**D. Southern New England/Mid Atlantic yellowtail flounder**
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Additional details and supporting information can be found in the Appendix of the GARM-III Report (NEFSC 2008).

**1.0 Background**

The Southern New England-Mid Atlantic yellowtail flounder stock was last assessed at the Groundfish Assessment Meeting (GARM) in 2005 (Cadrin and Legault 2005). That assessment was based on a virtual population analyses (VPA) with a 7+ age group formulation. The stock exhibited poor recruitment and high fishing mortality rates, leading to very low abundance. Reference point estimation was derived from spawning stock biomass per recruit (SSB/R) and yield per recruit (YPR) analyses, with the assumption of constant recruitment (Cadrin 2003). The value for $F_{40\%}$ (i.e. proxy for $F_{MSY}$) was 0.26 and the corresponding $SSB_{MSY}$ and MSY was 69,500mt and 14,200mt respectively. VPA estimate of SSB (694mt) was 1% of $SSB_{MSY}$ and the estimate of $F_{2004}$ (0.99) was four times $F_{MSY}$, indicating that the stock was severely overfished and overfishing was occurring. The current benchmark assessment revises and updates the 1994-2007 fishery catch estimates to reflect recommendations at the GARM III data meeting (GARM 2007), and updates research survey abundance indices and analytical models (VPA) through 2007/2008 as recommended at both the GARM III Methods and Biological Reference Points meetings (GARM 2008a, GARM 2008b). The VPA analysis uses an age-6+ formulation by incorporating the entire time series of catch data and tunes to winter, spring and fall survey swept area biomass indices. Finally, reference points were re-evaluated using the revised VPA formulation, and a two-stanza recruitment approach (i.e. recruitment associated with SSB either greater than or less than 5000t) to determine the current status of the stock.

**2.0 Fishery**

*Landings*

Landings of yellowtail flounder from the Southern New England-Mid Atlantic stock (Figure D1) during 1994-2007 were derived from the new trip-based allocation described in the GARM data meeting (GARM 2007, Table D1, Figure D2). Changes to previous estimates were minimal and uncertainty in the landings due to the random component of the allocation was insignificant (Legault et al. 2008). Landings at age and mean weight at age were determined by port sampling of small, medium, large, and unclassified market categories and pooled age-length keys by half year to achieve the full length frequency distributions. Sampling intensity has increased in recent years (Table D2) resulting in lower variability in landings at age estimates (Table D3). Of special note for this stock, port sampling in years 2003-2005 was supplemented heavily by an industry-based survey (IBS) which provided length distributions for the unclassified market category as well as the majority of the age samples for these years.

*Discards*

Discarded catch for years 1994-2007 was estimated using the Standardized Bycatch Reporting Methodolgy (SBRM) recommended in the GARM III data meeting (GARM 2007).

Three commercial fleets (large mesh otter trawl, ≥ 5.5"; small mesh otter trawl, < 5.5"; and scallop dredge) were considered to estimate discards as these fleets constituted the majority of the total discards of yellowtail flounder in the Southern New England-Mid Atlantic stock area. Observed ratios of discards of yellowtail flounder to kept of all species for large mesh otter trawl, small mesh otter trawl, and scallop dredge were applied to the total landings by half-year. Uncertainty in discards was estimated based on the SBRM approach detailed in the GARM III data meeting (GARM 2007, Table D4). Discards were approximately 28% of the catch in years 1994-2007 and contributed to almost 50% of the catch in 2007 (Table D1; Figure D2). Discards at age and associated mean weights at age were estimated from sea sampled lengths and pooled observer and survey age-length keys. The age-length key was supplemented significantly by the industry-based survey (IBS) in years 2003-2005. However, precision of discards at age could not be assessed using the conventional method due to the combined sources of information used (i.e. survey and commercial discards).

*Total Catch at Age*

Total catch at age was generated by adding the landings and discards (Table D5a-c). Average weight at age was computed as the catch numbers weighted average of the weights at age from these two sources (Table D6).

**3.0 Research Surveys**

Survey abundance (stratified mean number per tow) and biomass (stratified mean kg per tow) indices are reported in Table D7a-c. Estimates are from valid NEFSC winter, spring, and fall bottom trawl surveys (BTS) from 1973-2008 (note: autumn surveys commenced in 1992). The indices were derived from station-catches defined within the NEFSC survey strata for the Southern New England-Mid Atlantic area [offshore strata 1, 2, 5, 6, 9, 10, 69, 73, 74 (strata 69, 73, 74 excluded from the fall series)], and standardized according to net, vessel, and door changes. These indices are presented as minimum swept area estimates to allow direct interpretation of the catchability estimates associated with each catch at age from the surveys. Survey trends generally indicate stock biomass has remained low since the early 1990s with an indication of a stronger 2005 year-class relative to the previous decade (Figure D3).

**4.0 Assessment Results**

*Input Data and Model Formulation*

The previous VPA formulation for the Southern New England-Mid Atlantic yellowtail flounder stock was based on a plus group definition set at age-7 (Cadrin and Legault 2005). However, an age-6+ VPA formulation was also considered for comparative analyses due to continued age truncation (i.e. predominance of zeros at older age classes) observed in the survey series. The winter, spring and fall NEFSC survey minimum swept area estimates were used as age-specific tuning indices in both VPA formulations (i.e. age-6+ and age-7+). Mohn's rho retrospective statistics (Mohn 1999), calculated based on a seven year series of retrospective estimates was used to quantify the relative bias in terminal year estimates of fishing mortality (F), spawning stock biomass (SSB) and recruitment (R) for both model formulations. It was further recommended by the panel reviewers at the benchmark GARM III meeting to adjust terminal year point estimates for F and SSB based on Mohn's rho estimates to characterize the degree of bias in the final status determination. Finally, 1000 bootstrap realizations were conducted to evaluate the precision of the 2008 (terminal year + 1) stock size at age, F at age in 2007, and SSB in 2007.

*Model Selection Process*

A comparison between both the plus group formulations (age-6+ and age-7+) with the addition of new catch data indicated that the results from the age-7+ definition exhibited a much higher mean square residual than the 6+ results (Table D8a-b). The VPA for the age-6+ formulation was also estimated with better precision for stock size, *N* (CV =31-51%), and catchability estimates, *q* (CV = 10-35%). Relatively, the age-6+ formulation did not exhibit strong retrospective patterns compared to the age-7+ formulation (Figures D4a-b, D5a-b, D6a-b). Additionally, Mohn's rho values for F, SSB and R showed less retrospective pattern in the age-6+ formulation (Tables D9a-b). Given the improvement of the age-6+ VPA model formulation over the age-7+ definition the review panel at the GARM III benchmark assessment meeting agreed with the recommendations made at the Biological Reference Points meeting and accepted the age 6+ formulation as the final model for basis for this assessment to provide scientific advice.

*Assessment Results*

VPA assessment results show that stock numbers has continued to show an increasing trend since 2004, driven potentially by two moderately strong recruitment levels in 2004 and 2005 (Table D10; Figure D6a). Fishing mortality continues to decline with $F_{2007}$ on fully recruited fish ($F_{2007}$ = 0.41) and significantly lower than the levels estimated in recent years (Table D11). Spawning stock biomass slightly increased in the 1990's and remained fairly stable between 1999 and 2003. In 2004 and 2005, SSB declined by more than 50%. Moderate recruitment of the 2004 and 2005 year classes led to the recent increases in SSB for 2006 and 2007. The 2007 SSB is estimated at approximately 3508mt, which is more than twice the average estimated SSB over the last ten years. However, SSB is still relatively low compared to levels observed in the past decades (Table D12). The 2007 estimates of F and SSB were well estimated as seen in the relatively precise 80% confidence intervals derived from bootstrapping (Table D13a). The Mohn's Rho adjusted estimates for SSB were well within the confidence bounds of the bootstrap estimates but barely overlaps with the F bootstrap confidence limits (Table D13b). Adopting the panel recommendations at the final benchmark assessment meeting, the point estimates were used for final status determination.

*Diagnostics*

Survey residuals do not have strong patterns, but there are some occasional year effects in some surveys (Figure D7). With the exception of the winter survey, catchability coefficients have reasonable magnitudes (q < 1.00) with the NEFSC survey exhibiting a flat-top pattern (Figure D8). Estimates of winter survey catchability suggest that either swept area calculations or VPA abundances are underestimated, but catchability estimates may not be reliable because of the narrow range of abundance during the winter survey series. Alternatively, it is worth noting that the autumn surveys are conducted with a net design specifically to catch flounder and may have significant herding effect between the doors, which could explain the q values above 1.00. Back calculated partial recruitment pattern from the fishery are flat-topped due to the formulation of the VPA, but also show a decrease in selectivity of age-2 and 3 yellowtail flounder in recent years, potentially due to the mesh size regulations (Figure D9).

## 5.0 Biological Reference Points

*Method and Special Consideration*

For the 2008 GARM Biological Reference Point meeting, the stock-recruitment estimates from the VPA did not conform to a parametric relationship (Figure D10) and therefore a non-parametric approach was adopted. Following the panel recommendations from the final benchmark assessment meeting, recruitment values associated with spawning stock biomass below and above 5000t were used to estimate $SSB_{MSY}$ and MSY proxies. The 5000t threshold was derived based on the minimum residual variance analysis from the stock-recruitment relationship. The Panel also agreed with previous recommendations (GARM 2008b) that the hindcast estimates should not be included in the recruitment sample for projection as these values tends to extend beyond the range of 'observed' recruitment, and may not be representative of current stock productivity.

Recent five year averages of partial recruitment, maturity, and weight at age were used in yield per recruit analysis to estimate F40%MSP as a proxy for $F_{MSY}$ (Table D14). Applying $F_{MSY}$ for 100 years in stochastic projections, while sampling of recruitments from the empirical distribution generated equilibrium $SSB_{MSY}$ and MSY as median values at the end of the projections (Legault 2008).

*Final Values: $F_{MSY}$, $SSB_{MSY}$, MSY*

The estimated values of $F_{MSY}$ (0.254), $SSB_{MSY}$ (27,400 mt) and MSY (6100 mt) are similar to those from the GARM III Biological Reference Points meeting and significantly different from the GARM II meeting with the exception of $F_{MSY}$ (Table D15). The relatively large changes observed in $SSB_{MSY}$ and MSY from GARM II to GARM III reflect mainly changes in recruitment used in the calculations. In the previous assessment, hindcast recruitments were used while current assessments uses only updated VPA estimated recruitment. The panel at the final benchmark assessment meeting supported the no-hindcast approach due to the continued low recruitment in the recent decade which could potentially indicate a change in stock productivity. Based on VPA 2007 estimates of F and SSB ($F_{2007}$ = 0.413; $SSB_{2007}$ = 3508 mt) relative to $F_{MSY}$ and $SSB_{MSY}$, Southern New England-Mid Atlantic yellowtail is overfished ($SSB_{2007}$ = 13%$SSB_{MSY}$) and overfishing is occurring ($F_{2007}$ = 1.6$F_{MSY}$; Figure D11)

## 6.0 Projections

*Initial Conditions*

The recent five year average of partial recruitment, maturity and weight at age used in the yield per recruit analysis were also used in the projections (Table D14). The population abundance at age at the start of 2008 was derived from the bootstrap results, with recruitment generated as geometric mean of the estimated recruitments during 1973-2007 from each bootstrap solution. Catch in 2008 was assumed equal to the catch in 2007 (396 mt).

*$F_{REBUILD}$*

The Southern New England-Mid Atlantic yellowtail flounder stock is currently in a rebuilding plan with end date of 2014. The $F_{REBUILD}$ (0.08) was estimated by iteratively solving for the F which applied in years 2009-2014 and resulted in median 2014 SSB equal to $SSB_{MSY}$.

*Projected Catch in 2009*

Median catch in 2009 was estimated under four conditions for F in 2009: 1) $F_{STATUS\ QUO}$, meaning the $F_{2009}$ is equal to $F_{2007}$, 2) $F_{2008}$ which sets $F_{2009}$ equal to the estimated $F_{2008}$ from the 100yr projection, 3) $F_{MSY}$, and 4) $F_{REBUILD}$ (Table D16). All four scenarios estimate catch higher than the levels in 2007 while allowing SSB to increase. This is probably due to the 2005 strong year class progressing through the fishery. However, it should be noted that neither $F_{status\text{-}quo}$ nor $F_{MSY}$ will reach rebuilding target of $SSB_{MSY}$ by 2014.

**7.0 Summary**

Based on this assessment, the Southern New England-Mid Atlantic yellowtail flounder continues to be overfished (SSB2007/$SSB_{MSY}$ = 13%) and overfishing is still occurring (F2007/ $F_{MSY}$ = 160%). However, fishing mortality has been declining since 2005 and it is at lowest levels observed in the time series. SSB has shown slight increases over the past couple of years and could potentially continue to grow with the support of the incoming 2005 strong year class. The age-6+ VPA formulation is recommended as the basis of management because it does not exhibit strong retrospective patterns and overall, demonstrates reasonable diagnostics. Given the strength of the 2005 year class in other adjacent stock areas (i.e. Georges Bank and Cape Cod-Gulf of Maine) and the current knowledge of yellowtail flounder movement among stock areas (GARM 2007), a source of uncertainty for this assessment is determining which causing factor(s) (i.e. favorable environmental conditions or migration) may have contributed to the coincidental strong year class. Another area of uncertainty is the lack of age-length data available for discard estimation.

**8.0 Panel Discussion/Comments**

**Conclusions**

Two VPA assessment formulations were presented which used different age ranges in the plus group - 6+ and 7+. As the best available estimate of stock status and a sufficient basis for management advice, the Panel accepted as Final the formulation that used the 6+ age group. This model had a considerably lower mean square residual and lower coefficients of variation (CVs) on the survey catchability estimates. As well, the 7+ formulation estimated catchability for the NMFS winter survey greater than 1.0, which was considered unreasonable.

There was a small retrospective pattern for which the Panel considered not sufficient to warrant an adjustment.

The Panel recommended that one year forward projections use a 2008 recruitment estimate equal to the geometric mean of recruitment estimates since 1990, and not include recruitment estimates from the early part of the assessment time series as these were much larger than any observed since 1990.

The Panel recommended that the $F_{REBUILD}$ forecast use the same recruitment assumptions as for the BRP estimation but also sample from recruitment estimates below the SSB breakpoint of 5,000t.

**Research Recommendations**

The use of 'windows' of biomass rather than the breakpoint should be explored to create the stanzas in the stock – recruitment relationship. This may better address inconsistencies in rebuilding plans that might arise as the biomass grows from the lower to the higher stanza.

**9.0 References**


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Table D1. Landings, discards, total catch (metric tons), and proportion of total catch which is discards for Southern New England-Mid Atlantic yellowtail flounder.

| Year | U.S. landings | U.S. discards | foreign catch | total catch | percent discards |
|---|---|---|---|---|---|
| 1935 | 6000 | 2400 | 0 | 8400 | 29% |
| 1936 | 6800 | 2700 | 0 | 9500 | 28% |
| 1937 | 7600 | 3000 | 0 | 10600 | 28% |
| 1938 | 7700 | 3100 | 0 | 10800 | 29% |
| 1939 | 9500 | 3800 | 0 | 13300 | 29% |
| 1940 | 14200 | 5700 | 0 | 19900 | 29% |
| 1941 | 19300 | 7700 | 0 | 27000 | 29% |
| 1942 | 28400 | 9900 | 0 | 38300 | 26% |
| 1943 | 18000 | 7300 | 0 | 25300 | 29% |
| 1944 | 10600 | 4800 | 0 | 15400 | 31% |
| 1945 | 10400 | 4200 | 0 | 14600 | 29% |
| 1946 | 10800 | 4400 | 0 | 15200 | 29% |
| 1947 | 12100 | 4900 | 0 | 17000 | 29% |
| 1948 | 9900 | 4000 | 0 | 13900 | 29% |
| 1949 | 4900 | 1900 | 0 | 6800 | 28% |
| 1950 | 4900 | 1900 | 0 | 6800 | 28% |
| 1951 | 2900 | 1100 | 0 | 4000 | 28% |
| 1952 | 3200 | 1200 | 0 | 4400 | 27% |
| 1953 | 2300 | 800 | 0 | 3100 | 26% |
| 1954 | 1700 | 600 | 0 | 2300 | 26% |
| 1955 | 2500 | 900 | 0 | 3400 | 26% |
| 1956 | 4100 | 1400 | 0 | 5500 | 25% |
| 1957 | 6200 | 2200 | 0 | 8400 | 26% |
| 1958 | 9500 | 3600 | 0 | 13100 | 27% |
| 1959 | 8200 | 3100 | 0 | 11300 | 27% |
| 1960 | 8800 | 3200 | 0 | 12000 | 27% |
| 1961 | 13000 | 4700 | 0 | 17700 | 27% |
| 1962 | 13500 | 5300 | 0 | 18800 | 28% |
| 1963 | 22600 | 5400 | 200 | 28200 | 19% |
| 1964 | 21809 | 9500 | 0 | 31309 | 30% |
| 1965 | 22517 | 7000 | 1400 | 30917 | 23% |
| 1966 | 22540 | 5300 | 700 | 28540 | 19% |
| 1967 | 25140 | 7700 | 2800 | 35640 | 22% |
| 1968 | 25372 | 6300 | 3500 | 35172 | 18% |
| 1969 | 23686 | 2400 | 18283 | 44369 | 5% |
| 1970 | 21350 | 4500 | 2618 | 28468 | 16% |
| 1971 | 15867 | 2200 | 1261 | 19328 | 11% |
| 1972 | 17574 | 1800 | 3117 | 22491 | 8% |
| 1973 | 12441 | 1711 | 397 | 14549 | 12% |
| 1974 | 8284 | 8688 | 116 | 17088 | 51% |
| 1975 | 3833 | 1896 | 3 | 5732 | 33% |
| 1976 | 1853 | 1583 | 0 | 3436 | 46% |
| 1977 | 3335 | 1888 | 0 | 5223 | 36% |
| 1978 | 3059 | 5026 | 0 | 8085 | 62% |
| 1979 | 5452 | 4431 | 0 | 9883 | 45% |
| 1980 | 6300 | 1721 | 0 | 8021 | 21% |
| 1981 | 5400 | 1207 | 0 | 6607 | 18% |
| 1982 | 10726 | 5038 | 0 | 15764 | 32% |
| 1983 | 18500 | 3711 | 0 | 22211 | 17% |
| 1984 | 10100 | 1125 | 0 | 11225 | 10% |
| 1985 | 3600 | 1217 | 0 | 4817 | 25% |
| 1986 | 3548 | 1072 | 0 | 4620 | 23% |
| 1987 | 1771 | 881 | 0 | 2652 | 33% |
| 1988 | 994 | 1788 | 0 | 2782 | 64% |
| 1989 | 2897 | 5452 | 0 | 8349 | 65% |
| 1990 | 8236 | 9680 | 0 | 17916 | 54% |
| 1991 | 4113 | 2317 | 0 | 6430 | 36% |
| 1992 | 1640 | 1055 | 0 | 2695 | 39% |
| 1993 | 674 | 97 | 0 | 771 | 13% |
| 1994 | 367 | 362 | 0 | 729 | 50% |
| 1995 | 200 | 144 | 0 | 345 | 42% |
| 1996 | 477 | 277 | 0 | 754 | 37% |
| 1997 | 849 | 398 | 0 | 1247 | 32% |
| 1998 | 690 | 416 | 0 | 1106 | 38% |
| 1999 | 1307 | 172 | 0 | 1479 | 12% |
| 2000 | 1122 | 138 | 0 | 1261 | 11% |
| 2001 | 1295 | 31 | 0 | 1326 | 2% |
| 2002 | 792 | 24 | 0 | 816 | 3% |
| 2003 | 496 | 106 | 0 | 603 | 18% |
| 2004 | 489 | 125 | 0 | 614 | 20% |
| 2005 | 242 | 125 | 0 | 367 | 34% |
| 2006 | 209 | 160 | 0 | 369 | 43% |
| 2007 | 209 | 187 | 0 | 396 | 47% |

Table D2. Southern New England-Mid Atlantic landings (metric tons) and number of lengths available from port samples by half year and market category along with number of ages available for age-length key and number of lengths sampled per 100 metric tons.

| | | Landings (metric tons) | | | | | Number of Lengths | | | | | Number | Lengths / |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | half | unclass | large | small | medium | Total | unclass | large | small | medium | Total | of Ages | 100 mt |
| 1994 | 1 | 17 | 58 | 59 | | 134 | | 102 | 228 | | 330 | | |
| | 2 | 4 | 126 | 103 | 0 | 233 | | 170 | 254 | | 424 | | |
| | Total | 22 | 184 | 162 | 0 | 367 | | 272 | 482 | | 754 | 204 | 205 |
| 1995 | 1 | 19 | 37 | 48 | 0 | 104 | 78 | | | | 78 | | |
| | 2 | 24 | 28 | 45 | 0 | 97 | | | | | | | |
| | Total | 43 | 65 | 92 | 0 | 200 | 78 | | | | 78 | 36 | 39 |
| 1996 | 1 | 102 | 32 | 87 | 0 | 222 | | | | | | | |
| | 2 | 75 | 66 | 114 | 0 | 256 | 129 | 752 | 939 | | 1820 | | |
| | Total | 178 | 98 | 201 | 0 | 477 | 129 | 752 | 939 | | 1820 | 456 | 381 |
| 1997 | 1 | 456 | 95 | 110 | 0 | 660 | 277 | 736 | 915 | | 1928 | | |
| | 2 | 76 | 40 | 73 | | 189 | 319 | 328 | 548 | | 1195 | | |
| | Total | 532 | 134 | 182 | 0 | 849 | 596 | 1064 | 1463 | | 3123 | 729 | 368 |
| 1998 | 1 | 129 | 59 | 52 | 0 | 240 | 92 | 283 | 596 | | 971 | | |
| | 2 | 105 | 109 | 236 | 0 | 450 | 230 | | 127 | | 357 | | |
| | Total | 235 | 168 | 287 | 0 | 690 | 322 | 283 | 723 | | 1328 | 337 | 192 |
| 1999 | 1 | 314 | 303 | 427 | 0 | 1044 | 535 | 1016 | 560 | | 2111 | | |
| | 2 | 82 | 83 | 98 | 0 | 263 | | 84 | 239 | | 323 | | |
| | Total | 396 | 386 | 525 | 0 | 1307 | 535 | 1100 | 799 | | 2434 | 337 | 186 |
| 2000 | 1 | 136 | 282 | 193 | 0 | 612 | 85 | 251 | 555 | | 891 | | |
| | 2 | 128 | 154 | 228 | 0 | 510 | 51 | 186 | 411 | | 648 | | |
| | Total | 264 | 436 | 421 | 1 | 1122 | 136 | 437 | 966 | | 1539 | 348 | 137 |
| 2001 | 1 | 198 | 468 | 357 | 0 | 1023 | | 336 | 1227 | | 1563 | | |
| | 2 | 56 | 95 | 121 | 0 | 272 | 212 | 413 | 514 | | 1139 | | |
| | Total | 254 | 563 | 478 | 0 | 1295 | 212 | 749 | 1741 | | 2702 | 736 | 209 |
| 2002 | 1 | 86 | 355 | 170 | 1 | 612 | 373 | 643 | 533 | | 1549 | | |
| | 2 | 38 | 69 | 73 | 1 | 180 | 214 | 347 | 329 | | 890 | | |
| | Total | 124 | 423 | 242 | 2 | 792 | 587 | 990 | 862 | | 2439 | 553 | 308 |
| 2003 | 1 | 51 | 156 | 103 | | 310 | 9990 | 341 | 515 | | 10846 | | |
| | 2 | 34 | 102 | 50 | 0 | 186 | 2140 | 209 | 84 | | 2433 | | |
| | Total | 85 | 258 | 153 | 0 | 496 | 12130 | 550 | 599 | | 13279 | 485 | 2676 |
| 2004 | 1 | 21 | 177 | 44 | 2 | 243 | 4692 | 277 | | | 4969 | | |
| | 2 | 16 | 172 | 51 | 8 | 246 | 3207 | 99 | | | 3306 | | |
| | Total | 37 | 349 | 94 | 10 | 489 | 7899 | 376 | | | 8275 | 943 | 1692 |
| 2005 | 1 | 13 | 46 | 34 | 7 | 100 | 5140 | 205 | 61 | | 5406 | | |
| | 2 | 9 | 72 | 52 | 9 | 142 | 4212 | 191 | 192 | | 4595 | | |
| | Total | 23 | 118 | 86 | 16 | 242 | 9352 | 396 | 253 | | 10001 | 1921 | 4130 |
| 2006 | 1 | 8 | 56 | 31 | 11 | 105 | 73 | 536 | 726 | | 1335 | | |
| | 2 | 6 | 38 | 41 | 18 | 104 | 83 | 452 | 629 | | 1164 | | |
| | Total | 14 | 94 | 72 | 29 | 209 | 156 | 988 | 1355 | | 2499 | 851 | 1195 |
| 2007 | 1 | 17 | 31 | 37 | 14 | 100 | 379 | 563 | 1077 | | 2019 | | |
| | 2 | 10 | 28 | 51 | 20 | 109 | 720 | 1191 | 1697 | | 3608 | | |
| | Total | 27 | 59 | 88 | 35 | 209 | 1099 | 1754 | 2774 | | 5627 | 1497 | 2692 |
| Grand Total | | 2233 | 3337 | 3083 | 93 | 8746 | 33231 | 9711 | 12956 | | 55898 | 9433 | 639 |

Table D3. Southern New England-Mid Atlantic yellowtail flounder coefficient of variation for landings at age by year.

| Year | age 1 | age 2 | age 3 | age 4 | age 5 | age 6+ |
|---|---|---|---|---|---|---|
| 1994 | | 71% | 13% | 15% | 18% | 28% |
| 1995 | | | 39% | 17% | 52% | 41% |
| 1996 | | 27% | 10% | 27% | 29% | 31% |
| 1997 | | 31% | 10% | 13% | 32% | 40% |
| 1998 | | 12% | 11% | 15% | 44% | 78% |
| 1999 | | 36% | 8% | 23% | 34% | 59% |
| 2000 | 137% | 13% | 10% | 13% | 44% | 96% |
| 2001 | | 19% | 6% | 10% | 24% | 36% |
| 2002 | | 17% | 8% | 16% | 42% | |
| 2003 | | 2% | 1% | 1% | 2% | 5% |
| 2004 | | 3% | 2% | 12% | 4% | 8% |
| 2005 | | 2% | 7% | 10% | 5% | 18% |
| 2006 | | 12% | 8% | 9% | 14% | 13% |
| 2007 | | 12% | 3% | 7% | 14% | 15% |

Table D4. Southern New England-Mid Atlantic yellowtail flounder discards (metric tons) and coefficient of variation by gear and year.

| | Otter Trawl Large Mesh | | Otter Trawl Small Mesh | | Scallop Dredge | |
|---|---|---|---|---|---|---|
| Year | D (mt) | CV | D (mt) | CV | D (mt) | CV |
| 1994 | 4 | 107% | 299 | 30% | 58 | 90% |
| 1995 | 5 | 87% | 2 | 39% | 137 | 76% |
| 1996 | 15 | 109% | 12 | 56% | 251 | 30% |
| 1997 | 172 | 24% | 13 | 80% | 212 | 46% |
| 1998 | 271 | 137% | 16 | 50% | 130 | 44% |
| 1999 | 6 | 47% | 19 | 0% | 147 | 50% |
| 2000 | 4 | 0% | 17 | 416% | 118 | 57% |
| 2001 | 2 | 99% | 10 | 66% | 20 | 116% |
| 2002 | 0 | 123% | 5 | 227% | 19 | 57% |
| 2003 | 24 | 66% | 17 | 317% | 64 | 78% |
| 2004 | 104 | 49% | 2 | 52% | 19 | 26% |
| 2005 | 48 | 47% | 8 | 39% | 68 | 23% |
| 2006 | 79 | 27% | 10 | 158% | 71 | 29% |
| 2007 | 81 | 29% | 5 | 60% | 91 | 28% |

Table D5a. Southern New England-Mid Atlantic yellowtail flounder landings at age (thousands of fish).

| Year | age 1 | age 2 | age 3 | age 4 | age 5 | age 6+ |
|---|---|---|---|---|---|---|
| 1973 | 28 | 2650 | 10595 | 7927 | 5226 | 6286 |
| 1974 | 130 | 1853 | 4760 | 7325 | 3687 | 3347 |
| 1975 | 176 | 2692 | 1883 | 1120 | 1597 | 1452 |
| 1976 | 0 | 1474 | 1167 | 327 | 449 | 896 |
| 1977 | 68 | 2260 | 4848 | 507 | 278 | 649 |
| 1978 | 21 | 4089 | 2157 | 1470 | 247 | 179 |
| 1979 | 19 | 5114 | 8548 | 1062 | 438 | 131 |
| 1980 | 137 | 4774 | 6577 | 3829 | 512 | 167 |
| 1981 | 0 | 3016 | 7259 | 2926 | 1111 | 183 |
| 1982 | 56 | 17980 | 13453 | 1855 | 415 | 86 |
| 1983 | 57 | 14416 | 37156 | 3584 | 385 | 192 |
| 1984 | 47 | 3058 | 19038 | 8054 | 878 | 276 |
| 1985 | 166 | 5030 | 2155 | 1968 | 1109 | 246 |
| 1986 | 40 | 6215 | 3287 | 635 | 356 | 149 |
| 1987 | 76 | 1403 | 2349 | 926 | 167 | 65 |
| 1988 | 0 | 1213 | 532 | 506 | 134 | 32 |
| 1989 | 0 | 5918 | 1513 | 331 | 42 | 3 |
| 1990 | 0 | 423 | 18922 | 1536 | 79 | 5 |
| 1991 | 0 | 253 | 2343 | 6814 | 156 | 51 |
| 1992 | 0 | 301 | 1011 | 2080 | 264 | 18 |
| 1993 | 0 | 245 | 432 | 702 | 145 | 4 |
| 1994 | 0 | 14 | 273 | 221 | 212 | 78 |
| 1995 | 0 | 0 | 84 | 252 | 46 | 29 |
| 1996 | 0 | 292 | 621 | 174 | 21 | 23 |
| 1997 | 0 | 39 | 947 | 646 | 85 | 40 |
| 1998 | 0 | 495 | 772 | 337 | 48 | 5 |
| 1999 | 0 | 261 | 2053 | 383 | 110 | 7 |
| 2000 | 2 | 688 | 1089 | 465 | 53 | 7 |
| 2001 | 0 | 392 | 1626 | 468 | 125 | 39 |
| 2002 | 0 | 225 | 945 | 377 | 23 | 0 |
| 2003 | 0 | 95 | 462 | 304 | 79 | 18 |
| 2004 | 0 | 199 | 187 | 251 | 262 | 99 |
| 2005 | 0 | 82 | 149 | 110 | 87 | 38 |
| 2006 | 0 | 88 | 154 | 97 | 39 | 45 |
| 2007 | 0 | 38 | 303 | 87 | 22 | 15 |

Table D5b. Southern New England-Mid Atlantic yellowtail flounder discards at age (thousands of fish).

| Year | age 1 | age 2 | age 3 | age 4 | age 5 | age 6+ |
|---|---|---|---|---|---|---|
| 1973 | 192 | 2982 | 1355 | 52 | 0 | 0 |
| 1974 | 731 | 26666 | 796 | 45 | 0 | 0 |
| 1975 | 8734 | 1438 | 1 | 10 | 0 | 0 |
| 1976 | 214 | 5203 | 14 | 0 | 0 | 0 |
| 1977 | 5445 | 2767 | 43 | 0 | 0 | 0 |
| 1978 | 8677 | 10102 | 7 | 0 | 0 | 0 |
| 1979 | 186 | 14305 | 119 | 0 | 0 | 0 |
| 1980 | 869 | 5441 | 18 | 0 | 0 | 0 |
| 1981 | 38 | 4013 | 319 | 0 | 0 | 0 |
| 1982 | 113 | 17716 | 905 | 3 | 0 | 0 |
| 1983 | 2611 | 4872 | 5682 | 18 | 0 | 0 |
| 1984 | 470 | 3141 | 951 | 75 | 0 | 0 |
| 1985 | 2073 | 3044 | 20 | 0 | 0 | 0 |
| 1986 | 423 | 3755 | 39 | 0 | 0 | 0 |
| 1987 | 1518 | 2034 | 19 | 0 | 0 | 0 |
| 1988 | 5899 | 896 | 4 | 0 | 0 | 0 |
| 1989 | 24 | 14002 | 1834 | 131 | 6 | 0 |
| 1990 | 192 | 1634 | 23721 | 673 | 11 | 0 |
| 1991 | 446 | 1357 | 2826 | 2889 | 12 | 0 |
| 1992 | 477 | 1152 | 1086 | 659 | 33 | 0 |
| 1993 | 13 | 212 | 15 | 9 | 0 | 0 |
| 1994 | 362 | 836 | 126 | 183 | 85 | 8 |
| 1995 | 1 | 373 | 114 | 37 | 4 | 7 |
| 1996 | 3 | 227 | 497 | 58 | 11 | 7 |
| 1997 | 22 | 446 | 565 | 142 | 25 | 2 |
| 1998 | 19 | 968 | 364 | 60 | 3 | 25 |
| 1999 | 10 | 214 | 164 | 24 | 15 | 1 |
| 2000 | 2 | 217 | 101 | 49 | 2 | 6 |
| 2001 | 0 | 13 | 57 | 9 | 1 | 0 |
| 2002 | 1 | 26 | 20 | 11 | 2 | 1 |
| 2003 | 2 | 60 | 131 | 41 | 10 | 5 |
| 2004 | 4 | 80 | 56 | 60 | 51 | 25 |
| 2005 | 66 | 144 | 68 | 40 | 31 | 15 |
| 2006 | 19 | 224 | 190 | 42 | 6 | 12 |
| 2007 | 6 | 206 | 261 | 47 | 22 | 0 |

Table D5c. Southern New England-Mid Atlantic yellowtail flounder catch at age (thousands of fish).

| Year | age 1 | age 2 | age 3 | age 4 | age 5 | age 6+ |
|---|---|---|---|---|---|---|
| 1973 | 220 | 5632 | 11951 | 7978 | 5226 | 6286 |
| 1974 | 861 | 28519 | 5556 | 7370 | 3687 | 3347 |
| 1975 | 8910 | 4129 | 1884 | 1130 | 1597 | 1452 |
| 1976 | 214 | 6677 | 1181 | 327 | 449 | 896 |
| 1977 | 5513 | 5027 | 4891 | 507 | 278 | 649 |
| 1978 | 8698 | 14191 | 2164 | 1470 | 247 | 179 |
| 1979 | 205 | 19419 | 8667 | 1062 | 438 | 131 |
| 1980 | 1006 | 10215 | 6595 | 3829 | 512 | 167 |
| 1981 | 38 | 7029 | 7578 | 2926 | 1111 | 183 |
| 1982 | 169 | 35696 | 14358 | 1858 | 415 | 86 |
| 1983 | 2668 | 19288 | 42837 | 3601 | 385 | 192 |
| 1984 | 517 | 6200 | 19990 | 8129 | 878 | 276 |
| 1985 | 2239 | 8074 | 2175 | 1968 | 1109 | 246 |
| 1986 | 463 | 9970 | 3326 | 635 | 356 | 149 |
| 1987 | 1594 | 3437 | 2368 | 926 | 167 | 65 |
| 1988 | 5899 | 2109 | 536 | 506 | 134 | 32 |
| 1989 | 24 | 19920 | 3347 | 462 | 48 | 3 |
| 1990 | 192 | 2056 | 42644 | 2209 | 90 | 5 |
| 1991 | 446 | 1610 | 5169 | 9703 | 168 | 51 |
| 1992 | 477 | 1453 | 2097 | 2739 | 297 | 18 |
| 1993 | 13 | 457 | 447 | 711 | 145 | 4 |
| 1994 | 362 | 851 | 399 | 404 | 297 | 86 |
| 1995 | 1 | 373 | 198 | 288 | 51 | 36 |
| 1996 | 3 | 519 | 1117 | 232 | 32 | 30 |
| 1997 | 22 | 485 | 1512 | 789 | 110 | 42 |
| 1998 | 19 | 1463 | 1136 | 396 | 52 | 31 |
| 1999 | 10 | 475 | 2217 | 407 | 125 | 8 |
| 2000 | 4 | 905 | 1190 | 514 | 55 | 13 |
| 2001 | 0 | 405 | 1683 | 477 | 126 | 39 |
| 2002 | 1 | 250 | 966 | 388 | 25 | 1 |
| 2003 | 2 | 155 | 594 | 344 | 89 | 23 |
| 2004 | 4 | 280 | 243 | 311 | 313 | 124 |
| 2005 | 66 | 226 | 217 | 150 | 118 | 52 |
| 2006 | 19 | 312 | 344 | 139 | 44 | 57 |
| 2007 | 6 | 245 | 564 | 135 | 44 | 15 |

Table D6. Southern New England-Mid Atlantic yellowtail flounder catch weight at age (kg).

| Year | age 1 | age 2 | age 3 | age 4 | age 5 | age 6+ |
|---|---|---|---|---|---|---|
| 1973 | 0.210 | 0.296 | 0.348 | 0.375 | 0.382 | 0.428 |
| 1974 | 0.203 | 0.308 | 0.352 | 0.396 | 0.439 | 0.457 |
| 1975 | 0.218 | 0.289 | 0.376 | 0.432 | 0.435 | 0.481 |
| 1976 | 0.228 | 0.303 | 0.408 | 0.498 | 0.499 | 0.557 |
| 1977 | 0.215 | 0.283 | 0.381 | 0.504 | 0.513 | 0.542 |
| 1978 | 0.234 | 0.293 | 0.383 | 0.536 | 0.662 | 0.656 |
| 1979 | 0.189 | 0.301 | 0.364 | 0.475 | 0.590 | 0.662 |
| 1980 | 0.206 | 0.281 | 0.384 | 0.500 | 0.682 | 0.925 |
| 1981 | 0.140 | 0.262 | 0.342 | 0.474 | 0.596 | 0.650 |
| 1982 | 0.226 | 0.263 | 0.353 | 0.499 | 0.660 | 0.833 |
| 1983 | 0.175 | 0.261 | 0.339 | 0.496 | 0.668 | 0.819 |
| 1984 | 0.182 | 0.237 | 0.295 | 0.388 | 0.487 | 0.656 |
| 1985 | 0.183 | 0.260 | 0.365 | 0.408 | 0.504 | 0.608 |
| 1986 | 0.186 | 0.284 | 0.331 | 0.463 | 0.587 | 0.642 |
| 1987 | 0.247 | 0.268 | 0.353 | 0.404 | 0.520 | 0.631 |
| 1988 | 0.270 | 0.293 | 0.396 | 0.493 | 0.611 | 0.821 |
| 1989 | 0.311 | 0.338 | 0.394 | 0.553 | 0.735 | 0.957 |
| 1990 | 0.301 | 0.327 | 0.378 | 0.455 | 0.763 | 0.884 |
| 1991 | 0.206 | 0.262 | 0.337 | 0.414 | 0.678 | 0.800 |
| 1992 | 0.167 | 0.316 | 0.368 | 0.434 | 0.599 | 0.918 |
| 1993 | 0.122 | 0.354 | 0.430 | 0.451 | 0.641 | 1.040 |
| 1994 | 0.123 | 0.198 | 0.353 | 0.416 | 0.504 | 0.672 |
| 1995 | 0.072 | 0.227 | 0.356 | 0.446 | 0.597 | 0.849 |
| 1996 | 0.105 | 0.344 | 0.381 | 0.469 | 0.613 | 0.734 |
| 1997 | 0.192 | 0.254 | 0.402 | 0.512 | 0.665 | 0.841 |
| 1998 | 0.168 | 0.280 | 0.384 | 0.519 | 0.587 | 0.693 |
| 1999 | 0.200 | 0.361 | 0.430 | 0.609 | 0.769 | 1.114 |
| 2000 | 0.144 | 0.348 | 0.479 | 0.625 | 0.748 | 0.888 |
| 2001 | 0.153 | 0.378 | 0.444 | 0.614 | 0.753 | 0.917 |
| 2002 | 0.165 | 0.374 | 0.473 | 0.628 | 0.838 | 0.797 |
| 2003 | 0.100 | 0.347 | 0.436 | 0.620 | 0.639 | 0.846 |
| 2004 | 0.158 | 0.320 | 0.403 | 0.493 | 0.576 | 0.744 |
| 2005 | 0.096 | 0.298 | 0.422 | 0.528 | 0.669 | 0.841 |
| 2006 | 0.118 | 0.255 | 0.391 | 0.534 | 0.675 | 0.852 |
| 2007 | 0.124 | 0.273 | 0.382 | 0.501 | 0.737 | 0.869 |

Table D7a. NEFSC Spring survey indices of minimum swept area abundance for Southern New England-Mid Atlantic yellowtail flounder in 000's and metric tons.

| Year | age 1 | age 2 | age 3 | age 4 | age 5 | age 6+ | B (mt) |
|---|---|---|---|---|---|---|---|
| 1973 | 912.670 | 5523.648 | 15096.903 | 8491.120 | 6586.563 | 9407.466 | 13266.215 |
| 1974 | 592.291 | 2507.711 | 2956.943 | 5712.165 | 3454.975 | 3114.542 | 6081.679 |
| 1975 | 414.470 | 1512.983 | 454.914 | 588.280 | 866.042 | 1020.298 | 1616.433 |
| 1976 | 49.803 | 4269.710 | 580.091 | 278.430 | 264.559 | 499.871 | 1879.989 |
| 1977 | 1572.981 | 1642.170 | 2881.736 | 263.222 | 164.785 | 457.923 | 2226.606 |
| 1978 | 3105.517 | 11899.133 | 2109.786 | 900.971 | 292.636 | 483.158 | 4344.414 |
| 1979 | 986.706 | 2921.846 | 1548.413 | 278.263 | 121.166 | 61.001 | 1384.965 |
| 1980 | 708.610 | 6520.048 | 4418.451 | 2786.141 | 274.419 | 109.300 | 5314.074 |
| 1981 | 849.162 | 18261.415 | 4743.509 | 2497.516 | 554.354 | 94.760 | 7284.143 |
| 1982 | 340.099 | 29950.638 | 9722.831 | 2437.852 | 799.025 | 273.584 | 10663.745 |
| 1983 | 66.349 | 10831.873 | 17948.557 | 1220.180 | 389.234 | 0.000 | 8764.871 |
| 1984 | 78.382 | 924.034 | 1838.208 | 4301.296 | 800.027 | 456.084 | 2786.308 |
| 1985 | 446.057 | 2695.893 | 677.859 | 802.869 | 1192.938 | 258.542 | 1584.178 |
| 1986 | 27.241 | 4834.425 | 1530.029 | 395.251 | 207.402 | 26.406 | 1758.656 |
| 1987 | 0.000 | 144.396 | 1170.711 | 278.430 | 0.000 | 0.000 | 532.962 |
| 1988 | 476.473 | 595.801 | 208.071 | 290.129 | 491.348 | 48.132 | 631.733 |
| 1989 | 229.797 | 15925.508 | 761.923 | 160.607 | 0.000 | 0.000 | 2968.641 |
| 1990 | 127.015 | 689.558 | 21804.632 | 3115.711 | 112.475 | 0.000 | 7193.394 |
| 1991 | 346.450 | 844.483 | 3564.609 | 5903.691 | 765.433 | 85.234 | 3563.105 |
| 1992 | 60.165 | 84.732 | 954.618 | 2669.488 | 0.000 | 0.000 | 1326.973 |
| 1993 | 27.241 | 423.328 | 187.180 | 827.102 | 28.578 | 0.000 | 569.896 |
| 1994 | 22.395 | 382.048 | 23.230 | 0.000 | 97.267 | 27.241 | 193.364 |
| 1995 | 26.406 | 1952.856 | 114.146 | 154.089 | 31.252 | 115.316 | 550.176 |
| 1996 | 0.000 | 664.322 | 2178.140 | 946.596 | 119.829 | 0.000 | 1247.922 |
| 1997 | 87.908 | 1479.223 | 1911.576 | 546.165 | 112.141 | 0.000 | 1318.115 |
| 1998 | 113.478 | 5040.490 | 644.601 | 269.238 | 60.666 | 34.261 | 1417.220 |
| 1999 | 59.329 | 1087.148 | 3225.513 | 583.266 | 124.341 | 38.272 | 1902.384 |
| 2000 | 32.088 | 1935.809 | 2478.297 | 355.141 | 0.000 | 0.000 | 1654.370 |
| 2001 | 0.000 | 115.651 | 1934.639 | 400.599 | 137.377 | 38.272 | 1090.491 |
| 2002 | 81.557 | 1990.292 | 393.078 | 333.916 | 111.807 | 0.000 | 851.669 |
| 2003 | 51.642 | 125.678 | 339.431 | 179.492 | 54.149 | 0.000 | 279.266 |
| 2004 | 27.241 | 227.123 | 488.172 | 169.465 | 58.494 | 32.088 | 383.051 |
| 2005 | 245.507 | 343.275 | 161.443 | 112.475 | 254.531 | 26.406 | 370.182 |
| 2006 | 83.897 | 2646.926 | 374.360 | 176.818 | 0.000 | 52.812 | 651.286 |
| 2007 | 0.000 | 962.974 | 1320.622 | 145.900 | 0.000 | 0.000 | 613.850 |
| 2008 | 0.000 | 83.061 | 1144.806 | 802.367 | 82.393 | 0.000 | 741.199 |

Table D7b. NEFSC Fall survey indices of minimum swept area abundance for Southern New England-Mid Atlantic yellowtail flounder in 000's and metric tons.

| Year | age 1 | age 2 | age 3 | age 4 | age 5 | age 6+ | B (mt) |
|---|---|---|---|---|---|---|---|
| 1973 | 2006.103 | 2935.399 | 5725.930 | 3248.458 | 2191.641 | 1302.439 | 4595.242 |
| 1974 | 949.631 | 1735.092 | 582.002 | 2273.783 | 962.842 | 698.954 | 2271.715 |
| 1975 | 1994.155 | 553.281 | 180.023 | 290.312 | 289.852 | 146.477 | 837.848 |
| 1976 | 2752.274 | 5892.512 | 490.439 | 64.795 | 102.247 | 714.348 | 2873.017 |
| 1977 | 2726.540 | 1714.068 | 618.076 | 93.745 | 33.431 | 92.826 | 1406.064 |
| 1978 | 2477.587 | 5684.227 | 352.579 | 280.776 | 28.606 | 88.690 | 2504.814 |
| 1979 | 1778.288 | 3910.879 | 1880.535 | 286.521 | 31.248 | 30.329 | 2272.404 |
| 1980 | 1373.667 | 3464.095 | 901.609 | 372.454 | 0.000 | 0.000 | 1692.585 |
| 1981 | 11330.772 | 11315.263 | 1490.734 | 235.397 | 108.336 | 57.787 | 5057.076 |
| 1982 | 2858.542 | 24940.267 | 6155.251 | 749.618 | 301.800 | 0.000 | 8390.548 |
| 1983 | 2691.156 | 15806.650 | 7839.909 | 642.316 | 53.651 | 37.108 | 6603.069 |
| 1984 | 2023.795 | 1786.560 | 2142.930 | 468.152 | 0.000 | 0.000 | 1519.570 |
| 1985 | 848.762 | 365.790 | 106.038 | 103.166 | 0.000 | 0.000 | 291.001 |
| 1986 | 604.519 | 1832.284 | 511.119 | 114.769 | 39.750 | 0.000 | 754.213 |
| 1987 | 1226.386 | 518.816 | 411.974 | 34.580 | 27.457 | 27.457 | 461.029 |
| 1988 | 5019.853 | 373.947 | 153.255 | 161.757 | 15.165 | 56.753 | 586.482 |
| 1989 | 134.989 | 10303.710 | 1337.364 | 70.769 | 0.000 | 0.000 | 2303.882 |
| 1990 | 240.797 | 2089.279 | 3043.275 | 189.214 | 0.000 | 0.000 | 1274.063 |
| 1991 | 574.075 | 237.235 | 1480.279 | 358.093 | 0.000 | 0.000 | 737.440 |
| 1992 | 192.431 | 27.457 | 82.257 | 326.845 | 0.000 | 0.000 | 168.879 |
| 1993 | 324.432 | 27.227 | 126.947 | 101.213 | 0.000 | 0.000 | 112.931 |
| 1994 | 841.065 | 514.450 | 122.811 | 163.710 | 60.659 | 28.606 | 353.728 |
| 1995 | 159.689 | 741.001 | 295.481 | 132.576 | 0.000 | 60.544 | 349.247 |
| 1996 | 514.910 | 184.733 | 367.054 | 0.000 | 0.000 | 0.000 | 238.499 |
| 1997 | 944.691 | 596.248 | 1676.501 | 311.450 | 27.227 | 0.000 | 978.122 |
| 1998 | 1022.467 | 1861.464 | 141.882 | 55.834 | 0.000 | 26.308 | 752.375 |
| 1999 | 1422.148 | 450.000 | 320.526 | 32.053 | 32.053 | 0.000 | 537.082 |
| 2000 | 56.753 | 1917.413 | 348.098 | 196.566 | 0.000 | 26.308 | 824.867 |
| 2001 | 448.507 | 701.711 | 181.976 | 81.568 | 0.000 | 0.000 | 481.938 |
| 2002 | 291.231 | 1977.957 | 982.372 | 191.741 | 0.000 | 0.000 | 1257.519 |
| 2003 | 1344.142 | 28.491 | 289.508 | 263.199 | 0.000 | 56.982 | 498.826 |
| 2004 | 80.649 | 112.471 | 0.000 | 26.423 | 55.029 | 28.491 | 118.216 |
| 2005 | 2031.148 | 532.832 | 212.880 | 84.325 | 164.744 | 0.000 | 569.250 |
| 2006 | 1369.991 | 2472.072 | 196.222 | 22.058 | 0.000 | 0.000 | 804.992 |
| 2007 | 257.455 | 1286.355 | 409.331 | 0.000 | 30.329 | 0.000 | 518.356 |

Table D7c. NEFSC Winter survey indices of minimum swept area abundance for Southern New England-Mid Atlantic yellowtail flounder in 000's and metric tons.

| Year | age 1 | age 2 | age 3 | age 4 | age 5 | age 6+ | B (mt) |
|---|---|---|---|---|---|---|---|
| 1992 | 13.717 | 2098.702 | 4591.911 | 10616.249 | 1235.388 | 0.000 | 6910.085 |
| 1993 | 852.026 | 2749.117 | 1510.728 | 3553.277 | 417.369 | 0.000 | 3026.172 |
| 1994 | 444.803 | 10510.800 | 901.322 | 2009.113 | 1173.519 | 571.971 | 4765.231 |
| 1995 | 128.311 | 15261.314 | 3854.908 | 853.169 | 361.357 | 286.771 | 4948.839 |
| 1996 | 58.154 | 1835.793 | 11767.192 | 1216.527 | 200.468 | 136.741 | 4780.949 |
| 1997 | 222.758 | 3400.961 | 13981.632 | 4226.839 | 755.436 | 53.582 | 8172.765 |
| 1998 | 168.891 | 11203.223 | 2280.310 | 1654.614 | 160.460 | 26.005 | 3972.931 |
| 1999 | 347.069 | 4155.968 | 14540.028 | 1109.935 | 444.517 | 112.880 | 7467.910 |
| 2000 | 155.174 | 7025.394 | 4294.709 | 1658.043 | 103.878 | 142.457 | 4322.000 |
| 2001 | 40.151 | 1278.682 | 12204.850 | 2307.458 | 362.215 | 202.469 | 6838.643 |
| 2002 | 17.289 | 3907.775 | 3683.588 | 2924.866 | 143.028 | 28.006 | 3698.734 |
| 2003 | 473.808 | 996.483 | 3710.451 | 756.150 | 60.869 | 37.007 | 2204.152 |
| 2004 | 72.157 | 1373.844 | 455.948 | 841.596 | 204.612 | 62.155 | 1184.092 |
| 2005 | 559.397 | 1112.792 | 880.318 | 741.861 | 837.881 | 148.029 | 1350.982 |
| 2006 | 993.912 | 26771.027 | 6512.578 | 493.669 | 127.311 | 205.041 | 5494.090 |
| 2007 | 46.152 | 9756.650 | 10771.280 | 1909.379 | 135.170 | 0.000 | 5582.822 |

Table D8a. Diagnostics for VPA estimates (Age 6+ formulation).

Model MSR 0.746

Stock Numbers Predicted in Terminal Year Plus One (2008)

| Age | N | Std. Error | CV |
|---|---|---|---|
| 2 | 953 | 487 | 0.51 |
| 3 | 6071 | 2083 | 0.34 |
| 4 | 5190 | 1602 | 0.31 |
| 5 | 237 | 90 | 0.38 |

Catchability Values for Each Survey Used in Estimate

| Index | Catchability | Std. Error | CV |
|---|---|---|---|
| NEFSC_S_1 | 0.014 | 0.002 | 0.168 |
| NEFSC_S_2 | 0.183 | 0.027 | 0.150 |
| NEFSC_S_3 | 0.283 | 0.037 | 0.131 |
| NEFSC_S_4 | 0.419 | 0.044 | 0.104 |
| NEFSC_S_5 | 0.550 | 0.095 | 0.173 |
| NEFSC_S_6 | 0.568 | 0.114 | 0.200 |
| NEFSC_F_1 | 0.101 | 0.016 | 0.158 |
| NEFSC_F_2 | 0.176 | 0.029 | 0.163 |
| NEFSC_F_3 | 0.200 | 0.025 | 0.124 |
| NEFSC_F_4 | 0.217 | 0.028 | 0.130 |
| NEFSC_F_5 | 0.222 | 0.042 | 0.190 |
| NEFSC_F_6 | 0.450 | 0.133 | 0.295 |
| NEFSC_W_1 | 0.045 | 0.013 | 0.276 |
| NEFSC_W_2 | 1.426 | 0.259 | 0.182 |
| NEFSC_W_3 | 2.292 | 0.418 | 0.183 |
| NEFSC_W_4 | 2.548 | 0.320 | 0.126 |
| NEFSC_W_5 | 1.895 | 0.439 | 0.232 |
| NEFSC_W_6 | 2.341 | 0.827 | 0.353 |

Table D8b. Diagnostics for VPA estimates (Age 7+ formulation).

Model MSR 1.528

Stock Numbers Predicted in Terminal Year Plus One (2008)

| Age | N | Std. Error | CV |
|---|---|---|---|
| 2 | 986 | 720 | 0.73 |
| 3 | 6321 | 3100 | 0.49 |
| 4 | 5534 | 2431 | 0.44 |
| 5 | 322 | 208 | 0.65 |
| 6 | 55 | 48 | 0.88 |

Catchability Values for Each Survey Used in Estimate

| Index | Catchability | Std. Error | CV |
|---|---|---|---|
| NEFSC_S_1 | 0.014 | 0.002 | 0.165 |
| NEFSC_S_2 | 0.177 | 0.026 | 0.148 |
| NEFSC_S_3 | 0.267 | 0.035 | 0.131 |
| NEFSC_S_4 | 0.367 | 0.041 | 0.111 |
| NEFSC_S_5 | 0.367 | 0.068 | 0.186 |
| NEFSC_S_6 | 0.250 | 0.068 | 0.271 |
| NEFSC_S_7 | 0.753 | 0.588 | 0.782 |
| NEFSC_F_1 | 0.098 | 0.015 | 0.157 |
| NEFSC_F_2 | 0.168 | 0.027 | 0.163 |
| NEFSC_F_3 | 0.183 | 0.023 | 0.128 |
| NEFSC_F_4 | 0.176 | 0.023 | 0.130 |
| NEFSC_F_5 | 0.138 | 0.030 | 0.220 |
| NEFSC_F_6 | 0.092 | 0.048 | 0.521 |
| NEFSC_F_7 | 0.555 | 0.702 | 1.265 |
| NEFSC_W_1 | 0.044 | 0.012 | 0.280 |
| NEFSC_W_2 | 1.365 | 0.246 | 0.180 |
| NEFSC_W_3 | 2.163 | 0.392 | 0.181 |
| NEFSC_W_4 | 2.284 | 0.260 | 0.114 |
| NEFSC_W_5 | 1.372 | 0.315 | 0.229 |
| NEFSC_W_6 | 1.521 | 0.593 | 0.390 |
| NEFSC_W_7 | 4.992 | 4.987 | 0.999 |

Table D9a. Mohn’s Rho retrospective statistics for F, SSB, and R (Age 6+ Formulation).

| | Mohn's rho | | |
|---|---|---|---|
| **Peel** | **F** | **SSB** | **Rec** |
| 2000 | -49% | 95% | -65% |
| 2001 | -24% | 8% | 66% |
| 2002 | 51% | -21% | 35% |
| 2003 | 204% | -31% | 221% |
| 2004 | 89% | -20% | -11% |
| 2005 | 24% | 20% | 76% |
| 2006 | 28% | 25% | 9% |
| **Average** | **46%** | **11%** | **47%** |

Table D9b. Mohn’s Rho retrospective statistics for F, SSB, and R (Age 7+ Formulation).

| | Mohn's rho | | |
|---|---|---|---|
| **Peel** | **F** | **SSB** | **Rec** |
| 2000 | 302% | 302% | -59% |
| 2001 | 149% | 149% | 67% |
| 2002 | -14% | -14% | 31% |
| 2003 | -30% | -30% | 248% |
| 2004 | -17% | -17% | -18% |
| 2005 | 8% | 8% | 71% |
| 2006 | 18% | 18% | 8% |
| **Average** | **59%** | **59%** | **50%** |

Table D10. Estimated population abundance at age (000's).

| | age 1 | age 2 | age 3 | age 4 | age 5 | age 6+ | sum |
|---|---|---|---|---|---|---|---|
| 1973 | 42491 | 18128 | 29322 | 16834 | 11027 | 13264 | 131066 |
| 1974 | 10362 | 34590 | 9789 | 13316 | 6662 | 6047 | 80766 |
| 1975 | 31479 | 7707 | 3386 | 3074 | 4344 | 3950 | 53940 |
| 1976 | 14339 | 17773 | 2633 | 1096 | 1504 | 3002 | 40347 |
| 1977 | 49917 | 11547 | 8572 | 1101 | 604 | 1409 | 73150 |
| 1978 | 53116 | 35899 | 4961 | 2670 | 449 | 325 | 97420 |
| 1979 | 30998 | 35657 | 16692 | 2127 | 877 | 262 | 86613 |
| 1980 | 43355 | 25194 | 11907 | 5943 | 795 | 259 | 87453 |
| 1981 | 136011 | 34588 | 11488 | 3880 | 1473 | 243 | 187683 |
| 1982 | 62906 | 111322 | 21995 | 2697 | 602 | 125 | 199647 |
| 1983 | 16407 | 51350 | 59128 | 5292 | 566 | 282 | 133025 |
| 1984 | 18836 | 11031 | 24770 | 10637 | 1149 | 361 | 66784 |
| 1985 | 20560 | 14955 | 3516 | 2772 | 1562 | 346 | 43711 |
| 1986 | 7067 | 14815 | 5055 | 949 | 532 | 223 | 28641 |
| 1987 | 14717 | 5369 | 3309 | 1194 | 215 | 84 | 24888 |
| 1988 | 121166 | 10612 | 1349 | 620 | 164 | 39 | 133950 |
| 1989 | 17049 | 93879 | 6791 | 625 | 65 | 4 | 118413 |
| 1990 | 8019 | 13937 | 58946 | 2575 | 105 | 6 | 83588 |
| 1991 | 4092 | 6392 | 9559 | 10656 | 184 | 56 | 30939 |
| 1992 | 2476 | 2948 | 3787 | 3224 | 350 | 21 | 12806 |
| 1993 | 2223 | 1598 | 1118 | 1234 | 252 | 7 | 6432 |
| 1994 | 4434 | 1809 | 898 | 515 | 379 | 110 | 8145 |
| 1995 | 4288 | 3304 | 721 | 379 | 67 | 47 | 8806 |
| 1996 | 3465 | 3510 | 2369 | 413 | 57 | 53 | 9867 |
| 1997 | 6904 | 2834 | 2406 | 942 | 131 | 50 | 13267 |
| 1998 | 3624 | 5633 | 1884 | 629 | 83 | 49 | 11902 |
| 1999 | 5372 | 2950 | 3298 | 534 | 164 | 10 | 12328 |
| 2000 | 4192 | 4389 | 1987 | 739 | 79 | 19 | 11405 |
| 2001 | 2428 | 3429 | 2779 | 570 | 151 | 47 | 9404 |
| 2002 | 1133 | 1987 | 2442 | 781 | 50 | 2 | 6395 |
| 2003 | 1326 | 926 | 1402 | 1135 | 294 | 76 | 5159 |
| 2004 | 1666 | 1084 | 619 | 617 | 621 | 246 | 4853 |
| 2005 | 10877 | 1360 | 636 | 289 | 228 | 100 | 13490 |
| 2006 | 9408 | 8846 | 910 | 326 | 103 | 134 | 19727 |
| 2007 | 1170 | 7686 | 6961 | 437 | 143 | 49 | 16446 |
| 2008 | 9744 | 953 | 6071 | 5190 | 237 | 104 | 22299 |

Table D11. Estimated fishing mortality rate at age

| | age 1 | age 2 | age 3 | age 4 | age 5 | age 6+ |
|---|---|---|---|---|---|---|
| 1973 | 0.01 | 0.42 | 0.59 | 0.73 | 0.73 | 0.73 |
| 1974 | 0.10 | 2.12 | 0.96 | 0.92 | 0.92 | 0.92 |
| 1975 | 0.37 | 0.87 | 0.93 | 0.51 | 0.51 | 0.51 |
| 1976 | 0.02 | 0.53 | 0.67 | 0.40 | 0.40 | 0.40 |
| 1977 | 0.13 | 0.64 | 0.97 | 0.70 | 0.70 | 0.70 |
| 1978 | 0.20 | 0.57 | 0.65 | 0.91 | 0.91 | 0.91 |
| 1979 | 0.01 | 0.90 | 0.83 | 0.78 | 0.78 | 0.78 |
| 1980 | 0.03 | 0.59 | 0.92 | 1.19 | 1.19 | 1.19 |
| 1981 | 0.00 | 0.25 | 1.25 | 1.66 | 1.66 | 1.66 |
| 1982 | 0.00 | 0.43 | 1.22 | 1.36 | 1.36 | 1.36 |
| 1983 | 0.20 | 0.53 | 1.52 | 1.33 | 1.33 | 1.33 |
| 1984 | 0.03 | 0.94 | 1.99 | 1.72 | 1.72 | 1.72 |
| 1985 | 0.13 | 0.88 | 1.11 | 1.45 | 1.45 | 1.45 |
| 1986 | 0.07 | 1.30 | 1.24 | 1.28 | 1.28 | 1.28 |
| 1987 | 0.13 | 1.18 | 1.47 | 1.78 | 1.78 | 1.78 |
| 1988 | 0.06 | 0.25 | 0.57 | 2.06 | 2.06 | 2.06 |
| 1989 | 0.00 | 0.27 | 0.77 | 1.59 | 1.59 | 1.59 |
| 1990 | 0.03 | 0.18 | 1.51 | 2.44 | 2.44 | 2.44 |
| 1991 | 0.13 | 0.32 | 0.89 | 3.22 | 3.22 | 3.22 |
| 1992 | 0.24 | 0.77 | 0.92 | 2.35 | 2.35 | 2.35 |
| 1993 | 0.01 | 0.38 | 0.57 | 0.98 | 0.98 | 0.98 |
| 1994 | 0.09 | 0.72 | 0.66 | 1.84 | 1.84 | 1.84 |
| 1995 | 0.00 | 0.13 | 0.36 | 1.70 | 1.70 | 1.70 |
| 1996 | 0.00 | 0.18 | 0.72 | 0.94 | 0.94 | 0.94 |
| 1997 | 0.00 | 0.21 | 1.14 | 2.23 | 2.23 | 2.23 |
| 1998 | 0.01 | 0.34 | 1.06 | 1.15 | 1.15 | 1.15 |
| 1999 | 0.00 | 0.19 | 1.30 | 1.71 | 1.71 | 1.71 |
| 2000 | 0.00 | 0.26 | 1.05 | 1.39 | 1.39 | 1.39 |
| 2001 | 0.00 | 0.14 | 1.07 | 2.23 | 2.23 | 2.23 |
| 2002 | 0.00 | 0.15 | 0.57 | 0.78 | 0.78 | 0.78 |
| 2003 | 0.00 | 0.20 | 0.62 | 0.40 | 0.40 | 0.40 |
| 2004 | 0.00 | 0.33 | 0.56 | 0.80 | 0.80 | 0.80 |
| 2005 | 0.01 | 0.20 | 0.47 | 0.83 | 0.83 | 0.83 |
| 2006 | 0.00 | 0.04 | 0.53 | 0.63 | 0.63 | 0.63 |
| 2007 | 0.01 | 0.04 | 0.09 | 0.41 | 0.41 | 0.41 |

Table D12. Estimated spawning stock biomass (mt).

| | age 1 | age 2 | age 3 | age 4 | age 5 | age 6+ | sum |
|---|---|---|---|---|---|---|---|
| 1973 | 0 | 1876 | 7852 | 5731 | 5523 | 7833 | 28815 |
| 1974 | 0 | 1982 | 2071 | 3306 | 1834 | 1733 | 10926 |
| 1975 | 0 | 698 | 775 | 986 | 1403 | 1411 | 5273 |
| 1976 | 0 | 1947 | 728 | 426 | 586 | 1304 | 4991 |
| 1977 | 0 | 1126 | 1956 | 382 | 213 | 525 | 4202 |
| 1978 | 0 | 3746 | 1300 | 900 | 187 | 134 | 6267 |
| 1979 | 0 | 3330 | 3848 | 670 | 343 | 115 | 8306 |
| 1980 | 0 | 2501 | 2791 | 1662 | 303 | 134 | 7391 |
| 1981 | 0 | 3677 | 2092 | 846 | 404 | 73 | 7092 |
| 1982 | 0 | 11021 | 4177 | 702 | 207 | 54 | 16161 |
| 1983 | 0 | 4847 | 9553 | 1389 | 200 | 122 | 16111 |
| 1984 | 0 | 796 | 2857 | 1856 | 252 | 107 | 5868 |
| 1985 | 0 | 1212 | 724 | 569 | 396 | 106 | 3007 |
| 1986 | 0 | 1104 | 893 | 237 | 168 | 77 | 2479 |
| 1987 | 0 | 397 | 566 | 211 | 49 | 23 | 1246 |
| 1988 | 0 | 1265 | 378 | 119 | 39 | 13 | 1814 |
| 1989 | 0 | 12807 | 1740 | 164 | 23 | 2 | 14736 |
| 1990 | 0 | 1908 | 10640 | 391 | 27 | 2 | 12968 |
| 1991 | 0 | 660 | 1995 | 1062 | 30 | 11 | 3758 |
| 1992 | 0 | 305 | 851 | 484 | 72 | 7 | 1719 |
| 1993 | 0 | 218 | 339 | 340 | 99 | 4 | 1000 |
| 1994 | 0 | 120 | 216 | 92 | 82 | 32 | 542 |
| 1995 | 0 | 320 | 198 | 77 | 18 | 18 | 631 |
| 1996 | 0 | 505 | 599 | 120 | 22 | 24 | 1270 |
| 1997 | 0 | 298 | 539 | 175 | 32 | 15 | 1059 |
| 1998 | 0 | 618 | 417 | 186 | 28 | 19 | 1268 |
| 1999 | 0 | 443 | 740 | 147 | 57 | 5 | 1392 |
| 2000 | 0 | 619 | 551 | 238 | 30 | 9 | 1447 |
| 2001 | 0 | 551 | 708 | 127 | 41 | 16 | 1443 |
| 2002 | 0 | 315 | 818 | 326 | 28 | 1 | 1488 |
| 2003 | 0 | 133 | 423 | 547 | 146 | 50 | 1299 |
| 2004 | 0 | 136 | 177 | 201 | 236 | 121 | 871 |
| 2005 | 0 | 168 | 198 | 99 | 99 | 55 | 619 |
| 2006 | 0 | 1000 | 255 | 123 | 49 | 81 | 1508 |
| 2007 | 0 | 932 | 2292 | 170 | 81 | 33 | 3508 |

Table D13a. Bootstrap estimates of uncertainty in 2007 Fishing Mortality (F) and Spawning Stock Biomass (SSB)

| | Point | 10th%ile | 90th%ile | CV's |
|---|---|---|---|---|
| F 2007 | | | | |
| age 1 | 0.006 | 0.003 | 0.012 | 0.619 |
| age 2 | 0.036 | 0.022 | 0.056 | 0.361 |
| age 3 | 0.094 | 0.066 | 0.133 | 0.286 |
| age 4 | 0.413 | 0.290 | 0.626 | 0.334 |
| age 5 | 0.413 | 0.290 | 0.626 | 0.334 |
| age 6+ | 0.413 | 0.290 | 0.626 | 0.334 |
| Avg F 4-5 | 0.413 | 0.290 | 0.626 | 0.334 |
| | | | | |
| SSB | 3508 | 2679 | 4609 | 0.207 |

Table D13b. Mohn's rho adjusted estimate in 2007 Fishing Mortality and Spawning Stock Biomass

| | |
|---|---|
| SSB adj | 3160 |
| F adj. | 0.282 |

Table D14. Values of Partial Recruitment, maturity, and weight at age (kg) used in yield per recruit calculations and age based projections

| Age | PR | Maturity | WAA |
|---|---|---|---|
| 1 | 0.006 | 0.000 | 0.119 |
| 2 | 0.265 | 0.490 | 0.298 |
| 3 | 0.741 | 0.974 | 0.407 |
| 4 | 1.000 | 1.000 | 0.535 |
| 5 | 1.000 | 1.000 | 0.659 |
| 6+ | 1.000 | 1.000 | 0.830 |

Table D15. Biological Reference Points for Southern New England-Mid Atlantic yellowtail flounder from GARM-II, GARM-III Reference points meeting, and this assessment.

| | GARM-II | GARM-III BRP | GARM-III Final |
|---|---|---|---|
| Fmsy | 0.26 | 0.264 | 0.254 |
| SSBmsy (mt) | 69500 | 27600 | 27400 |
| MSY (mt) | 14200 | 6300 | 6100 |

Table D16. Four projection scenarios for 2009 catch, based on the assumption that catch in 2007 equal to catch in 2008: F status quo applied F2007 in 2009; F2008 uses F2008 from the 100year projections in 2009; $F_{MSY}$ is assumed in 2009; and $F_{REBUILD}$ is solved iteratively to generate a 50% probability of SSB>$SSB_{MSY}$ in 2014, assuming that F is applied every year from 2009 to 2014.

| | 2007 | 2008 | 2009 | | | |
|---|---|---|---|---|---|---|
| | | | $F_{STATUS\ QUO}$ | F2008 | Fmsy | $F_{REBUILD}$ |
| C(mt) | 396 | 396 | 1893 | 525 | 1247 | 425 |
| F(4-5) | 0.413 | 0.089 | 0.413 | 0.089 | 0.254 | 0.080 |
| SSB(mt) | 3508 | 5143 | 4957 | 6604 | 5272 | 5638 |

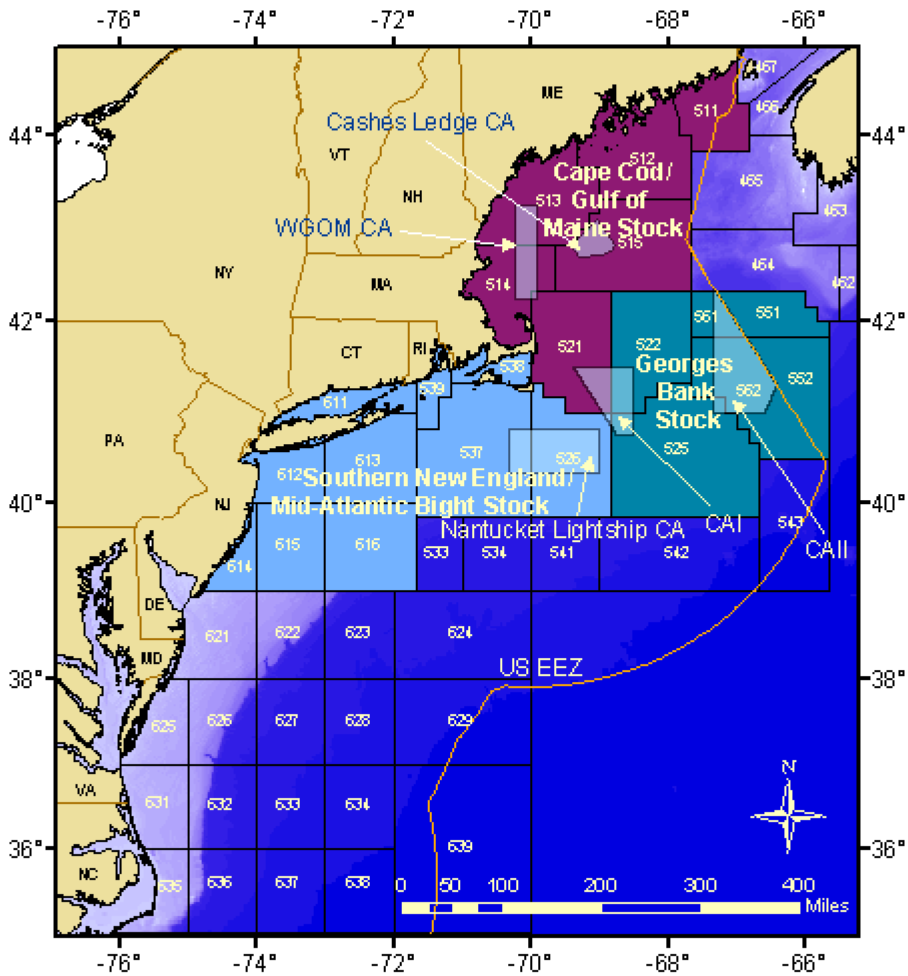



Figure D1. Statistical areas used to define the Southern New England-Mid Atlantic yellowtail flounder stock (http://www.nefsc.noaa.gov/sos)

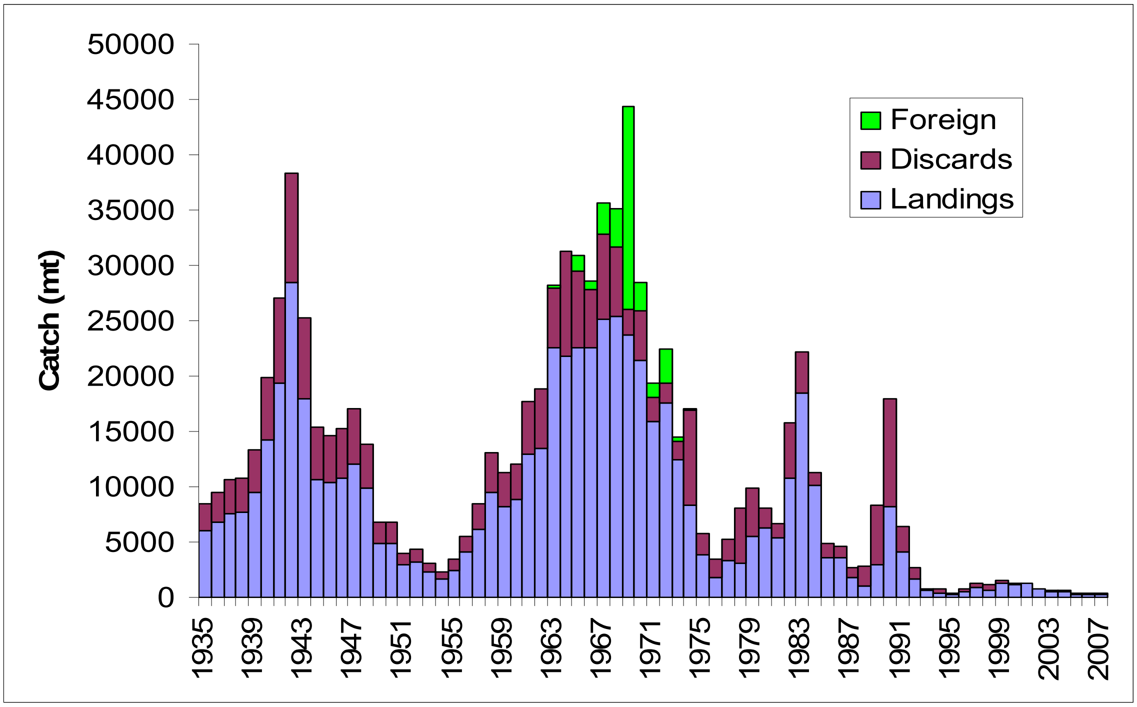



Figure D2. Total catch (mt) of Southern New England-Mid Atlantic yellowtail flounder.

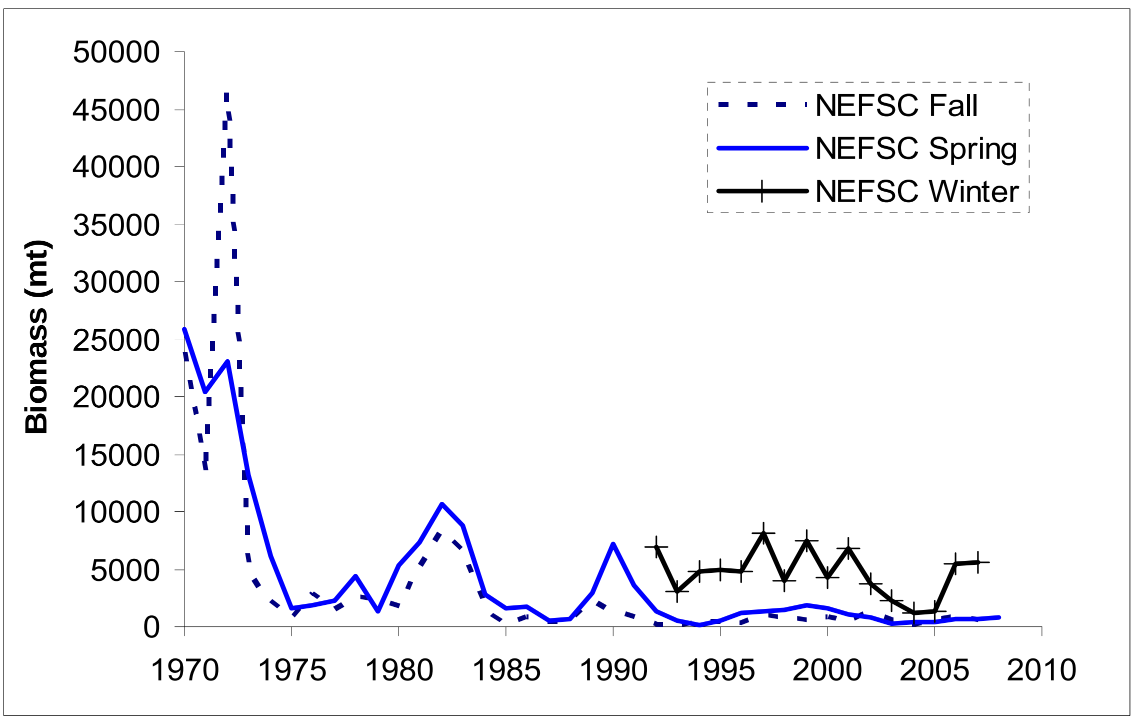
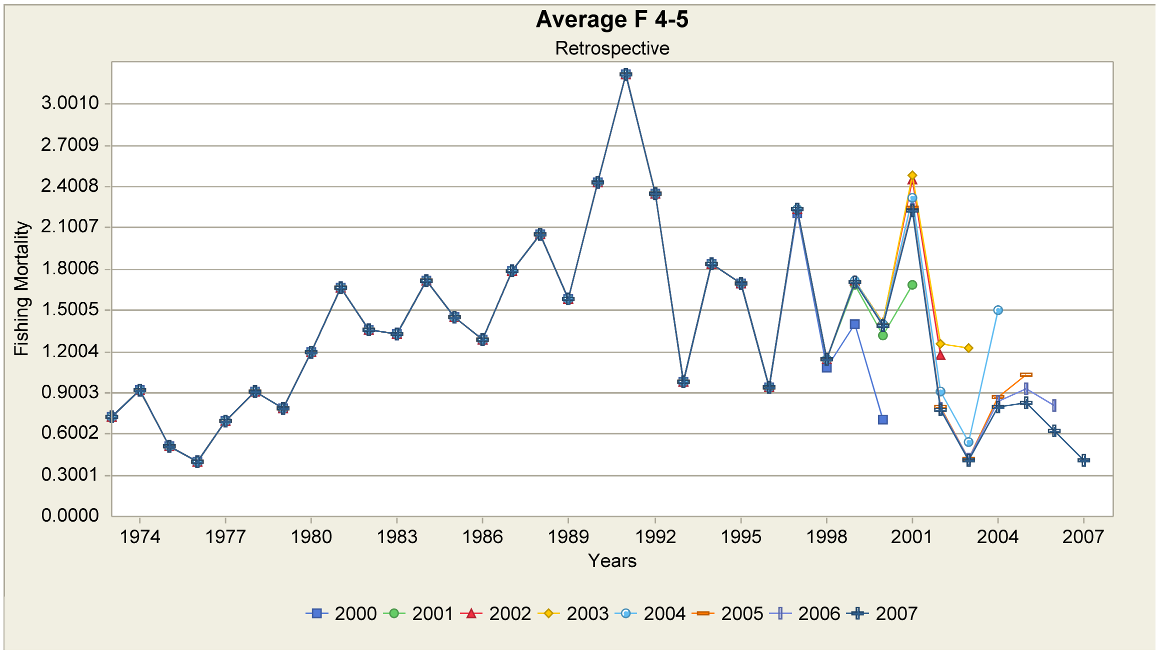



Figure D3. Trends in survey biomass for Southern New England-Mid Atlantic yellowtail flounder.



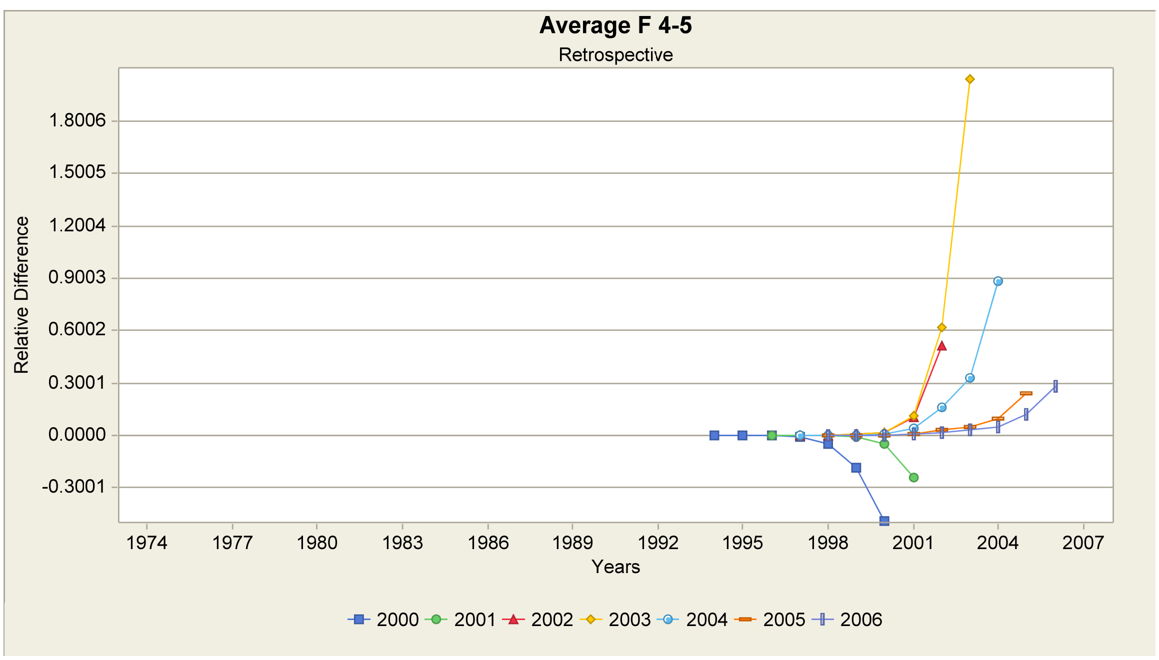
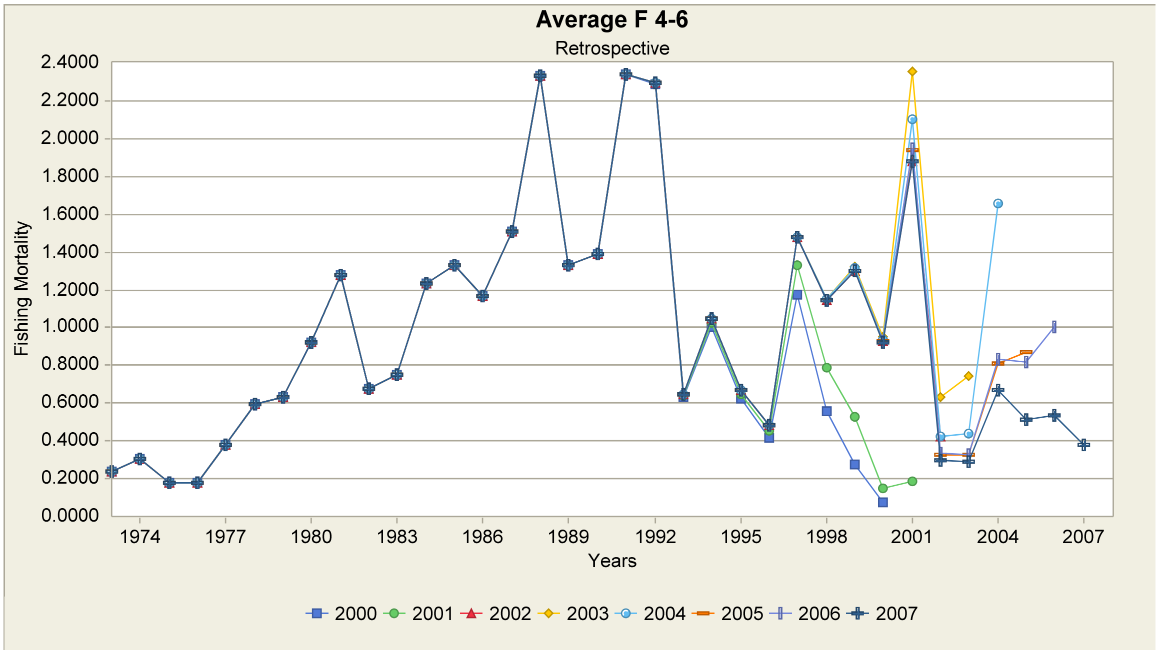




Figure D4a. Age 6+ VPA formulation - Retrospective plots of fully recruited fishing mortality rate (ages 4-5)



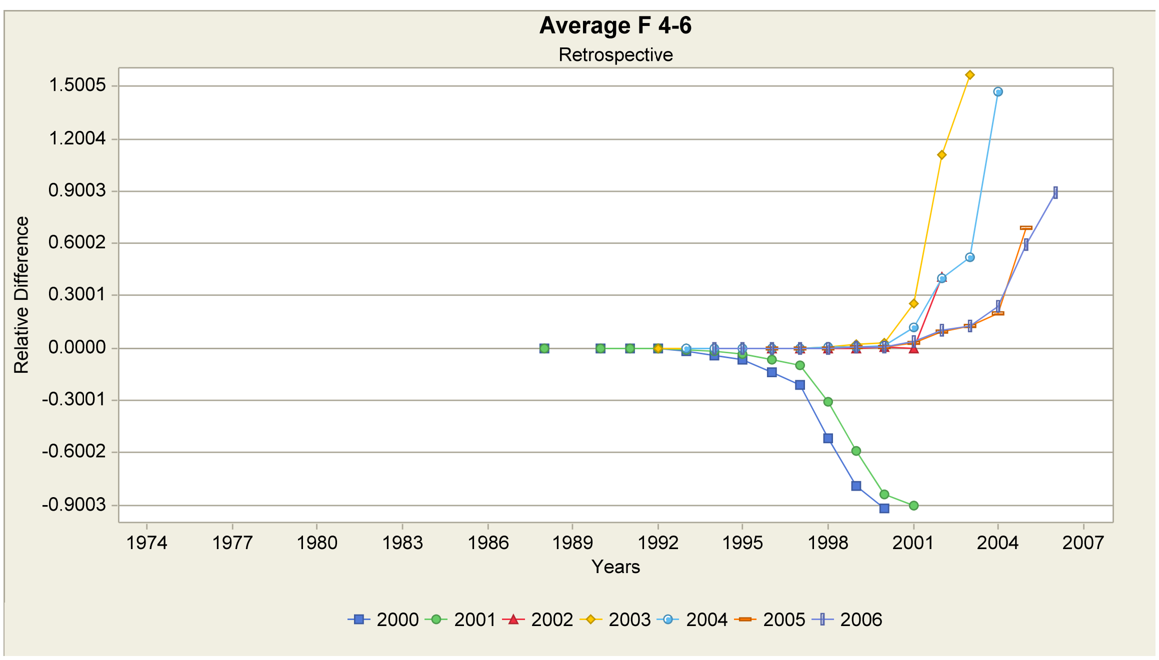
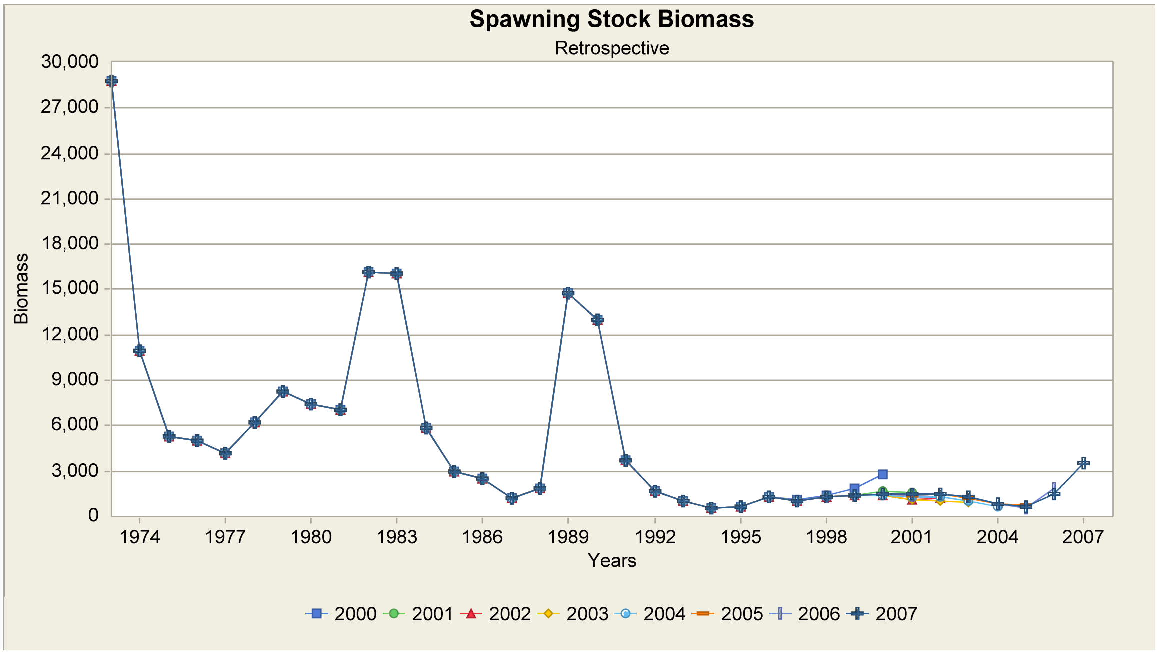




Figure D4b. Age 7+ VPA formulation - Retrospective plots of fully recruited fishing mortality rate (ages 4-5)



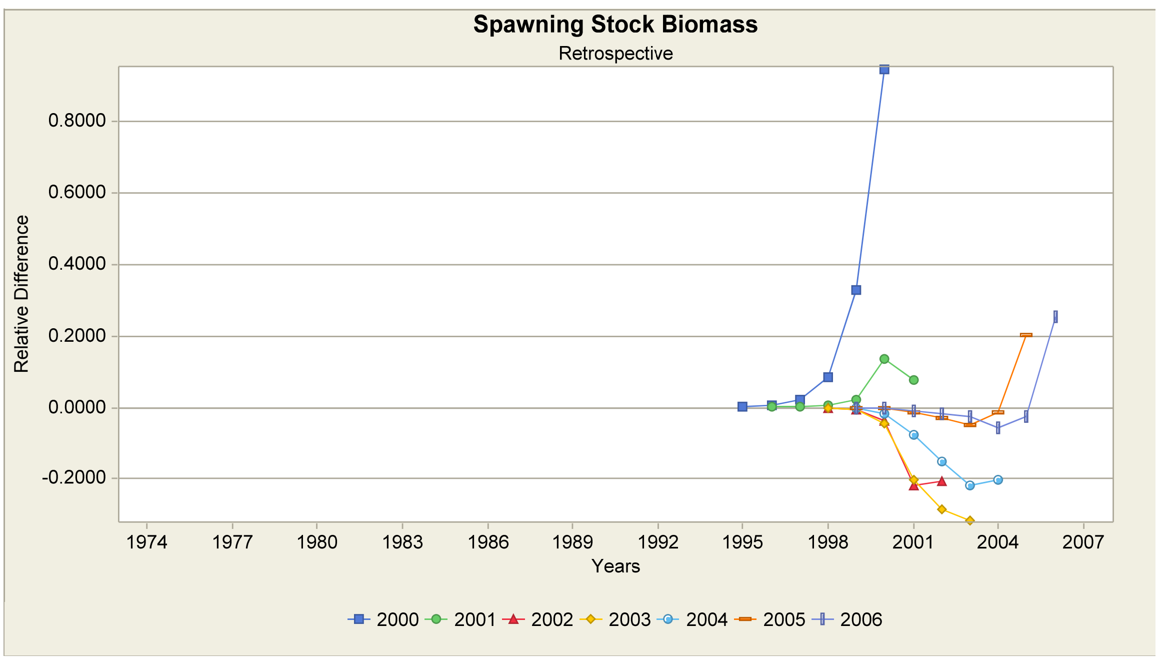
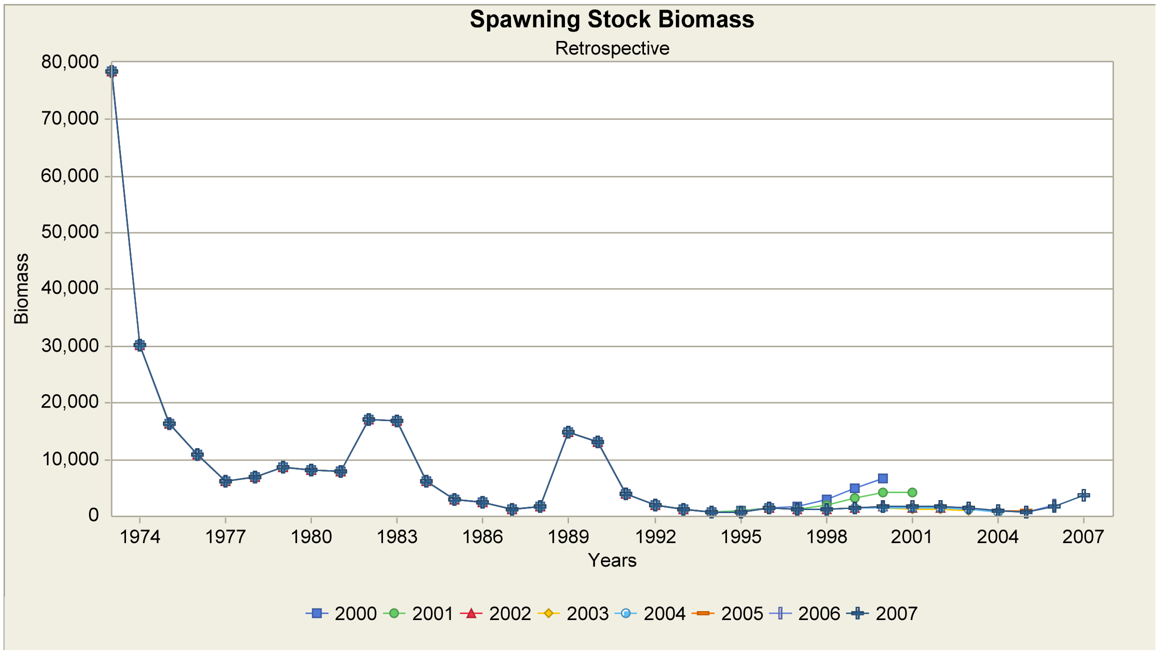




Figure D5a. Age 6+ VPA formulation - Retrospective plots of spawning stock biomass



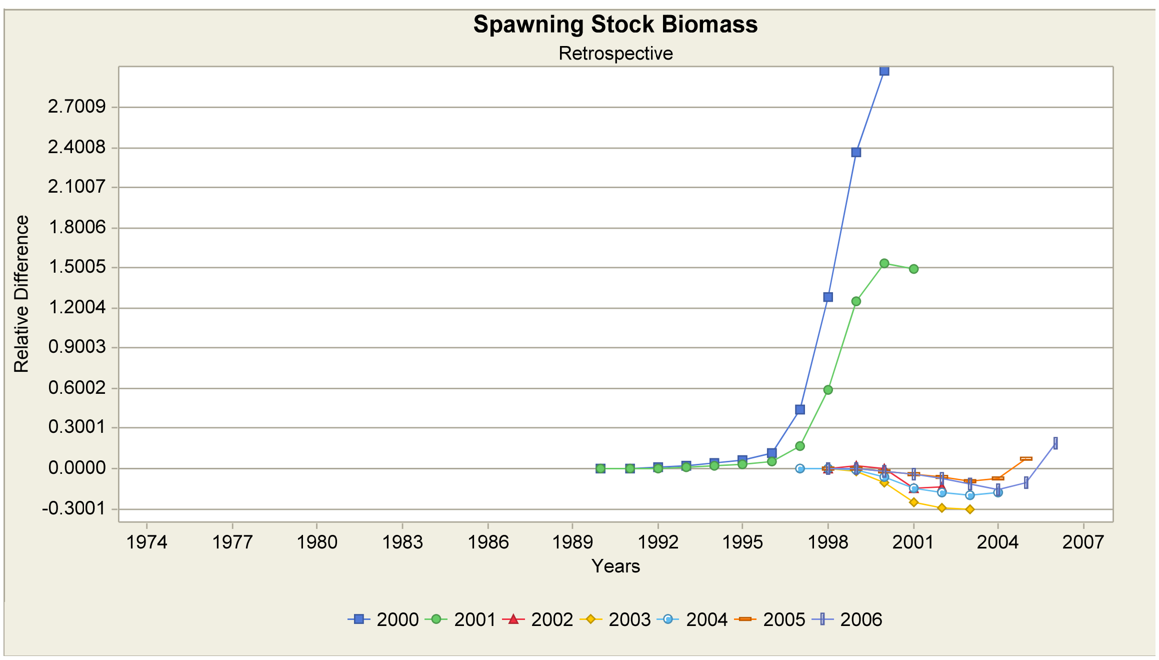
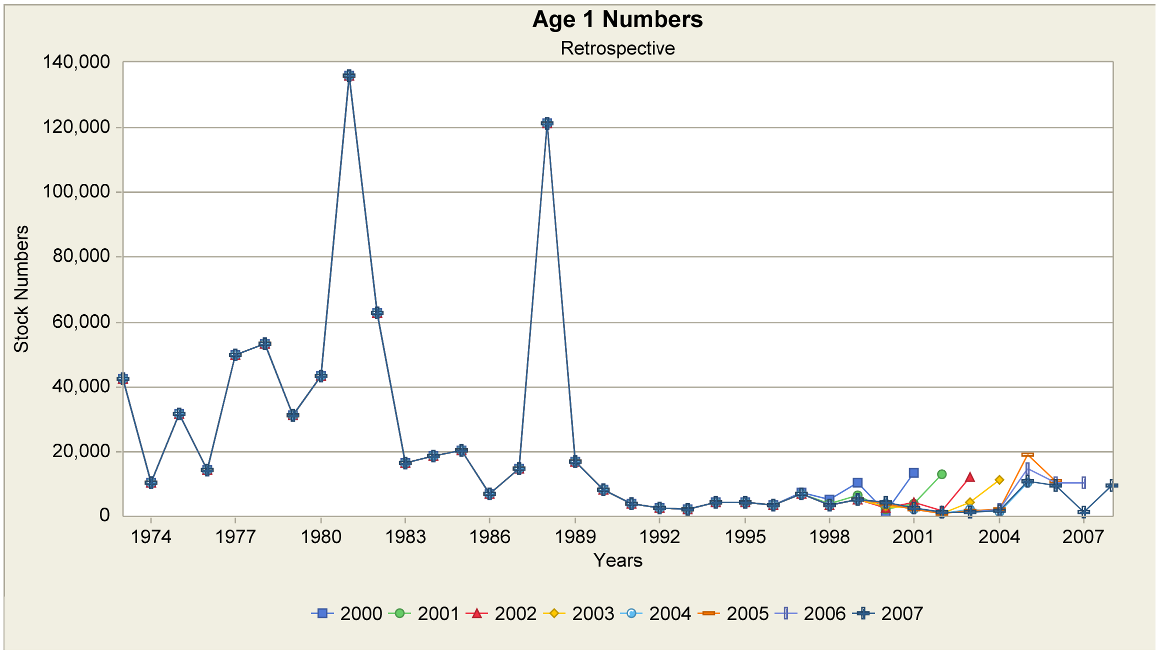




Figure D5b. Age 7+ VPA formulation - Retrospective plots of spawning stock biomass



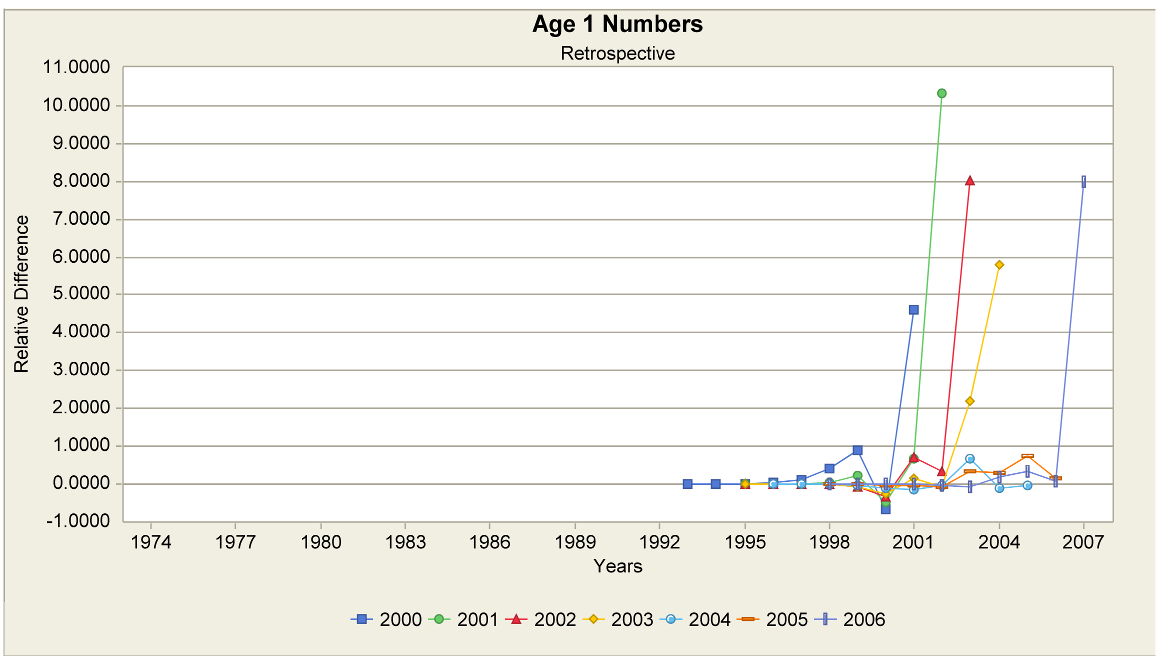
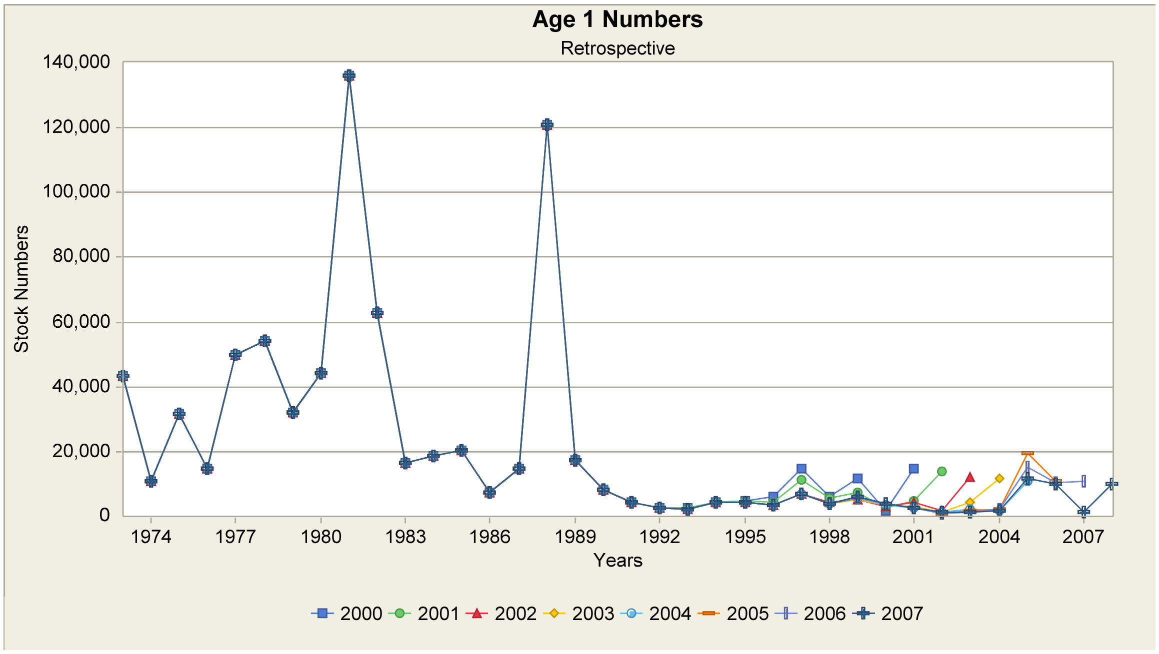




Figure D6a. Age 6+ VPA formulation - Retrospective plots of Age-1 recruitment.



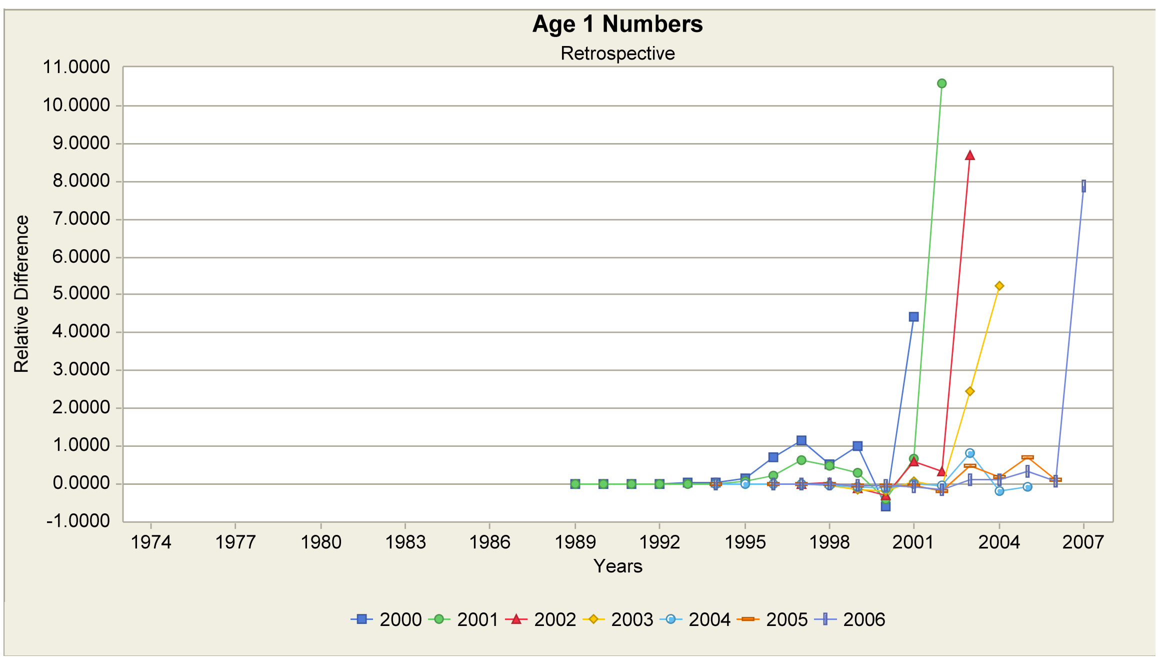




Figure D6b. Age 7+ VPA formulation - Retrospective plots of Age-1 recruitment.

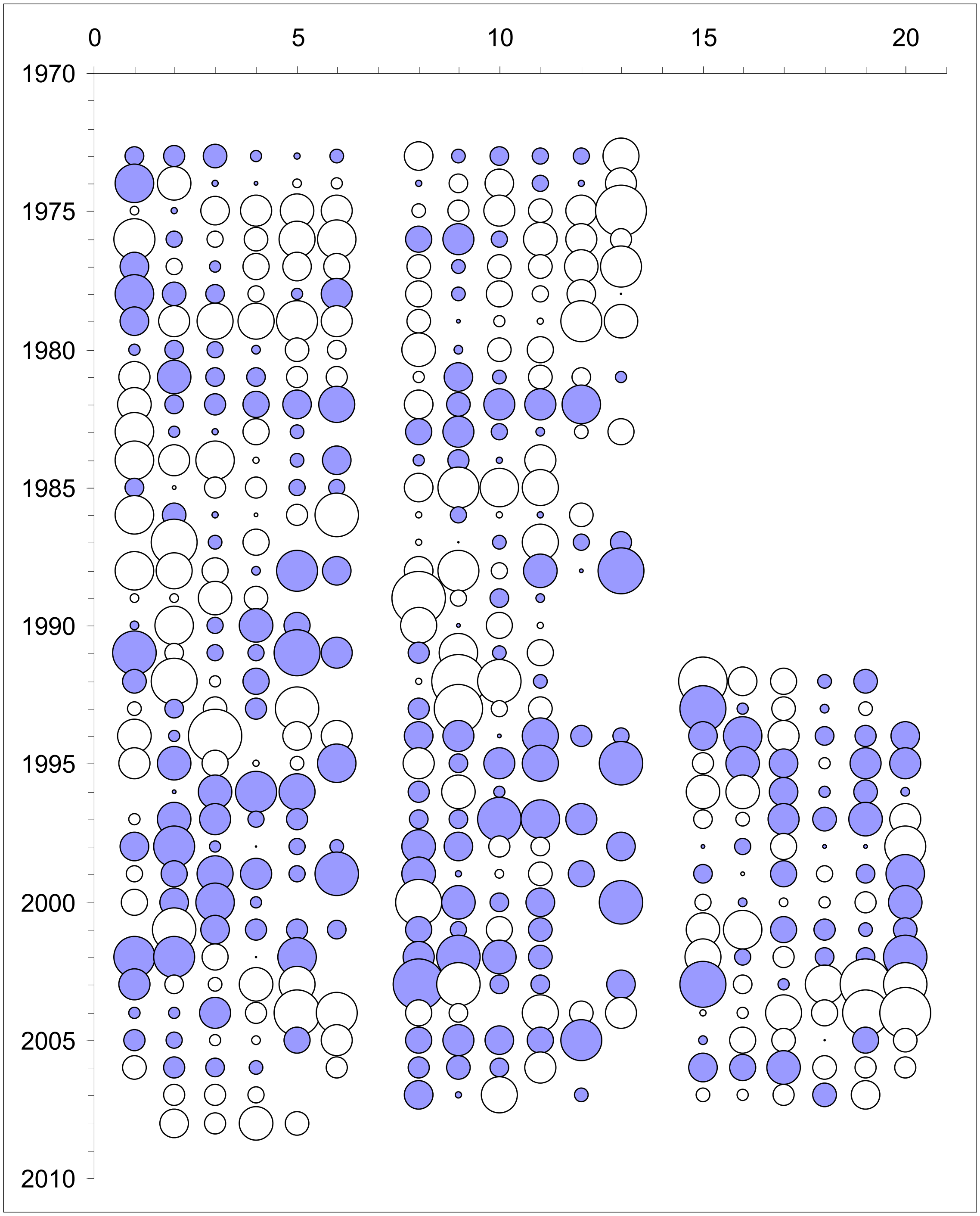
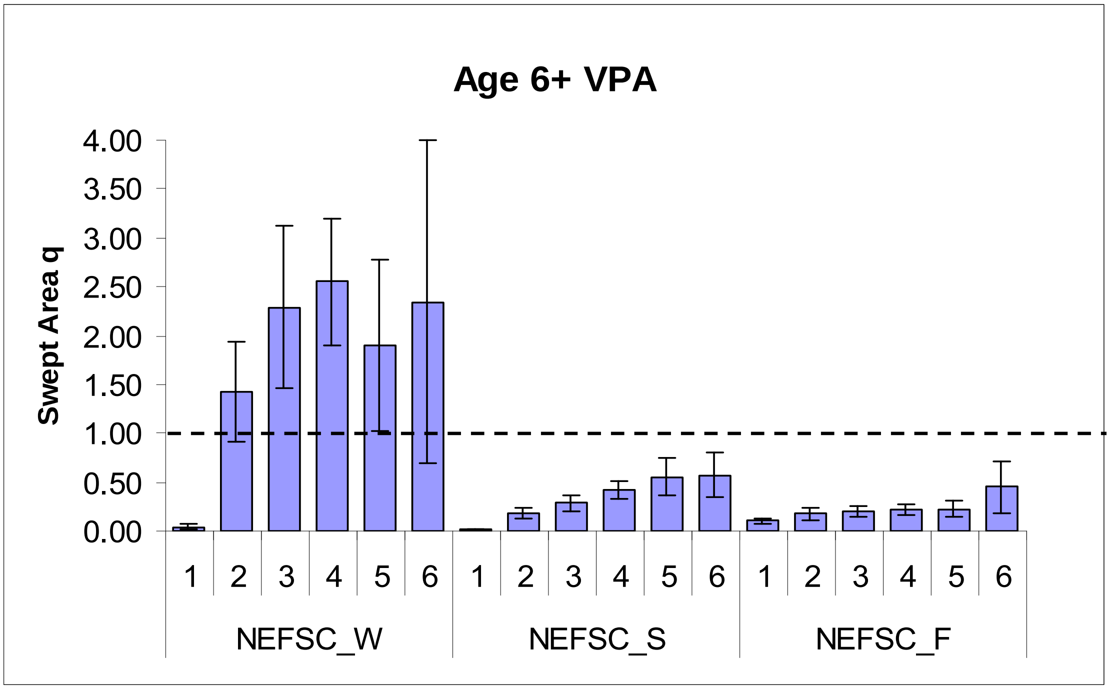



Figure D7. Residuals for indices of abundance in VPA grouped by survey: columns 1-6 are the NEFSC Spring ages 1-6, columns 8-13 are the NEFSC Fall ages 1-6 and columns 15-20 are the NEFSC autumn ages 1-6.



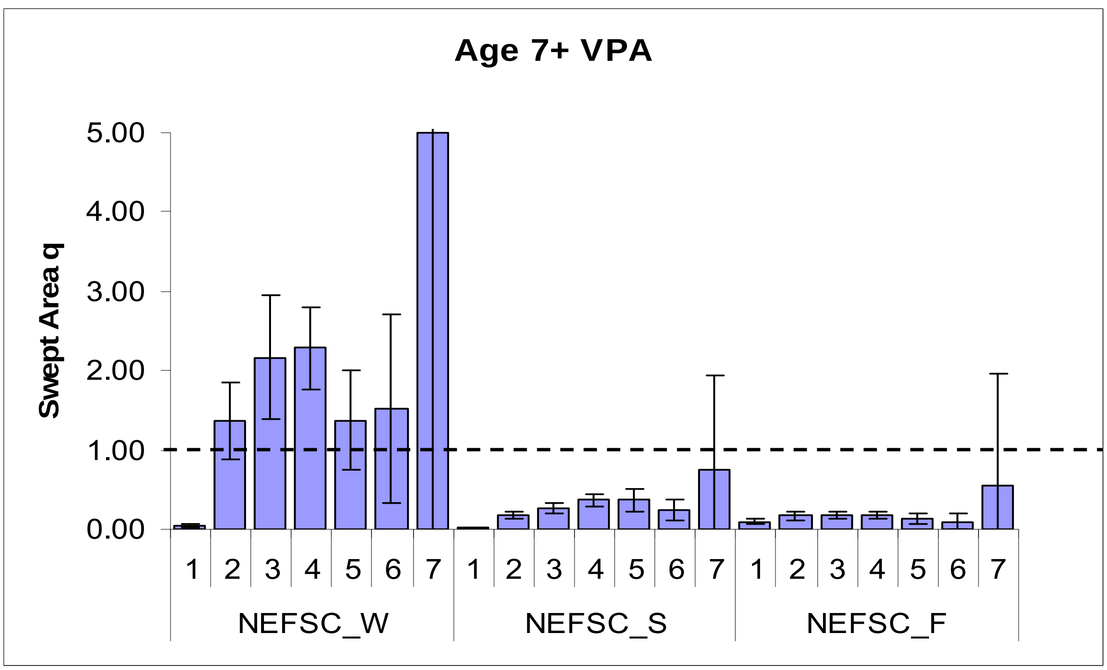




Figure D8. Catchability estimates with two standard deviations for swept area indices for both ages 6+ and 7+ formulation.

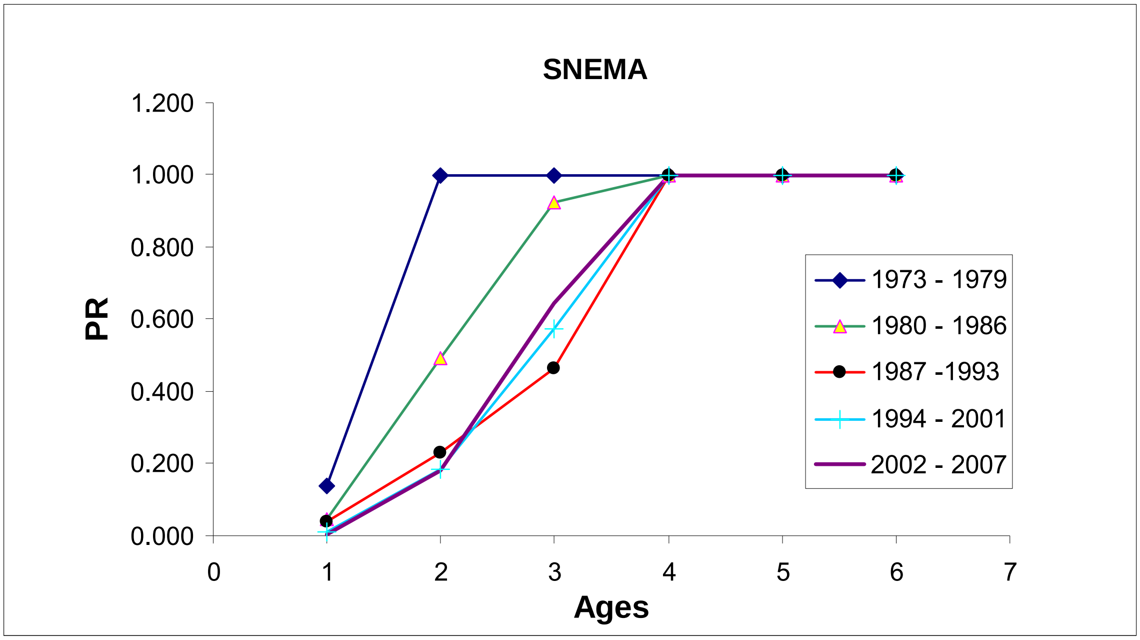



Figure D9. Average back-calculated partial recruitment from VPA showing age 2 PR is well below 1.0 in recent years

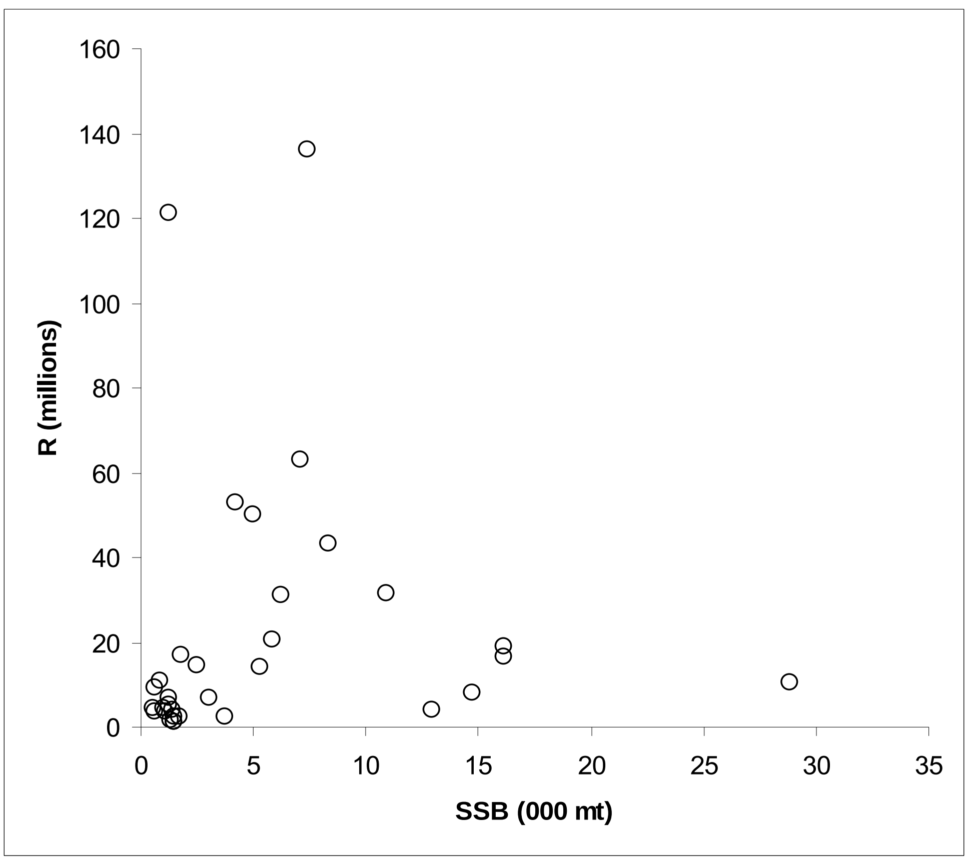



Figure D10. Stock recruitment relationship for Southern New England-Mid Atlantic yellowtail flounder

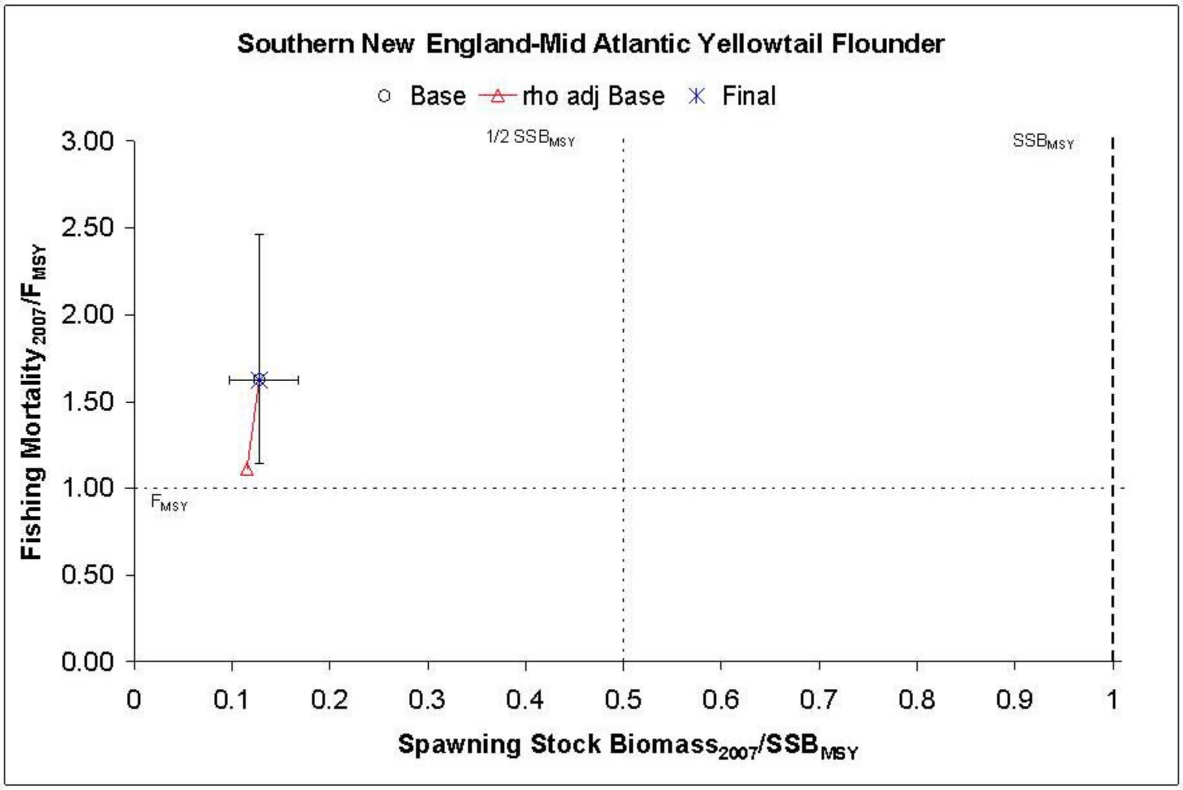



Figure D11. Current Status of Southern New England-Mid Atlantic yellowtail flounder with rho-adjusted base-run (triangle) and the associated point estimate base-run (circle) with 80% confidence intervals. The final accepted VPA run (asterisk) is the point estimate base-run for the 2007 status determination.