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Assessment of the Georges Bank Atlantic Cod Stock for 2000

by

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ABSTRACT

This report presents an updated analytical assessment of the status of the Georges Bank cod *Gadus morhua* stock (NAFO Division 5Z and subarea 6) for the period 1978-1999 based on analysis of USA and Canadian commercial landings and effort data and research vessel survey data through 1999. Estimates of 1999 fishing mortality and spawning stock biomass, 2000 beginning year stock size, and the precision of the fishing mortality and spawning stock biomass estimates are presented.

Total commercial landings of Georges Bank cod in 1999 were estimated at 9,880 mt, a 12% increase from the 8,800 mt landed in 1998. The USA fleet landed 82% of the total, and the Canadian fleet landed the remaining 18%. Commercial landings per unit of standardized effort (LPUE) declined to a record low in 1995, then increased in 1996 and 1997 and have remained relatively stable through 1999. Fishery-independent surveys, conducted by the Northeast Fisheries Science Center, show a similar decline in both biomass and numbers of cod since 1982. The 1999 indices remain well below the long term average. Recent recruitment indices of age 1 cod remain among the lowest in the time series, however, indices of age 2 fish indicate that the 1996 year class is about average.

Spawning stock biomass declined from about 92,000 mt in the early 1980s to a record low of 20,000 mt in 1994 and has since increased to 35,000 mt in 1999. Mean biomass exhibits similar trends. Fishing mortality doubled between 1979 and 1985, increased to a record high of 1.42 (70% exploitation rate) in 1994 and has since declined to 0.22 (18% exploitation rate) in 1999. Recruiting year classes have been well below the long term average (16 million fish) since 1991.

INTRODUCTION

This report presents an updated analytical assessment of the Georges Bank cod *Gadus morhua* stock (NAFO Division 5Z and Subarea 6) for the period 1978-1999 based on analysis of commercial landings and research vessel survey data through 1999. The life history of Georges Bank cod and the history of the commercial fishery is described in O'Brien (1999). An outline of the history of management is provided in Table 1.

THE FISHERY

Commercial Landings

The collecting and processing of the commercial fishery and landings data has been conducted using two methods during the time series. Prior to 1994, information of the catch quantity, by market category, was derived from reports of landings transactions submitted voluntarily by processors and dealers. More detailed data on fishing effort and location of fishing activity were obtained for a subset of trips from personal interviews of fishing captains conducted by port agents in the major ports of the Northeast. Information acquired from the interview was used to augment the total catch information obtained from the dealer.

In 1994, a mandatory reporting system was initiated requiring anyone fishing for or purchasing regulated groundfish in the Northeast to submit either vessel trip reports (logbooks) or dealer reports, respectively (Power *et al.* 1997 WP). Information on fishing effort (number of hauls, average haul time) and catch location were now obtained from logbooks submitted to NMFS by vessel captains instead of personal interviews. Estimates of total catch by species and market category were derived from mandatory dealer reports submitted on a trip basis to NMFS. Catches by market category were allocated to stock based on a matched subset of trips between the dealer and logbook databases. Both databases were stratified by calendar quarter, port group and gear group to form a pool of observations from which proportion of catch, by stock, could be allocated to market category with the matched subset. The cross products of the market category by stock proportions derived from the matched subset were employed to compute the total catch by stock, market category, calendar quarter, port group, and gear group in the full dealer database. The USA landings for Atlantic cod for 1994-1996 were derived for Eastern Georges Bank (statistical areas 560, 561, 562, 551, 552) and Western Georges Bank (statistical areas 520-526,530,537-539,600-639) using the proration methodology described above. The 1997-1999 data were also prorated using the same methodology, however, the criteria for matching the data were modified and resulted in a larger data set being available for proration (Wigley *et al.* 1998).

Total commercial landings of Georges Bank cod in 1999 were estimated to be 9,880 mt, 12% higher than in 1998 (Table 2, Figure 1). The USA fleets landed 82% (8,061 mt) of the total, and the Canadian fleets landed the remaining 18% (1,819 mt).

USA cod landings are generally highest in the second calender quarter (April-June) and are

predominantly from the western part (statistical areas 521-522, 525-526, 537-539, and Subarea 6) of Georges Bank (Figures 2 and 3) throughout the year. Historically, landings from the eastern part (SA 561-562) of Georges Bank were taken in the first and second calender quarter (January to June). Since 1993, the contribution of landings from the eastern part of Georges Bank has declined by about 50% (Table 3). The Canadian fishery for Georges Bank cod opens in June, and the majority of the landings are taken in the third calendar quarter (July-September).

USA landings were taken primarily by otter trawl gear (62%)and line trawl gear (20%) during 1994-1998. In 1999, otter trawl gear accounted for the majority (59%) of the USA landings (Table 4). Canadian landings were taken primarily by the otter trawl (35%) and long line (47%) fisheries during 1994-1998. In 1999, otter trawl gear accounted for 35% and long line gear accounted for 47% of the Canadian landings (Hunt and Hatt, 2000).

Cod landings from Georges Bank, categorized by size as 'scrod' (small) , 'market' (medium), and 'large', continue to be dominated by 'market' cod in both weight (56%) and number (53%) in 1999 (Table 5). Historically, 'market' cod have accounted for 30-60% of the landings.

Commercial Discards

Preliminary estimates of the weight of fish discarded on otter trawl and gill net trips were derived for 1989-1999 using the Sea Sampling data base. Discard ratios were estimated as the amount of cod discarded to the amount kept for catch taken in the western part and the eastern part of Georges Bank. In the otter trawl fishery discard ratios ranged from 0.0 to 0.10 with less discarding occurring in the eastern part of Georges Bank than in the western part of Georges Bank (Appendix 1, Table 1a). In the gill net fishery discard ratios ranged from 0.0 to 0.19 but were predominantly less than 0.10 (Appendix 1, Table 1b). Discard estimates were not included in the assessment, however, due primarily to the lack of data for 1978-1988. In addition, the available data from 1989-1999 are limited by both inadequate coverage of trips and few biological samples.

Recreational Landings

Recreational cod landings during 1981-1999 ranged between 400 to 9,000 mt, accounting for 1-19% of the total landings (Table 6). Recreational landings decreased 31% from 1998 to an estimated 357 mt in 1999. The 1999 recreational landings account for 3.5% of the total (total commercial + recreational) landings.

An analysis that incorporated recreational landings resulted in slightly elevated stock sizes with little change in fishing mortality or spawning stock biomass (O'Brien 1999). The 24th SARC recommended that recreational catches not be included in the assessment analysis at that time because 1) the recreational catch at age is based on very few length samples and may not fully characterize the recreational landings, 2) including the recreational catch at age would require excluding the first three years of the time series given the lack of recreational landings data for 1978-1980, and 3) the minimal difference observed in estimates of fishing mortality and spawning stock biomass in the terminal year from comparable ADAPT formulations that had commercial

catch at age only and commercial plus recreational catch at age (NEFSC 1997) .

Sampling Intensity

Commercial Landings

The numbers of samples taken to characterize the length and age composition of the USA and Canadian commercial cod landings from Georges Bank are summarized in Table 7. Sampling intensity was high in 1999 with 1 sample per 118 mt for the USA (Table 8) and 1 sample per 22 mt for the Canadian fishery. The average number in each length sample was 88 fish for the USA and 297 fish for Canada during 1999. Although overall sampling intensity was high, the spatial and temporal pattern of sampling for USA landings resulted in semi-annual pooling of quarterly samples. The sampling for USA landings from the eastern part of Georges Bank (SA 561 and 562) was minimal in 1999 with a total of 10 samples for three market categories across four quarters. The distribution of sampling by market category (large:13%, market:56%, scrod:31%) approximates the distribution of the 1999 landings in number by market category (Table 5).

Recreational Catch

Since 1981, 0.02% of the total recreational landings have been sampled for both weight and length (0.1% of the USA commercial landings were sampled for the same time period). During 1981-1999, the number of fish sampled ranged from 0.01 to 0.06% of the total number landed. In 1999, 0.02% of the fish landed were sampled. Based on an average of 85 fish per sample, one sample was taken for every 1,167 mt in 1999.

Commercial Landings at Age

The age composition of the 1978-1993 USA landings was estimated, by market category, from length frequency and age samples pooled by calendar quarter. Landed mean weights were estimated by applying the length-weight equation:

$$\ln \text{Weight (kg,live)} = -11.7231 + 3.0521 \ln \text{Length (cm)},$$

to the quarterly length frequency samples, by market category. Numbers landed, by quarter, were estimated by dividing the mean weight into the quarterly landings, by market category, and prorating the total numbers by the corresponding market category sample length frequency. Quarterly age-length keys were then applied to the numbers-at-length to estimate numbers caught at age. Annual estimates of landings at age were obtained by summing values over market category and quarter (Table 9). Derivation of landings by quarter, rather than by month, was performed since not all months had at least two length frequency samples per market category (i.e., minimum desired for monthly catch estimates).

The age composition of the 1994-1996 USA landings was also estimated, by market category, from

quarterly length frequency and age samples, but in some years samples were pooled semi-annually due to an insufficient number of samples within a quarter. The landings were dis-aggregated into eastern (SA 561-562) and western Georges Bank (SA 521-522, 525-526, 537-539). The age composition of the USA landings from eastern Georges Bank was estimated by applying USA length frequencies and combined USA and Canadian age samples, while the age composition of the USA landings from western Georges Bank was estimated by applying USA length frequencies and age samples.

The age composition of the 1997-1999 USA landings was estimated in a similar manner, however, due to the lack of length samples from eastern Georges Bank, combined length frequencies were applied. The assumption was made that length frequencies from eastern and western Georges Bank would be similar, therefore, all length frequencies were combined to characterize the eastern component of landings. The 1994-1999 landings-at-age was then derived as described above for the 1978-1993 landings-at-age. The eastern and western Georges Bank landings-at-age were combined to obtain the landings-at-age matrix for USA Georges Bank cod landings for 1999 (Table 9). The USA eastern Georges Bank landings-at-age was included in the Canadian assessment of cod in area 5Zj,m (Hunt and Hatt 2000).

Canadian landings-at-age data (Table 10) from the Northeast Peak of Georges Bank (SA 551-552) were provided by J. Hunt (DFO, St. Andrews, NB, pers. comm) for 1999. Canadian and USA data were combined to produce a total landings-at-age matrix for 1978-1999 (Table 11). The USA fishery accounted for 84% and 82% of the total landings by number and weight, respectively in 1999.

Total commercial landings and USA landings were dominated by age 3 fish from the 1996 year class in both numbers and weight in 1999 (Table 12). In the Canadian fishery the landings were dominated by the 1996 year class in numbers of fish and by the 1995 year class in the weight of fish.

Commercial Mean Weights at Age

Mean lengths and weights at age for ages 1-10+ are summarized for USA, Canadian, and total landings in Tables 9-11. There does not appear to be a consistent trend in mean weight by age during the 23-year time series. Variability in mean weight of the older fish in recent years may be due to poorer sampling in these years. Beginning year stock mean weights at age, derived from catch mean weights at age (Rivard 1980), are presented in Table 13.

STOCK ABUNDANCE AND BIOMASS INDICES

Commercial Catch Rates

A general linear model (GLM) was applied to all USA interviewed otter trawl trips landing cod from Georges Bank and South during 1978-1993 to derive standardized fishing effort and commercial landings-per-unit-effort (LPUE) (O'Brien 1999; Mayo *et al.* 1994). Standardized

fishing effort and LPUE during 1994-1999 were estimated by applying the re-transformed GLM coefficients (area, quarter, tonnage class, and depth) to the effort estimate of all trips reporting cod landings in the Vessel Trip Reporting (VTR) database (Table 14). Total standardized or 'raised' effort was calculated by dividing total USA landings by the standardized LPUE (Table 15).

Nominal and standardized LPUE exhibit similar trends and, since 1985, are almost equivalent (Table 15, Figure 4). Standardized LPUE peaked in 1980 at 2.9 mt/day fished and declined steadily from 1982 to1987. LPUE increased slightly until 1990 and then declined steadily until 1995. LPUE increased in 1996 and 1997 and has remained relatively stable through 1999. LPUE is estimated to be about 0.6 mt/day fished in 1999. Standardized raised effort and nominal effort have similar trends in general, although effort trends did diverge in 1989, 1991, and 1995 (Figure 5). Raised effort more than doubled from 1978 to 1985, declined in 1986, and then increased to historic high levels until 1991. Standardized raised effort has since declined and in 1999 is similar to estimates in the early 1980s.

Under the current management restrictions of days at sea (DAS), greater mesh sizes, closed areas since December of 1994, mandatory logbooks for collection of effort data, implemented in May 1994, and other management measures, the 1994-1999 effort data may no longer be equivalent to the historic 1978-1993 effort series. Additionally, the effort estimates for 1994-1999 were derived from provisional data. The LPUE series was, therefore, not used as an index of abundance in the subsequent calibration of the VPA.

Research Vessel Survey Indices

USA Surveys

NEFSC spring and autumn research bottom trawl surveys have been conducted off the Northeast coast of the USA since 1968 and 1963, respectively (Azarovitz 1981). Indices of abundance (stratified mean number per tow) and biomass (stratified mean weight per tow (kg)) were estimated from both the spring and autumn surveys for Georges Bank cod (strata 13-25) during 1963-1999 (Table 16). The indices were adjusted for differences in fishing power of the *Albatross IV* and the *Delaware II,* and for differences between catchability of BMV and polyvalent doors, introduced in 1985. The fishing power coefficients of 0.79 and 0.67 and the door conversion coefficients of 1.56 and 1.62 were applied to abundance and biomass indices, respectively (NEFSC 1991). Standardized catch per tow at age in number for NEFSC spring and autumn surveys and the catch per tow at age for Canadian spring surveys are presented in Appendix 2: Tables 1 and 2.

NEFSC spring and autumn catch per tow biomass and abundance indices show similar trends throughout the time series (Table 16, Figures 6-7). Survey biomass indices were stable between 1963 and 1971 and then increased to a record high in 1973. Biomass indices generally declined over the next two decades, reaching record low levels between 1991 and 1994. The index increased in 1995, then declined and remained relatively stable in 1999. Both the spring and autumn biomass and abundance indices remained well below average in 1999. Survey abundance indices for ages 1 and 2 indicate above-average recruitment of the 1966, 1971, 1975, 1977, 1980, 1985, and 1988 year classes (Appendix 2: Table 1; Figure 8). As 2 year old fish, the 1993 year

class was above average, and the 1996 year class was average. The magnitude of an above-average year class has been declining over time, particularly noticeable in the recruits at age 1.

Canadian Surveys
Canadian research bottom trawl surveys have been conducted in the spring on Georges Bank since 1986. Survey abundance indices have fluctuated and generally have declined during 1990-1998. Both the 1999 and 2000 indices have increased primarily due to the recruitment of the 1996 year class (Appendix 2: Table 2, Figure 7). Abundance indices for ages 1 and 2 indicate above average recruitment of the 1985, 1988, and 1990 year classes and below average recruitment for the 1991 - 1998 year classes (Figure 9). In 1993 and 1994, the Canadian survey did not sample the western part of Georges Bank (Canadian strata 5Z5 - 5Z7), therefore, the indices of stratified mean number per tow at age in those years were not used in the calibration of the VPA.

MORTALITY

Total Mortality

Estimates of instantaneous total mortality (Z) were derived from both spring and autumn survey catch per tow indices (Appendix 2: Table 1). Total mortality in the spring was estimated as:

$$\ln\left(\Sigma \text{ age 4+ for years i to j} / \Sigma \text{ age 5+ for years i+1 to j+1}\right).$$

Total mortality in the autumn was estimated as :

$$\ln\left(\Sigma \text{ age 3+ for years i-1 to j-1} / \Sigma \text{ age 4+ for years i to j}\right).$$

A three year moving average was fit to the combined spring and autumn mortality estimates. The estimates are highly variable throughout the time series, although there appears to be a trend of increasing Z from the mid-1970s to the mid-1990s (Figure 10).

ESTIMATES OF STOCK SIZE AND FISHING MORTALITY

Virtual Population Analysis Calibration

The ADAPT calibration method (Parrack 1986, Gavaris 1988, Conser and Powers 1990) was used to derive estimates of instantaneous fishing mortality (F) in 1999 and beginning-year stock sizes in 2000. The landings at age data used in the VPA consisted of combined USA and Canadian commercial landings from 1978-1999 for ages 1-9 with a 10+ age group (Table 11). The indices of abundance used to calibrate the VPA included the NEFSC 1978-1999 spring survey indices for ages 1-8, the Canadian 1986-2000 spring survey indices for ages 1-8, and the NEFSC 1977-1999 autumn survey indices for ages 0-6 (Appendix 2: Tables 1 and 2). The NEFSC spring survey was dis-aggregated into two series based on the use of the Yankee #36 or #41 trawls. The NEFSC employed the #41 trawl during 1973 to 1981. The spring indices were split into a index series for

1978-1981 for the #41 trawl and a series for 1982-1999 for the #36 trawl. The autumn survey indices were lagged forward one age and one year to match cohorts in the subsequent year.

Several trial ADAPT calibrations were performed and the results are presented in Table 17. The base ADAPT formulation provided stock size estimates for ages 1-8 in 2000 and corresponding unweighted F estimates for ages 1-7 in 1999. Assuming full recruitment at age 4, the unweighted F on ages 8 and 9 in the terminal year was estimated as the average of the F on ages 4-8. The unweighted F on age 9 in all years prior to the terminal year was derived from weighted estimates of Z for ages 4-9. For all years, the unweighted F on age 9 was applied to the 10+ age group. Spawning stock size estimates were derived by applying pooled maturity ogives for 1978-1981, 1982-1985, 1986-1989, 1990-1993, 1994-1996, and 1997-1999 (Table 18) derived from NEFSC spring research survey data using methodology described in O'Brien (1990). Due to the insufficiency of the annual number of samples, data for adjacent years that had similar annual median maturity at length and age were pooled to derive a more representative ogive.

The final ADAPT calibration results are presented in Appendix 3 for estimates of F, stock size, and SSB at age and are summarized in Table 18. Estimates of stock size were more precise for ages 2-8, with CVs ranging from 0.29 to 0.40, than for age 1 (CV=0.51). The residual patterns of the indices did not show any strong trends for the four surveys (Figure 11). The natural log of the observed survey indices, standardized to the mean, generally show similar trends between surveys (Figure 12).

Average fishing mortality (ages 4-8) in 1999 was estimated at 0.22 (18% exploitation), a decrease from the 1998 estimate of 0.39 (30% exploitation) (Table 18, Figure 13). The 1999 estimate of SSB was 35,000 mt, an increase of about 10% from the 1998 estimate (Table 18, Figure 14).

Since 1978, recruitment has ranged from 3 million (1997 year class) to 43 million (1985 year class). The 1999 year class is estimated to be about 5 million fish at age 1, well below the long term average of 16 million fish. The most recent above average year class occurred in 1990 (18 million age 1 fish). The 1996 year class (10 million age 1 fish), although below average, is the strongest since 1990. The 1994 and 1997 year classes are the poorest of the 23-year time series (Table 18, Figure 15). The relationship of SSB and recruitment at age 1 is presented in Figure 16.

Precision of F and Stock Biomass Estimates

A conditional non-parametric bootstrap procedure (Efron 1982) was used to evaluate the uncertainty associated with the estimates of fishing mortality and spawning stock biomass from the final VPA. One thousand bootstrap iterations were performed to estimate standard errors, coefficients of variation (CVs), and bias for age 1-8 stock size estimates at the start of 2000, the catchability estimates (q) for each index of abundance used in calibrating the VPA, and the F at ages 1-7 in 1999 (Appendix 4).

The bootstrap results indicate that stock sizes were well estimated for ages 1-8 with coefficients of

variation (CVs) varying between 0.21 and 0.47. The CVs for the catchability coefficients for all indices ranged between 0.11 and 0.30. The fully recruited F for ages 4+ was well estimated with a CV=0.13 . The bootstrap estimate was almost equivalent to the NLLS estimate (Appendix 4). The distribution of the 1999 F estimates, derived from 1,000 bootstrap iterations, ranged from 0.16 to 0.40. There is an 80% probability that the F in 1999 is between 0.19 and 0.26 (Figure 17).

The spawning stock biomass was reasonably well estimated (CV=0.09) and slightly higher than the NLLS estimate of 34,800 mt (Appendix 4). The distribution of the 1999 spawning stock biomass estimates, derived from the 1000 bootstrap iterations, ranged from 28,000 to 48,000 mt (Figure 18). There is an 80% probability that the 1999 SSB is between 31,000 and 39,000 mt (Figure 18). The distribution of the 1999 mean biomass estimates, derived from 1000 bootstrap iterations, ranged from 32,000 to 62,000 mt (Figure 19). There is a 80% probability that the mean biomass in 1999 was between 38,000 mt and 48,000 mt.

Retrospective Analysis

A retrospective analysis was performed to evaluate how well the current ADAPT calibration would estimate recruits at age 1, spawning stock biomass, and fishing mortality for the five years prior to the current assessment, 1994-1998. Convergence of the estimates generally occurs after about four years (Figures 20-22). With the exception of 1998, the retrospective analysis indicates a pattern of underestimating the recruits at age 1 (Figure 20). Estimates of SSB are consistently overestimated, (Figure 21) and estimates of fishing mortality (F) are consistently underestimated (Figure 22). The retrospective pattern in 1993 and 1994 may be partially due to the lack of 1993 and 1994 Canadian survey indices in the calibration and these missing indices may also influence the F estimate in the more recent years. Other factors influencing the retrospective pattern may include mis-reporting of catch, immigration or emigration, an unrepresentative estimate of natural mortality, and mis-specification of the model.

Fishing mortality in 1999 was projected to be 0.28 (= status quo F in 1998) and landings were projected to be 8,300 mt (NDWG, NESAW 2000). The current assessment estimated F in 1999 to be 0.22, 21% lower than projected, and USA landings were 8,100 mt.

BIOLOGICAL REFERENCE POINTS

Yield and Spawning Stock Biomass per Recruit

Yield, total stock biomass, and spawning stock biomass per recruit were estimated using methodology of Thompson and Bell (1934). The input data and the results presented were derived in the 1998 assessment (O'Brien and Cadrin 1999). Estimates were based on arithmetic means of the 1995-1997 catch mean weight at age and stock mean weight at age and the 1994-1997 maturity ogive. A partial recruitment (PR) vector was calculated as the geometric mean of the 1994-1997 F estimates from the final VPA based on the change in mesh regulations in 1994. The final exploitation pattern was derived by dividing the PR by the geometric mean of the unweighted F for ages 4-8 and smoothed by applying full exploitation at ages 4 and older.

Input values for the yield-per-recruit analysis are provided in Table 19, and results of the analysis are provided in Table 19 and Figure 23. The resulting biological reference points were $F_{0.1} = 0.18$ and $F_{max} = 0.34$.

Projections

Short term projections will not be presented in this assessment. These analyses will be performed at a later date by the Multispecies Monitoring Committee (MMC) of the New England Fisheries Management Council.

The SFA control rule for Georges Bank cod is based on B_{MSY} (108,000 mt) and states that when the stock biomass is between 1/4 and ½ B_{MSY} (27,000-54,000 mt), the threshold mortality rate is defined by a five year rebuilding time period, and if the stock is between 1/2 B_{MSY} and B_{MSY} the rebuilding time period is10 years. In 1999, mean biomass is estimated to have been about 43,000 mt, less than ½ B_{MSY}. Applying the 1999 mean biomass to the target control rule indicates that the stock should be fished at a biomass weighted F of about 0.125 (Figure 24).

CONCLUSIONS

The Georges Bank cod stock remains at a low biomass level. Biomass indices derived from research surveys indicate that the stock remains near the record-low of the 37 year time series. Fishing mortality (ages 4-8) declined from record-high levels in 1993 and 1994 (1.1,1.4) to 0.22 in 1999. Spawning stock biomass declined from about 90,000 mt in the early 1980's and reached a record-low of 20,000 mt in 1994. As fishing mortality has declined, the SSB has gradually increased, primarily due to somatic growth, but was still near record-low size (35,000 mt) in 1999. Trends in mean biomass have been similar to the trends in SSB. Recruiting year classes have been well below the long term average (16 million fish) since 1991. The 1999 year class is estimated to be about 5 million fish, less than a third of the long-term average.

Accounting for the estimation uncertainty associated with SSB (35,000 mt), mean biomass (43,000 mt), and F (0.22) estimates, there is an 80% probability that SSB was between 32,000 and 38,000 mt, mean biomass was between 32,000 mt and 62,000 mt, and F was between 0.19 and 0.26 in 1999. Retrospective analysis indicates a pattern of inconsistencies in which estimates of SSB in the last year of the VPA are greater than the converged estimates of SSB. Similarly, F in the last year of the VPA are less than the converged estimates of F.

Recovery of the stock will depend on further reductions in fishing mortality as well as improved recruitment.

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LITERATURE CITED

Azarovitz, T.R. 1981. A brief historical review of the Woods Hole Laboratory trawl survey time series, *In*: Doubleday, W.G. and D. Rivard (eds.), Bottom Trawl Surveys. Can. Spec. Publ. Fish. Aquat. Sci. 58: 62-67.

Conser, R. J. and J. E. Powers. 1990. Extensions of the ADAPT VPA tuning method designed to facilitate assessment work on tuna and swordfish stocks. Int. Comm. Conserv. Atlantic Tunas, Coll. Vol. Sci. Pap. 32: 461-467.

Efron, B. 1982. The jackknife, the bootstrap and other resampling plans. Phila. Soc. For Ind. And Appl. Math. 38: 92 p.

Gavaris, S. 1988. An adaptive framework for the estimation of population size. CAFSAC Res.Doc. 88/29: 12 p.

Hunt, J.J and B. Hatt. 2000. Population status of Eastern Georges Bank Cod (Unit Areas 5Zj,m) for 1978-2000. Canadian Stock Assess. Sec. Res. Doc. 2000/085.

Mayo, R.K. T.E. Helser, L. O'Brien, K.A. Sosebee, B.F. Figuerido, and D. Hayes. 1994. Estimation of standardized otter trawl effort, landings per unit effort, and landings at age for Gulf of Maine and Georges Bank cod. NEFSC Ref. Doc. 94-12, 17 p.

Northeast Fisheries Science Center. 1991. Report of the 12th NE Regional Stock Assessment Workshop (12 SAW) Spring 1991.

Northeast Fisheries Science Center. 1997. 24th Northeast Regional Stock Assessment Workshop (24th SAW). Stock assessment review committee (SARC) consensus summary of assessments. NEFSC Ref. Doc. 97-12, 291 p.

Northern Demersal Working Group, Northeast Regional Stock Assessment Workshop. 2000. Assessment of 11 Northeast groundfish stocks through 1999: a report to the New England Fishery Managements Council's Multi-Species Monitoring Committee. Northeast Fish. Sci. Cent. Ref. Doc. 00-05; 175 p.

O'Brien, L. 1990. Effects of fluctuations in stock abundance upon life history parameters of Atlantic cod, *Gadus morhua* L., for the 1970-1987 year classes from Georges Bank and the Gulf of Maine. Masters Thesis, University of Washington, Seattle. 95 p.

O'Brien, L. 1999. Assessment of the Georges Bank cod stock for 1997. NEFSC Ref. Doc. 99-02,

122 p.

O'Brien, L. and S. X.Cadrin 1999. Assessment of the Georges Bank cod stock for 1998. NEFSC Ref. Doc. 99-03, 127 p.

Parrack, M.L. 1986. A method of analyzing catches and abundance indices from a fishery. Int Comm. Conserv. Atlantic Tunas, Coll. Vol. Sci. Pap. 24:209-221.

Power, G. , K. Wilhelm, K. McGrath, T. Theriault. 1997. Commercial fisheries dependent data collection in the Northeastern United States. SAW-24 Working Paper Gen 3.

Rivard, D. 1980. APL programs for stock assessment. Can Tech. Rep. Fish. Aquat. Sci. 953: 103 p.

Thompson, W.F. and F.H. Bell. 1934. Biological statistics of the Pacific halibut fishery. 2.Effect of changes in intensity upon total yield and yield per unit of gear. Rep. Int. Fish. (Pacific Halibut) Comm. 8: 49 p.

Wigley, S.E., M. Terceiro, A. DeLong, and K. Sosebee. 1998. Proration of 1994-1996 USA commercial landings of Atlantic cod, haddock, and yellowtail flounder to unit stock areas. NEFSC Ref. Doc. 98-02. 32p.

Table 1. History of USA management of Atlantic cod.

1953-1977		ICNAF Era
1953		Minimum mesh in body and codend - 4 ½".
1970		Areas 1(A) and 2(B) closed during haddock spawning season; from March through April. 1972-1974 Areas 1(A) and 2(B) closure extended to March through May. Total Allowable Catch (TAC) regulations implemented for Div. 5Z cod on an annual basis beginning in 1973-76; set at 35,000 mt per year.
1975		Areas 1(A) and 2(B) closure extended to February through May
1977-Present		Extended Jurisdiction and National Management
1977		USA Magnuson-Stevens Fishery Conservation and Management Act of 1976 (FCMA) effective.
1977-1982		Fishery Management Plan (FMP) for Atlantic groundfish (cod, haddock and yellowtail fl.); mesh size of 5 1/8 ", seasonal spawning closure (areas 1 and 2), quotas established on annual, quarterly and vessel class basis, eventually leading to trip limits.
1982-1985		The "Interim Plan" for Atlantic groundfish; eliminated all catch controls, retained closed area and mesh size regulations, implemented minimum landings sizes.
1983		Mesh size increased to 5½" diamond.
1984	October	The 'Hague' line established separate fishing zones for the USA and Canada in the Gulf of Maine and on Georges Bank.
1986	September	Fishery Management Plan for the Northeast Multispecies Fishery Effective; Areas 1 and 2 closed during February 1-May 31. Mesh size increased to 5 ½" (yr 1+ 2), 6 " (yr 3) Minimum size landed - commercial 17 " (yr 1), 19 "(yr 2+) Recreational 15" (yr 1),17" (yr 2+3), 19" (yr 4+)
1989	January	Amendment # 2 - seasonal large-mesh area for Nantucket Shoals winter fishery Eliminate scheduled 6" mesh increase. Minimum size in recreational = commercial = 19 "
1993		Area 2 closure in effect from Jan 1-June 30.
1994	January	Amendment 5: 50% reduction in effort (5-7 years) Expanded Area 2 closure; Area 1 closure not in effect. Days at sea (DAS) monitoring; mandatory logbook reporting.
	May	6" diamond or square mesh restriction (delayed from March 1).

		Fishing year May-April.
1994	December	Both Area 1,2 and Nantucket Lightship Area closed year-round until *further notice*.
1996	October	Sustainable Fisheries Act (SFA) effective.
	May	Recreational minimum size increases to 20"
	July 1	Amendment 7 effective. Establishes target TACs, rebuilding target of $F_{0.1}$
1997	May	Recreational minimum size increases to 21"
1999	May	Minimum mesh size increase to 6 ½" square, remains at 6" diamond
	June 15	Scallopers allowed limited access to Area II
	November 15	Amendment 9 effective; Redefines overfishing definitions to comply with SFA
	August 15	Trip limit: 2000 lb/ day, 20,000 lb/trip with trigger when approach TAC
2000	May	Proposed: SQ Trip limit: 2000 lb/ day, 20,000 lb/trip without trigger Additional closures on Georges Bank for May only (109-114, 98-99), Adjacent to Area 1

Year	USA Target TAC (May $_{yr}$ - April $_{yr+1}$)	Assumed Canadian TAC	Canadian TAC (June-Dec $_{yr}$)
1996	1,851 mt	1,000 mt	2,000 mt
1997	3,646 mt	2,000 mt	3,000 mt
1998	4,692 mt	3,000 mt	1,900 mt
1999	5,354 mt	1,900 mt	1,900 mt
2000	4,145 mt	1,900 mt	

Table 2. Commercial landings (metric tons, live) of Atlantic cod from Georges Bank and South (Division 5Z and Subarea 6), 1960 - 1999.

	Country						
Year	USA	Canada	USSR	Spain	Poland	Other	Total
1960	10834	19	-	-	-	-	10853
1961	14453	223	55	-	-	-	14731
1962	15637	2404	5302	-	143	-	23486
1963	14139	7832	5217	-	-	1	27189
1964	12325	7108	5428	18	48	238	25165
1965	11410	10598	14415	59	1851	-	38333
1966	11990	15601	16830	8375	269	69	53134
1967	13157	8232	511	14730	-	122	36752
1968	15279	9127	1459	14622	2611	38	43136
1969	16782	5997	646	13597	798	119	37939
1970	14899	2583	364	6874	784	148	25652
1971	16178	2979	1270	7460	256	36	28179
1972	13406	2545	1878	6704	271	255	25059
1973	16202	3220	2977	5980	430	114	28923
1974	18377	1374	476	6370	566	168	27331
1975	16017	1847	2403	4044	481	216	25008
1976	14906	2328	933	1633	90	36	19926
1977	21138	6173	54	2	-	-	27367
1978	26579	8778	-	-	-	-	35357
1979	32645	5978	-	-	-	-	38623
1980	40053	8063	-	-	-	-	48116
1981	33849	8499	-	-	-	-	42348
1982	39333	17824	-	-	-	-	57157
1983	36756	12130	-	-	-	-	48886
1984	32915	5763	-	-	-	-	38678
1985	26828	10443	-	-	-	-	37271
1986	17490	8411	-	-	-	-	25901
1987	19035	11845	-	-	-	-	30880
1988	26310	12932	-	-	-	-	39242
1989	25097	8001	-	-	-	-	33098
1990	28193	14310	-	-	-	-	42503
1991	24175	13455	-	-	-	-	37630
1992	16855	11712	-	-	-	-	28567
1993	14594	8519	-	-	-	-	23113
1994	9893*	5276	-	-	-	-	15169
1995	6759*	1100	-	-	-	-	7859
1996	7020*	1885	-	-	-	-	8905
1997	7537*	2898	-	-	-	-	10435
1998	6959*	1873	-	-	-	-	8832
1999	8061*	1819	-	-	-	-	9880

*Provisional data

Table 3. Distribution of USA commercial landings by quarter and area (Georges Bank, Georges Bank West, Georges Bank East) in metric tons and percentage of total landings, 1978-1999 (SA=statistical area).

Landings (metric tons, live)

Year	Georges Bank (Division 5Z and Subarea 6)					Georges Bank West SA 521-522, 525-526, 537-539 & Subarea 6					Georges Bank East SA 561-562				
	Quarter					Quarter					Quarter				
	1	2	3	4	TOTAL	1	2	3	4	TOTAL	1	2	3	4	TOTAL
1978	5494	8435	5925	5603	25457	3519	6523	5130	4783	19955	1975	1912	795	820	5502
1979	4480	10067	10136	7074	31757	2729	8019	8569	6032	25349	1751	2048	1567	1042	6408
1980	7104	13078	12111	6735	39028	3755	11366	11101	6388	32610	3349	1712	1010	347	6418
1981	7482	11047	9027	5471	33027	4037	9178	7035	4686	24936	3445	1869	1992	785	8091
1982	6801	10936	12204	8502	38443	3500	8768	9691	7918	29877	3301	2168	2513	584	8566
1983	7655	10793	10617	6870	35935	4528	8822	8258	5755	27363	3127	1971	2359	1115	8572
1984	8907	9820	8252	5058	32037	3895	7100	6226	4266	21487	5012	2720	2026	792	10550
1985	6725	8537	5756	5077	26095	3206	7064	4719	4465	19454	3519	1473	1037	612	6641
1986	6234	5526	3207	2309	17276	2625	3759	3012	2184	11580	3609	1767	195	125	5696
1987	4089	6326	4334	4006	18755	2651	4012	3976	3322	13961	1438	2314	358	684	4794
1988	7235	7305	5714	5781	26035	3641	4500	5255	4993	18389	3594	2805	459	788	7646
1989	5614	8767	6163	4243	24787	3707	5683	5809	3405	18604	1907	3084	354	838	6183
1990	5949	9102	7012	5781	27844	3616	5650	6553	5610	21429	2333	3452	459	171	6415
1991	6323	9828	4264	3575	23990	4275	6070	4120	3172	17637	2048	3758	144	403	6353
1992	4528	5514	3258	3473	16773	2574	3340	3068	2711	11693	1954	2174	190	762	5080
1993	3553	5140	2547	3200	14440	2242	3148	2314	2709	10413	1311	1992	233	491	4027
1994	2595	3529	2114	1615	9853	2488	2837	1882	1418	8624	107	692	233	197	1229
1995	1348	2248	2002	1161	6759	1164	1830	1972	1128	6094	185	419	29	33	665
1996	1375	2863	1858	924	7020	1206	2411	1789	840	6246	169	452	69	83	773
1997	1097	3482	1849	1108	7537	1010	3062	1822	1086	6980	88	420	27	21	557
1998	1309	2860	1432	1305	6907	1269	2148	1396	1292	6106	41	712	36	13	801
1999	1588	3649	1740	1084	8061	1338	2783	1715	1075	6911	250	867	25	9	1150

Percentage of Annual Landings

Year	Georges Bank (Div. 5Z and 6)					Georges Bank West SA 521-522, 525-526, 537-539 and Div. 6					Georges Bank East SA 561-562					
	Quarter					Quarter					Quarter					GRAND
	1	2	3	4	TOTAL	1	2	3	4	TOTAL	1	2	3	4	TOTAL	TOTAL
1978	21.6	33.1	23.3	22.0	100.0	13.8	25.6	20.2	18.8	78.4	7.8	7.5	3.1	3.2	21.6	100.0
1979	14.1	31.7	31.9	22.3	100.0	8.6	25.3	27.0	19.0	79.8	5.5	6.4	4.9	3.3	20.2	100.0
1980	18.2	33.5	31.0	17.3	100.0	9.6	29.1	28.4	16.4	83.6	8.6	4.4	2.6	0.9	16.4	100.0
1981	22.7	33.4	27.3	16.6	100.0	12.2	27.8	21.3	14.2	75.5	10.4	5.7	6.0	2.4	24.5	100.0
1982	17.7	28.4	31.7	22.1	100.0	9.1	22.8	25.2	20.6	77.7	8.6	5.6	6.5	1.5	22.3	100.0
1983	21.3	30.0	29.5	19.1	100.0	12.6	24.5	23.0	16.0	76.1	8.7	5.5	6.6	3.1	23.9	100.0
1984	27.8	30.7	25.8	15.8	100.0	12.2	22.2	19.4	13.3	67.1	15.6	8.5	6.3	2.5	32.9	100.0
1985	25.8	32.7	22.1	19.5	100.0	12.3	27.1	18.1	17.1	74.6	13.5	5.6	4.0	2.3	25.4	100.0
1986	36.1	32.0	18.6	13.4	100.0	15.2	21.8	17.4	12.6	67.0	20.9	10.2	1.1	0.7	33.0	100.0
1987	21.8	33.7	23.1	21.4	100.0	14.1	21.4	21.2	17.7	74.4	7.7	12.3	1.9	3.6	25.6	100.0
1988	27.8	28.1	21.9	22.2	100.0	14.0	17.3	20.2	19.2	70.6	13.8	10.8	1.8	3.0	29.4	100.0
1989	22.6	35.4	24.9	17.1	100.0	15.0	22.9	23.4	13.7	75.1	7.7	12.4	1.4	3.4	24.9	100.0
1990	21.4	32.7	25.2	20.8	100.0	13.0	20.3	23.5	20.1	77.0	8.4	12.4	1.6	0.6	23.0	100.0
1991	26.4	41.0	17.8	14.9	100.0	17.8	25.3	17.2	13.2	73.5	8.5	15.7	0.6	1.7	26.5	100.0
1992	27.0	32.9	19.4	20.7	100.0	15.3	19.9	18.3	16.2	69.7	11.6	13.0	1.1	4.5	30.3	100.0
1993	24.6	35.6	17.6	22.2	100.0	15.5	21.8	16.0	18.8	72.1	9.1	13.8	1.6	3.4	27.9	100.0
1994	26.3	35.8	21.5	16.4	100.0	25.2	28.8	19.1	14.4	87.5	1.1	7.0	2.4	2.0	12.5	100.0
1995	20.0	33.3	29.6	17.2	100.0	17.2	27.1	29.2	16.7	90.2	2.7	6.2	0.4	0.5	9.8	100.0
1996	19.6	40.8	26.5	13.2	100.0	17.2	34.3	25.5	12.0	89.0	2.4	6.4	1.0	1.2	11.0	100.0
1997	14.6	46.2	24.5	14.7	100.0	13.4	40.6	24.2	14.4	92.6	1.2	5.6	0.4	0.3	7.4	100.0
1998	19.0	41.4	20.7	18.9	100.0	18.4	31.1	20.2	18.7	88.4	0.6	10.3	0.5	0.2	11.6	100.0
1999	19.7	45.3	21.6	13.4	100.0	16.6	34.5	21.3	13.3	85.7	3.1	10.7	0.3	0.1	14.3	100.0

Table 4. Distribution of USA commercial landings (metric tons, live) of Atlantic cod from Georges Bank (Division 5Z), by gear type, 1965-1999. The percentage of total USA commercial landings of Atlantic cod from Georges Bank, by gear type, is also presented for each year. Data only reflect Georges Bank cod landings that could be identified by gear type.

	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	10251	0	582	505	9	11347	90.3	-	5.1	4.5	0.1	100.0
1966	10206	0	787	757	19	11769	86.7	-	6.7	6.4	0.2	100.0
1967	10915	0	894	704	9	12522	87.2	-	7.1	5.6	0.1	100.0
1968	12084	0	936	524	<1	13544	89.2	-	6.9	3.9	-	100.0
1969	13194	0	1371	387	<1	14952	88.2	-	9.2	2.6	-	100.0
1970	11270	0	1676	404	<1	13350	84.4	-	12.6	3.0	-	100.0
1971	12436	0	2334	230	2	15002	82.9	-	15.6	1.5	-	100.0
1972	10179	0	2071	217	10	12477	81.6	-	16.6	1.7	0.1	100.0
1973	12431	3	2185	206	21	14846	83.7	-	14.7	1.4	0.2	100.0
1974	14078	3	2548	11	9	16649	84.6	-	15.3	0.1	-	100.0
1975	12069	0	2435	84	4	14592	82.7	-	16.7	0.6	-	100.0
1976	12257	4	1519	153	5	13938	88.0	-	10.9	1.1	-	100.0
1977	18529	30	912	83	22	19576	94.7	0.2	4.7	0.4	0.1	100.0
1978	20862	81	1569	1180	59	23751	87.8	0.3	6.6	5.0	0.3	100.0
1979	26562	620	2707	860	159	30908	85.9	2.0	8.8	2.8	0.5	100.0
1980	32479	4491	1102	0	273	38345	84.7	11.7	2.9	-	0.7	100.0
1981	27694	3515	120	584	197	32110	86.2	10.9	0.4	1.8	0.6	100.0
1982	33371	2935	385	624	210	37525	88.9	7.8	1.0	1.7	0.6	100.0
1983	30981	1812	831	441	81	34146	90.7	5.3	2.4	1.3	0.3	100.0
1984	26161	2573	366	753	197	30050	87.1	8.6	1.2	2.5	0.6	100.0
1985	21444	2482	436	284	163	24809	86.4	10.0	1.8	1.1	0.7	100.0
1986	13576	1679	692	305	95	16347	83.0	10.3	4.2	1.9	0.6	100.0
1987	13711	1522	1636	222	71	17162	79.9	8.9	9.5	1.3	0.4	100.0
1988	20296	1864	1950	232	116	24458	83.0	7.6	8.0	0.9	0.5	100.0
1989	17946	3150	1583	119	91	22889	78.4	13.8	6.9	0.5	0.4	100.0
1990	21707[1]	2316	1252	395	133	25803	84.1	9.0	4.9	1.5	0.5	100.0
1991	17892[2]	2171	1919	286	180	22448	79.7	9.7	8.5	1.3	0.8	100.0
1992	11696[3]	1747	1709	186	114	15452	75.7	11.3	11.1	1.2	0.7	100.0
1993	10893[4]	1321	1316	62	78	13670	79.7	9.7	9.6	0.4	0.6	100.0
1994	7139	1318	1372	-[5]	21	9850	72.5	13.4	13.9	-	0.2	100.0
1995	3780	1300	1660	-[5]	18	6758	55.9	19.2	24.6	-	0.3	100.0
1996	4047	1552	1413	-[5]	6	7018	57.7	22.1	20.1	-	0.1	100.0
1997	4583	1595	1331	-[5]	28	7537	60.8	21.2	17.7	-	0.3	100.0
1998	4083	858	1995	-[5]	23	6959	58.6	12.3	28.7	-	0.4	100.0
1999	4760	1452	1831	-[5]	18	8061	59.1	18.0	22.7	-	0.2	100.0

[1] Includes 849 tons taken by pair-trawl (Note: 1990 was the first year that pair-trawl landings exceeded a few tons)
[2] Includes 1068 tons taken by pair-trawl
[3] Includes 1149 tons taken by pair-trawl
[4] Includes 1352 tons taken by pair-trawl
[5] Handline included with line trawl

Table 5. Percentage, by weight and number of fish landed, of USA commercial Atlantic cod landings from Georges Bank and South (NAFO Division 5Z and Subarea 6), by market category, 1964 - 1999. Percent values, by number, are only available from 1978 onwards.

	Percentage by Weight				Percentage by Number			
Year	Large	Market	Scrod	Total [a]	Large	Market	Scrod	Total [a]
1964	45	47	8	100	-	-	-	-
1965	56	40	3	100	-	-	-	-
1966	53	37	10	100	-	-	-	-
1967	41	42	16	100	-	-	-	-
1968	34	46	19	100	-	-	-	-
1969	27	57	16	100	-	-	-	-
1970	30	62	8	100	-	-	-	-
1971	40	51	9	100	-	-	-	-
1972	37	53	10	100	-	-	-	-
1973	24	40	36	100	-	-	-	-
1974	24	59	17	100	-	-	-	-
1975	28	62	10	100	-	-	-	-
1976	34	48	18	100	-	-	-	-
1977	26	39	34	100	-	-	-	-
1978	29	60	11	100	14	64	22	100
1979	37	55	8	100	20	57	23	100
1980	42	47	11	100	20	53	27	100
1981	37	51	12	100	13	56	31	100
1982	31	47	22	100	10	42	48	100
1983	25	53	22	100	9	48	43	100
1984	32	56	12	100	13	60	27	100
1985	28	47	25	100	10	35	55	100
1986	31	48	21	100	11	46	43	100
1987	25	38	37	100	8	27	65	100
1988	24	48	28	100	9	43	48	100
1989	24	54	22	100	10	49	41	100
1990	23	45	32	100	9	36	55	100
1991	31	50	19	100	14	49	37	100
1992	31	42	27	100	12	37	51	100
1993	28	43	29	100	10	39	51	100
1994	27	52	21	100	11	49	40	100
1995	26	49	25	100	11	40	49	100
1996	23	57	20	100	12	54	34	100
1997	27	55	18	100	13	51	36	100
1998	25	50	25	100	10	44	46	100
1999	23	56	21	100	10	53	37	100

[a] Includes landings of 'mixed' cod.

Table 6. Estimated number (000's) and weight (metric tons, live) of Atlantic cod caught by marine recreational fishermen from the Georges Bank stock during 1979 - 1999.[1]

Year	Total Cod Caught		Total Cod Retained (excluding those caught and released)			
	No. of Cod (000's)	Wt. of Cod (mt)	No. of Cod (000's)	Wt. of Cod (mt)	Mean Weight (kg)	Percent of Total Landings
1979	393	580	393	580	1.476	1.5
1980	186	471	133	270	2.523	1.0
1981	1749	6265	1695	6074	3.161	12.5
1982	1650	4582	1600	4444	1.022	7.2
1983	1885	5994	1709	5435	2.860	10.0
1984	499	1385	464	1289	2.603	3.2
1985	2144	9075	2054	8693	3.619	18.9
1986	354	1060	291	872	2.311	3.3
1987	472	797	434	734	2.539	2.3
1988	1321	4368	1102	3643	3.096	8.5
1989	567	1979	404	1411	3.517	4.1
1990	586	989	463	782	2.728	1.8
1991	485	1908	333	1308	3.356	3.4
1992	265	556	193	405	2.046	1.4
1993	1106	2856	755	1948	1.864	7.8
1994	437	1458	303	1010	2.140	6.2
1995	742	2080	471	1320	2.272	14.4
1996	235	817	174	603	3.059	6.3
1997	392	1220	247	769	2.591	6.9
1998	818	1724	244	515	3.018	5.5
1999	419	1344	111	357	2.348	3.5

[1] 1981 to present derived from new expanded catch methodology from Marine Recreational Fishery Statistics Survey (MRFSS) methodology (1 January 1997).

Table 7. USA and Canadian sampling of commercial Atlantic cod landings from the Georges Bank and South cod stock (NAFO Division 5Z and Subarea 6), 1978 - 1999.

	USA				Canada			
	Length Samples		Age Samples		Length Samples		Age Samples	
Year	No.	# Fish Measured	No.	# Fish Aged	No.	# Fish Measured	No.	# Fish Aged
1978	88	6841	76	1463	29	7684	29	1308
1979	80	6973	79	1647	13	3991	12	656
1980	69	4990	67	1119	10	2784	10	536
1981	57	4304	57	1231	17	4147	16	842
1982	151	11970	147	2579	17	4756	8	858
1983	146	12544	138	2945	15	3822	14	604
1984	100	8721	100	2431	7	1889	7	385
1985	100	8366	100	2321	29	7644	20	1062
1986	94	7515	94	2222	19	5745	19	888
1987	80	6395	79	1704	33	9477	33	1288
1988	76	6483	76	1576	40	11709	40	1984
1989	66	5547	66	1350	32	8716	32	1561
1990	83	7158	83	1700	40	9901	40	2012
1991	88	7708	88	1865	45	10873	45	1782
1992	77	6549	77	1631	48	10878	48	1906
1993	82	6636	82	1598	51	12158	51	2146
1994	58	4688	54	1064	104	25845	101	1268
1995	40	2879	40	778	36	11598	36	548
1996	55	4600	54	1080	129	26663	129	879
1997	80	6638	80	1581	118	31882	38	1244
1998	80	7076	81	1545	139	26549	139	1720
1999	68	5987	67	1503	84	24954	84	918

Table 8. USA sampling of commercial Atlantic cod landings, by market category, for the Georges Bank and South cod stock (NAFO Division 5Z and Subarea 6), 1978 - 1999.

	Number of Samples, by Market Category & Quarter															Annual Sampling Intensity			
	Scrod					Market					Large					No. of Tons Landed/Sample			
Year	Q1	Q2	Q3	Q4	Σ	Q1	Q2	Q3	Q4	Σ	Q1	Q2	Q3	Q4	Σ	Scrd	Mkt	Lge	Σ
1978	17	15	6	3	41	9	12	13	9	43	1	0	1	2	4	69	374	1922	302
1979	2	5	14	8	29	6	19	11	8	44	2	0	4	1	7	88	407	1742	408
1980	7	10	13	4	34	12	14	5	1	32	3	0	0	0	3	136	588	5546	580
1981	4	10	11	3	28	6	9	10	2	27	2	0	0	0	2	149	634	6283	594
1982	5	9	32	9	55	6	20	27	13	66	8	8	9	5	30	156	279	410	260
1983	4	12	17	10	43	12	19	22	14	67	2	15	16	3	36	185	291	259	252
1984	6	8	8	7	29	8	15	8	11	42	18	5	3	3	29	138	441	358	329
1985	6	7	16	5	34	11	11	12	8	42	4	8	7	5	24	201	299	310	268
1986	6	7	7	6	26	8	10	10	11	39	6	5	10	8	29	142	215	186	186
1987	7	8	6	8	29	6	8	9	10	33	6	6	4	2	18	240	220	267	238
1988	8	6	7	5	26	13	7	9	9	38	4	4	3	1	12	283	331	532	346
1989	2	7	9	9	27	7	8	8	7	30	3	4	1	1	9	210	450	660	380
1990	8	9	10	4	31	10	13	9	8	40	4	4	4	0	12	295	315	538	340
1991	6	11	7	5	29	12	13	8	8	41	4	6	3	5	18	158	293	423	275
1992	6	7	7	10	30	8	10	6	9	33	5	5	3	1	14	149	215	377	219
1993	5	16	7	6	34	10	10	7	9	36	6	1	3	2	12	126	173	339	178
1994	3	9	8	2	22	5	11	7	4	27	1	4	3	1	9	92	187	290	167
1995	2	3	13	2	20	2	4	10	2	18	0	1	0	1	2	83	181	880	167
1996	6	2	12	3	23	5	6	11	6	28	0	2	1	1	4	59	143	400	127
1997	3	11	3	10	27	5	16	9	9	39	3	6	0	5	14	50	105	148	94
1998	3	7	23	5	38	10	10	15	3	38	1	2	1	0	3	44	92	573	88
1999	5	3	10	1	21	7	13	10	5	38	2	4	2	0	9	80	118	205	118

Table 9. Landings at age (thousands of fish; metric tons) and mean weight (kg) and mean length (cm) at age of USA commercial landings of Atlantic cod from the Georges Bank and South cod stock (NAFO Division 5Z and Subarea 6), 1978 - 1999.

Year	Age 1	2	3	4	5	6	7	8	9	10+	Total
					USA Commercial Landings in Numbers (000's) at Age						
1978	-	331	5731	1636	625	53	288	35	28	8	8735
1979	34	1618	572	4107	910	403	59	244	-	45	7992
1980	88	3002	4707	286	1888	951	413	76	153	-	11564
1981	25	3060	3613	1960	101	1026	330	72	109	46	10342
1982	325	7855	2466	1682	1258	117	452	116	50	57	14378
1983	81	3542	5557	1244	854	722	85	218	88	62	12453
1984	81	1281	3305	2961	500	393	386	25	153	82	9167
1985	130	4280	1539	985	1388	273	173	165	12	86	9031
1986	137	1091	3290	432	337	412	58	53	38	26	5874
1987	12	4878	804	1380	188	173	153	41	23	18	7670
1988	-	1345	5662	688	1076	175	100	86	21	18	9171
1989	-	1770	2638	3237	207	362	51	20	13	-	8298
1990	-	4603	3273	1265	1465	134	143	28	3	8	10922
1991	41	1032	2731	2040	873	572	52	23	8	3	7375
1992	-	2387	1268	746	936	217	133	9	12	3	5711
1993	-	781	3178	521	269	228	68	74	15	2	5136
1994	0.1	258	1186	1232	181	62	90	24	22	4	3059
1995	-	354	895	629	237	35	24	14	1	1	2190
1996	0.1	183	744	971	190	88	6	0.4	3	-	2185
1997	-	427	511	633	565	72	58	8	6	3	2283
1998	0.1	682	989	327	235	165	26	6	4	3	2437
1999	0.3	256	1690	536	153	69	96	10	1.3	.4	2812
					USA Commercial Landings in Weight (Tons) at Age						
1978	-	430	14159	6041	2794	276	2168	274	356	81	26579
1979	30	2462	1411	17662	4525	2943	541	2507	-	564	32645
1980	74	4475	11663	1141	10937	6375	3504	657	1227	-	40053
1981	22	4592	8528	6644	524	7532	2773	716	1628	890	33849
1982	249	10960	7032	6465	6856	755	4281	1200	624	911	39333
1983	80	5303	13647	4271	4015	4628	679	2244	975	914	36756
1984	85	2099	8096	10650	2655	2655	3456	246	1739	1234	32915
1985	118	6094	3320	3930	7219	1746	1397	1707	148	1149	26828
1986	131	1586	7498	1475	1892	2964	528	537	507	372	17490
1987	10	6888	1953	5581	1063	1349	1306	392	242	251	19035
1988	-	2098	12981	2288	5677	1157	848	776	226	259	26310
1989	-	2958	5964	11861	1106	2403	439	209	157	-	25097
1990	-	7094	7411	4346	6902	817	1193	297	35	98	28193
1991	47	1615	6840	6943	4362	3526	406	285	96	55	24175
1992	-	3663	3040	2949	4470	1379	1070	93	137	54	16855
1993	-	1192	7081	1865	1417	1581	560	692	166	40	14594
1994	-	378	2491	4407	868	473	726	234	236	79	9893
1995	-	515	1810	2412	1314	267	253	161	9	20	6759
1996	-	275	1823	3303	915	593	64	3	45	-	7020
1997	-	678	1192	2301	2284	441	461	73	69	37	7537
1998	0.1	1011	2263	1173	1152	984	229	55	53	37	6959
1999	0.3	400	3742	1837	784	447	720	106	18	6	8061

Table 9 continued. Landings at age (thousands of fish; metric tons) and mean weight (kg) and mean length (cm) at age of USA commercial landings of Atlantic cod from the Georges Bank and South cod stock (NAFO Division 5Z and Subarea 6), 1978 - 1999.

Year	Age 1	2	3	4	5	6	7	8	9	10+	Mean
					USA Commercial Landings Mean Weight (kg) at Age						
1978	-	1.298	2.470	3.692	4.473	5.199	7.522	7.924	12.794	10.125	3.043
1979	0.889	1.522	2.464	4.301	4.974	7.309	9.127	10.264	-	12.533	4.085
1980	0.839	1.490	2.478	3.992	5.792	6.703	8.489	8.648	8.046	-	3.464
1981	0.885	1.501	2.360	3.389	5.209	7.339	8.397	9.988	14.884	19.348	3.274
1982	0.767	1.395	2.852	3.845	5.449	6.457	9.473	10.297	12.434	15.982	2.736
1983	0.993	1.497	2.456	3.434	4.703	6.407	7.955	10.280	11.091	14.742	2.952
1984	1.053	1.638	2.450	3.597	5.308	6.751	8.960	9.710	11.361	15.049	3.590
1985	0.914	1.424	2.157	3.989	5.201	6.398	8.075	10.355	12.107	13.360	2.971
1986	0.957	1.454	2.279	3.414	5.608	7.198	9.066	10.135	13.339	14.308	2.978
1987	0.801	1.412	2.429	4.043	5.657	7.811	8.520	9.466	10.621	13.944	2.482
1988	-	1.559	2.293	3.326	5.278	6.629	8.487	9.067	10.606	14.389	2.869
1989	-	1.672	2.260	3.664	5.351	6.632	8.686	10.673	11.622	-	3.025
1990	-	1.541	2.264	3.436	4.712	6.103	8.366	10.482	10.246	12.250	2.581
1991	1.131	1.566	2.504	3.403	4.955	6.161	7.829	12.392	11.991	20.861	3.278
1992	-	1.535	2.397	3.951	4.775	6.359	8.035	10.457	11.107	17.418	2.951
1993	-	1.526	2.228	3.580	5.271	6.936	8.185	9.386	10.520	21.211	2.841
1994	0.900	1.463	2.101	3.577	4.804	7.591	8.089	9.786	10.980	19.055	3.234
1995	-	1.453	2.022	3.837	5.535	7.679	10.701	11.761	10.678	14.953	3.088
1996	-	1.503	2.451	3.400	4.825	6.727	10.497	8.346	13.836	-	3.212
1997	-	1.586	2.335	3.635	4.041	6.156	7.987	8.705	11.898	12.843	3.302
1998	0.534	1.483	2.288	3.585	4.910	5.981	8.799	8.986	13.831	14.461	2.855
1999	1.000	1.566	2.214	3.428	5.122	6.469	7.476	10.835	14.001	14.823	2.867
					USA Commercial Landings Mean Length (cm) at Age						
1978	-	50.2	61.5	69.8	73.7	79.3	89.3	91.3	107.1	101.0	64.9
1979	44.7	52.9	61.0	73.9	77.5	88.2	95.3	99.4	-	106.1	70.9
1980	43.9	52.6	61.6	72.4	81.9	86.3	92.9	92.2	91.2	-	66.5
1981	44.6	52.3	60.4	68.5	78.4	88.7	93.1	98.2	112.8	123.2	64.6
1982	42.3	51.4	64.4	70.8	79.9	84.1	96.5	99.2	105.5	114.9	60.7
1983	46.3	52.7	61.5	68.1	75.9	84.5	90.7	99.1	101.5	111.7	63.3
1984	47.2	54.1	61.5	69.8	79.3	86.5	94.8	97.5	102.5	112.0	67.7
1985	45.1	51.8	58.6	72.4	79.0	84.5	91.4	99.4	104.7	107.9	62.5
1986	45.8	52.0	60.1	67.6	81.1	88.2	95.2	98.7	108.2	109.8	63.2
1987	43.3	51.7	61.3	72.7	81.6	90.9	93.2	96.6	100.1	110.1	59.4
1988	-	53.6	60.3	67.6	79.2	85.5	92.7	94.8	100.1	109.6	63.4
1989	-	54.7	60.1	70.0	79.3	85.3	94.2	100.4	103.6	-	64.8
1990	-	53.4	59.8	68.6	76.1	82.7	92.2	99.7	99.3	106.0	61.1
1991	48.4	53.5	62.1	68.0	77.5	82.8	90.0	106.1	105.7	125.8	66.3
1992	-	53.1	61.0	71.7	75.9	83.5	91.1	99.3	101.8	118.2	63.3
1993	-	53.1	59.8	69.4	78.4	87.0	91.7	96.1	99.8	126.0	63.0
1994	45.0	52.4	58.7	69.5	76.4	89.4	91.3	97.4	101.4	122.1	65.7
1995	-	52.4	57.8	71.0	81.0	89.9	100.9	104.3	100.9	113.0	64.6
1996	46.0	53.0	61.6	68.4	76.7	86.4	99.4	92.1	109.8	-	66.4
1997	-	53.8	60.6	69.9	71.9	83.5	91.1	93.7	104.4	107.0	66.5
1998	37.9	52.5	60.3	69.7	77.4	82.8	94.1	94.9	109.8	111.6	60.7
1999	45.0	53.6	59.7	68.9	78.6	84.6	89.2	100.8	108.5	109.8	63.7

Table 10. Landings at age (thousands of fish; metric tons) and mean weight (kg) and mean length (cm) at age of Canadian commercial landings of Atlantic cod from the Georges Bank and South cod stock (NAFO Division 5Z and Subarea 6), 1978 - 1999.

Year	Age 1	2	3	4	5	6	7	8	9	10+	Total
CAN Commercial Landings in Numbers (000's) at Age											
1978	2	62	2017	667	205	78	57	12	12	7	3119
1979	-	371	328	763	302	55	18	9	4	3	1853
1980	1	775	1121	214	420	125	32	11	14	10	2723
1981	2	145	608	504	134	380	87	51	21	16	1948
1982	6	1283	1358	1105	742	164	221	97	21	26	5023
1983	27	744	2506	1212	201	54	10	17	12	3	4786
1984	-	26	118	375	340	123	72	19	18	39	1130
1985	4	2146	904	383	497	139	45	38	9	11	4176
1986	19	235	1283	365	143	215	29	19	9	3	2320
1987	14	2595	602	741	91	79	117	22	15	6	4282
1988	10	232	2360	324	421	69	61	111	29	29	3646
1989	-	318	284	918	124	179	31	23	37	18	1932
1990	7	339	1769	617	799	95	102	8	14	30	3780
1991	11	493	512	1241	585	516	74	47	15	20	3514
1992	70	1790	902	292	546	187	176	25	21	7	4016
1993	4	252	1068	594	171	244	91	69	17	15	2525
1994	2	140	340	593	213	34	47	22	16	2	1409
1995	0.1	38	162	63	53	10	2	1	1	-	331
1996	0.6	24	159	262	51	35	9	2	1	0.2	545
1997	3	89	128	249	228	60	26	7	4	1	795
1998	0.1	57	198	95	89	73	13	7	3	2	538
1999	1	30	236	170	48	28	23	7	1	3	547
CAN Commercial Landings in Weight (Tons) at Age											
1978	1	85	4913	1949	803	483	378	122	113	107	8778
1979	-	509	525	2842	1398	342	169	105	47	42	5978
1980	1	1041	2720	692	2099	809	228	133	177	157	8063
1981	2	197	1426	1772	699	2624	801	497	220	224	8499
1982	4	1853	3156	4217	3849	1074	2019	914	266	418	17824
1983	24	1084	5521	3854	876	335	80	176	147	37	12130
1984	-	38	292	1423	1615	743	622	202	195	620	5763
1985	3	3017	1775	1388	2370	895	368	369	94	160	10443
1986	14	369	3691	1442	800	1543	250	180	89	28	8411
1987	9	4183	1556	3302	557	596	1113	243	189	93	11845
1988	8	300	5942	1265	2406	462	564	1188	334	437	12932
1989	-	417	669	3812	678	1221	231	247	432	276	8011
1990	5	615	5001	2283	4173	631	876	85	187	454	14310
1991	12	866	1425	4278	2593	2885	527	451	127	291	13455
1992	80	2778	2308	1042	2501	1107	1252	241	265	138	11712
1993	3	393	2485	1852	767	1431	635	623	150	180	8519
1994	2	203	817	2266	1023	243	370	196	128	23	5272
1995	0.1	56	405	237	281	60	20	14	12	-	1085
1996	1	37	376	875	268	224	62	18	14	2	1877
1997	3	138	290	813	972	348	213	62	43	16	2898
1998	0.1	85	471	304	380	425	94	62	28	24	1873
1999	1	46	541	600	202	175	154	54	8	39	1819

Table 10 continued. Landings at age (thousands of fish; metric tons) and mean weight (kg) and mean length (cm) at age of Canadian commercial landings of Atlantic cod from the Georges Bank and South cod stock (NAFO Division 5Z and Subarea 6), 1978 - 1999

Year	Age 1	2	3	4	5	6	7	8	9	10+	Mean
					CAN Commercial Landings Mean Weight (kg) at Age						
1978	0.707	1.376	2.436	2.922	3.918	6.187	6.625	10.148	9.429	15.262	2.814
1979	-	1.371	1.601	3.725	4.630	6.222	9.365	11.638	11.699	14.064	3.226
1980	0.567	1.343	2.426	3.235	4.997	6.468	7.119	12.135	12.652	15.721	2.961
1981	0.839	1.362	2.345	3.516	5.216	6.905	9.204	9.747	10.465	13.993	4.363
1982	0.652	1.444	2.324	3.816	5.188	6.550	9.137	9.418	12.667	16.092	3.548
1983	0.904	1.457	2.203	3.180	4.357	6.203	8.042	10.368	12.222	12.270	2.534
1984	-	1.477	2.473	3.794	4.751	6.043	8.633	10.622	10.807	15.897	5.100
1985	0.686	1.406	1.964	3.625	4.768	6.440	8.181	9.718	10.499	14.537	2.501
1986	0.723	1.572	2.877	3.952	5.592	7.179	8.612	9.453	9.934	9.437	3.625
1987	0.661	1.612	2.584	4.456	6.125	7.540	9.510	11.031	12.629	15.444	2.766
1988	0.786	1.294	2.518	3.904	5.716	6.694	9.251	10.700	11.531	15.065	3.547
1989	-	1.310	2.356	4.153	5.471	6.820	7.459	10.757	11.680	15.356	4.141
1990	0.831	1.812	2.827	3.699	5.221	6.657	8.582	11.227	13.080	14.821	3.786
1991	1.051	1.756	2.783	3.447	4.432	5.591	7.116	9.604	8.457	14.550	3.829
1992	1.148	1.552	2.559	3.568	4.581	5.921	7.112	9.626	12.603	19.714	2.916
1993	0.872	1.557	2.327	3.116	4.489	5.858	7.006	9.035	8.974	12.173	3.374
1994	0.906	1.453	2.404	3.822	4.805	7.141	7.869	8.914	7.970	11.637	3.742
1995	0.906	1.472	2.495	3.759	5.298	6.313	10.903	10.181	10.175	-	3.284
1996	1.034	1.538	2.358	3.337	5.237	6.358	6.916	8.455	10.594	12.002	3.443
1997	0.954	1.536	2.264	3.269	4.257	5.855	8.190	8.546	11.825	12.688	3.644
1998	0.626	1.484	2.375	3.195	4.274	5.828	6.991	8.298	10.984	14.840	3.482
1999	0.799	1.554	2.288	3.527	4.162	6.304	6.768	8.003	9.390	13.572	3.327
					CAN Commercial Landings Mean Length (cm) at Age						
1978	39.5	48.9	59.0	63.3	69.6	81.2	82.5	98.3	94.7	112.8	61.8
1979	-	49.3	51.9	69.3	74.8	82.2	95.2	103.2	103.4	110.4	64.1
1980	36.6	48.9	59.5	66.2	76.4	83.6	86.6	104.7	105.7	114.6	61.7
1981	41.8	49.1	59.1	68.1	78.0	86.1	94.8	96.6	97.5	108.9	70.6
1982	38.3	50.1	58.9	70.0	77.8	84.4	94.9	95.2	106.4	115.3	65.5
1983	42.9	50.4	57.9	65.8	73.0	82.9	90.9	99.0	105.1	105.0	59.9
1984	-	50.7	60.4	70.0	75.7	82.3	92.3	100.1	100.8	114.5	75.6
1985	39.0	49.8	55.7	68.7	75.3	83.8	91.1	96.3	99.0	110.8	58.1
1986	39.6	51.7	63.5	71.0	79.6	86.8	92.8	95.9	96.3	96.1	67.2
1987	38.5	52.1	61.0	73.6	82.3	88.4	96.1	101.2	106.3	114.4	60.1
1988	40.8	48.3	60.5	70.4	80.2	84.8	95.2	99.9	102.5	112.2	65.8
1989	-	48.6	59.1	71.9	79.0	85.1	87.7	100.3	103.1	113.3	69.4
1990	41.7	54.3	63.1	69.0	77.6	84.0	92.0	102.0	107.4	112.1	68.2
1991	45.1	53.7	62.6	67.2	73.3	78.8	86.2	96.1	90.6	112.1	68.4
1992	46.2	51.4	60.6	67.7	73.8	80.6	85.4	94.8	105.8	115.1	61.1
1993	42.2	51.4	58.9	64.9	72.9	80.4	85.5	94.1	92.4	104.5	65.0
1994	43.0	50.3	59.6	69.8	75.3	85.9	89.4	93.0	88.6	102.6	67.9
1995	43.0	50.6	60.4	69.5	78.3	83.1	100.9	98.4	97.8	-	65.0
1996	44.9	51.3	59.3	66.6	77.7	83.3	84.7	90.8	99.9	104.6	66.4
1997	43.7	51.3	58.6	66.1	72.4	80.9	91.3	92.5	103.9	105.5	67.4
1998	37.7	50.5	59.4	65.6	72.6	80.9	86.1	91.6	101.2	112.2	66.1
1999	40.7	51.5	58.6	67.9	71.5	82.9	85.4	90.4	95.8	108.9	65.3

Table 11. Landings at age (thousands of fish; metric tons) and mean weight (kg) and mean length (cm) at age of total commercial landings of Atlantic cod from the Georges Bank and South cod stock (NAFO Division 5Z and Subarea 6), 1978 - 1999.

Year	Age 1	2	3	4	5	6	7	8	9	10+	Total	% of Total Landings: USA	Canada
Total Commercial Landings in Numbers (000's) at Age													
1978	2	393	7748	2303	830	131	345	47	40	15	11854	73.7	26.3
1979	34	1989	900	4870	1212	458	77	253	4	48	9845	81.2	18.8
1980	89	3777	5828	500	2308	1076	445	87	167	10	14287	80.9	19.1
1981	27	3205	4221	2464	235	1406	417	123	130	62	12290	84.1	15.9
1982	331	9138	3824	2787	2000	281	673	213	71	83	19401	74.1	25.9
1983	108	4286	8063	2456	1055	776	95	235	100	65	17239	72.2	27.8
1984	81	1307	3423	3336	840	516	458	44	171	121	10297	89.0	11.0
1985	134	6426	2443	1368	1885	412	218	203	21	97	13207	68.4	31.6
1986	156	1326	4573	797	480	627	87	72	47	29	8194	71.7	28.3
1987	26	7473	1406	2121	279	252	270	63	38	24	11952	64.2	35.8
1988	10	1577	8022	1012	1497	244	161	197	50	47	12817	71.6	28.4
1989	-	2088	2922	4155	331	541	82	43	50	18	10230	81.1	18.9
1990	7	4942	5042	1882	2264	229	245	36	17	38	14702	74.3	25.7
1991	52	1525	3243	3281	1458	1088	126	70	23	23	10889	67.7	32.3
1992	70	4177	2170	1038	1482	404	309	34	33	10	9727	58.7	41.3
1993	4	1033	4246	1115	440	472	159	143	32	17	7661	67.0	33.0
1994	2	398	1526	1825	394	96	137	46	38	6	4468	68.5	31.5
1995	0.1	392	1058	692	290	44	26	15	2	1	2520	86.9	13.1
1996	0.7	207	903	1234	241	123	15	3	5	0.2	2731	80.0	20.0
1997	3	517	639	881	794	131	84	16	9	4	3078	74.2	25.8
1998	0.2	739	1188	423	324	237	39	14	6	4	2975	81.9	18.1
1999	2	285	1927	706	201	97	119	16	2	3	3359	83.7	16.3
Total Commercial Landings in Weight (Tons) at Age													
1978	1	515	18890	7990	3597	757	2549	395	465	198	35357	75.2	24.8
1979	30	2970	1936	20504	5923	3288	711	2611	44	606	38623	84.5	15.5
1980	75	5516	14382	1833	13036	7184	3735	793	1408	154	48116	83.2	16.8
1981	24	4789	9953	8416	1224	10156	3575	1212	1848	1151	42348	79.9	20.1
1982	253	12812	10187	10681	10705	1827	6303	2110	891	1388	57157	68.8	31.2
1983	105	6387	19167	8126	4891	4963	763	2418	1120	946	48886	75.2	24.8
1984	85	2137	8389	12074	4271	3401	4078	447	1938	1858	38678	85.1	14.9
1985	121	9111	5095	5319	9588	2644	1765	2073	246	1309	37271	72.0	28.0
1986	145	1955	11189	2917	2692	4505	776	717	596	409	25901	67.5	32.5
1987	19	11071	3509	8882	1619	1945	2416	633	426	360	30880	61.6	38.4
1988	8	2399	18923	3552	8085	1618	1412	1960	566	719	39242	67.0	33.0
1989	-	3375	6633	15673	1783	3625	669	455	588	298	33098	75.8	24.2
1990	5	7709	12412	6629	11075	1448	2069	382	222	552	42503	66.3	33.7
1991	59	2481	8265	11221	6955	6411	933	736	223	346	37630	64.2	35.8
1992	80	6441	5348	3991	6971	2486	2322	334	402	192	28567	59.0	41.0
1993	3	1585	9566	3717	2184	3012	1195	1315	316	220	23113	63.1	36.9
1994	2	581	3308	6673	1892	716	1095	430	364	103	15165	65.2	34.8
1995	0.1	577	2215	2649	1595	327	273	174	20	20	7851	86.1	13.9
1996	0.6	311	2199	4178	1183	817	127	21	59	2	8898	78.9	21.1
1997	3	816	1483	3114	3256	790	674	135	111	53	10435	72.2	27.8
1998	0.1	1096	2735	1477	1532	1408	323	117	82	61	8832	78.8	21.2
1999	1	446	4283	2437	985	622	874	159	27	45	9880	81.6	18.4

Table 11 continued. Landings at age (thousands of fish; metric tons) and mean weight (kg) and mean length (cm) at age of total commercial landings of Atlantic cod from the Georges Bank and South cod stock (NAFO Division 5Z and Subarea 6), 1978 - 1999.

	Age										
Year	1	2	3	4	5	6	7	8	9	10+	Mean
Total Commercial Landings Mean Weight (kg) at Age											
1978	0.707	1.310	2.461	3.469	4.336	5.787	7.374	8.492	11.785	13.200	2.983
1979	0.889	1.494	2.149	4.211	4.888	7.178	9.183	10.313	11.699	12.625	3.923
1980	0.836	1.460	2.468	3.668	5.647	6.676	8.390	9.089	8.432	15.400	3.368
1981	0.882	1.495	2.358	3.415	5.213	7.222	8.565	9.888	14.170	18.565	3.446
1982	0.765	1.402	2.664	3.834	5.352	6.511	9.363	9.897	12.503	16.723	2.946
1983	0.971	1.490	2.377	3.309	4.637	6.393	7.964	10.286	11.227	14.554	2.836
1984	1.053	1.635	2.451	3.619	5.083	6.582	8.909	10.104	11.303	15.356	3.756
1985	0.907	1.418	2.086	3.887	5.087	6.412	8.097	10.236	11.418	13.494	2.822
1986	0.929	1.475	2.447	3.660	5.603	7.191	8.915	9.955	12.687	14.104	3.161
1987	0.726	1.481	2.495	4.187	5.810	7.726	8.949	10.013	11.414	15.000	2.584
1988	0.786	1.520	2.359	3.511	5.401	6.647	8.776	9.987	11.143	15.298	3.062
1989	-	1.617	2.269	3.772	5.396	6.694	8.222	10.718	11.665	17.111	3.235
1990	0.831	1.560	2.462	3.522	4.892	6.333	8.456	10.648	12.580	14.526	2.891
1991	1.114	1.627	2.548	3.420	4.769	5.891	7.410	10.520	9.686	15.373	3.456
1992	1.148	1.542	2.464	3.843	4.704	6.156	7.509	9.846	12.059	19.025	2.937
1993	0.872	1.534	2.253	3.333	4.967	6.379	7.510	9.217	9.699	13.236	3.017
1994	0.906	1.459	2.168	3.657	4.804	7.432	8.013	9.368	9.698	16.659	3.394
1995	0.906	1.471	2.095	3.830	5.492	7.384	10.715	11.617	10.383	14.953	3.087
1996	0.882	1.507	2.435	3.387	4.912	6.622	8.369	8.438	12.883	12.002	3.212
1997	0.954	1.577	2.321	3.532	4.103	6.019	8.050	8.631	11.870	12.795	3.390
1998	0.579	1.483	2.302	3.497	4.735	5.934	8.185	8.610	12.684	14.606	2.969
1999	0.830	1.565	2.223	3.452	4.891	6.422	7.341	9.685	12.153	13.735	2.941
Total Commercial Landings Mean Length (cm) at Age											
1978	39.5	50.0	60.8	67.9	72.7	80.4	80.2	93.1	103.4	106.5	64.1
1979	44.7	52.2	57.7	73.2	76.8	87.5	95.3	99.5	103.4	106.4	69.6
1980	43.8	51.8	61.2	69.7	80.9	86.0	92.4	93.8	92.4	114.6	65.6
1981	44.4	52.2	60.2	68.4	78.2	88.0	93.5	97.5	110.3	119.5	65.6
1982	42.2	51.2	62.4	70.5	79.1	84.3	96.0	97.4	105.8	115.0	61.9
1983	45.5	52.3	60.4	67.0	75.3	84.4	90.7	99.1	101.9	111.4	62.4
1984	47.2	54.0	61.5	69.8	77.8	85.5	94.4	98.6	102.3	112.8	68.6
1985	44.9	51.1	57.5	71.4	78.0	84.3	91.3	98.8	102.3	108.2	61.1
1986	45.0	51.9	61.1	69.2	80.7	87.7	94.4	98.0	105.9	108.4	64.3
1987	40.7	51.8	61.2	73.0	81.8	90.1	94.5	98.2	102.5	111.2	59.7
1988	40.8	52.8	60.4	68.5	79.5	85.3	93.6	97.7	101.5	111.2	64.1
1989	-	53.8	60.0	70.4	79.2	85.2	91.7	100.3	103.2	113.3	65.7
1990	41.7	53.5	61.0	68.7	76.6	83.2	92.1	100.2	106.0	110.8	62.9
1991	47.7	53.6	62.2	67.7	75.8	80.9	87.8	99.4	95.9	113.9	67.0
1992	46.2	52.4	60.8	70.6	75.1	82.2	87.9	96.0	104.3	116.0	62.4
1993	42.2	52.7	59.6	67.0	76.3	83.6	88.2	95.1	95.9	107.0	63.0
1994	43.1	51.7	58.9	69.6	75.8	88.2	90.7	95.3	95.9	115.8	65.8
1995	43.0	50.6	58.2	70.9	80.5	88.5	100.9	103.8	99.1	113.0	64.6
1996	45.1	52.7	61.2	68.0	76.9	85.5	90.7	91.0	106.9	104.6	66.4
1997	43.7	53.4	60.2	68.8	72.1	82.3	91.2	93.1	104.2	106.5	66.7
1998	37.8	52.4	60.1	68.8	76.0	82.2	91.4	93.1	106.4	111.9	61.7
1999	41.5	53.4	59.6	68.6	76.9	84.1	88.5	96.6	103.4	109.0	64.0

Table 12. Summary of USA and Canadian 1999 commercial landings of Atlantic cod from the Georges Bank and South cod stock (NAFO Division 5Z and Subarea 6).

	USA Catch at Age				Canadian Catch at Age				Total 1999 Catch at Age			
Age	Catch in Numbers (000s's)	% of USA Total	Catch in Weight (mt)	% of USA Total	Catch in Numbers (000s's)	% of Can Total	Catch in Weight (mt)	% of Can Total	Catch in Numbers (000s's)	% of Total	Catch in Weight (mt)	% of Total
1	0.3	0.0	0.3	0.0	1	0.2	1	0.1	2	0.0	1	0.0
2	256	9.1	400	5.0	30	5.4	46	2.5	286	8.5	446	4.5
3	1690	60.1	3742	46.4	236	43.2	541	29.7	1926	57.3	4283	43.3
4	536	19.1	1837	22.8	170	31.1	600	33.0	706	21.0	2437	24.7
5	153	5.4	784	9.7	48	8.9	202	11.1	201	6.0	986	10.0
6	69	2.5	447	5.5	28	5.1	175	9.6	97	2.9	622	6.3
7	96	3.4	720	8.9	23	4.2	154	8.5	119	3.5	874	8.8
8	10	0.4	106	1.3	7	1.2	54	2.9	17	0.5	160	1.6
9	1.3	0.0	18	0.2	1	0.2	8	0.5	2	0.1	26	0.3
10+	0.43	0.0	6.4	0.1	3	0.5	39	2.1	3	0.1	45	0.5
Total	2812.03	100.0	8060.7	100.0	546.82	100.0	1819	100.0	3358.85	100.0	9879	100.0
	Mean Weight Per Fish (kg)			2.867	Mean Weight Per Fish (kg)			3.326	Mean Weight Per Fish (kg)			2.941

Table 13. Mean weight at age (kg, January 1) for Georges Bank and South cod stock (NAFO Division 5Z and Subarea 6), 1978-2000. Values derived form landings mean weights at age using the method described by Rivard (1980).

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	0.486	0.694	0.625	0.7	0.548	0.748	0.907	0.711	0.736	0.502	0.548
2	1.023	1.028	1.139	1.118	1.112	1.068	1.26	1.222	1.157	1.173	1.05
3	1.881	1.678	1.92	1.855	1.996	1.826	1.911	1.847	1.863	1.918	1.869
4	2.922	3.219	2.808	2.903	3.007	2.969	2.933	3.087	2.763	3.201	2.96
5	3.37	4.118	4.876	4.373	4.275	4.216	4.101	4.291	4.667	4.611	4.755
6	4.594	5.579	5.712	6.386	5.826	5.849	5.525	5.709	6.048	6.579	6.214
7	6.235	7.29	7.76	7.562	8.223	7.201	7.547	7.3	7.561	8.022	8.234
8	7.235	8.721	9.136	9.108	9.207	9.814	8.97	9.549	8.978	9.448	9.454
9	10	9.967	9.325	11.35	11.12	10.54	10.78	10.74	11.4	10.66	10.56
10	13.2	12.63	15.4	18.57	16.72	14.55	15.36	13.49	14.1	15	15.3

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	0.583	0.594	0.947	0.993	0.674	0.711	0.702	0.66	0.765	0.352	0.724	0.661
2	1.127	1.123	1.163	1.311	1.327	1.128	1.154	1.168	1.179	1.189	0.952	0.952
3	1.857	1.995	1.994	2.002	1.864	1.824	1.748	1.893	1.87	1.905	1.816	2.573
4	2.983	2.827	2.902	3.129	2.866	2.87	2.882	2.664	2.933	2.849	2.819	2.722
5	4.353	4.296	4.098	4.011	4.369	4.001	4.482	4.337	3.728	4.09	4.136	4.227
6	6.013	5.846	5.368	5.418	5.478	6.076	5.956	6.031	5.437	4.934	5.514	5.784
7	7.393	7.524	6.85	6.651	6.799	7.149	8.924	7.861	7.301	7.019	6.6	7.479
8	9.699	9.357	9.432	8.542	8.319	8.388	9.648	9.509	8.499	8.325	8.903	8.165
9	10.79	11.61	10.16	11.26	9.772	9.454	9.862	12.23	10.01	10.46	10.23	10.54
10	17.11	14.53	15.37	19.03	13.24	16.66	14.95	12	12.8	14.61	13.74	13.74

Table 14. General linear model (GLM) analysis of LPUE of Georges Bank cod for interviewed trips landing cod during 1978-1993 as a function of year, area, quarter, tonnage class and depth with no interaction.

General Linear Models Procedure

Dependent Variable: LNCPUEDF

Source	DF	Sum of Squares	Mean Square	F Value	> F
Model	28	31732.79388553	1133.31406734	735.46	0.0001
Error	54356	83760.33125977	1.54095834		
Corrected Total	54384	115493.12514529			

R-Square	C.V.	Root MSE	LNCPUEDF Mean
0.274759	-549.0211	1.24135343	-0.22610303

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	15	12685.54117665	845.70274511	548.82	0.0001
AREA	5	5241.16957276	1048.23391455	680.25	0.0001
QTR	3	4097.78364005	1365.92788002	886.41	0.0001
TC2	3	6023.47684536	2007.82561512	1302.97	0.0001
DEPTH	2	3684.82265071	1842.41132535	1195.63	0.0001
Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	15	15953.77293165	1063.58486211	690.21	0.0001
AREA	5	7615.39757423	1523.07951485	988.40	0.0001
QTR	3	3159.27477519	1053.09159173	683.40	0.0001
TC2	3	6322.64153966	2107.54717989	1367.69	0.0001
DEPTH	2	3684.82265071	1842.41132535	1195.63	0.0001

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate	Retransformed Estimate
INTERCEPT		0.760997649 B	26.75	0.0001	0.02844571	
AREA	522	-0.444577000 B	-29.48	0.0001	0.01507858	0.641168
	523	-0.010785910 B	-0.53	0.5968	0.02038704	0.989478
	524	-0.735978983 B	-41.37	0.0001	0.01778914	0.479112
	525	-0.843403568 B	-36.88	0.0001	0.02286656	0.430356
	526	-1.194326116 B	-60.80	0.0001	0.01964379	0.302966
	521	0.000000000 B	.	.	.	1.000000
QTR	1	-0.057274522 B	-3.86	0.0001	0.01482597	0.944439
	3	-0.621223632 B	-41.41	0.0001	0.01500215	0.537347
	4	-0.417172723 B	-26.54	0.0001	0.01571823	0.658989
	2	0.000000000 B	.	.	.	1.000000
Tonclass	31	-0.793757151 B	-32.66	0.0001	0.02430028	0.452276
	32	-0.540370836 B	-33.92	0.0001	0.01593153	0.582606
	41	0.433927651 B	33.67	0.0001	0.01288832	1.543435
	33	0.000000000 B	.	.	.	1.000000
DEPTHCD	1	0.731465629 B	48.11	0.0001	0.01520442	2.078364
	2	0.373888353 B	24.87	0.0001	0.01503558	1.453539
	3	0.000000000 B	.	.	.	1.000000

Table 15. Georges Bank cod landings (mt), nominal and standardized effort (days fished) and landings per day fished (LPUE), USA only.

Year	USA Landings Used in GLM (mt)	Nominal		Standardized		
		Effort	LPUE	Effort	LPUE	Raised Effort[1]
1978	15776	7980	1.977	5937	2.657	10003
1979	20584	9406	2.188	7720	2.666	12244
1980	25213	10080	2.501	8525	2.958	13543
1981	18339	9089	2.018	8130	2.256	15005
1982	23289	10045	2.319	8833	2.607	15087
1983	22072	11668	1.892	10561	2.090	17587
1984	19669	14641	1.343	12632	1.557	21140
1985	18012	16447	1.095	15045	1.197	22408
1986	11572	12520	0.924	11956	0.968	18072
1987	12731	14945	0.852	13942	0.913	20846
1988	19010	17769	1.070	17099	1.112	23666
1989	15557	15834	0.983	15581	0.998	25136
1990	18358	15882	1.156	15007	1.223	23047
1991	14173	14857	0.954	15085	0.940	25730
1992	8786	13606	0.646	12989	0.676	24919
1993	7749	12958	0.598	12883	0.602	24262
1994	2126	5687	0.374	4825	0.441	22456
1995	2054	6843	0.300	6362	0.323	20930
1996	2391	6563	0.364	5986	0.400	17568
1997	2725	5282	0.516	4845	0.562	13399
1998	2525	5617	0.450	5389	0.469	14853
1999	2690	5476	0.491	4888	0.550	14647

[1] Derived as total landings/ standardized LPUE.

Table 16. Standardized stratified mean catch per tow in numbers and weight (kg) for Atlantic cod in NEFSC offshore spring and autumn research vessel bottom trawl surveys on Georges Bank (Strata 13-25), 1963 - 1999. [a,b,c]

	Spring		Autumn	
Year	No/Tow	Wt/Tow	No/Tow	Wt/Tow
1963	-	-	4.37	17.8
1964	-	-	2.98	11.6
1965	-	-	4.25	11.7
1966	-	-	4.81	8.1
1967	-	-	10.38	13.6
1968	4.72	12.6	3.30	8.6
1969	4.64	17.8	2.20	8.0
1970	4.34	15.6	5.07	12.5
1971	3.39	14.2	3.19	9.9
1972	8.97	19.0	13.09	23.0
1973	18.68 [d]	39.7 [d]	12.28	30.8
1974	14.75	36.4	3.49	8.2
1975	6.89	26.0	6.41	14.1
1976	7.06	18.6	10.44	17.7
1977	6.30	15.4	5.45	12.5
1978	12.31	31.2	8.59	23.3
1979	5.16	16.9	5.95	16.5
1980	6.12	16.7	2.91	6.7
1981	10.44	26.1	9.04	19.0
1982	8.20 [e]	15.4 [e]	3.71	6.9
1983	7.70	24.0	3.64	6.5
1984	4.08	15.4	4.75	10.3
1985	6.94	21.5	2.43	3.5
1986	5.04	16.7	3.12	4.7
1987	3.26	10.3	2.33	4.4
1988	5.86	13.5	3.11	5.8
1989	4.80	10.8	4.78	4.6
1990	4.74	11.6	3.62 [f]	7.1 [f]
1991	4.39	9.0	0.96	1.4
1992	2.67	7.5	1.84	3.1
1993	2.48	7.3	2.15	2.2
1994	0.94	1.2	1.82	3.3
1995	3.29	8.4	3.62	5.6
1996	2.70	7.5	1.10	2.7
1997	2.32	5.2	0.87	1.9
1998	4.36	11.7	1.87	2.8
1999	2.15	4.7	1.02	3.0

[a] During 1963-1984, BMV oval doors were used in 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 (NEFC 1991).

[b] Spring surveys during 1980-1982, 1989-1991 and 1994 and autumn surveys during 1977-1981, 1989-1991, and 1993 were accomplished with the R/V Delaware II; in all other years, the surveys were accomplished using the R/V Albatross IV. 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 (NEFC 1991).

[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 gear differences.

[d] Excludes unusually high catch of 1894 cod (2558 kg) at Station 230 (Strata tow 20-4).

[e] Excludes unusually high catch of 1032 cod (4096 kg) at Station 323 (Strata tow 16-7).

[f] Excludes unusually high catch of 111 cod (504 kg) at Station 205 (Strata tow 23-4).

Table 17. Parameter estimates of stock size, with coefficients of variation (CVs), fishing mortality (ages 4-8), and partial variance of the survey indices for 3 ADAPT calibrations for Georges Bank cod, 1999.

	Base Run #10		BASE w/o 5Zjm lg tow #11		Base w/o Age 1 tuning #12	
	SS	200.9	SS	198.85	SS	152.0253
	MSq Res	0.532	MSq Res	0.526	MSq Res	0.46777
Age	N	CV	N	CV	N	CV
1	5330	0.54	5200	0.53		
2	5590	0.34	4950	0.34	2890	0.5
3	1650	0.3	1380	0.3	2880	0.33
4	3430	0.32	2990	0.33	3900	0.33
5	2120	0.29	2010	0.29	2270	0.29
6	727	0.29	710	0.29	771	0.28
7	850	0.29	837	0.29	827	0.28
8	333	0.4	336	0.4	408	0.36
F 4- 8	0.22		0.22		0.20	
Age Index	Partial Var	Proportion	Partial Var	Proportion	Partial Var	Proportion
1 spr_36	0.861	0.051	0.889	0.053		
2 spr_36	0.127	0.008	0.138	0.008	0.11	0.009
3 spr_36	0.143	0.008	0.143	0.009	0.145	0.012
4 spr_36	0.25	0.015	0.251	0.015	0.243	0.02
5 spr_36	0.434	0.026	0.435	0.026	0.435	0.037
6 spr_36	0.911	0.054	0.91	0.055	0.895	0.076
7 spr_36	0.769	0.046	0.772	0.046	0.775	0.065
8 spr_36	0.534	0.032	0.537	0.032	0.522	0.044
1 spr_41	2.475	0.147	2.475	0.148		
2 spr_41	0.213	0.013	0.213	0.013	0.213	0.018
3 spr_41	0.196	0.012	0.196	0.012	0.196	0.017
4 spr_41	0.104	0.006	0.104	0.006	0.104	0.009
5 spr_41	0.201	0.012	0.201	0.012	0.202	0.017
6 spr_41	0.086	0.005	0.086	0.005	0.086	0.007
7 spr_41	0.466	0.028	0.466	0.028	0.467	0.039
8 spr_41	1.741	0.103	1.741	0.104	1.742	0.147
1 sp_can	0.794	0.047	0.767	0.046		
2 sp_can	0.242	0.014	0.283	0.017	0.251	0.021
3 sp_can	0.175	0.01	0.101	0.006	0.121	0.01
4 sp_can	0.368	0.022	0.274	0.016	0.341	0.029
5 sp_can	0.312	0.019	0.292	0.017	0.3	0.025
6 sp_can	0.657	0.039	0.639	0.038	0.655	0.055
7 sp_can	0.691	0.041	0.698	0.042	0.709	0.06
8 sp_can	0.757	0.045	0.752	0.045	0.777	0.066
1 us0aut	0.738	0.044	0.706	0.042		
2 us1aut	0.337	0.02	0.333	0.02	0.281	0.024
3 us2aut	0.491	0.029	0.498	0.03	0.5	0.042
4 us3aut	0.433	0.026	0.431	0.026	0.433	0.037
5 us4aut	0.798	0.047	0.8	0.048	0.798	0.067
6 us5aut	0.549	0.033	0.55	0.033	0.546	0.046

Table 18. Estimates of beginning year stock size (thousands of fish), instantaneous fishing mortality (F), mean biomass (mt), spawning stock biomass (mt), and percent mature of Georges Bank cod, estimated from virtual population analysis (VPA), calibrated using the commercial catch at age ADAPT formulation, 1978-1999.

Stock Numbers (Jan 1) in thousands

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	27711	23512	20109	41393	17471	9615	27391	8675	42754	16377	23456	15718	9252	17881	6880	9225	7706	4656	8803	10420	2842	6830	5329
2	4270	22686	19220	16383	33865	14004	7774	22352	6981	34863	13385	19195	12869	7568	14593	5569	7549	6308	3812	7206	8528	2327	5590
3	25527	3140	16774	12318	10514	19458	7588	5182	12486	4516	21781	9532	13827	6064	4817	8168	3625	5820	4810	2933	5432	6314	1647
4	7933	13889	1756	8460	6266	5148	8635	3115	2032	6085	2425	10574	5160	6758	2031	1980	2846	1587	3808	3121	1823	3373	3426
5	2877	4411	6965	986	4697	2608	1992	4052	1312	943	3063	1070	4898	2522	2564	723	612	679	673	2001	1758	1110	2122
6	1127	1604	2515	3614	594	2036	1181	871	1611	640	519	1153	576	1962	745	758	194	145	293	333	920	1146	727
7	1414	804	899	1085	1687	232	965	500	340	752	296	205	455	265	622	245	194	72	79	129	154	539	850
8	67	846	588	334	511	772	104	375	212	200	371	97	93	150	103	229	57	35	35	51	29	91	333
9	147	12	463	403	162	226	419	46	124	108	107	126	40	44	60	53	58	5	15	26	27	11	60
10+	55	148	27	191	187	145	293	208	76	68	99	45	89	43	18	28	9	2	1	2	18	17	19
1 +	71127	71053	69317	85167	75953	54244	56343	45375	67929	64552	65503	57714	47259	43258	32432	26979	22850	19308	22328	26222	21533	21757	20104

Fishing Mortality

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	0	0	0	0	0.02	0.01	0	0.02	0	0	0	0	0	0	0.01	0	0	0	0	0	0	0
2	0.11	0.1	0.24	0.24	0.35	0.41	0.21	0.38	0.24	0.27	0.14	0.13	0.55	0.25	0.38	0.23	0.06	0.07	0.06	0.08	0.1	0.15
3	0.41	0.38	0.48	0.48	0.51	0.61	0.69	0.74	0.52	0.42	0.52	0.41	0.52	0.89	0.69	0.85	0.63	0.22	0.23	0.28	0.28	0.41
4	0.39	0.49	0.38	0.39	0.68	0.75	0.56	0.66	0.57	0.49	0.62	0.57	0.52	0.77	0.83	0.97	1.23	0.66	0.44	0.37	0.3	0.26
5	0.38	0.36	0.46	0.31	0.64	0.59	0.63	0.72	0.52	0.4	0.78	0.42	0.72	1.02	1.02	1.12	1.24	0.64	0.5	0.58	0.23	0.22
6	0.14	0.38	0.64	0.56	0.74	0.55	0.66	0.74	0.56	0.57	0.73	0.73	0.58	0.95	0.91	1.16	0.79	0.41	0.62	0.57	0.34	0.1
7	0.31	0.11	0.79	0.55	0.58	0.6	0.74	0.66	0.33	0.51	0.92	0.59	0.91	0.75	0.8	1.27	1.52	0.51	0.24	1.28	0.33	0.28
8	1.49	0.4	0.18	0.52	0.62	0.41	0.63	0.91	0.47	0.43	0.88	0.68	0.56	0.72	0.46	1.17	2.3	0.65	0.1	0.43	0.75	0.22
9	0.36	0.44	0.51	0.44	0.66	0.67	0.6	0.71	0.54	0.49	0.73	0.58	0.63	0.87	0.94	1.09	1.27	0.64	0.46	0.47	0.28	0.22
10+	0.36	0.44	0.51	0.44	0.66	0.67	0.6	0.71	0.54	0.49	0.73	0.58	0.63	0.87	0.94	1.09	1.27	0.64	0.46	0.47	0.28	0.22
mn4-8,u	0.54	0.35	0.49	0.47	0.65	0.58	0.64	0.74	0.49	0.48	0.79	0.60	0.65	0.84	0.80	1.14	1.42	0.57	0.38	0.65	0.39	0.22
Fwb	0.31	0.29	0.39	0.32	0.47	0.52	0.41	0.53	0.29	0.33	0.42	0.35	0.53	0.55	0.57	0.64	0.5	0.26	0.25	0.26	0.22	0.23

Table 18 continued. Estimates of beginning year stock size (thousands of fish), instantaneous fishing mortality (F), mean biomass (mt), spawning stock biomass (mt), and percent mature of Georges Bank cod, estimated from virtual population analysis (VPA), calibrated using the commercial catch at age ADAPT formulation, 1978-1999.

Mean biomass (mt)

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	17756	18930	15201	33078	11990	8411	26100	7072	35928	10767	16706	11525	6965	18026	7119	7289	6327	3823	7037	9008	1492	5137
2	4816	29255	22650	19782	36452	15601	10449	24026	8347	41188	17252	26461	14109	9907	17073	6946	9698	8127	5054	9900	10923	3079
3	47057	5118	29978	21113	20017	31667	12313	7020	21792	8390	36585	16164	24310	9394	7862	11373	5349	9937	9507	5419	9947	10500
4	20817	42243	4894	21840	16000	10999	21921	8106	5192	18433	5814	27821	12978	14801	4867	3884	5528	4082	9512	8386	5027	9319
5	9449	16495	28841	4033	17037	8352	6889	13464	5247	4126	10558	4304	15698	6951	6973	1999	1557	2522	2375	5708	6772	4427
6	5533	8742	11357	18264	2510	9170	5214	3621	8109	3448	2246	5023	2536	6869	2768	2640	916	800	1323	1398	4228	6364
7	8154	6341	4785	6532	10957	1273	5563	2718	2353	4828	1564	1165	2326	1267	2954	965	742	553	533	541	981	3141
8	275	6555	4453	2347	3458	5943	717	2321	1538	1487	2266	691	697	1034	741	1151	195	273	259	326	163	721
9	1326	107	2801	4217	1355	1693	3264	341	1107	894	774	1020	345	260	431	290	296	33	140	227	273	113
10+	553	1376	303	2611	2091	1408	3101	1839	751	735	986	533	880	407	202	206	79	23	5	19	209	191
Total	115735	135163	125263	133817	121867	94516	95531	70527	90365	94297	94751	94707	80844	68916	50990	36742	30687	30172	35744	40933	40013	42991

SSB at the start of the spawning season - males and females (mt)

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	912	1104	850	1962	1200	902	3122	773	8516	2226	3481	2482	638	1964	791	722	106	63	112	1002	126	622
2	1411	7540	6911	5784	16138	6347	4303	11650	5032	25333	8898	13723	6629	4245	9031	3577	3180	2713	1662	4620	5497	1192
3	33839	3730	22412	15924	15649	26066	10500	6879	18778	7106	32841	14541	22033	9069	7483	11494	5473	9005	8047	4662	8793	9526
4	20179	38255	4300	21375	15792	12655	21656	8076	4842	17024	6137	27191	12817	16519	5296	4619	6431	3965	9113	8318	4783	8801
5	8796	16541	30441	3962	17468	9636	7118	14908	5434	3936	12375	4200	18065	8434	8395	2538	1926	2644	2597	6554	6695	4279
6	4892	8127	12487	20325	2961	10514	5653	4252	8584	3704	2763	5937	2959	8694	3355	3310	1000	779	1541	1593	4152	6013
7	8094	5563	5914	7240	12174	1464	6221	3163	2355	5364	2024	1326	2844	1548	3501	1303	1041	572	575	734	991	3282
8	366	6672	5047	2693	4108	6842	815	2980	1702	1701	2932	811	769	1217	786	1518	313	291	321	389	209	756
9	1339	111	3841	4111	1557	2059	3958	420	1245	1030	965	1193	408	372	557	420	432	40	163	236	262	109
10+	657	1674	376	3178	2704	1825	3942	2407	941	907	1296	673	1127	554	281	296	117	30	6	24	242	217
Total	80485	89318	92581	86552	89751	78311	67288	55509	57430	68331	73713	72077	68289	52617	39476	29798	20019	20102	24138	28131	31750	34796

Percent Mature (females)

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	7	7	7	7	13	13	13	13	28	28	28	28	12	12	12	12	2	2	2	13	13	13
2	34	34	34	34	47	47	47	47	67	67	67	67	52	52	52	52	39	39	39	57	57	57
3	78	78	78	78	84	84	84	84	91	91	91	91	90	90	90	90	95	95	95	92	92	92
4	96	96	96	96	97	97	97	97	98	98	98	98	99	99	99	99	100	100	100	100	100	100
5-10+	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Table 19. Yield and SSB per Recruit results for Georges Bank cod from O'Brien and Cadrin (1999).

```
   The NEFC Yield and Stock Size per Recruit Program - PDBYPRC
    PC Ver.1.2 [Method of Thompson and Bell (1934)] 1-Jan-1992
              ---------------------------------------
              Run Date:  7- 4-1998;  Time: 17:28:09.47  Cod Georges Bank - 1998

Proportion of F before spawning:  .1667
Proportion of M before spawning:  .1667
Natural Mortality is Constant at:  .200
Initial age is:  1; Last age is: 10
Last age is a PLUS group;
Original age-specific PRs, Mats, and Mean Wts from file: ==> GBYPR10P.DAT
```

Age-specific Input data for Yield per Recruit Analysis

Age	Fish Mort Pattern	Nat Mort Pattern	Proportion Mature	Average Weights Catch	Stock
1	.0001	1.0000	.0400	.914	.711
2	.1700	1.0000	.4400	1.518	1.167
3	.6600	1.0000	.9300	2.283	1.837
4	1.0000	1.0000	1.0000	3.583	2.826
5	1.0000	1.0000	1.0000	4.835	4.182
6	1.0000	1.0000	1.0000	6.675	5.808
7	1.0000	1.0000	1.0000	9.044	8.028
8	1.0000	1.0000	1.0000	9.562	9.218
9	1.0000	1.0000	1.0000	11.712	10.700
10+	1.0000	1.0000	1.0000	13.250	13.250

Summary of Yield per Recruit Analysis for: Cod Georges Bank - 1998

```
 Slope of the Yield/Recruit Curve at F=0.00: -->   24.7823
   F level at slope=1/10 of the above slope (F0.1): ----->    .175
     Yield/Recruit corresponding to F0.1: ----->    1.6614
   F level to produce Maximum Yield/Recruit (Fmax): ----->    .340
     Yield/Recruit corresponding to Fmax: ----->    1.8051
   F level at 20 % of Max Spawning Potential (F20): ----->    .406
     SSB/Recruit corresponding to F20: -------->    5.0472
```

Listing of Yield per Recruit Results for:
Cod Georges Bank - 1998

	FMORT	TOTCTHN	TOTCTHW	TOTSTKN	TOTSTKW	SPNSTKN	SPNSTKW	% MSP
	.000	.00000	.00000	5.5167	27.3986	3.9184	25.2391	100.00
	.050	.13115	.89059	4.8636	20.3778	3.2642	18.3023	72.52
	.100	.21908	1.34762	4.4265	16.0044	2.8262	13.9970	55.46
	.150	.28229	1.58847	4.1130	13.0878	2.5116	11.1361	44.12
F0.1	.175	.30759	1.66141	3.9877	11.9857	2.3858	10.0580	39.85
	.200	.33004	1.71408	3.8766	11.0438	2.2743	9.1382	36.21
	.250	.36748	1.77563	3.6918	9.5555	2.0886	7.6881	30.46
	.300	.39770	1.80069	3.5430	8.4381	1.9389	6.6026	26.16
Fmax	.340	.41785	1.80513	3.4440	7.7381	1.8392	5.9243	23.47
	.350	.42265	1.80475	3.4205	7.5772	1.8155	5.7687	22.86
	.400	.44364	1.79678	3.3176	6.8995	1.7119	5.1139	20.26
F20%	.406	.44587	1.79535	3.3068	6.8304	1.7009	5.0472	20.00
	.450	.46159	1.78208	3.2299	6.3559	1.6234	4.5898	18.19
	.500	.47715	1.76384	3.1542	5.9126	1.5469	4.1633	16.50
	.550	.49077	1.74397	3.0880	5.5458	1.4800	3.8111	15.10
	.600	.50284	1.72364	3.0296	5.2382	1.4209	3.5163	13.93
	.650	.51360	1.70352	2.9776	4.9774	1.3683	3.2667	12.94
	.700	.52329	1.68402	2.9310	4.7539	1.3210	3.0531	12.10
	.750	.53206	1.66535	2.8889	4.5605	1.2783	2.8684	11.36
	.800	.54006	1.64762	2.8506	4.3918	1.2395	2.7074	10.73
	.850	.54738	1.63085	2.8156	4.2433	1.2040	2.5660	10.17
	.900	.55412	1.61504	2.7835	4.1118	1.1713	2.4408	9.67
	.950	.56036	1.60016	2.7539	3.9945	1.1412	2.3292	9.23
	1.000	.56615	1.58616	2.7265	3.8892	1.1133	2.2291	8.83

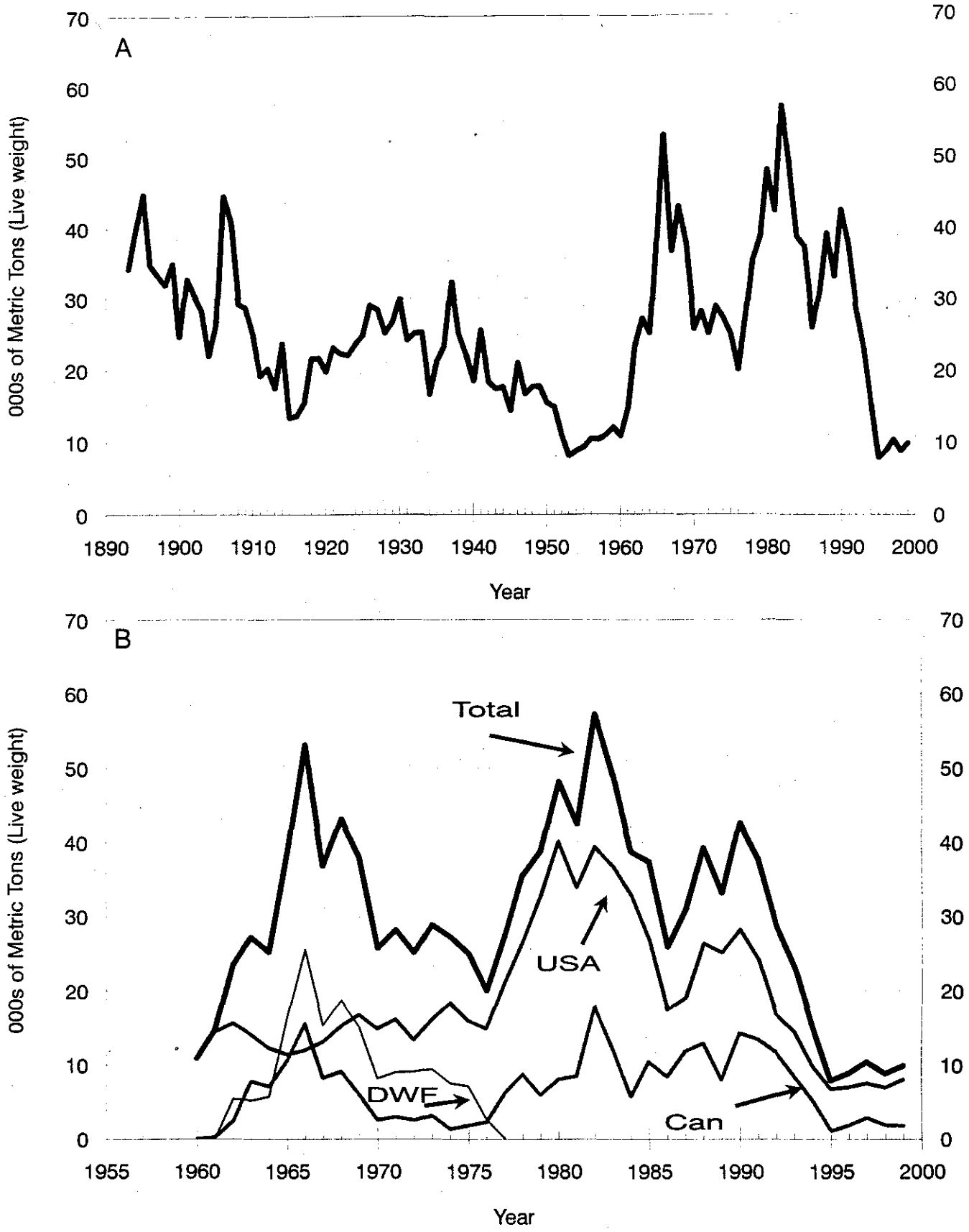

Figure 1. Total commercial landings of Georges Bank cod (Division 5Z and Subarea 6), 1893-1999 (Panel A) and total commercial landings of Georges Bank cod by country, 1960-1999 (Panel B).

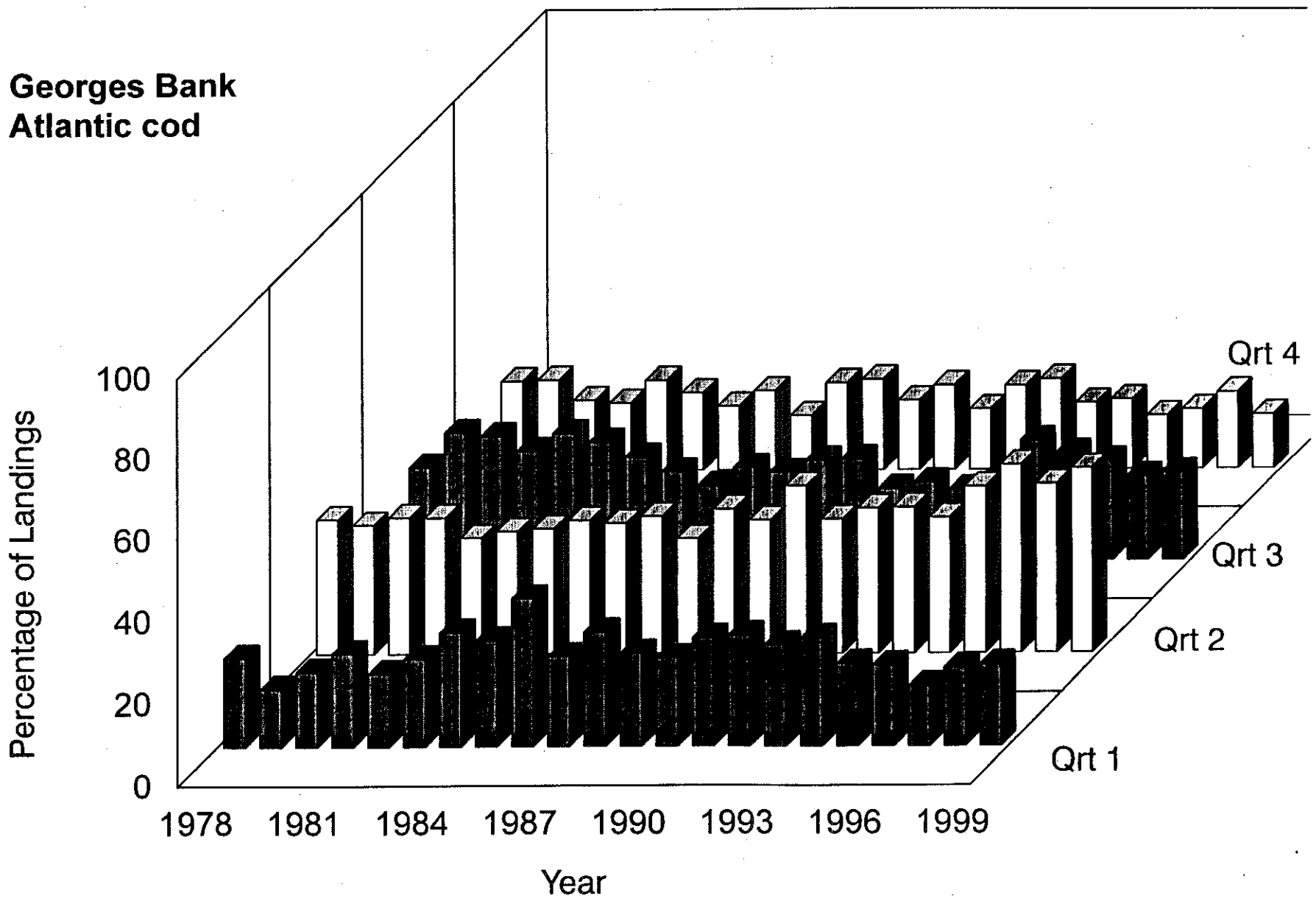

Figure 2. USA commercial landings of Georges Bank cod (Division 5Z and Subarea 6) by quarter, 1978-1999.

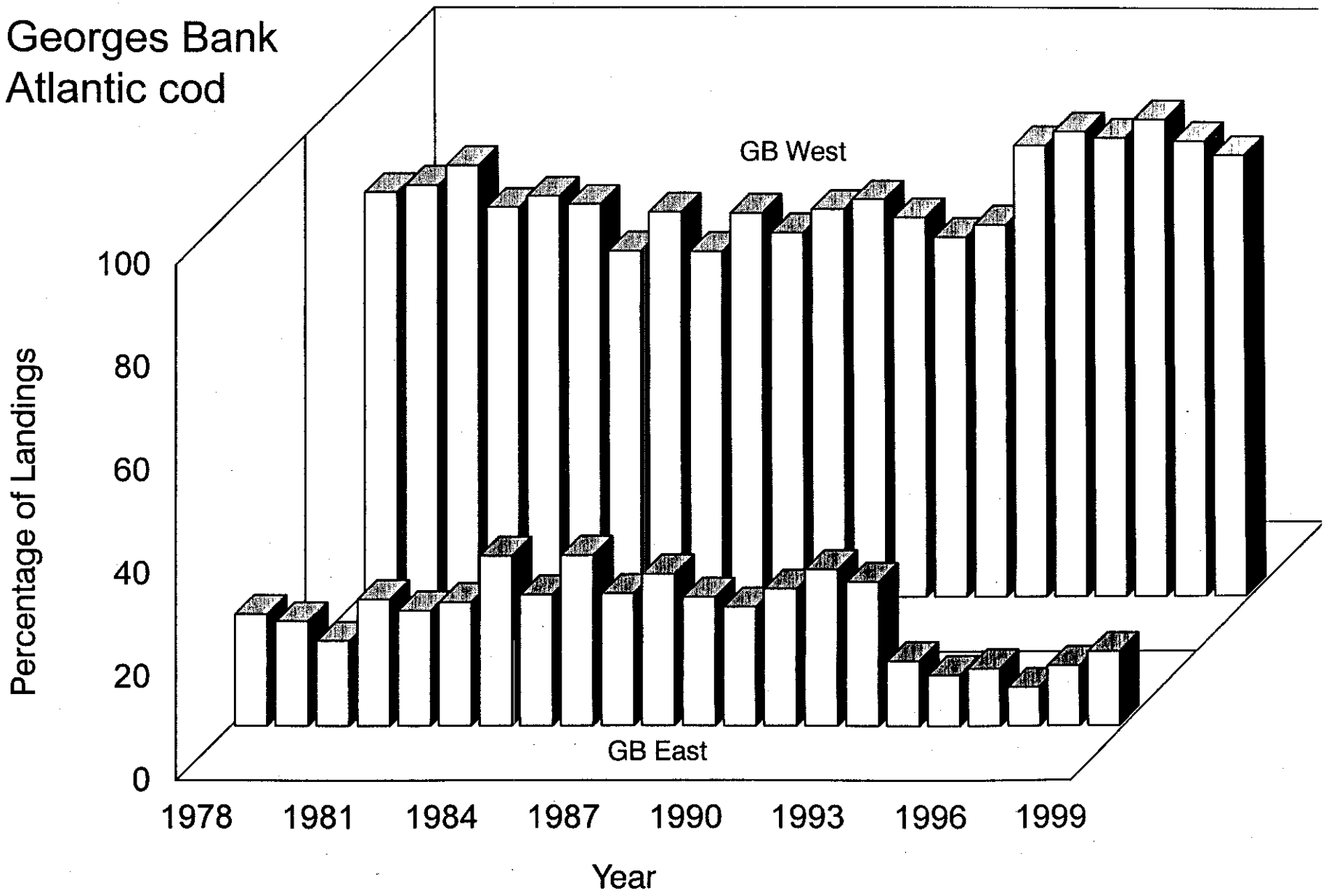

Figure 3. USA commercial landings of Georges Bank cod (Division 5Z and Subarea 6) for Eastern Georges Bank (SA 561-562) and Western Georges Bank (SA 521-522,525-526, 537-539, and Subarea 6), 1978-1999.

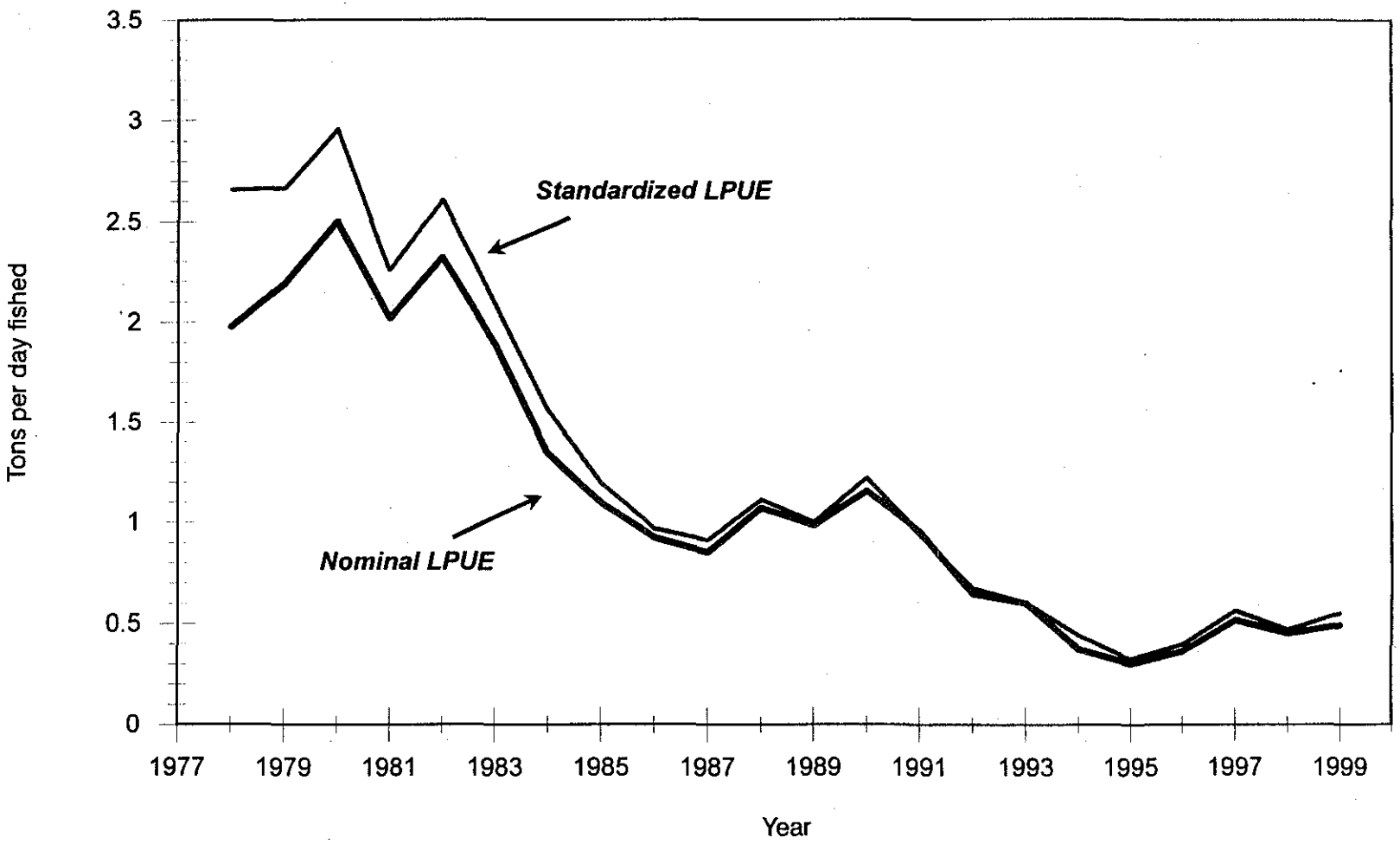

Figure 4. Trends in USA LPUE (landings per day fished) of Georges Bank cod, 1978-1999. Nominal LPUE is based on all otter trawl trips landing cod. Standardized LPUE is derived from a GLM incorporating year, tonnage class, area, quarter, and depth from 1978-1993.

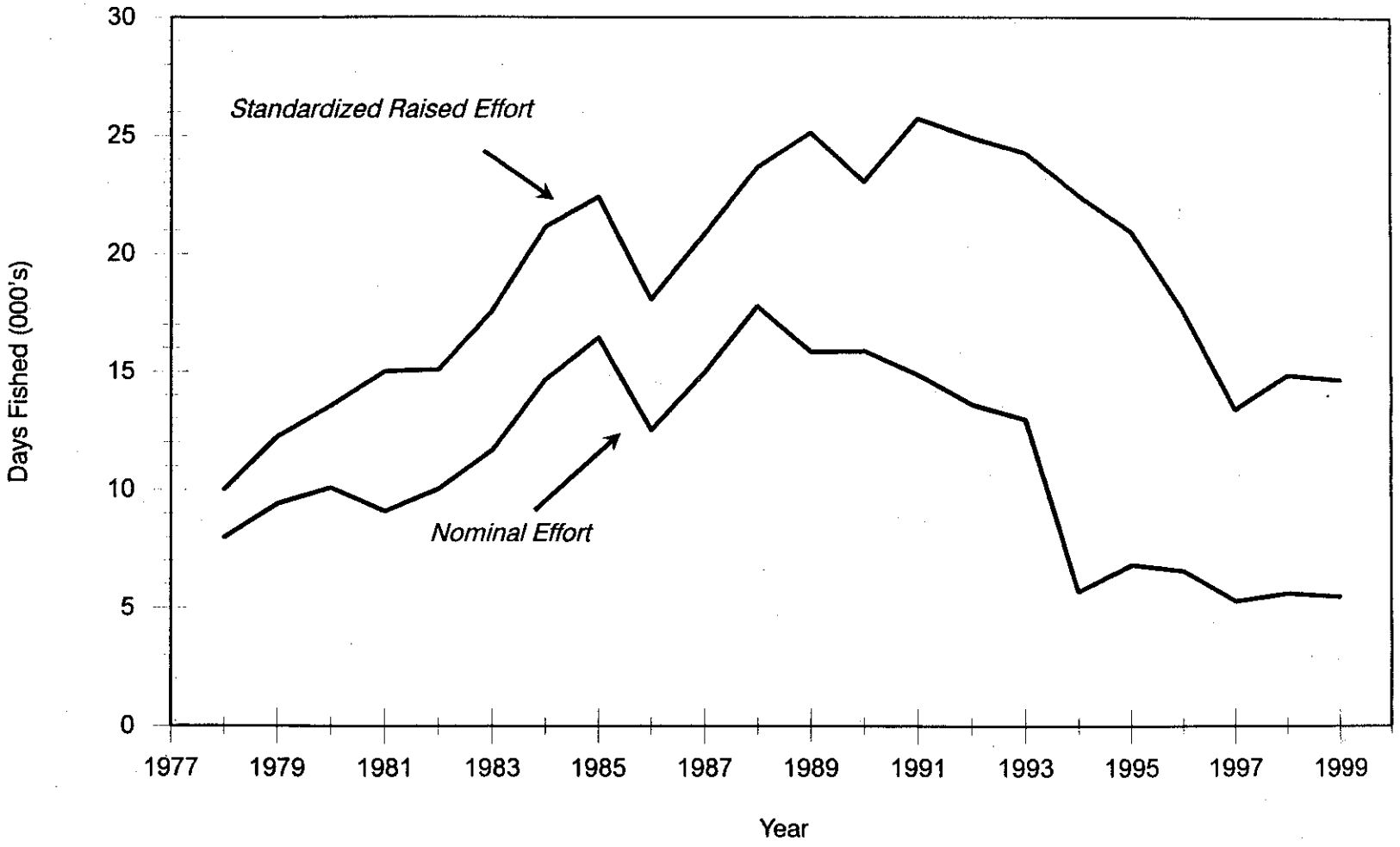

Figure 5. Trends in USA fishing effort (days fished) on Georges Bank, 1978-1999. Nominal effort based on all otter trawl trips landing cod. Standardized-raised effort derived from a GLM incorporating year, tonnage class, area, quarter, and depth.

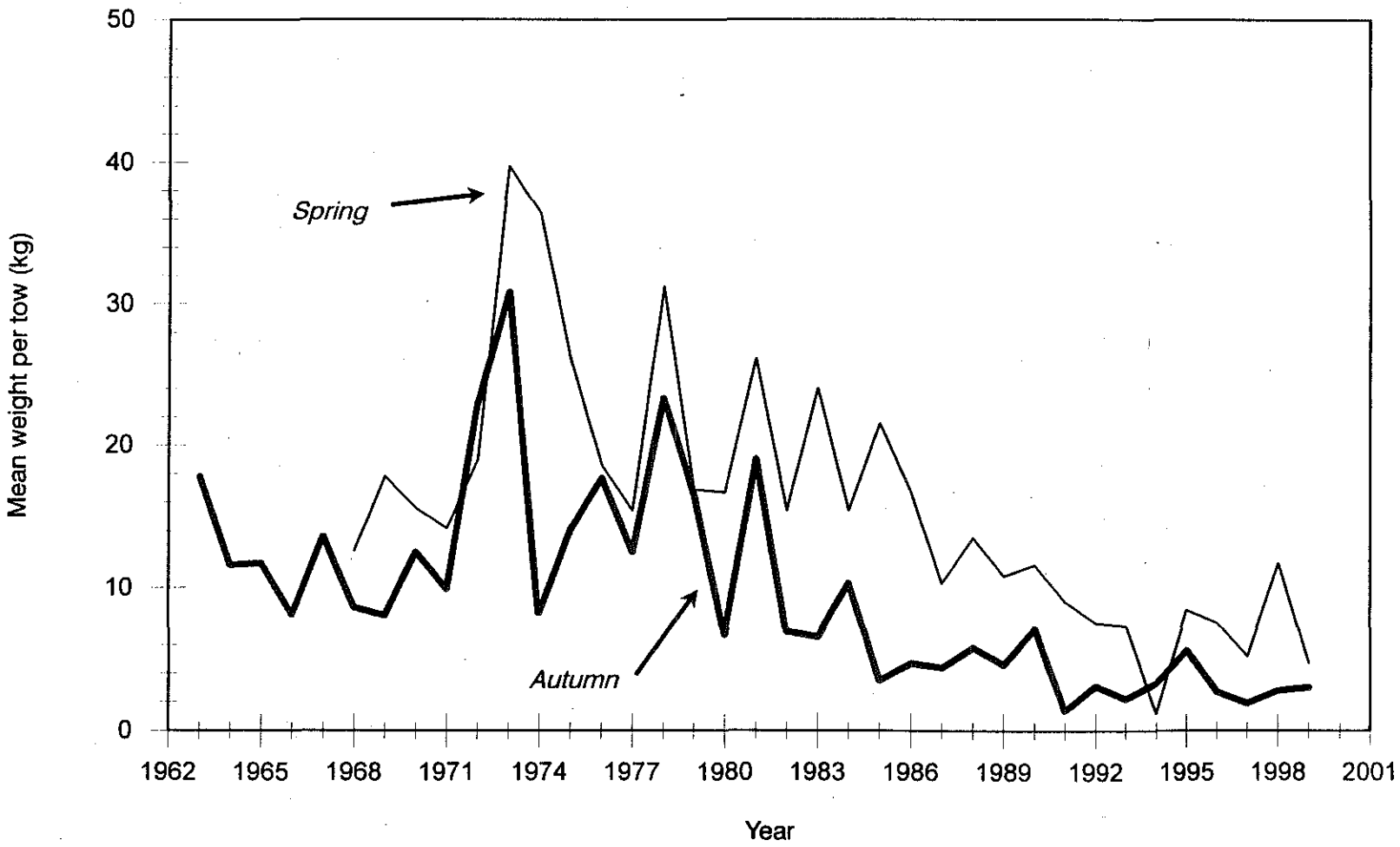

Figure 6. Standardized stratified mean catch per tow (kg) of Atlantic cod in NEFSC spring and autumn research vessel bottom trawl surveys on Georges Bank, 1963-1999.

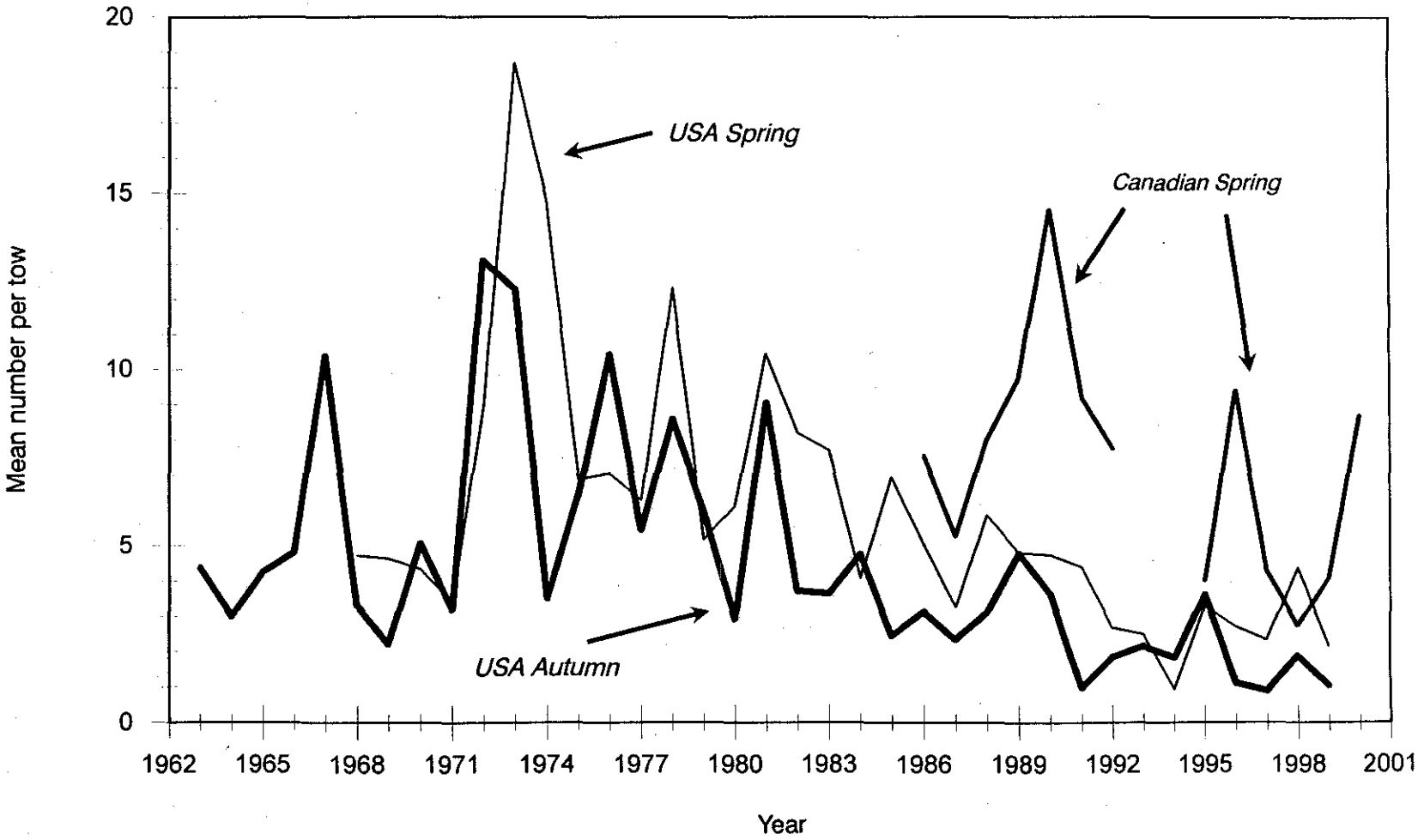

Figure 7. Standardized stratified mean number per tow of Atlantic cod in NEFSC spring and autumn research vessel bottom trawl surveys, 1963 -1999, and Candian spring research vessel bottom trawl surveys, 1986-1992 and 1994-2000, on Georges Bank.

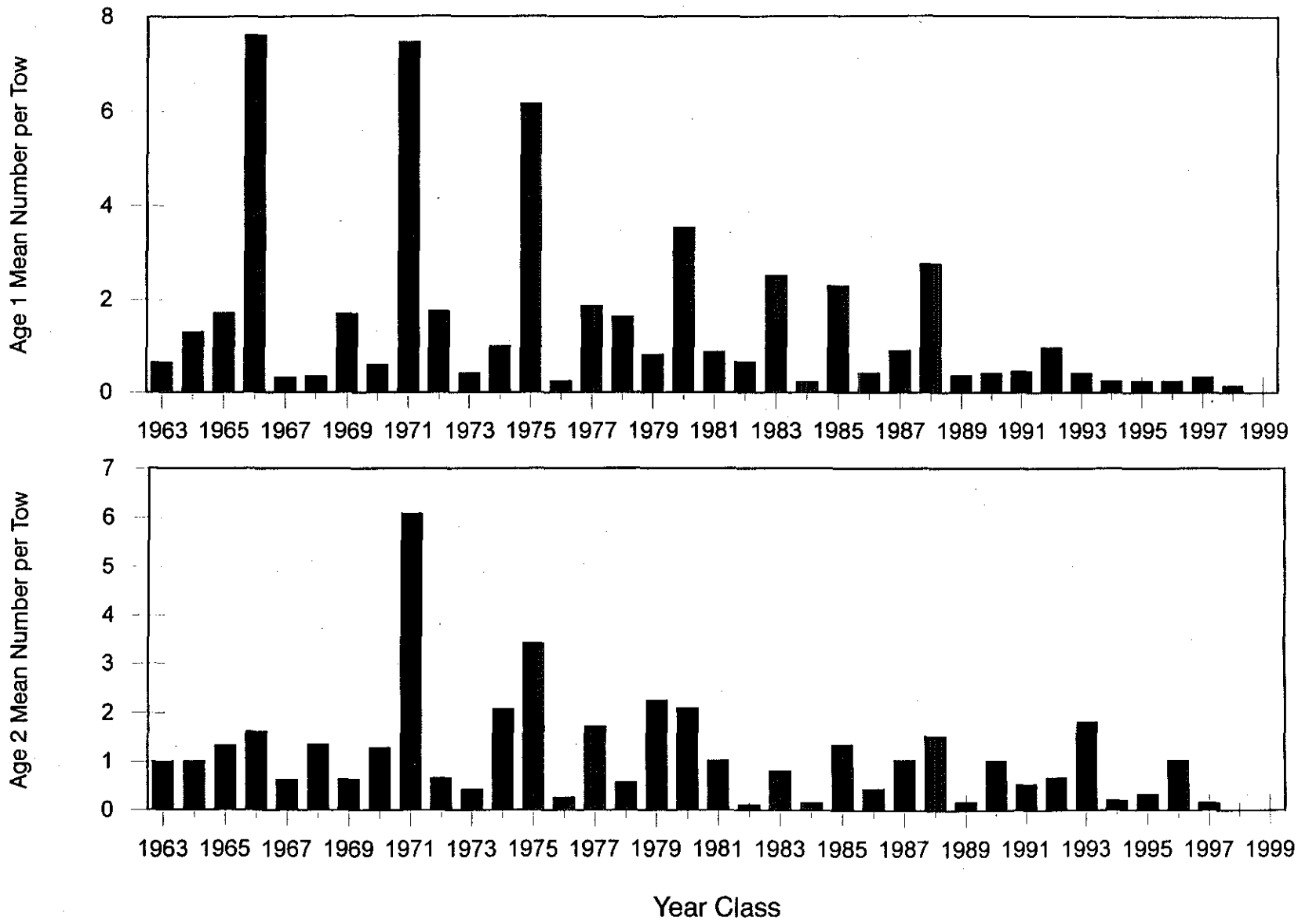

Figure 8. Relative year class strengths of Georges Bank cod age 1 and age 2 based on standardized catch (number) per tow indices from NEFSC autumn research vessel bottom trawl surveys, 1963-1999.

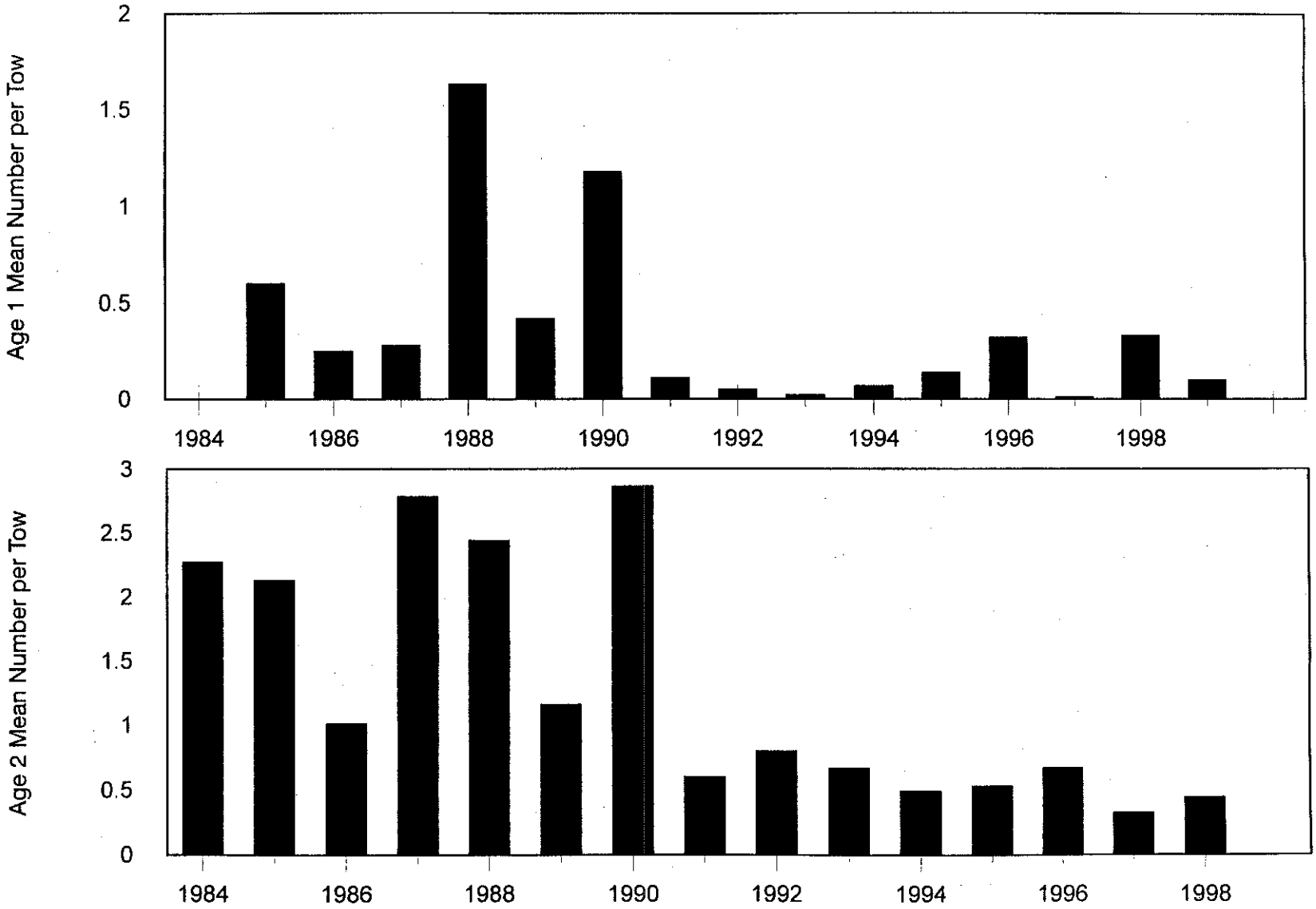

Figure 9. Relative year class strengths of Georges Bank cod age 1 and age 2 based on standardized catch (number) per tow indices from Canadian spring research vessel bottom trawl surveys, 1986-2000.

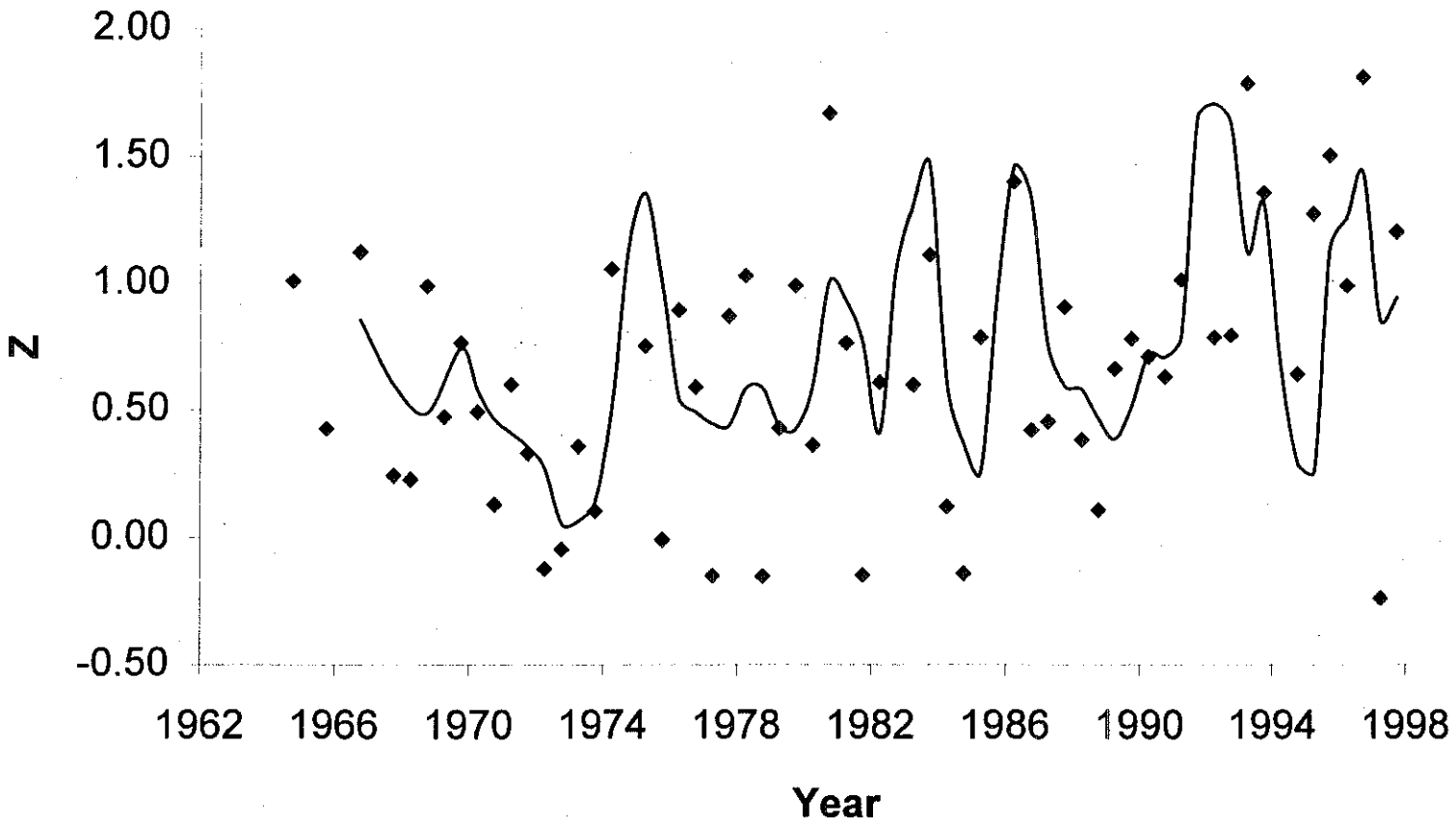

Figure 10. Estimates of instantaneous fishing mortality (Z) dervived from spring and autumn research surveys and fit with a 3-year moving average over the time series, for Georges Bank cod, 1963-1999.

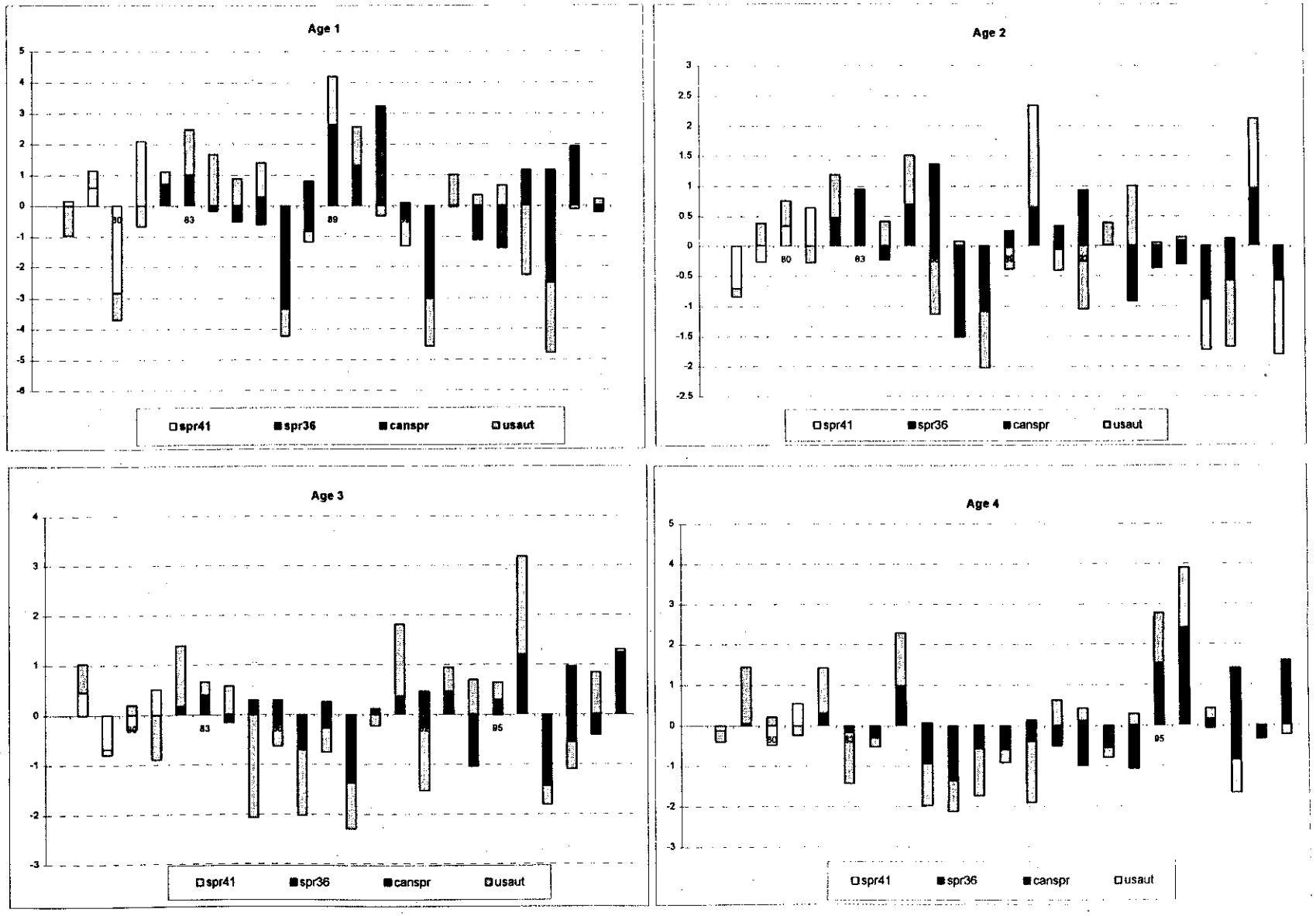

Figure 11. Residual plots (observed-predicted) for ages 1-8 for the USA spring #41 Yankee (1978-1981) and #36 Yankee (1982-1999) and Canadian spring (1986-2000) abundance indices, and ages 1-6 for the USA autumn (1978-1999) research survey indices.

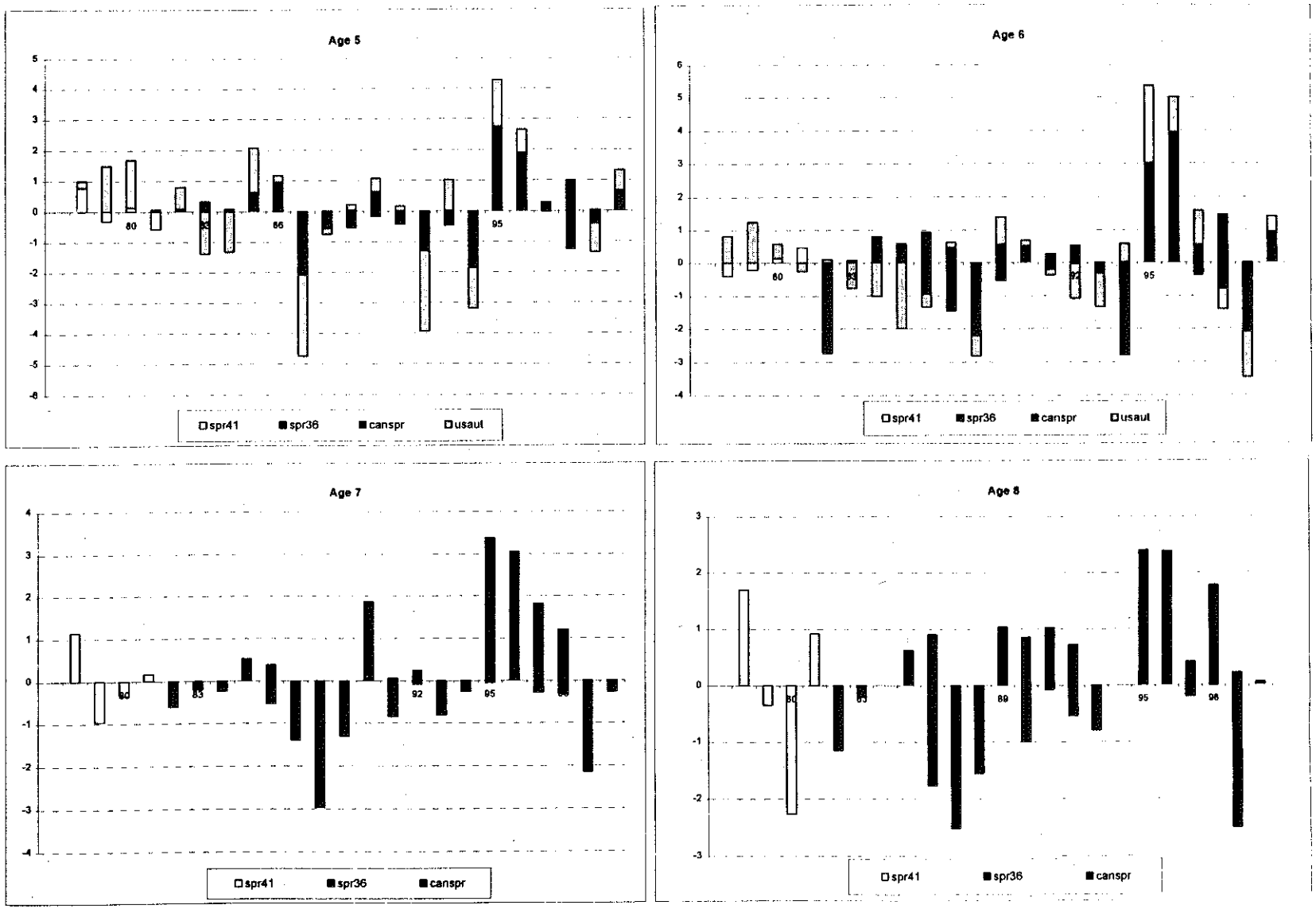

Figure 11 continued. Residual plots (observed-predicted) for ages 1-8 for the USA spring #41 Yankee (1978-1981) and #36 Yankee (1982-1999) and Canadian spring (1986-2000) abundance indices, and ages 1-6 for the USA autumn (1978-1999) research survey indices.

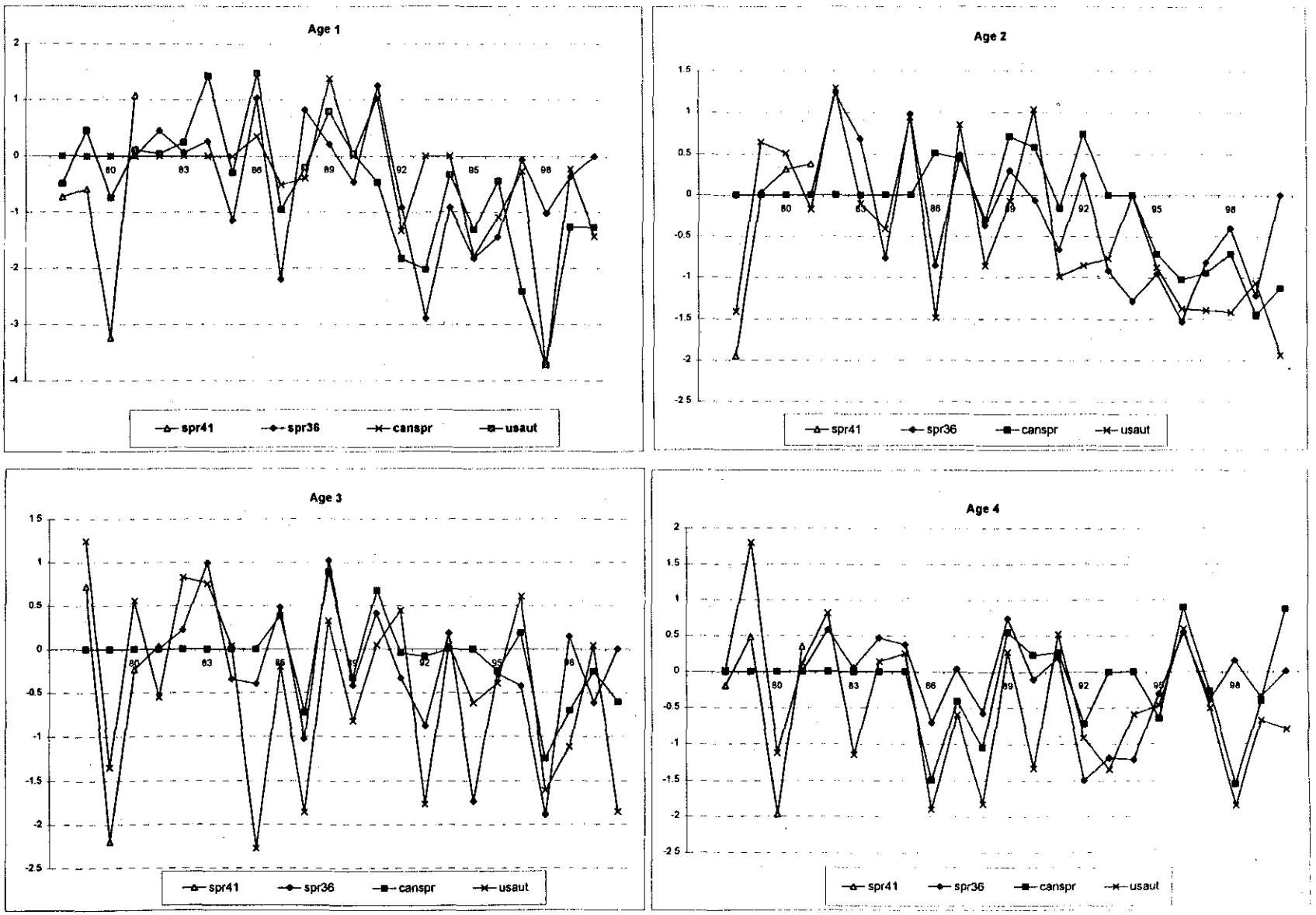

Figure 12. Scaled observed indices (ln[index/mean]) for ages 1-8 for the USA #41 Yankee (1978-1981), #36 Yankee (1982-1999), and Canadian spring (1986-2000) surveys and ages 1-6 for the USA autumn (1963-1999) survey.

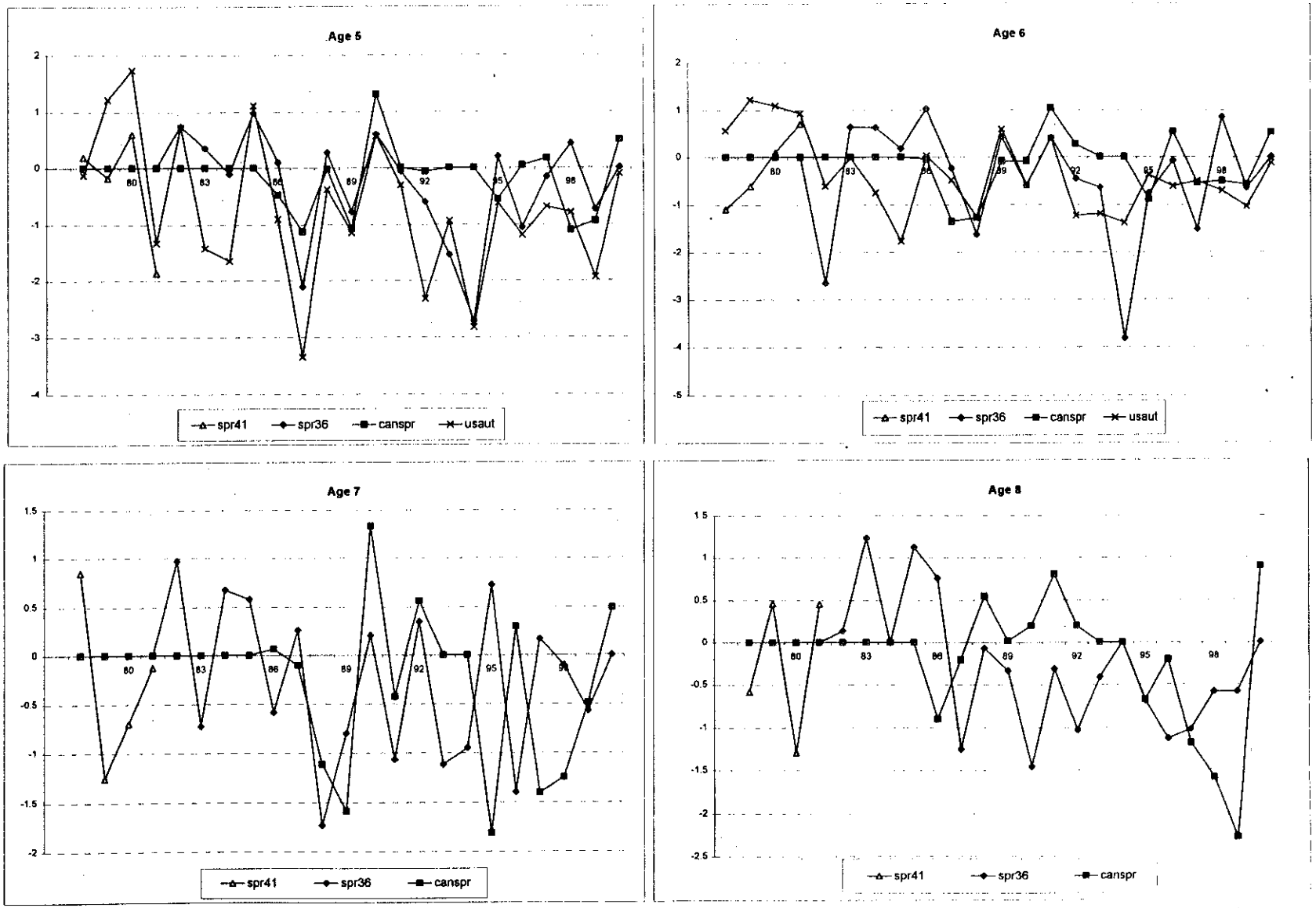

Figure 12 continued. Scaled observed indices (ln[index/mean]) for ages 1-8 for the USA #41 Yankee (1978-1981), #36 Yankee (1982-1999), and Canadian (1986-2000) spring surveys and ages 1-6 for the USA autumn (1963-1999) survey.

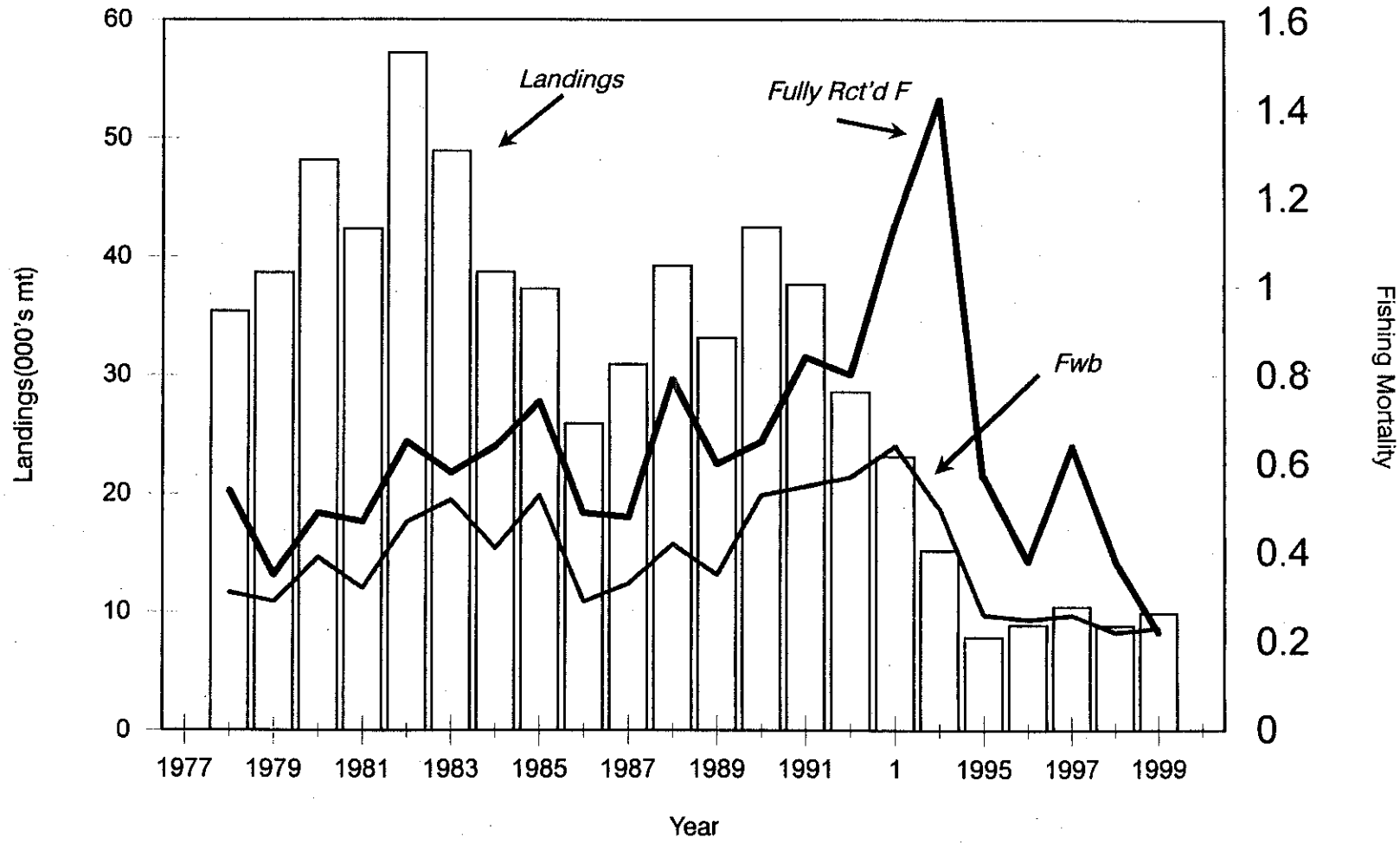

Figure 13. Trends in total commercial landings and fishing mortality for Georges Bank cod, 1978-1999.

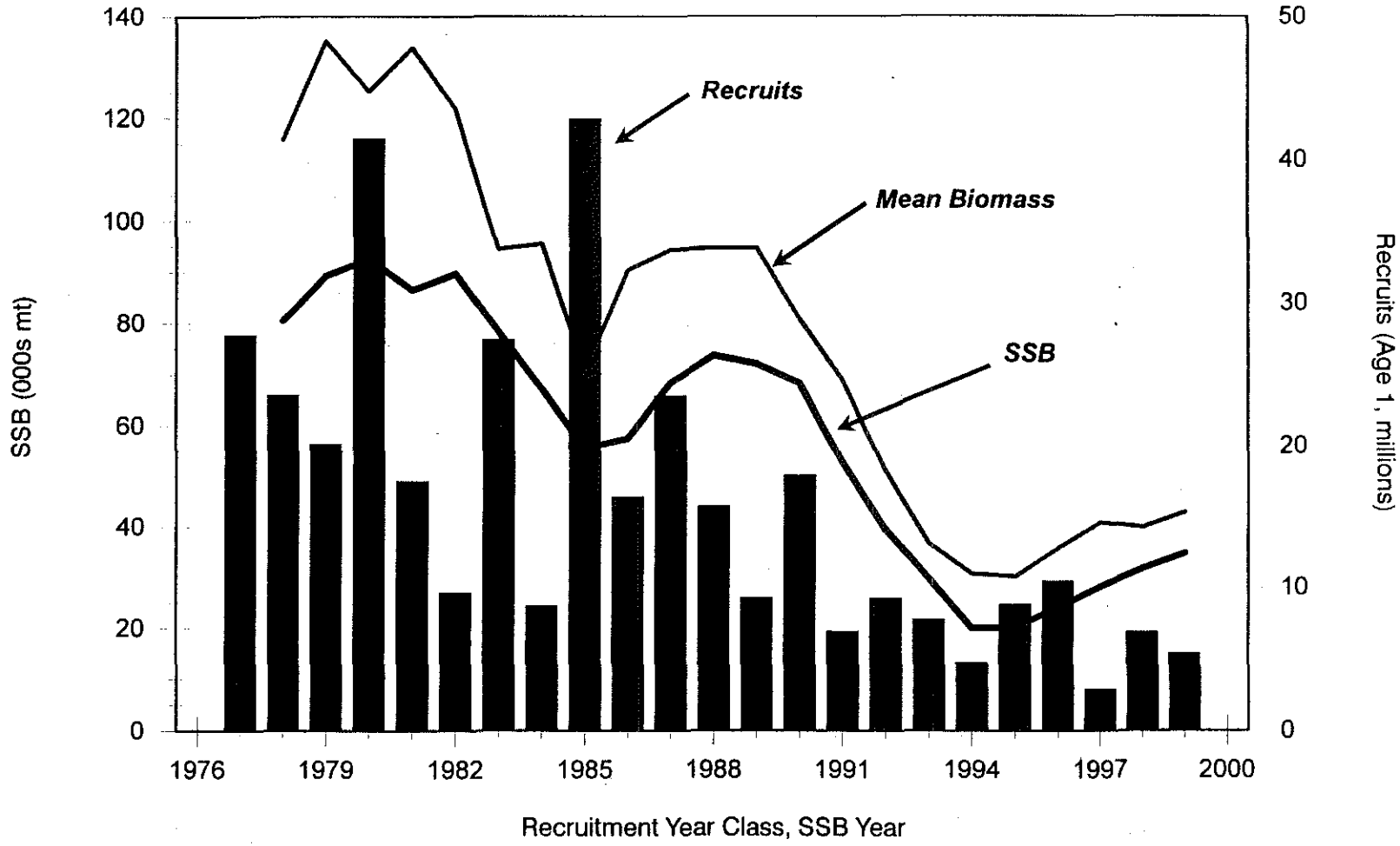

Figure 14. Trends in spawning stock biomass and recruitment for Georges Bank cod, 1978-1999.

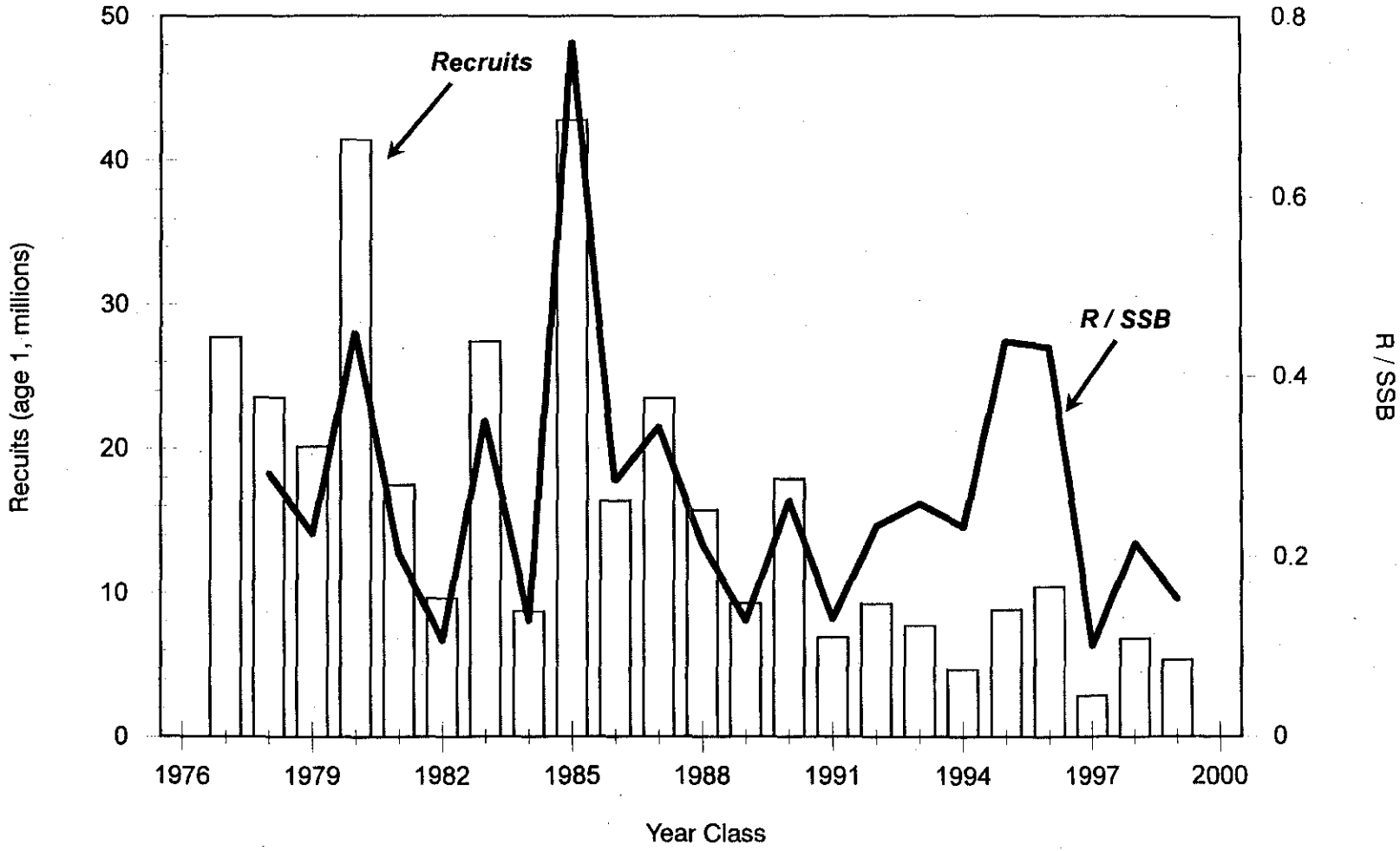

Figure 15. Trends in recruitment and recruitment/ SSB survival ratio for Georges Bank cod, 1978-1999.

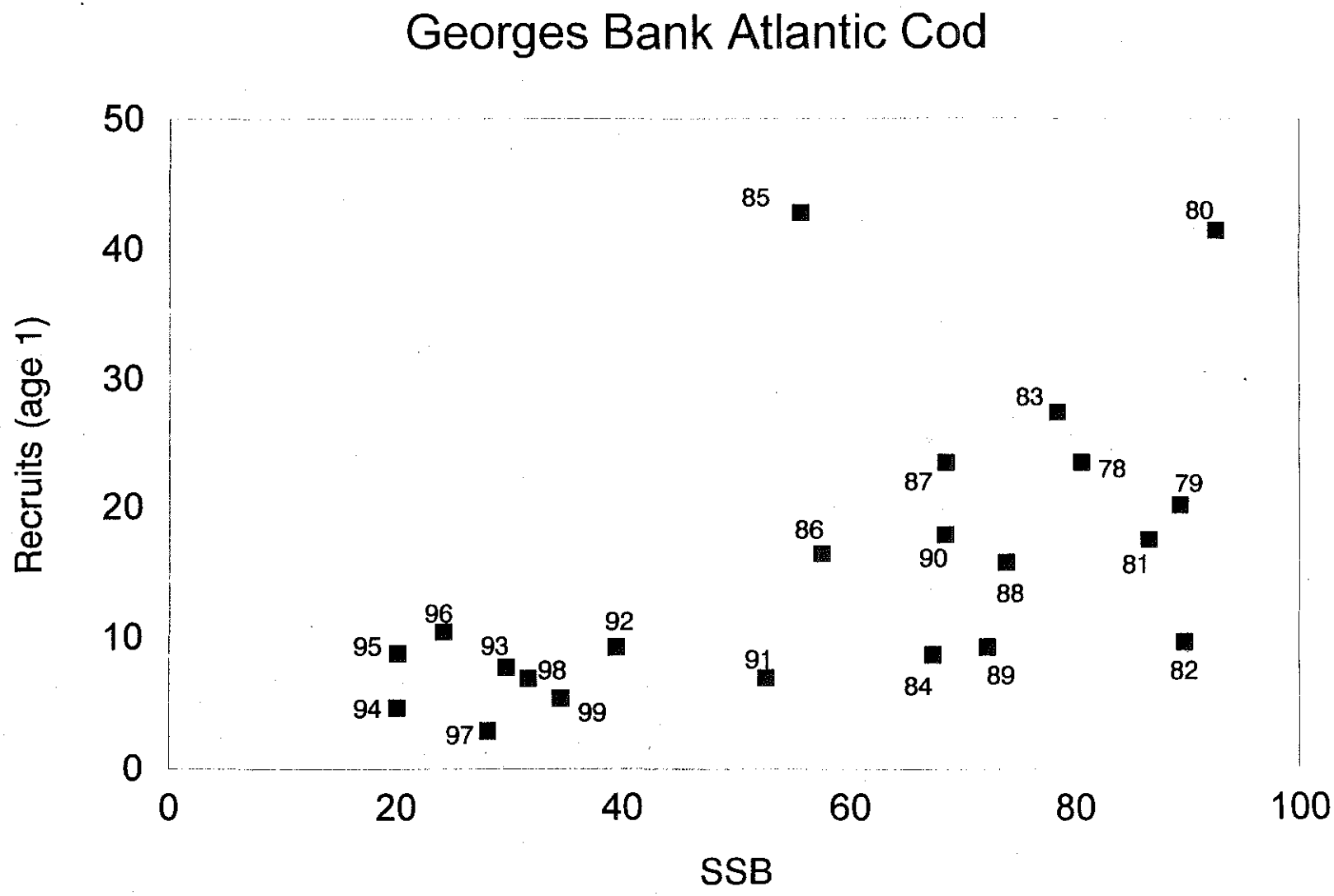

Figure 16. Spawning stock and recruits at age 1 for Georges Bank Atlantic cod, 1978-1999.

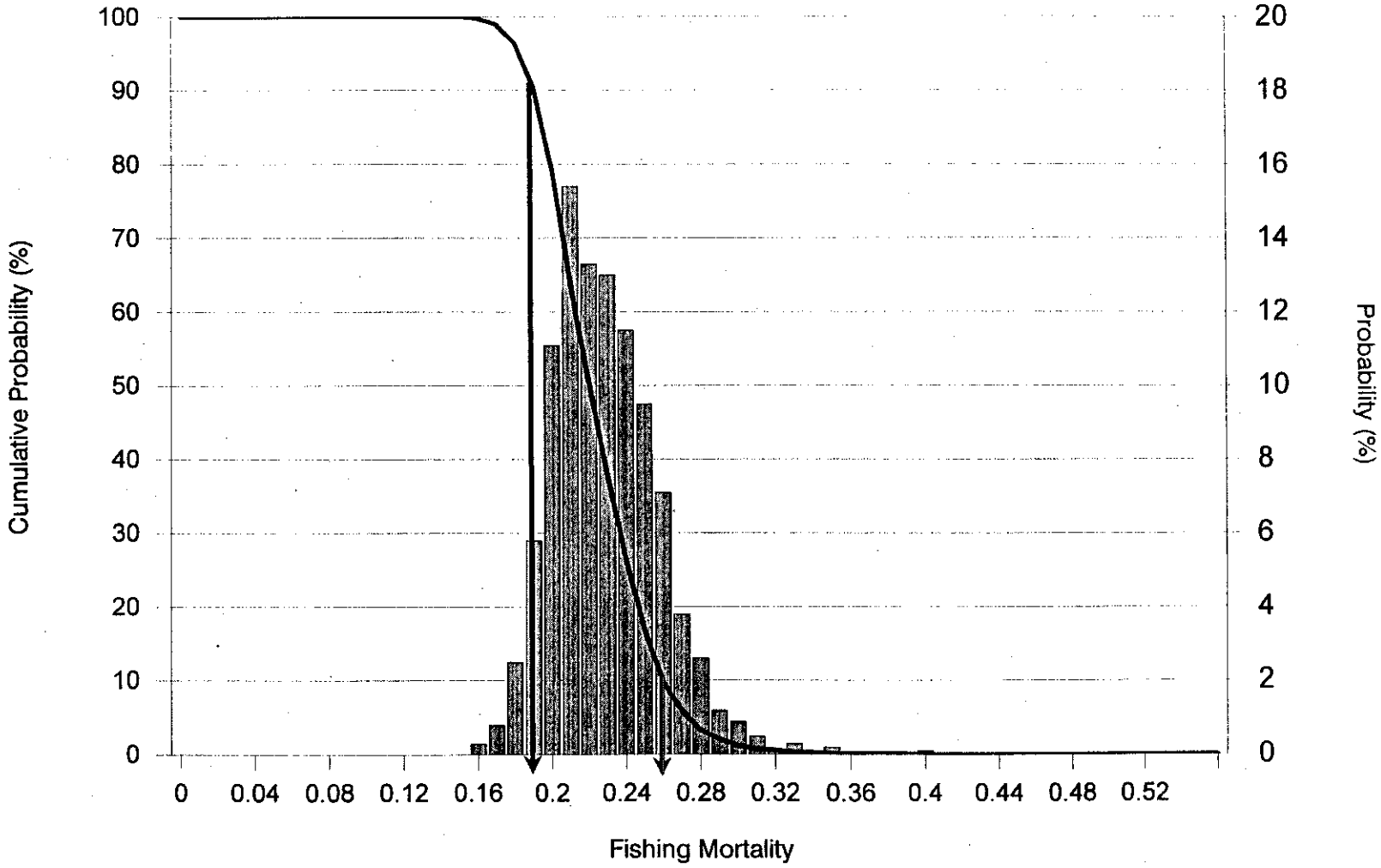

Figure 17. Precision of the estimates of the instantaneous rate of fishing (F) on the fully recruited ages (4+) in 1999 for Georges Bank cod. The bar height indicates the probability of values within that range. The solid line gives the probability that F is greater than any selected value on the X-axis.

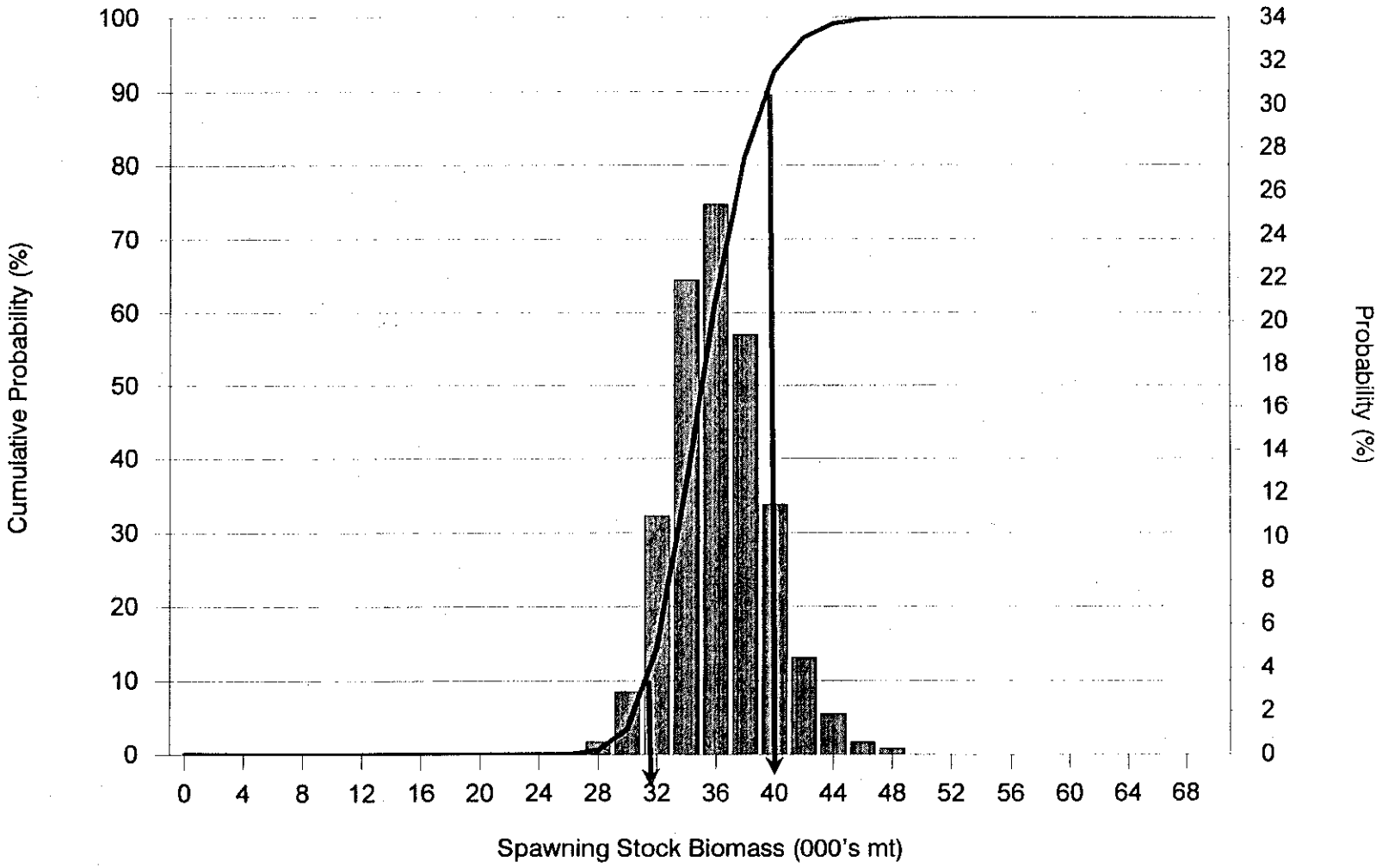

Figure 18. Precision of the estimates of spawning stock biomass (SSB) at the beginning of the spawning season for Georges Bank cod, 1999. The bar height indicates the probability of values within that range. The solid line gives the probability that SSB is less than any selected value on the X-axis.

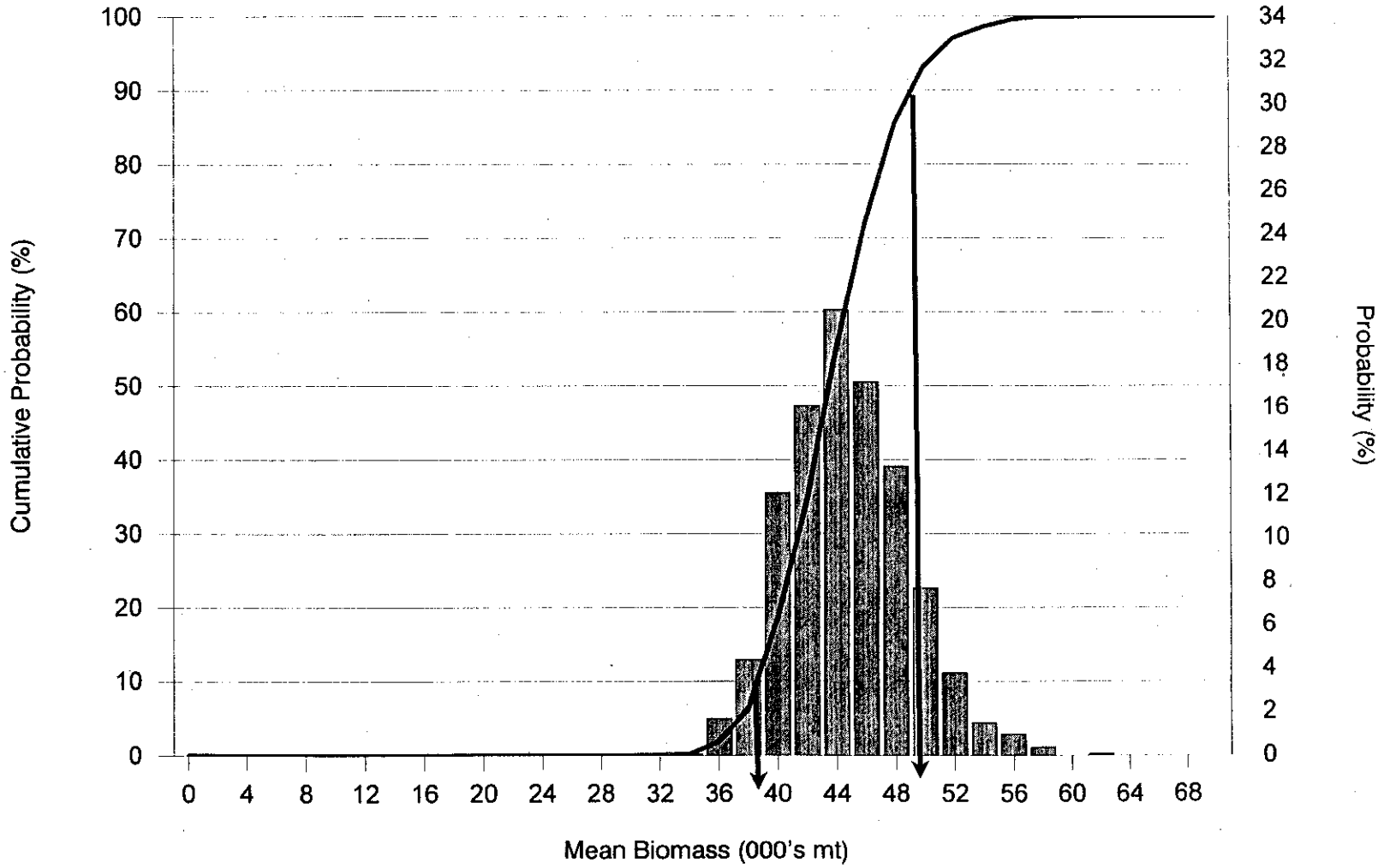

Figure 19. Precision of the estimates of mean stock biomass for Georges Bank cod, 1999. The bar height indicates the probability of values within that range. The solid line gives the probability that mean biomass is less than any selected value on the X-axis.

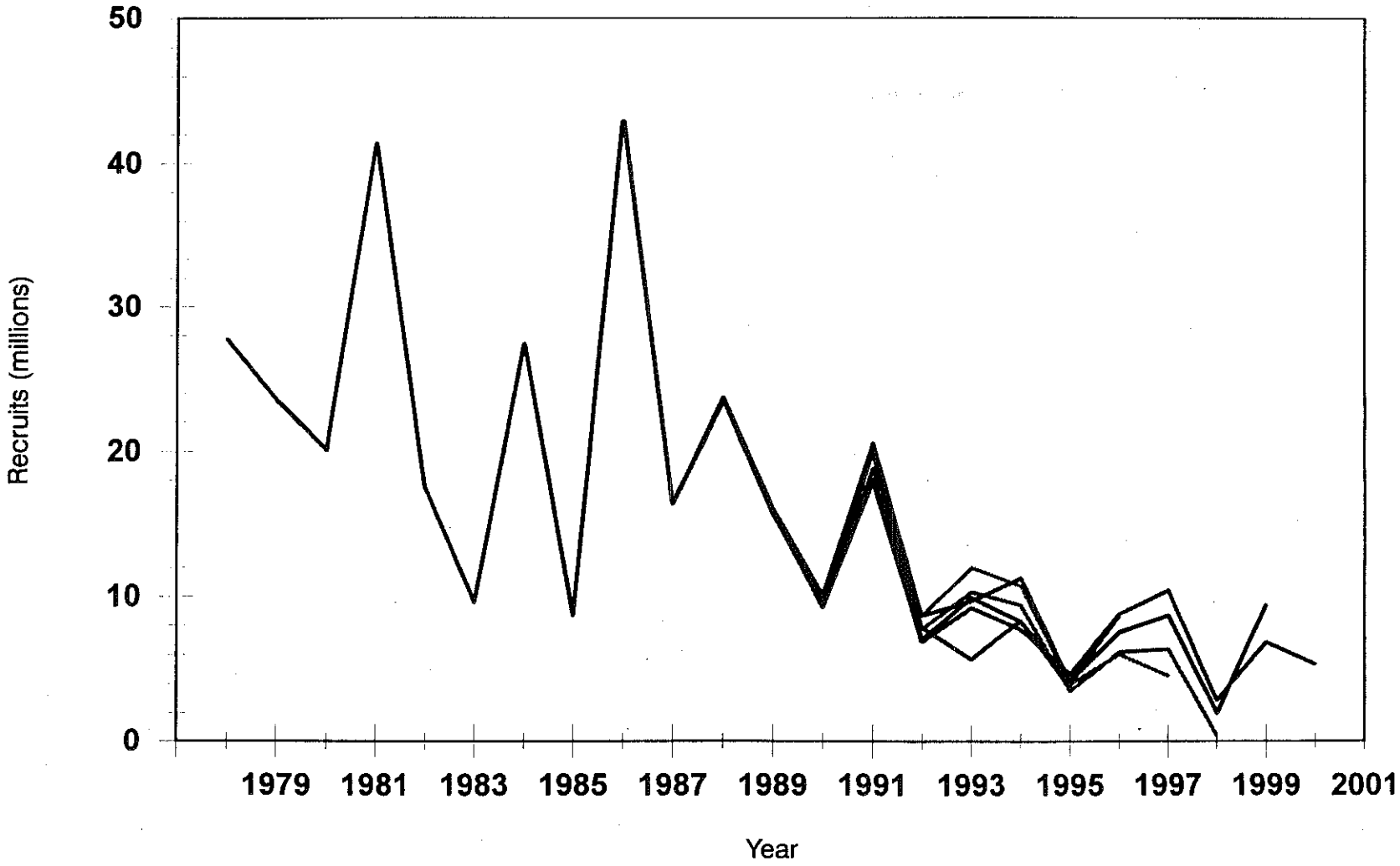

Figure 20. Retrospective analysis of Georges Bank cod recruits at age 1 based on the final ADAPT VPA formulation, 1999-1993.

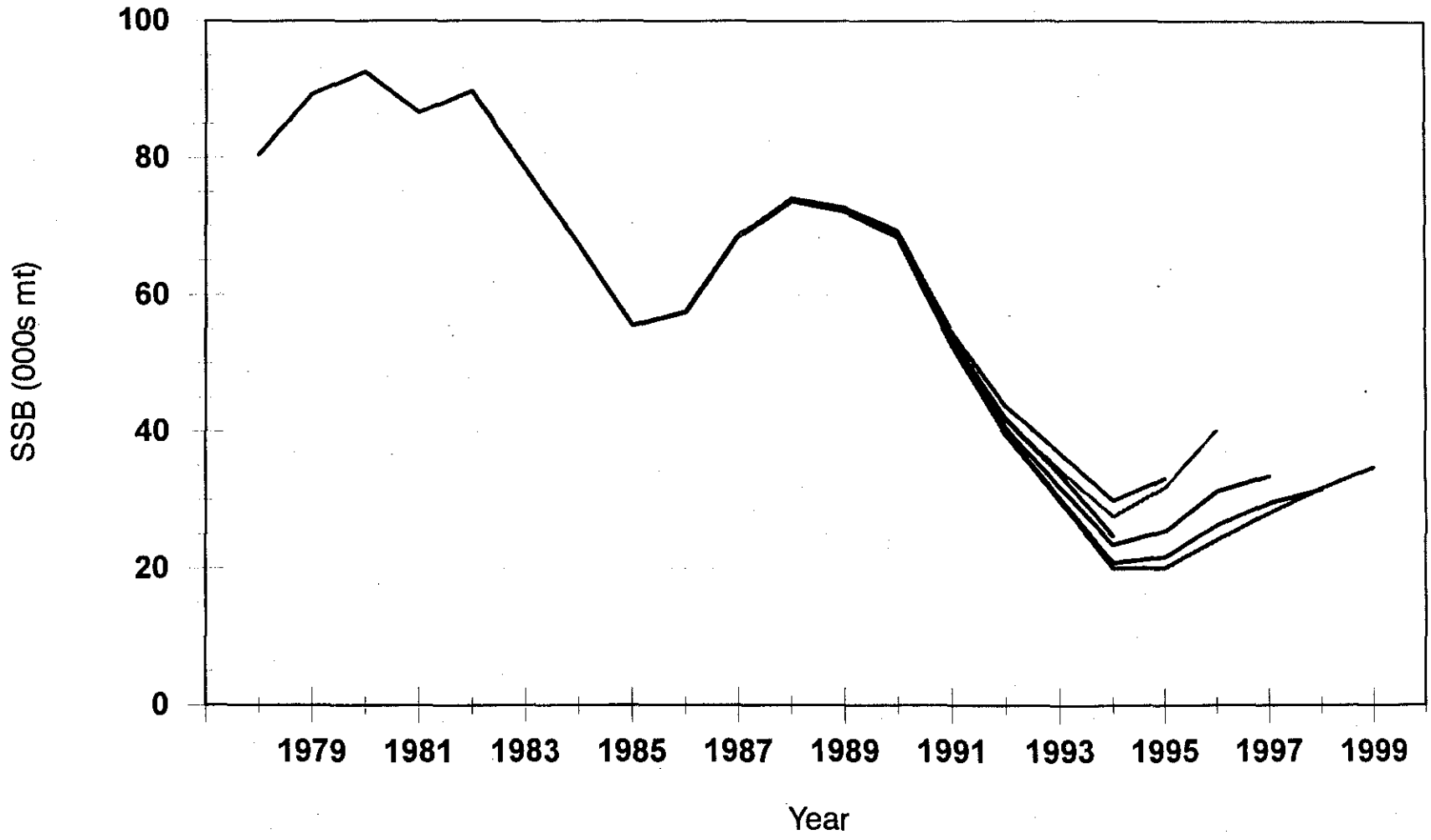

Figure 21. Retrospective analysis of Georges Bank cod spawning stock biomass based on the final ADAPT VPA formulation, 1999-1994.

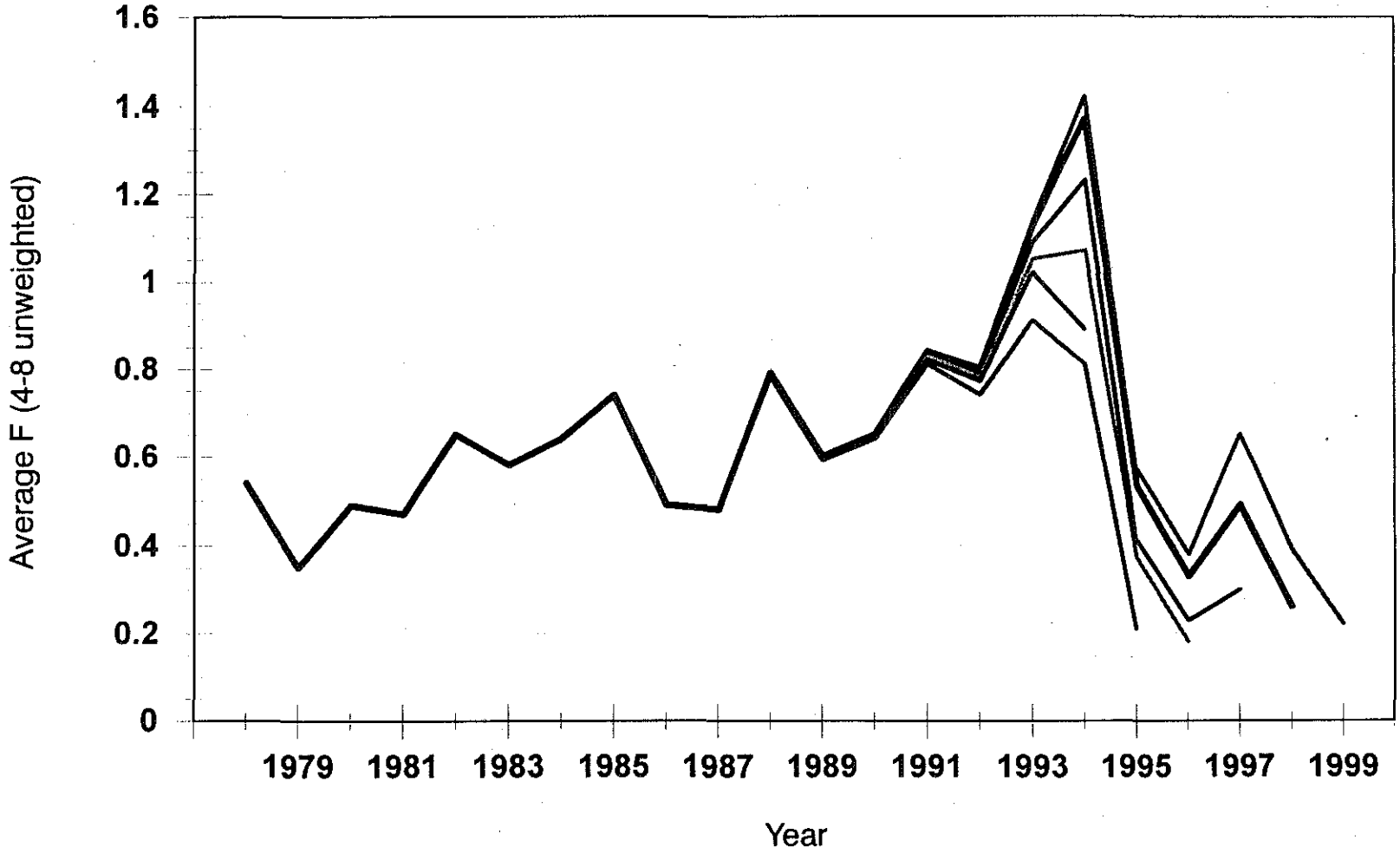

Figure 22. Retrospective analysis of Georges Bank cod fishing mortality (average F, ages 4-8, unweighted) based on the final ADAPT VPA formulation, 1999-1994.

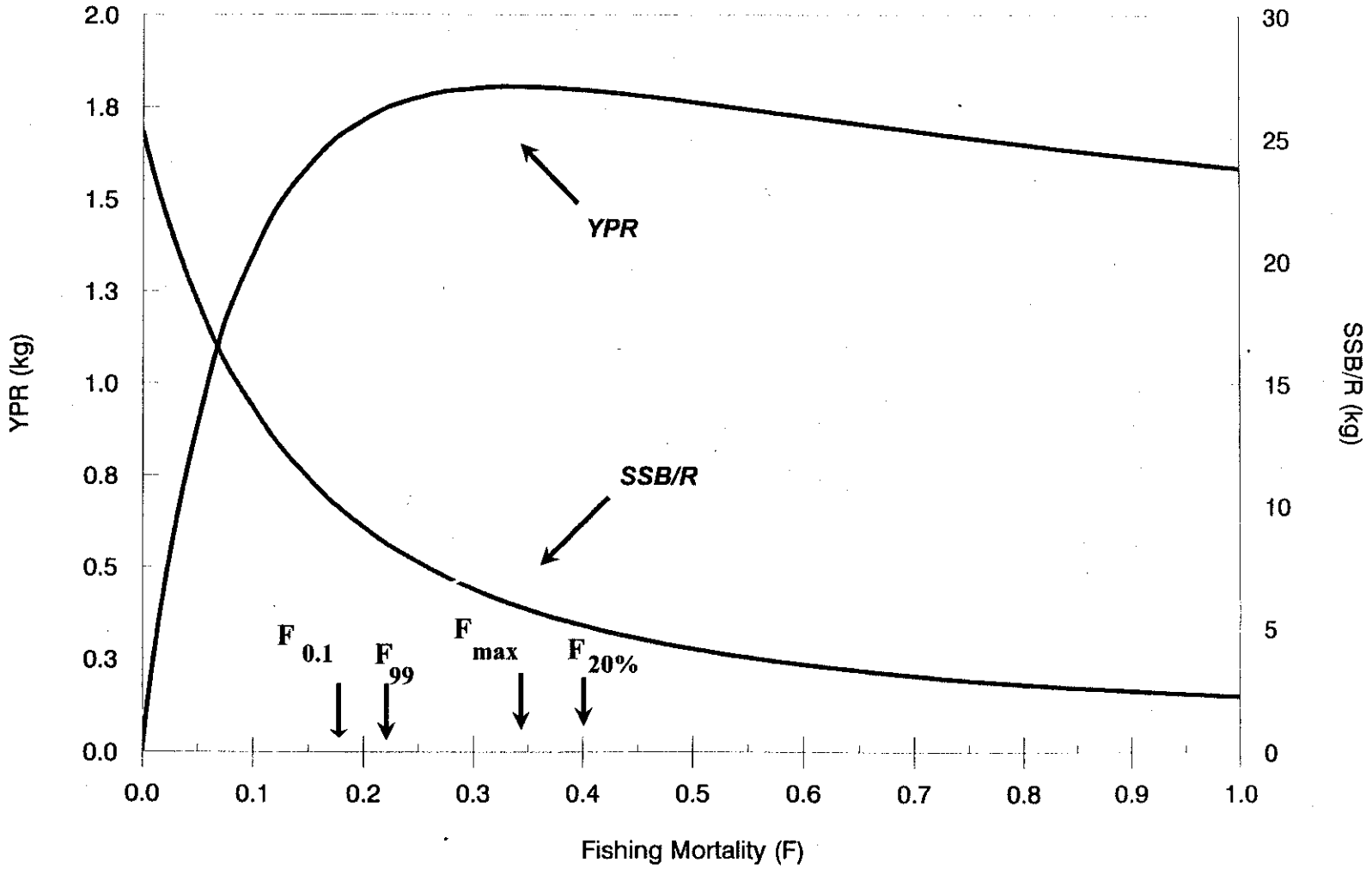

Figure 23. Yield per recruit (YPR) and spawning stock per recruit (SSB/R) for Georges Bank fromO'Brien and Cadrin (1999).

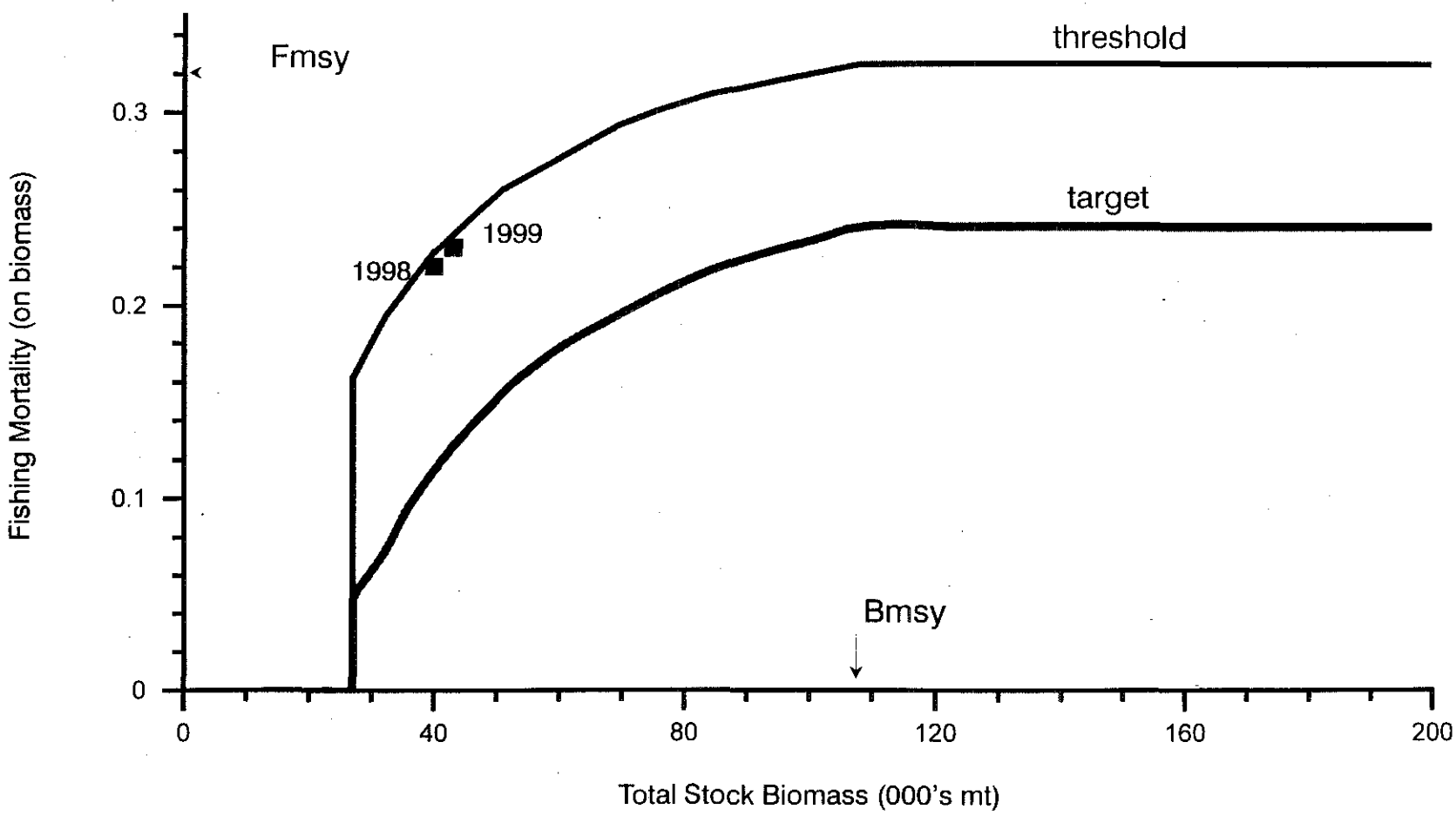

Figure 24. SFA control rule and recent stock status for Geroges Bank Atlantic cod.

APPENDIX 1

Discard / Kept Ratios, Landings, and Discards of Otter Trawls and Gill Nets from the Sea Sampling Database for Georges Bank Cod

Appendix 1. Table 1a. Observed number of tows and discard ratios derived from the Sea Sampling Database, landings (mt), estimated discards (mt), and catch (mt) of Georges Bank Atlantic cod in the otter trawl and gillnet fisheries in the western part (SA 521-522,525-526, 537-539 & Div.6) and the eastern part (SA 561, 562) of Georges Bank, by quarter,1989-1999.

OTTER TRAWL

WEST							EAST							West +East		
Year	Quarter	# Tows	D/K	Landings	Discard	Catch	Year	Quarter	# Tows	D/K	Landings	Discard	Catch	Landings	Discard	Catch
1989	1	126	0.029	2686	77.894	2763.89	1989	1	16	0.018	1898	34.164	1932.16			
	2	239	0.054	3987	215.298	4202.3		2	100	0.027	3061	82.647	3143.65			
	3	222	0.073	3386	247.178	3633.18		3	16	0.043	353	15.179	368.179			
	4	151	0.057	2878	164.046	3042.05		4	27	0.03	824	24.72	848.72			
			Annual	12937	704.416	13641.4				Annual	6136	156.71	6292.71	19073	861.126	19934.126
Year	Quarter	# Tows	D/K	Landings	Discard	Catch	Year	Quarter	# Tows	D/K	Landings	Discard	Catch			
1990	1	175	0.1	2668	266.8	2934.8	1990	1	63	0.012	2331	27.972	2358.97			
	2	130	0.074	4247	314.278	4561.28		2	20	0.008	3433	27.464	3460.46			
	3	116	0.027	4495	121.365	4616.37		3	14	0.002	457	0.914	457.914			
	4	172	0.02	5206	104.12	5310.12		4	35	0.026	169	4.394	173.394			
			Annual	16616	806.563	17422.6				Annual	6390	60.744	6450.74	23006	867.307	23873.307
Year	Quarter	# Tows	D/K	Landings	Discard	Catch	Year	Quarter	# Tows	D/K	Landings	Discard	Catch			
1991	1	187	0.005	3254	16.27	3270.27	1991	1	81	0.016	2040	32.64	2072.64			
	2	173	0.032	4331	138.592	4469.59		2	1	0.027	3745	101.115	3846.12			
	3	167	0.02	2291	45.82	2336.82		3	0	0	143	0	143			
	4	220	0.075	2502	187.65	2689.65		4	0	0	399	0	399			
			Annual	12378	388.332	12766.3				Annual	6327	133.755	6460.76	18705	522.087	19227.087
Year	Quarter	# Tows	D/K	Landings	Discard	Catch	Year	Quarter	# Tows	D/K	Landings	Discard	Catch			
1992	1	121	0.012	1692	20.304	1712.3	1992	1	120	0.022	1951	42.922	1993.92			
	2	108	0.009	2120	19.08	2139.08		2	21	0.001	2162	2.162	2164.16			
	3	67	0.053	1340	71.02	1411.02		3	0	0	186	0	186			
	4	90	0.018	2199	39.582	2238.58		4	31	0.061	756	46.116	802.116			
			Annual	7351	149.986	7500.99				Annual	5055	91.2	5146.2	2955	85.698	3040.698
Year	Quarter	# Tows	D/K	Landings	Discard	Catch	Year	Quarter	# Tows	D/K	Landings	Discard	Catch			
1993	1	41	0.053	1595	84.535	1679.54	1993	1	18	0.017	1304	22.168	1326.17			
	2	38	0.023	2171	49.933	2220.93		2	203	0.018	1987	35.766	2022.77			
	3	74	0.088	1257	110.616	1367.62		3	0	0	231	0	231			
	4	123	0.03	2242	67.26	2309.26		4	15	0.015	488	7.32	495.32			
			Annual	7265	312.344	7577.34				Annual	4010	65.254	4075.25	11275	377.598	11652.598

Appendix 1.Table 1a continued. Observed number of tows and discard ratios derived from the Sea Sampling Database, landings (mt), estimated discards (mt), and catch (mt) of Georges Bank Atlantic cod in the otter trawl and gillnet fisheries in the western part (SA 521-522,525-526, 537-539 & Div.6) and the eastern part (SA 561, 562) of Georges Bank, by quarter,1989-1999.

OTTER TRAWL

WEST							EAST							West +East		
Year	Quarter	# Tows	D/K	Landings	Discard	Catch	Year	Quarter	# Tows	D/K	Landings	Discard	Catch			
1994	1	172	0.008		0	0	1994	1	114	0.003		0	0		1994 not avalable by qtr	
	2	36	0.043		0	0		2	172	0.005		0	0			
	3	13	0		0	0		3	43	0.003		0	0			
	4	49	0.004		0	0		4	10	0		0	0			
			Annual	5916.63	0	0				Annual	1222.72	0	0	7139.35	0	0
Year	Quarter	# Tows	D/K	Landings	Discard	Catch	Year	Quarter	# Tows	D/K	Landings	Discard	Catch			
1995	1	227	0.004	504.29	2.01716	506.307	1995	1	38	0.002	147.29	0.29458	147.585			
	2	217	0.032	1008.17	32.2614	1040.43		2	38	0.001	373.8	0.3738	374.174			
	3	114	0.01	879.81	8.7981	888.608		3	8	0	38.46	0	38.46			
	4	103	0.012	800.6	9.6072	810.207		4	28	0.001	22.47	0.02247	22.4925			
			Annual	3192.87	52.6839	3245.55				Annual	582.02	0.69085	582.711	3774.89	53.3748	3828.26475
Year	Quarter	# Tows	D/K	Landings	Discard	Catch	Year	Quarter	# Tows	D/K	Landings	Discard	Catch			
1996	1	99	0.012	635.26	7.62312	642.883	1996	1	30	0.007	147.6	1.0332	148.633			
	2	165	0.001	1330.48	1.33048	1331.81		2	124	0	497.91	0	497.91			
	3	0	0	868.53	0	868.53		3	0	0	35.87	0	35.87			
	4	58	0.009	463.88	4.17492	468.055		4	0	0	73.76	0	73.76			
			Annual	3298.15	13.1285	3311.28				Annual	755.14	1.0332	756.173	4053.29	14.1617	4067.45172
Year	Quarter	# Tows	D/K	Landings	Discard	Catch	Year	Quarter	# Tows	D/K	Landings	Discard	Catch			
1997	1	152	0.008	627.06	5.01648	632.076	1997	1	0	0	85.99	0	85.99			
	2	1	0	2058.16	0	2058.16		2	0	0	373.71	0	373.71			
	3	157	0.005	825.99	4.12995	830.12		3	0	0	26.49	0	26.49			
	4	100	0.013	602.12	7.82756	609.948		4	0	0	17.64	0	17.64			
			Annual	4113.33	16.974	4130.3				Annual	503.83	0	503.83	4617.16	16.974	4634.13399
Year	Quarter	# Tows	D/K	Landings	Discard	Catch	Year	Quarter	# Tows	D/K	Landings	Discard	Catch			
1998	1	62	0.02	476.17	9.5234	485.693	1998	1	3	0.013	40.72	0.52936	41.2494			
	2	0	0	1408.29	0	1408.29		2	0	0	705.43	0	705.43			
	3	40	0.004	657.07	2.62828	659.698		3	31	0.016	35.45	0.5672	36.0172			
	4	0	0	721.76	0	721.76		4	0	0	12.93	0	12.93			
			Annual	3263.29	12.1517	3275.44				Annual	794.53	1.09656	795.627	4057.82	13.2482	4071.06824
Year	Quarter	# Tows	D/K	Landings	Discard	Catch	Year	Quarter	# Tows	D/K	Landings	Discard	Catch			
1999	1	1	0	514.27	0	514.27	1999	1	0	0	249.49	0	249.49			
	2	33	0.002	1679.74	3.35948	1683.1		2	46	0.006	862.95	5.1777	868.128			
	3	57	0.009	755.14	6.79626	761.936		3	12	0	25.48	0	25.48			
	4	106	0.018	664.57	11.9623	676.532		4	0	0	8.3	0	8.3			
			Annual	3613.72	22.118	3635.84				Annual	1146.22	5.1777	1151.4	4759.94	27.2957	4787.2357

Appendix 1. Table 1b. Observed number of tows and discard ratios derived from the Sea Sampling Database, landings (mt), estimated discards (mt), and catch (mt) of Georges Bank Atlantic cod in the otter trawl and gillnet fisheries in the western part (SA 521-522,525-526, 537-539 & Div.6) and the eastern part (SA 561, 562) of Georges Bank, by quarter,1989-1999.

GILL NET

	WEST						EAST						West +East		
Year	Quarter	# Tows	D/K	Landings	Discard	Catch	Quarter	# Tows	D/K	Landings	Discard	Catch	Landings	Discard	Catch
1989	1	0	0	325	0	325	1	0	0	0	0	0			
	2	3	0.001	997	0.997	997.997	2	0	0	0	0	0			
	3	58	0.011	1901	20.911	1921.91	3	0	0	0	0	0			
	4	36	0.067	304	20.368	324.368	4	0	0	8	0	8			
			Annual	3527	42.276	3569.28			Annual	8	0	8	3535	42.276	3577.28
1990	1	8	0.017	311	5.287	316.287	1	0	0	0	0	0			
	2	37	0.017	856	14.552	870.552	2	0	0	4	0	4			
	3	15	0.072	1294	93.168	1387.17	3	0	0	0	0	0			
	4	21	0.142	186	26.412	212.412	4	0	0	0	0	0			
			Annual	2647	139.419	2786.42			Annual	4	0	4	2651	139.419	2790.42
1991	1	4	0.115	186	21.39	207.39	1	0	0	0	0	0			
	2	220	0.011	742	8.162	750.162	2	14	0.001	5	0.005	5.005			
	3	508	0.033	1236	40.788	1276.79	3	0	0	0	0	0			
	4	128	0.102	395	40.29	435.29	4	0	0	0	0	0			
			Annual	2559	110.63	2669.63			Annual	5	0.005	5.005	2564	110.635	2674.64
1992	1	29	0.033	280	9.24	289.24	1	0	0	2	0	2			
	2	340	0.046	464	21.344	485.344	2	18	0.03	1	0.03	1.03			
	3	257	0.028	1134	31.752	1165.75	3	0	0	1	0	1			
	4	188	0.04	297	11.88	308.88	4	0	0	0	0	0			
			Annual	2175	74.216	2249.22			Annual	4	0.03	4.03	2179	74.246	2253.25
1993	1	83	0.06	134	8.04	142.04	1	0	0	0	0	0			
	2	140	0.074	561	41.514	602.514	2	5	0.064	0	0	0			
	3	9	0.007	579	4.053	583.053	3	5	0.003	0	0	0			
	4	197	0.056	275	15.4	290.4	4	0	0	0	0	0			
			Annual	1549	69.007	1618.01			Annual	0	0	0	1549	69.007	1618.01

Appendix 1. Table 1b continued. Observed number of tows and discard ratios derived from the Sea Sampling Database, landings (mt), estimated discards (mt), and catch (mt) of Georges Bank Atlantic cod in the otter trawl and gillnet fisheries in the western part (SA 521-522,525-526, 537-539 & Div.6) and the eastern part (SA 561, 562) of Georges Bank, by quarter,1989-1999.

GILL NET

WEST							EAST							West +East		
Year	Quarter	# Tows	D/K	Landings	Discard	Catch	Year	Quarter	# Tows	D/K	Landings	Discard	Catch			
1994	1	88	0.124		0	0	1994	1	0	0		0	0	*1994 not avalable by qtr*		
	2	0	0		0	0		2	0	0		0	0			
	3	18	0.043		0	0		3	0	0		0	0			
	4	70	0.07		0	0		4	0	0		0	0			
			Annual	1318.19	0	0				Annual	0	0	0	1318.19	0	0
Year	Quarter	# Tows	D/K	Landings	Discard	Catch	Year	Quarter	# Tows	D/K	Landings	Discard	Catch			
1995	1	32	0.193	119.89	23.1388	143.029	1995	1	0	0	3.51	0	3.51			
	2	40	0.028	381.02	10.6686	391.689		2	0	0	1.92	0	1.92			
	3	35	0.029	617.54	17.9087	635.449		3	0	0	0	0	0			
	4	44	0.081	194.9	15.7869	210.687		4	0	0	0	0	0			
			Annual	1313.35	67.5029	1380.85				Annual	5.43	0	5.43	1318.78	67.5029	1386.28
Year	Quarter	# Tows	D/K	Landings	Discard	Catch	Year	Quarter	# Tows	D/K	Landings	Discard	Catch			
1996	1	32	0.017	94.64	1.60888	96.2489	1996	1	0	0	0	0	0			
	2	18	0.08	544.07	43.5256	587.596		2	0	0	0	0	0			
	3	6	0.146	631.26	92.164	723.424		3	0	0	0	0	0			
	4	50	0.05	286.98	14.349	301.329		4	0	0	0	0	0			
			Annual	1556.95	151.647	1708.6				Annual	0	0	0	1556.95	151.647	1708.6
Year	Quarter	# Tows	D/K	Landings	Discard	Catch	Year	Quarter	# Tows	D/K	Landings	Discard	Catch			
1997	1	28	0.068	59.45	4.0426	63.4926	1997	1	0	0	0	0	0			
	2	23	0.049	775.67	38.0078	813.678		2	0	0	0	0	0			
	3	22	0.02	588.88	11.7776	600.658		3	0	0	0.14	0	0.14			
	4	26	0.093	175.34	16.3066	191.647		4	0	0	1.88	0	1.88			
			Annual	1599.34	70.1347	1669.47				Annual	2.02	0	2.02	1601.36	70.1347	1671.49
Year	Quarter	# Tows	D/K	Landings	Discard	Catch	Year	Quarter	# Tows	D/K	Landings	Discard	Catch			
1998	1	57	0.104	110.33	11.4743	121.804	1998	1	0	0	0	0	0			
	2	34	0.111	329.06	36.5257	365.586		2	0	0	10.03	0	10.03			
	3	12	0.08	240.86	19.2688	260.129		3	0	0	0	0	0			
	4	87	0.046	143.24	6.56904	149.829		4	0	0	0.91	0	0.91			
			Annual	823.49	73.8578	897.348				Annual	10.94	0	10.94	834.43	73.8578	908.288
Year	Quarter	# Tows	D/K	Landings	Discard	Catch	Year	Quarter	# Tows	D/K	Landings	Discard	Catch			
1999	1	56	0.043	131.44	22.1136	536.384	1999	1	0	0	0	0	0			
	2	79	0.037	663.92	62.1504	1741.89		2	0	0	0.03	0	0.03			
	3	40	0.055	471.95	41.5327	796.673		3	0	0	0	0	0			
	4	27	0.041	184.48	27.2474	691.817		4	0	0	0.28	0	0.28			
			Annual	1451.79	153.044	3766.76				Annual	0.31	0	0.31	1452.1	153.044	3767.07

APPENDIX 2

Age-specific bottom trawl survey abundance indices for Georges Bank Cod.

Table 1. Standardized (for vessel and door changes) stratified mean catch per tow at age (numbers) of Atlantic cod in NEFSC offshore spring and autumn bottom trawl surveys on Georges Bank (Strata 13-25), 1963 - 1999.

Table 2. Stratified mean catch per tow at age (numbers) of Atlantic cod in Canadian spring bottom trawl surveys on Eastern Georges Bank, 1986 - 2000.

Appendix 2: Table 1. Standardized (for vessel and door changes) stratified mean catch per tow at age (numbers) of Atlantic cod in NEFSC offshore spring and autumn bottom trawl surveys on Georges Bank (Strata 13-25), 1963 - 1999. [a,b,c]

	Age Group											Totals					
Year	0	1	2	3	4	5	6	7	8	9	10+	0+	1+	2+	3+	4+	5+
Spring																	
1968	0.513	0.136	1.615	0.825	0.665	0.385	0.246	0.140	0.083	0.056	0.058	4.722	4.209	4.073	2.459	1.633	0.969
1969	0.000	0.123	0.546	1.780	0.888	0.451	0.326	0.215	0.128	0.072	0.112	4.641	4.641	4.518	3.972	2.192	1.304
1970	0.000	0.381	0.814	0.480	1.295	0.162	0.655	0.275	0.061	0.136	0.083	4.341	4.341	3.961	3.147	2.666	1.371
1971	0.000	0.207	0.819	0.502	0.223	0.585	0.142	0.351	0.304	0.080	0.175	3.388	3.388	3.181	2.362	1.860	1.636
1972	0.056	2.902	1.833	2.641	0.510	0.119	0.324	0.122	0.220	0.115	0.125	8.967	8.911	6.009	4.176	1.535	1.025
1973 [d]	0.056	0.521	11.644	2.189	2.540	0.426	0.314	0.354	0.050	0.203	0.388	18.684	18.628	18.107	6.463	4.274	1.735
1974	0.000	0.446	4.557	5.972	0.761	2.003	0.440	0.101	0.257	0.034	0.175	14.747	14.747	14.301	9.744	3.772	3.011
1975	0.000	0.064	0.378	2.042	3.092	0.261	0.686	0.129	0.094	0.108	0.039	6.892	6.892	6.828	6.451	4.409	1.317
1976	0.111	1.301	1.922	0.944	0.691	1.572	0.164	0.262	0.036	0.000	0.055	7.057	6.947	5.646	3.724	2.780	2.089
1977	0.000	0.028	3.527	1.080	0.523	0.279	0.727	0.051	0.066	0.000	0.020	6.301	6.301	6.273	2.746	1.666	1.143
1978	3.312	0.376	0.187	5.530	0.969	0.778	0.144	0.713	0.051	0.142	0.109	12.312	9.000	8.624	8.436	2.906	1.938
1979	0.109	0.435	1.359	0.298	1.913	0.541	0.234	0.087	0.145	0.012	0.022	5.156	5.047	4.611	3.253	2.955	1.042
1980	0.083	0.031	1.790	2.124	0.165	1.171	0.472	0.152	0.025	0.024	0.088	6.122	6.039	6.008	4.219	2.095	1.930
1981	0.301	2.303	1.916	2.779	1.667	0.100	0.870	0.269	0.144	0.000	0.085	10.435	10.134	7.831	5.914	3.135	1.468
1982 [e]	0.148	0.488	3.395	1.406	1.295	1.039	0.016	0.298	0.064	0.016	0.035	8.200	8.053	7.564	4.169	2.763	1.468
1983	0.081	0.329	1.967	3.048	0.766	0.697	0.431	0.055	0.192	0.000	0.136	7.702	7.621	7.291	5.324	2.276	1.510
1984	0.000	0.402	0.462	0.797	1.161	0.446	0.424	0.223	0.000	0.156	0.008	4.079	4.079	3.677	3.215	2.418	1.257
1985	0.244	0.098	2.633	0.757	1.058	1.328	0.270	0.203	0.172	0.025	0.150	6.938	6.694	6.596	3.963	3.206	2.148
1986	0.092	0.871	0.423	1.824	0.360	0.545	0.633	0.063	0.119	0.095	0.015	5.040	4.948	4.077	3.654	1.830	1.470
1987	0.000	0.034	1.612	0.403	0.752	0.060	0.179	0.147	0.016	0.027	0.025	3.255	3.255	3.221	1.609	1.206	0.454
1988	0.180	0.700	0.684	3.115	0.413	0.645	0.045	0.020	0.052	0.000	0.007	5.861	5.681	4.981	4.297	1.182	0.769
1989	0.000	0.380	1.334	0.743	1.532	0.228	0.344	0.051	0.040	0.081	0.067	4.798	4.798	4.418	3.084	2.342	0.810
1990	0.041	0.194	0.926	1.707	0.653	0.896	0.125	0.139	0.013	0.016	0.027	4.736	4.695	4.501	3.575	1.868	1.215
1991	0.195	1.068	0.511	0.807	0.883	0.464	0.336	0.039	0.041	0.000	0.045	4.389	4.194	3.126	2.615	1.808	0.925
1992	0.000	0.123	1.255	0.470	0.163	0.270	0.144	0.161	0.020	0.037	0.028	2.671	2.671	2.548	1.293	0.823	0.660
1993	0.115	0.017	0.398	1.347	0.222	0.107	0.120	0.037	0.037	0.021	0.055	2.476	2.361	2.344	1.946	0.599	0.377
1994	0.029	0.123	0.273	0.199	0.216	0.033	0.005	0.044	0.000	0.019	0.000	0.943	0.914	0.791	0.518	0.318	0.102
1995	0.482	0.050	0.382	0.854	0.534	0.599	0.107	0.234	0.028	0.022	0.000	3.292	2.810	2.760	2.378	1.524	0.990
1996	0.000	0.073	0.214	0.736	1.247	0.174	0.209	0.028	0.018	0.000	0.000	2.699	2.699	2.626	2.412	1.676	0.429
1997	0.302	0.291	0.437	0.170	0.489	0.422	0.050	0.134	0.020	0.000	0.000	2.315	2.013	1.722	1.285	1.115	0.626
1998	0.018	0.111	0.665	1.298	0.848	0.755	0.533	0.102	0.031	0.000	0.000	4.360	4.342	4.231	3.566	2.268	1.420
1999	0.067	0.212	0.291	0.609	0.510	0.238	0.119	0.064	0.031	0.117	0.000	2.148	2.081	1.869	1.578	0.969	0.459

[a]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 made.

[b] During 1963-1984, BMV oval doors were used in 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).

[c] Spring surveys during 1980-1982, 1989-1991 and 1994, and autumn surveys during 1977-1981, 1989-1991, and 1993 were accomplished with the *R/V Delaware II*; in all other years, the surveys were accomplished using the *R/V Albatross IV*. 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).

[d] Excludes unusually high catch of 1894 cod (2558 kg) at Station 230 (Strata tow 20-4).

[e] Excludes unusually high catch of 1032 cod (4096 kg) at Station 323 (Strata tow 16-7).

Appendix 2:Table 1 (Continued). Standardized (for vessel and door changes) stratified mean catch per tow at age (numbers) of Atlantic cod in NEFSC offshore spring and autumn bottom trawl surveys on Georges Bank (Strata 13-25), 1963 - 1999. [b,c]

	Age Group											Totals					
Year	0	1	2	3	4	5	6	7	8	9	10+	0+	1+	2+	3+	4+	5+
Autumn																	
1963	0.019	0.719	0.778	0.920	0.897	0.354	0.326	0.175	0.103	0.014	0.069	4.374	4.356	3.636	2.858	1.938	1.041
1964	0.009	0.640	0.699	0.588	0.538	0.145	0.136	0.062	0.050	0.030	0.083	2.980	2.970	2.331	1.632	1.044	0.505
1965	0.173	1.299	0.998	0.707	0.484	0.167	0.179	0.112	0.081	0.023	0.023	4.248	4.075	2.775	1.777	1.070	0.587
1966	1.025	1.693	1.000	0.515	0.264	0.100	0.095	0.062	0.039	0.002	0.017	4.811	3.786	2.094	1.094	0.579	0.315
1967	0.072	7.596	1.334	0.523	0.406	0.133	0.133	0.055	0.051	0.012	0.070	10.383	10.312	2.716	1.382	0.860	0.454
1968	0.070	0.314	1.611	0.783	0.271	0.073	0.067	0.027	0.023	0.008	0.048	3.296	3.226	2.913	1.301	0.518	0.246
1969	0.000	0.343	0.622	0.626	0.331	0.094	0.061	0.019	0.023	0.022	0.059	2.200	2.200	1.856	1.234	0.608	0.278
1970	0.413	1.688	1.353	0.524	0.694	0.153	0.000	0.033	0.055	0.055	0.098	5.065	4.652	2.964	1.611	1.087	0.393
1971	0.399	0.602	0.632	0.390	0.301	0.476	0.183	0.042	0.089	0.000	0.075	3.189	2.789	2.187	1.555	1.165	0.864
1972	0.947	7.443	1.295	1.771	0.399	0.243	0.571	0.109	0.204	0.022	0.083	13.087	12.140	4.697	3.402	1.632	1.232
1973	0.203	1.749	6.070	1.182	2.012	0.211	0.226	0.175	0.062	0.139	0.251	12.280	12.078	10.329	4.259	3.076	1.064
1974	0.462	0.409	0.654	1.521	0.164	0.114	0.103	0.000	0.069	0.000	0.000	3.494	3.033	2.624	1.970	0.449	0.285
1975	2.377	0.994	0.421	0.624	1.685	0.112	0.156	0.000	0.000	0.000	0.037	6.407	4.029	3.036	2.615	1.991	0.306
1976	0.000	6.148	2.072	0.763	0.278	0.739	0.055	0.270	0.039	0.053	0.020	10.436	10.436	4.288	2.217	1.454	1.176
1977	0.152	0.237	3.424	0.702	0.251	0.174	0.396	0.007	0.027	0.000	0.078	5.447	5.296	5.059	1.635	0.933	0.682
1978	0.396	1.855	0.255	4.180	0.964	0.335	0.165	0.344	0.051	0.030	0.014	8.587	8.192	6.337	6.082	1.902	0.938
1979	0.118	1.619	1.717	0.224	1.613	0.296	0.180	0.036	0.115	0.007	0.022	5.948	5.829	4.210	2.493	2.269	0.656
1980	0.280	0.818	0.564	0.774	0.076	0.251	0.053	0.067	0.025	0.000	0.000	2.908	2.629	1.810	1.246	0.472	0.396
1981	0.261	3.525	2.250	1.559	0.589	0.054	0.579	0.057	0.064	0.018	0.083	9.040	8.778	5.254	3.003	1.444	0.855
1982	0.320	0.875	2.094	0.220	0.069	0.097	0.000	0.016	0.000	0.000	0.022	3.711	3.391	2.516	0.423	0.203	0.134
1983	1.031	0.647	1.022	0.796	0.055	0.047	0.003	0.000	0.012	0.000	0.023	3.636	2.605	1.958	0.936	0.140	0.086
1984	0.186	2.496	0.101	0.886	0.870	0.017	0.062	0.039	0.006	0.039	0.044	4.747	4.561	2.065	1.964	1.078	0.207
1985	1.084	0.220	0.803	0.103	0.115	0.101	0.000	0.000	0.004	0.000	0.000	2.430	1.346	1.126	0.323	0.220	0.105
1986	0.096	2.280	0.153	0.382	0.010	0.061	0.090	0.016	0.000	0.008	0.028	3.124	3.028	0.748	0.595	0.213	0.203
1987	0.204	0.414	1.353	0.112	0.195	0.028	0.012	0.000	0.000	0.007	0.000	2.325	2.121	1.707	0.354	0.242	0.047
1988	0.549	0.903	0.433	0.909	0.091	0.178	0.000	0.011	0.039	0.000	0.000	3.113	2.564	1.661	1.228	0.319	0.228
1989	0.262	2.738	1.030	0.183	0.499	0.055	0.008	0.004	0.000	0.000	0.000	4.780	4.518	1.780	0.750	0.566	0.067
1990 [f]	0.156	0.362	1.534	1.164	0.209	0.145	0.012	0.013	0.000	0.000	0.022	3.617	3.460	3.098	1.564	0.401	0.192
1991	0.040	0.415	0.168	0.277	0.028	0.029	0.000	0.000	0.000	0.000	0.000	0.957	0.917	0.502	0.334	0.057	0.029
1992	0.033	0.454	1.024	0.180	0.112	0.030	0.010	0.000	0.000	0.000	0.000	1.843	1.810	1.356	0.332	0.152	0.040
1993	0.179	0.970	0.532	0.382	0.017	0.025	0.022	0.000	0.000	0.022	0.000	2.149	1.970	1.000	0.468	0.086	0.070
1994	0.067	0.406	0.664	0.433	0.153	0.068	0.021	0.000	0.006	0.000	0.000	1.818	1.751	1.345	0.681	0.248	0.095
1995	0.160	0.245	1.811	1.249	0.087	0.054	0.011	0.000	0.000	0.000	0.000	3.617	3.457	3.212	1.401	0.152	0.065
1996	0.022	0.240	0.196	0.414	0.143	0.060	0.027	0.000	0.000	0.000	0.000	1.102	1.080	0.840	0.644	0.230	0.087
1997	0.006	0.236	0.321	0.109	0.129	0.049	0.009	0.007	0.000	0.000	0.000	0.867	0.860	0.624	0.303	0.194	0.065
1998	0.070	0.336	1.026	0.352	0.041	0.035	0.004	0.000	0.004	0.000	0.000	1.867	1.797	1.461	0.435	0.083	0.042
1999	0.070	0.140	0.154	0.310	0.255	0.087	0.000	0.000	0.000	0.000	0.000	1.016	0.946	0.806	0.652	0.342	0.087

[b] During 1963-1984, BMV oval doors were used in 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).

[c] Spring surveys during 1980-1982, 1989-1991 and 1994, and autumn surveys during 1977-1981, 1989-1991, and 1993 were accomplished with the *R/V Delaware II*; in all other years, the surveys were accomplished using the *R/V Albatross IV*. 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).

[f] Excludes unusually high catch of 111 cod (504 kg) at Station 205 (Strata tow 23-4).

Appendix 2: Table 2. Stratified mean catch per tow at age (numbers) of Atlantic cod in Canadian spring bottom trawl surveys on Georges Bank (5Z), 1986 - 2000.

	Age Group										Totals				
Year	1	2	3	4	5	6	7	8	9	10+	1+	2+	3+	4+	5+
1986	0.60	2.27	2.81	0.37	0.65	0.44	0.26	0.04	0.07	0.03	7.54	6.94	4.67	1.86	1.49
1987	0.25	2.13	0.93	1.09	0.34	0.12	0.22	0.08	0.03	0.07	5.26	5.01	2.88	1.95	0.86
1988	0.28	1.01	4.66	0.58	1.02	0.13	0.08	0.17	0.04	0.07	8.04	7.76	6.75	2.09	1.51
1989	1.63	2.78	1.38	2.85	0.36	0.42	0.05	0.10	0.12	0.06	9.75	8.12	5.34	3.96	1.11
1990	0.42	2.44	3.78	2.08	3.87	0.42	0.93	0.12	0.12	0.35	14.53	14.11	11.67	7.89	5.81
1991	1.18	1.16	1.84	2.15	1.05	1.31	0.16	0.22	0.03	0.09	9.19	8.01	6.85	5.01	2.86
1992	0.11	2.86	1.77	0.80	0.98	0.60	0.43	0.12	0.07	0.02	7.76	7.65	4.79	3.02	2.22
1993 (1)	0.05	0.60	2.83	1.04	0.62	1.23	0.44	0.42	0.07	0.12	7.42	7.37	6.77	3.94	2.90
1994 (1)	0.02	0.80	0.89	1.65	0.60	0.23	0.45	0.11	0.15	0.04	4.94	4.92	4.12	3.23	1.58
1995	0.07	0.67	1.50	0.86	0.60	0.19	0.04	0.05	0.02	0.02	4.02	3.95	3.28	1.78	0.92
1996	0.14	0.49	2.31	4.02	1.09	0.79	0.33	0.08	0.11	0.03	9.39	9.25	8.76	6.45	2.43
1997	0.32	0.53	0.55	1.25	1.23	0.27	0.06	0.03	0.02	0.01	4.27	3.95	3.42	2.87	1.62
1998	0.01	0.67	0.95	0.35	0.35	0.28	0.07	0.02	0.00	0.02	2.72	2.71	2.04	1.09	0.74
1999	0.33	0.32	1.49	1.09	0.41	0.26	0.15	0.01	0.02	0.01	4.09	3.76	3.44	1.95	0.86
2000	0.10	0.44	1.05	3.92	1.71	0.78	0.40	0.24	0.01	0.03	8.68	8.58	8.14	7.09	3.17

[1] 5Zjm indices only; not used as tuning indices in ADAPT

APPENDIX 3

Full Listing of ADAPT VPA Calibration Output and Diagnostics for Georges Bank Cod.

Fisheries Assessment Toolbox Georges Bank Cod - 2000 Assessment, 1999 TY Run Number
4/10/2000
BASE RUN
2:49:31 PM
FACT Version 1.1.2
Georges Bank Cod - 2000 Assessment, 1999 TY 1978 - 2000
Input Parameters and Options Selected

Natural mortality is a matrix below
Oldest age (not in the plus group) is 9
For all years prior to the terminal year (22), backcalculated
stock sizes for the following ages used to estimate
total mortality (Z) for age 9 : 4 5 6 7 8
This method for estimating F on the oldest age is generally used when a
flat-topped partial recruitment curve is thought to be characteristic of the stock.
F for age 10 + is then calculated from the following
ratios of F[age 10 +] to F[age 9]

1978	1
1979	1
1980	1
1981	1
1982	1
1983	1
1984	1
1985	1
1986	1
1987	1
1988	1
1989	1
1990	1
1991	1
1992	1
1993	1
1994	1
1995	1
1996	1
1997	1
1998	1
1999	1

Stock size of the 10 + group is then calculated using
the following method: CATCH EQUATION
Partial recruitment estimate for 2000

1	0.0027
2	0.334
3	0.8209
4	1
5	1
6	1
7	1
8	1
9	1

Objective function is Sum w*(LOG(OBS)-LOG(PRED))**2
Indices normalized (by dividing by mean observed value)
before tuning to VPA stocksizes
Downweighting is None or Uniform

Biomass estimates (other than SSB) reflect mean stock sizes.
SSB calculated as in the NEFSC projection program
(see note below SSB table for description of the algorithm).
Initial estimates of parameters for the Marquardt algorithm
and lower and upper bounds on the parameter estimates:

Par.	Initial Est	Lower Bnd	Upper Bnd
N 1	2.00E+03	1.00E+00	1.00E+06
N 2	9.00E+03	1.00E+00	1.00E+06
N 3	4.00E+03	1.00E+00	1.00E+06
N 4	5.00E+03	1.00E+00	1.00E+06
N 5	2.00E+03	1.00E+00	1.00E+06
N 6	2.00E+03	1.00E+00	1.00E+06
N 7	2.00E+03	1.00E+00	1.00E+06
N 8	1.00E+03	1.00E+00	1.00E+06
q spr_361	1.00E-04	0.00E+00	1.00E+00
q spr_362	1.00E-04	0.00E+00	1.00E+00
q spr_363	1.00E-04	0.00E+00	1.00E+00
q spr_364	1.00E-04	0.00E+00	1.00E+00
q spr_365	1.00E-04	0.00E+00	1.00E+00
q spr_366	1.00E-04	0.00E+00	1.00E+00
q spr_367	1.00E-04	0.00E+00	1.00E+00
q spr_368	1.00E-04	0.00E+00	1.00E+00
q spr_411	1.00E-04	0.00E+00	1.00E+00
q spr_412	1.00E-04	0.00E+00	1.00E+00
q spr_413	1.00E-04	0.00E+00	1.00E+00
q spr_414	1.00E-04	0.00E+00	1.00E+00
q spr_415	1.00E-04	0.00E+00	1.00E+00
q spr_416	1.00E-04	0.00E+00	1.00E+00
q spr_417	1.00E-04	0.00E+00	1.00E+00
q spr_418	1.00E-04	0.00E+00	1.00E+00
q sp_can1	1.00E-04	0.00E+00	1.00E+00
q sp_can2	1.00E-04	0.00E+00	1.00E+00
q sp_can3	1.00E-04	0.00E+00	1.00E+00
q sp_can4	1.00E-04	0.00E+00	1.00E+00
q sp_can5	1.00E-04	0.00E+00	1.00E+00
q sp_can6	1.00E-04	0.00E+00	1.00E+00
q sp_can7	1.00E-04	0.00E+00	1.00E+00
q sp_can8	1.00E-04	0.00E+00	1.00E+00
q us0aut1	1.00E-04	0.00E+00	1.00E+00
q us1aut2	1.00E-04	0.00E+00	1.00E+00
q us2aut3	1.00E-04	0.00E+00	1.00E+00
q us3aut4	1.00E-04	0.00E+00	1.00E+00
q us4aut5	1.00E-04	0.00E+00	1.00E+00
q us5aut6	1.00E-04	0.00E+00	1.00E+00

The following indices of abundance are available

1	spr_361
2	spr_362
3	spr_363
4	spr_364
5	spr_365
6	spr_366
7	spr_367
8	spr_368
9	spr_411
10	spr_412

```
11              spr_413
12              spr_414
13              spr_415
14              spr_416
15              spr_417
16              spr_418
17              sp_can1
18              sp_can2
19              sp_can3
20              sp_can4
21              sp_can5
22              sp_can6
23              sp_can7
24              sp_can8
25              us0aut1
26              us1aut2
27              us2aut3
28              us3aut4
29              us4aut5
30              us5aut6
The Indices that will be used in this run are:
1               spr_361
2               spr_362
3               spr_363
4               spr_364
5               spr_365
6               spr_366
7               spr_367
8               spr_368
9               spr_411
10              spr_412
11              spr_413
12              spr_414
13              spr_415
14              spr_416
15              spr_417
16              spr_418
17              sp_can1
18              sp_can2
19              sp_can3
20              sp_can4
21              sp_can5
22              sp_can6
23              sp_can7
24              sp_can8
25              us0aut1
26              us1aut2
27              us2aut3
28              us3aut4
29              us4aut5
30              us5aut6
Obs Indices (before transformation) by index and year; with Index means

          1978      1979      1980      1981      1982      1983      1984
-------------------------------------------------------------------------
```

spr_361	0.00	0.00	0.00	0.00	0.49	0.33	0.40
spr_362	0.00	0.00	0.00	0.00	3.40	1.97	0.46
spr_363	0.00	0.00	0.00	0.00	1.41	3.05	0.80
spr_364	0.00	0.00	0.00	0.00	1.30	0.77	1.16
spr_365	0.00	0.00	0.00	0.00	1.04	0.70	0.45
spr_366	0.00	0.00	0.00	0.00	0.02	0.43	0.42
spr_367	0.00	0.00	0.00	0.00	0.30	0.06	0.22
spr_368	0.00	0.00	0.00	0.00	0.06	0.19	0.00
spr_411	0.38	0.44	0.03	2.30	0.00	0.00	0.00
spr_412	0.19	1.36	1.79	1.92	0.00	0.00	0.00
spr_413	5.53	0.30	2.12	2.78	0.00	0.00	0.00
spr_414	0.97	1.91	0.17	1.67	0.00	0.00	0.00
spr_415	0.78	0.54	1.17	0.10	0.00	0.00	0.00
spr_416	0.14	0.23	0.47	0.87	0.00	0.00	0.00
spr_417	0.71	0.09	0.15	0.27	0.00	0.00	0.00
spr_418	0.05	0.15	0.03	0.14	0.00	0.00	0.00
sp_can1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sp_can2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sp_can3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sp_can4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sp_can5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sp_can6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sp_can7	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sp_can8	0.00	0.00	0.00	0.00	0.00	0.00	0.00
us0aut1	0.15	0.40	0.12	0.28	0.26	0.32	1.03
us1aut2	0.24	1.86	1.62	0.82	3.53	0.88	0.65
us2aut3	3.42	0.26	1.72	0.56	2.25	2.09	1.02
us3aut4	0.70	4.18	0.22	0.77	1.56	0.22	0.80
us4aut5	0.25	0.96	1.61	0.08	0.59	0.07	0.06
us5aut6	0.17	0.34	0.30	0.25	0.05	0.10	0.05

	1985	1986	1987	1988	1989	1990	1991
spr_361	0.10	0.87	0.03	0.70	0.38	0.19	1.07
spr_362	2.63	0.42	1.61	0.68	1.33	0.93	0.51
spr_363	0.76	1.82	0.40	3.12	0.74	1.71	0.81
spr_364	1.06	0.36	0.75	0.41	1.53	0.65	0.88
spr_365	1.33	0.55	0.06	0.65	0.23	0.90	0.46
spr_366	0.27	0.63	0.18	0.05	0.34	0.13	0.34
spr_367	0.20	0.06	0.15	0.02	0.05	0.14	0.04
spr_368	0.17	0.12	0.02	0.05	0.04	0.01	0.04
spr_411	0.00	0.00	0.00	0.00	0.00	0.00	0.00
spr_412	0.00	0.00	0.00	0.00	0.00	0.00	0.00
spr_413	0.00	0.00	0.00	0.00	0.00	0.00	0.00
spr_414	0.00	0.00	0.00	0.00	0.00	0.00	0.00
spr_415	0.00	0.00	0.00	0.00	0.00	0.00	0.00
spr_416	0.00	0.00	0.00	0.00	0.00	0.00	0.00
spr_417	0.00	0.00	0.00	0.00	0.00	0.00	0.00
spr_418	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sp_can1	0.00	0.60	0.25	0.28	1.63	0.42	1.18
sp_can2	0.00	2.27	2.13	1.01	2.78	2.44	1.16
sp_can3	0.00	2.81	0.93	4.66	1.38	3.78	1.84
sp_can4	0.00	0.37	1.09	0.58	2.85	2.08	2.15
sp_can5	0.00	0.65	0.34	1.02	0.36	3.87	1.05
sp_can6	0.00	0.44	0.12	0.13	0.42	0.42	1.31

sp_can7	0.00	0.26	0.22	0.08	0.05	0.93	0.16
sp_can8	0.00	0.04	0.08	0.17	0.10	0.12	0.22
us0aut1	0.19	1.08	0.10	0.20	0.55	0.26	0.16
us1aut2	2.50	0.22	2.28	0.41	0.90	2.74	0.36
us2aut3	0.10	0.80	0.15	1.35	0.43	1.03	1.53
us3aut4	0.89	0.10	0.38	0.11	0.91	0.18	1.16
us4aut5	0.87	0.12	0.01	0.20	0.09	0.50	0.21
us5aut6	0.02	0.10	0.06	0.03	0.18	0.06	0.15

	1992	1993	1994	1995	1996	1997	1998
spr_361	0.12	0.02	0.12	0.05	0.07	0.29	0.11
spr_362	1.26	0.40	0.27	0.38	0.21	0.44	0.67
spr_363	0.47	1.35	0.20	0.85	0.74	0.17	1.30
spr_364	0.16	0.22	0.22	0.53	1.25	0.49	0.85
spr_365	0.27	0.11	0.03	0.60	0.17	0.42	0.76
spr_366	0.14	0.12	0.01	0.11	0.21	0.05	0.53
spr_367	0.16	0.04	0.04	0.23	0.03	0.13	0.10
spr_368	0.02	0.04	0.00	0.03	0.02	0.02	0.03
spr_411	0.00	0.00	0.00	0.00	0.00	0.00	0.00
spr_412	0.00	0.00	0.00	0.00	0.00	0.00	0.00
spr_413	0.00	0.00	0.00	0.00	0.00	0.00	0.00
spr_414	0.00	0.00	0.00	0.00	0.00	0.00	0.00
spr_415	0.00	0.00	0.00	0.00	0.00	0.00	0.00
spr_416	0.00	0.00	0.00	0.00	0.00	0.00	0.00
spr_417	0.00	0.00	0.00	0.00	0.00	0.00	0.00
spr_418	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sp_can1	0.11	0.00	0.00	0.07	0.14	0.32	0.01
sp_can2	2.86	0.00	0.00	0.67	0.49	0.53	0.67
sp_can3	1.77	0.00	0.00	1.50	2.31	0.55	0.95
sp_can4	0.80	0.00	0.00	0.86	4.02	1.25	0.35
sp_can5	0.98	0.00	0.00	0.60	1.09	1.23	0.35
sp_can6	0.60	0.00	0.00	0.19	0.79	0.27	0.28
sp_can7	0.43	0.00	0.00	0.04	0.33	0.06	0.07
sp_can8	0.12	0.00	0.00	0.05	0.08	0.03	0.02
us0aut1	0.04	0.03	0.18	0.07	0.16	0.02	0.01
us1aut2	0.42	0.45	0.97	0.41	0.25	0.24	0.24
us2aut3	0.17	1.02	0.53	0.66	1.81	0.20	0.32
us3aut4	0.28	0.18	0.38	0.43	1.25	0.41	0.11
us4aut5	0.03	0.11	0.02	0.15	0.09	0.14	0.13
us5aut6	0.03	0.03	0.03	0.07	0.05	0.06	0.05

	1999	2000	Average
spr_361	0.21	0.00	0.309
spr_362	0.29	0.00	0.992
spr_363	0.61	0.00	1.127
spr_364	0.51	0.00	0.728
spr_365	0.24	0.00	0.497
spr_366	0.12	0.00	0.227
spr_367	0.06	0.00	0.113
spr_368	0.03	0.00	0.056
spr_411	0.00	0.00	0.786
spr_412	0.00	0.00	1.313
spr_413	0.00	0.00	2.683

spr_414	0.00	0.00	1.179
spr_415	0.00	0.00	0.648
spr_416	0.00	0.00	0.430
spr_417	0.00	0.00	0.305
spr_418	0.00	0.00	0.091
sp_can1	0.33	0.10	0.418
sp_can2	0.32	0.44	1.367
sp_can3	1.49	1.05	1.925
sp_can4	1.09	3.92	1.647
sp_can5	0.41	1.71	1.051
sp_can6	0.26	0.78	0.462
sp_can7	0.15	0.40	0.245
sp_can8	0.01	0.24	0.098
us0aut1	0.07	0.07	0.250
us1aut2	0.34	0.14	0.975
us2aut3	1.03	0.15	0.984
us3aut4	0.35	0.31	0.691
us4aut5	0.04	0.26	0.286
us5aut6	0.04	0.09	0.099

Catch at age (thousands) - D:\GBcod\assess_2000\vpa\gbcod_99.4

	1978	1979	1980	1981	1982	1983	1984
1	02	34	89	27	331	108	81
2	393	1989	3777	3205	9138	4286	1307
3	7748	900	5828	4221	3824	8063	3423
4	2303	4870	500	2464	2787	2456	3336
5	830	1212	2308	235	2000	1055	840
6	131	458	1076	1406	281	776	516
7	345	77	445	417	673	95	458
8	47	253	87	123	213	235	44
9	40	04	167	130	71	100	171
10	15	48	10	62	83	65	121
1+	11854	9845	14287	12290	19401	17239	10297

	1985	1986	1987	1988	1989	1990	1991
1	134	156	26	10	00	07	52
2	6426	1326	7473	1577	2088	4942	1525
3	2443	4573	1406	8022	2922	5042	3243
4	1368	797	2121	1012	4155	1882	3281
5	1885	480	279	1497	331	2264	1458
6	412	627	252	244	541	229	1088
7	218	87	270	161	82	245	126
8	203	72	63	197	43	36	70
9	21	47	38	50	50	17	23
10	97	29	24	47	18	38	23
1+	13207	8194	11952	12817	10230	14702	10889

	1992	1993	1994	1995	1996	1997	1998
1	70	04	02	00	01	03	00

2	4177	1033	398	392	207	517	739
3	2170	4246	1526	1058	903	639	1188
4	1038	1115	1825	692	1234	881	423
5	1482	440	394	290	241	794	324
6	404	472	96	44	123	131	237
7	309	159	137	26	15	84	39
8	34	143	46	15	03	16	14
9	33	32	38	02	05	09	06
10	10	17	06	01	00	01	04
1+	9727	7661	4468	2520	2732	3075	2974

	1999
1	02
2	285
3	1927
4	706
5	201
6	97
7	119
8	16
9	02
10	03
1+	3358

CAA Summary for ages 4 - 10

1978	1979	1980	1981	1982	1983	1984
3711	6922	4593	4837	6108	4782	5486

1985	1986	1987	1988	1989	1990	1991
4204	2139	3047	3208	5220	4711	6069

1992	1993	1994	1995	1996	1997	1998
3310	2378	2542	1070	1621	1916	1047

1999
1144

Weight at age (mid year) in kg - D:\GBcod\assess_2000\vpa\gbcod_99.4

	1978	1979	1980	1981	1982	1983	1984
1	0.707	0.889	0.836	0.882	0.765	0.971	1.053
2	1.310	1.494	1.460	1.495	1.402	1.490	1.635
3	2.461	2.149	2.468	2.358	2.664	2.377	2.451
4	3.469	4.211	3.668	3.415	3.834	3.309	3.619
5	4.336	4.888	5.647	5.213	5.352	4.637	5.083
6	5.787	7.178	6.676	7.222	6.511	6.393	6.582

7	7.374	9.183	8.390	8.565	9.363	7.964	8.909
8	8.492	10.313	9.089	9.888	9.897	10.286	10.104
9	11.785	11.699	8.432	14.170	12.503	11.227	11.303
10	13.200	12.625	15.400	18.565	16.723	14.554	15.356

	1985	1986	1987	1988	1989	1990	1991
1	0.907	0.929	0.726	0.786	0.809	0.831	1.114
2	1.418	1.475	1.481	1.520	1.617	1.560	1.627
3	2.086	2.447	2.495	2.359	2.269	2.462	2.548
4	3.887	3.660	4.187	3.511	3.772	3.522	3.420
5	5.087	5.603	5.810	5.401	5.396	4.892	4.769
6	6.412	7.191	7.726	6.647	6.694	6.333	5.891
7	8.097	8.915	8.949	8.776	8.222	8.456	7.410
8	10.236	9.955	10.013	9.987	10.718	10.648	10.520
9	11.418	12.687	11.414	11.143	11.665	12.580	9.686
10	13.494	14.104	15.000	15.298	17.111	14.526	15.373

	1992	1993	1994	1995	1996	1997	1998
1	1.148	0.872	0.906	0.906	0.882	0.954	0.579
2	1.542	1.534	1.459	1.471	1.507	1.577	1.483
3	2.464	2.253	2.168	2.095	2.435	2.321	2.302
4	3.843	3.333	3.657	3.830	3.387	3.532	3.497
5	4.704	4.967	4.804	5.492	4.912	4.103	4.735
6	6.156	6.379	7.432	7.384	6.622	6.019	5.934
7	7.509	7.510	8.013	10.715	8.369	8.050	8.185
8	9.846	9.217	9.368	11.617	8.438	8.631	8.610
9	12.059	9.699	9.698	10.383	12.883	11.870	12.684
10	19.025	13.236	16.659	14.953	12.002	12.795	14.606

	1999
1	0.830
2	1.565
3	2.223
4	3.452
5	4.891
6	6.422
7	7.341
8	9.685
9	12.153
10	13.735

January 1 Biomass Weights - D:\GBcod\assess_2000\vpa\gbcod_99.4

	1978	1979	1980	1981	1982	1983	1984
1	0.486	0.694	0.625	0.700	0.548	0.748	0.907
2	1.023	1.028	1.139	1.118	1.112	1.068	1.260
3	1.881	1.678	1.920	1.855	1.996	1.826	1.911
4	2.922	3.219	2.808	2.903	3.007	2.969	2.933
5	3.370	4.118	4.876	4.373	4.275	4.216	4.101
6	4.594	5.579	5.712	6.386	5.826	5.849	5.525

7	6.235	7.290	7.760	7.562	8.223	7.201	7.547
8	7.235	8.721	9.136	9.108	9.207	9.814	8.970
9	10.004	9.967	9.325	11.349	11.119	10.541	10.783
10	13.200	12.625	15.400	18.565	16.723	14.554	15.356

	1985	1986	1987	1988	1989	1990	1991
1	0.711	0.736	0.502	0.548	0.583	0.594	0.947
2	1.222	1.157	1.173	1.050	1.127	1.123	1.163
3	1.847	1.863	1.918	1.869	1.857	1.995	1.994
4	3.087	2.763	3.201	2.960	2.983	2.827	2.902
5	4.291	4.667	4.611	4.755	4.353	4.296	4.098
6	5.709	6.048	6.579	6.214	6.013	5.846	5.368
7	7.300	7.561	8.022	8.234	7.393	7.524	6.850
8	9.549	8.978	9.448	9.454	9.699	9.357	9.432
9	10.741	11.396	10.660	10.563	10.793	11.612	10.156
10	13.494	14.104	15.000	15.298	17.111	14.526	15.373

	1992	1993	1994	1995	1996	1997	1998
1	0.993	0.674	0.711	0.702	0.660	0.765	0.352
2	1.311	1.327	1.128	1.154	1.168	1.179	1.189
3	2.002	1.864	1.824	1.748	1.893	1.870	1.905
4	3.129	2.866	2.870	2.882	2.664	2.933	2.849
5	4.011	4.369	4.001	4.482	4.337	3.728	4.090
6	5.418	5.478	6.076	5.956	6.031	5.437	4.934
7	6.651	6.799	7.149	8.924	7.861	7.301	7.019
8	8.542	8.319	8.388	9.648	9.509	8.499	8.325
9	11.263	9.772	9.454	9.862	12.234	10.008	10.463
10	19.025	13.236	16.659	14.953	12.002	12.795	14.606

	1999
1	0.724
2	0.952
3	1.816
4	2.819
5	4.136
6	5.514
7	6.600
8	8.903
9	10.229
10	13.735

SSB Weights - D:\GBcod\assess_2000\vpa\gbcod_99.4

	1978	1979	1980	1981	1982	1983	1984
1	0.486	0.694	0.625	0.700	0.548	0.748	0.907
2	1.023	1.028	1.139	1.118	1.112	1.068	1.260
3	1.881	1.678	1.920	1.855	1.996	1.826	1.911
4	2.922	3.219	2.808	2.903	3.007	2.969	2.933
5	3.370	4.118	4.876	4.373	4.275	4.216	4.101
6	4.594	5.579	5.712	6.386	5.826	5.849	5.525

7	6.235	7.290	7.760	7.562	8.223	7.201	7.547
8	7.235	8.721	9.136	9.108	9.207	9.814	8.970
9	10.004	9.967	9.325	11.349	11.119	10.541	10.783
10	13.200	12.625	15.400	18.565	16.723	14.554	15.356

	1985	1986	1987	1988	1989	1990	1991
1	0.711	0.736	0.502	0.548	0.583	0.594	0.947
2	1.222	1.157	1.173	1.050	1.127	1.123	1.163
3	1.847	1.863	1.918	1.869	1.857	1.995	1.994
4	3.087	2.763	3.201	2.960	2.983	2.827	2.902
5	4.291	4.667	4.611	4.755	4.353	4.296	4.098
6	5.709	6.048	6.579	6.214	6.013	5.846	5.368
7	7.300	7.561	8.022	8.234	7.393	7.524	6.850
8	9.549	8.978	9.448	9.454	9.699	9.357	9.432
9	10.741	11.396	10.660	10.563	10.793	11.612	10.156
10	13.494	14.104	15.000	15.298	17.111	14.526	15.373

	1992	1993	1994	1995	1996	1997	1998
1	0.993	0.674	0.711	0.702	0.660	0.765	0.352
2	1.311	1.327	1.128	1.154	1.168	1.179	1.189
3	2.002	1.864	1.824	1.748	1.893	1.870	1.905
4	3.129	2.866	2.870	2.882	2.664	2.933	2.849
5	4.011	4.369	4.001	4.482	4.337	3.728	4.090
6	5.418	5.478	6.076	5.956	6.031	5.437	4.934
7	6.651	6.799	7.149	8.924	7.861	7.301	7.019
8	8.542	8.319	8.388	9.648	9.509	8.499	8.325
9	11.263	9.772	9.454	9.862	12.234	10.008	10.463
10	19.025	13.236	16.659	14.953	12.002	12.795	14.606

	1999
1	0.724
2	0.952
3	1.816
4	2.819
5	4.136
6	5.514
7	6.600
8	8.903
9	10.229
10	13.735

Computed (Rivard)from midyear weights: Jan 1 Weights - D:\GBcod\assess_2000\vpa\gbcod_

	1978	1979	1980	1981	1982	1983	1984
1	0.486	0.694	0.625	0.700	0.548	0.748	0.907
2	1.023	1.028	1.139	1.118	1.112	1.068	1.260
3	1.881	1.678	1.920	1.855	1.996	1.826	1.911
4	2.922	3.219	2.808	2.903	3.007	2.969	2.933
5	3.370	4.118	4.876	4.373	4.275	4.216	4.101
6	4.594	5.579	5.712	6.386	5.826	5.849	5.525

7	6.235	7.290	7.760	7.562	8.223	7.201	7.547
8	7.235	8.721	9.136	9.108	9.207	9.814	8.970
9	10.004	9.967	9.325	11.349	11.119	10.541	10.783
10	13.200	12.625	15.400	18.565	16.723	14.554	15.356

	1985	1986	1987	1988	1989	1990	1991
1	0.711	0.736	0.502	0.548	0.583	0.594	0.947
2	1.222	1.157	1.173	1.050	1.127	1.123	1.163
3	1.847	1.863	1.918	1.869	1.857	1.995	1.994
4	3.087	2.763	3.201	2.960	2.983	2.827	2.902
5	4.291	4.667	4.611	4.755	4.353	4.296	4.098
6	5.709	6.048	6.579	6.214	6.013	5.846	5.368
7	7.300	7.561	8.022	8.234	7.393	7.524	6.850
8	9.549	8.978	9.448	9.454	9.699	9.357	9.432
9	10.741	11.396	10.660	10.563	10.793	11.612	10.156
10	13.494	14.104	15.000	15.298	17.111	14.526	15.373

	1992	1993	1994	1995	1996	1997	1998
1	0.993	0.674	0.711	0.702	0.660	0.765	0.352
2	1.311	1.327	1.128	1.154	1.168	1.179	1.189
3	2.002	1.864	1.824	1.748	1.893	1.870	1.905
4	3.129	2.866	2.870	2.882	2.664	2.933	2.849
5	4.011	4.369	4.001	4.482	4.337	3.728	4.090
6	5.418	5.478	6.076	5.956	6.031	5.437	4.934
7	6.651	6.799	7.149	8.924	7.861	7.301	7.019
8	8.542	8.319	8.388	9.648	9.509	8.499	8.325
9	11.263	9.772	9.454	9.862	12.234	10.008	10.463
10	19.025	13.236	16.659	14.953	12.002	12.795	14.606

	1999	2000
1	0.724	0.661
2	0.952	0.952
3	1.816	2.573
4	2.819	2.722
5	4.136	4.227
6	5.514	5.784
7	6.600	7.479
8	8.903	8.165
9	10.229	10.535
10	13.735	13.735

Percent Mature (females)- D:\GBcod\assess_2000\vpa\gbcod_99.4

	1978	1979	1980	1981	1982	1983	1984
1	07	07	07	07	13	13	13
2	34	34	34	34	47	47	47
3	78	78	78	78	84	84	84

4	96	96	96	96	97	97	97
5	100	100	100	100	100	100	100
6	100	100	100	100	100	100	100
7	100	100	100	100	100	100	100
8	100	100	100	100	100	100	100
9	100	100	100	100	100	100	100
10	100	100	100	100	100	100	100

	1985	1986	1987	1988	1989	1990	1991
1	13	28	28	28	28	12	12
2	47	67	67	67	67	52	52
3	84	91	91	91	91	90	90
4	97	98	98	98	98	99	99
5	100	100	100	100	100	100	100
6	100	100	100	100	100	100	100
7	100	100	100	100	100	100	100
8	100	100	100	100	100	100	100
9	100	100	100	100	100	100	100
10	100	100	100	100	100	100	100

	1992	1993	1994	1995	1996	1997	1998
1	12	12	02	02	02	13	13
2	52	52	39	39	39	57	57
3	90	90	95	95	95	92	92
4	99	99	100	100	100	100	100
5	100	100	100	100	100	100	100
6	100	100	100	100	100	100	100
7	100	100	100	100	100	100	100
8	100	100	100	100	100	100	100
9	100	100	100	100	100	100	100
10	100	100	100	100	100	100	100

	1999
1	13
2	57
3	92
4	100
5	100
6	100
7	100
8	100
9	100
10	100

Natural Mortality D:\GBcod\assess_2000\vpa\gbcod_99.4

	1978	1979	1980	1981	1982	1983	1984
1	.200	.200	.200	.200	.200	.200	.200
2	.200	.200	.200	.200	.200	.200	.200
3	.200	.200	.200	.200	.200	.200	.200
4	.200	.200	.200	.200	.200	.200	.200

5	.200	.200	.200	.200	.200	.200	.200
6	.200	.200	.200	.200	.200	.200	.200
7	.200	.200	.200	.200	.200	.200	.200
8	.200	.200	.200	.200	.200	.200	.200
9	.200	.200	.200	.200	.200	.200	.200
10	.200	.200	.200	.200	.200	.200	.200

	1985	1986	1987	1988	1989	1990	1991
1	.200	.200	.200	.200	.200	.200	.200
2	.200	.200	.200	.200	.200	.200	.200
3	.200	.200	.200	.200	.200	.200	.200
4	.200	.200	.200	.200	.200	.200	.200
5	.200	.200	.200	.200	.200	.200	.200
6	.200	.200	.200	.200	.200	.200	.200
7	.200	.200	.200	.200	.200	.200	.200
8	.200	.200	.200	.200	.200	.200	.200
9	.200	.200	.200	.200	.200	.200	.200
10	.200	.200	.200	.200	.200	.200	.200

	1992	1993	1994	1995	1996	1997	1998
1	.200	.200	.200	.200	.200	.200	.200
2	.200	.200	.200	.200	.200	.200	.200
3	.200	.200	.200	.200	.200	.200	.200
4	.200	.200	.200	.200	.200	.200	.200
5	.200	.200	.200	.200	.200	.200	.200
6	.200	.200	.200	.200	.200	.200	.200
7	.200	.200	.200	.200	.200	.200	.200
8	.200	.200	.200	.200	.200	.200	.200
9	.200	.200	.200	.200	.200	.200	.200
10	.200	.200	.200	.200	.200	.200	.200

	1999
1	.200
2	.200
3	.200
4	.200
5	.200
6	.200
7	.200
8	.200
9	.200
10	.200

Sex Ratio (Percent Female) - D:\GBcod\assess_2000\vpa\gbcod_99.4

	1978	1979	1980	1981	1982	1983	1984
1	0.5	0.5	0.5	0.5	0.5	0.5	0.5
2	0.5	0.5	0.5	0.5	0.5	0.5	0.5
3	0.5	0.5	0.5	0.5	0.5	0.5	0.5
4	0.5	0.5	0.5	0.5	0.5	0.5	0.5
5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

6	0.5	0.5	0.5	0.5	0.5	0.5	0.5
7	0.5	0.5	0.5	0.5	0.5	0.5	0.5
8	0.5	0.5	0.5	0.5	0.5	0.5	0.5
9	0.5	0.5	0.5	0.5	0.5	0.5	0.5
10	0.5	0.5	0.5	0.5	0.5	0.5	0.5

	1985	1986	1987	1988	1989	1990	1991
1	0.5	0.5	0.5	0.5	0.5	0.5	0.5
2	0.5	0.5	0.5	0.5	0.5	0.5	0.5
3	0.5	0.5	0.5	0.5	0.5	0.5	0.5
4	0.5	0.5	0.5	0.5	0.5	0.5	0.5
5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
6	0.5	0.5	0.5	0.5	0.5	0.5	0.5
7	0.5	0.5	0.5	0.5	0.5	0.5	0.5
8	0.5	0.5	0.5	0.5	0.5	0.5	0.5
9	0.5	0.5	0.5	0.5	0.5	0.5	0.5
10	0.5	0.5	0.5	0.5	0.5	0.5	0.5

	1992	1993	1994	1995	1996	1997	1998
1	0.5	0.5	0.5	0.5	0.5	0.5	0.5
2	0.5	0.5	0.5	0.5	0.5	0.5	0.5
3	0.5	0.5	0.5	0.5	0.5	0.5	0.5
4	0.5	0.5	0.5	0.5	0.5	0.5	0.5
5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
6	0.5	0.5	0.5	0.5	0.5	0.5	0.5
7	0.5	0.5	0.5	0.5	0.5	0.5	0.5
8	0.5	0.5	0.5	0.5	0.5	0.5	0.5
9	0.5	0.5	0.5	0.5	0.5	0.5	0.5
10	0.5	0.5	0.5	0.5	0.5	0.5	0.5

	1999
1	0.5
2	0.5
3	0.5
4	0.5
5	0.5
6	0.5
7	0.5
8	0.5
9	0.5
10	0.5

pF is 0.1667
pM is 0.1667

Residual Sum of Squares from Marquardt Algorithm
Number 1
RSS 1408.60891653194
Lambda 1.00E-02

Number 2

```
RSS              1205.47267707873
Lambda          1.00E-03

Number  3
RSS              1036.34109846107
Lambda          1.00E-01

Number  4
RSS               904.721008731107
Lambda          1.00E-02

Number  5
RSS               495.698145230756
Lambda          1.00E+00

Number  6
RSS               269.698186435972
Lambda          1.00E-01

Number  7
RSS               207.364910280572
Lambda          1.00E+01

Number  8
RSS               201.067583183521
Lambda          1.00E+00

Number  9
RSS               200.933846210185
Lambda          1.00E-01

Number  10
RSS               200.933654672491
Lambda          1.00E-02

Number  11
RSS               200.933644455733
Lambda          1.00E-03

Number  12
RSS               200.933642504241
Lambda          1.00E-04
```

RESULTS

Approximate Statistics Assuming Linearity Near Solution
Sum of Squares: 200.933642504241
Mean Square Residuals: 0.53157

	PAR. EST.	STD. ERR.	T-STATISTIC	C.V.
N 1	5.33E+03	2.85E+03	1.87E+00	0.54
N 2	5.59E+03	1.90E+03	2.95E+00	0.34
N 3	1.65E+03	4.91E+02	3.36E+00	0.30
N 4	3.43E+03	1.11E+03	3.08E+00	0.32
N 5	2.12E+03	6.21E+02	3.42E+00	0.29
N 6	7.27E+02	2.11E+02	3.45E+00	0.29
N 7	8.50E+02	2.43E+02	3.50E+00	0.29
N 8	3.33E+02	1.33E+02	2.51E+00	0.40
q spr_361	5.38E-05	9.46E-06	5.69E+00	0.18
q spr_362	7.16E-05	1.25E-05	5.73E+00	0.17
q spr_363	1.05E-04	1.82E-05	5.75E+00	0.17
q spr_364	2.30E-04	3.99E-05	5.75E+00	0.17
q spr_365	4.23E-04	7.36E-05	5.74E+00	0.17
q spr_366	8.78E-04	1.53E-04	5.73E+00	0.17
q spr_367	2.44E-03	4.26E-04	5.72E+00	0.17
q spr_368	5.20E-03	9.60E-04	5.42E+00	0.18
q spr_411	1.54E-05	5.64E-06	2.73E+00	0.37
q spr_412	5.57E-05	2.04E-05	2.73E+00	0.37
q spr_413	5.80E-05	2.13E-05	2.73E+00	0.37
q spr_414	1.13E-04	4.13E-05	2.73E+00	0.37
q spr_415	2.38E-04	8.73E-05	2.73E+00	0.37
q spr_416	3.96E-04	1.45E-04	2.73E+00	0.37
q spr_417	7.16E-04	2.62E-04	2.73E+00	0.37
q spr_418	2.42E-03	8.88E-04	2.73E+00	0.37
q sp_can1	5.28E-05	1.12E-05	4.71E+00	0.21
q sp_can2	8.77E-05	1.82E-05	4.81E+00	0.21
q sp_can3	1.36E-04	2.81E-05	4.84E+00	0.21
q sp_can4	2.19E-04	4.53E-05	4.83E+00	0.21
q sp_can5	4.78E-04	9.90E-05	4.84E+00	0.21
q sp_can6	1.18E-03	2.46E-04	4.81E+00	0.21
q sp_can7	2.37E-03	4.94E-04	4.79E+00	0.21
q sp_can8	7.01E-03	1.48E-03	4.75E+00	0.21
q us0aut1	4.47E-05	7.01E-06	6.38E+00	0.16
q us1aut2	6.32E-05	9.78E-06	6.46E+00	0.15
q us2aut3	8.99E-05	1.39E-05	6.48E+00	0.15
q us3aut4	1.58E-04	2.44E-05	6.48E+00	0.15
q us4aut5	2.58E-04	3.99E-05	6.48E+00	0.15
q us5aut6	8.50E-04	1.32E-04	6.46E+00	0.15

Catchability Estimates in Original Units

	Estimate	Std.Err.	C.V.
q spr_361	1.66E-05	2.92E-06	0.18
q spr_362	7.11E-05	1.24E-05	0.17
q spr_363	1.18E-04	2.06E-05	0.17
q spr_364	1.67E-04	2.91E-05	0.17

q spr_365	2.10E-04	3.66E-05	0.17
q spr_366	2.00E-04	3.48E-05	0.17
q spr_367	2.77E-04	4.84E-05	0.17
q spr_368	2.90E-04	5.36E-05	0.18
q spr_411	1.21E-05	4.44E-06	0.37
q spr_412	7.31E-05	2.68E-05	0.37
q spr_413	1.56E-04	5.70E-05	0.37
q spr_414	1.33E-04	4.87E-05	0.37
q spr_415	1.54E-04	5.65E-05	0.37
q spr_416	1.70E-04	6.24E-05	0.37
q spr_417	2.19E-04	8.01E-05	0.37
q spr_418	2.21E-04	8.10E-05	0.37
q sp_can1	2.21E-05	4.69E-06	0.21
q sp_can2	1.20E-04	2.49E-05	0.21
q sp_can3	2.61E-04	5.40E-05	0.21
q sp_can4	3.60E-04	7.45E-05	0.21
q sp_can5	5.03E-04	1.04E-04	0.21
q sp_can6	5.47E-04	1.14E-04	0.21
q sp_can7	5.79E-04	1.21E-04	0.21
q sp_can8	6.90E-04	1.45E-04	0.21
q us0aut1	1.12E-05	1.75E-06	0.16
q us1aut2	6.16E-05	9.54E-06	0.15
q us2aut3	8.84E-05	1.36E-05	0.15
q us3aut4	1.09E-04	1.68E-05	0.15
q us4aut5	7.37E-05	1.14E-05	0.15
q us5aut6	8.41E-05	1.30E-05	0.15

Summary of Residuals
spr_36
Tuned to: 1-Jan and number
For ages: 1

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	0.488	0.941	0.457	-0.061	1	0.518	0.710	17471
1983	0.329	0.518	0.062	-0.658	1	0.721	0.989	9615
1984	0.402	1.475	0.263	0.389	1	-0.126	-0.173	27391
1985	0.098	0.467	-1.149	-0.761	1	-0.387	-0.531	8675
1986	0.871	2.302	1.036	0.834	1	0.202	0.277	42754
1987	0.034	0.882	-2.207	-0.126	1	-2.082	-2.855	16377
1988	0.700	1.263	0.817	0.233	1	0.584	0.801	23456
1989	0.380	0.846	0.206	-0.167	1	0.373	0.512	15718
1990	0.194	0.498	-0.466	-0.697	1	0.231	0.317	9252
1991	1.068	0.963	1.240	-0.038	1	1.278	1.753	17881
1992	0.123	0.370	-0.922	-0.993	1	0.072	0.098	6880
1993	0.017	0.497	-2.900	-0.700	1	-2.201	-3.018	9225
1994	0.123	0.415	-0.922	-0.880	1	-0.042	-0.057	7706
1995	0.050	0.251	-1.822	-1.384	1	-0.438	-0.601	4656
1996	0.073	0.474	-1.443	-0.747	1	-0.697	-0.955	8803
1997	0.291	0.561	-0.060	-0.578	1	0.518	0.710	10420
1998	0.111	0.153	-1.024	-1.877	1	0.853	1.170	2842
1999	0.212	0.368	-0.377	-1.000	1	0.623	0.855	6830
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 0.861

spr_36
Tuned to: 1-Jan and number
For ages: 2

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sz
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	3.395	2.425	1.230	0.886	1	0.344	0.472	33865
1983	1.967	1.003	0.684	0.003	1	0.682	0.935	14004
1984	0.462	0.557	-0.764	-0.586	1	-0.179	-0.245	7774
1985	2.633	1.600	0.976	0.470	1	0.506	0.693	22352
1986	0.423	0.500	-0.853	-0.693	1	-0.159	-0.218	6981
1987	1.612	2.496	0.485	0.915	1	-0.430	-0.589	34863
1988	0.684	0.958	-0.372	-0.043	1	-0.330	-0.452	13385
1989	1.334	1.374	0.296	0.318	1	-0.022	-0.030	19195
1990	0.926	0.921	-0.069	-0.082	1	0.013	0.017	12869
1991	0.511	0.542	-0.664	-0.613	1	-0.051	-0.070	7568
1992	1.255	1.045	0.235	0.044	1	0.191	0.262	14593
1993	0.398	0.399	-0.914	-0.919	1	0.006	0.008	5569
1994	0.273	0.540	-1.291	-0.615	1	-0.675	-0.926	7549
1995	0.382	0.452	-0.955	-0.795	1	-0.160	-0.219	6308
1996	0.214	0.273	-1.534	-1.299	1	-0.235	-0.323	3812
1997	0.437	0.516	-0.820	-0.662	1	-0.158	-0.217	7206
1998	0.665	0.611	-0.400	-0.493	1	0.093	0.128	8528
1999	0.291	0.167	-1.227	-1.792	1	0.565	0.775	2327
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 0.127

spr_36
Tuned to: 1-Jan and number
For ages: 3

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	1.406	1.103	0.221	0.098	1	0.123	0.169	10514
1983	3.048	2.041	0.995	0.713	1	0.281	0.386	19458
1984	0.797	0.796	-0.347	-0.228	1	-0.118	-0.162	7588
1985	0.757	0.543	-0.398	-0.610	1	0.212	0.290	5182
1986	1.824	1.309	0.481	0.270	1	0.212	0.290	12486
1987	0.403	0.474	-1.029	-0.747	1	-0.281	-0.386	4516
1988	3.115	2.284	1.016	0.826	1	0.190	0.261	21781
1989	0.743	1.000	-0.417	0.000	1	-0.416	-0.571	9532
1990	1.707	1.450	0.415	0.372	1	0.043	0.060	13827
1991	0.807	0.636	-0.334	-0.453	1	0.118	0.162	6064
1992	0.470	0.505	-0.875	-0.683	1	-0.192	-0.263	4817
1993	1.347	0.857	0.178	-0.155	1	0.333	0.457	8168
1994	0.199	0.380	-1.734	-0.967	1	-0.767	-1.052	3625
1995	0.854	0.610	-0.278	-0.494	1	0.216	0.296	5820
1996	0.736	0.504	-0.426	-0.684	1	0.258	0.354	4810
1997	0.170	0.308	-1.892	-1.179	1	-0.713	-0.978	2933

1998	1.298	0.570	0.141	-0.563	1	0.704	0.965	5432
1999	0.609	0.662	-0.616	-0.412	1	-0.203	-0.279	6314
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 0.143

spr_36
Tuned to: 1-Jan and number
For ages: 4

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	1.295	1.439	0.576	0.364	1	0.212	0.291	6266
1983	0.766	1.182	0.051	0.167	1	-0.116	-0.160	5148
1984	1.161	1.983	0.467	0.685	1	-0.218	-0.299	8635
1985	1.058	0.715	0.374	-0.335	1	0.709	0.972	3115
1986	0.360	0.467	-0.704	-0.762	1	0.058	0.079	2032
1987	0.752	1.398	0.033	0.335	1	-0.302	-0.414	6085
1988	0.413	0.557	-0.567	-0.585	1	0.019	0.026	2425
1989	1.532	2.429	0.744	0.887	1	-0.143	-0.196	10574
1990	0.653	1.185	-0.109	0.170	1	-0.278	-0.382	5160
1991	0.883	1.552	0.193	0.440	1	-0.246	-0.338	6758
1992	0.163	0.466	-1.496	-0.763	1	-0.734	-1.006	2031
1993	0.222	0.455	-1.187	-0.788	1	-0.399	-0.548	1980
1994	0.216	0.654	-1.215	-0.425	1	-0.790	-1.083	2846
1995	0.534	0.365	-0.310	-1.009	1	0.699	0.959	1587
1996	1.247	0.875	0.538	-0.134	1	0.672	0.922	3808
1997	0.489	0.717	-0.398	-0.333	1	-0.065	-0.089	3121
1998	0.848	0.419	0.153	-0.870	1	1.023	1.403	1823
1999	0.510	0.775	-0.356	-0.255	1	-0.100	-0.138	3373
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 0.25

spr_36
Tuned to: 1-Jan and number
For ages: 5

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	1.039	1.987	0.737	0.687	1	0.051	0.070	4697
1983	0.697	1.103	0.338	0.098	1	0.240	0.329	2608
1984	0.446	0.843	-0.108	-0.171	1	0.063	0.086	1992
1985	1.328	1.714	0.983	0.539	1	0.444	0.609	4052
1986	0.545	0.555	0.092	-0.588	1	0.681	0.934	1312
1987	0.060	0.399	-2.114	-0.919	1	-1.195	-1.639	943
1988	0.645	1.296	0.261	0.259	1	0.002	0.002	3063
1989	0.228	0.452	-0.779	-0.793	1	0.014	0.019	1070
1990	0.896	2.072	0.589	0.729	1	-0.139	-0.191	4898
1991	0.464	1.067	-0.069	0.065	1	-0.133	-0.183	2522
1992	0.270	1.085	-0.610	0.081	1	-0.692	-0.948	2564
1993	0.107	0.306	-1.536	-1.184	1	-0.352	-0.482	723
1994	0.033	0.259	-2.712	-1.351	1	-1.361	-1.867	612

1995	0.599	0.287	0.187	-1.248	1	1.435	1.968	679
1996	0.174	0.285	-1.050	-1.256	1	0.206	0.283	673
1997	0.422	0.847	-0.164	-0.167	1	0.003	0.004	2001
1998	0.755	0.744	0.418	-0.296	1	0.714	0.980	1758
1999	0.238	0.470	-0.736	-0.756	1	0.019	0.027	1110
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 0.434

spr_36
Tuned to: 1-Jan and number
For ages: 6

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. S
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	0.016	0.522	-2.653	-0.650	1	-2.003	-2.747	594
1983	0.431	1.788	0.640	0.581	1	0.059	0.081	2036
1984	0.424	1.037	0.624	0.036	1	0.588	0.806	1181
1985	0.270	0.765	0.172	-0.268	1	0.441	0.604	871
1986	0.633	1.415	1.025	0.347	1	0.677	0.929	1611
1987	0.179	0.562	-0.239	-0.576	1	0.338	0.463	640
1988	0.045	0.456	-1.619	-0.785	1	-0.834	-1.144	519
1989	0.344	1.012	0.415	0.012	1	0.402	0.552	1153
1990	0.125	0.506	-0.598	-0.681	1	0.084	0.115	576
1991	0.336	1.722	0.391	0.544	1	-0.152	-0.209	1962
1992	0.144	0.655	-0.456	-0.424	1	-0.032	-0.044	745
1993	0.120	0.666	-0.638	-0.407	1	-0.232	-0.318	758
1994	0.005	0.170	-3.816	-1.769	1	-2.047	-2.808	194
1995	0.107	0.127	-0.753	-2.063	1	1.310	1.797	145
1996	0.209	0.257	-0.084	-1.357	1	1.274	1.747	293
1997	0.050	0.293	-1.514	-1.229	1	-0.285	-0.390	333
1998	0.533	0.808	0.853	-0.214	1	1.066	1.462	920
1999	0.119	1.006	-0.647	0.006	1	-0.653	-0.896	1146
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 0.911

spr_36
Tuned to: 1-Jan and number
For ages: 7

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. S
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	0.298	4.114	0.966	1.414	1	-0.449	-0.615	1687
1983	0.055	0.567	-0.724	-0.568	1	-0.156	-0.214	232
1984	0.223	2.353	0.676	0.856	1	-0.180	-0.247	965
1985	0.203	1.219	0.582	0.198	1	0.384	0.526	500
1986	0.063	0.830	-0.588	-0.186	1	-0.402	-0.552	340
1987	0.147	1.835	0.259	0.607	1	-0.348	-0.477	752
1988	0.020	0.722	-1.736	-0.325	1	-1.410	-1.934	296
1989	0.051	0.499	-0.799	-0.695	1	-0.104	-0.143	205
1990	0.139	1.109	0.203	0.103	1	0.100	0.137	455
1991	0.039	0.645	-1.068	-0.438	1	-0.630	-0.864	265

1992	0.161	1.516	0.350	0.416	1	-0.066	-0.091	622
1993	0.037	0.597	-1.120	-0.516	1	-0.605	-0.829	245
1994	0.044	0.473	-0.947	-0.749	1	-0.198	-0.272	194
1995	0.234	0.176	0.724	-1.738	1	2.462	3.377	72
1996	0.028	0.192	-1.399	-1.651	1	0.252	0.345	79
1997	0.134	0.314	0.167	-1.159	1	1.325	1.817	129
1998	0.102	0.376	-0.106	-0.978	1	0.871	1.195	154
1999	0.064	1.314	-0.572	0.273	1	-0.846	-1.160	539
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 0.769

spr_36
Tuned to: 1-Jan and number
For ages: 8

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	0.064	2.658	0.136	0.977	1	-0.842	-1.154	511
1983	0.192	4.012	1.234	1.389	1	-0.155	-0.212	772
1984	0.000	0.000	0	0	1	0.000	0.000	00
1985	0.172	1.951	1.124	0.669	1	0.456	0.625	375
1986	0.119	1.102	0.756	0.097	1	0.659	0.904	212
1987	0.016	1.039	-1.251	0.039	1	-1.289	-1.768	200
1988	0.052	1.930	-0.072	0.658	1	-0.730	-1.001	371
1989	0.040	0.503	-0.334	-0.687	1	0.353	0.484	97
1990	0.013	0.485	-1.458	-0.724	1	-0.734	-1.006	93
1991	0.041	0.782	-0.310	-0.246	1	-0.064	-0.087	150
1992	0.020	0.533	-1.027	-0.629	1	-0.399	-0.547	103
1993	0.037	1.192	-0.412	0.175	1	-0.588	-0.806	229
1994	0.000	0.000	0	0	1	0.000	0.000	00
1995	0.028	0.181	-0.691	-1.710	1	1.020	1.398	35
1996	0.018	0.184	-1.133	-1.690	1	0.558	0.765	35
1997	0.020	0.264	-1.027	-1.331	1	0.304	0.417	51
1998	0.031	0.153	-0.589	-1.880	1	1.291	1.770	29
1999	0.031	0.473	-0.589	-0.749	1	0.160	0.219	91
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 0.534

spr_41
Tuned to: 1-Jan and number
For ages: 1

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1978	0.376	0.427	-0.738	-0.851	1	0.113	0.156	27711
1979	0.435	0.362	-0.592	-1.015	1	0.424	0.581	23512
1980	0.031	0.310	-3.233	-1.172	1	-2.061	-2.827	20109
1981	2.303	0.638	1.075	-0.450	1	1.525	2.091	41393
1982	0.000	0.000	0	0	1	0.000	0.000	00
1983	0.000	0.000	0	0	1	0.000	0.000	00
1984	0.000	0.000	0	0	1	0.000	0.000	00
1985	0.000	0.000	0	0	1	0.000	0.000	00
1986	0.000	0.000	0	0	1	0.000	0.000	00
1987	0.000	0.000	0	0	1	0.000	0.000	00
1988	0.000	0.000	0	0	1	0.000	0.000	00

1989	0.000	0.000	0	0	1	0.000	0.000	00
1990	0.000	0.000	0	0	1	0.000	0.000	00
1991	0.000	0.000	0	0	1	0.000	0.000	00
1992	0.000	0.000	0	0	1	0.000	0.000	00
1993	0.000	0.000	0	0	1	0.000	0.000	00
1994	0.000	0.000	0	0	1	0.000	0.000	00
1995	0.000	0.000	0	0	1	0.000	0.000	00
1996	0.000	0.000	0	0	1	0.000	0.000	00
1997	0.000	0.000	0	0	1	0.000	0.000	00
1998	0.000	0.000	0	0	1	0.000	0.000	00
1999	0.000	0.000	0	0	1	0.000	0.000	00
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 2.475

spr_41
Tuned to: 1-Jan and number
For ages: 2

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1978	0.187	0.238	-1.949	-1.437	1	-0.512	-0.703	4270
1979	1.359	1.263	0.034	0.234	1	-0.199	-0.273	22686
1980	1.790	1.070	0.310	0.068	1	0.242	0.332	19220
1981	1.916	0.912	0.378	-0.092	1	0.470	0.644	16383
1982	0.000	0.000	0	0	1	0.000	0.000	00
1983	0.000	0.000	0	0	1	0.000	0.000	00
1984	0.000	0.000	0	0	1	0.000	0.000	00
1985	0.000	0.000	0	0	1	0.000	0.000	00
1986	0.000	0.000	0	0	1	0.000	0.000	00
1987	0.000	0.000	0	0	1	0.000	0.000	00
1988	0.000	0.000	0	0	1	0.000	0.000	00
1989	0.000	0.000	0	0	1	0.000	0.000	00
1990	0.000	0.000	0	0	1	0.000	0.000	00
1991	0.000	0.000	0	0	1	0.000	0.000	00
1992	0.000	0.000	0	0	1	0.000	0.000	00
1993	0.000	0.000	0	0	1	0.000	0.000	00
1994	0.000	0.000	0	0	1	0.000	0.000	00
1995	0.000	0.000	0	0	1	0.000	0.000	00
1996	0.000	0.000	0	0	1	0.000	0.000	00
1997	0.000	0.000	0	0	1	0.000	0.000	00
1998	0.000	0.000	0	0	1	0.000	0.000	00
1999	0.000	0.000	0	0	1	0.000	0.000	00
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 0.213

spr_41
Tuned to: 1-Jan and number
For ages: 3

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. S e.
1978	5.530	1.481	0.723	0.393	1	0.330	0.453	25527
1979	0.298	0.182	-2.198	-1.703	1	-0.495	-0.679	3140
1980	2.124	0.973	-0.234	-0.027	1	-0.207	-0.283	16774
1981	2.779	0.715	0.035	-0.336	1	0.371	0.509	12318
1982	0.000	0.000	0	0	1	0.000	0.000	00
1983	0.000	0.000	0	0	1	0.000	0.000	00
1984	0.000	0.000	0	0	1	0.000	0.000	00
1985	0.000	0.000	0	0	1	0.000	0.000	00

1986	0.000	0.000	0	0	1	0.000	0.000	00
1987	0.000	0.000	0	0	1	0.000	0.000	00
1988	0.000	0.000	0	0	1	0.000	0.000	00
1989	0.000	0.000	0	0	1	0.000	0.000	00
1990	0.000	0.000	0	0	1	0.000	0.000	00
1991	0.000	0.000	0	0	1	0.000	0.000	00
1992	0.000	0.000	0	0	1	0.000	0.000	00
1993	0.000	0.000	0	0	1	0.000	0.000	00
1994	0.000	0.000	0	0	1	0.000	0.000	00
1995	0.000	0.000	0	0	1	0.000	0.000	00
1996	0.000	0.000	0	0	1	0.000	0.000	00
1997	0.000	0.000	0	0	1	0.000	0.000	00
1998	0.000	0.000	0	0	1	0.000	0.000	00
1999	0.000	0.000	0	0	1	0.000	0.000	00
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 0.196

spr_41
Tuned to: 1-Jan and number
For ages: 4

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1978	0.969	0.894	-0.196	-0.112	1	-0.084	-0.115	7933
1979	1.913	1.566	0.484	0.448	1	0.036	0.050	13889
1980	0.165	0.198	-1.966	-1.620	1	-0.347	-0.475	1756
1981	1.667	0.954	0.347	-0.047	1	0.394	0.541	8460
1982	0.000	0.000	0	0	1	0.000	0.000	00
1983	0.000	0.000	0	0	1	0.000	0.000	00
1984	0.000	0.000	0	0	1	0.000	0.000	00
1985	0.000	0.000	0	0	1	0.000	0.000	00
1986	0.000	0.000	0	0	1	0.000	0.000	00
1987	0.000	0.000	0	0	1	0.000	0.000	00
1988	0.000	0.000	0	0	1	0.000	0.000	00
1989	0.000	0.000	0	0	1	0.000	0.000	00
1990	0.000	0.000	0	0	1	0.000	0.000	00
1991	0.000	0.000	0	0	1	0.000	0.000	00
1992	0.000	0.000	0	0	1	0.000	0.000	00
1993	0.000	0.000	0	0	1	0.000	0.000	00
1994	0.000	0.000	0	0	1	0.000	0.000	00
1995	0.000	0.000	0	0	1	0.000	0.000	00
1996	0.000	0.000	0	0	1	0.000	0.000	00
1997	0.000	0.000	0	0	1	0.000	0.000	00
1998	0.000	0.000	0	0	1	0.000	0.000	00
1999	0.000	0.000	0	0	1	0.000	0.000	00
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 0.104

spr_41
Tuned to: 1-Jan and number
For ages: 5

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1978	0.778	0.685	0.184	-0.378	1	0.562	0.770	2877
1979	0.541	1.051	-0.180	0.049	1	-0.229	-0.314	4411
1980	1.171	1.659	0.592	0.506	1	0.086	0.118	6965
1981	0.100	0.235	-1.868	-1.449	1	-0.419	-0.574	986
1982	0.000	0.000	0	0	1	0.000	0.000	00

1983	0.000	0.000	0	0	1	0.000	0.000	00
1984	0.000	0.000	0	0	1	0.000	0.000	00
1985	0.000	0.000	0	0	1	0.000	0.000	00
1986	0.000	0.000	0	0	1	0.000	0.000	00
1987	0.000	0.000	0	0	1	0.000	0.000	00
1988	0.000	0.000	0	0	1	0.000	0.000	00
1989	0.000	0.000	0	0	1	0.000	0.000	00
1990	0.000	0.000	0	0	1	0.000	0.000	00
1991	0.000	0.000	0	0	1	0.000	0.000	00
1992	0.000	0.000	0	0	1	0.000	0.000	00
1993	0.000	0.000	0	0	1	0.000	0.000	00
1994	0.000	0.000	0	0	1	0.000	0.000	00
1995	0.000	0.000	0	0	1	0.000	0.000	00
1996	0.000	0.000	0	0	1	0.000	0.000	00
1997	0.000	0.000	0	0	1	0.000	0.000	00
1998	0.000	0.000	0	0	1	0.000	0.000	00
1999	0.000	0.000	0	0	1	0.000	0.000	00
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 0.201

spr_41
Tuned to: 1-Jan and number
For ages: 6

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1978	0.144	0.446	-1.094	-0.807	1	-0.287	-0.394	1127
1979	0.234	0.636	-0.608	-0.453	1	-0.155	-0.213	1604
1980	0.472	0.996	0.093	-0.004	1	0.097	0.133	2515
1981	0.870	1.432	0.705	0.359	1	0.346	0.474	3614
1982	0.000	0.000	0	0	1	0.000	0.000	00
1983	0.000	0.000	0	0	1	0.000	0.000	00
1984	0.000	0.000	0	0	1	0.000	0.000	00
1985	0.000	0.000	0	0	1	0.000	0.000	00
1986	0.000	0.000	0	0	1	0.000	0.000	00
1987	0.000	0.000	0	0	1	0.000	0.000	00
1988	0.000	0.000	0	0	1	0.000	0.000	00
1989	0.000	0.000	0	0	1	0.000	0.000	00
1990	0.000	0.000	0	0	1	0.000	0.000	00
1991	0.000	0.000	0	0	1	0.000	0.000	00
1992	0.000	0.000	0	0	1	0.000	0.000	00
1993	0.000	0.000	0	0	1	0.000	0.000	00
1994	0.000	0.000	0	0	1	0.000	0.000	00
1995	0.000	0.000	0	0	1	0.000	0.000	00
1996	0.000	0.000	0	0	1	0.000	0.000	00
1997	0.000	0.000	0	0	1	0.000	0.000	00
1998	0.000	0.000	0	0	1	0.000	0.000	00
1999	0.000	0.000	0	0	1	0.000	0.000	00
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 0.086

spr_41
Tuned to: 1-Jan and number
For ages: 7

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1978	0.713	1.013	0.848	0.013	1	0.835	1.146	1414
1979	0.087	0.576	-1.255	-0.552	1	-0.703	-0.965	804

1980	0.152	0.644	-0.697	-0.440	1	-0.257	-0.353	899
1981	0.269	0.778	-0.126	-0.252	1	0.125	0.172	1085
1982	0.000	0.000	0	0	1	0.000	0.000	00
1983	0.000	0.000	0	0	1	0.000	0.000	00
1984	0.000	0.000	0	0	1	0.000	0.000	00
1985	0.000	0.000	0	0	1	0.000	0.000	00
1986	0.000	0.000	0	0	1	0.000	0.000	00
1987	0.000	0.000	0	0	1	0.000	0.000	00
1988	0.000	0.000	0	0	1	0.000	0.000	00
1989	0.000	0.000	0	0	1	0.000	0.000	00
1990	0.000	0.000	0	0	1	0.000	0.000	00
1991	0.000	0.000	0	0	1	0.000	0.000	00
1992	0.000	0.000	0	0	1	0.000	0.000	00
1993	0.000	0.000	0	0	1	0.000	0.000	00
1994	0.000	0.000	0	0	1	0.000	0.000	00
1995	0.000	0.000	0	0	1	0.000	0.000	00
1996	0.000	0.000	0	0	1	0.000	0.000	00
1997	0.000	0.000	0	0	1	0.000	0.000	00
1998	0.000	0.000	0	0	1	0.000	0.000	00
1999	0.000	0.000	0	0	1	0.000	0.000	00
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 0.466

spr_41
Tuned to: 1-Jan and number
For ages: 8

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1978	0.051	0.163	-0.582	-1.817	1	1.235	1.694	67
1979	0.145	2.049	0.463	0.718	1	-0.254	-0.349	846
1980	0.025	1.426	-1.295	0.355	1	-1.650	-2.262	588
1981	0.144	0.808	0.456	-0.213	1	0.669	0.918	334
1982	0.000	0.000	0	0	1	0.000	0.000	00
1983	0.000	0.000	0	0	1	0.000	0.000	00
1984	0.000	0.000	0	0	1	0.000	0.000	00
1985	0.000	0.000	0	0	1	0.000	0.000	00
1986	0.000	0.000	0	0	1	0.000	0.000	00
1987	0.000	0.000	0	0	1	0.000	0.000	00
1988	0.000	0.000	0	0	1	0.000	0.000	00
1989	0.000	0.000	0	0	1	0.000	0.000	00
1990	0.000	0.000	0	0	1	0.000	0.000	00
1991	0.000	0.000	0	0	1	0.000	0.000	00
1992	0.000	0.000	0	0	1	0.000	0.000	00
1993	0.000	0.000	0	0	1	0.000	0.000	00
1994	0.000	0.000	0	0	1	0.000	0.000	00
1995	0.000	0.000	0	0	1	0.000	0.000	00
1996	0.000	0.000	0	0	1	0.000	0.000	00
1997	0.000	0.000	0	0	1	0.000	0.000	00
1998	0.000	0.000	0	0	1	0.000	0.000	00
1999	0.000	0.000	0	0	1	0.000	0.000	00
2000	0.000	0.000	0	0	0	0.000	0.000	00

Partial Variance: 1.741

sp_can
Tuned to: 1-Jan and number
For ages: 1

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. S e.
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	0.000	0.000	0	0	1	0.000	0.000	00
1983	0.000	0.000	0	0	1	0.000	0.000	00
1984	0.000	0.000	0	0	1	0.000	0.000	00
1985	0.000	0.000	0	0	1	0.000	0.000	00
1986	0.600	2.257	0.360	0.814	1	-0.453	-0.622	42754
1987	0.250	0.864	-0.515	-0.146	1	-0.369	-0.507	16377
1988	0.280	1.238	-0.402	0.214	1	-0.615	-0.844	23456
1989	1.630	0.830	1.360	-0.187	1	1.547	2.121	15718
1990	0.420	0.488	0.004	-0.717	1	0.720	0.988	9252
1991	1.180	0.944	1.037	-0.058	1	1.095	1.501	17881
1992	0.110	0.363	-1.336	-1.013	1	-0.323	-0.443	6880
1993	0.000	0.000	0	0	1	0.000	0.000	00
1994	0.000	0.000	0	0	1	0.000	0.000	00
1995	0.070	0.246	-1.788	-1.404	1	-0.385	-0.527	4656
1996	0.140	0.465	-1.095	-0.767	1	-0.328	-0.450	8803
1997	0.320	0.550	-0.268	-0.598	1	0.330	0.452	10420
1998	0.010	0.150	-3.734	-1.897	1	-1.837	-2.520	2842
1999	0.330	0.360	-0.237	-1.020	1	0.783	1.074	6830
2000	0.100	0.281	-1.431	-1.268	1	-0.163	-0.224	5329

Partial Variance: 0.794

sp_can
Tuned to: 1-Jan and number
For ages: 2

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. S e.
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	0.000	0.000	0	0	1	0.000	0.000	00
1983	0.000	0.000	0	0	1	0.000	0.000	00
1984	0.000	0.000	0	0	1	0.000	0.000	00
1985	0.000	0.000	0	0	1	0.000	0.000	00
1986	2.270	0.612	0.507	-0.491	1	0.998	1.369	6981
1987	2.130	3.057	0.444	1.118	1	-0.674	-0.924	34863
1988	1.010	1.174	-0.303	0.160	1	-0.463	-0.635	13385
1989	2.780	1.683	0.710	0.521	1	0.189	0.259	19195
1990	2.440	1.129	0.579	0.121	1	0.458	0.629	12869
1991	1.160	0.664	-0.164	-0.410	1	0.246	0.337	7568
1992	2.860	1.280	0.738	0.247	1	0.492	0.674	14593
1993	0.000	0.000	0	0	1	0.000	0.000	00
1994	0.000	0.000	0	0	1	0.000	0.000	00
1995	0.670	0.553	-0.713	-0.592	1	-0.121	-0.166	6308
1996	0.490	0.334	-1.026	-1.096	1	0.070	0.096	3812
1997	0.530	0.632	-0.947	-0.459	1	-0.489	-0.670	7206
1998	0.670	0.748	-0.713	-0.290	1	-0.423	-0.580	8528
1999	0.320	0.204	-1.452	-1.589	1	0.137	0.188	2327
2000	0.440	0.490	-1.134	-0.713	1	-0.421	-0.577	5590

Partial Variance: 0.242

sp_can
Tuned to: 1-Jan and number
For ages: 3

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	0.000	0.000	0	0	1	0.000	0.000	00
1983	0.000	0.000	0	0	1	0.000	0.000	00
1984	0.000	0.000	0	0	1	0.000	0.000	00
1985	0.000	0.000	0	0	1	0.000	0.000	00
1986	2.810	1.696	0.378	0.529	1	-0.150	-0.206	12486
1987	0.930	0.614	-0.727	-0.489	1	-0.239	-0.327	4516
1988	4.660	2.959	0.884	1.085	1	-0.201	-0.275	21781
1989	1.380	1.295	-0.333	0.259	1	-0.591	-0.811	9532
1990	3.780	1.879	0.675	0.630	1	0.045	0.061	13827
1991	1.840	0.824	-0.045	-0.194	1	0.149	0.204	6064
1992	1.770	0.654	-0.084	-0.424	1	0.340	0.467	4817
1993	0.000	0.000	0	0	1	0.000	0.000	00
1994	0.000	0.000	0	0	1	0.000	0.000	00
1995	1.500	0.791	-0.249	-0.235	1	-0.015	-0.020	5820
1996	2.310	0.653	0.183	-0.426	1	0.608	0.834	4810
1997	0.550	0.399	-1.253	-0.920	1	-0.333	-0.456	2933
1998	0.950	0.738	-0.706	-0.304	1	-0.402	-0.552	5432
1999	1.490	0.858	-0.256	-0.153	1	-0.103	-0.141	6314
2000	1.050	0.224	-0.606	-1.497	1	0.891	1.222	1647

Partial Variance: 0.175

sp_can
Tuned to: 1-Jan and number
For ages: 4

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	0.000	0.000	0	0	1	0.000	0.000	00
1983	0.000	0.000	0	0	1	0.000	0.000	00
1984	0.000	0.000	0	0	1	0.000	0.000	00
1985	0.000	0.000	0	0	1	0.000	0.000	00
1986	0.370	0.445	-1.493	-0.810	1	-0.683	-0.936	2032
1987	1.090	1.331	-0.413	0.286	1	-0.699	-0.959	6085
1988	0.580	0.531	-1.044	-0.634	1	-0.410	-0.562	2425
1989	2.850	2.314	0.548	0.839	1	-0.290	-0.398	10574
1990	2.080	1.129	0.233	0.121	1	0.112	0.154	5160
1991	2.150	1.479	0.267	0.391	1	-0.125	-0.171	6758
1992	0.800	0.444	-0.722	-0.811	1	0.089	0.122	2031
1993	0.000	0.000	0	0	1	0.000	0.000	00
1994	0.000	0.000	0	0	1	0.000	0.000	00
1995	0.860	0.347	-0.650	-1.058	1	0.408	0.560	1587
1996	4.020	0.833	0.892	-0.182	1	1.075	1.474	3808
1997	1.250	0.683	-0.276	-0.382	1	0.106	0.145	3121
1998	0.350	0.399	-1.549	-0.919	1	-0.630	-0.864	1823
1999	1.090	0.738	-0.413	-0.304	1	-0.109	-0.149	3373

2000	3.920	0.750	0.867	-0.288	1	1.156	1.585	3426

Partial Variance: 0.368

sp_can
Tuned to: 1-Jan and number
For ages: 5

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	0.000	0.000	0	0	1	0.000	0.000	00
1983	0.000	0.000	0	0	1	0.000	0.000	00
1984	0.000	0.000	0	0	1	0.000	0.000	00
1985	0.000	0.000	0	0	1	0.000	0.000	00
1986	0.650	0.628	-0.480	-0.465	1	-0.015	-0.021	1312
1987	0.340	0.451	-1.128	-0.796	1	-0.332	-0.456	943
1988	1.020	1.466	-0.030	0.382	1	-0.412	-0.565	3063
1989	0.360	0.512	-1.071	-0.670	1	-0.401	-0.551	1070
1990	3.870	2.344	1.304	0.852	1	0.452	0.620	4898
1991	1.050	1.207	-0.001	0.188	1	-0.189	-0.259	2522
1992	0.980	1.227	-0.070	0.205	1	-0.274	-0.376	2564
1993	0.000	0.000	0	0	1	0.000	0.000	00
1994	0.000	0.000	0	0	1	0.000	0.000	00
1995	0.600	0.325	-0.560	-1.125	1	0.565	0.774	679
1996	1.090	0.322	0.037	-1.133	1	1.169	1.604	673
1997	1.230	0.958	0.157	-0.043	1	0.201	0.276	2001
1998	0.350	0.841	-1.099	-0.173	1	-0.926	-1.270	1758
1999	0.410	0.531	-0.941	-0.633	1	-0.309	-0.423	1110
2000	1.710	1.016	0.487	0.015	1	0.472	0.647	2122

Partial Variance: 0.312

sp_can
Tuned to: 1-Jan and number
For ages: 6

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	0.000	0.000	0	0	1	0.000	0.000	00
1983	0.000	0.000	0	0	1	0.000	0.000	00
1984	0.000	0.000	0	0	1	0.000	0.000	00
1985	0.000	0.000	0	0	1	0.000	0.000	00
1986	0.440	1.905	-0.049	0.645	1	-0.694	-0.952	1611
1987	0.120	0.757	-1.349	-0.279	1	-1.070	-1.468	640
1988	0.130	0.614	-1.269	-0.488	1	-0.781	-1.071	519
1989	0.420	1.363	-0.096	0.310	1	-0.406	-0.557	1153
1990	0.420	0.681	-0.096	-0.384	1	0.288	0.395	576
1991	1.310	2.319	1.042	0.841	1	0.200	0.275	1962
1992	0.600	0.881	0.261	-0.126	1	0.387	0.531	745
1993	0.000	0.000	0	0	1	0.000	0.000	00
1994	0.000	0.000	0	0	1	0.000	0.000	00
1995	0.190	0.171	-0.889	-1.766	1	0.877	1.202	145
1996	0.790	0.347	0.536	-1.060	1	1.596	2.188	293

1997	0.270	0.394	-0.538	-0.932	1	0.394	0.540	333
1998	0.280	1.088	-0.501	0.084	1	-0.585	-0.803	920
1999	0.260	1.355	-0.576	0.304	1	-0.879	-1.206	1146
2000	0.780	0.860	0.523	-0.151	1	0.674	0.925	727

Partial Variance: 0.657

sp_can
Tuned to: 1-Jan and number
For ages: 7

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	0.000	0.000	0	0	1	0.000	0.000	00
1983	0.000	0.000	0	0	1	0.000	0.000	00
1984	0.000	0.000	0	0	1	0.000	0.000	00
1985	0.000	0.000	0	0	1	0.000	0.000	00
1986	0.260	0.805	0.061	-0.217	1	0.278	0.381	340
1987	0.220	1.779	-0.106	0.576	1	-0.682	-0.936	752
1988	0.080	0.700	-1.118	-0.356	1	-0.762	-1.045	296
1989	0.050	0.484	-1.588	-0.726	1	-0.862	-1.182	205
1990	0.930	1.075	1.335	0.073	1	1.263	1.732	455
1991	0.160	0.626	-0.425	-0.469	1	0.044	0.061	265
1992	0.430	1.470	0.564	0.385	1	0.179	0.245	622
1993	0.000	0.000	0	0	1	0.000	0.000	00
1994	0.000	0.000	0	0	1	0.000	0.000	00
1995	0.040	0.170	-1.811	-1.769	1	-0.042	-0.057	72
1996	0.330	0.186	0.299	-1.682	1	1.981	2.717	79
1997	0.060	0.304	-1.405	-1.189	1	-0.216	-0.296	129
1998	0.070	0.365	-1.251	-1.008	1	-0.243	-0.333	154
1999	0.150	1.274	-0.489	0.242	1	-0.732	-1.003	539
2000	0.400	2.012	0.492	0.699	1	-0.207	-0.284	850

Partial Variance: 0.691

sp_can
Tuned to: 1-Jan and number
For ages: 8

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1978	0.000	0.000	0	0	1	0.000	0.000	00
1979	0.000	0.000	0	0	1	0.000	0.000	00
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.000	0.000	0	0	1	0.000	0.000	00
1982	0.000	0.000	0	0	1	0.000	0.000	00
1983	0.000	0.000	0	0	1	0.000	0.000	00
1984	0.000	0.000	0	0	1	0.000	0.000	00
1985	0.000	0.000	0	0	1	0.000	0.000	00
1986	0.040	1.487	-0.901	0.397	1	-1.297	-1.779	212
1987	0.080	1.402	-0.208	0.338	1	-0.546	-0.748	200
1988	0.170	2.604	0.546	0.957	1	-0.411	-0.564	371
1989	0.100	0.679	0.016	-0.388	1	0.403	0.553	97
1990	0.120	0.654	0.198	-0.425	1	0.623	0.854	93
1991	0.220	1.055	0.804	0.054	1	0.750	1.029	150
1992	0.120	0.720	0.198	-0.329	1	0.527	0.723	103
1993	0.000	0.000	0	0	1	0.000	0.000	00

1994	0.000	0.000	0	0	1	0.000	0.000	00
1995	0.050	0.244	-0.678	-1.411	1	0.733	1.006	35
1996	0.080	0.249	-0.208	-1.391	1	1.183	1.623	35
1997	0.030	0.356	-1.188	-1.032	1	-0.157	-0.215	51
1998	0.020	0.206	-1.594	-1.580	1	-0.014	-0.019	29
1999	0.010	0.638	-2.287	-0.449	1	-1.838	-2.520	91
2000	0.240	2.338	0.891	0.849	1	0.042	0.057	333

Partial Variance: 0.757

us0aut
Tuned to: 1-Jan and number
For ages: 1

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1978	0.152	1.239	-0.496	0.214	1	-0.710	-0.974	27711
1979	0.396	1.051	0.461	0.050	1	0.412	0.565	23512
1980	0.118	0.899	-0.749	-0.107	1	-0.643	-0.882	20109
1981	0.280	1.850	0.115	0.615	1	-0.501	-0.687	41393
1982	0.261	0.781	0.044	-0.247	1	0.292	0.400	17471
1983	0.320	0.430	0.248	-0.845	1	1.093	1.499	9615
1984	1.031	1.224	1.418	0.202	1	1.216	1.668	27391
1985	0.186	0.388	-0.294	-0.947	1	0.653	0.896	8675
1986	1.084	1.911	1.468	0.648	1	0.821	1.126	42754
1987	0.096	0.732	-0.956	-0.312	1	-0.644	-0.883	16377
1988	0.204	1.048	-0.202	0.047	1	-0.249	-0.342	23456
1989	0.549	0.703	0.788	-0.353	1	1.141	1.565	15718
1990	0.262	0.414	0.048	-0.883	1	0.931	1.277	9252
1991	0.156	0.799	-0.470	-0.224	1	-0.246	-0.338	17881
1992	0.040	0.307	-1.831	-1.179	1	-0.652	-0.894	6880
1993	0.033	0.412	-2.024	-0.886	1	-1.138	-1.560	9225
1994	0.179	0.344	-0.333	-1.066	1	0.733	1.006	7706
1995	0.067	0.208	-1.315	-1.570	1	0.254	0.349	4656
1996	0.160	0.393	-0.445	-0.933	1	0.488	0.669	8803
1997	0.022	0.466	-2.429	-0.764	1	-1.665	-2.283	10420
1998	0.006	0.127	-3.728	-2.063	1	-1.665	-2.284	2842
1999	0.070	0.305	-1.272	-1.187	1	-0.085	-0.117	6830
2000	0.070	0.238	-1.272	-1.435	1	0.163	0.224	5329

Partial Variance: 0.738

us1aut
Tuned to: 1-Jan and number
For ages: 2

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1978	0.237	0.270	-1.415	-1.311	1	-0.104	-0.143	4270
1979	1.855	1.433	0.643	0.360	1	0.283	0.388	22686
1980	1.619	1.214	0.507	0.194	1	0.313	0.429	19220
1981	0.818	1.035	-0.176	0.034	1	-0.210	-0.288	16383
1982	3.525	2.139	1.285	0.760	1	0.525	0.720	33865
1983	0.875	0.885	-0.108	-0.123	1	0.014	0.019	14004
1984	0.647	0.491	-0.410	-0.711	1	0.301	0.413	7774
1985	2.496	1.412	0.940	0.345	1	0.595	0.816	22352
1986	0.220	0.441	-1.489	-0.819	1	-0.670	-0.919	6981
1987	2.280	2.202	0.849	0.789	1	0.060	0.082	34863
1988	0.414	0.845	-0.857	-0.168	1	-0.689	-0.945	13385
1989	0.903	1.212	-0.077	0.193	1	-0.270	-0.370	19195
1990	2.738	0.813	1.032	-0.207	1	1.240	1.700	12869

1991	0.362	0.478	-0.991	-0.738	1	-0.253	-0.347	7568
1992	0.415	0.922	-0.854	-0.082	1	-0.773	-1.060	14593
1993	0.454	0.352	-0.765	-1.045	1	0.280	0.384	5569
1994	0.970	0.477	-0.005	-0.741	1	0.735	1.008	7549
1995	0.406	0.398	-0.876	-0.920	1	0.044	0.060	6308
1996	0.245	0.241	-1.381	-1.424	1	0.043	0.058	3812
1997	0.240	0.455	-1.402	-0.787	1	-0.615	-0.843	7206
1998	0.236	0.539	-1.419	-0.619	1	-0.800	-1.098	8528
1999	0.336	0.147	-1.066	-1.918	1	0.852	1.168	2327
2000	0.140	0.353	-1.941	-1.041	1	-0.900	-1.234	5590

Partial Variance: 0.337

us2aut
Tuned to: 1-Jan and number
For ages: 3

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1978	3.424	2.294	1.247	0.830	1	0.417	0.571	25527
1979	0.255	0.282	-1.350	-1.265	1	-0.085	-0.117	3140
1980	1.717	1.508	0.557	0.411	1	0.146	0.201	16774
1981	0.564	1.107	-0.556	0.102	1	-0.658	-0.903	12318
1982	2.250	0.945	0.827	-0.057	1	0.884	1.212	10514
1983	2.094	1.749	0.755	0.559	1	0.196	0.269	19458
1984	1.022	0.682	0.038	-0.383	1	0.421	0.577	7588
1985	0.101	0.466	-2.276	-0.764	1	-1.512	-2.074	5182
1986	0.803	1.122	-0.203	0.115	1	-0.318	-0.437	12486
1987	0.153	0.406	-1.861	-0.902	1	-0.959	-1.316	4516
1988	1.353	1.958	0.319	0.672	1	-0.353	-0.484	21781
1989	0.433	0.857	-0.821	-0.155	1	-0.666	-0.914	9532
1990	1.030	1.243	0.046	0.217	1	-0.171	-0.235	13827
1991	1.534	0.545	0.444	-0.607	1	1.051	1.442	6064
1992	0.168	0.433	-1.768	-0.837	1	-0.930	-1.276	4817
1993	1.024	0.734	0.040	-0.309	1	0.349	0.479	8168
1994	0.532	0.326	-0.615	-1.121	1	0.507	0.695	3625
1995	0.664	0.523	-0.393	-0.648	1	0.255	0.349	5820
1996	1.811	0.432	0.610	-0.839	1	1.449	1.987	4810
1997	0.196	0.264	-1.613	-1.333	1	-0.280	-0.384	2933
1998	0.321	0.488	-1.120	-0.717	1	-0.403	-0.553	5432
1999	1.026	0.567	0.042	-0.567	1	0.608	0.835	6314
2000	0.154	0.148	-1.855	-1.910	1	0.056	0.076	1647

Partial Variance: 0.491

us3aut
Tuned to: 1-Jan and number
For ages: 4

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1978	0.702	1.252	0.015	0.225	1	-0.210	-0.288	7933
1979	4.180	2.192	1.799	0.785	1	1.014	1.391	13889
1980	0.224	0.277	-1.127	-1.283	1	0.156	0.214	1756
1981	0.774	1.336	0.113	0.289	1	-0.176	-0.242	8460
1982	1.559	0.989	0.813	-0.011	1	0.824	1.130	6266
1983	0.220	0.813	-1.145	-0.208	1	-0.937	-1.286	5148
1984	0.796	1.363	0.141	0.310	1	-0.169	-0.232	8635
1985	0.886	0.492	0.248	-0.710	1	0.958	1.314	3115
1986	0.103	0.321	-1.904	-1.137	1	-0.767	-1.052	2032
1987	0.382	0.961	-0.593	-0.040	1	-0.553	-0.758	6085

1988	0.112	0.383	-1.820	-0.960	1	-0.860	-1.179	2425
1989	0.909	1.669	0.274	0.512	1	-0.239	-0.327	10574
1990	0.183	0.815	-1.329	-0.205	1	-1.124	-1.542	5160
1991	1.164	1.067	0.521	0.065	1	0.456	0.626	6758
1992	0.277	0.321	-0.915	-1.138	1	0.223	0.306	2031
1993	0.180	0.313	-1.346	-1.163	1	-0.183	-0.251	1980
1994	0.382	0.449	-0.593	-0.800	1	0.207	0.284	2846
1995	0.433	0.251	-0.468	-1.384	1	0.916	1.257	1587
1996	1.249	0.601	0.592	-0.509	1	1.100	1.509	3808
1997	0.414	0.493	-0.513	-0.708	1	0.195	0.268	3121
1998	0.109	0.288	-1.847	-1.245	1	-0.602	-0.826	1823
1999	0.352	0.532	-0.675	-0.630	1	-0.045	-0.061	3373
2000	0.310	0.541	-0.802	-0.615	1	-0.187	-0.257	3426

Partial Variance: 0.433

us4aut
Tuned to: 1-Jan and number
For ages: 5

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. S e.
1978	0.251	0.743	-0.129	-0.298	1	0.168	0.231	2877
1979	0.964	1.139	1.216	0.130	1	1.086	1.490	4411
1980	1.613	1.798	1.731	0.586	1	1.144	1.570	6965
1981	0.076	0.254	-1.324	-1.369	1	0.045	0.061	986
1982	0.589	1.212	0.723	0.193	1	0.531	0.728	4697
1983	0.069	0.673	-1.421	-0.396	1	-1.025	-1.406	2608
1984	0.055	0.514	-1.648	-0.665	1	-0.982	-1.348	1992
1985	0.870	1.046	1.114	0.045	1	1.069	1.466	4052
1986	0.115	0.339	-0.910	-1.083	1	0.173	0.237	1312
1987	0.010	0.243	-3.352	-1.413	1	-1.939	-2.660	943
1988	0.195	0.791	-0.382	-0.235	1	-0.147	-0.201	3063
1989	0.091	0.276	-1.144	-1.287	1	0.143	0.196	1070
1990	0.499	1.264	0.558	0.234	1	0.323	0.443	4898
1991	0.209	0.651	-0.313	-0.429	1	0.117	0.160	2522
1992	0.028	0.662	-2.323	-0.413	1	-1.910	-2.620	2564
1993	0.112	0.187	-0.936	-1.678	1	0.742	1.017	723
1994	0.017	0.158	-2.822	-1.845	1	-0.977	-1.339	612
1995	0.153	0.175	-0.624	-1.742	1	1.118	1.533	679
1996	0.087	0.174	-1.189	-1.750	1	0.561	0.769	673
1997	0.143	0.517	-0.692	-0.661	1	-0.031	-0.043	2001
1998	0.129	0.454	-0.795	-0.790	1	-0.005	-0.007	1758
1999	0.041	0.287	-1.941	-1.250	1	-0.691	-0.948	1110
2000	0.255	0.548	-0.114	-0.602	1	0.488	0.670	2122

Partial Variance: 0.798

us5aut
Tuned to: 1-Jan and number
For ages: 6

Year	Obs.	Pred.	Scd. Obs.	Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. S e.
1978	0.174	0.958	0.564	-0.043	1	0.608	0.834	1127
1979	0.335	1.364	1.219	0.310	1	0.909	1.247	1604
1980	0.296	2.138	1.096	0.760	1	0.336	0.461	2515
1981	0.251	3.072	0.931	1.122	1	-0.191	-0.263	3614
1982	0.054	0.505	-0.606	-0.683	1	0.077	0.106	594
1983	0.097	1.731	-0.020	0.548	1	-0.568	-0.780	2036
1984	0.047	1.004	-0.745	0.004	1	-0.748	-1.026	1181

1985	0.017	0.740	-1.761	-0.301	1	-1.461	-2.004	871
1986	0.101	1.370	0.020	0.315	1	-0.294	-0.403	1611
1987	0.061	0.544	-0.484	-0.609	1	0.125	0.171	640
1988	0.028	0.442	-1.262	-0.818	1	-0.445	-0.610	519
1989	0.178	0.980	0.587	-0.020	1	0.607	0.833	1153
1990	0.055	0.490	-0.587	-0.714	1	0.126	0.173	576
1991	0.145	1.667	0.382	0.511	1	-0.129	-0.177	1962
1992	0.029	0.634	-1.227	-0.456	1	-0.771	-1.058	745
1993	0.030	0.645	-1.193	-0.439	1	-0.754	-1.035	758
1994	0.025	0.165	-1.376	-1.802	1	0.426	0.584	194
1995	0.068	0.123	-0.375	-2.096	1	1.720	2.360	145
1996	0.054	0.249	-0.606	-1.390	1	0.784	1.075	293
1997	0.060	0.283	-0.500	-1.262	1	0.761	1.044	333
1998	0.049	0.782	-0.703	-0.246	1	-0.457	-0.627	920
1999	0.035	0.974	-1.039	-0.026	1	-1.013	-1.389	1146
2000	0.087	0.618	-0.129	-0.481	1	0.353	0.483	727

Partial Variance: 0.549

Partial variance (and proportion of total) by index

Index	Partial Variance	Proportion
spr_36 1	0.861	0.051
spr_36 2	0.127	0.008
spr_36 3	0.143	0.008
spr_36 4	0.25	0.015
spr_36 5	0.434	0.026
spr_36 6	0.911	0.054
spr_36 7	0.769	0.046
spr_36 8	0.534	0.032
spr_41 1	2.475	0.147
spr_41 2	0.213	0.013
spr_41 3	0.196	0.012
spr_41 4	0.104	0.006
spr_41 5	0.201	0.012
spr_41 6	0.086	0.005
spr_41 7	0.466	0.028
spr_41 8	1.741	0.103
sp_can 1	0.794	0.047
sp_can 2	0.242	0.014
sp_can 3	0.175	0.01
sp_can 4	0.368	0.022
sp_can 5	0.312	0.019
sp_can 6	0.657	0.039
sp_can 7	0.691	0.041
sp_can 8	0.757	0.045
us0aut 1	0.738	0.044
us1aut 2	0.337	0.02
us2aut 3	0.491	0.029
us3aut 4	0.433	0.026
us4aut 5	0.798	0.047
us5aut 6	0.549	0.033

Standardized residuals by index and year; with row/column/grand means

	1978	1979	1980	1981	1982	1983	1984
spr_361	0.000	0.000	0.000	0.000	0.710	0.989	-0.173
spr_362	0.000	0.000	0.000	0.000	0.472	0.935	-0.245
spr_363	0.000	0.000	0.000	0.000	0.169	0.386	-0.162
spr_364	0.000	0.000	0.000	0.000	0.291	-0.160	-0.299
spr_365	0.000	0.000	0.000	0.000	0.070	0.329	0.086
spr_366	0.000	0.000	0.000	0.000	-2.747	0.081	0.806
spr_367	0.000	0.000	0.000	0.000	-0.615	-0.214	-0.247
spr_368	0.000	0.000	0.000	0.000	-1.154	-0.212	0.000
spr_411	0.156	0.581	-2.827	2.091	0.000	0.000	0.000
spr_412	-0.703	-0.273	0.332	0.644	0.000	0.000	0.000
spr_413	0.453	-0.679	-0.283	0.509	0.000	0.000	0.000
spr_414	-0.115	0.050	-0.475	0.541	0.000	0.000	0.000
spr_415	0.770	-0.314	0.118	-0.574	0.000	0.000	0.000
spr_416	-0.394	-0.213	0.133	0.474	0.000	0.000	0.000
spr_417	1.146	-0.965	-0.353	0.172	0.000	0.000	0.000
spr_418	1.694	-0.349	-2.262	0.918	0.000	0.000	0.000
sp_can1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
sp_can2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
sp_can3	0.000	0.000	0.000	0.000	0.000	0.000	0.000
sp_can4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
sp_can5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
sp_can6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
sp_can7	0.000	0.000	0.000	0.000	0.000	0.000	0.000
sp_can8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
us0aut1	-0.974	0.565	-0.882	-0.687	0.400	1.499	1.668
us1aut2	-0.143	0.388	0.429	-0.288	0.720	0.019	0.413
us2aut3	0.571	-0.117	0.201	-0.903	1.212	0.269	0.577
us3aut4	-0.288	1.391	0.214	-0.242	1.130	-1.286	-0.232
us4aut5	0.231	1.490	1.570	0.061	0.728	-1.406	-1.348
us5aut6	0.834	1.247	0.461	-0.263	0.106	-0.780	-1.026
Col Avg	0.231	0.200	-0.259	0.175	0.107	0.032	-0.014

	1985	1986	1987	1988	1989	1990	1991
spr_361	-0.531	0.277	-2.855	0.801	0.512	0.317	1.753
spr_362	0.693	-0.218	-0.589	-0.452	-0.030	0.017	-0.070
spr_363	0.290	0.290	-0.386	0.261	-0.571	0.060	0.162
spr_364	0.972	0.079	-0.414	0.026	-0.196	-0.382	-0.338
spr_365	0.609	0.934	-1.639	0.002	0.019	-0.191	-0.183
spr_366	0.604	0.929	0.463	-1.144	0.552	0.115	-0.209
spr_367	0.526	-0.552	-0.477	-1.934	-0.143	0.137	-0.864
spr_368	0.625	0.904	-1.768	-1.001	0.484	-1.006	-0.087
spr_411	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_412	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_413	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_414	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_415	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_416	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_417	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_418	0.000	0.000	0.000	0.000	0.000	0.000	0.000
sp_can1	0.000	-0.622	-0.507	-0.844	2.121	0.988	1.501

sp_can2	0.000	1.369	-0.924	-0.635	0.259	0.629	0.337
sp_can3	0.000	-0.206	-0.327	-0.275	-0.811	0.061	0.204
sp_can4	0.000	-0.936	-0.959	-0.562	-0.398	0.154	-0.171
sp_can5	0.000	-0.021	-0.456	-0.565	-0.551	0.620	-0.259
sp_can6	0.000	-0.952	-1.468	-1.071	-0.557	0.395	0.275
sp_can7	0.000	0.381	-0.936	-1.045	-1.182	1.732	0.061
sp_can8	0.000	-1.779	-0.748	-0.564	0.553	0.854	1.029
us0aut1	0.896	1.126	-0.883	-0.342	1.565	1.277	-0.338
us1aut2	0.816	-0.919	0.082	-0.945	-0.370	1.700	-0.347
us2aut3	-2.074	-0.437	-1.316	-0.484	-0.914	-0.235	1.442
us3aut4	1.314	-1.052	-0.758	-1.179	-0.327	-1.542	0.626
us4aut5	1.466	0.237	-2.660	-0.201	0.196	0.443	0.160
us5aut6	-2.004	-0.403	0.171	-0.610	0.833	0.173	-0.177
Col Avg	0.300	-0.071	-0.880	-0.580	0.047	0.287	0.205

	1992	1993	1994	1995	1996	1997	1998
spr_361	0.098	-3.018	-0.057	-0.601	-0.955	0.710	1.170
spr_362	0.262	0.008	-0.926	-0.219	-0.323	-0.217	0.128
spr_363	-0.263	0.457	-1.052	0.296	0.354	-0.978	0.965
spr_364	-1.006	-0.548	-1.083	0.959	0.922	-0.089	1.403
spr_365	-0.948	-0.482	-1.867	1.968	0.283	0.004	0.980
spr_366	-0.044	-0.318	-2.808	1.797	1.747	-0.390	1.462
spr_367	-0.091	-0.829	-0.272	3.377	0.345	1.817	1.195
spr_368	-0.547	-0.806	0.000	1.398	0.765	0.417	1.770
spr_411	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_412	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_413	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_414	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_415	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_416	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_417	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_418	0.000	0.000	0.000	0.000	0.000	0.000	0.000
sp_can1	-0.443	0.000	0.000	-0.527	-0.450	0.452	-2.520
sp_can2	0.674	0.000	0.000	-0.166	0.096	-0.670	-0.580
sp_can3	0.467	0.000	0.000	-0.020	0.834	-0.456	-0.552
sp_can4	0.122	0.000	0.000	0.560	1.474	0.145	-0.864
sp_can5	-0.376	0.000	0.000	0.774	1.604	0.276	-1.270
sp_can6	0.531	0.000	0.000	1.202	2.188	0.540	-0.803
sp_can7	0.245	0.000	0.000	-0.057	2.717	-0.296	-0.333
sp_can8	0.723	0.000	0.000	1.006	1.623	-0.215	-0.019
us0aut1	-0.894	-1.560	1.006	0.349	0.669	-2.283	-2.284
us1aut2	-1.060	0.384	1.008	0.060	0.058	-0.843	-1.098
us2aut3	-1.276	0.479	0.695	0.349	1.987	-0.384	-0.553
us3aut4	0.306	-0.251	0.284	1.257	1.509	0.268	-0.826
us4aut5	-2.620	1.017	-1.339	1.533	0.769	-0.043	-0.007
us5aut6	-1.058	-1.035	0.584	2.360	1.075	1.044	-0.627
Col Avg	-0.327	-0.464	-0.448	0.803	0.877	-0.054	-0.148

	1999	2000
spr_361	0.855	0.000
spr_362	0.775	0.000
spr_363	-0.279	0.000
spr_364	-0.138	0.000

spr_365	0.027	0.000
spr_366	-0.896	0.000
spr_367	-1.160	0.000
spr_368	0.219	0.000
spr_411	0.000	0.000
spr_412	0.000	0.000
spr_413	0.000	0.000
spr_414	0.000	0.000
spr_415	0.000	0.000
spr_416	0.000	0.000
spr_417	0.000	0.000
spr_418	0.000	0.000
sp_can1	1.074	-0.224
sp_can2	0.188	-0.577
sp_can3	-0.141	1.222
sp_can4	-0.149	1.585
sp_can5	-0.423	0.647
sp_can6	-1.206	0.925
sp_can7	-1.003	-0.284
sp_can8	-2.520	0.057
us0aut1	-0.117	0.224
us1aut2	1.168	-1.234
us2aut3	0.835	0.076
us3aut4	-0.061	-0.257
us4aut5	-0.948	0.670
us5aut6	-1.389	0.483
Col Avg	-0.240	0.237

Percent of total sum of squares by index and year; with row/column sums

	1978	1979	1980	1981	1982	1983	1984
spr_361	0.000	0.000	0.000	0.000	0.133	0.259	0.008
spr_362	0.000	0.000	0.000	0.000	0.059	0.231	0.016
spr_363	0.000	0.000	0.000	0.000	0.008	0.039	0.007
spr_364	0.000	0.000	0.000	0.000	0.022	0.007	0.024
spr_365	0.000	0.000	0.000	0.000	0.001	0.029	0.002
spr_366	0.000	0.000	0.000	0.000	1.997	0.002	0.172
spr_367	0.000	0.000	0.000	0.000	0.100	0.012	0.016
spr_368	0.000	0.000	0.000	0.000	0.353	0.012	0.000
spr_411	0.006	0.089	2.115	1.157	0.000	0.000	0.000
spr_412	0.131	0.020	0.029	0.110	0.000	0.000	0.000
spr_413	0.054	0.122	0.021	0.069	0.000	0.000	0.000
spr_414	0.004	0.001	0.060	0.077	0.000	0.000	0.000
spr_415	0.157	0.026	0.004	0.087	0.000	0.000	0.000
spr_416	0.041	0.012	0.005	0.060	0.000	0.000	0.000
spr_417	0.347	0.246	0.033	0.008	0.000	0.000	0.000
spr_418	0.759	0.032	1.354	0.223	0.000	0.000	0.000
sp_can1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
sp_can2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
sp_can3	0.000	0.000	0.000	0.000	0.000	0.000	0.000
sp_can4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
sp_can5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
sp_can6	0.000	0.000	0.000	0.000	0.000	0.000	0.000

sp_can7	0.000	0.000	0.000	0.000	0.000	0.000	0.000
sp_can8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
us0aut1	0.251	0.084	0.206	0.125	0.042	0.594	0.736
us1aut2	0.005	0.040	0.049	0.022	0.137	0.000	0.045
us2aut3	0.086	0.004	0.011	0.216	0.389	0.019	0.088
us3aut4	0.022	0.512	0.012	0.015	0.338	0.437	0.014
us4aut5	0.014	0.587	0.652	0.001	0.140	0.523	0.480
us5aut6	0.184	0.411	0.056	0.018	0.003	0.161	0.279
++	2.062	2.187	4.606	2.187	3.722	2.325	1.886

	1985	1986	1987	1988	1989	1990	1991
spr_361	0.075	0.020	2.156	0.170	0.069	0.027	0.813
spr_362	0.127	0.013	0.092	0.054	0.000	0.000	0.001
spr_363	0.022	0.022	0.039	0.018	0.086	0.001	0.007
spr_364	0.250	0.002	0.045	0.000	0.010	0.039	0.030
spr_365	0.098	0.231	0.711	0.000	0.000	0.010	0.009
spr_366	0.097	0.228	0.057	0.346	0.081	0.003	0.012
spr_367	0.073	0.081	0.060	0.990	0.005	0.005	0.197
spr_368	0.103	0.216	0.827	0.265	0.062	0.268	0.002
spr_411	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_412	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_413	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_414	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_415	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_416	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_417	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_418	0.000	0.000	0.000	0.000	0.000	0.000	0.000
sp_can1	0.000	0.102	0.068	0.188	1.190	0.258	0.596
sp_can2	0.000	0.496	0.226	0.107	0.018	0.105	0.030
sp_can3	0.000	0.011	0.028	0.020	0.174	0.001	0.011
sp_can4	0.000	0.232	0.243	0.084	0.042	0.006	0.008
sp_can5	0.000	0.000	0.055	0.084	0.080	0.102	0.018
sp_can6	0.000	0.240	0.570	0.304	0.082	0.041	0.020
sp_can7	0.000	0.038	0.232	0.289	0.369	0.794	0.001
sp_can8	0.000	0.838	0.148	0.084	0.081	0.193	0.280
us0aut1	0.212	0.335	0.206	0.031	0.648	0.432	0.030
us1aut2	0.176	0.224	0.002	0.236	0.036	0.765	0.032
us2aut3	1.138	0.050	0.458	0.062	0.221	0.015	0.550
us3aut4	0.457	0.293	0.152	0.368	0.028	0.629	0.104
us4aut5	0.569	0.015	1.871	0.011	0.010	0.052	0.007
us5aut6	1.062	0.043	0.008	0.099	0.183	0.008	0.008
++	4.460	3.729	8.255	3.809	3.478	3.752	2.765

	1992	1993	1994	1995	1996	1997	1998
spr_361	0.003	2.410	0.001	0.096	0.242	0.133	0.362
spr_362	0.018	0.000	0.227	0.013	0.028	0.012	0.004
spr_363	0.018	0.055	0.293	0.023	0.033	0.253	0.246
spr_364	0.268	0.079	0.310	0.243	0.225	0.002	0.521
spr_365	0.238	0.062	0.922	1.025	0.021	0.000	0.254

spr_366	0.001	0.027	2.086	0.854	0.807	0.040	0.566
spr_367	0.002	0.182	0.020	3.017	0.032	0.874	0.378
spr_368	0.079	0.172	0.000	0.517	0.155	0.046	0.829
spr_411	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_412	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_413	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_414	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_415	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_416	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_417	0.000	0.000	0.000	0.000	0.000	0.000	0.000
spr_418	0.000	0.000	0.000	0.000	0.000	0.000	0.000
sp_can1	0.052	0.000	0.000	0.074	0.054	0.054	1.679
sp_can2	0.120	0.000	0.000	0.007	0.002	0.119	0.089
sp_can3	0.058	0.000	0.000	0.000	0.184	0.055	0.081
sp_can4	0.004	0.000	0.000	0.083	0.575	0.006	0.197
sp_can5	0.037	0.000	0.000	0.159	0.681	0.020	0.427
sp_can6	0.075	0.000	0.000	0.382	1.267	0.077	0.171
sp_can7	0.016	0.000	0.000	0.001	1.953	0.023	0.029
sp_can8	0.138	0.000	0.000	0.268	0.697	0.012	0.000
us0aut1	0.211	0.644	0.267	0.032	0.118	1.379	1.380
us1aut2	0.297	0.039	0.269	0.001	0.001	0.188	0.319
us2aut3	0.431	0.061	0.128	0.032	1.045	0.039	0.081
us3aut4	0.025	0.017	0.021	0.418	0.603	0.019	0.180
us4aut5	1.816	0.274	0.475	0.622	0.157	0.000	0.000
us5aut6	0.296	0.283	0.090	1.473	0.306	0.288	0.104
++	4.202	4.304	5.109	9.340	9.184	3.642	7.897

	1999	2000	++
spr_361	0.193	0.000	7.169
spr_362	0.159	0.000	1.055
spr_363	0.021	0.000	1.193
spr_364	0.005	0.000	2.083
spr_365	0.000	0.000	3.611
spr_366	0.212	0.000	7.587
spr_367	0.356	0.000	6.400
spr_368	0.013	0.000	3.919
spr_411	0.000	0.000	3.367
spr_412	0.000	0.000	0.289
spr_413	0.000	0.000	0.266
spr_414	0.000	0.000	0.141
spr_415	0.000	0.000	0.274
spr_416	0.000	0.000	0.117
spr_417	0.000	0.000	0.634
spr_418	0.000	0.000	2.368
sp_can1	0.305	0.013	4.635
sp_can2	0.009	0.088	1.416
sp_can3	0.005	0.395	1.023
sp_can4	0.006	0.664	2.150
sp_can5	0.047	0.111	1.821
sp_can6	0.385	0.226	3.839
sp_can7	0.266	0.021	4.033
sp_can8	1.681	0.001	4.421

us0aut1	0.004	0.013	7.982
us1aut2	0.361	0.403	3.647
us2aut3	0.184	0.002	5.308
us3aut4	0.001	0.017	4.683
us4aut5	0.238	0.119	8.632
us5aut6	0.511	0.062	5.937
++	4.962	2.136	100.000

STOCK NUMBERS (Jan 1) in thousands - D:\GBcod\assess_2000\vpa\gbcod_99.4

	1978	1979	1980	1981	1982	1983	1984
1	27711	23512	20109	41393	17471	9615	27391
2	4270	22686	19220	16383	33865	14004	7774
3	25527	3140	16774	12318	10514	19458	7588
4	7933	13889	1756	8460	6266	5148	8635
5	2877	4411	6965	986	4697	2608	1992
6	1127	1604	2515	3614	594	2036	1181
7	1414	804	899	1085	1687	232	965
8	67	846	588	334	511	772	104
9	147	12	463	403	162	226	419
10	55	148	27	191	187	145	293
1+	71127	71053	69317	85167	75953	54244	56343

	1985	1986	1987	1988	1989	1990	1991
1	8675	42754	16377	23456	15718	9252	17881
2	22352	6981	34863	13385	19195	12869	7568
3	5182	12486	4516	21781	9532	13827	6064
4	3115	2032	6085	2425	10574	5160	6758
5	4052	1312	943	3063	1070	4898	2522
6	871	1611	640	519	1153	576	1962
7	500	340	752	296	205	455	265
8	375	212	200	371	97	93	150
9	46	124	108	107	126	40	44
10	208	76	68	99	45	89	43
1+	45375	67929	64552	65503	57714	47259	43258

	1992	1993	1994	1995	1996	1997	1998
1	6880	9225	7706	4656	8803	10420	2842
2	14593	5569	7549	6308	3812	7206	8528
3	4817	8168	3625	5820	4810	2933	5432
4	2031	1980	2846	1587	3808	3121	1823
5	2564	723	612	679	673	2001	1758
6	745	758	194	145	293	333	920
7	622	245	194	72	79	129	154
8	103	229	57	35	35	51	29
9	60	53	58	05	15	26	27

10	18	28	09	02	01	02	18
1+	32432	26979	22850	19308	22328	26222	21533

	1999	2000
1	6830	5329
2	2327	5590
3	6314	1647
4	3373	3426
5	1110	2122
6	1146	727
7	539	850
8	91	333
9	11	60
10	17	19
1+	21757	20104

FISHING MORTALITY - D:\GBcod\assess_2000\vpa\gbcod_99.4

	1978	1979	1980	1981	1982	1983	1984
1	0.00	0.00	0.00	0.00	0.02	0.01	0.00
2	0.11	0.10	0.24	0.24	0.35	0.41	0.21
3	0.41	0.38	0.48	0.48	0.51	0.61	0.69
4	0.39	0.49	0.38	0.39	0.68	0.75	0.56
5	0.38	0.36	0.46	0.31	0.64	0.59	0.63
6	0.14	0.38	0.64	0.56	0.74	0.55	0.66
7	0.31	0.11	0.79	0.55	0.58	0.60	0.74
8	1.49	0.40	0.18	0.52	0.62	0.41	0.63
9	0.36	0.44	0.51	0.44	0.66	0.67	0.60
10	0.36	0.44	0.51	0.44	0.66	0.67	0.60

	1985	1986	1987	1988	1989	1990	1991
1	0.02	0.00	0.00	0.00	0.00	0.00	0.00
2	0.38	0.24	0.27	0.14	0.13	0.55	0.25
3	0.74	0.52	0.42	0.52	0.41	0.52	0.89
4	0.66	0.57	0.49	0.62	0.57	0.52	0.77
5	0.72	0.52	0.40	0.78	0.42	0.72	1.02
6	0.74	0.56	0.57	0.73	0.73	0.58	0.95
7	0.66	0.33	0.51	0.92	0.59	0.91	0.75
8	0.91	0.47	0.43	0.88	0.68	0.56	0.72
9	0.71	0.54	0.49	0.73	0.58	0.63	0.87
10	0.71	0.54	0.49	0.73	0.58	0.63	0.87

	1992	1993	1994	1995	1996	1997	1998
1	0.01	0.00	0.00	0.00	0.00	0.00	0.00
2	0.38	0.23	0.06	0.07	0.06	0.08	0.10
3	0.69	0.85	0.63	0.22	0.23	0.28	0.28
4	0.83	0.97	1.23	0.66	0.44	0.37	0.30
5	1.02	1.12	1.24	0.64	0.50	0.58	0.23

6	0.91	1.16	0.79	0.41	0.62	0.57	0.34
7	0.80	1.27	1.52	0.51	0.24	1.28	0.33
8	0.46	1.17	2.30	0.65	0.10	0.43	0.75
9	0.94	1.09	1.27	0.64	0.46	0.47	0.28
10	0.94	1.09	1.27	0.64	0.46	0.47	0.28

	1999
1	0.00
2	0.15
3	0.41
4	0.26
5	0.22
6	0.10
7	0.28
8	0.22
9	0.22
10	0.22

Average F for 2,8 3,8 4,8 5,8 6,8

	1978	1979	1980	1981	1982	1983	1984
2,8	0.46	0.32	0.45	0.44	0.59	0.56	0.59
3,8	0.52	0.35	0.49	0.47	0.63	0.59	0.65
4,8	0.54	0.35	0.49	0.47	0.65	0.58	0.64
5,8	0.58	0.31	0.52	0.49	0.64	0.54	0.66
6,8	0.65	0.30	0.54	0.55	0.65	0.52	0.68

	1985	1986	1987	1988	1989	1990	1991
2,8	0.69	0.46	0.44	0.66	0.50	0.62	0.76
3,8	0.74	0.49	0.47	0.74	0.57	0.63	0.85
4,8	0.74	0.49	0.48	0.79	0.60	0.65	0.84
5,8	0.76	0.47	0.48	0.83	0.60	0.69	0.86
6,8	0.77	0.45	0.50	0.84	0.66	0.68	0.81

	1992	1993	1994	1995	1996	1997	1998
2,8	0.73	0.97	1.11	0.45	0.31	0.51	0.33
3,8	0.78	1.09	1.28	0.51	0.36	0.58	0.37
4,8	0.80	1.14	1.42	0.57	0.38	0.65	0.39
5,8	0.80	1.18	1.46	0.55	0.37	0.71	0.41
6,8	0.72	1.20	1.53	0.52	0.32	0.76	0.47

	1999
2,8	0.23
3,8	0.25
4,8	0.22
5,8	0.20
6,8	0.20

Average F weighted by N for 2,8 3,8 4,8 5,8 6,8

	1978	1979	1980	1981	1982	1983	1984

2,8	0.36	0.27	0.39	0.38	0.45	0.56	0.51
3,8	0.39	0.43	0.49	0.46	0.59	0.62	0.63
4,8	0.36	0.44	0.49	0.44	0.65	0.65	0.59
5,8	0.33	0.34	0.51	0.52	0.63	0.55	0.66
6,8	0.27	0.32	0.61	0.56	0.62	0.52	0.69

	1985	1986	1987	1988	1989	1990	1991
2,8	0.51	0.44	0.32	0.43	0.33	0.56	0.68
3,8	0.72	0.52	0.46	0.57	0.51	0.56	0.87
4,8	0.71	0.54	0.48	0.73	0.57	0.62	0.85
5,8	0.73	0.52	0.48	0.79	0.58	0.71	0.97
6,8	0.75	0.52	0.52	0.83	0.71	0.71	0.91

	1992	1993	1994	1995	1996	1997	1998
2,8	0.56	0.70	0.50	0.23	0.27	0.26	0.20
3,8	0.81	0.92	0.95	0.35	0.35	0.41	0.28
4,8	0.91	1.07	1.24	0.63	0.46	0.48	0.28
5,8	0.95	1.16	1.27	0.59	0.50	0.61	0.27
6,8	0.83	1.19	1.30	0.47	0.50	0.73	0.35

	1999
2,8	0.29
3,8	0.32
4,8	0.23
5,8	0.18
6,8	0.16

Average F for weighted by Catch for 2,8 3,8 4,8 5,8 6,8

	1978	1979	1980	1981	1982	1983	1984
2,8	0.39	0.37	0.43	0.41	0.48	0.57	0.58
3,8	0.40	0.44	0.50	0.47	0.60	0.63	0.63
4,8	0.38	0.45	0.52	0.46	0.65	0.66	0.60
5,8	0.38	0.36	0.54	0.53	0.63	0.56	0.66
6,8	0.38	0.36	0.66	0.56	0.63	0.52	0.70

	1985	1986	1987	1988	1989	1990	1991
2,8	0.55	0.48	0.34	0.53	0.44	0.57	0.78
3,8	0.72	0.53	0.47	0.58	0.52	0.57	0.87
4,8	0.71	0.54	0.49	0.74	0.58	0.64	0.86
5,8	0.73	0.52	0.48	0.79	0.61	0.72	0.97
6,8	0.76	0.53	0.53	0.83	0.71	0.73	0.92

	1992	1993	1994	1995	1996	1997	1998
2,8	0.63	0.84	0.93	0.38	0.36	0.39	0.24
3,8	0.83	0.93	1.02	0.43	0.38	0.45	0.28
4,8	0.92	1.07	1.25	0.64	0.46	0.51	0.29
5,8	0.96	1.16	1.31	0.60	0.53	0.63	0.29

6,8	0.84	1.19	1.40	0.48	0.57	0.82	0.35

	1999
2,8	0.33
3,8	0.35
4,8	0.24
5,8	0.21
6,8	0.20

Biomass Weighted F

1978	1979	1980	1981	1982	1983	1984
0.31	0.29	0.39	0.32	0.47	0.52	0.41

1985	1986	1987	1988	1989	1990	1991
0.53	0.29	0.33	0.42	0.35	0.53	0.55

1992	1993	1994	1995	1996	1997	1998
0.57	0.64	0.50	0.26	0.25	0.26	0.22

1999
0.23

BACKCALCULATED PARTIAL RECRUITMENT

	1978	1979	1980	1981	1982	1983	1984
1	0.00	0.00	0.01	0.00	0.03	0.02	0.00
2	0.07	0.21	0.31	0.43	0.48	0.55	0.28
3	0.27	0.78	0.61	0.85	0.70	0.82	0.93
4	0.26	1.00	0.48	0.69	0.92	1.00	0.75
5	0.26	0.74	0.58	0.54	0.86	0.79	0.84
6	0.09	0.77	0.81	1.00	1.00	0.73	0.89
7	0.21	0.23	1.00	0.98	0.79	0.80	1.00
8	1.00	0.82	0.23	0.93	0.83	0.55	0.84
9	0.24	0.90	0.64	0.78	0.90	0.90	0.81
10	0.24	0.90	0.64	0.78	0.90	0.90	0.81

	1985	1986	1987	1988	1989	1990	1991
1	0.02	0.01	0.00	0.00	0.00	0.00	0.00
2	0.42	0.41	0.47	0.15	0.18	0.61	0.25
3	0.81	0.91	0.74	0.57	0.57	0.57	0.88
4	0.73	1.00	0.85	0.67	0.78	0.57	0.75
5	0.79	0.91	0.69	0.85	0.57	0.79	1.00
6	0.81	0.99	1.00	0.80	1.00	0.64	0.93
7	0.72	0.58	0.89	1.00	0.80	1.00	0.73
8	1.00	0.83	0.75	0.96	0.92	0.61	0.71

9	0.78	0.96	0.86	0.79	0.79	0.69	0.85
10	0.78	0.96	0.86	0.79	0.79	0.69	0.85

	1992	1993	1994	1995	1996	1997	1998
1	0.01	0.00	0.00	0.00	0.00	0.00	0.00
2	0.37	0.18	0.03	0.11	0.10	0.06	0.13
3	0.68	0.68	0.27	0.34	0.37	0.22	0.37
4	0.82	0.77	0.54	1.00	0.71	0.29	0.40
5	1.00	0.88	0.54	0.97	0.81	0.45	0.30
6	0.90	0.92	0.34	0.62	1.00	0.45	0.45
7	0.78	1.00	0.66	0.77	0.38	1.00	0.44
8	0.45	0.92	1.00	0.98	0.16	0.33	1.00
9	0.92	0.86	0.55	0.98	0.74	0.37	0.37
10	0.92	0.86	0.55	0.98	0.74	0.37	0.37

	1999
1	0.00
2	0.35
3	1.00
4	0.64
5	0.54
6	0.24
7	0.68
8	0.53
9	0.53
10	0.53

MEAN BIOMASS (using catch mean weights at age)

	1978	1979	1980	1981	1982	1983	1984
1	17756	18930	15201	33078	11990	8411	26100
2	4816	29255	22650	19782	36452	15601	10449
3	47057	5118	29978	21113	20017	31667	12313
4	20817	42243	4894	21840	16000	10999	21921
5	9449	16495	28841	4033	17037	8352	6889
6	5533	8742	11357	18264	2510	9170	5214
7	8154	6341	4785	6532	10957	1273	5563
8	275	6555	4453	2347	3458	5943	717
9	1326	107	2801	4217	1355	1693	3264
10	553	1376	303	2611	2091	1408	3101
1+	115735	135163	125263	133817	121867	94516	95531

	1985	1986	1987	1988	1989	1990	1991
1	7072	35928	10767	16706	11525	6965	18026
2	24026	8347	41188	17252	26461	14109	9907
3	7020	21792	8390	36585	16164	24310	9394
4	8106	5192	18433	5814	27821	12978	14801
5	13464	5247	4126	10558	4304	15698	6951
6	3621	8109	3448	2246	5023	2536	6869
7	2718	2353	4828	1564	1165	2326	1267

8	2321	1538	1487	2266	691	697	1034
9	341	1107	894	774	1020	345	260
10	1839	751	735	986	533	880	407
1+	70527	90365	94297	94751	94707	80844	68916

	1992	1993	1994	1995	1996	1997	1998
1	7119	7289	6327	3823	7037	9008	1492
2	17073	6946	9698	8127	5054	9900	10923
3	7862	11373	5349	9937	9507	5419	9947
4	4867	3884	5528	4082	9512	8386	5027
5	6973	1999	1557	2522	2375	5708	6772
6	2768	2640	916	800	1323	1398	4228
7	2954	965	742	553	533	541	981
8	741	1151	195	273	259	326	163
9	431	290	296	33	140	227	273
10	202	206	79	23	05	19	209
1+	50990	36742	30687	30172	35744	40933	40013

	1999
1	5137
2	3079
3	10500
4	9319
5	4427
6	6364
7	3141
8	721
9	113
10	191
1+	42991

Summaries for ages 2,8 3,8 4,8 5,8 6,8

	1978	1979	1980	1981	1982	1983	1984
2,8	96100	114750	106958	93911	106431	83005	63065
3,8	91284	85495	84308	74128	69979	67404	52616
4,8	44227	80377	54330	53016	49962	35737	40303
5,8	23411	38134	49436	31176	33961	24738	18383
6,8	13962	21638	20595	27144	16924	16386	11494

	1985	1986	1987	1988	1989	1990	1991
2,8	61275	52578	81900	76285	81630	72653	50223
3,8	37249	44231	40712	59034	55168	58545	40316
4,8	30230	22439	32322	22448	39004	34234	30922
5,8	22124	17248	13890	16635	11183	21256	16121
6,8	8660	12001	9763	6076	6879	5558	9170

	1992	1993	1994	1995	1996	1997	1998
2,8	43238	28957	23985	26293	28562	31678	38040
3,8	26165	22011	14287	18166	23509	21778	27117
4,8	18303	10638	8937	8229	14002	16360	17170
5,8	13436	6755	3409	4148	4490	7973	12143
6,8	6462	4756	1852	1626	2115	2265	5372

	1999
2,8	37550
3,8	34471
4,8	23971
5,8	14653
6,8	10226

Catch BIOMASS (using catch mean weights)

	1978	1979	1980	1981	1982	1983	1984
1	01	30	75	24	254	105	85
2	517	2982	5546	4819	12909	6441	2148
3	19229	1950	14524	10049	10291	19393	8500
4	8054	20709	1849	8483	10823	8241	12205
5	3628	5970	13154	1233	10835	4948	4321
6	761	3314	7272	10266	1855	5014	3439
7	2562	710	3789	3610	6373	765	4137
8	409	2631	794	1229	2133	2438	450
9	475	47	1422	1859	899	1137	1955
10	198	606	154	1151	1388	946	1858
1+	35834	38948	48578	42723	57759	49429	39099

	1985	1986	1987	1988	1989	1990	1991
1	122	145	19	08	00	06	58
2	9185	1967	11136	2407	3389	7793	2496
3	5167	11305	3539	19120	6687	12541	8399
4	5385	2949	8967	3596	15847	6696	11383
5	9720	2717	1634	8203	1802	11225	7081
6	2679	4558	1969	1644	3671	1467	6520
7	1787	781	2441	1437	682	2106	947
8	2113	724	636	1999	467	388	746
9	243	603	438	565	590	216	226
10	1309	409	360	719	308	552	354
1+	37709	26159	31139	39697	33443	42990	38210

	1992	1993	1994	1995	1996	1997	1998
1	81	04	02	00	01	03	00

2	6493	1593	582	578	313	818	1100
3	5417	9717	3348	2229	2211	1492	2752
4	4051	3782	6820	2684	4217	3136	1489
5	7100	2229	1934	1612	1196	3295	1543
6	2529	3073	724	328	824	797	1417
7	2355	1221	1127	281	126	691	322
8	338	1346	447	176	25	139	122
9	405	316	377	21	65	108	77
10	190	225	100	15	02	09	58
1+	28957	23506	15461	7924	8981	10489	8879

	1999
1	02
2	448
3	4320
4	2452
5	988
6	625
7	879
8	156
9	24
10	41
1+	9936

Summaries for ages 2,8 3,8 4,8 5,8 6,8

	1978	1979	1980	1981	1982	1983	1984
2,8	35160	38264	46927	39689	55219	47241	35200
3,8	34643	35283	41381	34870	42310	40800	33053
4,8	15414	33333	26857	24822	32019	21407	24553
5,8	7360	12624	25009	16339	21196	13166	12348
6,8	3732	6654	11855	15105	10361	8218	8027

	1985	1986	1987	1988	1989	1990	1991
2,8	36035	25002	30322	38405	32545	42216	37572
3,8	26850	23035	19186	35999	29156	34423	35077
4,8	21683	11730	15647	16879	22469	21882	26678
5,8	16298	8780	6680	13283	6622	15186	15295
6,8	6578	6063	5046	5080	4820	3960	8214

	1992	1993	1994	1995	1996	1997	1998
2,8	28281	22961	14982	7888	8913	10369	8743
3,8	21789	21368	14400	7310	8600	9551	7644
4,8	16372	11651	11052	5081	6389	8059	4892
5,8	12321	7869	4232	2398	2172	4922	3403
6,8	5221	5640	2298	785	976	1628	1860

	1999

2,8	9868
3,8	9420
4,8	5100
5,8	2648
6,8	1660

Jan 1 BIOMASS (using Jan 1 mean weights)

	1978	1979	1980	1981	1982	1983	1984
1	13468	16318	12568	28975	9574	7192	24844
2	4368	23322	21891	18317	37658	14957	9795
3	48016	5269	32207	22850	20985	35531	14500
4	23180	44708	4932	24560	18841	15284	25328
5	9695	18165	33960	4310	20080	10996	8170
6	5175	8951	14365	23078	3463	11908	6524
7	8818	5860	6978	8208	13868	1673	7281
8	486	7376	5376	3038	4708	7575	935
9	1469	124	4322	4574	1799	2381	4522
10	721	1863	423	3537	3123	2110	4504
1+	115396	131954	137021	141446	134099	109607	106403

	1985	1986	1987	1988	1989	1990	1991
1	6168	31467	8221	12854	9164	5496	16934
2	27315	8077	40894	14054	21633	14452	8802
3	9572	23262	8661	40709	17701	27584	12092
4	9616	5615	19478	7178	31544	14588	19612
5	17385	6125	4347	14564	4656	21042	10335
6	4973	9746	4212	3228	6934	3369	10530
7	3649	2574	6033	2438	1512	3420	1812
8	3585	1904	1889	3511	939	873	1419
9	489	1410	1156	1127	1358	468	445
10	2803	1065	1017	1514	767	1294	662
1+	85554	91245	95909	101178	96206	92584	82643

	1992	1993	1994	1995	1996	1997	1998
1	6831	6217	5479	3268	5810	7971	1001
2	19132	7390	8515	7279	4452	8496	10140
3	9643	15226	6612	10174	9104	5485	10349
4	6354	5675	8167	4574	10144	9153	5195
5	10285	3161	2449	3041	2920	7460	7189
6	4039	4155	1180	862	1768	1811	4539
7	4134	1664	1386	643	618	940	1083
8	877	1908	474	336	337	432	244
9	674	520	552	46	182	264	284
10	339	367	150	34	07	26	263

1+	62308	46283	34964	30257	35344	42039	40286

	1999
1	4945
2	2215
3	11466
4	9508
5	4592
6	6319
7	3556
8	810
9	116
10	233
1+	43759

Summaries for ages 2,8 3,8 4,8 5,8 6,8

	1978	1979	1980	1981	1982	1983	1984
2,8	99738	113650	119708	104360	119604	97924	72534
3,8	95370	90329	97817	86043	81945	82967	62738
4,8	47354	85060	65610	63193	60960	47437	48239
5,8	24174	40351	60678	38634	42119	32153	22911
6,8	14479	22186	26718	34323	22039	21157	14741

	1985	1986	1987	1988	1989	1990	1991
2,8	76095	57303	85514	85683	84918	85326	64602
3,8	48780	49226	44620	71628	63284	70875	55800
4,8	39208	25964	35959	30919	45584	43291	43708
5,8	29593	20349	16481	23741	14040	28703	24096
6,8	12208	14224	12134	9178	9384	7661	13761

	1992	1993	1994	1995	1996	1997	1998
2,8	54463	39178	28783	26909	29344	33778	38739
3,8	35331	31787	20268	19630	24892	25281	28599
4,8	25689	16562	13656	9456	15788	19796	18250
5,8	19335	10887	5489	4882	5644	10643	13055
6,8	9049	7727	3040	1841	2724	3183	5866

	1999
2,8	38465
3,8	36249
4,8	24784
5,8	15276
6,8	10685

SSB AT THE START OF THE SPAWNING SEASON -MALES AND FEMALES (MT) (using SSB mean weights

	1978	1979	1980	1981	1982	1983	1984
1	912	1104	850	1962	1200	902	3122
2	1411	7540	6911	5784	16138	6347	4303
3	33839	3730	22412	15924	15649	26066	10500
4	20179	38255	4300	21375	15792	12655	21656
5	8796	16541	30441	3962	17468	9636	7118
6	4892	8127	12487	20325	2961	10514	5653
7	8094	5563	5914	7240	12174	1464	6221
8	366	6672	5047	2693	4108	6842	815
9	1339	111	3841	4111	1557	2059	3958
10	657	1674	376	3178	2704	1825	3942
1+	80485	89318	92581	86552	89751	78311	67288

	1985	1986	1987	1988	1989	1990	1991
1	773	8516	2226	3481	2482	638	1964
2	11650	5032	25333	8898	13723	6629	4245
3	6879	18778	7106	32841	14541	22033	9069
4	8076	4842	17024	6137	27191	12817	16519
5	14908	5434	3936	12375	4200	18065	8434
6	4252	8584	3704	2763	5937	2959	8694
7	3163	2355	5364	2024	1326	2844	1548
8	2980	1702	1701	2932	811	769	1217
9	420	1245	1030	965	1193	408	372
10	2407	941	907	1296	673	1127	554
1+	55509	57430	68331	73713	72077	68289	52617

	1992	1993	1994	1995	1996	1997	1998
1	791	722	106	63	112	1002	126
2	9031	3577	3180	2713	1662	4620	5497
3	7483	11494	5473	9005	8047	4662	8793
4	5296	4619	6431	3965	9113	8318	4783
5	8395	2538	1926	2644	2597	6554	6695
6	3355	3310	1000	779	1541	1593	4152
7	3501	1303	1041	572	575	734	991
8	786	1518	313	291	321	389	209
9	557	420	432	40	163	236	262
10	281	296	117	30	06	24	242
1+	39476	29798	20019	20102	24138	28131	31750

	1999
1	622
2	1192
3	9526
4	8801
5	4279
6	6013
7	3282

8	756
9	109
10	217
1+	34796

APPENDIX 4

Precision Estimates of 1999 Fishing Mortality and Spawning Stock Biomass for Georges Bank Cod.

Appendix 4. Table 1.

The number of bootstraps: 1000
Bootstrap Output Variable: N hat

	NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
N 1	5329	5746	2508	0.47
N 2	5590	5774	1456	0.26
N 3	1647	1696	383	0.23
N 4	3426	3553	864	0.25
N 5	2122	2143	470	0.22
N 6	727	738	159	0.22
N 7	850	855	180	0.21
N 8	333	341	96	0.29

	BIAS ESTIMATE	BIAS STD ERROR	PERCENT BIAS	NLLS EST CORRECTED FOR BIAS	C.V. FOR CORRECTED ESTIMATE	LOWER 80%CI	UPPER 80%CI
N 1	417	79	7.82	4913	0.510523	3503	9566
N 2	184	46	3.29	5406	0.269369	4056	7480
N 3	49	12	2.96	1598	0.239448	1249	2155
N 4	127	27	3.72	3298	0.262020	2348	4433
N 5	21	15	0.98	2102	0.223414	1594	2792
N 6	11	05	1.46	716	0.221990	542	937
N 7	05	06	0.55	846	0.212258	653	1110
N 8	08	03	2.35	326	0.295756	224	460

Bootstrap Output Variable: Q_unscaled

	NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
q spr_361	0.0000166	0.0000168	0.0000021	0.12
q spr_362	0.0000711	0.0000716	0.0000091	0.13
q spr_363	0.0001182	0.0001195	0.0000152	0.13
q spr_364	0.0001672	0.0001691	0.0000226	0.14
q spr_365	0.0002102	0.0002130	0.0000285	0.14
q spr_366	0.0001995	0.0002016	0.0000247	0.12
q spr_367	0.0002767	0.0002809	0.0000386	0.14
q spr_368	0.0002904	0.0002932	0.0000391	0.13
q spr_411	0.0000121	0.0000126	0.0000036	0.30
q spr_412	0.0000731	0.0000757	0.0000206	0.28
q spr_413	0.0001557	0.0001619	0.0000451	0.29
q spr_414	0.0001328	0.0001393	0.0000395	0.30
q spr_415	0.0001542	0.0001609	0.0000443	0.29
q spr_416	0.0001704	0.0001777	0.0000498	0.29
q spr_417	0.0002187	0.0002215	0.0000603	0.28
q spr_418	0.0002211	0.0002308	0.0000602	0.27
q sp_can1	0.0000221	0.0000224	0.0000035	0.16
q sp_can2	0.0001199	0.0001208	0.0000186	0.16
q sp_can3	0.0002615	0.0002648	0.0000387	0.15
q sp_can4	0.0003604	0.0003651	0.0000548	0.15
q sp_can5	0.0005028	0.0005078	0.0000802	0.16
q sp_can6	0.0005466	0.0005521	0.0000880	0.16
q sp_can7	0.0005786	0.0005896	0.0000902	0.16
q sp_can8	0.0006904	0.0007039	0.0001058	0.15
q us0aut1	0.0000112	0.0000112	0.0000013	0.12
q us1aut2	0.0000616	0.0000619	0.0000071	0.12
q us2aut3	0.0000884	0.0000883	0.0000100	0.11
q us3aut4	0.0001091	0.0001099	0.0000126	0.12
q us4aut5	0.0000737	0.0000746	0.0000087	0.12
q us5aut6	0.0000841	0.0000848	0.0000096	0.11

	BIAS ESTIMATE	BIAS STD ERROR	PERCENT BIAS	NLLS EST CORRECTED FOR BIAS	C.V. FOR CORRECTED ESTIMATE	LOWER 80%CI	UPPER 80%CI
q spr_361	0.00000013	0.000000066	0.808	0.000016509	0.13	0.0000141	0.0000192
q spr_362	0.00000054	0.000000288	0.758	0.000070513	0.13	0.0000596	0.0000819
q spr_363	0.00000127	0.000000480	1.073	0.000116948	0.13	0.0001010	0.0001396
q spr_364	0.00000197	0.000000716	1.178	0.000165208	0.14	0.0001412	0.0001958
q spr_365	0.00000277	0.000000902	1.320	0.000207469	0.14	0.0001768	0.0002460
q spr_366	0.00000213	0.000000780	1.068	0.000197372	0.13	0.0001691	0.0002320
q spr_367	0.00000413	0.000001220	1.493	0.000272598	0.14	0.0002299	0.0003261
q spr_368	0.00000282	0.000001237	0.973	0.000287587	0.14	0.0002457	0.0003454
q spr_411	0.00000048	0.000000115	3.978	0.000011632	0.31	0.0000084	0.0000167
q spr_412	0.00000262	0.000000651	3.582	0.000070496	0.29	0.0000508	0.0000998
q spr_413	0.00000620	0.000001426	3.984	0.000149473	0.30	0.0001050	0.0002127
q spr_414	0.00000648	0.000001250	4.876	0.000126364	0.31	0.0000920	0.0001844
q spr_415	0.00000663	0.000001401	4.298	0.000147597	0.30	0.0001102	0.0002139
q spr_416	0.00000735	0.000001575	4.316	0.000163008	0.31	0.0001229	0.0002404
q spr_417	0.00000284	0.000001906	1.298	0.000215825	0.28	0.0001623	0.0003041
q spr_418	0.00000969	0.000001903	4.384	0.000211422	0.28	0.0001523	0.0002899
q sp_can1	0.00000036	0.000000110	1.627	0.000021727	0.16	0.0000179	0.0000265
q sp_can2	0.00000088	0.000000589	0.736	0.000118998	0.16	0.0000983	0.0001460
q sp_can3	0.00000334	0.000001223	1.277	0.000258147	0.15	0.0002167	0.0003148
q sp_can4	0.00000476	0.000001734	1.320	0.000355594	0.15	0.0002981	0.0004337
q sp_can5	0.00000505	0.000002535	1.005	0.000497734	0.16	0.0004187	0.0006170
q sp_can6	0.00000558	0.000002784	1.022	0.000540969	0.16	0.0004446	0.0006582
q sp_can7	0.00001098	0.000002852	1.898	0.000567643	0.16	0.0004784	0.0007046
q sp_can8	0.00001353	0.000003347	1.960	0.000676878	0.16	0.0005534	0.0008157
q us0aut1	0.00000009	0.000000041	0.771	0.000011073	0.12	0.0000095	0.0000127
q us1aut2	0.00000032	0.000000225	0.519	0.000061280	0.12	0.0000534	0.0000711
q us2aut3	-0.00000009	0.000000317	-0.103	0.000088521	0.11	0.0000775	0.0001031
q us3aut4	0.00000077	0.000000397	0.705	0.000108359	0.12	0.0000934	0.0001251
q us4aut5	0.00000084	0.000000276	1.140	0.000072899	0.12	0.0000636	0.0000860
q us5aut6	0.00000068	0.000000302	0.809	0.000083431	0.11	0.0000720	0.0000962

Bootstrap Output Variable: N t1

	NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
Age 1	5329.5	5746.1	2508.1	0.4706
Age 2	5590.0	5774.0	1456.2	0.2605
Age 3	1647.2	1696.0	382.7	0.2323
Age 4	3425.5	3552.9	864.2	0.2523
Age 5	2122.5	2143.2	469.6	0.2212
Age 6	727.1	737.7	159.0	0.2188
Age 7	850.5	855.2	179.5	0.2111
Age 8	333.4	341.3	96.3	0.2888
Age 9	60.0	58.8	8.1	0.1345
Age 10	18.7	18.3	2.5	0.1347

	BIAS ESTIMATE	BIAS STD ERROR	PERCENT BIAS	NLLS EST CORRECTED FOR BIAS	C.V. FOR CORRECTED ESTIMATE	LOWER 80%CI	UPPER 80%CI
Age 1	416.64	79.31	7.818	4912.82	0.51	3503.2	9565.5
Age 2	184.00	46.05	3.292	5405.95	0.27	4055.7	7480.5
Age 3	48.83	12.10	2.965	1598.36	0.24	1248.6	2154.6
Age 4	127.37	27.33	3.718	3298.18	0.26	2347.6	4433.5
Age 5	20.74	14.85	0.977	2101.73	0.22	1594.5	2791.5
Age 6	10.60	5.03	1.458	716.47	0.22	542.3	937.1
Age 7	4.70	5.68	0.553	845.77	0.21	653.1	1110.4
Age 8	7.85	3.04	2.355	325.56	0.30	224.1	459.5
Age 9	-1.20	0.26	-1.998	61.21	0.13	51.1	71.7
Age 10	-0.37	0.08	-2.002	19.07	0.13	15.9	22.4

Bootstrap Output Variable: F t

	NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
Age 1	0.0003	0.0003	0.0001	0.27
Age 2	0.1454	0.1480	0.0326	0.22
Age 3	0.4115	0.4160	0.0865	0.21
Age 4	0.2631	0.2709	0.0540	0.21
Age 5	0.2233	0.2292	0.0486	0.22
Age 6	0.0982	0.1018	0.0216	0.22
Age 7	0.2799	0.2922	0.0781	0.28
Age 8	0.2161	0.2235	0.0286	0.13
Age 9	0.2161	0.2235	0.0286	0.13
Age 10	0.2161	0.2235	0.0286	0.13

	BIAS ESTIMATE	BIAS STD ERROR	PERCENT BIAS	NLLS EST CORRECTED FOR BIAS	C.V. FOR CORRECTED ESTIMATE	LOWER 80%CI	UPPER 80%CI
Age 1	0.0000097	0.0000027	2.990	0.0003140	0.28	0.0002	0.0004
Age 2	0.0025388	0.0010306	1.746	0.1429085	0.23	0.1129	0.1867
Age 3	0.0045272	0.0027353	1.100	0.4069233	0.21	0.3315	0.5545
Age 4	0.0077839	0.0017092	2.958	0.2553322	0.21	0.2059	0.3362
Age 5	0.0059547	0.0015356	2.667	0.2173052	0.22	0.1773	0.2882
Age 6	0.0036115	0.0006816	3.677	0.0946047	0.23	0.0758	0.1250
Age 7	0.0123579	0.0024710	4.416	0.2675094	0.29	0.2102	0.3912
Age 8	0.0074270	0.0009051	3.437	0.2086879	0.14	0.1832	0.2495
Age 9	0.0074270	0.0009051	3.437	0.2086879	0.14	0.1832	0.2495
Age 10	0.0074270	0.0009051	3.437	0.2086879	0.14	0.1832	0.2495

Bootstrap Output Variable: F full t

NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
0.2161	0.2235	0.0286	0.13

BIAS ESTIMATE	BIAS STD ERROR	PERCENT BIAS	NLLS EST CORRECTED FOR BIAS	C.V. FOR CORRECTED ESTIMATE	LOWER 80%CI	UPPER 80%CI
0.00743	0.00091	3.44	0.20869	0.14	0.1832	0.2495

Bootstrap Output Variable: PR t

	NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
Age 1	0.0008	0.0008	0.0003	0.32
Age 2	0.3535	0.3588	0.1041	0.29
Age 3	1.0000	0.9748	0.0759	0.08
Age 4	0.6395	0.6526	0.1574	0.25
Age 5	0.5426	0.5527	0.1400	0.26
Age 6	0.2387	0.2465	0.0680	0.29
Age 7	0.6802	0.6998	0.1865	0.27
Age 8	0.5253	0.5379	0.0984	0.19
Age 9	0.5253	0.5379	0.0984	0.19
Age 10	0.5253	0.5379	0.0984	0.19

	BIAS ESTIMATE	BIAS STD ERROR	PERCENT BIAS	NLLS EST CORRECTED FOR BIAS	C.V. FOR CORRECTED ESTIMATE	LOWER 80%CI	UPPER 80%CI
Age 1	0.00002	0.000008	2.42	0.00076767	0.33	0.0005	0.0012
Age 2	0.00528	0.003291	1.49	0.34821890	0.30	0.2581	0.5240
Age 3	-0.02516	0.002400	-2.52	1.02515701	0.07	0.4021	1.0000
Age 4	0.01309	0.004976	2.05	0.62639606	0.25	0.4628	0.8743
Age 5	0.01007	0.004428	1.85	0.53255146	0.26	0.3961	0.7577
Age 6	0.00784	0.002151	3.28	0.23087059	0.29	0.1677	0.3337
Age 7	0.01964	0.005899	2.89	0.66055521	0.28	0.4724	1.0000
Age 8	0.01266	0.003111	2.41	0.51259333	0.19	0.3765	0.6379
Age 9	0.01266	0.003111	2.41	0.51259333	0.19	0.3765	0.6379
Age 10	0.01266	0.003111	2.41	0.51259333	0.19	0.3765	0.6379

Bootstrap Output Variable: PR mean

	NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
Age 1	0.0003	0.0003	0.0000	0.11
Age 2	0.1454	0.1434	0.0127	0.09
Age 3	0.4303	0.4245	0.0241	0.06
Age 4	0.4200	0.4186	0.0386	0.09
Age 5	0.4209	0.4192	0.0393	0.09
Age 6	0.3626	0.3629	0.0349	0.10
Age 7	0.6678	0.6696	0.0631	0.09
Age 8	0.5602	0.5612	0.0388	0.07
Age 9	0.4179	0.4169	0.0337	0.08
Age 10	0.4179	0.4169	0.0337	0.08

	BIAS ESTIMATE	BIAS STD ERROR	PERCENT BIAS	NLLS EST CORRECTED FOR BIAS	C.V. FOR CORRECTED ESTIMATE	LOWER 80%CI	UPPER 80%CI
Age 1	0.00000	0.0000010	-1.29	0.0002811	0.11	0.0002	0.0003
Age 2	-0.00203	0.0004021	-1.39	0.1474207	0.09	0.1335	0.1654
Age 3	-0.00578	0.0007629	-1.34	0.4360773	0.06	0.4088	0.4586
Age 4	-0.00139	0.0012215	-0.33	0.4213559	0.09	0.3680	0.4664
Age 5	-0.00171	0.0012437	-0.41	0.4226514	0.09	0.3773	0.4782
Age 6	0.00027	0.0011050	0.07	0.3623585	0.10	0.3217	0.4118
Age 7	0.00182	0.0019960	0.27	0.6660112	0.09	0.5896	0.7609
Age 8	0.00100	0.0012273	0.18	0.5591690	0.07	0.5047	0.6067
Age 9	-0.00102	0.0010666	-0.24	0.4189168	0.08	0.3800	0.4649
Age 10	-0.00102	0.0010666	-0.24	0.4189168	0.08	0.3800	0.4649

Bootstrap Output Variable: Mean Biomass

	NLLS	BOOTSTRAP	BOOTSTRAP	C.V. FOR

ESTIMATE	MEAN	StdError	NLLS SOLN
42990.9865	43768.7306	4109.1410	0.10

BIAS ESTIMATE	BIAS STD ERROR	PERCENT BIAS	NLLS EST CORRECTED FOR BIAS	C.V. FOR CORRECTED ESTIMATE	LOWER 80%CI	UPPER 80%CI
777.7442	129.9424	1.81	42213.2423	0.10	37649.9533	47602.5306

Bootstrap Output Variable: SSB f mean

NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
15065.6708	18463.5589	1810.1374	0.12

BIAS ESTIMATE	BIAS STD ERROR	PERCENT BIAS	NLLS EST CORRECTED FOR BIAS	C.V. FOR CORRECTED ESTIMATE	LOWER 80%CI	UPPER 80%CI
3397.888	57.242	22.55	11667.783	0.16	13840.6496	13942.4828

Bootstrap Output Variable: SSB spawn t

NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
34796.2504	35289.9206	3209.8035	0.09

BIAS ESTIMATE	BIAS STD ERROR	PERCENT BIAS	NLLS EST CORRECTED FOR BIAS	C.V. FOR CORRECTED ESTIMATE	LOWER 80%CI	UPPER 80%CI
493.67	101.50	1.42	34302.58	0.09	30734.3653	38508.7267