitment per spawner biomass (R/SSB_{90}) , and maximum observed recruitment per spawner biomass (R/SSB_{max}) for five groundfish stocks.

STOCK	SSB_{min} ¹	R/SSB_{min}	R/SSB_{10}	R/SSB_{90}	R/SSB_{max}
Georges Bank cod	31317	0.1070	0.1265	0.4462	0.7722
Georges Bank haddock	10938	0.0096	0.0445	1.2184	5.6173
Georges Bank yellowtail	2299	0.4558	1.0318	5.9047	7.1427
Gulf of Maine cod	8810	0.0900	0.1295 ²	0.6838 ³	1.5055
Southern New England yellowtail	1057	0.2677	0.6326	10.6236	71.3602

¹ metric tons

² 0.00 was used in the analysis

³ 0.30 was used in the analysis

Table 4. Maximum recruitment ($R_{\max}$, thousands) values for five groundfish stocks with the probability levels associated with tests for a lognormal distribution of residuals.

STOCK	$R_{\max}$	P
Georges Bank cod	42553	0.6643
Georges Bank haddock	43633	0.9193
Georges Bank yellowtail	61806	0.2335
Gulf of Maine cod	7868	0.4432
Southern New England yellowtail	39374	0.8632

Table 5. Values of $F_{0.1}$ and F_{96} (F in 1996) for 5 stocks of New England groundfish used in the 10-year projections.

Stock	$F_{0.1}$	F_{96}
Georges Bank cod	0.17	0.18
Georges Bank haddock ¹	0.26	0.18
Georges Bank yellowtail	0.25	0.10
Gulf of Maine cod ²	0.29 ³	1.04
Southern New England yellowtail	0.27	0.12

¹. An additional simulation with $F=0.1$ was completed for GB haddock.

². An additional simulation with $F=0.0$ was completed for GOM cod.

³. F_{max}

Table 6. 10-year projections at $F_{0.1}$ ($F=0.17$) and F_{96} ($F=0.18$) for Georges Bank cod during 1997-2006.

PROJECTION RUN: gb cod 10 yr projection

INPUT FILE: gbcod97.in

OUTPUT FILE: gbcod97.out

RECRUITMENT MODEL: 5

NUMBER OF SIMULATIONS: 100

F-BASED PROJECTIONS

CONSTANT $F=0.170$

SPAWNING STOCK BIOMASS (THOUSAND MT)

YEAR	AVG SSB (000 MT)	STD
1997	47.987	5.516
1998	54.089	6.228
1999	63.107	8.396
2000	76.073	12.137
2001	91.778	16.696
2002	111.049	21.809
2003	131.992	27.336
2004	153.998	33.241
2005	178.597	39.553
2006	204.933	46.168

PERCENTILES OF SPAWNING STOCK BIOMASS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	37.420	39.509	41.065	43.862	47.460	51.253	55.226	57.359	61.755
1998	41.803	44.723	46.428	49.655	53.660	58.245	62.177	64.302	69.634
1999	46.872	50.682	52.972	57.116	62.409	68.454	74.223	77.945	85.003
2000	53.125	58.455	61.597	67.320	74.885	83.495	92.210	97.776	109.399
2001	60.465	67.733	71.973	79.861	90.054	101.804	114.166	122.011	138.209
2002	70.392	79.501	84.972	95.378	108.905	124.278	140.124	150.456	170.735
2003	81.272	92.336	99.351	112.311	129.154	148.598	168.334	181.516	208.420
2004	92.268	105.771	114.422	130.335	150.290	174.047	197.999	213.830	248.139
2005	105.787	121.110	131.670	150.436	174.092	202.207	230.608	250.536	290.860
2006	120.079	138.161	150.444	172.172	199.878	232.636	265.721	287.691	335.850

ANNUAL PROBABILITY THAT SSB EXCEEDS THRESHOLD: 70.0000 THOUSAND MT

YEAR Pr(SSB > Threshold Value)

1997	0.000
1998	0.009
1999	0.200
2000	0.666
2001	0.925
2002	0.991
2003	0.999
2004	1.000
2005	1.000
2006	1.000

RECRUITMENT UNITS ARE: 1000.000 FISH

BIRTH

YEAR	AVG RECRUITMENT	STD
1997	14298.010	6893.848
1998	15693.130	7485.311
1999	17528.033	8497.029
2000	19923.439	9761.759
2001	22837.088	11311.425

2002	25730.691	12581.818
2003	28910.783	13924.074
2004	31908.676	14985.196
2005	34925.234	16020.179
2006	38617.590	17259.662

PERCENTILES OF RECRUITMENT UNITS ARE: 1000.000 FISH

BIRTH

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	5086.479	6078.574	6920.583	9053.123	12708.046	17986.258	24270.758	28183.004	34831.785
1998	5694.256	6790.725	7685.703	10031.450	13997.837	19545.473	26257.699	30932.008	38682.574
1999	6416.993	7697.010	8614.604	11113.065	15418.109	21895.574	29392.668	34799.711	44093.301
2000	7424.962	8881.770	9987.140	12750.417	17518.229	24547.990	33320.223	39815.859	52053.711
2001	8658.897	10374.664	11718.184	14671.151	19927.707	27935.826	37983.168	45404.922	61259.336
2002	9794.586	11892.270	13375.033	16780.961	22480.438	31219.461	42677.891	50984.352	68745.000
2003	11644.161	13959.387	15527.883	19054.059	25276.068	34851.367	46977.148	56284.465	77768.398
2004	13073.045	15834.056	17589.945	21606.119	28055.578	37986.023	51182.586	61624.527	84116.203
2005	14716.522	17718.303	19675.338	23953.262	30893.469	41186.668	55385.414	66171.172	91724.625
2006	16394.814	19830.750	22159.865	26852.854	34427.500	45650.961	60055.898	71712.242	101375.062

LANDINGS FOR F-BASED PROJECTIONS

YEAR	AVG LANDINGS (000 MT)	STD
1997	7.710	0.973
1998	8.263	0.961
1999	9.043	1.082
2000	10.365	1.500
2001	12.929	2.422
2002	15.865	3.231
2003	19.090	4.098
2004	22.453	5.022
2005	26.204	6.013
2006	30.210	7.048

PERCENTILES OF LANDINGS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	5.875	6.304	6.512	6.982	7.679	8.283	9.033	9.337	10.113
1998	6.354	6.930	7.051	7.565	8.160	8.873	9.524	9.853	10.721
1999	6.970	7.455	7.705	8.296	8.962	9.738	10.559	10.884	11.626
2000	7.546	8.183	8.565	9.287	10.208	11.314	12.414	13.057	14.314
2001	8.559	9.524	10.085	11.165	12.627	14.381	16.182	17.383	19.712
2002	9.940	11.262	12.034	13.534	15.502	17.783	20.214	21.738	24.980
2003	11.580	13.210	14.212	16.136	18.624	21.554	24.618	26.587	30.509
2004	13.248	15.272	16.492	18.821	21.912	25.465	29.103	31.559	36.584
2005	15.205	17.592	19.100	21.917	25.508	29.733	34.119	37.119	43.467
2006	17.399	20.103	21.940	25.222	29.387	34.366	39.487	43.071	50.286

Table 6. Continued

PROJECTION RUN: gb cod 10 yr projection

INPUT FILE: gbcod97.in

OUTPUT FILE: gbcod97.out

RECRUITMENT MODEL: 5

NUMBER OF SIMULATIONS: 100

F-BASED PROJECTIONS

CONSTANT F:0.180

SPAWNING STOCK BIOMASS (THOUSAND MT)

YEAR	AVG SSB (000 MT)	STD
1997	47.918	5.508
1998	53.612	6.182
1999	62.218	8.359
2000	74.719	12.121
2001	89.874	16.670
2002	108.392	21.674
2003	128.388	26.957
2004	149.306	32.536
2005	172.629	38.478
2006	197.575	44.754

PERCENTILES OF SPAWNING STOCK BIOMASS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	37.366	39.453	41.006	43.799	47.391	51.186	55.143	57.277	61.663
1998	41.358	44.251	45.995	49.260	53.177	57.762	61.618	63.739	69.294
1999	45.826	49.756	52.075	56.297	61.522	67.594	73.182	77.009	84.240
2000	51.746	57.192	60.286	65.975	73.464	82.155	90.888	96.543	107.690
2001	58.704	66.065	70.224	77.846	87.982	99.940	112.325	120.408	135.854
2002	67.776	77.358	82.625	92.730	105.959	121.477	137.466	147.862	168.169
2003	78.309	89.840	96.267	108.939	125.501	144.616	164.186	177.467	203.907
2004	89.059	102.696	110.794	125.827	145.841	168.734	192.187	208.078	241.570
2005	102.643	117.699	127.022	145.071	168.463	195.477	223.451	242.710	282.948
2006	115.665	133.224	144.711	165.722	192.469	223.939	256.981	278.623	326.251

ANNUAL PROBABILITY THAT SSB EXCEEDS THRESHOLD: 70.0000 THOUSAND MT

YEAR	Pr(SSB > Threshold Value)
1997	0.000
1998	0.008
1999	0.174
2000	0.618
2001	0.903
2002	0.986
2003	0.998
2004	1.000
2005	1.000
2006	1.000

RECRUITMENT UNITS ARE: 1000.000 FISH

BIRTH

YEAR	AVG RECRUITMENT	STD
1997	14313.363	6892.788
1998	15564.679	7458.868
1999	17337.148	8400.354
2000	19786.969	9713.032
2001	22433.666	11012.352

2002	25228.676	12373.543
2003	28433.312	13778.904
2004	31378.877	14893.023
2005	34209.012	15757.006
2006	37701.277	17166.209

PERCENTILES OF RECRUITMENT UNITS ARE: 1000.000 FISH

BIRTH

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	5074.217	6074.305	6934.803	9076.300	12722.329	17960.828	24180.498	28356.967	34966.746
1998	5641.319	6693.704	7619.823	9907.771	13832.896	19438.725	26215.154	30501.934	38419.441
1999	6357.110	7571.647	8532.156	11028.427	15280.487	21667.338	29074.160	34268.035	43748.715
2000	7266.230	8699.605	9817.573	12635.105	17424.629	24443.400	33178.336	39364.012	51411.996
2001	8489.071	10257.048	11474.738	14466.372	19626.309	27388.678	37186.680	44408.457	59683.324
2002	9715.416	11729.786	13149.332	16424.941	22066.895	30599.943	41603.625	50195.227	67540.484
2003	11243.684	13474.276	15151.393	18710.238	24866.457	34414.410	46341.625	55748.309	76869.562
2004	12660.149	15201.585	17097.998	21034.297	27477.301	37626.883	50479.684	60779.633	83529.484
2005	14186.372	17229.105	19210.062	23344.072	30320.123	40395.785	54453.773	64777.586	90202.391
2006	16051.709	19248.455	21471.537	26037.824	33252.801	44597.055	59188.000	70789.719	98200.016

LANDINGS FOR F-BASED PROJECTIONS

YEAR	AVG LANDINGS (000 MT)	STD
1997	8.127	1.025
1998	8.637	1.004
1999	9.389	1.127
2000	10.722	1.570
2001	13.347	2.542
2002	16.319	3.385
2003	19.575	4.270
2004	22.956	5.196
2005	26.687	6.164
2006	30.676	7.195

PERCENTILES OF LANDINGS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	6.192	6.646	6.865	7.360	8.094	8.731	9.522	9.841	10.660
1998	6.641	7.244	7.368	7.905	8.527	9.273	9.949	10.297	11.205
1999	7.224	7.728	7.996	8.612	9.302	10.119	10.963	11.287	12.112
2000	7.750	8.425	8.826	9.599	10.571	11.713	12.836	13.535	14.881
2001	8.759	9.762	10.375	11.486	13.025	14.841	16.776	18.057	20.534
2002	10.137	11.523	12.338	13.854	15.906	18.361	20.909	22.540	25.695
2003	11.798	13.489	14.544	16.499	19.068	22.158	25.346	27.396	31.617
2004	13.473	15.583	16.813	19.219	22.378	26.036	29.862	32.466	37.705
2005	15.484	17.929	19.439	22.267	25.983	30.307	34.852	37.906	44.176
2006	17.667	20.503	22.181	25.547	29.871	34.868	40.233	43.759	51.348

Table 7. 10-year projections at $F_{0.1}$ ($F=0.26$) and F_{96} ($F=0.18$), and $F=0.1$ for Georges Bank haddock during 1997-2006.

PROJECTION RUN: gbhad 10 yr projection at fo.1

INPUT FILE: gbhad97.in

OUTPUT FILE: gbhad97.out

RECRUITMENT MODEL: 5

NUMBER OF SIMULATIONS: 100

F-BASED PROJECTIONS

CONSTANT $F=0.260$

SPAWNING STOCK BIOMASS (THOUSAND MT)

YEAR	AVG SSB (000 MT)	STD
1997	39.354	5.566
1998	39.652	5.470
1999	41.920	8.924
2000	48.527	23.130
2001	55.511	32.668
2002	61.817	39.406
2003	67.223	44.705
2004	72.558	50.426
2005	77.410	56.072
2006	81.735	61.179

PERCENTILES OF SPAWNING STOCK BIOMASS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	25.622	31.200	32.921	35.286	39.455	42.623	45.815	48.652	57.565
1998	28.727	31.394	32.516	35.997	39.583	42.976	45.965	48.193	55.821
1999	26.165	29.640	32.035	36.047	40.783	45.953	53.480	58.261	71.125
2000	23.452	27.538	30.049	34.829	42.097	53.840	72.908	91.940	148.651
2001	20.756	25.277	28.290	34.549	45.565	64.586	95.111	123.487	183.345
2002	18.565	23.699	27.272	35.273	49.926	75.186	112.419	143.215	204.612
2003	17.379	22.931	27.202	36.953	54.449	84.037	124.339	155.627	225.879
2004	16.401	22.719	27.387	38.601	58.724	91.536	134.019	168.635	254.672
2005	16.064	22.785	27.883	40.536	62.068	96.600	144.194	181.203	283.903
2006	15.859	22.880	28.621	41.969	65.432	101.639	153.533	195.224	305.017

ANNUAL PROBABILITY THAT SSB EXCEEDS THRESHOLD: 80.0000 THOUSAND MT

YEAR	Pr(SSB > Threshold Value)
1997	0.000
1998	0.000
1999	0.003
2000	0.077
2001	0.154
2002	0.219
2003	0.273
2004	0.317
2005	0.353
2006	0.377

RECRUITMENT UNITS ARE: 1000.000 FISH

BIRTH

YEAR	AVG RECRUITMENT	STD
1997	18872.314	28516.051
1998	18602.660	28219.359
1999	19283.287	29753.234
2000	20153.010	32292.779
2001	21682.578	36099.574

2002	22548.451	38840.598
2003	23382.566	40954.551
2004	23490.260	40760.219
2005	24798.137	44034.195
2006	25115.943	44313.883

PERCENTILES OF RECRUITMENT UNITS ARE: 1000.000 FISH

BIRTH

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	522.355	992.545	1524.664	3419.335	8475.471	21320.598	47872.938	74113.109	150073.516
1998	534.122	1000.003	1568.074	3443.571	8534.974	20798.268	46213.457	72458.438	149683.094
1999	543.017	1025.902	1576.401	3489.698	8673.667	21327.795	48180.754	75808.250	155526.875
2000	560.097	1085.375	1693.902	3669.990	8947.640	22441.129	50370.238	77827.766	155082.703
2001	534.475	1105.785	1713.392	3775.472	9319.855	23581.004	52563.258	84954.680	178355.734
2002	554.974	1143.707	1781.400	3963.369	9707.272	23941.658	55026.125	88400.406	187887.828
2003	546.782	1166.245	1803.634	4029.242	10127.934	25087.998	55964.344	89935.656	200463.609
2004	660.032	1286.911	1943.290	4083.929	10166.018	25480.881	56432.777	89930.766	196018.062
2005	605.750	1286.496	1972.045	4170.536	10374.687	26270.537	59614.340	95632.828	214754.250
2006	659.445	1329.766	2067.845	4426.375	10723.734	26548.064	60462.098	95736.516	217481.406

LANDINGS FOR F-BASED PROJECTIONS

YEAR	AVG LANDINGS (000 MT)	STD.
1997	7.943	1.197
1998	8.076	1.101
1999	8.188	1.233
2000	8.969	2.900
2001	10.320	5.297
2002	11.817	7.330
2003	12.977	8.440
2004	14.094	9.557
2005	15.110	10.681
2006	16.055	11.815

PERCENTILES OF LANDINGS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	4.761	6.133	6.571	7.162	7.912	8.536	9.439	10.027	11.978
1998	5.838	6.519	6.706	7.290	8.028	8.649	9.284	9.711	11.164
1999	5.692	6.309	6.605	7.377	8.131	8.894	9.660	10.595	11.576
2000	5.114	5.808	6.356	7.187	8.320	9.905	12.156	14.257	20.990
2001	4.493	5.361	5.903	7.020	8.779	11.722	16.521	20.857	31.620
2002	3.948	4.906	5.556	6.974	9.568	14.078	20.995	26.809	39.614
2003	3.556	4.671	5.458	7.241	10.508	15.956	23.803	29.894	43.114
2004	3.383	4.543	5.465	7.610	11.407	17.698	25.136	32.875	48.140
2005	3.213	4.555	5.530	7.986	12.179	18.946	28.092	35.172	53.907
2006	3.174	4.570	5.706	8.319	12.859	20.072	29.964	38.282	59.840

Table 7. Continued.

PROJECTION RUN: gbhad 10 yr projection at fo.1

INPUT FILE: gbhad97.in

OUTPUT FILE: gbhad97.out

RECRUITMENT MODEL: 5

NUMBER OF SIMULATIONS: 100

F-BASED PROJECTIONS

CONSTANT F:0.180

SPAWNING STOCK BIOMASS (THOUSAND MT)

YEAR	AVG SSB (000 MT)	STD
1997	39.968	5.656
1998	42.273	5.788
1999	46.163	9.232
2000	54.284	23.652
2001	63.259	34.850
2002	71.782	43.245
2003	79.569	50.323
2004	87.180	57.730
2005	94.349	65.222
2006	100.767	70.975

PERCENTILES OF SPAWNING STOCK BIOMASS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	25.985	31.727	33.428	35.835	40.068	43.276	46.544	49.431	58.514
1998	30.601	33.592	34.753	38.387	42.220	45.616	48.925	51.203	59.053
1999	29.370	33.228	35.689	40.039	45.064	50.426	58.445	63.127	75.197
2000	27.698	32.219	35.030	40.273	47.675	59.981	80.360	98.915	154.255
2001	25.590	30.709	33.951	40.917	52.777	73.418	105.042	135.026	200.518
2002	23.665	29.551	33.517	42.593	59.018	86.457	126.722	160.758	230.773
2003	22.473	29.035	33.814	45.156	65.185	98.512	143.968	181.280	258.906
2004	21.698	29.313	34.774	48.015	70.996	108.689	160.366	197.651	294.952
2005	21.606	29.931	36.011	51.015	76.800	117.506	173.720	215.660	332.289
2006	21.858	30.640	37.760	53.634	81.963	125.290	186.220	233.147	361.683

ANNUAL PROBABILITY THAT SSB EXCEEDS THRESHOLD: 80.0000 THOUSAND MT

YEAR Pr(SSB > Threshold Value)

1997	0.000
1998	0.000
1999	0.005
2000	0.101
2001	0.204
2002	0.291
2003	0.365
2004	0.426
2005	0.473
2006	0.517

RECRUITMENT UNITS ARE: 1000.000 FISH

BIRTH

YEAR	AVG RECRUITMENT	STD
1997	19031.309	28585.988
1998	19672.215	30261.258
1999	20320.793	31169.877
2000	21694.623	34914.176
2001	23044.637	38675.758

2002	24621.154	42689.211
2003	24883.379	42307.660
2004	26556.326	47458.547
2005	27399.199	49069.199
2006	27609.213	49354.305

PERCENTILES OF RECRUITMENT UNITS ARE: 1000.000 FISH

BIRTH

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	541.162	1016.714	1588.829	3518.837	8632.977	21353.848	48308.516	75492.781	151302.406
1998	547.199	1047.095	1609.677	3591.027	8813.098	21894.871	49075.824	77297.445	160944.516
1999	571.210	1100.760	1698.561	3718.364	9237.797	22525.590	50383.980	79602.367	163497.469
2000	635.213	1173.258	1772.354	3915.818	9563.365	23709.020	52813.848	85055.578	175256.312
2001	617.519	1207.516	1867.507	4110.818	10165.740	25167.092	55762.926	88665.914	185221.453
2002	678.236	1342.590	2020.760	4220.441	10346.995	26050.232	59164.754	95164.578	212490.656
2003	693.813	1341.748	2047.786	4422.741	10871.854	27034.818	59864.184	95337.617	205710.906
2004	732.184	1430.296	2180.788	4515.860	11188.364	27991.527	62748.109	102677.039	237180.109
2005	743.726	1488.058	2231.494	4747.412	11518.558	28620.289	64527.930	104716.078	239052.266
2006	751.313	1532.588	2311.413	4821.913	11718.603	29077.490	66372.570	106614.117	233348.781

LANDINGS FOR F-BASED PROJECTIONS

YEAR	AVG LANDINGS (000 MT)	STD
1997	5.678	0.857
1998	6.116	0.835
1999	6.471	0.946
2000	7.233	2.097
2001	8.443	3.951
2002	9.841	5.730
2003	11.043	6.828
2004	12.201	7.881
2005	13.290	8.984
2006	14.287	9.995

PERCENTILES OF LANDINGS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	3.401	4.381	4.696	5.114	5.651	6.098	6.751	7.164	8.563
1998	4.375	4.924	5.077	5.501	6.099	6.558	7.045	7.383	8.510
1999	4.560	5.020	5.274	5.834	6.442	7.009	7.594	8.242	9.188
2000	4.297	4.850	5.296	5.938	6.781	7.963	9.615	11.112	15.468
2001	3.940	4.652	5.114	5.977	7.327	9.539	13.146	16.313	24.036
2002	3.612	4.394	4.917	6.060	8.112	11.668	16.872	21.524	32.051
2003	3.351	4.266	4.897	6.382	9.074	13.476	19.799	24.980	36.276
2004	3.211	4.216	4.999	6.799	9.959	15.225	22.274	27.924	39.980
2005	3.110	4.300	5.129	7.250	10.810	16.627	24.527	30.402	45.519
2006	3.160	4.421	5.371	7.640	11.624	17.812	26.470	32.950	51.079

Table 7. Continued.

PROJECTION RUN: gbhad 10 yr projection at fo.1

INPUT FILE: gbhad97.in

OUTPUT FILE: gbhad97.out

RECRUITMENT MODEL: 5

NUMBER OF SIMULATIONS: 100

F-BASED PROJECTIONS

CONSTANT F:0.100

SPAWNING STOCK BIOMASS (THOUSAND MT)

YEAR	AVG SSB (000 MT)	STD
1997	40.590	5.748
1998	45.126	6.143
1999	51.056	9.711
2000	61.095	24.373
2001	72.471	36.496
2002	84.112	47.182
2003	95.261	56.978
2004	106.534	66.759
2005	117.374	76.338
2006	127.819	85.502

PERCENTILES OF SPAWNING STOCK BIOMASS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	26.355	32.263	33.915	36.393	40.692	43.940	47.286	50.223	59.479
1998	32.560	35.961	37.245	41.024	45.038	48.578	52.113	54.490	63.038
1999	33.162	37.292	39.882	44.637	50.048	55.634	64.014	68.803	81.503
2000	32.802	37.829	41.022	46.675	54.650	67.211	86.898	106.685	163.377
2001	31.800	37.724	41.430	49.119	61.658	82.773	117.190	147.004	213.897
2002	30.636	37.631	42.306	52.438	70.180	100.041	146.096	181.390	256.368
2003	30.332	38.274	43.718	56.466	79.206	116.382	168.661	208.090	293.709
2004	30.339	39.149	45.821	61.444	88.043	131.703	190.779	236.995	339.206
2005	30.874	40.504	48.548	66.347	96.182	145.190	212.484	262.706	396.310
2006	31.103	42.231	51.422	71.079	104.666	157.811	232.379	289.518	442.126

ANNUAL PROBABILITY THAT SSB EXCEEDS THRESHOLD: 80.0000 THOUSAND MT

YEAR Pr(SSB > Threshold Value)

1997	0.000
1998	0.000
1999	0.012
2000	0.134
2001	0.272
2002	0.396
2003	0.493
2004	0.568
2005	0.630
2006	0.678

RECRUITMENT UNITS ARE: 1000.000 FISH

BIRTH

YEAR	AVG RECRUITMENT	STD
1997	19105.998	28873.740
1998	20262.934	30768.361
1999	21864.168	33874.312
2000	23113.861	38259.258
2001	25082.719	41963.980

2002	26542.686	45830.043
2003	28050.090	50039.961
2004	28974.607	53300.148
2005	29631.645	53456.754
2006	30464.707	53314.945

PERCENTILES OF RECRUITMENT UNITS ARE: 1000.000 FISH

BIRTH

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	559.287	1042.242	1579.428	3587.190	8792.755	21436.789	47362.355	75335.742	151050.297
1998	580.132	1091.339	1681.263	3764.481	9084.395	22417.061	51015.895	80013.711	163317.859
1999	639.899	1193.610	1843.099	3953.570	9701.034	24248.275	54470.238	87791.703	174322.594
2000	698.550	1269.124	1916.054	4112.037	10016.239	25151.107	56368.352	89861.336	194777.016
2001	745.587	1393.051	2049.471	4444.399	10950.171	27194.135	60442.758	96061.922	216631.328
2002	761.066	1439.492	2162.683	4515.557	11177.599	27922.926	63068.652	104820.742	231669.594
2003	813.348	1591.143	2382.598	4891.905	11914.891	29423.121	67561.023	108761.977	244525.406
2004	896.562	1622.399	2433.690	5083.299	12362.575	30107.494	67455.906	107972.930	264870.156
2005	882.997	1737.609	2545.166	5200.665	12758.934	31136.953	69597.609	112078.422	260796.172
2006	975.196	1794.099	2688.911	5521.005	13196.332	31919.918	72664.398	117113.016	263530.062

LANDINGS FOR F-BASED PROJECTIONS

YEAR	AVG LANDINGS (000 MT)	STD
1997	3.259	0.493
1998	3.722	0.509
1999	4.123	0.590
2000	4.721	1.239
2001	5.591	2.356
2002	6.640	3.554
2003	7.625	4.416
2004	8.620	5.287
2005	9.567	6.129
2006	10.490	6.934

PERCENTILES OF LANDINGS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	1.951	2.513	2.694	2.937	3.241	3.498	3.877	4.110	4.915
1998	2.630	2.988	3.089	3.346	3.698	3.995	4.287	4.511	5.212
1999	2.941	3.206	3.376	3.721	4.108	4.453	4.796	5.215	5.892
2000	2.891	3.269	3.530	3.950	4.480	5.169	6.095	6.941	9.526
2001	2.799	3.274	3.574	4.131	4.956	6.272	8.362	10.240	15.047
2002	2.672	3.217	3.576	4.312	5.576	7.748	11.111	13.833	20.172
2003	2.569	3.218	3.669	4.633	6.345	9.167	13.359	16.609	23.545
2004	2.565	3.262	3.797	5.011	7.128	10.589	15.435	19.070	26.989
2005	2.594	3.378	3.990	5.437	7.861	11.877	17.286	21.401	31.419
2006	2.620	3.511	4.260	5.857	8.583	12.984	19.122	23.592	36.139

Table 8. 10-year projections at $F_{0.1}$ ($F=0.25$) and F_{96} ($F=0.1$) for Georges Bank yellowtail flounder during 1997-2006.

PROJECTION RUN: gb yt 10 yr projection at fo.1

INPUT FILE: gby97.in

OUTPUT FILE: gby97.out

RECRUITMENT MODEL: 5

NUMBER OF SIMULATIONS: 100

F-BASED PROJECTIONS

CONSTANT $F=0.250$

SPAWNING STOCK BIOMASS (THOUSAND MT)

YEAR	AVG SSB (000 MT)	STD
1997	14.797	2.413
1998	15.131	2.216
1999	17.726	2.839
2000	22.406	5.485
2001	27.010	7.368
2002	31.607	8.914
2003	36.287	10.650
2004	40.583	12.136
2005	44.548	13.299
2006	48.220	14.443

PERCENTILES OF SPAWNING STOCK BIOMASS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	10.562	11.343	11.657	13.016	14.621	16.428	18.130	18.818	20.452
1998	10.804	11.840	12.301	13.641	14.930	16.616	18.177	18.579	20.624
1999	12.622	13.727	14.431	15.712	17.362	19.341	21.527	23.005	26.118
2000	13.659	15.334	16.380	18.452	21.417	25.274	29.844	32.926	39.396
2001	14.702	17.081	18.586	21.602	25.929	31.188	36.926	40.894	48.864
2002	16.537	19.460	21.366	25.168	30.260	36.722	43.592	48.309	57.731
2003	18.256	21.833	24.133	28.589	34.707	42.272	50.611	56.166	67.529
2004	20.080	24.273	26.728	31.914	38.819	47.409	56.695	63.032	76.428
2005	21.941	26.337	29.263	34.969	42.746	52.037	62.141	69.017	83.486
2006	23.595	28.503	31.701	37.915	46.230	56.207	67.321	74.915	90.954

ANNUAL PROBABILITY THAT SSB EXCEEDS THRESHOLD: 10.00000 THOUSAND MT

YEAR Pr(SSB > Threshold Value)

1997	1.000
1998	1.000
1999	1.000
2000	1.000
2001	1.000
2002	1.000
2003	1.000
2004	1.000
2005	1.000
2006	1.000

RECRUITMENT UNITS ARE: 1000000. FISH

BIRTH

YEAR	AVG RECRUITMENT	STD
1997	33.783	20.414
1998	34.097	20.382
1999	37.091	22.889
2000	41.164	26.143
2001	45.060	29.523

2002	47.491	30.337
2003	50.659	32.575
2004	52.608	33.403
2005	55.134	34.743
2006	57.080	35.536

PERCENTILES OF RECRUITMENT UNITS ARE: 1000000. FISH

BIRTH

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	7.652	10.376	12.858	18.570	28.649	43.613	62.456	75.502	99.123
1998	7.819	10.571	13.126	18.977	29.069	43.884	62.682	75.721	99.397
1999	8.951	11.820	14.340	20.460	31.061	47.403	68.410	84.245	112.419
2000	9.968	13.238	15.861	22.422	34.336	52.408	75.806	92.917	131.941
2001	11.063	14.838	17.749	24.680	37.033	56.303	82.482	102.715	153.484
2002	12.552	16.384	19.484	26.562	39.007	59.149	86.586	108.245	157.017
2003	13.709	18.023	21.107	28.539	41.798	62.702	90.796	113.766	169.745
2004	14.928	19.346	22.560	29.973	43.315	64.511	94.562	118.260	174.376
2005	15.864	20.717	24.150	31.966	45.367	67.721	96.993	122.325	188.059
2006	16.805	21.997	25.426	33.324	47.190	69.570	100.559	126.309	190.615

LANDINGS FOR F-BASED PROJECTIONS

YEAR	AVG LANDINGS (000 MT)	STD
1997	2.713	0.442
1998	2.853	0.450
1999	3.016	0.415
2000	3.708	0.753
2001	4.583	1.210
2002	5.475	1.511
2003	6.390	1.850
2004	7.230	2.154
2005	8.010	2.406
2006	8.738	2.620

PERCENTILES OF LANDINGS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	1.895	2.078	2.174	2.339	2.655	3.014	3.324	3.506	3.831
1998	2.036	2.201	2.278	2.546	2.815	3.136	3.470	3.607	3.989
1999	2.227	2.402	2.493	2.730	2.970	3.295	3.574	3.720	4.178
2000	2.476	2.726	2.880	3.179	3.574	4.097	4.731	5.157	6.011
2001	2.618	2.988	3.229	3.698	4.385	5.252	6.215	6.878	8.280
2002	2.935	3.420	3.744	4.373	5.258	6.335	7.520	8.317	9.960
2003	3.260	3.871	4.268	5.065	6.118	7.445	8.865	9.839	11.784
2004	3.588	4.327	4.777	5.674	6.910	8.440	10.130	11.252	13.541
2005	3.942	4.743	5.262	6.295	7.661	9.366	11.202	12.437	15.011
2006	4.242	5.157	5.721	6.860	8.385	10.206	12.195	13.554	16.506

DISCARDS FOR F-BASED PROJECTIONS

YEAR	AVG DISCARDS (000 MT)	STD
1997	0.049	0.010
1998	0.052	0.011
1999	0.080	0.024
2000	0.105	0.038
2001	0.115	0.041
2002	0.127	0.046
2003	0.139	0.052
2004	0.149	0.056
2005	0.159	0.059
2006	0.167	0.063

PERCENTILES OF DISCARDS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	0.030	0.035	0.038	0.042	0.048	0.054	0.060	0.065	0.081
1998	0.034	0.038	0.040	0.044	0.051	0.058	0.067	0.073	0.085
1999	0.044	0.050	0.054	0.062	0.075	0.092	0.113	0.127	0.154
2000	0.044	0.054	0.062	0.077	0.098	0.126	0.156	0.176	0.218
2001	0.049	0.062	0.070	0.086	0.109	0.138	0.171	0.193	0.233
2002	0.054	0.067	0.076	0.094	0.119	0.152	0.189	0.216	0.267
2003	0.058	0.072	0.082	0.101	0.130	0.166	0.208	0.237	0.299
2004	0.062	0.078	0.088	0.109	0.139	0.178	0.223	0.256	0.325
2005	0.067	0.084	0.094	0.116	0.148	0.188	0.237	0.270	0.351
2006	0.072	0.089	0.100	0.123	0.155	0.198	0.248	0.285	0.374

Table 8. Continued.

PROJECTION RUN: gb yt 10 yr projection at fo.1

INPUT FILE: gbyt97.in

OUTPUT FILE: gbyt97.out

RECRUITMENT MODEL: 5

NUMBER OF SIMULATIONS: 100

F-BASED PROJECTIONS

CONSTANT F:0.100

SPAWNING STOCK BIOMASS (THOUSAND MT)

YEAR	AVG SSB (000 MT)	STD
1997	15.610	2.545
1998	17.724	2.621
1999	21.872	3.353
2000	28.291	6.171
2001	35.342	8.748
2002	43.107	11.165
2003	51.255	13.858
2004	59.103	16.319
2005	66.850	18.608
2006	74.491	20.719

PERCENTILES OF SPAWNING STOCK BIOMASS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	11.126	11.966	12.292	13.732	15.383	17.315	19.128	19.817	21.616
1998	12.724	13.894	14.293	15.926	17.491	19.395	21.377	21.816	24.152
1999	15.720	17.040	17.897	19.464	21.488	23.872	26.286	27.939	31.428
2000	18.140	20.223	21.465	23.848	27.212	31.606	36.500	39.849	47.047
2001	20.838	23.571	25.404	28.896	33.985	40.328	47.204	51.734	61.041
2002	24.046	27.808	30.158	34.936	41.516	49.632	58.264	63.885	75.063
2003	27.530	32.267	35.289	41.181	49.263	59.220	69.955	76.750	91.734
2004	31.409	37.011	40.433	47.258	56.735	68.378	80.832	89.005	106.923
2005	35.252	41.792	45.615	53.424	64.214	77.259	91.256	101.236	121.819
2006	39.146	46.386	50.923	59.583	71.637	86.078	101.733	112.414	136.460

ANNUAL PROBABILITY THAT SSB EXCEEDS THRESHOLD: 10.00000 THOUSAND MT

YEAR Pr(SSB > Threshold Value)

1997	1.000
1998	1.000
1999	1.000
2000	1.000
2001	1.000
2002	1.000
2003	1.000
2004	1.000
2005	1.000
2006	1.000

RECRUITMENT UNITS ARE: 1000000. FISH

BIRTH

YEAR	AVG RECRUITMENT	STD
1997	34.344	20.784
1998	36.804	22.090
1999	41.415	25.909
2000	45.744	29.330
2001	50.036	32.645

2002	54.192	34.391
2003	58.972	36.644
2004	62.577	36.998
2005	66.858	39.219
2006	70.406	39.477

PERCENTILES OF RECRUITMENT UNITS ARE: 1000000. FISH

BIRTH

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	8.010	10.803	13.157	19.074	29.238	44.109	63.193	77.123	102.089
1998	8.855	11.796	14.232	20.506	31.144	47.332	67.515	81.875	108.082
1999	10.342	13.285	15.895	22.627	34.497	52.805	76.612	94.312	130.320
2000	12.148	15.517	18.115	25.170	37.692	57.209	83.807	104.405	151.620
2001	13.942	17.864	20.807	27.913	40.836	61.704	90.464	114.416	171.348
2002	16.324	20.710	23.838	31.218	44.559	65.978	96.259	121.454	185.102
2003	18.423	23.306	26.738	34.652	48.691	71.824	103.394	128.847	198.805
2004	20.745	26.003	29.702	37.896	52.390	75.554	107.998	133.886	197.780
2005	22.574	28.503	32.410	41.254	56.125	80.094	113.614	141.833	214.905
2006	24.847	30.997	35.235	44.489	59.775	84.021	117.091	146.358	216.927

LANDINGS FOR F-BASED PROJECTIONS

YEAR	AVG LANDINGS (000 MT)	STD
1997	1.158	0.188
1998	1.377	0.217
1999	1.584	0.225
2000	1.996	0.360
2001	2.532	0.596
2002	3.158	0.793
2003	3.838	1.026
2004	4.489	1.232
2005	5.128	1.430
2006	5.760	1.614

PERCENTILES OF LANDINGS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	0.810	0.885	0.928	1.000	1.131	1.284	1.416	1.497	1.630
1998	0.990	1.067	1.095	1.227	1.356	1.513	1.673	1.726	1.913
1999	1.165	1.254	1.297	1.429	1.559	1.736	1.891	1.966	2.222
2000	1.374	1.507	1.589	1.739	1.944	2.191	2.472	2.672	3.074
2001	1.557	1.748	1.870	2.098	2.432	2.862	3.323	3.649	4.331
2002	1.827	2.081	2.250	2.576	3.041	3.613	4.236	4.640	5.466
2003	2.080	2.428	2.651	3.092	3.693	4.441	5.228	5.740	6.790
2004	2.390	2.805	3.069	3.592	4.315	5.202	6.136	6.751	8.115
2005	2.715	3.206	3.493	4.087	4.919	5.932	7.040	7.766	9.298
2006	3.029	3.583	3.915	4.595	5.539	6.654	7.876	8.743	10.577

DISCARDS FOR F-BASED PROJECTIONS

YEAR	AVG DISCARDS (000 MT)	STD
1997	0.020	0.004
1998	0.022	0.004
1999	0.034	0.010
2000	0.046	0.016
2001	0.053	0.018
2002	0.059	0.021
2003	0.065	0.024
2004	0.071	0.026
2005	0.077	0.028
2006	0.083	0.030

PERCENTILES OF DISCARDS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	0.012	0.014	0.016	0.017	0.020	0.022	0.025	0.027	0.034
1998	0.014	0.016	0.017	0.019	0.021	0.024	0.028	0.030	0.035
1999	0.019	0.021	0.023	0.027	0.032	0.039	0.047	0.053	0.065
2000	0.020	0.024	0.027	0.034	0.043	0.055	0.068	0.077	0.094
2001	0.023	0.028	0.032	0.039	0.050	0.063	0.078	0.088	0.106
2002	0.025	0.032	0.036	0.044	0.055	0.071	0.088	0.100	0.123
2003	0.029	0.035	0.039	0.048	0.060	0.077	0.097	0.111	0.142
2004	0.031	0.038	0.043	0.052	0.066	0.084	0.105	0.121	0.158
2005	0.034	0.042	0.047	0.057	0.072	0.091	0.113	0.130	0.168
2006	0.038	0.046	0.051	0.062	0.077	0.097	0.121	0.139	0.179

Table 9. 10-year projections at F_{96} ($F=1.04$), F_{max} ($F=0.29$), and $F=0.00$ for Gulf of Maine cod during 1997-2006.

PROJECTION RUN: gm cod 10 yr projection

INPUT FILE: gmcdt1.in

OUTPUT FILE: gmcdt1.out2

RECRUITMENT MODEL: 5

NUMBER OF SIMULATIONS: 100

F-BASED PROJECTIONS

CONSTANT $F=1.040$

SPAWNING STOCK BIOMASS (THOUSAND MT)

YEAR	AVG SSB (000 MT)	STD
1997	7.181	1.757
1998	5.607	1.572
1999	5.782	2.718
2000	5.819	3.475
2001	5.084	3.336
2002	4.552	3.459
2003	4.501	4.159
2004	4.236	4.451
2005	3.913	4.533
2006	3.702	4.736

PERCENTILES OF SPAWNING STOCK BIOMASS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	3.942	4.607	5.149	5.953	6.861	8.091	9.548	10.785	12.041
1998	3.144	3.562	3.874	4.420	5.299	6.540	7.815	8.547	10.108
1999	2.575	3.045	3.320	3.842	4.777	7.139	9.692	11.303	14.551
2000	2.226	2.675	2.929	3.473	4.390	7.255	10.843	13.007	17.883
2001	1.924	2.307	2.536	3.015	3.800	5.924	9.597	12.172	17.699
2002	1.661	1.980	2.186	2.599	3.277	4.831	9.256	12.288	18.084
2003	1.445	1.750	1.933	2.305	2.936	4.403	10.330	14.136	20.915
2004	1.242	1.524	1.689	2.020	2.567	3.807	10.406	14.709	22.176
2005	1.082	1.323	1.474	1.772	2.251	3.320	10.006	14.970	22.697
2006	0.948	1.166	1.292	1.564	1.989	2.914	10.081	15.475	23.054

RECRUITMENT UNITS ARE: 1000.000 FISH

BIRTH

YEAR	AVG RECRUITMENT	STD
1997	3535.476	3205.899
1998	1942.079	1977.396
1999	1260.284	1030.863
2000	1644.520	2104.780
2001	1732.434	2409.190
2002	1436.595	2074.887
2003	1305.444	2069.446
2004	1335.712	2347.774
2005	1259.335	2326.479
2006	1170.378	2340.580

PERCENTILES OF RECRUITMENT UNITS ARE: 1000.000 FISH

BIRTH

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	483.589	818.982	1041.381	1493.598	2146.894	4608.981	8171.625	10691.039	14755.774
1998	359.593	589.043	740.927	1050.665	1434.965	1895.760	3343.951	5948.053	11681.116
1999	313.714	480.817	598.333	821.431	1101.676	1424.246	1814.281	2108.371	6303.387
2000	282.523	433.349	536.173	752.343	1032.477	1498.364	2902.638	5903.533	11941.925

2001	269.003	408.550	503.694	694.674	963.568	1504.075	3766.488	6748.176	12756.438
2002	233.792	361.391	440.276	605.186	834.944	1253.198	2438.582	5406.586	11598.952
2003	205.750	316.618	389.508	530.843	725.895	1055.595	2117.908	5238.961	11713.653
2004	187.449	285.829	351.218	478.163	651.539	976.053	2548.341	5672.077	12829.202
2005	170.629	255.931	312.508	423.954	577.823	861.965	2487.457	5665.715	12755.750
2006	148.217	224.269	277.034	371.704	505.494	749.685	2186.310	5373.587	12745.474

LANDINGS FOR F-BASED PROJECTIONS

YEAR	AVG LANDINGS (000 MT)	STD
1997	6.089	1.596
1998	4.097	0.922
1999	3.527	1.249
2000	4.243	2.615
2001	3.842	2.524
2002	3.246	2.247
2003	3.141	2.751
2004	3.044	3.139
2005	2.819	3.193
2006	2.629	3.278

PERCENTILES OF LANDINGS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	3.321	3.778	4.215	4.969	5.838	6.950	8.233	9.255	10.453
1998	2.411	2.753	3.016	3.413	3.964	4.643	5.316	5.863	6.809
1999	1.812	2.089	2.278	2.603	3.195	4.183	5.296	5.981	7.408
2000	1.532	1.862	2.063	2.469	3.141	5.357	8.003	9.742	13.052
2001	1.368	1.677	1.853	2.231	2.849	4.648	7.196	9.181	13.217
2002	1.213	1.457	1.614	1.928	2.435	3.629	6.110	7.937	12.193
2003	1.056	1.268	1.408	1.682	2.136	3.153	6.720	9.416	14.197
2004	0.902	1.103	1.228	1.472	1.875	2.779	7.324	10.307	15.771
2005	0.778	0.961	1.073	1.294	1.647	2.439	6.989	10.437	16.284
2006	0.682	0.843	0.939	1.141	1.454	2.138	6.818	10.580	16.363

Table 9. Continued.

PROJECTION RUN: gm cod 10 yr projection

INPUT FILE: gmcodt1.in

OUTPUT FILE: gmcodt1.out3

RECRUITMENT MODEL: 5

NUMBER OF SIMULATIONS: 100

F-BASED PROJECTIONS

CONSTANT F:0.290

SPAWNING STOCK BIOMASS (THOUSAND MT)

YEAR	AVG SSB (000 MT)	STD
1997	7.972	1.976
1998	10.037	2.619
1999	13.604	4.542
2000	15.770	6.095
2001	17.836	7.758
2002	21.710	9.805
2003	28.030	12.965
2004	33.183	14.692
2005	39.488	16.765
2006	46.313	18.762

PERCENTILES OF SPAWNING STOCK BIOMASS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	4.333	5.076	5.702	6.583	7.579	9.015	10.626	12.042	13.447
1998	5.525	6.387	6.968	8.065	9.581	11.673	13.688	14.955	17.136
1999	6.685	7.997	8.805	10.108	12.334	16.592	20.073	22.185	26.092
2000	7.709	8.779	9.489	10.904	14.074	19.635	24.503	27.520	33.122
2001	7.601	8.714	9.639	11.626	15.924	22.662	28.945	32.789	40.479
2002	7.685	9.263	10.890	14.003	19.721	27.745	35.386	40.122	50.301
2003	8.431	10.663	13.480	18.270	25.666	35.713	46.010	52.433	65.881
2004	9.050	12.502	16.458	22.562	30.866	41.574	53.140	60.657	76.572
2005	9.890	15.277	20.222	27.577	37.251	49.099	61.731	70.247	88.166
2006	11.268	19.010	24.708	33.517	44.046	57.008	70.892	80.691	101.615

RECRUITMENT UNITS ARE: 1000.000 FISH

BIRTH

YEAR	AVG RECRUITMENT	STD
1997	3517.865	3179.276
1998	2477.908	2530.922
1999	3977.246	3482.968
2000	5586.955	4237.963
2001	6047.459	4552.932
2002	6380.541	4930.282
2003	7061.950	5453.861
2004	8071.136	6335.721
2005	8837.021	6775.436
2006	9450.923	6961.327

PERCENTILES OF RECRUITMENT UNITS ARE: 1000.000 FISH

BIRTH

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	496.951	811.456	1037.475	1482.759	2149.967	4555.691	8195.632	10634.147	14390.613
1998	403.409	643.825	826.151	1164.144	1622.578	2302.557	5637.129	8231.938	13066.778
1999	507.446	858.751	1098.024	1579.892	2448.252	5408.195	9105.646	11622.897	15585.545
2000	783.022	1302.795	1647.429	2452.079	4352.767	7405.925	11446.575	14127.984	20003.762

2001	1011.343	1512.672	1883.117	2815.395	4730.085	7940.235	11968.395	14997.522	22637.676
2002	1003.167	1539.090	1946.657	2974.439	4937.496	8257.940	12671.919	15940.524	24145.316
2003	1121.219	1727.111	2193.223	3380.787	5469.604	9005.206	13901.290	17774.668	27184.611
2004	1365.726	2158.325	2694.039	4012.720	6202.842	10003.006	15536.821	20216.395	32658.057
2005	1637.572	2548.319	3194.278	4552.958	6842.123	10836.991	16873.828	22073.332	34889.035
2006	1945.436	2939.414	3620.280	5049.337	7430.866	11562.216	17457.164	22733.027	36889.570

LANDINGS FOR F-BASED PROJECTIONS

YEAR	AVG LANDINGS (000 MT)	STD
1997	2.269	0.606
1998	2.725	0.662
1999	3.240	0.862
2000	3.786	1.413
2001	4.242	1.956
2002	5.249	2.626
2003	6.867	3.384
2004	8.359	3.868
2005	10.000	4.388
2006	11.664	4.869

PERCENTILES OF LANDINGS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	1.204	1.398	1.565	1.833	2.178	2.602	3.057	3.487	3.881
1998	1.535	1.759	1.972	2.256	2.615	3.098	3.622	4.045	4.635
1999	1.752	2.062	2.257	2.570	3.095	3.785	4.409	4.848	5.643
2000	1.927	2.182	2.367	2.713	3.336	4.622	5.821	6.594	7.992
2001	1.873	2.152	2.352	2.737	3.594	5.364	7.121	8.119	10.155
2002	1.900	2.272	2.546	3.132	4.576	6.885	9.002	10.295	13.012
2003	2.080	2.600	3.100	4.205	6.219	8.903	11.611	13.230	16.813
2004	2.287	3.018	3.904	5.515	7.757	10.555	13.607	15.568	19.923
2005	2.510	3.620	4.933	6.914	9.414	12.455	15.767	18.141	22.812
2006	2.771	4.499	6.088	8.325	11.078	14.386	18.016	20.616	25.846

Table 9. Continued.

PROJECTION RUN: gm cod 10 yr projection

INPUT FILE: gmcodt1.in

OUTPUT FILE: gmcodt1.out4

RECRUITMENT MODEL: 5

NUMBER OF SIMULATIONS: 100

F-BASED PROJECTIONS

CONSTANT F:0.000

SPAWNING STOCK BIOMASS (THOUSAND MT)

YEAR	AVG SSB (000 MT)	STD
1997	8.304	2.068
1998	12.942	3.369
1999	21.377	6.592
2000	28.407	8.767
2001	34.598	11.281
2002	44.189	15.309
2003	60.743	23.453
2004	77.528	29.372
2005	100.953	36.437
2006	127.498	44.561

PERCENTILES OF SPAWNING STOCK BIOMASS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	4.495	5.272	5.933	6.846	7.889	9.409	11.077	12.568	14.036
1998	6.986	8.187	9.001	10.467	12.393	14.993	17.515	19.325	22.234
1999	10.431	12.683	14.114	16.250	19.805	25.872	30.413	33.644	39.567
2000	14.963	16.894	18.665	21.767	26.226	34.376	40.614	44.492	52.577
2001	17.427	19.921	22.086	26.112	31.958	41.893	50.302	55.436	66.478
2002	20.819	24.573	27.262	32.634	41.086	53.471	65.458	73.181	88.207
2003	26.549	31.932	35.422	42.946	55.557	74.333	93.516	105.757	130.187
2004	33.518	40.573	45.383	55.299	71.729	94.313	118.215	133.616	164.492
2005	42.796	52.666	59.318	73.722	95.393	121.600	150.281	168.594	208.875
2006	55.228	68.287	77.159	95.014	120.719	152.506	185.994	210.335	262.378

RECRUITMENT UNITS ARE: 1000.000 FISH

BIRTH

YEAR	AVG RECRUITMENT	STD
1997	3507.360	3164.108
1998	2778.377	2777.832
1999	5495.904	4080.610
2000	7245.079	5361.851
2001	8225.336	6115.429
2002	8981.558	6540.785
2003	10069.920	7251.428
2004	12095.539	8425.792
2005	14055.829	9583.616
2006	16651.701	9953.930

PERCENTILES OF RECRUITMENT UNITS ARE: 1000.000 FISH

BIRTH

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	488.467	825.874	1047.373	1487.148	2148.048	4540.325	8087.418	10546.966	14541.959
1998	427.417	691.563	876.358	1227.677	1735.756	2863.704	6624.565	9202.603	13555.396
1999	851.247	1350.133	1654.644	2416.884	4302.793	7357.741	11243.932	13839.141	19130.072
2000	1566.995	2080.787	2543.959	3571.663	5588.112	9143.003	14226.869	18205.639	26239.076

2001	2021.285	2548.418	3042.309	4155.112	6316.746	10110.040	15934.562	20485.182	31414.447
2002	2272.910	2944.770	3470.718	4695.527	6945.838	10990.860	16911.129	22082.244	34408.215
2003	2723.485	3512.706	4110.478	5498.318	7945.567	12116.322	18439.883	23819.611	38303.184
2004	3386.343	4354.849	5093.272	6794.833	9710.378	14517.108	21545.826	27863.582	44925.148
2005	4169.674	5333.564	6205.869	8207.205	11501.703	16622.420	24427.762	31430.904	51200.695
2006	5269.396	6791.823	7935.174	10300.466	13993.305	19870.242	28312.713	35478.395	54373.535

LANDINGS FOR P-BASED PROJECTIONS

YEAR	AVG LANDINGS (000 MT)	STD
1997	0.000	0.000
1998	0.000	0.000
1999	0.000	0.000
2000	0.000	0.000
2001	0.000	0.000
2002	0.000	0.000
2003	0.000	0.000
2004	0.000	0.000
2005	0.000	0.000
2006	0.000	0.000

PERCENTILES OF LANDINGS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1998	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1999	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 10. 10-year projections at $F_{0.1}$ ($F=0.27$) and F_{96} ($F=0.12$) for Southern New England yellowtail flounder during 1997-2006.

PROJECTION RUN: sne yt 10 yr projection at fo.

INPUT FILE: sneyt97.in

OUTPUT FILE: sneyt97.out

RECRUITMENT MODEL: 5

NUMBER OF SIMULATIONS: 100

F-BASED PROJECTIONS

CONSTANT $F=0.270$

SPAWNING STOCK BIOMASS (THOUSAND MT)

YEAR	AVG SSB (000 MT)	STD
1997	5.143	1.279
1998	8.919	4.318
1999	14.433	8.662
2000	20.277	12.637
2001	25.875	16.031
2002	31.237	19.360
2003	36.122	22.294
2004	40.445	24.705
2005	44.217	26.707
2006	47.380	28.122

PERCENTILES OF SPAWNING STOCK BIOMASS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	2.751	3.244	3.627	4.239	5.083	5.791	6.783	7.063	9.124
1998	3.625	4.440	5.019	6.157	7.837	10.335	13.981	17.130	25.707
1999	4.577	5.897	6.815	8.776	12.016	17.252	24.997	31.754	48.132
2000	5.740	7.488	8.790	11.871	16.836	24.859	35.997	45.265	66.710
2001	6.948	9.343	11.080	15.113	21.712	31.735	45.799	57.170	84.485
2002	8.208	11.405	13.547	18.443	26.268	38.298	54.861	67.003	101.885
2003	9.690	13.328	15.914	21.534	30.520	44.104	62.463	76.777	117.444
2004	11.081	15.267	18.185	24.342	34.385	49.097	69.534	85.394	132.418
2005	12.502	16.991	20.159	26.864	37.676	53.625	74.942	93.793	142.840
2006	13.669	18.412	21.800	29.093	40.719	57.211	80.386	98.587	149.214

ANNUAL PROBABILITY THAT SSB EXCEEDS THRESHOLD: 10.00000 THOUSAND MT

YEAR	Pr(SSB > Threshold Value)
1997	0.000
1998	0.273
1999	0.650
2000	0.846
2001	0.934
2002	0.971
2003	0.988
2004	0.995
2005	0.998
2006	0.999

RECRUITMENT UNITS ARE: 1000000. FISH

BIRTH

YEAR	AVG RECRUITMENT	STD
1997	24.943	29.990
1998	29.604	37.820
1999	33.319	43.580
2000	37.748	51.482
2001	40.886	56.072

2002	43.474	57.553
2003	46.334	61.170
2004	47.929	61.774
2005	49.012	58.665
2006	50.891	59.807

PERCENTILES OF RECRUITMENT UNITS ARE: 1000000. FISH

BIRTH

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	1.321	2.579	3.735	7.127	14.734	30.493	57.335	84.048	151.107
1998	1.837	3.164	4.417	8.352	17.163	35.338	66.469	97.810	193.363
1999	2.477	3.844	5.313	9.641	19.252	38.748	74.868	110.818	221.976
2000	3.006	4.758	6.382	11.069	21.732	43.713	82.846	122.512	254.925
2001	3.651	5.806	7.635	12.660	23.751	47.058	88.929	129.381	278.127
2002	4.317	6.800	8.831	14.248	25.889	49.688	92.771	137.064	275.954
2003	5.054	7.613	9.801	15.669	28.025	53.609	98.144	142.797	294.960
2004	5.619	8.535	10.868	16.992	29.611	55.419	100.734	144.416	290.283
2005	6.066	9.219	11.608	17.966	30.930	56.698	102.925	148.487	291.710
2006	6.561	9.697	12.327	18.779	32.270	59.501	106.713	151.072	293.179

LANDINGS FOR F-BASED PROJECTIONS

YEAR	AVG LANDINGS (000 MT)	STD
1997	0.712	0.166
1998	1.015	0.270
1999	1.748	0.710
2000	2.819	1.678
2001	3.871	2.371
2002	4.945	3.012
2003	5.990	3.671
2004	6.909	4.234
2005	7.715	4.665
2006	8.430	5.070

PERCENTILES OF LANDINGS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	0.407	0.448	0.508	0.608	0.689	0.799	0.951	1.000	1.222
1998	0.538	0.657	0.713	0.830	0.983	1.145	1.353	1.533	1.861
1999	0.757	0.921	1.036	1.267	1.598	2.051	2.651	3.098	4.277
2000	0.941	1.189	1.362	1.739	2.350	3.348	4.820	6.120	9.326
2001	1.154	1.496	1.739	2.315	3.241	4.706	6.699	8.411	12.830
2002	1.392	1.861	2.195	2.944	4.159	6.018	8.635	10.712	16.312
2003	1.635	2.248	2.668	3.576	5.055	7.315	10.422	12.839	19.175
2004	1.914	2.626	3.093	4.167	5.841	8.400	11.825	14.685	22.133
2005	2.181	2.965	3.519	4.688	6.557	9.337	13.153	16.202	24.881
2006	2.445	3.294	3.892	5.143	7.206	10.214	14.223	17.804	27.178

DISCARDS FOR F-BASED PROJECTIONS

YEAR	AVG DISCARDS (000 MT)	STD
1997	0.132	0.032
1998	0.197	0.083
1999	0.294	0.137
2000	0.461	0.295
2001	0.633	0.423
2002	0.754	0.514
2003	0.845	0.592
2004	0.927	0.664
2005	0.995	0.710
2006	1.053	0.749

PERCENTILES OF DISCARDS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	0.073	0.082	0.093	0.113	0.129	0.151	0.174	0.190	0.230
1998	0.090	0.111	0.123	0.146	0.176	0.223	0.290	0.353	0.518
1999	0.111	0.139	0.159	0.201	0.262	0.351	0.465	0.554	0.780
2000	0.123	0.167	0.198	0.268	0.381	0.560	0.820	1.040	1.616
2001	0.149	0.205	0.251	0.351	0.518	0.786	1.147	1.445	2.203
2002	0.167	0.239	0.296	0.417	0.620	0.924	1.362	1.734	2.727
2003	0.189	0.273	0.334	0.468	0.687	1.035	1.530	1.957	3.069
2004	0.216	0.306	0.370	0.512	0.752	1.129	1.656	2.115	3.441
2005	0.240	0.333	0.402	0.553	0.813	1.205	1.754	2.269	3.681
2006	0.260	0.356	0.429	0.593	0.862	1.271	1.869	2.380	3.947

Table 10. Continued

PROJECTION RUN: sne yt 10 yr projection at fo.

INPUT FILE: sneyt97.in

OUTPUT FILE: sneyt97.out

RECRUITMENT MODEL: 5

NUMBER OF SIMULATIONS: 100

F-BASED PROJECTIONS

CONSTANT F:0.120

SPAWNING STOCK BIOMASS (THOUSAND MT)

YEAR	AVG SSB (000 MT)	STD
1997	5.337	1.314
1998	9.641	4.374
1999	16.002	9.031
2000	23.251	13.700
2001	30.696	18.205
2002	38.204	22.528
2003	45.570	26.747
2004	52.619	30.819
2005	59.244	34.258
2006	65.487	37.310

PERCENTILES OF SPAWNING STOCK BIOMASS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	2.863	3.394	3.753	4.425	5.296	6.049	7.005	7.333	9.388
1998	4.103	4.946	5.569	6.636	8.554	11.171	14.827	18.101	26.301
1999	5.483	6.924	7.947	10.088	13.505	18.993	27.188	34.222	50.070
2000	7.149	9.285	10.770	14.043	19.523	28.136	40.219	50.484	75.080
2001	8.922	11.955	13.927	18.462	25.966	37.242	53.100	65.814	98.742
2002	11.051	14.775	17.327	23.237	32.556	46.591	65.444	80.537	119.758
2003	13.375	17.804	20.943	27.880	38.882	55.368	77.874	94.580	144.651
2004	15.469	20.863	24.600	32.490	45.274	63.640	88.191	107.971	165.573
2005	17.735	23.938	27.866	37.186	51.525	71.587	98.711	120.322	184.128
2006	19.860	26.757	31.231	41.279	57.100	79.178	108.735	132.295	195.902

ANNUAL PROBABILITY THAT SSB EXCEEDS THRESHOLD: 10.00000 THOUSAND MT

YEAR Pr(SSB > Threshold Value)

1997	0.000
1998	0.338
1999	0.756
2000	0.927
2001	0.980
2002	0.995
2003	0.999
2004	1.000
2005	1.000
2006	1.000

RECRUITMENT UNITS ARE: 1000000. FISH

BIRTH

YEAR	AVG RECRUITMENT	STD
1997	25.240	29.714
1998	30.196	38.853
1999	34.524	45.758
2000	38.697	53.548
2001	41.517	54.815

2002	45.674	64.341
2003	49.259	62.896
2004	51.673	67.728
2005	55.186	67.218
2006	58.438	68.310

PERCENTILES OF RECRUITMENT UNITS ARE: 1000000. FISH

BIRTH

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	1.380	2.586	3.752	7.283	14.917	31.099	58.841	83.782	148.101
1998	1.895	3.218	4.549	8.390	17.104	35.733	68.583	101.613	202.448
1999	2.532	4.042	5.472	9.837	19.788	40.247	77.520	115.261	231.852
2000	3.232	5.163	6.855	11.506	22.250	44.715	84.233	125.297	261.214
2001	4.106	6.426	8.280	13.455	24.709	47.691	89.022	131.652	265.980
2002	5.145	7.593	9.834	15.407	27.684	51.968	95.127	139.246	292.929
2003	5.819	8.916	11.360	17.564	30.823	57.375	103.680	145.427	299.668
2004	6.881	10.172	12.742	19.301	32.763	59.532	106.574	153.651	299.641
2005	7.715	11.338	14.104	21.351	35.562	63.687	112.472	159.326	329.000
2006	8.559	12.652	15.536	23.232	37.891	66.939	118.504	171.787	330.332

LANDINGS FOR F-BASED PROJECTIONS

YEAR	AVG LANDINGS (000 MT)	STD
1997	0.336	0.079
1998	0.516	0.130
1999	0.922	0.341
2000	1.539	0.844
2001	2.199	1.268
2002	2.933	1.700
2003	3.687	2.161
2004	4.392	2.541
2005	5.070	2.973
2006	5.708	3.285

PERCENTILES OF LANDINGS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	0.192	0.211	0.238	0.285	0.326	0.377	0.450	0.471	0.578
1998	0.278	0.337	0.367	0.426	0.500	0.581	0.684	0.766	0.901
1999	0.421	0.506	0.567	0.689	0.852	1.071	1.367	1.568	2.086
2000	0.558	0.697	0.794	0.994	1.304	1.809	2.551	3.209	4.751
2001	0.714	0.920	1.053	1.358	1.858	2.635	3.728	4.696	7.015
2002	0.892	1.178	1.371	1.796	2.496	3.546	5.013	6.215	9.120
2003	1.099	1.452	1.697	2.259	3.142	4.471	6.296	7.803	11.374
2004	1.316	1.736	2.040	2.704	3.763	5.336	7.445	9.115	13.736
2005	1.520	2.028	2.389	3.150	4.365	6.116	8.484	10.416	16.001
2006	1.716	2.315	2.705	3.589	4.939	6.914	9.476	11.585	17.674

DISCARDS FOR F-BASED PROJECTIONS

YEAR	AVG DISCARDS (000 MT)	STD
1997	0.062	0.015
1998	0.098	0.038
1999	0.149	0.065
2000	0.238	0.147
2001	0.339	0.225
2002	0.412	0.281
2003	0.466	0.333
2004	0.513	0.366
2005	0.558	0.407
2006	0.603	0.432

PERCENTILES OF DISCARDS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1997	0.034	0.038	0.044	0.053	0.060	0.071	0.081	0.089	0.107
1998	0.046	0.057	0.063	0.074	0.089	0.111	0.142	0.172	0.242
1999	0.060	0.074	0.084	0.105	0.134	0.176	0.231	0.273	0.382
2000	0.065	0.089	0.106	0.141	0.200	0.288	0.415	0.530	0.798
2001	0.081	0.114	0.136	0.188	0.277	0.418	0.615	0.786	1.203
2002	0.093	0.131	0.161	0.227	0.339	0.507	0.746	0.956	1.477
2003	0.108	0.151	0.184	0.258	0.378	0.566	0.846	1.071	1.748
2004	0.121	0.171	0.206	0.285	0.417	0.623	0.918	1.170	1.908
2005	0.136	0.190	0.227	0.314	0.458	0.671	0.983	1.258	2.063
2006	0.149	0.208	0.249	0.344	0.496	0.726	1.053	1.346	2.186

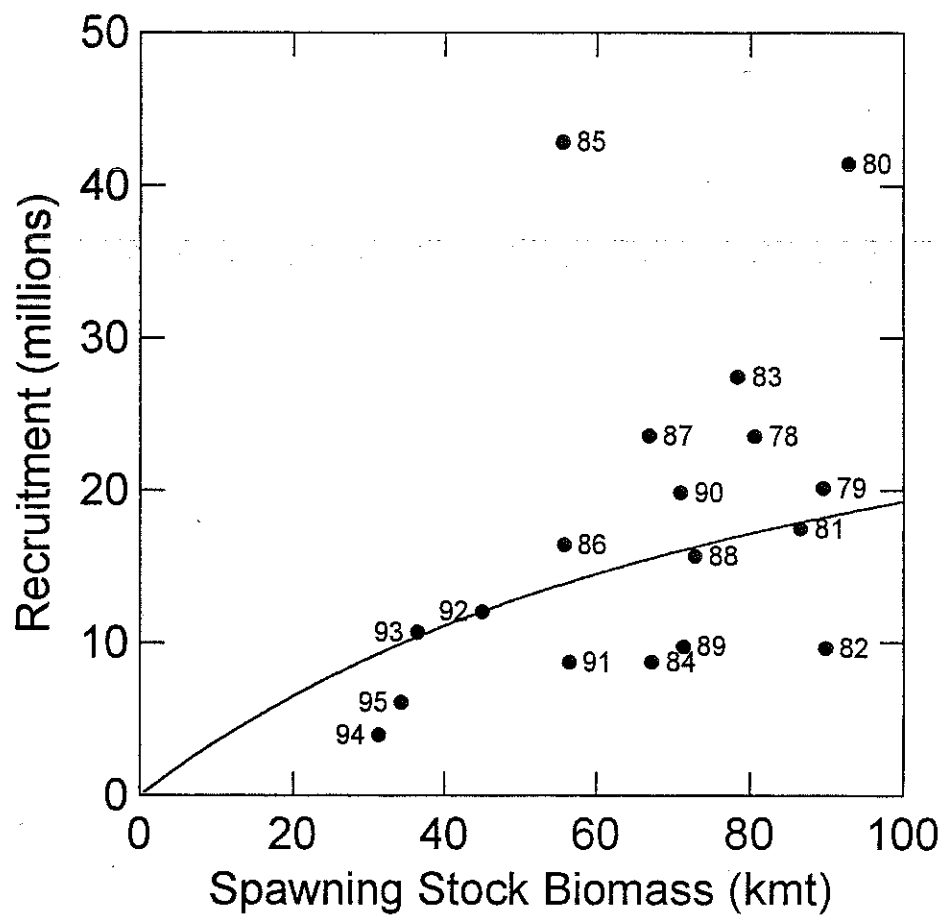


Figure 1A. Stock-recruitment time series for Georges Bank cod during 1978-1995 (SSB kmt; recruitment millions age-1).

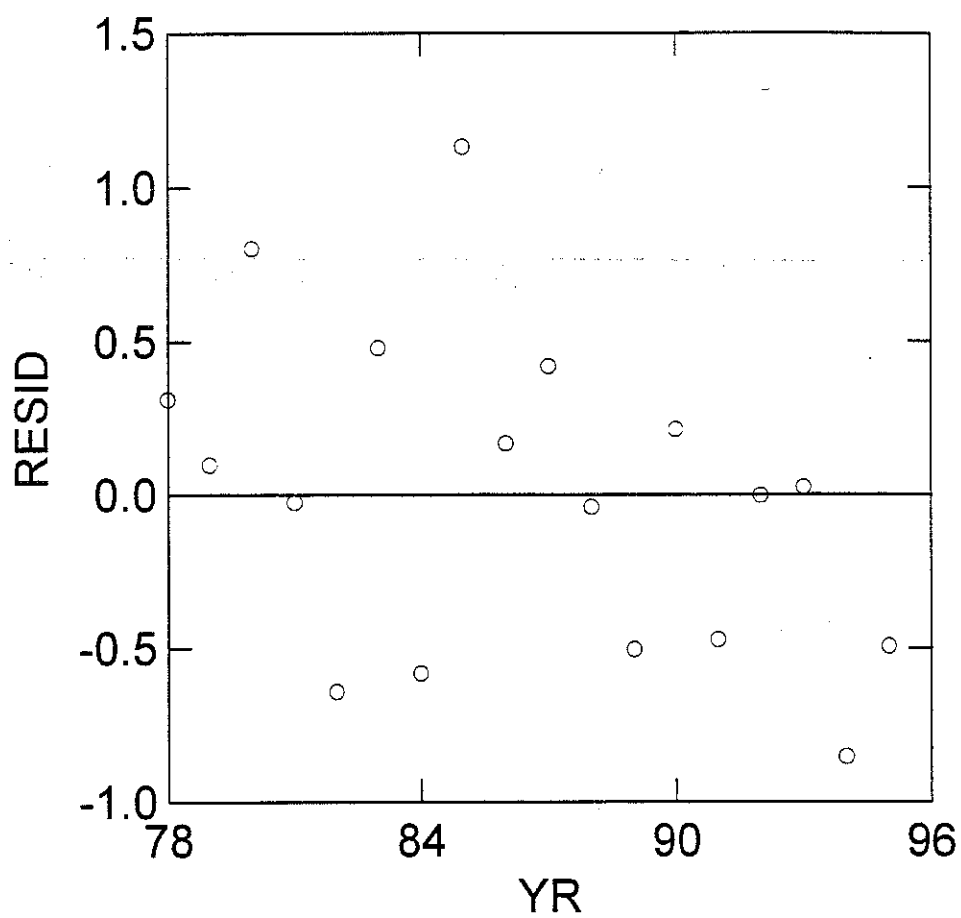


Figure 1B. Residual plot for Georges Bank cod from a Beverton-Holt stock-recruitment model fit using non-linear regression for the years 1978-1995.

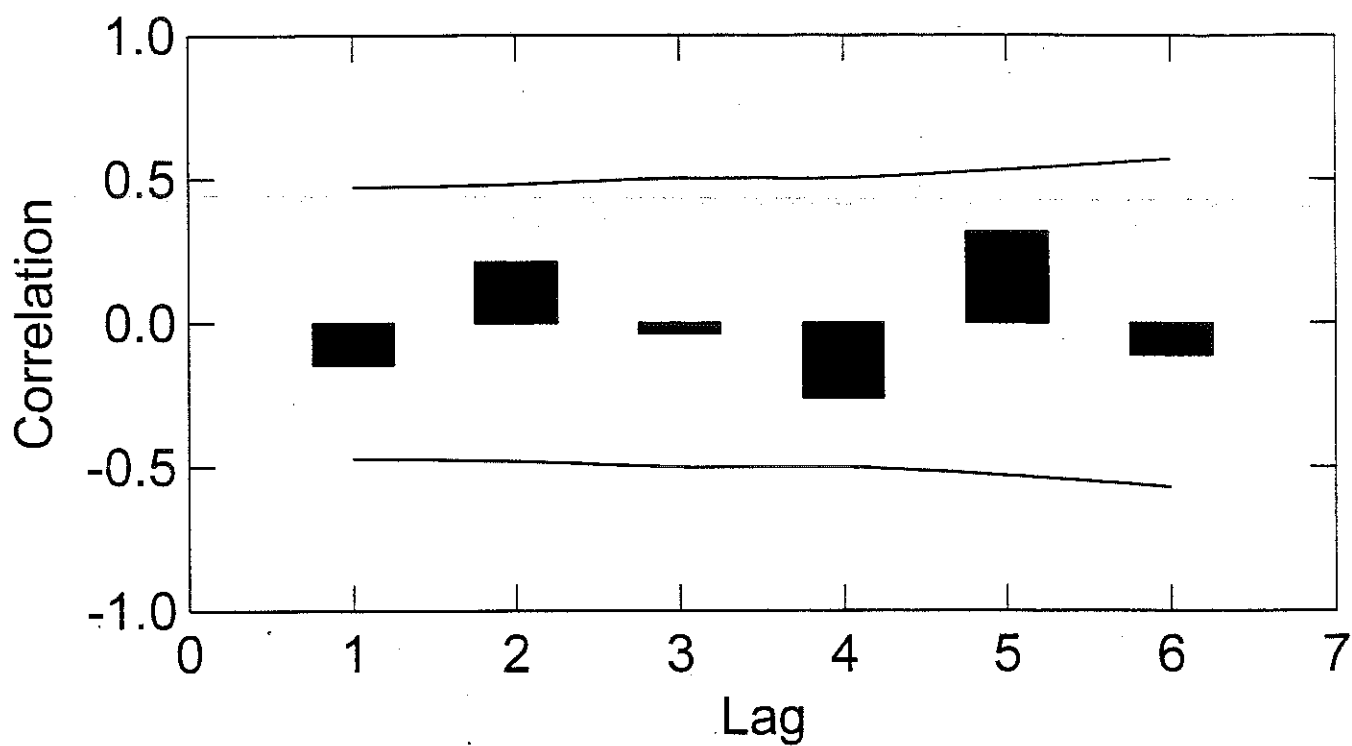


Figure 1C. Autocorrelation plot of residuals for Georges Bank cod for order 1-6 autocorrelation from a Beverton-Holt stock-recruitment model non-linear regression fit for years 1978-1995.

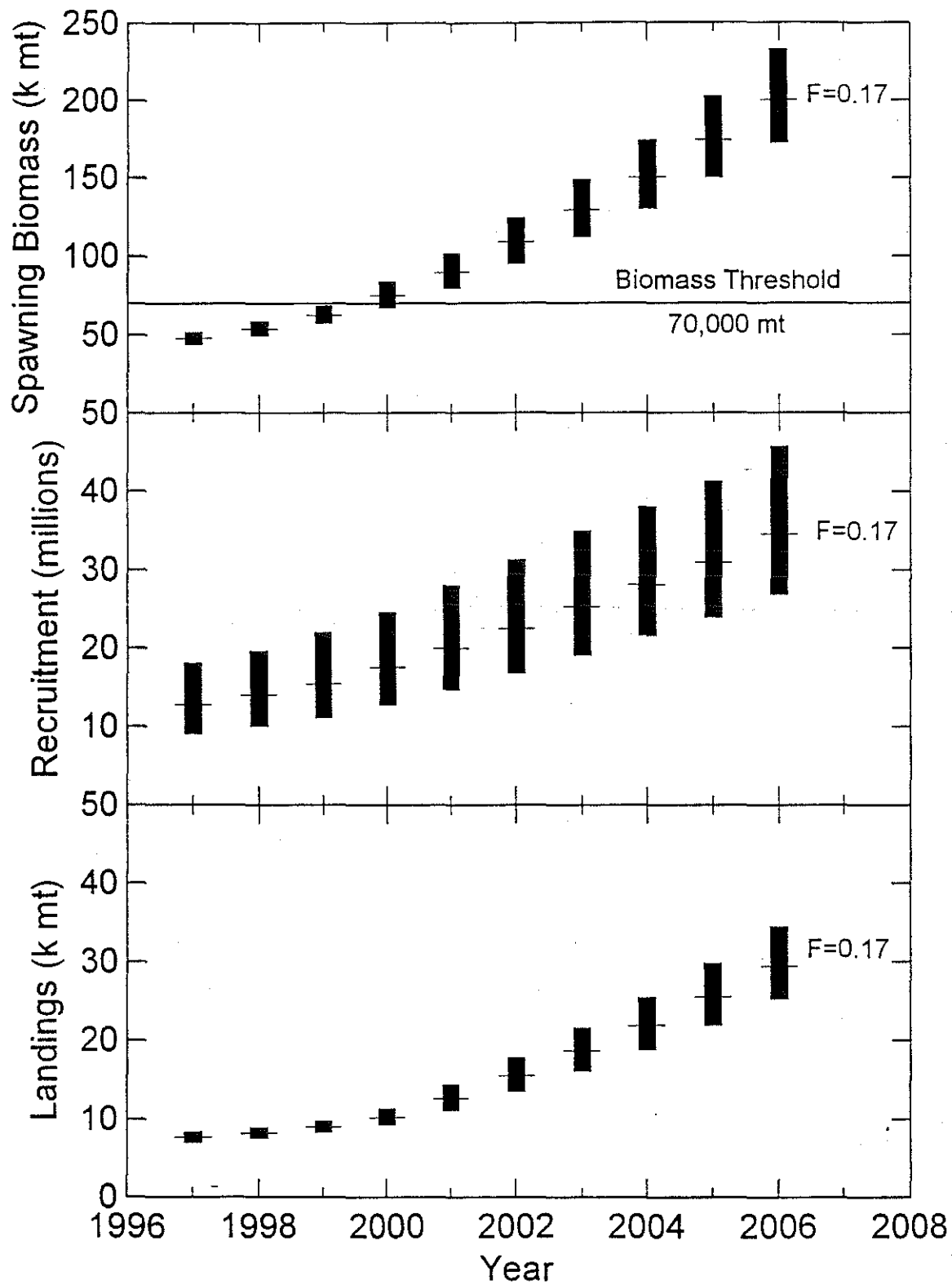


Figure 1D. Ten year projection (1997-2006) of landings, SSB, and recruitment for Georges Bank cod under a fishing mortality rate scenario of $F_{0.1}$ ($F=0.17$). Horizontal bars are the median values, vertical bars are the inter-quartile range (lower 25th percentile to the upper 75th percentile).

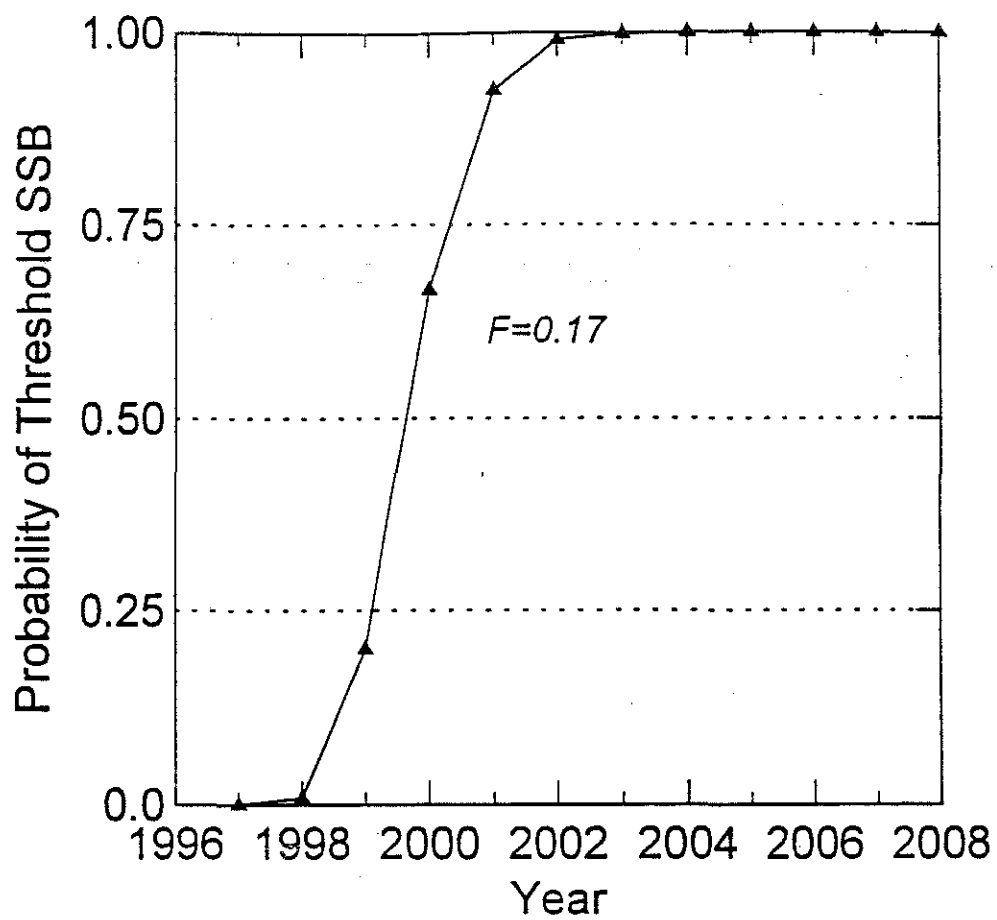


Figure 1E. Annual probabilities of Georges Bank cod spawning biomass at or above 70,000 mt, under a fishing mortality rate scenario of $F_{0.1}$ (0.17).

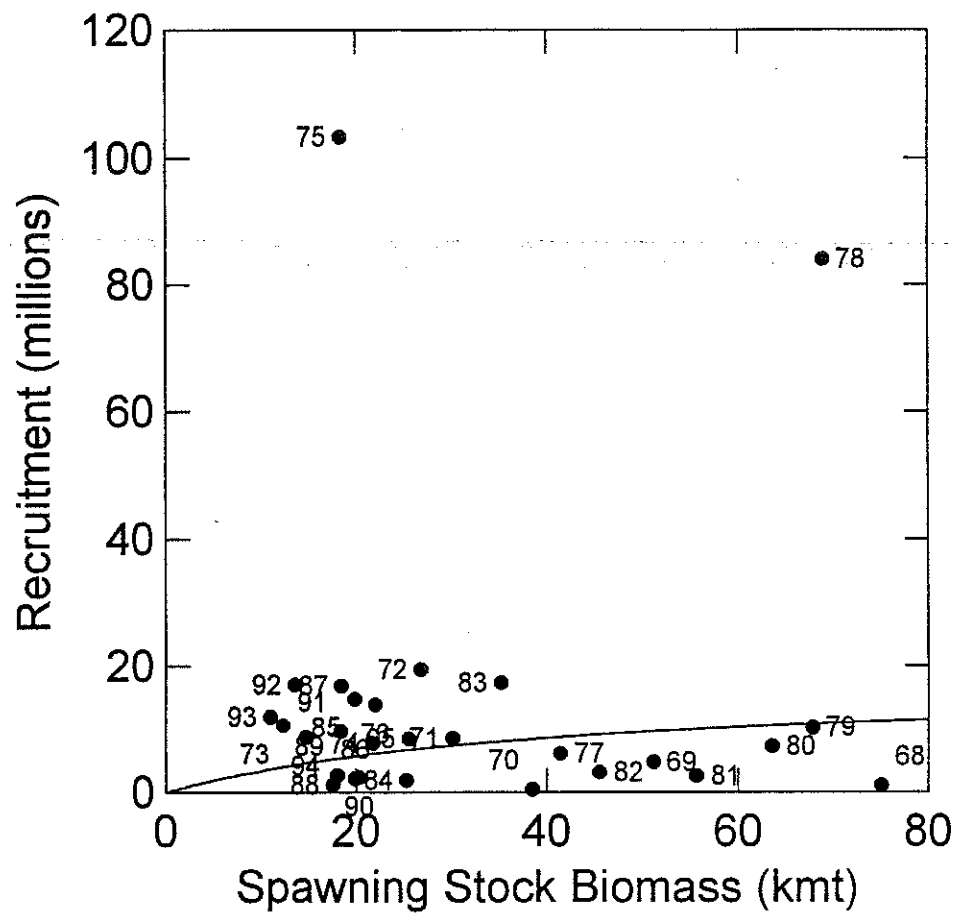


Figure 2A. Stock-recruitment time series for Georges Bank haddock during 1968-1995 (SSB kmt; recruitment millions age-1).

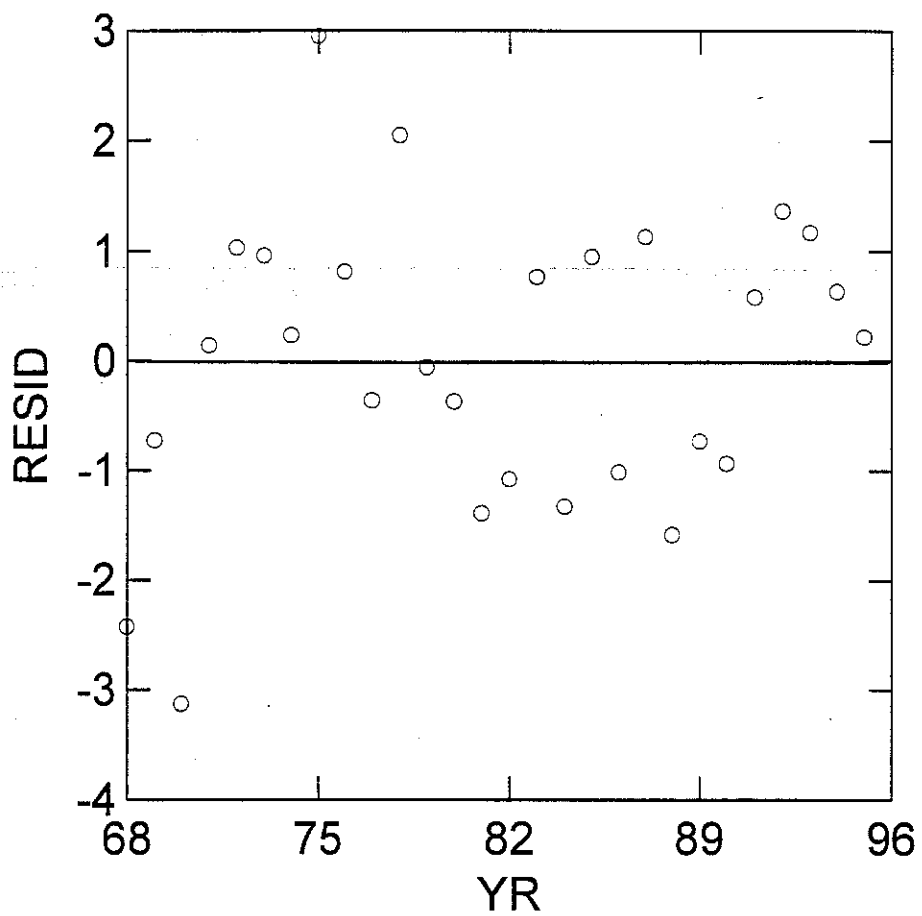


Figure 2B. Residual plot for Georges Bank haddock from a Beverton-Holt stock-recruitment model fit using non-linear regression for the years 1968-1995.

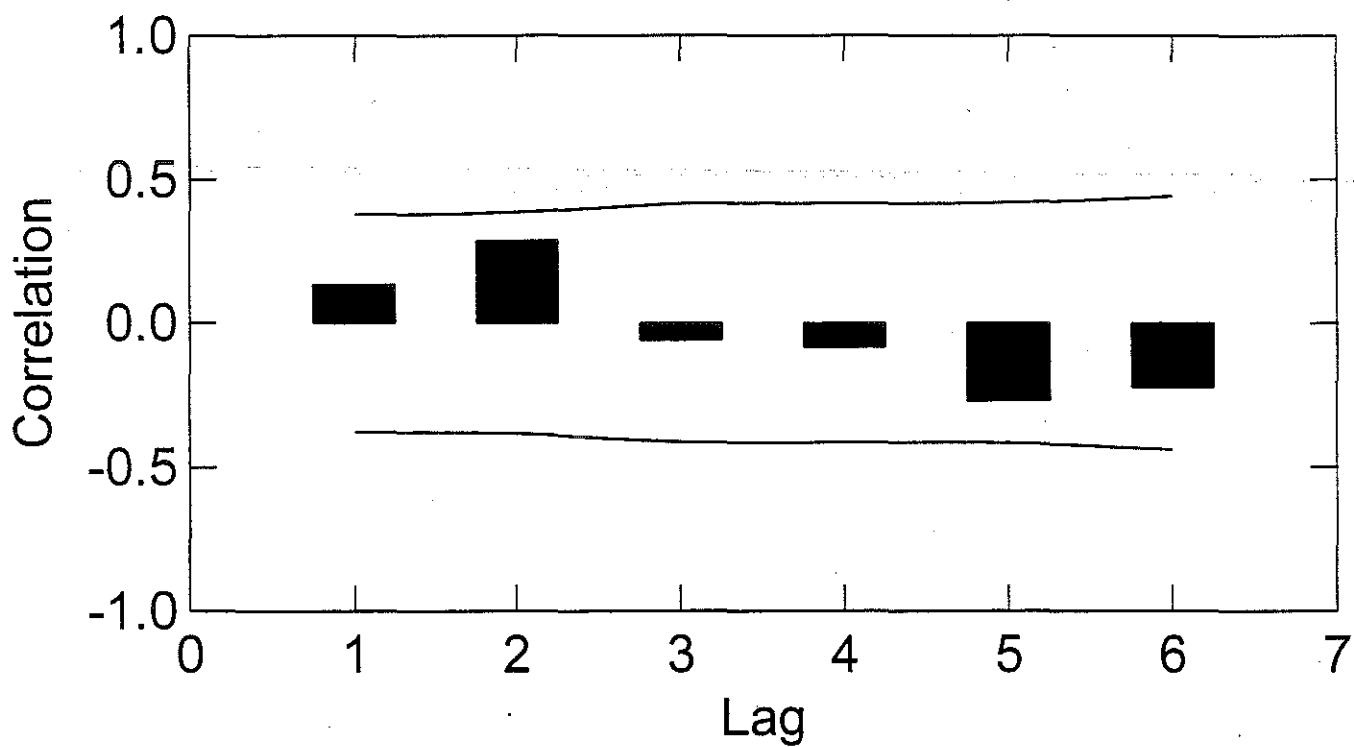


Figure 2C. Autocorrelation plot of residuals for Georges Bank haddock for order 1-6 autocorrelation from a Beverton-Holt stock-recruitment model non-linear regression fit for years 1968-1995.

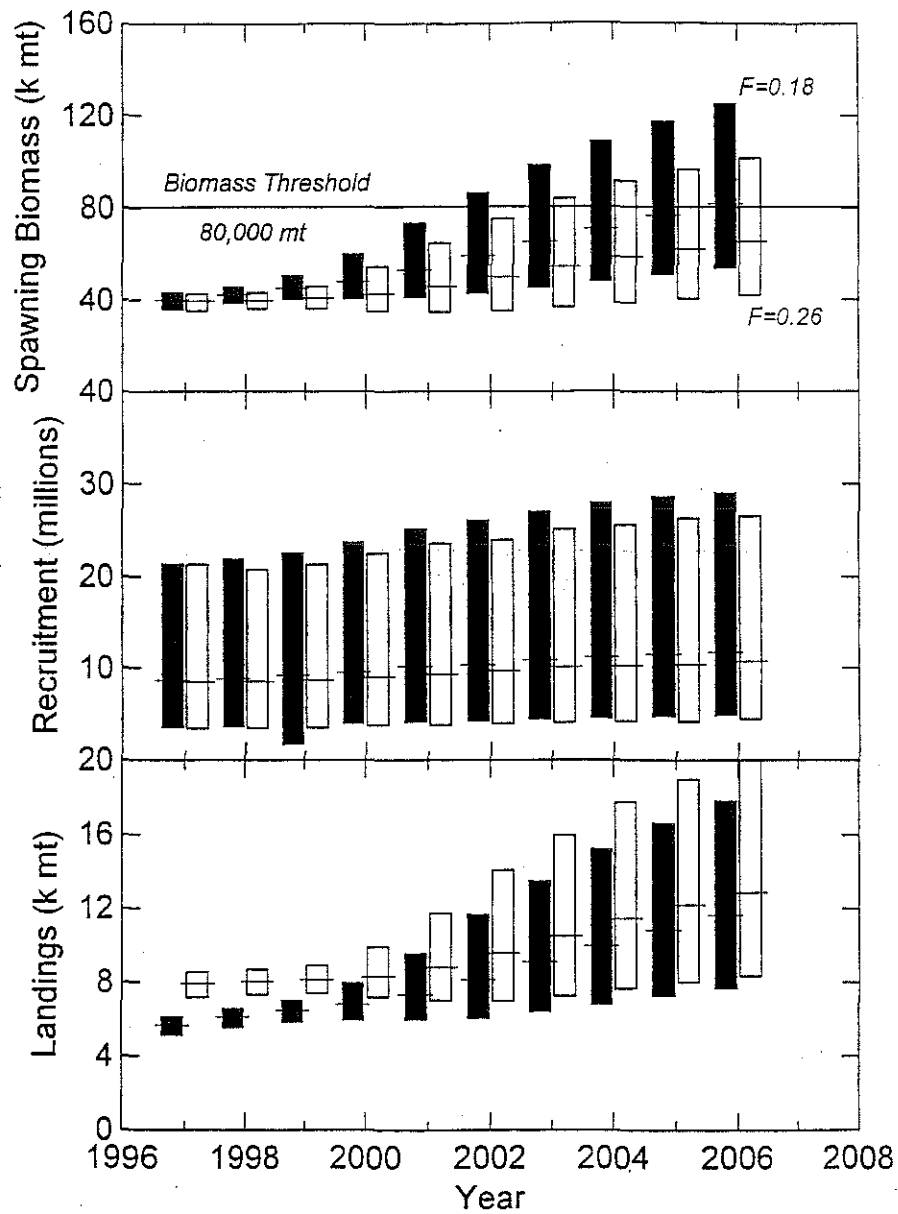


Figure 2D. Ten year projection (1997-2006) of landings, SSB, and recruitment for Georges Bank haddock under two levels of fishing mortality, $F_{0.1}$ (0.26) (open bar), and F_{96} (0.18) (black bar). Horizontal bars are the median values, vertical bars are the inter-quartile range (lower 25th percentile to the upper 75th percentile). Projection results for a fishing mortality scenario of $F=0.1$ are not displayed; numerical results from this simulation are presented in Table 7.

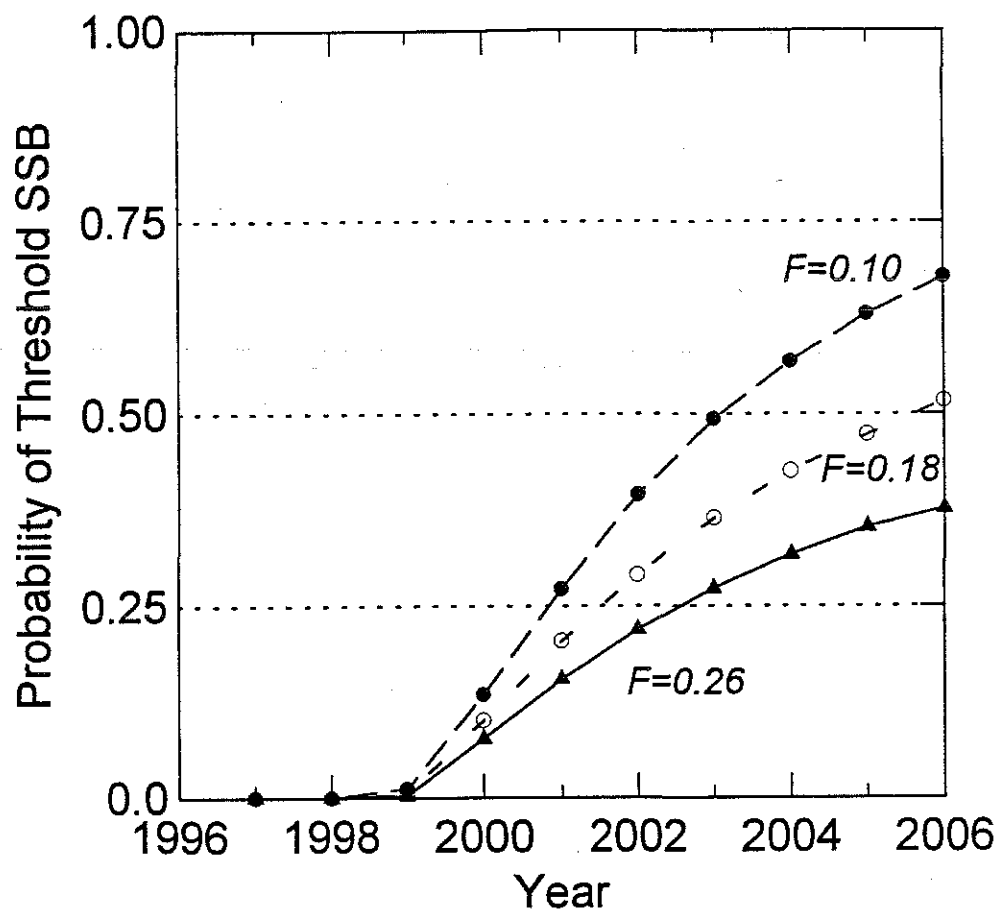


Figure 2E. Annual probabilities of Georges Bank haddock spawning biomass at or above 80,000 mt, under two fishing mortality rate scenarios.

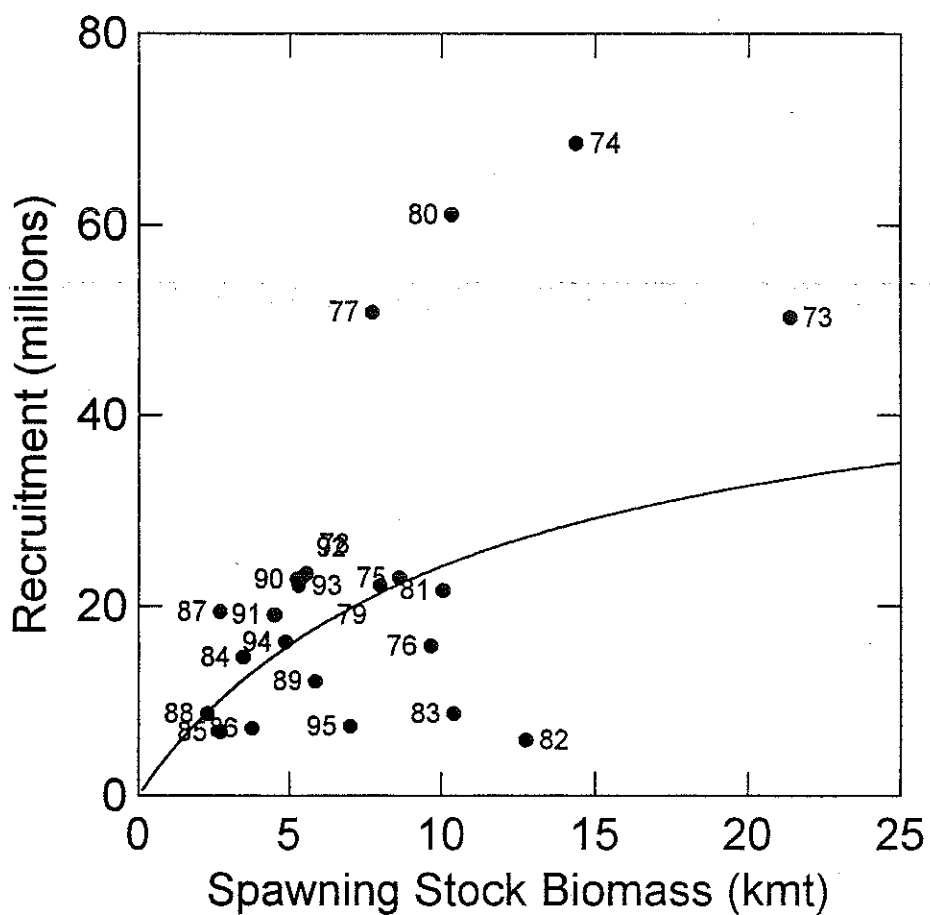


Figure 3A. Stock-recruitment time series for Georges Bank yellowtail flounder during 1973-1995 (SSB kmt; recruitment millions age-1).

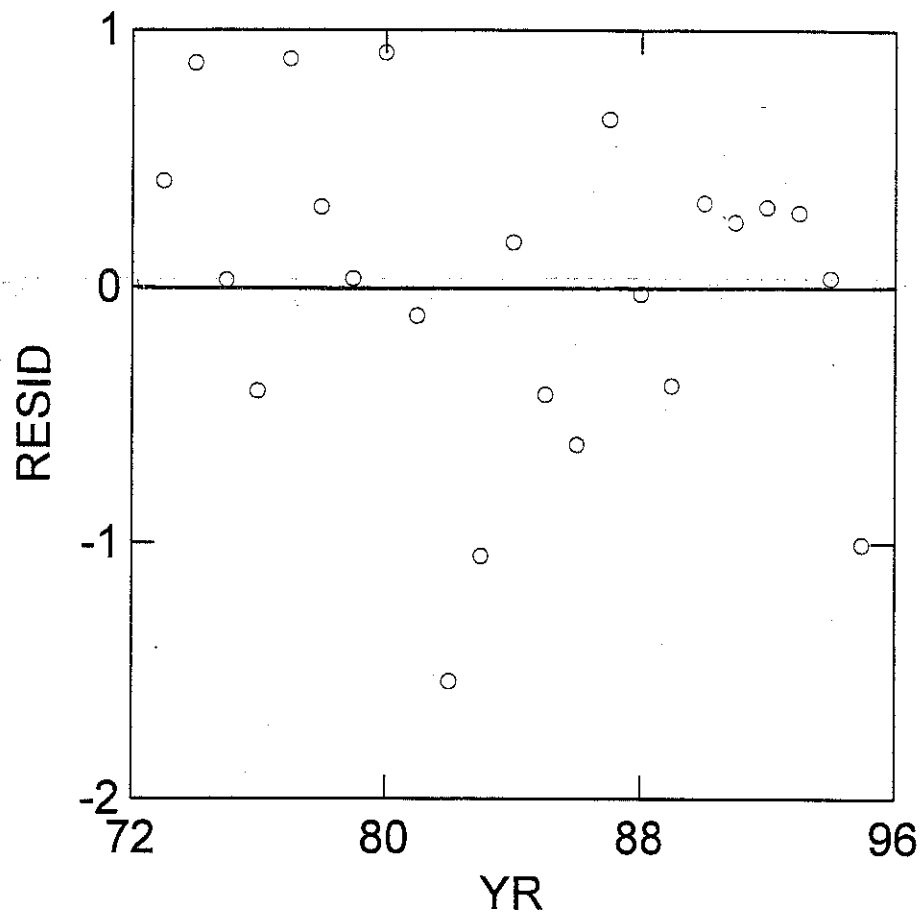


Figure 3B. Residual plot for Georges Bank yellowtail flounder from a Beverton-Holt stock-recruitment model fit using non-linear regression for the years 1973-1995

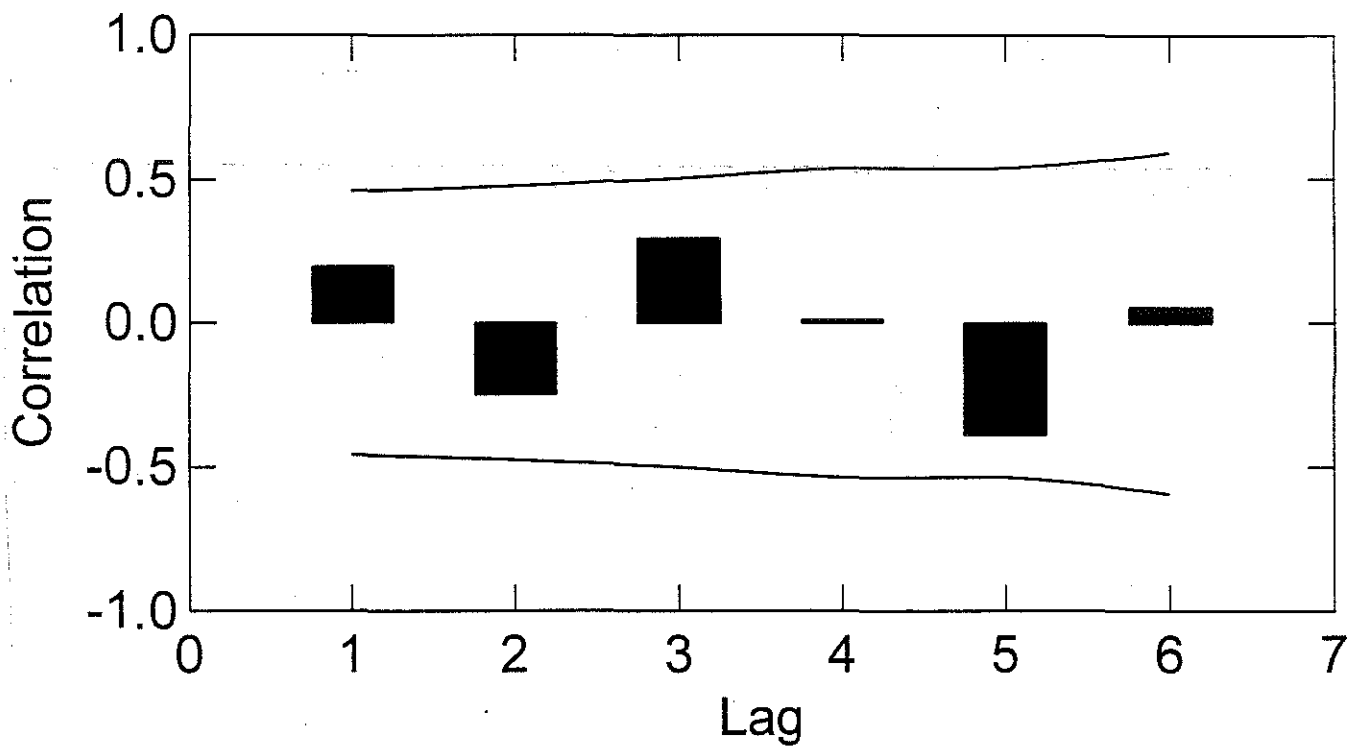


Figure 3C. Autocorrelation plot of residuals for Georges Bank yellowtail flounder for order 1-6 autocorrelation from a Beverton-Holt stock-recruitment model non-linear regression fit for years 1973-1995.

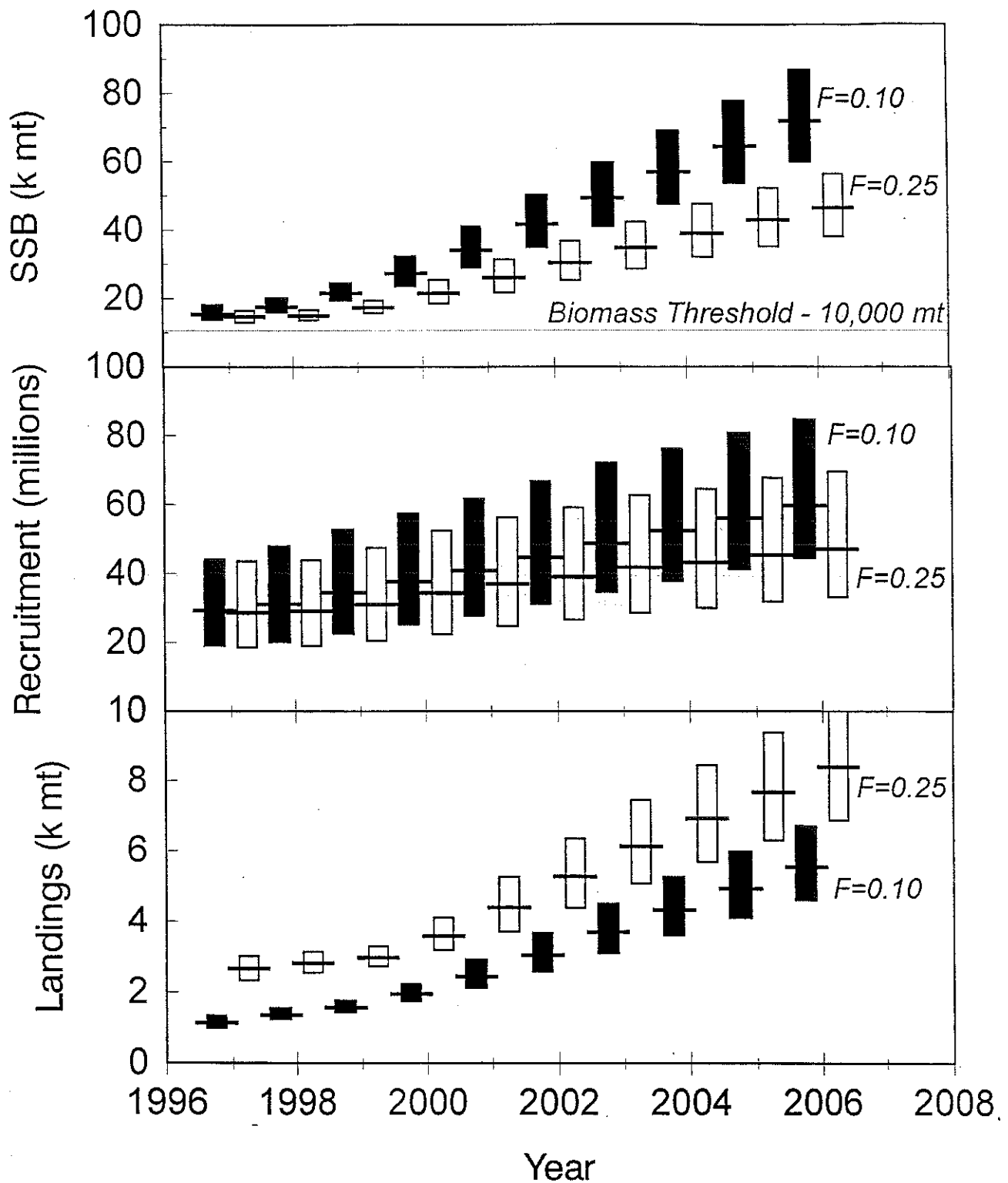


Figure 3D. Ten year projection (1997-2006) of landings, SSB, and recruitment for Georges Bank yellowtail flounder under two levels of fishing mortality, $F_{0.1}$ (0.25) (open bar), and F_{96} (0.10) (black bar). Horizontal bars are the median values, vertical bars are the inter-quartile range (lower 25th percentile to the upper 75th percentile).

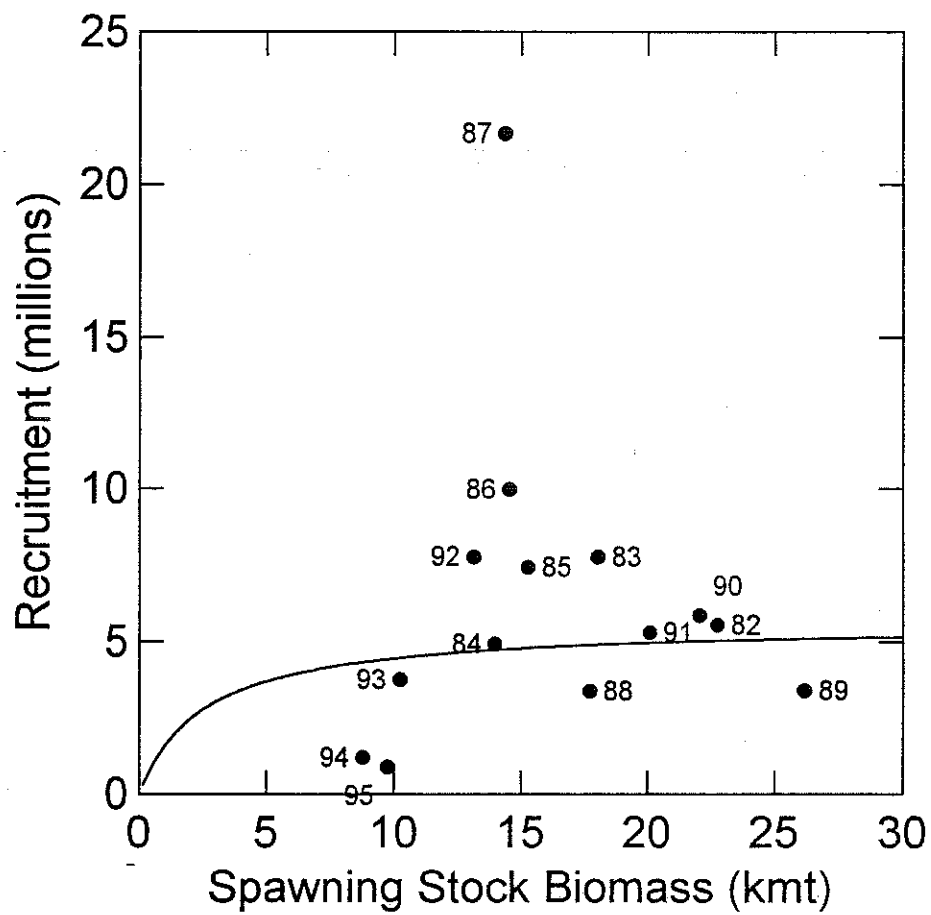


Figure 4A. Stock-recruitment time series for Gulf of Maine cod during 1982-1995 (SSB kmt; recruitment millions age-1).

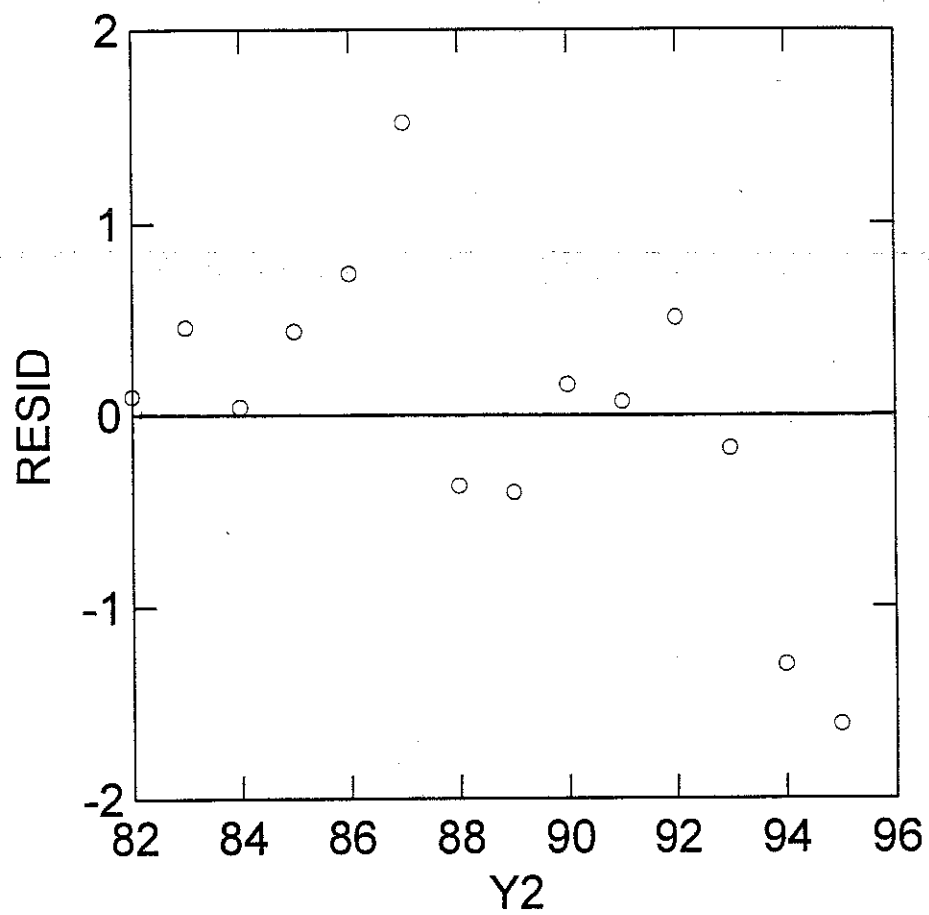


Figure 4B. Residual plot for Gulf of Maine cod from a Beverton-Holt stock-recruitment model fit using non-linear regression for the years 1982-1995.

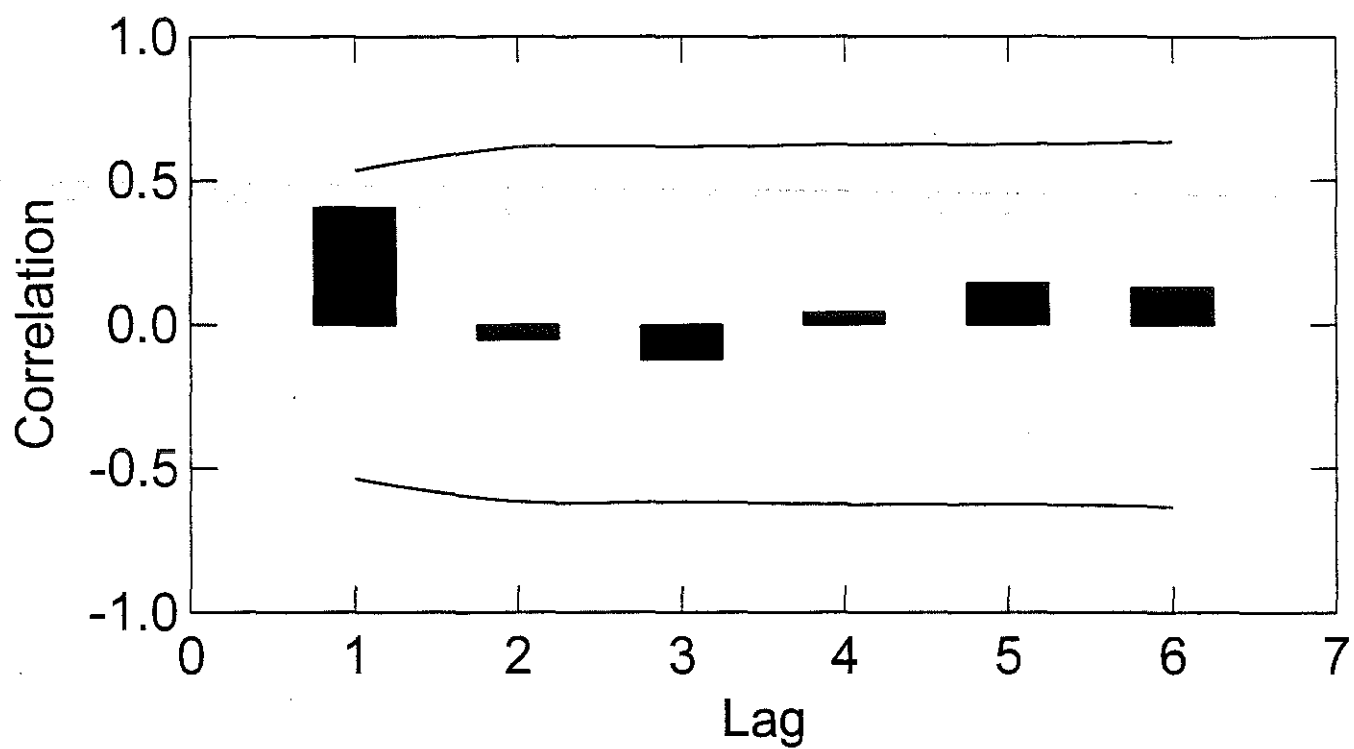


Figure 4C. Autocorrelation plot of residuals for Gulf of Maine cod for order 1-6 autocorrelation from a Beverton-Holt stock-recruitment model non-linear regression fit for years 1982-1995.

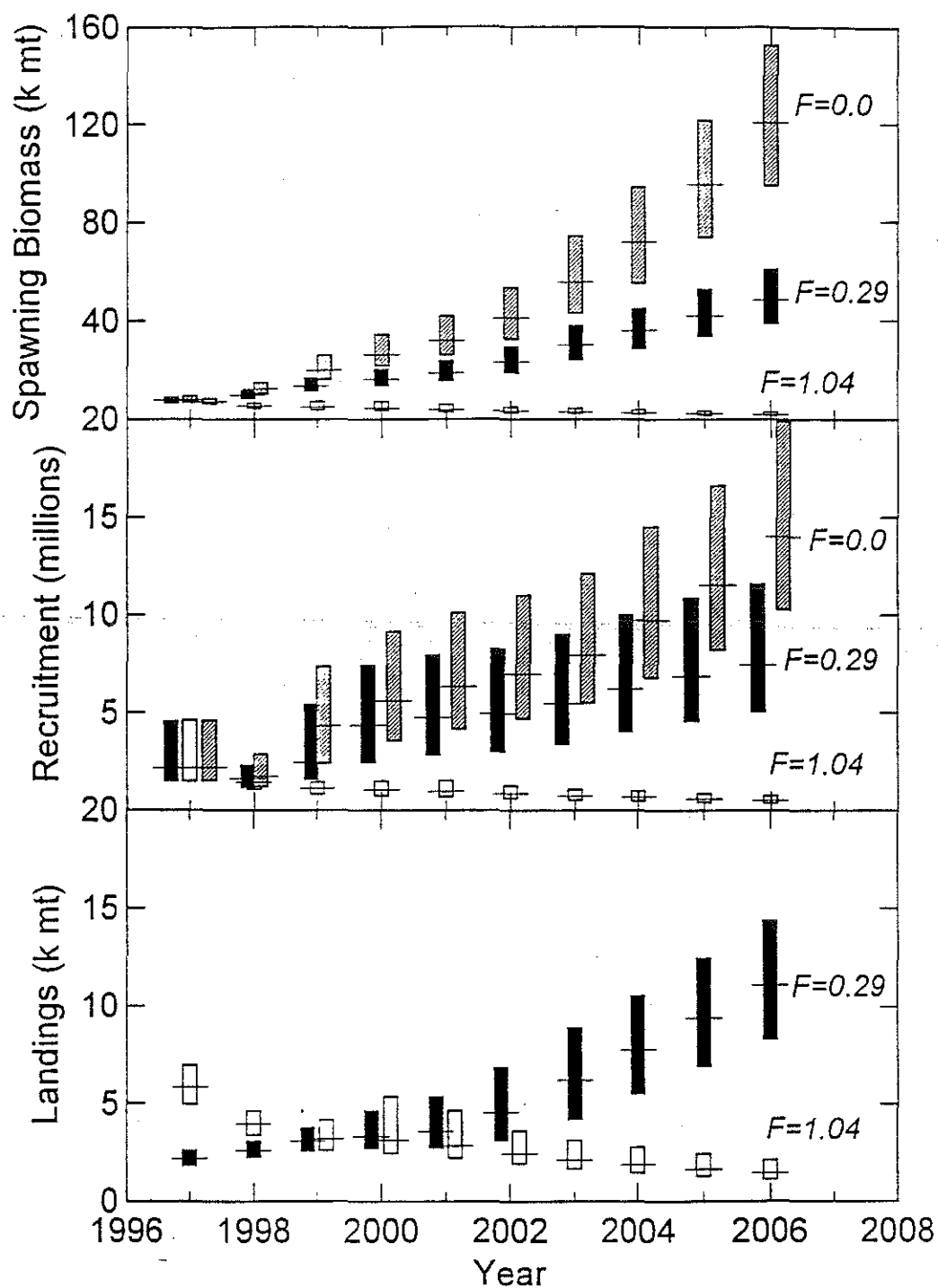


Figure 4D. Ten year projection (1997-2006) of landings, SSB, and recruitment for Gulf of Maine cod under three levels of fishing mortality, $F_{0.1}$ (0.29) (black bar), and F_{96} (1.04) (open bar), and $F=0.0$ (shaded bar). Horizontal bars are the median values, vertical bars are the inter-quartile range (lower 25th percentile to the upper 75th percentile).

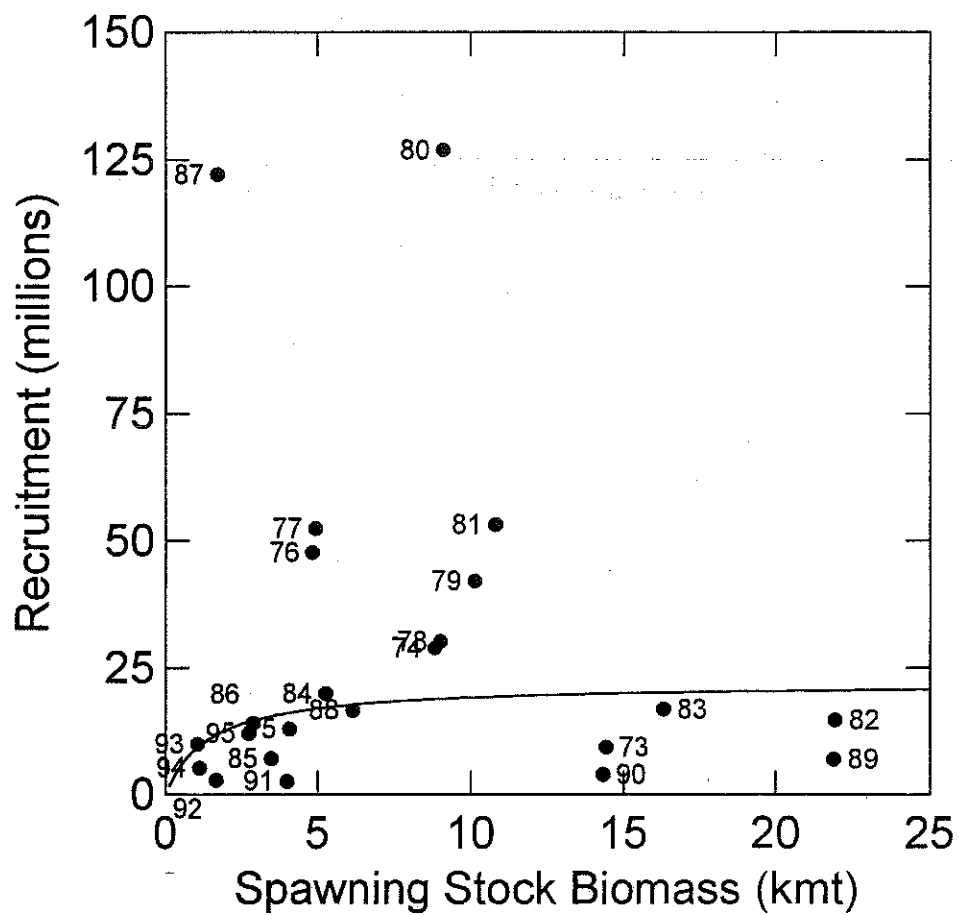


Figure 5A. Stock-recruitment time series for Southern New England yellowtail flounder during 1973-1995 (SSB kmt; recruitment millions age-1).

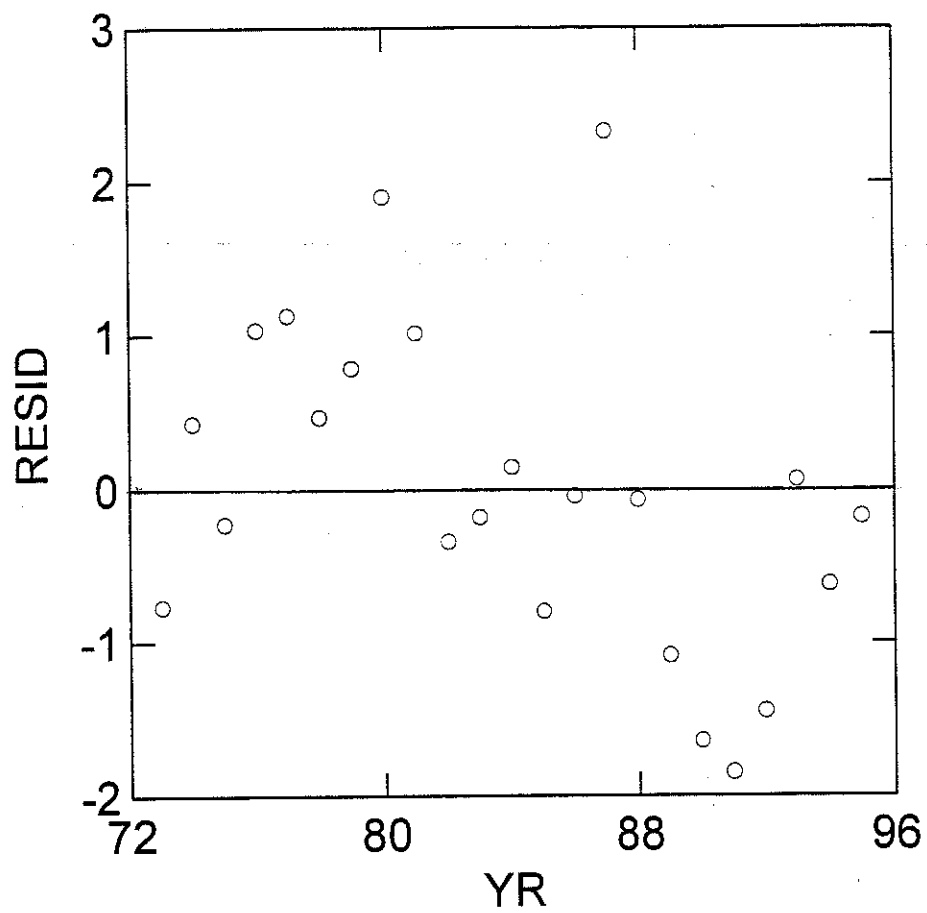


Figure 5B. Residual plot for Southern New England yellowtail flounder from a Beverton- Holt stock-recruitment model fit using non-linear regression for the years 1973-1995

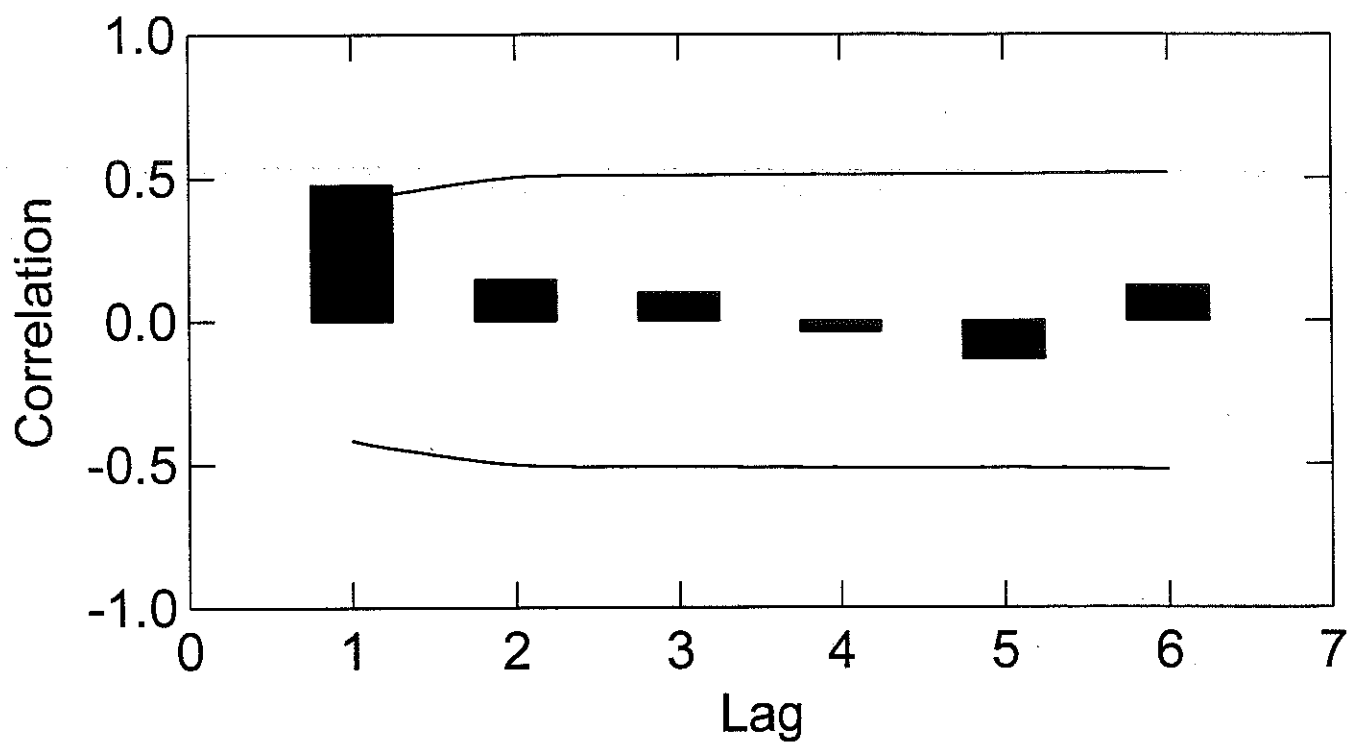


Figure 5C. Autocorrelation plot of residuals for Southern New England yellowtail flounder for order 1-6 autocorrelation from a Beverton-Holt Stock-recruitment model non-linear regression fit for years 1973-1995.

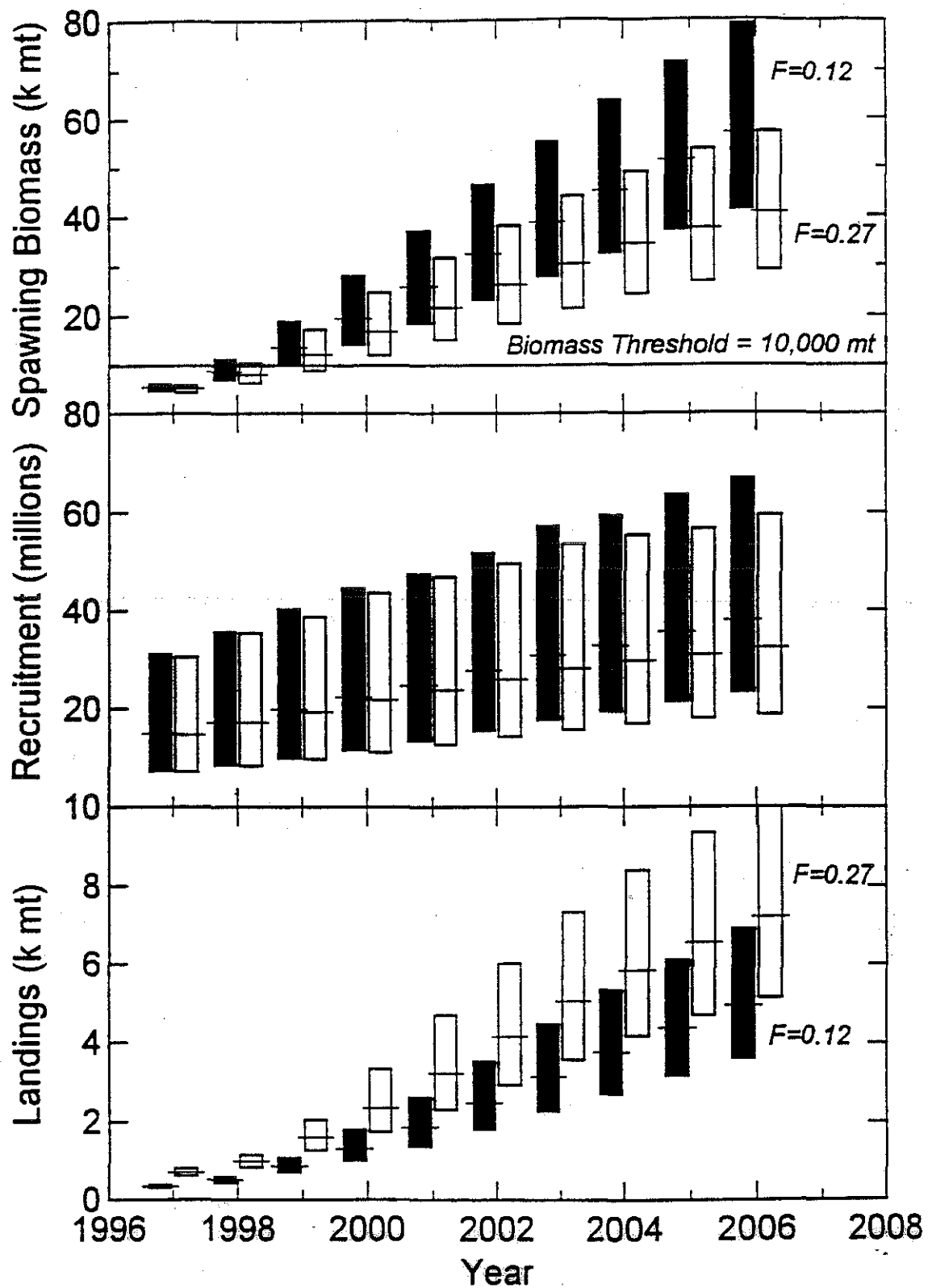


Figure 5D. Ten year projection (1997-2006) of landings, SSB, and recruitment for Southern New England yellowtail flounder under two levels of fishing mortality, $F_{0.1}$ (0.27) (open bar), and F_{96} (0.12) (black bar). Horizontal bars are the median values, vertical bars are the inter-quartile range (lower 25th percentile to the upper 75th percentile).

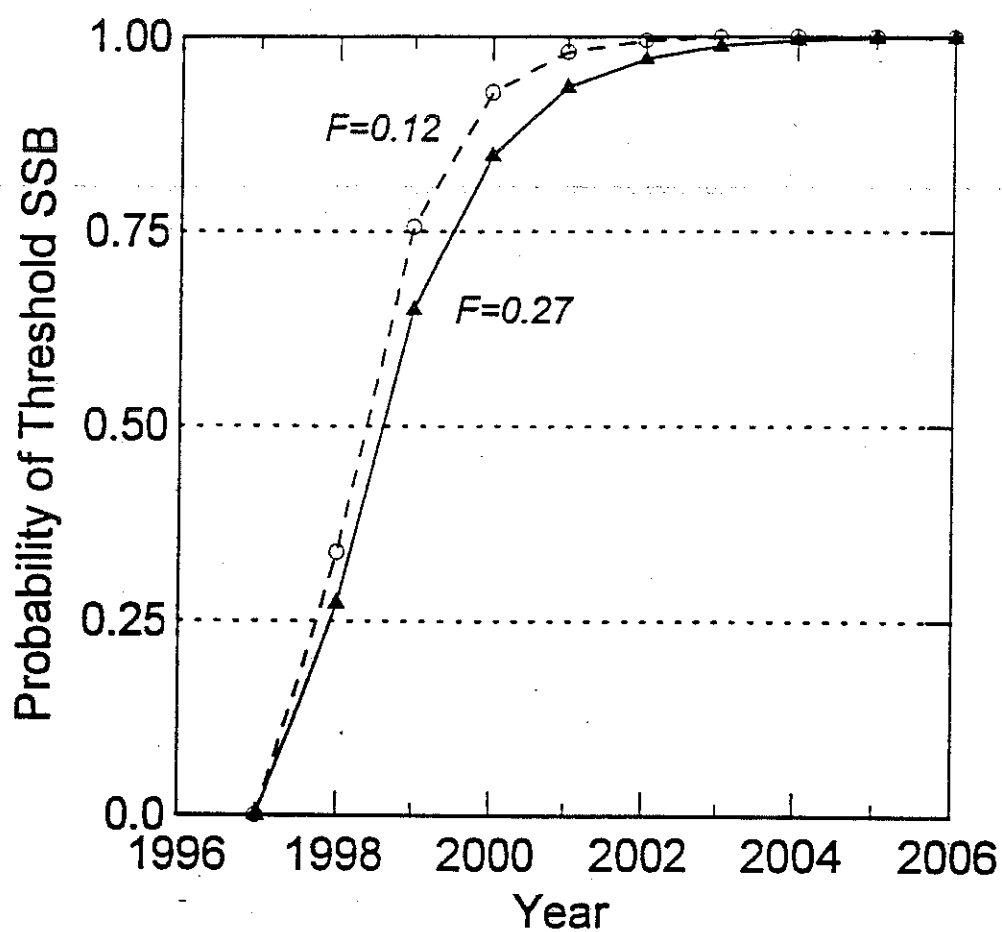


Figure 5E. Annual probabilities of Southern New England yellowtail flounder spawning biomass at or above 10,000 mt, under two fishing mortality rate scenarios; $F_{0.1}$ (0.27) and F_{96} (0.12)

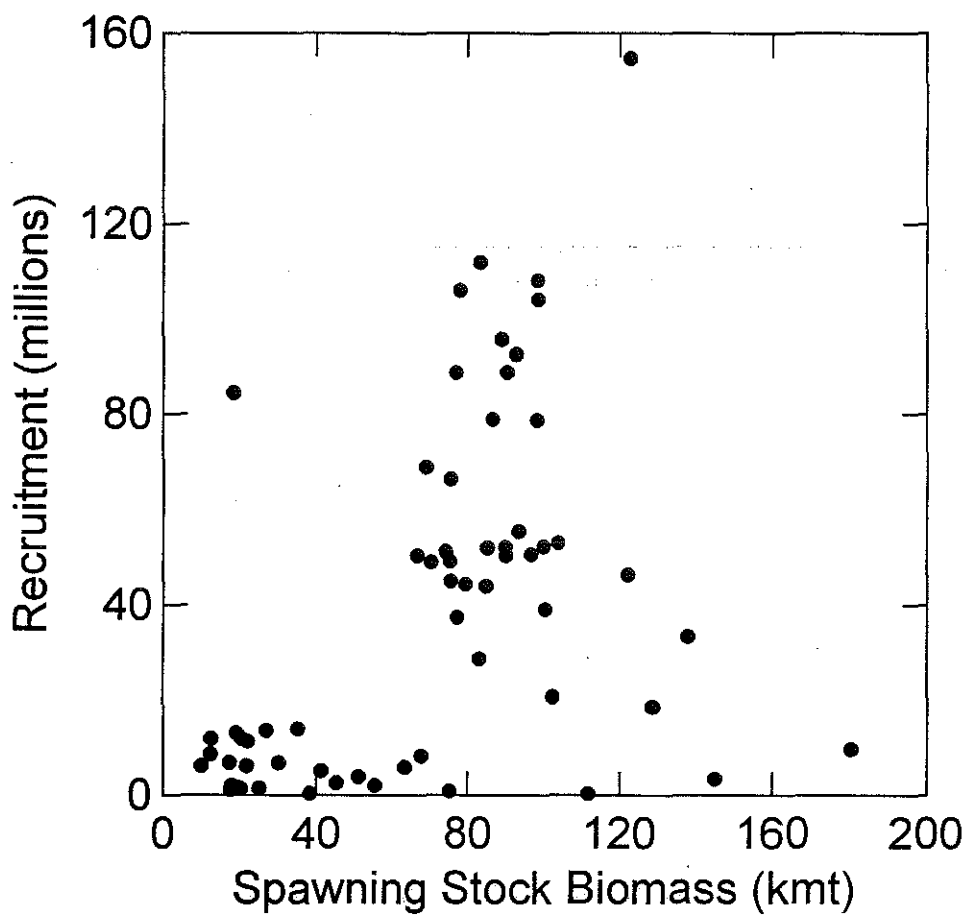


Figure 6. Stock-recruitment data for the Georges Bank haddock stock during 1931-1995.

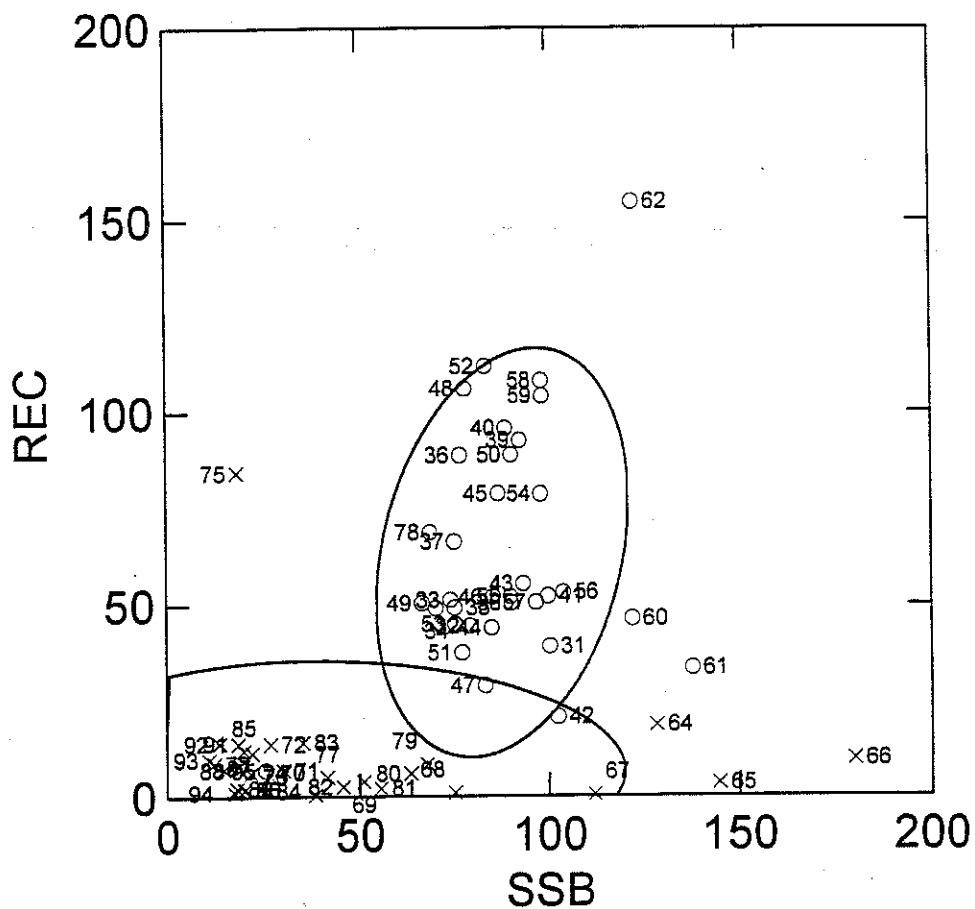


Figure 7. Cluster groups from K-means cluster analysis of 1931-1995 Georges Bank haddock stock-recruitment data with 75% probability ellipse regions.

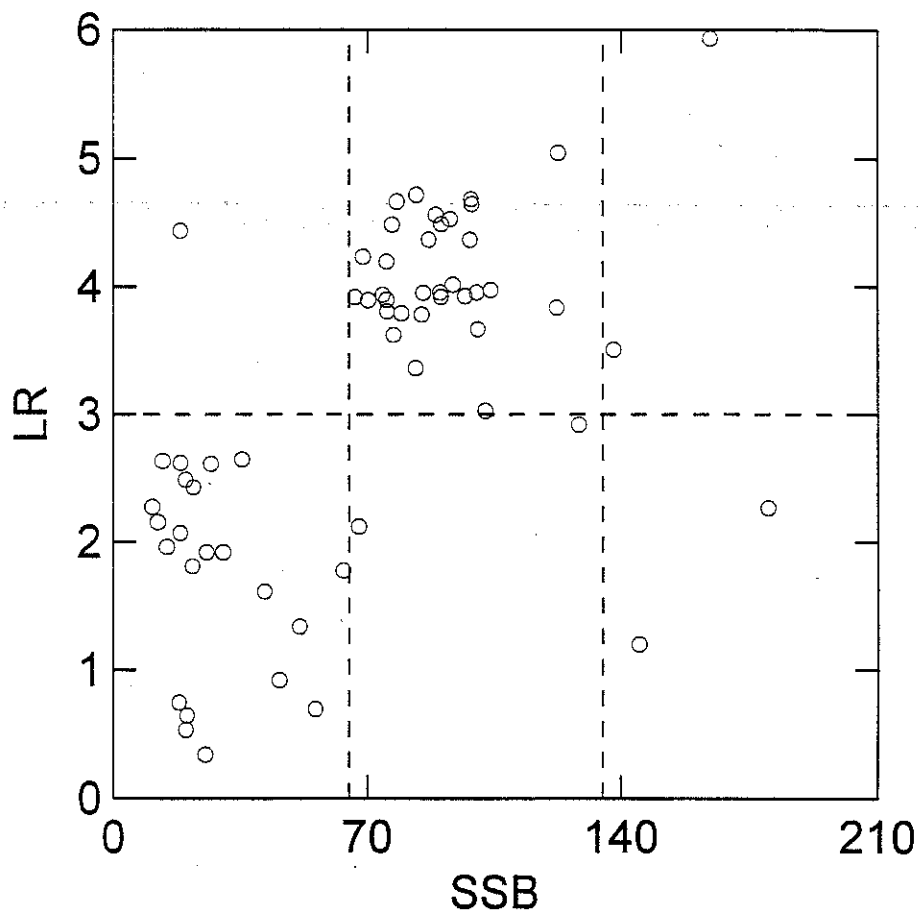


Figure 8. Georges Bank haddock stock (SSB ooo's mt) and recruitment ($LR = \ln(\text{recruits})$) during 1931-1995.

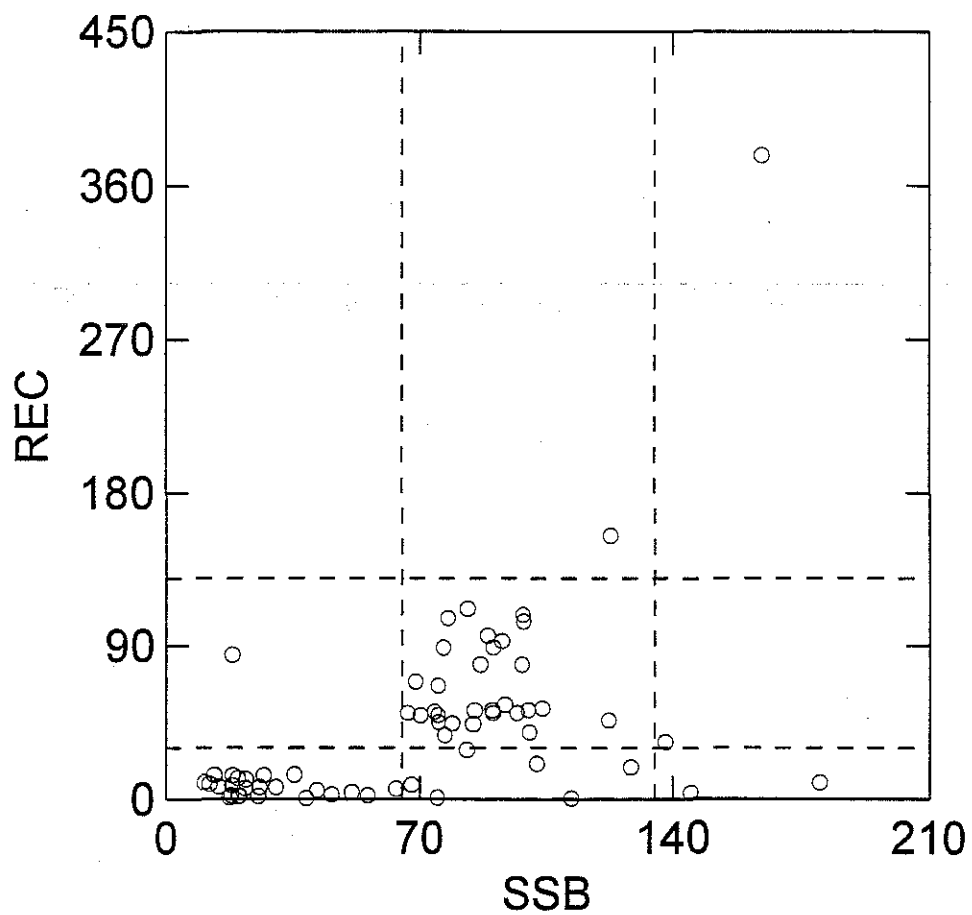


Figure 9. Possible cut points for a probability transition approach to modeling the Georges Bank haddock stock-recruitment data from 1931-1995.