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Update Assessment of American Plaice in the Gulf of Maine - Georges Bank Region for 2000

by

Loretta O'Brien and Christine Esteves

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

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ABSTRACT

This report presents an updated and revised analytical assessment of the Gulf of Maine-Georges Bank American plaice stock for the period 1980-1999 based on analysis of commercial discards, landings and effort data, and research vessel survey data through 1999. Estimates of 1999 fishing mortality and spawning stock biomass, 2000 stock size, and the precision of the fishing mortality and spawning stock biomass estimates are presented. Short-term forecasts of landings in 2000 and the resulting spawning stock biomass in 2001 are given based on relevant 1999 fishing mortalities. This assessment was reviewed by the Stock Assessment Review Committee (SARC) in the 32nd Northeast Regional Stock Assessment Workshop (SAW).

Total commercial landings for American plaice were estimated to be 3,257 mt in 1999, a 12% decline from 1998. Commercial landings per unit of effort generally declined from 1964 to 1972, gradually increased to a record high in 1977 and declined to a record low in 1988. Catch rates have been variable but relatively stable from 1989-1999. Fishery-independent surveys indicate higher abundance of American plaice in the early 1960s and during the late 1970s to early 1980s compared to the lower abundance during the 1990s. Above average year classes occurred in 1979, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, and 1998.

Spawning stock biomass declined from 47,000 mt in 1980 to 7,500 mt in 1989, then increased to 13,000 mt in 1992 and has remained relatively stable during the 1990s. Spawning stock biomass was 14,000 mt in 1999. Fishing mortality increased from 1980 to 1983, declined until 1990, then increased to a record high of 0.64 (43% exploitation) in 1994 and 1995, and has since declined to 0.26 (21% exploitation) in 1999. At the current level of exploitation landings are projected to increase to 3,400 mt in 2000 and spawning stock biomass is expected to increase to 16,000 mt in 2001.

INTRODUCTION

American plaice, *Hippoglossoides platessoides*, is distributed along the continental shelf from southern Labrador to Montauk Point, New York. In U.S waters, plaice are most abundant in the deeper (> 50 m) waters of the Gulf of Maine and off the northern edge of Georges Bank (Figure 1). Spawning occurs in the spring from February to June, with peak spawning occurring in April and May. Median maturity for females occurs at 3.6 years and 26.8 cm, and for males at 3.0 years and 22.1 cm (O'Brien *et al.* 1993). The maximum age attained is between 24-30 years and the maximum size is 70-80 cm (Bigelow and Schroeder 1953). After age four, the growth rate for females is faster than that of males (Sullivan 1981).

The fishery for American plaice developed in the mid-seventies as other popular flounder stocks became less abundant and fisheries were more heavily regulated (Sullivan 1981). Historically, American plaice had either been discarded or used as bait (Lange and Lux 1979). A history of management measures pertaining to American plaice in the Gulf of Maine and Georges Bank region are presented in Table 1.

This report presents an updated and revised analytical assessment of the Gulf of Maine-Georges Bank American plaice stock for the period 1980-1999 based on analyses of commercial discards, landings and effort data, and research vessel survey data through 1999. The previous analytical assessments of this stock were conducted in 1992 (O'Brien *et al.* 1992) and 1998 (O'Brien *et al.* 1999).

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). 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 now obtained from mandatory dealer reports submitted on a trip basis to NMFS.

A master data base for the 1994-1999 commercial landings has not currently been developed. In the future, the landings information from the dealer reports will be augmented with information from the vessel trip reports (VTR) to create a master data base similar to what exists prior to

1994.

The analyses conducted in this assessment using data from the commercial data base from 1994-1999 are, therefore, considered provisional. Although the estimate of total landings may not change, the allocation by area, Georges Bank or the Gulf of Maine, may change. In addition, other results such as estimation of discards in both the large mesh and shrimp fishery and estimates of landings per day fished (LPUE) and effort in the fishery, which all rely on unauditted data fields (number of trips, days fished), will change when derived using the final master data base.

Since 1960, US landings of American plaice have ranged from 1,309 mt (1960) to 15,126 mt (1982) (Table 2, Figure 2). As the fishery developed, landings gradually increased from an average of 2,280 mt during 1972-1976 to an average of 12,694 mt during 1979-1984. Subsequently, landings declined to 2,300 mt in 1989, then increased to 6,400 mt by 1992. Landings have declined annually since 1992 and were 3,134 mt in 1999.

Otter trawl gear has accounted for the largest percentage of American plaice landings each year since 1980. In 1999, 94% of the landings were caught by otter trawl and 2% by both shrimp trawl and gill net gear (Table 3). The fishery occurs primarily during the second and third quarter of the year (Table 4). Historically, the majority of the landings were in the large (large+jumbo) market category for all four quarters, however, in 1988, the majority of the landings shifted to the small category (small+peewee) in quarters 3 and 4. Since 1991 landings have been primarily in the small category in all four quarters (Table 5) .

Commercial Fishery Sampling Intensity

The number of length and age samples taken are summarized for each year by quarter and market category in Table 6. The number of metric tons landed per length frequency sample by market category ranged from 34 mt to 116 mt during 1985-1991. During 1992-1995, the sampling intensity decreased, ranging between 97 mt to 336 mt per sample. Sampling intensity has increased since 1996, ranging between 31 mt and 189 mt per sample and was high in 1999, similar to the 1985-1991 period.

Commercial Landings Age Composition

Age-length keys

American plaice landings have been sampled for both length composition and age at length since 1975, however, adequate numbers of samples by market category and season are only available since 1982. Commercial age samples are now routinely aged and are currently available for 1985-1999. The age data for 1982-1984 will be available for the next benchmark assessment. The age composition for 1980-1984 landings were estimated using the NEFSC bottom trawl survey age-length relationship (O'Brien *et al.* 1992).

A study by Esteves and Burnett (1993) concluded that there were significant growth differences between American plaice in the Gulf of Maine and Georges Bank based on analyses of 1988 samples from both commercial landings and NEFSC spring and autumn bottom trawl surveys. This conclusion was tested further using commercial age at length data pooled from 1985-1990 (O'Brien *et al.* 1999). The hypothesis of no difference in the proportion at age within

a length class between Gulf of Maine and Georges Bank commercial age length keys, by quarter, was tested using Fisher's exact test (Zar 1984, SAS 1990). The results indicated a difference in the age at length between the Gulf of Maine and Georges Bank American plaice. The hypothesis of no difference in the proportion at age within a length class between quarters 1 and 2 and between quarters 3 and 4 was also tested for each area. The analysis indicated greater differences between quarters for American plaice from the Gulf of Maine than for those from Georges Bank but the differences were only within a narrow range of lengths, 36-46 cm.

Based on the conclusion of Esteves and Burnett (1993) and the results of the Fisher's exact test (O'Brien *et al.* 1999) , the age composition of the 1985-1993 commercial landings were derived separately for the Gulf of Maine and Georges Bank area, and areas were pooled only when sampling was not adequate. The 1994-1999 data were pooled over the entire area because of inadequate sampling by area and uncertainty in the spatial assignment of samples and landings. Samples were generally applied on a quarterly basis, but when samples were not adequate, pooling to semi-annual or annual level was necessary.

Age composition

The pooled age composition of the 1980-1984 landings from the Gulf of Maine-Georges Bank region was estimated, by market category, from seasonal age-length keys derived from the NEFSC groundfish surveys and quarterly length compositions derived from the sampled commercial landings (O'Brien *et al.* 1992). The age composition of the 1985-1993 landings from the Gulf of Maine and from Georges Bank were estimated separately, by market category, from commercial length frequency and age samples, pooled by calendar quarter. The pooled age composition of the 1994-1999 landings from the Gulf of Maine-Georges Bank region were estimated by market category from commercial length frequency and age samples pooled by calendar quarter. In quarters where the sampling was not adequate samples were pooled semi-annually or annually (Table 6). Due to the lack of adequate sampling in every market category for each area, the five market categories were aggregated to three categories: small + peewee, medium, and large + jumbo. Landed mean weights were estimated by applying the American plaice length weight equation (Lux 1969):

$$Weight(kg) = (2.4548 \times 10^{-6}) \times Length(cm)^{3.345}$$

to quarterly length frequencies, by market category. Total numbers landed by quarter were estimated by dividing the mean weights into quarterly landings, by market category, and prorating according to the sample length frequency. Age-length keys were then applied to the quarterly numbers at length, by market category, to obtain the quarterly catch at age. Numbers at age were summed over market category within each quarter and annual estimates of landings at age were obtained by summing over quarters. Numbers at age for the Gulf of Maine and for Georges Bank were combined to obtain the estimated annual numbers at age and were expanded to total landings (Table 2) by the ratio of (total landings)/ (Gulf of Maine-Georges Bank landings). The ratios varied between 1% and 12%. The total landings in numbers and weight (mt) and the mean weight at age for the landed commercial catch are presented in Table 7.

Commercial Fishery Discards

Data for estimating discarded catch is available in the Sea Sampling Database (SSDBS; 1989-1997) and the Vessel Trip Log (VTR; 1994-1999) database. The number of trips, by gear, and metric tons of kept and discarded catch are summarized for Massachusetts state sea sampled trips and for NEFSC sea sampled trips in Appendix 1, Tables 1 and 2. The number of length samples taken on NEFSC sea sampled trips is also summarized in Appendix 1, Table 3. In addition, the number of trips and weight (mt) of American plaice either landed or discarded is summarized from a subset of trips (VTRs) with a history of reporting discards of any species (Appendix 1, Table 4). Only the NEFSC sea sampling data from the shrimp fishery was used in the estimation of discarded catch of American plaice in this assessment.

The quantity of discarded catch of American plaice in the Northern shrimp fishery and in the large mesh otter trawl fishery were estimated using different methodologies for each fishery, although both incorporate NEFSC bottom trawl survey abundance estimates at length in the analysis. A method of estimating discards for the small mesh otter trawl fishery has not been developed yet.

Northern Shrimp Fishery

The total number of American plaice discarded, by length, in the Gulf of Maine northern shrimp fishery were derived based on two estimation procedures which are described by Mayo *et al.* (1992). An indirect estimation of discards for 1980-1988 and 1998-1999 was derived from NEFSC bottom trawl data and shrimp effort and a direct estimation of discards for 1989-1997 was calculated from NEFSC sea-sampling data. In both the direct and indirect method, discards were estimated for 3 time periods, based on the seasonality of the shrimp fishery, which varies from year to year, but is generally prosecuted from December to May. The winter fishing season was defined by combining trips landed in January and February, and the spring season was defined by combining all trips landed in March, April, and May. December trips were treated as a single group. The total number of shrimp otter trawl trips, by month, is summarized in Table 8.

Indirect method

The indirect method was used to estimate discarded catch in the shrimp fishery from 1980-1988, prior to the implementation of the Sea Sampling program, and in 1998 and 1999 because no sea sampling data were obtained from shrimp trips during this time period. Discards were estimated indirectly based on NEFSC research survey abundance data, a mesh selectivity ogive, a sorting ogive based on the current minimum size regulations, shrimp effort (number of trips) and the proportionality constant (q) between catch per unit effort (discards/trip) of a commercial shrimp trawl and the survey abundance index adjusted for mesh selection. The discards/trip were estimated from the sea sampling database for 1989-1997. The method is described in more detail in both Appendix 1, Table 5a and Mayo *et al.* (1992).

The abundance of American plaice available to the shrimp fishery was estimated, by month, using indices from the NEFSC spring and autumn bottom trawl surveys. The indices of abundance, numbers per tow at length, were summarized by 2 cm length intervals for the strata corresponding to the area of the shrimp fishery (NEFSC offshore survey strata 26, 27, 38, and 40). The winter months (January and February) were assigned the autumn indices from the

previous year; the spring months (March, April, and May) were assigned the spring indices of the current year; and December was assigned the autumn indices of the current year. The indices of numbers per tow at length for each month were then filtered through a 46 mm mesh (shrimp trawl) selection ogive, derived from conversion of a 99 mm mesh selectivity ogive (Smolowitz 1983). A mesh selection ogive for a 1" (25.4 mm) Nordmore grate, introduced in April 1992 (Table 1), was also used in addition to the selection ogive for the 46 mm shrimp otter trawl. The selection ogive for the 25.4 mm grate was derived using logistic regression with the same slope (beta) and selection factor as estimated for the selection ogive of a 22 mm grate (Hickey *et al.* 1993). The resulting length frequency was then filtered through a sorting ogive based on the minimum plaice landing sizes observed in the landed component of the otter trawl catches. The sorting ogive was set to zero beginning in December 1994 because possession of any regulated species by a shrimp trip became illegal at that time. The total number of plaice discarded at length by season was computed by raising the filtered survey indices by the total amount of shrimp fishing effort, i.e, number of trips (Table 8), and by the seasonal mean q determined from the sea sample data (Table 9).

The proportionality constant, q, was estimated for each season (Winter, Spring, and December) using the sea sampling database from 1989-1997. Abundance of plaice available to the fishery was estimated by assigning the survey number per tow indices, at length, to the appropriate season, as described above. Survey discards were then derived as the difference between the length frequency filtered through the retention ogive and the length frequency filtered through both the retention ogive and the culling ogive. The proportionality constant, q, was then derived from the regression of survey discards at length against the number of discards at length, by trip, estimated from the sea sampling database (Table 9). A mean q of the 1989-1997 estimates was applied for each season in the estimation of discards in 1980-1988 and 1998-1999 (Table 9).

The age composition of the estimated discarded numbers at length were derived by applying seasonal age length keys from the NEFSC bottom trawl surveys to the seasonal estimates of discards. The age composition of the discards from the winter season were derived by applying the previous autumn bottom trawl survey age-length key for American plaice, lagged forward by one age and one year. Age composition of discards from the spring season were derived by applying the spring bottom trawl age-length key of the current year, and the age composition of the December discards were derived by applying the autumn age-length key of the current year.

Direct Method

Direct estimates of discard rates (lbs/trip) during 1989-1997 were estimated for the winter and spring season, and in December for two fishing areas using NEFSC sea-sampling data . Fishing Area 1 and 2 were defined, respectively, as north and south of 43 degrees 15 minutes latitude as described by Clark and Power (1991). A geometric mean discard per trip was computed by exponentiating the mean (log discard per trip) (Table 10). Discard rates (lbs/trip) for each year-season-area stratum were then raised to total discarded weight by the number of trips for each stratum. Discard weights were combined by area to obtain total discards (lbs) by season. The length-weight equation for American plaice (Lux 1969) was applied to the sea sample length frequency by season to obtain a sample mean weight. Total discard numbers by season were estimated by dividing the total discard weight by the sample mean weight. Total discards at

length were derived by prorating the total numbers to the sampled length frequency. The age composition of the discard length frequency was derived by applying age samples obtained from sea sampling supplemented with seasonal age-length keys from the NEFSC surveys. The seasonal age compositions were summarized to obtain an annual age composition of discarded American plaice in the shrimp fishery (Table 11).

Large Mesh Otter Trawl

The total number of American plaice discarded, at length, in the large mesh otter trawl fishery in the Gulf of Maine-Georges Bank region was derived using the survey method described in Appendix 1, Table 5b and by Mayo *et al.* (1992). The model utilizes abundance of American plaice at length as indicated by NEFSC bottom trawl survey indices filtered through a large mesh selection ogive and a culling ogive to approximate the relative composition of the retained and discarded components of the catch. The minimum regulated mesh size increased over the time period from 130 mm (5.0") to 140 mm (5.5"), to 155 mm (6") diamond or square mesh, to 165 mm (6.5") square and remaining at 6" diamond (Table 12). Mesh selection ogives were derived from studies by Walsh *et al.* (1992).

The retained portion of the survey length composition was compared to the estimated number landed at length, and coefficients relating landings and retained survey abundance of plaice were determined from linear regression analysis for each semi-annual period from 1980-1999. The coefficients were then applied to the discarded portion of the survey length composition for the same semi-annual periods to expand the indices at length to estimated numbers discarded. The numbers discarded at length were adjusted by the proportion of large mesh otter trawl gear with the appropriate mesh (5.5",6.0",or 6.5") (Table 12). The age composition of the discard length frequency was then derived by applying age length keys obtained from sea sampling supplemented with seasonal age-length keys from the NEFSC surveys. The semi-annual age compositions were summarized to obtain an annual age composition of discarded American plaice in the large mesh otter trawl fishery (Table 13).

Total Commercial Fishery Age Composition and Mean Weight at Age

The catch in numbers and weight (mt) and the mean weight at age for the total commercial catch including landings and discarded catch from the shrimp and large mesh otter trawl fishery are presented in Table 14 (ages 1-14) and Table 15 (ages1-9+) for the Gulf of Maine-Georges Bank region for 1980-1999. The 1987 year class and the 1992 year class appear dominant in the catch at age through age 6. The recent average mean weights (1995-1999) are slightly lower than the long term average (1980-1999) for ages 1-9, and slightly higher for ages 10-14. The variability in mean weight in the older year classes is most likely due to poor sampling.

Commercial Catch Rates

The landings per day fished (L/DF) for ton class 2, 3, and 4 otter trawlers from the Gulf of Maine-Georges Bank area were estimated for trips that landed any amount of American plaice and for trips that landed 50% or more American plaice (50% trips) during 1964-1999 (Table 16).

The total L/DF was estimated by summing the individual ton class L/DF weighted by the percentage of the total landings. The total L/DF for the 50% trips and for all trips landing American plaice generally declined from 1964 to 1972 then gradually increased to a record high in 1977, peaked again in 1981, and then gradually declined to a record low in 1988. Catch rates have been variable but relatively stable from 1989-1999 (Table 16, Figure 3). Nominal fishing effort (df; days fished) for all trips landing any amount of plaice increased between 1971-1985, remained relatively high between 1985 and 1992, but has declined during 1993-1999 (Figure 4).

Research Survey Indices

Indices of abundance and biomass were estimated for American plaice from both the NEFSC and the Massachusetts Division of Marine Fisheries (MADMF) spring and autumn bottom trawl surveys. The NEFSC stratified mean number per tow by age and stratified mean weight per tow estimates, adjusted for differences in fishing power of the Albatross IV and the Delaware II, are presented in Table 17 and Figures 5-6. Abundance indices were adjusted by 0.82 and biomass indices were adjusted by 0.69 for surveys conducted by the Delaware II (NEFSC 1991). Indices of abundance from the NEFSC surveys (offshore strata 13-30, 36-40) indicate strong year classes occurring in 1979, 1981, 1987 and 1992. The 1998 year class at age 1 is above average, and about average at age 2 (Appendix 2, Table 1, Figure 7a). The MADMF survey (region 4 and 5) indicates strong year classes in 1984, 1987, and 1992 (Appendix 2, Table 2, Figure 7b).

Mortality

Instantaneous natural mortality was assumed to be 0.2, based on studies of unexploited stocks by Pitt (1972). Estimates of instantaneous total mortality (Z) were estimated from survey catch per tow at age for the NEFSC and Massachusetts state research surveys for spring and autumn. For the NEFSC surveys, Z was estimated as the ln (4+/5+) in the spring and ln (3+/4+) in the autumn. For the Massachusetts state surveys, Z was similarly estimated as the ln(3+/4+) in the spring and ln(2+/3+) in the autumn. Different age groups were used for spring and autumn so that Z values could be evaluated for identical year classes.

Estimates of fishing mortality (F= Z-0.2) are plotted annually for each season and fit with a 3-point moving average for the NEFSC surveys and for the Massachusetts state surveys and then compared to the VPA mean F (ages 5-8, unweighted) (Figure 8). NEFSC survey estimated F, denoted by the 3 year moving average, is similar to the VPA F trend throughout the time series (Figure 8A). The MADMF survey F does not follow the VPA F trend well during the first half of the time series (1980-1991), however, in the latter half, the trends are more similar (Figure 8B).

Maturation

Logistic regression was used to estimate annual maturity ogives and median age at maturity (A_{50}) from data collected on spring NEFSC research bottom trawl surveys during 1981 and 1983-2000. Numbers of samples were higher from the Gulf of Maine than from Georges Bank

reflecting the distribution of the stock. Maturity ogives were derived for both females and males from both areas. Results indicate that American plaice males mature one year earlier than the females in the Gulf of Maine, and ½ year earlier than the females on Georges Bank, based on the term average A_{50} (1983-2000). The differences in A_{50} between females from the Gulf of Maine and those from Georges Bank ranged from no difference to a difference of one age, but the differences were not always in the same direction. Given the low sampling size from Georges Bank and the lack of trend in the difference of A_{50} between areas, the samples were pooled from the Gulf of Maine and Georges Bank. Since the females mature at a later age than the males, maturity ogives were derived for females only. Annual maturity ogives were compared graphically, and data from years with similar ogives were pooled to derive new ogives: 1981+1983-1985, 1986-1987, 1988-1992, 1993-1997, and 1998-2000.

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 fishing mortality in 1999 and beginning year stock sizes in 2000. The catch-at-age used in the VPA consisted of combined commercial landings and estimated discards from 1980-1999 for ages 1-8 with a 9+ age group. The indices of abundance used to calibrate the VPA included the NEFSC 1980-1999 spring research survey abundance indices for ages 1-8, the MADMF 1982-2000 spring research survey abundance indices for ages 1-5, the NEFSC 1980-1999 autumn research survey abundances for ages 1-7, and the MADMF 1982-1999 autumn research survey abundance indices for ages 1-5. The autumn survey indices were lagged forward one age and one year to match cohorts in the subsequent year.

The final ADAPT formulation provided stock size estimates for ages 1-8 in 2000 and corresponding F estimates for ages 1-7 in 1999. Assuming full recruitment at age 5, the F on age 8 in the terminal year was estimated as the average of the F on ages 5 through 7. The F on age 8 in all years prior to the terminal year was derived from weighted estimates of Z for ages 5 to 7. For all years, the F on age 8 was applied to the 9+ age group. Spawning stock biomass (SSB) estimates were derived by applying maturity ogives pooled by years: 1980-1985, 1986-1987, 1988-1992, 1993-1997, and 1998-2000.

The final ADAPT calibration results for estimates of F, stock size, and SSB at age are presented in Table 18 and Appendix 3. Estimates of stock size were more precise for ages 2-8 (CVs ranging from 0.17 to 0.26) than for age 1 (CV=0.45). The residuals (observed indices-predicted) indicated a pattern of positive residuals in the early years and negative residuals in the later years for ages 1 and 2, primarily for the Massachusetts spring indices. The residual pattern in ages 5 and 6 were negative in the early years and positive in the later years. All indices in 2000 were positive indicating that the numbers in the catch at age are too low (Figure 9).

Average fully recruited fishing mortality (ages 5-8) in 1999 was estimated as 0.27, the lowest in the time series (Table 18, Figure 10). The 1999 estimate of SSB was 14,056 mt, a decrease of 9% from 1998 (Table 18, Figure 11). Since 1980, recruitment has ranged from 13 million (1996 year class) to 53 million (1979 year class). The 1998 year class (34 million age 1 fish) is the first

above average (31 million age 1 fish) year class since the 1993 year class (42 million age 1 fish) (Table 18, Figure 11).

The typical stock-recruit relationship of increased recruitment with increasing spawning stock biomass is not apparent for this stock (Figure 12). During 1986-1993 the stock appears to have been under a different regime than during 1980-1985 and 1994-1996, suggesting that recruitment was strongly influenced by factors (i.e. temperature, predation) other than spawning stock biomass. Including back-calculated estimates of stock- recruit for 1976-1979 suggests that a more typical stock-recruit relationship may exist if sufficient data were available. Back-calculated estimates of SSB for 1976-1979 were derived based on the relationship of VPA estimates of SSB and the spring survey index for 1980-1999 and estimates of recruits were back-calculated by applying fishing mortality and natural mortality to stock size at ages 1-4 in 1980 (Figure 12).

Precision of Estimates of F and SSB

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, catchability estimates (q) for indices of abundance, and age 1 to 7 F's in 1999 (Appendix 4).

The bootstrap results indicate that stock sizes were well estimated for ages 2 to 8 with CVs varying between 0.16 and 0.25, however age 1 was not as well estimated with a CV of 0.5 (Appendix 4, Table 1). The CVs for the catchability coefficients for all indices ranged between 0.13 and 0.14 (Appendix 4, Table 2). The fully recruited F for ages 5+ was well estimated with a CV=0.11. The bootstrap estimate of 0.271 was only slightly higher than the NLLS estimate of 0.267. The distribution of the 1999 fully recruited average F estimates, derived from the 1000 bootstrap iterations, ranged from 0.20 to 0.40. There is an 80% probability that the average F in 1999 is between 0.23 and 0.30 (Figure 13A, Appendix 4, Table 4)

The bootstrap results indicate that spawning stock biomass was reasonably well estimated (CV=0.10) and slightly higher than the NLLS estimate of 14,056 mt. The distribution of the 1999 spawning stock biomass estimates, derived from the 1000 bootstrap iterations, ranged from 10,500 to 19,000 mt (Figure 13 B). There is an 80% probability that the 1999 SSB is between 12,400 and 15,700 mt (Figure 13B, Appendix 4, Table 5).

Retrospective Analysis

A retrospective analysis was performed to evaluate how well the current ADAPT calibration would estimate spawning stock biomass, fishing mortality, and recruits at age 1 for the five years prior to the current assessment, 1994-1998. Convergence of the estimates generally occurs after about six years (Figures 15). The retrospective analysis indicates a pattern of underestimating the recruits at age 1 (Figure 15A). Estimates of SSB appear to be only slightly underestimated (Figure 15B) and estimates of F are overestimated (Figure 14C). A pattern of overestimation of F suggests that the catch at age is too low. The retrospective pattern in F observed here is the

opposite of the pattern observed in the 1998 assessment (O'Brien *et al.* 1999).

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 parameters for the yield- and spawning stock biomass- per recruit analysis and the results presented in Table 19 are from the analyses performed in 1998 (O'Brien *et al.* 1999). The estimates of mean weight at age are the arithmetic means of the 1994-1996 catch mean weight at age and stock mean weight at age from O'Brien *et al.* (1999). Proportion mature at age were obtained from O'Brien *et. al* (1992). A partial recruitment (PR) vector was calculated from the geometric mean of the 1994-1996 F estimates from the final VPA in 1998 (O'Brien *et al.* 1999), coinciding with the change in mesh regulations in 1994. The final exploitation pattern was derived by dividing the geometric mean F at age by the geometric mean of the unweighted average F for ages 5 to 8 and smoothed by applying full exploitation at ages 5 and older. Input values and results for the yield-per-recruit analysis are provided in Table 19 and Figure 15. The resulting biological reference points were $F_{0.1}$=.019 and F_{max}=.35. The estimation of $F_{0.1}$ and SSB/R was influenced by the inclusion of discarded catch, however, discarding continues to occur and contributes to the overall mortality on the stock.

A second yield- and spawning stock biomass-per recruit analysis was performed using results from the current VPA. The $F_{0.1}$ estimated was almost identical to the previous analysis (O'Brien *et al.* 1999) because the input parameters of mean weights and PR vectors had not changed substantially. The biological reference points from the 1998 analysis (O'Brien *et al.* 1999) are therefore used in all further analyses.

MSY Based Reference Points

Estimates of maximum sustainable yield (MSY) and SSB_{MSY} were derived using the long term average recruitment and yield per recruit (Y/R) and spawning stock biomass per recruit (SSB/R) at $F_{0.1}$ as derived in the 1998 assessment (O'Brien *et al.* 1999). MSY was estimated to be about 4,400 mt and SSB_{MSY} was estimated to be about 24,200 mt using a geometric mean recruitment of 24,695 mt (1980-1997) (O'Brien *et al.* 1999). These estimates differed from those provided by the Overfishing Definition Review Panel (NEFMC 1998) which appeared to be incorrect. Updated biological reference points derived from the same Y/R and SSB/R values as in 1998 (O'Brien *et al.* 1999), but with an updated geometric mean recruitment of 28,091 mt (1980-1999) from the current VPA indicate that MSY = 5,034 mt and SSB_{MSY} = 27,504 mt.

The Panel recommended a control law with $F_{0.1}$ (0.19) as the maximum fishing mortality threshold when the stock is greater than SSB_{MSY} (24,200 mt) then decreasing linearly to zero at 1/4 of SSB_{MSY} (NEFMC 1998). The target F is 60% of $F_{0.1}$ (0.11) when SSB is above SSB_{MSY} and decreases linearly to zero at ½ of SSB_{MSY} (12,100 mt). The 1999 SSB estimate is 14,100 mt,

just above ½ SSB_{MSY} (Figure 16).

PROJECTIONS

Short term, three year stochastic projections were performed to estimate landings and SSB during 2000-2002 under the F scenarios of $F_{99} = 0.27$, $F_{0.1} = 0.19$, and $F_{control\ rule} = 0.04$. The partial recruitment (PR) vector of landed catch was calculated from the geometric mean of the 1995-1999 F estimates from the final VPA. The discard fraction was calculated as the percentage of total discards at age (in numbers) to total catch at age (in numbers). Mean weight at age for the stock and for landed and discarded catch was estimated as the average mean weight for 1995-1999. The proportion mature used was the pooled maturity ogive for 1998-2000. Recruitment in 2000-2002 was estimated from re-sampling of the distribution of the observed 1980-1999 recruits at age one (Table 18).

At the status quo fishing mortality of 0.27, landings are projected to increase to 3,701 mt in 2000 and 3,760 mt in 2001 (Table 20, Figure 17). SSB increases to 16,076 mt in 2000 and to 16,747 mt in 2001. Fishing at $F_{0.1} = 0.19$, landings will decline to 2,743 mt in 2001 and SSB will increase to 17,068 mt in 2001. If fishing mortality is reduced to F=0.04 , landings will decline to 619 mt in 2001 and SSB will increase to 17,679 mt in 2001 and 22,618 mt in 2002 (Table 20).

CONCLUSIONS

The Gulf of Maine-Georges Bank stock of American plaice is not overfished but overfishing is occurring according to the current overfishing definition (NEFMC 1999). Biomass is low, compared to the mean biomass early in the time series (1980-1984). Biomass indices derived from autumn research surveys indicate that the stock has been near or below the long term average since 1984 with the exception of the 1987 and 1992 year classes. Fishing mortality increased rapidly from 1991 (0.43) to a record high in 1995 (0.64). Fishing mortality in 1999 was 0.27, the lowest in the time series, but 37% higher than $F_{0.1} = 0.19$. Spawning stock biomass declined steadily from 47,000 mt in 1980 to a record low value in 1989 (7,500 mt), and has since increased to 14,100 mt in 1999. The last strong year classes occurred in 1992 and 1993 followed by below average recruiting year classes (1994, 1995 ,1996, 1997), however, the 1998 year class appears to be about average.

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Table 1. History of USA management relevant to Gulf of Maine-Georges Bank American plaice.

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" (140 mm) diamond from 5.1"(130 mm)**
1984 October	The 'Hague' line established separate fishing zones for the USA and Canada in the Gulf of Maine and on Georges Bank.
1985	**Minimum size set at 12" (30.5 cm)**
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)
1988	**Minimum size increases 14" (35.6 cm) from 12" (30.5 cm)**
1989 January	Amendment # 2 - seasonal large-mesh area for Nantucket Shoals winter fishery. Eliminate scheduled 6" mesh increase.

1992	**April**	**Nordmore Grate (1" or less) required in Northern Shrimp fishery trawls. Inshore vessels in 'low discard areas' exempt.**
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 is May-April.
1994	December	Both Area 1,2 (Georges Bank) and Nantucket Lightship Area closed year-round until *further notice.*
		Northern Shrimp Fishery - all vessels required to have Nordmore grate and possession of regulated species illegal.
1996	October	Sustainable Fisheries Act (SFA) effective.
	July 1	Amendment 7 effective. Establishes target TACs, rebuilding target of $F_{0.1}$
1999	Feb	Add closure of 7 30-minute blocks (protect spawning cod); inshore areas of Western Gulf of Maine (Framework (FW) 26)
1999	May	Minimum mesh size increase to 6 ½" square, remains at 6" diamond Stellwagen Bank, and Jeffreys Ledge Regulated Mesh areas eliminated.
		Inshore GM gear restriction: Otter trawl vessels limited to maximum diameter of 12 inches for roller gear.
		Expanded seasonal closed area and continued year round closed of the Western GM Closed Area.
	June 15	Scallopers allowed limited access to Area II
	November 15	Amendment 9 effective; Redefines overfishing definitions to comply with SFA
2000	May	Additional closures on Georges Bank for May only (109-114, 98-99), Adjacent to Area 1
2000	**January**	**Logbooks (VTR) required for shrimp fishery.**

Table 2. Commerical landings (metric tons, live weight) of American plaice from the Gulf of Maine, Georges Bank, Southern New England and the Mid-Atlantic, 1960-1999.

Year	Gulf of Maine			Georges Bank					Southern New England				Mid - Atlantic			Grand Total		
	USA	Can	Total	USA	Can	USSR	Other	Total	USA	USSR	Other	Total	USA	Other	Total	USA	Other	Total
1960	620	1	621	689	-	-	-	689	-	-	-	0	-	-	0	1309	1	1310
1961	692	-	692	830	-	-	-	830	-	-	-	0	-	-	0	1522	0	1522
1962	694	-	694	1233	44	-	-	1277	-	-	-	0	-	-	0	1927	44	1971
1963	693	-	693	1489	127	24	-	1640	-	-	-	0	-	-	0	2182	151	2333
1964	811	-	811	2800	177	-	11	2988	-	-	-	0	-	-	0	3611	188	3799
1965	967	-	967	2376	180	112	-	2668	-	-	-	0	-	-	0	3343	292	3635
1966	955	2	957	2388	242	279	1	2910	-	-	-	0	-	-	0	3343	524	3867
1967	1066	6	1072	2166	203	1018	10	3397	-	-	-	0	4	-	4	3236	1237	4473
1968	904	5	909	1695	173	193	5	2066	637	145	-	782	18	2	20	3254	523	3777
1969	1059	7	1066	1738	71	63	17	1889	505	349	-	854	130	-	130	3432	507	3939
1970	895	-	895	1603	92	927	658	3280	88	18	40	146	8	-	8	2594	1735	4329
1971	648	5	653	1511	38	228	296	2071	11	112	206	329	6	2	8	2176	887	3063
1972	569	-	569	1222	22	358	-	1602	3	71	-	74	-	-	0	1794	451	2245
1973	687	-	687	910	38	289	-	1237	5	158	-	163	-	-	0	1602	485	2087
1974	945	2	947	1039	27	16	2	1084	92	4	-	96	-	-	0	2076	51	2127
1975	1507	-	1507	913	25	148	-	1086	3	-	-	3	-	-	0	2423	173	2596
1976	2550	-	2550	948	24	3	-	975	10	-	-	10	1	-	1	3509	27	3536
1977	5647	-	5647	1408	35	50	-	1493	6	78	-	84	7	-	7	7068	163	7231
1978	7287	30	7317	2193	77	-	-	2270	15	-	-	15	8	-	8	9503	107	9610
1979	8835	-	8835	2478	23	-	-	2501	13	-	7	20	4	-	4	11330	30	11360
1980	11139	-	11139	2399	43	-	5	2447	10	-	-	10	1	-	1	13549	48	13597
1981	10327	1	10328	2482	15	-	2	2499	26	-	2	28	46	-	46	12881	20	12901
1982	11147	-	11147	3935	27	-	1	3963	35	-	2	37	9	-	9	15126	30	15156
1983	9142	7	9149	3955	30	-	-	3985	40	-	-	40	4	-	4	13141	37	13178
1984	6833	2	6835	3277	6	-	-	3283	17	-	-	17	7	-	7	10134	8	10142
1985	4766	1	4767	2249	40	-	-	2289	12	-	-	12	2	-	2	7029	41	7070
1986	3319	-	3319	1146	34	-	-	1180	4	-	-	4	3	-	3	4472	34	4506
1987	2766	-	2766	1032	48	-	-	1080	2	-	-	2	1	-	1	3801	48	3849
1988	2271	-	2271	1097	108	-	-	1205	13	-	-	13	1	-	1	3382	108	3490
1989	1646	-	1646	703	68	-	-	771	1	-	-	1	3	-	3	2353	68	2421
1990	1802	-	1802	639	52	-	-	690	2	-	-	2	2	-	2	2445	52	2497
1991	2936	-	2936	1310	26	-	-	1310	15	-	-	15	0	-	0	4261	26	4287
1992	4564	-	4566	1838	3	-	-	1838	10	-	-	10	4	-	4	6416	3	6419
1993	3865	-	3865	1838	-	-	-	1838	11	-	-	11	4	-	4	5718	-	5718
1994	***3357***	-	3431	***1683***	30	-	-	1562	***22***	-	-	22	***4***	-	4	5066	30	5096
1995	***3105***	-	3126	***1505***	2	-	-	1486	***15***	-	-	15	***20***	-	20	4645	2	4647
1996	***2912***	-	2922	***1430***	2	-	-	1423	***40***	-	-	40	***15***	-	15	4396	2	4398
1997	***2312***	-	2396	***1576***	65	-	-	1560	***23***	-	-	23	***26***	-	26	3937	65	4002
1998	***2234***	-	2234	***1385***	20	-	-	1405	***23***			23	***20***		20	3663	20	3683
1999	***1718***	-	1718	***1384***	123	-	-	1507	***11***			11	***21***		21	3134	123	3257

** 1994-1999 data are provisional and spatially distributed based on proportions of landings recorded by area in the VTR database

Table 3. Percentage of landings of American plaice by gear type, 1980-1999.

	GEAR TYPE					
Year	Otter Trawl	Shrimp Trawl	Sink Gill Net	Scottish Seine	Danish Seine	Other
1980	96.8	0.7	0.8	0.0	1.5	0.3
1981	96.5	2.2	0.7	0.0	0.5	0.1
1982	96.3	2.0	0.8	0.5	0.3	0.1
1983	96.3	1.7	0.3	1.1	0.3	0.3
1984	97.2	1.0	0.2	0.6	0.6	0.4
1985	96.9	1.6	0.1	0.5	0.8	0.1
1986	96.1	2.5	0.3	0.3	0.7	0.1
1987	95.5	2.6	0.6	0.4	0.9	0.2
1988	96.2	1.7	0.6	0.4	1.0	0.2
1989	95.5	1.4	1.2	0.9	1.0	0.1
1990	93.4	2.2	2.0	0.9	1.2	0.4
1991	94.8	0.9	0.9	1.2	0.9	1.2
1992	96.1	1.3	0.1	0.9	0.2	1.4
1993	95.9	1.2	0.1	0.0	0.3	2.5
1994	97.2	0.1	1.1	0.2	0.0	1.4
1995	93.0	0.7	4.0	0.7	0.0	1.6
1996	94.6	0.1	3.2	0.7	0.0	1.4
1997	93.8	0.2	2.9	0.7	0.0	2.4
1998	91.4	2.0	3.5	0.9	0.0	2.2
1999	93.7	1.8	2.0	0.4	0.0	2.1

Table 4. Combined market category landings (mt) of American plaice, excluding unclassified category, for the Georges Bank - Gulf of Maine region (areas 511-515, 522-526, 561-562), by quarter, 1980-1999.

	Q1	Q2	Q3	Q4	Total
1980	2087	5065	3429	1967	12548
1981	2505	4791	3219	1989	12504
1982	2049	5704	4358	2440	14551
1983	2562	5347	3340	1765	13014
1984	1750	3958	2735	1589	10032
1985	1315	2768	1918	961	6962
1986	728	1901	1079	699	4407
1987	581	1479	1044	571	3675
1988	576	1221	923	386	3106
1989	350	931	585	356	2222
1990	306	780	793	454	2333
1991	331	1309	1505	939	4084
1992	764	2339	2183	1097	6383
1993	867	2082	1561	1054	5564
1994*	599	1831	1586	999	5015
1995*	530	1820	1414	829	4593
1996*	529	1585	1407	836	4357
1997*	578	1446	1201	636	3861
1998*	476	1506	1004	634	3620
1999*	550	1094	829	640	3113

* 1994-1999 are not disaggregated by area.

Table 5. Landings by market category (Sm = small + peewee; Md=medium; Lg=large+jumbo; Un=unclassified) for statistical areas 511-515, 521-522, 525-526, 561-562 for American plaice, 1980-1999. (1994-1999 includes all areas).

	Quarter 1				Quarter 2				Quarter 3				Quarter 4				Total			
YEAR	Sm	Md	Lg	Un	Sm	Md	Lg	Un	Sm	Md	Lg	Un	Sm	Md	Lg	Un	Sm	Md	Lg	Un
1980	565	0	1527	3	1398	0	3667	100	1026	0	2399	16	479	0	1488	1	3468	0	9081	120
1981	730	0	1775	26	1233	0	3557	253	993	0	2209	34	457	0	1532	2	3413	0	9073	315
1982	581	0	1468	11	1353	5	4350	318	1191	524	2643	131	571	299	1570	40	3696	827	10031	500
1983	580	356	1624	5	1488	713	3148	57	1027	497	1816	18	399	276	1090	3	3494	1843	7678	83
1984	431	247	1071	10	954	649	2355	27	812	479	1444	19	372	309	909	13	2568	1684	5779	70
1985	512	253	708	14	709	511	1548	22	503	369	1046	13	239	188	521	9	1963	1321	3823	59
1986	187	132	409	13	539	350	1014	33	342	201	536	11	202	146	349	6	1269	829	2308	63
1987	169	108	304	20	460	275	744	43	367	203	475	20	199	126	246	35	1195	711	1768	117
1988	203	94	279	39	447	244	529	75	433	186	303	47	155	88	143	36	1238	612	1254	197
1989	117	76	158	25	300	208	423	68	222	126	222	29	139	81	135	21	778	491	938	142
1990	101	66	142	19	269	194	317	49	323	196	273	20	190	118	146	19	883	573	879	107
1991	138	78	116	20	594	347	367	61	773	378	353	40	435	263	241	41	1939	1066	1077	162
1992	302	174	291	35	902	634	805	112	887	624	674	80	426	278	394	17	2517	1710	2164	244
1993	276	181	410	17	702	515	867	80	589	371	602	26	423	232	401	14	1990	1299	2280	137
1994	237	120	243	22	685	434	711	15	692	387	506	8	437	218	345	6	2051	1159	1805	51
1995	214	117	198	10	811	425	585	29	800	287	327	9	436	178	216	4	2261	1007	1326	52
1996	240	108	180	4	808	343	434	22	913	242	253	10	493	159	183	3	2454	852	1050	39
1997	322	99	158	2	696	390	360	56	550	406	245	16	321	176	139	2	1889	1071	902	76
1998	175	148	153	2	637	478	391	30	404	336	264	5	222	180	233	6	1438	1142	1041	43
1999	162	163	225	4	395	330	368	13	353	234	242	2	262	178	199	3	1172	905	1034	22

Table 6. Sampling of commercial American plaice landings, by market category, for the Gulf of Maine and Georges Bank areas (NAFO Division 5Y and 5Z), 1985-1999. Outline indicates samples pooled to estimate landings at age.

	Small				Medium				Large				Number of tons landed / sample		
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Sm.	Med.	Lrg.
1985 GB	2	4	14	3	—	2	2	2	—	3	7	1			
GM	2	5	5	5	3	1	9	5	1	10	6	5			
total	4	9	19	8	3	3	11	7	1	13	13	6	49	55	116
1986 GB	3	6	5	3	2	4	3	2	1	4	3	2			
GM	9	5	3	5	3	4	5	1	10	10	7	4			
total	12	11	8	8	5	8	8	3	11	14	10	6	33	35	56
1987 GB	4	5	5	1	—	2	3	2	2	4	4	1			
GM	2	6	5	3	1	5	2	3	3	3	6	5			
total	6	11	10	4	1	7	5	5	5	7	10	6	39	40	63
1988 GB	3	7	4	2	1	3	4	2	4	5	2	4			
GM	4	7	4	5	6	6	4	3	6	5	3	2			
total	7	14	8	7	7	9	8	5	10	10	5	6	34	21	40
1989 GB	2	5	5	—	1	1	6	1	5	3	3	—			
GM	1	3	3	3	1	—	4	3	2	1	—	1			
total	3	8	8	3	2	1	10	4	7	4	3	1	35	29	63
1990 GB	—	5	6	—	2	1	2	2	—	2	5	—			
GM	5	5	3	3	1	6	3	5	1	5	3	5			
total	5	10	9	3	3	7	5	7	1	7	8	5	33	26	42
1991 GB	—	3	1	—	3	1	1	—	3	3	2	—			
GM	5	3	7	6	3	1	4	3	—	1	5	2			
total	5	6	8	6	6	2	5	3	3	4	7	2	78	67	67
1992 GB	—	4	1	—	—	1	1	—	—	2	2	1			
GM	1	5	2	2	1	4	3	2	2	2	3	2			
total	1	9	3	2	1	5	4	2	2	4	5	3	168	143	155
1993 GB	—	2	1	1	—	1	—	—	—	3	2	1			
GM	2	4	4	1	—	2	2	—	—	1	2	—			
total	2	6	5	2	0	3	2	0	0	4	4	1	133	260	253
1994 GB	—	—	—	—	—	—	1	1	—	1	—	1			
GM	—	2	5	3	—	4	3	3	—	2	3	3			
total	0	2	5	3	0	4	4	4	0	3	3	4	205	97	181
1995 GB	1	—	—	—	1	—	—	—	1	—	—	—			
GM	1	3	—	2	—	2	—	—	—	2	—	1			
total	2	3	0	2	1	2	0	0	1	2	0	1	323	336	332
1996 GB	—	2	2	1	—	1	4	—	—	2	1	1			
GM	2	3	2	1	2	1	3	5	3	1	4	2			
total	2	5	4	2	2	2	7	5	3	3	5	3	189	53	75
1997 GB	2	4	2	3	—	2	3	1	—	2	—	—			
GM	4	4	3	1	2	3	3	—	1	5	3	2			
total	6	8	5	4	2	5	6	1	1	7	3	2	82	77	69
1998 GB	1	4	1	—	2	1	1	1	1	1	1	1			
GM	2	3	1	1	6	3	7	7	2	2	2	2			
total	3	7	2	1	8	4	8	8	3	3	3	3	111	41	87
1999 GB	4	4	—	1	5	2	1	—	—	4	1	—			
GM	6	8	6	9	7	4	5	7	1	6	3	2			
total	10	12	6	10	12	6	6	7	1	10	4	2	31	29	61

Table 7. Landings at age (thousands of fish; metric tons), mean weight (kg), and mean length (cm) at age of commercial landings of American plaice from Gulf of Maine - Georges Bank, and South, 1980-1999.

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
Landings in Numbers (000's) at Age																
1980	0	0	0	22	770	3129	3903	3629	1185	1139	850	323	155	215	687	16007
1981	0	0	587	1332	4331	5100	3618	2381	1573	645	440	196	146	45	234	20628
1982	0	0	113	2134	3495	4295	3481	3293	2038	1256	737	317	34	137	230	21558
1983	0	0	1	438	3735	4270	3809	2252	1271	697	450	455	230	59	168	17834
1984	0	0	3	253	1298	4819	2865	1913	577	274	307	65	57	0	647	13078
1985	0	0	0	60	786	2066	2787	2213	1081	438	267	79	54	19	30	9880.6
1986	0	0	1	198	1082	1502	1462	1307	631	255	105	51	26	7	15	6644
1987	0	0	15	343	486	1703	1271	891	541	187	62	26	15	14	5	5557
1988	0	0	1	446	1148	1456	1427	543	270	177	88	25	13	11	6	5612.5
1989	0	0	0	76	451	686	504	749	469	193	103	35	29	22	31	3345.7
1990	0	0	0	202	846	1049	500	290	349	193	96	74	42	16	29	3685.8
1991	0	0	0	23	1850	2818	1105	319	164	201	97	66	23	9	6	6682.4
1992	0	0	0	46	739	4871	2563	812	191	131	118	38	33	18	4	9564.4
1993	0	0	0	123	1028	2036	2452	1382	265	287	151	71	22	7	25	7847.8
1994	0	0	24	200	914	1903	1287	1178	608	239	153	64	49	26	157	6800.3
1995	0	0	0	141	717	2880	1745	646	582	212	53	26	16	0	8	7027.6
1996	0	0	101	175	2515	2396	1412	533	241	125	35	21	15	22	5	7598
1997	0	0	0	2	1275	2615	1558	620	184	86	67	48	19	11	41	6524.8
1998	0	0	0	6	175	1501	1899	1002	319	60	57	24	22	22	87	5175
1999	0	0	0	2	218	958	1617	1125	429	143	41	42	23	3	10	4610
Landings at Age (mt)																**Total**
1980	0	0	0	6	271	1387	2562	3008	1232	1347	1168	508	269	391	1448	13597
1981	0	0	78	276	1485	2318	2832	2122	1545	729	552	266	257	82	358	12898
1982	0	0	23	620	1166	1845	2007	3164	2320	1502	1144	551	65	224	524	15153
1983	0	0	0	149	1720	2484	2596	1864	1326	867	650	638	405	108	380	13187
1984	0	0	1	84	549	2913	1957	1713	688	310	421	134	93	0	1279	10142
1985	0	0	0	13	212	747	1516	1884	1263	603	445	158	115	42	73	7070
1986	0	0	0	53	349	616	864	1101	741	380	183	102	58	17	42	4506
1987	0	0	3	97	187	809	797	797	636	278	107	56	34	32	15	3849
1988	0	0	0	126	413	689	922	484	333	247	151	49	29	26	20	3490
1989	0	0	0	26	177	335	295	553	403	257	150	62	51	46	66	2421
1990	0	0	0	78	355	547	330	240	338	210	125	104	76	30	62	2496
1991	0	0	0	8	839	1532	790	307	191	256	150	107	46	18	17	4261
1992	0	0	0	22	314	2623	1895	774	237	173	193	72	63	40	13	6418
1993	0	0	0	51	463	1054	1591	1305	327	399	238	126	55	13	94	5718
1994	0	0	3	48	391	1008	807	938	659	308	217	106	92	54	466	5097
1995	0	0	0	51	301	1482	1141	531	652	283	112	51	28	0	17	4648
1996	0	0	17	59	1017	1236	918	490	290	172	55	41	33	57	13	4398
1997	0	0	0	0	541	1245	992	510	208	115	105	82	40	32	131	4002
1998	0	0	0	2	68	649	1090	818	325	80	83	38	57	59	351	3620
1999	0	0	0	0	94	466	953	841	395	158	59	75	46	6	20	3113

Table 7 continued. Landings at age (thousands of fish; metric tons), mean weight (kg), and mean length (cm) at age of commercial landings of American plaice from Gulf of Maine - Georges Bank, and South, 1980-1999..

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Mean Weight at age (kg)																Average
1980	-----	-----	-----	0.285	0.352	0.443	0.656	0.829	1.039	1.183	1.374	1.573	1.732	1.815	2.109	0.849
1981	-----	-----	0.133	0.207	0.343	0.454	0.783	0.891	0.982	1.130	1.254	1.354	1.755	1.836	1.534	0.625
1982	-----	-----	0.200	0.291	0.334	0.429	0.577	0.961	1.138	1.196	1.552	1.737	1.944	1.636	2.281	0.703
1983	-----	-----	0.184	0.341	0.460	0.582	0.682	0.828	1.043	1.244	1.446	1.404	1.762	1.843	2.255	0.740
1984	-----	-----	0.180	0.331	0.423	0.605	0.683	0.895	1.192	1.133	1.369	2.058	1.628	0.000	1.977	0.775
1985	-----	-----	0.000	0.221	0.270	0.362	0.544	0.852	1.167	1.377	1.665	1.991	2.115	2.254	2.437	0.715
1986	-----	-----	0.191	0.267	0.322	0.410	0.591	0.842	1.174	1.491	1.747	2.002	2.207	2.344	2.751	0.678
1987	-----	-----	0.201	0.284	0.386	0.475	0.627	0.895	1.177	1.483	1.732	2.148	2.213	2.359	2.988	0.692
1988	-----	-----	0.151	0.282	0.360	0.473	0.646	0.893	1.231	1.396	1.717	1.991	2.265	2.278	3.074	0.622
1989	-----	-----	-----	0.339	0.393	0.489	0.586	0.739	0.858	1.334	1.463	1.789	1.780	2.106	2.142	0.724
1990	-----	-----	-----	0.384	0.420	0.522	0.660	0.826	0.968	1.089	1.305	1.409	1.811	1.881	2.154	0.678
1991	-----	-----	-----	0.333	0.453	0.543	0.715	0.963	1.161	1.276	1.541	1.618	2.012	2.050	2.837	0.639
1992	-----	-----	-----	0.473	0.424	0.538	0.739	0.953	1.240	1.319	1.640	1.902	1.928	2.151	2.884	0.671
1993	-----	-----	-----	0.416	0.451	0.518	0.649	0.945	1.234	1.394	1.577	1.784	2.468	1.989	3.750	0.729
1994	-----	-----	0.138	0.239	0.427	0.530	0.627	0.796	1.083	1.289	1.424	1.657	1.880	2.082	2.963	0.750
1995	-----	-----	0.000	0.359	0.420	0.517	0.685	0.914	1.168	1.099	2.105	1.934	1.757	0.000	2.213	0.517
1996	-----	-----	0.166	0.339	0.404	0.516	0.650	0.919	1.202	1.383	1.565	1.962	2.127	2.525	2.486	0.579
1997	-----	-----	-----	0.214	0.424	0.476	0.636	0.822	1.127	1.336	1.570	1.709	2.138	3.084	3.231	0.613
1998	-----	-----	-----	0.343	0.395	0.437	0.581	0.826	1.031	1.350	1.463	1.628	2.622	2.703	4.066	0.708
1999	-----	-----	-----	0.255	0.437	0.490	0.593	0.753	0.925	1.113	1.462	1.799	2.020	2.082	2.067	0.680
Mean Length at age (cm)																Average
1980	-----	-----	-----	32.6	34.7	37.1	41.7	44.8	47.9	49.9	52.2	54.4	56.0	56.7	59.1	44.1
1981	-----	-----	25.8	28.8	34.0	36.9	43.3	45.2	46.7	48.8	50.3	51.8	55.6	57.0	53.8	39.4
1982	-----	-----	29.0	32.4	33.7	36.4	39.5	46.3	48.8	49.9	53.9	55.7	58.0	55.0	60.7	40.8
1983	-----	-----	28.7	34.2	37.2	39.8	41.9	44.2	47.5	50.2	52.9	52.2	56.1	56.9	60.1	42.2
1984	-----	-----	28.5	33.9	36.3	40.3	41.8	45.3	49.9	49.3	52.2	59.0	54.9	0.0	59.3	42.8
1985	-----	-----	-----	30.0	31.9	34.6	39.1	45.0	49.6	52.0	55.2	58.2	59.3	60.4	61.8	41.4
1986	-----	-----	29.0	31.9	33.6	36.0	40.1	44.6	49.5	53.3	56.0	58.4	60.0	61.1	64.2	40.7
1987	-----	-----	29.4	32.5	35.5	37.8	41.0	45.6	49.5	53.3	55.8	59.6	60.2	61.3	65.7	41.3
1988	-----	-----	27.0	32.4	34.8	37.6	41.4	45.6	50.4	52.3	55.7	58.3	60.6	60.6	66.4	39.9
1989	-----	-----	-----	34.3	35.8	38.2	40.2	43.0	44.6	51.5	52.9	56.2	56.2	59.2	59.4	41.9
1990	-----	-----	-----	35.6	36.5	38.9	41.6	44.5	46.7	48.3	51.1	52.3	56.6	57.3	59.5	41.3
1991	-----	-----	-----	34.2	37.4	39.4	42.6	46.6	49.3	50.6	53.9	54.5	58.5	58.6	64.8	40.8
1992	-----	-----	-----	38.0	36.7	39.2	43.1	46.4	50.5	51.4	54.9	57.5	57.7	59.6	65.2	41.5
1993	-----	-----	-----	36.5	37.3	38.8	41.4	46.6	50.5	52.4	54.4	56.5	62.2	58.3	70.4	42.3
1994	-----	-----	26.2	30.4	36.7	39.2	41.2	44.2	48.6	51.2	52.6	55.2	57.4	59.2	65.6	42.3
1995	-----	-----	0.0	35.0	36.6	38.8	41.6	44.6	49.0	51.7	59.4	57.9	56.1	-----	60.3	41.3
1996	-----	-----	27.7	34.1	36.2	38.8	41.4	46.1	50.0	52.1	54.3	58.1	59.5	62.6	62.1	39.5
1997	-----	-----	-----	30.0	36.7	37.9	41.3	44.5	49.0	51.7	54.2	55.6	59.6	66.5	66.9	40.2
1998	-----	-----	-----	34.5	35.9	37.0	40.1	44.7	47.8	51.8	53.0	54.9	63.4	63.9	72.2	41.5
1999	-----	-----	-----	31.6	36.9	38.2	40.4	43.4	46.2	48.9	52.9	56.3	58.2	59.2	59.0	41.7

Table 8. Total number of trips in the Gulf of Maine northern shrimp fishery by year, season, and month, 1980-2000.

	Winter		Spring			Winter	
	Jan	Feb	Mar	Apr	May	Dec	Total
1980	0	299	263	55	72	0	689
1981	329	653	874	291	4	0	2151
1982	831	1074	1152	252	14	190	3513
1983	1185	1504	796	317	92	467	4361
1984	2017	2328	1457	174	0	777	6753
1985	1785	2079	1348	361	104	852	6529
1986	1704	2980	1367	383	489	1273	8196
1987	2601	3266	2489	884	652	1068	10960
1988	2587	2987	1466	197	147	1158	8542
1989	3149	2816	1102	534	154	1359	9114
1990	2485	1883	2099	1059	350	1093	8969
1991	1980	2502	1283	611	280	570	7226
1992	2366	2647	1246	320	158	381	7118
1993	1451	2096	1310	497	5	502	5861
1994 *	1666	2290	1190	150	0	1904	7200
1995 *	2784	2823	1712	1097	0	1858	10274
1996 *	2556	4114	2044	740	606	2291	12351
1997 *	2285	3404	1703	1238	853	1224	10707
1998 *	2089	2119	814	551	375	322	6270
1999 *	787	1211	573	567	356	15	3509
2000 *	73	187	49	8	12		329

* Provisional

Table 9. Estimate of catchability (q), standard error of q, degrees of freedom (df) and r^2 for 1989-1997 seasonal (winter, spring, December) regressions of American plaice sea sample discard per trip on filtered NEFSC bottom trawl survey abundance indices (number per tow) at length for the Gulf of Maine Northern shrimp fishery.

Year	Season	Coefficient q	Std. Error q	df	r^2
1989	Winter	5.258	0.819	13	0.76
1990	Winter	11.92	1.069	12	0.91
1991	Winter	2.326	0.188	13	0.92
1992	Winter	1.259	0.095	12	0.94
1993	Winter	13.916	4.148	12	0.48
1994	Winter	12.016	3.743	13	0.44
1995	Winter	3.681	1.035	13	0.49
1996	Winter	19.285	2.744	11	0.82
1997	Winter	49.219	7.557	11	0.79
Mean (1989-1997)		13.20889			
1989	Spring	43.41	3.296	13	0.93
1990	Spring	13.337	1.268	11	0.91
1991	Spring	5.012	0.485	12	0.90
1992	Spring	16.791	3.525	15	0.60
1993	Spring	15.403	3.353	14	0.60
1994	Spring	15.117	1.533	14	0.87
1995	Spring	61.625	10.417	16	0.68
1996	Spring	24.613	2.643	16	0.84
1997	Spring	39.068	12.459	12	0.45
Mean		26.04178			
1989	December	12.15	1.0905	12	0.91
1990	December	2.888	0.234	13	0.92
1991	December	3.829	0.288	12	0.94
1992	December	18.441	5.497	12	0.48
1993	December	14.65	4.564	13	0.44
1994	December	3.729	1.049	13	0.49
1995	December	20.028	2.85	11	0.82
1996	December	50.557	7.762	11	0.79
1997	December	43.048	5.255	10	0.87
Mean		18.81333			

Table 10. Discard rate (lbs/trip), number of trips and total discards (lbs) of American plaice in the Northern Shrimp fishery for Area I (N of 43 degrees, 15 minutes latitude) and Area 2 (S of 43 degrees,15 minutes latitude), 1993-1997.

	AREA 1 (N of 43 degrees 15 minutes)					AREA 2 (S <= of 43 degrees 15 minutes)					
Year	Month	Disc. Rate lbs / trip	No. Trips	Total Disc. (lbs)		Year	Month	Disc. Rate lbs / trip	No. Trips	Total Disc. (lbs)	Total Disc. (lbs)
1989						**1989**					
Winter	Jan	8.17	1398	11,422		Winter	Jan	33.12	1751	57,993	
	Feb	8.17	1591	12,998			Feb	33.12	1225	40,572	
	total		2989	24420.13					2976	98565.12	122,985
Spring	Mar	298.87	469	140,170		Spring	Mar	99.48	633	62,971	
	Apr	298.87	37	11,058			Apr	99.48	497	49,442	
	May	298.87	2	598			May	99.48	152	15,121	
	total		508	151,826			Total		1282	127,533	279,359
	Dec	109.95	343	37,713			Dec	121.51	1016	123,454	161,167
Annual Total			3840	213958.9					5274	349552.6	563,512
1990						**1990**					
Winter	Jan	109.95	1041	114,458		Winter	Jan	121.51	1444	175,460	
	Feb	109.95	910	100,055			Feb	121.51	973	118,229	
	total		1951	214512.5					2417	293689.7	508,202
Spring	Mar	99.48	1335	132,806		Spring	Mar	81.45	764	62,228	
	Apr	99.48	460	45,761			Apr	81.45	599	48,789	
	May	99.48	44	4,377			May	81.45	306	24,924	
	total		1839	182,944			Total		1669	135,940	318,884
	Dec	18.17	273	4,960			Dec	73.7	820	60,434	65,394
Annual Total			4063	402416.6					4906	490063.7	892,480
1991						**1991**					
Winter	Jan	18.17	685	12,446		Winter	Jan	73.7	1295	95,442	
	Feb	18.17	1376	25,002			Feb	73.7	1126	82,986	
	total		2061	37448.37					2421	178427.7	215,876
Spring	Mar	12.18	654	7,966		Spring	Mar	81.45	629	51,232	
	Apr	12.18	183	2,229			Apr	81.45	428	34,861	
	May	12.18	30	365			May	81.45	250	20,363	
	total		867	10,560			Total		1307	106,455	117,015
	Dec	6.69	235	1,572			Dec	44.7	335	14,975	16,547
Annual Total			3163	49580.58					4063	299857.4	349,438

Table 10 continued. Discard rate (lbs/trip), number of trips and total discards (lbs) of American plaice in the Northern Shrimp fishery for Area 1 (N of 43 degrees 15 minutes latitude) and Area 2 (S of 43 degrees 15 minutes latitude), 1993-1997.

	AREA 1 (N of 43 degrees 15 minutes)					AREA 2 (S <= of 43 degrees 15 minutes)					
Year	Month	Disc. Rate lbs / trip	No. Trips	Total Disc. (lbs)		Year	Month	Disc. Rate lbs / trip	No. Trips	Total Disc. (lbs)	Total Disc. (lbs)
1992						**1992**					
Winter	Jan	6.69	2366	15,819		Winter	Jan	44.70	0	0	
	Feb	6.69	2269	15,170			Feb	44.70	378	16,897	
	total		4635	30,989					378	16,897	47,886
Spring	Mar	5.47	822	4,500		Spring	Mar	22.20	424	9,412	
	Apr	5.47	137	750			Apr	22.20	183	4,062	
	May	5.47	10	55			May	22.20	148	3,285	
	total		969	5,304			Total		755	16,759	22,064
	Dec	5.47	129	706			Dec	14.88	252	3,750	4,456
Annual Total			5733	36999.51					1385	37406.19	74,406
1993						**1993**					
Winter	Jan	5.47	901	4,932		Winter	Jan	14.88	550	8,184	
	Feb	5.47	1382	7,565			Feb	14.88	714	10,624	
	total		2283	12,497					1264	18,808	31,305
Spring	Mar	4.48	526	2,357		Spring	Mar	16.44	784	12,893	
	Apr	4.48	111	497			Apr	16.44	386	6,348	
	May	4.48	0	0			May	16.44	5	82	
	total		637	2,855			Total		1175	19,322	22,177
	Dec	3.67	173	634.7883			Dec	12.18	329	4008.041	4,643
Annual Total			3093	15,987					2768	42,138	58,125
1994						**1994**					
Winter	Jan	3.67	893	3,277		Winter	Jan	12.18	773	9,417	
	Feb	3.67	1243	4,561			Feb	12.18	1047	12,755	
	total		2136	7,838					1820	22,172	30,010
Spring	Mar	4.95	561	2,779		Spring	Mar	3.67	629	2,308	
	Apr	4.95	38	188			Apr	3.67	112	411	
	May	4.95	0	0			May	3.67	0	0	
	total		599	2966.866			Total		741	2718.949	5,686
	Dec	24.53	271	6,648			Dec	7.38	1633	12,052	18,699
Annual Total			3006	17,452					4194	36,943	54,395

Table 10 continued. Discard rate (lbs/trip), number of trips and total discards (lbs) of American plaice in the Northern Shrimp fishery for Area 1 (N of 43 degrees 15 minutes latitude) and Area 2 (S of 43 degrees 15 minutes latitude), 1993-1997.

AREA 1 (N of 43 degrees 15 minutes)					AREA 2 (S <= of 43 degrees 15 minutes)					
Year	Month	Disc. Rate lbs / trip	No. Trips	Total Disc. (lbs)	Year	Month	Disc. Rate lbs / trip	No. Trips	Total Disc. (lbs)	Total Disc. (lbs)
1995					**1995**					
Winter	Jan	24.53	276	6,770	Winter	Jan	7.38	2508	18,509	
	Feb	24.53	480	11,774		Feb	7.38	2343	17,291	
	total		756	18,545				4851	35,800	54,345
Spring	Mar	14.89	146	2,174	Spring	Mar	54.60	1566	85,504	
	Apr	14.89	21	312.69		Apr	54.60	1076	58749.6	
	May	14.89	0	0		May	54.60	0	0	
	total		167	2,487		Total		2642	144,253	146,740
	Dec	9.03	132	1,192		Dec	24.53	1726	42,339	43,531
Annual Total			1055	22,223				9219	222,392	244,616
1996					**1996**					
Winter	Jan	9.03	227	2,050	Winter	Jan	24.53	2329	57,130	
	Feb	9.03	621	5,608		Feb	24.53	3493	85,683	
	total		848	7,657				5822	142,814	150,471
Spring	Mar	81.45	323	26308.35	**Spring**	Mar	27.11	1721	46656.31	
	Apr	81.45	31	2,525		Apr	27.11	709	19,221	
	May	81.45	12	977		May	27.11	594	16,103	
	total		366	29,811		Total		3024	81,981	111,791
	Dec	7.39	113	835		Dec	18.17	2178	39,574	40,409
Annual Total			1327	38,303				11024	264,369	302,672
1997					**1997**					
Winter	Jan	7.39	208	1,537	Winter	Jan	18.17	2077	37,739	
	Feb	7.39	319	2357.41		Feb	18.17	3085	56054.45	
	total		527	3894.53				5162	93793.54	97,688
Spring	Mar	*81.45*	72	5864.4	Spring	Mar	29.96	1631	48864.76	
	Apr	*81.45*	42	3420.9		Apr	29.96	1703	51021.88	
	May	*81.45*	25	2036.25		May	29.96	1238	37090.48	
	total		139	11321.55		Total		4572	136977.1	148,299
	Dec	*7.39*	28	206.92		Dec	*18.17*	1196	21731.32	21,938
Annual Total			694	15423				10930	252502	267,925

Table 11. Discards at age (thousands of fish; metric tons) and mean weight (kg) at age of American plaice discarded in the northern shrimp fishery in the Gulf of Maine region, 1980-1999.

Year	0	1	2	3	4	5	6	7	8	9	10	
						Discards in Numbers (000's) at Age						Total
1980	0.0	0.0	0.0	114.0	115.1	28.7	0.0	0.0	0.0	0.0	0.0	257.8
1981	0.0	0.9	147.8	364.4	287.2	79.6	0.4	0.0	2.9	0.0	0.0	883.2
1982	0.0	6.9	154.7	545.6	632.7	105.9	95.7	4.2	0.0	0.0	0.0	1545.7
1983	0.2	14.0	614.3	641.0	760.7	319.9	51.0	5.9	0.0	0.7	0.0	2407.8
1984	0.0	2.5	302.0	488.3	575.1	494.6	98.1	5.9	2.8	0.0	0.0	1969.3
1985	0.0	53.9	103.2	930.9	464.9	307.8	79.0	14.8	0.0	0.0	0.0	1954.6
1986	0.2	53.7	552.0	399.9	933.5	131.9	9.9	0.0	0.1	0.0	0.0	2081.2
1987	0.0	31.4	439.1	1107.6	609.5	338.4	12.8	0.7	0.0	0.0	0.0	2539.6
1988	0.0	283.1	587.4	786.4	408.4	90.8	11.8	10.1	0.0	0.0	0.0	2178.0
1989	0.0	129.0	1458.3	1180.6	325.7	24.1	0.8	0.0	0.0	0.0	0.0	3118.4
1990	0.0	61.0	597.9	1965.4	1004.4	151.6	8.9	0.0	0.0	0.0	0.0	3789.2
1991	0.0	7.5	191.3	436.2	467.3	92.4	2.8	1.1	0.0	0.0	0.0	1198.7
1992	0.0	20.0	68.8	173.4	79.6	24.7	1.5	0.3	0.3	0.0	0.0	368.5
1993	0.0	81.9	95.8	113.2	85.2	22.7	4.3	0.0	0.0	0.2	0.0	403.4
1994	0.7	288.2	475.7	123.3	19.9	5.8	1.5	0.5	0.0	0.0	0.0	915.6
1995	1.1	518.3	1470.5	717.3	96.7	11.9	4.6	0.2	0.6	0.0	0.0	2821.1
1996	0.0	194.7	834.5	1041.0	359.3	53.4	19.9	6.9	0.1	0.0	0.0	2509.8
1997	0.0	158.0	1365.4	511.5	358.7	85.6	14.6	0.7	0.0	0.0	0.0	2494.5
1998	0.0	37.2	61.3	127.0	78.3	48.7	7.3	1.3	0.0	0.0	0.0	361.3
1999	0.0	4.2	200.0	73.6	79.0	41.5	26.0	6.8	0.6	0.0	0.0	431.6
						Discards at age (mt)						Total
1980	0.0	0.0	0.0	11.9	19.6	6.0	0.0	0.0	0.0	0.0	0.0	37.5
1981	0.0	0.0	5.9	31.9	43.4	15.2	0.1	0.0	0.7	0.0	0.0	97.3
1982	0.0	0.1	4.6	49.4	87.9	20.9	17.2	1.0	0.0	0.0	0.0	181.1
1983	0.0	0.2	18.0	58.3	103.4	53.4	9.8	1.1	0.0	0.2	0.0	244.3
1984	0.0	0.0	9.5	35.4	73.2	73.2	17.5	1.2	0.7	0.0	0.0	210.6
1985	0.0	0.8	4.4	63.2	56.2	44.4	16.7	2.9	0.0	0.0	0.0	188.6
1986	0.0	0.7	20.5	31.2	129.5	24.1	2.0	0.0	0.0	0.0	0.0	208.1
1987	0.0	0.3	12.7	83.0	80.3	66.1	3.2	0.2	0.0	0.0	0.0	245.8
1988	0.0	4.4	22.4	66.6	54.6	15.9	3.0	2.1	0.0	0.0	0.0	168.9
1989	0.0	1.6	55.5	124.8	51.1	5.5	0.2	0.0	0.0	0.0	0.0	238.6
1990	0.0	1.3	34.0	168.8	143.8	29.7	2.4	0.0	0.0	0.0	0.0	380.0
1991	0.0	0.1	8.8	39.5	75.4	24.6	1.0	0.4	0.0	0.0	0.0	149.8
1992	0.0	0.4	2.1	10.8	11.8	6.0	0.4	0.1	0.1	0.0	0.0	31.7
1993	0.0	1.3	3.6	4.9	8.5	5.0	1.2	0.0	0.0	0.1	0.0	24.6
1994	0.0	4.1	10.1	5.6	1.9	1.2	0.4	0.2	0.0	0.0	0.0	23.4
1995	0.0	6.4	37.5	40.1	13.0	3.0	1.2	0.1	0.2	0.0	0.0	101.4
1996	0.0	2.7	18.4	49.1	39.6	11.1	5.3	1.8	0.1	0.0	0.0	128.0
1997	0.0	2.1	27.5	28.6	38.2	12.4	2.8	0.3	0.0	0.0	0.0	111.9
1998	0.0	0.5	1.7	7.8	8.3	8.2	1.8	0.3	0.0	0.0	0.0	28.7
1999	0.0	0.0	3.4	3.2	7.9	5.1	4.4	1.8	0.2	0.0	0.0	26.0

Table 11 continued. Discards at age (thousands of fish; metric tons) and mean weight (kg) at age of American plaice discarded in the northern shrimp fishery in the Gulf of Maine region, 1980-1999.

Year	0	1	2	3	4	5	6	7	8	9	10	
						Mean weight at age (kg)						Average
1980	---	—	---	0.104	0.170	0.210	0.359	—	---	---	----	0.145
1981	—	0.007	0.040	0.087	0.151	0.192	0.320	—	0.239	---	----	0.110
1982	—	0.014	0.030	0.091	0.139	0.197	0.180	0.239	0.000	—	----	0.117
1983	0.002	0.013	0.029	0.091	0.136	0.167	0.193	0.177	0.359	0.295	----	0.101
1984	---	0.004	0.032	0.072	0.127	0.148	0.178	0.198	0.239	—	—	0.107
1985	---	0.015	0.043	0.068	0.121	0.144	0.211	0.196	0.000	---	—	0.096
1986	0.001	0.014	0.037	0.078	0.139	0.183	0.204	0.000	0.359	—	—	0.100
1987	---	0.011	0.029	0.075	0.132	0.195	0.247	0.307	—	—	—	0.097
1988	---	0.016	0.038	0.085	0.134	0.175	0.253	0.209	---	---	—	0.078
1989	---	0.012	0.038	0.106	0.157	0.227	0.313	---	---	---	----	0.077
1990	—	0.021	0.057	0.086	0.143	0.196	0.265	—	---	—	----	0.100
1991	—	0.013	0.046	0.091	0.161	0.266	0.370	0.359	---	—	—	0.125
1992	—	0.018	0.031	0.062	0.149	0.241	0.299	0.359	0.239	—	—	0.086
1993	—	0.016	0.037	0.044	0.100	0.221	0.278	—	---	0.239	—	0.061
1994	0.001	0.014	0.021	0.045	0.095	0.205	0.240	0.359	---	---	—	0.026
1995	0.001	0.012	0.026	0.056	0.134	0.248	0.266	0.359	0.289	---	—	0.036
1996	—	0.014	0.022	0.047	0.110	0.208	0.267	0.256	0.359	---	----	0.051
1997	---	0.014	0.020	0.056	0.107	0.145	0.191	0.361	—	---	----	0.045
1998	0.001	0.013	0.027	0.062	0.106	0.168	0.248	0.258	0.604	0.714	----	0.079
1999	---	0.008	0.017	0.044	0.100	0.124	0.171	0.259	0.295	0.533	----	0.060
						Mean Length at age (cm)						Average
1980	—	---	---	23.84	27.69	29.60	35.00	----	—	—	----	26.20
1981	—	11.00	17.90	22.51	26.65	28.78	33.79	----	31.00	—	—	23.67
1982	—	13.18	16.22	22.56	26.00	28.90	28.30	31.00	----	—	—	24.10
1983	6.76	12.60	16.31	22.90	25.77	27.49	28.95	28.10	35.00	33.00	—	22.82
1984	—	8.55	16.11	21.08	25.12	26.31	28.21	29.25	31.00	—	—	23.19
1985	—	13.33	17.96	20.57	24.87	26.25	29.71	29.04	----	—	—	22.58
1986	5.00	13.20	16.84	21.62	25.86	28.32	29.50	----	35.00	—	—	22.50
1987	—	11.86	15.86	21.60	25.59	29.01	31.19	33.38	----	—	—	22.49
1988	—	13.56	17.19	22.01	25.68	27.97	31.49	29.70	----	—	—	20.64
1989	—	12.67	16.24	22.05	27.75	31.85	33.66	----	----	—	—	21.26
1990	—	13.12	18.04	20.33	23.94	26.02	31.08	----	----	—	—	19.26
1991	—	12.79	15.27	20.61	25.00	28.43	35.00	35.00	----	—	—	19.05
1992	3.00	14.74	16.92	18.90	24.92	28.54	31.24	35.00	31.00	—	—	19.91
1993	3.00	12.57	17.37	21.49	23.67	28.44	29.17	—	----	31.00	—	19.13
1994	5.00	13.63	17.25	21.69	24.12	28.07	27.58	29.57	----	—	—	17.41
1995	5.00	12.98	15.06	19.29	24.85	28.25	28.17	35.00	29.12	—	—	17.81
1996	5.00	13.57	15.14	19.23	23.99	28.62	30.74	31.26	37.19	—	—	19.71
1997	—	13.61	15.79	20.36	24.20	26.27	28.59	35.49	43.00	35.70	—	20.68
1998	5.00	12.77	15.87	20.32	23.84	27.51	30.78	31.36	40.80	43.00	—	20.77
1999	—	9.96	13.61	18.43	23.39	24.84	27.61	31.52	32.90	39.39	—	18.42

Table 12. The percent of total American plaice landings caught by large mesh otter trawl gear (5.0", 5.1", and 6.0" mesh), 1980-1999.

Year	Mesh(inches)	Percent of total landings
1980	5.0	55.5
1981	5.0	63.2
1982	5.0	85.4
1983	5.5	62.3
1984	5.5	80.5
1985	5.5	84.9
1986	5.5	90.8
1987	5.5	97.8
1988	5.5	98.3
1989	5.5	95.6
1990	5.5	97.3
1991	5.5	95.7
1992	5.5	93.7
1993	5.5	91.7
1994 *	5.5 (May 6.0)	89.2
1995 *	6.0	88.4
1996 *	6.0	90.2
1997 *	6.0	88.3
1998 *	6.0	86.0
1999 *	6.0 (May-6.5)	86.8

* Provisional

Table 13. Discards at age (thousands of fish; metric tons) and mean weight (kg) at age of American plaice discarded in the large mesh fishery in the Gulf of Maine-Georges Bank region, 1980-1999.

Year		0	1	2	3	4	5	6	7	8	9	10	Total
Discards in Numbers (000's) at Age													
1980		0.0	5.2	98.9	935.7	1786.7	781.2	30.2	2.9	0.0	0.0	0.0	3640.8
1981		0.0	4.2	246.7	495.9	436.9	157.6	29.8	19.9	5.4	0.0	0.0	1396.4
1982		0.0	2.7	335.4	668.9	446.8	101.8	21.7	0.0	0.0	0.0	0.0	1577.3
1983		0.0	0.6	47.8	399.5	681.4	327.8	52.6	12.2	1.4	3.4	0.0	1526.6
1984		0.0	0.0	65.0	249.1	549.4	718.1	281.5	16.3	0.3	0.0	0.0	1879.8
1985		0.0	10.9	54.6	227.0	85.8	30.8	5.6	0.0	0.0	0.0	0.0	414.5
1986		0.0	5.6	85.9	139.6	268.3	65.7	4.4	0.1	0.0	0.0	0.0	569.6
1987		0.0	7.1	135.9	390.4	343.7	241.1	53.2	3.8	1.9	0.0	0.0	1177.1
1988		0.0	30.4	197.1	606.9	276.6	50.3	5.7	0.2	0.0	0.0	0.0	1167.0
1989		0.0	3.4	194.6	574.8	347.7	119.2	31.5	4.0	1.1	0.0	0.0	1276.3
1990		0.0	6.9	77.9	1221.4	814.0	168.3	22.1	1.0	0.1	0.0	0.0	2311.7
1991		0.0	5.6	132.1	541.9	2092.5	492.0	14.8	0.8	0.0	0.0	0.0	3279.7
1992		0.0	17.3	162.1	863.4	1403.5	1913.9	160.3	6.3	7.3	0.0	0.0	4533.9
1993		0.0	24.9	330.1	1795.9	3027.9	1523.5	683.4	20.9	0.0	0.0	0.0	7406.5
1994	*	0.0	0.0	6.9	299.6	1693.0	2550.8	414.3	110.4	0.0	0.5	0.0	5075.5
1995	*	0.0	0.0	17.6	1426.0	5689.0	1933.9	251.5	7.2	1.0	0.0	0.0	9326.3
1996	*	0.0	0.0	0.7	201.8	1568.8	508.8	38.9	8.7	8.8	0.0	0.0	2336.6
1997	*	0.0	0.0	9.7	289.5	1104.8	1219.2	128.2	97.0	45.6	42.5	21.9	2958.5
1998	*	0.0	0.0	1.4	148.1	630.3	1056.9	569.2	40.2	0.5	0.0	0.0	2446.6
1999	*	0.0	0.0	2.1	130.1	688.8	712.8	429.9	141.7	33.1	0.2	0.0	2138.6
Discards at age (mt)													
1980		0.0	0.2	7.5	147.2	423.8	218.3	9.4	1.1	0.0	0.0	0.0	807.6
1981		0.0	0.2	21.9	61.7	70.0	26.7	5.6	3.4	1.1	0.0	0.0	190.6
1982		0.0	0.1	42.1	98.8	69.3	18.6	3.8	0.0	0.0	0.0	0.0	232.6
1983		0.0	0.0	4.0	65.8	134.5	69.7	12.0	2.8	0.4	0.8	0.0	290.0
1984		0.0	0.0	6.7	40.2	112.4	172.8	71.3	5.2	0.1	0.0	0.0	408.7
1985		0.0	0.3	4.8	25.4	11.3	4.8	0.9	0.0	0.0	0.0	0.0	47.6
1986		0.0	0.2	6.2	17.9	44.7	12.4	0.7	0.0	0.0	0.0	0.0	82.2
1987		0.0	0.1	11.4	60.2	69.5	59.2	15.2	1.1	0.2	0.0	0.0	216.9
1988		0.0	0.6	13.5	100.1	53.5	11.3	1.5	0.1	0.0	0.0	0.0	180.5
1989		0.0	0.1	12.8	96.5	81.0	29.2	7.5	0.8	0.4	0.0	0.0	228.2
1990		0.0	0.1	5.2	222.8	207.9	45.5	6.6	0.4	0.0	0.0	0.0	488.4
1991		0.0	0.1	8.4	73.1	543.5	139.9	6.0	0.4	0.0	0.0	0.0	771.4
1992		0.0	0.7	12.8	139.9	375.4	674.6	60.0	1.8	1.7	0.0	0.0	1267.0
1993		0.0	0.4	29.5	374.4	787.5	496.6	259.9	7.7	0.0	0.0	0.0	1956.1
1994		0.0	0.0	0.7	67.4	470.7	856.4	153.7	45.8	0.0	0.3	0.0	1595.0
1995		0.0	0.0	2.7	373.2	1776.5	693.5	95.5	3.5	0.3	0.0	0.0	2945.3
1996		0.0	0.0	0.1	47.1	446.6	156.2	13.6	3.2	3.2	0.0	0.0	669.9
1997		0.0	0.0	1.7	59.9	285.8	319.5	36.0	25.2	10.9	12.5	6.5	758.0
1998		0.0	0.0	0.2	36.5	170.5	303.4	176.6	12.0	0.3	0.0	0.0	699.6
1999		0.0	0.0	0.3	37.1	216.6	240.6	146.4	45.8	9.6	0.1	0.0	696.5
Mean weight at age (kg)													
1980		----	0.030	0.076	0.157	0.237	0.279	0.311	0.392	0.000	----	----	0.222
1981		----	0.037	0.089	0.124	0.160	0.169	0.189	0.171	0.209	----	----	0.136
1982		----	0.029	0.126	0.148	0.155	0.182	0.173	----	----	----	----	0.147
1983		0.007	0.024	0.083	0.165	0.197	0.213	0.228	0.234	0.308	0.229	----	0.190
1984		----	----	0.103	0.162	0.205	0.241	0.253	0.317	0.432	----	----	0.217
1985		----	0.030	0.088	0.112	0.132	0.155	0.168	0.000	0.000	----	----	0.115
1986		----	0.035	0.072	0.128	0.167	0.189	0.171	0.295	----	----	----	0.144
1987		----	0.020	0.084	0.154	0.202	0.246	0.286	0.295	0.116	----	----	0.184
1988		----	0.019	0.068	0.165	0.193	0.226	0.262	0.359	----	----	----	0.155
1989		----	0.017	0.066	0.168	0.233	0.245	0.239	0.209	0.369	----	----	0.179
1990		----	0.015	0.067	0.182	0.255	0.270	0.300	0.359	0.432	----	----	0.211
1991		----	0.019	0.063	0.135	0.260	0.284	0.406	0.515	----	----	----	0.235
1992		----	0.039	0.079	0.162	0.267	0.353	0.374	0.290	0.239	----	----	0.279
1993		----	0.017	0.090	0.208	0.260	0.326	0.380	0.371	----	----	----	0.264
1994		----	0.047	0.102	0.225	0.278	0.336	0.371	0.415	----	0.609	----	0.314
1995		----	----	0.156	0.262	0.312	0.359	0.380	0.489	0.295	0.000	----	0.316
1996		----	0.065	0.101	0.233	0.285	0.307	0.349	0.366	0.359	0.000	----	0.287
1997		----	0.065	0.170	0.207	0.259	0.262	0.281	0.260	0.239	0.295	0.295	0.256
1998		0.065	0.138	0.246	0.271	0.287	0.310	0.299	0.515	----	----	----	0.286
1999		----	0.143	0.285	0.314	0.337	0.341	0.323	0.291	0.515	----	----	0.326

* Provisional

Table 14. Catch at age (thousands of fish; metric tons) and mean weight (kg), of commercial landings, and large mesh and northern shrimp fishery discards of American plaice from Gulf of Maine - Georges Bank, and South, 1980-1999.

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
Catch in Numbers (000's) at Age																
1980	0	5	99	1072	2672	3939	3933	3632	1185	1139	850	323	155	215	687	19906
1981	0	5	982	2192	5055	5337	3648	2401	1582	645	440	196	146	45	234	22907
1982	0	10	603	3348	4574	4503	3599	3297	2038	1256	737	317	34	137	230	24681
1983	0	15	663	1478	5177	4918	3913	2270	1272	701	450	455	230	59	168	21768
1984	1	3	370	991	2422	6031	3244	1936	580	274	307	65	57	0	647	16928
1985	0	65	158	1217	1336	2405	2872	2228	1081	438	267	79	54	19	30	12250
1986	0	59	639	738	2284	1700	1476	1307	631	255	105	51	26	7	15	9295
1987	0	38	590	1840	1439	2282	1337	895	543	187	62	26	15	14	5	9274
1988	0	314	786	1840	1833	1597	1444	553	270	177	88	25	13	11	6	8957
1989	0	132	1653	1831	1125	829	536	753	471	193	103	35	29	22	31	7740
1990	0	68	676	3389	2664	1369	531	291	349	193	96	74	42	16	29	9787
1991	0	13	323	1001	4410	3403	1123	321	164	201	97	66	23	9	6	11161
1992	0	37	231	1083	2222	6810	2724	819	198	131	118	38	33	18	4	14467
1993	0	107	426	2032	4141	3583	3139	1403	265	287	151	71	22	7	25	15658
1994 *	1	288	506	623	2627	4459	1703	1288	608	240	153	64	49	26	157	12791
1995 *	1	518	1488	2285	6503	4826	2001	654	584	212	53	26	16	0	8	19175
1996 *	0	195	936	1418	4443	2958	1471	549	250	125	35	21	15	22	5	12444
1997 *	0	158	1375	803	2739	3919	1701	718	230	128	89	48	19	11	41	11978
1998 *	0	37	63	281	883	2607	2476	1044	320	60	57	24	22	22	87	7983
1999 *	0	4	202	205	985	1713	2073	1273	463	143	41	42	23	3	10	7180
Catch at Age (mt)																**Total**
1980	0	0	10	160	705	1609	2571	3009	1232	1347	1168	508	269	391	1448	14429
1981	0	1	106	353	1570	2351	2838	2126	1547	729	552	266	257	82	358	13134
1982	0	1	75	735	1277	1870	2020	3164	2320	1502	1144	551	65	224	524	15471
1983	0	1	16	179	1781	2527	2608	1872	1334	876	660	649	417	121	394	13436
1984	0	1	14	144	700	3105	2037	1719	688	310	421	134	93	0	1279	10644
1985	0	1	15	62	249	769	1525	1884	1263	603	445	158	115	42	73	7203
1986	0	2	15	100	412	637	865	1101	741	380	183	102	58	17	42	4655
1987	0	2	30	187	295	883	813	798	637	278	107	56	34	32	15	4165
1988	0	3	28	247	483	705	925	484	333	247	151	49	29	26	20	3730
1989	0	2	68	247	309	370	303	554	403	257	150	62	51	46	66	2888
1990	0	1	39	469	707	623	339	240	338	210	125	104	76	30	62	3364
1991	0	0	17	120	1458	1696	797	308	191	256	150	107	46	18	17	5182
1992	0	1	15	173	701	3304	1956	776	238	173	193	72	63	40	13	7717
1993	0	2	33	430	1259	1556	1852	1313	327	399	238	126	55	13	94	7699
1994	0	4	14	121	863	1866	961	984	659	309	217	106	92	54	466	6715
1995	0	6	40	464	2091	2178	1238	534	653	283	112	51	28	0	17	7695
1996	0	3	35	155	1503	1403	937	495	294	172	55	41	33	57	13	5196
1997	0	2	29	89	865	1577	1030	536	219	127	112	82	40	32	131	4872
1998	0	1	2	46	247	960	1268	830	326	80	83	38	57	59	351	4348
1999	0	0	4	41	319	712	1104	888	405	158	59	75	46	6	20	3835

Table 14 continued. Catch at age (thousands of fish; metric tons) and mean weight (kg), of commercial landings, and large mesh and northern shrimp fishery discards of American plaice from Gulf of Maine - Georges Bank, and South, 1980-1999.

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
							Mean weight at Age (kg)									Average
1980	0.000	0.030	0.076	0.154	0.267	0.409	0.653	0.829	1.039	1.183	1.374	1.573	1.732	1.815	2.109	0.725
1981	0.000	0.032	0.108	0.168	0.316	0.442	0.778	0.885	0.978	1.130	1.254	1.354	1.755	1.836	1.534	0.576
1982	0.000	0.018	0.115	0.230	0.290	0.418	0.564	0.960	1.138	1.196	1.552	1.737	1.944	1.636	2.281	0.631
1983	0.002	0.013	0.033	0.185	0.378	0.530	0.670	0.823	1.042	1.238	1.446	1.404	1.762	1.843	2.255	0.630
1984	0.000	0.004	0.045	0.161	0.303	0.524	0.630	0.888	1.187	1.133	1.369	2.058	1.628	2.014	1.977	0.636
1985	0.000	0.018	0.058	0.084	0.209	0.331	0.534	0.847	1.167	1.377	1.665	1.991	2.115	2.254	2.437	0.596
1986	0.001	0.016	0.042	0.138	0.229	0.384	0.587	0.842	1.174	1.491	1.747	2.002	2.207	2.344	2.751	0.516
1987	0.000	0.013	0.046	0.131	0.234	0.409	0.609	0.892	1.173	1.483	1.732	2.148	2.213	2.359	2.988	0.465
1988	0.000	0.016	0.046	0.159	0.284	0.449	0.641	0.880	1.231	1.396	1.717	1.991	2.265	2.278	3.074	0.429
1989	0.000	0.012	0.041	0.135	0.275	0.446	0.566	0.736	0.857	1.334	1.463	1.789	1.780	2.106	2.142	0.373
1990	0.000	0.021	0.058	0.138	0.265	0.455	0.639	0.824	0.968	1.089	1.305	1.409	1.811	1.881	2.154	0.344
1991	0.000	0.015	0.053	0.120	0.330	0.498	0.710	0.960	1.161	1.276	1.541	1.618	2.012	2.050	2.837	0.464
1992	0.000	0.028	0.065	0.159	0.315	0.485	0.717	0.948	1.202	1.319	1.640	1.902	1.928	2.151	2.884	0.533
1993	0.000	0.016	0.078	0.212	0.304	0.434	0.590	0.936	1.234	1.393	1.577	1.784	2.468	1.989	3.750	0.492
1994	0.001	0.014	0.028	0.194	0.328	0.418	0.564	0.763	1.083	1.287	1.424	1.657	1.880	2.082	2.963	0.525
1995	0.001	0.012	0.027	0.203	0.322	0.453	0.646	0.909	1.166	1.099	2.105	1.934	1.757	0.000	2.213	0.407
1996	0.000	0.014	0.038	0.110	0.338	0.474	0.637	0.902	1.172	1.383	1.565	1.962	2.127	2.525	2.486	0.418
1997	0.000	0.014	0.021	0.111	0.316	0.402	0.605	0.746	0.951	0.992	1.256	1.709	2.138	3.084	3.231	0.407
1998	0.001	0.013	0.030	0.165	0.281	0.371	0.518	0.805	1.031	1.350	1.463	1.628	2.622	2.703	4.066	0.550
1999	0.000	0.008	0.018	0.198	0.324	0.417	0.535	0.702	0.879	1.112	1.462	1.799	2.020	2.082	2.067	0.537
1980-1999	0.001	0.016	0.051	0.158	0.296	0.438	0.620	0.854	1.092	1.263	1.533	1.772	2.008	2.051	2.610	0.513
1995-1999	0.001	0.012	0.027	0.157	0.316	0.424	0.588	0.813	1.040	1.187	1.570	1.806	2.133	2.079	2.813	0.464

Table 15. Catch at age (thousands of fish; metric tons) and mean weight (kg), of commercial landings, large mesh and northern shrimp fishery discards of American plaice, ages 1-9+, from Gulf of Maine - Georges Bank, and South, 1980-1999.

Year	0	1	2	3	4	5	6	7	8	9+	Total
Catch in Numbers (000's) at Age											
1980	0	5	99	1072	2672	3939	3933	3632	1185	3369	19906
1981	0	5	982	2192	5055	5337	3648	2401	1582	1706	22907
1982	0	10	603	3348	4574	4503	3599	3297	2038	2710	24681
1983	0	15	663	1478	5177	4918	3913	2270	1272	2062	21768
1984	0	3	370	991	2422	6031	3244	1936	580	1350	16927
1985	0	65	158	1217	1336	2405	2872	2228	1081	887	12250
1986	0	59	639	738	2284	1700	1476	1307	631	460	9295
1987	0	38	590	1840	1439	2282	1337	895	543	309	9274
1988	0	314	786	1840	1833	1597	1444	553	270	321	8957
1989	0	132	1653	1831	1125	829	536	753	471	411	7740
1990	0	68	676	3389	2664	1369	531	291	349	450	9787
1991	0	13	323	1001	4410	3403	1123	321	164	402	11161
1992	0	37	231	1083	2222	6810	2724	819	198	342	14467
1993	0	107	426	2032	4141	3583	3139	1403	265	563	15658
1994	1	288	506	623	2627	4459	1703	1288	608	688	12791
1995	1	518	1488	2285	6503	4826	2001	654	584	315	19174
1996	0	195	936	1418	4443	2958	1471	549	250	224	12444
1997	0	158	1375	803	2739	3919	1701	718	230	335	11978
1998	0	37	63	281	883	2607	2476	1044	320	272	7983
1999	0	4	202	205	985	1713	2073	1273	463	261	7180
Catch at Age (mt)											
1980	0	0	10	160	705	1609	2571	3009	1232	5132	14429
1981	0	1	106	353	1570	2351	2838	2126	1547	2243	13134
1982	0	1	75	735	1277	1870	2020	3164	2320	4010	15471
1983	0	1	16	179	1781	2527	2608	1872	1334	3117	13436
1984	0	1	14	144	700	3105	2037	1719	688	2236	10644
1985	0	1	15	62	249	769	1525	1884	1263	1435	7203
1986	0	2	15	100	412	637	865	1101	741	782	4655
1987	0	2	30	187	295	883	813	798	637	521	4166
1988	0	3	28	247	483	705	925	484	333	522	3730
1989	0	2	68	247	309	370	303	554	403	632	2888
1990	0	1	39	469	707	623	339	240	338	608	3364
1991	0	0	17	120	1458	1696	797	308	191	594	5182
1992	0	1	15	173	701	3304	1956	776	238	554	7717
1993	0	2	33	430	1259	1556	1852	1313	327	927	7699
1994	0	4	14	121	863	1866	961	984	659	1244	6715
1995	0	6	40	464	2091	2178	1238	534	653	490	7695
1996	0	3	35	155	1503	1403	937	495	294	371	5196
1997	0	2	29	89	865	1577	1030	536	219	525	4872
1998	0	1	2	46	247	960	1268	830	326	668	4348
1999	0	0	4	41	319	712	1104	888	405	363	3835
Mean Weight at age (kg)											Average
1980	0.000	0.030	0.076	0.154	0.267	0.409	0.653	0.829	1.039	1.523	0.725
1981	0.000	0.032	0.108	0.168	0.316	0.442	0.778	0.885	0.978	1.315	0.576
1982	0.000	0.018	0.115	0.230	0.290	0.418	0.564	0.960	1.138	1.479	0.631
1983	0.002	0.013	0.033	0.185	0.378	0.530	0.670	0.823	1.042	1.479	0.630
1984	0.001	0.004	0.045	0.161	0.303	0.524	0.630	0.888	1.187	1.657	0.636
1985	0.001	0.018	0.058	0.084	0.209	0.331	0.534	0.847	1.167	1.618	0.596
1986	0.001	0.016	0.042	0.138	0.229	0.384	0.587	0.842	1.174	1.702	0.516
1987	0.001	0.013	0.046	0.131	0.234	0.409	0.609	0.892	1.173	1.688	0.465
1988	0.000	0.016	0.046	0.159	0.284	0.449	0.641	0.880	1.231	1.630	0.429
1989	0.000	0.012	0.041	0.135	0.275	0.446	0.566	0.736	0.857	1.537	0.373
1990	0.000	0.021	0.058	0.138	0.265	0.455	0.639	0.824	0.968	1.352	0.344
1991	0.000	0.015	0.053	0.120	0.330	0.498	0.710	0.960	1.161	1.479	0.464
1992	0.000	0.028	0.065	0.159	0.315	0.485	0.717	0.948	1.202	1.617	0.533
1993	0.000	0.016	0.078	0.212	0.304	0.434	0.590	0.936	1.234	1.647	0.492
1994	0.001	0.014	0.028	0.194	0.328	0.418	0.564	0.763	1.083	1.807	0.525
1995	0.001	0.012	0.027	0.203	0.322	0.453	0.646	0.909	1.166	1.399	0.407
1996	0.000	0.014	0.038	0.110	0.338	0.474	0.637	0.902	1.172	1.657	0.418
1997	0.000	0.014	0.021	0.111	0.316	0.402	0.605	0.746	0.951	1.565	0.407
1998	0.001	0.013	0.030	0.165	0.281	0.371	0.518	0.805	1.031	2.482	0.550
1999	0.000	0.008	0.018	0.198	0.324	0.417	0.535	0.702	0.879	1.401	0.537
1980-1999	0.001	0.016	0.051	0.158	0.296	0.438	0.620	0.854	1.092	1.602	0.513
1995-1999	0.001	0.012	0.027	0.157	0.316	0.424	0.588	0.813	1.040	1.701	0.464

Table 16. USA commercial landings (L), days fished (DF), and landings per day fished (L/DF), by vessel tonnage class (class 2: 5-50 GRT; class 4: 151-500 GRT), of American plaice for otter trawl trips landing plaice from the Gulf of Maine-Georges Bank area, 1964-1999. Data are also provided for otter trawl trips where American plaice comprised 50% or more of the total trip catch, by weight [directed trips'], 1964-1999.

	TON CLASS 2			TON CLASS 3			TON CLASS 4			TOTALS		
YEAR	L	DF	L/DF	L	DF	L/DF	L	DF	L/DF	L	DF	L/DF
						ALL TRIPS						
1964	729.7	2207.5	0.33	1640.3	6016.4	0.27	157.1	1370.4	0.11	2527.1	9594.3	0.28
1965	898.5	2333.1	0.39	1591.4	6052.1	0.26	274.3	1754.9	0.16	2764.2	10140.1	0.29
1966	871.4	2221.7	0.39	1816.1	6664.4	0.27	421.3	2828.9	0.15	3108.8	10140.1	0.29
1967	787.1	1883.1	0.42	2026.8	6016.0	0.34	283.3	2121.2	0.13	3097.2	10020.3	0.34
1968	603.3	2277.7	0.26	1711.4	5640.2	0.30	232.9	1954.4	0.12	2547.6	9872.3	0.27
1969	783.9	2434.4	0.32	1681.5	5761.4	0.29	303.6	1640.0	0.19	2769.0	9835.8	0.29
1970	634.7	3690.0	0.17	1556.3	5783.9	0.27	281.9	1505.5	0.19	2472.9	10979.4	0.24
1971	484.1	2989.1	0.16	1442.0	5823.2	0.25	215.6	1176.6	0.18	2141.7	9988.9	0.22
1972	389.4	2972.9	0.13	1252.0	6806.6	0.18	135.0	1120.7	0.12	1776.4	10900.2	0.16
1973	466.0	2703.0	0.17	931.1	5675.7	0.16	161.7	1056.9	0.15	1558.8	9435.6	0.16
1974	687.3	3161.3	0.22	1053.0	5766.4	0.18	192.8	1310.3	0.15	1933.1	10238.0	0.19
1975	1076.6	3733.5	0.29	992.3	5868.2	0.17	227.3	1393.8	0.16	2296.2	10995.5	0.23
1976	1715.4	3680.3	0.47	1421.4	5776.2	0.25	184.3	1334.0	0.14	3321.1	10790.5	0.36
1977	3667.4	3805.7	0.96	2577.5	6862.8	0.38	354.3	1358.6	0.26	6599.2	12027.1	0.70
1978	4494.9	4648.2	0.97	3862.5	8187.4	0.47	513.8	1769.1	0.29	8871.2	14604.7	0.71
1979	4942.8	5264.5	0.94	4553.0	8549.1	0.53	639.4	2313.9	0.28	10135.2	16127.5	0.71
1980	5909.9	5900.6	1.00	4749.0	8784.4	0.54	1042.6	2832.0	0.37	11701.5	17517.0	0.76
1981	5779.1	4935.6	1.17	5153.3	8847.7	0.58	1167.4	3307.4	0.35	12099.8	17090.7	0.84
1982	5782.7	5929.6	0.98	6437.3	10602.2	0.61	1808.5	4425.2	0.41	14028.5	20957.0	0.74
1983	4472.8	5312.0	0.84	5738.0	10378.2	0.55	2131.4	4960.8	0.43	12342.2	20651.0	0.63
1984	3097.5	5285.0	0.59	4723.9	12641.8	0.37	1753.6	5164.8	0.34	9575.0	23091.6	0.44
1985	1858.9	4704.0	0.40	3259.9	13665.9	0.24	1546.4	6092.7	0.25	6665.2	24462.6	0.29
1986	1168.1	4385.6	0.27	1971.3	11202.2	0.18	969.1	5806.7	0.17	4108.5	21394.5	0.20
1987	919.6	4485.8	0.21	1816.8	10943.8	0.17	826.8	5567.0	0.15	3563.2	20996.6	0.18
1988	899.1	4709.4	0.19	1539.0	10711.6	0.14	635.5	5500.3	0.12	3073.6	20921.3	0.15
1989	574.9	3794.6	0.15	1158.7	9218.6	0.13	438.4	4669.8	0.09	2172.0	17683.0	0.13
1990	696.2	4060.5	0.17	1145.5	8788.5	0.13	412.7	5063.1	0.08	2254.4	17912.1	0.13
1991	973.6	4299.5	0.23	2236.2	10370.2	0.22	749.0	5653.8	0.13	3958.8	20323.5	0.21
1992	1481.0	4561.3	0.32	3545.1	13565.9	0.26	1169.9	6292.3	0.19	6196.0	24419.5	0.26
1993	1176.7	3688.7	0.32	3066.3	13872.1	0.22	1073.4	6059.5	0.18	5316.4	23620.3	0.23
1994 *	712.1	2458.5	0.29	1674.3	6823.4	0.25	814.8	3419.4	0.24	3201.2	12701.3	0.25
1995 *	895.6	3092.1	0.29	1861.0	8267.3	0.23	711.1	3992.1	0.18	3467.7	15351.5	0.23
1996 *	862.6	3137.0	0.27	2035.4	8371.2	0.24	721.6	3415.5	0.21	3619.6	14923.7	0.24
1997 *	821.3	3038.8	0.27	1664.3	6132.6	0.27	671.1	2654.9	0.25	3156.7	11826.3	0.27
1998 *	856.8	3439.1	0.25	1405.3	5762.3	0.24	535.8	2270.8	0.24	2797.9	11472.2	0.24
1999 *	734.1	2999.4	0.24	1253.5	5702.6	0.22	524.0	2244.1	0.23	2511.6	10946.1	0.23

* Provisional

Table 16. continued — USA commercial landings (L), days fished (DF), and landings per day fished (L/DF), by vessel tonnage class (class 2: 5-50 GRT; class 4: 151-500 GRT), of American plaice for otter trawl trips landing plaice from the Gulf of Maine-Georges Bank area, 1964-1999. Data are also provided for otter trawl trips where American plaice comprised 50% or more of the total trip catch, by weight [directed trips'], 1964-1999.

YEAR		TON CLASS 2 L	TON CLASS 2 DF	TON CLASS 2 L/DF	TON CLASS 3 L	TON CLASS 3 DF	TON CLASS 3 L/DF	TON CLASS 4 L	TON CLASS 4 DF	TON CLASS 4 L/DF	TOTALS L	TOTALS DF	TOTALS L/DF
						50% TRIPS							
1964		201.6	115.8	1.74	429.6	166.9	2.57	0.0	0.0	0.00	631.2	282.7	2.30
1965		268.5	161.7	1.66	413.8	180.5	2.29	3.8	2.0	1.91	686.1	344.2	2.04
1966		218.6	133.9	1.63	527.3	249.9	2.11	1.2	1.5	0.82	747.1	385.3	1.97
1967		155.2	78.7	1.97	685.6	365.5	1.88	15.8	6.0	2.64	856.6	450.2	1.91
1968		55.0	30.5	1.80	557.9	291.6	1.91	3.9	2.0	1.93	616.8	324.1	1.90
1969		135.6	61.0	2.22	320.9	154.8	2.07	0.7	1.0	0.68	457.2	216.8	2.11
1970		10.0	9.2	1.09	309.6	143.6	2.16	31.2	14.6	2.14	350.8	167.4	2.13
1971		3.5	3.6	0.98	147.7	1.6	2.06	20.7	6.3	3.28	171.9	81.5	2.18
1972		8.6	7.5	1.15	92.8	2.5	1.28	1.1	2.4	0.45	102.5	82.4	1.26
1973		17.3	23.1	0.75	70.6	42.2	1.67	6.5	3.0	2.16	94.4	68.3	1.54
1974		110.0	99.2	1.11	142.3	3.4	1.52	10.2	8.5	1.20	262.5	201.1	1.34
1975		158.5	119.3	1.33	103.2	70.4	1.47	20.8	15.7	1.32	282.5	205.4	1.38
1976		496.9	371.6	1.34	184.2	101.6	1.81	3.8	5.0	0.75	684.9	478.2	1.46
1977		1516.3	570.0	2.66	520.8	203.5	2.56	12.9	7.4	1.74	2050.0	780.9	2.63
1978		981.1	806.1	2.46	721.1	273.5	2.64	6.6	5.0	1.32	2708.8	1084.6	2.51
1979		2865.8	1418.6	2.02	1219.3	435.8	2.80	14.5	9.2	1.58	4099.6	1863.6	2.25
1980		3083.4	1499.5	2.06	1188.3	443.2	2.68	57.0	19.0	3.00	4328.7	1961.7	2.24
1981		3391.9	1416.5	2.39	1651.0	585.7	2.82	69.3	22.1	3.13	5112.2	2024.3	2.54
1982		3276.6	1838.5	1.78	2078.2	976.9	2.13	132.2	60.3	2.19	5487.0	2875.7	1.92
1983		2087.0	1248.1	1.67	1344.2	761.9	1.76	105.5	58.2	1.81	3536.7	2068.2	1.71
1984		1189.8	964.1	1.23	707.7	539.9	1.31	108.1	58.0	1.86	2005.6	1562.0	1.29
1985		538.4	567.2	0.95	226.0	255.2	0.89	46.5	52.1	0.89	810.9	874.5	0.93
1986		179.4	237.7	0.75	112.7	166.3	0.68	33.3	33.9	0.98	325.4	437.9	0.75
1987		178.5	244.3	0.73	126.1	251.3	0.50	17.4	31.3	0.56	322.0	526.9	0.63
1988		149.2	298.3	0.50	212.0	401.1	0.53	4.0	8.8	0.46	365.2	708.2	0.52
1989		80.4	136.3	0.59	31.7	48.4	0.66	2.4	2.5	0.97	114.5	187.2	0.62
1990		111.8	192.0	0.58	138.0	210.2	0.66	0.0	0.0	0.00	249.8	402.2	0.62
1991		277.7	365.3	0.76	529.7	812.9	0.65	26.7	33.7	0.79	834.1	1211.9	0.69
1992		560.7	796.2	0.70	1131.3	1579.1	0.72	75.9	93.4	0.81	1767.9	2468.7	0.72
1993		467.9	809.3	0.58	628.8	968.8	0.65	31.2	52.0	0.60	1127.9	1830.1	0.62
1994	*	399.7	824.7	0.48	533.7	991.7	0.54	50.1	60.0	0.84	983.5	1876.4	0.53
1995	*	539.8	1145.1	0.47	582.8	1132.9	0.51	57.8	119.2	0.48	1180.4	2397.2	0.49
1996	*	441.2	905.6	0.49	589.9	958.7	0.62	29.9	48.5	0.62	1061.0	1912.8	0.56
1997	*	356.9	677.3	0.53	293.9	423.5	0.69	11.5	21.5	0.53	662.3	1122.3	0.60
1998	*	432.8	809.9	0.53	319.5	495.9	0.64	15.3	20.6	0.74	767.6	1326.4	0.58
1999	*	272.5	554.1	0.49	145.9	242.3	0.60	37.5	27.0	1.39	455.9	823.4	0.60

* Provisional

Table 17. Standardized stratified mean number and mean weight per tow (kg) of American plaice in NEFSC spring and autumn bottom trawl surveys in the Gulf of Maine - Georges Bank area, 1963 -2000 (Offshore strata 26-30,36-40,13-25).

	SPRING		AUTUMN	
	Number	Weight	Number	Weight
1963	—	—	14.17	5.87
1964	—	—	8.20	2.84
1965	—	—	11.95	3.80
1966	—	—	17.78	4.90
1967	—	—	11.05	2.69
1968	11.36	3.40	8.61	2.91
1969	8.59	2.68	7.51	2.36
1970	5.43	1.81	6.46	2.01
1971	3.80	1.26	7.47	1.96
1972	4.28	1.32	7.44	1.60
1973	7.18	1.85	6.19	1.94
1974	8.34	1.94	6.89	1.42
1975	5.78	1.72	8.12	2.43
1976	11.85	3.37	9.98	2.99
1977	14.57	5.11	11.80	3.52
1978	10.61	3.82	15.13	4.66
1979	9.23	3.62	9.96	4.00
1980	18.34	4.78	14.24	5.12
1981	18.75	5.88	13.04	5.62
1982	11.61	3.80	5.88	2.49
1983	16.94	4.60	9.34	3.45
1984	4.10	1.42	7.12	2.02
1985	4.94	1.88	6.95	2.00
1986	3.09	0.92	5.61	1.56
1987	3.50	0.81	4.38	1.09
1988	3.58	0.84	9.69	1.46
1989	4.81	0.75	9.21	1.17
1990	5.09	0.75	15.46	2.90
1991	5.91	1.05	7.71	1.56
1992	4.11	1.36	6.31	1.78
1993	5.29	1.39	11.89	2.39
1994	4.89	0.85	18.07	2.67
1995	9.43	1.94	11.84	2.58
1996	7.83	1.69	7.58	2.23
1997	7.62	1.62	6.27	1.94
1998	4.52	1.11	9.29	2.22
1999	4.18	1.20	11.03	2.57
2000	9.96	2.30		

Table 18. Estimates of beginning year stock size (thousands of fish), instantaneous fishing mortality (F) and spawning stock biomass (mt) of Gulf of Maine-Georges Bank American plaice, estimated from virtual population analysis (VPA) and calibrated using the commercial catch at age ADAPT formulation, 1980-1999.

Stock Numbers (Jan 1) in thousands

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	52643	25119	21949	25120	13184	14385	18443	36859	53355	27101	33361	33777	39816	50074	41884	24426	24189	13064	27527	34453	14187
2	42217	43096	20561	17962	20553	10791	11719	15046	30143	43399	22069	27252	27643	32565	40900	34031	19529	19628	10553	22504	28204
3	35915	34475	34395	16288	14106	16492	8692	9017	11785	23968	34036	17457	22020	22423	26276	33028	26516	15142	14826	8583	18242
4	24231	28434	26242	25131	11998	10652	12402	6449	5717	7984	17966	24800	13387	17049	16520	20950	24974	20426	11671	11884	6841
5	21550	17421	18706	17346	15891	7632	7512	8087	3978	3022	5519	12299	16314	8949	10211	11148	11268	16427	14245	8756	8839
6	17203	14080	9434	11241	9752	7554	4072	4612	4556	1812	1724	3280	6991	7195	4085	4326	4761	6549	9903	9304	5619
7	11092	10526	8227	4467	5663	5049	3586	1999	2567	2424	998	931	1669	3259	3051	1804	1731	2567	3823	5867	5742
8	5101	5795	6446	3752	1603	2884	2118	1753	826	1601	1303	554	472	625	1398	1332	885	920	1452	2185	3652
9+	14407	6202	8496	6026	3695	2342	1531	989	974	1386	1668	1347	806	1313	1563	710	787	1331	1226	1224	2138
1 +	224359	185147	154455	127333	96445	77782	70075	84810	113900	112695	118645	121698	129116	143451	145888	131754	114639	96054	95225	104761	93463

Fishing Mortality

	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	0.01	0	0	0.01	0.01	0	0	0	0	0.01	0.02	0.01	0.01	0	0
2	0	0.03	0.03	0.04	0.02	0.02	0.06	0.04	0.03	0.04	0.03	0.01	0.01	0.01	0.01	0.05	0.05	0.08	0.01	0.01
3	0.03	0.07	0.11	0.11	0.08	0.09	0.1	0.26	0.19	0.09	0.12	0.07	0.06	0.11	0.03	0.08	0.06	0.06	0.02	0.03
4	0.13	0.22	0.21	0.26	0.25	0.15	0.23	0.28	0.44	0.17	0.18	0.22	0.2	0.31	0.19	0.42	0.22	0.16	0.09	0.1
5	0.23	0.41	0.31	0.38	0.54	0.43	0.29	0.37	0.59	0.36	0.32	0.36	0.62	0.58	0.66	0.65	0.34	0.31	0.23	0.24
6	0.29	0.34	0.55	0.49	0.46	0.55	0.51	0.39	0.43	0.4	0.42	0.48	0.56	0.66	0.62	0.72	0.42	0.34	0.32	0.28
7	0.45	0.29	0.59	0.82	0.47	0.67	0.52	0.68	0.27	0.42	0.39	0.48	0.78	0.65	0.63	0.51	0.43	0.37	0.36	0.27
8	0.3	0.36	0.43	0.47	0.51	0.53	0.4	0.42	0.45	0.39	0.35	0.4	0.62	0.63	0.65	0.66	0.37	0.32	0.28	0.27
9+	0.3	0.36	0.43	0.47	0.51	0.53	0.4	0.42	0.45	0.39	0.35	0.4	0.62	0.63	0.65	0.66	0.37	0.32	0.28	0.27
mn 5-8,	0.32	0.35	0.47	0.54	0.50	0.55	0.43	0.47	0.44	0.39	0.37	0.43	0.65	0.63	0.64	0.64	0.39	0.34	0.30	0.27

Table 18 continued. Estimates of beginning year stock size (thousands of fish), instantaneous fishing mortality (F) and spawning stock biomass (mt) of Gulf of Maine-Georges Bank American plaice, estimated from virtual population analysis (VPA), calibrated using the commercial catch at age ADAPT formulation, 1980-1999.

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

age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	24	12	8	5	0	5	11	17	0	0	0	0	0	0	0	0	0	0	0	0
2	164	186	95	32	37	12	71	92	14	21	11	17	16	15	8	6	4	3	6	10
3	878	873	1206	529	230	225	395	327	156	300	401	230	323	292	366	277	161	111	141	106
4	2413	2943	2719	3438	1321	929	1286	854	612	989	2008	3092	1526	1980	2372	2691	3536	2083	1154	1530
5	4546	4061	4723	4652	4639	1633	1788	2037	995	879	1612	3644	4999	2558	2757	3261	3616	5021	4029	2466
6	7938	6457	3632	4659	4447	3085	1488	1909	1972	779	781	1558	3420	3075	1632	1771	2169	3037	3922	3641
7	7052	6935	5724	2308	3615	2907	2012	1160	1670	1426	589	615	1071	2160	1664	1081	1128	1534	2320	3143
8	4181	4535	5528	3174	1326	2444	1818	1493	737	1198	958	467	413	550	1137	1013	791	748	1129	1635
9+	19380	7092	10734	7538	5126	3153	2243	1430	1350	1836	1964	1716	1061	1756	2281	800	1129	1828	2700	1526
Total	46575	33095	34370	26335	20741	14393	11111	9319	7505	7427	8324	11340	12828	12385	12217	10900	12533	14364	15401	14056

Percent Mature (females)

age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	3	3	3	3	3	3	7	7	0	0	0	0	0	0	0	0	0	0	0	0
2	8	8	8	8	8	8	24	24	2	2	2	2	2	1	1	1	1	1	3	3
3	24	24	24	24	24	24	55	55	17	17	17	17	17	12	12	12	12	12	17	17
4	52	52	52	52	52	52	83	83	65	65	65	65	65	60	60	60	60	60	60	60
5	79	79	79	79	79	79	95	95	94	94	94	94	94	94	94	94	94	94	92	92
6	93	93	93	93	93	93	99	99	99	99	99	99	99	99	99	99	99	99	99	99
7	98	98	98	98	98	98	100	100	100	100	100	100	100	100	100	100	100	100	100	100
8	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Table 19. Yield and Spawning Stock Biomass per recruit results for American plaice where catch = landings+ discards. Results taken from O'Brien *et al.* 1999).

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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: 24-11-1998;  Time: 10:35:19.11
American plaice Gulf of Maine-Georges Bank - 1998

 Proportion of F before spawning:  .2500
 Proportion of M before spawning:  .2500
 Natural Mortality is Constant at:  .200
 Initial age is:  1; Last age is:  9   Last age is a PLUS group;
 Original age-specific PRs, Mats, and Mean Wts from file: ==> APYPR9.DAT
```

Age-specific Input data for Yield per Recruit Analysis

Age	Fish Mort Pattern	Nat Mort Pattern	Proportion Mature	Average Weights Catch	Stock
1	.0200	1.0000	.0000	.016	.010
2	.0500	1.0000	.0400	.052	.029
3	.0800	1.0000	.2400	.160	.092
4	.4200	1.0000	.7200	.305	.221
5	1.0000	1.0000	.9500	.449	.366
6	1.0000	1.0000	1.0000	.632	.534
7	1.0000	1.0000	1.0000	.866	.742
8	1.0000	1.0000	1.0000	1.107	.980
9+	1.0000	1.0000	1.0000	1.564	1.564

```
Summary of Yield per Recruit Analysis for:American plaice Gulf of Maine-Georges Bank -
1998
  Slope of the Yield/Recruit Curve at F=0.00: -->     2.5298
    F level at slope=1/10 of the above slope (F0.1): -----> .185
      Yield/Recruit corresponding to F0.1: ----->      .1792
    F level to produce Maximum Yield/Recruit (Fmax): -----> .346
      Yield/Recruit corresponding to Fmax: ----->      .1940
    F level at 20 % of Max Spawning Potential (F20): -----> .397
      SSB/Recruit corresponding to F20: -------->      .5065

 Listing of Yield per Recruit Results for:
 American plaice Gulf of Maine-Georges Bank - 1998
```

	FMORT	TOTCTHN	TOTCTHW	TOTSTKN	TOTSTKW	SPNSTKN	SPNSTKW	% MSP
	.000	.00000	.00000	5.5167	2.7847	2.8966	2.5330	100.00
	.050	.10278	.09231	5.0049	2.0916	2.3887	1.8518	73.11
	.100	.17196	.14135	4.6610	1.6510	2.0487	1.4214	56.12
	.150	.22193	.16810	4.4131	1.3517	1.8047	1.1308	44.64
F0.1	.185	.24967	.17920	4.2757	1.1945	1.6701	.9791	38.65
	.200	.25989	.18256	4.2251	1.1384	1.6207	.9251	36.52
	.250	.28983	.18996	4.0772	.9809	1.4766	.7741	30.56
	.300	.31416	.19320	3.9574	.8611	1.3607	.6601	26.06
Fmax	.346	.33281	.19396	3.8656	.7750	1.2725	.5785	22.84
	.350	.33439	.19395	3.8579	.7679	1.2651	.5719	22.58
F20%	.397	.35046	.19332	3.7790	.6984	1.1899	.5065	20.00
	.400	.35155	.19323	3.7737	.6939	1.1848	.5023	19.83
	.450	.36634	.19165	3.7013	.6341	1.1163	.4464	17.62
	.500	.37926	.18959	3.6382	.5851	1.0571	.4008	15.82
	.550	.39069	.18727	3.5825	.5443	1.0053	.3632	14.34
	.600	.40089	.18486	3.5329	.5100	.9596	.3317	13.10
	.650	.41009	.18243	3.4883	.4808	.9188	.3051	12.04
	.700	.41845	.18005	3.4478	.4557	.8822	.2823	11.14
	.750	.42609	.17775	3.4108	.4339	.8491	.2626	10.37
	.800	.43313	.17553	3.3768	.4148	.8190	.2456	9.69
	.850	.43964	.17341	3.3454	.3980	.7915	.2306	9.10
	.900	.44570	.17139	3.3163	.3831	.7662	.2173	8.58
	.950	.45136	.16947	3.2890	.3697	.7429	.2056	8.12
	1.000	.45668	.16764	3.2635	.3576	.7213	.1950	7.70

Table 20. Input and summary of stochastic projections for Gulf of Maine-Georges Bank American plaice for fishing mortalities of $F_{0.1}$=0.19, F_{99}= 0.27, and F_{ctl}=0.04 in 2000-2002.

Input for Projections:

Age	Fishing Mortality(PR)	Discard Fraction	% Mature	Average Weight Stock	Landed	Discarded
1	0.03	1.00	0.00	0.009	0.012	0.012
2	0.08	1.00	0.03	0.018	0.027	0.024
3	0.12	1.00	0.17	0.066	0.157	0.148
4	0.46	0.54	0.60	0.221	0.316	0.266
5	1.00	0.33	0.92	0.366	0.423	0.303
6	1.00	0.16	0.99	0.499	0.588	0.322
7	1.00	0.10	1.00	0.694	0.813	0.336
8	1.00	0.10	1.00	0.924	1.040	0.340
9	1.00	0.00	1.00	1.701	1.701	0.509

Projection results:

Year	Recruitment	F	Median Landings	Median Discards	Median SSB
2000	27101	0.27	3701	524	16076
2001	27101	0.27	3760	549	16747
2002	27527	0.27	3945	638	17833
2000	27101	0.27	3701	524	16076
2001	27101	0.19	2743	395	17068
2002	27527	0.19	3080	474	19370
2000	27101	0.27	3701	524	16076
2001	27101	0.04	619	87	17679
2002	27527	0.04	790	111	22618

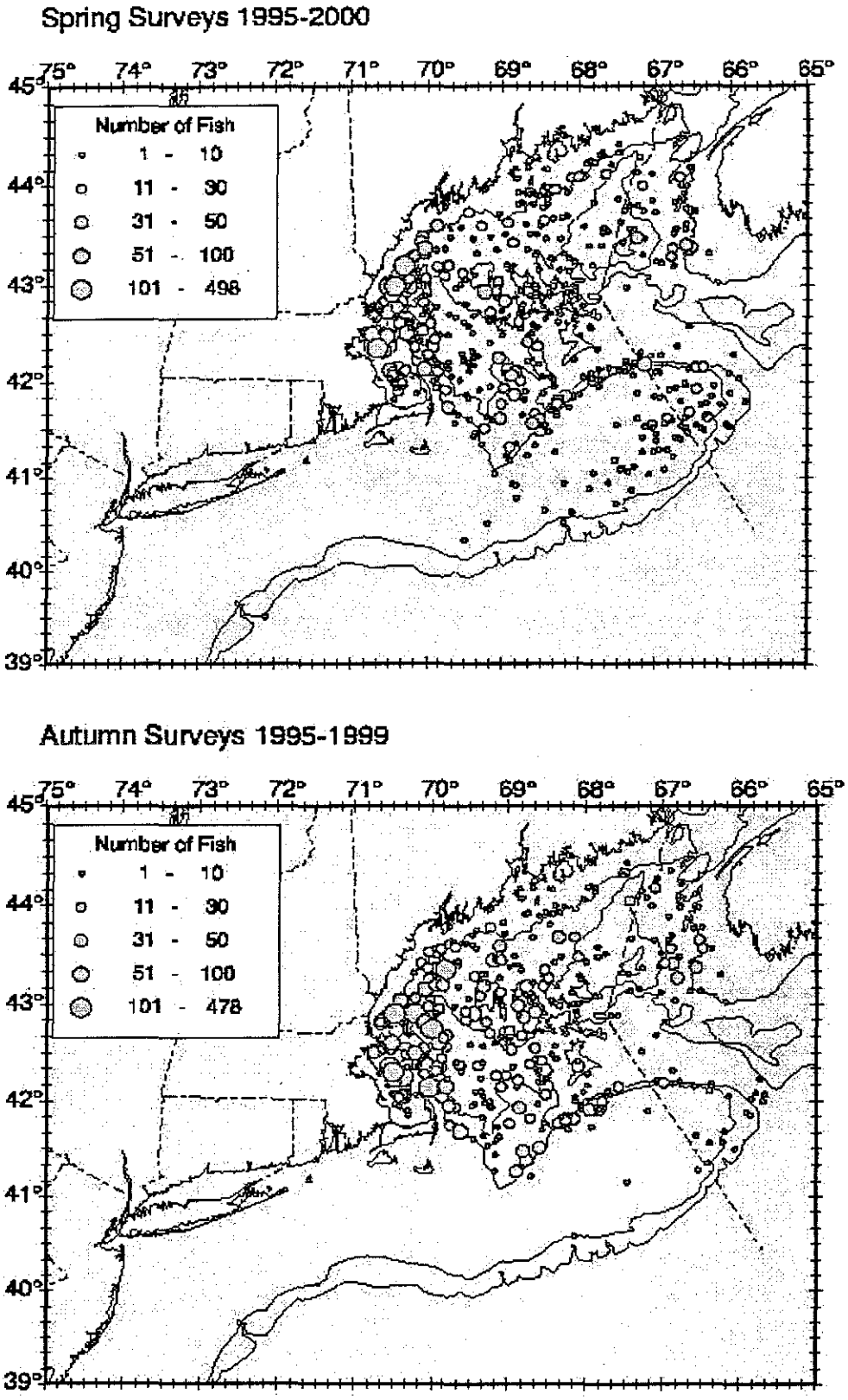


Figure 1. Distribution of American plaice in the NEFSC spring and autumn bottom trawl surveys, 1996-2000.

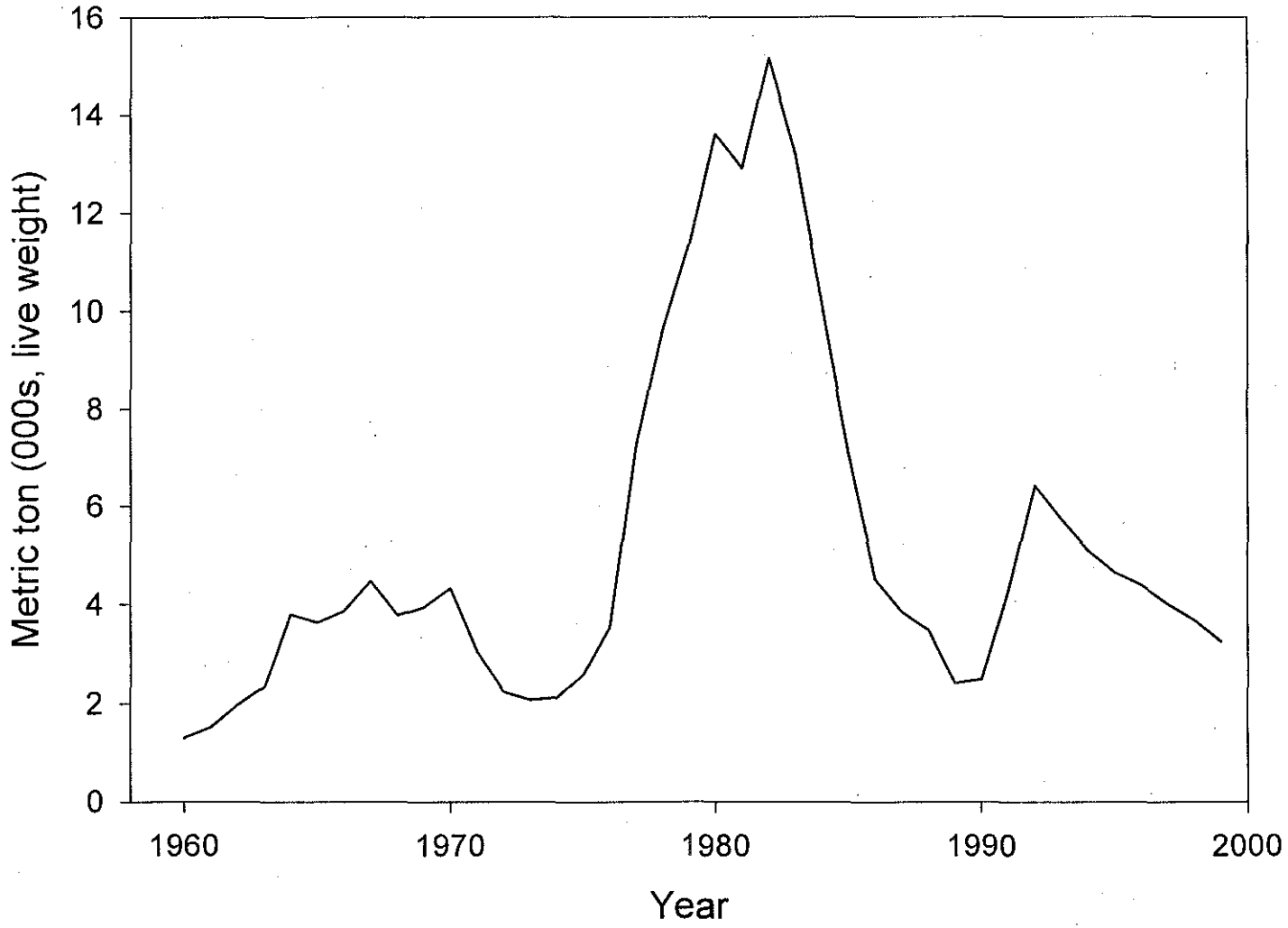


Figure 2. Total commecial landings of Gulf of Maine-Georges Bank American plaice (Division 5Z and 6), 1960-1999.

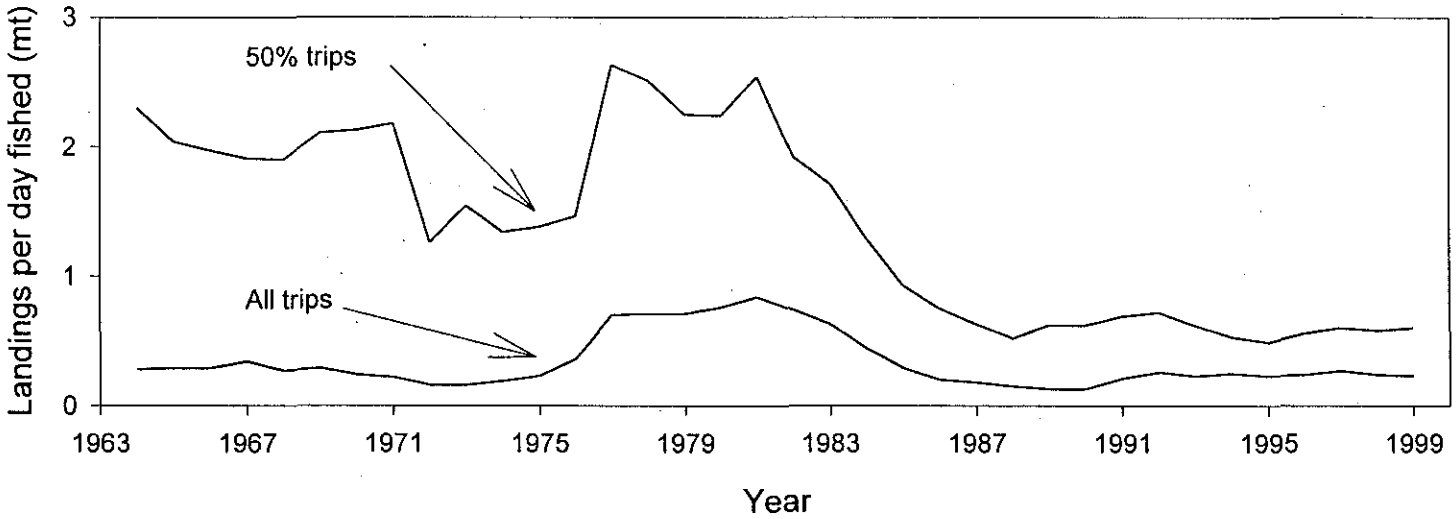


Figure 3. Trends in catch rates (landings per day (mt)) of Gulf of Maine-Georges Bank Ameican plaice for all trips landing plaice and for trips with 50% or more of the landings comprised of plaice, 1964-1999.

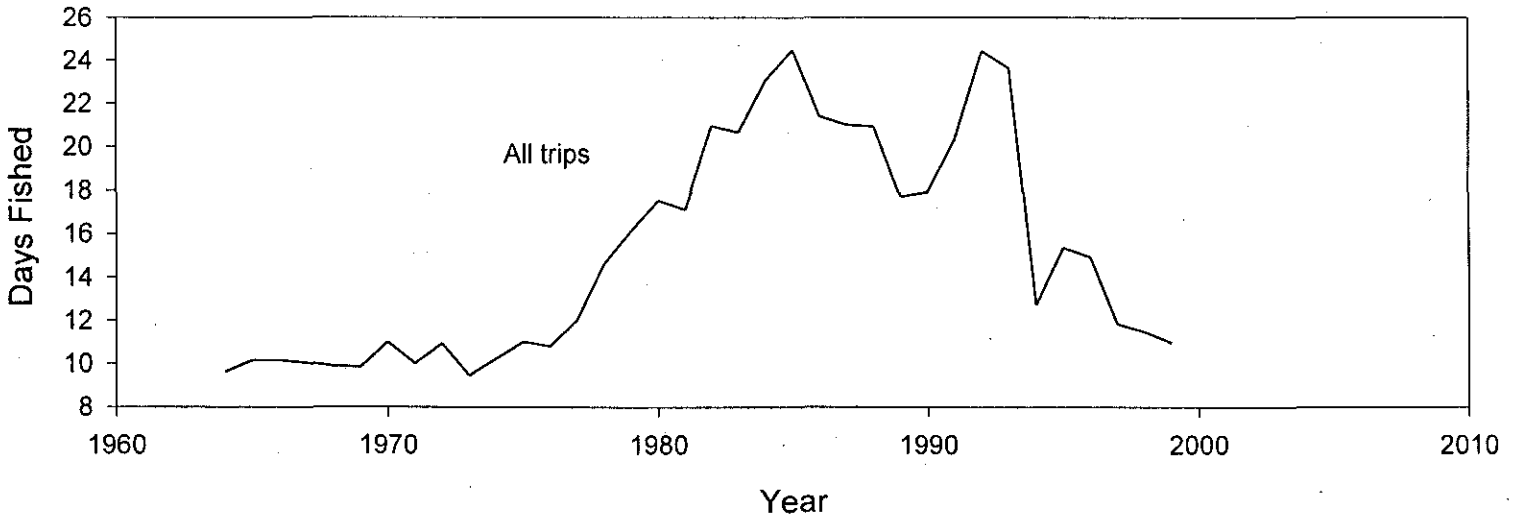


Figure 4. Trends in nominal fishing effort (days fished) for otter trawl trips landing American plaice in the Gulf of Maine-Georges Bank region, 1964-1999.

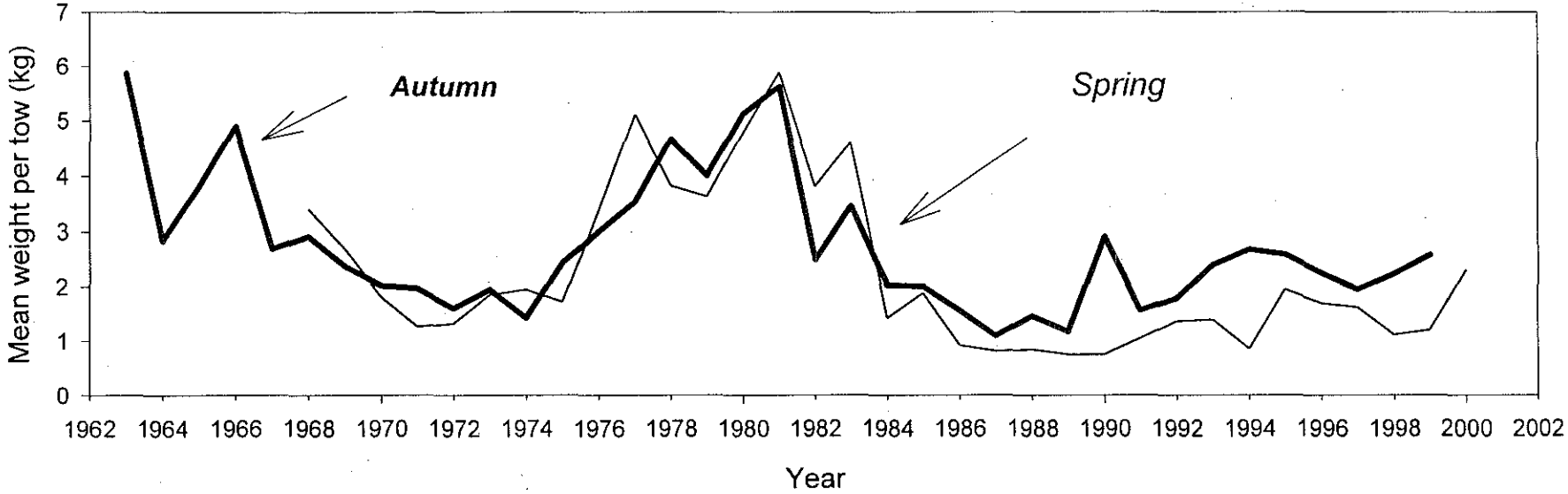


Figure 5. Standardized stratified mean weight per tow (kg) of American plaice in NEFSC spring and autumn research vessel bottom trawl survey in the Gulf of Maine-Georges Bank region, 1963-2000.

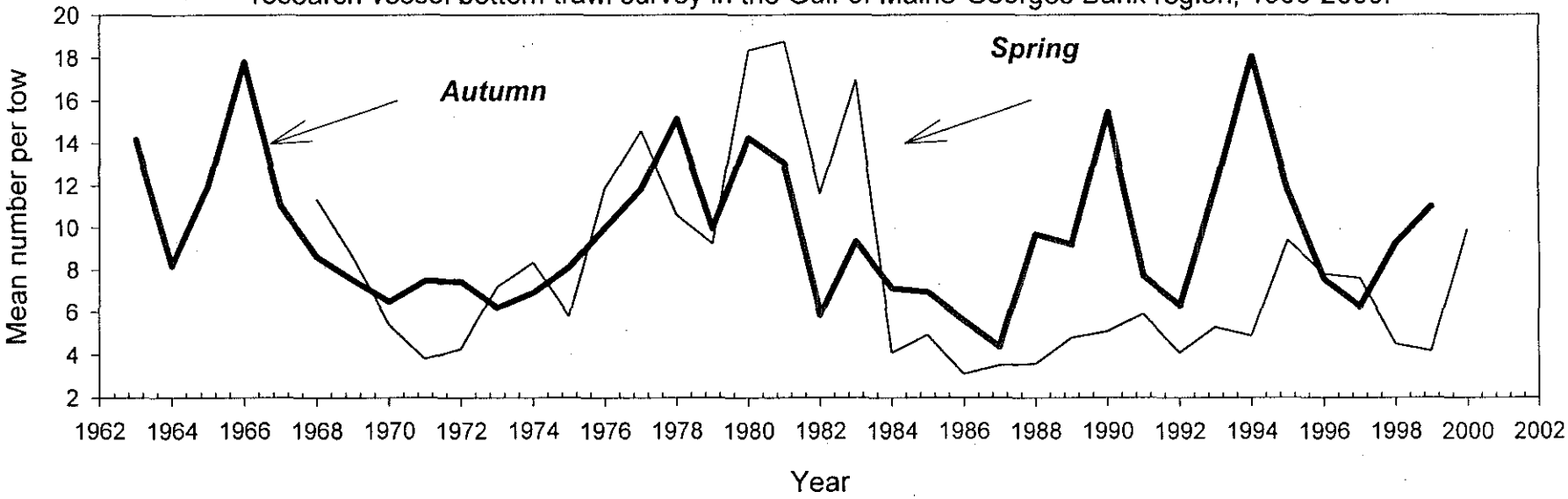
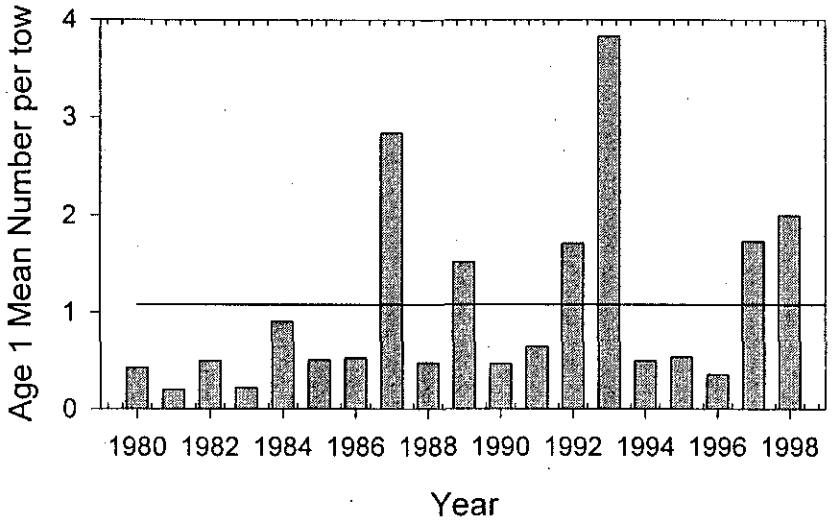


Figure 6. Standardized stratified mean number per tow (kg) of American plaice in NEFSC spring and autumn research vessel bottom trawl survey in the Gulf of Maine-Georges Bank region, 1963-2000.



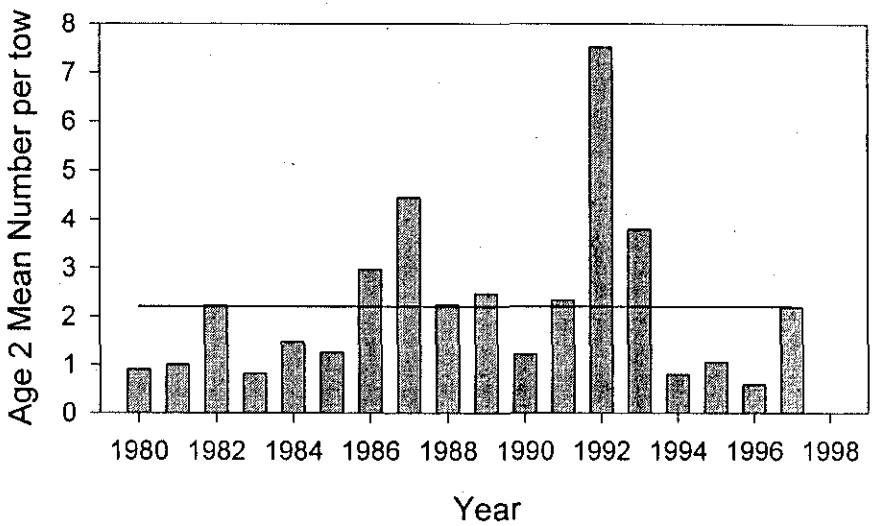
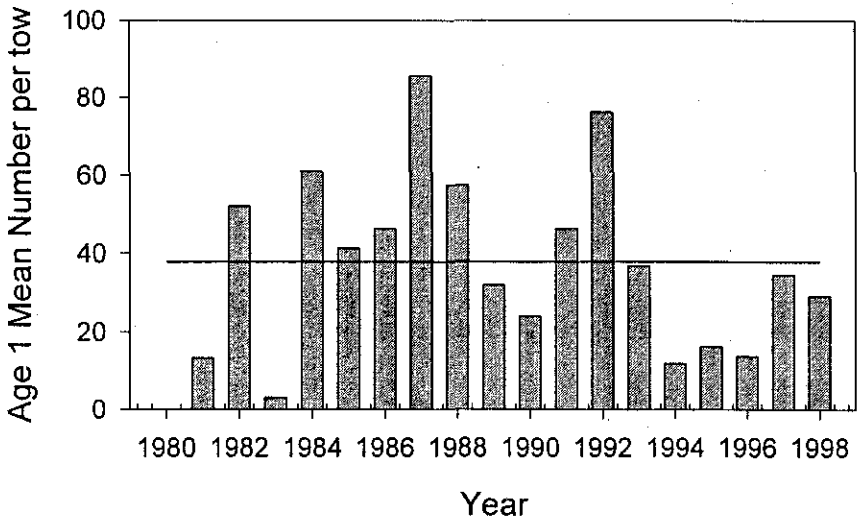


Figure 7a. Relative year class strength of age 1 and age 2 Gulf of Maine-George Bank American plaice from standardized catch (number) per tow indices from NEFSC autumn research vessel bottom trwl surveys, 1980-1999.



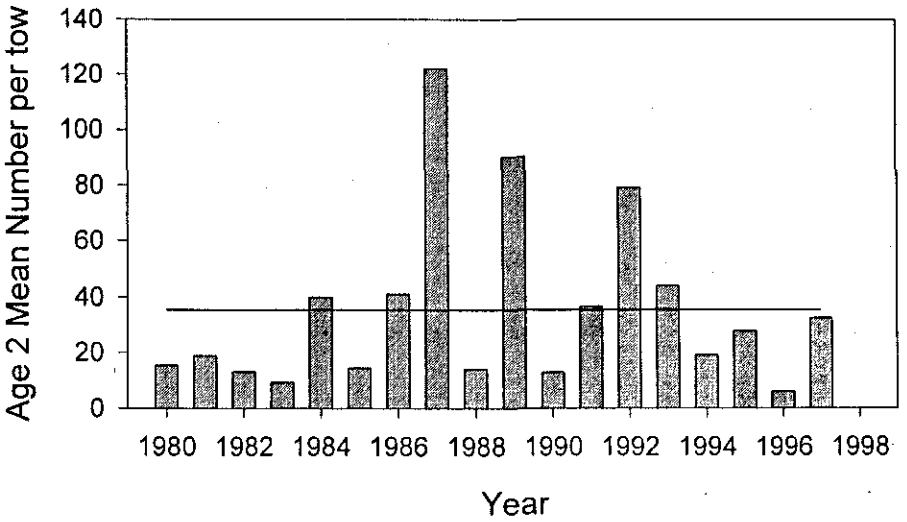


Figure 7b. Relative year class strength of age 1 and age 2 Gulf of Maine-George Bank American plaice from standardized catch (number) per tow indices from MADMF autumn research vessel bottom trwl surveys, 1980-1999.

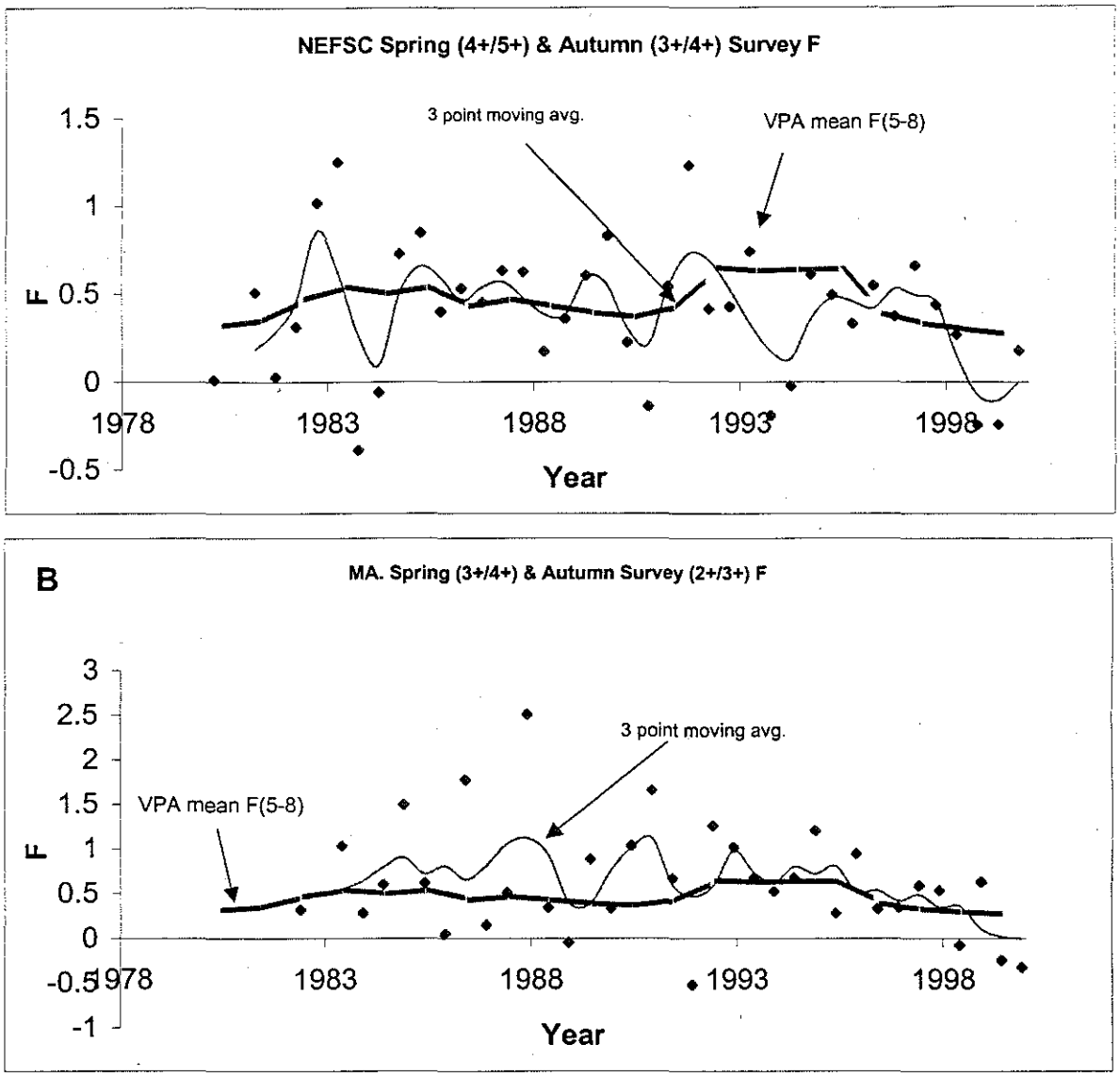


Figure 8. Mortality estimates from NEFSC (Panel A) and MADMF (Panel B) spring and autumn research bottom trawl surveys (solid squares) fitted with a smoothed 3 point running average, 1980-2000. The dashed line is the VPA estimate of mean F (ages 5-8, unweighted).

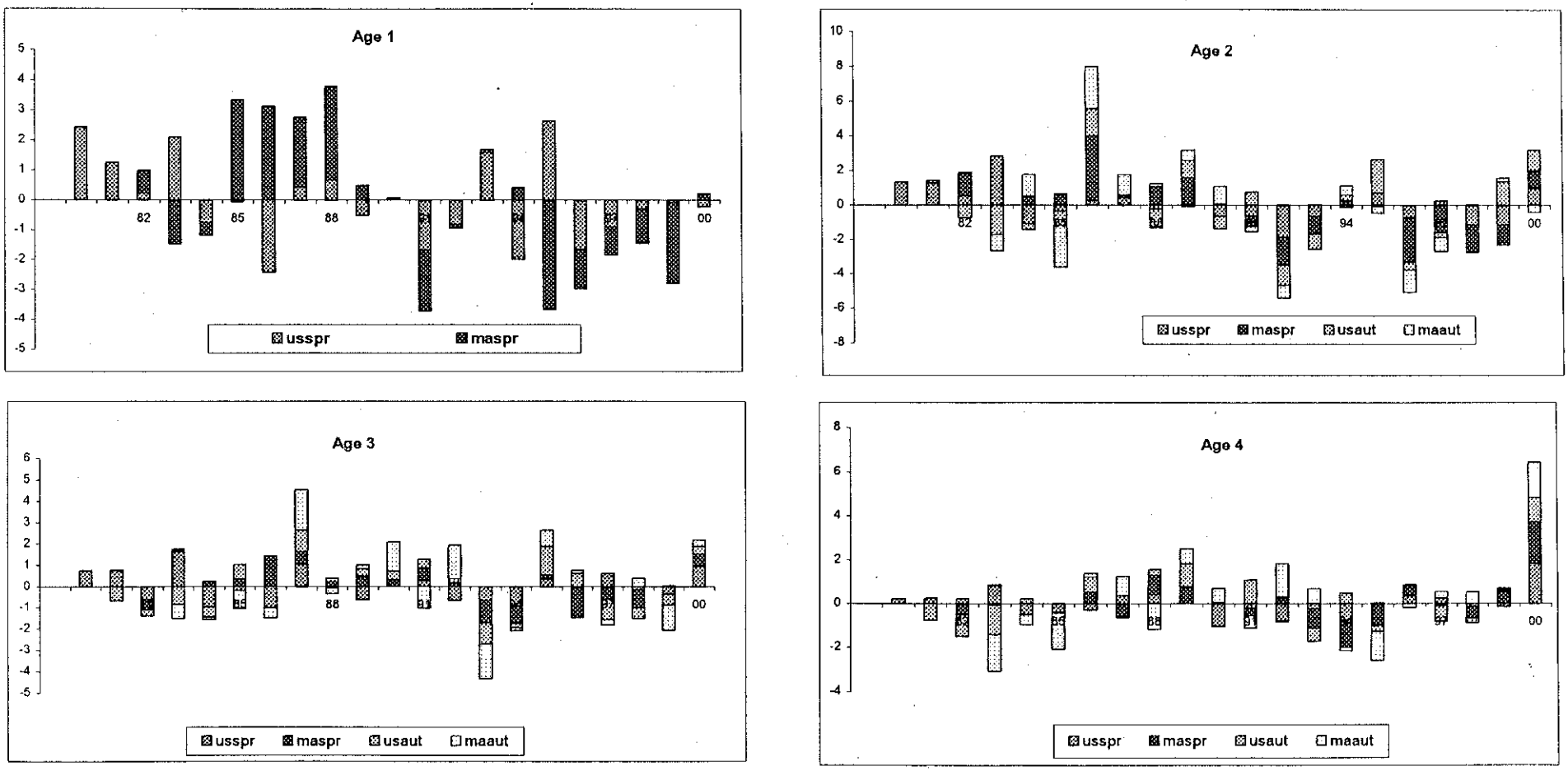
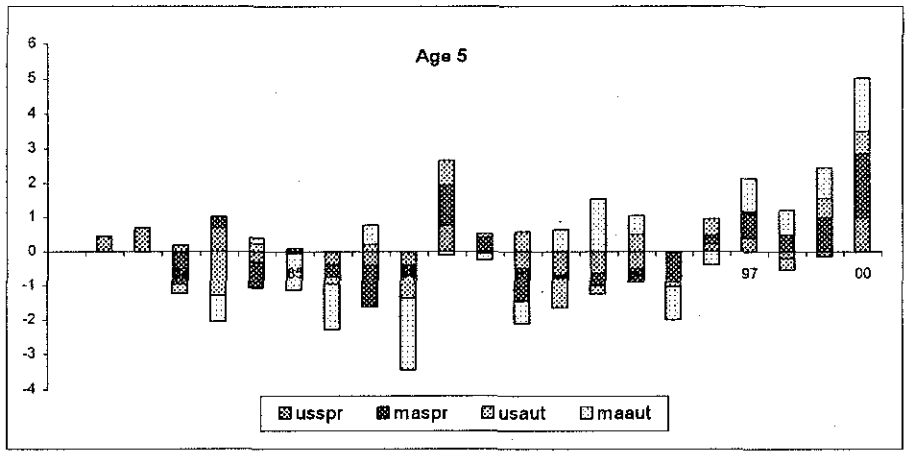
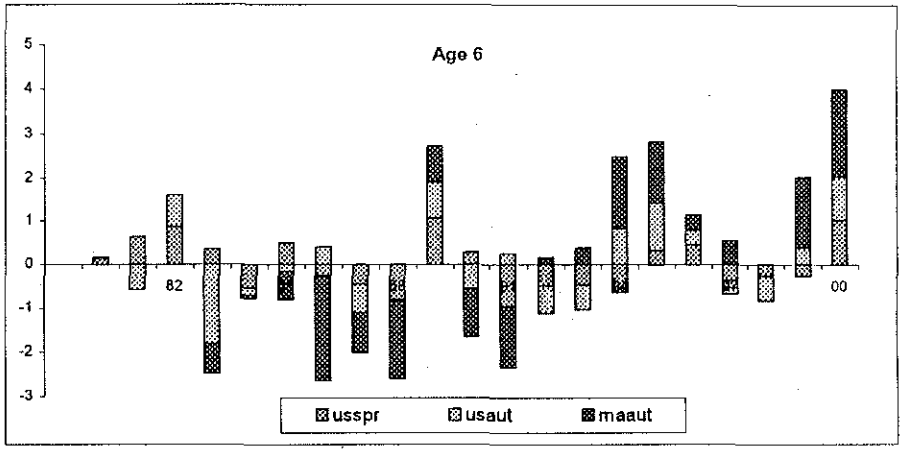
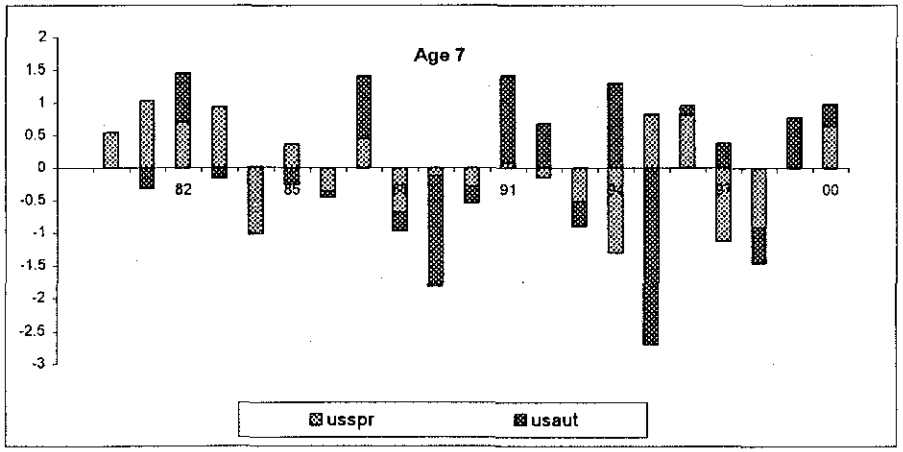


Figure 9 Residual plots (observed-predicted) for ages 1-8 for the USA and ages 1-5 for the Massachusetts spring abundance indicies, and ages 2-8 for the USA and ages 2-6 for the Massachusetts autumn abundance indices.







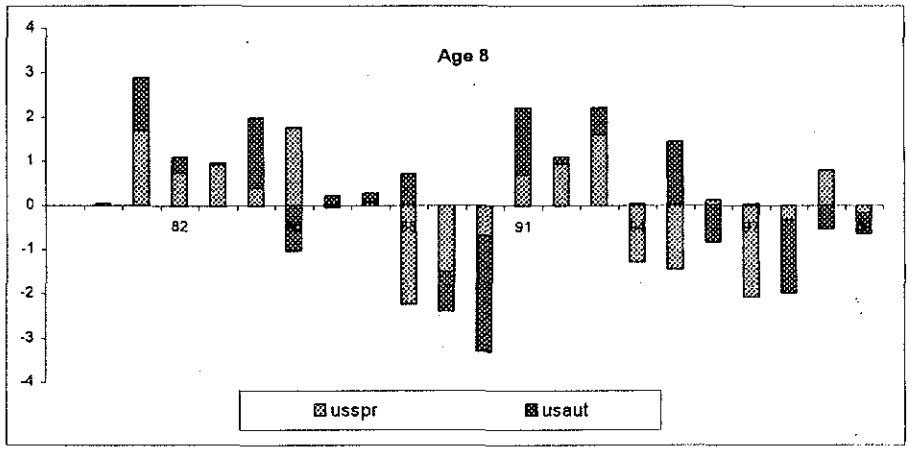


Figure 9. continued. Residual plots (observed-predicted) for ages 1-8 for the USA and ages 1-5 for the Massachusetts spring abundance indicies, and ages 2-8 for the USA and ages 2-6 for the Massachusetts autumn abundance indices.

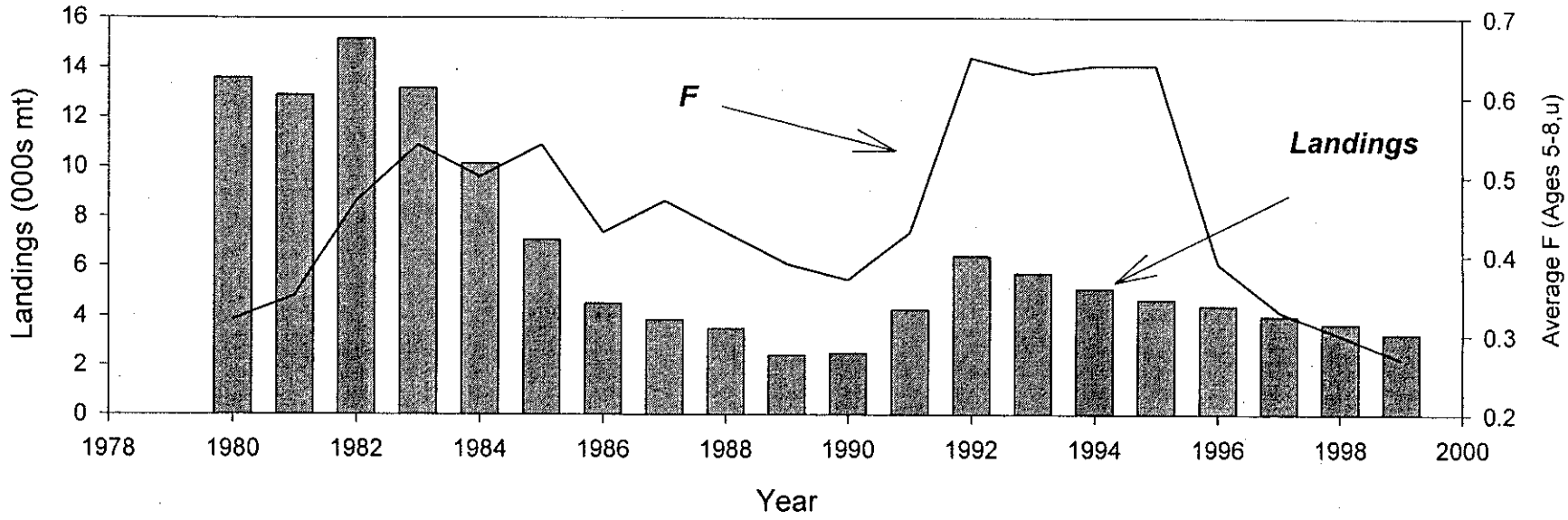


Figure 10. Trends in total commercial landings and fishing mortality for Gulf of Maine-Georges Bank American plaice, 1980-1999.

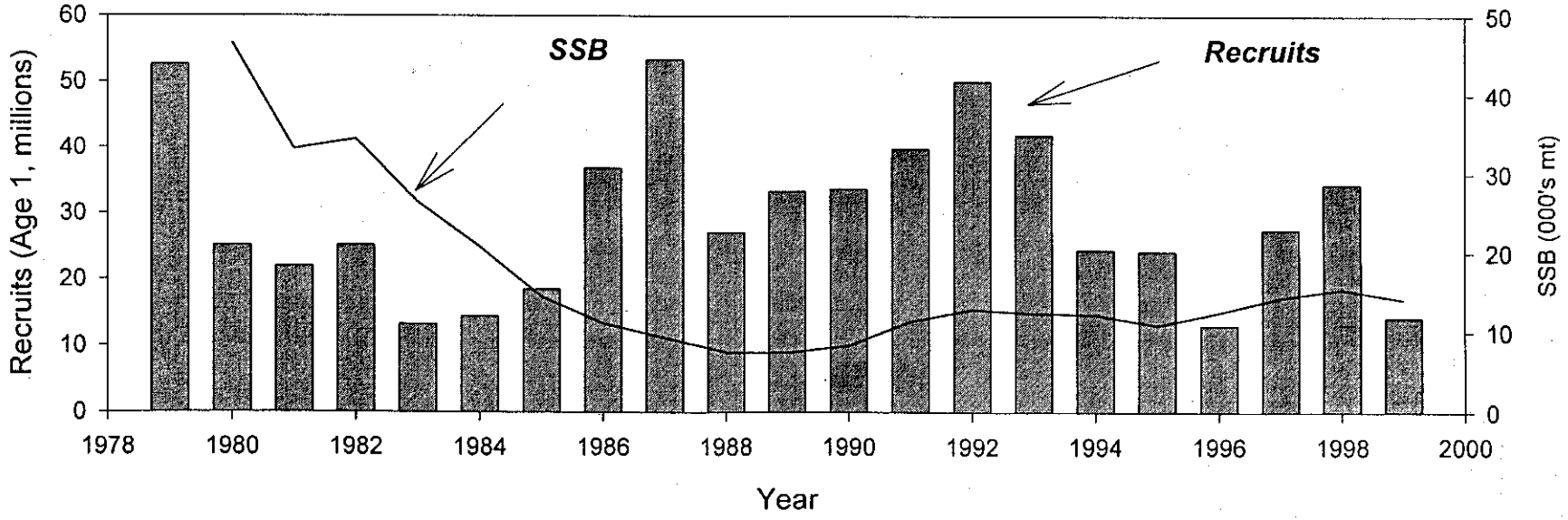


Figure 11. Trends in recruitment and spawning stock biomass for Gulf of Maine-Georges Bank American plaice, 1980-1999.

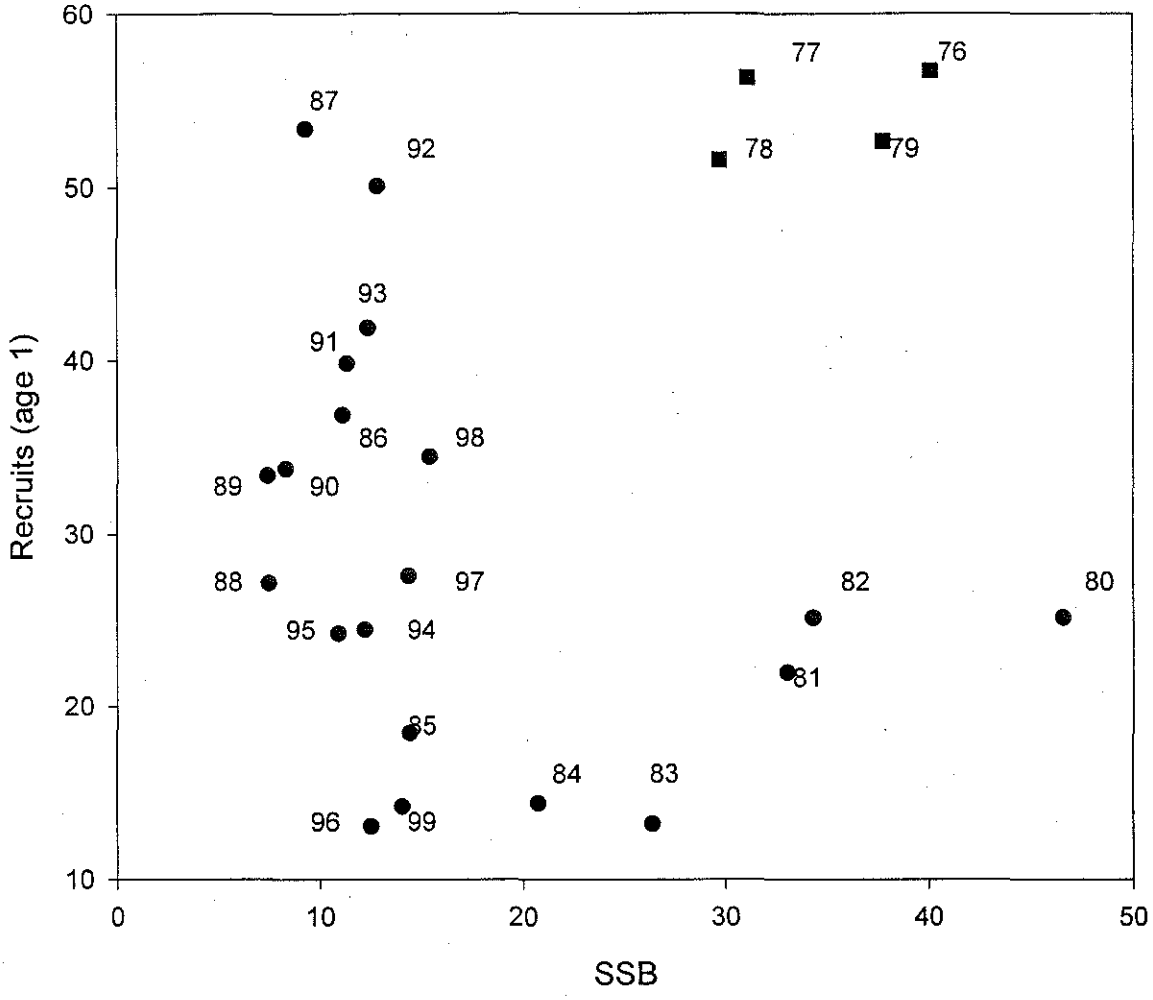


Figure 12. Spawning stock biomass and recruits (age1) for Gulf of Maine-Georges Bank American plaice, 1980-1999 (1976-1979 are backcalulated).

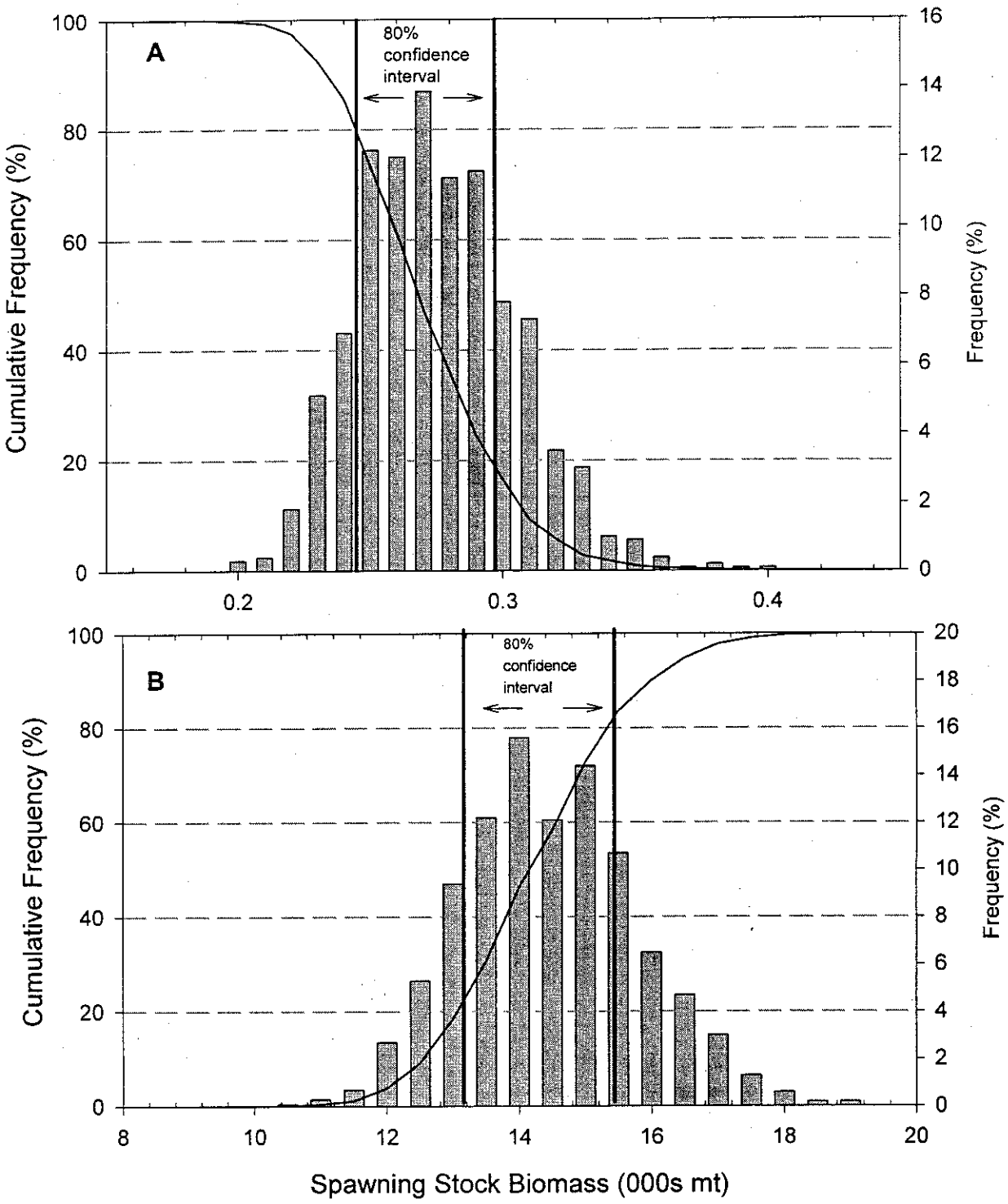


Figure 13. Precision of the estimates of the instantaneous rate of fishing (F) on the fully recruited ages (5+) (Panel A) and spawning stock biomass (Panel B) at the beginning of the spawning season for Gulf of Maine-Georges Bank American plaice, 1999. The bar height indicates the frequency of values within that range. The solid line gives the cumulative probability that F is greater than any selected value on the x-axis or the SSB is less than any selected value on the x-axis.

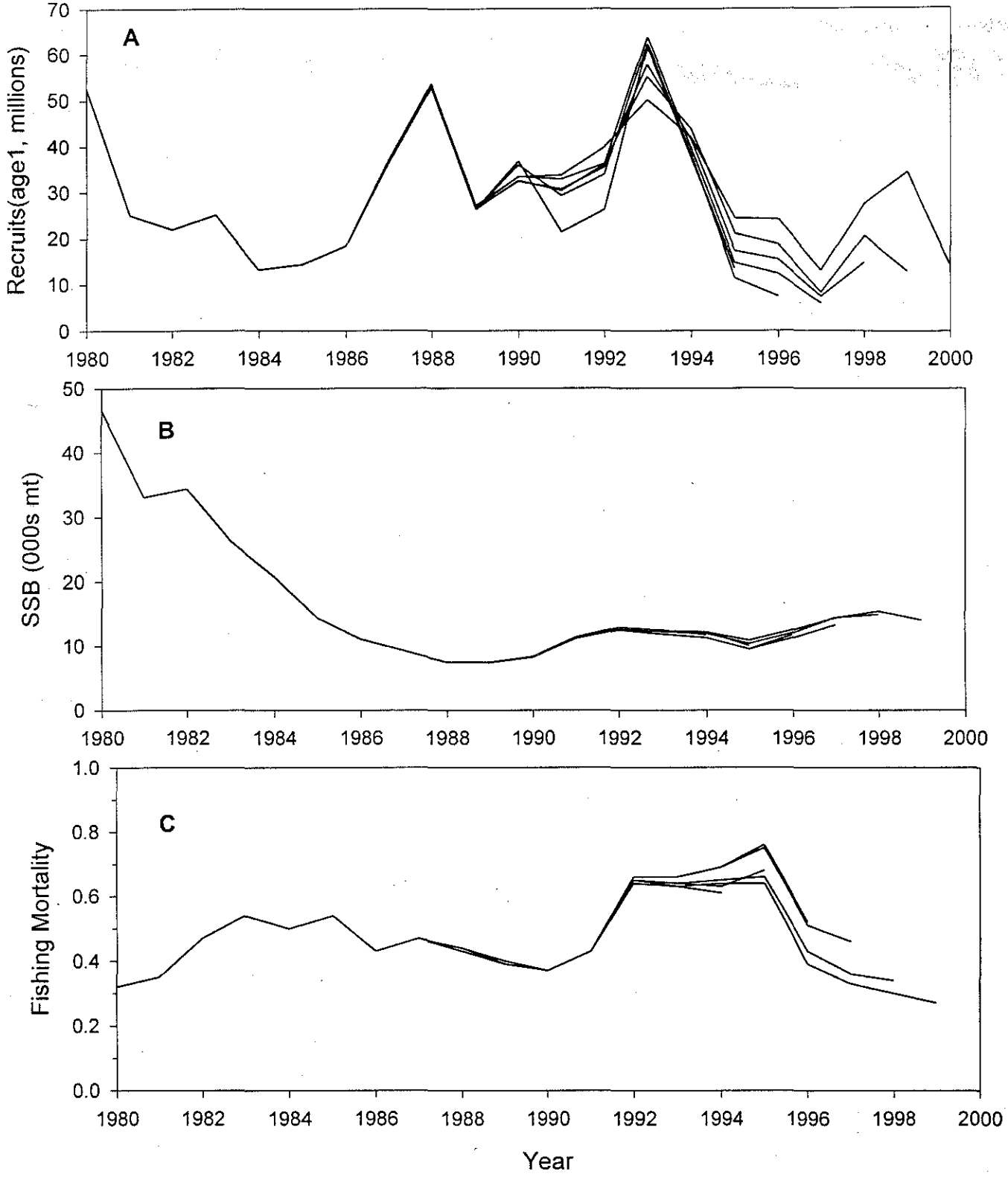


Figure 14. Retrospective analysis of Gulf of Maine-Georges Bank American plaice recruits at age 1 (A), spawning stock biomass (B), and fishing mortality (C, average F, aged 5-8, unweighted) based on the final ADAPT VPA formulation, 1999-1994.

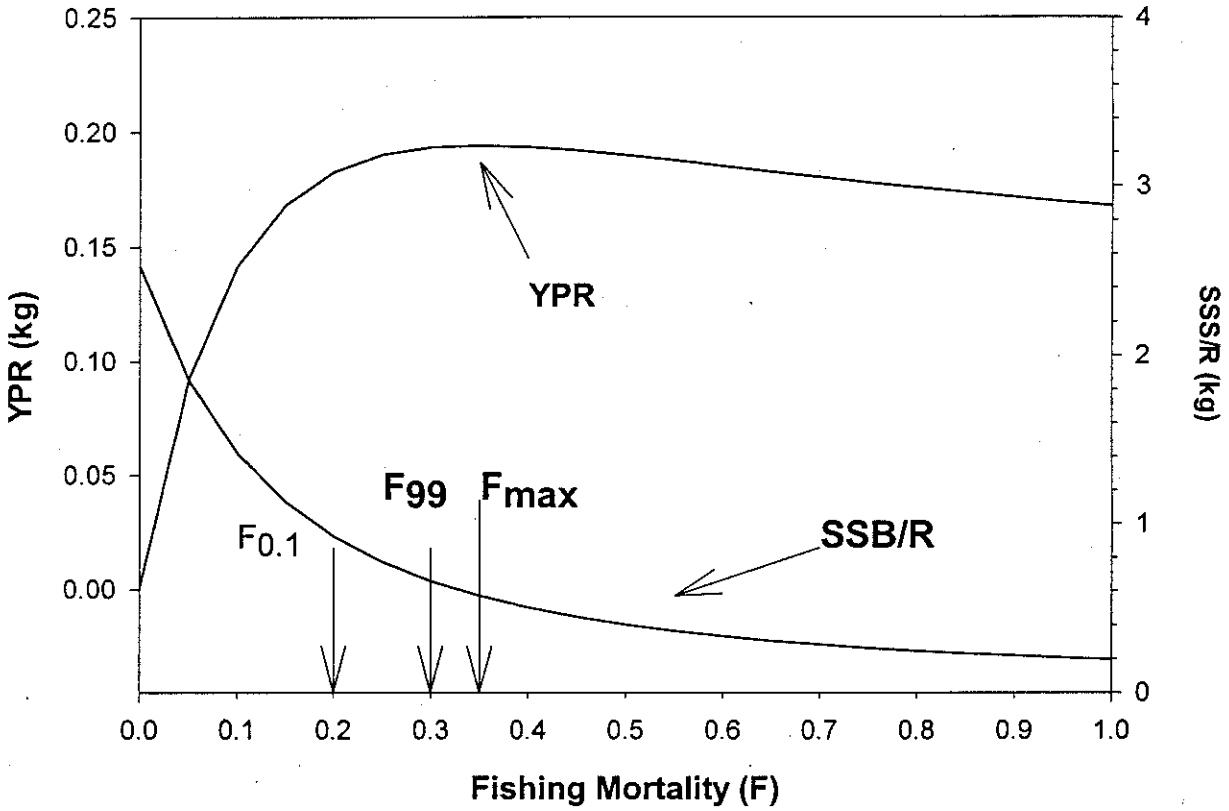


Figure 15. Yield per recruit (YPR) and spawning stock biomass per recruit (SSB/R) for Gulf of Maine-Georges Bank American plaice, from O'Brien *et al.* (1998).

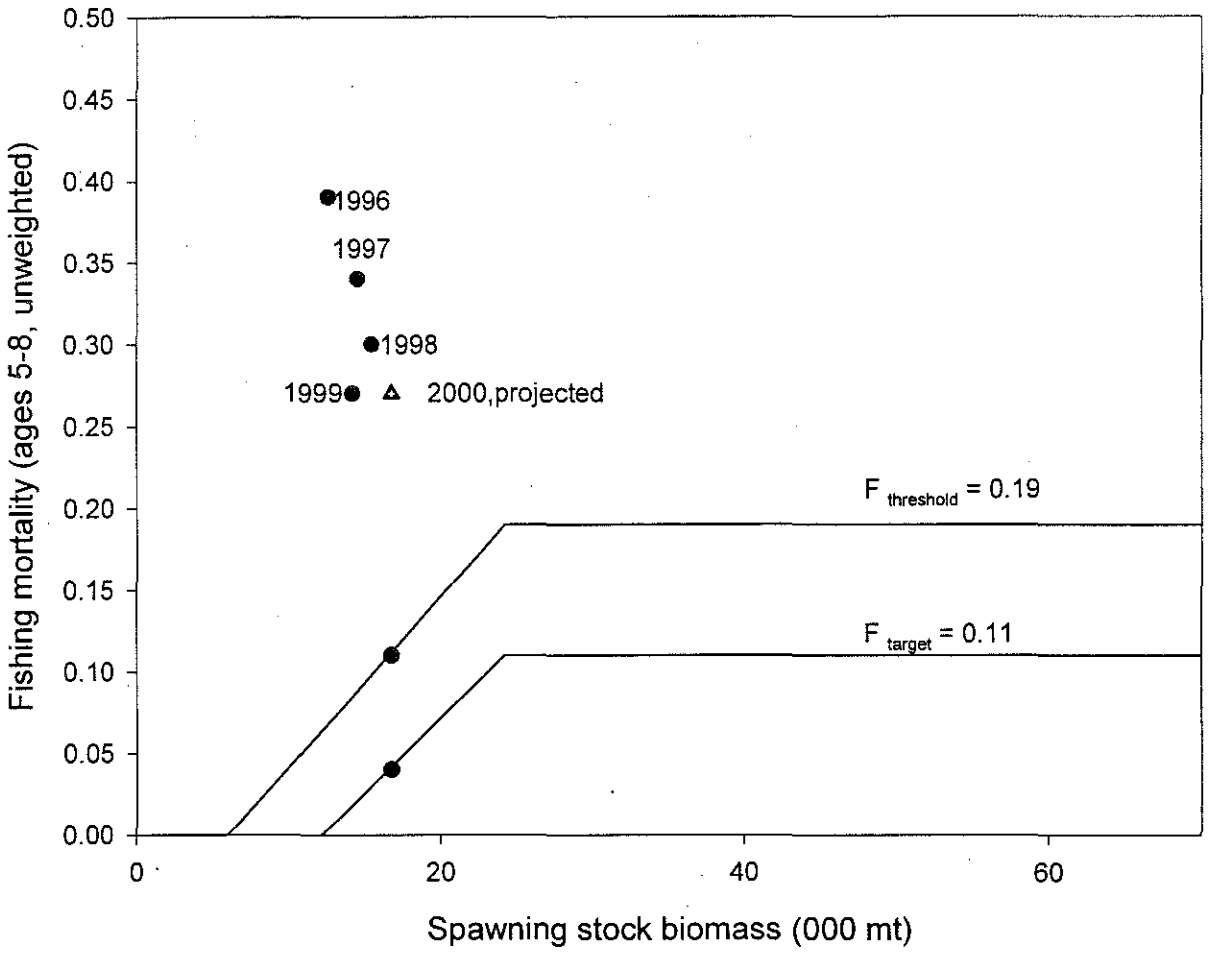


Figure 16. Amendment 9 control rule and recent stock status for Gulf of Maine-Georges Bank American plaice. Triangle is the projected 2000 SSB and status quo F (0.27).

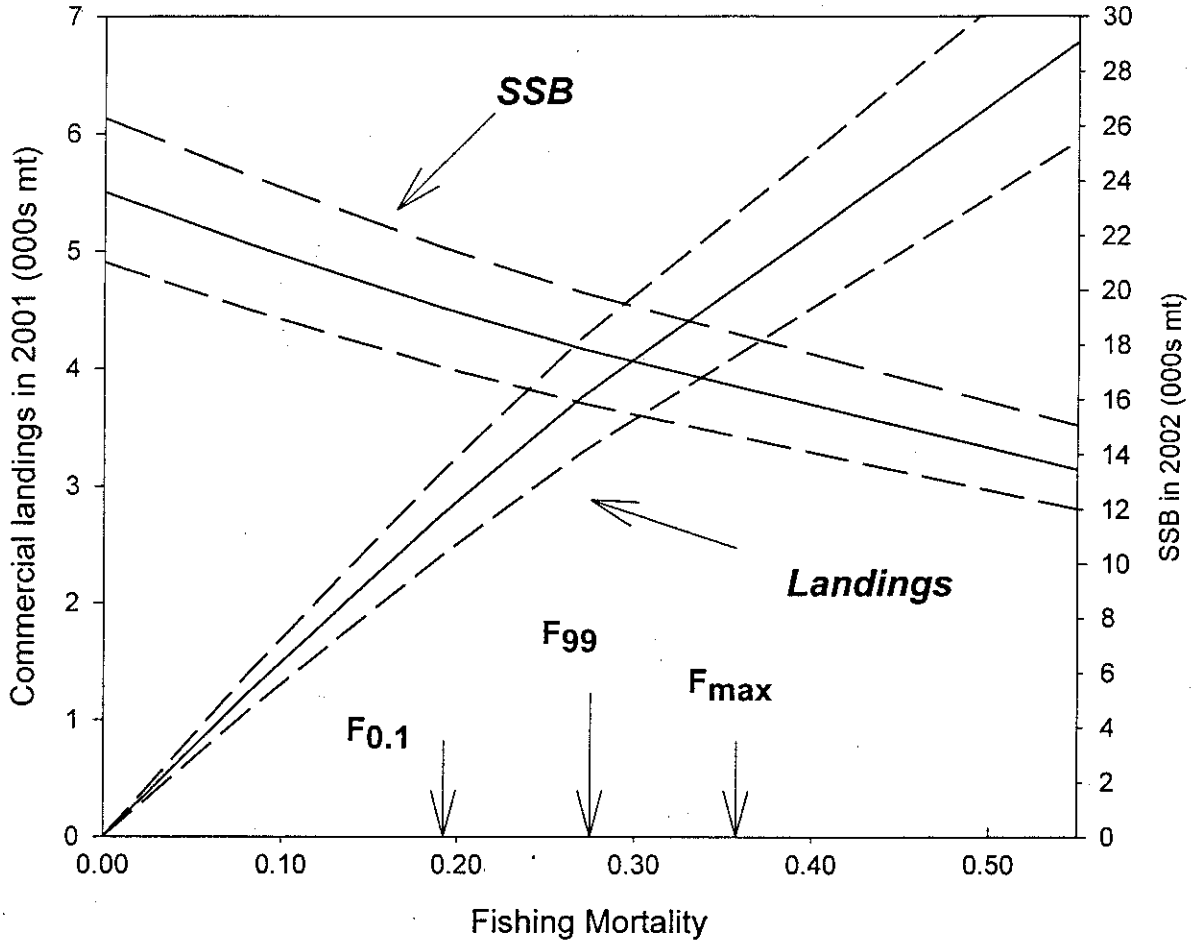


Figure 17. Predicted landings in 2000 and spawning stock biomass in 2001 with 80% confidence intervals for Gulf of Maine-Georges Bank American plaice as a function of fishing mortality in 2000.

APPENDIX 1

Sea Sampling and VTR Discard Information and Discard Estimation Methodology

Table 1. American plaice kept and discarded (mt) on trips sampled by the Massachusetts Sea Sampling Program, 1992-1999.

Table 2. American plaice kept and discarded (mt) on trips sampled by the NEFSC Sea Sampling Program, 1989-1999.

Table 3. Number of trips and length samples sampled by the NEFSC Sea Sampling Program, 1989-1999. VTR sampling discard information, 1994-1999.

Table 4. American plaice kept and discarded (mt), by gear, recorded in the VTR database, 1994-1999.

Table 5a. Estimation of discards in the Northern shrimp otter trawl fishery.

Table 5b. Estimation of discards in the large mesh fishery.

Appendix 1. Table 1. Metric tons of American plaice kept and discarded on otter trawl and shrimp trawl trips sampled by the Massachusetts Sea Sampling Program, 1989-1999

	otter trawl					shrimp				
	Qtr1	**Qtr2**	**Qtr3**	**Qtr4**	**Total**	**Qtr1**	**Qtr2**	**Qtr3**	**Qtr4**	**Total**
1992										
Trips	0	0	1	8	9	0	0	0	0	0
Total kept (mt)	0	0	0	0.12	0.12	0	0	0	0	0
Total discard (mt)	0	0	0.06	0.67	0.73	0	0	0	0	0
1993										
Trips	0	0	0	6	6	3	0	0	2	5
Total kept (mt)	0	0	0	0.07	0.07	0	0	0	0	0
Total discard (mt)	0	0	0	1.6	1.6	0.05	0	0	0.1	0.15
1994										
Trips	0	0	0	2	2	9	0	0	3	12
Total kept (mt)	0	0	0	0	0	0	0	0	0	0
Total discard (mt)	0	0	0	0.26	0.26	0.18	0	0	0.19	0.37
1995										0
Trips	0	0	4	3	7	2	0	0	1	3
Total kept (mt)	0	0	0.01	0	0.01	0	0	0	0	0
Total discard (mt)	0	0	0.22	0.05	0.27	0.15	0	0	0.03	0.18
1996										
Trips	0	0	0	0	0	9	0	0	2	11
Total kept (mt)	0	0	0	0	0	0	0	0	0	0
Total discard (mt)	0	0	0	0	0	0.14	0	0	0.03	0.17
1997										
Trips	0	0	0	0	0	4	0	0	1	5
Total kept (mt)	0	0	0	0	0	0	0	0	0	0
Total discard (mt)	0	0	0	0	0	0.04	0	0	0.06	0.1
1998										
Trips	0	0	0	0	0	3	0	0	0	3
Total kept (mt)	0	0	0	0	0	0	0	0	0	0
Total discard (mt)	0	0	0	0	0	0.01	0	0	0	0.01
1999	0	0	0	0	0	5	1	0	0	6
Trips	0	0	0	0	0	0	0	0	0	0
Total kept (mt)	0	0	0	0	0	0.02	0.01	0	0	0.03
Total discard (mt)										

Appendix 1. Table 2. Metric tons of American plaice kept and discarded on otter trawl and shrimp trawl trips sampled by the NEFSC Sea Sampling Program, 1989-1999

	otter trawl					shrimp				
	Qtr1	**Qtr2**	**Qtr3**	**Qtr4**	**Total**	**Qtr1**	**Qtr2**	**Qtr3**	**Qtr4**	**Total**
1989										
Trips	9	21	35	15	80	17	13	0	8	38
Total kept (mt)	0	0	0	0	8	0.19	0.26	0	0.11	0.56
Total discard (mt)	0	0	1	0	273	0.86	0.85	0	0.68	2.39
	0	0	136	0	3672					
1990										
Trips	4	9	11	13	37	23	4	0	4	31
Total kept (mt)	0.27	0.87	2.05	0.21	3.4	0.16	0.06	0	0.04	0.26
Total discard (mt)	0.09	0.32	0.86	0.72	1.99	1.78	0.22	0	0.6	2.6
1991										
Trips	14	14	26	47	101	36	11	0	7	54
Total kept (mt)	1.18	2.8	8.26	10.6	22.84	0.17	0.27	0	0.05	0.49
Total discard (mt)	0.32	1.27	2.92	4.09	8.6	1.02	0.71	0	0.25	1.98
1992										
Trips	30	16	12	12	70	70	5	0	6	81
Total kept (mt)	9.85	13.1	3.33	2.5	28.74	0.26	0	0	0.07	0.33
Total discard (mt)	1.11	0.73	0.82	0.45	3.11	1.33	0.01	0	0.11	1.45
1993										
Trips	8	11	7	8	34	61	3	0	4	68
Total kept (mt)	2.73	7.67	1.83	3.14	15.37	0.02	0	0	0	0.02
Total discard (mt)	0.46	0.51	0.6	0.15	1.72	0.31	0.03	0	0.04	0.38
1994										
Trips	13	5	3	5	26	67	2	0	5	74
Total kept (mt)	4.39	5.41	4.97	5.41	20.18	0	0	0	0	0
Total discard (mt)	0.21	0.15	0.23	0.67	1.26	0.31	0.01	0	0.05	0.37
1995										
Trips	20	11	22	22	75	54	6	0	9	69
Total kept (mt)	12.6	11.7	6.12	4.18	34.55	0	0	0	0	0
Total discard (mt)	1	2.98	1.55	1.01	6.55	0.38	0.09	0	0.29	0.76
1996										
Trips	8	15	27	21	71	23	8	0	5	36
Total kept (mt)	6.53	8.77	0	2.61	17.91	0	0	0	0	0
Total discard (mt)	0.83	1.67	0.78	0.98	4.27	0.15	0.24	0	0.04	0.43
1997										
Trips	19	2	4	3	28	17	0	0	0	17
Total kept (mt)	9.4	0	9.6	0.8	19.8	0	0	0	0	0
Total discard (mt)	1.2	0.02	1.09	0.1	2.41	0.07	0	0	0	0.07
1998										
Trips	3	4	2	0	9	0	0	0	0	0
Total kept (mt)	1.8	0.3	0.3	0	2.4	0	0	0	0	0
Total discard (mt)	0.34	0.15	0.05	0	0.54	0	0	0	0	0
1999										
Trips	2	3	13	22	40	0	0	0	0	0
Total kept (mt)	0	2.1	2.6	2.85	7.55	0	0	0	0	0
Total discard (mt)	0.01	0.21	0.47	0.22	0.91	0	0	0	0	0

Appendix 1. Table 3. Number of trips and total number of lengths sampled by gear from the Sea Sampling Database, 1989-1999

		Otter trawl					Shrimp trawl				
Year		Qtr1	Qtr2	Qtr3	Qtr4	Total	Qtr1	Qtr2	Qtr3	Qtr4	Total
1989	No. trips (kept)	1	5	8	0	14	0	0	0	0	0
	No. lengths (kept)	372	464	418	0	1254	0	0	0	0	0
	No. trips (discards)	3	15	28	10	56	11	12	0	5	28
	No. lengths (discards)	409	2510	3840	1917	8676	2189	3354	0	860	6403
1990	No. trips (kept)	0	1	1	0	2	0	0	0	0	0
	No. lengths (kept)	0	79	122	0	201	0	0	0	0	0
	No. trips (discards)	1	5	7	6	19	19	3	0	2	24
	No. lengths (discards)	292	380	2488	511	3671	3201	288	0	150	3639
1991	No. trips (kept)	2	2	2	3	9	0	0	0	0	0
	No. lengths (kept)	246	193	246	164	849	0	0	0	0	0
	No. trips (discards)	5	9	12	10	36	27	11	0	3	41
	No. lengths (discards)	699	2034	2984	1019	6736	2586	1534	0	256	4376
1992	No. trips (kept)	7	3	1	0	11	0	0	0	0	0
	No. lengths (kept)	396	195	78	0	669	0	0	0	0	0
	No. trips (discards)	8	4	2	4	18	32	2	0	5	39
	No. lengths (discards)	956	373	285	229	1843	2244	51	0	253	2548
1993	No. trips (kept)	1	4	1	2	8	2	0	0	0	2
	No. lengths (kept)	176	516	33	686	1411	2	0	0	0	2
	No. trips (discards)	3	6	3	3	15	54	2	0	3	59
	No. lengths (discards)	339	617	544	80	1580	2792	272	0	163	3227
1994	No. trips (kept)	9	2	1	3	15	0	0	0	0	0
	No. lengths (kept)	340	77	58	251	726	0	0	0	0	0
	No. trips (discards)	5	1	1	2	9	49	1	0	2	52
	No. lengths (discards)	77	17	1458	95	1647	2172	22	0	339	2533
1995	No. trips (kept)	8	10	3	3	24	0	0	0	0	0
	No. lengths (kept)	1638	1095	484	127	3344	0	0	0	0	0
	No. trips (discards)	11	9	13	9	42	10	3	0	3	16
1996	No. trips (kept)	3	5	0	2	10	0	0	0	0	0
	No. lengths (kept)	491	158	0	66	715	0	0	0	0	0
	No. trips (discards)	3	5	13	7	28	7	5	0	4	16
	No. lengths (discards)	483	482	1995	4183	7143	1192	953	0	355	2500
1997	No. trips (kept)	9	0	2	2	13	0	0	0	0	0
	No. lengths (kept)	714	0	364	137	1215	0	0	0	0	0
	No. trips (discards)	10	0	2	3	15	9	0	0	0	9
	No. lengths (discards)	597	0	86	46	729	811	0	0	0	811
1998	No. trips (kept)	2	0	0	0	2					
	No. lengths (kept)	230	0	0	0	230			NO TRIPS		
	No. trips (discards)	2	3	2	0	7					
	No. lengths (discards)	63	307	17	0	387					
1999	No. trips (kept)	0	2	4	5	11					
	No. lengths (kept)	0	115	243	315	673			NO TRIPS		
	No. trips (discards)	0	0	6	5	11					
	No. lengths (discards)	0	0	473	144	617					

Appendix 1 Table 4. Metric tons of American plaice kept and discarded on shrimp trawl, gill net, and otter trawl trips from all trips with a history of recording discarded fish in the VTR database

1994	Quarter 1		Quarter 2		Quarter 3		Quarter 4		Total	
	mt	trips	mt	trips	mt	trips	mt	trips	mt	trips
Discards										
Shrimp trawl	0.0	0	0.0	0	0.0	8	0.8	138	0.8	146
Gill net	0.0	0	1.9	314	0.5	168	0.1	44	2.5	526
Otter trawl	0.5	3	45.8	1264	53.4	1860	41.5	1019	141.2	4146
Kept										
Shrimp trawl	0.0	0	0.0	0	0.1	7	0.2	3	0.3	10
Gill net	0.0	0	21.4	655	5.6	873	1.9	364	28.9	1892
Otter trawl	3.9	3	673.1	1844	1200.0	2836	803.8	1814	2680.8	6497

1995	Quarter 1		Quarter 2		Quarter 3		Quarter 4		Total	
	mt	trips	mt	trips	mt	trips	mt	trips	mt	trips
Discards										
Shrimp trawl	1.0	374	0.6	93	0.0	14	0.5	120	2.1	601
Gill net	0.2	44	3.9	482	0.3	102	0.0	4	4.4	632
Otter trawl	11.7	665	53.1	2731	36.6	1454	17.9	539	119.2	5389
Kept										
Shrimp trawl	0.1	13	6.9	10	0.4	3	0.2	18	7.5	44
Gill net	5.9	210	89.9	1577	9.0	666	0.8	181	105.6	2634
Otter trawl	335.2	1124	1226.7	4217	939.5	1890	454.0	1067	2955.3	8298

1996	Quarter 1		Quarter 2		Quarter 3		Quarter 4		Total	
	mt	trips	mt	trips	mt	trips	mt	trips	mt	trips
Discards										
Shrimp trawl	1.1	372	0.2	62	0.3	48	0.2	120	1.8	602
Gill net	0.2	60	6.3	362	0.2	63	0.0	2	6.7	487
Otter trawl	7.9	390	40.6	2267	34.0	1192	18.4	512	100.8	4361
Kept										
Shrimp trawl	0.7	48	1.3	5	0.2	1	0.2	2	2.5	56
Gill net	4.9	233	86.3	1440	4.9	486	1.3	160	97.3	2319
Otter trawl	303.5	1052	1063.8	3804	1030.5	2002	569.7	1169	2967.5	8027

Appendix 1 Table 4 (continued). Metric tons of American plaice kept and discarded on shrimp trawl, gill net, and otter trawl trips from all trips with a history of recording discarded fish in the VTR database .

1997	Quarter 1		Quarter 2		Quarter 3		Quarter 4		Total	
	mt	trips	mt	trips	mt	trips	mt	trips	mt	trips
Discards										
Shrimp trawl	0.7	330	0.4	90	0.0	6	0.1	45	1.3	471
Gill net	0.1	18	4.9	252	0.8	65	0.0	5	5.8	340
Otter trawl	13.0	339	28.2	1791	20.0	945	10.8	561	72.0	3636
Kept										
Shrimp trawl	0.1	8	2.9	4	0.0	0	0.0	2	3.0	14
Gill net	8.0	108	33.2	809	2.2	355	0.4	111	43.8	1383
Otter trawl	322.4	895	797.5	2854	734.5	1521	398.7	1023	2253.1	6293

1998	Quarter 1		Quarter 2		Quarter 3		Quarter 4		Total	
	mt	trips	mt	trips	mt	trips	mt	trips	mt	trips
Discards										
Shrimp trawl	0.3	142	0.4	48	0.1	22	0.1	23	0.8	235
Gill net	0.2	30	3.6	308	0.5	95	0.0	0	4.3	433
Otter trawl	4.4	399	21.8	1572	15.3	910	7.1	453	48.5	3334
Kept										
Shrimp trawl	1.4	3	0.8	6	5.9	6	0.0	1	8.1	16
Gill net	3.8	167	52.7	776	2.1	323	0.2	79	58.8	1345
Otter trawl	274.6	1056	735.0	2705	599.7	1379	347.6	970	1956.8	6110

1999	Quarter 1		Quarter 2		Quarter 3		Quarter 4		Total	
	mt	trips	mt	trips	mt	trips	mt	trips	mt	trips
Discards										
Shrimp trawl	0.4	153	0.4	65	0.3	42	0.0	1	1.0	261
Gill net	0.0	0	1.4	100	0.8	96	0.1	12	2.3	208
Otter trawl	4.8	391	17.3	950	15.8	1044	8.9	551	46.8	2936
Kept										
Shrimp trawl	1.1	6	5.9	11	6.3	10	5.4	13	18.7	40
Gill net	0.6	50	36.7	521	5.5	399	0.3	67	43.1	1037
Otter trawl	293.4	1010	557.6	1684	494.9	1592	328.0	1159	1673.9	5445

Appendix 1 Table 5a. Estimation of discards in the Northern shrimp otter trawl fishery.

Model Description

The indirect method for estimation of discards is based on the assumption that catch and discard of American plaice on shrimp trips is a function of both plaice abundance and fishing effort. The catch can be estimated from the abundance of plaice measured by the NEFSC research survey index of number per tow (N_i) filtered through both a shrimp trawl mesh selection ogive (m_i) and a culling or sorting ogive (s_i). Discards are then estimated as $1-s_i$.

For a given level of abundance, a unit of fishing effort will produce a unit of catch and therefore discard. The proportionality constant (q) between effort and catch must be estimated and may be a function of depth, area and time of year. Thus, the overall level of plaice catch and discard in the shrimp fishery becomes a function of plaice abundance as well as the quantity and distribution of shrimp fishing effort.

Starting with the catch equation

$$C = F/(F+M) * [1-\exp^{-(F+M)}] * N \qquad [1.1]$$

catch is a function of population size (N) and some measure of exploitation, which can be viewed as either fishing mortality (F) or fishing effort (f). Since

$$F = q*f, \qquad [1.2]$$

the catch equation can be expressed generally in terms of effort,

$$C = (q*f) * N. \qquad [1.3]$$

Simulating the kept and discarded portions of the catch based on bottom trawl survey abundance indices.

When the bottom trawl survey abundance index corresponds to the season and area of the shrimp fishery, the catch of plaice per unit of shrimp effort at length will be proportional to the survey abundance index of plaice at length adjusted for mesh selection by commercial shrimp trawls as follows.

If $C_i/f = q * (N_i*m_i)$, then [1.4]

$$C_i = (q*f) * (N_i*m_i) \text{ as above.} \quad [1.5]$$

If $$K_i = C_i * s_i, \text{ and} \quad [1.6]$$

$$D_i = C_i * (1-s_i), \text{ then} \quad [1.7]$$

$$D_i = (q*f) * (N_i*m_i) * (1-s_i), \quad [1.8]$$

where:

C_i = Catch retained by a given commercial mesh at length i,
N_i = Abundance of fish in the survey at length i,
m_i = proportion of the available population retained by a given mesh at length i,
s_i = proportion of the retained catch kept at length i,
K_i = Kept portion of the catch at length i, and
D_i = Discarded portion of the catch at length i.

Estimating the proportionality constant (q) between plaice abundance as measured by the survey and plaice catch/effort in the shrimp fishery

Although landings of plaice taken by shrimp gear are relatively low, the actual catch and discard may be quite high. Therefore, plaice discards are not likely to be well estimated as function of plaice landings, but may be better correlated with shrimp landings, or with effort in the shrimp fishery. From the sea sampling and bottom trawl survey data, we first estimate the amount of plaice catch obtained per unit of shrimp effort for a given level of plaice abundance in the bottom trawl survey.

As above, catch (C) at length is proportional to effort (f) and to the abundance of plaice retained at length (N_i*m_i) by the constant q. Since,

$$C_i = (q*f) * (N_i*m_i), \text{ and} \quad [1.9]$$

$$C_i/f = q * (N_i*m_i), \text{ then} \quad [1.10]$$

$$q = (C_i/f) / (N_i*m_i). \quad [1.11]$$

Therefore, q is the proportionality between plaice abundance and the catch of plaice at length per unit of shrimp effort. It is therefore, the catchability constant between CPUE of a commercial shrimp trawl (C/f) and the survey abundance index adjusted for mesh selection (N*m).

Similarly,

$$D_i/f = q * [N_i*m_i*(1-s_i)], \qquad [1.12]$$

since the amount discarded per unit of effort in the shrimp fishery will be proportional to the abundance of plaice in the discard length range. Estimates of q can be obtained from this relationship by regression of D/f on N*m*(1-s) using the 1989-1997 sea sample and bottom trawl survey data. The estimates of q obtained from this analysis can then be used to estimate discards in years when sea sampling data are not available (prior to 1989, 1998-1999). Since almost all of the plaice caught in the shrimp fishery are discarded, the discard of plaice at length can be estimated from the historical surveys as

$$D_i = f * q * [N_i*m_i*(1-s_i)]. \qquad [1.13]$$

Appendix 1 Table 5b. Estimation of discards in the large mesh fishery.

Model description

Assume that the catch (C_i) and discard (D_i) of plaice are proportional to abundance of plaice (N_i) for a given level of fishing effort (f) within a season. Abundance of retainable plaice can be measured by the survey index of number/tow (N_i) at length i, filtered through a mesh selection ogive (m_i). Abundance of discardable plaice can also be measured by further filtering of the retainable fish through a sorting ogive (s_i). Discards will be a function of $1-s_i$.

When the bottom trawl survey abundance index corresponds to the entire Gulf of Maine - Georges Bank area of the large mesh trawl fishery, catch of plaice at length for a given level of effort is proportional to the survey abundance index of plaice at length adjusted for mesh selection by commercial large mesh trawls. If

$$C_i = q * (N_i * m_i), \text{ then} \qquad [2.1]$$

$$K_i = C_i * s_i, \text{ and} \qquad [2.2]$$

$$D_i = C_i * (1-s_i). \qquad [2.3]$$

where, as above,

C_i = Catch retained by a given commercial mesh at length i,
N_i = Abundance of fish in the survey at length i,
m_i = proportion of the available population retained by a given mesh at length i,
s_i = proportion of the retained catch kept at length i,
K_i = Kept portion of the catch at length i, and
D_i = Discarded portion of the catch at length i.

Estimating the proportionality constant (q) between plaice abundance as measured by the survey and plaice landings in the fishery

For a given level of abundance, a unit of fishing effort will produce a unit of catch and, therefore, kept and discarded components. The proportionality constant (q) between the kept component of the survey abundance length composition and numbers landed at length can be derived by regression. The coefficient which relates numbers landed to the kept component of the survey abundance index can be then used to estimate numbers discarded from the discarded component of the survey index. If

$$L_i = q * (N_i * m_i), \text{ then} \qquad [2.4]$$

$$D_i = q * (N_i * m_i) * (1-s_i), \qquad [2.5]$$

Therefore, q is the proportionality between plaice abundance and the catch of plaice at length at a given level of effort and can be estimated by regression of L on (N*m) at length. This factor is computed on a semi-annual basis throughout 1980-1999

APPENDIX 2

Age-specific bottom trawl survey abundance indices for Gulf of Maine-Georges Bank American Plaice

Table 1. Standardized (for vessel changes) stratified mean catch per tow at age (numbers) of American plaice in NEFSC offshore spring and autumn bottom trawl surveys in the Gulf of Maine-Georges Bank region (Strata 26-30,13-25, 36-40), 1963 - 2000.

Table 2. Stratified mean catch per tow at age (numbers) of American plaice in MDMF spring and autumn bottom trawl surveys in Massachusetts Bay and Cape Cod Bay (Regions 4+5), 1982-2000

Appendix 2. Table 1. Standardized stratified mean number per tow by age and mean weight per tow (kg) of American plaice in NEFSC spring and autumn bottom trawl surveys in the Gulf of Maine - Georges Bank[1] area, 1980-2000.

		AGE GROUP															
YEAR	kg/tow	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	#/tow
Spring																	
1980	0.00	0.57	3.55	4.49	3.00	2.89	1.60	1.12	0.25	0.31	0.23	0.04	0.02	0.02	0.04	18.34	4.78
1981	0.00	0.13	3.49	4.31	3.55	2.67	1.74	1.45	0.79	0.41	0.34	0.07	0.09	0.07	0.09	18.75	5.88
1982	0.00	0.06	1.04	1.79	3.17	2.13	1.34	0.92	0.49	0.35	0.19	0.07	0.01	0.04	0.02	11.601	3.80
1983	0.00	0.20	3.68	3.33	4.48	2.64	1.18	0.58	0.32	0.15	0.15	0.11	0.05	0.02	0.04	16.94	4.60
1984	0.00	0.02	0.35	0.57	0.90	1.30	0.58	0.22	0.10	0.01	0.02	0.01	0.01	0.00	0.03	4.10	1.42
1985	0.00	0.03	0.32	0.98	0.86	0.73	0.86	0.46	0.42	0.12	0.07	0.04	0.02	0.02	0.02	4.94	1.88
1986	0.00	0.01	0.46	0.34	1.01	0.59	0.29	0.21	0.10	0.04	0.04	0.00	0.00	0.00	0.00	3.09	0.92
1987	0.00	0.09	0.61	0.99	0.69	0.51	0.25	0.17	0.07	0.03	0.03	0.03	0.01	0.00	0.00	3.50	0.81
1988	0.00	0.20	0.99	0.84	0.76	0.31	0.23	0.12	0.01	0.09	0.01	0.01	0.00	0.00	0.00	3.58	0.84
1989	0.00	0.05	1.59	1.27	0.86	0.49	0.29	0.16	0.03	0.07	0.01	0.01	0.00	0.00	0.00	4.81	0.75
1990	0.00	0.00	0.57	2.65	1.02	0.54	0.17	0.06	0.04	0.05	0.00	0.00	0.00	0.00	0.00	5.09	0.75
1991	0.00	0.03	0.71	1.63	2.33	0.92	0.15	0.07	0.04	0.02	0.00	0.02	0.00	0.00	0.01	5.91	1.05
1992	0.00	0.06	0.34	1.15	0.88	1.07	0.43	0.11	0.04	0.02	0.01	0.00	0.01	0.00	0.00	4.11	1.36
1993	0.00	0.33	0.84	1.16	1.58	0.61	0.45	0.17	0.08	0.02	0.01	0.02	0.03	0.00	0.00	5.29	1.39
1994	0.00	0.03	1.43	1.14	1.12	0.75	0.23	0.10	0.03	0.01	0.00	0.01	0.01	0.01	0.01	4.88	0.85
1995	0.00	0.31	1.97	3.21	2.31	1.11	0.44	0.22	0.03	0.03	0.03	0.01	0.02	0.01	0.01	9.43	1.94
1996	0.00	0.02	0.47	1.94	3.30	1.31	0.53	0.20	0.05	0.02	0.00	0.00	0.00	0.00	0.00	7.83	1.69
1997	0.00	0.01	0.85	1.66	2.52	2.05	0.39	0.09	0.01	0.00	0.01	0.00	0.02	0.00	0.00	7.62	1.62
1998	0.00	0.06	0.19	1.02	1.12	1.22	0.68	0.16	0.06	0.01	0.01	0.003	0.01	0.00	0.00	4.52	1.11
1999	0.00	0.08	0.41	0.52	1.13	0.79	0.64	0.41	0.17	0.02	0.02	0.00	0.00	0.00	0.00	4.18	1.20
2000	0.00	0.03	1.91	2.48	2.22	1.60	0.86	0.60	0.15	0.07	0.02	0.003	0.01	0.00	0.00	9.96	2.30

Appendix 2. Table 1 (continued). Standardized stratified mean number per tow by age and mean weight per tow (kg) of American plaice in NEFSC spring and autumn bottom trawl surveys in the Gulf of Maine - Georges Bank[1] area, 1980-2000.

YEAR		AGE GROUP															
kg/tow		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	#/tow
Autumn																	
1980	0.00	1.58	2.22	2.72	2.85	1.53	1.03	0.93	0.57	0.31	0.20	0.11	0.04	0.07	0.08	14.24	5.12
1981	0.00	0.43	2.79	2.22	2.62	2.30	1.55	0.63	0.58	0.07	0.20	0.20	0.02	0.02	0.12	13.04	5.62
1982	0.00	0.20	0.91	1.65	1.27	0.57	0.48	0.30	0.17	0.19	0.08	0.03	0.00	0.00	0.02	5.88	2.49
1983	0.06	0.50	1.01	2.02	2.92	1.36	0.68	0.34	0.17	0.10	0.03	0.05	0.06	0.01	0.03	9.34	3.45
1984	0.02	0.22	2.24	1.56	1.21	1.07	0.51	0.12	0.10	0.00	0.03	0.01	0.02	0.00	0.01	7.12	2.02
1985	0.02	0.91	0.83	2.64	1.05	0.79	0.41	0.19	0.05	0.03	0.02	0.00	0.00	0.01	0.00	6.95	2.00
1986	0.10	0.51	1.48	0.89	1.45	0.47	0.43	0.16	0.12	0.04	0.01	0.02	0.01	0.00	0.00	5.61	1.56
1987	0.01	0.53	1.27	0.99	0.43	0.69	0.25	0.10	0.04	0.04	0.01	0.02	0.00	0.00	0.00	4.38	1.09
1988	0.00	2.84	2.97	2.39	0.78	0.47	0.10	0.07	0.00	0.03	0.00	0.02	0.00	0.00	0.00	9.69	1.46
1989	0.05	0.48	4.45	2.86	0.98	0.19	0.10	0.02	0.02	0.02	0.02	0.00	0.01	0.02	0.00	9.21	1.17
1990	0.01	1.52	2.26	7.49	2.89	0.59	0.25	0.11	0.07	0.02	0.02	0.01	0.01	0.00	0.01	15.46	2.90
1991	0.02	0.47	2.48	2.03	1.59	0.73	0.30	0.04	0.07	0.00	0.01	0.00	0.00	0.00	0.01	7.71	1.56
1992	0.02	0.65	1.23	1.85	1.28	0.78	0.30	0.07	0.05	0.03	0.02	0.00	0.02	0.00	0.00	6.31	1.78
1993	0.01	1.71	2.35	3.47	2.28	1.05	0.80	0.11	0.04	0.04	0.04	0.00	0.00	0.00	0.00	11.89	2.39
1994	0.04	3.83	7.53	2.81	1.71	1.30	0.04	0.25	0.13	0.01	0.03	0.02	0.00	0.00	0.00	18.07	2.67
1995	0.01	0.50	3.80	3.82	2.50	0.90	0.22	0.04	0.03	0.00	0.00	0.00	0.02	0.00	0.00	11.84	2.58
1996	0.01	0.54	0.81	2.00	2.74	0.93	0.39	0.07	0.04	0.03	0.00	0.00	0.02	0.00	0.02	7.58	2.23
1997	0.01	0.36	1.06	1.55	1.86	1.04	0.32	0.04	0.01	0.01	0.00	0.00	0.00	0.00	0.02	6.27	1.94
1998	0.01	1.73	0.60	1.88	2.01	1.78	1.08	0.12	0.05	0.01	0.01	0.00	0.01	0.00	0.00	9.29	2.22
1999	0.02	2.00	2.20	2.05	2.13	1.60	0.81	0.20	0.03	0.00	0.00	0.00	0.00	0.00	0.00	11.03	2.57

[1] Offshore strata 13-30, 36-40

Appendix 2. Table 2. Stratified mean number per tow by age of American plaice in Massachusetts State spring and autumn bottom trawl surveys in Massachusetts Bay and Cape Cod Bay (Regions 4+5), 1982-2000.

Year	0	1	2	3	4	Age 5	6	7	8	9	10	11	Total #/tow
Spring													
1982	0.00	7.18	49.25	33.35	17.14	5.00	2.42	1.12	0.26	0.15	0.03	0.07	115.97
1983	0.00	1.93	18.76	22.42	21.46	10.22	2.37	0.73	0.20	0.19	0.06	0.10	78.44
1984	0.00	2.15	27.44	21.32	10.57	4.64	1.21	0.18	0.09	0.01	0.03	0.07	67.71
1985	0.00	21.56	17.16	24.22	9.50	3.77	2.24	0.65	0.76	0.12	0.04	0.03	80.05
1986	0.00	27.06	110.27	26.91	14.43	2.84	0.61	0.05	0.08	0.06	0.00	0.16	182.47
1987	0.00	34.36	17.26	15.79	3.90	1.76	0.51	0.10	0.02	0.00	0.00	0.00	73.70
1988	0.00	81.47	63.57	17.85	8.72	1.54	0.47	0.09	0.00	0.00	0.00	0.00	173.71
1989	0.00	8.07	127.26	44.97	11.99	3.03	1.31	0.20	0.03	0.03	0.00	0.05	196.94
1990	0.00	7.73	25.37	56.71	16.48	3.43	0.53	0.11	0.10	0.13	0.00	0.00	110.59
1991	0.00	2.10	19.98	34.77	18.98	3.24	0.18	0.07	0.01	0.00	0.00	0.00	79.33
1992	0.00	8.20	11.06	33.98	14.99	7.42	1.11	0.45	0.00	0.00	0.00	0.00	77.21
1993	0.00	11.60	18.98	16.08	9.16	3.45	0.81	0.04	0.02	0.00	0.00	0.00	60.14
1994	0.00	11.60	52.57	22.12	7.13	3.88	1.03	0.31	0.00	0.00	0.00	0.00	98.64
1995	0.00	0.54	34.65	49.64	10.32	3.16	0.62	0.17	0.03	0.05	0.02	0.00	99.20
1996	0.00	2.29	4.14	14.92	31.39	6.33	1.01	0.77	0.01	0.00	0.00	0.00	60.86
1997	0.00	1.55	7.96	13.95	17.24	12.21	2.41	0.21	0.00	0.00	0.00	0.00	55.52
1998	0.00	2.83	4.33	11.45	7.53	8.93	3.95	0.49	0.00	0.03	0.00	0.00	39.54
1999	0.00	1.35	11.65	11.65	15.11	7.57	3.96	1.62	0.35	0.01	0.00	0.00	53.27
2000	0.00	3.45	56.51	34.86	19.98	13.29	4.95	3.64	0.17	0.03	0.00	0.00	136.88
Autumn													
1982	0.17	13.24	15.46	10.22	5.11	1.14	0.56	0.14	0.05	0.05	0.01	0.08	46.23
1983	1.29	52.17	18.98	10.02	8.30	1.39	0.32	0.15	0.05	0.06	0.00	0.01	92.74
1984	0.11	3.14	13.24	4.27	1.83	0.77	0.24	0.04	0.05	0.00	0.00	0.00	23.69
1985	0.00	60.97	9.45	14.21	1.56	0.14	0.03	0.02	0.00	0.00	0.00	0.00	86.38
1986	0.23	41.27	40.08	12.07	5.30	0.39	0.13	0.01	0.00	0.00	0.00	0.00	99.48
1987	0.24	46.36	14.60	3.00	0.52	0.23	0.07	0.01	0.04	0.00	0.00	0.00	65.07
1988	0.00	85.63	41.28	13.98	1.34	0.45	0.08	0.00	0.00	0.00	0.00	0.00	142.76
1989	0.03	57.56	122.25	31.03	2.33	0.13	0.01	0.01	0.00	0.00	0.00	0.00	213.35
1990	0.08	31.99	14.20	20.12	3.93	0.21	0.03	0.00	0.00	0.00	0.00	0.00	70.56
1991	0.04	24.07	90.36	40.05	11.51	1.17	0.14	0.00	0.00	0.00	0.00	0.00	167.34
1992	0.00	46.33	12.99	29.79	11.04	1.38	0.00	0.00	0.12	0.00	0.00	0.00	101.66
1993	0.00	76.21	36.80	17.59	6.85	1.71	0.69	0.00	0.00	0.00	0.00	0.00	139.84
1994	0.00	36.71	79.31	10.76	2.91	1.56	0.23	0.14	0.00	0.00	0.00	0.00	131.62
1995	0.00	11.84	44.22	24.93	4.21	0.91	0.08	0	0.00	0.00	0.00	0.00	86.19
1996	0.09	16.25	19.25	27.55	13.96	1.39	0.28	0	0.00	0.00	0.00	0.00	78.78
1997	0.00	13.61	28.08	17.91	10.29	1.46	0.19	0.01	0.00	0.00	0.00	0.00	71.55
1998	0.16	34.56	6.12	13.80	7.10	3.76	0.62	0.01	0.00	0.00	0.00	0.00	66.13
1999	0.00	29.23	32.57	20.61	10.58	2.85	1.2	0.41	0.00	0.00	0.00	0.00	97.45
2000													

APPENDIX 3

Full listing of ADAPT VPA Calibration Output and Diagnostics for Gulf of Maine-Georges Bank American Plaice.

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Fisheries Assessment Toolbox  American Plaice Gulf of Maine-Georges Bank 2000 Base Run  Run
Number  1   11/21/2000   6:09:03 PM
FACT Version 1.4.7
American Plaice Gulf of Maine-Georges Bank 2000 Base Run  1980 - 2000
Input Parameters and Options Selected
---------------------------------------
Natural mortality is a matrix below
Oldest age (not in the plus group) is  8
For all years prior to the terminal year ( 20 ), backcalculated
stock sizes for the following ages used to estimate
total mortality (Z) for age  8 : 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  9 + is then calculated from the following
ratios of F[age 9 +] to F[age 8 ]
          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  9 + group is then calculated using
the following method:  CATCH EQUATION
 Partial recruitment estimate for  2000
 1             0.01
 2             0.06
 3             0.15
 4             0.36
 5             1
 6             1
 7             1
 8             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          1.00E+03      0.00E+00      1.00E+06
N  2          1.00E+03      0.00E+00      1.00E+06
N  3          1.00E+03      0.00E+00      1.00E+06
N  4          2.00E+03      0.00E+00      1.00E+06
N  5          9.00E+03      0.00E+00      1.00E+06
N  6          5.00E+03      0.00E+00      1.00E+06
```

```
N  7          5.00E+03      0.00E+00      1.00E+06
N  8          5.00E+03      0.00E+00      1.00E+06
q spr_us1     1.00E-02      0.00E+00      1.00E+00
q spr_us2     1.00E-02      0.00E+00      1.00E+00
q spr_us3     1.00E-02      0.00E+00      1.00E+00
q spr_us4     1.00E-02      0.00E+00      1.00E+00
q spr_us5     1.00E-02      0.00E+00      1.00E+00
q spr_us6     1.00E-02      0.00E+00      1.00E+00
q spr_us7     1.00E-02      0.00E+00      1.00E+00
q spr_us8     1.00E-02      0.00E+00      1.00E+00
q us1aut2     1.00E-02      0.00E+00      1.00E+00
q us2aut3     1.00E-02      0.00E+00      1.00E+00
q us3aut4     1.00E-02      0.00E+00      1.00E+00
q us4aut5     1.00E-02      0.00E+00      1.00E+00
q us5aut6     1.00E-02      0.00E+00      1.00E+00
q us6aut7     1.00E-02      0.00E+00      1.00E+00
q us7aut8     1.00E-02      0.00E+00      1.00E+00
q spr_ma1     1.00E-02      0.00E+00      1.00E+00
q spr_ma2     1.00E-02      0.00E+00      1.00E+00
q spr_ma3     1.00E-02      0.00E+00      1.00E+00
q spr_ma4     1.00E-02      0.00E+00      1.00E+00
q spr_ma5     1.00E-02      0.00E+00      1.00E+00
q ma1aut2     1.00E-02      0.00E+00      1.00E+00
q ma2aut3     1.00E-02      0.00E+00      1.00E+00
q ma3aut4     1.00E-02      0.00E+00      1.00E+00
q ma4aut5     1.00E-02      0.00E+00      1.00E+00
q ma5aut6     1.00E-02      0.00E+00      1.00E+00
The following indices of abundance are available
 1            spr_us1
 2            spr_us2
 3            spr_us3
 4            spr_us4
 5            spr_us5
 6            spr_us6
 7            spr_us7
 8            spr_us8
 9            spr_us9
 10           us0aut1
 11           us1aut2
 12           us2aut3
 13           us3aut4
 14           us4aut5
 15           us5aut6
 16           us6aut7
 17           us7aut8
 18           us8aut9
 19           lpue_all1:6
 20           spr_ma1
 21           spr_ma2
 22           spr_ma3
 23           spr_ma4
 24           spr_ma5
 25           ma0aut1
 26           ma1aut2
 27           ma2aut3
 28           ma3aut4
 29           ma4aut5
 30           ma5aut6
The Indices that will be used in this run are:
1             spr_us1
2             spr_us2
3             spr_us3
```

4	spr_us4
5	spr_us5
6	spr_us6
7	spr_us7
8	spr_us8
9	us1aut2
10	us2aut3
11	us3aut4
12	us4aut5
13	us5aut6
14	us6aut7
15	us7aut8
16	spr_ma1
17	spr_ma2
18	spr_ma3
19	spr_ma4
20	spr_ma5
21	ma1aut2
22	ma2aut3
23	ma3aut4
24	ma4aut5
25	ma5aut6

Obs Indices (before transformation) by index and year; with Index means

	1980	1981	1982	1983	1984	1985	1986
spr_us1	0.57	0.13	0.06	0.20	0.02	0.03	0.01
spr_us2	3.55	3.49	1.04	3.68	0.35	0.32	0.46
spr_us3	4.49	4.31	1.79	3.33	0.57	0.98	0.34
spr_us4	3.00	3.55	3.17	4.48	0.90	0.86	1.01
spr_us5	2.89	2.67	2.13	2.64	1.30	0.73	0.59
spr_us6	1.60	1.74	1.34	1.18	0.58	0.86	0.29
spr_us7	1.12	1.45	0.92	0.58	0.22	0.46	0.21
spr_us8	0.25	0.79	0.49	0.32	0.10	0.42	0.10
us1aut2	0.00	1.58	0.43	0.20	0.50	0.22	0.92
us2aut3	0.00	2.22	2.79	0.91	1.01	2.24	0.84
us3aut4	0.00	2.72	2.22	1.65	2.02	1.56	2.68
us4aut5	0.00	2.85	2.62	1.27	2.92	1.21	1.07
us5aut6	0.00	1.53	2.30	0.57	1.36	1.07	0.81
us6aut7	0.00	1.03	1.55	0.48	0.68	0.51	0.41
us7aut8	0.00	0.93	0.63	0.30	0.34	0.12	0.19
spr_ma1	0.00	0.00	7.18	1.93	2.15	21.56	27.06
spr_ma2	0.00	0.00	49.25	18.76	27.44	17.16	110.27
spr_ma3	0.00	0.00	33.35	22.42	21.32	24.22	26.91
spr_ma4	0.00	0.00	17.14	21.46	10.57	9.50	14.43
spr_ma5	0.00	0.00	5.00	10.22	4.64	3.77	2.84
ma1aut2	0.00	0.00	0.00	13.24	52.17	3.14	60.97
ma2aut3	0.00	0.00	0.00	15.46	18.98	13.24	9.45
ma3aut4	0.00	0.00	0.00	10.22	10.02	4.27	14.21
ma4aut5	0.00	0.00	0.00	5.11	8.30	1.83	1.56
ma5aut6	0.00	0.00	0.00	1.14	1.39	0.77	0.14

	1987	1988	1989	1990	1991	1992	1993
spr_us1	0.12	0.20	0.05	0.00	0.03	0.06	0.33
spr_us2	0.72	0.99	1.59	0.57	0.71	0.34	0.84
spr_us3	1.18	0.84	1.27	2.65	1.63	1.15	1.16
spr_us4	0.81	0.76	0.86	1.02	2.33	0.88	1.58
spr_us5	0.61	0.31	0.49	0.54	0.92	1.07	0.61
spr_us6	0.29	0.23	0.29	0.17	0.15	0.43	0.45
spr_us7	0.19	0.12	0.16	0.06	0.07	0.11	0.17
spr_us8	0.09	0.01	0.03	0.04	0.04	0.04	0.08

us1aut2	0.51	0.53	2.84	0.48	1.52	0.47	0.65
us2aut3	1.48	1.27	2.97	4.45	2.26	2.48	1.23
us3aut4	0.89	0.99	2.39	2.86	7.49	2.03	1.85
us4aut5	1.45	0.43	0.78	0.98	2.89	1.59	1.28
us5aut6	0.47	0.69	0.47	0.19	0.59	0.73	0.78
us6aut7	0.43	0.25	0.10	0.10	0.25	0.30	0.30
us7aut8	0.16	0.10	0.07	0.02	0.11	0.04	0.07
spr_ma1	34.36	81.47	8.07	7.73	2.10	8.20	11.60
spr_ma2	17.26	63.57	127.26	25.37	19.98	11.06	18.98
spr_ma3	15.79	17.85	44.97	56.71	34.77	33.98	16.08
spr_ma4	3.90	8.72	11.99	16.48	18.98	14.99	9.16
spr_ma5	1.76	1.54	3.03	3.43	3.24	7.42	3.45
ma1aut2	41.27	46.36	85.63	57.56	31.99	24.07	46.33
ma2aut3	40.08	14.60	41.28	122.25	14.20	90.36	13.00
ma3aut4	12.07	3.00	13.98	31.03	20.12	40.05	29.79
ma4aut5	5.30	0.52	1.34	2.33	3.93	11.51	11.04
ma5aut6	0.39	0.23	0.45	0.13	0.21	1.17	1.38

	1994	1995	1996	1997	1998	1999	2000
spr_us1	0.03	0.31	0.02	0.02	0.06	0.08	0.03
spr_us2	1.43	1.97	0.47	0.85	0.19	0.41	1.91
spr_us3	1.14	3.21	1.94	1.67	1.02	0.52	2.48
spr_us4	1.12	2.31	3.30	2.51	1.12	1.13	2.22
spr_us5	0.75	1.11	1.31	2.06	1.22	0.79	1.60
spr_us6	0.23	0.44	0.53	0.39	0.68	0.64	0.86
spr_us7	0.10	0.22	0.20	0.09	0.16	0.41	0.60
spr_us8	0.03	0.03	0.05	0.01	0.06	0.17	0.15
us1aut2	1.71	3.83	0.50	0.54	0.36	1.73	2.00
us2aut3	2.35	7.53	3.80	0.81	1.06	0.60	2.20
us3aut4	3.47	2.81	3.82	2.00	1.55	1.88	2.05
us4aut5	2.28	1.71	2.50	2.74	1.86	2.01	2.13
us5aut6	1.05	1.30	0.90	0.93	1.04	1.78	1.60
us6aut7	0.80	0.04	0.22	0.39	0.32	1.08	0.81
us7aut8	0.11	0.25	0.04	0.07	0.04	0.12	0.20
spr_ma1	11.60	0.54	2.29	1.55	2.83	1.35	3.45
spr_ma2	52.57	34.65	4.14	7.96	4.33	11.65	56.51
spr_ma3	22.12	49.64	14.92	13.95	11.45	11.65	34.86
spr_ma4	7.13	10.32	31.39	17.24	7.53	15.11	19.98
spr_ma5	3.88	3.16	6.33	12.21	8.93	7.57	13.29
ma1aut2	76.21	36.71	11.84	16.25	13.61	34.56	29.23
ma2aut3	36.80	79.31	44.22	19.25	28.08	6.12	32.57
ma3aut4	17.59	10.76	24.93	27.56	17.91	13.80	20.61
ma4aut5	6.85	2.91	4.21	13.97	10.29	7.10	10.58
ma5aut6	1.71	1.56	0.91	1.39	1.46	3.76	2.85

	Average
spr_us1	0.118
spr_us2	1.233
spr_us3	1.794
spr_us4	1.853
spr_us5	1.254
spr_us6	0.637
spr_us7	0.363
spr_us8	0.157
us1aut2	1.076
us2aut3	2.225
us3aut4	2.446
us4aut5	1.828
us5aut6	1.008

us6aut7	0.502
us7aut8	0.196
spr_ma1	12.474
spr_ma2	35.693
spr_ma3	26.682
spr_ma4	14.001
spr_ma5	5.564
ma1aut2	37.841
ma2aut3	35.513
ma3aut4	17.884
ma4aut5	6.038
ma5aut6	1.169

Catch at age (thousands) - D:\AP\assess_2000\vpa\ap_2000_w1_corr.9

	1980	1981	1982	1983	1984	1985	1986
1	05	05	10	15	03	65	59
2	99	982	603	663	370	158	639
3	1072	2192	3348	1478	991	1217	738
4	2672	5055	4574	5177	2422	1336	2284
5	3939	5337	4503	4918	6031	2405	1700
6	3933	3648	3599	3913	3244	2872	1476
7	3632	2401	3297	2270	1936	2228	1307
8	1185	1582	2038	1272	580	1081	631
9	3369	1706	2710	2062	1350	887	460
1+	19906	22908	24682	21768	16927	12249	9294

	1987	1988	1989	1990	1991	1992	1993
1	38	314	132	68	13	37	107
2	590	786	1653	676	323	231	426
3	1840	1840	1831	3389	1001	1083	2032
4	1439	1833	1125	2664	4410	2222	4141
5	2282	1597	829	1369	3403	6810	3583
6	1337	1444	536	531	1123	2724	3139
7	895	553	753	291	321	819	1403
8	543	270	471	349	164	198	265
9	309	321	411	450	402	342	563
1+	9273	8958	7741	9787	11160	14466	15659

	1994	1995	1996	1997	1998	1999
1	288	518	195	158	37	04
2	506	1488	936	1375	63	202
3	623	2285	1418	803	281	205
4	2627	6503	4443	2739	883	985
5	4459	4826	2958	3919	2607	1713
6	1703	2001	1471	1701	2476	2073
7	1288	654	549	718	1044	1273
8	608	584	250	230	320	463
9	688	315	224	335	272	261
1+	12790	19174	12444	11978	7983	7179

CAA Summary for ages 5 - 9

	1980	1981	1982	1983	1984	1985	1986

	16058	14674	16147	14435	13141	9473	5574
	1987	1988	1989	1990	1991	1992	1993
	5366	4185	3000	2990	5413	10893	8953
	1994	1995	1996	1997	1998	1999	
	8746	8380	5452	6903	6719	5783	

Weight at age (mid year) in kg - D:\AP\assess_2000\vpa\ap_2000_w1_corr.9

	1980	1981	1982	1983	1984	1985	1986
1	0.030	0.032	0.018	0.013	0.004	0.018	0.016
2	0.076	0.108	0.115	0.033	0.045	0.058	0.042
3	0.154	0.168	0.230	0.185	0.161	0.084	0.138
4	0.267	0.316	0.290	0.378	0.303	0.209	0.229
5	0.409	0.442	0.418	0.530	0.524	0.331	0.384
6	0.653	0.778	0.564	0.670	0.630	0.534	0.587
7	0.829	0.885	0.960	0.823	0.888	0.847	0.842
8	1.039	0.978	1.138	1.042	1.187	1.167	1.174
9	1.523	1.315	1.479	1.479	1.657	1.618	1.702

	1987	1988	1989	1990	1991	1992	1993
1	0.013	0.016	0.012	0.021	0.015	0.028	0.016
2	0.046	0.046	0.041	0.058	0.053	0.065	0.078
3	0.131	0.159	0.135	0.138	0.120	0.159	0.212
4	0.234	0.284	0.275	0.265	0.330	0.315	0.304
5	0.409	0.449	0.446	0.455	0.498	0.485	0.434
6	0.609	0.641	0.566	0.639	0.710	0.717	0.590
7	0.892	0.880	0.736	0.824	0.960	0.948	0.936
8	1.173	1.231	0.857	0.968	1.161	1.202	1.234
9	1.688	1.630	1.537	1.352	1.479	1.617	1.647

	1994	1995	1996	1997	1998	1999
1	0.014	0.012	0.014	0.014	0.013	0.008
2	0.028	0.027	0.038	0.021	0.030	0.018
3	0.194	0.203	0.110	0.111	0.165	0.198
4	0.328	0.322	0.338	0.316	0.281	0.324
5	0.418	0.453	0.474	0.402	0.371	0.417
6	0.564	0.646	0.637	0.605	0.518	0.535
7	0.763	0.909	0.902	0.746	0.805	0.702
8	1.083	1.166	1.172	0.951	1.031	0.879
9	1.807	1.399	1.657	1.565	2.482	1.401

January 1 Biomass Weights - D:\AP\assess_2000\vpa\ap_2000_w1_corr.9

	1980	1981	1982	1983	1984	1985	1986
1	0.016	0.017	0.013	0.007	0.001	0.012	0.009
2	0.051	0.057	0.061	0.024	0.024	0.015	0.027
3	0.108	0.113	0.158	0.146	0.073	0.061	0.089
4	0.208	0.221	0.221	0.295	0.237	0.183	0.139
5	0.297	0.344	0.363	0.392	0.445	0.317	0.283
6	0.561	0.564	0.499	0.529	0.578	0.529	0.441

7	0.763	0.760	0.864	0.681	0.771	0.730	0.671
8	0.928	0.900	1.004	1.000	0.988	1.018	0.997
9	1.523	1.315	1.479	1.479	1.657	1.618	1.702

	1987	1988	1989	1990	1991	1992	1993
1	0.007	0.010	0.005	0.013	0.007	0.017	0.012
2	0.027	0.024	0.026	0.026	0.033	0.031	0.047
3	0.074	0.086	0.079	0.075	0.083	0.092	0.117
4	0.180	0.193	0.209	0.189	0.213	0.194	0.220
5	0.306	0.324	0.356	0.354	0.363	0.400	0.370
6	0.484	0.512	0.504	0.534	0.568	0.598	0.535
7	0.724	0.732	0.687	0.683	0.783	0.820	0.819
8	0.994	1.048	0.868	0.844	0.978	1.074	1.082
9	1.688	1.630	1.537	1.352	1.479	1.617	1.647

	1994	1995	1996	1997	1998	1999
1	0.010	0.007	0.011	0.010	0.011	0.004
2	0.021	0.019	0.021	0.017	0.020	0.015
3	0.123	0.075	0.054	0.065	0.059	0.077
4	0.264	0.250	0.262	0.186	0.177	0.231
5	0.356	0.385	0.391	0.369	0.342	0.342
6	0.495	0.520	0.537	0.536	0.456	0.446
7	0.671	0.716	0.763	0.689	0.698	0.603
8	1.007	0.943	1.032	0.926	0.877	0.841
9	1.807	1.399	1.657	1.565	2.482	1.401

SSB Weights - D:\AP\assess_2000\vpa\ap_2000_w1_corr.9

	1980	1981	1982	1983	1984	1985	1986
1	0.016	0.017	0.013	0.007	0.001	0.012	0.009
2	0.051	0.057	0.061	0.024	0.024	0.015	0.027
3	0.108	0.113	0.158	0.146	0.073	0.061	0.089
4	0.208	0.221	0.221	0.295	0.237	0.183	0.139
5	0.297	0.344	0.363	0.392	0.445	0.317	0.283
6	0.561	0.564	0.499	0.529	0.578	0.529	0.441
7	0.763	0.760	0.864	0.681	0.771	0.730	0.671
8	0.928	0.900	1.004	1.000	0.988	1.018	0.997
9	1.523	1.315	1.479	1.479	1.657	1.618	1.702

	1987	1988	1989	1990	1991	1992	1993
1	0.007	0.010	0.005	0.013	0.007	0.017	0.012
2	0.027	0.024	0.026	0.026	0.033	0.031	0.047
3	0.074	0.086	0.079	0.075	0.083	0.092	0.117
4	0.180	0.193	0.209	0.189	0.213	0.194	0.220
5	0.306	0.324	0.356	0.354	0.363	0.400	0.370
6	0.484	0.512	0.504	0.534	0.568	0.598	0.535
7	0.724	0.732	0.687	0.683	0.783	0.820	0.819
8	0.994	1.048	0.868	0.844	0.978	1.074	1.082
9	1.688	1.630	1.537	1.352	1.479	1.617	1.647

	1994	1995	1996	1997	1998	1999
1	0.010	0.007	0.011	0.010	0.011	0.004
2	0.021	0.019	0.021	0.017	0.020	0.015
3	0.123	0.075	0.054	0.065	0.059	0.077
4	0.264	0.250	0.262	0.186	0.177	0.231
5	0.356	0.385	0.391	0.369	0.342	0.342

6	0.495	0.520	0.537	0.536	0.456	0.446
7	0.671	0.716	0.763	0.689	0.698	0.603
8	1.007	0.943	1.032	0.926	0.877	0.841
9	1.807	1.399	1.657	1.565	2.482	1.401

Computed (Rivard)from midyear weights: Jan 1 Weights -
D:\AP\assess_2000\vpa\ap_2000_w1_corr.9

	1980	1981	1982	1983	1984	1985	1986
1	0.016	0.017	0.013	0.007	0.001	0.012	0.009
2	0.051	0.057	0.061	0.024	0.024	0.015	0.027
3	0.108	0.113	0.158	0.146	0.073	0.061	0.089
4	0.208	0.221	0.221	0.295	0.237	0.183	0.139
5	0.297	0.344	0.363	0.392	0.445	0.317	0.283
6	0.561	0.564	0.499	0.529	0.578	0.529	0.441
7	0.763	0.760	0.864	0.681	0.771	0.730	0.671
8	0.928	0.900	1.004	1.000	0.988	1.018	0.997
9	1.523	1.315	1.479	1.479	1.657	1.618	1.702

	1987	1988	1989	1990	1991	1992	1993
1	0.007	0.010	0.005	0.013	0.007	0.017	0.012
2	0.027	0.024	0.026	0.026	0.033	0.031	0.047
3	0.074	0.086	0.079	0.075	0.083	0.092	0.117
4	0.180	0.193	0.209	0.189	0.213	0.194	0.220
5	0.306	0.324	0.356	0.354	0.363	0.400	0.370
6	0.484	0.512	0.504	0.534	0.568	0.598	0.535
7	0.724	0.732	0.687	0.683	0.783	0.820	0.819
8	0.994	1.048	0.868	0.844	0.978	1.074	1.082
9	1.688	1.630	1.537	1.352	1.479	1.617	1.647

	1994	1995	1996	1997	1998	1999	2000
1	0.010	0.007	0.011	0.010	0.011	0.004	0.009
2	0.021	0.019	0.021	0.017	0.020	0.015	0.015
3	0.123	0.075	0.054	0.065	0.059	0.077	0.021
4	0.264	0.250	0.262	0.186	0.177	0.231	0.509
5	0.356	0.385	0.391	0.369	0.342	0.342	0.454
6	0.495	0.520	0.537	0.536	0.456	0.446	0.508
7	0.671	0.716	0.763	0.689	0.698	0.603	0.642
8	1.007	0.943	1.032	0.926	0.877	0.841	0.817
9	1.807	1.399	1.657	1.565	2.482	1.401	1.401

Percent Mature (females)- D:\AP\assess_2000\vpa\ap_2000_w1_corr.9

	1980	1981	1982	1983	1984	1985	1986
1	03	03	03	03	03	03	07
2	08	08	08	08	08	08	24
3	24	24	24	24	24	24	55
4	52	52	52	52	52	52	83
5	79	79	79	79	79	79	95
6	93	93	93	93	93	93	99
7	98	98	98	98	98	98	100
8	100	100	100	100	100	100	100
9	100	100	100	100	100	100	100

	1987	1988	1989	1990	1991	1992	1993
1	07	00	00	00	00	00	00
2	24	02	02	02	02	02	01

3	55	17	17	17	17	17	12
4	83	65	65	65	65	65	60
5	95	94	94	94	94	94	94
6	99	99	99	99	99	99	99
7	100	100	100	100	100	100	100
8	100	100	100	100	100	100	100
9	100	100	100	100	100	100	100

	1994	1995	1996	1997	1998	1999
1	00	00	00	00	00	00
2	01	01	01	01	03	03
3	12	12	12	12	17	17
4	60	60	60	60	60	60
5	94	94	94	94	92	92
6	99	99	99	99	99	99
7	100	100	100	100	100	100
8	100	100	100	100	100	100
9	100	100	100	100	100	100

Natural Mortality D:\AP\assess_2000\vpa\ap_2000_w1_corr.9

	1980	1981	1982	1983	1984	1985	1986
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

	1987	1988	1989	1990	1991	1992	1993
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

	1994	1995	1996	1997	1998	1999
1	.200	.200	.200	.200	.200	.200
2	.200	.200	.200	.200	.200	.200
3	.200	.200	.200	.200	.200	.200
4	.200	.200	.200	.200	.200	.200
5	.200	.200	.200	.200	.200	.200
6	.200	.200	.200	.200	.200	.200
7	.200	.200	.200	.200	.200	.200
8	.200	.200	.200	.200	.200	.200
9	.200	.200	.200	.200	.200	.200

Sex Ratio (Percent Female) - D:\AP\assess_2000\vpa\ap_2000_w1_corr.9

	1980	1981	1982	1983	1984	1985	1986

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

	1987	1988	1989	1990	1991	1992	1993
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

	1994	1995	1996	1997	1998	1999
1	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
3	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
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
7	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
9	0.5	0.5	0.5	0.5	0.5	0.5

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pF is 0.25
pM is 0.25

Residual Sum of Squares from Marquardt Algorithm
Number 1
RSS 11946.2534249083
Lambda 1.00E-02

Number 2
RSS 8809.89197603136
Lambda 1.00E-03

Number 23
RSS 172.957290807342
Lambda 1.00E-03

Number 24
RSS 172.957290807342
Lambda 1.00E-04

RESULTS

Approximate Statistics Assuming Linearity Near Solution
Sum of Squares: 172.957290807342

Mean Square Residuals: 0.37681

	PAR. EST.	STD. ERR.	T-STATISTIC	C.V.
N 1	1.42E+04	6.37E+03	2.23E+00	0.45
N 2	2.82E+04	7.32E+03	3.85E+00	0.26
N 3	1.82E+04	3.70E+03	4.93E+00	0.20
N 4	6.84E+03	1.19E+03	5.73E+00	0.17
N 5	8.84E+03	1.48E+03	5.96E+00	0.17
N 6	5.62E+03	1.04E+03	5.41E+00	0.18
N 7	5.74E+03	1.23E+03	4.66E+00	0.21
N 8	3.65E+03	9.26E+02	3.94E+00	0.25
q spr_us1	2.05E-05	2.92E-06	7.03E+00	0.14
q spr_us2	2.99E-05	4.10E-06	7.31E+00	0.14
q spr_us3	4.22E-05	5.75E-06	7.35E+00	0.14
q spr_us4	5.72E-05	7.77E-06	7.37E+00	0.14
q spr_us5	7.98E-05	1.08E-05	7.37E+00	0.14
q spr_us6	1.30E-04	1.77E-05	7.35E+00	0.14
q spr_us7	1.98E-04	2.71E-05	7.31E+00	0.14
q spr_us8	3.05E-04	4.19E-05	7.28E+00	0.14
q us1aut2	3.12E-05	4.37E-06	7.13E+00	0.14
q us2aut3	4.38E-05	6.11E-06	7.17E+00	0.14
q us3aut4	6.21E-05	8.64E-06	7.18E+00	0.14
q us4aut5	8.94E-05	1.24E-05	7.19E+00	0.14
q us5aut6	1.53E-04	2.13E-05	7.17E+00	0.14
q us6aut7	2.34E-04	3.28E-05	7.13E+00	0.14
q us7aut8	3.96E-04	5.58E-05	7.10E+00	0.14
q spr_ma1	1.71E-05	2.50E-06	6.84E+00	0.15
q spr_ma2	2.99E-05	4.30E-06	6.94E+00	0.14
q spr_ma3	4.98E-05	7.13E-06	6.98E+00	0.14
q spr_ma4	6.49E-05	9.27E-06	7.00E+00	0.14
q spr_ma5	8.56E-05	1.22E-05	7.00E+00	0.14
q ma1aut2	3.53E-05	5.23E-06	6.75E+00	0.15
q ma2aut3	4.19E-05	6.17E-06	6.79E+00	0.15
q ma3aut4	6.27E-05	9.20E-06	6.81E+00	0.15
q ma4aut5	7.81E-05	1.15E-05	6.81E+00	0.15
q ma5aut6	1.29E-04	1.89E-05	6.79E+00	0.15

Catchability Estimates in Original Units

	Estimate	Std.Err.	C.V.
q spr_us1	2.41E-06	3.43E-07	0.14
q spr_us2	3.69E-05	5.05E-06	0.14
q spr_us3	7.57E-05	1.03E-05	0.14
q spr_us4	1.06E-04	1.44E-05	0.14
q spr_us5	1.00E-04	1.36E-05	0.14
q spr_us6	8.30E-05	1.13E-05	0.14
q spr_us7	7.17E-05	9.81E-06	0.14
q spr_us8	4.77E-05	6.56E-06	0.14
q us1aut2	3.36E-05	4.71E-06	0.14
q us2aut3	9.74E-05	1.36E-05	0.14
q us3aut4	1.52E-04	2.11E-05	0.14
q us4aut5	1.63E-04	2.27E-05	0.14
q us5aut6	1.54E-04	2.15E-05	0.14
q us6aut7	1.18E-04	1.65E-05	0.14
q us7aut8	7.74E-05	1.09E-05	0.14
q spr_ma1	2.13E-04	3.12E-05	0.15
q spr_ma2	1.07E-03	1.53E-04	0.14
q spr_ma3	1.33E-03	1.90E-04	0.14
q spr_ma4	9.08E-04	1.30E-04	0.14

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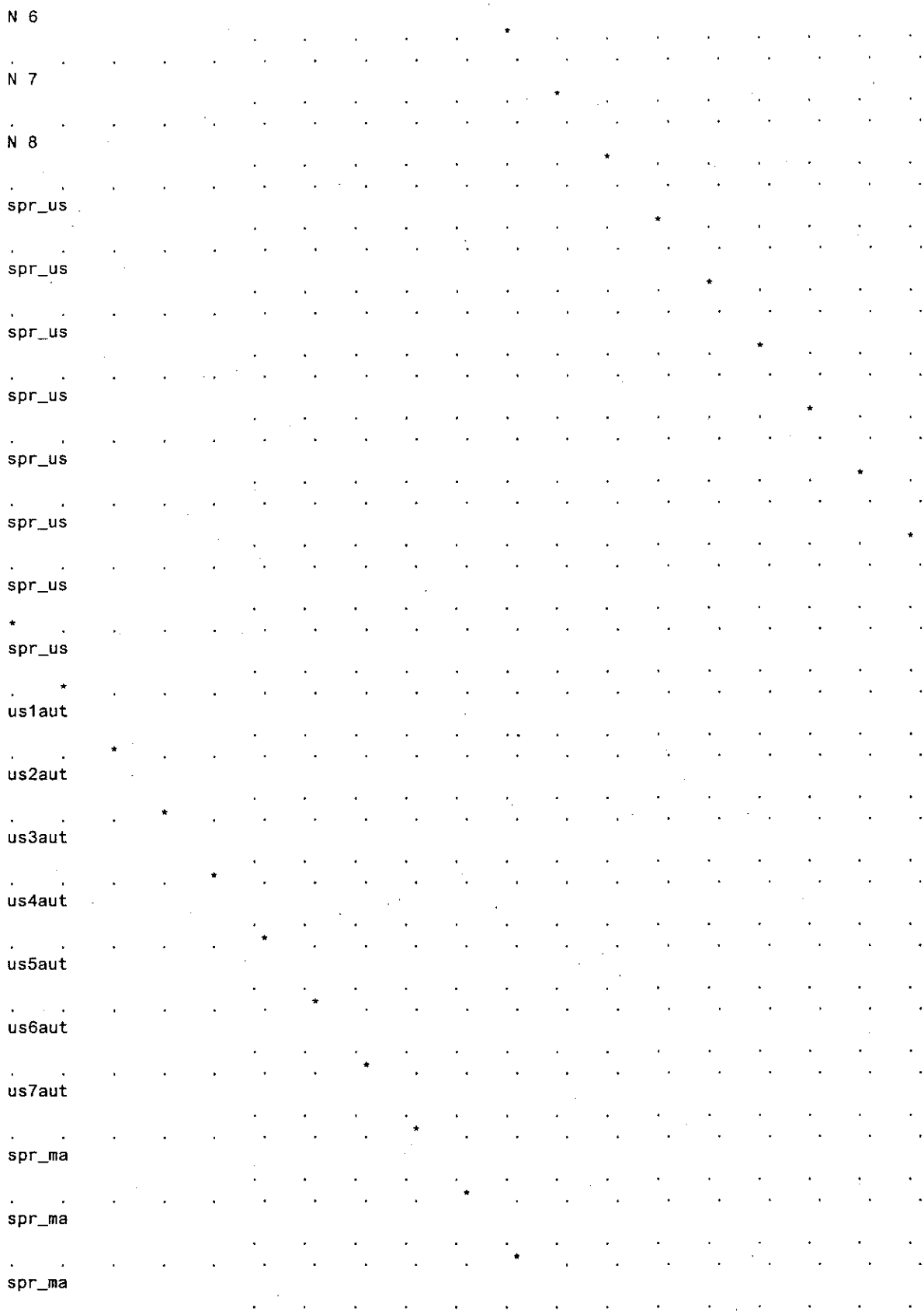
q spr_ma5       4.76E-04        6.80E-05        0.14
q ma1aut2       1.34E-03        1.98E-04        0.15
q ma2aut3       1.49E-03        2.19E-04        0.15
q ma3aut4       1.12E-03        1.65E-04        0.15
q ma4aut5       4.72E-04        6.92E-05        0.15
q ma5aut6       1.50E-04        2.21E-05        0.15

CORRELATION BETWEEN PARAMETERS ESTIMATED
 1     0.04   0.03   0.03   0.02   0.02   0.02   0.02  -0.17  -0.01  -0.01  -0.01   0      0
 -0.01  -0.01  -0.01  -0.01  -0.01  -0.01  -0.01  -0.01  -0.01  -0.17  -0.01  -0.01  -0.01
-0.01  -0.01  -0.01  -0.01  -0.01  -0.01
 0.04  1       0.05   0.04   0.04   0.04   0.04   0.03  -0.11  -0.1   -0.01  -0.01  -0.01
-0.01  -0.01  -0.01  -0.11  -0.01  -0.01  -0.01  -0.01  -0.01  -0.01  -0.11  -0.11  -0.01
-0.01  -0.01  -0.11  -0.01  -0.01  -0.01  -0.01
 0.03  0.05   1       0.06   0.05   0.05   0.05   0.04  -0.09  -0.09  -0.08  -0.01  -0.01
-0.01  -0.01  -0.01  -0.09  -0.08  -0.01  -0.01  -0.01  -0.01  -0.01  -0.09  -0.09  -0.09
-0.01  -0.01  -0.09  -0.09  -0.01  -0.01  -0.01
 0.03  0.04   0.06   1       0.06   0.05   0.05   0.05  -0.08  -0.08  -0.07  -0.07  -0.01
-0.01  -0.01  -0.01  -0.08  -0.08  -0.07  -0.01  -0.01  -0.01  -0.01  -0.08  -0.08  -0.08
-0.08  -0.01  -0.08  -0.08  -0.08  -0.01  -0.01
 0.02  0.04   0.05   0.06   1       0.06   0.06   0.06  -0.07  -0.07  -0.07  -0.07  -0.07
-0.01  -0.02  -0.02  -0.07  -0.07  -0.07  -0.07  -0.02  -0.02  -0.02  -0.07  -0.07  -0.07
-0.07  -0.07  -0.07  -0.07  -0.07  -0.08  -0.02
 0.02  0.04   0.05   0.05   0.06   1       0.05   0.04  -0.07  -0.06  -0.06  -0.06  -0.07
-0.08  -0.03  -0.04  -0.06  -0.06  -0.06  -0.07  -0.09  -0.03  -0.04  -0.07  -0.07  -0.07
-0.07  -0.07  -0.07  -0.07  -0.07  -0.07  -0.09
 0.02  0.04   0.05   0.05   0.06   0.05   1       0.03  -0.06  -0.06  -0.06  -0.06  -0.07
-0.09  -0.12  -0.07  -0.06  -0.06  -0.06  -0.07  -0.09  -0.13  -0.07  -0.07  -0.06  -0.06
-0.06  -0.07  -0.07  -0.07  -0.07  -0.08  -0.1
 0.02  0.03   0.04   0.05   0.06   0.04   0.03   1      -0.06  -0.06  -0.05  -0.05  -0.07
-0.09  -0.13  -0.18  -0.06  -0.06  -0.06  -0.07  -0.09  -0.14  -0.19  -0.06  -0.06  -0.06
-0.06  -0.07  -0.06  -0.06  -0.06  -0.07  -0.1
-0.17 -0.11  -0.09  -0.08  -0.07  -0.07  -0.06  -0.06   1       0.03   0.02   0.02   0.02
0.02   0.02   0.02   0.03   0.02   0.02   0.02   0.02   0.02   0.02   0.06   0.03   0.02
0.02   0.02   0.04   0.03   0.02   0.02   0.02
-0.01 -0.1   -0.09  -0.08  -0.07  -0.06  -0.06  -0.06   0.03   1       0.02   0.02   0.01
0.01   0.02   0.02   0.03   0.02   0.02   0.01   0.02   0.02   0.02   0.03   0.03   0.02
0.02   0.02   0.03   0.02   0.02   0.02   0.02
-0.01 -0.01  -0.08  -0.07  -0.07  -0.06  -0.06  -0.05   0.02   0.02   1       0.02   0.01
0.01   0.02   0.02   0.02   0.02   0.02   0.01   0.01   0.02   0.02   0.02   0.02   0.02
0.02   0.02   0.02   0.02   0.02   0.02   0.02
-0.01 -0.01  -0.01  -0.07  -0.07  -0.06  -0.06  -0.05   0.02   0.02   0.02   1       0.01
0.01   0.02   0.02   0.02   0.02   0.02   0.01   0.02   0.02   0.02   0.02   0.02   0.02
0.02   0.02   0.02   0.02   0.02   0.02   0.02
 0     -0.01  -0.01  -0.01  -0.07  -0.07  -0.07  -0.07   0.02   0.01   0.01   0.01   1
0.02   0.02   0.02   0.01   0.01   0.01   0.02   0.02   0.02   0.02   0.02   0.02   0.02
0.02   0.02   0.02   0.02   0.02   0.02   0.02
 0     -0.01  -0.01  -0.01  -0.01  -0.08  -0.09  -0.09   0.02   0.01   0.01   0.01   0.02   1
  0.02   0.02   0.02   0.01   0.02   0.02   0.02   0.02   0.03   0.02   0.02   0.02   0.02
0.02   0.02   0.02   0.02   0.02   0.02
-0.01 -0.01  -0.01  -0.01  -0.02  -0.03  -0.12  -0.13   0.02   0.02   0.02   0.02   0.02
0.02   1       0.03   0.02   0.02   0.02   0.02   0.02   0.03   0.03   0.02   0.02   0.02
0.02   0.02   0.02   0.02   0.02   0.02   0.03
-0.01 -0.01  -0.01  -0.01  -0.02  -0.04  -0.07  -0.18   0.02   0.02   0.02   0.02   0.02
0.02   0.03   1       0.02   0.02   0.02   0.02   0.03   0.03   0.04   0.02   0.02   0.02
0.02   0.02   0.02   0.02   0.02   0.02   0.03
-0.01 -0.11  -0.09  -0.08  -0.07  -0.06  -0.06  -0.06   0.03   0.03   0.02   0.02   0.01
0.02   0.02   0.02   1       0.02   0.02   0.02   0.02   0.02   0.02   0.03   0.03   0.02
0.02   0.02   0.03   0.02   0.02   0.02   0.02
-0.01 -0.01  -0.08  -0.08  -0.07  -0.06  -0.06  -0.06   0.02   0.02   0.02   0.02   0.01
0.01   0.02   0.02   0.02   1       0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02
0.02   0.02   0.02   0.02   0.02   0.02   0.02
```

```
-0.01 -0.01  -0.01  -0.07  -0.07  -0.06  -0.06  -0.06   0.02   0.02   0.02   0.02   0.01
0.02   0.02   0.02   0.02   0.02   1      0.02   0.02   0.02   0.02   0.02   0.02   0.02
0.02   0.02   0.02   0.02   0.02   0.02   0.02
-0.01 -0.01  -0.01  -0.01  -0.07  -0.07  -0.07  -0.07   0.02   0.01   0.01   0.01   0.02
0.02   0.02   0.02   0.02   0.02   0.02   1      0.02   0.02   0.02   0.02   0.02   0.02
0.02   0.02   0.02   0.02   0.02   0.02   0.02
-0.01 -0.01  -0.01  -0.01  -0.02  -0.09  -0.09  -0.09   0.02   0.02   0.01   0.02   0.02
0.02   0.02   0.03   0.02   0.02   0.02   0.02   1      0.02   0.03   0.02   0.02   0.02
0.02   0.02   0.02   0.02   0.02   0.02   0.02
-0.01 -0.01  -0.01  -0.01  -0.02  -0.03  -0.13  -0.14   0.02   0.02   0.02   0.02   0.02
0.02   0.03   0.03   0.02   0.02   0.02   0.02   0.02   1      0.03   0.02   0.02   0.02
0.02   0.02   0.02   0.02   0.02   0.02   0.03
-0.01 -0.01  -0.01  -0.01  -0.02  -0.04  -0.07  -0.19   0.02   0.02   0.02   0.02   0.02
0.03   0.03   0.04   0.02   0.02   0.02   0.02   0.03   0.03   1      0.02   0.02   0.02
0.02   0.02   0.02   0.02   0.02   0.02   0.03
-0.17 -0.11  -0.09  -0.08  -0.07  -0.07  -0.07  -0.06   0.06   0.03   0.02   0.02   0.02
0.02   0.02   0.02   0.03   0.02   0.02   0.02   0.02   0.02   0.02   1      0.04   0.03
0.02   0.02   0.04   0.03   0.02   0.02   0.02
-0.01 -0.11  -0.09  -0.08  -0.07  -0.07  -0.06  -0.06   0.03   0.03   0.02   0.02   0.02
0.02   0.02   0.02   0.03   0.02   0.02   0.02   0.02   0.02   0.02   0.04   1      0.02
0.02   0.02   0.04   0.03   0.02   0.02   0.02
-0.01 -0.01  -0.09  -0.08  -0.07  -0.07  -0.06  -0.06   0.02   0.02   0.02   0.02   0.02
0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.03   0.02   1
0.02   0.02   0.03   0.02   0.02   0.02   0.02
-0.01 -0.01  -0.01  -0.08  -0.07  -0.07  -0.06  -0.06   0.02   0.02   0.02   0.02   0.02
0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   1
  0.02   0.02   0.02   0.02   0.02   0.02
-0.01 -0.01  -0.01  -0.01  -0.07  -0.07  -0.07  -0.07   0.02   0.02   0.02   0.02   0.02
0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02
0.02   1      0.02   0.02   0.02   0.02   0.02
-0.01 -0.11  -0.09  -0.08  -0.07  -0.07  -0.07  -0.06   0.04   0.03   0.02   0.02   0.02
0.02   0.02   0.02   0.03   0.02   0.02   0.02   0.02   0.02   0.02   0.04   0.04   0.03
0.02   0.02   1      0.03   0.02   0.02   0.02
-0.01 -0.01  -0.09  -0.08  -0.07  -0.07  -0.07  -0.06   0.03   0.02   0.02   0.02   0.02
0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.03   0.03   0.02
0.02   0.02   0.03   1      0.02   0.02   0.02
-0.01 -0.01  -0.01  -0.08  -0.07  -0.07  -0.07  -0.06   0.02   0.02   0.02   0.02   0.02
0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02
0.02   0.02   0.02   0.02   1      0.02   0.02
-0.01 -0.01  -0.01  -0.01  -0.08  -0.07  -0.08  -0.07   0.02   0.02   0.02   0.02   0.02
0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02   0.02
0.02   0.02   0.02   0.02   0.02   1      0.02
-0.01 -0.01  -0.01  -0.01  -0.02  -0.09  -0.1   -0.1    0.02   0.02   0.02   0.02   0.02
0.02   0.03   0.03   0.02   0.02   0.02   0.02   0.02   0.03   0.03   0.02   0.02   0.02
0.02   0.02   0.02   0.02   0.02   0.02   1
```

CORRELATION BETWEEN PARAMETERS ESTIMATED (SYMBOLIC FORM)

```
N 1
                    *
. . . . . .
N 2
                      *
. . . . . .
N 3
                        *
. . . . . .
N 4
                          *
. . . . . .
N 5
                            *
. . . . . .
```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N 7
N 8
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spr_us
spr_us
spr_us
spr_us
spr_us
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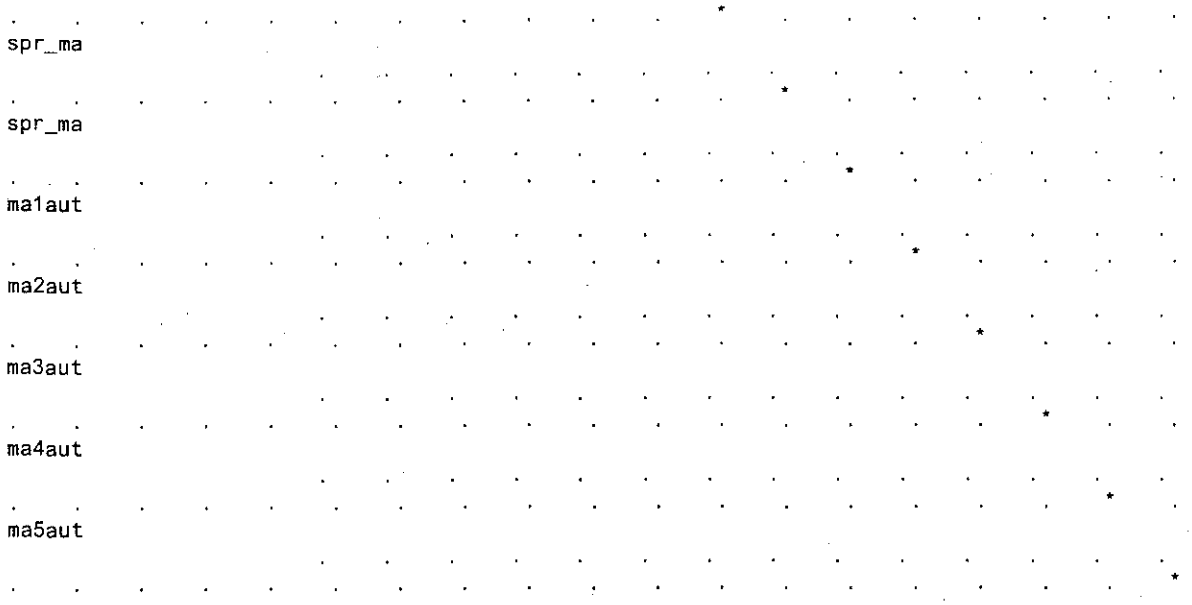
us5aut
us6aut
us7aut
spr_ma
spr_ma
spr_ma



SYMBOLS: = LARGE NEGATIVE CORRELATION whenever -1 <= R < -L
- MODERATE NEGATIVE CORRELATION whenever -L <= R < -M
. SMALL CORRELATION whenever -M <= R <= +M
+ MODERATE POSITIVE CORRELATION whenever +M < R <= +L
* LARGE POSITIVE CORRELATION whenever +L < R <= +1

Where R is the estimated correlation, M is, 0.25 and L is 0.5

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

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1980	0.570	0.127	1.579	0.078	1	1.502	2.446	52643
1981	0.130	0.061	0.101	-0.662	1	0.763	1.244	25119
1982	0.060	0.053	-0.672	-0.797	1	0.125	0.204	21949
1983	0.200	0.061	0.532	-0.662	1	1.194	1.945	25120
1984	0.020	0.032	-1.771	-1.307	1	-0.464	-0.755	13184
1985	0.030	0.035	-1.365	-1.220	1	-0.145	-0.237	14385
1986	0.010	0.044	-2.464	-0.971	1	-1.493	-2.431	18443
1987	0.120	0.089	0.021	-0.279	1	0.300	0.489	36859
1988	0.200	0.129	0.532	0.091	1	0.441	0.718	53355
1989	0.050	0.065	-0.854	-0.586	1	-0.268	-0.437	27101
1990	0.000	0.000	0	0	1	0.000	0.000	00
1991	0.030	0.081	-1.365	-0.366	1	-0.999	-1.627	33777
1992	0.060	0.096	-0.672	-0.202	1	-0.470	-0.766	39816
1993	0.330	0.121	1.033	0.028	1	1.005	1.637	50074
1994	0.030	0.101	-1.365	-0.151	1	-1.214	-1.978	41884
1995	0.305	0.059	0.954	-0.690	1	1.644	2.679	24426
1996	0.021	0.058	-1.722	-0.700	1	-1.022	-1.665	24189
1997	0.018	0.032	-1.876	-1.316	1	-0.560	-0.912	13064
1998	0.056	0.066	-0.741	-0.571	1	-0.170	-0.277	27527
1999	0.080	0.083	-0.384	-0.346	1	-0.038	-0.062	34453
2000	0.030	0.034	-1.365	-1.234	1	-0.132	-0.214	14187

Partial Variance: 0.798

spr_us
Tuned to: 1-Jan and number

For ages: 2

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1980	3.550	1.558	1.058	0.235	1	0.823	1.341	42217
1981	3.490	1.591	1.041	0.255	1	0.786	1.280	43096
1982	1.040	0.759	-0.170	-0.485	1	0.315	0.513	20561
1983	3.680	0.663	1.094	-0.620	1	1.714	2.792	17962
1984	0.350	0.759	-1.259	-0.485	1	-0.774	-1.260	20553
1985	0.320	0.398	-1.349	-1.130	1	-0.219	-0.357	10791
1986	0.460	0.433	-0.986	-1.047	1	0.061	0.100	11719
1987	0.720	0.555	-0.538	-0.797	1	0.259	0.423	15046
1988	0.990	1.113	-0.219	-0.102	1	-0.117	-0.190	30143
1989	1.590	1.602	0.255	0.262	1	-0.008	-0.012	43399
1990	0.570	0.815	-0.771	-0.414	1	-0.357	-0.582	22069
1991	0.710	1.006	-0.552	-0.203	1	-0.349	-0.568	27252
1992	0.340	1.020	-1.288	-0.189	1	-1.099	-1.790	27643
1993	0.840	1.202	-0.384	-0.025	1	-0.358	-0.584	32565
1994	1.430	1.510	0.148	0.203	1	-0.054	-0.089	40900
1995	1.974	1.256	0.471	0.019	1	0.452	0.736	34031
1996	0.470	0.721	-0.964	-0.536	1	-0.428	-0.697	19529
1997	0.850	0.725	-0.372	-0.531	1	0.160	0.260	19628
1998	0.192	0.390	-1.859	-1.152	1	-0.708	-1.153	10553
1999	0.410	0.831	-1.101	-0.395	1	-0.706	-1.150	22504
2000	1.910	1.041	0.438	-0.169	1	0.607	0.988	28204

Partial Variance: 0.428

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

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1980	4.490	2.720	0.918	0.416	1	0.501	0.817	35915
1981	4.310	2.611	0.877	0.375	1	0.501	0.817	34475
1982	1.790	2.605	-0.002	0.373	1	-0.375	-0.611	34395
1983	3.330	1.233	0.619	-0.374	1	0.993	1.618	16288
1984	0.570	1.068	-1.146	-0.518	1	-0.628	-1.023	14106
1985	0.980	1.249	-0.604	-0.362	1	-0.243	-0.395	16492
1986	0.340	0.658	-1.663	-1.002	1	-0.661	-1.076	8692
1987	1.180	0.683	-0.419	-0.966	1	0.547	0.891	9017
1988	0.840	0.892	-0.759	-0.698	1	-0.061	-0.099	11785
1989	1.270	1.815	-0.345	0.012	1	-0.357	-0.582	23968
1990	2.650	2.578	0.390	0.363	1	0.028	0.045	34036
1991	1.630	1.322	-0.096	-0.305	1	0.209	0.341	17457
1992	1.150	1.668	-0.444	-0.073	1	-0.372	-0.605	22020
1993	1.160	1.698	-0.436	-0.055	1	-0.381	-0.621	22423
1994	1.140	1.990	-0.453	0.104	1	-0.557	-0.907	26276
1995	3.212	2.501	0.583	0.333	1	0.250	0.407	33028
1996	1.935	2.008	0.076	0.113	1	-0.037	-0.060	26516
1997	1.671	1.147	-0.071	-0.447	1	0.377	0.613	15142
1998	1.018	1.123	-0.566	-0.468	1	-0.098	-0.160	14826
1999	0.520	0.650	-1.238	-1.015	1	-0.223	-0.363	8583
2000	2.480	1.381	0.324	-0.261	1	0.585	0.953	18242

Partial Variance: 0.213

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

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1980	3.000	2.569	0.482	0.327	1	0.155	0.252	24231
1981	3.550	3.015	0.650	0.487	1	0.163	0.266	28434
1982	3.170	2.783	0.537	0.407	1	0.130	0.212	26242

1983	4.480	2.665	0.883	0.364	1	0.520	0.846	25131
1984	0.900	1.272	-0.722	-0.376	1	-0.346	-0.564	11998
1985	0.860	1.129	-0.767	-0.495	1	-0.273	-0.444	10652
1986	1.010	1.315	-0.607	-0.343	1	-0.264	-0.430	12402
1987	0.810	0.684	-0.827	-0.997	1	0.169	0.276	6449
1988	0.760	0.606	-0.891	-1.117	1	0.226	0.368	5717
1989	0.860	0.847	-0.767	-0.783	1	0.016	0.026	7984
1990	1.020	1.905	-0.597	0.028	1	-0.625	-1.018	17966
1991	2.330	2.630	0.229	0.350	1	-0.121	-0.197	24800
1992	0.880	1.419	-0.744	-0.266	1	-0.478	-0.779	13387
1993	1.580	1.808	-0.159	-0.025	1	-0.135	-0.219	17049
1994	1.120	1.752	-0.503	-0.056	1	-0.447	-0.729	16520
1995	2.307	2.221	0.219	0.182	1	0.038	0.062	20950
1996	3.296	2.648	0.576	0.357	1	0.219	0.357	24974
1997	2.506	2.166	0.302	0.156	1	0.146	0.238	20426
1998	1.116	1.237	-0.507	-0.404	1	-0.103	-0.168	11671
1999	1.130	1.260	-0.494	-0.385	1	-0.109	-0.178	11884
2000	2.220	0.725	0.181	-0.938	1	1.119	1.822	6841

Partial Variance: 0.146

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

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1980	2.890	2.156	0.835	0.542	1	0.293	0.477	21550
1981	2.670	1.743	0.756	0.329	1	0.426	0.695	17421
1982	2.130	1.872	0.530	0.401	1	0.129	0.210	18706
1983	2.640	1.736	0.744	0.325	1	0.419	0.683	17346
1984	1.300	1.590	0.036	0.238	1	-0.201	-0.328	15891
1985	0.730	0.764	-0.541	-0.496	1	-0.045	-0.073	7632
1986	0.590	0.752	-0.754	-0.512	1	-0.242	-0.395	7512
1987	0.610	0.809	-0.721	-0.438	1	-0.283	-0.460	8087
1988	0.310	0.398	-1.398	-1.148	1	-0.250	-0.407	3978
1989	0.490	0.302	-0.940	-1.422	1	0.483	0.786	3022
1990	0.540	0.552	-0.843	-0.820	1	-0.022	-0.036	5519
1991	0.920	1.231	-0.310	-0.019	1	-0.291	-0.474	12299
1992	1.070	1.633	-0.159	0.264	1	-0.422	-0.688	16314
1993	0.610	0.896	-0.721	-0.337	1	-0.384	-0.625	8949
1994	0.750	1.022	-0.514	-0.205	1	-0.309	-0.504	10211
1995	1.109	1.116	-0.123	-0.117	1	-0.006	-0.010	11148
1996	1.309	1.128	0.043	-0.106	1	0.149	0.243	11268
1997	2.057	1.644	0.495	0.271	1	0.224	0.365	16427
1998	1.219	1.425	-0.028	0.128	1	-0.156	-0.255	14245
1999	0.790	0.876	-0.462	-0.358	1	-0.104	-0.169	8756
2000	1.600	0.884	0.244	-0.349	1	0.593	0.966	8839

Partial Variance: 0.097

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

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1980	1.600	1.427	0.922	0.808	1	0.114	0.186	17203
1981	1.740	1.168	1.006	0.607	1	0.398	0.649	14080
1982	1.340	0.783	0.744	0.207	1	0.538	0.876	9434
1983	1.180	0.933	0.617	0.382	1	0.235	0.383	11241
1984	0.580	0.809	-0.093	0.240	1	-0.333	-0.543	9752
1985	0.860	0.627	0.301	-0.015	1	0.316	0.515	7554
1986	0.290	0.338	-0.786	-0.633	1	-0.153	-0.249	4072
1987	0.290	0.383	-0.786	-0.509	1	-0.277	-0.452	4612
1988	0.230	0.378	-1.018	-0.521	1	-0.497	-0.810	4556

1989	0.290	0.150	-0.786	-1.443	1	0.657	1.070	1812
1990	0.170	0.143	-1.320	-1.493	1	0.172	0.281	1724
1991	0.150	0.272	-1.445	-0.850	1	-0.596	-0.970	3280
1992	0.430	0.580	-0.392	-0.093	1	-0.299	-0.488	6991
1993	0.450	0.597	-0.347	-0.064	1	-0.283	-0.461	7195
1994	0.230	0.339	-1.018	-0.630	1	-0.388	-0.632	4085
1995	0.437	0.359	-0.376	-0.573	1	0.197	0.321	4326
1996	0.529	0.395	-0.185	-0.477	1	0.292	0.476	4761
1997	0.391	0.543	-0.487	-0.158	1	-0.329	-0.536	6549
1998	0.680	0.822	0.066	0.255	1	-0.189	-0.308	9903
1999	0.640	0.772	0.005	0.193	1	-0.188	-0.306	9304
2000	0.860	0.466	0.301	-0.311	1	0.612	0.997	5619

Partial Variance: 0.147

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

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1980	1.120	0.796	1.128	0.786	1	0.342	0.557	11092
1981	1.450	0.755	1.386	0.733	1	0.653	1.063	10526
1982	0.920	0.590	0.931	0.487	1	0.444	0.724	8227
1983	0.580	0.320	0.470	-0.124	1	0.594	0.967	4467
1984	0.220	0.406	-0.500	0.113	1	-0.613	-0.999	5663
1985	0.460	0.362	0.238	-0.002	1	0.239	0.390	5049
1986	0.210	0.257	-0.546	-0.344	1	-0.203	-0.330	3586
1987	0.190	0.143	-0.646	-0.928	1	0.282	0.459	1999
1988	0.120	0.184	-1.106	-0.678	1	-0.428	-0.697	2567
1989	0.160	0.174	-0.818	-0.735	1	-0.083	-0.135	2424
1990	0.060	0.072	-1.799	-1.622	1	-0.177	-0.288	998
1991	0.070	0.067	-1.645	-1.692	1	0.047	0.076	931
1992	0.110	0.120	-1.193	-1.109	1	-0.084	-0.138	1669
1993	0.170	0.234	-0.758	-0.439	1	-0.318	-0.518	3259
1994	0.098	0.219	-1.309	-0.505	1	-0.803	-1.308	3051
1995	0.216	0.129	-0.518	-1.031	1	0.513	0.835	1804
1996	0.203	0.124	-0.580	-1.072	1	0.492	0.801	1731
1997	0.093	0.184	-1.361	-0.678	1	-0.683	-1.112	2567
1998	0.156	0.274	-0.844	-0.280	1	-0.564	-0.919	3823
1999	0.410	0.421	0.123	0.149	1	-0.026	-0.042	5867
2000	0.600	0.412	0.503	0.127	1	0.376	0.613	5742

Partial Variance: 0.206

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

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1980	0.250	0.244	0.467	0.441	1	0.026	0.043	5101
1981	0.790	0.277	1.618	0.569	1	1.049	1.709	5795
1982	0.490	0.308	1.140	0.675	1	0.465	0.758	6446
1983	0.320	0.179	0.714	0.134	1	0.580	0.945	3752
1984	0.100	0.077	-0.449	-0.716	1	0.267	0.435	1603
1985	0.420	0.138	0.986	-0.129	1	1.115	1.817	2884
1986	0.100	0.101	-0.449	-0.438	1	-0.011	-0.018	2118
1987	0.090	0.084	-0.554	-0.627	1	0.073	0.118	1753
1988	0.010	0.039	-2.752	-1.379	1	-1.373	-2.236	826
1989	0.030	0.076	-1.653	-0.718	1	-0.935	-1.524	1601
1990	0.040	0.062	-1.365	-0.924	1	-0.442	-0.720	1303
1991	0.040	0.026	-1.365	-1.779	1	0.413	0.674	554
1992	0.040	0.023	-1.365	-1.939	1	0.574	0.935	472
1993	0.080	0.030	-0.672	-1.658	1	0.986	1.606	625
1994	0.030	0.067	-1.653	-0.853	1	-0.800	-1.303	1398

1995	0.026	0.064	-1.796	-0.901	1	-0.895	-1.457	1332
1996	0.045	0.042	-1.247	-1.310	1	0.063	0.103	885
1997	0.012	0.044	-2.569	-1.271	1	-1.298	-2.115	920
1998	0.057	0.069	-1.011	-0.815	1	-0.196	-0.319	1452
1999	0.170	0.104	0.082	-0.407	1	0.488	0.795	2185
2000	0.150	0.174	-0.043	0.107	1	-0.150	-0.245	3652

Partial Variance: 0.55

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

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	1.580	1.447	0.384	0.296	1	0.088	0.144	43096
1982	0.430	0.690	-0.917	-0.444	1	-0.473	-0.771	20561
1983	0.200	0.603	-1.683	-0.579	1	-1.104	-1.798	17962
1984	0.500	0.690	-0.766	-0.444	1	-0.322	-0.525	20553
1985	0.220	0.362	-1.587	-1.089	1	-0.499	-0.812	10791
1986	0.920	0.393	-0.157	-1.006	1	0.850	1.384	11719
1987	0.510	0.505	-0.747	-0.756	1	0.010	0.016	15046
1988	0.530	1.012	-0.708	-0.062	1	-0.647	-1.053	30143
1989	2.840	1.457	0.970	0.303	1	0.668	1.087	43399
1990	0.480	0.741	-0.807	-0.373	1	-0.434	-0.707	22069
1991	1.520	0.915	0.345	-0.162	1	0.508	0.827	27252
1992	0.470	0.928	-0.828	-0.148	1	-0.680	-1.108	27643
1993	0.650	1.093	-0.504	0.016	1	-0.520	-0.847	32565
1994	1.710	1.373	0.463	0.244	1	0.220	0.358	40900
1995	3.830	1.142	1.270	0.060	1	1.210	1.971	34031
1996	0.500	0.656	-0.766	-0.496	1	-0.271	-0.441	19529
1997	0.542	0.659	-0.686	-0.491	1	-0.195	-0.318	19628
1998	0.360	0.354	-1.095	-1.111	1	0.016	0.026	10553
1999	1.730	0.755	0.475	-0.354	1	0.829	1.350	22504
2000	2.000	0.947	0.620	-0.128	1	0.748	1.218	28204

Partial Variance: 0.398

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

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	2.220	3.358	-0.002	0.412	1	-0.414	-0.674	34475
1982	2.790	3.350	0.226	0.409	1	-0.183	-0.298	34395
1983	0.910	1.586	-0.894	-0.338	1	-0.556	-0.905	16288
1984	1.010	1.374	-0.790	-0.482	1	-0.308	-0.501	14106
1985	2.240	1.606	0.007	-0.326	1	0.333	0.542	16492
1986	0.840	0.847	-0.974	-0.966	1	-0.008	-0.013	8692
1987	1.480	0.878	-0.408	-0.930	1	0.522	0.850	9017
1988	1.270	1.148	-0.561	-0.662	1	0.101	0.165	11785
1989	2.970	2.334	0.289	0.048	1	0.241	0.392	23968
1990	4.450	3.315	0.693	0.399	1	0.294	0.480	34036
1991	2.260	1.700	0.016	-0.269	1	0.285	0.464	17457
1992	2.480	2.145	0.109	-0.037	1	0.145	0.237	22020
1993	1.230	2.184	-0.593	-0.019	1	-0.574	-0.935	22423
1994	2.350	2.559	0.055	0.140	1	-0.085	-0.139	26276
1995	7.530	3.217	1.219	0.369	1	0.850	1.385	33028
1996	3.800	2.583	0.535	0.149	1	0.386	0.629	26516
1997	0.807	1.475	-1.014	-0.411	1	-0.603	-0.982	15142
1998	1.060	1.444	-0.741	-0.432	1	-0.309	-0.504	14826
1999	0.600	0.836	-1.311	-0.979	1	-0.332	-0.540	8583
2000	2.200	1.777	-0.011	-0.225	1	0.214	0.348	18242

Partial Variance: 0.164

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

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	2.720	4.318	0.106	0.568	1	-0.462	-0.753	28434
1982	2.220	3.985	-0.097	0.488	1	-0.585	-0.953	26242
1983	1.650	3.816	-0.394	0.445	1	-0.838	-1.366	25131
1984	2.020	1.822	-0.192	-0.295	1	0.103	0.168	11998
1985	1.560	1.618	-0.450	-0.414	1	-0.036	-0.059	10652
1986	2.680	1.883	0.091	-0.262	1	0.353	0.575	12402
1987	0.890	0.979	-1.011	-0.916	1	-0.096	-0.156	6449
1988	0.990	0.868	-0.905	-1.036	1	0.131	0.214	5717
1989	2.390	1.212	-0.023	-0.702	1	0.679	1.106	7984
1990	2.860	2.728	0.156	0.109	1	0.047	0.077	17966
1991	7.490	3.766	1.119	0.431	1	0.688	1.120	24800
1992	2.030	2.033	-0.187	-0.185	1	-0.001	-0.002	13387
1993	1.850	2.589	-0.279	0.057	1	-0.336	-0.547	17049
1994	3.470	2.509	0.350	0.025	1	0.324	0.529	16520
1995	2.810	3.181	0.139	0.263	1	-0.124	-0.202	20950
1996	3.820	3.792	0.446	0.438	1	0.007	0.012	24974
1997	1.998	3.102	-0.202	0.237	1	-0.440	-0.717	20426
1998	1.550	1.772	-0.456	-0.322	1	-0.134	-0.218	11671
1999	1.880	1.805	-0.263	-0.304	1	0.041	0.067	11884
2000	2.050	1.039	-0.177	-0.856	1	0.680	1.107	6841

Partial Variance: 0.175

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

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	2.850	2.847	0.444	0.443	1	0.001	0.001	17421
1982	2.620	3.058	0.360	0.514	1	-0.154	-0.252	18706
1983	1.270	2.835	-0.364	0.439	1	-0.803	-1.308	17346
1984	2.920	2.597	0.468	0.351	1	0.117	0.191	15891
1985	1.210	1.247	-0.413	-0.382	1	-0.030	-0.050	7632
1986	1.070	1.228	-0.536	-0.398	1	-0.138	-0.224	7512
1987	1.450	1.322	-0.232	-0.324	1	0.093	0.151	8087
1988	0.430	0.650	-1.447	-1.034	1	-0.413	-0.674	3978
1989	0.780	0.494	-0.852	-1.309	1	0.457	0.744	3022
1990	0.980	0.902	-0.624	-0.707	1	0.083	0.135	5519
1991	2.890	2.010	0.458	0.095	1	0.363	0.591	12299
1992	1.590	2.667	-0.140	0.377	1	-0.517	-0.842	16314
1993	1.280	1.463	-0.357	-0.223	1	-0.133	-0.217	8949
1994	2.280	1.669	0.221	-0.091	1	0.312	0.508	10211
1995	1.710	1.822	-0.067	-0.003	1	-0.064	-0.104	11148
1996	2.500	1.842	0.313	0.007	1	0.306	0.498	11268
1997	2.738	2.685	0.404	0.384	1	0.020	0.032	16427
1998	1.860	2.328	0.017	0.242	1	-0.225	-0.366	14245
1999	2.010	1.431	0.095	-0.245	1	0.340	0.553	8756
2000	2.130	1.445	0.153	-0.236	1	0.388	0.632	8839

Partial Variance: 0.108

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

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk.

Sze.

1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	1.530	2.168	0.417	0.766	1	-0.349	-0.568	14080
1982	2.300	1.453	0.825	0.365	1	0.460	0.749	9434
1983	0.570	1.731	-0.570	0.541	1	-1.111	-1.809	11241
1984	1.360	1.502	0.300	0.399	1	-0.099	-0.161	9752
1985	1.070	1.163	0.060	0.143	1	-0.083	-0.136	7554
1986	0.810	0.627	-0.219	-0.475	1	0.256	0.417	4072
1987	0.470	0.710	-0.763	-0.350	1	-0.413	-0.673	4612
1988	0.690	0.702	-0.379	-0.362	1	-0.017	-0.027	4556
1989	0.470	0.279	-0.763	-1.284	1	0.522	0.850	1812
1990	0.190	0.266	-1.669	-1.334	1	-0.335	-0.545	1724
1991	0.590	0.505	-0.536	-0.691	1	0.156	0.253	3280
1992	0.730	1.076	-0.323	0.066	1	-0.388	-0.633	6991
1993	0.780	1.108	-0.256	0.095	1	-0.351	-0.572	7195
1994	1.050	0.629	0.041	-0.471	1	0.512	0.835	4085
1995	1.300	0.666	0.254	-0.414	1	0.669	1.089	4326
1996	0.900	0.733	-0.113	-0.318	1	0.205	0.334	4761
1997	0.928	1.008	-0.083	0.000	1	-0.083	-0.135	6549
1998	1.040	1.525	0.031	0.414	1	-0.383	-0.623	9903
1999	1.780	1.433	0.569	0.352	1	0.217	0.354	9304
2000	1.600	0.865	0.462	-0.153	1	0.615	1.001	5619

Partial Variance: 0.205

us6aut
Tuned to: 1-Jan and number
For ages: 7

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk.
Sze.								
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	1.030	1.238	0.718	0.902	1	-0.184	-0.299	10526
1982	1.550	0.967	1.127	0.655	1	0.471	0.768	8227
1983	0.480	0.525	-0.045	0.045	1	-0.090	-0.147	4467
1984	0.680	0.666	0.303	0.282	1	0.021	0.034	5663
1985	0.510	0.594	0.015	0.167	1	-0.152	-0.248	5049
1986	0.410	0.422	-0.203	-0.175	1	-0.028	-0.046	3586
1987	0.430	0.235	-0.155	-0.760	1	0.604	0.984	1999
1988	0.250	0.302	-0.698	-0.509	1	-0.188	-0.307	2567
1989	0.100	0.285	-1.614	-0.567	1	-1.047	-1.706	2424
1990	0.100	0.117	-1.614	-1.454	1	-0.160	-0.261	998
1991	0.250	0.110	-0.698	-1.523	1	0.825	1.345	931
1992	0.300	0.196	-0.515	-0.940	1	0.424	0.691	1669
1993	0.300	0.383	-0.515	-0.271	1	-0.245	-0.399	3259
1994	0.800	0.359	0.465	-0.337	1	0.802	1.307	3051
1995	0.040	0.212	-2.530	-0.862	1	-1.668	-2.717	1804
1996	0.220	0.204	-0.826	-0.903	1	0.078	0.127	1731
1997	0.386	0.302	-0.263	-0.509	1	0.246	0.401	2567
1998	0.320	0.449	-0.451	-0.111	1	-0.340	-0.554	3823
1999	1.080	0.690	0.766	0.317	1	0.448	0.730	5867
2000	0.810	0.675	0.478	0.296	1	0.182	0.297	5742

Partial Variance: 0.352

us7aut
Tuned to: 1-Jan and number
For ages: 8

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk.
Sze.								
1980	0.000	0.000	0	0	1	0.000	0.000	00
1981	0.930	0.449	1.559	0.830	1	0.729	1.187	5795
1982	0.630	0.499	1.170	0.937	1	0.233	0.380	6446
1983	0.300	0.291	0.428	0.396	1	0.032	0.052	3752
1984	0.340	0.124	0.553	-0.455	1	1.007	1.641	1603

1985	0.120	0.223	-0.489	0.133	1	-0.621	-1.012	2884
1986	0.190	0.164	-0.029	-0.176	1	0.147	0.240	2118
1987	0.160	0.136	-0.201	-0.365	1	0.165	0.268	1753
1988	0.100	0.064	-0.671	-1.117	1	0.446	0.727	826
1989	0.070	0.124	-1.028	-0.456	1	-0.571	-0.931	1601
1990	0.020	0.101	-2.280	-0.662	1	-1.618	-2.636	1303
1991	0.110	0.043	-0.576	-1.517	1	0.942	1.534	554
1992	0.040	0.037	-1.587	-1.677	1	0.090	0.147	472
1993	0.070	0.048	-1.028	-1.396	1	0.369	0.601	625
1994	0.110	0.108	-0.576	-0.591	1	0.016	0.026	1398
1995	0.250	0.103	0.245	-0.640	1	0.885	1.442	1332
1996	0.040	0.069	-1.587	-1.049	1	-0.538	-0.877	885
1997	0.072	0.071	-0.999	-1.010	1	0.010	0.017	920
1998	0.040	0.112	-1.587	-0.554	1	-1.033	-1.683	1452
1999	0.120	0.169	-0.489	-0.145	1	-0.343	-0.559	2185
2000	0.200	0.283	0.022	0.368	1	-0.346	-0.564	3652

Partial Variance: 0.46

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

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
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	7.180	4.680	-0.552	-0.980	1	0.428	0.697	21949
1983	1.930	5.356	-1.866	-0.845	1	-1.021	-1.663	25120
1984	2.150	2.811	-1.758	-1.490	1	-0.268	-0.437	13184
1985	21.560	3.067	0.547	-1.403	1	1.950	3.177	14385
1986	27.060	3.932	0.774	-1.154	1	1.929	3.142	18443
1987	34.360	7.859	1.013	-0.462	1	1.475	2.403	36859
1988	81.470	11.376	1.877	-0.092	1	1.969	3.207	53355
1989	8.070	5.778	-0.436	-0.770	1	0.334	0.544	27101
1990	7.730	7.113	-0.479	-0.562	1	0.083	0.135	33361
1991	2.100	7.202	-1.782	-0.549	1	-1.232	-2.008	33777
1992	8.198	8.489	-0.420	-0.385	1	-0.035	-0.057	39816
1993	11.596	10.676	-0.073	-0.156	1	0.083	0.135	50074
1994	11.600	8.930	-0.073	-0.334	1	0.262	0.426	41884
1995	0.540	5.208	-3.140	-0.874	1	-2.266	-3.692	24426
1996	2.290	5.157	-1.695	-0.883	1	-0.812	-1.323	24189
1997	1.550	2.785	-2.085	-1.499	1	-0.586	-0.955	13064
1998	2.830	5.869	-1.483	-0.754	1	-0.729	-1.188	27527
1999	1.350	7.346	-2.224	-0.530	1	-1.694	-2.760	34453
2000	3.450	3.025	-1.285	-1.417	1	0.132	0.214	14187

Partial Variance: 1.479

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

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
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	49.250	21.907	0.322	-0.488	1	0.810	1.320	20561
1983	18.760	19.137	-0.643	-0.623	1	-0.020	-0.032	17962
1984	27.440	21.898	-0.263	-0.489	1	0.226	0.368	20553
1985	17.160	11.498	-0.732	-1.133	1	0.400	0.652	10791
1986	110.270	12.486	1.128	-1.050	1	2.178	3.549	11719
1987	17.260	16.031	-0.727	-0.800	1	0.074	0.120	15046
1988	63.570	32.116	0.577	-0.106	1	0.683	1.112	30143
1989	127.260	46.240	1.271	0.259	1	1.012	1.649	43399
1990	25.370	23.513	-0.341	-0.417	1	0.076	0.124	22069

1991	19.980	29.037	-0.580	-0.206	1	-0.374	-0.609	27252
1992	11.057	29.452	-1.172	-0.192	1	-0.980	-1.596	27643
1993	18.981	34.697	-0.632	-0.028	1	-0.603	-0.983	32565
1994	52.570	43.577	0.387	0.200	1	0.188	0.306	40900
1995	34.650	36.259	-0.030	0.016	1	-0.045	-0.074	34031
1996	4.140	20.808	-2.154	-0.540	1	-1.615	-2.630	19529
1997	7.960	20.913	-1.501	-0.535	1	-0.966	-1.574	19628
1998	4.330	11.243	-2.109	-1.155	1	-0.954	-1.554	10553
1999	11.650	23.977	-1.120	-0.398	1	-0.722	-1.176	22504
2000	56.510	30.050	0.459	-0.172	1	0.632	1.029	28204

Partial Variance: 0.791

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

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
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	33.350	45.689	0.223	0.538	1	-0.315	-0.513	34395
1983	22.420	21.636	-0.174	-0.210	1	0.036	0.058	16288
1984	21.320	18.737	-0.224	-0.353	1	0.129	0.210	14106
1985	24.220	21.908	-0.097	-0.197	1	0.100	0.163	16492
1986	26.910	11.546	0.009	-0.838	1	0.846	1.378	8692
1987	15.790	11.977	-0.525	-0.801	1	0.276	0.450	9017
1988	17.850	15.655	-0.402	-0.533	1	0.131	0.214	11785
1989	44.970	31.838	0.522	0.177	1	0.345	0.563	23968
1990	56.710	45.212	0.754	0.527	1	0.227	0.369	34036
1991	34.770	23.189	0.265	-0.140	1	0.405	0.660	17457
1992	33.979	29.251	0.242	0.092	1	0.150	0.244	22020
1993	16.083	29.786	-0.506	0.110	1	-0.616	-1.004	22423
1994	22.120	34.904	-0.188	0.269	1	-0.456	-0.743	26276
1995	49.640	43.873	0.621	0.497	1	0.123	0.201	33028
1996	14.920	35.223	-0.581	0.278	1	-0.859	-1.399	26516
1997	13.950	20.114	-0.649	-0.283	1	-0.366	-0.596	15142
1998	11.450	19.694	-0.846	-0.304	1	-0.542	-0.883	14826
1999	11.650	11.401	-0.829	-0.850	1	0.022	0.035	8583
2000	34.860	24.232	0.267	-0.096	1	0.364	0.592	18242

Partial Variance: 0.181

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

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
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	17.140	23.838	0.202	0.532	1	-0.330	-0.537	26242
1983	21.460	22.829	0.427	0.489	1	-0.062	-0.101	25131
1984	10.570	10.899	-0.281	-0.250	1	-0.031	-0.050	11998
1985	9.500	9.677	-0.388	-0.369	1	-0.018	-0.030	10652
1986	14.430	11.266	0.030	-0.217	1	0.248	0.403	12402
1987	3.900	5.858	-1.278	-0.871	1	-0.407	-0.663	6449
1988	8.720	5.194	-0.474	-0.992	1	0.518	0.844	5717
1989	11.990	7.253	-0.155	-0.658	1	0.503	0.819	7984
1990	16.480	16.321	0.163	0.153	1	0.010	0.016	17966
1991	18.980	22.529	0.304	0.476	1	-0.171	-0.279	24800
1992	14.992	12.160	0.068	-0.141	1	0.209	0.341	13387
1993	9.159	15.487	-0.424	0.101	1	-0.525	-0.856	17049
1994	7.130	15.007	-0.675	0.069	1	-0.744	-1.212	16520
1995	10.320	19.031	-0.305	0.307	1	-0.612	-0.997	20950
1996	31.390	22.686	0.807	0.483	1	0.325	0.529	24974

1997	17.240	18.556	0.208	0.282	1	-0.074	-0.120	20426
1998	7.530	10.602	-0.620	-0.278	1	-0.342	-0.557	11671
1999	15.110	10.796	0.076	-0.260	1	0.336	0.548	11884
2000	19.980	6.215	0.356	-0.812	1	1.168	1.902	6841

Partial Variance: 0.217

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

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
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	5.000	8.913	-0.107	0.471	1	-0.578	-0.942	18706
1983	10.220	8.265	0.608	0.396	1	0.212	0.346	17346
1984	4.640	7.571	-0.182	0.308	1	-0.490	-0.798	15891
1985	3.770	3.636	-0.389	-0.425	1	0.036	0.059	7632
1986	2.840	3.579	-0.672	-0.441	1	-0.231	-0.377	7512
1987	1.760	3.853	-1.151	-0.367	1	-0.784	-1.276	8087
1988	1.540	1.895	-1.284	-1.077	1	-0.208	-0.338	3978
1989	3.030	1.440	-0.608	-1.352	1	0.744	1.212	3022
1990	3.430	2.629	-0.484	-0.750	1	0.266	0.433	5519
1991	3.240	5.860	-0.541	0.052	1	-0.593	-0.965	12299
1992	7.422	7.773	0.288	0.334	1	-0.046	-0.075	16314
1993	3.448	4.264	-0.478	-0.266	1	-0.212	-0.346	8949
1994	3.880	4.865	-0.360	-0.134	1	-0.226	-0.369	10211
1995	3.160	5.312	-0.566	-0.046	1	-0.519	-0.846	11148
1996	6.330	5.369	0.129	-0.036	1	0.165	0.268	11268
1997	12.210	7.827	0.786	0.341	1	0.445	0.724	16427
1998	8.930	6.787	0.473	0.199	1	0.274	0.447	14245
1999	7.570	4.172	0.308	-0.288	1	0.596	0.971	8756
2000	13.290	4.211	0.871	-0.279	1	1.149	1.872	8839

Partial Variance: 0.263

ma1aut
Tuned to: 1-Jan and number
For ages: 2

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
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	13.240	24.006	-1.050	-0.455	1	-0.595	-0.969	17962
1984	52.170	27.469	0.321	-0.320	1	0.641	1.045	20553
1985	3.140	14.423	-2.489	-0.965	1	-1.525	-2.484	10791
1986	60.970	15.663	0.477	-0.882	1	1.359	2.214	11719
1987	41.270	20.110	0.087	-0.632	1	0.719	1.171	15046
1988	46.360	40.287	0.203	0.063	1	0.140	0.229	30143
1989	85.630	58.004	0.817	0.427	1	0.390	0.635	43399
1990	57.560	29.495	0.419	-0.249	1	0.669	1.089	22069
1991	31.990	36.424	-0.168	-0.038	1	-0.130	-0.211	27252
1992	24.070	36.945	-0.452	-0.024	1	-0.428	-0.698	27643
1993	46.329	43.524	0.202	0.140	1	0.062	0.102	32565
1994	76.207	54.664	0.700	0.368	1	0.332	0.541	40900
1995	36.710	45.484	-0.030	0.184	1	-0.214	-0.349	34031
1996	11.841	26.101	-1.162	-0.371	1	-0.790	-1.288	19529
1997	16.250	26.233	-0.845	-0.366	1	-0.479	-0.780	19628
1998	13.610	14.104	-1.023	-0.987	1	-0.036	-0.058	10553
1999	34.560	30.077	-0.091	-0.230	1	0.139	0.226	22504
2000	29.230	37.695	-0.258	-0.004	1	-0.254	-0.414	28204

Partial Variance: 0.442

ma2aut
Tuned to: 1-Jan and number
For ages: 3

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
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	15.460	24.220	-0.832	-0.383	1	-0.449	-0.731	16288
1984	18.980	20.974	-0.627	-0.527	1	-0.100	-0.163	14106
1985	13.240	24.523	-0.987	-0.370	1	-0.616	-1.004	16492
1986	9.450	12.925	-1.324	-1.011	1	-0.313	-0.510	8692
1987	40.080	13.407	0.121	-0.974	1	1.095	1.784	9017
1988	14.600	17.523	-0.889	-0.706	1	-0.183	-0.297	11785
1989	41.280	35.639	0.150	0.004	1	0.147	0.239	23968
1990	122.250	50.610	1.236	0.354	1	0.882	1.437	34036
1991	14.200	25.957	-0.917	-0.313	1	-0.603	-0.983	17457
1992	90.360	32.743	0.934	-0.081	1	1.015	1.654	22020
1993	12.995	33.342	-1.005	-0.063	1	-0.942	-1.535	22423
1994	36.798	39.071	0.036	0.095	1	-0.060	-0.098	26276
1995	79.314	49.111	0.804	0.324	1	0.479	0.781	33028
1996	44.218	39.428	0.219	0.105	1	0.115	0.187	26516
1997	19.247	22.516	-0.613	-0.456	1	-0.157	-0.256	15142
1998	28.080	22.045	-0.235	-0.477	1	0.242	0.394	14826
1999	6.120	12.762	-1.758	-1.023	1	-0.735	-1.197	8583
2000	32.570	27.125	-0.087	-0.269	1	0.183	0.298	18242

Partial Variance: 0.354

ma3aut
Tuned to: 1-Jan and number
For ages: 4

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
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	10.220	28.163	-0.560	0.454	1	-1.014	-1.651	25131
1984	10.020	13.446	-0.579	-0.285	1	-0.294	-0.479	11998
1985	4.270	11.937	-1.432	-0.404	1	-1.028	-1.675	10652
1986	14.210	13.898	-0.230	-0.252	1	0.022	0.036	12402
1987	12.070	7.227	-0.393	-0.906	1	0.513	0.836	6449
1988	3.000	6.407	-1.785	-1.027	1	-0.759	-1.236	5717
1989	13.980	8.947	-0.246	-0.693	1	0.446	0.727	7984
1990	31.030	20.134	0.551	0.118	1	0.433	0.705	17966
1991	20.120	27.792	0.118	0.441	1	-0.323	-0.526	24800
1992	40.050	15.002	0.806	-0.176	1	0.982	1.600	13387
1993	29.794	19.106	0.510	0.066	1	0.444	0.724	17049
1994	17.588	18.513	-0.017	0.035	1	-0.051	-0.083	16520
1995	10.763	23.477	-0.508	0.272	1	-0.780	-1.271	20950
1996	24.928	27.987	0.332	0.448	1	-0.116	-0.189	24974
1997	27.555	22.891	0.432	0.247	1	0.185	0.302	20426
1998	17.910	13.079	0.001	-0.313	1	0.314	0.512	11671
1999	13.800	13.318	-0.259	-0.295	1	0.036	0.058	11884
2000	20.610	7.667	0.142	-0.847	1	0.989	1.611	6841

Partial Variance: 0.384

ma4aut
Tuned to: 1-Jan and number
For ages: 5

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
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	5.110	8.181	-0.167	0.304	1	-0.471	-0.767	17346
1984	8.300	7.495	0.318	0.216	1	0.102	0.166	15891
1985	1.830	3.599	-1.194	-0.517	1	-0.676	-1.102	7632
1986	1.560	3.543	-1.353	-0.533	1	-0.820	-1.336	7512
1987	5.300	3.814	-0.130	-0.459	1	0.329	0.536	8087
1988	0.520	1.876	-2.452	-1.169	1	-1.283	-2.090	3978
1989	1.340	1.425	-1.505	-1.444	1	-0.062	-0.101	3022
1990	2.330	2.603	-0.952	-0.841	1	-0.111	-0.180	5519
1991	3.930	5.801	-0.429	-0.040	1	-0.389	-0.634	12299
1992	11.510	7.694	0.645	0.242	1	0.403	0.656	16314
1993	11.044	4.221	0.604	-0.358	1	0.962	1.567	8949
1994	6.851	4.816	0.126	-0.226	1	0.352	0.574	10211
1995	2.906	5.258	-0.731	-0.138	1	-0.593	-0.966	11148
1996	4.214	5.314	-0.360	-0.128	1	-0.232	-0.378	11268
1997	13.965	7.747	0.839	0.249	1	0.589	0.960	16427
1998	10.290	6.718	0.533	0.107	1	0.426	0.694	14245
1999	7.100	4.130	0.162	-0.380	1	0.542	0.883	8756
2000	10.580	4.168	0.561	-0.370	1	0.931	1.517	8839

Partial Variance: 0.395

ma5aut
Tuned to: 1-Jan and number
For ages: 6

Year	Obs.	Pred.	Ln Scd. Obs.	Ln Scd. Pred.	Wt.	Wt. Res.	Std. Res.	Pred. Stk. Sze.
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	1.140	1.690	-0.025	0.369	1	-0.394	-0.641	11241
1984	1.390	1.466	0.173	0.227	1	-0.053	-0.087	9752
1985	0.770	1.135	-0.417	-0.029	1	-0.388	-0.633	7554
1986	0.140	0.612	-2.122	-0.647	1	-1.475	-2.403	4072
1987	0.390	0.693	-1.097	-0.522	1	-0.575	-0.937	4612
1988	0.230	0.685	-1.625	-0.534	1	-1.091	-1.778	4556
1989	0.450	0.272	-0.954	-1.457	1	0.502	0.818	1812
1990	0.130	0.259	-2.196	-1.506	1	-0.690	-1.124	1724
1991	0.210	0.493	-1.716	-0.863	1	-0.853	-1.390	3280
1992	1.170	1.051	0.001	-0.106	1	0.107	0.175	6991
1993	1.378	1.082	0.165	-0.077	1	0.242	0.395	7195
1994	1.710	0.614	0.381	-0.643	1	1.024	1.668	4085
1995	1.557	0.650	0.287	-0.586	1	0.873	1.422	4326
1996	0.910	0.716	-0.250	-0.490	1	0.240	0.391	4761
1997	1.390	0.984	0.173	-0.172	1	0.345	0.562	6549
1998	1.460	1.489	0.223	0.242	1	-0.019	-0.032	9903
1999	3.760	1.399	1.169	0.180	1	0.989	1.611	9304
2000	2.850	0.845	0.892	-0.325	1	1.216	1.981	5619

Partial Variance: 0.598

Partial variance (and proportion of total) by index

Index	Partial Variance	Proportion
spr_us 1	0.798	0.084
spr_us 2	0.428	0.045
spr_us 3	0.213	0.022
spr_us 4	0.146	0.015
spr_us 5	0.097	0.01
spr_us 6	0.147	0.015
spr_us 7	0.206	0.022

spr_us 8	0.55	0.058
us1aut 2	0.398	0.042
us2aut 3	0.164	0.017
us3aut 4	0.175	0.018
us4aut 5	0.108	0.011
us5aut 6	0.205	0.021
us6aut 7	0.352	0.037
us7aut 8	0.46	0.048
spr_ma 1	1.479	0.155
spr_ma 2	0.791	0.083
spr_ma 3	0.181	0.019
spr_ma 4	0.217	0.023
spr_ma 5	0.263	0.028
ma1aut 2	0.442	0.046
ma2aut 3	0.354	0.037
ma3aut 4	0.384	0.04
ma4aut 5	0.395	0.041
ma5aut 6	0.598	0.063

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

	1980	1981	1982	1983	1984	1985	1986
spr_us1	2.446	1.244	0.204	1.945	-0.755	-0.237	-2.431
spr_us2	1.341	1.280	0.513	2.792	-1.260	-0.357	0.100
spr_us3	0.817	0.817	-0.611	1.618	-1.023	-0.395	-1.076
spr_us4	0.252	0.266	0.212	0.846	-0.564	-0.444	-0.430
spr_us5	0.477	0.695	0.210	0.683	-0.328	-0.073	-0.395
spr_us6	0.186	0.649	0.876	0.383	-0.543	0.515	-0.249
spr_us7	0.557	1.063	0.724	0.967	-0.999	0.390	-0.330
spr_us8	0.043	1.709	0.758	0.945	0.435	1.817	-0.018
us1aut2	0.000	0.144	-0.771	-1.798	-0.525	-0.812	1.384
us2aut3	0.000	-0.674	-0.298	-0.905	-0.501	0.542	-0.013
us3aut4	0.000	-0.753	-0.953	-1.366	0.168	-0.059	0.575
us4aut5	0.000	0.001	-0.252	-1.308	0.191	-0.050	-0.224
us5aut6	0.000	-0.568	0.749	-1.809	-0.161	-0.136	0.417
us6aut7	0.000	-0.299	0.768	-0.147	0.034	-0.248	-0.046
us7aut8	0.000	1.187	0.380	0.052	1.641	-1.012	0.240
spr_ma1	0.000	0.000	0.697	-1.663	-0.437	3.177	3.142
spr_ma2	0.000	0.000	1.320	-0.032	0.368	0.652	3.549
spr_ma3	0.000	0.000	-0.513	0.058	0.210	0.163	1.378
spr_ma4	0.000	0.000	-0.537	-0.101	-0.050	-0.030	0.403
spr_ma5	0.000	0.000	-0.942	0.346	-0.798	0.059	-0.377
ma1aut2	0.000	0.000	0.000	-0.969	1.045	-2.484	2.214
ma2aut3	0.000	0.000	0.000	-0.731	-0.163	-1.004	-0.510
ma3aut4	0.000	0.000	0.000	-1.651	-0.479	-1.675	0.036
ma4aut5	0.000	0.000	0.000	-0.767	0.166	-1.102	-1.336
ma5aut6	0.000	0.000	0.000	-0.641	-0.087	-0.633	-2.403
Col Avg	0.765	0.451	0.127	-0.130	-0.177	-0.137	0.144

	1987	1988	1989	1990	1991	1992	1993
spr_us1	0.489	0.718	-0.437	0.000	-1.627	-0.766	1.637
spr_us2	0.423	-0.190	-0.012	-0.582	-0.568	-1.790	-0.584
spr_us3	0.891	-0.099	-0.582	0.045	0.341	-0.605	-0.621
spr_us4	0.276	0.368	0.026	-1.018	-0.197	-0.779	-0.219
spr_us5	-0.460	-0.407	0.786	-0.036	-0.474	-0.688	-0.625
spr_us6	-0.452	-0.810	1.070	0.281	-0.970	-0.488	-0.461
spr_us7	0.459	-0.697	-0.135	-0.288	0.076	-0.138	-0.518
spr_us8	0.118	-2.236	-1.524	-0.720	0.674	0.935	1.606
us1aut2	0.016	-1.053	1.087	-0.707	0.827	-1.108	-0.847
us2aut3	0.850	0.165	0.392	0.480	0.464	0.237	-0.935

us3aut4	-0.156	0.214	1.106	0.077	1.120	-0.002	-0.547
us4aut5	0.151	-0.674	0.744	0.135	0.591	-0.842	-0.217
us5aut6	-0.673	-0.027	0.850	-0.545	0.253	-0.633	-0.572
us6aut7	0.984	-0.307	-1.706	-0.261	1.345	0.691	-0.399
us7aut8	0.268	0.727	-0.931	-2.636	1.534	0.147	0.601
spr_ma1	2.403	3.207	0.544	0.135	-2.008	-0.057	0.135
spr_ma2	0.120	1.112	1.649	0.124	-0.609	-1.596	-0.983
spr_ma3	0.450	0.214	0.563	0.369	0.660	0.244	-1.004
spr_ma4	-0.663	0.844	0.819	0.016	-0.279	0.341	-0.856
spr_ma5	-1.276	-0.338	1.212	0.433	-0.965	-0.075	-0.346
ma1aut2	1.171	0.229	0.635	1.089	-0.211	-0.698	0.102
ma2aut3	1.784	-0.297	0.239	1.437	-0.983	1.654	-1.535
ma3aut4	0.836	-1.236	0.727	0.705	-0.526	1.600	0.724
ma4aut5	0.536	-2.090	-0.101	-0.180	-0.634	0.656	1.567
ma5aut6	-0.937	-1.778	0.818	-1.124	-1.390	0.175	0.395
Col Avg	0.304	-0.178	0.314	-0.115	-0.142	-0.143	-0.180

	1994	1995	1996	1997	1998	1999	2000
spr_us1	-1.978	2.679	-1.665	-0.912	-0.277	-0.062	-0.214
spr_us2	-0.089	0.736	-0.697	0.260	-1.153	-1.150	0.988
spr_us3	-0.907	0.407	-0.060	0.613	-0.160	-0.363	0.953
spr_us4	-0.729	0.062	0.357	0.238	-0.168	-0.178	1.822
spr_us5	-0.504	-0.010	0.243	0.365	-0.255	-0.169	0.966
spr_us6	-0.632	0.321	0.476	-0.536	-0.308	-0.306	0.997
spr_us7	-1.308	0.835	0.801	-1.112	-0.919	-0.042	0.613
spr_us8	-1.303	-1.457	0.103	-2.115	-0.319	0.795	-0.245
us1aut2	0.358	1.971	-0.441	-0.318	0.026	1.350	1.218
us2aut3	-0.139	1.385	0.629	-0.982	-0.504	-0.540	0.348
us3aut4	0.529	-0.202	0.012	-0.717	-0.218	0.067	1.107
us4aut5	0.508	-0.104	0.498	0.032	-0.366	0.553	0.632
us5aut6	0.835	1.089	0.334	-0.135	-0.623	0.354	1.001
us6aut7	1.307	-2.717	0.127	0.401	-0.554	0.730	0.297
us7aut8	0.026	1.442	-0.877	0.017	-1.683	-0.559	-0.564
spr_ma1	0.426	-3.692	-1.323	-0.955	-1.188	-2.760	0.214
spr_ma2	0.306	-0.074	-2.630	-1.574	-1.554	-1.176	1.029
spr_ma3	-0.743	0.201	-1.399	-0.596	-0.883	0.035	0.592
spr_ma4	-1.212	-0.997	0.529	-0.120	-0.557	0.548	1.902
spr_ma5	-0.369	-0.846	0.268	0.724	0.447	0.971	1.872
ma1aut2	0.541	-0.349	-1.288	-0.780	-0.058	0.226	-0.414
ma2aut3	-0.098	0.781	0.187	-0.256	0.394	-1.197	0.298
ma3aut4	-0.083	-1.271	-0.189	0.302	0.512	0.058	1.611
ma4aut5	0.574	-0.966	-0.378	0.960	0.694	0.883	1.517
ma5aut6	1.668	1.422	0.391	0.562	-0.032	1.611	1.981
Col Avg	-0.121	0.026	-0.240	-0.265	-0.388	-0.013	0.821

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

	1980	1981	1982	1983	1984	1985	1986
spr_us1	1.304	0.337	0.009	0.825	0.124	0.012	1.288
spr_us2	0.392	0.357	0.057	1.698	0.346	0.028	0.002
spr_us3	0.145	0.145	0.081	0.570	0.228	0.034	0.252
spr_us4	0.014	0.015	0.010	0.156	0.069	0.043	0.040
spr_us5	0.050	0.105	0.010	0.102	0.023	0.001	0.034
spr_us6	0.008	0.092	0.167	0.032	0.064	0.058	0.014
spr_us7	0.068	0.246	0.114	0.204	0.217	0.033	0.024
spr_us8	0.000	0.636	0.125	0.195	0.041	0.719	0.000
us1aut2	0.000	0.004	0.129	0.704	0.060	0.144	0.417
us2aut3	0.000	0.099	0.019	0.179	0.055	0.064	0.000
us3aut4	0.000	0.123	0.198	0.407	0.006	0.001	0.072

us4aut5	0.000	0.000	0.014	0.373	0.008	0.001	0.011
us5aut6	0.000	0.070	0.122	0.713	0.006	0.004	0.038
us6aut7	0.000	0.020	0.128	0.005	0.000	0.013	0.000
us7aut8	0.000	0.307	0.031	0.001	0.587	0.223	0.013
spr_ma1	0.000	0.000	0.106	0.602	0.042	2.199	2.151
spr_ma2	0.000	0.000	0.379	0.000	0.029	0.093	2.743
spr_ma3	0.000	0.000	0.057	0.001	0.010	0.006	0.414
spr_ma4	0.000	0.000	0.063	0.002	0.001	0.000	0.035
spr_ma5	0.000	0.000	0.193	0.026	0.139	0.001	0.031
ma1aut2	0.000	0.000	0.000	0.205	0.238	1.344	1.068
ma2aut3	0.000	0.000	0.000	0.117	0.006	0.220	0.057
ma3aut4	0.000	0.000	0.000	0.594	0.050	0.611	0.000
ma4aut5	0.000	0.000	0.000	0.128	0.006	0.265	0.389
ma5aut6	0.000	0.000	0.000	0.090	0.002	0.087	1.258
++	1.980	2.558	2.015	7.926	2.357	6.202	10.352

	1987	1988	1989	1990	1991	1992	1993
spr_us1	0.052	0.112	0.042	0.000	0.577	0.128	0.584
spr_us2	0.039	0.008	0.000	0.074	0.070	0.698	0.074
spr_us3	0.173	0.002	0.074	0.000	0.025	0.080	0.084
spr_us4	0.017	0.030	0.000	0.226	0.008	0.132	0.010
spr_us5	0.046	0.036	0.135	0.000	0.049	0.103	0.085
spr_us6	0.045	0.143	0.250	0.017	0.205	0.052	0.046
spr_us7	0.046	0.106	0.004	0.018	0.001	0.004	0.059
spr_us8	0.003	1.089	0.506	0.113	0.099	0.190	0.562
us1aut2	0.000	0.242	0.258	0.109	0.149	0.268	0.156
us2aut3	0.158	0.006	0.034	0.050	0.047	0.012	0.191
us3aut4	0.005	0.010	0.266	0.001	0.273	0.000	0.065
us4aut5	0.005	0.099	0.121	0.004	0.076	0.155	0.010
us5aut6	0.099	0.000	0.157	0.065	0.014	0.087	0.071
us6aut7	0.211	0.020	0.634	0.015	0.394	0.104	0.035
us7aut8	0.016	0.115	0.189	1.514	0.513	0.005	0.079
spr_ma1	1.258	2.241	0.065	0.004	0.878	0.001	0.004
spr_ma2	0.003	0.270	0.593	0.003	0.081	0.555	0.210
spr_ma3	0.044	0.010	0.069	0.030	0.095	0.013	0.220
spr_ma4	0.096	0.155	0.146	0.000	0.017	0.025	0.160
spr_ma5	0.355	0.025	0.320	0.041	0.203	0.001	0.026
ma1aut2	0.299	0.011	0.088	0.258	0.010	0.106	0.002
ma2aut3	0.693	0.019	0.012	0.450	0.210	0.596	0.513
ma3aut4	0.152	0.333	0.115	0.108	0.060	0.558	0.114
ma4aut5	0.063	0.952	0.002	0.007	0.088	0.094	0.535
ma5aut6	0.191	0.688	0.146	0.275	0.421	0.007	0.034
++	4.068	6.723	4.223	3.383	4.564	3.973	3.929

	1994	1995	1996	1997	1998	1999	2000	++
spr_us1	0.852	1.563	0.604	0.181	0.017	0.001	0.010	8.622
spr_us2	0.002	0.118	0.106	0.015	0.289	0.288	0.213	4.875
spr_us3	0.179	0.036	0.001	0.082	0.006	0.029	0.198	2.426
spr_us4	0.116	0.001	0.028	0.012	0.006	0.007	0.723	1.664
spr_us5	0.055	0.000	0.013	0.029	0.014	0.006	0.203	1.100
spr_us6	0.087	0.022	0.049	0.063	0.021	0.020	0.217	1.670
spr_us7	0.373	0.152	0.140	0.270	0.184	0.000	0.082	2.344
spr_us8	0.370	0.463	0.002	0.974	0.022	0.138	0.013	6.261
us1aut2	0.028	0.846	0.042	0.022	0.000	0.397	0.323	4.299

us2aut3	0.004	0.418	0.086	0.210	0.055	0.064	0.026	1.776
us3aut4	0.061	0.009	0.000	0.112	0.010	0.001	0.267	1.888
us4aut5	0.056	0.002	0.054	0.000	0.029	0.067	0.087	1.171
us5aut6	0.152	0.259	0.024	0.004	0.085	0.027	0.219	2.216
us6aut7	0.372	1.609	0.003	0.035	0.067	0.116	0.019	3.801
us7aut8	0.000	0.453	0.167	0.000	0.617	0.068	0.069	4.967
spr_ma1	0.040	2.970	0.381	0.199	0.308	1.659	0.010	15.116
spr_ma2	0.020	0.001	1.507	0.539	0.526	0.301	0.231	8.087
spr_ma3	0.120	0.009	0.427	0.077	0.170	0.000	0.076	1.848
spr_ma4	0.320	0.217	0.061	0.003	0.068	0.065	0.788	2.223
spr_ma5	0.030	0.156	0.016	0.114	0.044	0.205	0.764	2.689
ma1aut2	0.064	0.027	0.361	0.133	0.001	0.011	0.037	4.263
ma2aut3	0.002	0.133	0.008	0.014	0.034	0.312	0.019	3.415
ma3aut4	0.002	0.352	0.008	0.020	0.057	0.001	0.565	3.700
ma4aut5	0.072	0.203	0.031	0.201	0.105	0.170	0.502	3.811
ma5aut6	0.606	0.441	0.033	0.069	0.000	0.565	0.855	5.770
++	3.983	10.459	4.153	3.378	2.735	4.520	6.518	

STOCK NUMBERS (Jan 1) in thousands - D:\AP\assess_2000\vpa\ap_2000_w1_corr.9

	1980	1981	1982	1983	1984	1985	1986
1	52643	25119	21949	25120	13184	14385	18443
2	42217	43096	20561	17962	20553	10791	11719
3	35915	34475	34395	16288	14106	16492	8692
4	24231	28434	26242	25131	11998	10652	12402
5	21550	17421	18706	17346	15891	7632	7512
6	17203	14080	9434	11241	9752	7554	4072
7	11092	10526	8227	4467	5663	5049	3586
8	5101	5795	6446	3752	1603	2884	2118
9	14407	6202	8496	6026	3695	2342	1531
1+	224359	185147	154455	127333	96445	77782	70075

	1987	1988	1989	1990	1991	1992	1993
1	36859	53355	27101	33361	33777	39816	50074
2	15046	30143	43399	22069	27252	27643	32565
3	9017	11785	23968	34036	17457	22020	22423
4	6449	5717	7984	17966	24800	13387	17049
5	8087	3978	3022	5519	12299	16314	8949
6	4612	4556	1812	1724	3280	6991	7195
7	1999	2567	2424	998	931	1669	3259
8	1753	826	1601	1303	554	472	625
9	989	974	1386	1668	1347	806	1313
1+	84810	113900	112695	118645	121698	129116	143451

	1994	1995	1996	1997	1998	1999	2000
1	41884	24426	24189	13064	27527	34453	14187
2	40900	34031	19529	19628	10553	22504	28204
3	26276	33028	26516	15142	14826	8583	18242
4	16520	20950	24974	20426	11671	11884	6841
5	10211	11148	11268	16427	14245	8756	8839
6	4085	4326	4761	6549	9903	9304	5619

7	3051	1804	1731	2567	3823	5867	5742
8	1398	1332	885	920	1452	2185	3652
9	1563	710	787	1331	1226	1224	2138
1+	145888	131754	114639	96054	95225	104761	93463

FISHING MORTALITY - D:\AP\assess_2000\vpa\ap_2000_w1_corr.9

	1980	1981	1982	1983	1984	1985	1986
1	0.00	0.00	0.00	0.00	0.00	0.01	0.00
2	0.00	0.03	0.03	0.04	0.02	0.02	0.06
3	0.03	0.07	0.11	0.11	0.08	0.09	0.10
4	0.13	0.22	0.21	0.26	0.25	0.15	0.23
5	0.23	0.41	0.31	0.38	0.54	0.43	0.29
6	0.29	0.34	0.55	0.49	0.46	0.55	0.51
7	0.45	0.29	0.59	0.82	0.47	0.67	0.52
8	0.30	0.36	0.43	0.47	0.51	0.53	0.40
9	0.30	0.36	0.43	0.47	0.51	0.53	0.40

	1987	1988	1989	1990	1991	1992	1993
1	0.00	0.01	0.01	0.00	0.00	0.00	0.00
2	0.04	0.03	0.04	0.03	0.01	0.01	0.01
3	0.26	0.19	0.09	0.12	0.07	0.06	0.11
4	0.28	0.44	0.17	0.18	0.22	0.20	0.31
5	0.37	0.59	0.36	0.32	0.36	0.62	0.58
6	0.39	0.43	0.40	0.42	0.48	0.56	0.66
7	0.68	0.27	0.42	0.39	0.48	0.78	0.65
8	0.42	0.45	0.39	0.35	0.40	0.62	0.63
9	0.42	0.45	0.39	0.35	0.40	0.62	0.63

	1994	1995	1996	1997	1998	1999
1	0.01	0.02	0.01	0.01	0.00	0.00
2	0.01	0.05	0.05	0.08	0.01	0.01
3	0.03	0.08	0.06	0.06	0.02	0.03
4	0.19	0.42	0.22	0.16	0.09	0.10
5	0.66	0.65	0.34	0.31	0.23	0.24
6	0.62	0.72	0.42	0.34	0.32	0.28
7	0.63	0.51	0.43	0.37	0.36	0.27
8	0.65	0.66	0.37	0.32	0.28	0.27
9	0.65	0.66	0.37	0.32	0.28	0.27

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

	1980	1981	1982	1983	1984	1985	1986
2,8	0.20	0.25	0.32	0.37	0.33	0.35	0.30
3,8	0.24	0.28	0.37	0.42	0.39	0.40	0.34
4,8	0.28	0.32	0.42	0.48	0.45	0.47	0.39
5,8	0.32	0.35	0.47	0.54	0.50	0.54	0.43
6,8	0.35	0.33	0.52	0.59	0.48	0.58	0.48

	1987	1988	1989	1990	1991	1992	1993
2,8	0.35	0.34	0.27	0.26	0.29	0.41	0.42
3,8	0.40	0.39	0.30	0.30	0.33	0.47	0.49
4,8	0.43	0.44	0.35	0.33	0.39	0.56	0.57
5,8	0.47	0.43	0.39	0.37	0.43	0.65	0.63
6,8	0.50	0.38	0.40	0.39	0.45	0.66	0.65

	1994	1995	1996	1997	1998	1999
2,8	0.40	0.44	0.27	0.23	0.19	0.17
3,8	0.46	0.51	0.31	0.26	0.22	0.20
4,8	0.55	0.59	0.36	0.30	0.26	0.23
5,8	0.64	0.64	0.39	0.33	0.30	0.27
6,8	0.63	0.63	0.41	0.34	0.32	0.27

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

	1980	1981	1982	1983	1984	1985	1986
2,8	0.13	0.18	0.23	0.27	0.27	0.25	0.23
3,8	0.18	0.23	0.27	0.33	0.35	0.30	0.28
4,8	0.25	0.31	0.35	0.39	0.44	0.41	0.33
5,8	0.30	0.36	0.43	0.47	0.50	0.53	0.40
6,8	0.34	0.33	0.53	0.56	0.47	0.58	0.49

	1987	1988	1989	1990	1991	1992	1993
2,8	0.25	0.18	0.10	0.13	0.16	0.22	0.22
3,8	0.35	0.34	0.17	0.17	0.22	0.32	0.34
4,8	0.38	0.45	0.29	0.24	0.29	0.47	0.48
5,8	0.42	0.45	0.39	0.35	0.39	0.61	0.62
6,8	0.46	0.38	0.41	0.39	0.47	0.61	0.65

	1994	1995	1996	1997	1998	1999
2,8	0.16	0.24	0.17	0.17	0.14	0.12
3,8	0.26	0.32	0.20	0.20	0.17	0.18
4,8	0.43	0.53	0.28	0.25	0.22	0.21
5,8	0.64	0.65	0.37	0.32	0.28	0.27
6,8	0.63	0.66	0.42	0.35	0.33	0.28

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

	1980	1981	1982	1983	1984	1985	1986
2,8	0.27	0.28	0.34	0.39	0.43	0.44	0.32
3,8	0.27	0.30	0.35	0.41	0.44	0.45	0.34
4,8	0.28	0.32	0.40	0.43	0.46	0.49	0.36
5,8	0.32	0.36	0.46	0.50	0.51	0.54	0.42
6,8	0.36	0.33	0.53	0.59	0.47	0.59	0.49

	1987	1988	1989	1990	1991	1992	1993
2,8	0.35	0.36	0.20	0.19	0.28	0.50	0.45
3,8	0.37	0.40	0.25	0.21	0.29	0.51	0.46
4,8	0.40	0.46	0.32	0.26	0.31	0.54	0.52
5,8	0.44	0.47	0.39	0.35	0.40	0.62	0.62
6,8	0.49	0.39	0.41	0.39	0.47	0.61	0.65

	1994	1995	1996	1997	1998	1999
2,8	0.48	0.45	0.26	0.24	0.25	0.23
3,8	0.51	0.49	0.27	0.26	0.25	0.23
4,8	0.53	0.55	0.30	0.27	0.26	0.24
5,8	0.65	0.66	0.37	0.32	0.29	0.27
6,8	0.63	0.67	0.42	0.35	0.33	0.28

Biomass Weighted F

1985	1986					
0.25	0.27	0.34	0.39	0.42	0.45	0.34

1987	1988	1989	1990	1991	1992	1993
0.37	0.33	0.24	0.21	0.27	0.38	0.37

1994	1995	1996	1997	1998	1999
0.35	0.39	0.26	0.25	0.22	0.21

BACKCALCULATED PARTIAL RECRUITMENT

	1980	1981	1982	1983	1984	1985	1986
1	0.00	0.00	0.00	0.00	0.00	0.01	0.01
2	0.01	0.06	0.06	0.05	0.04	0.02	0.12
3	0.07	0.18	0.19	0.13	0.15	0.13	0.19
4	0.29	0.53	0.37	0.31	0.46	0.22	0.44
5	0.50	1.00	0.53	0.46	1.00	0.64	0.56
6	0.65	0.82	0.94	0.59	0.84	0.82	0.99
7	1.00	0.70	1.00	1.00	0.87	1.00	1.00
8	0.66	0.87	0.73	0.57	0.94	0.80	0.77
9	0.66	0.87	0.73	0.57	0.94	0.80	0.77

	1987	1988	1989	1990	1991	1992	1993
1	0.00	0.01	0.01	0.01	0.00	0.00	0.00
2	0.06	0.05	0.10	0.08	0.03	0.01	0.02
3	0.37	0.32	0.21	0.28	0.14	0.07	0.16
4	0.41	0.75	0.40	0.43	0.46	0.26	0.47
5	0.55	1.00	0.86	0.77	0.76	0.79	0.89
6	0.57	0.74	0.94	1.00	0.99	0.72	1.00
7	1.00	0.46	1.00	0.93	1.00	1.00	0.98
8	0.61	0.76	0.93	0.84	0.83	0.80	0.96
9	0.61	0.76	0.93	0.84	0.83	0.80	0.96

	1994	1995	1996	1997	1998	1999
1	0.01	0.03	0.02	0.04	0.00	0.00
2	0.02	0.07	0.13	0.22	0.02	0.04
3	0.04	0.11	0.14	0.16	0.06	0.09
4	0.29	0.59	0.51	0.43	0.24	0.34
5	1.00	0.91	0.79	0.83	0.63	0.86
6	0.94	1.00	0.97	0.91	0.90	1.00
7	0.95	0.72	1.00	1.00	1.00	0.97
8	0.99	0.93	0.87	0.87	0.78	0.94
9	0.99	0.93	0.87	0.87	0.78	0.94

MEAN BIOMASS (using catch mean weights at age)

	1980	1981	1982	1983	1984	1985	1986
1	1431	728	358	296	48	234	267
2	2904	4167	2109	527	830	563	433
3	4933	5069	6790	2596	1980	1205	1037
4	5511	7341	6232	7620	2924	1879	2311
5	7178	5756	6127	6989	5874	1876	2283

6	8876	8474	3747	5451	4501	2844	1710
7	6764	7363	5472	2300	3657	2858	2156
8	4177	4342	5442	2850	1363	2384	1870
9	17293	6247	9323	6497	4383	2684	1960
1+	59067	49487	45600	35126	25560	16526	14028

	1987	1988	1989	1990	1991	1992	1993
1	434	771	294	634	459	1010	725
2	614	1239	1580	1141	1301	1621	2286
3	949	1552	2811	4026	1840	3089	4096
4	1197	1201	1836	3963	6686	3471	4055
5	2517	1237	1032	1958	4679	5403	2692
6	2126	2166	773	823	1693	3506	2850
7	1184	1800	1329	622	649	1008	2058
8	1533	749	1035	970	485	387	524
9	1245	1168	1606	1733	1501	888	1468
1+	11798	11883	12295	15869	19292	20382	20754

	1994	1995	1996	1997	1998	1999
1	530	263	306	165	324	250
2	1031	813	655	359	286	365
3	4561	5849	2567	1480	2195	1521
4	4480	5027	6896	5420	2850	3333
5	2864	3401	4122	5182	4304	2949
6	1574	1830	2262	3064	3994	3949
7	1583	1173	1158	1460	2357	3280
8	1018	1041	789	682	1189	1535
9	1898	665	992	1622	2418	1371
1+	19539	20061	19747	19433	19917	18551	00

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

	1980	1981	1982	1983	1984	1985	1986
2,8	40343	42511	35919	28333	21129	13608	11800
3,8	37438	38344	33810	27807	20299	13046	11367
4,8	32506	33276	27020	25210	18319	11840	10330
5,8	26995	25934	20788	17590	15395	9961	8019
6,8	19817	20179	14661	10601	9521	8085	5737

	1987	1988	1989	1990	1991	1992	1993
2,8	10119	9943	10395	13502	17333	18484	18561
3,8	9505	8704	8815	12361	16032	16863	16275
4,8	8556	7152	6004	8335	14192	13774	12179
5,8	7359	5951	4168	4372	7506	10303	8124
6,8	4843	4715	3136	2414	2826	4900	5432

	1994	1995	1996	1997	1998	1999
2,8	17111	19133	18449	17646	17174	16931
3,8	16080	18320	17794	17286	16888	16566
4,8	11519	12471	15227	15807	14694	15045

5,8	7039	7444	8331	10387	11843	11712
6,8	4174	4044	4209	5205	7540	8763

Catch BIOMASS (using catch mean weights)

	1980	1981	1982	1983	1984	1985	1986
1	00	00	00	00	00	01	01
2	08	106	70	22	17	09	27
3	166	369	773	274	160	103	102
4	716	1606	1333	1969	738	280	526
5	1620	2379	1895	2627	3194	803	657
6	2585	2859	2052	2647	2063	1550	875
7	3039	2139	3201	1897	1736	1911	1112
8	1239	1559	2340	1338	696	1275	747
9	5131	2243	4008	3050	2237	1435	783
1+	14503	13261	15672	13824	10840	7368	4830

	1987	1988	1989	1990	1991	1992	1993
1	01	05	02	01	00	01	02
2	27	36	68	39	17	15	33
3	243	294	248	469	121	173	432
4	339	525	311	709	1463	704	1268
5	941	725	373	627	1708	3342	1573
6	821	934	306	342	805	1975	1875
7	809	490	559	242	311	788	1330
8	642	335	407	340	192	241	331
9	522	523	632	608	595	553	927
1+	4343	3868	2904	3379	5211	7791	7771

	1994	1995	1996	1997	1998	1999
1	04	06	03	02	01	00
2	14	40	36	29	02	04
3	121	465	156	89	47	41
4	866	2112	1510	869	249	320
5	1887	2213	1412	1586	973	718
6	972	1310	945	1037	1292	1116
7	995	601	500	540	847	899
8	667	690	295	220	332	410
9	1243	441	371	524	675	366
1+	6769	7878	5228	4897	4416	3873

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

	1980	1981	1982	1983	1984	1985	1986
2,8	9372	11017	11663	10774	8603	5931	4046
3,8	9364	10911	11594	10752	8586	5922	4019
4,8	9199	10542	10821	10478	8426	5820	3917
5,8	8483	8936	9488	8509	7688	5539	3391
6,8	6863	6557	7593	5882	4494	4736	2734

	1987	1988	1989	1990	1991	1992	1993
2,8	3821	3340	2271	2770	4617	7237	6842
3,8	3794	3303	2203	2730	4599	7222	6808
4,8	3552	3009	1955	2261	4479	7049	6376
5,8	3213	2484	1644	1552	3016	6346	5109
6,8	2272	1759	1272	924	1308	3003	3536

	1994	1995	1996	1997	1998	1999
2,8	5522	7431	4854	4370	3740	3508
3,8	5508	7391	4819	4341	3738	3504
4,8	5387	6926	4662	4252	3692	3463
5,8	4521	4814	3152	3383	3443	3143
6,8	2633	2600	1740	1797	2470	2425

Jan 1 BIOMASS (using Jan 1 mean weights)

	1980	1981	1982	1983	1984	1985	1986
1	842	427	285	176	13	173	166
2	2153	2456	1254	431	493	162	316
3	3879	3896	5434	2378	1030	1006	774
4	5040	6284	5800	7414	2844	1949	1724
5	6401	5993	6790	6800	7072	2419	2126
6	9651	7941	4708	5946	5637	3996	1796
7	8464	8000	7108	3042	4366	3686	2406
8	4734	5216	6471	3752	1584	2936	2111
9	21942	8156	12565	8912	6122	3789	2606
1+	63105	48368	50416	38851	29160	20116	14025

	1987	1988	1989	1990	1991	1992	1993
1	258	534	136	434	236	677	601
2	406	723	1128	574	899	857	1531
3	667	1014	1894	2553	1449	2026	2624
4	1161	1103	1669	3396	5282	2597	3751
5	2475	1289	1076	1954	4465	6526	3311
6	2232	2333	913	921	1863	4180	3849
7	1447	1879	1665	682	729	1369	2669
8	1743	866	1390	1100	542	507	677
9	1670	1587	2130	2255	1992	1303	2162
1+	12058	11327	11999	13866	17458	20041	21174

	1994	1995	1996	1997	1998	1999
1	419	171	266	131	303	138
2	859	647	410	334	211	338
3	3232	2477	1432	984	875	661
4	4361	5237	6543	3799	2066	2745
5	3635	4292	4406	6061	4872	2995
6	2022	2249	2557	3510	4516	4150
7	2047	1291	1321	1768	2668	3538
8	1408	1256	913	852	1273	1838
9	2824	993	1304	2083	3044	1715
1+	20807	18614	19151	19524	19827	18117

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

	1980	1981	1982	1983	1984	1985	1986
2,8	40321	39785	37565	29763	23025	16154	11253
3,8	38167	37329	36311	29332	22532	15993	10937
4,8	34289	33433	30877	26954	21502	14986	10163
5,8	29249	27149	25077	19541	18658	13037	8439
6,8	22848	21157	18287	12741	11587	10618	6313

	1987	1988	1989	1990	1991	1992	1993
2,8	10131	9207	9734	11178	15229	18061	18411
3,8	9724	8483	8606	10604	14330	17204	16880
4,8	9057	7470	6712	8052	12881	15179	14257
5,8	7896	6366	5044	4656	7598	12582	10506
6,8	5422	5078	3968	2702	3134	6056	7195

	1994	1995	1996	1997	1998	1999
2,8	17565	17450	17581	17310	16480	16264
3,8	16706	16804	17171	16976	16269	15926
4,8	13474	14326	15739	15992	15395	15265
5,8	9112	9089	9196	12192	13329	12520
6,8	5477	4797	4790	6131	8457	9525

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

	1980	1981	1982	1983	1984	1985	1986
1	24	12	08	05	00	05	11
2	164	186	95	32	37	12	71
3	878	873	1206	529	230	225	395
4	2413	2943	2719	3438	1321	929	1286
5	4546	4061	4723	4652	4639	1633	1788
6	7938	6457	3632	4659	4447	3085	1488
7	7052	6935	5724	2308	3615	2907	2012
8	4181	4535	5528	3174	1326	2444	1818
9	19380	7092	10734	7538	5126	3153	2243
1+	46575	33095	34370	26335	20741	14393	11111

	1987	1988	1989	1990	1991	1992	1993
1	17	00	00	00	00	00	00
2	92	14	21	11	17	16	15
3	327	156	300	401	230	323	292
4	854	612	989	2008	3092	1526	1980
5	2037	995	879	1612	3644	4999	2558
6	1909	1972	779	781	1558	3420	3075
7	1160	1670	1426	589	615	1071	2160
8	1493	737	1198	958	467	413	550
9	1430	1350	1836	1964	1716	1061	1756
1+	9319	7505	7427	8324	11340	12828	12385

	1994	1995	1996	1997	1998	1999
1	00	00	00	00	00	00
2	08	06	04	03	06	10
3	366	277	161	111	141	106

4	2372	2691	3536	2083	1154	1530
5	2757	3261	3616	5021	4029	2466
6	1632	1771	2169	3037	3922	3641
7	1664	1081	1128	1534	2320	3143
8	1137	1013	791	748	1129	1635
9	2281	800	1129	1828	2700	1526
1+	12217	10900	12533	14364	15401	14056

APPENDIX 4

Precision Estimates of 1999 Fishing Mortality and Spawning Stock Biomass for Gulf of Maine-Georges Bank American Plaice.

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	14187	15462	7301	0.51
N 2	28204	29183	7110	0.25
N 3	18242	18564	3667	0.20
N 4	6841	6907	1109	0.16
N 5	8839	8938	1407	0.16
N 6	5619	5670	991	0.18
N 7	5742	5896	1153	0.20
N 8	3652	3735	871	0.24

	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	1276	231	8.99	12911	0.565462	8681	25076
N 2	979	225	3.47	27225	0.261166	20779	38165
N 3	323	116	1.77	17919	0.204634	14568	23697
N 4	66	35	0.96	6776	0.163658	5470	8202
N 5	99	44	1.12	8739	0.160964	7118	10769
N 6	51	31	0.90	5568	0.177984	4532	7057
N 7	154	36	2.68	5588	0.206398	4387	7218
N 8	83	28	2.27	3569	0.243979	2664	4848

Appendix 4: Table 2.

Bootstrap Output Variable: Q_unscaled

	NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
q spr_us1	0.0000024	0.0000024	0.0000003	0.13
q spr_us2	0.0000369	0.0000372	0.0000048	0.13
q spr_us3	0.0000757	0.0000759	0.0000094	0.12
q spr_us4	0.0001060	0.0001068	0.0000135	0.13
q spr_us5	0.0001001	0.0001019	0.0000131	0.13
q spr_us6	0.0000830	0.0000835	0.0000105	0.13
q spr_us7	0.0000717	0.0000723	0.0000093	0.13
q spr_us8	0.0000477	0.0000481	0.0000063	0.13
q us1aut2	0.0000336	0.0000337	0.0000046	0.14
q us2aut3	0.0000974	0.0000975	0.0000125	0.13
q us3aut4	0.0001519	0.0001530	0.0000200	0.13
q us4aut5	0.0001635	0.0001649	0.0000219	0.13
q us5aut6	0.0001540	0.0001544	0.0000205	0.13
q us6aut7	0.0001176	0.0001185	0.0000159	0.14
q us7aut8	0.0000774	0.0000785	0.0000102	0.13
q spr_ma1	0.0002132	0.0002162	0.0000300	0.14
q spr_ma2	0.0010655	0.0010700	0.0001441	0.14
q spr_ma3	0.0013284	0.0013492	0.0001827	0.14
q spr_ma4	0.0009084	0.0009159	0.0001199	0.13
q spr_ma5	0.0004765	0.0004787	0.0000638	0.13
q ma1aut2	0.0013365	0.0013413	0.0001867	0.14
q ma2aut3	0.0014869	0.0015039	0.0002089	0.14
q ma3aut4	0.0011206	0.0011320	0.0001518	0.14
q ma4aut5	0.0004716	0.0004767	0.0000651	0.14
q ma5aut6	0.0001503	0.0001515	0.0000207	0.14

	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_us1	0.00000004	0.000000010	1.456	0.000002377	0.14	0.0000021	0.0000029
q spr_us2	0.00000025	0.000000151	0.674	0.000036668	0.13	0.0000315	0.0000437
q spr_us3	0.00000020	0.000000297	0.266	0.000075527	0.12	0.0000642	0.0000890
q spr_us4	0.00000073	0.000000426	0.691	0.000105301	0.13	0.0000915	0.0001266
q spr_us5	0.00000183	0.000000413	1.832	0.000098233	0.13	0.0000833	0.0001163
q spr_us6	0.00000056	0.000000333	0.678	0.000082415	0.13	0.0000717	0.0000995
q spr_us7	0.00000053	0.000000295	0.744	0.000071185	0.13	0.0000609	0.0000848
q spr_us8	0.00000034	0.000000199	0.720	0.000047401	0.13	0.0000407	0.0000565
q us1aut2	0.00000017	0.000000144	0.510	0.000033398	0.14	0.0000285	0.0000406
q us2aut3	0.00000011	0.000000396	0.113	0.000097288	0.13	0.0000838	0.0001161
q us3aut4	0.00000111	0.000000633	0.730	0.000150747	0.13	0.0001280	0.0001795
q us4aut5	0.00000149	0.000000691	0.910	0.000161965	0.13	0.0001388	0.0001928
q us5aut6	0.00000038	0.000000649	0.245	0.000153602	0.13	0.0001317	0.0001859
q us6aut7	0.00000094	0.000000504	0.800	0.000116648	0.14	0.0000986	0.0001393
q us7aut8	0.00000103	0.000000323	1.328	0.000076397	0.13	0.0000647	0.0000907
q spr_ma1	0.00000300	0.000000950	1.408	0.000210213	0.14	0.0001759	0.0002521
q spr_ma2	0.00000455	0.000004556	0.427	0.001060912	0.14	0.0009010	0.0012777
q spr_ma3	0.00002088	0.000005777	1.572	0.001307471	0.14	0.0011051	0.0015570
q spr_ma4	0.00000753	0.000003792	0.829	0.000900876	0.13	0.0007550	0.0010637
q spr_ma5	0.00000224	0.000002016	0.471	0.000474215	0.13	0.0004079	0.0005745
q ma1aut2	0.00000476	0.000005904	0.356	0.001331777	0.14	0.0011312	0.0016145
q ma2aut3	0.00001695	0.000006605	1.140	0.001469987	0.14	0.0012349	0.0017570
q ma3aut4	0.00001134	0.000004799	1.012	0.001109313	0.14	0.0009478	0.0013322
q ma4aut5	0.00000510	0.000002057	1.082	0.000466517	0.14	0.0003942	0.0005603
q ma5aut6	0.00000122	0.000000655	0.813	0.000149096	0.14	0.0001253	0.0001779

Appendix 4 Table 3.

Bootstrap Output Variable: F t

	NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
Age 1	0.0001	0.0001	0.0000	0.25
Age 2	0.0100	0.0102	0.0020	0.20
Age 3	0.0268	0.0272	0.0044	0.16
Age 4	0.0961	0.0972	0.0147	0.15
Age 5	0.2436	0.2476	0.0388	0.16
Age 6	0.2827	0.2844	0.0494	0.17
Age 7	0.2741	0.2802	0.0580	0.21
Age 8	0.2668	0.2707	0.0297	0.11
Age 9	0.2668	0.2707	0.0297	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
Age 1	0.0000031	0.0000010	2.428	0.0001252	0.26	0.0001	0.0002
Age 2	0.0001992	0.0000625	1.998	0.0097705	0.20	0.0077	0.0125
Age 3	0.0004249	0.0001386	1.588	0.0263271	0.17	0.0224	0.0333
Age 4	0.0011460	0.0004664	1.193	0.0949265	0.16	0.0794	0.1177
Age 5	0.0039507	0.0012261	1.622	0.2396576	0.16	0.1982	0.2939
Age 6	0.0017569	0.0015611	0.622	0.2809156	0.18	0.2308	0.3552
Age 7	0.0060714	0.0018340	2.215	0.2680762	0.22	0.2122	0.3588
Age 8	0.0039263	0.0009387	1.472	0.2628831	0.11	0.2295	0.3035
Age 9	0.0039263	0.0009387	1.472	0.2628831	0.11	0.2295	0.3035

Appendix 4 Table 4 Bootstrap Output Variable: F full t

NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
0.2668	0.2707	0.0297	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
0.00393	0.00094	1.47	0.26288	0.11	0.2295	0.3035

Appendix 4 Table 5.

Bootstrap Output Variable: SSB spawn t

NLLS ESTIMATE	BOOTSTRAP MEAN	BOOTSTRAP StdError	C.V. FOR NLLS SOLN
14056.4503	14219.7851	1336.1300	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
163.33	42.25	1.16	13893.12	0.10	12350.6829	15743.3104