

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 Methodology (SBRM) recommended in the GARM III data meeting (GARM 2007).

Three commercial fleets (large mesh otter trawl, $\geq 5.5''$; 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 $F_{40\%MSP}$ 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 ($F_{2007} = 1.6F_{MSY}$; 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 $F_{status-quo}$ 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 ($SSB_{2007}/SSB_{MSY} = 13\%$) and overfishing is still occurring ($F_{2007}/F_{MSY} = 160\%$). 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.

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

Year	Otter Trawl Large Mesh		Otter Trawl Small Mesh		Scallop Dredge	
	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).

Peel	Mohn's rho		
	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).

Peel	Mohn's rho		
	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
F _{msy}	0.26	0.264	0.254
SSB _{msy} (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}	F ₂₀₀₈	F _{msy}	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

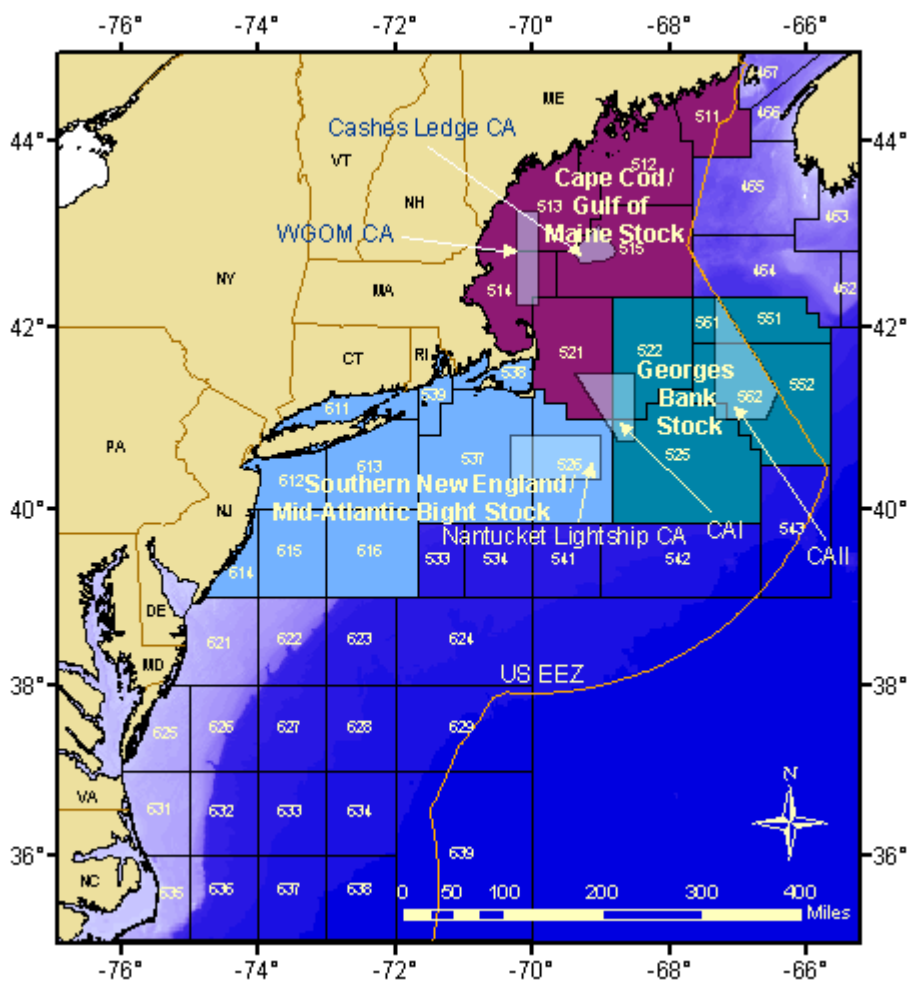


Figure D1. Statistical areas used to define the Southern New England-Mid Atlantic yellowtail flounder stock (<http://www.nefsc.noaa.gov/sos>)

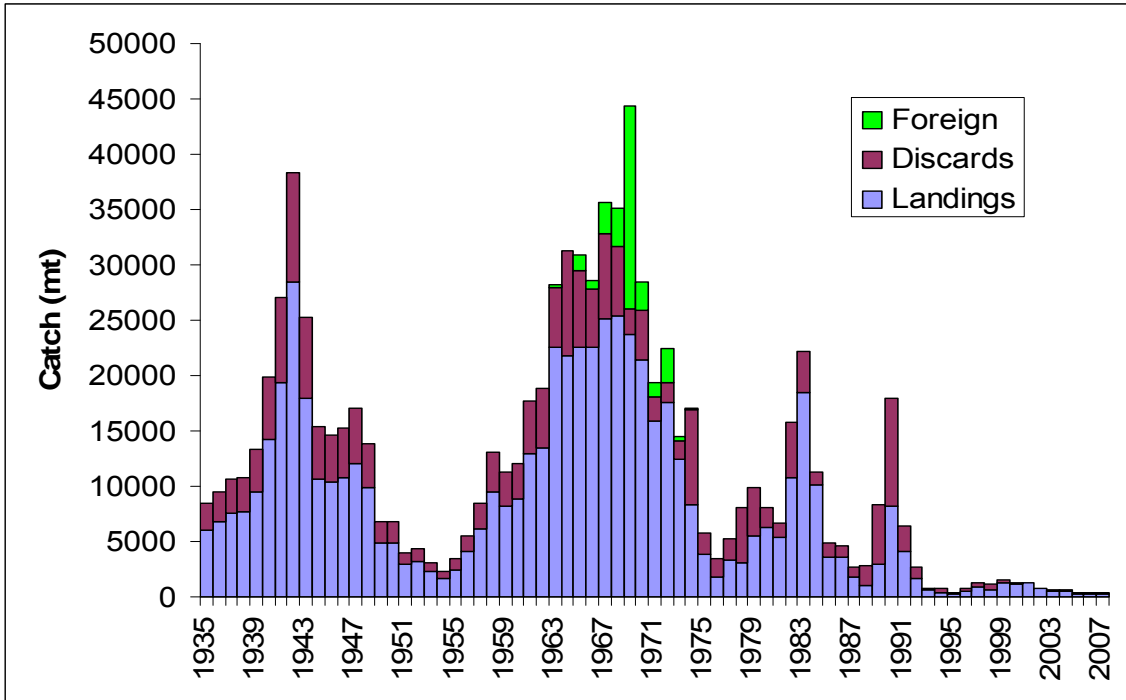


Figure D2. Total catch (mt) of Southern New England-Mid Atlantic yellowtail flounder.

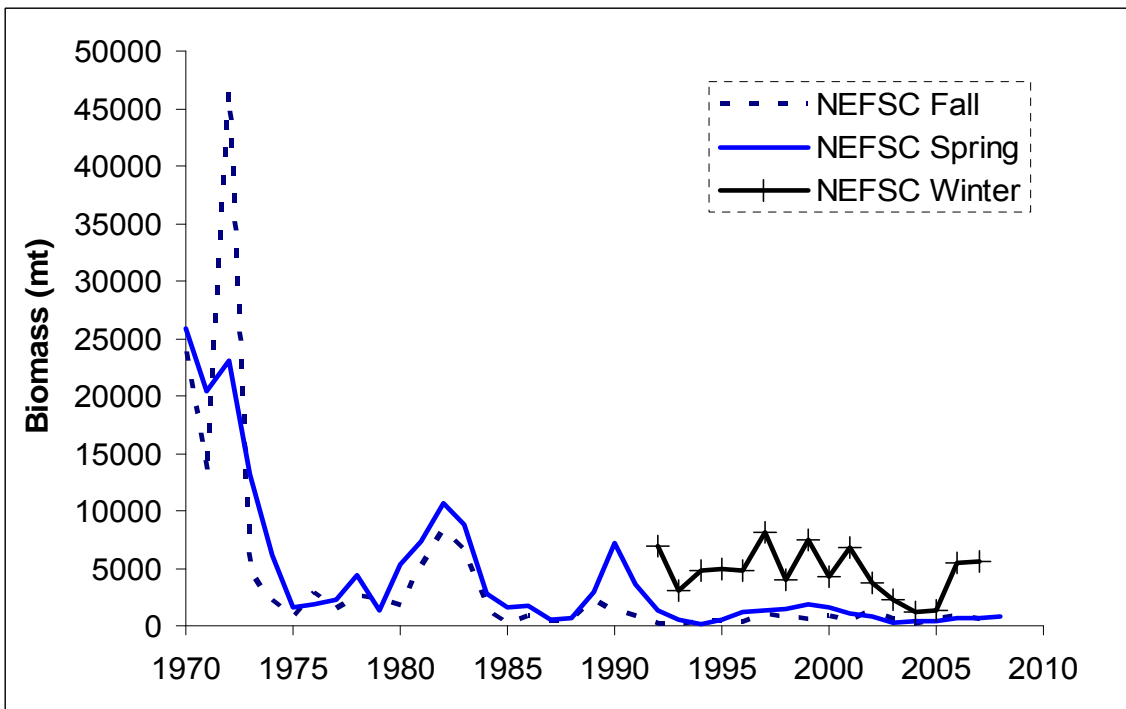


Figure D3. Trends in survey biomass for Southern New England-Mid Atlantic yellowtail flounder.

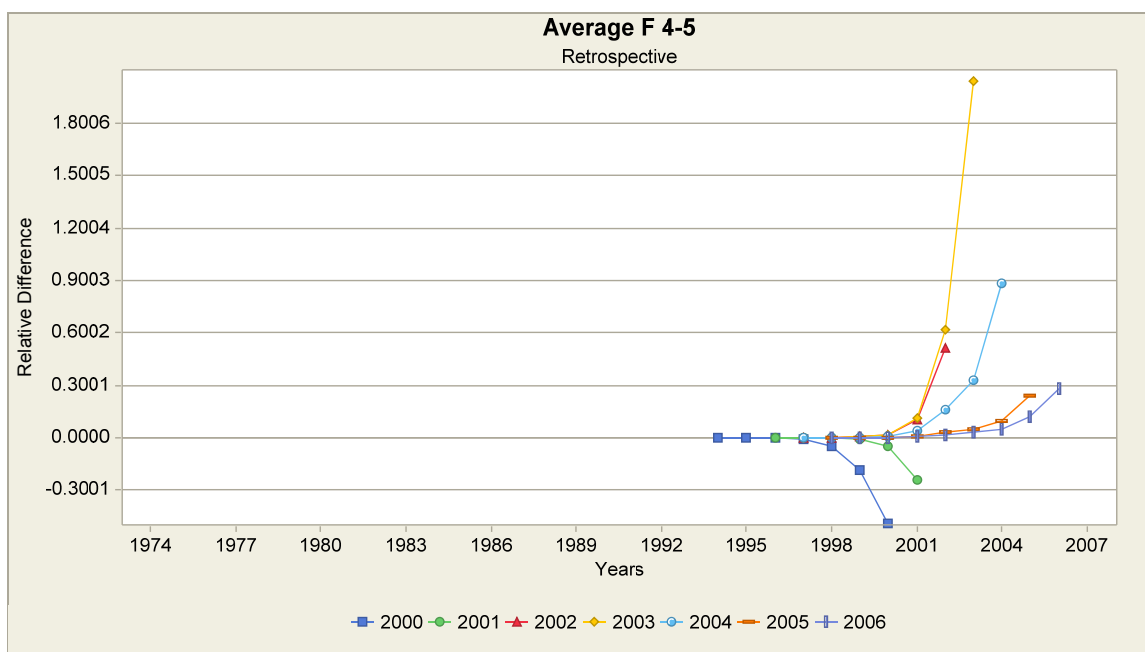
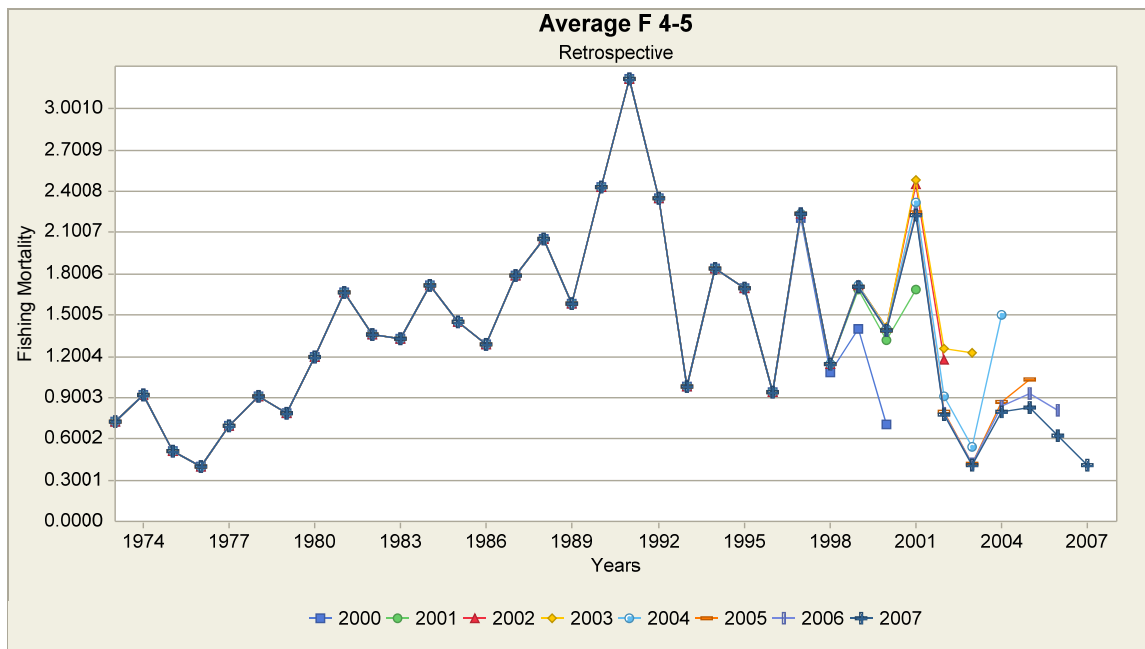


Figure D4a. Age 6+ VPA formulation - Retrospective plots of fully recruited fishing mortality rate (ages 4-5)

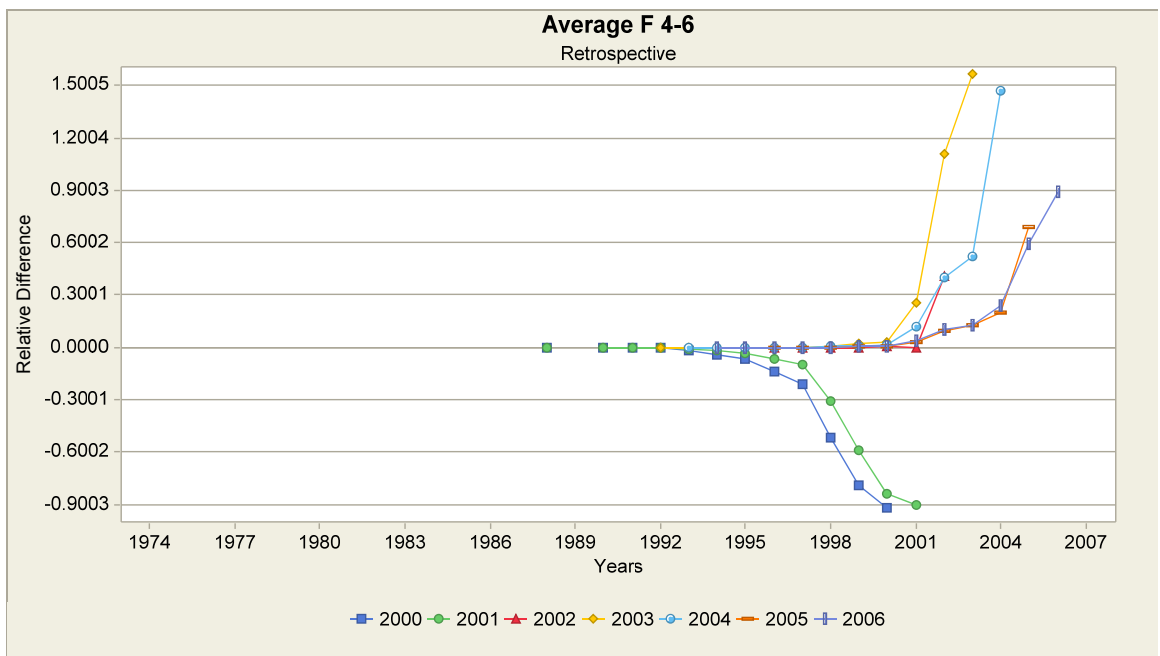
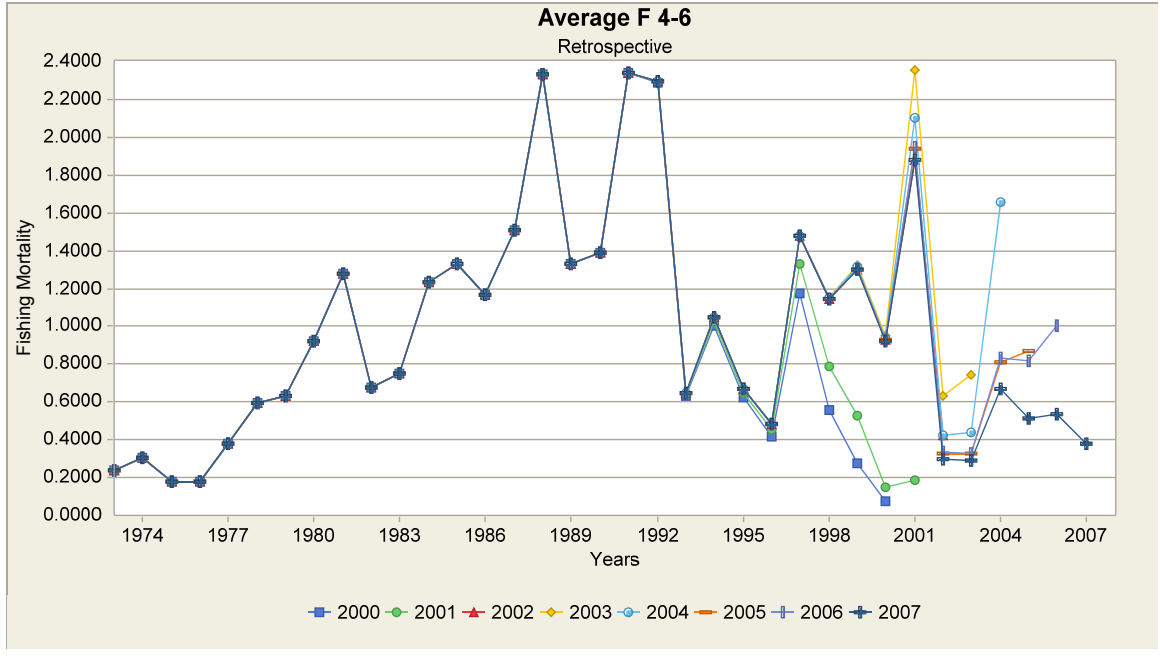


Figure D4b. Age 7+ VPA formulation - Retrospective plots of fully recruited fishing mortality rate (ages 4-5)

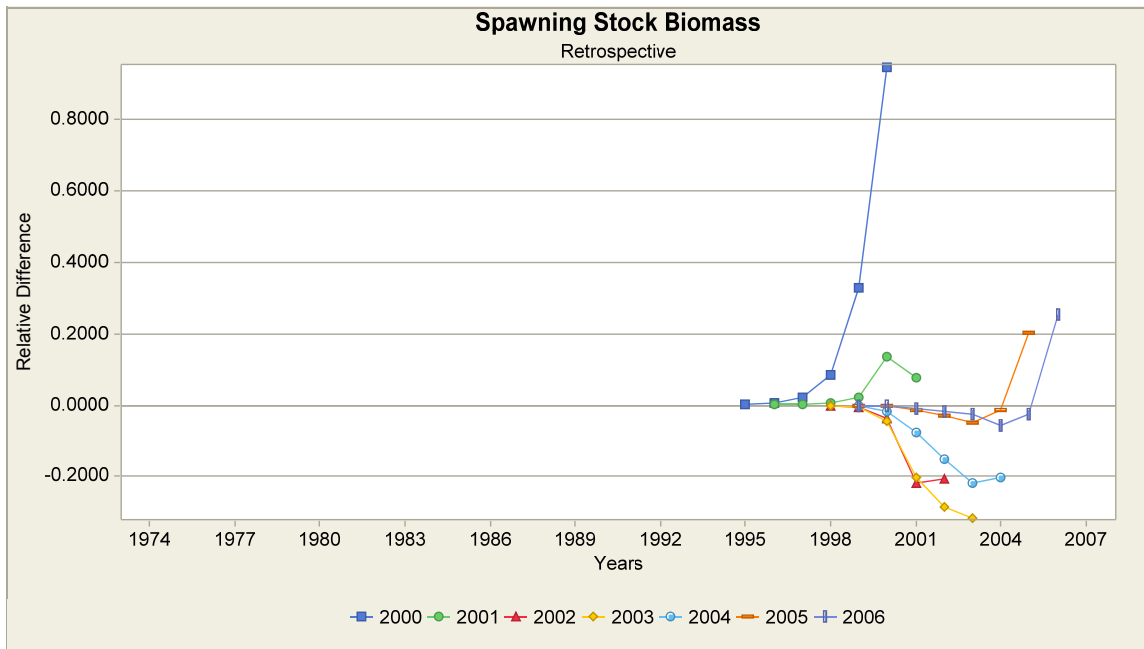
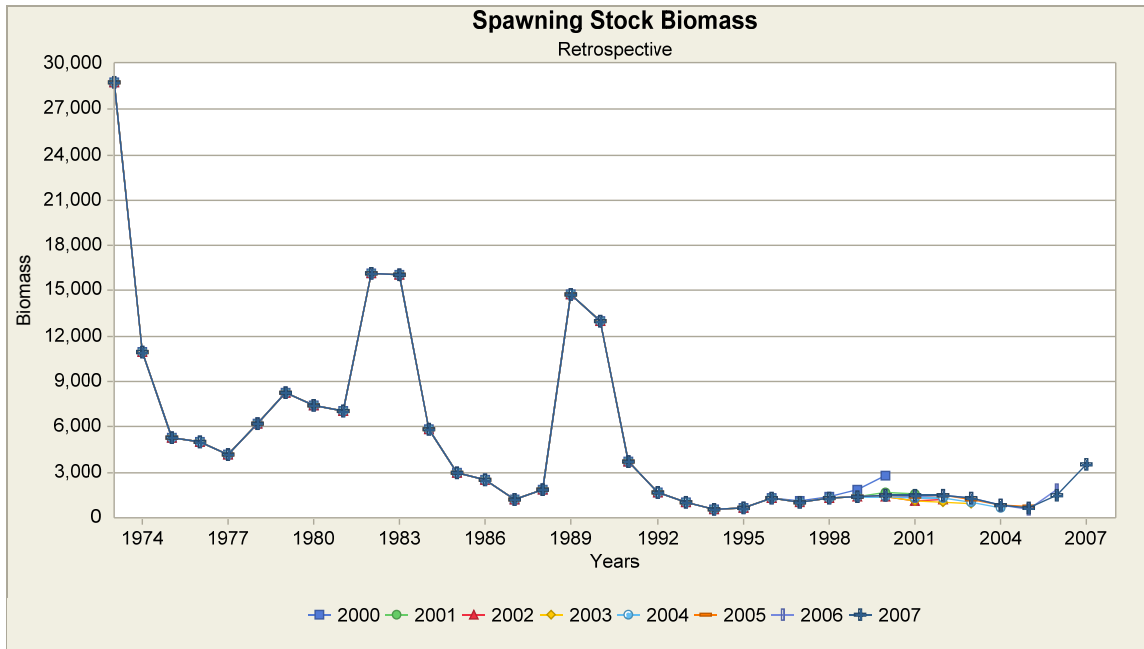


Figure D5a. Age 6+ VPA formulation - Retrospective plots of spawning stock biomass

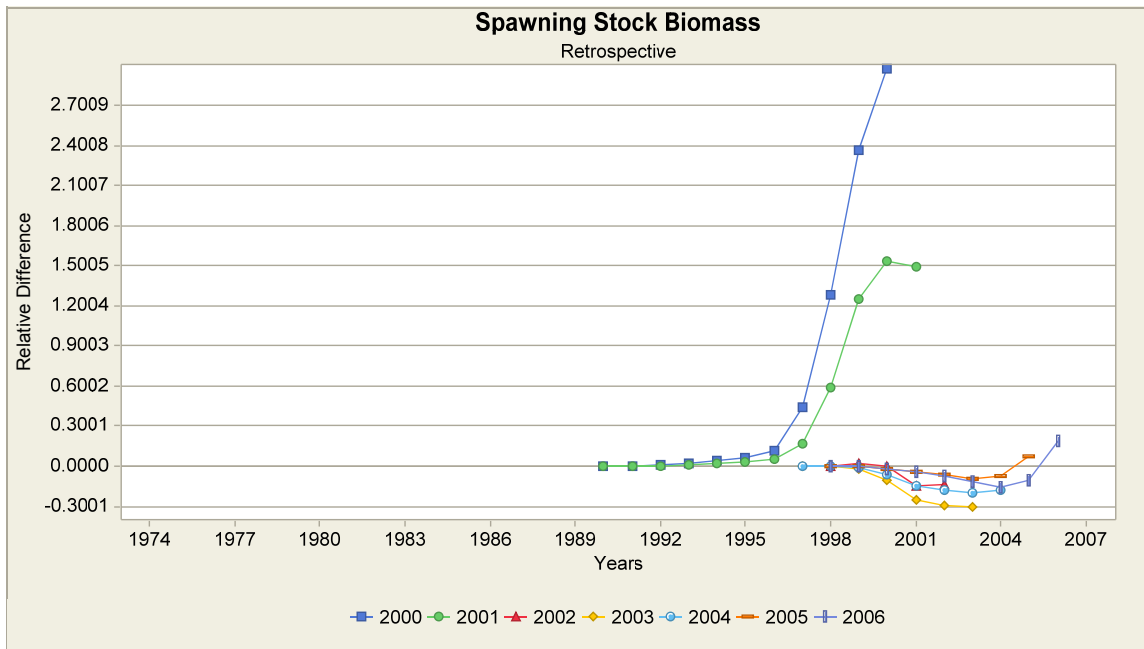
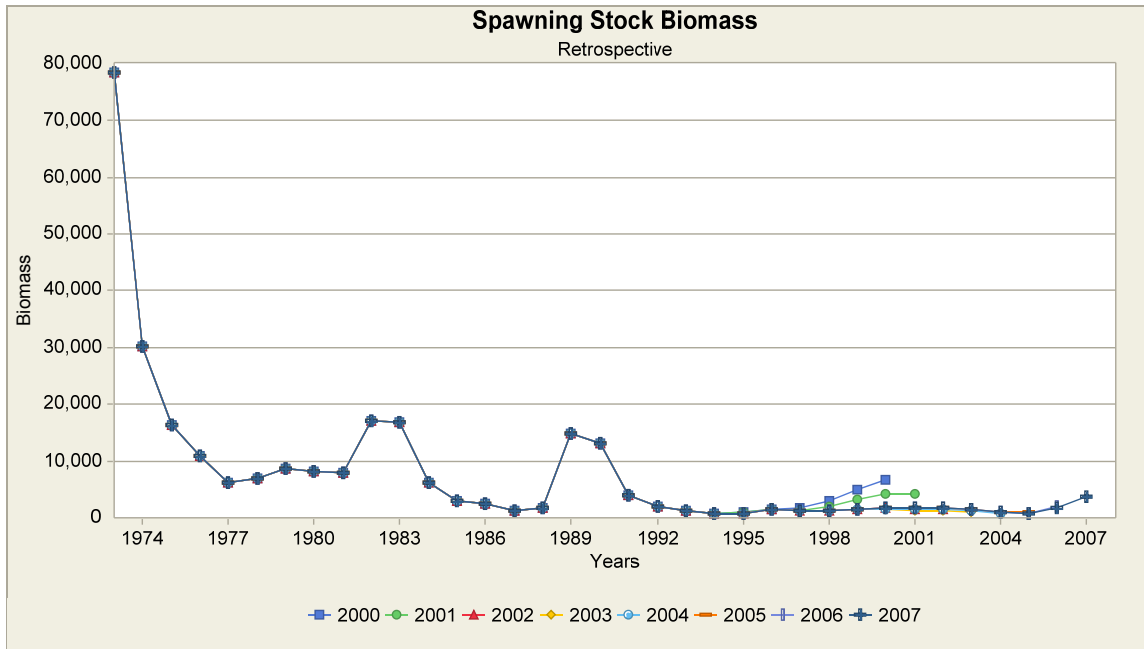


Figure D5b. Age 7+ VPA formulation - Retrospective plots of spawning stock biomass

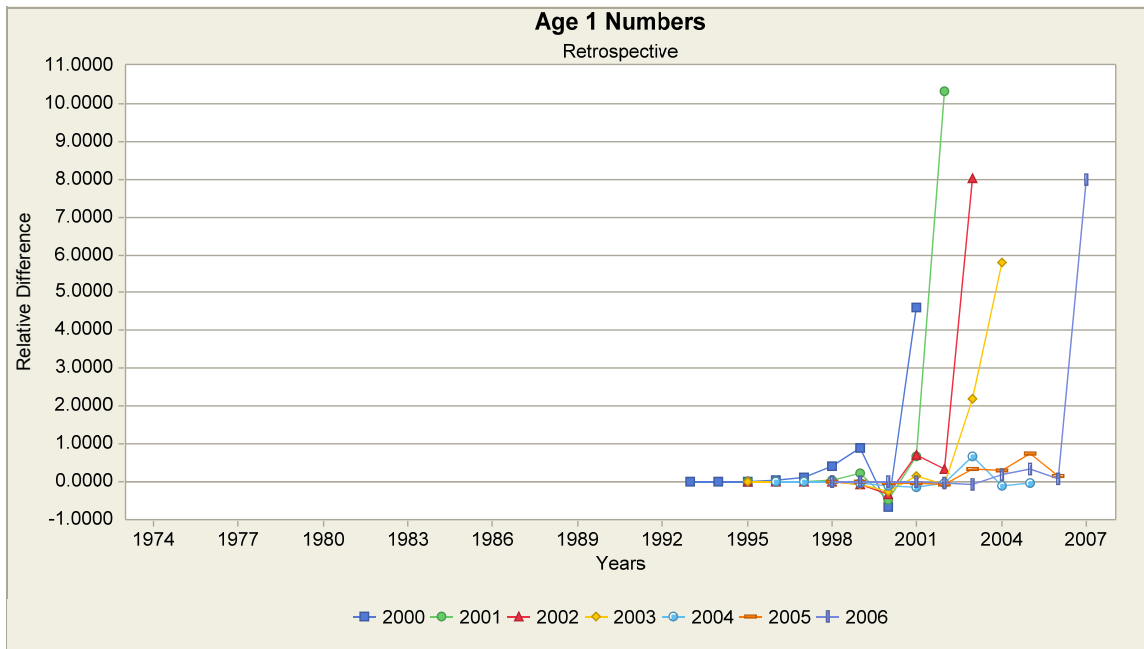
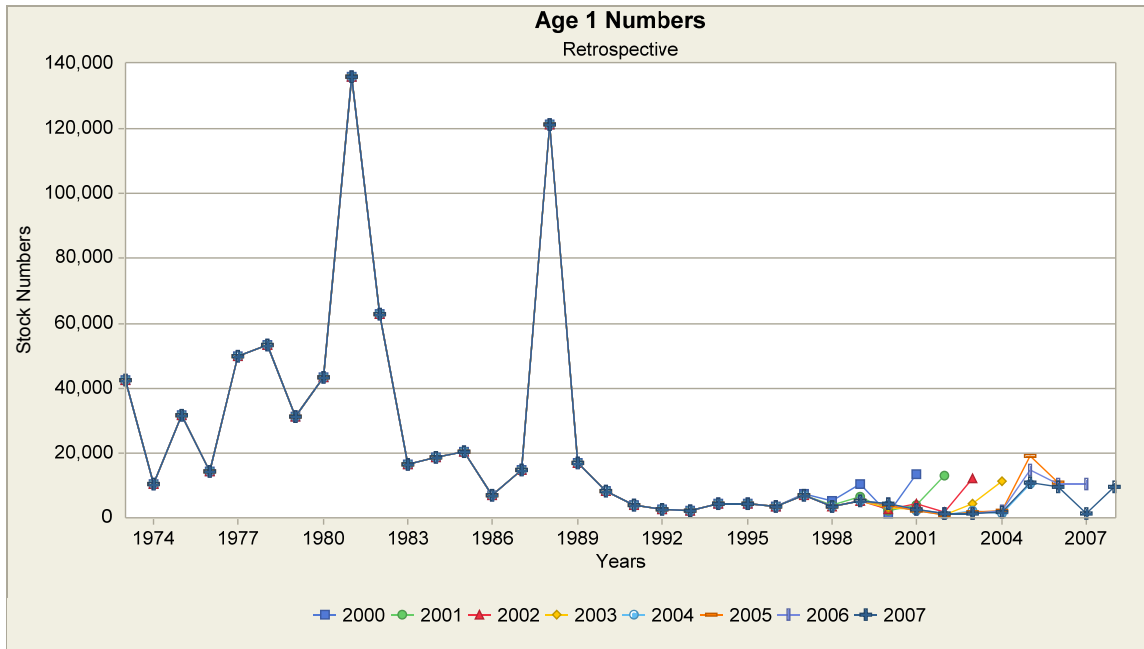


Figure D6a. Age 6+ VPA formulation - Retrospective plots of Age-1 recruitment.

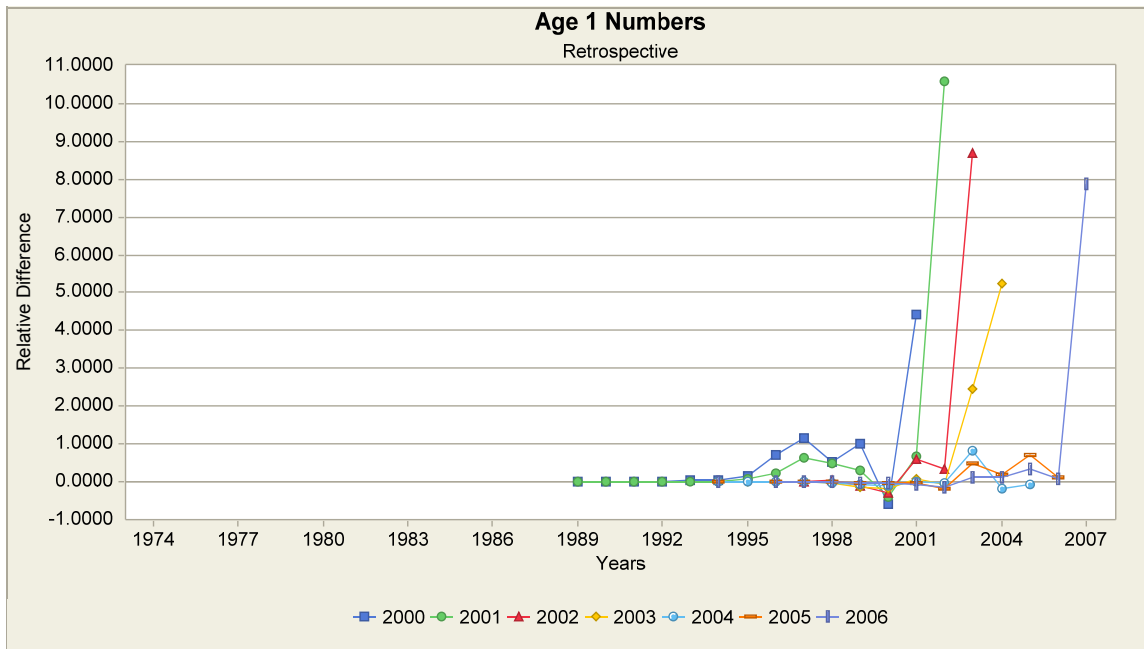
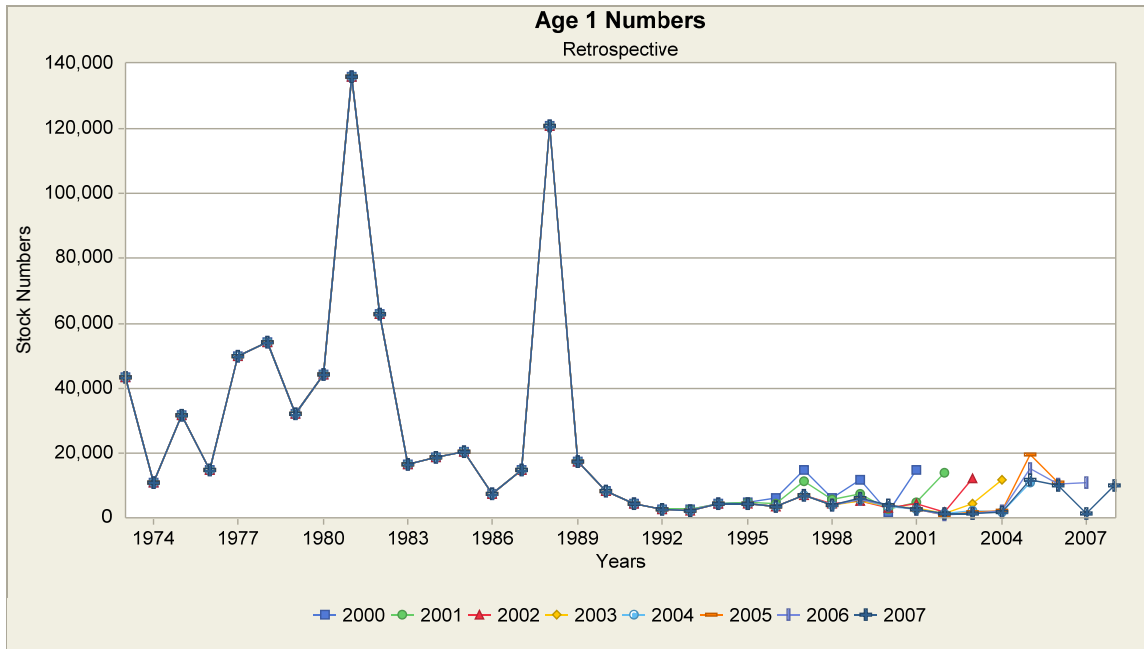


Figure D6b. Age 7+ VPA formulation - Retrospective plots of Age-1 recruitment.

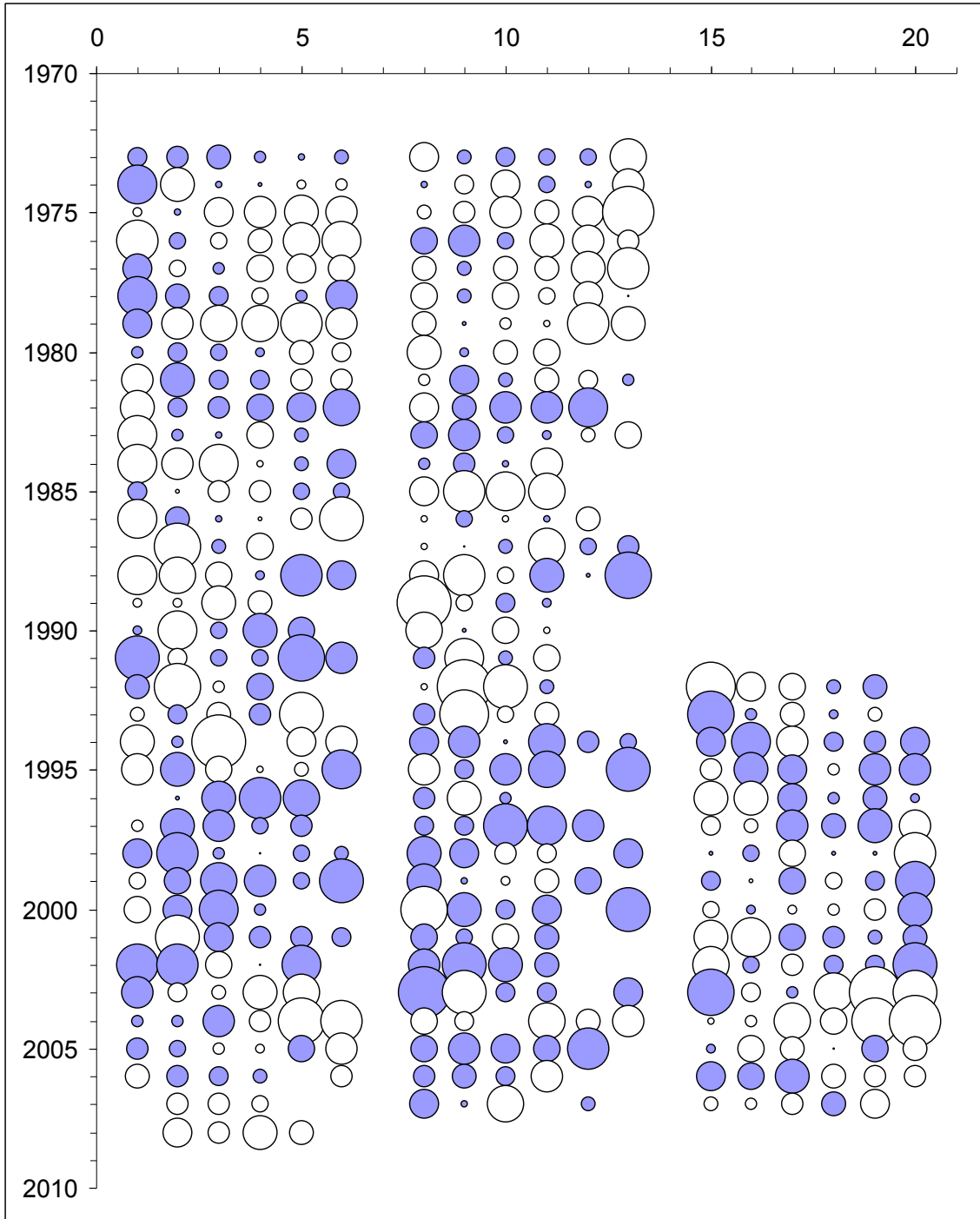


Figure D7. Residuals for indices of abundance in VPA grouped by survey: columns 1-6 are the NEFSC Spring ages 1-6, columns 8-13 are the NEFSC Fall ages 1-6 and columns 15-20 are the NEFSC autumn ages 1-6.

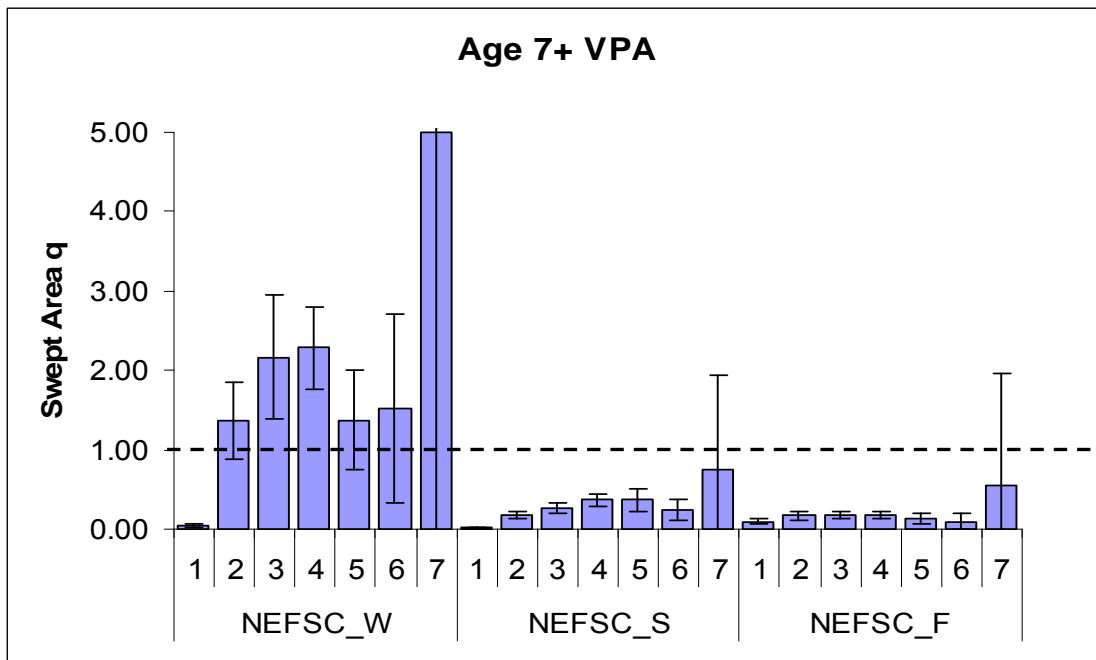
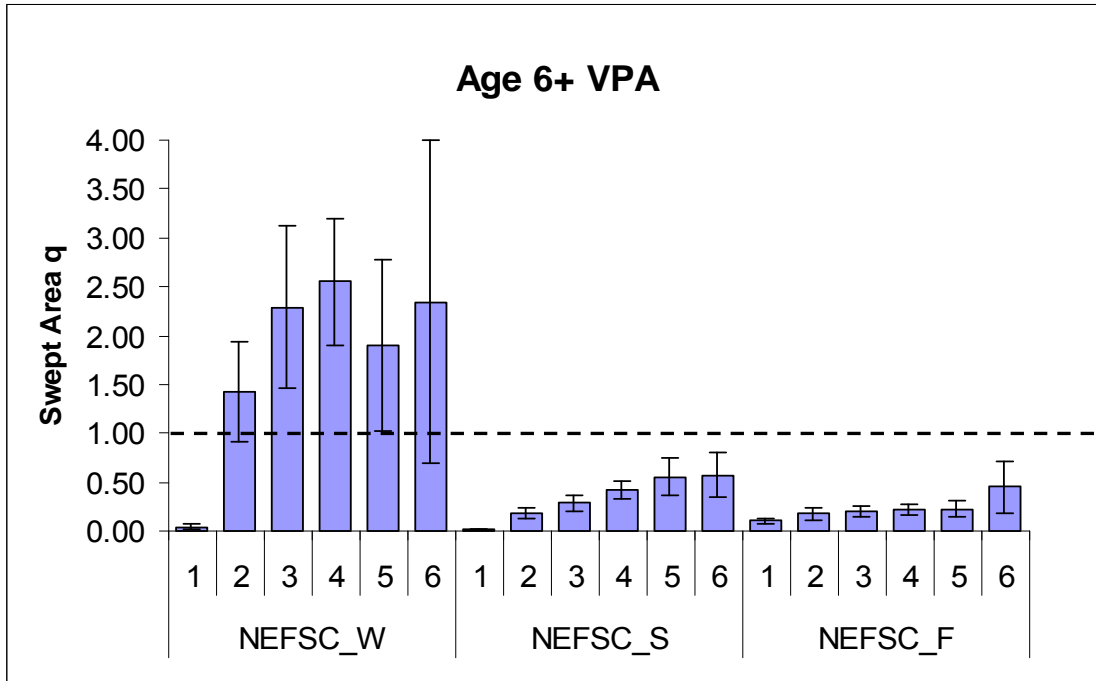


Figure D8. Catchability estimates with two standard deviations for swept area indices for both ages 6+ and 7+ formulation.

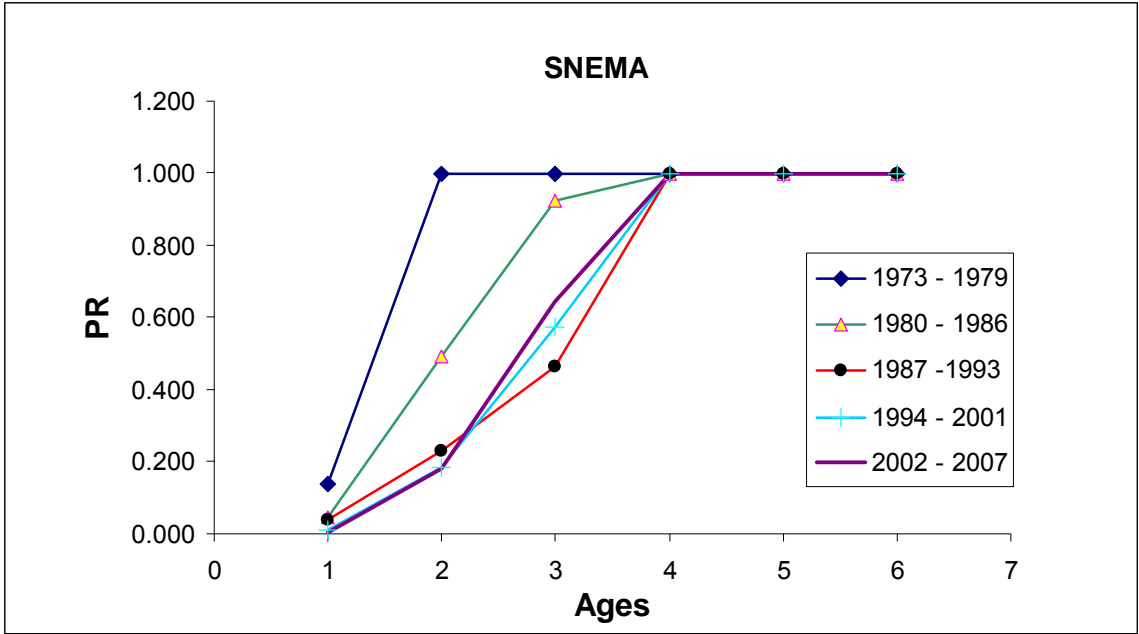


Figure D9. Average back-calculated partial recruitment from VPA showing age 2 PR is well below 1.0 in recent years

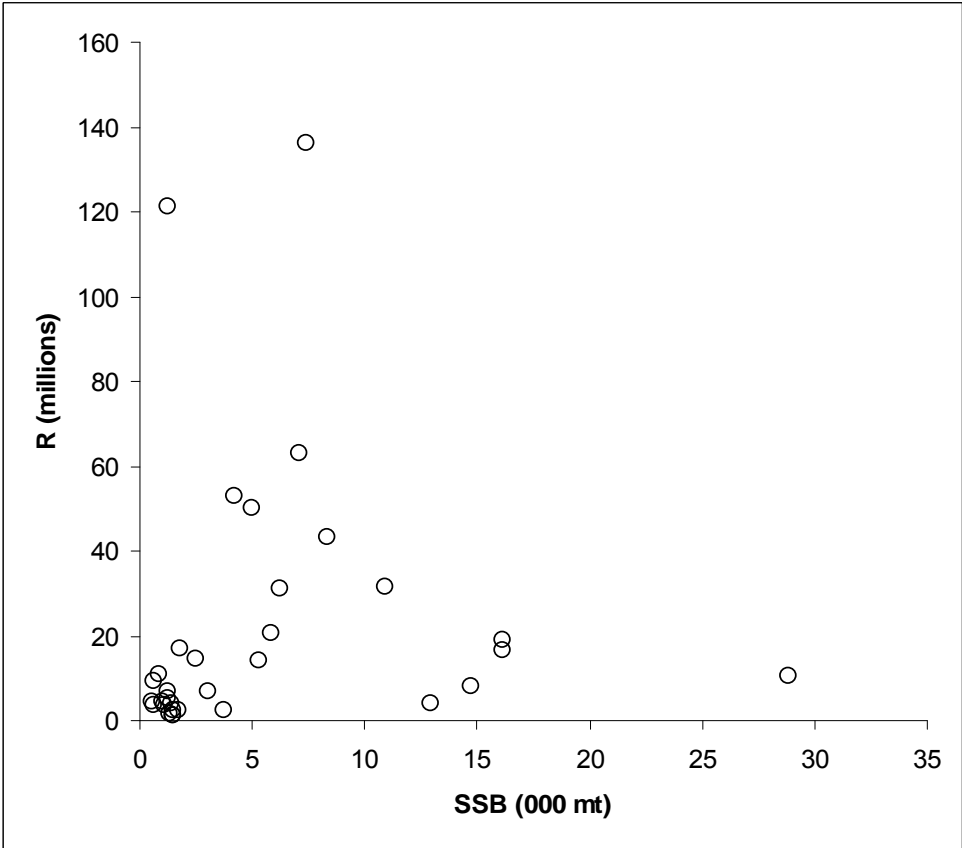


Figure D10. Stock recruitment relationship for Southern New England-Mid Atlantic yellowtail flounder

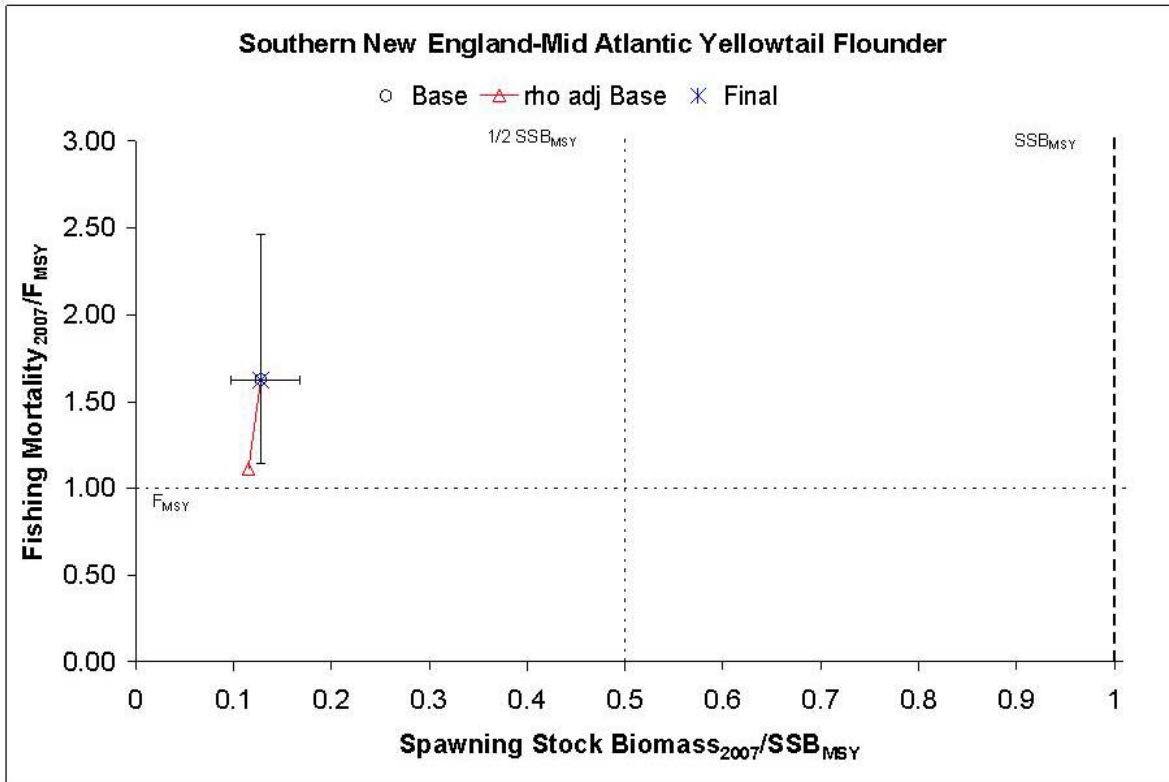


Figure D11. Current Status of Southern New England-Mid Atlantic yellowtail flounder with rho-adjusted base-run (triangle) and the associated point estimate base-run (circle) with 80% confidence intervals. The final accepted VPA run (asterisk) is the point estimate base-run for the 2007 status determination.