A. SUMMER FLOUNDER

TERMS OF REFERENCE

The following terms of reference were addressed for summer flounder:

1. Characterize the commercial and recreational catch including landings and discards.

2. Estimate fishing mortality, spawning stock biomass, and total stock biomass for the current year and characterize the uncertainty of those estimates.

3. Evaluate and either update or re-estimate biological reference points as appropriate.

4. Where appropriate, estimate a TAC and/or TAL based on stock status and target mortality rate for the year following the terminal assessment year.

5. If stock projections are possible,

    a. provide short term projections (2-3 years) of stock status under various TAC/F strategies and

    b. evaluate current and projected stock status against existing rebuilding or recovery schedules, as appropriate.

INTRODUCTION

For assessment purposes, the previous definition of Wilk *et al.* (1980) of a unit stock extending from Cape Hatteras north to New England has been accepted. The joint Mid-Atlantic Fishery Management Council (MAFMC) Atlantic States Marine Fisheries Commission (ASMFC) Fishery Management Plan (FMP) for summer flounder has as a management unit all summer flounder from the southern border of North Carolina, northeast to the U.S.-Canadian border. A recent summer flounder genetics study (Jones and Quattro, 1999) revealed no significant population subdivision centered around Cape Hatteras.

Amendment 1 to the FMP in 1990 established the overfishing definition for summer flounder as fishing mortality rate equal to F_{max}, initially estimated as 0.23 (NEFC 1990). Amendment 2 in 1992 set target fishing mortality rates for summer flounder for 1993-1995 (F = 0.53) and 1996 and beyond ($F_{max} = 0.23$). Major regulations enacted under Amendment 2 to meet those fishing mortality rate targets included: 1) an annual fishery landings quota, with 60% allocated to the commercial fishery and 40% to the recreational fishery, based on the historical (1980-1989) division of landings, with the commercial allocation further distributed among the states based on their share of

commercial landings during 1980-1989, 2) commercial minimum landed fish size limit at 13 in (33 cm), as established in the original FMP, 3) a minimum mesh size of 5.5 in (140 mm) diamond or 6.0 in (152 mm) square for commercial vessels using otter trawls that possess 100 lb (45 kg) or more of summer flounder, with exemptions for the flynet fishery and vessels fishing in an exempted area off southern New England (the Northeast Exemption Area) during 1 November to 30 April, 4) permit requirements for the sale and purchase of summer flounder, and 5) annually adjustable regulations for the recreational fishery, including seasons, a 14 in (36 cm) minimum landed fish size, and possession limits.

Amendment 3 to the FMP revised the western boundary of the Northeast Exemption Area to $72^0 30'$W (west of Hudson Canyon), increased the large mesh net possession threshold to 200 lbs during 1 November to 30 April, and stipulated that only 100 lbs could be retained before using a large mesh net during 1 May to 31 October. Amendment 4 adjusted Connecticut's commercial landings of summer flounder and revised the state-specific shares of the commercial quota accordingly. Amendment 5 allowed states to transfer or combine the commercial quota. Amendment 6 allowed multiple nets on board commercial fishing vessels if properly stowed, and changes the deadline for publication of overall catch limits and annual commercial management measures to 15 October and the recreational management measures to 15 February.

The results of previous assessments indicated that summer flounder abundance was not increasing as rapidly as projected when Amendment 2 regulations were implemented. In anticipation of the need to drastically reduce fishery quotas in 1996 to meet the management target of F_{max}, the MAFMC and ASMFC modified the fishing mortality rate reduction schedule in 1995 to allow for more stable landings from year to year while slowing the rate of stock rebuilding. Amendment 7 to the FMP set target fishing mortality rates of 0.41 for 1996 and 0.30 for 1997, with a target of F_{max} = 0.23 for 1998 and beyond. Total landings were to be capped at 8,400 mt (18.51 million lbs) in 1996-1997, unless a higher quota in those years provided a realized F of 0.23. Amendment 12 in 1999 defined overfishing for summer flounder to occur when the fishing mortality rate exceeds the threshold fishing mortality rate of F_{MSY}. Since F_{MSY} could not be reliably estimated for summer flounder, F_{max} = 0.24 was used as a proxy for F_{MSY}, and was also defined as the target fishing mortality rate. The stock was defined to be overfished when the total stock biomass falls below the minimum biomass threshold of one-half of the biomass target, B_{MSY}. Because B_{MSY} could not be reliably estimated, the biomass target was defined as the product of total biomass per recruit and contemporary (1982-1996) median recruitment, estimated to be 153,350 mt (338 million lbs), with the biomass threshold defined as 76,650 mt (169 million lbs). In a recent stock assessment (Terceiro 1999), those references points were updated using recent estimates of median recruitment (1982-1998) and mean weights at age (1997-1998), providing a biomass target of 106,444 mt (235 million lbs) and biomass threshold of 53,222 mt (118 million lbs). The Terceiro (1999) reference points were retained in the 2000 and 2001 stock assessments (NEFSC 2000, MAFMC 2001a) because of the stability of the input data. Concurrent with the development of the 2001 assessment, the MAFMC and ASMFC convened the ASMFC Summer Flounder Overfishing Definition Review Committee to review the reference points. The work of the Committee was reviewed by the MAFMC Scientific and Statistical Committee (SSC) in August 2001. The SSC recommended that the F_{MSY} proxy of F_{max} = 0.26 remain for 2002, and endorsed the recommendation of SARC 31

(NEFSC 2000) which stated that "...the use of F_{max} as a proxy for F_{MSY} should be reconsidered as more information on the dynamics of growth in relation to biomass and the shape of the stock recruitment function become available (MAFMC 2001b).

The 2001 stock assessment (MAFMC 2001a) found that the fishing mortality rate had declined from 1.32 in 1994 to 0.30 in 2000, about 15% higher than the FMP overfishing definition. Total stock biomass in 2000 was estimated to be 46,400 mt, 13% below the FMP biomass threshold. Therefore, the stock was found to be overfished and overfishing was occurring relative to the FMP reference points.

FISHERY DATA

Commercial Fishery Landings
        Total U.S. commercial landings of summer flounder from Maine to North Carolina peaked in 1979 at nearly 18,000 mt (40 million lbs, Table A1). The reported landings in 2001 of 4,916 mt (about 10.8 million lbs) were about 1% over the adjusted 2001 quota of 4,875 mt (10.7 million lbs). Since 1980, 70% of the commercial landings of summer flounder have come from the Exclusive Economic Zone (EEZ; greater than 3 miles from shore). The percentage of landings attributable to the EEZ was lowest in 1983 and 1990 at 63% and was highest in 1989 at 77%. Large variability in summer flounder landings exist among the states, over time, and the percent of total summer flounder landings taken from the EEZ has varied widely among the states.

Northeast Region Commercial Fishery Landings
        Annual commercial landings data for summer flounder in years prior to 1994 were obtained from trip-level detailed landings records contained in master data files maintained by the NEFSC (the weighout system; 1963-1993) and from summary reports of the Bureau of Commercial Fisheries and its predecessor the U.S. Fish Commission (1940-1962). Beginning in 1994, landings estimates were derived from mandatory dealer reports under the current NMFS Northeast Region (NER) summer flounder quota monitoring system.

        Prior to 1994, summer flounder commercial landings were allocated to NEFSC 3-digit statistical area according to interview data (Burns *et al. In* Doubleday and Rivard 1983). For 1994-2001, dealer landings were allocated to statistical area using fishing Vessel Trip Reports (VTR data) according to the general procedures developed by Wigley *et al.* (1997), in which a matched set of dealer and VTR data is used as a sample to characterize the statistical area distribution of monthly state landings. Since the implementation of the annual commercial landings quota in 1993, the commercial landings have become concentrated during the first calender quarter of the year, with about 46% of the landings taken during the first quarter in 2001.

        The distribution of 1992-2001 landings by three-digit statistical area is presented in Table A2. Areas 537-539 (Southern New England), areas 611-616 (New York Bight), areas 621, 622, 625, and 626 (Delmarva region), and areas 631 and 632 (Norfolk Canyon area) have generally accounted for over 80% of the NER commercial landings. In 2001, these areas accounted for 95% of the NER

commercial landings. A summary of length and age sampling of summer flounder landings collected by the NEFSC commercial fishery port agent system in the NER is presented in Table A3. For comparability with the manner in which length frequency sampling in the recreational fishery has been evaluated, sampling intensity is expressed in terms of metric tons of landings (mt) per 100 fish lengths measured. The sampling is proportionally stratified by market category (jumbo, large, medium, small, and unclassified), with the sampling distribution generally reflecting the distribution of commercial landings by market category. Overall sampling intensity has improved markedly since 1995, from 165 mt per 100 lengths to 30-40 mt per 100 lengths, and temporal and geographic coverage has generally improved as well.

The age composition of the NER commercial landings for 1994-2001 was generally estimated semiannually by market category and (usually) 1-digit statistical area (e.g., area 5 or area 6), using standard NEFSC procedures (market category length frequency samples converted to mean weights by length-weight relationships; mean weights in turn divided into landings to calculate numbers landed by market category; market category numbers at length apportioned to age by application of age-length keys, on semiannual area basis). For 2000 and 2001, sampling was generally sufficient to make quarterly estimates of the age composition in area 6 (in some cases, by division) for the large and medium market categories.

NER landed numbers at age were raised to total NER (general canvas) commercial landings when necessary by assuming that landings not accounted for in the weighout/mandatory reporting system had the same age composition as that sampled, as follows: calculate proportion at age by weight; apply proportions at age by weight to total NER commercial landings to derive total NER commercial catch at age by weight; divide by mean weights at age to derive total NER commercial landed numbers at age (Table A4). The proportion of large and jumbo market category fish in the NER landings has increased since 1996, while the proportion of small market category landings has become very small. The mean size of fish landed in the NER commercial fishery has been increasing since 1993, and was about 1.01 kg (2.2 lbs) in 2001, typical of an age 3 summer flounder (Table A5).

North Carolina Commercial Fishery Landings
The North Carolina winter trawl fishery accounts for about 99% of summer flounder commercial landings in North Carolina. A separate landings at age matrix for this component of the commercial fishery was developed from North Carolina Division of Marine Fisheries (NCDMF) length and age frequency sampling data. The NCDMF program samples about 10% of the winter trawl fishery landings annually, at a rate of between 53 and 5 mt of landings per 100 lengths measured (Table A6). All length frequency data used in construction of the North Carolina winter trawl fishery landings at age matrix were collected in the NCDMF program; age-length keys from NEFSC commercial data and NEFSC spring survey data (1982-1987) and NCDMF commercial fishery data (1988-2001) were combined by appropriate statistical area and semiannual period to resolve lengths to age. Fishery regulations in North Carolina also changed between 1987 and 1988, with increases in both the minimum mesh size of the codend and minimum landed fish size taking effect. It is not clear whether the change in regulations or the change in keys, or some combination, is responsible for the decreases in the numbers of age-0 and age-1 fish estimated in the North Carolina commercial fishery landings since 1987. Landed numbers at age and mean weights at age

from this fishery are shown in Tables A7-A8.

Commercial Fishery Discards

In a previous assessment, analysis of variance of the fishery observer data for summer flounder was used to identify stratification variables for an expansion procedure to estimate total landings and discards from fishery observer data kept and discard rates (weight per day fished) in the commercial fishery. Initial models included year, quarter, fisheries statistical division (2-digit area), area (divisions north and south of Delaware Bay), and tonnage class as main effects, with quarter and division emerging (along with year) as consistently significant main effects without significant interaction with the year (NEFSC 1993). The estimation procedure expands transformation bias-corrected geometric mean catch (landings and discards) rates in year, quarter, and division strata by total days fished (days fished on trips landing any summer flounder by any mobile gear, including fish trawls and scallop dredges) to estimate fishery landings and discards. The use of fishery effort as the multiplier (raising factor) allows estimation of landings from the fishery observer data for comparison with dealer reported landings, to help judge the potential accuracy of the procedure and/or sample data.

For strata with no fishery observer sampling, catch rates from adjacent or comparable strata were substituted as appropriate (except for Division 51, which generally has very low catch rates and negligible catch). Estimates of discard are stratified by 2 gear types (scallop dredge and trawl and others) for years when data are adequate (1992-2001). Estimates at length and age are stratified by gear only for 1994-2000, again due to sample size considerations. Only 11 fish were sampled from the sea scallop dredge fishery 2001, and so the scallop dredge discards were assumed to have the same length and age composition as the trawl fishery discards in 2001.

While estimates of catch rates from the NER fishery observer data are used in this assessment to estimate total discards, information on catch rate is also reported in the VTR data. A comparison of discard to total catch ratios for the fishery observer and VTR data sets for trawl and scallop dredge gear indicated similar discard rates in the trawl fishery from the two data sources, while discard rates in the scallop dredge fishery were often higher in the fishery observer data. Overall fishery observer and VTR discard to total catch ratios for 1994-2000 were generally within 10% of each other; 2001 was an exception, with an overall discard to total catch ratio of 45% in the fishery observer data and 29% in the VTR data (Tables A9-A10).

The change from the interview/weighout data reporting system to the VTR/mandatory dealer report system required a change in the estimation of effort (days fished) used as a multiplier with the fishery observer geometric mean discard rate in the procedure used to estimate total discard for 1994-2001. An initial examination of days fished and catch per unit effort (CPUE; landings per day fished) for cod conducted at SAW 24 (NEFSC 1997a) compared these quantities as reported in the full weighout and VTR data sets (DeLong *et al.*, 1997). This comparison indicated a shift to a higher frequency of short trips (trips with one or two days fished reported), and to a mode at a lower rate of CPUE. It was not clear at SAW 24 if these changes were due to the change in reporting system (units reported not comparable), or real changes in the fishery, and so effort data reported by the VTR system were not used quantitatively in the SAW 24 assessments. In the SAW 25 assessment

for summer flounder (NEFSC 1997a), a slightly different comparison was made. The port agent interview data for 1991-93 and merged dealer/VTR data for 1994-1996 (the matched set data), which under each system serve as the "sample" to characterize the total commercial landings, were compared in relative terms (percent frequency). For summer flounder, the percent frequency of short trips (lower number of days fished per trip) increased during 1991-1996, but not to the degree observed for cod, and the mode of CPUE rates for summer flounder increased in spite of lower effort per trip. For the summer flounder fishery, these may reflect actual changes in the fishery, due to increasing restrictions of allowable landings per trip (trip landings limits might lead to shorter trips) and increasing stock size (higher CPUE). As for cod, however, the influence of each of these changes (reporting system, management changes, stock size changes) has not been quantified. Total days fished in the summer flounder fishery were comparable between 1989-1993 period and 1994. With increasing restrictions on the fishery in 1995-2001 (lower landings quota, higher stock size, and thus increasing impact of trips limits and closures), total days fished declined relative to the early 1990s. Questions will remain about the accuracy of the VTR data . However, because the effort measure is critical to the estimation of discards for summer flounder, the VTR data were used as the best data source to estimate summer flounder fishery days fished for 1994-2001.

Two adjustments were made to the dealer/VTR matched data subset days fished estimates to fully accounted for summer flounder fishery effort during 1994-2001. First, the landings to days fished relationship in the matched set was assumed to be the same for unmatched trips, and so the days fished total in each discard estimation stratum (2-digit area and quarter) was raised by the dealer to matched set landings ratio. This step in the estimation accounted for days fished associated with trips landing summer flounder, and provided an estimate of discard for trips landing summer flounder.

Given the restrictions on the fishery however, there is fishing activity which results in summer flounder discard, but no landings, especially in the scallop dredge fishery. The days fished associated with these trips was accounted for by raising strata discard estimates by the ratio of the total days fished on trips catching any summer flounder (trips with landings and discard, plus trips with discard only) to the days fished on trips landing summer flounder (trips with landings and discard), for VTR trips reporting discard of any species (DeLong *et al.* 1997). For this step, it is necessary to assume that the discard rate (as indicated by the fishery observer data, which includes trips with discard but no landings, and which is used in previous estimation procedure steps) is the same for trips with only discard as for trips which both land and discard.

The expansion procedure provided fishery observer data estimates of landings ranging from +35% (1996) to -69% (2001) of the reported landings in the fisheries, with discard ranging from 41% (1990) to 6% (1995) of the reported landings. Total discards estimated for 2000 and 2001 were 18% and 16% of the reported landings. Scallop dredge fishery discard to landed ratios are much higher than trawl fishery ratios, purportedly because of closures and trip limits. Thus, although the scallop dredge landings are less than 5% of the total, the discard is of the same order of magnitude as that in the trawl fishery.

These discard estimates were based only on the days fished data for ports in the NER during

1989-1996, and so it was necessary to raise the discard estimate to account for discarding which occurs in components of the commercial fishery outside the NER reporting system (i.e., NER state reporting systems such as Connecticut and Virginia, and North Carolina) for those years. To determine the proper raising factor, landings accounted for by the NER reporting system (which result from the fishing effort on which the fishery observer discard estimate is based) were compared with total NER landings, plus that portion of North Carolina landings removed from the EEZ (it is assumed that only the North Carolina fishery in the EEZ would experience significant discard, as mesh regulations in state waters have resulted in very low discards in state waters since implementation of the regulation in 1989; R. Monaghan, pers. comm.). Since 1996, all states' landings and are included in the NER dealer reporting system, so no raising is necessary to account for missing landings. As recommended by SAW 16 (NEFSC 1993), a commercial fishery discard mortality rate of 80% was assumed to develop the final estimate of discard mortality (Table A11).

Existing fishery observer data were used to develop estimates of commercial fishery discard for 1989-2001. However, adequate data (e.g., interviewed trip data, survey data) are not available for summer flounder to develop discard estimates for 1982-1988. Discard numbers were assumed to be very small relative to landings during 1982-1988 (because of the lack of a minimum size limit in the EEZ), but to have increased since 1989 with the implementation of fishery regulations under the FMP. It is recognized that not accounting directly for commercial fishery discards would result in an underestimation of fishing mortality and population sizes in 1982-1988.

NEFSC fishery observer length frequency samples were converted to sample numbers at age and sample weight at age frequencies by application of NEFSC survey length-weight relationships and fishery observer, commercial fishery, and survey age-length keys. Sample weight proportions at age were next applied to the raised fishery discard estimates to derive fishery total discard weight at age. Fishery discard weights at age were then divided by fishery observer mean weights at age to derive fishery discard numbers at age. Classification to age for 1989-1993 was done by semiannual (quarters 1 and 2 pooled, quarters 3 and 4 pooled) periods using NEFSC fishery observer age-length keys, except for 1989, when first period lengths were aged using combined commercial (quarters 1 and 2) and NEFSC spring survey age-length keys. For 1994-2001, only NEFSC winter, spring, and fall survey age-length keys were used. Fishery observer sampling intensity is summarized in Table A11. Estimates of discarded numbers at age, mean length and mean weight at age are summarized in Tables A12-A14.

The reason for discarding in the trawl and scallop dredge fisheries has been changing over time. During 1989 to 1995, the minimum size regulation was recorded as the reason for discarding summer flounder for over 90% of the observed trawl and scallop dredge tows. In 1999, the minimum size regulation was provided as the reason for discarding for 61% of the observed trawl tows, with quota or trip limits given as the discard reason for 26% of the observed tows, and high-grading for 11% of the observed tows. In the scallop fishery in 1999, quota or trip limits was given as the discard reason for over 90% of the observed tows. During 2000-2001, minimum size regulations were identified as the discard reason for 40-45% of the observed trawl tows, quota or trip limits for 25-30% of the tows, and high grading for 3-8%. In the scallop fishery during 2000-2001, quota or trip limits was given as the discard reason for over 99% of the observed tows. As a result of the

increasing impact of trip limits, fishery closures, and high grading as the reasons for discarding, the age structure of the summer flounder discards has also changed, with more older fish being discarded (Table A12).

Recreational Fishery Landings

Summary landings statistics for the recreational fishery (catch type A+B1) as estimated by the National Marine Fisheries Service (NMFS) Marine Recreational Fishery Statistics Survey (MRFSS) are presented in Tables A15-A16. Recreational fishery landings decreased 29% by number and 26% by weight from 2000 to 2001, although the fishery still landed 162% (5,250 mt, 11.6 million lbs) of the 3,250 mt (7.2 million lbs) harvest limit established for 2001.

The length frequency sampling intensity for the recreational fishery for summer flounder was calculated by MRFSS subregions (North - Maine to Connecticut; Mid - New York to Virginia; South - North Carolina) on a metric tons of landings per hundred lengths measured basis (Burns *et al. In* Doubleday and Rivard, 1983). For 2001, aggregate sampling intensity averaged 123 mt of landings per 100 fish measured, an improvement over 2000 (Table A17).

MRFSS sample length frequency data, NEFSC commercial age-length data, and NEFSC survey age-length data were examined in terms of number of fish measured/aged on various temporal and geographical bases. Correspondences were made between MRFSS intercept date (quarter), commercial quarter, and survey season (spring and summer/fall) on temporal bases, and between MRFSS subregion, commercial statistical areas, and survey depth strata on geographic bases in order to integrate data from the different sources. Based on the number, size range, and distribution of lengths and ages, a semiannual (quarters 1 and 2, quarters 3 and 4), subregional basis of aggregation was adopted for matching of commercial and survey age-length keys with recreational length frequency distributions for conversion of the lengths to ages.

The recreational landings historically have been dominated by relatively young fish. Over the 1982-1996 period, age 1 fish accounted for an average of over 50% of the landings by number; summer flounder of ages 0 to 4 accounted for an average of over 99% of landings by number. No fish from the recreational landings were determined to be older than age 7. With increases in the minimum size during 1997-2001 (to 14.5 in [37 cm] in 1997, 15 in [38 cm] in 1998-1999, generally 15.5 in [39 cm] in 2000, and various state minimum sizes from 15.5 [38 cm] to 17.5 in [44 cm] in 2001), reductions in fishing mortality, and patterns in recruitment to the stock, the age composition of the recreational landings now includes mainly fish at ages 2 and 3. The number of summer flounder of ages 4 and older landed by the recreational fishery in 2000 (11% of the landings by number) and 2001 (13%) was the highest since 1983 (Table A18).

Small MRFSS intercept length sample sizes for larger fish resulted in a high degree of variability in mean length for older fish, especially at ages 5 and older. Attempts to estimate length-weight relationships from MRFSS biological sample data for use in estimating weight at age provided unsatisfactory results. As a result, quarterly length (mm) to weight (g) relationships from Lux and Porter (1966), which are employed in the conversion of length to weight in NEFSC compilation of commercial fishery statistics for summer flounder, were used to calculate annual

mean weights at age from the estimated age-length frequency distribution of the landings.

Recreational Fishery Discards

MRFSS catch estimates were aggregated on a subregional basis for calculation of the proportion of live discard (catch type B2) to total catch (catch types A+B1+B2) in the recreational fishery for summer flounder. Examination of catch data in this manner shows that the live discard has varied from about 18% (1985) to about 81% (1999, 2001) of the total catch (Table A19).

To account for all removals from the summer flounder stock by the recreational fishery, some assumptions about the biological characteristics and hooking mortality rate of the recreational live discard needed to be made, because no biological samples are taken from MRFSS catch type B2. In previous assessments, data available from New York Department of Environmental Conservation (NYDEC) surveys (1988-92) of New York party boats suggested the following for this component (Mid-Atlantic subregion, anglers fishing from boats) of the recreational fishery: 1) nearly all (>95%) of the fish released alive were below the minimum regulated size (during 1988-92, 14 in [36 cm] in New York state waters), 2) nearly all of these fish were age 0 and age 1 summer flounder, and 3) age 0 and 1 summer flounder occurred in approximately the same proportions in the live discard as in the landings. It was assumed that all B2 catch would be of lengths below regulated size limits, and so either age 0 or age 1 in all three subregions during 1982-1996. Catch type B2 was therefore allocated on a subregional basis in the same ratio as the annual age 0 to age 1 proportion observed in the landings during 1982-1996. Mean weights at age were assumed to be the same as in the landings during 1982-1996.

The minimum landed size in federal and most state waters increased to 14.5 in (37 cm) in 1997, to 15.0 in (38 cm) in 1998-1999, and to 15.5 in (39 cm) in 2000. Applying the same logic employed to classify the 1982-1996 recreational released catch to size and age for 1997-2000 implied that the recreational fishery released catch included fish of ages 2 and 3. Investigation of data from the CTDEP Volunteer Angler Survey (VAS, 1997-1999) and American Littoral Society (ALS, 1999), comparing the length frequency of released fish in those programs with the MRFSS data on the length frequency of landed fish less than the minimum size, suggested this assumption was valid for 1997-1999 (MAFMC 2001a). The CTDEP VAS and ALS data, along with data from the NYDEC Party Boat Survey (PBS) was used to validate this assumption for 2000. For 1997-2000 it was therefore assumed that all B2 catch would be of lengths below regulated size limits, and so of ages 0 to 3. Catch type B2 was therefore allocated on a sub-regional basis in the same ratio as the annual age 0 to age 3 proportions observed in the landings at lengths less than 37 cm in 1997, 38 cm in 1998-1999, and 39 cm in 2000 (Table A20).

In 2001, many states adopted different combinations of minimum size and possession limits to meet management requirements. As a result, minimum sizes for summer flounder ranged from 15.5 in (39 cm) in Federal, VA, and NC waters, 16 in (41 cm) in NJ, 16.5 in (42 cm) in MA, 17 in (43 cm) in MD and NY, to 17.5 in (44 cm) in CT, RI, and DE. Examination of data provided by MD sport fishing clubs, the CTDEP VAS, the ALS, and the NYDEP PBS indicated that the basic assumption that fish released are those smaller than the minimum size remained valid. Thus for 2001, catch type B2 was characterized by the same proportion at length as the landed catch less than

the minimum size in the respective states. Due to sample size considerations, lengths and B2 catch were aggregated to semi-annual, subregional strata to calculate the expanded discards at length. The number of age 1 fish discarded in the recreational fishery in 2001 was the most since 1996 (Table A20).

Studies conducted cooperatively by NEFSC and the state of Massachusetts to estimate hooking mortality for striped bass and black sea bass suggest a hooking mortality rate of 8% for striped bass (Diodati and Richards 1996) and 5% for black sea bass (Bugley and Shepherd, 1991). Work by the states of Washington and Oregon with Pacific halibut (a potentially much larger flatfish species, but otherwise morphologically similar to summer flounder) found "average hooking mortality...between eight and 24 percent" (IPHC, 1988). An unpublished tagging study by the NYDEC (Weber MS 1984) on survival of released sublegal summer flounder caught by hook-and-line suggested a total, non-fishing mortality rate of 53%, which included hooking plus tagging mortality as well as deaths by natural causes (i.e., predation, disease, senescence). Assuming deaths by natural causes to be about 18%, (an instantaneous rate of 0.20), an annual hooking plus tagging mortality rate of about 35% can be derived from the NYDEC results. In the SARC 25 (NEFSC 1997b) and earlier assessments of summer flounder, a 25% hooking mortality rate was assumed reasonable for summer flounder released alive by anglers.

Two more recent investigations of summer flounder recreational fishery release mortality suggest that a lower release mortality rate is appropriate. Lucy and Holton (1998) used field trials and tank experiments to investigate the release mortality rate for summer flounder in Virginia, and found rates ranging from 6% (field trials) to 11% (tank experiments). Malchoff and Lucy (1998) used field cages to hold fish angled in New York and Virginia during 1997 and 1998, and found a mean short term mortality rate of 14% across all trials. Given the results of these release mortality studies conducted specifically for summer flounder, a 10% release mortality rate was adopted in the Terceiro (1999) and has been retained in subsequent assessments (NEFSC 2000, MAFMC 2001a).

Ten percent of the total B2 catch at age is added to estimates of summer flounder landings at age to provide estimates of summer flounder recreational fishery discard at age (Table A20), total recreational fishery catch at age in numbers (Table A21) and mean weights at age (Table A22). The number of fish discarded and assumed dead in the recreational fishery (2.3 million fish, 1,184 mt) was 43% by number and 23% by weight of the total landed (5.2 million fish, 5,250 mt) in the recreational fishery in 2001.

Total Catch Composition

NER total commercial fishery landings and discards at age, North Carolina winter trawl fishery landings and discards at age, and MRFSS recreational fishery landings and discards at age totals were summed to provide a total fishery catch at age matrix for 1982-2001 (Table A23; Figure A1). The percentage of age-3 and older fish in the total catch in numbers has increased in recent years from only 4% in 1993, to about 40% during 1998-2001. Overall mean lengths and weights at age for the total catch were calculated as weighted means (by number in the catch at age) of the respective mean values at age from the NER commercial (Maine to Virginia), North Carolina

commercial, and recreational (Maine to North Carolina) fisheries (Tables A24-A25; Figure A2). The recreational fishery share of the total summer flounder catch has increased since 1995 (Figure A3).

BIOLOGICAL DATA

Aging

Work performed for the SAW 22 assessment (NEFSC 1996b) indicated a major expansion in the size range of 1-year old summer flounder collected during the 1995 and 1996 NEFSC winter bottom trawl surveys, and brought to light differences between ages determined by the NEFSC and NCDMF fishery biology staffs. Age structure (scale) exchanges were performed after the SAW 22 assessment to explore these aspects of summer flounder biology. The results of the first two exchanges, which were reported at SAW 22 (NEFSC 1996b), indicated low levels of agreement between age readers at the NEFSC and NC DMF (31 and 46%). In 1996, research was conducted to determine inter-annular distances and to back-calculate mean length at age from scale samples collected on all NEFSC bottom trawl surveys (winter, spring and fall) in order to compare with NCDMF samples. While mean length at age remained relatively constant from year to year, inter-annular distances increased sharply in the samples from the 1995-1996 winter surveys, and increased to a lesser degree in samples from other 1995-1996 surveys as well. As a result, further exchanges were suspended pending the resolution of an apparent aging problem.

Age data from the winter 1997 bottom trawl survey, aged utilizing both scales and otoliths by only by one reader, indicated a similar pattern as the previous two winter surveys (i.e., several large age 1 individuals) from scale readings, and some disagreement between scale and otolith ages obtained from the same fish. Because of these problems, a team of five experienced NEFSC readers was formed to re-examine the scales aged from the winter survey. After examining several hundred scales, the team determined that re-aging all samples from 1995-1997, including all winter, spring, and fall samples from the NEFSC and MA DMF bottom trawl surveys and all samples from the commercial fishery, would be appropriate. The age determination criteria used remained the same as developed at the 1990 summer flounder workshop (Almeida *et al.* 1992) and described in the standard aging manual utilized by NEFSC staff (Dery 1997). Only those fish for which a 100% consensus of all group members could be reached were included in the revised database, however. The data from the re-aged database were used in analyses in the SAW 25 assessment (NEFSC 1997b).

A third summer flounder aging workshop was held at NEFSC in February, 1999, to continue the exchange of age structures and review of aging protocols for summer flounder (Bolz *et al.* 2000). The participants of the latest workshop concluded that the majority of aging disagreements in recent NEFSC-NCDMF exchanges arose from the interpretation of marginal scale increments due to highly variable timing of annulus formation, and from the interpretation of first year growth patterns and first annulus selection. The workshop recommended regular samples exchanges between NEFSC and NCDMF, and further analyses of first year growth.

<u>Maturity</u>

The maturity schedule for summer flounder used in the 1990 SAW 11 and subsequent stock assessments through 1999 was developed by the SAW 11 Working Group using NEFSC Fall Survey maturity data for 1978-1989 and mean lengths at age from the NEFSC fall survey (G. Shepherd, NEFSC, personal communication; NEFC 1990; Terceiro 1999). The SAW 11 work indicated that the median length at maturity (50th percentile, L_{50}) was 25.7 cm for male summer flounder and 27.6 cm for female summer flounder, and 25.9 cm for the sexes combined. Under the aging convention used in the SAW 11 and subsequent assessments (Smith *et al.* 1981, Almeida *et al.* 1992, Szedlmayer and Able 1992, Bolz *et al.* 2000), the median age of maturity (50th percentile, A_{50}) for summer flounder was determined to be 1.0 years for males and 1.5 years for females. Combined maturities indicated that 38% of age-0 fish are mature, 72% of age-1 fish are mature, 90% of age-2 fish are mature, 97% of age-3 fish are mature, 99% of age-4 fish are mature, and 100% of age-5 and older fish are mature at peak spawning time in the autumn. The maturities for age-3 and older were rounded to 100% in the SAW 11 and subsequent assessments.

In the series of summer flounder assessments, it has been noted that the maturity schedules have been based on simple gross morphological examination of the gonads and therefore may not accurately reflect (i.e., may overestimate) the true spawning potential of the summer flounder stock (especially for age-0 and age-1 fish). It should also be noted, however, that spawning stock biomass (SSB) estimates based on age-2 and older fish show the same long term trends in SSB as estimates which include age 0 and 1 fish in the spawning stock. A research recommendation that the true spawning contribution of young summer flounder to the SSB be investigation has been included in summer flounder stock assessments since 1993 (NEFSC 1993). In light of the completion of a URI study to address this research recommendation, the maturity data for summer flounder for 1982-1998 were examined in the 2000 assessment (NEFSC 2000) to determine if changes in the maturity schedule were warranted.

The research at the University of Rhode Island (URI) by Drs. Jennifer Specker and Rebecca Rand Merson (hereafter referred to collectively as the "URI 1999" study) attempted to address the issue of the true contribution of young summer flounder to the spawning stock. The URI 1999 study examined the histological and biochemical characteristics of female summer flounder oocytes (1) to determine if age-0 and age-1 female summer flounder produce viable eggs, and (2) to develop an improved guide for classifying the maturity of summer flounder collected in NEFSC surveys (Specker *et al.* 1999, Merson *et al.* In press, Merson *et al.* In review). The URI study examined 333 female summer flounder (321 aged fish) sampled during the NEFSC Winter 1997 Bottom Trawl Survey (February 1997) and 227 female summer flounder (210 aged fish) sampled during the NEFSC Autumn 1997 Bottom Trawl Survey (September 1997), using radioimmunoassays to quantify the biochemical cell components characteristic of mature fish.

To provide an increased sampled size for the calculation of length- and age-based maturity schedules, the fish in the URI study sampled from the NEFSC Winter and Autumn 1997 Surveys were combined, with the ages of the fish from the Winter Survey reduced by 1 year to reflect their age at spawning during the previous (1996) autumn. For this combined sample, the NEFSC and URI maturity criteria disagreed for 13% of the aged fish, with most (10%) of the disagreement due to

NEFSC mature fish classified as immature by the URI histological and biochemical criteria. Of the 531 female summer flounder in the combined age sample, the URI criteria indicated that 15% of the age-0 fish were mature, 82% of the age-1 fish were mature, 97% of the age-2 fish were mature, and 100% of the age 3 and older fish were mature. When the proportions of fish mature at length and age were estimated by probit analysis, the URI 1999 criteria a median length at maturity (50th percentile, L_{50}) of 34.7 cm for female summer flounder, with proportions mature at age of age-0: 30%, age-1: 68%, age-2: 92%, age-3: 98%, age-4: 100%., with a median age of maturity (50th percentile, A_{50}) of about 0.5 years.

SARC 31 (NEFSC 2000) considered 5 options for the summer flounder maturity schedule for the 2000 stock assessment:

1) No change, use the maturity schedule for combined sexes as in the SAW 11 and subsequent assessments (the schedule presented below is rounded to 0.38, 0.72, 0.90, 1.00, 1.00, and 1.00 as in the SAW 25 and Terceiro (1999) assessment analyses).

2) Consider only age-2 and older fish of both sexes in the SSB.

3) Knife edged, age-1 and older maturity for both sexes. This would eliminate age-0 fish of both sexes from the SSB, and assume that the proportions mature at age-1 "round" to 100%.

4) NEFSC 1982-1989, 1990-1998 for both sexes, assuming a 1:1 sex ratio to average proportions for a combined schedule.

5) NEFSC 1982-1989, 1990-1998 for males, URI 1999 for females, assuming a 1:1 sex ratio to average proportions for a combined schedule.

SARC 31 concluded that some contribution to spawning from ages 0 and 1 should be included, eliminating options 2 and 3. The differences among remaining options 1, 4, and 5 were considered to be relatively minor, and so the SAW 11 schedule (Option 1) was retained for the 2000 (NEFSC 2000), 2001 (MAFMC 2001a), and current (2002) assessment. SARC 31 recommended that more biochemical and histological work, for both male and female summer flounder, should be done for additional years to determine if the results of the URI 1999 study will be applicable over the full VPA time series. SARC 31 also noted the need for research to explore whether the viability of eggs produced by young, first time spawning summer flounder is comparable to the viability of eggs produced by older, repeat spawning summer flounder.

RESEARCH SURVEY ABUNDANCE AND BIOMASS INDICES

<u>NEFSC Spring</u>
Long-term trends in summer flounder abundance were derived from a stratified random bottom trawl survey conducted in spring by NEFSC between Cape Hatteras and Nova Scotia since

1968 (Clark 1978). NEFSC spring survey indices (Tables A26-A27) suggest that total stock biomass last peaked during 1976-1977, and in 2002 was now about 15% above that peak, and at a new historical high (Figure A4). Age composition data from the NEFSC spring survey indicate a substantial reduction in the number of ages in the stock between 1976-1990 (Table A27). Between 1976-1981, fish of ages 5-8 were captured regularly in the survey, with the oldest individuals aged 8-10 years. Between 1982-1986, fish aged 5 and older were only occasionally observed in the survey, and by 1986, the oldest fish observed in the survey were age 5. In 1990 and 1991, only three ages were observed in the survey catch, and there was an indication that the 1988 year class was very weak. Since 1991, the survey age composition has expanded significantly. There is strong evidence in the 1998-2002 NEFSC spring surveys of increasing abundance of age-3 and older fish, due to increased survival of the 1994 and subsequent year classes (Table A27). Mean lengths at age in the NEFSC spring survey are presented in Table A28.

NEFSC Autumn

Summer flounder are caught frequently in the NEFSC autumn survey at stations in the inshore strata (< 27 meters = 15 fathoms = 90 feet) and in the band of offshore strata of 27-55 meters depth (15-30 fathoms, 90-180 feet), at about the same magnitude as in the spring survey (Table A26). Furthermore, the autumn survey catches age-0 summer flounder in abundance, providing an index of summer flounder recruitment (Tables A29 & A48, Figure A7). Fall survey indices suggest improved recruitment since the late 1980s, and evidence of an increase in abundance at age-2 and older since 1995. The NEFSC autumn surveys indicate that the 1995 year class of summer flounder was the most abundant in recent years, and that subsequent, weaker year classes are experiencing increased survival (Table A29). Mean lengths at age in the NEFSC autumn survey are presented in Table A30.

NEFSC Winter

A new series of NEFSC winter trawl surveys was begun in February 1992 specifically to provide improved indices of abundance for flatfish, including summer flounder. This survey targets flatfish during the winter when they are concentrated offshore. A modified 36 Yankee trawl is used in the winter survey that differs from the standard trawl employed during the spring and autumn surveys in that 1) long trawl sweeps (wires) are added before the trawl doors, to better herd fish to the mouth of the net, and 2) the large rollers used on the standard gear are absent, and only a chain "tickler" and small spacing "cookies" are present on the footrope.

Based on a comparison of summer flounder catches during the winter surveys with recent spring and autumn surveys, the design and conduct of the winter survey (timing, strata sampled, and the use of the modified 36 Yankee trawl gear) has resulted in greater catchability of summer flounder compared to the other surveys. Most fish have been taken in survey strata 61-76 (27-110 meters; 15-60 fathoms), off the Delmarva and North Carolina coasts . Other concentrations of fish are found in strata 1-12, south of the New York and Rhode Island coasts, in slightly deeper waters. Significant numbers of large summer flounder are often captured along the southern flank of Georges Bank (strata 13-18).

Indices of summer flounder abundance from the winter survey indicated stable stock size during 1992-1995, with indices of stratified mean catch per tow in number ranging from 10.9 in

1995 to 13.6 in 1993. The NEFSC winter survey index for 1996 increased by 290% over the 1995 value, from 10.8 to 31.2 fish per tow. The largest increases in 1996 catch per tow occurred in the Mid-Atlantic Bight region (offshore strata 61-76), where increases in catch per tow of up to an order of magnitude over the 1995 level occurred in several strata, with the largest increases in strata 61,62, and 63, off the northern coast of North Carolina. Most of the increased catch in 1996 consisted of age-1 summer flounder from the 1995 year class. In 1997, the index dropped to 10.3 fish per tow, due to the lower numbers of age-1 (1996 year class) fish caught. The Winter 2002 survey kg per tow index is the highest of the 1992-2002 series (Tables A26 & A31, Figure A4). As with the other two NEFSC surveys, there is strong evidence in recent winter surveys of increased abundance of age-3 and older fish relative to earlier years in the time series, due to the abundance of the 1995 year class and increased survival of subsequent year classes (Table A32). Mean lengths at age in the NEFSC winter survey are presented in Table A33.

Massachusetts DMF

Spring and fall bottom trawl surveys conducted by the Massachusetts Division of Marine Fisheries (MADMF) show a decline in abundance in numbers of summer flounder from recent high levels in 1986 to record lows in 1990 (MADMF fall survey), and 1991 (MADMF spring survey). In 1994, the MADMF survey indices increased to values last observed during 1982-1986, but then declined substantially in 1995, although the indices remain higher than the levels observed in the late 1980s . Since 1996, both the MADMF spring and fall indices have increased substantially to values last observed during 1982-1986 (Tables A34-A35, Figure A5). The MADMF also captures a small number of age-0 summer flounder in a seine survey of estuaries, and these data are available as an index of recruitment (Tables A36 & A48, Figure A9).

Connecticut DEP

Spring and fall bottom trawl surveys are conducted by the Connecticut Department of Environmental Protection (CTDEP). The CTDEP surveys show a decline in abundance in numbers of summer flounder from high levels in 1986 to record lows in 1989. The CTDEP surveys indicate recovery since 1989, and evidence of increased abundance at ages 2 and older since 1995. The 2000 and 2001 spring indices were the highest of the 16 year time series, and the 2001 autumn index was the highest of the series (Tables A37-A38, Figure A6). An index of recruitment from the autumn series is available (Tables A38 & A48, Figure A7).

Rhode Island DFW

A standardized bottom trawl survey has been conducted during the spring and fall months in Narragansett Bay and state waters of Rhode Island Sound by the Rhode Island Department of Fish and Wildlife (RIDFW) since 1979. Indices of abundance at age for summer flounder have been developed from the autumn survey data using NEFSC autumn survey age-length keys. The 1988 and 1991 year classes are the weakest in recent years in this time series, and the index shows the 1984-1987, 1999, and 2000 year classes to have been the strongest. The autumn survey was at or near a time-series high during 1999-2000 (Table A39, Figure A5). A new series of indices was developed from a set of fixed stations sampled monthly during 1990-2000. Age-1 indices from this series indicate that strong year classes recruited to the stock in1996, 1999, and 2000, with age 2+ abundance peaking in 2000 (Table A40). Recruitment indices are available from both the autumn

and monthly fixed station surveys (Table A39-A40 & A48, Figure A9).

New Jersey BMF

The New Jersey Bureau of Marine Fisheries (NJBMF) has conducted a standardized bottom trawl survey since 1988. Indices of abundance for summer flounder incorporate data collected from April through October. NJBMF supplied annual total mean number per tow indices and associated annual length frequency distributions; lengths were converted to age using the corresponding annual NEFSC combined spring and fall survey age-length keys. Indices of the 1995 year class at age-0 and at older ages in subsequent years through 1999 indicate that it is the strongest of the 1988-2001 time series. Indices of the 1996-2001 year classes are below the time series average. The NJBMF survey indices show evidence of increased abundance at age-2 and older in the 1995-2000 surveys, but a decline in 2001 (Table A41, Figure A6). Recruitment indices are available from the NJBMF survey (Tables A41 & A48, Figure A7).

Delaware DFW

The Delaware Division of Fish and Wildlife (DEDFW) has conducted a standardized bottom trawl survey with a 16 foot headrope trawl since 1980, and with a 30 foot headrope trawl since 1991. Recruitment indices (age 0 fish; one index from the Delaware estuary proper, one from the inland bays) have been developed from the 16 foot trawl survey data for the 1980 to 2001 year classes. Indices for age-0 to age-4 and older summer flounder have been compiled from the 30 foot headrope survey. The indices incorporate data collected from June through October (arithmetic mean number per tow), with age 0 summer flounder separated from older fish by visual inspection of the length frequency. The 16 foot headrope survey indices suggest poor recruitment in 1988 and 1993, and improved recruitment in 1994-1995 (Tables A42-A43 & A48). The 16-foot trawl Estuary index indicates below average recruitment since 1995, except for 2000 (Figure A9). The 16-foot trawl Inland Bays index indicates above average recruitment during 1998-2000, and poor recruitment in 2001. The 30 foot headrope survey indices suggest stable stock sizes over the 1991-2001 time series, with strong recruitment in 1991, 1994, 1995, and 2000 (Table A44, Figure A6).

Maryland DNR

The Maryland Department of Natural Resources (MDDNR) has conducted a standardized trawl survey in the seaside bays and estuaries around Ocean City, MD since 1972. Samples collected during May to October with a 16 foot bottom trawl have been used to develop a recruitment index for summer flounder for the period 1972-2001. This index suggests that weakest year class in the time series recruited to the stock in 1988, and the strongest in 1972, 1983, 1986, and 1994. The 2000 and 2001 indices were about average (Tables A45 & A48, Figure A8).

Virginia Institute of Marine Science

The Virginia Institute of Marine Science (VIMS) conducts a juvenile fish survey using trawl gear in Virginia rivers and the mainstem of Chesapeake Bay. The time series for the rivers extends from 1979-2001. With the Bay included, the series is available only since 1988, but many more stations are included. Trends in the two time series are very similar. An index of recruitment developed from the rivers only series suggests weak year classes recruited to the stock in 1987 and 1999, with strongest year classes recruiting during 1980-1984, and 1990. Recruitment indices since

1990 have been below the time series average (Tables A46 & A48, Figure A8).

North Carolina DMF

The NCDMF has conducted a stratified random trawl survey using two 30 foot headrope nets with 3/4" mesh codend in Pamlico Sound since 1987. An index of recruitment developed from these data suggests weak year classes in 1988 and 2000, and strongest year classes in 1987, 1992, and 1996, and 2001 (Tables A47-A48, Figure A8). The survey normally takes place in mid-June, but in 1999 was delayed until mid-July. The 1999 index therefore inconsistent with the other indices in the time series, and the 1999 value was excluded from the VPA calibration in the SARC 31 assessment (NEFSC 2000).

ESTIMATES OF MORTALITY AND STOCK SIZE

Natural Mortality Rate

The instantaneous natural mortality rate (M) for summer flounder was assumed to be 0.2 in all analyses, although alternative estimates of M were considered in the SAW 20 assessment (NEFSC 1996a). In the SAW 20 work, estimates were derived with the methods described by 1) Pauly (1980) using growth parameters derived from NCDMF age-length data and a mean annual bottom temperature (17.5°C) from NC coastal waters, 2) Hoenig (1983) using a maximum age for summer flounder of 15 years, and 3) consideration of age structure expected in unexploited populations (5% rule, 3/M rule, e.g., Anthony 1982). SAW 20 (NEFSC 1996a) concluded that M = 0.2 was a reasonable value given the mean (0.23) and range (0.15-0.28) obtained from the various analyses, and that value for M has been used in all subsequent assessments.

ASPIC Model

The non-equilibrium surplus production model incorporating covariates (ASPIC; Prager 1994, 1995) can be used to estimate maximum sustainable yield (MSY) and other management benchmarks. An ASPIC analysis applied to summer flounder using various state and federal agency survey biomass indices (the 1998 analysis) was previously reviewed by the NEFMC Overfishing Review Panel (Applegate *et al.* 1998). Based on total weighted mean squared error (MSE), the NEFSC spring and autumn biomass indices gave the best fit to the data in that analysis. However, the Overfishing Review Panel concluded that biological reference points estimated in the 1998 analysis for summer flounder were unreliable, due to the short time series of reliable catch estimates and lack of dynamic range in the input data (Applegate *et al.* 1998).

An ASPIC analysis using projected catch and NEFSC survey biomass indices through 1999 was reviewed in the 1999 assessment (Terceiro 1999). Model results were examined for sensitivity by employing the Monte Carlo search routine and by initializing the values of MSY (10,000 to 50,000 mt) and the intrinsic rate of increase ® ; 0.12 to 1.25) over a broad range, with the ratio of initial to current biomass (B1 ratio) assigned a starting value of 0.50. Overall, the 1999 ASPIC model results for summer flounder were sensitive and suggested the possibility of numerous local minima in the sums of squared errors (SSE) response surface. The Monte Carlo search algorithm was employed in an attempt to provide a better search of the SSE response surface, and the this

procedure with restarts gave a range of estimates of MSY from 19,000 mt to 58,000 mt and of r from 0.49 to 1.08. Due to the number of restarts to reach convergence (>25) and the probable number of local minima, these results also appeared to be sensitive. Due to the unstable nature of the results, biological reference points for summer flounder estimated by the 1999 ASPIC analysis were considered to be unreliable, and the ASPIC analysis has not been repeated in this assessment.

Virtual Population Analysis and Tuning

Fishing mortality rates in 2001 and stock sizes in 2002 were estimated using the ADAPT method for calibration of the VPA (Parrack 1986, Gavaris 1988, Conser and Powers 1990) as implemented in the NEFSC FACT version 1.50 VPA. As recommended by the MAFMC S&S Committee during the review of the Terceiro (1999) assessment, and by the recent National Research Council review of the summer flounder assessment (NRC 2000), ages 0-6 were included in the analysis as true ages, with ages 7 and older combined as a plus group. An instantaneous natural mortality rate of $M = 0.2$ was assumed for all ages in all years, as noted earlier. Maturities at age for all years were 38% for age-0, 72% for age-1, 90% for age-2, and 100% for ages 3 and older, as noted earlier.   Stock sizes in 2002 were directly estimated for ages 1-6, while the age 7+ group was calculated from Fs estimated in 2001. Fishing mortality on the oldest true age (6) in the years prior to the terminal year was estimated from back-calculated stock sizes for ages 3-6. Fishing mortality on the age 7+ group was assumed equal to the fishing mortality for age 6. Winter, spring, and mid-year (e.g., RIDFW monthly fixed station, DEDFW, and NJBMF) survey indices and all survey recruitment (age-0) indices were compared to population numbers of the same age at the beginning of the same year. Fall survey indices were compared to population numbers one year older at the beginning of the next year. Tuning indices were unweighted.

A number of exploratory VPA runs using different combinations of research survey tuning indices were considered to examine the sensitivity of the summer flounder VPA.   The inclusion of each index was considered based on a pre-calibration correlation analysis among all indices, a post-calibration correlation analysis among the indices and resulting VPA estimates of stock size, and an examination of the VPA diagnostics including the partial variance accounted for by each index, patterns in residuals, and the mean squared residual (MSR) of the calibrated solution. Survey indices with trends that did not reasonably match corresponding patterns in abundance as estimated by other indices and/or the VPA, as evidenced by poor correlation, high partial variance in tuning diagnostics, or patterns in residuals, were eliminated from the VPA tuning configuration.

The run chosen as final (run F35_2) includes more indices (n=41) than were used in the 2000 (NEFSC 2000) and 2001 (MAFMC 2001a) assessments (n= 35). The MADMF seine survey recruitment index, MADMF spring survey age 2 index, RIDFW fall survey age 2 and age 3 indices (tuned to ages 3 and 4), the RIDFW fall and monthly fixed station survey age 0 indices, and the DEDFW 16 foot trawl Estuary age 0 indices that were excluded from the previous assessments are included in the current VPA based on consideration of the above analyses and criteria. One index which was included in the last VPA calibration, the RIDFW monthly fixed station survey age 1 index, was excluded this time.

A summary of the input catch and comparison with VPA estimated catch biomass is

presented in Table A49. The final 2002 assessment VPA (run F35_2), including input data and assumptions, solution statistics, residuals, and estimates of F at age, stock number, and biomass at age is presented in Table A50.

VPA Estimates of Fishing Mortality Rates

The annual partial recruitment of age-1 fish decreased from near 0.50 during the first half of the VPA time series to less than 0.30 since 1994; the partial recruitment of age-2 fish has decreased from 1.00 in 1993 to 0.78 during 1999-2001 (Table A50). These decreases in partial recruitment at age are in line with expectations given recent changes in commercial and recreational fishery regulations. For these reasons, summer flounder are currently considered to be fully recruited to the fisheries at age 3, and fully recruited fishing mortality is expressed as the unweighted average of fishing mortality at age for ages 3 to 5.

Fishing mortality on fully recruited ages 3-5 summer flounder was high for most of the VPA time series, varying between 0.9 and 2.2 during 1982-1998 (55%-83% exploitation), far in excess of the current overfishing definition, $F_{threshold} = F_{target} = F_{max} = 0.26$ (21% exploitation). The fishing mortality rate has declined substantially since 1998 and was estimated to be 0.27 (22% exploitation) in 2001, marginally above the overfishing definition (Table A50, Figure A10).

VPA Estimates of Stock Abundance

Summer flounder spawn in the late autumn and into early winter (peak spawning on November 1), and age 0 fish recruit to the fishery the autumn after they are spawned. For example, summer flounder spawned in autumn 1987 (from the November 1, 1987 spawning stock biomass) recruit to the fishery in autumn 1988, and appear in VPA tables as age 0 fish in 1988. This assessment indicates that the 1982 and 1983 year classes were the largest of the VPA series, at 74 and 80 million fish, respectively. The 1988 year class was the smallest of the series, at only 13 million fish. The 2000 year class is estimated at 39 million fish, above the 1982-2001 median of 36 million. The 2001 year class is currently estimated to be below average, at 27 million fish (Table A50, Figure A11).

Total stock biomass has increased substantially since 1989, and in 2001 total stock biomass was estimated to be 42,900 mt, the highest since 1983, but still 19% below the current biomass threshold (Table A50, Figure A11). Spawning stock biomass (SSB; Age 0+) declined 72% from 1983 to 1989 (18,800 mt to 5,200 mt), but has increased seven-fold, with improved recruitment and decreased fishing mortality, to 38,200 mt in 2001 (Table A50, Figure A11). In general, the abundance of summer flounder of ages 2 and older has increased substantially since the early 1990s (Figure A12). The age structure of the spawning stock has thus also expanded, with 72% at ages 2 and older, and 14% at ages 5 and older. Under equilibrium conditions at F_{max}, about 85% of the spawning stock biomass would be expected to be ages 2 and older, with 50% at ages 5 and older (Figure A13). Recent recruitment per unit of SSB has been lower than that observed during the early 1980s (Figure A14).

Precision of VPA Estimates

A bootstrap procedure (Efron 1982) was used to evaluate the precision of the final VPA estimates with respect to random variation in tuning data (survey abundance indices). The procedure

does not reflect uncertainty in the catch-at-age data. Five hundred bootstrap iterations were used to generate distributions of the 2001 fishing mortality rate and total stock biomass. Histogram plots of the distribution of the terminal year VPA estimates indicate the amount of uncertainty by visually depicting variability. The cumulative probability can be used to evaluate the risk of making a management decision based on the estimated value. It expresses the probability (chance) that the fishing mortality rate was greater than a given level when measurement errors are considered (e.g., some target fishing mortality rate). For stock biomass, the cumulative plot indicates the probability that it was less than a given level (e.g., some desired minimum stock biomass).

The precision and bias of the 2001 fishing mortality rates, 1 January 2002 stock sizes, 1 November 2001 spawning stock biomass, and 1 January 2001 total stock biomass estimates are presented in Table A51. Bias was less than 5% for all parameters estimated. The bootstrap estimate of the 2001 total stock biomass was relatively precise, with a corrected CV of 7%. The bootstrap mean (43,160 mt) was slightly higher than the VPA point estimate (42,875 mt).   The bootstrap results suggest a high probability (>90%) that total stock biomass in 2001 was at least 39,300 mt, reflecting only variability in survey observations (Table A51, Figure A15).

The corrected coefficients of variation for the Fs in 2001 on individual ages were 21% for age 0, 17% for age 1, 15% for age 2, 14% for age 3, 20% for age 4, 28% for age 5, 12% for age 6, and 12% for ages 7 and older. The distribution of bootstrap Fs was not strongly skewed, resulting in the bootstrap mean F for 2001 (0. 2804) being about equal to the point estimate from the VPA (0.2734). There is a 80% chance that F in 2001 was between about 0.24 and 0.32, given variability in survey observations (Table A51, Figure A15).

Retrospective Analysis of VPA

Retrospective analysis of the summer flounder VPA was carried out for terminal catch years 1996-2001. In the retrospective configuration, only the NEFSC surveys and MADMF, RIDFW, and CTDEP fall surveys are included in the calibration of terminal year + 1 stock size estimates, to duplicate the 2002 assessment. Expansion of the catch at age to ages 7 and older caused convergence problems for retrospective VPA configurations in the years 1996-1997. In order to account for the very low stock sizes at ages 5-7+ as indicated by survey indices during 1996-1997, given the estimates of catch at those ages, the VPA estimates unreasonable fishing mortality rates for age 5 in 1996 and ages 5-7+ in 1997 (Table A52, Figure A16). There were no convergence problems for the years 1982-1995, or for the 1998-2001 terminal years.

The retrospective analysis indicates a pattern of underestimation of fully recruited F (ages 3-5) for 1998-2000, following the pattern observed in the last two assessments (NEFSC 2000, MAFMC 2001a). Fishing mortality was underestimated by 31% for 1998, by 45% for 1999, and by 23% for 2000, relative to the current VPA estimates. Spawning stock biomass has been overestimated since 1996, ranging from 5% for 1998 to 23% for 1997. Summer flounder recruitment at age-0 has been underestimated since 1996, ranging from 8% for 1996 to 40% for 1997 (Table A52, Figure A16).

BIOLOGICAL REFERENCE POINTS

The calculation of biological reference points based on yield per recruit for summer flounder using the Thompson and Bell (1934) model was detailed in the 1990 SAW 11 assessment (NEFC 1990). The 1990 analysis estimated $F_{max} = 0.23$. In the 1997 SAW 25 assessment (NEFSC 1997b), an updated yield per recruit analysis reflecting the partial recruitment pattern and mean weights at age for 1995-1996 estimated that $F_{max} = 0.24$. The analysis in the Terceiro (1999) assessment, reflecting partial recruitment and mean weights at age for 1997-1998, estimated that Fmax = 0.263 (Figure A17).

The Overfishing Definition Review Panel (Applegate *et al.* 1998) recommended that the MAFMC base MSY proxy reference points on yield per recruit analysis, and this recommendation was adopted in formulating the current, FMP Amendment 12 reference points (see Introduction), based on the 1999 assessment (Terceiro 1999). The 1999 assessment yield per recruit analysis indicated that $F_{threshold} = F_{target} = F_{max} = 0.263$, yield per recruit (YPR) at F_{max} was 0.55219 kg/recruit, and January 1 biomass per recruit (BPR) at Fmax was 2.8127 kg/recruit. The median number of summer flounder recruits estimated from the 1999 VPA for the 1982-1998 period was 37.844 million fish. Based on this recruitment, maximum sustainable yield (MSY) was estimated to be 20,897 mt (46 million lbs) at a biomass (B_{MSY}) of 106,444 mt (235 million lbs). The biomass threshold, one-half B_{MSY}, was therefore estimated to be 53,222 mt (118 million lbs). Based on the stability of the input data, the SARC concluded that an update of the summer flounder biological reference points was not warranted at this time, and so the Terceiro (1999) estimates have been retained in this assessment.

PROJECTIONS

Stochastic projections were made to provide forecasts of stock size and catches in 2002-2004 consistent with target reference points established in the FMP. The projections assume that recent patterns of discarding will continue over the time span of the projections. Different patterns that could develop in the future due to further trip and bag limits and fishery closures have not been evaluated. The partial recruitment pattern (including discards) used in the projections was estimated as the geometric mean of F at age for 1999-2001, to reflect recent conditions in the fisheries. Mean weights at age were estimated as the geometric means of 1999-2001 values. Separate mean weight at age vectors were developed for the January 1 biomass, landings, and discards.

One hundred projections were made for each of the 500 bootstrapped realizations of 2002 stock sizes from the final 2002 VPA, using algorithms and software described by Brodziak and Rago (MS 1994) as implemented in FACT 1.50. Recruitment during 2002-2004 was generated randomly from a cumulative frequency distribution of VPA recruitment series for 1982-2001 (median recruitment = 35.613 million fish). Other input parameters were as in Table A53; uncertainty in partial recruitment patterns, discard rates, or components other than survey variability was not reflected.

Stochastic projections which assume the adjusted 2002 quota of 10,991 mt will be landed

estimate a median (50% probability) F = 0.32 and a median total stock biomass on January 1, 2003 of 57,600 mt, above the current biomass threshold of one-half B_{MSY} = 53,222 mt. (Table A53, Figures A18-A19). There is a 95% probability that the target F for 2002 (i.e., F_{max} = 0.26) will be exceeded. Landings of 10,580 mt and discards of 1,508 mt in 2003 provide a median F = 0.26 and a median total stock biomass level on January 1, 2004 of 65,600 mt (Table A53, Figures A18-A19). Landings of 12,179 mt (26.9 million lbs) and discards of 1,692 mt (3.7 million lbs) in 2004 provide a median F in 2004 = 0.26 (Table A53, Figure A19.).

CONCLUSIONS

Assessment Results

  The summer flounder stock is overfished and overfishing is occurring relative to the current biological reference points. The fishing mortality rate has declined from 1.32 in 1994 to 0.27 in 2001 (Figure A10) marginally above the current overfishing definition reference point ($F_{threshold} = F_{target} = F_{max}$ = 0.26; Figure A19). There is an 80% chance that the 2001 F was between 0.24 and 0.32 (Figure A15). The estimate of F for 2001 may understate the actual fishing mortality; retrospective analysis shows that the current assessment method tends to underestimate recent fishing mortality rates (e.g., by about 1/3 over the last three years).

  Total stock biomass has increased substantially since 1989, and in 2001 was estimated to be 42,900 mt, 19% below the current biomass threshold (53,200 mt) (Figures A11 & A19). There is an 80% chance that total stock biomass in 2001 was between 39,300 and 46,900 mt (Figure A15). Spawning stock biomass (SSB; Age 0+) declined 72% from 1983 to 1989 (18,800 mt to 5,200 mt), but has increased seven-fold, with improved recruitment and decreased fishing mortality, to 38,200 mt in 2001 (Figure A11). Comparison with previous assessments shows a tendency to slightly overestimate the SSB in recent years. The age structure of the spawning stock has expanded, with 72% at ages 2 and older, and 14% at ages 5 and older (Figure A13). Under equilibrium conditions at F_{max}, about 85% of the spawning stock biomass would be expected to be ages 2 and older, with 50% at ages 5 and older.

  The arithmetic average recruitment from 1982 to 2001 is 40 million fish at age 0, with a median of 36 million fish. The 2000 year class is estimated at 39 million fish. The 2001 year class is currently estimated to be below average, at 27 million fish (Figure A11). It should be noted that retrospective analysis shows that the current assessment method tends to underestimate the abundance of age 0 fish (e.g., by about 20% over the last three years). Recent recruitment per unit of SSB has been lower than that observed during the early 1980s (Figure A14).

  Stochastic forecasts only incorporate uncertainty in 2002 stock sizes due to survey variability and assume current discard to landings proportions. If landings in 2002 are 10,991 mt (24.2 million lbs) and discards are 1,700 mt (3.7 million lbs), the forecast estimates a median (50% probability) F in 2002 = 0.32 and a median total stock biomass on January 1, 2003 (equivalent to December 31, 2002) of 57,600 mt, above the biomass threshold of ½ B_{MSY} = 53,200 mt. (Figure A19). Landings of 10,580 mt (23.3 million lbs) and discards of 1,508 mt (3.3 million lbs) in 2003 provide a median

F in 2003 = 0.26 and a median total stock biomass level on January 1, 2004 of 65,600 mt (Table A53, Figures A18-A19). Landings of 12,179 mt (26.9 million lbs) and discards of 1,692 mt (3.7 million lbs) in 2004 provide a median F in 2004 = 0.26 (Table A53, Figure A19.).

During each of the past six years the recreational fishery has exceeded its harvest limit and, for the entire period, exceeded the limit by 58%. During the same period the commercial fishery exceeded its harvest limit by 5%. These excesses result in a fishing mortality that exceeds the target. Given that there is a persistent retrospective underestimation of fishing mortality, managers should consider adopting a lower TAL than that implied by the current overfishing threshold.

SARC COMMENTS

The SARC discussed the procedure for selecting survey indices used in the summer flounder VPA. The use of state surveys, which cover only a small component of the stock, was questioned. It was noted that YOY surveys may be variable due to the low numbers of fish caught per tow. The SARC requested that the standard error also be shown with the survey indices in the future. Whether differences in state surveys truly measure different trends in different components of the stock or whether differences are simply due to variation among surveys was questioned. It was noted that the F on age 2 fish in recent years was higher than the average F for ages 3-5.

The SARC commented on the presence of a retrospective pattern in the VPA. Discussion focused on whether removals were underestimated in either the commercial discard estimates or by an underestimation of the discard mortality rate in the commercial and/or recreational sectors. The SARC concluded that the tendency for F to be underestimated in the retrospective pattern should not be quantitatively adjusted in the assessment but rather stated as a qualitative concern in the management advice.

The SARC discussed whether the use of an assumption of 10% discard mortality for the recreational catch was appropriate. The discard mortality rate may vary spatially, and may not represent longer term mortality associated with capture and release.

The SARC questioned the appropriateness of setting the F target equal to the threshold. Under these circumstances, when the estimate of F is equal to the target, there is a 50% chance that the threshold is exceeded. With the retrospective pattern in this stock the current F is thus likely to be above the target. However the SARC noted that changing the F_{MSY} proxy and threshold was not a term of reference for this meeting. The proxy used for biological reference points will be re-evaluated for all stocks by a formal committee in the near future. The SARC discussed whether new information exists to warrant updating the values of the biological reference points. It was noted that the combined effect of increases in partial recruitment and decreases in the mean weight at ages 0 and 1 in recent years resulted in no change in F_{max}. However, decreases in biomass per recruit combined with a decrease in the median recruitment would decrease the B_{MSY} proxy by 16%. The SARC questioned the decrease in mean weights at age 0 and the appropriateness of using catch mean weights for estimating B_{MSY}. The SARC pointed out that the apparent decrease in catch mean

weights at age was likely due to changes in the fishery, and not reflective of real changes in the population since survey mean weights do not show the same decrease. Therefore the SARC concluded that changes in input data to the yield per recruit analysis did not justify a change in the reference points at this time.

The SARC was questioned on how to handle late data such as survey indices which are provided after the working group has met and developed an assessment for SARC review. The SARC agreed that data provided after the working group meeting should not be given special consideration and should be excluded from the assessment. The working group meeting is the appropriate place for anyone to contribute data and suggestions to the assessment, thereby allowing appropriate consideration and review by the SARC.

RESEARCH RECOMMENDATIONS

The SARC made the following recommendations:

1) Expand the NEFSC fishery observer program for summer flounder, with special emphasis on a) comprehensive areal and temporal coverage, b) adequate length and age sampling, and c) continued sampling after commercial fishery areal and seasonal quotas are reached and fisheries are limited or closed, and d) sampling of summer flounder discard in the scallop dredge fishery. Maintaining adequate observer coverage will be especially important in order to monitor a) the effects of implementation of gear and closed/exempted area regulations, both in terms of the response of the stock and the fishermen, b) potential continuing changes in "directivity" in the summer flounder fishery, as a results of changes in stock levels and regulations, and c) discards of summer flounder in the commercial fishery once quota levels have been attained and the summer flounder fishery is closed or restricted by trip limits.

2) Evaluate the amount of observer data needed to reliably estimate discards of summer flounder in all components of the fishery.

3) Conduct further research to better determine the discard mortality rate of recreational and commercial fishery summer flounder discards.

4) Develop a program to annually sample the length and age frequency of summer flounder discards from the recreational fishery.

5) RIDFW monthly fixed station survey length frequencies are currently converted to age using length cut-offs points. Investigate the utility of applying the appropriate NEFSC or MADMF age-length keys to convert the RIDFW monthly fixed station survey lengths to age.

6) Explore the possibility of weighting survey indices used in VPA calibration by the areal coverage (e.g., in square kilometers) of the respective seasonal surveys.

7) Explore the sensitivity of the VPA calibration to the addition of 1 and/or a small constant to values of survey series with "true zeros."

8) Statistically analyze changes in mean weights at age in the catch and NEFSC surveys. Determine if using mean weights at age in the survey are more appropriate for estimating the B_{MSY} proxy. Explore the sensitivity of the mean weights of the catch and partial recruitment pattern from a longer time series (1997 to 2001) to the re-estimated B_{MSY} proxy.) As the NEFSC fall survey age structure expands, investigate the use of survey mean weights at age for stock weights at age in yield per recruit, VPA, and projection analyses.

9) Monitor changes in life history (growth and maturity) as the stock rebuilds.

10) Evaluate use of a forward calculating age-structured model for comparison with VPA. Forward models would facilitate use of expanding age/sex structure and allow inclusion of historical data. If sex-specific assessments are explored, the implications on YPR should also be investigated.

11) Explore the sensitivity of the VPA results to separating the summer flounder stock into multiple components.

12) Evaluate trends in the regional components of the NEFSC surveys and contrast with the state surveys that potentially index components of the stock.

Major Sources of Assessment Uncertainty
        The SARC identified the following major sources of uncertainty in the summer flounder assessment:

1) The landings from the commercial fisheries used in this assessment assume no under reporting of summer flounder landings. Therefore, reported landings from the commercial fisheries should be considered minimal estimates.

2) The recreational fishery landings and discards used in the assessment are estimates developed from the Marine Recreational Fishery Statistics Survey (MRFSS). While the estimates of summer flounder catch are considered to be among the most reliable produced by the MRFSS, they are subject to possible error. The proportional standard error (PSE) of estimates of summer flounder total landings in numbers has averaged 7%, ranging from 26% in 1982 to 3% in 1996, during 1982-2001.

3) The intensity of fishery observer sampling of the commercial scallop dredge fishery (outside of exempted area fisheries) was particularly low in 2001. This level of observer coverage likely was insufficient to accurately characterize summer flounder discards.

4) The length and age composition of the recreational discards are based on data from a limited geographic area (Long Island, New York, 1988-1992; Connecticut, 1997-2001, New York party boats 2000-2001, ALS releases focused in New York and New Jersey, 1999-2001). Sampling of recreational fishery discards on a annual, synoptic basis is needed.

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Table A1. Summer Flounder Commercial Landings by State (thousands of lb) and coastwide (thousands of pounds ('000 lbs), metric tons (mt)).

Year	ME	NH	MA	RI	CT	NY	NJ	DE	MD+	VA+	NC+	Total '000 lbs	mt
1940	0	0	2847	258	149	1814	3554	3	444	1247	498	10814	4905
1941	na	na	na	na	na	na	na	na	183	764	na	947	430
1942	0	0	193	235	126	1286	987	2	143	475	498	3945	1789
1943	0	0	122	202	220	1607	2224	11	143	475	498	5502	2496
1944	0	0	719	414	437	2151	3159	8	197	2629	498	10212	4632
1945	0	0	1730	467	270	3182	3102	2	460	1652	1204	12297	5578
1946	0	0	1579	625	478	3494	3310	22	704	2889	1204	14305	6489
1947	0	0	1467	333	813	2695	2302	46	532	1754	1204	11146	5056
1948	0	0	2370	406	518	2308	3044	15	472	1882	1204	12219	5542
1949	0	0	1787	470	372	3560	3025	8	783	2361	1204	13570	6155
1950	0	0	3614	1036	270	3838	2515	25	543	1761	1840	15442	7004
1951	0	0	4506	1189	441	2636	2865	20	327	2006	1479	15469	7017
1952	0	0	4898	1336	627	3680	4721	69	467	1671	2156	19625	8902
1953	0	0	3836	1043	396	2910	7117	53	1176	1838	1844	20213	9168
1954	0	0	3363	2374	213	3683	6577	21	1090	2257	1645	21223	9627
1955	0	0	5407	2152	385	2608	5208	26	1108	1706	1126	19726	8948
1956	0	0	5469	1604	322	4260	6357	60	1049	2168	1002	22291	10111
1957	0	0	5991	1486	677	3488	5059	48	1171	1692	1236	20848	9456
1958	0	0	4172	950	360	2341	8109	209	1452	2039	892	20524	9310
1959	0	0	4524	1070	320	2809	6294	95	1334	3255	1529	21230	9630
1960	0	0	5583	1278	321	2512	6355	44	1028	2730	1236	21087	9565
1961	0	0	5240	948	155	2324	6031	76	539	2193	1897	19403	8801
1962	0	0	3795	676	124	1590	4749	24	715	1914	1876	15463	7014
1963	0	0	2296	512	98	1306	4444	17	550	1720	2674	13617	6177
1964	0	0	1384	678	136	1854	3670	16	557	1492	2450	12237	5551
1965	0	0	431	499	106	2451	3620	25	734	1977	272	10115	4588
1966	0	0	264	456	90	2466	3830	13	630	2343	4017	14109	6400
1967	0	0	447	706	48	1964	3035	0	439	1900	4391	12930	5865
1968	0	0	163	384	35	1216	2139	0	350	2164	2602	9053	4106
1969	0	0	78	267	23	574	1276	0	203	1508	2766	6695	3037

* = less than 500 lb; na = not available; + = NMFS did not identify flounders to species prior to 1978 for NC and 1957 for both MD and VA and thus the numbers represent all unclassified flounders.
Sources: 1940-1977 USDC 1984; 1978-1979 unpublished NMFS General Canvas data

Table A1 continued.

Year	ME	NH	MA	RI	CT	NY	NJ	DE	MD+	VA+	NC+	Total '000 lb	mt
1970	0	0	41	259	23	900	1958	0	371	2146	3163	8861	4019
1971	0	0	89	275	34	1090	1850	0	296	1707	4011	9352	4242
1972	0	0	93	275	7	1101	1852	0	277	1857	3761	9223	4183
1973	0	0	506	640	52	1826	3091	*	495	3232	6314	16156	7328
1974	*	0	1689	2552	26	2487	3499	0	709	3111	10028	22581	10243
1975	0	0	1768	3093	39	3233	4314	5	893	3428	9539	26311	11934
1976	*	0	4019	6790	79	3203	5647	3	697	3303	9627	33368	15135
1977	0	0	1477	4058	64	2147	6566	5	739	4540	10332	29927	13575
1978	0	0	1439	2238	111	1948	5414	1	676	5940	10820	28586	12966
1979	5	0	1175	2825	30	1427	6279	6	1712	10019	16084	39561	17945
1980	4	0	367	1277	48	1246	4805	1	1324	8504	13643	31216	14159
1981	3	0	598	2861	81	1985	4008	7	403	3652	7459	21056	9551
1982	18	*	1665	3983	64	1865	4318	8	360	4332	6315	22928	10400
1983	84	0	2341	4599	129	1435	4826	5	937	8134	7057	29548	13403
1984	2	*	1488	4479	131	2295	6364	9	813	9673	12510	37765	17130
1985	3	*	2249	7533	183	2517	5634	4	577	5037	8614	32352	14675
1986	0	*	2954	7042	160	2738	4017	4	316	3712	5924	26866	12186
1987	8	*	3327	4774	609	2641	4451	4	319	5791	5128	27052	12271
1988	5	0	2421	4719	741	3439	6006	7	514	7756	6770	32377	14686
1989	9	0	1878	3083	513	1464	2865	3	204	3689	4206	17913	8125
1990	3	0	628	1408	343	405	1458	2	138	2144	2728	9257	4199
1991	0	0	1124	1672	399	719	2341	4	232	3715	3516	13722	6224
1992	*	*	1383	2532	495	1239	2871	12	319	5172	2576	16599	7529
1993	6	0	903	1942	225	849	2466	6	254	3052	2894	12599	5715
1994	4	0	1031	2649	371	1269	2356	4	179	3091	3571	14525	6588
1995	5	0	1128	2325	319	1248	2319	4	174	3304	4555	15381	6977
1996	8	0	780	1664	266	928	2345	7	225	2280	4218	12721	5770
1997	3	0	745	1566	257	823	1321	5	215	2370	1501	8806	3994
1998	6	0	709	1716	263	823	1863	11	224	2616	2967	11199	5080
1999	6	0	813	1637	245	804	1918	8	201	2196	2801	10627	4820
2000	7	0	789	1703	240	800	1848	12	252	2206	3354	11211	5085
2001	22	0	694	1800	205	751	1745	7	223	2660	2730	10838	4916

* = less than 500 lb; na = not available; Sources: 1980-2001 State and Federal reporting systems,
    1995-98 NC DMF Trip Ticket System

Table A2. Distribution of Northeast Region (ME-VA) commercial fishery landings by
statistical area.

Area	1992	1993	1994	1995	1996	1997	1998	1999
511	0	0	0	0	1	0	0	0
512	0	0	0	0	1	1	0	0
513	0	3	0	0	2	0	0	2
514	9	11	10	12	3	15	17	11
515	0	0	0	0	0	0	0	0
521	8	3	14	4	16	2	9	2
522	8	8	7	6	13	6	2	3
561	2	1	0	0	1	1	3	2
562	6	4	5	10	1	1	0	3
525	22	35	26	85	137	16	27	28
526	294	242	193	128	44	22	33	17
533	0	0	0	0	6	2	3	5
537	916	557	707	770	539	449	418	354
538	228	255	341	332	267	270	229	275
539	217	157	223	258	242	284	374	418
611	117	35	181	283	166	141	204	230
612	404	393	169	221	344	297	317	403
613	237	167	280	242	184	194	128	171
614	81	97	141	129	18	41	41	13
615	61	15	49	99	20	37	41	44
616	532	476	743	730	462	245	280	122
621	1028	526	258	279	318	266	286	304
622	299	363	323	522	258	53	141	301
623	0	6	0	14	28	0	1	0
625	289	227	122	118	276	227	142	91
626	743	601	821	347	385	94	503	415
631	655	98	219	220	21	174	258	140
632	160	77	60	43	73	30	41	79
635	45	45	77	55	29	418	228	97
636	0	0	0	4	2	27	8	20
Total	6361	4402	4969	4911	3857	3313	3734	3550

Table A2 continued.

Area	2000	2001
511	1	0
512	1	0
513	0	1
514	2	1
515	0	0
521	4	15
522	6	5
561	4	7
562	8	3
525	41	29
526	16	23
533	10	2
537	326	337
538	260	214
539	455	437
611	142	157
612	308	379
613	170	162
614	3	11
615	70	115
616	384	281
621	208	274
622	101	234
623	8	18
625	60	129
626	697	442
631	185	142
632	39	41
635	54	212
636	1	7
Total	3564	3678

Table A3. Summary of NEFSC sampling of commercial fishery for summer flounder, ME-VA[1].

Year	Lengths	Ages	NER Landings (MT)	Sampling Intensity (mt/100 lengths)
1982	8,194	2,288	7,536	92
1983	6,893	1,347	10,202	148
1984	5,340	1,794	11,455	215
1985	6,473	1,611	10,767	166
1986	7,840	1,967	9,499	121
1987	6,605	1,788	9,945	151
1988	9,048	2,302	11,615	128
1989	8,411	1,325	6,217	74
1990	3,419	853	2,962	87
1991	4,627	1,089	4,626	100
1992	3,385	899	6,361	188
1993	3,638	844	4,402	121
1994	3,950	956	4,969	126
1995	2,982	682	4,911	165
1996	4,580	1,235	3,857	84
1997	8,855	2,332	3,313	37
1998	10,055	2,641	3,734	37
1999	10,460	3,244	3,550	34
2000	10,956	3,307	3,564	33
2001	9,521	2,838	3,678	39

1 Does not include unclassified market category landings for 1982-93.

Table A4. Commercial landings at age of summer flounder ('000), ME-VA. Does not include discards, assumes catch not sampled by NEFSC has same biological characteristics as port sampled catch.

					AGE						
Year	0	1	2	3	4	5	6	7	8	9+	Total
1982	1,441	6,879	5,630	232	61	97	57	22	2	0	14,421
1983	1,956	12,119	4,352	554	30	62	13	17	4	2	19,109
1984	1,403	10,706	6,734	1,618	575	72	3	5	1	4	21,121
1985	840	6,441	10,068	956	263	169	25	4	2	1	18,769
1986	407	7,041	6,374	2,215	158	93	29	7	2	0	16,326
1987	332	8,908	7,456	935	337	23	24	27	11	0	18,053
1988	305	11,116	8,992	1,280	327	79	18	9	5	0	22,131
1989	96	2,491	4,829	841	152	16	3	1	1	0	8,430
1990	0	2,670	861	459	81	18	6	1	1	0	4,096
1991	0	3,755	3,256	142	61	11	1	1	0	0	7,227
1992	114	5,760	3,575	338	19	22	0	1	0	0	9,829
1993	151	4,308	2,340	174	29	43	19	2	1	0	7,067
1994	119	3,698	3,692	272	64	12	6	0	5	0	7,868
1995	46	2,566	4,280	241	40	8	0	1	0	0	7,182
1996	0	1,401	3,187	798	156	15	3	0	1	0	5,559
1997	0	380	2,442	1,214	261	69	10	4	0	0	4,381
1998	0	196	1,719	2,022	437	72	15	1	0	0	4,462
1999	0	123	1,570	1,522	585	160	26	8	0	0	3,994
2000	0	212	1,934	1,083	449	119	47	15	6	2	3,867
2001	0	713	1,402	980	324	155	59	16	4	3	3,656

Table A5. Mean weight (kg) at age of summer flounder landed in the commercial fishery, ME-VA.

Year	0	1	2	3	4	5	6	7	8	9+	ALL
					AGE						
1982	0.26	0.42	0.62	1.84	2.33	2.94	2.71	4.04	5.99		0.55
1983	0.31	0.46	0.80	1.40	2.35	1.85	2.76	3.30	4.17	4.37	0.56
1984	0.28	0.39	0.60	0.11	1.43	2.16	3.21	3.62	4.64	4.03	0.54
1985	0.33	0.44	0.59	1.08	1.73	2.22	2.59	4.71	4.78	4.80	0.59
1986	0.30	0.44	0.63	1.11	1.76	1.89	3.14	2.96	4.81		0.63
1987	0.27	0.45	0.62	1.06	2.00	2.85	3.08	3.02	4.14		0.59
1988	0.36	0.46	0.60	1.21	2.07	2.88	3.98	3.91	4.50		0.60
1989	0.36	0.55	0.74	1.06	1.83	2.47	3.57	3.59	2.25		0.74
1990		0.52	0.86	1.37	1.84	2.13	3.21	3.92	5.03		0.72
1991		0.48	0.75	1.54	2.26	3.01	3.91	3.87			0.64
1992	0.34	0.50	0.82	1.88	2.68	3.09		4.59			0.67
1993	0.35	0.49	0.75	1.63	2.10	1.79	2.81	4.14	5.20		0.62
1994	0.39	0.55	0.62	1.43	2.27	3.08	3.32		3.70		0.63
1995	0.33	0.54	0.70	1.54	2.37	2.92		4.09			0.68
1996		0.54	0.58	1.14	1.88	2.85	3.78		4.76		0.69
1997		0.54	0.63	0.84	1.31	2.10	2.56	3.43			0.76
1998		0.55	0.64	0.85	1.39	2.31	2.52	3.98			0.84
1999		0.52	0.62	0.86	1.36	1.93	2.84	3.62			0.89
2000		0.57	0.68	0.97	1.46	2.13	2.51	2.60	3.30	3.53	0.92
2001		0.59	0.76	1.03	1.73	2.39	2.86	3.57	3.90	4.94	1.01

Table A6. Summary of North Carolina Division of Marine Fisheries (NCDMF) sampling
of the commercial winter trawl fishery for summer flounder.

Year	Lengths	Ages	Total Landings (MT)	Total MT per 100 lengths
1982	5,403	0	2,864	53
1983	8,491	0	3,201	38
1984	14,920	0	5,674	38
1985	13,787	0	3,907	28
1986	15,754	0	2,687	17
1987	12,126	0	2,326	19
1988	13,377	189	3,071	23
1989	15,785	106	1,908	12
1990	15,787	191	1,238	8
1991	24,590	534	1,582	6
1992	14,321	364	1,168	8
1993	18,019	442	1,313	7
1994	21,858	548	1,620	7
1995	18,410	548	2,066	11
1996	17,745	477	1,913	11
1997	12,802	388	681	5
1998	21,477	476	1,346	6
1999	11,703	412	1,271	11
2000	24,177	568	1,521	6
2001	19,655	499	1,263	6

Table A7. Number ('000) of summer flounder at age landed in the North Carolina commercial winter trawl fishery. The 1982-1987 NCDMF length samples were aged using NEFSC age-lengths keys for comparable times and areas (i.e., same quarter and statistical areas). Since 1987, the NCDMF length samples have been aged using NCDMF age-lengths keys.

Year	0	1	2	3	4	5	6	7	8+	Total
					AGE					
1982	981	3,463	1,021	142	52	19	6	4	2	5,691
1983	492	3,778	1,581	287	135	41	3	3	<1	6,321
1984	907	5,658	3,889	550	107	18	<1	0	0	11,130
1985	196	2,974	3,529	338	85	24	5	<1	0	7,152
1986	216	2,478	1,897	479	29	32	1	1	<1	5,134
1987	233	2,420	1,299	265	28	1	0	0	0	4,243
1988	0	2,917	2,225	471	227	39	1	6	<1	5,887
1989	2	49	1,437	716	185	37	1	2	0	2,429
1990	2	142	730	418	117	12	1	<1	0	1,424
1991	0	382	1,641	521	116	20	2	<1	0	2,682
1992	0	36	795	697	131	21	2	<1	0	1,682
1993	0	515	1,101	252	44	1	<1	0	0	1,913
1994	6	258	1,262	503	115	14	3	<1	0	2,161
1995	<1	181	1,391	859	331	53	2	<1	0	2,817
1996	0	580	2,187	554	132	56	13	<1	2	3,526
1997	0	17	625	378	18	3	<1	0	0	1,041
1998	18	548	694	230	28	3	<1	0	0	1,520
1999	1	70	504	579	152	88	6	3	<1	1,403
2000	0	50	398	906	345	55	18	1	2	1,775
2001	0	79	408	556	334	63	18	5	<1	1,463

Table A8. Mean weight (kg) at age of summer flounder landed in the North Carolina commercial winter trawl fishery.

					AGE					
Year	0	1	2	3	4	5	6	7	8+	ALL
1982	0.34	0.46	0.76	1.28	1.66	2.05	2.12	2.23	2.58	0.53
1983	0.32	0.45	0.75	1.14	1.26	1.49	1.73	2.43	2.70	0.57
1984	0.33	0.48	0.70	1.06	1.50	2.17	3.48			0.59
1985	0.38	0.46	0.66	1.20	1.66	2.49	3.07	4.57		0.62
1986	0.36	0.51	0.67	1.09	1.62	1.96	3.40	3.23	3.63	0.64
1987	0.33	0.51	0.66	1.09	1.88	2.94				0.59
1988		0.41	0.60	0.93	1.19	1.70	2.24	2.98	3.41	0.57
1989	0.12	0.38	0.60	0.99	1.16	2.10	3.09	2.50		0.78
1990	0.08	0.48	0.66	0.87	1.31	2.10	1.90	3.97		0.77
1991		0.45	0.66	1.07	1.73	2.25	2.51	3.13	4.10	0.77
1992		0.36	0.50	0.85	1.20	1.46	2.30			0.71
1993		0.49	0.61	1.13	1.37	2.95	3.41			0.66
1994	0.27	0.45	0.62	1.27	2.04	2.44	2.89	5.78		0.84
1995	0.04	0.21	0.46	0.85	1.47	2.49	3.79	3.82		0.72
1996		0.42	0.47	0.73	1.35	1.72	2.29	3.20	2.86	0.56
1997		0.41	0.62	0.76	1.32	2.07	3.25			0.68
1998	0.41	0.71	0.89	1.24	1.49	2.80	3.38			0.89
1999	0.14	0.58	0.73	0.92	1.40	1.68	2.61	3.06	3.90	0.95
2000		0.56	0.66	0.80	1.20	1.96	2.59	3.31	3.52	0.90
2001		0.59	0.67	0.76	1.07	1.72	2.39	3.07	4.24	0.87

Table A9. Summary NER fishery observer data for trips catching summer flounder. Total trips (trips are not split for multiple areas), observed tows, total summer flounder catch (lb), total summer flounder kept (lb), and total summer flounder discard (lb), and percentage of summer flounder discard (lb) to summer flounder catch (lb).

Year	Gear	Trips	Obs Tows	Total Catch	Total Kept	Total Discard	Discard: Total (%)
1989	All	57	413	53,714	48,406	5,308	9.9
1990	All	61	463	47,954	35,972	11,982	25.0
1991	All	82	635	61,650	50,410	11,240	18.2
1992	Trawl	66	643	136,632	118,026	18,606	13.6
	Scallop	8	178	1,477	767	710	48.1
	All	74	821	138,109	118,793	19,316	14.0
1993	Trawl	37	410	74,982	67,603	7,379	9.8
	Scallop	15	671	2,967	1,158	1,809	61.0
	All	52	1,081	77,949	68,761	9,188	11.8
1994	Trawl	51	574	174,347	163,734	10,612	6.1
	Scallop	14	651	5,811	435	5,376	92.5
	All	65	1,225	180,158	164,169	15,988	8.9
1995	Trawl	134	1,004	242,784	235,011	7,773	3.2
	Scallop	19	1,051	10,044	2,247	7,778	77.4
	All	153	2,055	252,828	237,258	15,551	6.2
1996	Trawl	111	653	101,389	90,789	10,600	10.5
	Scallop	24	1,083	9,575	1,345	8,230	86.0
	All	135	1,736	110,964	92,134	18,830	17.0
1997	Trawl	59	334	31,707	26,475	5,232	16.5
	Scallop	23	835	5,721	583	5,138	89.8
	All	82	1,169	37,428	27,058	10,370	27.7

Table A9 continued.

Year	Gear	Trips	Obs Tows	Total Catch	Total Kept	Total Discard	Discard: Total (%)
1998	Trawl	53	329	72,396	65,507	6,889	9.5
	Scallop	22	359	1,962	652	1,310	66.8
	All	75	688	74,358	66,159	8,199	11.0
1999	Trawl	56	374	60,733	45,987	14,746	24.3
	Scallop	10	247	3,199	458	2,741	85.7
	All	66	621	63,932	46,445	17,487	27.4
2000	Trawl	115	688	162,015	144,752	17,263	10.7
	Scallop	23	608	8,457	501	7,956	94.1
	All	138	1,296	170,472	145,253	25,219	14.8
2001	Trawl	132	581	109,285	61,497	47,789	53.9
	Scallop	4	176	1,835	6	1,830	99.7
	All	136	757	111,120	61,503	49,619	44.7

Table A10. Summary NER Vessel Trip Report (VTR) data for trips reporting discard of any species and catching summer flounder. Total trips, total summer flounder catch (lb), total summer flounder kept (lb), total summer flounder discard (lb), and percentage of summer flounder discard (lb) to summer flounder catch (lb).

Year	Gear	Trips	Total Catch	Total Kept	Total Discard	Discard: Total (%)
1994	Trawl	4,267	2,149,332	2,015,296	134,036	6.2
	Scallop	85	70,353	22,877	47,476	67.5
	All	4,352	2,219,685	2,038,173	181,512	8.2
1995	Trawl	3,733	2,444,231	2,332,516	111,715	4.6
	Scallop	113	78,758	25,084	53,674	68.2
	All	3,846	2,522,989	2,357,600	165,389	6.6
1996	Trawl	2,990	1,662,313	1,459,155	203,158	12.2
	Scallop	79	69,557	16,657	52,900	76.1
	All	3,069	1,731,870	1,475,812	256,058	14.8
1997	Trawl	3,044	988,599	851,090	137,509	13.9
	Scallop	51	21,553	4,665	16,888	78.4
	All	3,095	1,010,152	855,755	154,397	15.3
1998	Trawl	3,004	1,128,578	868,706	259,872	23.0
	Scallop	62	23,538	10,323	13,215	56.1
	All	3,066	1,152,116	879,029	273,087	23.7
1999	Trawl	2,884	959,275	772,924	186,351	19.4
	Scallop	41	26,334	14,324	12,010	45.6
	All	2,925	985,609	787,248	198,361	20.1
2000	Trawl	3,140	1,048,791	786,576	262,215	25.0
	Scallop	41	12,183	3,798	8,385	68.8
	All	3,181	1,060,974	790,374	270,600	25.5
2001	Trawl	3,035	1,086,331	783,900	307,156	28.3
	Scallop	69	14,592	1,349	13,243	90.8
	All	3,104	1,100,923	785,249	320,399	29.1

Table A11. Summary of Northeast Region fishery observer data to estimate summer flounder discard at age in the commercial fishery. Estimates developed using fishery observer length samples, age-length data, and estimates of total discard in mt. An 80% discard mortality rate is assumed. 1995-2001 lengths converted to age using 1995-2001 NEFSC trawl survey ages;   n/a = not available.

Year	Gear	Lengths	Ages	Fishery Observer Discard Estimate (mt)	Sampling Intensity (mt per 100 lengths)	Raised Discard Estimate (mt)	Raised Estimate with 80% mortality rate (mt)
1989	All	2,337	54	642	27	886	709
1990	All	3,891	453	1,121	29	1,517	1,214
1991	All	5,326	190	993	19	1,315	1,052
1992	All	9,626	331	755	8	862	690
1993	All	3,410	406	817	24	1,057	846
1994	Trawl	2,338	---	429	18	542	434
	Scallop	660	---	590	89	590	472
	All	2,998	354	1,019	34	1,132	906
1995	Trawl	1,822	---	130	7	173	138
	Scallop	731	---	212	29	212	170
	All	2,553	n/a	342	13	385	308
1996	Trawl	1,873	---	319	17	444	355
	Scallop	854	---	135	16	135	108
	All	2,727	n/a	454	17	579	463
1997	Trawl	839		299	36	299	239
	Scallop	556		108	19	108	86
	All	1,395	n/a	407	29	407	326

Table A11 continued.

Year	Gear	Lengths	Ages	Fishery Observer Discard Estimate (mt)	Sampling Intensity (mt per 100 lengths)	Raised Discard Estimate (mt)	Raised Estimate with 80% mortality rate (mt)
1998	Trawl	721		318	44	318	254
	Scallop	150		169	113	169	135
	All	871	n/a	487	56	487	389
1999	Trawl	1,145		1,476	129	1,476	1,181
	Scallop	216		459	213	459	367
	All	1,361	n/a	1,935	142	1,935	1,548
2000	Trawl	1,470		740	50	740	592
	Scallop	2,611		167	6	167	134
	All	4,081	n/a	907	22	907	726
2001	Trawl	1,394		284	20	284	227
	Scallop	11		515	4,682	515	412
	All	1,405	n/a	799	57	799	639

Table A12. Estimated summer flounder discard at age in the in the commercial fishery. 1995-2001 lengths converted to age using 1995-2001 NEFSC trawl survey ages. Includes an assumed 80% discard mortality rate.

Discard numbers at age (000s)

Year	Gear	0	1	2	3+	Total
1989	All	775	1,628	94	0	2,497
1990	All	1,441	2,755	67	0	4,263
1991	All	891	3,424	<1	0	4,315
1992	All	1,155	1,544	36	3	2,738
1993	All	1,041	1,532	179	1	2,753
1994	Trawl	571	1,014	95	0	1,680
	Scallop	0	663	398	36	1,098
	All	571	1,677	493	36	2,778
1995	Trawl	141	294	58	2	495
	Scallop	0	114	148	20	282
	All	141	408	206	22	777
1996	Trawl	23	417	167	56	663
	Scallop	<1	221	72	5	298
	All	23	638	239	61	961
1997	Trawl	8	215	203	50	476
	Scallop	0	34	98	22	154
	All	8	249	301	72	630
1998	Trawl	26	132	146	95	399
	Scallop	1	42	73	52	168
	All	27	174	219	157	567
1999	Trawl	95	1,159	1,012	255	2,521
	Scallop	1	64	239	176	479
	All	96	1,223	1,251	431	3,001
2000	Trawl	20	118	378	303	819
	Scallop	2	46	82	49	179
	All	22	164	460	352	998
2001	All	51	176	198	363	788

Table A13. Estimated summer flounder discard mean length at age in the commercial fishery. 1995-2001 lengths converted to age using 1995-2001 NEFSC trawl survey ages.

Discard mean length (cm) at age

Year	Gear	0	1	2	3+	All
1989	All	25.9	31.5	44.2		30.2
1990	All	29.0	31.7	38.9		30.9
1991	All	24.0	30.9	37.0		29.5
1992	All	29.3	30.0	36.6	51.2	29.8
1993	All	30.0	32.5	34.8	55.0	31.7
1994	Trawl	26.0	31.3	34.5		29.7
	Scallop		30.8	38.2	52.1	34.2
	All	26.0	31.1	37.5	52.1	31.5
1995	Trawl	29.6	29.4	37.0	50.9	30.4
	Scallop		30.7	40.6	52.4	37.4
	All	29.6	29.8	39.6	52.5	33.0
1996	Trawl	28.9	32.0	38.1	55.8	35.5
	Scallop	31.4	30.7	38.2	48.5	32.8
	All	29.0	31.6	38.1	55.2	34.7
1997	Trawl	26.9	32.1	37.8	46.6	36.0
	Scallop		32.5	37.2	45.9	37.5
	All	26.9	32.2	37.6	46.3	36.4
1998	Trawl	26.0	32.5	37.5	48.3	37.7
	Scallop	30.0	35.0	39.7	48.9	41.3
	All	26.1	33.1	38.2	48.5	38.8
1999	Trawl	25.8	32.0	35.9	48.5	34.9
	Scallop	31.0	33.2	36.3	48.8	40.5
	All	25.9	32.1	36.0	48.6	35.9
2000	Trawl	17.2	32.6	37.7	46.3	39.5
	Scallop	26.8	34.4	39.5	47.6	40.3
	All	18.1	33.2	38.0	46.5	39.6
2001	All	21.1	32.9	39.2	47.7	40.3

Table A14. Estimated summer flounder discard mean weight at age in the in the commercial fishery. 1995- 2001 lengths converted to age using 1995-2001 NEFSC trawl survey ages.

Discard mean weight (kg) at age

Year	Gear	0	1	2	3+	All
1989	All	0.182	0.296	0.909		0.284
1990	All	0.235	0.304	0.559		0.285
1991	All	0.124	0.275	0.491		0.244
1992	All	0.238	0.256	0.498	1.450	0.252
1993	All	0.253	0.332	0.413		0.307
1994	Trawl	0.177	0.291	0.392		0.258
	Scallop		0.287	0.565	1.565	0.430
	All	0.177	0.289	0.532	1.565	0.326
1995	Trawl	0.244	0.242	0.522	1.505	0.280
	Scallop		0.281	0.702	1.604	0.595
	All	0.244	0.253	0.651	1.597	0.395
1996	Trawl	0.226	0.312	0.586	2.004	0.521
	Scallop	0.305	0.274	0.572	1.254	0.363
	All	0.227	0.299	0.582	1.937	0.472
1997	Trawl	0.178	0.327	0.560	1.088	0.504
	Scallop		0.331	0.553	1.044	0.558
	All	0.178	0.328	0.558	1.075	0.517
1998	Trawl	0.158	0.332	0.533	1.346	0.637
	Scallop	0.247	0.421	0.651	1.357	0.808
	All	0.161	0.353	0.572	1.350	0.688
1999	Trawl	0.156	0.317	0.462	1.300	0.468
	Scallop	0.275	0.355	0.478	1.310	0.767
	All	0.157	0.319	0.465	1.304	0.516
2000	Trawl	0.055	0.355	0.555	1.114	0.722
	Scallop	0.174	0.412	0.643	1.023	0.741
	All	0.066	0.371	0.571	1.138	0.725
2001	All	0.084	0.356	0.622	1.207	0.797

Table A15. Estimated total landings (catch types A + B1, [000s]) of summer flounder by recreational fishermen. SHORE mode includes fish taken from beach/bank and man-made structures. P/C indicates catch taken from party/charter boats, while P/R indicates fish taken from private/rental boats.

	YEAR										
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
North											
Shore	167	144	62	10	70	39	42	4	16	9	26
P/C Boat	138	201	5	3	48	7	1	1	1	8	1
P/R Boat	1,293	747	568	382	2,562	648	379	137	99	173	211
TOTAL	1,598	1,092	635	395	2,680	694	422	142	116	190	238
Mid											
Shore	682	3,296	977	272	478	251	594	84	96	505	200
P/C Boat	5,745	3,321	2,381	1,068	1,541	1,143	1,164	141	412	589	374
P/R Boat	5,731	12,345	11,764	8,454	5,924	5,499	7,271	1,141	2,658	4,573	3,983
TOTAL	12,158	18,962	15,122	9,794	7,943	6,893	9,029	1,366	3,166	5,667	4,557
South											
Shore	272	523	316	504	689	115	306	91	150	51	50
P/C Boat	53	52	110	81	20	1	1	1	1	1	1
P/R Boat	1,392	367	1,292	292	289	162	355	117	361	159	156
TOTAL	1,717	942	1,718	877	998	278	662	209	512	211	207
All											
Shore	1,121	3,963	1,355	786	1,237	405	942	179	262	565	276
P/C Boat	5,936	3,574	2,496	1,152	1,609	1,151	1,166	143	414	598	376
P/R Boat	8,416	13,459	13,624	9,128	8,775	6,309	8,005	1,395	3,118	4,905	4,350
TOTAL	15,473	20,996	17,475	11,066	11,621	7,865	10,113	1,717	3,794	6,068	5,002

Table A15 continued.

					YEAR				
	1993	1994	1995	1996	1997	1998	1999	2000	2001
North									
Shore	36	49	19	22	27	44	34	57	4
P/C Boat	10	24	6	7	22	26	19	45	13
P/R Boat	250	596	449	717	669	970	769	1,355	539
TOTAL	296	669	474	746	718	1,040	822	1,457	556
Mid									
Shore	176	195	175	137	195	243	157	445	195
P/C Boat	872	773	267	1,167	907	333	281	557	311
P/R Boat	3,969	4,372	2,312	4,999	5,059	4,972	2,610	4,565	3,849
TOTAL	5,017	5,340	2,754	6,303	6,161	5,548	3,048	5,567	4,355
South									
Shore	113	180	48	46	32	30	23	38	23
P/C Boat	1	2	1	5	2	2	<1	1	<1
P/R Boat	236	197	100	274	247	360	214	312	302
TOTAL	350	379	149	325	281	391	237	351	325
All									
Shore	325	424	242	205	254	317	214	540	222
P/C Boat	883	799	274	1,179	931	361	301	603	325
P/R Boat	4,455	5,165	2,861	5,990	5,975	6,302	3,593	6,232	4,690
TOTAL	5,663	6,388	3,377	7,374	7,160	6,979	4,107	7,375	5,236

Table A16. Estimated total landings (catch types A + B1, [mt]) of summer flounder by recreational fishermen. SHORE mode includes fish taken from beach/bank and man-made structures. P/C indicates catch taken from party/charter boats, while P/R indicates fish taken from private/rental boats.

	YEAR										
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
North											
Shore	87	59	17	7	25	21	32	2	16	6	20
P/C Boat	85	87	4	2	45	4	<1	<1	<1	6	<1
P/R Boat	875	454	388	328	2,597	582	289	141	89	150	175
TOTAL	1,047	600	409	337	2,667	607	322	144	106	162	196
Mid											
Shore	295	1,254	399	140	293	129	329	52	56	306	126
P/C Boat	3,112	2,196	1,426	609	1,093	1,098	799	125	264	364	267
P/R Boat	3,085	8,389	5,686	4,187	3,521	3,596	5,003	985	1,665	2,673	2,536
TOTAL	6,492	11,839	7,511	4,936	4,907	4,823	6,131	1,162	1,985	3,343	2,929
South											
Shore	87	134	98	230	425	34	113	57	76	25	25
P/C Boat	12	12	23	20	7	1	<1	<1	<1	<1	<1
P/R Boat	629	102	471	142	96	54	166	71	161	80	91
TOTAL	728	248	592	392	528	89	280	129	238	106	117
All											
Shore	469	1,447	514	377	743	184	474	111	148	337	171
P/C Boat	3,209	2,295	1,453	631	1,145	1,103	801	127	266	371	269
P/R Boat	4,589	8,945	6,545	4,657	6,214	4,232	5,458	1,197	1,915	2,903	2,802
TOTAL	8,267	12,687	8,512	5,665	8,102	5,519	6,733	1,435	2,329	3,611	3,242

Table A16 continued.

	YEAR								
	1993	1994	1995	1996	1997	1998	1999	2000	2001
North									
Shore	25	30	14	15	17	56	27	69	6
P/C Boat	7	14	5	13	17	22	18	40	16
P/R Boat	181	424	371	531	445	833	738	1,454	698
TOTAL	213	468	390	559	479	911	783	1,563	720
Mid									
Shore	88	112	108	80	127	160	136	346	182
P/C Boat	534	478	185	746	712	274	286	611	344
P/R Boat	2,453	2,849	1,699	3,155	3,898	4,096	2,461	4,373	3,822
TOTAL	3,075	3,439	1,992	3,981	4,737	4,530	2,883	5,330	4,348
South									
Shore	59	100	29	24	18	18	13	22	15
P/C Boat	<1	1	<1	2	1	1	<1	<1	<1
P/R Boat	136	103	84	138	143	199	115	174	167
TOTAL	196	204	114	164	162	218	129	197	182
All									
Shore	172	242	151	119	162	234	176	437	203
P/C Boat	542	493	191	761	730	297	305	652	361
P/R Boat	2,770	3,376	2,154	3,824	4,486	5,128	3,314	6,001	4,687
TOTAL	3,484	4,111	2,496	4,704	5,378	5,659	3,795	7,090	5,250

Table A17. Recreational fishery sampling intensity for summer flounder by subregion.

Year	Subregion	Landings (A+B1; mt)	Number of Summer Flounder Measured	mt/100 Lengths
1982	North	1,047	231	453
	Mid	6,492	2,896	224
	South	728	576	126
	TOTAL	8,267	3,703	223
1983	North	600	311	192
	Mid	11,839	4,712	251
	South	248	170	146
	TOTAL	12,687	5,193	244
1984	North	409	168	243
	Mid	7,511	2,195	342
	South	592	283	209
	TOTAL	8,512	2,646	322
1985	North	337	78	432
	Mid	4,936	1,934	255
	South	392	274	143
	TOTAL	5,665	2,286	248
1986	North	2,667	266	1,003
	Mid	4,907	1,808	271
	South	528	288	183
	TOTAL	8,102	2,362	343
1987	North	607	217	280
	Mid	4,823	1,897	254
	South	89	445	20
	TOTAL	5,519	2,559	216

Table A17 continued.

Year	Subregion	Landings (A+B1; mt)	Number of Summer Flounder Measured	mt/100 Lengths
1988	North	322	310	104
	Mid	6,131	2,865	214
	South	280	743	38
	TOTAL	6,733	3,918	172
1989	North	144	107	135
	Mid	1,162	1,582	73
	South	129	358	36
	TOTAL	1,435	2,047	70
1990	North	106	110	96
	Mid	1,985	2,667	74
	South	238	1,293	18
	TOTAL	2,329	4,070	57
1991	North	162	189	86
	Mid	3,343	4,648	72
	South	106	820	13
	TOTAL	3,611	5,657	64
1992	North	196	425	46
	Mid	2,929	4,504	65
	South	117	566	21
	TOTAL	3,242	5,495	59
1993	North	213	338	63
	Mid	3,075	4,174	74
	South	196	995	20
	TOTAL	3,484	5,507	63
1994	North	468	621	75
	Mid	3,439	3,834	90
	South	204	1,467	14
	TOTAL	4,111	5,922	69

Table A17 continued.

Year	Subregion	Landings (A+B1; mt)	Number of Summer Flounder Measured	mt/100 Lengths
1995	North	390	501	78
	Mid	1,992	1,470	136
	South	114	485	24
	TOTAL	2,496	2,456	102
1996	North	559	919	61
	Mid	3,981	3,373	118
	South	164	1,188	14
	TOTAL	4,704	5,480	86
1997	North	480	786	61
	Mid	4,736	2,988	159
	South	162	1,026	16
	TOTAL	5,378	4,800	112
1998	North	911	857	106
	Mid	4,530	3,205	141
	South	218	1,259	17
	TOTAL	5,659	5,321	106
1999	North	783	442	177
	Mid	2,883	1,584	182
	South	129	564	23
	TOTAL	3,795	2,590	147
2000	North	1,563	707	221
	Mid	5,330	1,892	282
	South	197	722	27
	TOTAL	7,090	3,321	213
2001	North	720	351	205
	Mid	4,348	2,965	147
	South	182	953	19
	TOTAL	5,250	4,269	123

Table A18. Estimated recreational landings at age of summer flounder (000s), (catch type A + B1).

					AGE					
Year	0	1	2	3	4	5	6	7	8+	Total
1982	2,750	8,445	3,498	561	215	<1	4	0	0	15,473
1983	2,302	11,612	4,978	1,340	528	220	0	16	0	20,996
1984	2,282	9,198	4,831	1,012	147	5	<1	0	0	17,745
1985	1,002	5,002	4,382	473	148	59	0	0	0	11,066
1986	1,169	6,404	2,784	1,088	129	15	28	0	0	11,621
1987	466	4,674	2,083	448	182	1	5	0	0	7,865
1988	434	5,855	3,345	386	90	3	0	0	0	10,113
1989	74	539	946	135	16	2	5	0	0	1,717
1990	353	2,770	529	118	23	<1	1	0	0	3,794
1991	86	3,611	2,251	79	40	1	0	0	0	6,068
1992	82	3,183	1,620	90	<1	27	0	0	0	5,002
1993	71	3,470	1,981	139	<1	2	0	0	0	5,663
1994	765	3,872	1,549	171	26	<1	5	0	0	6,388
1995	235	1,557	1,426	117	26	16	<1	0	0	3,377
1996	115	3,093	3,664	372	129	1	0	0	0	7,374
1997	4	1,147	4,183	1,464	274	88	0	0	0	7,160
1998	0	768	2,915	2,714	515	63	3	0	0	6,979
1999	0	201	1,982	1,520	325	60	19	0	0	4,107
2000	0	544	3,897	2,161	609	160	4	0	0	7,375
2001	0	838	1,960	1,751	529	119	35	4	0	5,236

Table A19. Estimated summer flounder landings (catch types A + B1), live discard (catch type B2), and total catch (catch types A + B1 + B2) in numbers (000s), and live discard (catch type B2) as a proportion of total catch.

Year	A+B1	B2	A+B1+B2	B2 / (A+B1+B2)
1982	15,473	8,089	23,562	0.343
1983	20,996	11,066	32,062	0.345
1984	17,475	12,310	29,785	0.413
1985	11,066	2,460	13,526	0.182
1986	11,621	13,672	25,293	0.541
1987	7,865	13,159	21,024	0.626
1988	10,113	7,249	17,362	0.418
1989	1,717	960	2,677	0.359
1990	3,794	5,307	9,101	0.583
1991	6,068	10,007	16,075	0.623
1992	5,002	6,907	11,909	0.580
1993	5,663	14,321	19,984	0.717
1994	6,388	10,345	16,733	0.618
1995	3,377	12,860	16,237	0.792
1996	7,374	12,368	19,742	0.626
1997	7,160	12,860	20,020	0.642
1998	6,979	15,107	22,086	0.684
1999	4,107	17,271	21,378	0.808
2000	7,375	16,712	24,087	0.694
2001	5,236	22,561	27,797	0.812

Table A20. Estimated recreational fishery discard at age of summer flounder (catch type B2). Discards during 1982-1996 allocated to age groups in same relative proportions as ages 0 and 1 in the subregional catch. Discards during 1997-2000 allocated to age groups in same relative proportions as fish less than the annual EEZ minimum size in the subregional catch. Discards in 2001 allocated to age groups in the same relative proportion as fish less than the minimum size in the respective state catch. All years assume 10% release mortality.

| | Numbers at age | | | | | Metric Tons at age | | | | |
Year	0	1	2	3+	Total	0	1	2	3+	Total
1982	172	636	0	0	808	39	257	0	0	296
1983	175	932	0	0	1,107	31	345	0	0	376
1984	210	1,020	0	0	1,230	43	372	0	0	415
1985	40	206	0	0	246	10	82	0	0	92
1986	150	1,217	0	0	1,367	34	544	0	0	578
1987	106	1,210	0	0	1,316	24	498	0	0	522
1988	56	669	0	0	725	16	326	0	0	342
1989	13	83	0	0	96	3	42	0	0	45
1990	60	470	0	0	530	18	216	0	0	234
1991	24	977	0	0	1,001	6	423	0	0	429
1992	17	674	0	0	691	4	340	0	0	344
1993	22	1,410	0	0	1,432	6	730	0	0	736
1994	177	857	0	0	1,034	77	500	0	0	577
1995	170	1,116	0	0	1,286	72	642	0	0	714
1996	24	1,213	0	0	1,237	8	645	0	0	653
1997	18	752	495	21	1,286	4	296	206	9	515
1998	0	548	833	130	1,511	0	129	330	58	517
1999	84	569	954	122	1,729	11	215	407	55	688
2000	0	510	1,001	161	1,672	0	244	524	87	855
2001	0	1,171	864	221	2,256	0	553	483	148	1,184

Table A21. Estimated recreational catch at age of summer flounder ('000; catch type A + B1 + B2). Includes catch type B2 (fish released alive) with 10% release mortality.

					AGE					
Year	0	1	2	3	4	5	6	7	8+	Total
1982	2,922	9,081	3,498	561	215	<1	4	0	0	16,281
1983	2,477	12,544	4,978	1,340	528	220	0	16	0	22,103
1984	2,492	10,218	4,831	1,012	147	5	<1	0	0	18,705
1985	1,042	5,208	4,382	473	148	59	0	0	0	11,312
1986	1,319	7,621	2,784	1,088	129	15	28	4	0	12,988
1987	572	5,884	2,083	448	182	1	5	6	0	9,181
1988	490	6,524	3,345	386	90	3	0	0	0	10,838
1989	87	622	946	135	16	2	5	0	0	1,813
1990	413	3,240	529	118	23	<1	1	0	0	4,324
1991	110	4,588	2,251	79	40	1	0	0	0	7,069
1992	99	3,857	1,620	90	<1	27	0	0	0	5,693
1993	93	4,880	1,981	139	<1	2	0	0	0	7,095
1994	942	4,729	1,549	171	26	<1	5	0	0	7,422
1995	405	2,673	1,426	117	26	16	<1	0	0	4,664
1996	139	4,306	3,664	372	129	1	0	0	0	8,611
1997	22	1,899	4,678	1,485	274	88	0	0	0	8,446
1998	0	1,316	3,748	2,844	515	63	4	0	0	8,490
1999	84	769	2,935	1,642	325	60	19	0	0	5,834
2000	0	1,054	4,898	2,322	609	160	4	0	0	9,047
2001	0	2,009	2,824	1,963	538	119	35	4	0	7,492

Table A22. Mean weight (kg) at age of summer flounder catch in the recreational fishery.

Year					AGE					
	0	1	2	3	4	5	6	7	8+	ALL
1982	0.22	0.40	0.57	1.33	1.84	1.89	2.98			0.46
1983	0.18	0.37	0.63	0.93	1.19	1.40				0.47
1984	0.21	0.36	0.62	0.97	1.77	2.20	4.17			0.45
1985	0.24	0.40	0.63	1.10	1.75	2.44				0.53
1986	0.23	0.45	0.75	1.29	1.74	2.72	3.48	5.96		0.58
1987	0.23	0.41	0.76	1.34	1.84	3.05	4.81	4.64		0.56
1988	0.29	0.49	0.71	1.11	1.92	2.32				0.58
1989	0.26	0.51	0.81	1.23	1.78	3.33	1.58			0.73
1990	0.30	0.46	0.97	1.44	1.68	2.90	6.46			0.54
1991	0.27	0.43	0.67	1.31	1.37	2.45				0.52
1992	0.23	0.50	0.72	1.62	2.28	3.34				0.59
1993	0.25	0.52	0.72	1.87	2.44	3.03				0.60
1994	0.44	0.58	0.69	1.44	1.92	2.83	3.90			0.61
1995	0.43	0.58	0.82	1.46	2.60	2.93	3.54			0.68
1996	0.34	0.53	0.62	1.34	1.34	2.36				0.61
1997	0.23	0.45	0.65	0.90	1.15	2.38				0.68
1998		0.41	0.61	0.81	1.26	2.51	2.79			0.70
1999	0.13	0.41	0.62	0.91	1.55	2.33	2.60			0.74
2000		0.52	0.71	0.95	1.31	2.39	3.48			0.83
2001		0.53	0.78	1.00	1.53	2.09	2.30	3.75		0.86

Table A23. Total catch at age of summer flounder (000s), ME-NC.

Year	0	1	2	3	4	5	6	7	8	9+	Total
					AGE						
1982	5,344	19,423	10,149	935	328	116	67	26	4	0	36,392
1983	4,925	28,441	10,911	2,181	693	323	16	36	5	2	47,533
1984	4,802	26,582	15,454	3,180	829	95	4	5	1	4	50,956
1985	2,078	14,623	17,979	1,767	496	252	30	5	2	1	37,233
1986	1,942	17,140	11,055	3,782	316	140	58	12	3	0	34,448
1987	1,137	17,212	10,838	1,648	544	25	29	33	11	0	31,477
1988	795	20,557	14,562	2,137	644	121	19	15	6	0	38,856
1989	960	4,790	7,306	1,692	353	55	9	3	1	0	15,169
1990	1,856	8,808	2,187	995	221	30	8	2	1	0	14,108
1991	1,001	12,149	7,148	742	217	32	3	1	0	0	21,293
1992	1,368	11,197	6,026	1,125	151	70	2	1	0	0	19,940
1993	1,285	11,235	5,601	566	73	45	20	2	1	0	18,828
1994	1,638	10,362	6,996	982	205	26	14	0	5	0	20,227
1995	592	5,828	7,303	1,239	397	77	2	1	0	0	15,440
1996	162	6,925	9,278	1,785	417	71	16	1	3	0	18,658
1997	30	2,545	8,046	3,149	553	160	11	4	0	0	14,498
1998	45	2,233	6,380	5,243	980	138	19	1	0	0	15,039
1999	181	2,185	6,260	4,018	1,161	358	55	14	0	0	14,232
2000	22	1,480	7,690	4,538	1,495	360	73	19	8	2	15,687
2001	51	2,977	4,832	3,736	1,282	365	121	28	4	3	13,399

Table A24. Mean length (cm) at age of summer flounder catch, ME-NC.

					AGE						
Year	0	1	2	3	4	5	6	7	8	9+	ALL
1982	29.4	34.5	38.8	50.7	55.3	61.0	60.7	68.0	71.2		35.7
1983	28.8	34.5	40.9	46.5	48.8	51.6	60.7	60.9	69.3	72.0	36.3
1984	29.4	33.8	39.1	45.9	51.3	57.9	66.8	68.4	74.0	70.7	36.1
1985	30.6	34.8	38.8	46.8	53.9	58.6	61.5	74.5	73.3	75.0	37.5
1986	29.7	35.6	39.9	47.5	54.0	56.2	65.8	66.4	72.8		38.2
1987	29.9	35.3	39.7	46.9	55.8	63.3	65.9	63.2	73.5		37.7
1988	32.4	35.8	39.1	46.6	53.1	60.2	69.6	68.5	72.7		37.9
1989	27.1	35.7	40.8	45.5	50.6	58.5	59.1	63.1	59.0		39.1
1990	29.6	35.1	41.9	46.8	51.4	57.4	66.4	71.7	75.2		36.6
1991	24.8	34.5	40.4	47.1	54.3	61.0	61.7	68.1			36.7
1992	29.6	36.0	41.2	46.9	49.7	61.0	58.8	72.2			37.9
1993	30.3	36.5	40.6	50.4	52.9	54.7	62.6	70.6	75.5		37.9
1994	32.2	37.1	39.3	49.6	57.3	63.4	66.3		68.5		38.3
1995	33.7	37.1	39.9	44.9	52.4	62.2	70.5	71.9			39.4
1996	32.6	36.9	38.3	45.7	51.3	54.4	58.5	63.0	66.0		38.8
1997	28.5	36.2	39.8	43.4	48.3	58.1	60.8	66.3			40.4
1998	28.7	37.2	40.0	43.4	49.5	59.3	60.9	71.1			41.6
1999	25.3	33.6	38.8	43.9	50.7	55.5	62.2	67.1	67.0		40.8
2000	18.1	37.2	40.9	44.2	49.3	58.0	60.8	60.3	66.1	67.7	42.8
2001	21.1	37.7	41.8	45.0	50.4	57.3	60.5	66.1	68.9	71.8	43.2

Table A25. Mean weight (kg) at age of summer flounder catch, ME-NC.

Year	0	1	2	3	4	5	6	7	8	9+	ALL
1982	0.255	0.419	0.616	1.447	1.907	2.795	2.673	3.758	4.408	4.370	0.504
1983	0.243	0.419	0.716	1.075	1.257	1.495	2.572	2.594	3.849	4.030	0.521
1984	0.251	0.398	0.632	1.046	1.500	2.163	3.302	3.620	4.640	4.800	0.518
1985	0.290	0.429	0.613	1.109	1.726	2.297	2.671	4.682	4.780		0.575
1986	0.256	0.453	0.668	1.160	1.739	1.994	3.311	4.000	4.432		0.613
1987	0.263	0.446	0.651	1.140	1.941	2.855	3.326	3.314	4.140		0.581
1988	0.319	0.462	0.624	1.130	1.739	2.485	3.888	3.545	4.316		0.588
1989	0.207	0.459	0.723	1.044	1.479	2.249	2.399	2.861	2.251		0.668
1990	0.250	0.429	0.810	1.169	1.538	2.121	3.461	3.951	5.029		0.540
1991	0.140	0.404	0.702	1.186	1.811	2.527	2.837	3.586			0.537
1992	0.246	0.467	0.749	1.222	1.390	2.696	2.302	4.479			0.595
1993	0.264	0.480	0.699	1.461	1.659	1.859	2.816	4.136	5.199		0.571
1994	0.342	0.521	0.628	1.353	2.096	2.736	3.437		3.703		0.605
1995	0.375	0.527	0.678	1.056	1.639	2.628	3.750	4.047			0.675
1996	0.327	0.504	0.570	1.080	1.545	1.957	2.546	3.200	3.164		0.621
1997	0.212	0.452	0.639	0.866	1.233	2.252	2.572	3.429			0.697
1998	0.259	0.490	0.648	0.859	1.321	2.410	2.577	3.983			0.759
1999	0.143	0.371	0.594	0.896	1.439	1.998	2.716	3.496	3.904		0.755
2000	0.066	0.509	0.692	0.924	1.331	2.214	2.586	2.728	3.359	3.532	0.850
2001	0.084	0.538	0.760	0.968	1.451	2.154	2.586	3.418	3.914	4.532	0.894

Table A26. NEFSC research trawl survey indices of abundance. Indices are stratified mean numbers (n) and weight (kg) per tow. Spring indices are for offshore strata 1-12 61-76; autumn indices are for offshore strata 1-2, 5-6, 9-10, 61, 65, 69, and 73. Winter indices (1992 and later) are for NEFSC offshore strata 1-3, 5-7, 9-11, 13-14, 16-17, 61-63, 65-67, 69-71, and 73-75. n/a = not available due to incomplete coverage. **Note that 2002 indices are from preliminary, unaudited data.**

Year	Spring (n)	Spring (kg)	Autumn (n)	Autumn (kg)
1967	n/a	n/a	1.35	1.25
1968	0.15	0.16	1.10	1.00
1969	0.19	0.16	0.59	0.61
1970	0.09	0.09	0.15	0.13
1971	0.22	0.28	0.42	0.27
1972	0.47	0.21	0.39	0.27
1973	0.76	0.54	0.87	0.63
1974	1.37	1.26	1.70	1.86
1975	1.97	1.61	3.00	2.48
1976	2.83	2.00	1.14	0.85
1977	2.84	1.74	2.17	1.75
1978	2.62	1.43	0.32	0.40
1979	0.40	0.35	1.17	0.94
1980	1.30	0.78	0.94	0.57
1981	1.50	0.80	0.91	0.72
1982	2.27	1.11	1.57	0.90
1983	0.95	0.53	0.90	0.47
1984	0.66	0.38	0.99	0.65
1985	2.38	1.20	1.24	0.87
1986	2.14	0.82	0.68	0.45
1987	0.93	0.38	0.26	0.28
1988	1.47	0.68	0.11	0.11
1989	0.32	0.24	0.20	0.08
1990	0.72	0.27	0.27	0.19
1991	1.08	0.35	0.51	0.17

Table A26 continued.

Year	Winter (n)	Winter (kg)	Spring (n)	Spring (kg)	Autumn (n)	Autumn (kg)
1992	12.30	4.90	1.20	0.46	0.85	0.49
1993	13.60	5.50	1.27	0.48	0.11	0.04
1994	12.05	6.03	0.93	0.46	0.60	0.35
1995	10.93	4.81	1.09	0.46	1.13	0.83
1996	31.25	12.35	1.76	0.67	0.71	0.45
1997	10.28	5.54	1.06	0.61	1.32	0.92
1998	7.76	5.13	1.19	0.76	2.32	1.58
1999	11.06	7.99	1.60	1.01	2.42	1.66
2000	16.01	12.74	2.14	1.70	1.90	1.82
2001	18.59	15.68	2.69	2.16	1.60	1.61
2002	22.55	18.71	2.47	2.29		

Table A27. NEFSC spring trawl survey (offshore strata 1-12, 61-76) stratified mean number of summer flounder per tow at age. **Note that 2002 indices are from preliminary, unaudited data.**

						AGE					
Year	1	2	3	4	5	6	7	8	9	10+	ALL
1976	0.03	1.77	0.71	0.29	0.01	0.01	0.01				2.83
1977	0.61	1.31	0.71	0.10	0.09	0.01		0.01			2.84
1978	0.68	0.93	0.64	0.19	0.04	0.03	0.03			0.01	2.55
1979	0.06	0.18	0.08	0.04	0.03			0.01			0.40
1980	0.01	0.70	0.31	0.14	0.02	0.06	0.03	0.02		0.01	1.30
1981	0.60	0.54	0.17	0.08	0.05	0.03	0.02	0.01			1.50
1982	0.70	1.43	0.12	0.02							2.27
1983	0.32	0.39	0.19	0.03	0.01				0.01		0.95
1984	0.17	0.33	0.09	0.05		0.01	0.01				0.66
1985	0.55	1.56	0.21	0.04	0.02						2.38
1986	1.48	0.43	0.20	0.02	0.01						2.14
1987	0.47	0.43	0.02	0.01							0.93
1988	0.60	0.81	0.07	0.02							1.50
1989	0.06	0.23	0.02	0.01							0.32
1990	0.63	0.03	0.06								0.72
1991	0.79	0.27		0.02							1.08
1992	0.77	0.41	0.01		0.01						1.20
1993	0.73	0.50	0.04								1.27
1994	0.35	0.53	0.04	0.01							0.93
1995	0.79	0.27	0.02				0.01				1.09
1996	1.08	0.56	0.12								1.76
1997	0.29	0.67	0.09	0.01							1.06
1998	0.27	0.52	0.32	0.06	0.01	0.01					1.19
1999	0.22	0.74	0.48	0.13	0.02	0.01					1.60
2000	0.19	1.03	0.63	0.12	0.15	0.02					2.14
2001	0.48	0.89	1.02	0.20	0.05	0.04	0.01				2.69
2002	0.35	0.87	0.75	0.31	0.09	0.05	0.02	0.01	0.01	0.01	2.47
Mean	0.49	0.68	0.27	0.09	0.04	0.03	0.02	0.01	0.01	0.01	1.55

Table A28. NEFSC spring trawl survey (offshore strata 1-12, 61-76) summer flounder mean length (cm) at age. **Note that 2002 indices are from preliminary, unaudited data.**

						AGE						
Year	1	2	3	4	5	6	7	8	9	10	11	12
1976	25.9	36.0	43.1	53.5	60.8	70.0	72.0					
1977	25.2	35.0	43.4	51.7	59.6	63.0		74.0				
1978	27.3	34.8	40.9	46.9	53.3	59.5	64.0				65.0	75.0
1979	25.1	37.0	43.2	51.5	54.8			77.0				
1980	29.0	28.8	38.1	44.2	51.1	53.0	67.7	77.0		81.0		
1981	25.3	32.2	39.8	48.9	55.7	62.9	67.8	74.0				
1982	28.6	36.2	47.3	46.7								
1983	25.5	37.7	43.4	53.3	61.4				77.0			
1984	27.1	33.9	41.8	56.7		63.0	56.0					
1985	26.8	36.1	42.8	57.2	54.5							
1986	28.6	36.3	46.0	56.0	63.0							
1987	27.8	37.7	47.3	58.0								
1988	27.7	36.3	47.8	45.0								
1989	30.4	39.2	51.5	60.0								
1990	28.3	47.7	48.6									
1991	27.0	38.8		42.1								
1992	27.9	37.7	57.0		72.0							
1993	27.5	37.9	51.9									
1994	33.0	36.8	48.0	53.1								
1995	29.4	40.0	46.4				72.0					
1996	29.8	36.2	47.2									
1997	29.4	38.3	49.4	54.1								
1998	27.6	39.1	42.7	50.5	50.0	60.0						
1999	28.5	35.8	42.9	49.1	57.7	64.0						
2000	29.5	37.9	44.3	49.4	55.4	60.5						
2001	29.6	39.1	44.9	53.4	60.5	63.8	55.0					
2002	29.7	39.3	45.8	52.7	58.1	63.5	62.1	66.0	54.0	68.0		
Mean	28.1	37.1	45.6	51.5	57.9	62.1	64.6	73.6	65.5	74.5	65.0	75.0

Table A29. NEFSC autumn trawl survey (inshore strata 1-61, offshore strata <= 55 m (1,5,9,61,65,69,73)) mean number of summer flounder per tow at age.

| Year | AGE | | | | | | | | ALL |
	0	1	2	3	4	5	6	7	
1982	0.55	1.52	0.40	0.03					2.50
1983	0.96	1.46	0.34	0.12	0.01	0.01			2.90
1984	0.18	1.39	0.43	0.07	0.01	0.01	<0.01		2.09
1985	0.59	0.80	0.46	0.05		0.02			1.92
1986	0.39	0.83	0.11	0.11		<0.01			1.44
1987	0.07	0.58	0.20	0.03	0.02				0.90
1988	0.06	0.62	0.18	0.03					0.89
1989	0.31	0.21	0.05						0.57
1990	0.44	0.38	0.03	0.04		<0.01			0.89
1991	0.76	0.84	0.09		0.01	<0.01	<0.01		1.70
1992	0.99	1.04	0.25	0.03	0.01	<0.01			2.32
1993	0.23	0.80	0.03	0.01			<0.01		1.07
1994	0.75	0.67	0.09	0.01	0.01				1.53
1995	0.93	1.16	0.28	0.02	0.01				2.40
1996	0.11	1.24	0.57	0.04					1.96
1997	0.17	1.29	1.14	0.29	0.02	0.01	0.01	<0.01	2.93
1998	0.38	2.13	1.63	0.33	0.04	0.01			4.52
1999	0.21	1.73	1.49	0.31	0.04	0.01			3.79
2000	0.22	1.20	1.22	0.40	0.15	0.06	0.03	0.04	3.32
2001	0.08	1.36	0.93	0.39	0.11	0.11	0.01	0.01	3.00
Mean	0.42	1.06	0.50	0.13	0.04	0.02	0.01	0.02	2.13

Table A30. NEFSC autumn trawl survey (inshore strata 1-61, offshore strata <= 55 m (1,5,9,61,65,69,73)) summer flounder mean length (cm) at age.

				AGE				
Year	0	1	2	3	4	5	6	7
1982	28.2	35.1	43.3	47.1				
1983	24.5	33.5	42.7	52.3	60.0	58.0		
1984	23.5	33.6	41.1	46.5	62.6	65.0	70.0	
1985	25.5	35.4	43.1	53.0		63.0		
1986	23.1	35.7	40.8	53.5		57.0		
1987	27.4	34.4	46.0	53.6	47.7			
1988	30.1	35.9	43.4	61.7				
1989	25.8	35.8	48.2	60.0				
1990	24.8	36.0	45.2	54.9	60.0	68.0		
1991	23.2	34.7	43.7	59.0	61.2	67.0	69.0	
1992	25.3	34.4	42.7	51.3	58.8	68.0		
1993	29.9	35.1	44.0	58.1	59.0		70.0	
1994	27.5	38.0	44.3	61.5	57.0			
1995	26.5	36.7	47.4	59.0	65.0			
1996	26.6	35.4	41.6	56.1				
1997	28.4	35.1	40.3	46.5	51.7	59.3	56.0	63.0
1998	24.0	34.7	42.6	50.2	58.2	68.6		
1999	24.1	34.7	40.0	48.5	55.6	56.8		
2000	25.2	35.7	42.1	48.6	53.5	59.9	68.0	66.5
2001	22.9	36.3	42.5	50.0	54.1	62.1	56.0	67.0
Mean	25.8	35.3	43.3	53.6	57.5	62.7	64.8	65.5

Table A31. NEFSC Winter trawl survey (offshore strata from 27-185 meters (15-100 fathoms): 1-3, 5-7, 9-11, 13-14, 16-17, 61-63, 65-67, 69-71, 73-75; Southern Georges Bank to Cape Hatteras): mean number and mean weight (kg) per tow. **Note that 2002 indices are from preliminary, unaudited data.**

Year	Stratified mean number per tow	Coefficient of variation	Stratified mean weight (kg) per tow	Coefficient of variation
1992	12.295	15.6	4.898	15.4
1993	13.604	15.2	5.497	11.9
1994	12.051	17.8	6.033	16.1
1995	10.930	12.0	4.808	11.6
1996	31.246	24.2	12.351	22.0
1997	10.283	24.0	5.544	16.6
1998	7.756	20.7	5.131	16.6
1999	11.055	13.3	7.987	11.4
2000	15.759	13.0	12.593	12.8
2001	18.589	11.4	15.682	13.2
2002	22.550	15.6	18.705	15.7

Table A32. NEFSC Winter trawl survey (offshore strata from 27-185 meters (15-100 fathoms): 1-3, 5-7, 9-11, 13-14, 16-17, 61-63, 65-67, 69-71, 73-75; Southern Georges Bank to Cape Hatteras) : mean number at age per tow. **Note that 2002 indices are from preliminary, unaudited data.**

Year	AGE												Total
	1	2	3	4	5	6	7	8	9	10	11	12+	
1992	7.15	4.74	0.33	0.04	0.01	0.03							12.29
1993	6.50	6.70	0.31	0.05	0.02	0.02							13.60
1994	3.76	7.20	0.82	0.26			0.01						12.05
1995	6.07	4.59	0.25	0.02									10.93
1996	22.17	8.33	0.60	0.12	0.03								31.25
1997	3.86	4.80	1.04	0.43	0.11	0.04							10.28
1998	1.68	3.25	2.29	0.42	0.10	0.01				0.01			7.76
1999	2.11	4.80	2.90	0.84	0.28	0.06	0.04	0.02		0.01			11.06
2000	0.70	6.52	4.96	2.51	0.78	0.17	0.08	0.04	0.01				15.76
2001	3.06	5.36	6.40	2.44	0.80	0.37	0.09	0.05	0.01		0.01	0.01	18.57
2002	2.77	10.65	5.57	2.25	0.84	0.33	0.12	0.02	0.02				22.55
Mean	5.41	6.06	2.35	0.85	0.33	0.13	0.07	0.03	0.01	0.01	0.01	0.01	15.09

Table A33. NEFSC Winter trawl survey (offshore strata from 27-185 meters (15-100 fathoms): 1-3, 5-7, 9-11, 13-14, 16-17, 61-63, 65-67, 69-71, 73-75; Southern Georges Bank to Cape Hatteras): summer flounder mean length (cm) at age. **Note that 2002 indices are from preliminary, unaudited data.**

						AGE						
Year	1	2	3	4	5	6	7	8	9	10	11	12+
1992	28.0	38.4	48.8	60.0	70.0	69.0						
1993	27.9	37.3	49.4	58.7	58.5	65.0						
1994	28.0	37.5	46.1	56.4			69.0					
1995	27.4	40.2	50.8	59.6								
1996	30.9	38.2	51.4	61.2	63.6							
1997	29.2	37.8	44.5	50.0	57.3	62.5						
1998	28.4	38.0	43.3	52.2	59.7	66.3				64.0		
1999	28.4	36.9	44.5	51.6	59.2	64.1	70.2	68.8		78.0		
2000	28.2	35.9	41.4	49.0	56.3	62.2	68.2	67.1	77.0			
2001	28.3	37.3	43.6	50.2	56.3	61.0	65.3	69.4	58.6		70.0	74.0
2002	30.0	38.5	44.5	51.4	58.1	62.2	66.4	62.7	75.0			
Mean	28.6	37.8	46.2	54.6	59.9	64.0	67.8	67.0	70.2	71.0	70.0	74.0

Table A34. MADMF Spring survey cruises: stratified mean number per tow at age.

Year	0	1	2	3	4	5	6	7	8+	Total
1978		0.097	0.520	0.274	0.221		0.042			1.154
1979			0.084	0.087	0.147	0.048	0.011			0.377
1980		0.055	0.061	0.052	0.075	0.053	0.055	0.011		0.362
1981		0.405	0.558	0.074	0.031	0.043	0.060		0.031	1.202
1982		0.376	1.424	0.118	0.084	0.020		0.010		2.032
1983		0.241	1.304	0.544	0.021	0.009	0.003			2.122
1984		0.042	0.073	0.063	0.111	0.010				0.299
1985		0.142	1.191	0.034	0.042					1.409
1986		0.966	0.528	0.140	0.008					1.642
1987		0.615	0.583	0.012			0.011			1.221
1988		0.153	0.966	0.109	0.012					1.240
1989			0.338	0.079			0.010			0.427
1990		0.247	0.021	0.079	0.012					0.359
1991		0.029	0.048	0.010						0.087
1992		0.274	0.320	0.080		0.011	0.011			0.696
1993		0.120	0.470	0.060	0.010		0.020			0.680
1994		1.770	1.160	0.050	0.020		0.020			3.020
1995		0.089	1.245	0.050						1.384
1996		0.072	0.641	0.110	0.012					0.835
1997		0.512	1.212	0.169	0.109		0.005			2.007
1998		0.137	1.144	0.630	0.041	0.047				1.999
1999		0.073	0.814	1.042	0.286	0.028		0.015		2.258
2000		0.224	1.566	1.137	0.296	0.202	0.049		0.012	3.486
2001		0.172	0.963	0.687	0.216	0.054				2.092
Mean		0.310	0.718	0.237	0.092	0.048	0.025	0.012	0.022	1.350

Table A35. MADMF Autumn survey cruises: stratified mean number per tow at age.

Year	\ Age 0	1	2	3	4	5	6	7	8+	Total
1978		0.011	0.124	0.024		0.007				0.166
1979			0.047	0.101		0.019				0.167
1980		0.114	0.326	0.020	0.020	0.010				0.490
1981	0.009	0.362	0.367	0.011						0.749
1982		0.255	1.741	0.016						2.012
1983		0.026	0.583	0.140	0.004					0.753
1984	0.033	0.453	0.249	0.120	0.008					0.863
1985	0.051	0.108	1.662	0.033						1.854
1986	0.128	2.149	0.488	0.128						2.893
1987		1.159	0.598	0.010	0.004					1.771
1988		0.441	0.414	0.018						0.873
1989			0.286	0.024						0.310
1990		0.108		0.012						0.120
1991	0.021	0.493	0.262	0.010						0.786
1992		1.110	0.170							1.280
1993	0.010	0.300	0.430	0.020	0.020					0.780
1994	0.050	2.130	0.070							2.250
1995	0.032	0.401	0.323	0.013						0.769
1996	0.020	0.709	1.165	0.082	0.039	0.004				2.019
1997		0.462	1.399	0.323	0.018	0.030				2.232
1998		0.011	0.553	0.248	0.016	0.011				0.839
1999	0.058	0.325	0.878	0.359	0.035					1.655
2000	0.071	1.300	2.129	0.443	0.085	0.084	0.012	0.015		4.139
2001	0.011	1.166	1.000	0.271	0.025	0.000	0.010	0.012		2.494
Mean	0.041	0.618	0.664	0.110	0.025	0.021	0.011	0.013		1.344

Table A36. MADMF seine survey: total catch of age-0 summer flounder.

Year	Total catch
1982	3
1983	3
1984	1
1985	19
1986	5
1987	5
1988	2
1989	3
1990	11
1991	4
1992	0
1993	2
1994	1
1995	13
1996	7
1997	0
1998	12
1999	13
2000	10
2001	1
Mean	6

Table A37. CTDEP spring trawl survey: summer flounder index of abundance, geometric mean
number per tow at age.

Year	Age								
	0	1	2	3	4	5	6	7	Total
1984	0.000	0.314	0.271	0.044	0.000	0.000	0.000	0.000	0.629
1985	0.000	0.015	0.325	0.040	0.058	0.003	0.000	0.000	0.441
1986	0.000	0.753	0.100	0.082	0.008	0.006	0.000	0.000	0.949
1987	0.000	0.951	0.086	0.014	0.004	0.001	0.000	0.001	1.057
1988	0.000	0.232	0.223	0.035	0.009	0.001	0.000	0.000	0.500
1989	0.000	0.013	0.049	0.024	0.016	0.000	0.000	0.000	0.102
1990	0.000	0.304	0.022	0.013	0.006	0.001	0.000	0.001	0.347
1991	0.000	0.392	0.189	0.029	0.028	0.001	0.000	0.000	0.639
1992	0.000	0.319	0.188	0.021	0.004	0.023	0.000	0.000	0.555
1993	0.000	0.320	0.151	0.015	0.018	0.003	0.000	0.001	0.508
1994	0.000	0.496	0.314	0.025	0.018	0.005	0.000	0.002	0.860
1995	0.000	0.199	0.051	0.020	0.005	0.000	0.000	0.006	0.281
1996	0.000	0.578	0.266	0.086	0.023	0.004	0.000	0.004	0.961
1997	0.000	0.391	0.507	0.057	0.036	0.004	0.002	0.002	0.999
1998	0.000	0.064	0.594	0.503	0.116	0.006	0.025	0.002	1.310
1999	0.000	0.245	0.593	0.385	0.139	0.053	0.025	0.000	1.440
2000	0.000	0.321	0.726	0.524	0.074	0.111	0.034	0.000	1.790
2001	0.000	0.841	0.340	0.365	0.120	0.043	0.032	0.007	1.748
Mean	0.000	0.347	0.274	0.113	0.033	0.013	0.005	0.001	0.786

Table A38. CTDEP autumn trawl survey: summer flounder index of abundance, geometric mean number per tow at age.

Year	Age								
	0	1	2	3	4	5	6	7	Total
1984	0.000	0.571	0.331	0.072	0.014	0.004	0.004	0.003	0.999
1985	0.240	0.339	0.528	0.075	0.001	0.008	0.000	0.000	1.191
1986	0.172	1.170	0.298	0.072	0.006	0.001	0.000	0.000	1.719
1987	0.075	1.067	0.223	0.033	0.003	0.000	0.000	0.000	1.401
1988	0.015	0.884	0.481	0.037	0.002	0.001	0.000	0.000	1.420
1989	0.000	0.029	0.095	0.015	0.001	0.000	0.000	0.000	0.140
1990	0.032	0.674	0.110	0.042	0.007	0.005	0.000	0.000	0.870
1991	0.036	0.826	0.340	0.036	0.013	0.005	0.004	0.000	1.260
1992	0.013	0.570	0.366	0.046	0.016	0.009	0.000	0.000	1.020
1993	0.084	0.827	0.152	0.039	0.003	0.001	0.002	0.001	1.109
1994	0.132	0.300	0.085	0.024	0.009	0.000	0.000	0.000	0.550
1995	0.023	0.384	0.117	0.012	0.002	0.001	0.000	0.002	0.541
1996	0.069	0.887	1.188	0.042	0.005	0.000	0.000	0.000	2.191
1997	0.033	0.681	1.373	0.373	0.021	0.014	0.004	0.001	2.500
1998	0.000	0.269	1.054	0.321	0.054	0.021	0.000	0.000	1.719
1999	0.044	0.679	1.484	0.346	0.114	0.011	0.002	0.000	2.680
2000	0.112	0.395	0.871	0.341	0.124	0.043	0.011	0.013	1.910
2001	0.021	2.689	1.137	0.436	0.110	0.018	0.005	0.001	4.417
Mean	0.064	0.621	0.535	0.113	0.023	0.007	0.002	0.001	1.366

Table A39. RIDFW autumn trawl survey summer flounder index of abundance. RIDFW lengths aged with NEFSC autumn trawl survey age-length keys.

Year	Age										
	0	1	2	3	4	5	6	7	8	9	Total
1980	0.131	0.203	0.392	0.074	0.013	0.000	0.000	0.000	0.000	0.000	0.813
1981	0.304	0.971	1.740	0.199	0.013	0.003	0.002	0.002	0.001	0.001	3.236
1982	0.024	0.209	0.516	0.071	0.005	0.000	0.000	0.000	0.000	0.001	0.826
1983	0.030	0.135	0.420	0.110	0.014	0.001	0.000	0.001	0.000	0.001	0.712
1984	0.122	0.424	0.701	0.092	0.013	0.003	0.000	0.000	0.000	0.000	1.355
1985	0.342	0.218	0.338	0.048	0.004	0.001	0.000	0.001	0.000	0.000	0.952
1986	0.547	1.183	1.518	0.179	0.012	0.000	0.002	0.001	0.001	0.001	3.444
1987	0.135	0.503	0.579	0.121	0.014	0.001	0.003	0.003	0.001	0.000	1.360
1988	0.014	0.167	0.351	0.036	0.003	0.000	0.000	0.000	0.000	0.000	0.571
1989	0.000	0.001	0.037	0.030	0.003	0.000	0.000	0.000	0.000	0.000	0.071
1990	0.051	0.262	0.475	0.042	0.003	0.000	0.000	0.000	0.000	0.000	0.833
1991	0.002	0.060	0.128	0.034	0.007	0.000	0.000	0.000	0.000	0.000	0.231
1992	0.065	0.394	0.685	0.185	0.033	0.003	0.004	0.001	0.001	0.000	1.371
1993	0.024	0.152	0.396	0.139	0.021	0.002	0.000	0.001	0.000	0.000	0.735
1994	0.005	0.045	0.126	0.013	0.001	0.000	0.000	0.000	0.000	0.000	0.190
1995	0.031	0.175	0.393	0.140	0.013	0.005	0.000	0.004	0.000	0.001	0.762
1996	0.193	0.704	1.346	0.171	0.012	0.001	0.000	0.001	0.000	0.001	2.429
1997	0.080	0.557	1.053	0.174	0.012	0.003	0.000	0.002	0.000	0.000	1.881
1998	0.008	0.087	0.359	0.087	0.004	0.001	0.000	0.001	0.000	0.001	0.548
1999	0.241	0.931	1.888	0.254	0.020	0.005	0.000	0.002	0.000	0.000	3.341
2000	0.365	0.506	1.305	0.654	0.054	0.035	0.000	0.000	0.000	0.000	2.919
2001											
Mean	0.129	0.376	0.702	0.136	0.013	0.003	0.001	0.001	0.000	0.000	1.361

Table A40. RIDFW monthly fixed station trawl survey summer flounder index of abundance.

Year	Mean number/tow	Mean kg/tow	Mean age 0 number/tow	Mean age 1 number/tow	Mean age 2+ number/tow
1990	0.655	0.630	0.000	0.328	0.328
1991	0.111	0.100	0.000	0.037	0.074
1992	0.692	0.680	0.019	0.269	0.404
1993	0.419	0.580	0.016	0.065	0.339
1994	0.317	0.270	0.016	0.143	0.159
1995	0.891	0.810	0.000	0.359	0.531
1996	2.353	1.790	0.137	1.059	1.157
1997	1.633	1.390	0.033	0.700	0.900
1998	0.952	0.890	0.000	0.270	0.683
1999	2.038	1.600	0.135	0.962	0.942
2000	5.420	4.350	0.260	2.140	3.020
2001					
Mean	1.407	1.190	0.056	0.576	0.776

Age 0: Proportion of catch < 30 cm
Age 1: Proportion of 30 cm $\leq$ catch $\leq$ 39 cm
Age 2+: Proportion of fish > 39 cm

Table A41. NJBMF trawl survey, April - October: index of summer flounder abundance.

Year	Age					
	0	1	2	3	4+	Total
1988	0.29	4.22	1.19	0.01	0.00	5.71
1989	1.25	0.54	0.40	0.01	0.01	2.21
1990	1.88	1.89	0.15	0.05	0.00	3.97
1991	1.50	3.11	0.32	0.02	0.01	4.96
1992	1.34	3.76	0.76	0.08	0.05	5.99
1993	3.52	6.95	0.27	0.04	0.02	10.80
1994	2.22	1.46	0.13	0.01	0.03	3.85
1995	4.95	2.93	0.28	0.05	0.16	8.37
1996	1.65	5.16	2.71	0.18	0.05	9.75
1997	1.64	8.25	5.25	1.02	0.18	16.34
1998	0.67	5.80	2.67	0.29	0.03	9.46
1999	1.03	6.12	3.46	0.65	0.18	11.44
2000	0.95	3.91	1.82	0.45	0.22	7.35
2001	0.62	3.32	1.18	0.41	0.14	5.67
Mean	1.68	4.10	1.47	0.23	0.08	7.56

Table A42. DEDFW 16 foot trawl survey: index of summer flounder recruitment at age-0 in the Delaware Estuary.

Year	Geometric Mean number per tow
1980	0.12
1981	0.06
1982	0.11
1983	0.03
1984	0.08
1985	0.06
1986	0.10
1987	0.14
1988	0.01
1989	0.12
1990	0.23
1991	0.07
1992	0.31
1993	0.02
1994	0.29
1995	0.17
1996	0.03
1997	0.02
1998	0.03
1999	0.05
2000	0.18
2001	0.07
Mean	0.10

Table A43. DEDFW 16 foot trawl survey: index of summer flounder recruitment at age-0 in the Delaware Inland Bays.

Year	Geometric Mean number per tow
1986	0.01
1987	0.00
1988	0.00
1989	0.15
1990	0.02
1991	0.94
1992	0.06
1993	0.04
1994	0.70
1995	0.23
1996	0.05
1997	0.33
1998	0.99
1999	0.62
2000	0.70
2001	0.05
Mean	0.31

Table A44. DEDFW Delaware Bay 30 foot trawl survey: index of summer flounder abundance.

Year	Age					
	0	1	2	3	4+	Total
1991	1.44	1.13	0.18	0.04	0.00	2.79
1992	0.47	0.28	0.08	0.00	0.00	0.83
1993	0.04	1.56	0.73	0.07	0.00	2.40
1994	2.28	0.14	0.22	0.08	0.00	2.72
1995	0.94	1.00	0.28	0.10	0.09	2.41
1996	0.46	0.73	0.48	0.10	0.02	1.79
1997	0.03	0.12	0.49	0.47	0.16	1.27
1998	0.11	0.31	0.83	0.29	0.12	1.66
1999	0.20	0.06	0.77	0.47	0.19	1.69
2000	0.79	0.24	0.30	0.28	0.23	1.84
2001	0.34	1.55	0.49	0.26	0.13	2.77
Mean	0.65	0.65	0.44	0.20	0.09	2.02

Table A45. MD DNR Coastal Bays trawl survey: index of summer flounder recruitment at age-0.

Year	Geometric mean	Lower 95% CI	Upper 95% CI
1972	12.3	6.5	21.8
1973	4.2	3.0	5.7
1974	5.1	3.9	6.6
1975	2.1	1.6	2.6
1976	1.9	1.4	2.6
1977	2.4	1.8	3.2
1978	3.2	2.4	4.1
1979	2.9	2.0	4.1
1980	4.2	2.6	6.2
1981	3.9	2.6	5.4
1982	2.0	0.8	3.7
1983	10.6	6.0	17.9
1984	5.4	3.1	8.7
1985	5.6	3.6	8.1
1986	16.2	10.1	25.2
1987	4.6	2.4	7.8
1988	0.5	0.3	0.8
1989	1.3	0.9	1.9
1990	2.1	1.6	2.7
1991	3.1	2.4	3.9
1992	3.5	2.5	4.7
1993	1.6	1.2	2.1
1994	8.2	6.5	10.3
1995	5.0	4.0	6.2
1996	2.6	2.0	3.2
1997	3.3	2.5	4.3
1998	5.2	4.2	6.6
1999	3.4	2.6	4.2
2000	4.1	3.1	5.2
2001	5.3	4.1	6.9
Mean	4.5		

Table A46. VIMS juvenile fish trawl survey, VA rivers: index of summer flounder recruitment at
        age-0.

Year	Geometric mean catch per trawl	Lower 95% confidence limit	Upper 95% confidence limit	Number of samples
1979	1.0	0.6	1.6	48
1980	7.6	5.0	11.3	58
1981	5.1	3.5	7.3	61
1982	4.3	2.8	6.4	60
1983	5.2	3.7	7.1	62
1984	1.9	1.2	2.9	45
1985	1.1	0.6	1.9	27
1986	1.3	0.8	1.8	53
1987	0.4	0.2	0.8	52
1988	0.5	0.2	1.0	36
1989	1.0	0.6	1.4	36
1990	2.6	1.7	3.8	36
1991	1.4	0.9	2.1	36
1992	0.5	0.2	0.8	36
1993	0.5	0.3	0.8	36
1994	1.1	0.5	1.9	36
1995	0.7	0.4	1.2	36
1996	0.6	0.3	1.0	36
1997	0.7	0.4	1.1	36
1998	0.2	0.0	0.3	36
1999	0.4	0.2	0.6	36
2000	0.5	0.2	0.9	36
2001	0.5	0.2	0.9	36
Mean	1.7			

Table A47. North Carolina Division of Marine Fisheries (NCDMF) Pamlico Sound trawl survey:
June index of summer flounder recruitment at age-0.

Year	Mean number per tow
1987	19.86
1988	2.61
1989	6.63
1990	4.27
1991	5.85
1992	9.14
1993	5.13
1994	8.17
1995	5.59
1996	30.67
1997	14.14
1998	9.96
1999	n/a
2000	3.94
2001	22.03
Mean	10.57

Table A48. Summary of age-0 summer flounder recruitment indices from NEFSC and state surveys, Massachusetts to North Carolina.

Survey	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
																					YEAR CLASS	
CT					0.00	0.24	0.17	0.08	0.02	0.00	0.03	0.04	0.01	0.08	0.13	0.02	0.07	0.03	0.00	0.04	0.11	0.02
RI Autumn	0.13	0.31	0.02	0.03	0.12	0.34	0.55	0.14	0.01	0.00	0.05	0.01	0.07	0.02	0.01	0.03	0.17	0.08	0.01	0.24	0.37	
RI											0.00	0.00	0.02	0.02	0.02	0.00	0.14	0.03	0.00	0.14	0.26	
MA Seine			3	3	1	19	5	5	2	3	11	4	0	2	1	13	7	0	12	13	10	1
NJ Trawl									0.29	1.25	1.88	1.50	1.34	3.52	2.22	4.95	1.65	1.64	0.67	1.03	0.95	0.62
DE: 16 ft	0.12	0.06	0.11	0.03	0.08	0.06	0.10	0.14	0.01	0.12	0.23	0.07	0.31	0.02	0.29	0.17	0.03	0.02	0.03	0.05	0.18	0.07
DE: 16 ft							0.01	0.00	0.00	0.15	0.02	0.94	0.06	0.04	0.70	0.23	0.05	0.33	0.99	0.62	0.70	0.05
DE: 30ft												1.44	0.47	0.04	2.28	0.94	0.46	0.03	0.11	0.20	0.79	0.34
MD	4.2	3.9	2.0	10.6	5.4	5.6	16.2	4.6	0.5	1.3	2.1	3.1	3.5	1.6	8.2	5.0	2.6	3.3	5.2	3.4	4.1	5.3
VIMS	7.6	5.1	4.3	5.2	1.9	1.1	1.3	0.4	0.5	1.0	2.6	1.4	0.5	0.5	1.1	0.7	0.6	0.7	0.2	0.4	0.5	0.5
NC								19.86	2.61	6.63	4.27	5.85	9.14	5.13	8.17	5.59	30.67	14.14	9.96	n/a	3.94	22.03
NEFSC			0.55	0.96	0.18	0.59	0.39	0.07	0.06	0.31	0.44	0.76	0.99	0.23	0.75	0.93	0.11	0.17	0.38	0.21	0.22	0.08

Table A49. Commercial and recreational fishery landings, estimated discard, and total catch statistics (metric tons) as used in the assessment of summer flounder, Maine to North Carolina, compared with VPA estimates of total catch biomass.

| Year | Commercial | | | Recreational | | | Total | | | VPA Catch | VPA:Catch ratio |
	Landings	Discard	Catch	Landings	Discard	Catch	Landings	Discard	Catch		
1982	10,400	n/a	10,400	8,267	296	8,563	18,667	296	18,963	18,602	0.981
1983	13,403	n/a	13,403	12,687	376	13,063	26,090	376	26,466	25,142	0.950
1984	17,130	n/a	17,130	8,512	415	8,927	25,642	415	26,057	26,874	1.031
1985	14,675	n/a	14,675	5,665	92	5,757	20,340	92	20,432	21,828	1.068
1986	12,186	n/a	12,186	8,102	578	8,680	20,288	578	20,866	21,561	1.033
1987	12,271	n/a	12,271	5,519	522	6,041	17,790	522	18,312	18,551	1.013
1988	14,686	n/a	14,686	6,733	342	7,075	21,419	342	21,761	23,442	1.077
1989	8,125	709	8,834	1,435	45	1,480	9,560	754	10,314	10,388	1.007
1990	4,199	1,214	5,413	2,329	234	2,563	6,528	1,448	7,976	7,759	0.973
1991	6,224	1,052	7,276	3,611	429	4,040	9,835	1,481	11,316	11,730	1.037
1992	7,529	690	8,219	3,242	344	3,586	10,771	1,034	11,805	12,167	1.031
1993	5,715	846	6,561	3,484	736	4,220	9,199	1,582	10,781	10,992	1.020
1994	6,588	906	7,494	4,111	577	4,688	10,699	1,483	12,182	12,542	1.030
1995	6,977	308	7,285	2,496	714	3,210	9,473	1,022	10,495	10,648	1.015
1996	5,770	463	6,233	4,704	615	5,319	10,474	1,078	11,552	11,794	1.021
1997	3,994	326	4,320	5,378	627	6,005	9,372	953	10,325	10,240	0.992
1998	5,080	389	5,469	5,659	517	6,176	10,739	906	11,645	11,575	0.994
1999	4,820	1,548	6,368	3,795	688	4,483	8,615	2,236	10,851	10,847	1.000
2000	5,085	726	5,811	7,090	855	7,945	12,175	1,581	13,756	13,446	0.977
2001	4,916	639	5,555	5,250	1,184	6,434	10,166	1,823	11,989	12,058	1.006
Mean	8,489	755	8,979	5,403	509	5,913	13,892	1,000	14,892	15,109	1.013

Table A50. Virtual Population Analysis (VPA) for summer flounder, 1982-2001.

```
Fisheries Assessment Toolbox   Summer flounder: 2002   Run Number F35-2
 5/20/2002   6:46:32 PM
FACT Version 1.5.0
Summer flounder 2002:  1982 - 2001
Input Parameters and Options Selected
----------------------------------------
Natural mortality is 0.2 for all ages and years; Oldest age (not in the plus
group) is 6; For all years prior to the terminal year ( 19 ), back calculated
stock sizes for the following ages used to estimate total mortality (Z) for age
6 : 3 4 5 6.  Stock size of the  7 + group is then calculated using the following
method:  CATCH EQUATION

 Partial recruitment estimate for  2002
 0              0.01
 1              0.2
 2              0.8
 3              1
 4              1
 5              1
 6              1

 The Indices that will be used in this run are:
 1              NEC_W1
 2              NEC_W2
 3              NEC_W3
 4              NEC_W4
 5              NEC_W5:7
 6              NEC_S1
 7              NEC_S2
 8              NEC_S3
 9              NEC_S4
 10             NEC_S5:7
 11             NEC_F2
 12             NEC_F3
 13             NEC_F4
 14             MA_S2
 15             MA_S3
 16             MA_F3
 17             MA_F4
 18             CT_S2
 19             CT_S3
 20             CT_S4
 21             CT_F2
 22             CT_F3
 23             CT_F4
 24             CT_F5:7
 25             RI_F3
 26             RI_F4
 27             RI_X2
 28             NJ1
 29             NJ2
 30             DE2
 31             DE3
 32             CT_Y0
 33             VA_RY0
 34             NC_Y0
 35             MD_Y0
 36             NJ_Y0
 37             NEC_Y0
 38             MA_Y0
 39             RI_Y0
 40             DE_EY0
 41             RI_XY0
```

Table A50 continued.

```
STOCK NUMBERS (Jan 1) in thousands
         1982    1983    1984    1985    1986    1987    1988
         -------------------------------------------------------------
0        74269   80323   48380   48579   53444   43921   13033
1        42907   55970   61306   35265   37893   41999   34931
2        16205   17555   20090   26141   15641   15515   18812
3         2203    4085    4500    2465    5134    2803    2896
4          807     957    1371     807     419     782     804
5          161     364     157     372     212      57     148
6          152      27      06      42      77      47      24
7           67      70      14      11      19      69      26
         -------------------------------------------------------------
0+      136771  159350  135824  113683  112840  105194   70674
         1989    1990    1991    1992    1993    1994    1995
         -------------------------------------------------------------
0        27270   30353   28687   32322   33258   35480   39619
1         9951   21458   23172   22581   25225   26067   27566
2         9998    3813    9599    7979    8357   10487   11966
3         2226    1575    1143    1391    1080    1774    2256
4          438     291     389     264     121     372     564
5           75      39      38     122      80      33     119
6           11      12      05      03      37      25      03
7           05      04      02      01      05      09      02
         -------------------------------------------------------------
0+       49974   57546   63035   64664   68163   74245   82095
         1996    1997    1998    1999    2000    2001    2002
         -------------------------------------------------------------
0        32864   35613   39817   30766   39455   26594     n/a
1        31902   26760   29130   32559   25026   32283   21727
2        17296   19853   19607   21829   24680   19150   23737
3         3189    5766    8974   10280   12208   13248   11307
4          726     996    1871    2603    4781    5889    7466
5          102     217     315     645    1081    2561    3662
6           28      20      33     133     204     559    1767
7           05      07      02      33      80     161     448

         -------------------------------------------------------------
0+       86111   89231   99748   98849  107514  100445     n/a
```

Table A50 continued.

```
FISHING MORTALITY
          1982     1983     1984     1985     1986     1987     1988
     ---------------------------------------------------------------------
0         0.08     0.07     0.12     0.05     0.04     0.03     0.07
1         0.69     0.82     0.65     0.61     0.69     0.60     1.05
2         1.18     1.16     1.90     1.43     1.52     1.48     1.93
3         0.63     0.89     1.52     1.57     1.68     1.05     1.69
4         0.60     1.61     1.10     1.14     1.79     1.47     2.17
5         1.60     3.95     1.11     1.38     1.31     0.65     2.36
6         0.67     1.10     1.47     1.52     1.80     1.16     1.96
7         0.67     1.10     1.47     1.52     1.80     1.16     1.96
          1989     1990     1991     1992     1993     1994     1995
     ---------------------------------------------------------------------
0         0.04     0.07     0.04     0.05     0.04     0.05     0.02
1         0.76     0.60     0.87     0.79     0.68     0.58     0.27
2         1.65     1.00     1.73     1.80     1.35     1.34     1.12
3         1.83     1.20     1.26     2.24     0.87     0.95     0.93
4         2.22     1.82     0.96     1.00     1.10     0.94     1.51
5         1.64     1.92     2.51     1.00     0.97     2.08     1.26
6         2.07     1.34     1.24     1.98     0.92     0.98     1.07
7         2.07     1.34     1.24     1.98     0.92     0.98     1.07
          1996     1997     1998     1999     2000     2001
     ---------------------------------------------------------------------
0         0.01     0.00     0.00     0.01     0.00     0.00
1         0.27     0.11     0.09     0.08     0.07     0.11
2         0.90     0.59     0.45     0.38     0.42     0.33
3         0.96     0.93     1.04     0.57     0.53     0.37
4         1.01     0.95     0.86     0.68     0.42     0.28
5         1.46     1.69     0.66     0.95     0.46     0.17
6         1.01     0.97     1.03     0.61     0.50     0.27
7         1.01     0.97     1.03     0.61     0.50     0.27

Average F for 3,5
          1982     1983     1984     1985     1986     1987     1988
     ---------------------------------------------------------------------
3,5       0.94     2.15     1.24     1.36     1.59     1.06     2.07
          1989     1990     1991     1992     1993     1994     1995
     ---------------------------------------------------------------------
3,5       1.90     1.65     1.58     1.41     0.98     1.32     1.23
          1996     1997     1998     1999     2000     2001
     ---------------------------------------------------------------------
3,5       1.14     1.19     0.86     0.73     0.47     0.27
```

Table A50 continued.

```
BACK CALCULATED PARTIAL RECRUITMENT
          1982     1983     1984     1985     1986     1987     1988
--------------------------------------------------------------------
0         0.05     0.02     0.06     0.03     0.02     0.02     0.03
1         0.43     0.21     0.34     0.39     0.38     0.41     0.44
2         0.74     0.29     1.00     0.91     0.84     1.00     0.82
3         0.40     0.23     0.80     1.00     0.93     0.71     0.72
4         0.37     0.41     0.58     0.72     0.99     0.99     0.92
5         1.00     1.00     0.58     0.88     0.73     0.44     1.00
6         0.42     0.28     0.78     0.97     1.00     0.78     0.83
7         0.42     0.28     0.78     0.97     1.00     0.78     0.83

          1989     1990     1991     1992     1993     1994     1995
--------------------------------------------------------------------
0         0.02     0.04     0.02     0.02     0.03     0.03     0.01
1         0.34     0.31     0.35     0.35     0.50     0.28     0.18
2         0.74     0.52     0.69     0.80     1.00     0.64     0.75
3         0.83     0.62     0.50     1.00     0.64     0.46     0.62
4         1.00     0.95     0.38     0.44     0.82     0.45     1.00
5         0.74     1.00     1.00     0.45     0.72     1.00     0.83
6         0.93     0.70     0.50     0.88     0.68     0.47     0.71
7         0.93     0.70     0.50     0.88     0.68     0.47     0.71

          1996     1997     1998     1999     2000     2001
-----------------------------------------------------------
0         0.00     0.00     0.00     0.01     0.00     0.01
1         0.19     0.07     0.09     0.08     0.13     0.29
2         0.62     0.35     0.43     0.40     0.80     0.88
3         0.66     0.55     1.00     0.60     1.00     1.00
4         0.69     0.56     0.83     0.71     0.80     0.74
5         1.00     1.00     0.64     1.00     0.87     0.46
6         0.70     0.58     0.99     0.64     0.95     0.73
7         0.70     0.58     0.99     0.64     0.95     0.73

Catch BIOMASS (using catch mean weights)

          1982     1983     1984     1985     1986     1987     1988
--------------------------------------------------------------------
0         1362     1185     1195      602      493      295      252
1         8226    12042    10658     6333     7867     7697     9698
2         6383     7974    10077    11295     7578     7236     9380
3         1369     2383     3413     2013     4513     1914     2484
4          633      895     1268      874      566     1083     1160
5          333      510      210      593      286       72      312
6          181       42       14       82      198       99       76
7          116      112       39       38       61      155       79
--------------------------------------------------------------------
0+       18602    25142    26874    21828    21561    18551    23442

          1989     1990     1991     1992     1993     1994     1995
--------------------------------------------------------------------
0          200      469      146      336      340      583      231
1         2235     3841     5024     5341     5531     5533     3149
2         5431     1804     5165     4651     4008     4496     5051
3         1821     1188      900     1425      840     1352     1331
4          541      350      400      214      124      437      668
5          127       66       84      192       85       74      207
6           22       28       09       05       57       49       08
7           11       13       04       05       07       19       04
--------------------------------------------------------------------
0+       10388     7759    11730    12167    10992    12542    10648

          1996     1997     1998     1999     2000     2001
-----------------------------------------------------------
0           54       06       12       26       02       04
1         3554     1154     1098      813      755     1607
2         5376     5201     4172     3748     5368     3699
3         1962     2773     4588     3640     4237     3645
4          656      694     1315     1692     2007     1872
5          143      371      337      728      805      790
6           42       29       50      151      191      315
7           09       12       04       49       82      126
-----------------------------------------------------------
0+       11794    10240    11575    10847    13446    12058
```

Table A50 continued.

```
Jan 1 BIOMASS (using Jan 1 mean weights)

           1982    1983    1984    1985    1986    1987    1988
     ----------------------------------------------------------------
0        14705   15020    9144   11222   10208    8521    3415
1        13687   18190   18882   11497   13717   14028   12086
2         7552    9602   10306   12888    8368    8425    9876
3         3421    3325    3892    2063    4328    2447    2485
4         1738    1292    1741    1084     583    1173    1132
5          468     614     259     691     393     128     324
6          416      71      13     102     212     121      82
7          259     182      55      52      79     244      98

     ----------------------------------------------------------------
0+       42246   48297   44292   39598   37887   35086   29498

           1989    1990    1991    1992    1993    1994    1995
     ----------------------------------------------------------------
0         3927    6010    2324    5624    6219   10254   13510
1         3791    6416    7415    5894    8703    9723   12046
2         5789    2326    5279    4404    4788    5789    7156
3         1796    1448    1120    1288    1130    1724    1836
4          566     369     566     340     172     651     839
5          149      69      76     270     128      70     279
6           28      33      11      06     102      63      11
7           13      19      05      06      14      32      07

     ----------------------------------------------------------------
0+       16059   16690   16797   17832   21255   28305   35684

           1996    1997    1998    1999    2000    2001
     ----------------------------------------------------------------
0         9268    4950    8601    2338     908     984
1        14228   10330    9380   10093    6757    6069
2         9565   11336   10607   11766   12513   11911
3         2730    4053    6650    7833    9046   10837
4          927    1149    2002    2895    5221    6820
5          183     404     543    1048    1929    4336
6           72      44      79     340     464    1338
7           15      21      07     117     227     579

     ----------------------------------------------------------------
0+       36987   32287   37868   36431   37064   42875
```

Table A50 continued.

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

             1982      1983      1984      1985      1986      1987      1988
        ----------------------------------------------------------------------
    0     5668      5854      3507      4341      4207      3574      1251
    1     6150      7180      8615      5534      5890      6863      4123
    2     2862      3655      2003      3735      2257      2257      1797
    3     1596      1774      1130       629      1248      1133       682
    4      795       268       697       459       140       380       196
    5      101        17       115       230       120        81        44
    6      198        23        05        27        48        50        16
    7      126        62        14        12        15        79        16
        ----------------------------------------------------------------------
    0+   17497     18833     16086     14968     13926     14418      8124

             1989      1990      1991      1992      1993      1994      1995
        ----------------------------------------------------------------------
    0     1767      2323      1296      2450      2726      3882      4905
    1     1487      3415      2803      3349      4260      5193      7239
    2     1403      1023      1220      1023      1452      1655      2436
    3      430       577       402       224       651       927       929
    4       87        84       270       136        68       303       224
    5       37        14        10       122        56        14        93
    6       04        11        04        01        41        32        04
    7       02        05        02        01        05        12        02
        ----------------------------------------------------------------------
    0+    5216      7453      6007      7304      9260     12017     15834

             1996      1997      1998      1999      2000      2001
        ----------------------------------------------------------------------
    0     3475      2428      3316      1408      1777       872
    1     7902      6727      8089      6910      7345      9688
    2     3565      5907      6691      7204      9171      8458
    3     1311      1962      2760      4879      6159      7967
    4      411       472      1021      1806      3791      5760
    5       51       102       371       496      1385      4054
    6       26        19        31       184       295       976
    7       06        08        02        60       127       391
        ----------------------------------------------------------------------
    0+   16746     17625     22280     22948     30050     38166
```

Table A51. VPA Bootstrap results: precision of estimates.

```
The number of bootstraps: 500
Bootstrap Output Variable:  N hat
-------------------------------------------------------------------------
            NLLS          BOOTSTRAP     BOOTSTRAP     C.V. FOR
            ESTIMATE      MEAN          Std Error     NLLS SOLN
N 1          21727         22185         4399          0.20
N 2          23737         24038         4018          0.17
N 3          11307         11396         1904          0.17
N 4           7466          7510         1213          0.16
N 5           3662          3681          798          0.22
N 6           1767          1804          471          0.27
                                                       NLLS EST      C.V. FOR
            BIAS          BIAS          PERCENT        CORRECTED     CORRECTED     LOWER         UPPER
            ESTIMATE      STD ERROR     BIAS           FOR BIAS      ESTIMATE      80%CI         80%CI
N 1          458           197           2.11          21270         0.206828      16216         27505
N 2          300           180           1.27          23437         0.171459      19087         29100
N 3           90            85           0.79          11217         0.169766       9103         13864
N 4           44            54           0.59           7422         0.163492       5895          9064
N 5           20            36           0.54           3642         0.219021       2868          4959
N 6           37            21           2.10           1730         0.272477       1148          2305
```

Table A51 continued.

```
Bootstrap Output Variable:  F t
-------------------------------------------------------------------------
            NLLS         BOOTSTRAP     BOOTSTRAP     C.V. FOR
            ESTIMATE     MEAN          StdError      NLLS SOLN
Age 0         0.0021       0.0022        0.0004        0.21
Age 1         0.1075       0.1090        0.0177        0.17
Age 2         0.3269       0.3316        0.0487        0.15
Age 3         0.3735       0.3786        0.0519        0.14
Age 4         0.2752       0.2839        0.0544        0.20
Age 5         0.1714       0.1788        0.0475        0.28
Age 6         0.2734       0.2804        0.0315        0.12
Age 7         0.2734       0.2804        0.0315        0.12
                                                      NLLS EST      C.V. FOR
            BIAS         BIAS          PERCENT       CORRECTED     CORRECTED     LOWER         UPPER
            ESTIMATE     STD ERROR     BIAS          FOR BIAS      ESTIMATE      80%CI         80%CI
Age 0       0.0000396    0.0000197     1.865         0.0020821     0.21          0.0017        0.0028
Age 1       0.0014651    0.0007932     1.363         0.1060253     0.17          0.0884        0.1316
Age 2       0.0046466    0.0021784     1.421         0.3222752     0.15          0.2726        0.3892
Age 3       0.0051271    0.0023231     1.373         0.3683516     0.14          0.3160        0.4516
Age 4       0.0086827    0.0024324     3.155         0.2665285     0.20          0.2095        0.3390
Age 5       0.0074158    0.0021235     4.327         0.1639547     0.29          0.1335        0.2521
Age 6       0.0070752    0.0014103     2.588         0.2662783     0.12          0.2370        0.3162
Age 7       0.0070752    0.0014103     2.588         0.2662783     0.12          0.2370        0.3162
Bootstrap Output Variable:  F full t
-------------------------------------------------------------------------
            NLLS         BOOTSTRAP     BOOTSTRAP     C.V. FOR
            ESTIMATE     MEAN          StdError      NLLS SOLN
              0.2734       0.2804        0.0315        0.12

                                                      NLLS EST      C.V. FOR
            BIAS         BIAS          PERCENT       CORRECTED     CORRECTED     LOWER         UPPER
            ESTIMATE     STD ERROR     BIAS          FOR BIAS      ESTIMATE      80%CI         80%CI
            0.00708      0.00141       2.59          0.26628       0.12          0.2370        0.3162
```

Table A51 continued.
_____

```
Bootstrap Output Variable:  SSB spawn t
-----------------------------------------------------------------------
          NLLS          BOOTSTRAP     BOOTSTRAP     C.V. FOR
          ESTIMATE      MEAN          StdError      NLLS SOLN
           38166.3196    38502.5412    3309.9183     0.09


                                                    NLLS EST      C.V. FOR
          BIAS          BIAS          PERCENT       CORRECTED     CORRECTED    LOWER         UPPER
          ESTIMATE      STD ERROR     BIAS          FOR BIAS      ESTIMATE     80%CI         80%CI
           336.22        148.02        0.88          37830.10      0.09         34164.5520    42579.9361

Bootstrap Output Variable: Jan 1 biomass
-----------------------------------------------------------------------
          NLLS          BOOTSTRAP     BOOTSTRAP     C.V. FOR
          ESTIMATE      MEAN          StdError      NLLS SOLN
           42874.5306    43159.7457    2973.0448     0.07


                                                    NLLS EST      C.V. FOR
          BIAS          BIAS          PERCENT       CORRECTED     CORRECTED    LOWER         UPPER
          ESTIMATE      STD ERROR     BIAS          FOR BIAS      ESTIMATE     80%CI         80%CI
           285.22        132.96        0.67          42589.32      0.07         39279.15      46922.42
```

Table A52. VPA Retrospective analysis for summer flounder.

Fishing Mortality (F)

Terminal Year	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1996	0.94	2.15	1.24	1.36	1.59	1.06	2.07	1.90	1.65	1.58	1.42	0.99	1.37	1.41	1.99					
1997	0.94	2.15	1.24	1.36	1.59	1.06	2.07	1.90	1.65	1.58	1.41	0.98	1.33	1.25	1.26	5.99				
1998	0.94	2.15	1.24	1.36	1.59	1.06	2.07	1.90	1.65	1.58	1.41	0.98	1.32	1.22	1.09	1.02	0.59			
1999	0.94	2.15	1.24	1.36	1.59	1.06	2.07	1.90	1.65	1.58	1.41	0.98	1.32	1.21	1.08	1.03	0.60	0.40		
2000	0.94	2.15	1.24	1.36	1.59	1.06	2.07	1.90	1.65	1.58	1.41	0.98	1.32	1.23	1.12	1.12	0.72	0.57	0.36	
2001	0.94	2.15	1.24	1.36	1.59	1.06	2.07	1.90	1.65	1.58	1.41	0.98	1.32	1.23	1.14	1.19	0.86	0.73	0.47	0.27

Spawning Stock Biomass (SSB)

Terminal Year	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1996	17497	18833	16086	14968	13926	14418	8124	5215	7449	5997	7254	9101	12187	17674	19516					
1997	17497	18833	16086	14968	13926	14418	8124	5216	7453	6007	7293	9289	12754	18770	20969	21782				
1998	17497	18833	16086	14968	13926	14418	8124	5216	7453	6008	7311	9277	12251	17226	19430	20710	23482			
1999	17497	18833	16086	14968	13926	14418	8124	5216	7453	6008	7310	9287	12271	16844	18640	20262	24795	25243		
2000	17497	18833	16086	14968	13926	14418	8124	5216	7453	6007	7307	9271	12066	16372	17793	19111	24456	25644	32657	
2001	17497	18833	16086	14968	13926	14418	8124	5216	7453	6007	7304	9260	12017	15834	16746	17625	22280	22948	30050	38166

Population numbers: Age-0

Terminal Year	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1996	74269	80323	48380	48579	53444	43920	13031	27269	30329	28630	32028	32749	39614	48642	30368					
1997	74269	80323	48380	48579	53444	43922	13033	27270	30361	28663	32213	33965	40689	50289	29383	21451				
1998	74269	80323	48380	48579	53444	43921	13033	27270	30354	28697	32370	33269	37292	46534	35898	25251	26377			
1999	74269	80323	48380	48579	53444	43921	13033	27270	30356	28697	32351	33429	37139	43414	35712	34444	30853	26064		
2000	74269	80323	48380	48579	53444	43921	13033	27270	30354	28689	32343	33318	35689	43181	33101	37245	40276	27233	35822	
2001	74269	80323	48380	48579	53444	43921	13033	27270	30353	28687	32322	33258	35480	39619	32864	35613	39817	30766	39455	26594

Table A53. Input parameters and short term stochastic projection results for summer flounder. Starting stock sizes on January 1, 2002 are as estimated by VPA bootstrap procedure. Age-0 recruitment levels in 2002-2004 are estimated as the median of 500 random estimates selected from VPA estimated numbers at age 0 (000s) during 1982-2001. Fishing mortality was apportioned among landings and discard based on the proportion of F associated with landings and discards at age during 1999-2001. Mean weights at age (landings and discards) are weighted (by fishery) geometric means of 1999-2001 values. Total stock biomass is the product of January 1 numbers at age and January 1 mean weights at age estimated from total catch (landings plus discards) weights. Proportion of F and M before spawning = 0.83 (spawning peak at 1 November).

Age	Median Stock Size in 2002	Fishing Mortality Pattern	Proportion Landed	Proportion Mature	Mean Weights January 1 Total Biomass	Mean Weights Landings	Mean Weights Discards
0	35613	0.01	0.00	0.38	0.040	0.144	0.093
1	23156	0.18	0.43	0.72	0.251	0.536	0.425
2	26637	0.78	0.75	0.90	0.554	0.709	0.586
3	12957	1.00	0.90	1.00	0.773	0.933	0.890
4	6741	1.00	0.97	1.00	1.120	1.403	1.386
5	2861	1.00	0.97	1.00	1.700	2.103	2.099
6	2083	1.00	0.97	1.00	2.405	2.655	2.410
7+	395	1.00	0.97	1.00	3.291	3.135	2.972

2002 Landings = 10,991 mt; 2002-2004 median recruitment from 1982-2001 VPA estimates (35.6 million)

Forecast medians (50% probability level) (landings, discards, and total stock biomass (B) in '000 mt)

	2002				2003				2004		
F	Land.	Disc.	B	F	Land.	Disc.	B	F	Land.	Disc.	B
0.32	**11.0**	**1.7**	**51.4**	**0.26**	**10.6**	**1.5**	**57.6**	**0.26**	**12.2**	**1.7**	**65.6**

Summer flounder
Total Catch Age Composition
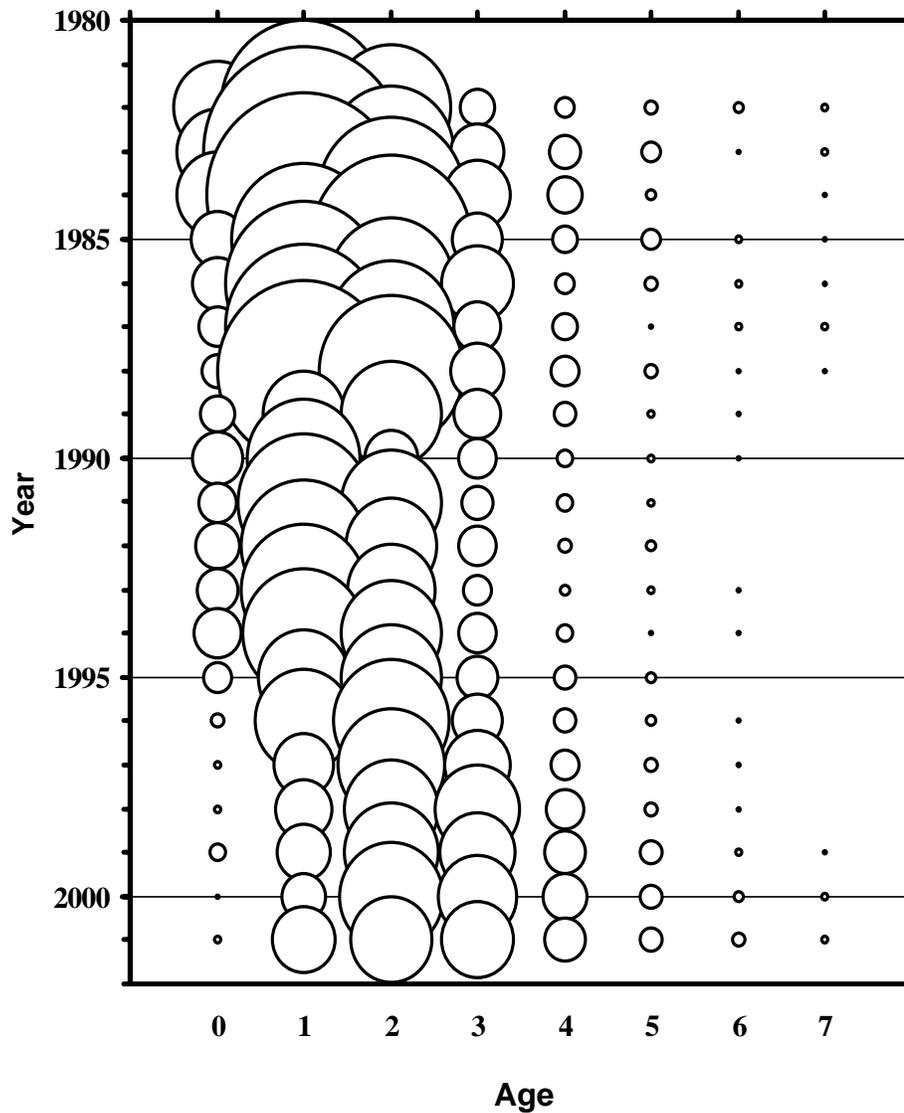
Figure A1. Total catch age composition for summer flounder: 1982-2001
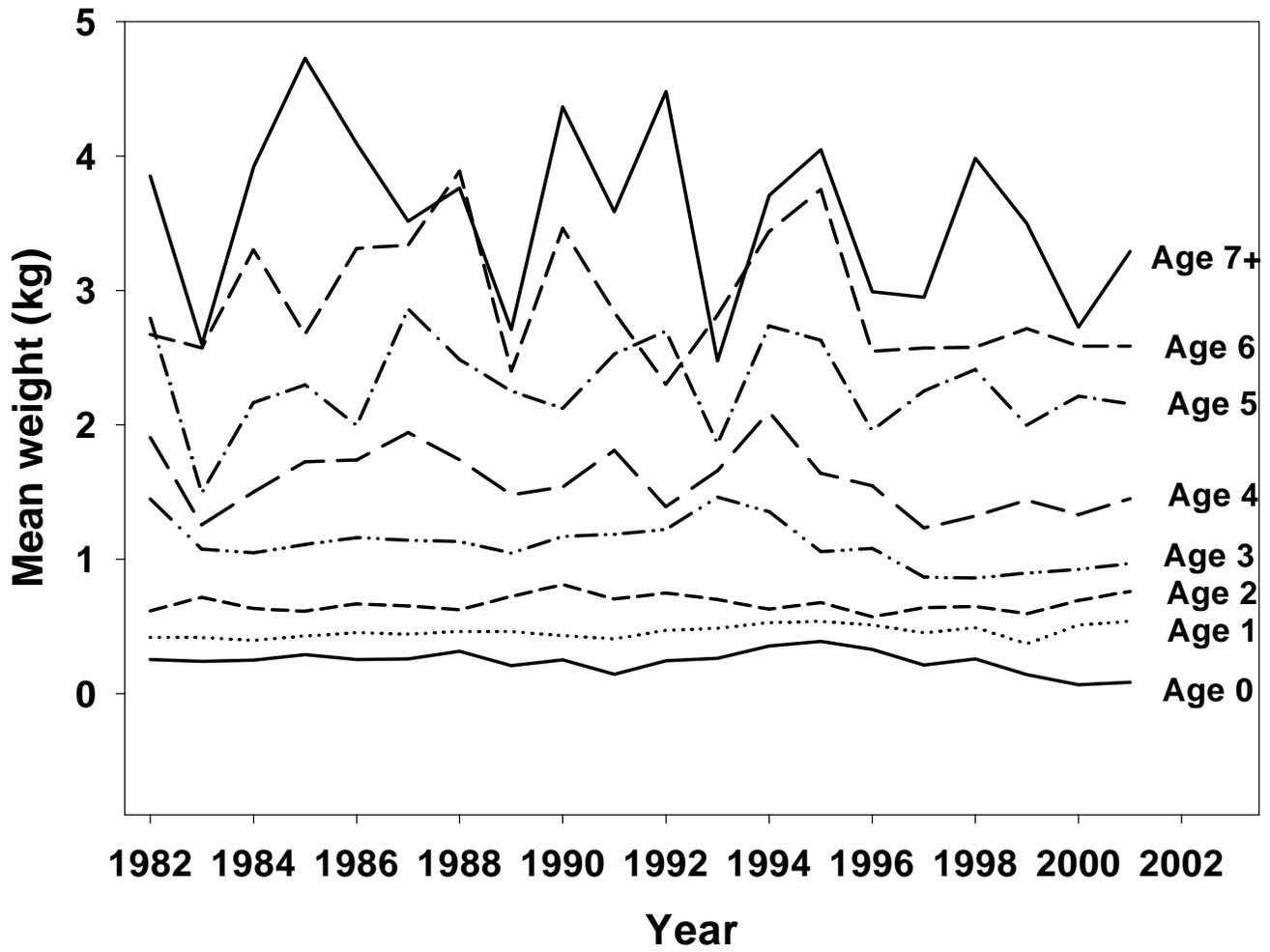
Figure A2. Trends in mean weight at age in the total catch of summer flounder.

Components of the summer flounder total catch
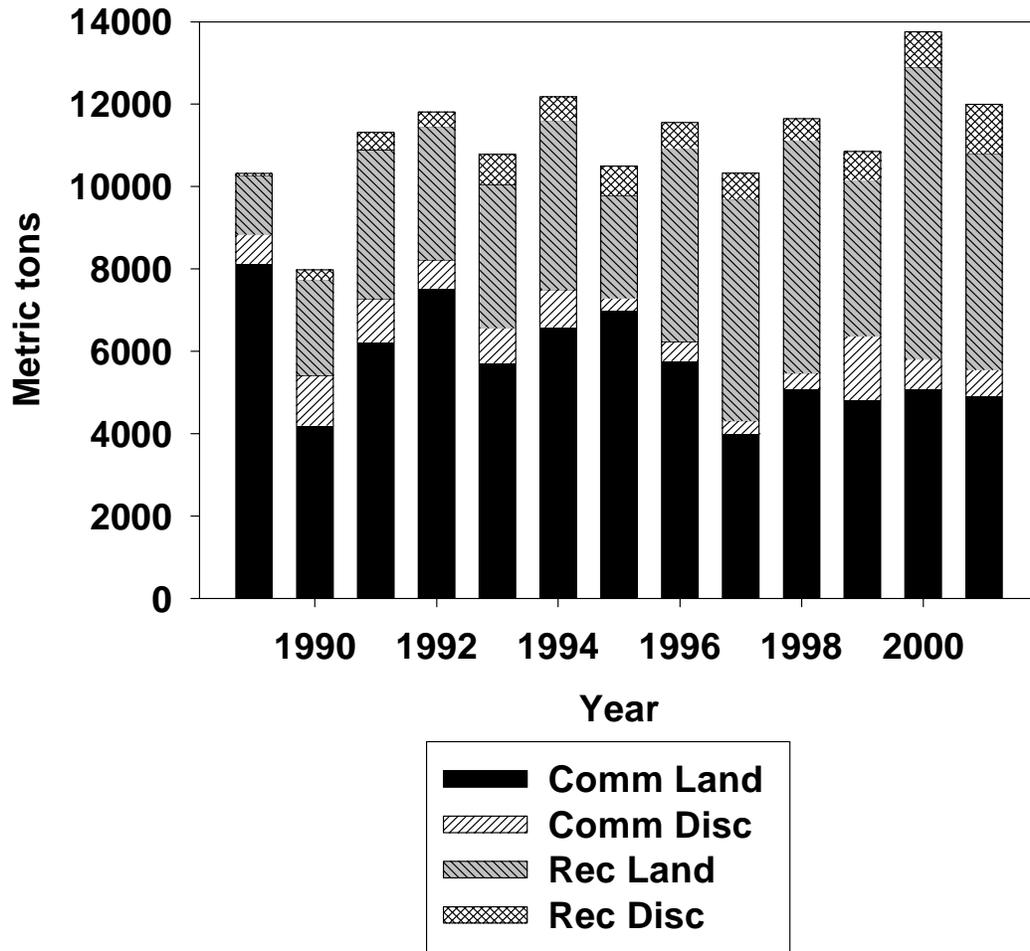
Figure A3. Components of the summer flounder total catch.
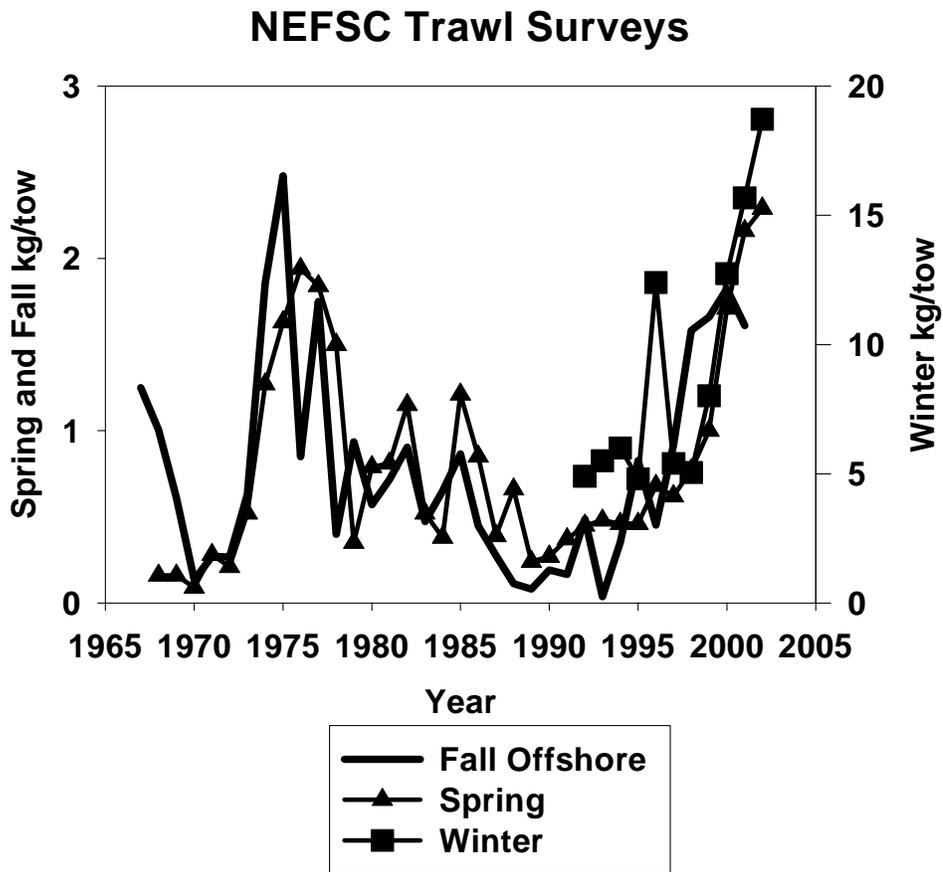
Figure A4. Trends in NEFSC trawl survey biomass indices for summer flounder.

MA and RI State Trawl Surveys
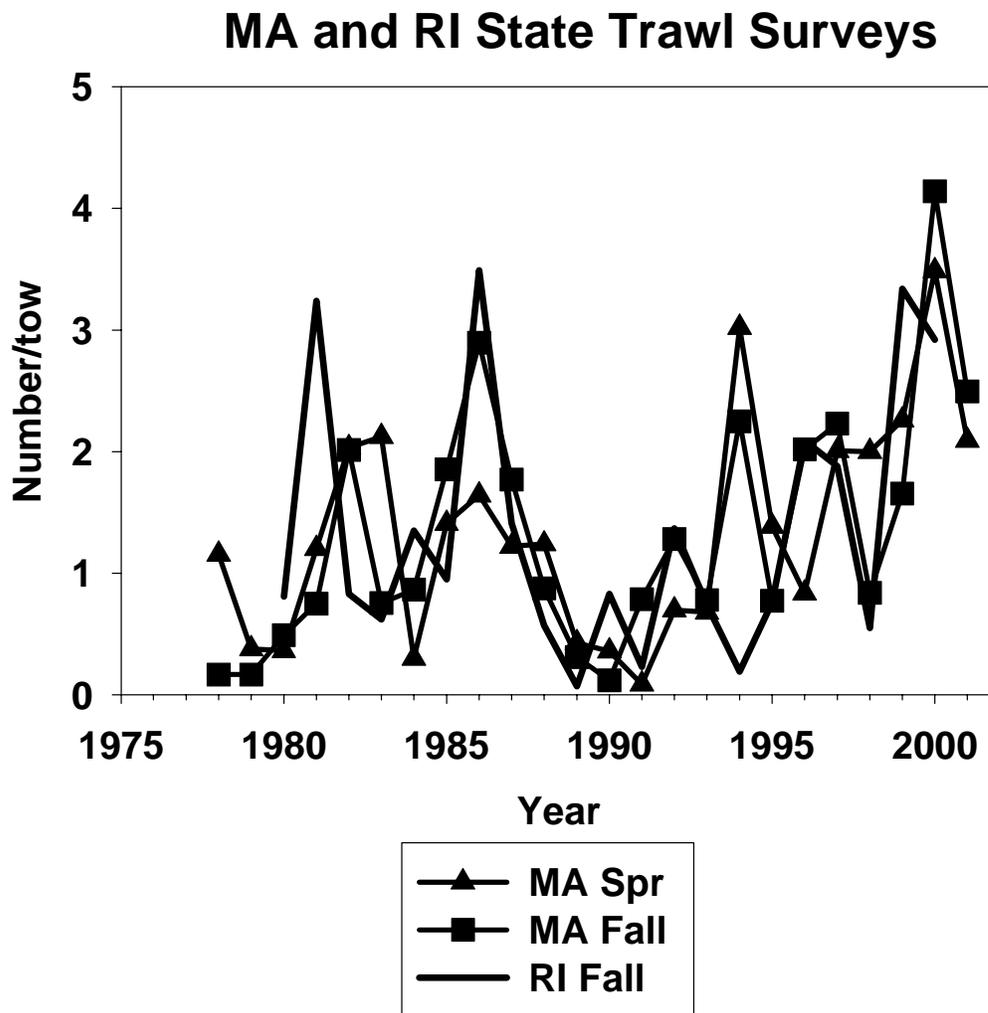
Figure A5. Trends in MA and RI trawl survey abundance indices for summer flounder.

CT, NJ, and DE State Trawl Surveys
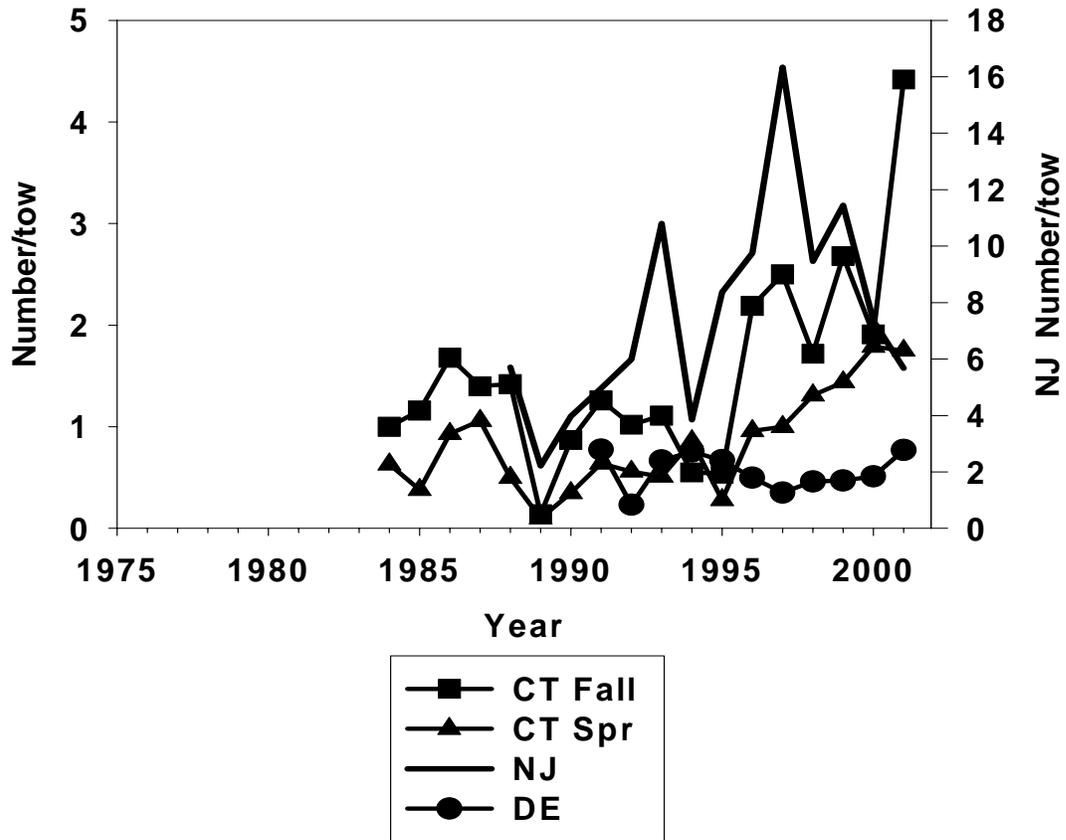
Figure A6. Trends in CT, NJ, and DE trawl survey abundance indices for summer flounder

NEFSC, CT, and NJ YOY Indices
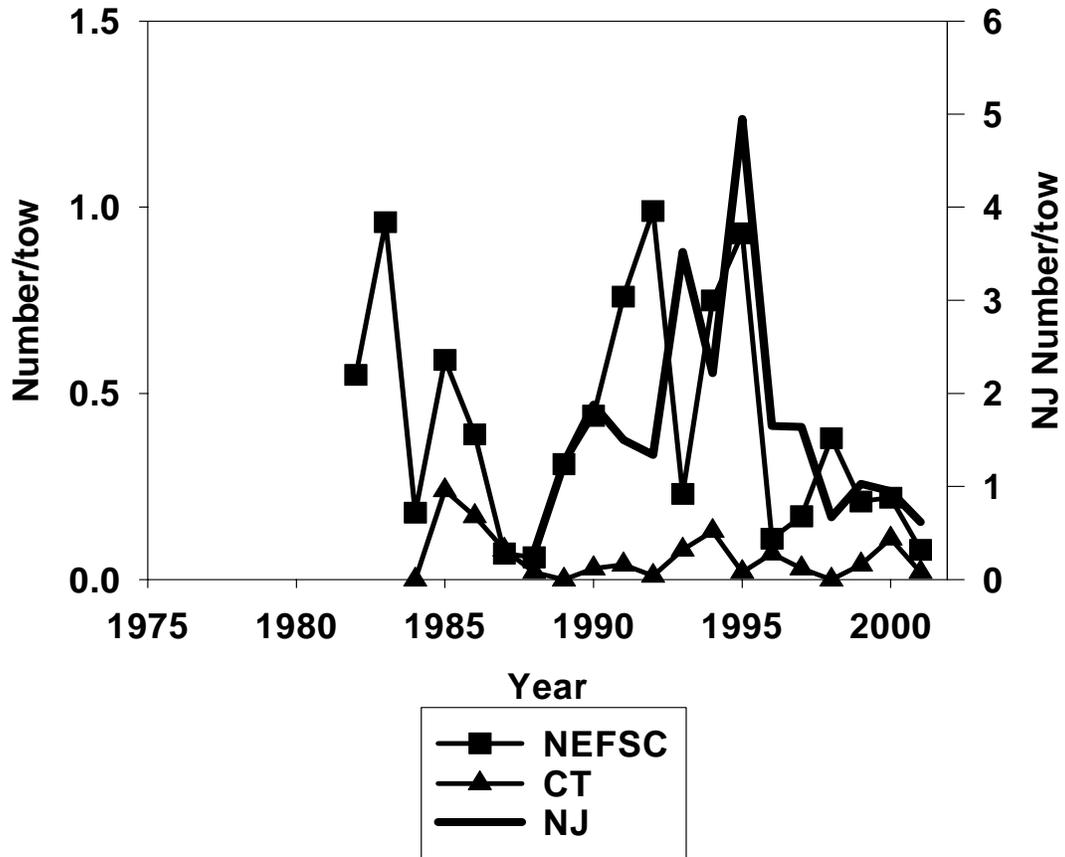
Figure A7. Trends in NEFSC, CT, and NJ trawl survey recruitment indices for summer flounder

MD, VIMS, and NC YOY Indices
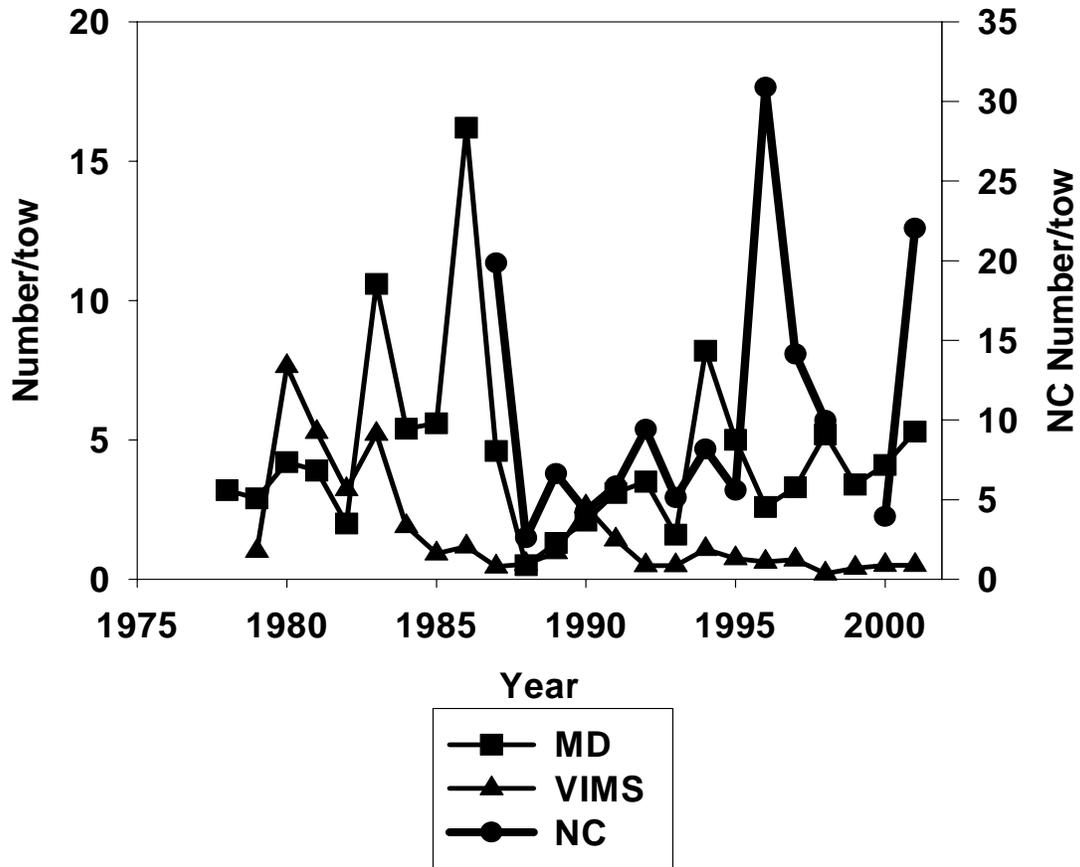
Figure A8. Trends in MD, VIMS, and NC trawl survey recruitment indices for summer flounder.

MA, RI, and DE YOY Indices
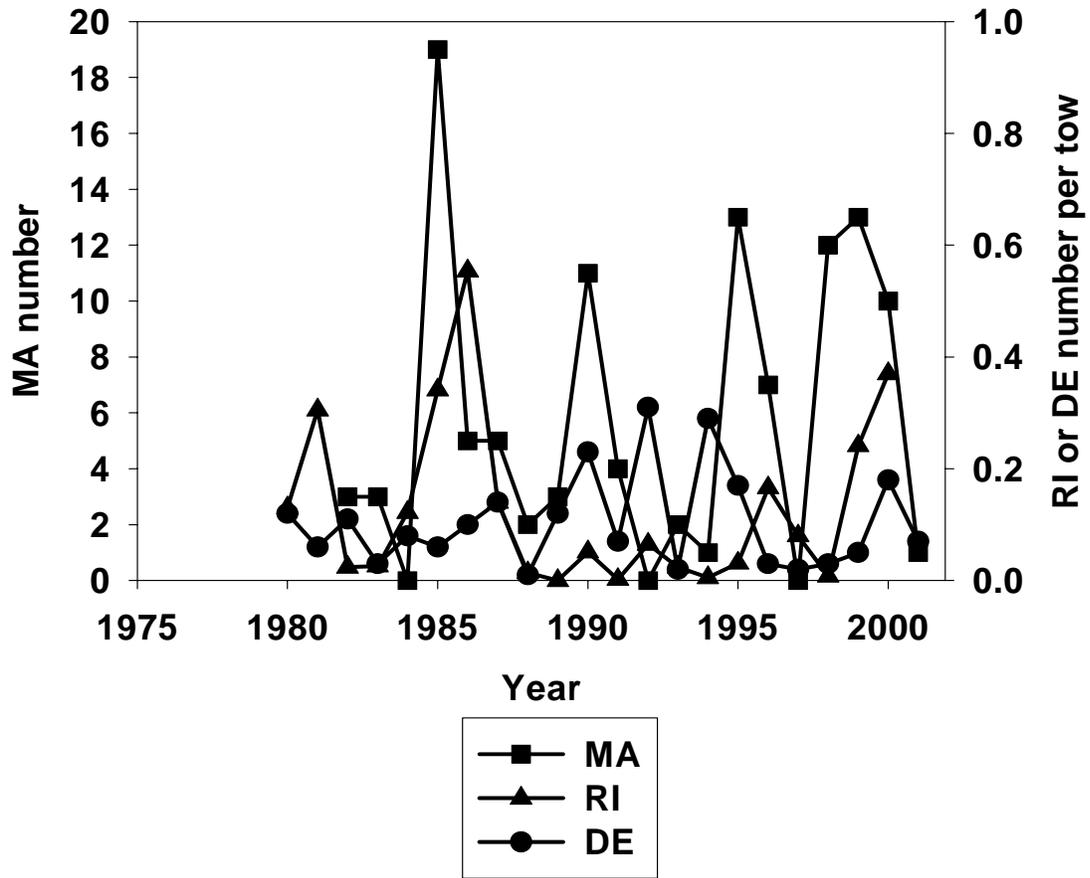
Figure A9. Trends in MA, RI, and DE survey recruitment indices for summer flounder.

Total Catch and Fishing Mortality
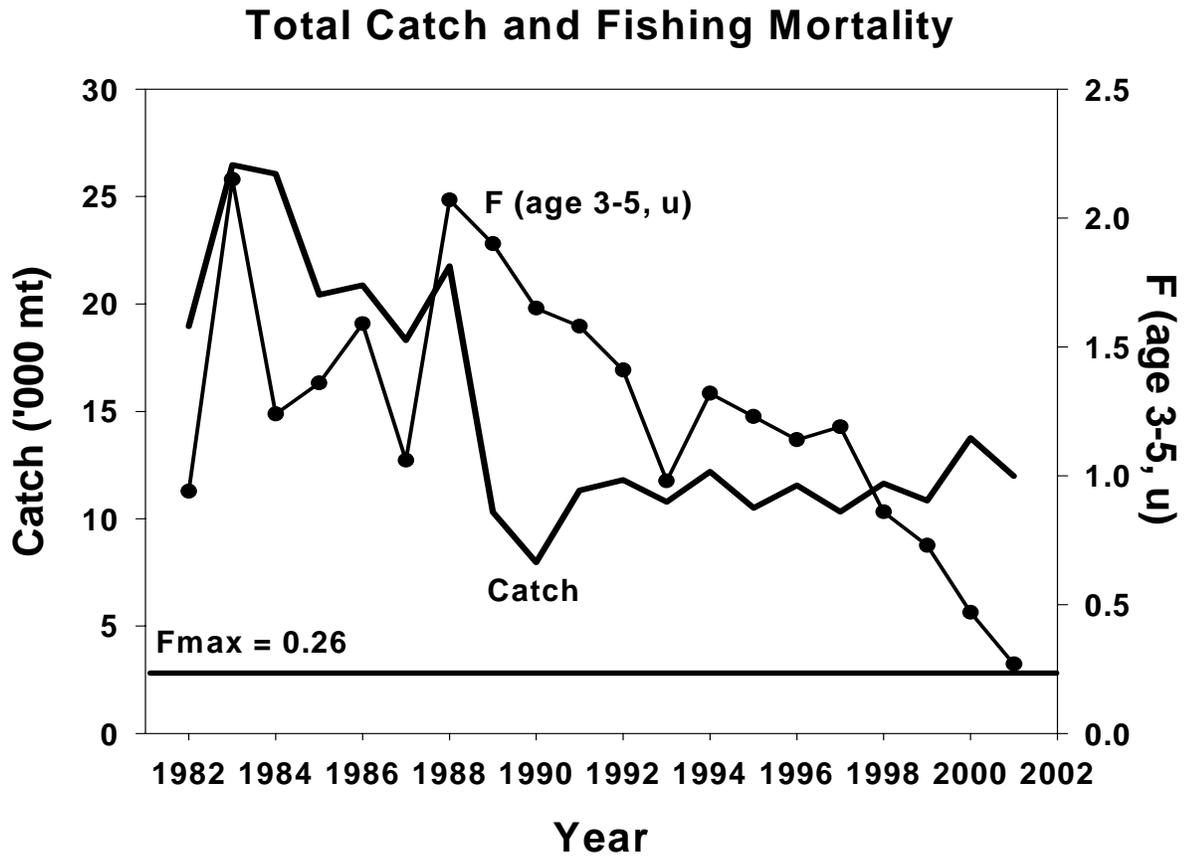
Figure A10. Total catch (landings and discards, thousands of metric tons) and fishing mortality rate (F, ages 3-5, unweighted) for summer flounder.

Total Biomass, SSB, and Recruitment (R)
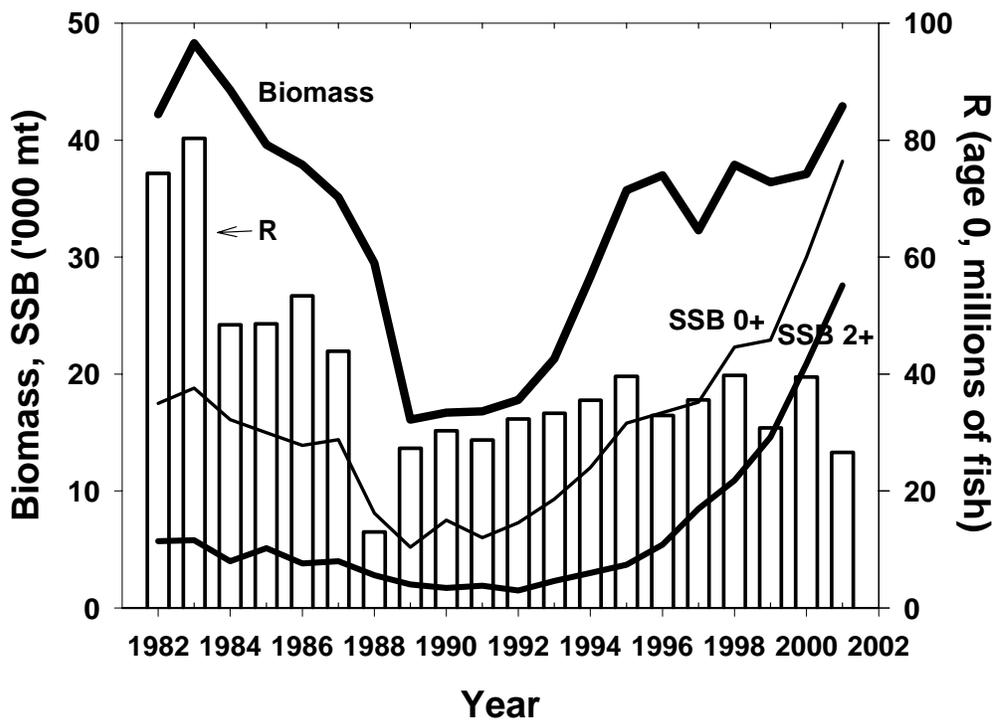
Figure A11. Total stock biomass ('000 mt), spawning stock biomass
(SSB ages 0-7+ and 2-7+, '000 mt), and recruitment
(millions of fish at age-0) for summer flounder.

Summer flounder
Stock Age Composition
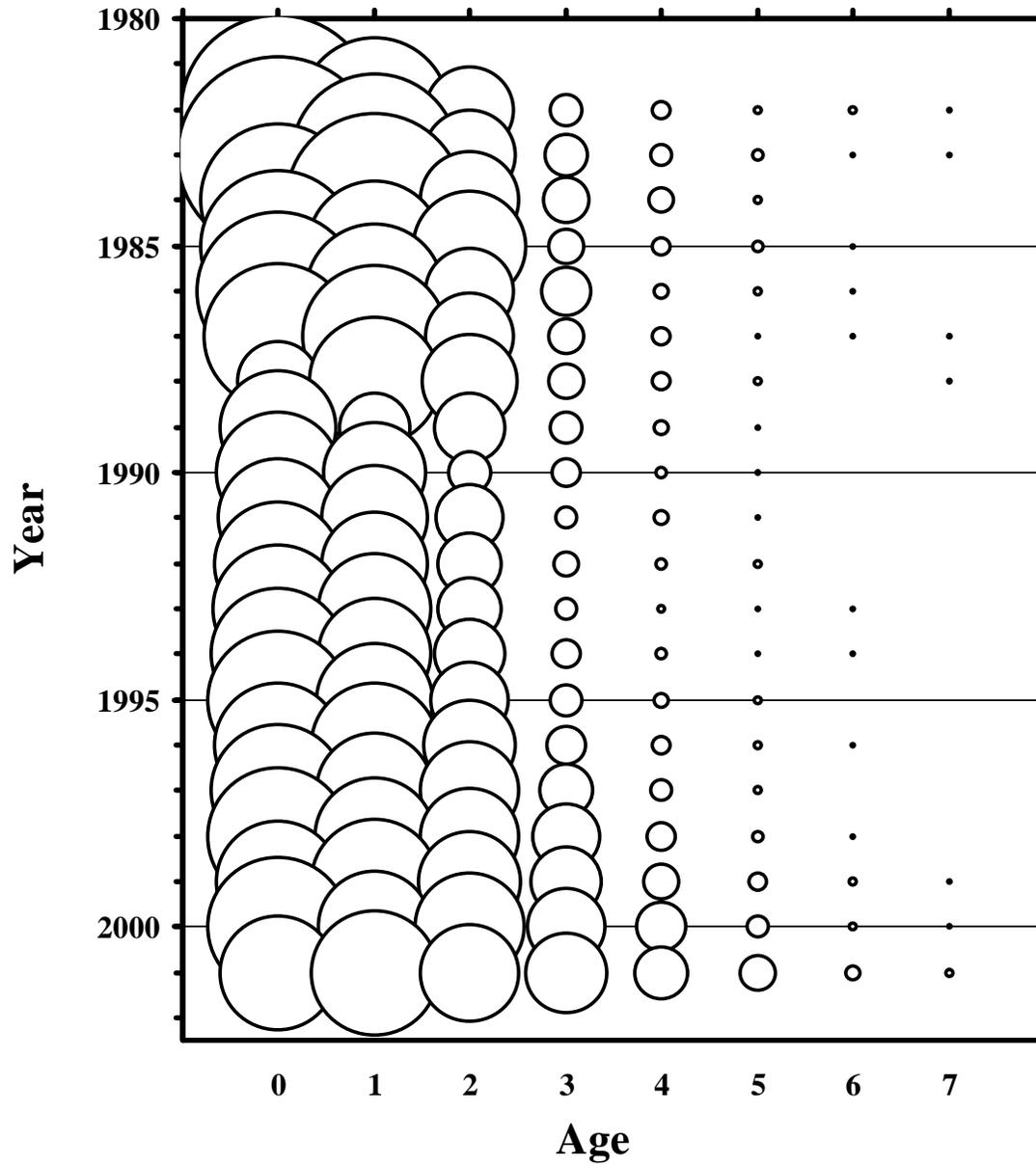
Figure A12. Stock age composition for summer flounder: 1982-2001
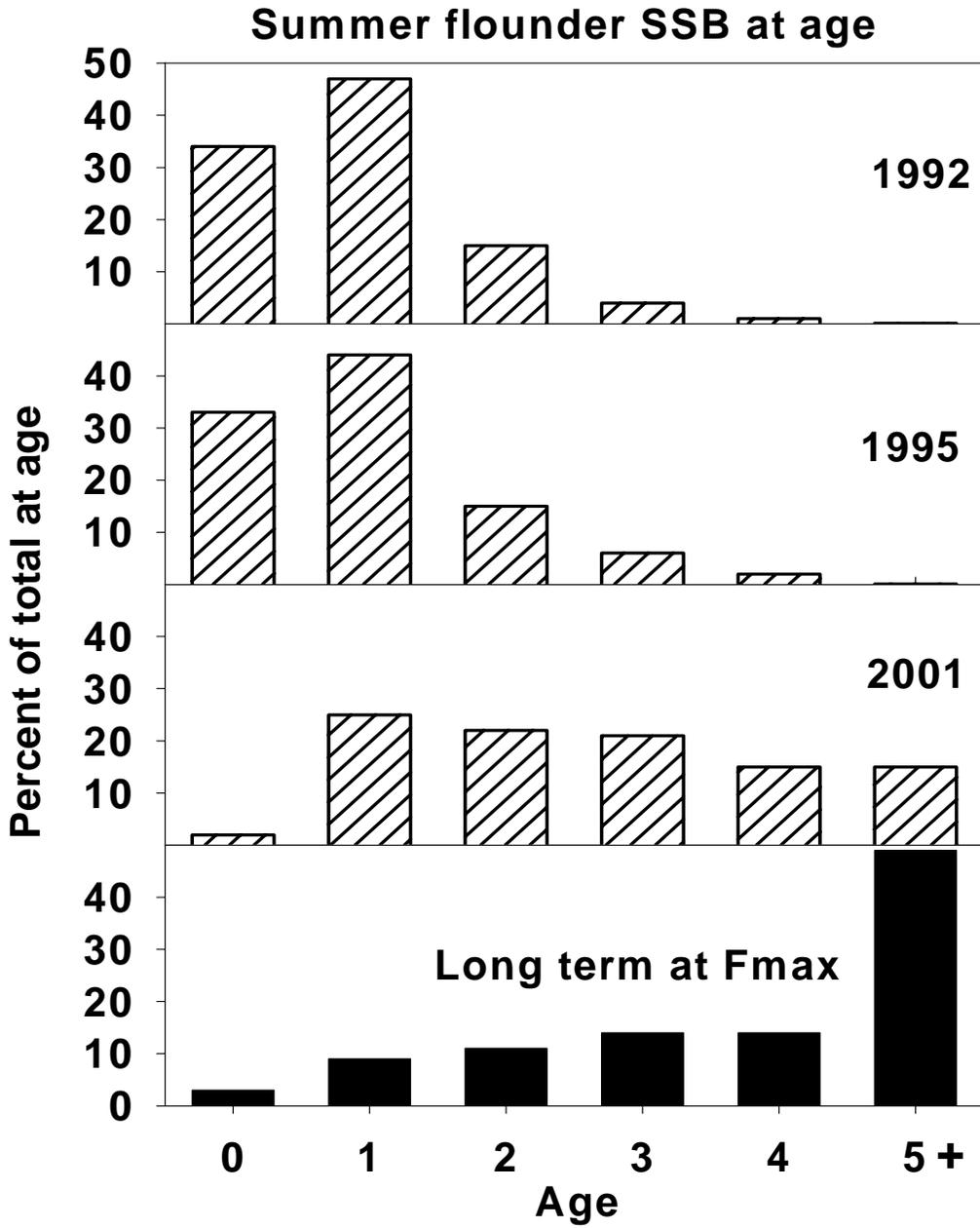
Figure A13. Spawning stock biomass for summer flounder: percent of total at age.

SSB - RECRUIT DATA FOR 1983-2001 YEAR CLASSES
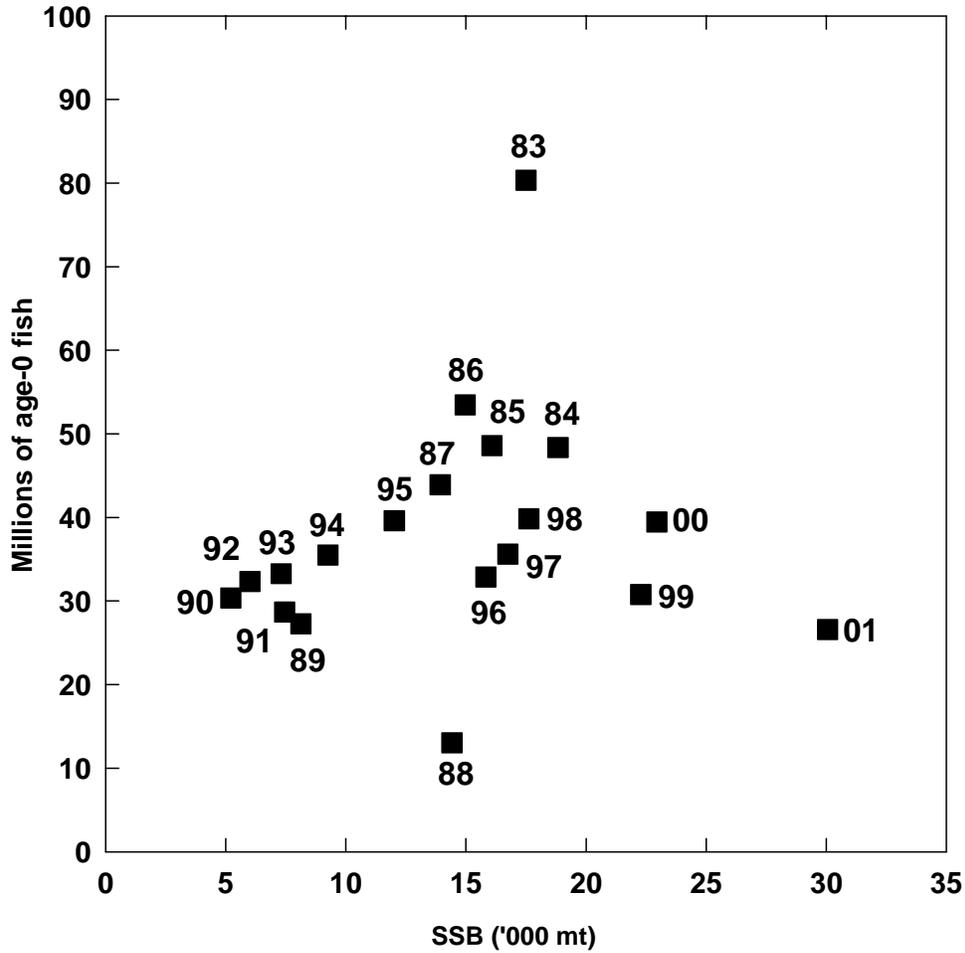
Figure A14. VPA spawning stock biomass and recruitment estimates for summer flounder.

Precision of 2001 Estimates of Stock Biomass and F
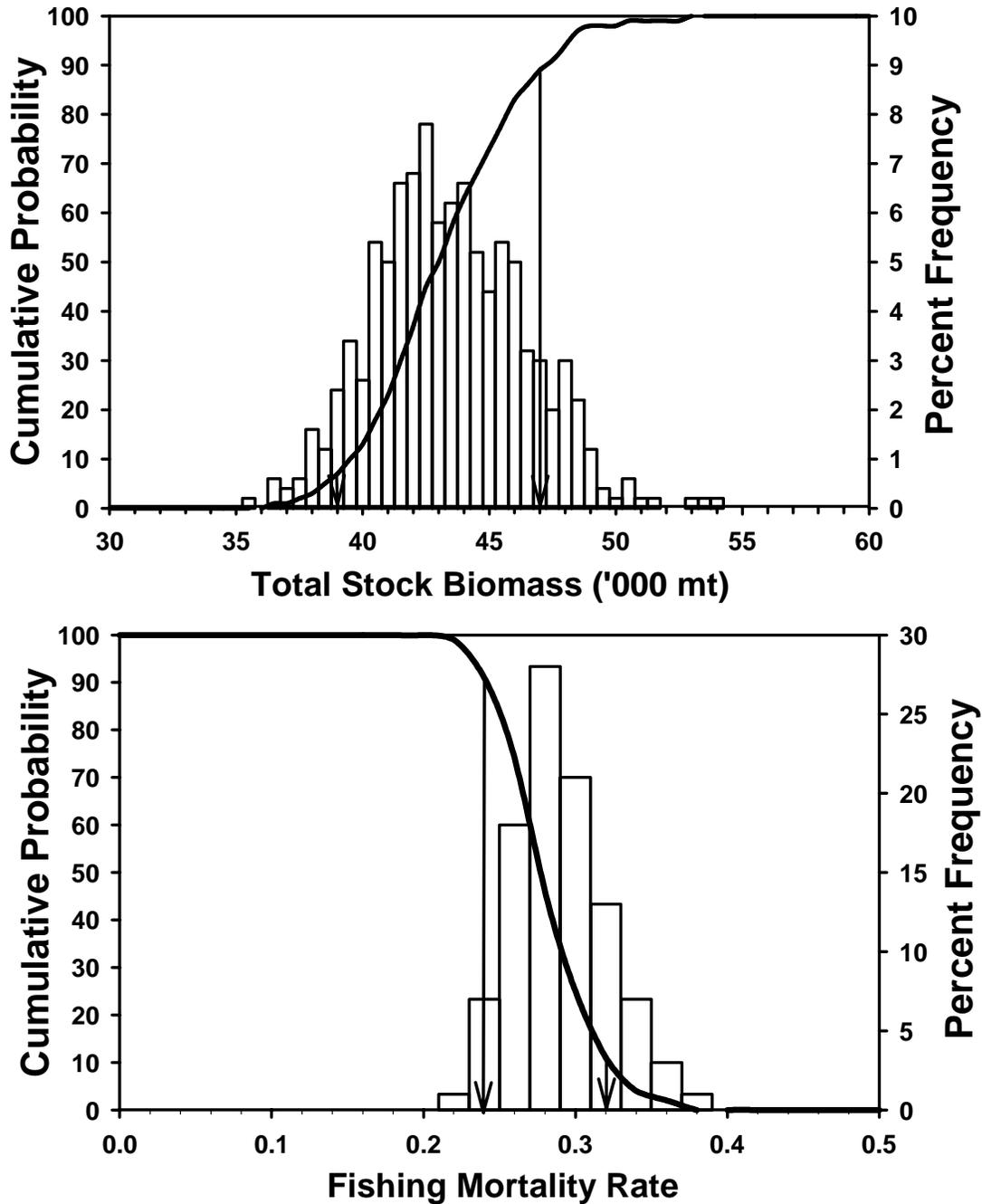
Figure A15. Precision of the estimates of January 1, 2001 total stock biomass (B) and fully recruited fishing mortality on age 3-5 (F) in 2001 for summer flounder.

Summer flounder Retrospective VPAs
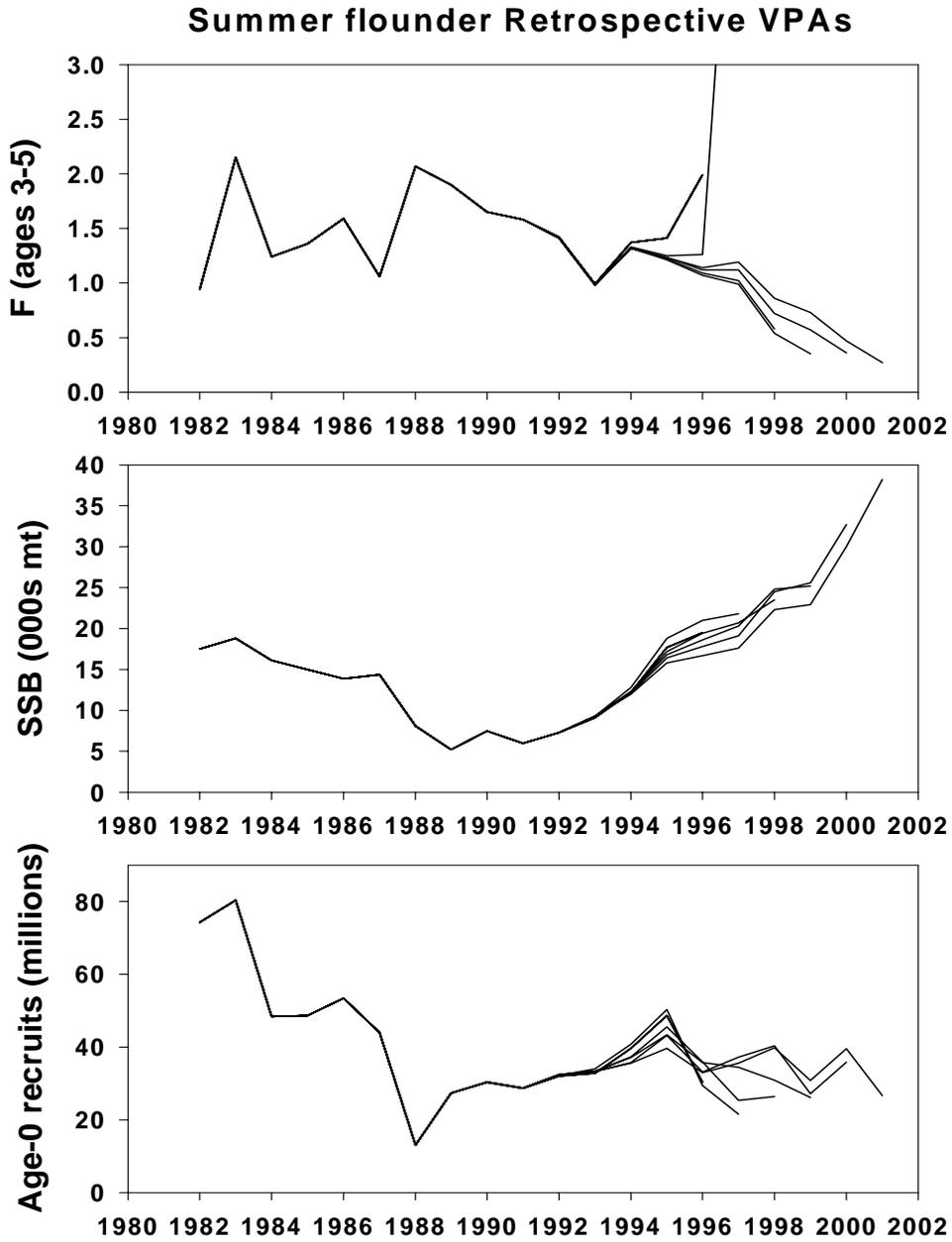
Figure A16. Retrospective VPAs for summer flounder.
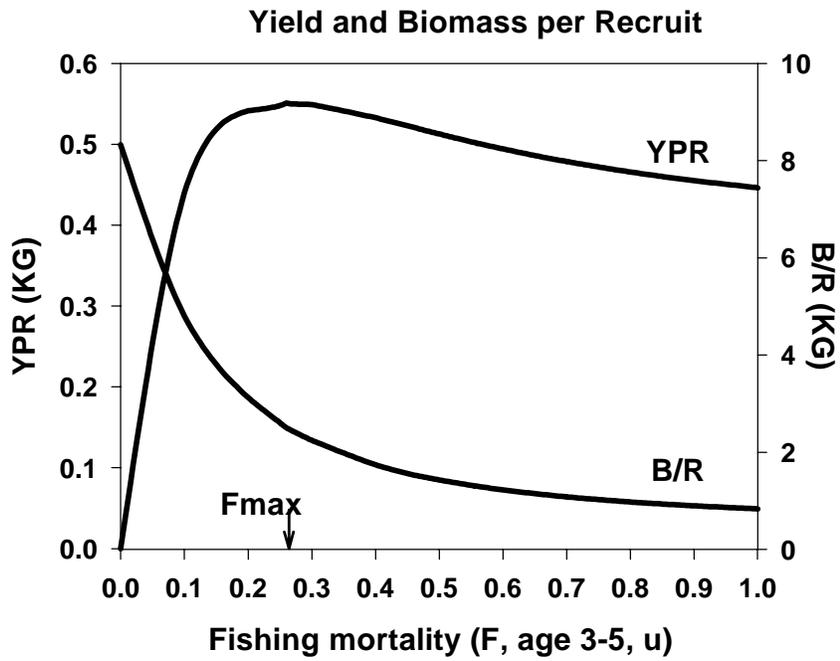
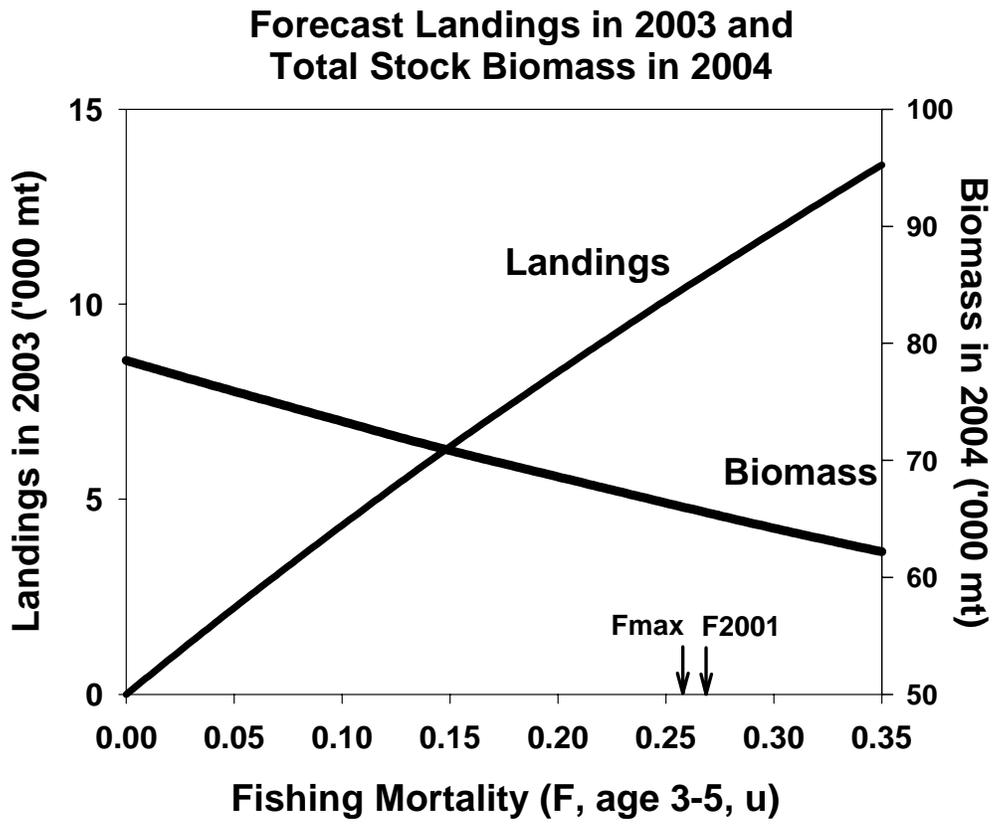Figure A17. Yield per recruit (YPR) and biomass per recruit (B/R).

Figure A18. Forecast landings in 2003 and total stock biomass on Jan.1, 2004
over a range of fishing mortalities in 2003.

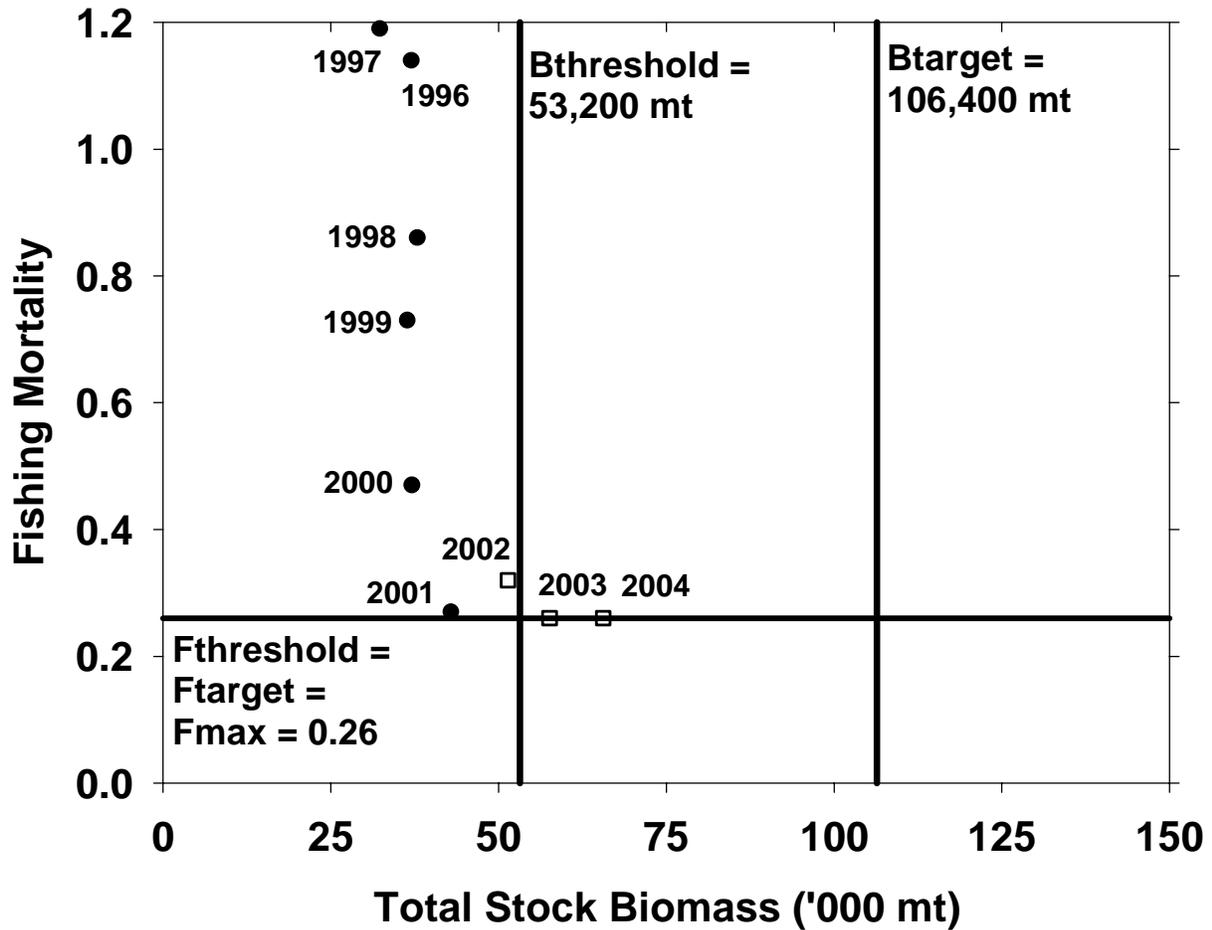# SFA Reference Points for Summer flounder

Figure A19. MAFMC FMP Amendment 12 SFA reference points for summer flounder, with 1996-2001 VPA estimates of F and total stock biomass, and forecast estimates of F and total stock biomass for 2002-2004.