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Stock Assessment of Summer Flounder for 2010

by Mark Terceiro

July 2010

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NOAA Fisheries, Northeast Fisheries Science Center, 166 Water Street, Woods Hole MA 02543

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EXECUTIVE SUMMARY

This assessment of the summer flounder (*Paralichthys dentatus*) stock along the Atlantic coast (Maine to North Carolina) is an update through 2009 of commercial and recreational fishery catch data, research survey indices of abundance, and the analyses of those data. Reported 2009 landings in the commercial fishery were 4,848 mt, about 1% under the commercial quota. Commercial discard losses in the otter trawl and scallop dredge fisheries are estimated from fishery observer data and have recently accounted for 5%-10% of the total commercial catch, assuming a discard mortality rate of 80%. Estimated 2009 landings in the recreational rod-and-reel fishery were 2,856 mt, about 12% under the recreational harvest limit. Recreational discard losses have recently accounted for 15%-20% of the total recreational catch, assuming a discard mortality rate of 10%. Total commercial and recreational landings in 2009 were 7,704 mt, and total catch was estimated at 9,017 mt.

The summer flounder stock is not overfished and overfishing is not occurring relative to the biological reference points established in the 2008 SAW 47 assessment. The stock is currently under a rebuilding program with a deadline of January 1, 2013 (corresponding to the November 1, 2012 estimate of SSB). Fishing mortality (F) calculated from the average of the currently fully recruited ages (3-7+) ranged between about 1.0 and 2.0 during 1982-1996. The fishing mortality rate has declined to below 1.0 since 1997 and was estimated to be 0.237 in 2009, below the threshold fishing mortality reference point FMSY = F35% = 0.310. There is a 50% probability that the fishing mortality rate in 2008 was between 0.224 and 0.250. Spawning stock biomass (SSB) decreased from about 25,000 mt in the early 1980s to about 7,000 in 1989, then increased to above 40,000 mt by 2002. SSB was estimated to be 53,458 mt in 2009, about 89% of the SSBMSY = SSB35% target reference point = 60,074 mt. There is a 50% chance that SSB in 2008 was between 50,560 and 55,998 mt. The arithmetic average recruitment from 1982 to 2008 is 42 million fish at age 0. The 1982 and 1983 year classes are the largest in the assessment time series, at 73 and 81 million fish; the 1988 year class is the smallest at 13 million fish. The 2008 year class is estimated to be about 49 million fish, 17% above the average. The 2009 year class is currently estimated to be about 82 million fish, about twice the average, and is the largest in the assessment time series. The summer flounder stock assessment has historically exhibited a consistent retrospective pattern of underestimation of F and overestimation of SSB; the causes of this pattern have not been determined. A recent pattern of overestimation in recruitment is also evident. Over the last 7 years, the annual internal model retrospective error in fishing mortality has ranged from +11% in the 2006 terminal year to -35% in 2003, while the annual internal model retrospective error in SSB has ranged from -13% in 2006 to +45% in 2003. Over the last 3 terminal years, the annual internal model retrospective error in recruitment has ranged from +54% for the 2008 year class to +80% for the 2006 year class. Comparison of the estimates for SSB, R and F over the last three assessments indicates consistency of those estimates in line with the most recent internal retrospective pattern of the 2010 assessment model.

STOCK UNIT

The definition of Wilk et al. (1980) of a unit stock extending from Cape Hatteras north to New England has been accepted in this and previous assessments. A consideration of summer flounder stock structure incorporating tagging data concluded that evidence supported the existence of stocks north and south of Cape Hatteras, with the stock north of Cape Hatteras possibly composed of two distinct spawning aggregations, off New Jersey and Virginia-North Carolina (Kraus and Musick 2001). The conclusions of Kraus and Musick (2001) are consistent with the current assessment unit stock. The MAFMC and ASMFC joint Fishery Management Plan (FMP) defines the management unit for summer flounder as extending from the southern border of North Carolina north to the U.S.-Canadian border. A summer flounder genetics study revealed no population subdivision at Cape Hatteras (Jones and Quattro 1999), consistent with the definition of the management unit.

HISTORY OF MANAGEMENT AND ASSESSMENT

An overview of the history of the summer flounder FMP and assessment is provided in this section and the box below. Management of the summer flounder fishery began through the implementation in 1988 of the original Summer Flounder FMP, a time that coincided with the lowest levels of stock biomass for summer flounder since the late 1960s. The MAFMC and ASMFC cooperatively develop fishery regulations, with NMFS serving as the federal implementation and enforcement entity. Cooperative management was developed because significant catch is taken from both state (0-3 miles offshore) and federal waters (3-200 miles offshore).

Amendment 1 to the FMP in 1990 established the overfishing definition for summer flounder as equal to Fmax, initially estimated as 0.23 (NEFC 1990). Amendment 2 in 1992 established target fishing mortality rates for summer flounder for 1993-1995 as F = 0.53, and Fmax = 0.23 for 1996 and beyond. 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) a commercial minimum landed fish size limit at 13 in (33 cm), 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 lbs (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 an annual harvest limit, closed seasons, a 14 in (36 cm) minimum landed fish size, and possession limits.

The results of stock assessments in the mid-1990s 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 Fmax, the MAFMC and ASMFC modified the fishing mortality rate reduction schedule in 1995 to allow for more stable landings from between years, 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 Fmax = 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 = 0.23.

Amendment 12 in 1999 defined overfishing for summer flounder as occurring when the fishing mortality rate exceeds the threshold fishing mortality rate of FMSY. Because FMSY could not be reliably estimated for summer flounder, Fmax = 0.24 was used as a proxy for FMSY; FMSY was also defined as the target fishing mortality rate. Under Amendment 12, the stock was defined to be overfished when total stock biomass fell below the biomass threshold of one-half of the biomass target, BMSY. Because BMSY could not be reliably estimated, the biomass target was defined as the product of total biomass per recruit and contemporary (1982-1996) median recruitment, at that time estimated to be 153,350 mt (338 million lbs), with the biomass threshold defined as 76,650 mt (169 million lbs). In the 1999 stock assessment (Terceiro 1999) the reference points were updated using new estimates of median recruitment (1982-1998) and mean weights at age (1997-1998), which resulted in a biomass target of 106,444 mt (235 million lbs) and minimum 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 Summer Flounder Overfishing Definition Review Committee to review these biological reference points. The work of this Committee was later reviewed by the MAFMC SSC in August 2001. The SSC recommended that using the FMSY proxy for Fmax = 0.26 was appropriate and should be retained for 2002, and endorsed the recommendation of SARC 31 (NEFSC 2000) which stated that "...the use of Fmax as a proxy for FMSY 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 2002 SAW 35 assessment (NEFSC 2002) indicated the summer flounder stock was overfished and overfishing was occurring relative to the biological reference points. The fishing mortality rate had declined from 1.32 in 1994 to 0.27 in 2001, marginally above the overfishing reference point (Fthreshold = Ftarget = Fmax = 0.26). Total stock biomass in 2001 was estimated as 42,900 mt (94.6 million lbs), or 19% below the biomass threshold (53,200 mt; 117.3 million lbs). The 2002 SAW35 Review Panel concluded that updating the biological reference points was not warranted at that time (NEFSC 2002). Subsequent updates to the stock assessment were completed in 2003 (Terceiro 2003), 2004 (SDWG 2004), and 2005 (NEFSC 2005). While the 2003 assessment found the summer flounder stock was not overfished and no overfishing was occurring, the 2004 and 2005 assessments found the stock again experiencing overfishing. The 2005 SAW 41 assessment recommended updating the values for the fishing mortality and stock biomass reference points (NEFSC 2005).

A peer review of the assessment occurred in 2006 by the NMFS Office of Science and Technology Division (S&T) (Terceiro 2006a, 2006b). This review made several recommendations, including modification of the definition of the overfished stock from the original definition under Amendment 2 to the FMP. Instead of using January 1 total stock biomass (TSB), the stock was considered overfished when November 1 spawning stock biomass (SSB) fell below one-half SSBMSY = 44,706 mt (98.6 million lbs). The 2006 S&T assessment concluded that the stock was not overfished, but that overfishing was occurring relative to the updated reference points (Terceiro 2006b).

The 2007 assessment update (SDWG 2007) found that relative to the 2006 S&T assessment biological reference points, the stock was overfished and overfishing was occurring. The fishing mortality rate estimated for 2006 was 0.35, a significant decline from the 1.32 estimated for 1994 but above the threshold of 0.28.

The most recent peer review of the assessment occurred at the 2008 SAW 47 (NEFSC 2008). In the 2008 SAW 47 assessment, the age-structured assessment model changed from an ADAPT virtual population analysis (VPA) model to a forward projecting, ASAP statistical catch at age (SCAA) model (NFT 2008a), and the fishery catch was modeled as two fleets: totals landings and total discards. A new value for the instantaneous natural mortality rate (M) was adopted, changing from a constant value of M = 0.20 to age- and sex-specific values that resulted in a mean value of M = 0.25. Biological reference points were therefore also revised; the proxy for FMSY changed from Fmax to F35%, and F40% was recommended as Ftarget. The assessment concluded that the stock was not overfished and overfishing was not occurring in 2007, relative to the revised biological reference points. Fishing mortality calculated from the average of the currently fully recruited ages (3-7+) ranged between 1.143 and 2.042 during 1982-1996. The fishing mortality rate was estimated to be 0.288 in 2007, below the fishing mortality reference point = F35% = FMSY = 0.310. SSB was estimated to be 43,363 in 2007, about 72% of the SSB35% = SSBMSY reference point = 60,074 mt. The assessment exhibited a consistent retrospective pattern of underestimation of F and overestimation of SSB, but no consistent retrospective pattern in recruitment.

This 2010 assessment update uses the same model as the 2008 SAW 47 and 2009 updated (Terceiro 2009) assessments. Fishery and survey catches have been updated through 2009. Status determination is made by comparison to the 2008 SAW 47 biological reference points.

Summary of the history of the Summer Flounder, Scup, and Black Sea Bass FMP.

Year	Document	Plan Species	Management Action
1988	Original FMP	summer flounder	- Established management plan for summer flounder
1991	Amendment 1	summer flounder	- Established an overfishing definition for summer flounder
1993	Amendment 2	summer flounder	- Established rebuilding schedule, commercial quotas, recreational harvest limits, size limits, gear restrictions, permits, and reporting requirements for summer flounder - Created the Summer Flounder Monitoring Committee
1993	Amendment 3	summer flounder	- Revised the exempted fishery line - Increased the large mesh net threshold - Established otter trawl retentions requirements for large mesh use
1993	Amendment 4	summer flounder	- Revised state-specific shares for summer flounder quota allocation
1993	Amendment 5	summer flounder	- Allowed states to combine or transfer commercial summer flounder quota
1994	Amendment 6	summer flounder	- Set criteria for allowance of multiple nets on board commercial vessels for summer flounder - Established deadline for publishing catch limits, commercial mgmt. measures for summer flounder
1995	Amendment 7	summer flounder	- Revised the F reduction schedule for summer flounder

1996	Amendment 8	summer flounder and scup	- Incorporated Scup FMP into Summer Flounder FMP and established scup measures including commercial quotas, recreational harvest limits, size limits, gear restrictions, permits, and reporting requirements
1996	Amendment 9	summer flounder and black sea bass	- Incorporated Black Sea Bass FMP into Summer Flounder FMP and established black sea bass measures including commercial quotas, recreational harvest limits, size limits, gear restrictions, permits, and reporting requirements
1997	Amendment 10	summer flounder, scup, and black sea bass	- Modified commercial minimum mesh requirements, continued commercial vessel moratorium, prohibited transfer of fish at sea, and established special permit for party/charter sector for summer flounder
1998	Amendment 11	summer flounder, scup, and black sea bass	- Modified certain provisions related to vessel replacement and upgrading, permit history transfer, splitting, and permit renewal regulations
1999	Amendment 12	summer flounder, scup, and black sea bass	- Revised FMP to comply with the SFA and established framework adjustment process
2001	Framework 1	summer flounder, scup, and black sea bass	-Established quota set-aside for research for all three species
2001	Framework 2	summer flounder	- Established state-specific conservation equivalency measures for summer flounder
2003	Amendment 13	summer flounder, scup, and black sea bass	- Addressed disapproved sections of Amendment 12 and included new EIS
2003	Framework 3	scup	- Allowed the rollover of winter scup quota - Revised start date for summer quota period for scup fishery
2003	Framework 4	scup	- Established system to transfer scup at sea
2004	Framework 5	summer flounder, scup, and black sea bass	- Established multi-year specification setting of quota for all three species
2006	Framework 6	summer flounder	- Established region-specific conservation equivalency measures for summer flounder
2007	Amendment 14	scup	- Established rebuilding schedule for scup
2007	Framework 7	summer flounder, scup, and black sea bass	- Built flexibility into process to define and update status determination criteria for each plan species - Scup GRAs made modifiable through framework adjustment process

COMMERCIAL FISHERY LANDINGS

Total U.S. commercial landings of summer flounder from Maine to North Carolina peaked in 1979 at nearly 18,000 mt (39.7 million lbs, Table 1, Figure 1). The reported landings in 2009 of 4,848 mt (10.69 million lbs) were about 1% under the final 2009 commercial quota. Since 1980, about 70% of the commercial landings of summer flounder have come from the Exclusive Economic

Zone (EEZ; greater than 3 miles from shore). 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 (NER; Maine to Virginia)

Annual commercial landings data for summer flounder in years prior to 1994 were obtained from detailed trip-level 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). Prior to 1994, summer flounder commercial landings were allocated to NEFSC 3-digit statistical area according to interview data (Burns et al. 1983). Beginning in 1994, landings estimates were derived from mandatory dealer reports under the current NMFS Northeast Region (NER) summer flounder quota monitoring system. During 1994-2008, dealer landings were allocated to statistical area using fishing Dealer and fishing Vessel Trip Reports (VTR data) in a multi-tiered allocation procedure at the fishing-trip level (Wigley et al., 2007). Three-digit statistical areas 537-539 (Southern New England), 611-616 (New York Bight), 621, 622, 625, and 626 (Delmarva region), and 631 and 632 (Norfolk Canyon area) have generally accounted for over 80% of the NER commercial landings since 1992 (Table 2).

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 3. 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 17 mt per 100 lengths, and temporal and geographic coverage has generally improved as well.

The age composition of the NER commercial landings for 1982-1999 was generally estimated semi-annually by market category and 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). For 2000-2002, sampling was generally sufficient to make quarterly estimates of the age composition in area 6 for the large and medium market categories. For 2003-2009, sampling was generally sufficient to make quarterly estimates of the age composition in areas 5 and 6 for the jumbo, large, and medium market categories. The proportion of large and jumbo market category fish (generally of ages 3 and older) in the NER landings has increased since 1996, while the proportion of small market category landings (generally of ages 0 and 1) has become very low (Table 4, Figure 2). The mean size of fish landed in the NER commercial fishery has been increasing since 1993, and was 0.9-1.1 kg (2.0-2.4 lbs) during 2000-2009, typical of an age 3 to 4 summer flounder (Table 5).

North Carolina

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 sample data. The NCDMF program samples about 10% of the winter trawl fishery landings annually, most recently (2006-2009) at rates of less than 10 metric tons of landings per 100 lengths measured (Table 6). 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 (1988-2009) were combined by appropriate statistical area and semi-annual 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 weight at age from this fishery are shown in Tables 7-8.

COMMERCIAL FISHERY DISCARDS

In the 1993 SAW 16 assessment, an analysis of variance of NER Fishery Observer data for summer flounder was used to identify stratification variables for an expansion procedure to estimate total landings and discards from the 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. Quarter and division consistently emerged as 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 derive 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. For strata with no 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 were stratified by 2 gear types (scallop dredges; trawls) for years when data were adequate (1992 and later years). The NER Fishery Observer sample data aggregated on an annual basis for 1989-2009 are summarized in Table 9.

While estimates of catch rates from the NER Fishery Observer data were used in this assessment to estimate total discards, catch rate information is also reported in the NER Vessel Trip Report (VTR) data for 1994-2008 (Table 10). A comparison of discard to total catch ratios for the Fishery Observer and VTR data sets for trawl and scallop dredge gear indicates similar discard rates from the two data sources through the 1990s. Since about 2000, Overall Fishery Observer and VTR discard to total catch ratios have diverged, with the Fishery Observer data generally indicating higher discard rates. Discard rates of summer flounder in the scallop dredge fishery were generally much higher than in the trawl fishery.

The change in mid-1994 from the interview/weighout data reporting system to the VTR/mandatory dealer report system required a change in the estimation of effort (days fished) to estimate total discards. 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 (i.e., the units reported were 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 1997 SAW 25 assessment for summer flounder (NEFSC 1997b), a slightly different comparison was made. The port agent interview data for 1991-1993 and merged dealer/VTR data for 1994-1996, 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 increased restrictions on allowable landings per trip (trip landings limits might lead to shorter trips) and stock size increases (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 the period from 1989-1993 and 1994. Since 1994, total days fished have ranged from 20,670 days in 1999 to 7,615 days in 2008 with a mean of about 12,000 days, a substantial decline relative to the 1989-1993 mean of 22,000 days. 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 1994-2009.

The approach described above was based only on the day fished data for ports in the NER during 1989-1996, and so it was necessary to raise the discard estimate to account for discarding occurring outside the NER reporting system (i.e., NER state reporting systems such as Connecticut, Virginia and North Carolina). 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 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, NCDMF; personal communication, June 30, 1997). As a result of this exercise, the total discard estimates were raised by 11 to 38% for 1989-1996. Since 1996, all states' landings and are included in the NER dealer reporting system, so no raising is necessary to account for missing landings.

Two additional adjustments were made to the dealer/VTR matched data subset days fished estimates to fully account for summer flounder fishery effort during 1994-2009. 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 discards, 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 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 discards as for trips with both landings and discards.

Discard estimates are summarized in Table 11. Commercial fishery discard mortality in weight was highest in 1990-1991 and 1999, and lowest in 2009. Scallop dredge fishery discard to landed ratios are much higher than trawl fishery ratios, purportedly because of closures and trip limits. Although the scallop dredge landings of summer flounder are less than 5% of the total, the discards of summer flounder are of the same order of magnitude as in the trawl fishery. Annual commercial fishery discards estimated for 2006-2009 were less than 20% of the annual reported commercial landings.

Table 12 presents a comparison of commercial fishery dealer reported landings of summer flounder with estimates of summer flounder commercial landings from landings rates of NEFSC Fishery Observer sampling and commercial fishing effort (days fished) reported on commercial NER Vessel Trip Reports (VTR). Estimates of landings from observer data ranged from +53% (1999) to -77% (2007) of the reported landings in the fisheries, with discards ranging from 38% (1990) to 3% (2009) of the dealer reported landings. Since 2003, the estimate of landings from the Observer data has averaged about 65% below the reported landings. An alternative discard estimation approach explored for the 2008 SAW 47 assessment provided no improvement in precision or "accuracy" of discard estimates through 2003, but the recent consistent trend suggests the estimation procedure needs to be reconsidered in next benchmark assessment.

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 11). The 2008 SAW 47 assessment (NEFSC 2008) considered some preliminary information from a 2007 Cornell University Cooperative Extension study which conducted ten scientific trips on inshore multispecies commercial trawling vessels to determine discard mortality rates relative to tow duration, fish size, and the amount of time fish were on the deck of the vessel. The median mortality for all tows combined was 78.7%, very close to the estimated overall discard mortality of 80% used in the assessment.. The 2008 SAW 47 Review Panel recommended additional work be conducted to understand factors affecting discard mortality rates and the difference between the inshore (day-trip) and offshore (multi-day) components of the multispecies trawl fishery to facilitate future application of this information at a broader scale.

Existing NER Fishery Observer data were used to develop estimates of commercial fishery discard for 1989-2009. However, adequate data (e.g., interviewed trip data, survey data) are not available to develop summer flounder 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 in the EEZ. It was recognized that not accounting directly for commercial fishery discards in 1982-1988 would result in an underestimation of fishing mortality and population sizes in these years.

Discard estimates at length and age were stratified by gear for 1994-2000 and 2002-2008, again due to sample size considerations (Table 13). 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. NER 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 semi-annual periods using Fishery Observer age-length keys, except for 1989, when first period lengths were aged using combined commercial landings (quarters 1 and 2) and NEFSC spring survey age-length keys. For 1994-2008, only NEFSC winter, spring, and fall survey age-length keys were used, since Fishery Observer age-length keys were not yet available and commercial landings age-length keys contained an insufficient number of small summer flounder (<40 cm = 16 inches) that comprise most of the discards. Estimates of discarded numbers at age, mean length and mean weight at age are summarized in Tables 13-15.

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 in over 90% of the observed trawl and scallop dredge tows. In 1999, the minimum size regulation was provided as the reason for discarding in 61% of the observed trawl tows, with quota or trip limits given as the discard reason in 26% of the observed tows, and high-grading in 11% of the observed tows. In the scallop fishery in 1999, quota or trip limits was given as the discard reason in over 90% of the observed tows. During 2000-2005, minimum size regulations were identified as the discard reason in 40-45% of the observed trawl tows, quota or trip limits in 25-30% of the tows, and high grading in 3-8%. In the scallop fishery during 2000-2005, quota or trip limits was given as the discard reason for over 99% of the observed tows. During 2006-2009, minimum size regulations were identified as the discard reason in 15-20% of the observed trawl tows, quota or trip limits in 60-70% of the tows, and high grading in 5-10%. In the scallop fishery during 2006-2009, quota or trip limits was given as the discard reason for about 40% of the observed tows, with about 50% reported as "unknown." As a result of the increasing impact of trip limits, fishery closures, and high grading as reasons for discarding, the age structure of the summer flounder discards has also changed, with a higher proportion of older fish being discarded (Table 13).

RECREATIONAL FISHERY LANDINGS

Summary landings statistics for the summer flounder recreational fishery (catch type A+B1) as estimated by the NMFS Marine Recreational Fishery Statistics Survey (MRFSS) are presented in Tables 16-17. Recreational fishery landings decreased 17% by number and 20% by weight from 2008 to 2009. and were about 12% under the 2009 recreational harvest limit.

The commercial fishery VTR system provides an alternative set of reported recreational landings by the party/charter boat sector. A comparison of VTR reports and MRFSS estimates indicates that MRFSS estimates are higher by a factor of 2-3 for the 1995-2009 period, with an increasing trend in recent years and ranging from a factor of 1.02 in 1998 to 5.47 in 2005 (Table 18). It is unclear if this is due mainly to under-reporting of party/charter boat recreational landings in the VTR system, or a systematic positive bias of MRFSS landings estimates for the party/charter boat sector.

Length frequency sampling intensity for the recreational fishery was calculated by MRFSS sub-regions (North - Maine to Connecticut; Mid - New York to Virginia; South - North Carolina) based on a metric tons of landings per hundred lengths measured basis (Burns et al.1983). For 2009, aggregate sampling intensity averaged 123 mt of landings per 100 fish measured (Table 19). To convert the recreational fishery length frequencies to age, MRFSS sample length frequency data, NEFSC commercial and 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), and between MRFSS sub-region, commercial statistical areas, and survey depth strata to integrate data from the different sources. Based on the number, size range, and distribution of lengths and ages, a semi-annual, sub-regional basis of aggregation was adopted for matching of commercial and survey age-length keys with recreational length frequency distributions to convert lengths to ages. Limited MRFSS length sampling for larger fish resulted in a high degree of variability in mean length for older fish, especially at ages 5 and older during the first decade of the time series. Attempts to estimate length-weight relationships from the MRFSS biological sampling data provided unsatisfactory results. As a result, the commercial fishery quarterly length (mm) to weight (g) relationships from Lux and Porter (1966) were used to calculate annual mean weights at age from the estimated age-length frequency distribution of the landings.

The recreational landings historically were dominated by relatively young fish. During 1982-1996, age 1 fish accounted for over 50% of the landings by number and fish of ages 0 to 3 accounted for over 95% of landings by number. No fish from the recreational landings were determined to be older than age 7. With increases in the minimum landed size since 1996 (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 14.0 [36 cm] to 21 in [53 cm] in 2001-2009) and a trend to lower fishing mortality rates, the age composition of the recreational landings now includes mainly fish at ages 3 and older, at mean weights of greater than 1 kg per fish (Tables 20-21). The number of summer flounder of ages 3 and older landed by the recreational fishery in 2008-2009, at over 90% of the landings by number, was the highest in the time series (Table 20).

RECREATIONAL FISHERY DISCARDS

MRFSS catch estimates were aggregated on a sub-regional 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. The live discard has varied from about 18% (1985) to about 91% (2008) of the total catch during 1982-2008 (Table 22). To account for all removals from the summer flounder stock by the recreational fishery, some assumptions about the biological characteristics and discard mortality rate of the recreational live discard need to be made, because biological samples are not routinely taken of MRFSS catch type B2 fish. In previous assessments, data available from NYDEC surveys (1988-1992) of New York party boats suggested that nearly all (>95%) of the fish released alive from boats were below the minimum regulated size (during 1988-1992, 14 in [36 cm] in New York state waters), that nearly all of these fish were age 0 and age 1 summer flounder, and that these age 0 and 1 summer flounder occurred in about the same proportions in the live discard as in the landings. It was therefore assumed that all B2 catch would be of lengths below regulated size limits, and be either age 0 or age 1 in all three sub-regions during 1982-1996. Catch type B2 was allocated on a semi-annual, sub-regional 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 used to allocate the 1982-1996 recreational released catch to size and age categories during 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) for 1997-1999 and from the American Littoral Society (ALS) for 1999, and comparing the length frequency of released fish in these programs with the MRFSS data on the length frequency of landed fish below the minimum size, indicated 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 all B2 catch was assumed to be of lengths below regulated size limits, and therefore comprised of ages 0 to 3. Catch type B2 was 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.

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 NYDEC PBS indicated that the assumption that fish released are those smaller than the minimum size remained valid for 2001, and so catch type B2 was characterized by the same proportion at length as the landed catch less than the minimum size in the respective states. The differential minimum size by state has continued since 2001, and increased samples of the recreational fishery discards by state agency Volunteer Angler Surveys (VAS) and the MRFSS For Hire Survey (FHS) has allowed direct characterization the length frequencies of the discards from sample data (Table 23).

Studies conducted to estimate recreational fishery discard mortality for striped bass and black sea bass suggest a 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 the survival of released sublegal summer flounder caught by hook-and-line suggested a total, non-fishing mortality rate of 53%, which included discard plus tagging mortality as well as deaths by natural mortality. Assuming deaths by natural mortality to be about 18%, (an instantaneous natural mortality rate of 0.20), an annual discard plus tagging mortality rate of about 35% can be derived from the NYDEC results.

In the 1997 SAW25 (NEFSC 1997b) and earlier assessments of summer flounder, a 25% discard mortality rate was assumed for summer flounder released alive by anglers. However, two subsequent investigations of summer flounder recreational fishery discard, or hooking, mortality suggested that a lower rate was more appropriate. Lucy and Holton (1998) used field trials and tank experiments to investigate the discard 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 studies conducted specifically for summer flounder, a 10% discard mortality rate was adopted in the Terceiro (1999) stock assessment and has been retained in all subsequent assessments. Ten percent of the total B2 catch at age is therefore the basis of estimates of summer flounder recreational fishery discard at age (Table 24). The mean weights at age of the recreational fishery discards are presented in Table 25.

TOTAL CATCH COMPOSITION

NER 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 1982-2009 (Table 26; Figure 2). The percentage of age 3 and older fish in the total catch in numbers has increased during the last decade from only 4% in 1993 to 72% in 2008 and 68% in 2009. Overall mean weight at age in the total catch was calculated as the weighted mean (by number in the catch at age) of the respective mean value at age from each fishery component (Table 27; Figure 3). The recreational fishery component of the total summer flounder catch has generally increased since 1995 (Table 28; Figure 4).

RESEARCH SURVEY INDICES OF ABUNDANCE

NEFSC spring

Long-term trends in summer flounder abundance were derived from a stratified random bottom trawl survey conducted in spring by the NEFSC between Cape Hatteras and Nova Scotia since 1968 (Clark 1979). NEFSC spring survey indices suggest that total stock biomass last peaked during 1976-1977. The 2007 index (3.17 kg/tow) represented a time series high before falling by over half to 1.41 kg/tow in 2008 (Table 29, Figure 5).

The Fisheries Survey Vessel (FSV) *Albatross IV* (ALB) was replaced in Spring 2009 by the FSV *Henry B. Bigelow* (HBB) as the main platform for NEFSC research surveys, including the Spring and Fall bottom trawl surveys. The size, towing power, and fishing gear characteristics of the HBB are significantly different from the ALB, resulting in different fishing power and therefore different survey catchability. Calibration experiments to estimate these differences were conducted during 2008 (Brown 2009), and the results of those experiments were peer reviewed by a Panel of three non-NMFS scientists during the summer of 2009 (Anonymous 2009, Miller et al. 2010). The terms of reference for the Panel were to review and evaluate the suite of statistical methods used to derive calibration factors by species before they were applied in a stock assessment context. Following the advice of the August 2009 Peer Review (Anonymous 2009), the beta-binomial model based calibration factors were used to convert 2009 HBB survey catch number and weight indices to 2009 ALB equivalents for use in this stock assessment update (Table 30).

Age composition data from the NEFSC spring surveys indicate a substantial reduction in the number of ages in the stock between 1976-1990 (Table 31, Figure 6). For the period 1976-1981, fish of ages 5-8 were captured regularly in the survey, with the oldest individuals aged 8-10 years. From 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 age groups were observed in the survey catch, and there was an indication that the 1988 year class was very weak. Since 1996, the NEFSC spring survey age composition has expanded significantly, with increasing abundance of age-3 and older fish. Mean lengths at age from the NEFSC spring survey are presented in Table 32.

NEFSC autumn

Summer flounder are frequently caught in the NEFSC autumn survey at stations in inshore strata (< 27 meters = 15 fathoms = 90 feet) and at offshore stations in the 27-55 meter depth zone (15-30 fathoms, 90-180 feet) at about the same bathymetry as in the spring survey. NEFSC autumn aggregate and at-age indices are presented in Tables 29-30 and 33. The NEFSC autumn survey catches age-0 summer flounder in abundance, providing an index of summer flounder recruitment (Table 33, Figure 7). NEFSC autumn survey indices suggest improved recruitment since the late 1980s, and an increase in abundance of age-2 and older fish since 1996. Mean lengths at age from the NEFSC autumn survey are presented in Table 34.

NEFSC winter

A series of NEFSC winter trawl surveys was initiated in February 1992 to provide improved abundance indices for flatfish, including summer flounder. The surveys targeted flatfish concentrated offshore during the winter. A modified trawl was used that differed from the standard trawl employed during the NEFSC spring and autumn surveys in that long trawl sweeps (wires) were added before the trawl doors to better herd fish to the mouth of the net, and the large rollers used on the standard gear were replaced on the footrope with a chain "tickler" and small spacing "cookies." The design and conduct of the winter survey (timing, strata sampled, and the use of the modified trawl gear) resulted in greater catchability of summer flounder compared to the other surveys. Most fish were captured in survey strata 61-76 (27-110 meters; 15-60 fathoms) off the Delmarva and North Carolina coasts. Other concentrations of fish were found in strata 1-12, south of the New York and Rhode Island coasts, in slightly deeper waters. Significant numbers of large summer flounder were often taken along the southern flank of Georges Bank (strata 13-18).

Indices of summer flounder abundance from the winter survey indicate stable stock size during 1992-1995, with catch per tow values ranging from 10.9 in 1995 to 13.6 in 1993 (Tables 29 & 35). For 1996, the winter survey index increased by 290% over 1995, from 10.9 to 31.2 fish per tow. The largest increases in 1996 occurred in the Mid-Atlantic Bight region (offshore strata 61-76), where increases up to an order of magnitude 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. From 1998-2003, the winter trawl survey indices increased; with the 2003 winter survey number and weight per tow indices being the highest in the time series at 27.58 kg/tow (Tables 29 & 35, Figure 9). The winter survey index was lower from 2004-2007, and values ranged from 10.3 to 15.9 fish per tow. Similar to the other NEFSC surveys, there is strong evidence since the mid-1990s of increased abundance of age-3 and older fish relative to earlier years in the time series (Tables 35-37). The NEFSC winter survey series ended in 2007.

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 high levels in 1986 to record lows in 1990 and 1991 (MADMF fall and spring survey, respectively). 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 to record high levels (Tables 38-39, Figure 8). The MADMF also captures a small number of age-0 summer flounder in a seine survey of estuaries, and these data constitute an index of recruitment (Table 40, Figure 9).

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 around 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 2003 spring and 2002 autumn indices were the highest in the respective time series; although index values decreased in 2004-2008 (Tables 41-42, Figure 10). An index of recruitment from the autumn series is available (Figure 7).

Rhode Island DFW

Standardized bottom trawl surveys have been conducted since 1979 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). Indices of abundance at age for summer flounder have been developed from the autumn survey data using NEFSC autumn survey age-length keys. The autumn survey reached a time series high in 2009 (Table 43, Figure 8). An abundance index has also been developed from a set of fixed stations sampled monthly since 1990, which also reached a time series high in 2009 (Table 44). Recruitment indices are available from both the autumn (Figure 9) and monthly fixed station surveys.

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 (Table 45, Figure 11). The NJBMF survey mean number per tow indices and frequency distributions were converted to age using the corresponding annual NEFSC combined spring and fall survey age-length keys. Since 1998, most year classes are at or below average; however, the 2005 year class is above average (Figure 12).

Delaware DFW

The Delaware Division of Fish and Wildlife (DEDFW) has conducted a standardized bottom trawl survey with a 16 foot head-rope trawl since 1980 and with a 30 foot head-rope trawl since 1991. Recruitment indices (age 0 fish; one index from the Delaware estuary proper for 1980 and later, one from the inland bays for 1986 and later) have been developed from the 16 foot trawl survey data (Tables 46-47, Figure 12). Indices for age-0 to age-4 and older summer flounder have been compiled from the 30 foot head-rope survey (Table 48, Figure 11). The indices use 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.

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 (Table 49, Figure 13). This index suggests that weakest year class in the time series recruited to the stock in 1988 and the strongest in 1986.

Virginia Institute of Marine Science

The Virginia Institute of Marine Science (VIMS) conducts a juvenile fish survey using trawl gear in Virginia rivers since 1955. An index of recruitment developed from the VIMS survey suggests weak year classes (<0.2 fish per trawl) recruited to the stock in 1955, 1959, 1961-1962, 1966, 1968, 1970, and 1975, with strong year classes (>2.0 fish per trawl) recruiting in 1956-57, 1963, 1971, 1979-1983, 1990-1991, and 1994. Recruitment indices since 1994 have been below average (Table 50, Figure 13).

The VIMS ChesMMap survey was started in 2002, providing research survey samples from Chesapeake Bay. The ChesMMap samples are dominated by age 0-2 summer flounder. Due to the brevity of the series, it has not yet been included in population models (Table 51, Figure 14).

The VIMS NEAMAP survey was started in Fall 2006, providing research survey samples along the Atlantic Coastal waters from Rhode Island to North Carolina, in depths of 20-90 feet (9-43 meters). Due to the brevity of the series, it has not yet been included in population models (Table 52, Figure 14).

North Carolina DMF

The North Carolina Divisions of Marine Fisheries (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 the weakest year class recruited to the stock in 1988, with strong year classes in 1987, 1996, 2001, 2002 and 2008 (Table 53, Figure 13). The survey normally takes place in mid-June, but in 1999 was delayed until mid-July. The 1999 index is therefore inconsistent with the other indices in the time series, and so the 1999 value has been excluded.

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. This also brought to light differences between ages determined by NEFSC and NCDMF fishery biology staffs; therefore, age structure (scale) exchanges were performed after the SAW 22 assessment to explore these differences. The results of the first two exchanges indicated low levels of agreement between age readers at the NEFSC and NCDMF (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) for comparison 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 a result, further exchanges were suspended pending the resolution of an apparent aging problem.

Age samples 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), and some disagreement between scale and otolith ages obtained from the same fish. Because of these problems, a team of five experienced NEFSC readers re-examined the scales aged from the winter 1997 survey. After reviewing several hundred scales, the team determined that re-aging all samples from 1995-1997 would be appropriate, including all winter, spring, and fall samples from the NEFSC and MADMF bottom trawl surveys and all samples from the commercial fishery. The age determination criteria remained the same as those developed at the 1990 summer flounder workshop (Almeida et al. 1992) and described in the aging manual utilized by NEFSC staff (Dery 1997). Only those fish for which a 100% agreement of all team members was attained 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 the NEFSC in 1999 to continue the exchange of age structures and review of aging protocols for summer flounder (Bolz et al. 2000). Participants at this workshop concluded that the majority of aging disagreements 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. Subsequently, Sipe and Chittenden (2001) concluded that sectioned otoliths were the best structure for aging summer flounder over the age range from 0 to 10 years. Since 2001, both scales and otoliths have routinely been collected in all NEFSC trawl surveys for fish larger than 60 cm, and studies are underway to determine the best structure to use for aging these large summer flounder. An exchange of NEFSC and NCDMF aging structures for summer flounder occurred again in 2006. This exchange examined samples from fish aged 1 to 9 (23-76 cm total length) and determined that the consistency of aging between NCDMF and the NEFSC was at an acceptable level.

Maturity

The maturity schedule for summer flounder used in the 1990 SAW 11 and subsequent stock assessments through 1999 was developed by the 1990 SDWG using NEFSC Fall Survey maturity data for 1978-1989 and mean lengths at age from the NEFSC fall survey (G. Shepherd, NEFSC, personal communication, July 1, 1990; NEFC 1990; Terceiro 1999). The 1990 SAW 11 work indicated that the median length at maturity (50^{th} percentile, L_{50}) was 25.7 cm for male summer flounder, 27.6 cm for female summer flounder, and 25.9 cm for the sexes combined. Under the aging convention used in the 1990 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 (50^{th} 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 at peak spawning time in the autumn, 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. The maturities for age-3 and older were rounded to 100% in the 1990 SAW 11 and subsequent assessments.

It has been noted that the NEFSC maturity schedules have been based on simple gross morphological examination of the gonads that may overestimate the true spawning potential of the summer flounder stock, especially for age-0 and age-1 fish. A research recommendation that the true spawning contribution of young summer flounder to the SSB be investigated was included in the 1993 SAW 16 assessment (NEFSC 1993). URI studies to address this research recommendation were completed in 1999 (Specker et al 1999, Merson et al 2000). In light of the URI results, the NEFSC maturity data for summer flounder for 1982-1998 were examined in the 2000 SAW 31 assessment (NEFSC 2000) to determine if changes in the maturity schedule were warranted.

The URI work examined the histological and biochemical characteristics of female summer flounder oocytes to determine if age-0 and age-1 female summer flounder produce viable eggs, and to develop an improved guide for classifying the maturity of summer flounder collected in NEFSC surveys. The URI studies 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 (Specker et al. 1999, Merson et al. 2000).

The NEFSC and URI maturity determinations disagreed for 13% of the 531 aged fish, with most (10%) of the disagreement due to NEFSC mature fish classified as immature by the URI histological and biochemical criteria. 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, median length at maturity (50^{th} percentile, L_{50}) was estimated to be 34.7 cm for female summer flounder, with the following proportions mature at age: age-0: 30%, age-1: 68%, age-2: 92%, age-3: 98%, and age-4: 100%. Median age of maturity (50^{th} percentile, A_{50}) was estimated to be about 0.5 years. Based on this new information, the 2000 SAW 31 (NEFSC 2000) considered 5 options for the summer flounder maturity schedule for the assessment:

1) No change, use the maturity schedule for combined sexes as in the 1990 SAW 11 and subsequent assessments (rounded to 0.38, 0.72, 0.90, 1.00, 1.00, and 1.00 as in the 1997 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 in deriving a combined schedule.
5) NEFSC 1982-1989, 1990-1998 for males, URI study for females, assuming a 1:1 sex ratio in deriving a combined schedule.

The 5 options produce the following maturity schedules for both sexes combined:

Option			Age			
	0	1	2	3	4	5+
1	0.38	0.72	0.90	1.00	1.00	1.00
2	0.00	0.00	0.90	1.00	1.00	1.00
3	0.00	1.00	1.00	1.00	1.00	1.00
4	0.45, 0.45	0.88, 0.82	0.97, 0.93	1.00, 0.98	1.00, 0.99	1.00, 1.00
5	0.29, 0.31	0.74, 0.76	0.95, 0.94	0.99, 0.98	1.00, 1.00	1.00, 1.00

The 2000 SAW 31 assessment 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 1990 SAW 11 schedule (Option 1) was retained for subsequent assessments (MAFMC 2001a, NEFSC 2002b). The 2000 SAW 31 recommended that more biochemical and histological work should be done to verify that results of the URI studies would be applicable in the future. The 2000 SAW 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 (NEFSC 2000). In the 2005 SAW 41 work (NEFSC 2005), the maturity schedule was updated and broadened to include data from 1992-2004, covering the year range for individually measured and weighed fish sampled in NEFSC research surveys. The resulting combined sex maturity schedule (0.38, 0.91, 0.98, 1.00, 1.00, and 1.00; respectively for age-0 to 5+) was retained in the 2006 assessment and S&T peer review (Terceiro, 2006b). The 2008 SDWG examined the proportions of summer flounder mature at age from 1981-2007 as well as individual fish information on length and age at maturity from 1992-2007, and concluded that it was appropriate to retain the maturity schedule from the 2006 assessment for the 2008 SAW47 assessment (NEFSC 2008). The 2006 schedule was retained in the 2009 (Terceiro 2009) and 2010 updated assessments.

Natural Mortality Rate (M)

In the 1996 SAW 20 assessment (NEFSC 1996a), estimates of M were derived using methods described by 1) Pauly (1980) using growth parameters derived from NCDMF age-length data and a mean annual bottom temperature (17.5^{o}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). The 1996 SAW 20 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 this value for M had been used in all assessments through 2007.

For the 2008 SAW 47 assessment (NEFSC 2008), sex and age-specific estimates of M were calculated from summer flounder age and growth data (1976-2007) from the NEFSC trawl surveys. Longevity based estimators of M are sensitive to underlying assumptions which include the terminal proportion of the population surviving to a given maximum age and the maximum observed age under no or low exploitation conditions. Using a maximum age of 15 years for summer flounder, the Hoenig (1983) and Hewitt and Hoenig (2005) longevity based estimates of M for combined sexes ranged from 0.20 to 0.36, depending on whether terminal proportion of 1.5% or 5% was assumed. Other life-history based models were examined and included Pauly (1980), Jensen (1996), Gunderson and Dygert (1988), and Gunderson (1997), with estimates ranging from 0.20 to 0.45. Age-specific and size variable estimates of M, based on the work of Peterson & Wroblewski (1984), Chen & Watanabe (1989), Lorenzen (1996), and Lorenzen (2000), ranged from 0.19 to 0.90, with the highest values obviously associated with age-0-1 fish (fish at smaller lengths). While these exercises provided a wide range of methods and M estimates to be considered, each estimate involved a suite of underlying assumptions which were debated. In addition, the assessment modeling frameworks considered in the 2008 SAW 47 assessment (ADAPT VPA, ASAP SCAA, and SS2 SCAA) allowed for log-likelihood profiling of M to determine which M estimate provided the best model fit. The M that minimized the log-likelihood was 0.35, 0.20, and 0.25 under the ADAPT VPA, ASAP SCAA, and SS2 SCAA models, respectively. The estimate of M that resulted in the best diagnostic value was sensitive to model selection and configuration, as the data inputs were similar across the three models.

The 2008 SAW47 Review Panel considered the different approaches to estimating M and after lengthy discussion assumed a natural mortality rate (M) of 0.20 for females and 0.30 for males, based mainly on recently observed maximum ages in the NEFSC survey data of 14 years (76 cm, in NEFSC Winter Survey 2005) for females and 12 years (63 cm, in NEFSC Spring Survey 2007) for males, and the expectation that larger and older fish would likely be observed if future fishing mortality rates are maintained near current rates (< F = 0.3). A combined sex M-schedule at age was developed by assuming these initial M rates by sex, an initial proportion of females at age 0 of 0.40 derived from the NEFSC Fall survey indices by age and sex, and population abundance decline over time at the sex specific M rates. The final abundance weighted combined sex M-schedule at age ranged from 0.26 at age 0 to 0.24 at age 7+, with a mean of 0.25. This M-schedule was retained in the 2009 (Terceiro 2009) and 2010 updated assessments.

2010 UPDATED FISHING MORTALITY RATE AND STOCK SIZE ESTIMATES

Fishing mortality rates and stock sizes were estimated using the ASAP statistical catch at age model (NFT 2008a). The catch at age, mean weights at age, maturity at age, and survey index calibration time series were input as in the 2008 SAW 47 assessment. An age-specific instantaneous natural mortality rate providing an average M = 0.25 was assumed for all years. Winter, spring, and mid-year 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. Lognormal error distributions were assumed for the total catch in weight, research survey catch at age calibration indices, internal

Beverton-Holt stock-recruitment relationship and parameters, selectivity parameters, annual fishing mortality parameters, survey catchability parameters, and estimated stock numbers at age. A multinomial distribution was assumed for fishery catch at age. A number of additional initial model settings including specification of likelihood component emphasis factors (lambdas), size of deviation factors expressed as standard deviations, and penalty functions for extreme fishing mortality estimates were set at consensus values by the 2008 SDWG after multiple sensitivity runs to evaluate a range of inputs.

The annual selection of age-1 fish decreased from about 0.5 during the first time block of selectivity estimation (1982-1994) to about 0.2 during the second block, 1995-2008. The annual selection of age-2 fish decreased from about 1.0 during the first time block of selectivity estimation (1982-1994) to about 0.7 during the second block, 1995-2008. These decreases in selection at age are in line with expectations given 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 un-weighted average of fishing mortality at age for ages 3 to 7+.

Summary estimates for the 2010 updated assessment are provided in Table 54, and population number and fishing mortality estimates at age are provided in Tables 55-56. The 2010 update indicates that fishing mortality ranged between 1.0 and 2.0 during 1982-1996. The fishing mortality rate has declined to below 1.0 since 1997 and was estimated to be 0.237 in 2009 (Figure 15). There is a 50% probability that the fishing mortality rate in 2008 was between 0.224 and 0.250 (Figure 16). The summer flounder stock assessment has historically exhibited a retrospective pattern of underestimation of F; the causes of this pattern have not been determined (Figure 17). Over the last 7 years, the annual internal model retrospective error in fishing mortality has ranged from +11% in the 2006 terminal year to -35% in 2003.

Spawning stock biomass (SSB) decreased from about 25,000 mt in the early 1980s to about 7,000 in 1989, then increased to above 40,000 mt by 2002. SSB was estimated to be 53,458 mt in 2009, about 89% of the SSBMSY = SSB35% reference point = 60,074 mt (Table 54, Figures 18-19). There is a 50% chance that SSB in 2009 was between 50,560 and 55,998 mt (Figure 20). The assessment has historically exhibited a retrospective pattern of overestimation of SSB; the causes of this pattern have not been determined (Figure 21). Over the last 7 years, the annual internal model retrospective error in SSB has ranged from -13% in the 2006 terminal year to +45% in 2003.

The arithmetic average recruitment from 1982 to 2009 is 42 million fish at age 0. The 1981 and 1982 year classes are the largest in the historical assessment time series, at 73 and 81 million fish; the 1988 year class is the smallest at 13 million fish. The 2008 year class is estimated to be about 49 million fish, 17% above the average. The 2009 year class is currently estimated to be about 82 million fish, about twice the average, and is the largest in the assessment time series (Table 54, Figures 18-19). A recent pattern of overestimation in recruitment is evident (Figure 22). Over the last 3 years, the annual internal model retrospective error in recruitment has ranged from +54% for the 2008 year class to +80% for the 2006 year class. Comparison of the estimates for SSB, R and F over the last three assessments indicates consistency of those estimates in line with the most recent internal retrospective pattern of the 2010 assessment model (Figures 23-25).

BIOLOGICAL REFERENCE POINTS (BRPs)

Background

The calculation of biological reference points for summer flounder based on yield per recruit analysis using the Thompson and Bell (1934) model was first detailed in the 1990 SAW 11 assessment (NEFC 1990). The 1990 analysis estimated that Fmax = 0.230. 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 Fmax = 0.240. 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 FMP Amendment 12 Overfishing Definition (MAFMC 1999). These reference points were based on the 1999 assessment (Terceiro 1999) and followed what would later be described as the Anon-parametric approach@ (i.e., biomass reference points calculated as the product of biomass per recruit and a reference period recruitment level; NEFSC 2002a). The analysis in the Terceiro (1999) assessment, reflecting partial recruitment and mean weights at age for 1997-1998, indicated that Fthreshold = Ftarget= Fmax = 0.263, yield per recruit (Y/R) at Fmax was 0.55219 kg/recruit, and January 1 Total Stock Biomass per recruit (TSB/R) at Fmax was 2.8127 kg/recruit. The median number of summer flounder recruits estimated from the 1999 assessment for 1982-1998 was 37.8 million age-0 fish. Based on this median recruitment level, maximum sustainable yield (Ymax as a proxy for MSY) was estimated to be 20,897 mt (46 million lbs) at a Total Stock Biomass (TSBmax as a proxy for BMSY) of 106,444 mt (235 million lbs). The biomass threshold, one-half TSBmax as a proxy for one-half BMSY, was therefore estimated to be 53,222 mt (118 million lbs). The Terceiro (1999) reference points were retained in the 2000 SAW 31 assessment (NEFSC 2000) because of the stability of the input data and resulting biological reference point estimates.

The MAFMC SSC conducted a peer review of the summer flounder Overfishing Definition in concert with the 2001 assessment update (MAFMC 2001a, b). The 2001 SSC reviewed six analyses to estimate biological reference points for summer flounder conducted by members of the Summer Flounder Biological Reference Point Working Group. After considerable discussion, the 2001 SSC decided that although the new analyses conducted by the Working Group had resulted in a wide range of estimates, they did not provide a reliable alternative set of reference points for summer flounder. The 2001 SSC therefore recommended that Ftarget remain at the Terceiro (1999) estimate of Fmax = 0.263 because a better estimate had not been established by any of the new analyses. The 2001 SSC also reviewed the biomass target (BMSY) and threshold (one-half BMSY) components of the Overfishing Definition and concluded that the new analyses did not justify an alternative estimate of the BMSY proxy. The 2001 SSC endorsed the recommendations of the 2000 SAW 31 which stated that Athe use of Fmax as a proxy for FMSY 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@ (NEFSC 2000). The 2001 SSC agreed that additional years of stock and recruitment data should be collected and encouraged further model development, including model evaluation through simulation studies. They also encouraged the evaluation of alternative proxies for biological reference points that might be more appropriate for an early maturing species like summer flounder and the development and evaluation of management strategies for fisheries where BMSY is unknown. The 2001 SSC indicated that as the stock size increases, population dynamic processes that could reflect density dependent mechanisms should be more closely monitored and corresponding analyses should be expanded, i.e., rates of size and age, maturity, fecundity, and egg viability should be closely monitored as potential indicators of compensation at higher stock sizes. Finally, the 2001 SSC recommended that potential environmental influences on recruitment, including oceanographic changes and predation mortality, should be reevaluated as additional recruitment data become available. As a result of the 2001 SSC peer review (MAFMC 2001a) the Terceiro (1999) reference points were retained in the 2001 stock assessment (MAFMC 2001b). In the review of the 2002 stock assessment (NEFSC 2002b), SAW 35 concluded that revision of the reference points was not warranted at that time due to the continuing stability of the input data and resulting reference point estimates. The Terceiro (1999) reference points were subsequently retained in the 2003 (Terceiro 2003) and 2004 (SDWG 2004) assessment updates.

The biological reference points for summer flounder were next peer-reviewed by the 2005 SAW 41, using fishery data through 2004 and research survey data through 2004/2005 (NEFSC 2005). The SAW 41 Panel noted that the Beverton-Holt (Beverton and Holt, 1957; Mace and Doonan 1988; BH) model fit the observed stock-recruitment data well, and provided reference points comparable to those derived from a non-parametric (yield and biomass per recruit) approach. The SAW 41 Panel noted, however, that the quantity of observed stock-recruitment data was limited (22 years), and the data during the early part of the time series, when the SSB was at the lowest observed levels, indicated a level of recruitment near the estimated Rmax, and exerted a high degree of leverage on the estimation of the model parameters. This leverage resulted in a high value (0.984) for the calculated steepness of the BH curve, outside of the $\pm$ one standard error interval of the estimate for Pleuronectid flatfish (0.8 $\pm$ 0.1) indicated by Myers et al. (1999). The BH model results suggested that summer flounder SSB could fall to very low levels (<2,000 mt) and still produce recruitment near that produced at SSBMSY. The SAW 41 Panel concluded a) that this result might not be reasonable for the long term, given the recent stock-recruitment history of the stock (i.e., production of a very poor year class in 1988), b) the BH model estimated parameters might prove to be sensitive to subsequent additional years of S-R data, especially if they accumulated at higher levels of SSB and recruitment in the near term, and c) the BH model fit might also be sensitive to the magnitude of recently estimated spawning stock and recruitment, given the recent retrospective pattern of overestimation of stock size evident in the assessment. Given these concerns, the SAW 41 Panel advised that the BH model estimates were not suitable for use as biological reference points for summer flounder, and recommended continued use of reference points developed using the non-parametric model approach. FMP biological reference points from the 2005 assessment were Fmax = FMSY = 0.276, Ymax = MSY = 19,072 mt (42.0 million lbs), TSBmax = BMSY = 92,645 mt (204.2 million lbs), and biomass threshold of 0.5*TSBmax = 46,323 mt (102.1 million lbs; NEFSC 2005).

The biological reference points for summer flounder were peer-reviewed again in 2006 by the National Marine Fisheries Service (NMFS) Office of Science and Technology (S&T) (Methot 2006). The 2006 S&T Peer Review recommended using SSB, rather than TSB as in previous assessments, as the metric for the biomass reference point proxy. The product of the mean recruitment (37.0 million fish) and Y/R at Fmax was 21,444 mt = 47.276 million lbs (as the proxy for MSY); the product of the mean recruitment and SSB/R at Fmax was 89,411 mt = 197.118 million lbs (as the proxy for BMSY; Terceiro 2006a, b). The 2006 S&T Peer Review Panel (Methot 2006) recommended adoption of these biological reference points from the non-parametric approach for summer flounder, advising:

"The low level of recruitment observed in 2005 is essentially the same as the low 1988 recruitment, so it is within the range of recruitment fluctuation used in calculating the expected time to rebuild this stock. The Panel finds that the most representative approach to calculating BRPs and rebuilding rates would be to use the entire set of recruitments from 1982-2005. The average, not median, of these recruitments should be used for calculation of biological reference points because much of the stock's accumulated biomass comes from the larger recruitments. Random draws from this set of recruitments would provide a probability distribution of rebuilding rates that is consistent with the occasional occurrence of small recruitments (1988 and 2005) and large recruitments (1982-1987). There is no documented and obvious reason why recruitments were higher during 1982-1987. If such recruitment levels become more common as the stock rebuilds, then the stock may rebuild to an even higher level than is currently targeted. If such recruitment levels do not occur during the next few years of the rebuilding, then the rebuilding target may be not be achieved by the target time to rebuild. More precise forecasts than this are not feasible."

The two biological reference point estimation approaches previously used in the 2005 SAW 41 (NEFSC 2005) and 2006 S&T Peer Review (Terceiro 2006b) assessments were again applied in the 2008 SAW 47 assessment work (NEFSC 2008), so as to be potentially complementary and supportive and because using both should build confidence in the results. Objective application of either approach is often compromised by lack of sufficient observation on stock and recruitment over a range of biomass to provide suitable contrast. Thus, it is often necessary to extrapolate beyond the range of observation and to infer the shape of the stock-recruit relationship from limited and variable observations (NEFSC 2002a). The 2001 MAFMC SSC review of summer flounder reference points also noted this concern (MAFMC 2001a).

The non-parametric approach was to evaluate various statistical moments (mean, variance, percentiles) of the observed series of recruitment data and apply the estimated spawning stock biomass and yield per recruit associated with common F reference points to derive the implied spawning stock biomass and equilibrium total yield (landings plus discards). The biomass and yield per recruit models were fit using the NOAA Fisheries Toolbox (NFT) YPR version 2.7.2 software (NFT 2008b). The full time series of recruitment during 1982-2007 as estimated in the 2008 SAW47 assessment was used in the yield and spawning stock biomass calculations at fishing mortality reference points, as per the 2006 S&T Peer Review Panel recommendation. The non-parametric approach assumes that compensatory mechanisms such as impaired growth, maturity, or recruit survival are negligible over the range of biomass considered (NEFSC 2002a). Once the Fmax reference point (i.e., the Fmax proxy for FMSY) was determined, a long-term (100 year) stochastic projection of stock sizes and catches was done to provide better consistency between the estimated medians of the BRP calculations and shorter-term (e.g., 1-5 year) projections (Legault 2008).

The parametric approach used fitted parametric stock-recruitment models along with yield and spawning biomass per recruit information to calculate MSY-based reference points following the procedure of Sissenwine and Shepherd (1987). Stock-recruitment models were fit using the NFT SRFIT version 6.3 software (NFT 2008c). Since a wide range of models (Beverton-Holt [BH] and Ricker [RK] models, incorporating autoregressive error, and Bayesian priors for various parameters) had been tested in the 2005 SAW 41 work, the 2008 SAW47 parametric model exercise was limited to the simple Beverton-Holt and Ricker models (Beverton and Holt 1957, Mace and Doonan 1988, Ricker 1954).

2008 SAW 47 Biological Reference Points (BRPs)

For the 2008 SAW 47 assessment, the ASAP SCAA model provided the basis for the 2008 biological reference points and stock status. Average values of mean weights at age in the catch and stock, maturity schedule, and partial recruitment pattern for the period 2005-2007 were used as input for ages 0-7+ for BRP calculations. In previous assessments (NEFSC 2005 and earlier) for older aged fish (ages 8-15) with very limited or missing samples, Gompertz functions based on younger ages were used to estimate mean weights for the older ages in the BRP calculations. However, the practice of extending the age structure to age 15 and use of Gompertz weights for the older ages resulted in inconsistency between the BRP biomass estimates based on long-term stochastic projections and shorter-term (e.g., 1-5 year) projections used for Total Allowable Landings (TAL) calculations (NEFSC 2002a, Legault 2008). Therefore, to increase consistency between these two types of projections, the age range of the BRP and projection calculations was set at 0-7+, with 8 additional ages (to age 15) included in the plus group calculation of yield and spawning biomass per recruit (NFT 2008b). The mean weight at age for the plus group (ages 7+) was updated for the 2008 SAW47 assessment in a new way, by using a weighted average of mean weights for ages 7-15 (observed catch weights for ages 7-10; calculated Gompertz weights for ages 11-15 as estimated from observed ages 0-10) based on the relative proportions at age given a 2007 total mortality rate of 0.55 (mean M = 0.25 + 2007 F = 0.30; this value is coincidently consistent with the F35% proxy for FMSY). The combined effects of the new assumption for M and the modeling of landings and discards as distinct fleets (which resulted in a slightly domed-shaped combined fishery selectivity pattern) resulted in higher estimates of F reference points, lower estimates of MSY, lower estimates of SSB reference points, and improved stock status with respect to both the F and SSB reference points, as compared to the S&T 2006 assessment.

The reference points estimated from the parametric approach were suspect because the Beverton-Holt function steepness parameters were always very near 1.0. Therefore Fmax, F40%, and F35% (and their corresponding biomass reference points) from the non-parametric approach were considered as candidate proxies for FMSY and BMSY. Fmax had been used in previous assessments as the proxy for FMSY. The estimate of Fmax using mean M = 0.25 and updated fishery selectivity and mean weights at age was relatively high (0.558) and the YPR to F relationship did not indicate a well defined peak. As a result, little gain in YPR (<5%) was realized at fishing mortality rates higher than F35% = 0.310. However, the corresponding decline in SSBR between F35% = 0.310 (~1.48 kg/r) and Fmax = 0.558 (~0.93 kg/r) was about 37%. The 2008 SAW47 concluded that F40% = 0.254 and F35% = 0.310 were candidate proxies that provided sufficient YPR (F40% YPR = 92% of Fmax YPR; F35% YPR = 97% of Fmax YPR) to allow for productive fisheries while also providing for substantial SSBR (F40% SSBR = 176% of Fmax SSBR; F35% SSBR = 155% of Fmax SSBR) to buffer against short-term declines in recruitment. Recommended proxies for FMSY and SSBMSY were F35% = 0.310 and the associated MSY (13,122 mt) and SSBMSY (60,074 mt) estimates from long-term stochastic projections. F40% (= 0.254) was recommended as a fishing mortality rate target for management. These 2008 SAW47 BRPs were subsequently adopted by the NMFS and MAFMC in the 2009 fishery regulation specification process, and have retained in the 2009 (Terceiro 2009) and 2010 updated assessments to evaluate stock status.

2010 UPDATED STOCK STATUS

Based on the 2008 SAW 47 assessment biological reference points the summer flounder stock was not overfished and overfishing was not occurring in 2009. The fishing mortality rate was estimated to be 0.237 in 2009, below the threshold fishing mortality reference point = F35% = FMSY = 0.310. Spawning stock biomass (SSB) was estimated to be 53,458 in 2009, about 89% of the SSB35% = SSBMSY target reference point = 60,074 mt (Table 54, Figure 26).

PROJECTIONS

Stochastic projections were made to provide forecasts of stock size and catches in 2010-2012 consistent with the 2008 SAW47 biological reference points. The projections do not explicitly account for the recent retrospective pattern in the assessment, as per the 2006 S&T Peer Review advice (Methot 2006, Terceiro 2006a, b). The projections assume that recent (2007-2009) patterns of discarding will continue over the time span of the projections. Different patterns that could develop in the future due to different trip and bag limits and fishery closures have not been evaluated. One hundred projections were made for each of the 1000 MCMC realizations of 2010 stock sizes using NFT AGEPRO version 3.1.3 (NFT 2008d). Future recruitment at age 0 was generated randomly from a cumulative density function of the updated recruitment series for 1982-2009 (mean recruitment = 42.0 million fish). The projected catch estimates in the following text-tables are percentile intervals of the catch distributions for fixed F.

If the landings in 2010 equal the TAL = 10,038 mt = 22.13 million lbs and the 2010 discards are 1,720 mt = 3.79 million lbs, the projections estimate a median (50% probability) F in 2010 = 0.241 and a median SSB on November 1, 2010 of 72,367 mt, above the biomass target of SSBMSY = SSB35% = 60,074 mt. Fishing at Ftarget = F40% = 0.255 during 2011-2012 is projected to maintain the stock above SSBMSY = SSB35% = 60,074 mt. The projections indicate that fishing at Ftarget = 0.255 in 2011 could provide landings that exceed MSY (13,122 mt landings = 28.93 million lbs).

Landings, Discards, and Spawning Stock Biomass (SSB) in metric tons

	2011		
Ftarget = 0.255	Landings	Discards	SSB
25%ile	12,663	1,904	72,433
50%ile	13,371	2,028	76,201
75%ile	14,304	2,176	80,973

Fishing at Fthreshold = F35% = 0.310 during 2011-2012 is projected to maintain the stock above SSBMSY = SSB35% = 60,074 mt. The projections indicate that fishing at Fthreshold = 0.310 in 2011 could provide landings that exceed MSY (13,122 mt landings = 28.93 million lbs).

Landings, Discards, and Spawning Stock Biomass (SSB) in metric tons

	2011		
Fthreshold = 0.310	Landings	Discards	SSB
25%ile	15,055	2,274	70,034
50%ile	15,899	2,422	73,678
75%ile	17,008	2,598	78,271

Fishing at 75% of Fthreshold = 0.233 during 2011-2012 is projected to maintain the stock above SSBMSY = SSB35% = 60,074, with landings about 6% less than MSY (13,122 mt landings = 28.93 million lbs) in 2011.

Landings, Discards, and Spawning Stock Biomass (SSB) in metric tons

0.75* Fthreshold = 0.233	**2011** Landings	Discards	SSB
25%ile	11,674	1,752	73,420
50%ile	12,327	1,867	77,237
75%ile	13,186	2,003	82,085

MAJOR SOURCES OF ASSESSMENT UNCERTAINTY

1) The landings from the commercial fisheries used in this assessment assume no under reporting of summer flounder landings. Therefore, reported landings and associated effort 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 error. The MRFSS program is being redesigned in light of the outcome of the NRC Review of the MRFSS methodology (NRC 2000).
3) The length and age composition of the recreational discards are based on data from a limited geographic area (MRFSS, MRFSS For-hire survey, ALS, Connecticut (CTDEP Volunteer Anglers), Maryland (MD-DNR Volunteer Anglers), except for the most recent years. Future sampling of recreational fishery discards on an annual, synoptic basis is needed.
4) The current estimate of M remains an ongoing source of uncertainty. M is highly influential on the assessment results and has a "rescaling affect" on SSB, F, R, point calculations, and the associated perception of current stock status.
5) Estimation of the mean weight at age for older fish (i.e. age 10+) remains an ongoing source of uncertainty.
6) Sex specific differences in life history parameters may have an affect on the results of the assessment model.

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Tables

Table 1. 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+	'000 lbs	Total 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
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

* = 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 1 continued.

Year	ME	NH	MA	RI	CT	NY	NJ	DE	MD+	VA+	NC+	Total '000 lb	mt
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	800	1763	266	936	2369	8	266	2286	4218	12920	5861
1997	3	0	745	1566	257	823	1321	5	215	2370	1501	8806	3994
1998	6	0	707	1712	263	822	1863	11	224	2616	2967	11190	5076
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	267	751	1745	7	223	2660	2789	10958	4970
2002	1	0	1009	2286	357	1053	2407	3	327	2970	4078	14491	6573
2003	0	0	926	2178	272	1073	2384	6	329	3492	3559	14219	6450
2004	0	0	1193	3085	406	1594	2831	8	284	3906	4834	18141	8228
2005	3	0	1274	2926	449	1804	2529	5	333	3869	4059	17253	7826
2006	7	0	910	2120	314	1262	2346	4	248	2669	3926	13806	6262
2007	3	0	660	1515	207	939	1698	3	178	2025	2669	9897	4489
2008	1	0	647	1469	223	858	1544	1	199	1764	2424	9133	4143
2009	0	0	732	1794	244	1140	1799	0	166	1993	2819	10689	4848

* = less than 500 lb; na = not available;

Sources: 1980-2009 State and Federal reporting systems

Table 2. 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	140	16	27	28
526	294	242	193	128	45	22	33	17
533	0	0	0	0	6	2	3	5
537	916	557	707	770	553	449	417	354
538	228	255	341	332	273	270	229	275
539	217	157	223	258	248	284	373	418
611	117	35	181	283	170	141	204	230
612	404	393	169	221	353	297	316	403
613	237	167	280	242	188	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	474	245	280	122
621	1028	526	258	279	325	266	286	304
622	299	363	323	522	264	53	141	301
623	0	6	0	14	28	0	1	0
625	289	227	122	118	282	227	142	91
626	743	601	821	347	395	94	502	415
631	655	98	219	220	21	174	258	140
632	160	77	60	43	75	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	3947	3313	3730	3550

Table 2 continued.

Area	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
511	1	0	0	0	1	0	0	0	0	0
512	1	0	0	0	3	0	1	3	0	1
513	0	1	0	1	1	5	1	0	0	2
514	2	1	2	2	3	14	4	3	2	3
515	0	0	3	1	2	0	0	0	0	4
521	4	15	31	12	11	12	3	4	3	5
522	6	5	12	10	18	10	14	3	13	6
561	4	7	8	1	0	1	1	0	0	1
562	8	3	24	9	5	11	3	4	2	1
525	41	29	43	32	67	93	38	40	9	22
526	16	23	23	17	36	75	25	20	7	4
533	10	2	1	2	6	6	4	6	3	2
537	326	337	446	451	875	860	635	475	419	532
538	260	214	257	275	290	223	255	203	182	234
539	455	432	543	551	500	455	386	276	353	272
611	142	155	206	217	317	389	369	299	228	265
612	308	379	613	606	685	611	603	422	414	551
613	170	162	241	240	319	284	304	191	151	205
614	3	11	26	25	30	48	12	33	31	15
615	70	115	90	63	87	68	126	94	69	43
616	384	247	218	359	600	722	524	574	486	426
621	208	274	533	303	397	270	285	179	247	297
622	101	234	153	394	614	424	360	34	203	297
623	8	18	3	14	28	74	22	3	0	62
625	60	129	296	261	156	326	123	121	12	30
626	697	510	648	763	899	880	331	197	174	153
631	185	142	189	119	13	68	13	70	18	97
632	39	41	8	82	39	54	31	12	1	9
635	54	212	99	21	9	1	8	12	16	30
636	1	7	5	4	27	1	0	0	0	1
Total	3564	3705	4723	4835	6036	5985	4481	3278	3043	3570

Table 3. Summary of sampling of the commercial fishery for summer flounder, ME-VA.

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	3,947	86
1997	8,855	2,332	3,313	37
1998	10,055	2,641	3,730	37
1999	10,460	3,244	3,550	34
2000	10,952	3,307	3,564	33
2001	10,310	2,838	3,705	36
2002	7,422	1,870	4,723	64
2003	8,687	2,210	4,835	56
2004	13,970	3,560	6,036	43
2005	17,188	4,903	5,985	35
2006	18,118	5,062	4,481	25
2007	19,581	6,247	3,278	17
2008	14,803	4,661	3,043	20
2009	18,560	4,694	3,570	19

Table 4. Commercial landings at age of summer flounder ('000), NER. Landings not sampled by NEFSC assumed to have the same biological characteristics as port sampled landings.

	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	4,097
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	2	1	0	0	7,184
1996	0	1,401	3,187	798	156	15	3	0	1	0	5,561
1997	0	380	2,442	1,214	261	69	10	4	0	0	4,380
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	706	1,402	1,000	331	155	59	16	4	3	3,676
2002	0	406	2,706	1,375	383	133	75	9	0	1	5,088
2003	0	470	2,112	1,353	532	255	110	39	17	3	4,891
2004	0	287	2,609	1,765	748	301	120	58	32	10	5,930
2005	0	506	1,373	1,629	1,091	675	364	182	127	62	6,009
2006	0	375	2,221	1,110	578	276	132	49	19	4	4,764
2007	0	160	762	1,449	485	225	115	43	16	10	3,265
2008	0	135	452	692	951	339	147	70	32	13	2,831
2009	0	164	728	1,005	775	521	164	63	29	14	3,463

Table 5. Mean weight (kg) at age of summer flounder landed in the commercial fishery, Northeast Region, Maine to Virginia.

	Age										
	0	1	2	3	4	5	6	7	8	9+	ALL
1982	0.260	0.420	0.620	1.840	2.330	2.940	2.710	4.040	5.990	0.000	0.545
1983	0.310	0.460	0.800	1.400	2.350	1.850	2.760	3.300	4.170	4.370	0.562
1984	0.280	0.390	0.600	1.090	1.430	2.160	3.210	3.620	4.640	4.030	0.540
1985	0.330	0.440	0.590	1.080	1.730	2.220	2.590	4.710	4.780	4.800	0.587
1986	0.300	0.440	0.630	1.110	1.760	1.890	3.140	2.960	4.810	0.000	0.629
1987	0.270	0.450	0.620	1.060	2.000	2.850	3.080	3.020	4.140	0.000	0.590
1988	0.360	0.460	0.600	1.210	2.070	2.880	3.980	3.910	4.500	0.000	0.596
1989	0.357	0.554	0.738	1.062	1.833	2.466	3.568	3.592	2.251	0.000	0.736
1990	0.000	0.518	0.857	1.374	1.835	2.134	3.212	3.915	5.029	0.000	0.724
1991	0.000	0.482	0.748	1.538	2.257	3.012	3.908	3.873	0.000	0.000	0.642
1992	0.340	0.500	0.820	1.880	2.680	3.090	0.000	4.590	0.000	0.000	0.673
1993	0.354	0.488	0.751	1.625	2.099	1.786	2.810	4.136	5.199	0.000	0.623
1994	0.389	0.552	0.616	1.426	2.266	3.083	3.323	0.000	3.703	0.000	0.632
1995	0.328	0.542	0.704	1.532	2.373	2.916	3.500	4.094	0.000	0.000	0.684
1996	0.000	0.544	0.577	1.137	1.881	2.845	3.776	0.000	4.762	0.000	0.694
1997	0.000	0.544	0.637	0.842	1.310	2.101	2.559	3.429	0.000	0.000	0.756
1998	0.000	0.550	0.643	0.845	1.386	2.307	2.524	3.983	0.000	0.000	0.837
1999	0.000	0.523	0.615	0.862	1.359	1.928	2.838	3.618	0.000	0.000	0.889
2000	0.000	0.566	0.676	0.972	1.459	2.125	2.514	2.600	3.303	3.530	0.923
2001	0.000	0.588	0.762	1.031	1.721	2.376	2.847	3.566	3.898	4.940	1.008
2002	0.000	0.596	0.711	1.006	1.652	2.162	2.845	3.601	3.357	2.983	0.928
2003	0.000	0.611	0.705	0.998	1.414	1.890	2.528	3.181	3.535	4.032	0.988
2004	0.000	0.555	0.716	0.995	1.427	1.914	2.488	2.984	3.138	3.874	1.018
2005	0.000	0.556	0.627	0.793	1.056	1.385	1.692	1.989	2.274	3.210	0.996
2006	0.000	0.580	0.651	0.935	1.319	1.788	2.333	2.828	3.253	3.791	0.940
2007	0.000	0.559	0.683	0.866	1.202	1.696	2.256	2.424	2.724	3.700	1.004
2008	0.000	0.563	0.636	0.804	1.103	1.497	1.933	2.265	2.588	2.914	1.075
2009	0.000	0.536	0.635	0.803	1.051	1.509	1.927	2.523	2.899	3.404	1.029

Table 6. 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	1,237	8
1991	24,590	534	1,595	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	1,265	6
2002	21,653	609	1,841	8
2003	17,476	610	1,615	9
2004	20,436	553	2,182	11
2005	20,598	620	1,827	9
2006	20,911	682	1,781	9
2007	26,187	697	1,211	5
2008	27,703	749	1,100	4
2009	19,580	723	1,279	7

Table 7. 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.

	Age									
Year	0	1	2	3	4	5	6	7	8+	Total
1982	981	3,463	1,021	142	52	19	6	4	2	5,690
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
2002	0	79	574	1,032	460	70	30	3	<1	2,248
2003	0	43	336	712	362	124	50	8	<1	1,635
2004	0	24	608	863	449	238	57	22	2	2,263
2005	0	17	471	832	389	143	44	14	3	1,913
2006	0	18	436	658	447	258	95	26	9	1,947
2007	0	12	120	581	345	135	54	25	14	1,286
2008	0	13	103	272	424	133	83	31	13	1,072
2009	0	3	122	398	443	298	99	24	20	1,407

Table 8. Mean weight (kg) at age of summer flounder landed in the North Carolina commercial winter trawl fishery.

	Age									
	0	1	2	3	4	5	6	7	8+	ALL
1982	0.340	0.456	0.756	1.284	1.658	2.054	2.116	2.231	2.577	0.531
1983	0.319	0.452	0.746	1.140	1.262	1.488	1.729	2.428	2.696	0.572
1984	0.331	0.475	0.704	1.059	1.504	2.167	3.482	0.000	0.000	0.585
1985	0.377	0.460	0.664	1.203	1.675	2.485	3.073	4.571	0.000	0.617
1986	0.360	0.512	0.674	1.092	1.623	1.955	3.398	3.233	3.626	0.636
1987	0.334	0.512	0.655	1.086	1.878	2.944	0.000	0.000	0.000	0.590
1988	0.000	0.411	0.598	0.926	1.189	1.702	2.241	2.982	3.412	0.565
1989	0.118	0.380	0.603	0.988	1.161	2.095	3.086	2.496	0.000	0.779
1990	0.079	0.483	0.664	0.867	1.306	2.095	1.897	3.972	0.000	0.773
1991	0.000	0.448	0.655	1.072	1.729	2.252	2.508	3.126	4.097	0.767
1992	0.000	0.363	0.504	0.851	1.198	1.457	2.302	0.000	0.000	0.713
1993	0.000	0.489	0.608	1.128	1.371	2.946	3.406	0.000	0.000	0.663
1994	0.272	0.451	0.618	1.270	2.039	2.443	2.888	5.780	0.000	1.414
1995	0.038	0.210	0.461	0.853	1.474	2.492	3.792	3.815	0.000	1.299
1996	0.000	0.420	0.470	0.730	1.350	1.720	2.290	3.200	2.860	0.564
1997	0.000	0.407	0.616	0.760	1.323	2.069	3.248	0.000	0.000	0.682
1998	0.405	0.714	0.890	1.237	1.491	2.802	3.381	0.000	0.000	0.889
1999	0.144	0.578	0.729	0.919	1.402	1.682	2.609	3.063	3.904	0.945
2000	0.000	0.558	0.656	0.801	1.201	1.963	2.590	3.307	3.521	0.898
2001	0.000	0.594	0.674	0.758	1.065	1.716	2.388	3.067	4.240	0.865
2002	0.000	0.520	0.650	0.760	0.990	1.650	2.200	3.030	4.420	0.821
2003	0.000	0.460	0.700	0.890	1.550	2.480	3.250	3.870	4.820	1.194
2004	0.000	0.510	0.640	0.820	1.120	1.410	2.140	2.990	3.980	0.948
2005	0.000	0.580	0.670	0.870	1.150	1.650	2.430	2.900	3.730	0.989
2006	0.000	0.600	0.669	0.815	1.070	1.427	1.842	2.573	3.370	1.004
2007	0.000	0.550	0.680	0.780	1.010	1.420	1.730	2.160	2.760	0.986
2008	0.000	0.596	0.667	0.834	1.015	1.375	1.551	1.916	2.947	1.018
2009	0.000	0.511	0.634	0.765	0.893	1.130	1.507	1.974	2.079	0.921

Table 9. Summary NER Fishery Observer sample data for trips catching summer flounder. Total trips (trips are not split for multiple areas), observed tows, total summer flounder catch observed (lb), total summer flounder kept (lb) observed, and total summer flounder discard (lb) observed, and percentage of summer flounder discard (lb) to summer flounder catch (lb) observed.

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 9 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	137	605	109,910	61,625	48,295	43.9
	Scallop	68	1,606	11,622	800	10,822	93.1
	All	205	2,211	121,532	62,425	59,117	48.6
2002	Trawl	175	837	141,246	124,053	17,193	12.2
	Scallop	55	2,522	25,871	887	24,984	96.6
	All	230	3,359	167,117	124,940	42,177	25.2
2003	Trawl	212	1,316	235,685	195,371	40,314	17.1
	Scallop	79	3,248	37,021	2,378	34,643	93.6
	All	291	4,564	272,706	197,749	74,957	27.5
2004	Trawl	546	2,570	561,689	477,634	84,055	15.0
	Scallop	132	4,444	59,787	4,016	55,771	93.3
	All	678	7,014	621,476	481,650	139,826	22.5
2005	Trawl	906	5,993	800,082	580,949	219,133	27.4
	Scallop	136	3,786	38,227	2,805	35,422	92.7
	All	1,042	9,779	838,309	583,754	254,555	30.4

Table 9 continued.

Year	Gear	Trips	Obs Tows	Total Catch	Total Kept	Total Discard	Discard: Total (%)
2006	Trawl	578	4,017	566,458	309,915	256,544	45.3
	Scallop	117	1,488	15,687	1,323	14,364	91.6
	All	695	5,505	582,145	311,238	270,908	46.5
2007	Trawl	682	3,972	759,360	332,373	426,987	56.2
	Scallop	233	4,059	58,865	729	56,136	95.4
	All	915	8,031	818,225	333,102	483,123	59.0
2008	Trawl	559	2,890	482,775	288,182	194,593	40.3
	Scallop	383	8,039	91,826	3,786	88,040	95.9
	All	942	10,929	574,601	291,968	282,633	49.2
2009	Trawl	845	4,450	736,910	506,768	230,142	31.2
	Scallop	300	8,042	69,857	3,382	66,475	95.2
	All	1,145	12,492	806,767	510,150	296,617	36.8

Table 10. 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	1,091,056	783,900	307,156	28.2
	Scallop	71	14,662	1,349	13,313	90.8
	All	3,106	1,105,718	785,249	320,469	29.0

Table 10 continued.

Year	Gear	Trips	Total Catch	Total Kept	Total Discard	Discard: Total (%)
2002	Trawl	3,549	1,164,038	924,590	239,448	20.6
	Scallop	107	23,879	6,913	16,966	71.1
	All	3,656	1,187,917	931,503	256,414	21.6
2003	Trawl	3,008	1,484,076	877,458	606,618	40.9
	Scallop	72	21,190	6,028	15,162	71.6
	All	3,080	1,505,266	883,486	621,780	41.3
2004	Trawl	3,607	1,866,542	1,511,013	355,529	19.0
	Scallop	69	24,814	9,478	15,336	61.8
	All	3,676	1,891,356	1,520,491	370,865	19.6
2005	Trawl	2,475	1,870,302	1,542,640	327,662	17.5
	Scallop	55	11,405	5,364	6,041	53.0
	All	2,530	1,881,707	1,548,004	333,703	17.7
2006	Trawl	2,575	1,373,070	974,264	398,806	29.0
	Scallop	144	17,613	3,091	14,522	82.5
	All	2,719	1,390,683	977,355	413,328	29.7
2007	Trawl	2,633	1,253,778	822,298	431,480	34.4
	Scallop	167	32,937	12,379	20,558	62.4
	All	2,800	1,286,715	834,677	452,038	35.1
2008	Trawl	2,164	1,065,118	807,501	257,617	24.2
	Scallop	109	44,992	11,362	33,630	74.7
	All	2,273	1,110,110	818,863	291,247	26.2
2009	Trawl	2,036	1,051,784	846,685	205,099	19.5
	Scallop	85	19,836	4,166	15,670	79.0
	All	2,121	1,071,620	850,851	220,769	20.6

Table 11. Summary of NER 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. 1994-2006 lengths converted to age using 1994-2006 NEFSC trawl survey age-length keys; 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 11 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	1,528		287	19	287	230
	Scallop	705		297	42	297	238
	All	2,233	n/a	584	26	584	468
2002	Trawl	3,438		384	11	384	307
	Scallop	2,952		178	6	178	142
	All	6,390	n/a	562	9	562	449
2003	Trawl	4,233		556	13	556	445
	Scallop	2,594		104	4	104	83
	All	6,827	n/a	660	10	660	528
2004	Trawl	5,760		213	4	213	170
	Scallop	8,811		92	1	92	74
	All	14,571	n/a	305	2	305	244
2005	Trawl	9,562		191	2	191	153
	Scallop	4,690		96	2	96	77
	All	14,252	n/a	287	2	287	230

Table 11 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)
2006	Trawl	8,283		268	3	268	214
	Scallop	1,911		93	5	93	74
	All	10,194	n/a	361	4	361	288
2007	Trawl	12,725		275	2	275	220
	Scallop	4,972		105	2	105	84
	All	17,697	n/a	380	2	380	304
2008	Trawl	6,815		279	4	279	223
	Scallop	8,211		107	1	107	86
	All	15,026	n/a	386	2	386	309
2009	Trawl	9,441		135	1	135	108
	Scallop	8,970		13	1	13	10
	All	18,411	n/a	148	1	148	118

Table 12. Comparison of commercial fishery dealer reported landings of summer flounder with estimates of summer flounder commercial landings from landings rates of NER Fishery Observer sampling and commercial fishing effort (days fished) reported on commercial Vessel Trip Reports (VTR). Dealer and Landings estimates prior to 1997 do not reflect NC landings and effort.

Year	VTR Days Fished (>000)	Observed Landings Estimate (mt)	Dealer landings Estimate (mt)	Percent Difference (Obs-Dealer)
1989	19,805	7,255	5,817	25
1990	15,980	2,959	2,749	8
1991	26,096	4,123	4,355	-5
1992	18,148	5,343	6,066	-12
1993	19,947	4,032	3,995	1
1994	18,402	6,004	4,968	21
1995	14,168	5,891	4,911	20
1996	10,351	5,024	3,718	35
1997	10,975	2,663	3,994	-33
1998	15,267	3,677	5,076	-28
1999	20,670	7,396	4,820	53
2000	11,268	6,702	5,085	32
2001	11,421	1,509	4,970	-70
2002	12,268	6,609	6,573	1
2003	13,415	5,786	6,450	-10
2004	9,288	4,997	8,228	-39
2005	13,215	3,478	7,826	-56
2006	11,856	1,794	6,262	-71
2007	8,872	1,012	4,431	-77
2008	7,615	1,445	4,143	-65
2009	7,294	1,277	4,848	-74

Table 13. Estimated summer flounder discard at age in the in the commercial fishery. Lengths converted to age using annual NEFSC trawl survey age-length keys. 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	1,097
	All	571	1,677	493	36	2,777
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	480
	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	Trawl	11	86	56	128	281
	Scallop	0	13	50	142	205
	All	11	99	106	270	486
2002	Trawl	12	94	137	106	349
	Scallop	1	30	83	63	177
	All	13	124	220	169	526
2003	Trawl	2	221	208	84	515
	Scallop	0	43	48	20	111
	All	2	264	256	104	626

Table 13 continued.

Discard numbers at age (000s)

Year	Gear	0	1	2	3+	Total
2004	Trawl	1	25	70	70	166
	Scallop	<1	14	64	27	105
	All	2	39	134	98	271
2005	Trawl	4	33	44	65	146
	Scallop	<1	8	52	40	100
	All	4	41	96	105	246
2006	Trawl	4	38	102	82	226
	Scallop	<1	11	79	34	124
	All	4	49	181	115	350
2007	Trawl	9	26	29	108	172
	Scallop	<1	3	51	55	109
	All	9	29	80	163	281
2008	Trawl	3	46	37	113	199
	Scallop	<1	7	16	71	95
	All	2	53	53	184	294
2009	Trawl	2	15	42	53	112
	Scallop	0	1	4	9	13
	All	2	16	46	61	125

Table 14. Estimated summer flounder discard mean length at age in the commercial fishery. Lengths converted to age using NEFSC trawl survey age-length keys.

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	Trawl	22.9	33.7	39.6	47.7	40.8
	Scallop		37.1	40.6	49.1	46.3
	All	22.9	34.2	40.1	48.5	43.1
2002	Trawl	27.7	32.4	37.6	53.6	40.7
	Scallop	27.7	35.1	39.1	48.1	41.5
	All	27.7	33.1	38.1	51.6	41.0
2003	Trawl	27.4	33.6	38.3	54.4	38.9
	Scallop		34.6	40.1	50.1	39.7
	All	27.4	33.8	38.6	53.6	39.0
2004	Trawl	28.4	33.6	38.8	51.8	43.4
	Scallop	29.1	32.9	37.9	47.4	39.7
	All	28.5	33.3	38.4	50.6	42.0

Table 14 continued.

Discard mean length (cm) at age

Year	Gear	0	1	2	3+	All
2005	Trawl	28.4	33.3	38.7	52.3	43.3
	Scallop	30.7	31.2	37.2	46.9	40.6
	All	28.4	32.9	37.9	50.3	42.2
2006	Trawl	25.8	33.9	37.6	50.5	41.4
	Scallop	25.0	33.9	36.2	43.9	38.1
	All	25.8	33.9	37.0	48.6	40.3
2007	Trawl	26.1	32.8	41.1	51.4	45.5
	Scallop	24.3	31.6	38.2	44.5	41.2
	All	26.1	32.7	39.3	49.0	43.8
2008	Trawl	25.2	30.0	36.0	52.3	43.7
	Scallop	27.1	32.9	38.2	50.2	46.8
	All	25.4	30.4	36.7	51.5	44.7
2009	Trawl	26.1	31.2	35.7	49.4	41.1
	Scallop		29.7	36.4	47.2	42.7
	All	26.1	31.1	35.8	49.1	41.6

Table 15. Estimated summer flounder discard mean weight at age in the in the commercial fishery. Lengths converted to age using NEFSC trawl survey age-length keys.

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	Trawl	0.114	0.373	0.642	1.210	0.797
	Scallop		0.510	0.692	1.339	1.127
	All	0.114	0.391	0.665	1.278	0.936
2002	Trawl	0.194	0.331	0.538	1.851	0.871
	Scallop	0.195	0.429	0.608	1.235	0.795
	All	0.194	0.355	0.565	1.623	0.845
2003	Trawl	0.186	0.371	0.583	1.871	0.701
	Scallop		0.413	0.672	1.430	0.705
	All	0.186	0.378	0.600	1.788	0.701
2004	Trawl	0.220	0.386	0.599	1.625	0.996
	Scallop	0.223	0.352	0.554	1.234	0.698
	All	0.220	0.374	0.578	1.508	0.880

Table 15 continued.

Discard mean weight (kg) at age

Year	Gear	0	1	2	3+	All
2005	Trawl	0.214	0.366	0.597	1.669	1.015
	Scallop	0.268	0.290	0.520	1.162	0.752
	All	0.214	0.351	0.555	1.480	0.908
2006	Trawl	0.157	0.382	0.547	1.505	0.860
	Scallop	0.137	0.374	0.468	0.976	0.597
	All	0.157	0.380	0.513	1.352	0.767
2007	Trawl	0.161	0.338	0.717	1.548	1.152
	Scallop	0.133	0.302	0.558	0.962	0.755
	All	0.161	0.334	0.616	1.349	0.998
2008	Trawl	0.147	0.269	0.462	1.687	1.109
	Scallop	0.179	0.353	0.566	1.481	1.233
	All	0.151	0.281	0.493	1.608	1.149
2009	Trawl	0.164	0.297	0.445	1.452	0.896
	Scallop		0.250	0.480	1.211	0.922
	All	0.164	0.295	0.448	1.420	0.898

Table 16. 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. Proportional Standard Error (PSE) is for the TOTAL landings estimate.

	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	377	137	99	173	211
TOTAL	1,598	1,092	635	395	2,680	694	420	142	116	190	238
Mid											
Shore	682	3,296	977	272	478	251	596	84	96	505	200
P/C Boat	5,745	3,321	2,381	1,068	1,541	1,143	1,134	141	412	589	374
P/R Boat	5,731	12,345	11,764	8,454	5,924	5,499	7,153	1,141	2,658	4,573	3,983
TOTAL	12,158	18,962	15,122	9,794	7,943	6,893	8,883	1,366	3,166	5,667	4,557
South											
Shore	272	523	316	504	689	115	308	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	348	117	361	159	156
TOTAL	1,717	942	1,718	877	998	278	657	209	512	211	207
All											
Shore	1,121	3,963	1,355	786	1,237	405	946	179	262	565	276
P/C Boat	5,936	3,574	2,496	1,152	1,609	1,151	1,136	143	414	598	376
P/R Boat	8,416	13,459	13,624	9,128	8,775	6,309	7,878	1,395	3,118	4,905	4,350
TOTAL	15,473	20,996	17,475	11,066	11,621	7,865	9,960	1,717	3,794	6,068	5,002
PSE (%)	26	7	8	12	7	5	4	6	4	4	4

Table 16 continued.

	YEAR										
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
North											
Shore	37	47	19	22	27	44	34	61	5	18	26
P/C Boat	14	25	7	5	22	26	19	49	14	21	36
P/R Boat	298	584	388	702	669	970	769	1,448	555	401	487
TOTAL	349	656	414	729	718	1,040	822	1,558	574	440	549
Mid											
Shore	186	217	173	134	195	243	157	467	199	123	145
P/C Boat	999	809	260	650	907	333	281	600	316	238	353
P/R Boat	4,579	4,633	2,330	5,137	5,059	4,972	2,610	4,802	3,878	2,272	3,424
TOTAL	5,764	5,659	2,763	5,921	6,161	5,548	3,048	5,869	4,393	2,633	3,922
South											
Shore	118	183	49	50	33	30	22	41	22	14	32
P/C Boat	1	3	1	5	2	1	<1	1	<1	3	<1
P/R Boat	262	202	99	292	253	360	214	332	304	172	55
TOTAL	381	388	149	347	288	391	237	374	327	189	88
All Regions											
Shore	341	447	241	206	255	317	213	569	226	155	203
P/C Boat	1,014	837	268	660	931	360	301	650	331	262	390
P/R Boat	5,139	5,419	2,817	6,131	5,981	6,302	3,593	6,582	4,737	2,845	3,966
TOTAL	6,494	6,703	3,326	6,997	7,167	6,979	4,107	7,801	5,294	3,262	4,559
PSE (%)	4	4	4	3	4	4	4	3	4	4	4

Table 16 continued.

	YEAR					
	2004	2005	2006	2007	2008	2009
North						
Shore	21	22	12	2	0	5
P/C Boat	25	33	37	55	33	12
P/R Boat	740	550	539	360	440	144
TOTAL	786	605	588	417	473	161
Mid						
Shore	143	109	90	145	51	52
P/C Boat	467	518	258	327	103	179
P/R Boat	2,988	2,751	2,965	2,319	1,614	1,460
TOTAL	3,598	3,378	3,313	2,791	1,768	1,691
South						
Shore	46	14	25	14	19	12
P/C Boat	3	1	1	20	1	1
P/R Boat	124	112	125	151	34	45
TOTAL	173	127	151	185	54	58
All						
Shore	210	145	127	161	70	69
P/C Boat	495	552	296	402	137	192
P/R Boat	3,852	3,413	3,629	2,830	2,088	1,649
TOTAL	4,557	4,110	4,052	3,393	2,295	1,910
PSE (%)	4	5	5	4	5	5

Table 17. 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. Proportional Standard Error (PSE) is for the TOTAL landings estimate.

	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	290	141	89	150	175
TOTAL	1,047	600	409	337	2,667	607	323	144	106	162	196
Mid											
Shore	295	1,254	399	140	293	129	330	52	56	306	126
P/C Boat	3,112	2,196	1,426	609	1,093	1,098	776	125	264	364	267
P/R Boat	3,085	8,389	5,686	4,187	3,521	3,596	4,928	985	1,665	2,673	2,536
TOTAL	6,492	11,839	7,511	4,936	4,907	4,823	6,034	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	163	71	161	80	91
TOTAL	728	248	592	392	528	89	277	129	238	106	117
All											
Shore	469	1,447	514	377	743	184	475	111	148	337	171
P/C Boat	3,209	2,295	1,453	631	1,145	1,103	778	127	266	371	269
P/R Boat	4,589	8,945	6,545	4,657	6,214	4,232	5,381	1,197	1,915	2,903	2,802
TOTAL	8,267	12,687	8,512	5,665	8,102	5,519	6,634	1,435	2,329	3,611	3,242
PSE (%)	25	7	8	11	9	9	4	6	4	4	4

Table 17 continued.

						YEAR					
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
North											
Shore	26	29	14	15	17	56	27	73	6	20	32
P/C Boat	10	14	6	8	17	22	18	43	16	30	35
P/R Boat	214	401	320	518	445	833	738	1,536	695	559	540
TOTAL	250	444	340	541	479	911	783	1,652	717	609	607
Mid											
Shore	94	122	108	78	127	160	136	363	187	135	148
P/C Boat	617	499	179	414	712	274	286	649	349	274	457
P/R Boat	2,833	2,958	1,721	3,246	3,898	4,096	2,461	4,596	3,842	2,517	4,009
TOTAL	3,544	3,579	2,008	3,738	4,737	4,530	2,883	5,608	4,378	2,926	4,614
South											
Shore	61	102	30	26	18	18	13	24	15	9	22
P/C Boat	<1	1	<1	2	1	1	<1	<1	<1	1	<1
P/R Boat	150	105	80	147	147	199	115	185	168	88	35
TOTAL	212	208	111	175	166	218	129	210	184	98	58
All											
Shore	181	253	152	119	162	234	176	460	208	164	202
P/C Boat	628	514	186	424	730	297	305	693	366	305	493
P/R Boat	3,197	3,464	2,121	3,911	4,490	5,128	3,314	6,317	4,705	3,164	4,584
TOTAL	4,006	4,231	2,459	4,454	5,382	5,659	3,795	7,470	5,279	3,632	5,279
PSE (%)	4	4	5	3	4	5	5	4	4	4	4

Table 17 continued.

	YEAR					
	2004	2005	2006	2007	2008	2009
North						
Shore	23	13	11	2	0	8
P/C Boat	18	25	16	75	56	23
P/R Boat	962	679	816	504	698	271
TOTAL	1,003	717	843	581	754	302
Mid						
Shore	147	100	81	136	74	60
P/C Boat	297	505	208	430	166	270
P/R Boat	3,374	3,321	3,766	3,167	2,553	2,184
TOTAL	3,818	3,926	4,055	3,733	2,793	2,514
South						
Shore	30	10	17	9	12	8
P/C Boat	4	<1	1	16	<1	1
P/R Boat	77	70	76	106	24	31
TOTAL	110	81	94	131	37	40
All						
Shore	200	123	109	147	86	76
P/C Boat	318	531	225	521	223	294
P/R Boat	4,413	4,070	4,658	3,777	3,275	2,486
TOTAL	4,931	4,724	4,992	4,445	3,584	2,856
PSE (%)	4	5	5	5	5	5

Table 18. Comparison of Vessel Trip Report (VTR) reported landings of summer flounder by Party (VTRPB) and charter (VTRCB) boats, with landings estimated by the MRFSS for the Party/Charter boat (P/C Boat) sector. Data are numeric landings in thousands of fish.

Year	VTRPB	VTRCB	VTR P/C Boat Total	MRFSS P/C Boat Total	Ratio MRFSS to VTR
1995	189	44	233	268	1.15
1996	289	58	347	660	1.90
1997	302	68	370	931	2.52
1998	281	73	354	361	1.02
1999	190	50	240	301	1.25
2000	208	75	283	650	2.30
2001	105	42	147	331	2.25
2002	104	40	144	262	1.82
2003	123	44	167	392	2.35
2004	101	32	133	494	3.71
2005	80	21	101	552	5.47
2006	42	20	62	296	4.77
2007	64	28	92	402	4.37
2008	40	13	53	124	2.34
2009	32	12	44	192	4.36

Table 19. Recreational fishery sampling intensity for summer flounder by MRFSS Subregion. Includes both MRFSS and state agency lengths.

Year	Subregion	Landings (A+B1; mt)	Number 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
1988	North	323	310	104
	Mid	6,034	2,865	214
	South	277	743	38
	TOTAL	6,634	3,918	172
1989	North	144	107	135
	Mid	1,162	1,582	73
	South	129	358	36
	TOTAL	1,435	2,047	70

Table 19 continued.

Year	Subregion	Landings (A+B1; mt)	Number Measured	mt/100 Lengths
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	250	338	63
	Mid	3,544	4,174	74
	South	212	995	20
	TOTAL	4,006	5,507	63
1994	North	444	621	75
	Mid	3,579	3,834	90
	South	208	1,467	14
	TOTAL	4,231	5,922	69
1995	North	340	501	68
	Mid	2,008	1,470	137
	South	111	485	23
	TOTAL	2,459	2,456	100
1996	North	541	919	59
	Mid	3,738	3,373	111
	South	175	1,188	15
	TOTAL	4,454	5,480	81
1997	North	480	786	61
	Mid	4,736	2,988	159
	South	166	1,026	16
	TOTAL	5,382	4,800	112

Table 19 continued.

Year	Subregion	Landings (A+B1; mt)	Number Measured	mt/100 Lengths
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	1,652	707	234
	Mid	5,608	1,892	296
	South	210	722	29
	TOTAL	7,470	3,321	225
2001	North	717	351	204
	Mid	4,378	2,963	148
	South	184	933	20
	TOTAL	5,279	4,247	124
2002	North	609	366	166
	Mid	2,925	2,695	109
	South	98	596	16
	TOTAL	3,632	3,657	99
2003	North	607	514	118
	Mid	4,614	3,003	154
	South	58	139	42
	TOTAL	5,279	3,656	144
2004	North	1,003	1,548	65
	Mid	3,818	2,486	154
	South	110	276	40
	TOTAL	4,931	4,310	114
2005	North	717	551	130
	Mid	3,926	1,994	197
	South	81	269	30
	TOTAL	4,724	2,814	168

Table 19 continued.

Year	Subregion	Landings (A+B1; mt)	Number Measured	mt/100 Lengths
2006	North	843	987	85
	Mid	4,055	1,423	285
	South	94	281	33
	TOTAL	4,992	2,691	186
2007	North	581	1,209	48
	Mid	3,733	1,863	200
	South	131	291	45
	TOTAL	4,445	3,363	132
2008	North	754	906	83
	Mid	2,793	1,022	273
	South	37	65	57
	TOTAL	3,584	1,993	180
2009	North	303	260	117
	Mid	2,514	1,939	130
	South	39	132	30
	TOTAL	2,856	2,331	123

Table 20. 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	429	5,742	3,311	387	88	3	0	0	0	9,960
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	79	3,929	2,323	159	<1	2	0	0	0	6,494
1994	790	3,998	1,698	184	28	1	4	0	0	6,703
1995	231	1,510	1,426	116	26	16	1	0	0	3,326
1996	116	2,935	3,468	354	123	1	0	0	0	6,997
1997	4	1,148	4,188	1,465	274	88	0	0	0	7,167
1998	0	768	2,915	2,714	515	63	4	0	0	6,979
1999	0	201	1,982	1,520	325	60	19	0	0	4,107
2000	0	578	4,121	2,284	643	170	0	0	0	7,801
2001	0	838	1,975	1,781	539	121	36	4	0	5,294
2002	1	194	1,327	1,204	421	92	20	1	2	3,262
2003	0	237	1,674	1,751	648	171	62	16	0	4,559
2004	24	213	1,554	1,720	681	220	120	25	0	4,557
2005	3	184	1,197	1,539	755	238	99	60	35	4,110
2006	4	72	1,412	1,319	729	317	135	40	24	4,052
2007	2	70	577	1,580	714	286	103	33	28	3,393
2008	1	25	97	437	854	520	213	77	148	2,295
2009	1	20	108	467	661	442	130	54	27	1,910

Table 21. Mean weight (kg) at age of summer flounder landings in the recreational fishery.

	Age									
	0	1	2	3	4	5	6	7	8+	All
1982	0.224	0.404	0.570	1.326	1.846	1.885	2.978	0.000	0.000	0.464
1983	0.176	0.370	0.633	0.927	1.194	1.396	0.000	0.000	0.000	0.478
1984	0.205	0.364	0.620	0.968	1.771	2.197	4.166	0.000	0.000	0.461
1985	0.242	0.398	0.626	1.101	1.748	2.441	0.000	0.000	0.000	0.533
1986	0.225	0.447	0.751	1.290	1.740	2.719	3.482	5.960	0.000	0.601
1987	0.230	0.412	0.761	1.340	1.839	3.050	4.808	4.640	0.000	0.583
1988	0.293	0.488	0.707	1.114	1.921	2.316	0.000	0.000	0.000	0.590
1989	0.263	0.512	0.813	1.232	1.784	3.333	1.576	0.000	0.000	0.742
1990	0.303	0.460	0.968	1.440	1.677	2.895	6.456	0.000	0.000	0.555
1991	0.273	0.433	0.670	1.306	1.372	2.450	0.000	0.000	0.000	0.537
1992	0.225	0.504	0.717	1.617	2.279	3.340	0.000	0.000	0.000	0.604
1993	0.246	0.518	0.715	1.871	2.442	3.027	0.000	0.000	0.000	0.619
1994	0.436	0.583	0.694	1.438	1.923	2.831	3.897	0.000	0.000	0.625
1995	0.426	0.575	0.816	1.457	2.603	2.930	3.537	0.000	0.000	0.727
1996	0.343	0.532	0.622	1.338	1.341	2.361	0.000	0.000	0.000	0.629
1997	0.225	0.487	0.675	0.909	1.153	2.377	0.000	0.000	0.000	0.732
1998	0.000	0.525	0.668	0.830	1.257	2.508	2.786	0.000	0.000	0.777
1999	0.000	0.508	0.706	0.945	1.549	2.330	2.604	0.000	0.000	0.884
2000	0.000	0.760	0.984	1.307	2.388	3.481	3.481	0.000	0.000	1.231
2001	0.000	0.621	0.879	1.037	1.539	2.089	2.291	3.738	0.000	0.998
2002	0.238	0.488	0.896	1.091	1.519	2.287	2.604	3.200	4.213	1.076
2003	0.000	0.677	0.910	1.137	1.597	2.018	2.807	2.714	0.000	1.156
2004	0.599	0.635	0.850	1.048	1.412	1.905	2.316	3.002	0.000	1.099
2005	0.308	0.571	0.869	1.133	1.408	1.756	2.330	2.357	2.269	1.173
2006	0.126	0.619	0.856	1.090	1.344	1.694	2.266	3.310	3.018	1.165
2007	0.175	0.492	0.799	1.137	1.467	1.805	2.148	2.878	3.448	1.258
2008	0.238	0.445	0.751	1.159	1.397	1.678	1.979	2.103	2.605	1.530
2009	0.207	0.424	0.866	1.085	1.265	1.666	2.114	2.507	2.791	1.396

Table 22. Estimated summer flounder recreational landings (catch types A + B1), live discard (catch type B2), and total catch (catch types A + B1 + B2) in numbers (000s), Proportional Standard Error (PSE) of the total catch estimate, and live discard (catch type B2) as a proportion of total catch. Catch type B2 uses estimates for NC from NCDMF (C.Batsavage, pers. comm)

	Numbers (000s)				
Year	A+B1	B2	A+B1+B2	PSE (%)	B2 / (A+B1+B2)
1982	15,473	8,084	23,557	59	0.343
1983	20,996	11,026	32,022	16	0.344
1984	17,475	12,307	29,782	11	0.413
1985	11,066	2,460	13,526	15	0.182
1986	11,621	13,655	25,276	8	0.540
1987	7,865	13,472	21,337	6	0.631
1988	9,960	7,201	17,161	6	0.420
1989	1,717	908	2,625	10	0.346
1990	3,794	5,283	9,077	5	0.582
1991	6,068	9,870	15,938	5	0.619
1992	5,002	7,540	12,542	5	0.601
1993	6,494	17,741	24,235	5	0.732
1994	6,703	12,332	19,035	5	0.648
1995	3,326	13,568	16,894	5	0.803
1996	6,997	12,987	19,984	4	0.650
1997	7,167	13,854	21,021	4	0.659
1998	6,979	16,960	23,939	4	0.708
1999	4,107	17,833	21,940	5	0.813
2000	7,801	18,643	26,444	4	0.705
2001	5,294	24,049	29,343	3	0.820
2002	3,262	13,386	16,648	3	0.804
2003	4,559	15,776	20,335	4	0.776
2004	4,557	17,009	21,566	4	0.789
2005	4,110	23,135	27,245	5	0.849
2006	4,052	17,516	21,568	5	0.812
2007	3,393	20,428	23,821	5	0.858
2008	2,295	22,204	24,499	5	0.906
2009	1,910	23,749	25,659	5	0.926

Table 23. Recreational fishery sample size for summer flounder discard mortality assumption. Includes MRFSS landed fish sampling, American Littoral Society (ALS) reported released lengths, CT Volunteer Angler Survey (CTVAS) reported released lengths, MADMF party boat sampling (MADMF), NYDEC Party Boat Survey sampling (NYPBS), MDDNR Volunteer Angler Logs (MDVAL), and MRF For-Hire Survey (MRF FHS) reported released lengths. Number of MRFSS lengths is for landed fish measured that were less than the state or federal minimum landed size, and assumed to be indicative of the length frequency of the discarded catch. This length frequency was used to characterize the length frequency of the released catch. All other sources of released lengths were used to verify this assumption. In 2002 and 2003, samples of discarded summer flounder from CTVAS and NYPBS used to directly characterize the discard in those states. The MRF FHS began sampling in 2005. B2 mt estimates use NC from NCDMF (C. Batsavage, pers. comm.)

Year	Source	Discard Mortality (B2; mt)	Number of Lengths	mt/100 Lengths
1982	MRFSS		2,048	
	ALS		1	
	Total	296	2,049	14
1983	MRFSS		2,683	
	ALS			
	Total	376	2,683	14
1984	MRFSS		1,521	
	ALS		1,134	
	Total	415	2,683	15
1985	MRFSS		1,032	
	ALS		695	
	Total	92	1,727	5
1986	MRFSS		976	
	ALS		1,445	
	Total	578	2,421	24
1987	MRFSS		1,164	
	ALS		1,496	
	Total	522	2,660	20
1988	MRFSS		1,065	
	ALS		1,640	
	Total	341	2,705	13
1989	MRFSS		448	
	ALS		171	
	Total	45	619	7

Table 23 continued.

Year	Source	Discard Mortality (B2; mt)	Number of Lengths	mt/100 Lengths
1990	MRFSS		1,588	
	ALS		1,318	
	Total	234	2,906	8
1991	MRFSS		2,230	
	ALS		2,126	
	Total	429	4,356	10
1992	MRFSS		1,401	
	ALS		1,807	
	Total	344	3,208	11
1993	MRFSS		966	
	ALS		3,923	
	Total	910	4,889	19
1994	MRFSS		1,079	
	ALS		3,061	
	Total	687	4,140	17
1995	MRFSS		267	
	ALS		2,307	
	Total	753	2,574	29
1996	MRFSS		639	
	ALS		2,383	
	Total	681	3,022	23
1997	MRFSS		221	
	ALS		2,468	
	Total	556	2,689	21
1998	MRFSS		1,083	
	ALS		3,015	
	Total	734	4,098	18
1999	MRFSS		429	
	ALS		3,688	
	Total	711	4,117	17

Table 23 continued.

Year	Source	Discard Mortality (B2; mt)	Number of Lengths	mt/100 Lengths
2000	MRFSS		421	
	ALS		5,962	
	CTVAS		2,893	
	NYPBS		681	
	Total	952	9,957	10
2001	MRFSS		637	
	ALS		3,453	
	CTVAS		999	
	NYPBS		834	
	MDVAL		2,316	
	Total	1,274	8,239	15
2002	MRFSS		721	
	CTVAS		1,526	
	ALS		2,931	
	NYPBS		1,840	
	MADMF		12	
	Total	777	7,030	11
2003	MRFSS		215	
	ALS		2,466	
	CTVAS		1,407	
	NYPBS		2,167	
	Total	882	6,255	14
2004	MRFSS		321	
	ALS		2,153	
	CTVAS		661	
	NYPBS		1,222	
	Total	1,034	4,357	24
2005	MRFSS		142	
	ALS		3,398	
	CTVAS		1,199	
	MRF FHS		3,210	
	Total	999	7,949	13

Table 23 continued.

Year	Source	Discard Mortality (B2; mt)	Number of Lengths	mt/100 Lengths
2006	MRFSS		180	
	ALS		3,104	
	CTVAS		1,124	
	MDVAL		2,944	
	MRF FHS		2,924	
	Total	795	10,276	8
2007	MRFSS		266	
	ALS		4,072	
	CTVAS		1,038	
	MRF FHS		3,364	
	Total	1,130	8,740	13
2008	MRFSS		224	
	ALS		5,437	
	CTVAS		843	
	NJVAS			
	MRF FHS		3,353	
	Total	1,251	9,857	13
2009	MRFSS		167	
	ALS		4,873	
	CTVAS		1,023	
	NJVAS		1,918	
	MDVAS		5,466	
	VAVAS		928	
	MRF FHS		3,366	
	Total	1,195	17,741	7

Table 24. Estimated recreational fishery discards at age of summer flounder (catch type B2). NC estimates by NCMDF. 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 2001-2009 allocated to age groups in the same relative proportion as fish less than the minimum size in the respective state catch from MRFSS sampling and as indicated by state agency or ALS sampling of the released catch. All years assume 10% release mortality.

					Age					
Year	0	1	2	3	4	5	6	7	8+	Total
1982	172	636	0	0	0	0	0	0	0	808
1983	175	932	0	0	0	0	0	0	0	1,107
1984	210	1,020	0	0	0	0	0	0	0	1,230
1985	40	206	0	0	0	0	0	0	0	246
1986	150	1,217	0	0	0	0	0	0	0	1,367
1987	106	1,210	0	0	0	0	0	0	0	1,316
1988	55	665	0	0	0	0	0	0	0	720
1989	13	83	0	0	0	0	0	0	0	96
1990	60	470	0	0	0	0	0	0	0	530
1991	24	977	0	0	0	0	0	0	0	1,001
1992	17	674	0	0	0	0	0	0	0	691
1993	34	1,740	0	0	0	0	0	0	0	1,774
1994	216	1,017	0	0	0	0	0	0	0	1,233
1995	189	1,168	0	0	0	0	0	0	0	1,357
1996	50	1,249	0	0	0	0	0	0	0	1,299
1997	24	820	522	23	0	0	0	0	0	1,389
1998	0	685	875	136	0	0	0	0	0	1,696
1999	84	587	987	125	0	0	0	0	0	1,783
2000	0	587	1,097	180	0	0	0	0	0	1,864
2001	0	1,261	888	239	17	0	0	0	0	2,405
2002	75	565	569	190	8	0	0	0	0	1,407
2003	49	785	599	194	14	0	0	0	0	1,641
2004	85	508	794	307	7	0	0	0	0	1,701
2005	254	1,153	739	160	8	0	0	0	0	2,314
2006	155	552	887	145	13	2	0	0	0	1,754
2007	101	667	674	514	65	7	0	0	0	2,028
2008	140	807	609	398	246	45	10	3	4	2,262
2009	218	897	626	440	162	28	2	1	1	2,375

Table 25. Mean weight (kg) at age of summer flounder discards in the recreational fishery.

	Age									
	0	1	2	3	4	5	6	7	8+	All
1982	0.224	0.404	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.366
1983	0.176	0.370	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.339
1984	0.205	0.364	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.337
1985	0.242	0.398	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.373
1986	0.225	0.447	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.423
1987	0.230	0.412	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.397
1988	0.293	0.488	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.473
1989	0.263	0.512	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.478
1990	0.303	0.460	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.442
1991	0.273	0.433	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.429
1992	0.225	0.504	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.497
1993	0.246	0.518	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.513
1994	0.436	0.583	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.560
1995	0.426	0.575	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.554
1996	0.343	0.532	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.525
1997	0.225	0.394	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.400
1998	0.000	0.400	0.453	0.469	0.000	0.000	0.000	0.000	0.000	0.433
1999	0.127	0.378	0.427	0.455	0.000	0.000	0.000	0.000	0.000	0.399
2000	0.000	0.478	0.523	0.540	0.000	0.000	0.000	0.000	0.000	0.510
2001	0.000	0.472	0.570	0.667	0.756	0.000	0.000	0.000	0.000	0.530
2002	0.206	0.419	0.665	0.737	0.807	1.893	0.000	0.000	0.000	0.552
2003	0.169	0.420	0.645	0.737	1.040	0.000	0.000	0.000	0.000	0.537
2004	0.255	0.454	0.678	0.769	1.078	0.000	0.000	0.000	0.000	0.608
2005	0.207	0.358	0.550	0.736	1.118	0.000	0.000	0.000	0.000	0.432
2006	0.157	0.348	0.523	0.686	0.919	1.389	0.000	0.000	0.000	0.453
2007	0.170	0.336	0.593	0.802	1.024	1.483	0.000	0.000	0.000	0.557
2008	0.184	0.349	0.558	0.742	0.897	1.162	1.634	2.321	2.930	0.553
2009	0.167	0.315	0.549	0.774	0.948	1.167	1.316	1.415	1.410	0.503

Table 26. Total catch at age of summer flounder (000s), ME-NC.

	Age										
Year	0	1	2	3	4	5	6	7	8	9+	Total
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	789	20,440	14,528	2,138	642	121	19	15	6	0	38,698
1989	959	4,789	7,308	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	12,145	7,152	742	217	32	3	1	0	0	21,294
1992	1,369	11,213	6,009	1,128	150	70	2	1	0	0	19,942
1993	1,305	12,024	5,943	586	75	46	19	2	1	0	20,001
1994	1,702	10,648	7,145	995	207	27	13	0	5	0	20,742
1995	607	5,832	7,303	1,236	396	77	5	1	0	0	15,457
1996	189	6,803	9,082	1,767	411	72	16	1	3	0	18,344
1997	36	2,614	8,078	3,152	553	160	10	4	0	0	14,607
1998	45	2,370	6,422	5,249	980	138	19	1	0	0	15,224
1999	181	2,204	6,293	4,177	1,062	308	51	11	0	0	14,288
2000	22	1,591	8,010	4,805	1,437	344	70	16	8	2	16,305
2001	11	2,983	4,779	3,846	1,221	339	113	25	4	3	13,324
2002	89	1,368	5,396	3,978	1,264	295	125	13	2	1	12,531
2003	51	1,799	4,977	4,066	1,581	560	232	66	17	3	13,352
2004	111	1,071	5,699	4,708	1,907	768	303	112	34	11	14,724
2005	261	1,901	3,876	4,212	2,265	1,069	517	264	150	77	14,592
2006	163	1,066	5,137	3,284	1,796	869	372	123	42	14	12,866
2007	112	938	2,213	4,217	1,645	670	284	106	43	25	10,253
2008	144	1,033	1,315	1,841	2,535	1,069	474	210	193	17	8,831
2009	221	1,100	1,630	2,332	2,054	1,302	401	146	71	24	9,281

Table 27. Mean weight (kg) at age of summer flounder catch, ME-NC.

	Age										
	0	1	2	3	4	5	6	7	8	9+	ALL
1982	0.255	0.419	0.616	1.447	1.907	2.787	2.668	3.762	4.284	0.000	0.504
1983	0.244	0.419	0.716	1.075	1.257	1.495	2.567	1.761	3.875	4.030	0.522
1984	0.251	0.398	0.632	1.046	1.500	2.163	3.456	3.620	4.640	4.030	0.518
1985	0.290	0.429	0.613	1.109	1.726	2.297	2.671	4.682	4.780	4.800	0.575
1986	0.256	0.454	0.668	1.160	1.739	1.994	3.310	2.994	4.415	0.000	0.613
1987	0.263	0.446	0.651	1.140	1.941	2.862	3.378	3.020	4.140	0.000	0.580
1988	0.319	0.462	0.624	1.130	1.738	2.486	3.888	3.539	4.319	0.000	0.588
1989	0.207	0.459	0.723	1.044	1.479	2.248	2.408	2.861	2.251	0.000	0.668
1990	0.250	0.429	0.810	1.169	1.538	2.143	3.024	3.944	5.029	0.000	0.540
1991	0.140	0.404	0.702	1.186	1.811	2.519	2.975	3.360	0.000	0.000	0.537
1992	0.246	0.467	0.749	1.222	1.390	2.687	2.302	4.456	0.000	0.000	0.595
1993	0.264	0.482	0.700	1.476	1.679	1.865	2.816	4.136	5.199	0.000	0.572
1994	0.345	0.523	0.629	1.354	2.063	2.742	3.399	0.000	3.703	0.000	0.606
1995	0.376	0.527	0.678	1.054	1.601	2.627	3.624	4.094	0.000	0.000	0.675
1996	0.329	0.503	0.569	1.077	1.548	1.963	2.569	3.200	3.394	4.510	0.621
1997	0.215	0.450	0.638	0.866	1.233	2.252	2.573	3.429	0.000	0.000	0.695
1998	0.259	0.522	0.653	0.859	1.321	2.410	2.588	3.983	0.000	0.000	0.764
1999	0.143	0.372	0.593	0.895	1.439	1.998	2.716	3.495	3.904	0.000	0.753
2000	0.066	0.584	0.806	1.082	1.785	2.721	2.598	2.730	3.358	3.532	1.010
2001	0.114	0.542	0.765	0.968	1.449	2.145	2.598	3.461	3.914	4.935	0.899
2002	0.205	0.481	0.739	0.954	1.373	2.101	2.666	3.728	4.232	2.983	0.902
2003	0.170	0.499	0.761	1.030	1.527	2.072	2.764	3.175	3.569	4.028	1.002
2004	0.328	0.516	0.737	0.969	1.350	1.757	2.357	3.024	3.176	3.754	0.982
2005	0.208	0.433	0.690	0.932	1.193	1.508	1.895	2.155	2.297	3.210	0.949
2006	0.156	0.454	0.682	0.961	1.264	1.645	2.184	2.943	3.119	3.620	0.949
2007	0.169	0.388	0.683	0.949	1.276	1.694	2.119	2.540	3.062	3.362	0.995
2008	0.184	0.379	0.605	0.881	1.170	1.560	1.902	2.253	2.621	3.190	1.063
2009	0.167	0.350	0.612	0.846	1.078	1.470	1.885	2.425	2.500	3.429	0.955

Table 28. 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.

	Commercial			Recreational			Total		
Year	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
1983	13,403	n/a	13,403	12,687	376	13,063	26,090	376	26,466
1984	17,130	n/a	17,130	8,512	415	8,927	25,642	415	26,057
1985	14,675	n/a	14,675	5,665	92	5,757	20,340	92	20,432
1986	12,186	n/a	12,186	8,102	578	8,680	20,288	578	20,866
1987	12,271	n/a	12,271	5,519	522	6,041	17,790	522	18,312
1988	14,686	n/a	14,686	6,634	341	6,975	21,320	341	21,661
1989	8,125	709	8,834	1,435	45	1,480	9,560	754	10,314
1990	4,199	1,214	5,413	2,329	234	2,563	6,528	1,448	7,976
1991	6,224	1,052	7,276	3,611	429	4,040	9,835	1,481	11,316
1992	7,529	690	8,219	3,242	344	3,586	10,771	1,034	11,805
1993	5,715	846	6,561	4,006	910	4,916	9,721	1,756	11,477
1994	6,588	906	7,494	4,231	687	4,918	10,819	1,593	12,412
1995	6,977	308	7,285	2,459	752	3,211	9,436	1,060	10,496
1996	5,861	463	6,324	4,454	681	5,135	10,315	1,144	11,459
1997	3,994	326	4,320	5,382	556	5,938	9,376	882	10,258
1998	5,076	389	5,465	5,659	734	6,393	10,735	1,123	11,858
1999	4,820	1,548	6,368	3,795	711	4,506	8,615	2,259	10,874
2000	5,085	726	5,811	7,470	952	8,422	12,555	1,678	14,233
2001	4,970	468	5,438	5,279	1,274	6,553	10,249	1,742	11,991
2002	6,573	449	7,022	3,632	777	4,409	10,205	1,226	11,431
2003	6,450	528	6,978	5,279	882	6,161	11,729	1,410	13,139
2004	8,228	244	8,472	4,831	1,034	5,865	13,059	1,278	14,337
2005	7,826	230	8,056	4,724	999	5,723	12,550	1,229	13,779
2006	6,262	288	6,550	4,992	795	5,787	11,254	1,083	12,337
2007	4,489	304	4,793	4,445	1,130	5,575	8,934	1,434	10,368
2008	4,143	309	4,452	3,584	1,251	4,835	7,727	1,560	9,287
2009	4,848	118	4,966	2,856	1,195	4,051	7,704	1,313	9,017
Mean	8,067	615	8,517	5,255	636	5,892	13,322	1,086	14,408

Table 29. NEFSC research trawl survey indices of abundance for summer flounder. 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 (1992-2007) 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 (spring) or end of survey (winter). Note that door and vessel conversion factors for 1967-2008 are not significant; 1967-2008 gear conversion factors have not been included due to limited sample size and extreme violation of underlying assumptions in experimental work.

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	2.55	1.40	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	1.50	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 29 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	15.76	12.59	2.14	1.70	1.90	1.82
2001	18.59	15.68	2.69	2.16	1.56	1.55
2002	22.68	18.43	2.47	2.29	1.32	1.40
2003	35.62	27.48	2.91	2.42	2.00	1.93
2004	17.77	15.25	3.03	2.43	3.00	3.06
2005	12.89	10.32	1.81	1.59	1.57	1.83
2006	21.04	15.93	1.77	1.34	2.10	1.79
2007	16.83	12.89	3.25	3.17	2.21	2.45
2008	n/a	n/a	1.40	1.38	1.38	1.62

Table 30. NEFSC research trawl spring and autumn survey indices from the FSV *Henry B. Bigelow* (HBB) and calibrated, equivalent indices for the FSV *Albatross IV* (ALB) time series. 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. The spring catch number calibration factor is 3.2255; the catch weight factor is 3.0657. The autumn catch number calibration factor is 2.4054; the catch weight factor is 2.1409.

Year	Spring (n) HBB	Spring (kg) HBB	Spring (n) ALB	Spring (kg) ALB
2009	5.642	3.605	1.749	1.176

Year	Autumn (n) HBB	Autumn (kg) HBB	Autumn (n) ALB	Autumn (kg) ALB
2009	7.062	5.622	2.936	2.626

Table 31. NEFSC spring trawl survey (offshore strata 1-12, 61-76) stratified mean number of summer flounder per tow at age.

	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	0.34	0.89	0.74	0.31	0.10	0.03	0.05	0.01			2.47
2003	0.54	1.29	0.59	0.29	0.13	0.06	0.01	0.01			2.91
2004	0.30	1.45	0.85	0.27	0.05	0.06	0.04				3.03
2005	0.26	0.65	0.58	0.15	0.10	0.05	0.02		0.001		1.81
2006	0.04	1.04	0.24	0.25	0.09	0.06	0.02	0.01		0.018	1.77
2007	0.24	0.52	1.46	0.57	0.18	0.13	0.07	0.04	0.010	0.030	3.25
2008	0.22	0.35	0.32	0.29	0.11	0.09	0.02				1.40
2009	0.53	0.48	0.36	0.18	0.14	0.03	0.01	0.01	0.007	0.002	1.75
Mean	0.45	0.71	0.35	0.13	0.06	0.04	0.02	0.01	0.01	0.01	1.70

Table 32. NEFSC spring trawl survey (offshore strata 1-12, 61-76) summer flounder mean length (cm) at age.

	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		
2003	32.4	39.3	46.5	51.4	57.5	65.2	51.0	65.0				
2004	29.5	37.6	46.1	50.4	56.9	61.9	63.3					
2005	29.2	39.1	45.1	50.9	55.0	58.3	71.3				73.0	
2006	28.3	36.3	42.1	47.6	51.8	54.0	57.0	63.0		62.0	66.0	
2007	28.3	38.7	43.0	48.2	55.2	53.9	60.4	65.6	61.0	69.4		63.0
2008	32.0	37.3	45.1	49.0	55.9	59.6	57.9					
2009	25.9	36.7	41.3	46.2	52.6	59.9	62.4	63.6	68.2	67.0		
Mean	28.3	37.3	45.3	51.0	56.9	60.9	62.7	69.5	65.0	69.5	68.0	69.0

Table 33. 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.

	Age								
Year	0	1	2	3	4	5	6	7+	ALL
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	0.12	1.36	0.93	0.37	0.11	0.10		0.01	3.00
2002	0.06	1.17	0.86	0.35	0.11	0.03	0.03	0.02	2.63
2003	0.18	1.31	1.03	0.25	0.10	0.03	0.07	0.01	2.98
2004	0.36	1.49	1.37	0.66	0.19	0.07	0.06	0.04	4.24
2005	0.16	1.14	0.54	0.47	0.18	0.10	0.13	0.03	2.75
2006	0.31	0.72	1.22	0.35	0.17	0.06	0.07	0.02	2.91
2007	0.12	0.84	0.91	0.96	0.31	0.09	0.09	0.04	3.36
2008	0.39	0.52	0.59	0.33	0.46	0.16	0.10	0.09	2.64
2009	0.20	1.01	0.67	0.47	0.28	0.13	0.06	0.04	2.86
Mean	0.39	1.02	0.64	0.24	0.10	0.05	0.04	0.03	2.41

Table 34. 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	21.8	36.3	42.6	50.0	54.0	62.1		67.0
2002	25.4	36.8	43.8	49.5	55.3	61.4	67.9	69.9
2003	23.2	37.0	43.4	51.8	56.8	59.5	58.5	72.0
2004	23.9	36.8	43.5	48.4	56.2	59.4	60.7	71.2
2005	28.8	34.2	42.2	47.5	51.6	56.4	63.5	63.8
2006	21.5	35.9	41.1	48.1	52.9	55.2	57.6	63.5
2007	22.7	34.2	41.9	46.4	52.4	55.1	58.7	71.0
2008	21.5	35.0	40.4	44.9	48.3	50.9	57.3	63.8
2009	26.8	33.2	39.8	44.5	49.7	53.5	61.1	67.7
Mean	25.3	35.3	42.9	51.9	55.8	60.2	62.9	67.2

Table 35. 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. The winter survey ended in 2007.

Year	Stratified mean number per tow	Coefficient of variation	Stratified mean weight (kg) per tow	Coefficient of variation
1992	12.30	15.6	4.90	15.4
1993	13.60	15.2	5.50	11.9
1994	12.05	17.8	6.03	16.1
1995	10.93	12.0	4.81	11.6
1996	31.25	24.2	12.35	22.0
1997	10.28	24.0	5.54	16.6
1998	7.76	20.7	5.13	16.6
1999	11.06	13.3	7.99	11.4
2000	15.76	13.0	12.59	12.8
2001	18.59	11.4	15.68	13.2
2002	22.55	15.6	18.71	15.7
2003	35.62	18.7	27.48	19.1
2004	17.77	13.9	15.25	14.6
2005	12.89	14.6	10.32	20.0
2006	21.04	13.9	15.93	13.6
2007	16.83	12.8	12.89	14.7

Table 36. 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. The winter survey ended in 2007.

Year	Age											
	1	2	3	4	5	6	7	8	9	10	11	12+	Total
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	3.07	5.33	6.42	2.44	0.80	0.37	0.09	0.05	0.01		0.01	0.01	18.59
2002	2.77	10.74	5.58	2.26	0.85	0.32	0.13	0.02	0.01				22.68
2003	8.17	14.36	8.48	2.67	1.04	0.39	0.32	0.15	0.05		0.01		35.62
2004	1.45	8.68	4.56	1.64	0.62	0.41	0.19	0.16	0.02	0.03	0.01		17.77
2005	2.96	4.03	3.07	1.34	0.70	0.33	0.17	0.13	0.12	0.03		0.01	12.89
2006	2.64	9.06	4.29	2.47	1.32	0.56	0.24	0.22	0.14	0.07	0.01	0.04	21.04
2007	2.77	6.18	5.15	1.54	0.58	0.31	0.16	0.05	0.08	0.01			16.83
Mean	4.84	6.82	3.22	1.19	0.52	0.23	0.14	0.09	0.06	0.02	0.01	0.02	16.89

Table 37. 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. The winter survey ended in 2007.

	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			
2003	30.8	39.2	45.2	51.4	55.9	61.0	65.6	67.8	67.1		67.0	
2004	28.8	38.6	44.5	50.8	55.0	60.2	65.0	66.6	67.1	72.4	69.0	
2005	27.7	37.6	44.1	48.9	53.3	56.4	60.8	64.1	65.3	70.6		71.5
2006	30.9	36.8	41.0	46.7	51.2	54.6	60.2	61.4	62.1	68.2	65.0	73.3
2007	27.8	38.2	43.5	49.1	53.8	57.3	62.1	63.6	66.0	65.0		
Mean	28.8	37.9	45.4	52.9	57.7	61.7	65.3	65.7	67.3	69.7	67.8	72.9

Table 38. MADMF spring survey cruises: stratified mean number per tow at age.

Year	Age									
	0	1	2	3	4	5	6	7	8+	Total
1978		0.102	0.547	0.288	0.232		0.045			1.214
1979			0.087	0.090	0.152	0.050	0.011			0.390
1980		0.056	0.062	0.053	0.077	0.054	0.056	0.012		0.370
1981		0.431	0.593	0.079	0.033	0.046	0.064		0.032	1.278
1982		0.350	1.584	0.142	0.042	0.022			0.010	2.150
1983		0.051	0.599	0.450	0.024	0.009	0.022		0.012	1.167
1984		0.044	0.078	0.067	0.116					0.305
1985		0.154	1.260	0.036	0.051	0.004				1.505
1986		0.995	0.522	0.185	0.009					1.711
1987		0.656	0.640	0.013			0.011			1.320
1988		0.211	1.005	0.123	0.014					1.353
1989			0.363	0.102			0.011			0.476
1990		0.257	0.021	0.081	0.013					0.372
1991		0.032	0.050	0.011						0.093
1992		0.280	0.342	0.090		0.012	0.011			0.735
1993		0.126	0.492	0.065	0.010				0.022	0.715
1994		1.860	1.217	0.048	0.023		0.011			3.159
1995		0.104	1.302	0.053						1.459
1996		0.076	0.686	0.114	0.012					0.888
1997		0.544	1.279	0.181	0.116		0.006			2.126
1998		0.144	1.212	0.659	0.049	0.050				2.114
1999		0.078	0.878	1.112	0.302	0.029		0.016		2.415
2000		0.237	1.659	1.205	0.305	0.232	0.054			3.692
2001		0.186	1.026	0.730	0.229	0.057				2.228
2002		0.151	1.511	0.397	0.102	0.066	0.026	0.014	0.019	2.286
2003		0.206	1.440	0.624	0.185	0.118	0.012	0.023		2.608
2004		0.027	0.283	0.323	0.061	0.061	0.026	0.023	0.010	0.814
2005		0.136	0.351	1.029	0.315	0.132	0.074	0.053	0.107	2.197
2006		0.049	2.440	0.975	0.229	0.070	0.086	0.020	0.021	3.890
2007		0.254	0.392	1.008	0.102	0.080	0.051	0.012		1.899
2008		0.328	0.383	0.167	0.309	0.061	0.016	0.066	0.018	1.348
2009		0.251	0.847	0.613	0.146	0.168	0.035	0.040	0.036	2.135
Mean		0.279	0.786	0.347	0.121	0.070	0.033	0.028	0.029	1.575

Table 39. MADMF autumn survey cruises: stratified mean number per tow at age.

Year	Age									
	0	1	2	3	4	5	6	7	8+	Total
1978		0.039	0.442	0.085		0.025				0.591
1979			0.050	0.109		0.020				0.179
1980		0.123	0.351	0.022	0.022	0.009				0.527
1981	0.010	0.400	0.405	0.012						0.827
1982	0.038	0.234	1.662	0.019						1.953
1983		0.033	0.625	0.154	0.006					0.818
1984	0.033	0.485	0.267	0.127		0.011				0.923
1985	0.057	0.117	1.895	0.039						2.108
1986	0.145	2.316	0.679	0.214	0.008	0.003				3.365
1987		1.202	0.663	0.011	0.006					1.882
1988		0.474	0.429	0.006	0.007	0.006				0.922
1989			0.317	0.016			0.012			0.345
1990		0.113		0.011						0.124
1991	0.024	0.531	0.288	0.005						0.848
1992		1.181	0.186							1.367
1993	0.009	0.335	0.478	0.030	0.022					0.874
1994	0.052	2.234	0.077							2.363
1995	0.011	0.342	0.507							0.860
1996		0.761	1.282	0.114	0.006					2.163
1997		0.494	1.508	0.351	0.020	0.036				2.409
1998		0.012	0.590	0.262	0.018	0.011				0.893
1999	0.061	0.347	0.940	0.379	0.037					1.764
2000	0.074	1.383	2.303	0.494	0.100	0.092	0.014	0.028		4.488
2001	0.011	1.244	1.083	0.307	0.027		0.011	0.017		2.700
2002	0.325	2.681	1.302	0.178	0.047	0.036				4.569
2003	0.133	3.059	1.254	0.256	0.037	0.028	0.006		0.010	4.783
2004	0.026	0.589	1.455	0.136	0.011	0.010				2.227
2005		1.557	2.049	1.350	0.446	0.096	0.015	0.015	0.017	5.545
2006	0.336	0.586	3.745	0.559	0.043	0.023	0.016			5.308
2007	0.399	0.500	0.401	1.039	0.168	0.067	0.016			2.590
2008	0.257	1.341	1.238	0.142	0.241	0.045				3.264
20098	0.320	0.362	0.784	0.551	0.172	0.126	0.050		0.019	2.383
Mean	0.122	0.836	0.944	0.241	0.072	0.038	0.017	0.020	0.015	2.061

Table 40. MADMF seine survey: total catch of age-0 summer flounder.

Year	Total catch
1982	3
1983	3
1984	1
1985	19
1986	5
1987	4
1988	2
1989	3
1990	11
1991	4
1992	0
1993	2
1994	1
1995	14
1996	7
1997	0
1998	12
1999	13
2000	10
2001	1
2002	70
2003	11
2004	4
2005	0
2006	43
2007	38
2008	86
2009	45
Mean	15

Table 41. CTDEP spring trawl survey: summer flounder index of abundance, geometric mean number per tow at age. CTDEP lengths aged with NEFSC spring trawl survey age-length keys.

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
2002	0.000	1.057	1.264	0.465	0.233	0.087	0.044	0.035	3.185
2003	0.000	1.608	1.016	0.395	0.232	0.085	0.046	0.039	3.421
2004	0.000	0.259	0.818	0.410	0.194	0.032	0.077	0.048	1.838
2005	0.000	0.253	0.264	0.150	0.033	0.036	0.039	0.029	0.804
2006	0.000	0.038	0.360	0.068	0.065	0.034	0.026	0.022	0.613
2007	0.000	1.152	0.210	0.560	0.316	0.115	0.089	0.065	2.507
2008	0.000	0.601	0.291	0.237	0.263	0.117	0.062	0.043	1.614
2008	0.000	0.777	0.377	0.291	0.180	0.195	0.070	0.040	1.930
Mean	0.000	0.481	0.369	0.187	0.085	0.037	0.022	0.013	1.193

Table 42. CTDEP autumn trawl survey: summer flounder index of abundance, geometric mean number per tow at age. CTDEP lengths aged with NEFSC autumn trawl survey age-length keys.

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
2002	0.442	3.087	1.930	0.479	0.123	0.031	0.024	0.005	6.121
2003	0.000	1.459	1.319	0.407	0.087	0.091	0.016	0.009	3.388
2004	0.255	0.385	0.755	0.440	0.080	0.024	0.015	0.000	1.954
2005	0.067	1.093	0.744	0.355	0.087	0.032	0.012	0.020	2.410
2006	0.098	0.217	0.592	0.230	0.096	0.044	0.021	0.018	1.315
2007	0.130	0.567	0.387	0.468	0.201	0.078	0.041	0.016	1.888
2008	0.681	0.515	1.155	0.660	0.048	0.013	0.013	0.000	3.085
2009	0.405	0.661	0.888	0.624	0.318	0.133	0.044	0.044	3.117
Mean	0.122	0.816	0.692	0.232	0.059	0.023	0.008	0.005	1.958

Table 43. 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
1981	0.30	0.97	1.74	0.20	0.01	0.00	0.00	0.00	0.00	0.00	3.24
1982	0.02	0.21	0.52	0.07	0.01	0.00	0.00	0.00	0.00	0.00	0.83
1983	0.03	0.14	0.42	0.11	0.01	0.00	0.00	0.00	0.00	0.00	0.71
1984	0.02	0.74	0.49	0.10	0.00	0.00	0.00	0.00	0.00	0.00	1.35
1985	0.35	0.31	0.28	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.97
1986	0.35	2.45	0.51	0.13	0.00	0.01	0.00	0.00	0.00	0.00	3.46
1987	0.04	0.94	0.37	0.02	0.04	0.00	0.00	0.00	0.00	0.00	1.42
1988	0.00	0.34	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.58
1989	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
1990	0.05	0.67	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.84
1991	0.00	0.12	0.08	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.22
1992	0.01	0.77	0.41	0.11	0.07	0.00	0.00	0.00	0.00	0.00	1.38
1993	0.01	0.41	0.22	0.07	0.00	0.00	0.03	0.00	0.00	0.00	0.74
1994	0.04	0.12	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19
1995	0.02	0.53	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.76
1996	0.10	0.95	1.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	2.09
1997	0.03	0.56	0.96	0.30	0.02	0.02	0.00	0.00	0.00	0.00	1.89
1998	0.00	0.09	0.36	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.54
1999	0.02	1.04	1.91	0.35	0.02	0.01	0.00	0.00	0.00	0.00	3.35
2000	0.40	0.50	1.24	0.45	0.14	0.03	0.00	0.00	0.00	0.00	2.76
2001	0.00	1.05	0.63	0.30	0.09	0.07	0.01	0.00	0.00	0.00	2.15
2002	0.44	2.42	1.38	0.40	0.08	0.02	0.03	0.03	0.00	0.00	4.79
2003	0.10	2.35	2.08	0.49	0.12	0.04	0.06	0.00	0.00	0.00	5.24
2004	0.03	0.48	1.30	0.78	0.19	0.06	0.01	0.00	0.00	0.00	2.85
2005	0.01	0.84	1.38	0.69	0.15	0.14	0.01	0.04	0.03	0.00	3.29
2006	0.10	0.14	1.13	0.44	0.16	0.02	0.01	0.00	0.00	0.00	2.00
2007	0.08	0.43	0.86	1.35	0.34	0.13	0.08	0.02	0.00	0.03	3.32
2008	0.12	0.55	1.10	0.62	0.85	0.41	0.16	0.10	0.02	0.00	3.93
2009	0.39	1.05	1.59	1.34	0.77	0.24	0.09	0.01	0.00	0.00	5.47
Mean	0.11	0.73	0.78	0.29	0.11	0.04	0.02	0.01	0.00	0.00	2.08

Table 44. RIDFW monthly fixed station trawl survey summer flounder index of abundance. RIDFW lengths aged with NEFSC spring and autumn trawl survey age-length keys.

Year	Age										
	0	1	2	3	4	5	6	7	8	9	2+	Total
1990	0.02	0.17	0.04	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.10	0.29
1991		0.07	0.08								0.08	0.15
1992	0.01	0.15	0.13	0.04	0.01						0.18	0.34
1993	0.01	0.11	0.09	0.04			0.01				0.14	0.26
1994	0.04	0.08	0.04		0.01						0.05	0.17
1995	0.03	0.02	0.02	0.01							0.03	0.08
1996	0.02	0.41	0.40	0.13							0.53	0.96
1997	0.04	0.17	0.38	0.13	0.01						0.52	0.73
1998		0.07	0.24	0.11	0.01						0.36	0.43
1999	0.03	0.26	0.37	0.17	0.05	0.02					0.61	0.90
2000	0.09	0.63	1.22	0.49	0.12	0.05	0.01				1.89	2.61
2001	0.01	0.42	0.28	0.15	0.06	0.04	0.02				0.55	0.98
2002	0.11	0.81	0.63	0.30	0.11	0.05		0.02			1.11	2.03
2003	0.05	1.48	1.44	0.45	0.24	0.08	0.04				2.25	3.78
2004	0.10	0.54	0.88	0.46	0.13	0.04	0.02				1.53	2.17
2005	0.04	0.55	0.98	0.53	0.17	0.16	0.02	0.03	0.01		1.90	2.49
2006	0.00	0.24	0.47	0.29	0.23	0.06	0.02	0.01			1.08	1.32
2007	0.04	0.25	0.51	0.55	0.20	0.07	0.05	0.01			1.39	1.68
2008	0.06	0.36	0.50	0.33	0.46	0.23	0.13	0.04	0.01		1.70	2.12
2009	0.12	0.89	1.50	1.28	0.74	0.36	0.12	0.04	0.02	0.01	4.07	5.08
Mean	0.05	0.38	0.51	0.31	0.16	0.10	0.04	0.02	0.01	0.01	1.00	1.43

Table 45. NJBMF trawl survey, April - October: index of summer flounder abundance. NJBMF lengths aged with NEFSC autumn trawl survey age-length keys.

Year	Age					
	0	1	2	3	4+	Total
1988	0.17	3.06	1.03	0.00	0.00	4.26
1989	1.00	0.51	0.18	0.00	0.00	1.69
1990	1.28	1.44	0.11	0.03	0.00	2.86
1991	1.00	2.69	0.27	0.02	0.00	3.98
1992	1.10	3.00	0.57	0.06	0.02	4.75
1993	2.55	5.69	0.20	0.01	0.01	8.46
1994	1.66	1.07	0.08	0.00	0.02	2.83
1995	4.95	2.93	0.28	0.05	0.16	8.37
1996	1.66	5.10	2.70	0.18	0.05	9.69
1997	1.65	8.25	5.25	1.02	0.18	16.35
1998	0.67	5.80	2.67	0.29	0.04	9.47
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	0.15	5.68
2002	1.51	9.11	4.13	1.28	0.81	16.84
2003	0.60	5.61	2.55	0.57	0.51	9.84
2004	0.90	6.27	2.49	0.57	0.43	10.66
2005	3.11	5.99	1.24	0.53	0.32	11.19
2006	0.81	5.74	3.22	0.48	0.40	10.65
2007	0.64	4.10	2.49	1.22	0.53	8.98
2008	1.31	2.34	1.61	0.45	0.58	6.29
2009	1.68	2.82	2.15	1.02	0.64	8.31
Mean	1.40	4.31	1.80	0.42	0.24	8.18

Table 46. DEDFW 16 foot trawl survey: index of summer flounder recruitment at age-0 in the Delaware Bay 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	0.03
1994	0.29
1995	0.17
1996	0.03
1997	0.02
1998	0.03
1999	0.05
2000	0.18
2001	0.07
2002	0.07
2003	0.09
2004	0.10
2005	0.00
2006	0.02
2007	0.03
2008	0.05
2009	0.31
Mean	0.10

Table 47. DEDFW 16 foot trawl survey: index of summer flounder recruitment at age-0 in Delaware's Inland Bays.

Year	Geometric Mean number per tow
1986	0.317
1987	0.258
1988	0.013
1989	0.139
1990	0.361
1991	0.378
1992	0.368
1993	0.047
1994	0.571
1995	0.301
1996	0.080
1997	0.222
1998	0.390
1999	0.350
2000	0.205
2001	0.142
2002	0.125
2003	0.214
2004	0.268
2005	0.012
2006	0.170
2007	0.170
2008	0.200
2009	0.420
Mean	0.238

Table 48. 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
2002	0.04	0.23	0.09	0.00	0.03	0.39
2003	0.15	0.14	0.29	0.15	0.12	0.85
2004	0.02	0.07	0.06	0.01	0.02	0.18
2005	0.00	0.30	0.11	0.02	0.01	0.44
2006	0.41	0.10	0.23	0.07	0.02	0.83
2007	0.11	0.14	0.83	0.09	0.12	1.29
2008	0.20	0.35	0.12	0.02	0.03	0.72
2009	0.45	0.49	0.10	0.09	0.03	1.16
Mean	0.45	0.47	0.35	0.14	0.07	1.48

Table 49. MD DNR Coastal Bays trawl survey: index of summer flounder recruitment at age-0. Geometric mean (re-transformed ln[number per hectare + 1])

Year	Geo. mean n/tow	Lower 95% CI	Upper 95% CI
1972	34.351	13.426	87.888
1973	10.321	5.529	19.267
1974	12.311	7.516	20.165
1975	3.606	2.547	5.104
1976	4.207	2.833	6.246
1977	4.337	2.728	6.894
1978	5.731	3.959	8.295
1979	6.715	4.077	11.060
1980	7.395	3.953	13.837
1981	8.849	5.544	14.123
1982	3.408	1.663	6.983
1983	17.699	0.031	10223.618
1984	13.310	7.161	24.738
1985	12.843	7.472	22.076
1986	59.526	21.950	161.427
1987	7.584	3.590	16.018
1988	1.763	1.371	2.267
1989	2.855	2.121	3.843
1990	4.733	3.639	6.156
1991	7.337	5.508	9.772
1992	8.487	6.285	11.461
1993	4.145	3.192	5.383
1994	22.311	16.486	30.194
1995	13.067	9.811	17.404
1996	6.493	4.954	8.509
1997	7.997	5.948	10.752
1998	14.983	11.391	19.708
1999	8.565	6.477	11.326
2000	9.874	7.272	13.407
2001	13.543	9.945	18.442
2002	5.406	4.136	7.066
2003	8.180	6.064	11.035
2004	6.993	5.230	9.350
2005	2.198	1.783	2.709
2006	9.658	7.263	12.843
2007	15.438	11.588	20.573
2008	12.079	9.214	15.834
2009	17.887	13.129	24.368
Mean	10.765		

Table 50. VIMS juvenile fish trawl survey: index of summer flounder recruitment at age-0. Includes all available data and incorporates gear conversion factors from studies conducted in the late 1990s. There was no survey in 1960.

Year	Geometric mean catch per trawl	Lower 95% confidence limit	Upper 95% confidence limit	Number of stations
1955	0.00	0.00	0.00	2
1956	4.44	2.91	6.56	29
1957	2.14	1.22	3.42	28
1958	1.48	0.23	4.00	27
1959	0.06	-0.03	0.15	27
1960				
1961	0.19	0.12	0.61	11
1962	0.00	0.00	0.00	7
1963	2.07	0.78	4.29	12
1964	0.65	0.54	0.76	16
1965	0.74	0.27	1.39	13
1966	0.00	0.00	0.00	17
1967	0.43	-0.17	1.46	27
1968	0.14	-0.05	0.36	27
1969	0.20	0.04	0.38	27
1970	0.04	-0.02	0.10	29
1971	3.72	3.43	4.04	129
1972	0.85	0.79	0.92	84
1973	1.27	0.77	1.89	94
1974	0.82	0.31	1.51	32
1975	0.14	0.00	0.30	22
1976	0.57	0.32	0.86	68
1977	1.67	1.16	2.31	36
1978	1.24	0.47	2.40	36
1979	2.94	2.74	3.15	50
1980	10.69	6.49	17.25	70
1981	3.97	2.39	6.31	67
1982	2.27	1.54	3.21	64
1983	5.01	3.62	6.82	60
1984	1.58	0.96	2.39	41
1985	1.26	0.52	2.37	27
1986	1.26	0.77	1.89	53
1987	0.39	0.20	0.63	52
1988	0.54	0.35	0.75	143
1989	1.24	0.94	1.58	162

Table 50 continued.

Year	Geometric mean catch per trawl	Lower 95% confidence limit	Upper 95% confidence limit	Number of stations
1990	2.54	2.06	3.09	162
1991	2.64	2.14	3.22	207
1992	0.89	0.68	1.12	187
1993	0.50	0.36	0.65	185
1994	2.41	1.91	2.99	186
1995	0.63	0.46	0.82	218
1996	0.81	0.62	1.02	224
1997	0.89	0.69	1.12	226
1998	0.73	0.55	0.93	226
1999	0.53	0.41	0.67	219
2000	0.57	0.43	0.73	227
2001	0.47	0.34	0.61	236
2002	0.77	0.54	1.04	179
2003	0.44	0.33	0.56	225
2004	1.30	1.03	1.60	225
2005	0.35	0.25	0.46	225
2006	0.80	0.60	1.02	203
2007	1.00	0.78	1.24	225
2008	1.35	1.10	1.63	225
2009	0.75	0.58	0.92	225
Mean	1.39			

Table 51. VIMS ChesMMAP trawl survey indices for summer flounder. Indices are geometric mean numbers (N) and biomass (kg) per tow.

Year	Number	Biomass	Age 0 N	Age 1 N	Age 2 N
2002	117.08	53.90	49.95	5.78	3.91
2003	30.97	12.40	8.13	4.12	1.41
2004	40.19	16.53	14.69	3.32	1.37
2005	128.89	49.25	22.90	18.76	5.77
2006	148.16	51.51	55.06	6.04	4.28
2007	99.48	33.46	56.67	4.69	1.66
2008	74.37	26.31	34.71	3.07	3.43
2009	30.95	13.80	9.00	3.80	1.72
Mean	91.31	34.77	34.59	6.54	3.12

Table 52. VIMS NEAMAP trawl survey indices for summer flounder. Indices are calculated as stratified geometric mean numbers and biomass (kg) per standard area swept tow.

Season	Number per tow	Biomass per tow
Fall2006	3.91	2.37
Fall2007	2.55	1.54
Fall2008	4.47	2.18
Spring 2008	2.76	1.73
Spring 2009	2.41	1.39

Table 53. 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	CV (%)
1987	19.86	14
1988	2.61	34
1989	6.63	17
1990	4.27	18
1991	5.85	24
1992	9.14	19
1993	5.13	24
1994	8.17	24
1995	6.65	25
1996	30.67	18
1997	14.14	21
1998	10.44	41
1999	n/a	n/a
2000	3.94	21
2001	22.03	15
2002	18.28	18
2003	7.23	24
2004	5.90	20
2005	9.88	22
2006	1.96	22
2007	3.62	22
2008	14.40	22
2009	4.53	22
Mean	9.79	22

Table 54. Summary results for 1982-2009 from the 2010 assessment update. Spawning Stock Biomass (SSB) in metric tons (mt); Recruitment (R) at age 0 (000s); Fishing Mortality (F) for fully recruited ages 3-7+.

Year	SSB	R	F
1982	24,976	72,732	1.114
1983	24,854	80,905	1.426
1984	21,120	45,738	1.555
1985	18,862	56,647	1.478
1986	17,919	61,469	1.671
1987	18,458	46,824	1.402
1988	10,965	12,780	1.979
1989	7,100	28,722	1.492
1990	9,658	36,978	1.104
1991	9,169	31,096	1.445
1992	10,666	35,909	1.477
1993	12,323	37,194	1.232
1994	15,327	42,205	1.158
1995	21,105	50,325	1.720
1996	23,966	37,047	1.450
1997	25,348	37,004	0.887
1998	28,504	40,674	0.788
1999	28,851	32,266	0.560
2000	31,316	40,187	0.669
2001	37,097	37,666	0.489
2002	42,092	44,226	0.426
2003	45,869	34,402	0.410
2004	46,841	54,449	0.443
2005	45,608	28,578	0.452
2006	46,644	29,585	0.342
2007	45,491	29,793	0.257
2008	44,950	48,893	0.242
2009	53,458	81,762	0.237

Table 55. January 1 population number (N, 000s) estimates at age for 1982-2009 from the 2010 assessment update.

N at age				Age				
	0	1	2	3	4	5	6	7+
1982	72732	45962	20984	3236	741	261	69	21
1983	80905	54585	21592	5536	828	189	67	23
1984	45738	60281	22381	4221	1038	155	35	17
1985	56647	33967	23313	3862	695	171	25	9
1986	61469	42232	13798	4336	687	123	30	6
1987	46824	45431	15281	2127	636	101	18	5
1988	12780	34843	18565	3052	408	122	19	4
1989	28722	9392	11141	2130	329	44	13	3
1990	36978	20837	3099	2014	374	58	8	3
1991	31096	27064	8137	814	521	96	15	3
1992	35909	22611	9201	1540	150	96	18	3
1993	37194	26333	8122	1698	274	27	17	4
1994	42205	27226	9951	1889	386	62	6	5
1995	50325	31135	11118	2492	462	94	15	3
1996	37047	38354	20318	3105	361	63	13	2
1997	37004	28284	25668	6647	586	65	11	3
1998	40674	28352	19929	11663	2169	186	21	5
1999	32266	31166	20022	9516	4176	760	66	9
2000	40187	24673	21541	10371	4152	1829	339	34
2001	37666	30776	17339	10814	4132	1636	728	149
2002	44226	28878	21981	9669	5137	1954	781	423
2003	34402	33955	21002	12905	4915	2592	992	617
2004	54449	26414	24716	12440	6664	2522	1339	839
2005	28578	41808	19232	14420	6234	3310	1260	1098
2006	29585	21942	30416	11160	7161	3067	1638	1178
2007	29793	22734	16151	18857	6174	3938	1695	1570
2008	48893	22882	16647	10356	11246	3691	2373	1991
2009	81762	37529	16635	10657	6237	6816	2261	2709

Table 56. Fishing mortality (F) estimates at age for 1982-2009 from the 2010 assessment update.

F at age	Age							
	0	1	2	3	4	5	6	7+
1982	0.027	0.495	1.073	1.113	1.114	1.114	1.114	1.114
1983	0.034	0.632	1.372	1.424	1.426	1.426	1.426	1.426
1984	0.038	0.690	1.497	1.554	1.555	1.555	1.555	1.555
1985	0.034	0.641	1.422	1.477	1.479	1.479	1.479	1.479
1986	0.042	0.757	1.610	1.669	1.671	1.671	1.671	1.671
1987	0.036	0.635	1.351	1.401	1.402	1.402	1.402	1.402
1988	0.048	0.880	1.905	1.977	1.979	1.979	1.979	1.979
1989	0.061	0.849	1.451	1.491	1.492	1.492	1.492	1.492
1990	0.052	0.680	1.077	1.103	1.104	1.104	1.104	1.104
1991	0.059	0.819	1.404	1.443	1.445	1.445	1.445	1.445
1992	0.050	0.764	1.430	1.475	1.477	1.477	1.477	1.477
1993	0.052	0.713	1.199	1.231	1.232	1.232	1.232	1.232
1994	0.044	0.636	1.124	1.157	1.158	1.158	1.158	1.158
1995	0.012	0.167	1.016	1.682	1.739	1.732	1.725	1.721
1996	0.010	0.142	0.857	1.418	1.466	1.460	1.454	1.450
1997	0.006	0.090	0.529	0.870	0.898	0.893	0.889	0.886
1998	0.006	0.088	0.479	0.777	0.799	0.793	0.787	0.784
1999	0.008	0.109	0.398	0.579	0.575	0.558	0.547	0.540
2000	0.007	0.093	0.429	0.670	0.681	0.671	0.664	0.659
2001	0.006	0.077	0.324	0.494	0.499	0.489	0.482	0.478
2002	0.004	0.058	0.273	0.427	0.434	0.428	0.423	0.420
2003	0.004	0.058	0.264	0.411	0.417	0.411	0.406	0.404
2004	0.004	0.057	0.279	0.441	0.450	0.444	0.440	0.438
2005	0.004	0.058	0.284	0.450	0.459	0.454	0.449	0.447
2006	0.003	0.046	0.218	0.342	0.348	0.343	0.339	0.337
2007	0.004	0.052	0.184	0.267	0.265	0.256	0.251	0.248
2008	0.005	0.059	0.186	0.257	0.251	0.240	0.233	0.229
2009	0.004	0.050	0.173	0.247	0.244	0.236	0.231	0.228

Figures

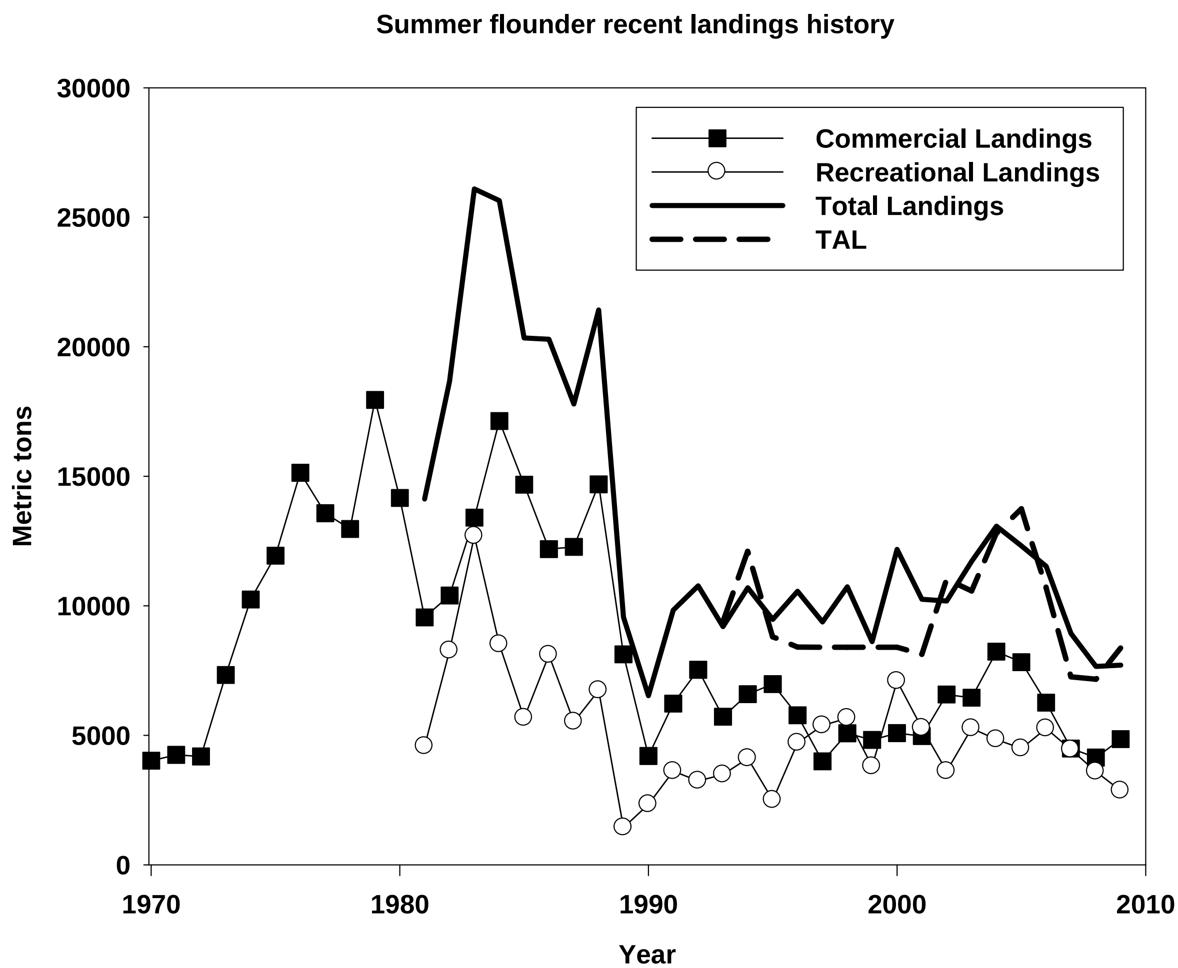

Figure 1. Summer flounder recent commercial (1970-2009), recreational (1981-2009), total fishery (1981-2009) landings, and the corresponding fishery Total Allowable Landings (TAL).

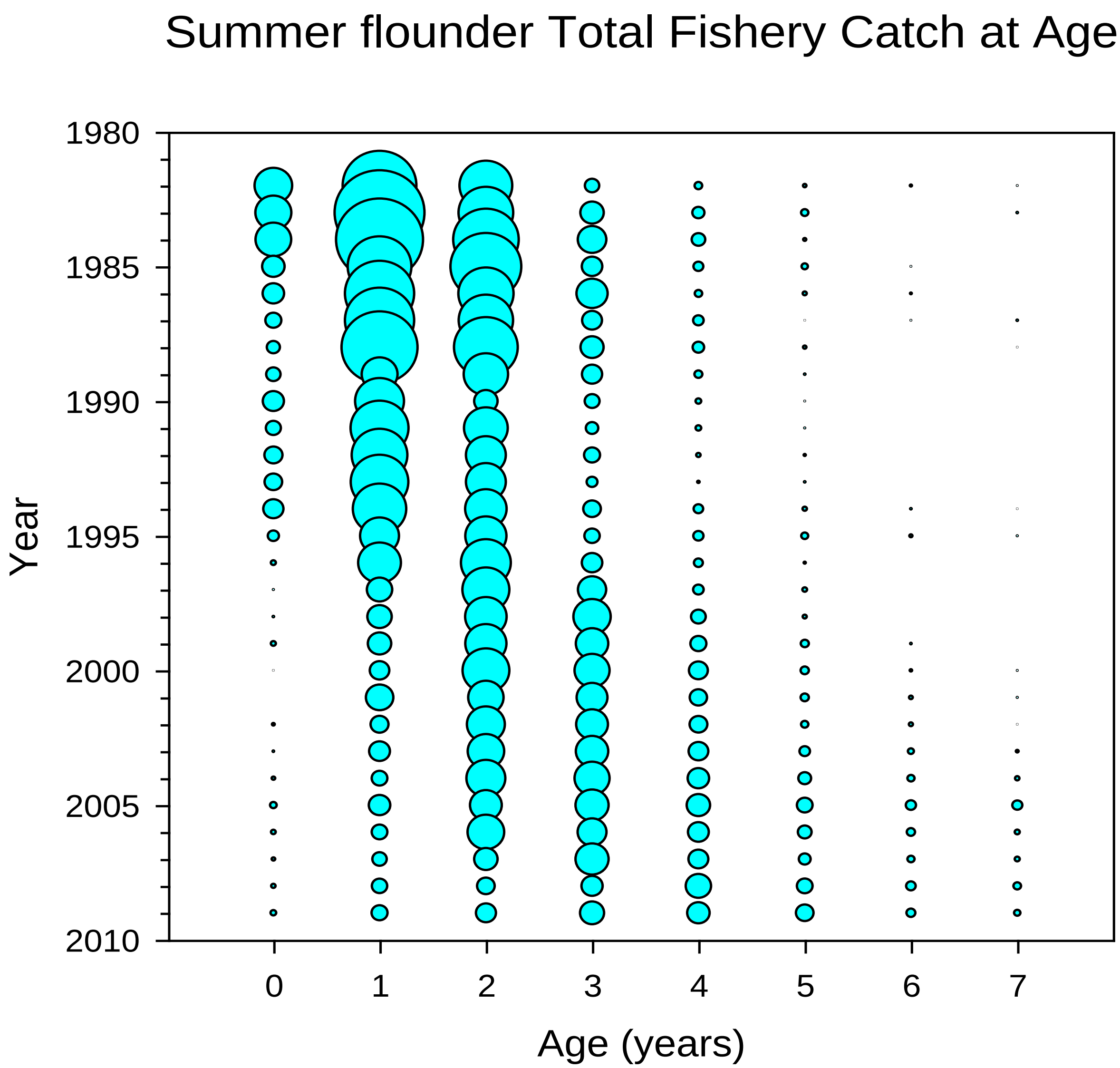

Figure 2. Total fishery catch at age for summer flounder.

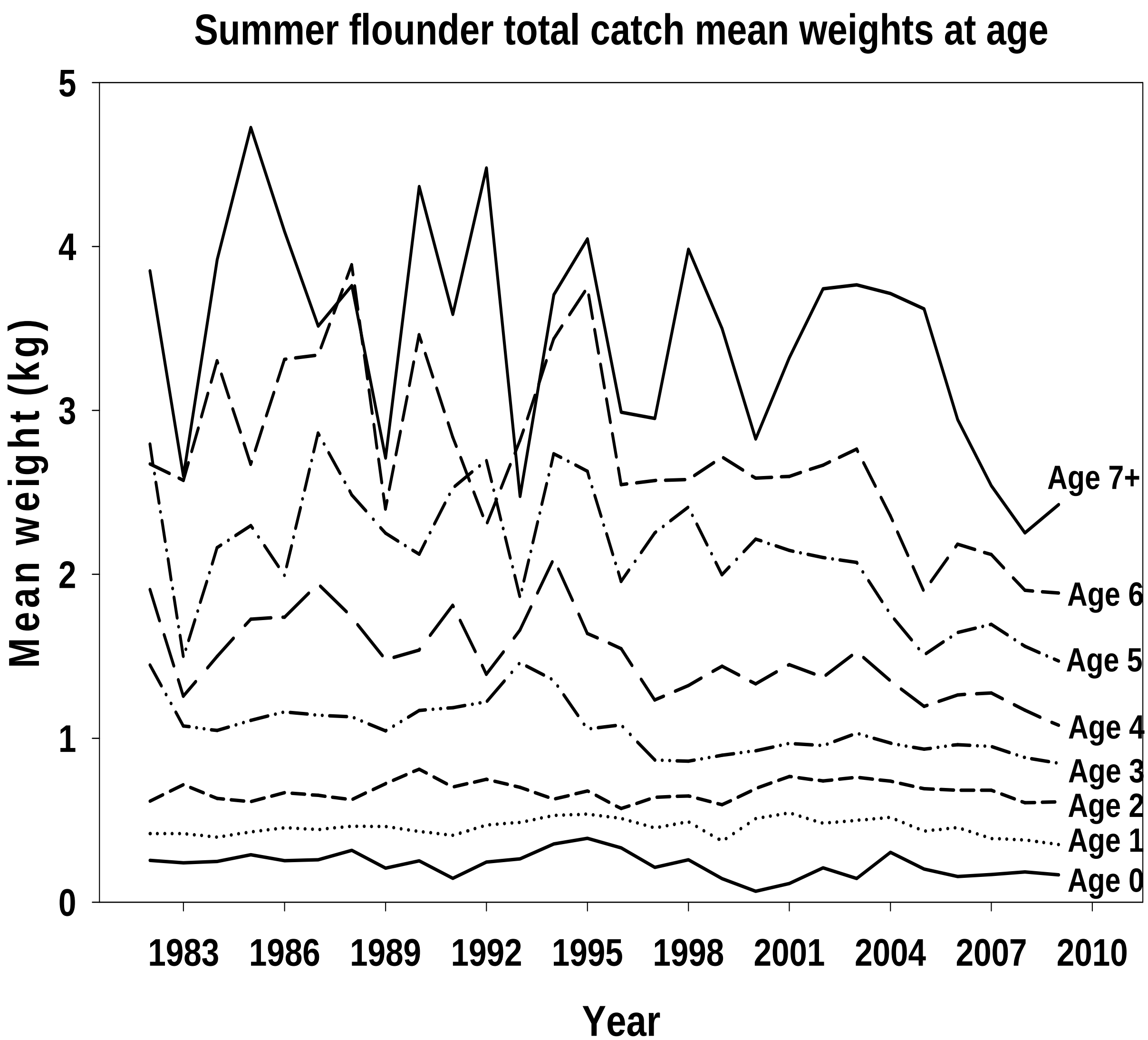

Figure 3. Mean weight at age in the total fishery catch of summer flounder.

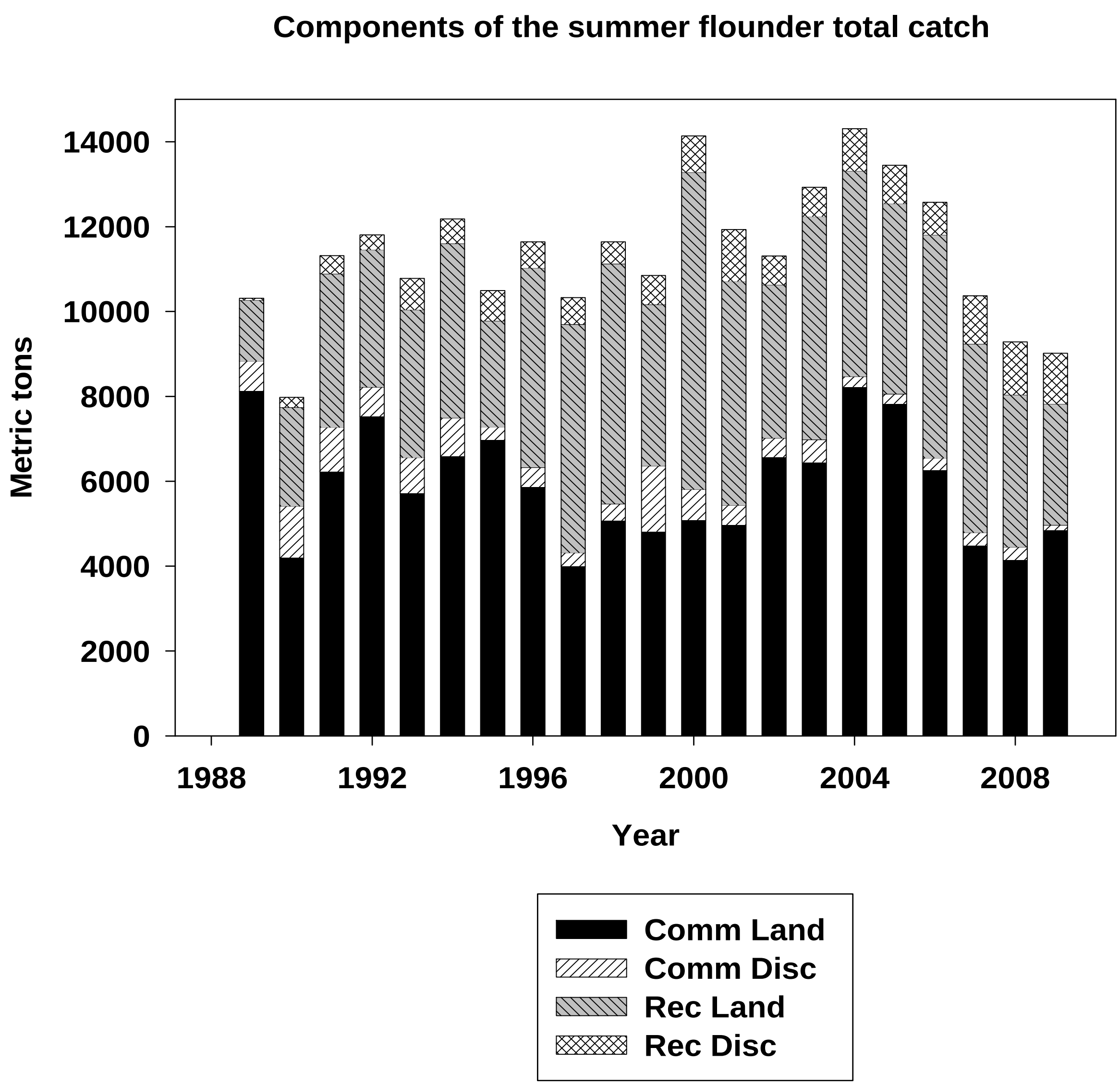

Figure 4. Components of the summer flounder fishery catch.

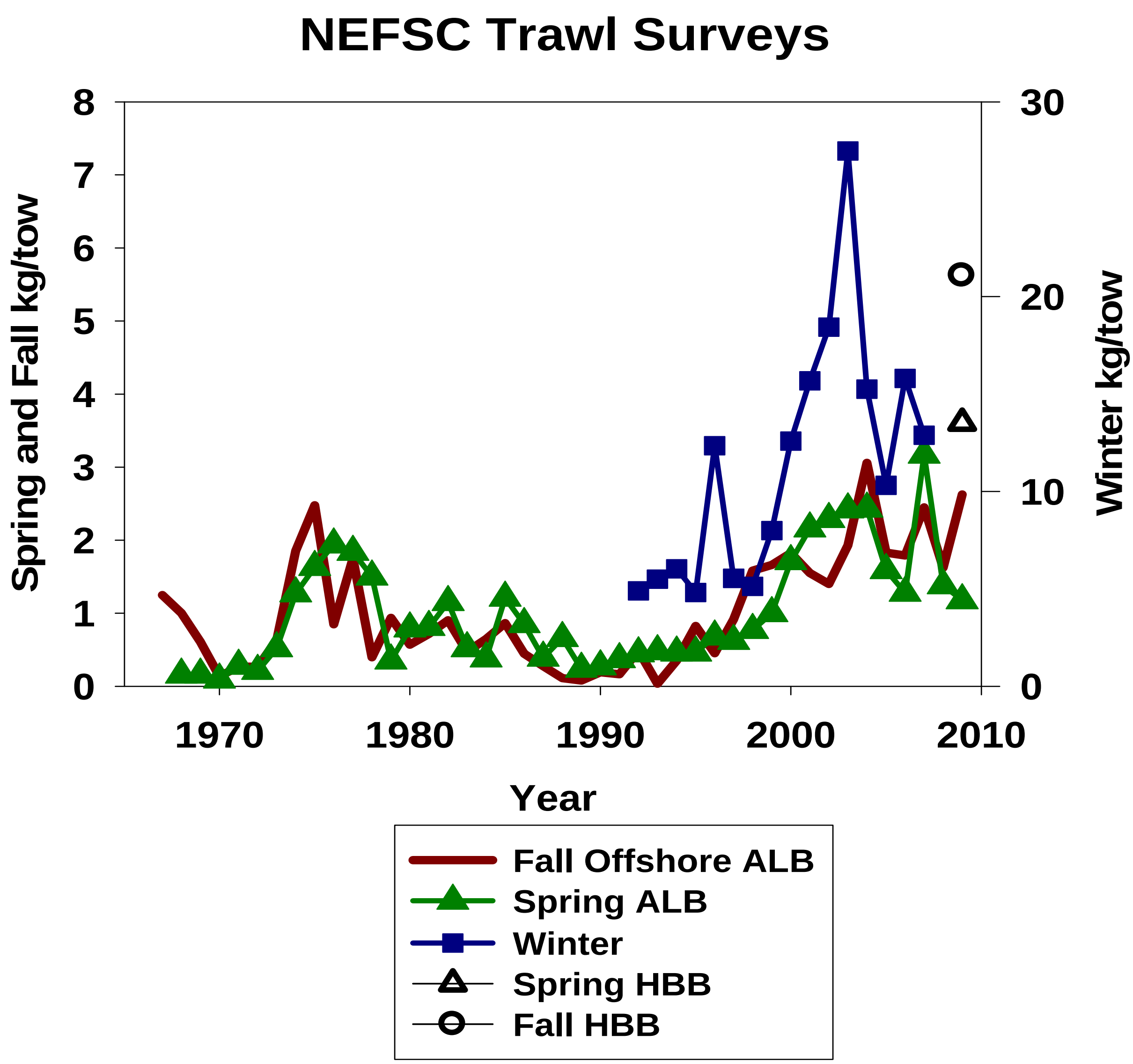

Figure 5. Trends in NEFSC trawl survey biomass indices for summer flounder.

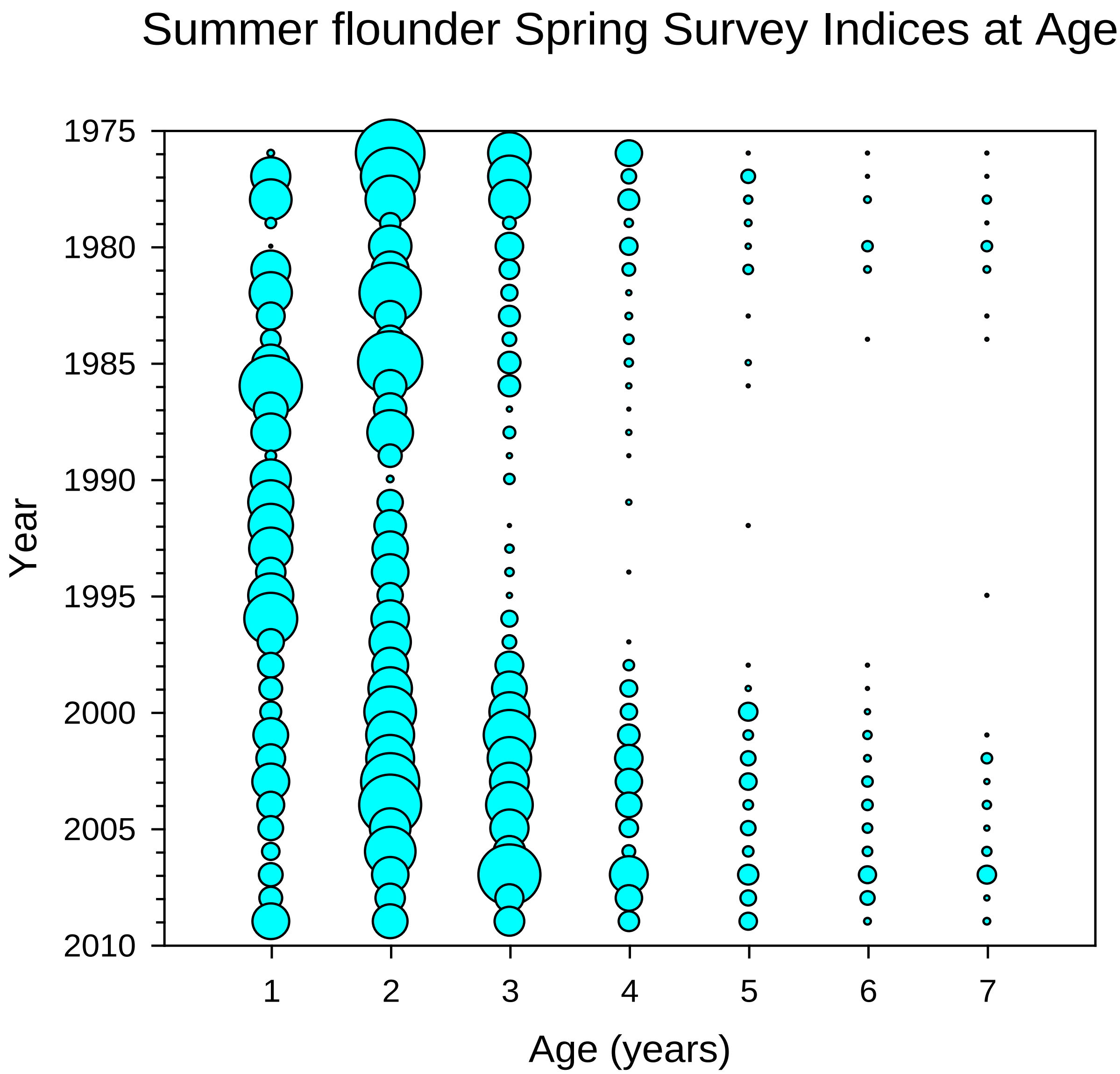

Figure 6. NEFSC spring trawl survey catch at age.

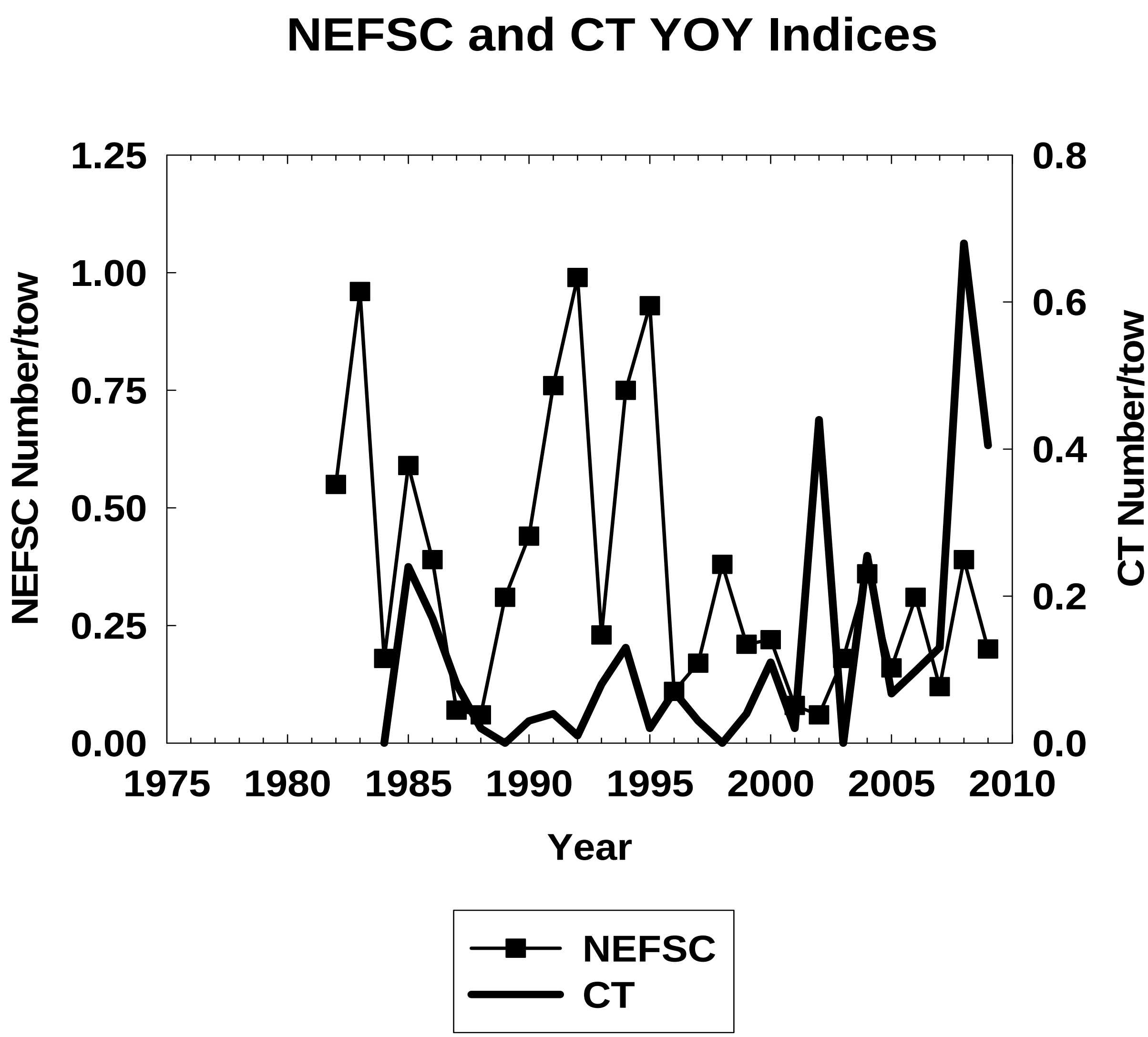

Figure 7. Trends in NEFSC and CT trawl survey recruitment indices for summer flounder.

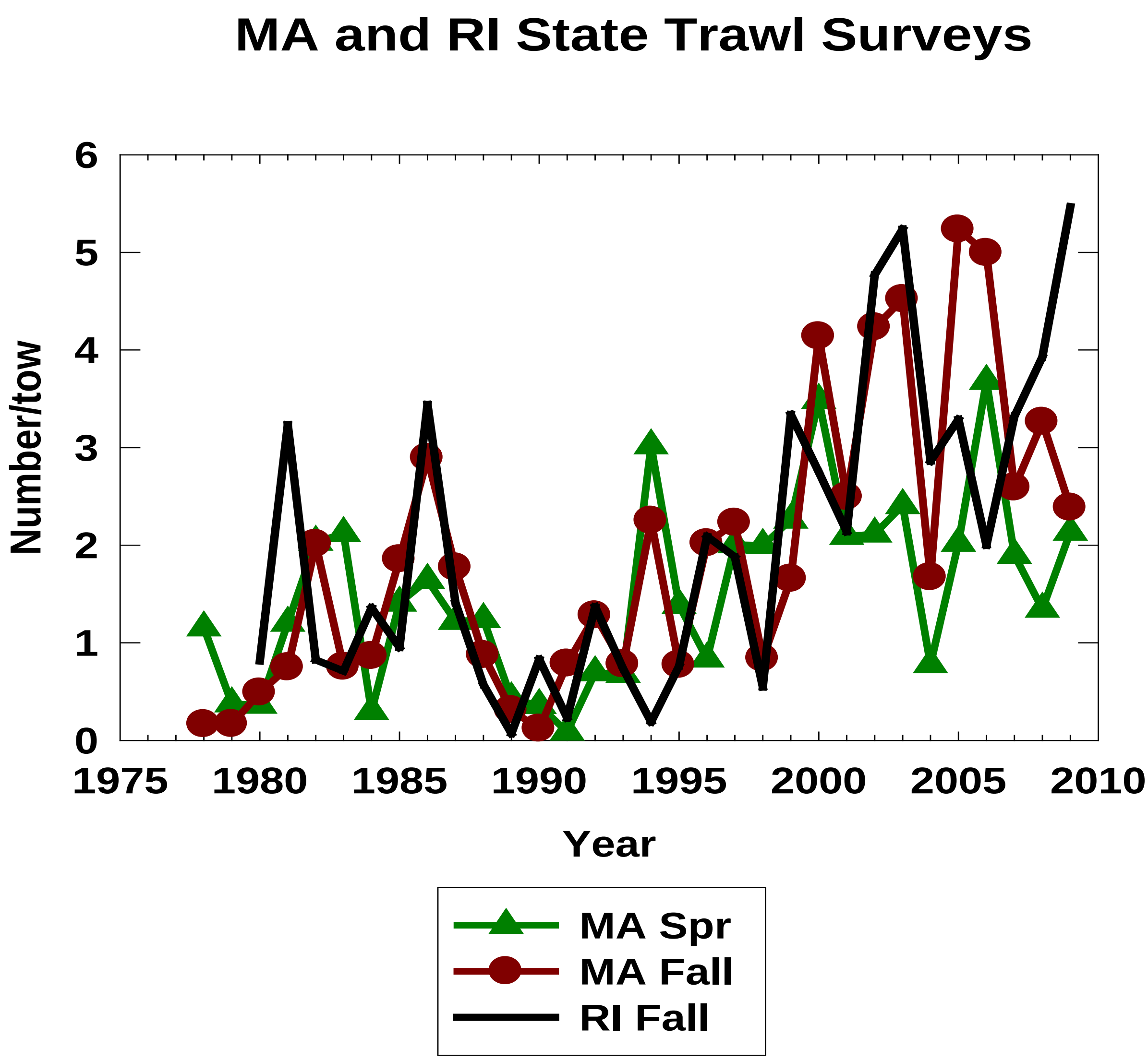

Figure 8. Trends in MA and RI trawl survey abundance indices for summer flounder.

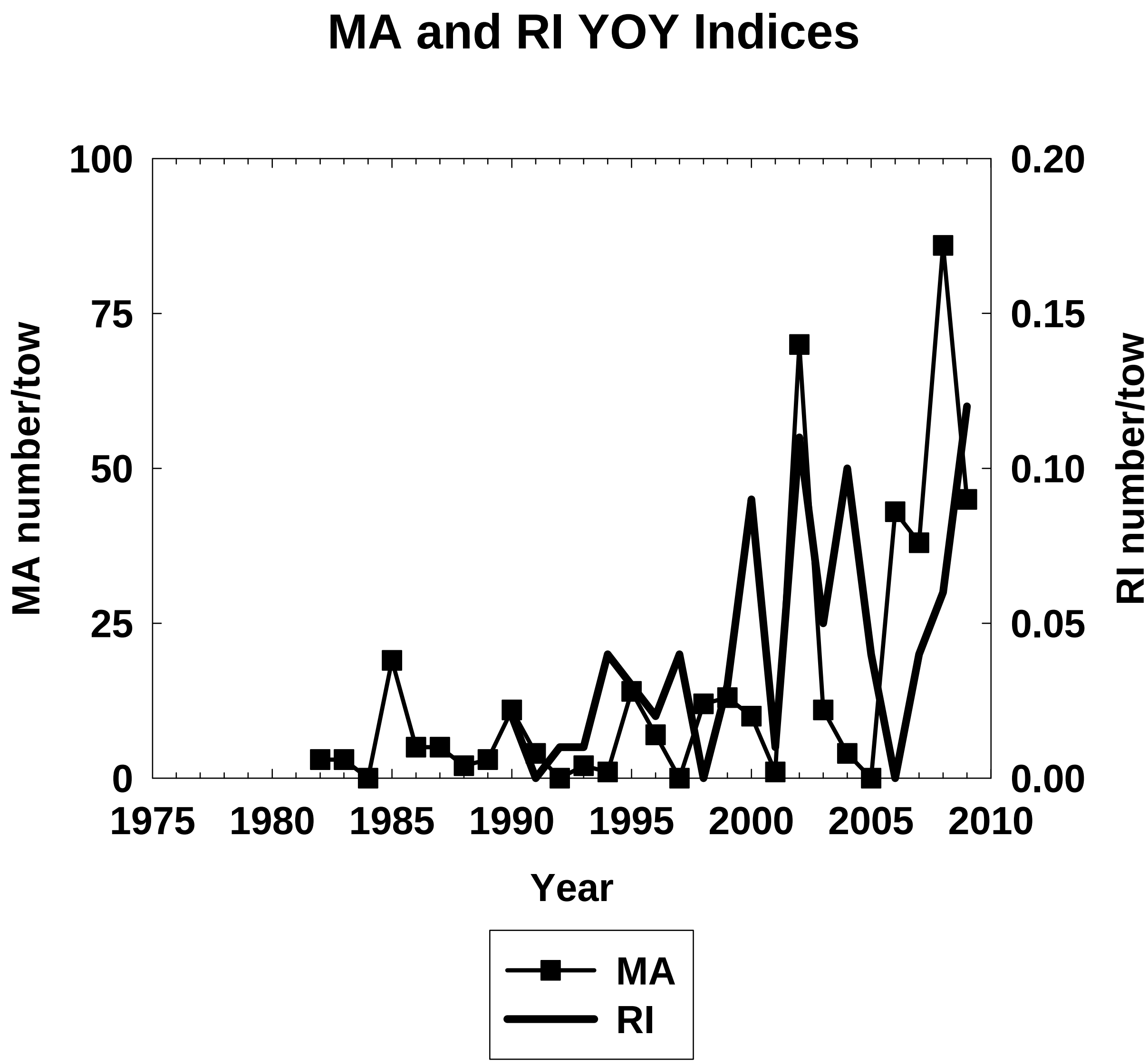

Figure 9. Trends in MA and RI trawl survey recruitment indices for summer flounder.

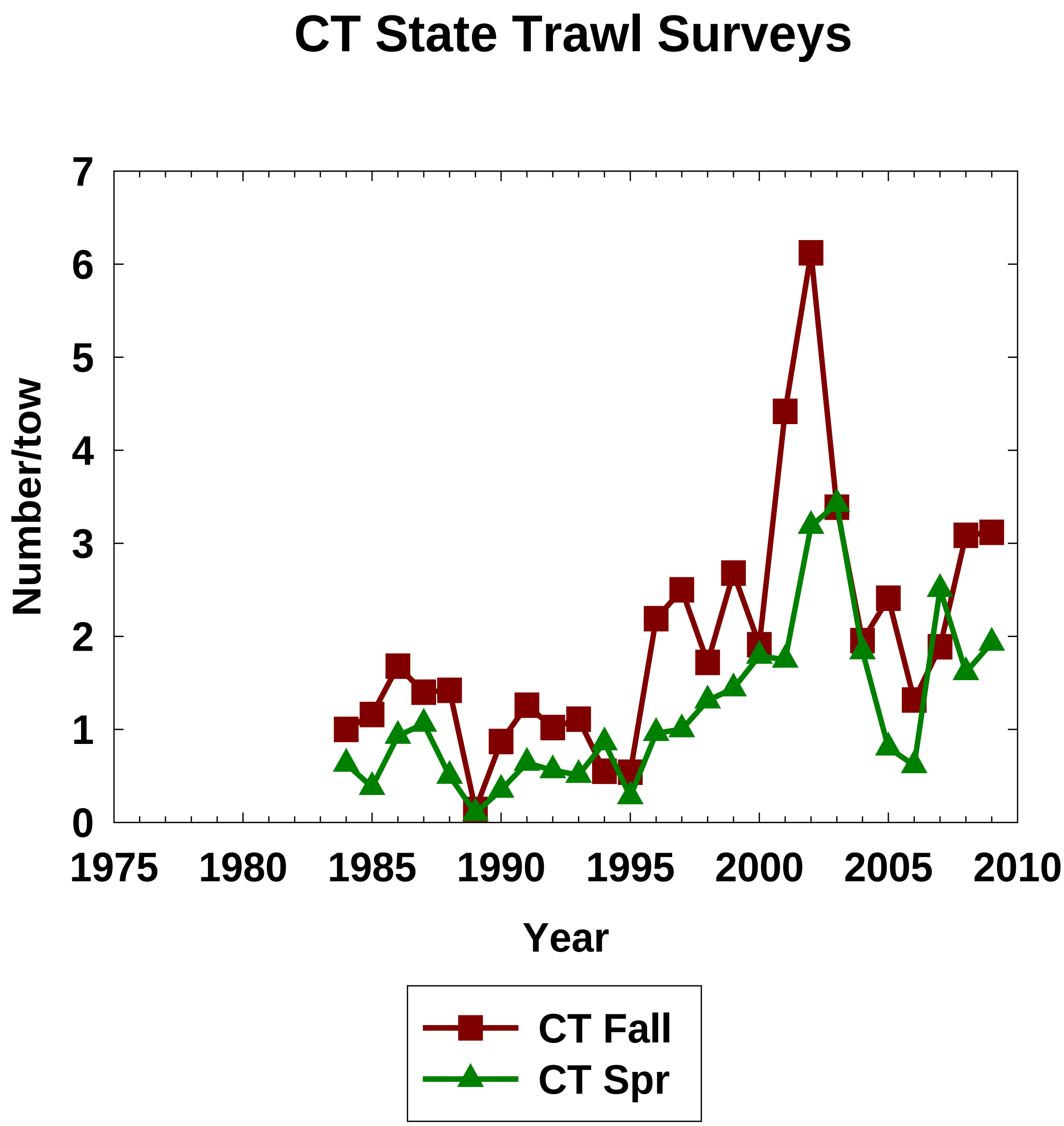

Figure 10. Trends in CT trawl survey abundance indices for summer flounder

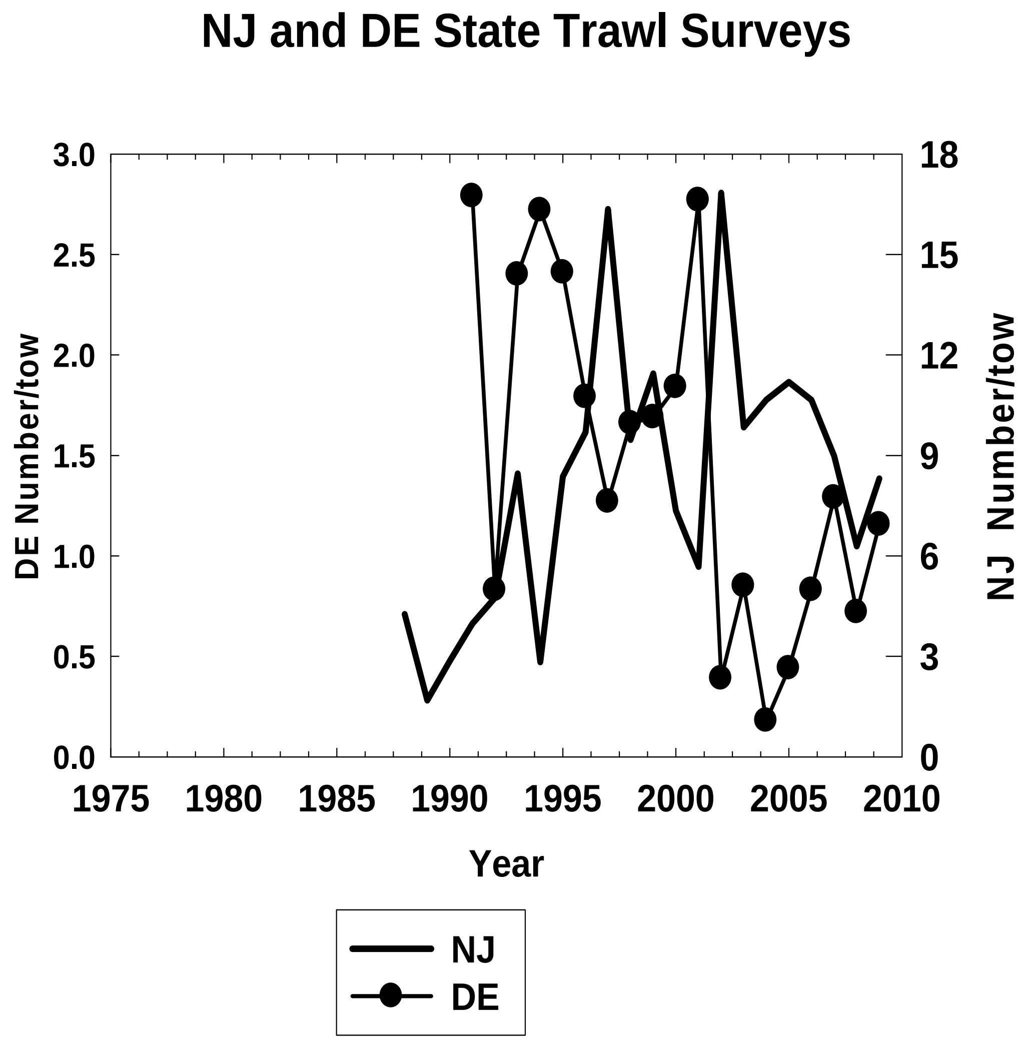

Figure 11. Trends in NJ and DE trawl survey abundance indices for summer flounder

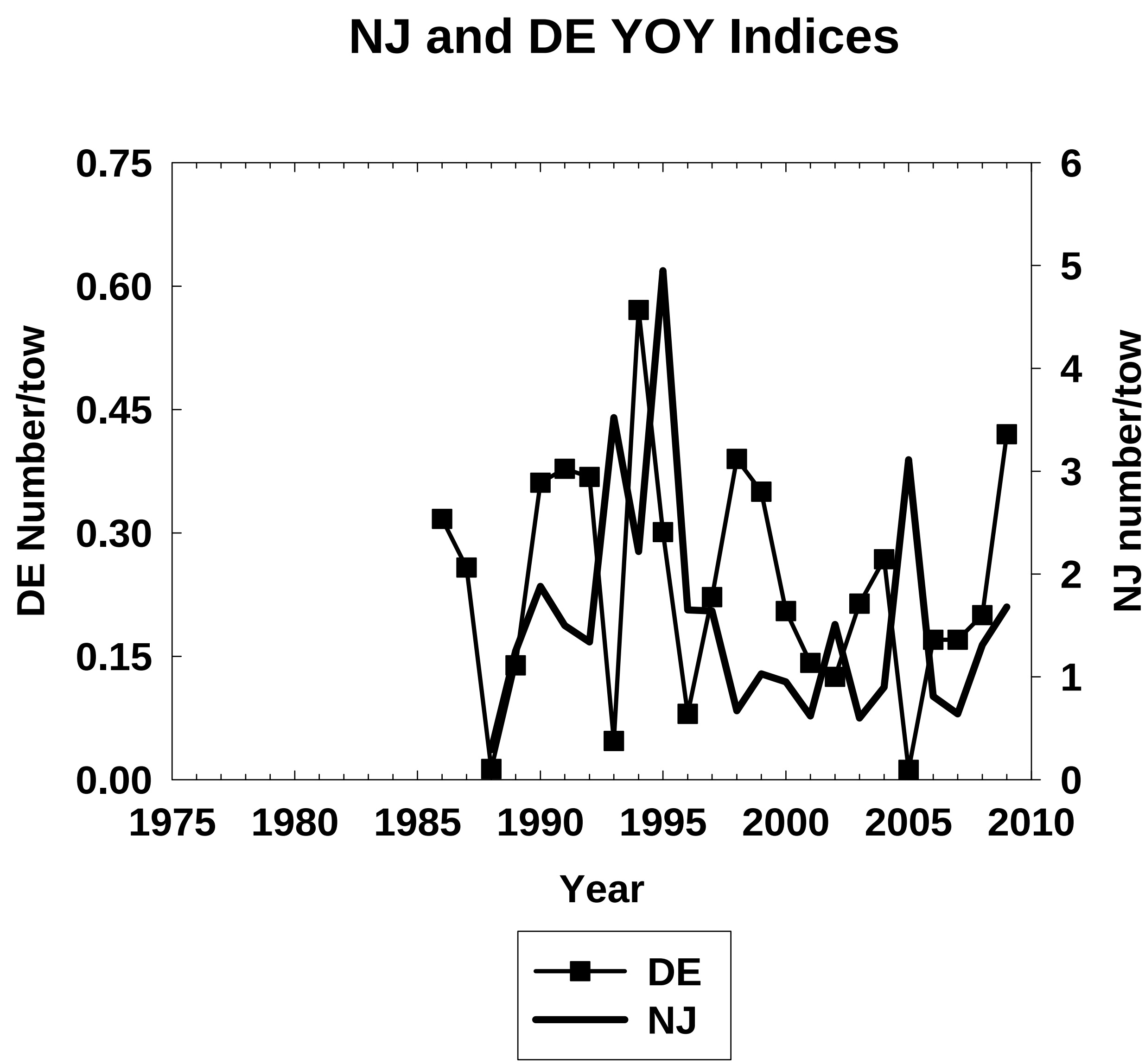

Figure 12. Trends in DE and NJ trawl survey recruitment indices for summer flounder

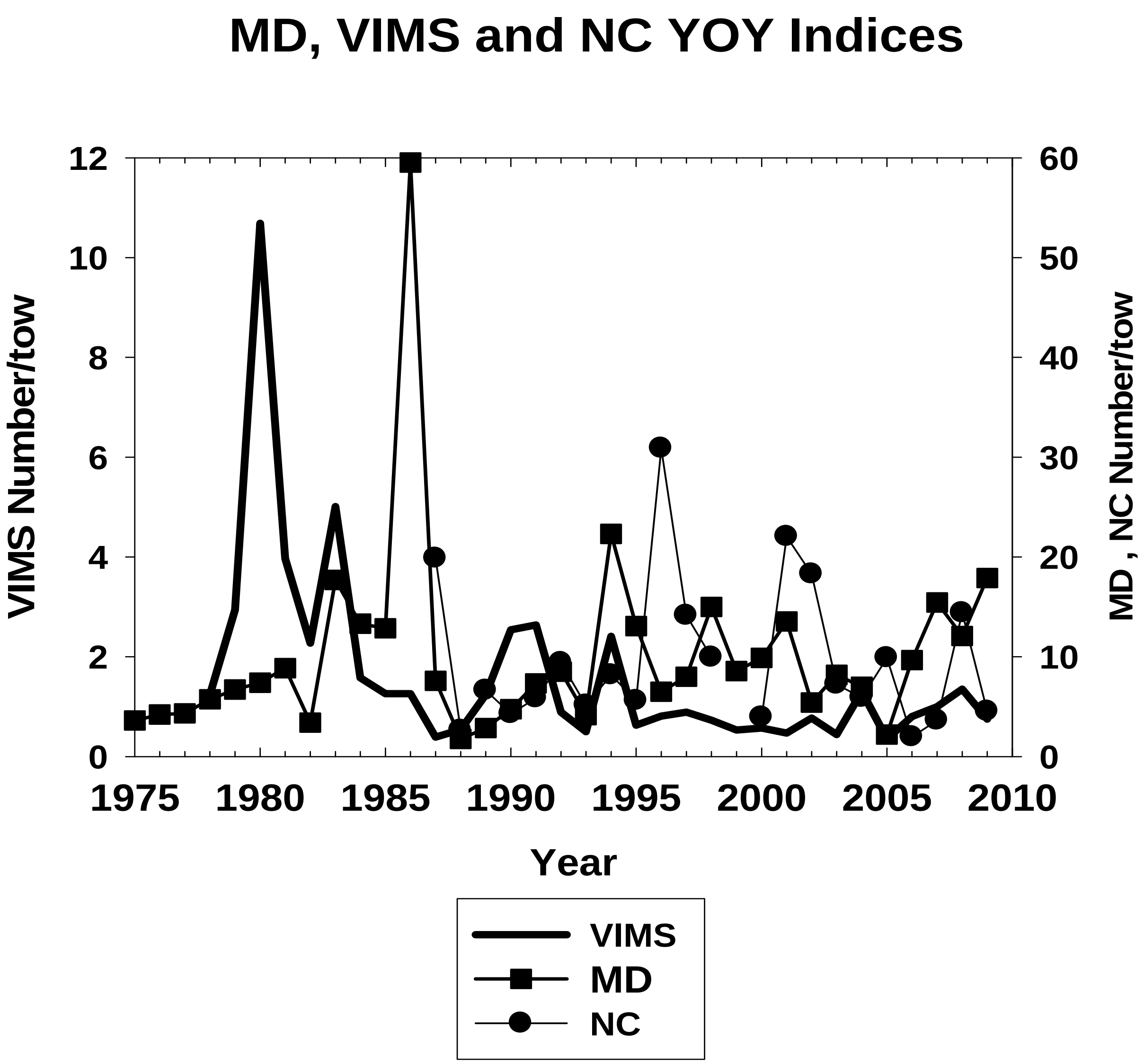

Figure 13. Trends in MD, VIMS and NC trawl survey recruitment indices for summer flounder

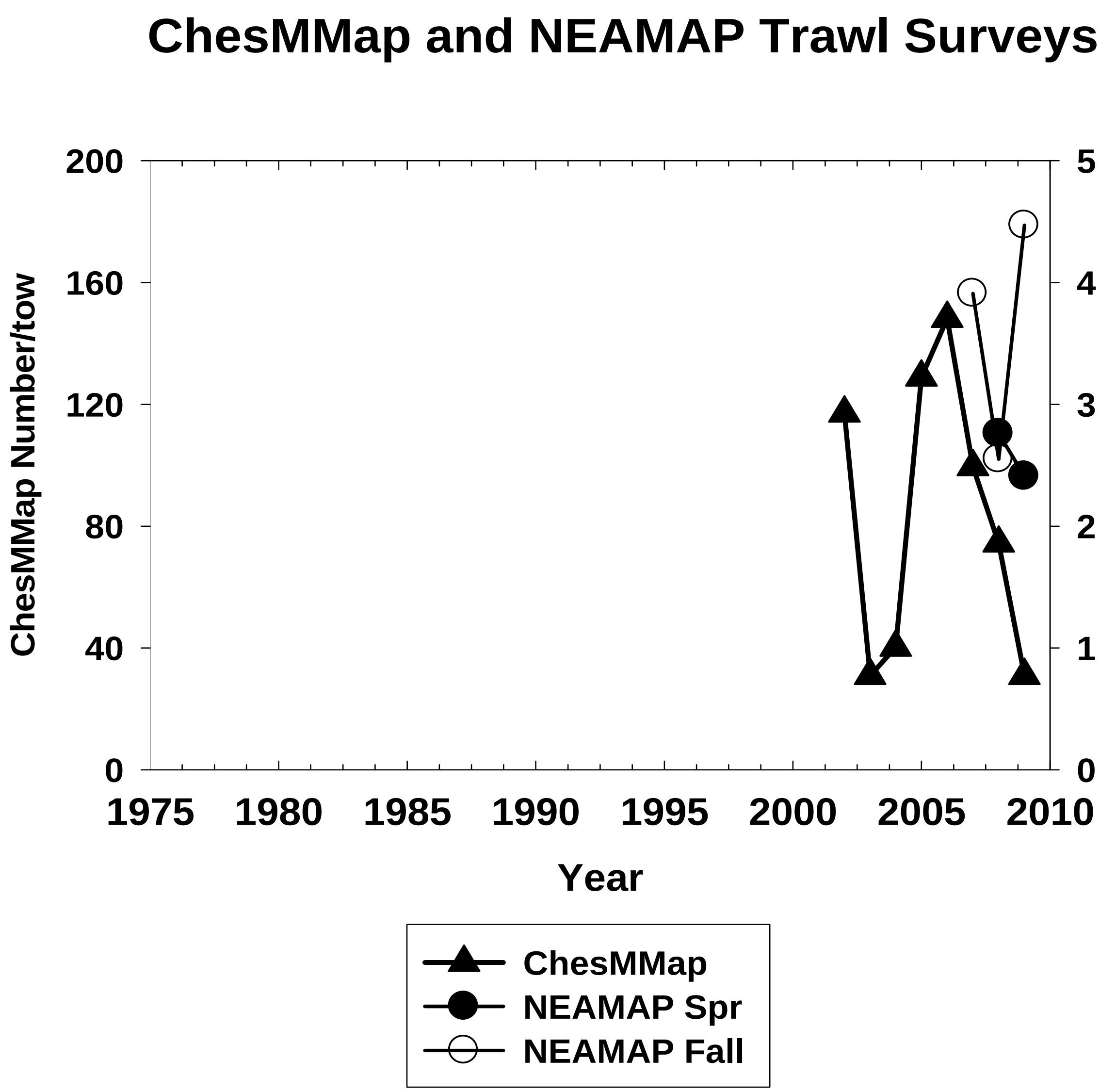

Figure 14. Trends in NEAMAP and ChesMMAP trawl survey abundance indices for summer flounder.

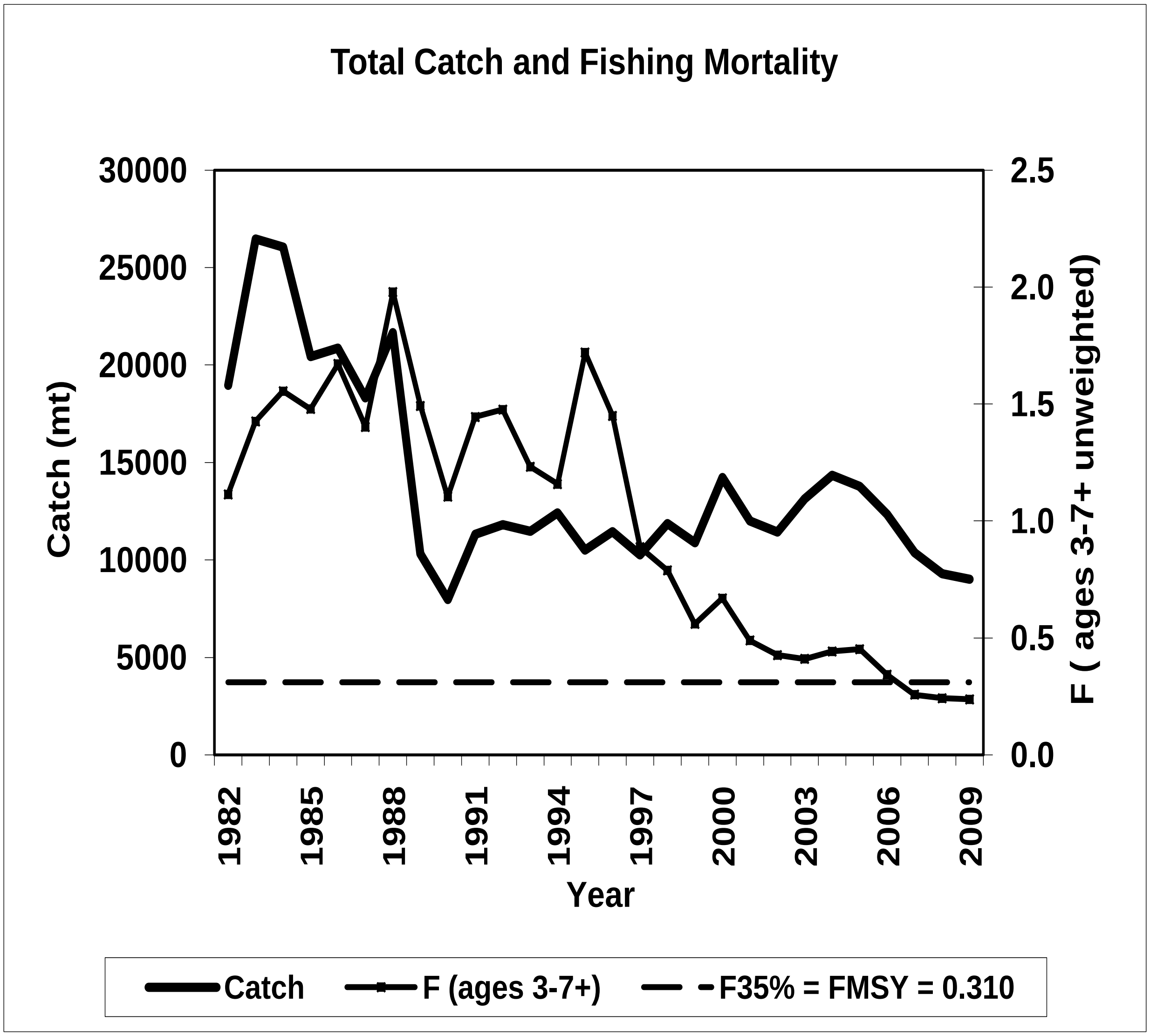

Figure 15. Total fishery catch and fishing mortality rate (F, ages 3-7+) for summer flounder. F35% is the proxy for FMSY.

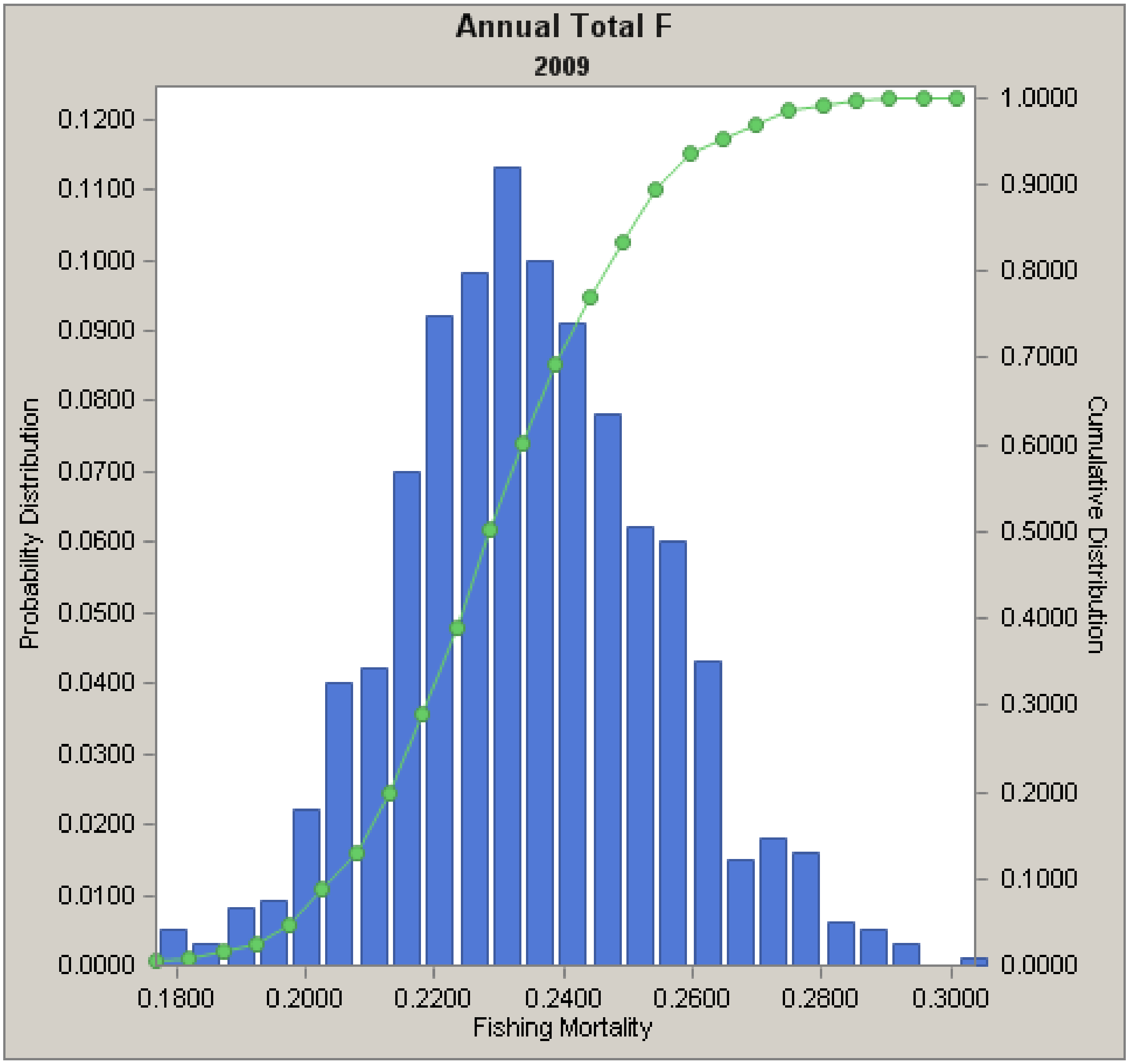

Figure 16. MCMC distribution of fishing mortality rate (F, ages 3-7+) in 2009.

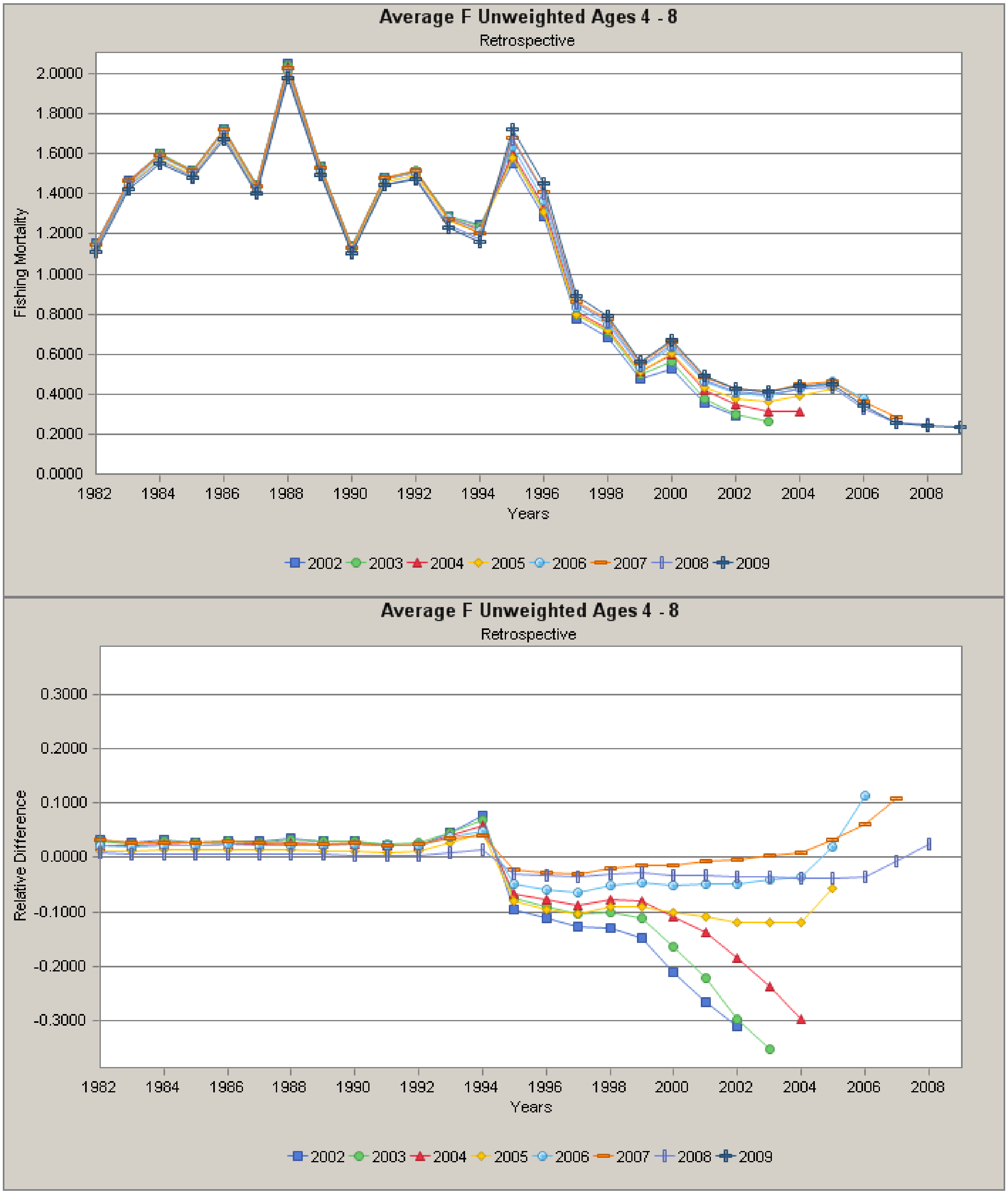

Figure 17. Retrospective analysis of fishing mortality rate (F, ages 3-7+). Note that model ages 4-8 are true ages 3-7+.

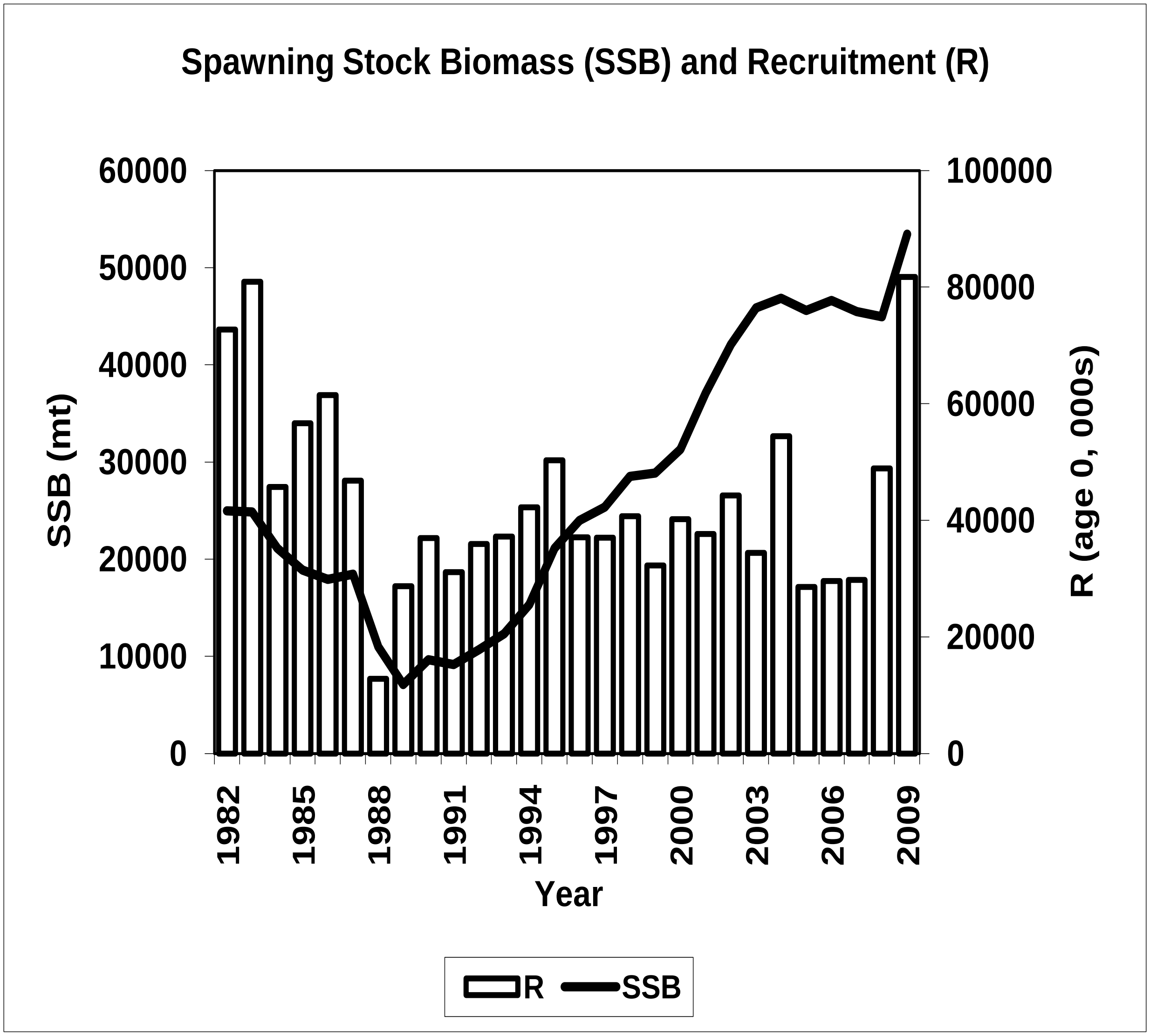

Figure 18. Spawning Stock Biomass (SSB) and Recruitment (R, age 0) by calendar year.

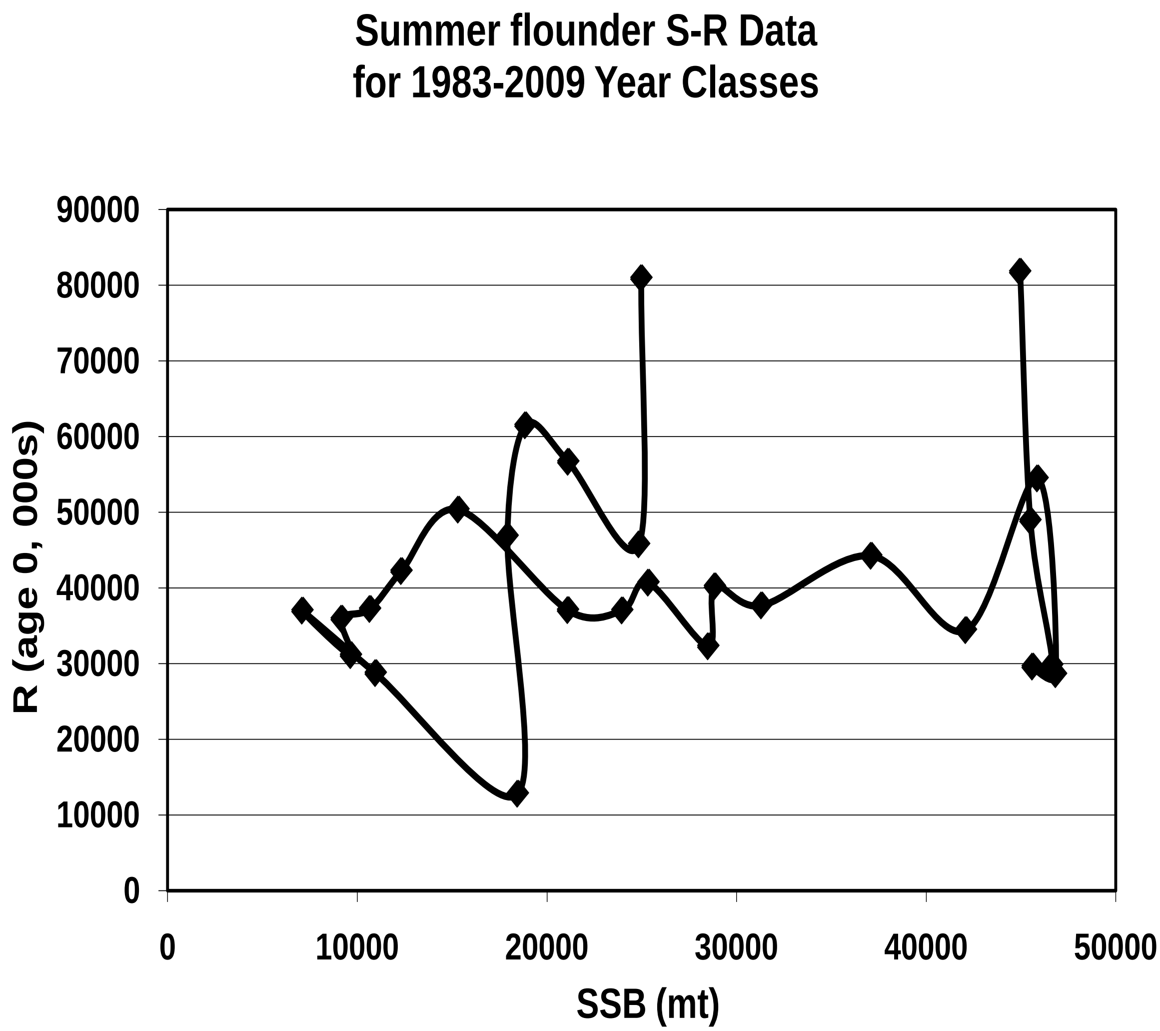

Figure 19. Spawning Stock Biomass (SSB) and Recruitment (R, age 0) scatterplot.

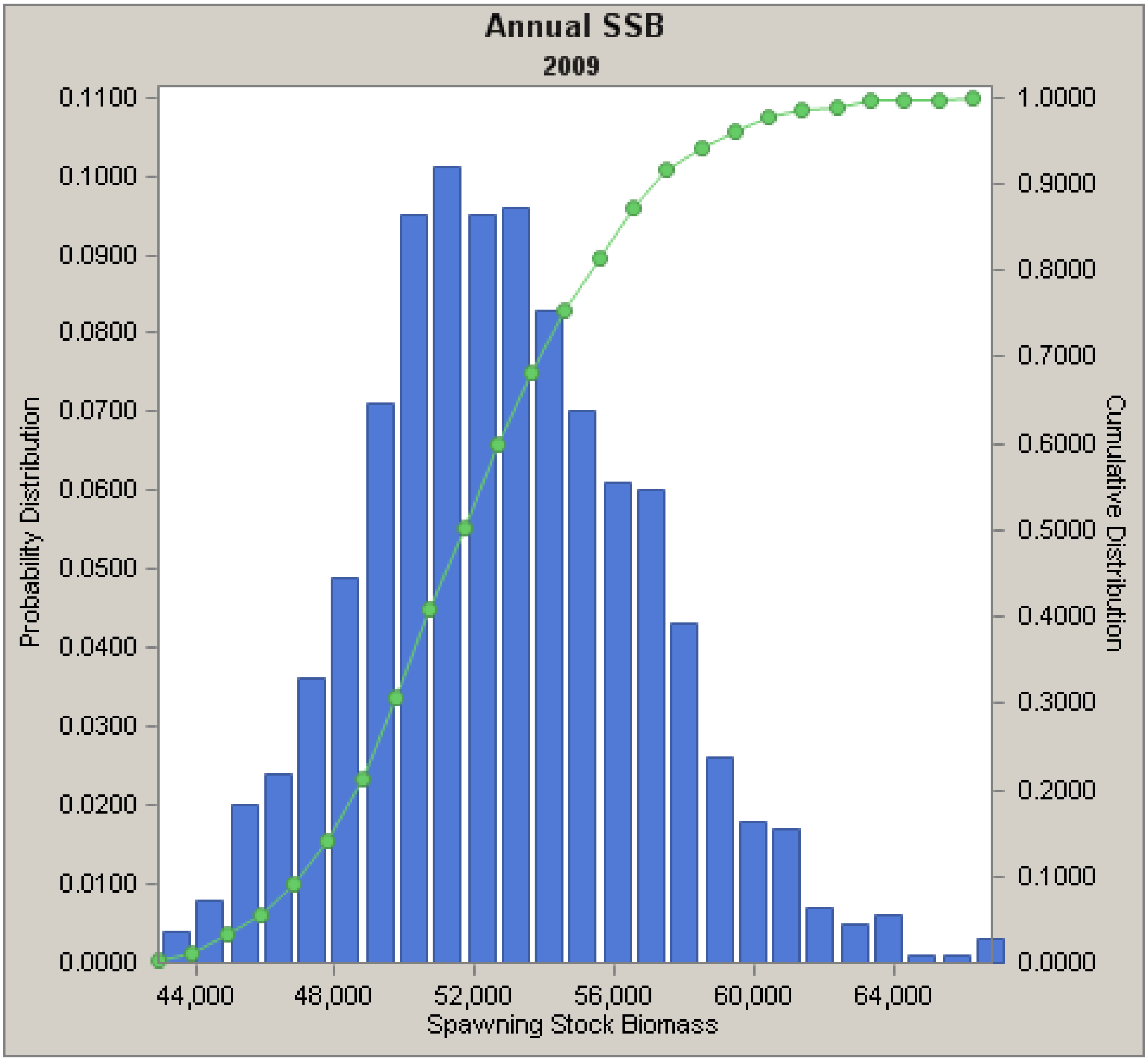

Figure 20. MCMC distribution of Spawning Stock Biomass (SSB) in 2009.

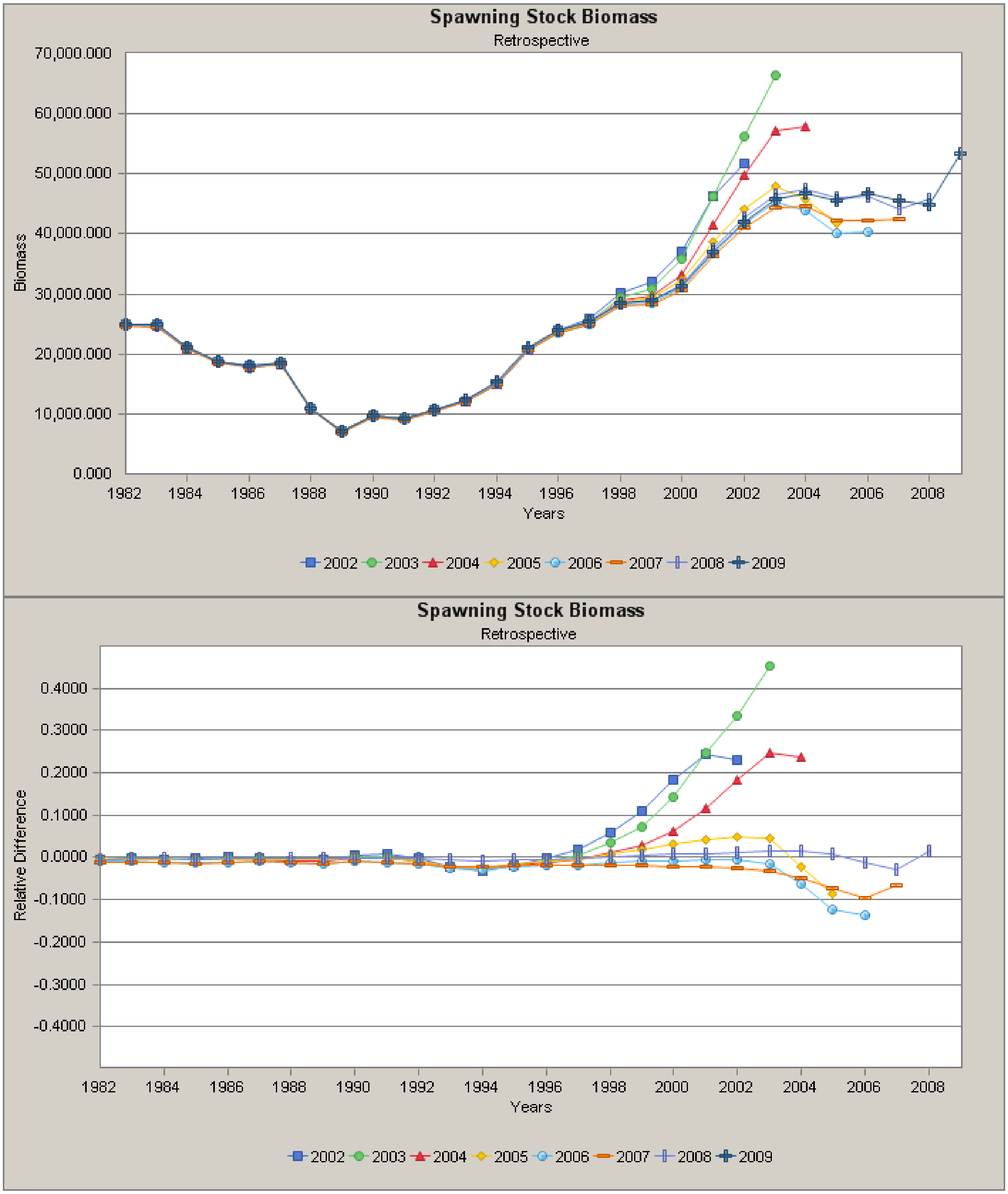

Figure 21. Retrospective analysis of Spawning Stock Biomass (SSB).

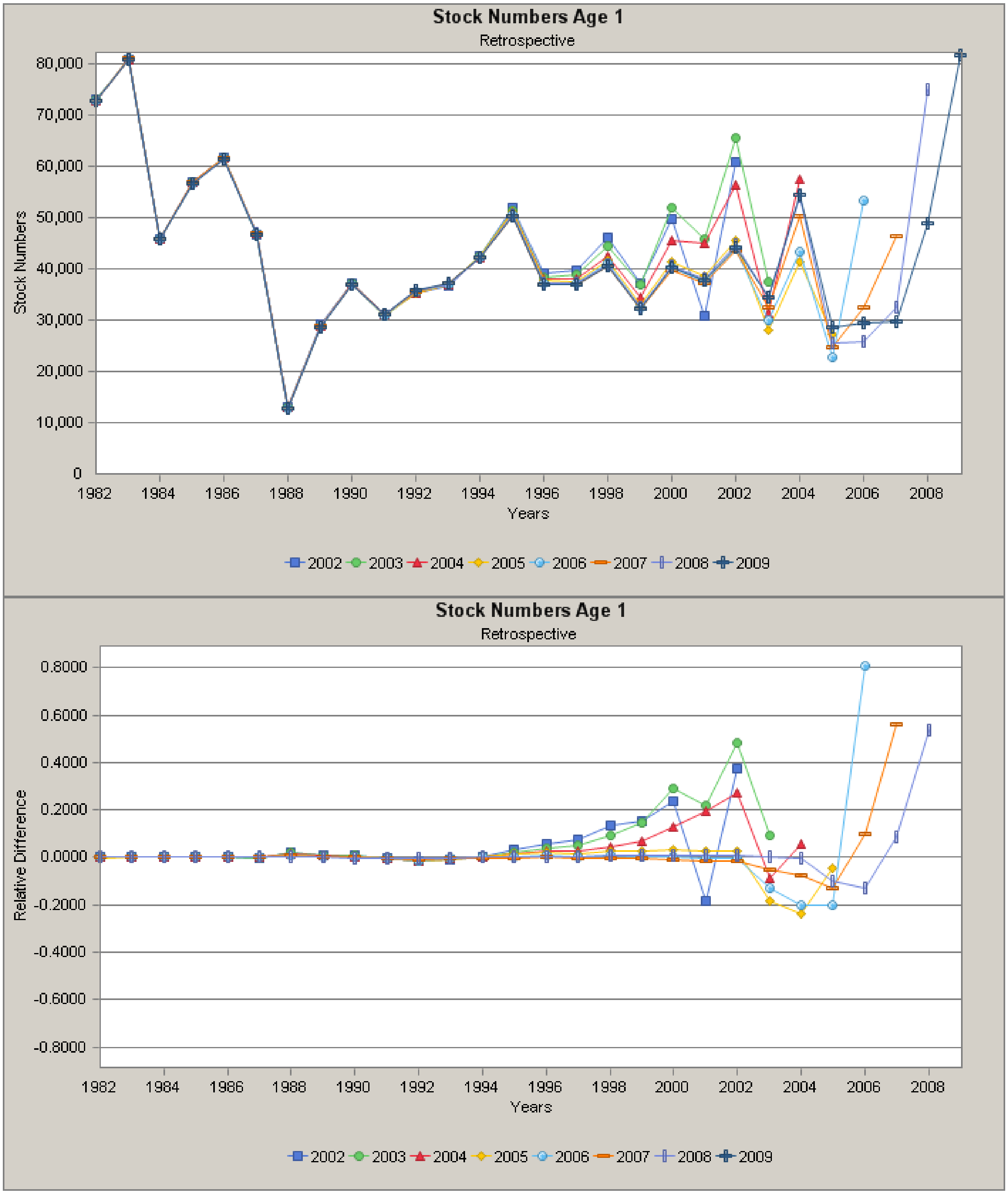

Figure 22. Retrospective analysis of recruitment (R, age 0). Note that model age 1 is true age 0.

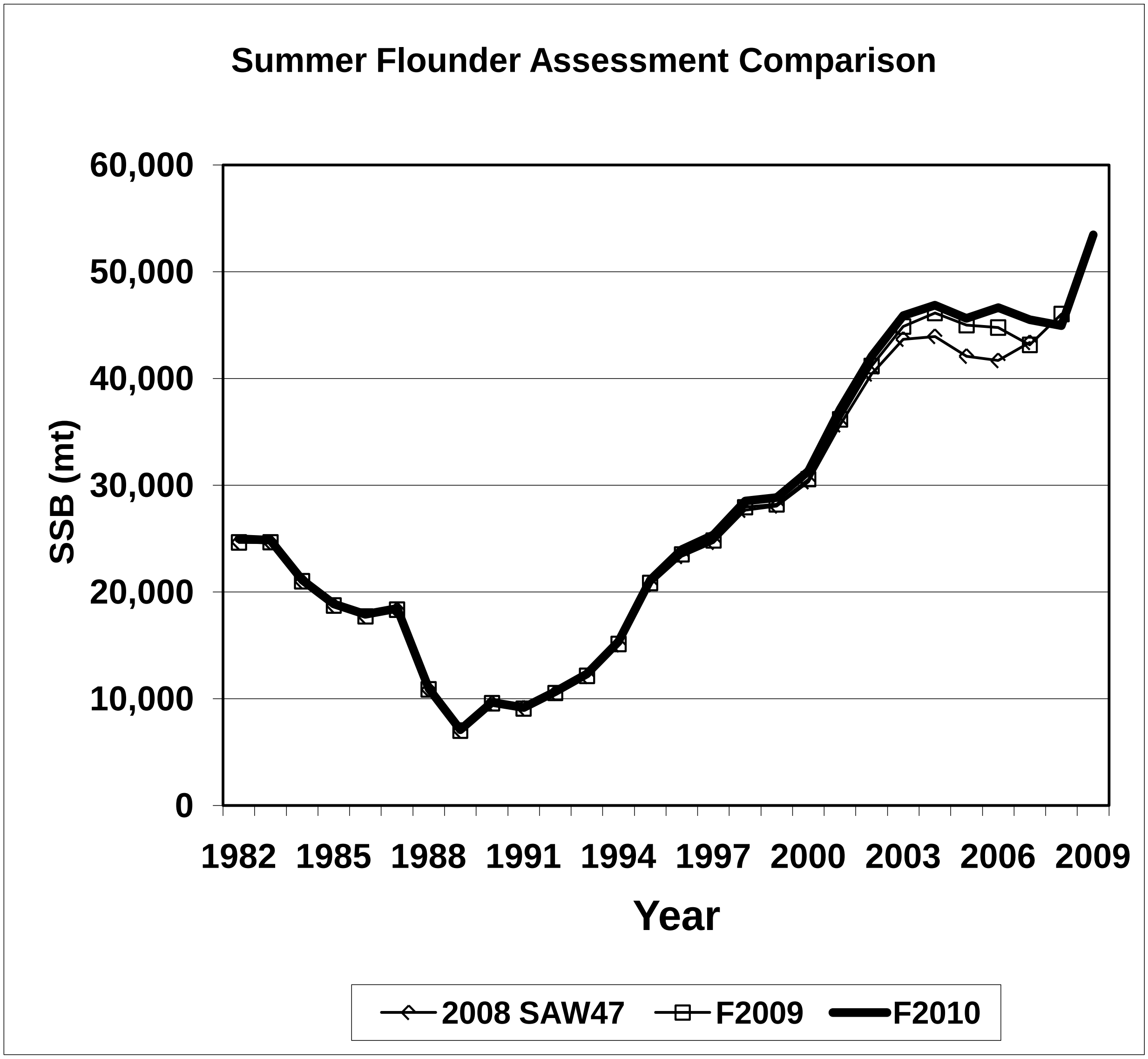

Figure 23. Comparison of the estimates for SSB from the 2008 SAW47, 2009 and 2010 updated assessments.

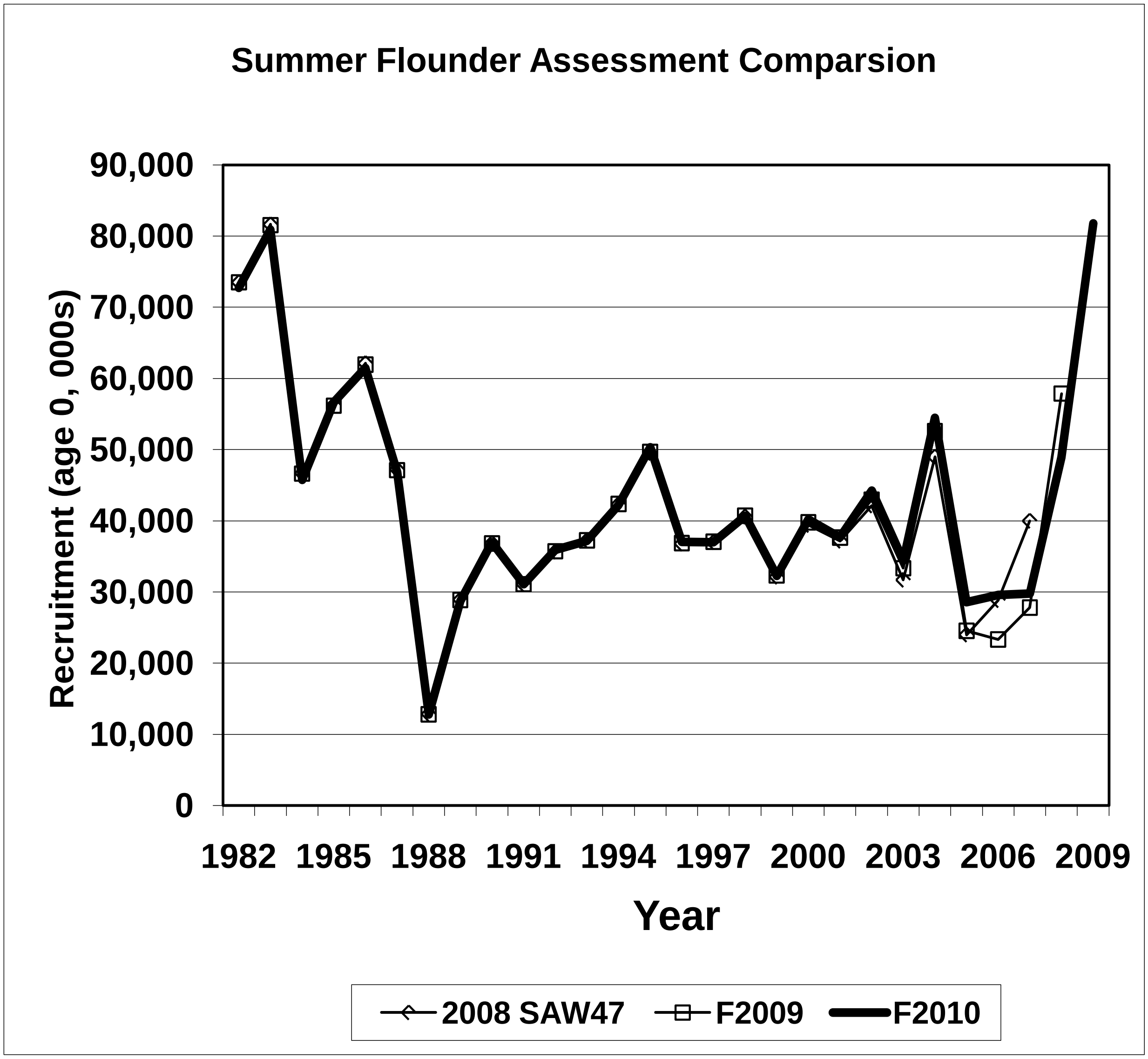

Figure 24. Comparison of the estimates for Recruitment from the 2008 SAW47, 2009 and 2010 updated assessments.

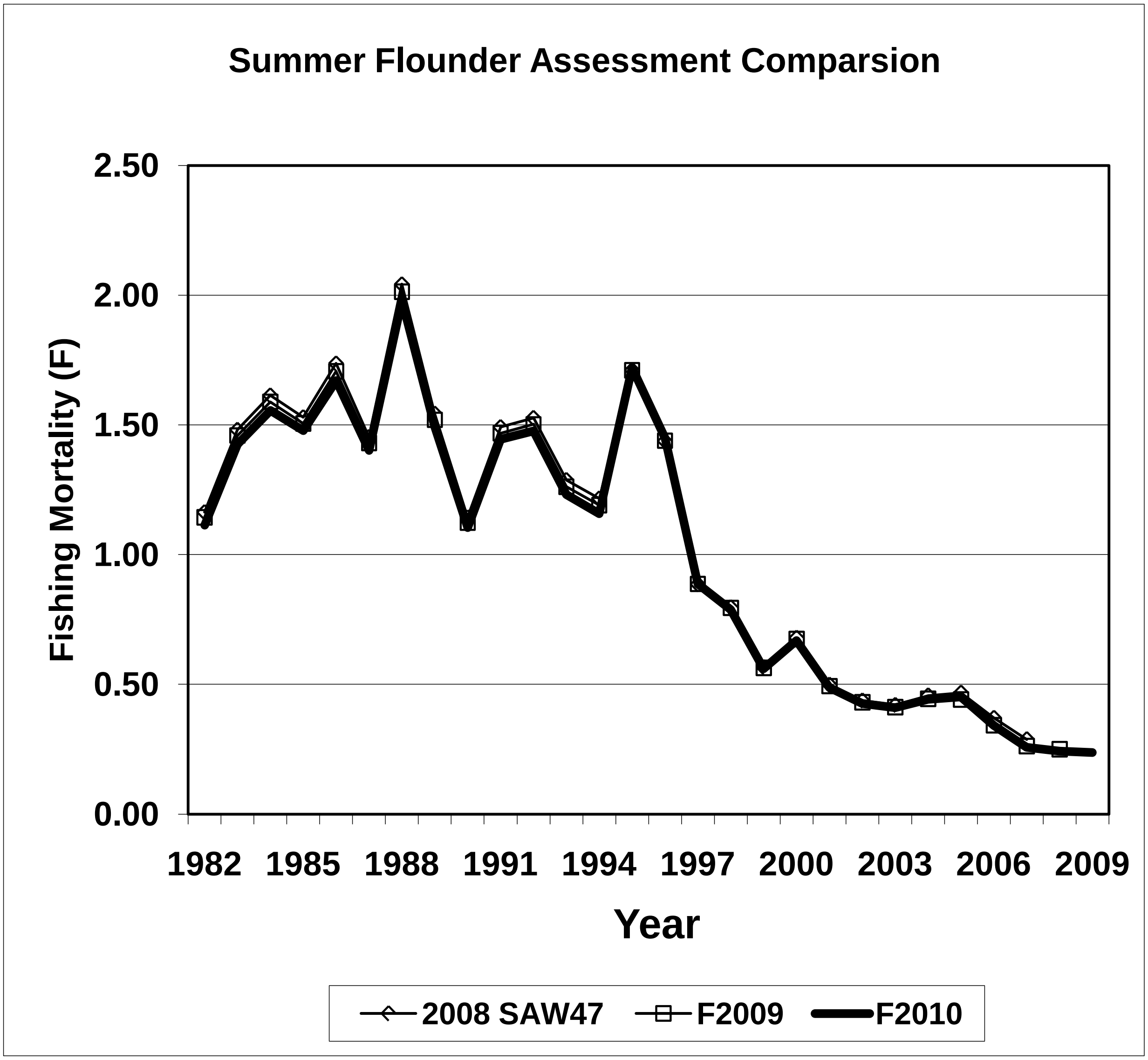

Figure 25. Comparison of the estimates for Fishing Mortality from the 2008 SAW47, 2009 and 2010 updated assessments.

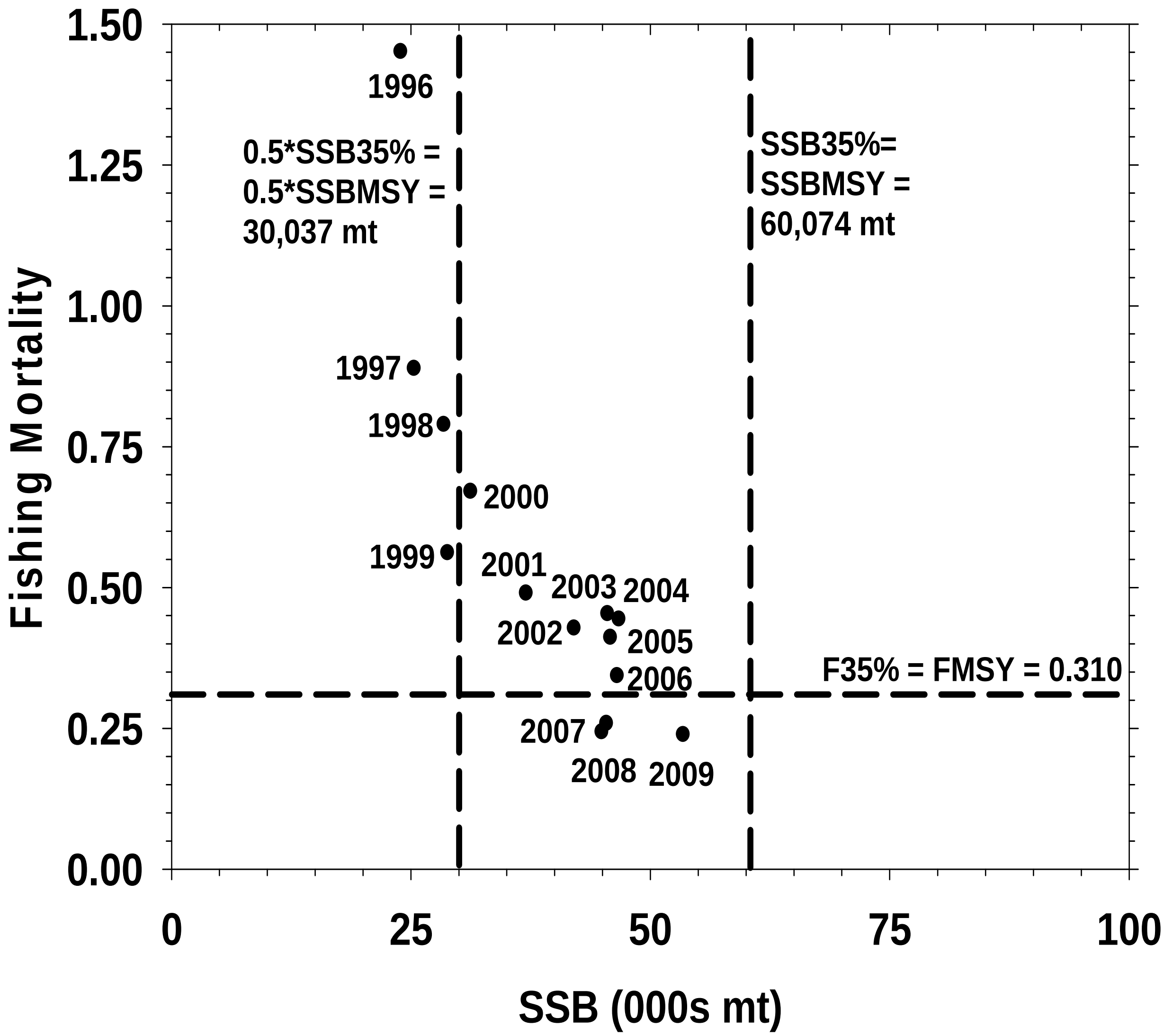

Figure 26. Trajectory in Spawning Stock Biomass (SSB) and Fishing Mortality rate (F, ages 3-7+) for summer flounder, 1996-2009. F35% is the proxy for the fishing mortality threshold FMSY; SSB35% is the proxy for the biomass target SSBMSY; 0.5*SSBMSY is the biomass threshold.

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