

D. Southern New England-Mid Atlantic Yellowtail Flounder by S.X. Cadrin and C.M. Legault

1.0 Background

The southern New England-Mid Atlantic yellowtail stock was at low biomass at relatively high F in 2001 (SSB was 1,900 mt and fully recruited F was 0.91; Cadrin 2003). This report updates catch and survey indices from the SAW36 analysis and estimates 2004 fishing mortality and 2005 stock abundance.

2.0 2005 Assessment

2.1 2002-2004 Landings

U.S. landings were prorated as described in NEFSC (1998; Table D1; Figure D1). Landings from southern New England-Mid Atlantic have steadily decreased since 2001 to 165mt in 2004. Port sampling was incomplete in 2002-2004 (Table D2), and does not allow for estimation of catch at age by geographic region, market category and half-year as done in the previous assessment (Cadrin 2003). Alternatively, 2002 and first-half 2003 landings at age were estimated by stock area, market category and half-year; second-half 2003 and 2003-2004 landings at age were derived from industry-based survey samples (Figure D2) for >33cm yellowtail, not separated by market category (Table D2).

2.2 2002-2004 Discards

Discarded catch from the trawl fishery was estimated from discard to kept ratios by half-year (NEFSC 1998). Discards from the scallop dredge fishery were estimated from discard to effort, because no yellowtail were landed by the scallop dredge fishery during 2002-2004. The number of observed trips, lengths and ages for 2002-2004 increased substantially (Table D3). Proportion of discarded catch increased from 14% of total catch in 2002 to 45% in 2004 (Table D1, Figure D1), primarily from trawl discards in the second half of 2004. Discards at age were estimated from observer lengths and combined observer and survey age-length keys. Total catch at age and mean weights at age are reported in Table D4 and Figure D3.

2.3 2002-2005 Survey Indices

Survey abundance and biomass indices are reported in Table D5. Estimates are from valid tows in 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); scallop strata 33, 34, 35, 46], standardized according to net, vessel, and door changes (NEFSC 1998). Survey data indicate a decrease in stock biomass since the 2002 stock assessment, weak recruitment and poor survival to older ages (Figures D4 and D5).

3.0 Assessment Results

3.1 Age-Based Analysis

Results of an updated VPA calibration of southern New England-Mid Atlantic yellowtail is summarized in Table D6. This analysis updates the assessment reported by Cadrin (2003) by including 2002-2004 landings and discards, 2002-2004 scallop and fall indices, and 2002-2005 winter and spring indices. Results indicate that fishing mortality remained high during 2002-2004, averaging 0.84 (Figure D6). Spawning biomass decreased to 695mt in 2004.

Retrospective analysis indicates a reversal in 2002 of the previous pattern of overestimating SSB and underestimating F (Figure D7). Bootstrap analysis indicates that abundance was estimated with moderate precision (CV=34-47%).

Reference points for status determination were estimated from yield and SSB per recruit analyses and the assumption of constant recruitment (Cadrin 2003). Assuming that F_{MSY} is approximately $F_{40\%}$ (0.26 on fully-recruited ages) and long-term average recruitment (61.57 million at age-1), $MSY=14,200$ mt and $SSB_{MSY}=69,500$ mt. Therefore, the stock is severely overfished (2004 $SSB=1\%SSB_{MSY}$) and overfishing is occurring (2004 $F=4 \cdot F_{MSY}$). The estimate of 2004 fishing mortality (0.99) is more than twice the F desired for the rebuilding program (0.37), and 2004 SSB is approximately 10% of the projected value (Figures D8 and 9).

3.2 Biomass-Based Analysis

Due to poor sampling in the late 1990s, a biomass dynamics model (ASPIC) was applied to the southern New England-Mid Atlantic yellowtail stock assessment to provide alternative perspectives on stock status. Biomass estimates from ASPIC are greater than those from the VPA in the last ten years, and estimates of F are lower, but the ASPIC estimate of 2004 biomass is only 6% of the ASPIC estimate of B_{MSY} (Figure D10). Therefore, ASPIC results also suggest that the stock is severely overfished.

4.0 Sources of Uncertainty

- Although historical perspective from production models are valuable, current biomass levels may not be reliable, because the model assumes high productivity at low stock size.
- Estimates of prorated landings and discard ratios are based on preliminary logbook data and are subject to change.

5.0 GARM Discussion

It was noted that there a number of trips with all discard and no kept in 2004 as well as a pattern of both large and small sizes discarded. This may be due in part to the inclusion of trips not using a groundfish day-at-sea, such as those targeting summer flounder that also catch and discard yellowtail. Industry representatives noted that even though catches have been low in recent years, there has still been a directed fishery for this stock with the possible exception of 2004. There will be additional disincentives to landing yellowtail in this region next year, since 1.5 DAS will be charged for every DAS fished. Therefore, continued discarding of legal sized fish as well as discards due to boats fishing on non-groundfish trips is likely.

Differences in the estimated fishing mortality rate for old fish between the SAW36 and updated versions of the ADAPT VPA software were discounted by the Panel because so few animals are present at the old ages. The Panel recommended use of the new software because it contains a number of improvements.

It was noted that the switching direction of retrospective bias coincides with the change to using observer samples in addition to port sampling. The Panel recommended that future assessments test using port sampling alone to see if the retrospective pattern is removed.

Patterns in residuals for the ASPIC fit were noted which led to discounting of the ASPIC model results. It was also noted that recent good sampling has increased confidence in the current VPA results. The Panel agreed that VPA is most appropriate method to measure stock status.

Projection Advice - The Panel recommended the average of 1994-2004 for both mean weights at age and partial recruitment for projections because there is no trend over time. The Panel agreed on using the most recent ten years of recruits-per-SSB to account for the low values of recruitment seen in the past decade while also accounting for the low SSB. The Panel notes that this choice of recruitment differs from that used in Amendment 13 projections and would not be expected to achieve rebuilding to Bmsy in long-term projections. However, since only short term projections will be conducted, the Panel thought the current low recruitment should be reflected in these short term projections.

Research Recommendations

- Given the large decline in the stock abundance, the Panel noted that changes in maturity would be expected and recommended that this be explored in future assessments.
- Results appear to be sensitive to the 'oldest age' assumption, and alternative methods should be considered for the next benchmark assessment.
- The NEFSC winter survey is now showing a trend in recent years, and should be included in future ASPIC runs.

6.0 References

Cadrin, S.X. 2003. Stock assessment of yellowtail flounder in the southern New England-Mid Atlantic area. NEFSC Ref. Doc. 03-02.

NEFSC (Northeast Fisheries Science Center). 1998. Southern New England yellowtail flounder. NEFSC Ref. Doc. 98-15: 328-350.

Table D1. Catch of southern New England-Mid Atlantic yellowtail flounder (thousand mt).

	U.S. landings	U.S. discards	foreign catch	total catch	percent discards
1935	6.0	2.4	0.0	8.4	29%
1936	6.8	2.7	0.0	9.5	28%
1937	7.6	3.0	0.0	10.6	28%
1938	7.7	3.1	0.0	10.8	29%
1939	9.5	3.8	0.0	13.3	29%
1940	14.2	5.7	0.0	19.9	29%
1941	19.3	7.7	0.0	27.0	29%
1942	28.4	9.9	0.0	38.3	26%
1943	18.0	7.3	0.0	25.3	29%
1944	10.6	4.8	0.0	15.4	31%
1945	10.4	4.2	0.0	14.6	29%
1946	10.8	4.4	0.0	15.2	29%
1947	12.1	4.9	0.0	17.0	29%
1948	9.9	4.0	0.0	13.9	29%
1949	4.9	1.9	0.0	6.8	28%
1950	4.9	1.9	0.0	6.8	28%
1951	2.9	1.1	0.0	4.0	28%
1952	3.2	1.2	0.0	4.4	27%
1953	2.3	0.8	0.0	3.1	26%
1954	1.7	0.6	0.0	2.3	26%
1955	2.5	0.9	0.0	3.4	26%
1956	4.1	1.4	0.0	5.5	25%
1957	6.2	2.2	0.0	8.4	26%
1958	9.5	3.6	0.0	13.1	27%
1959	8.2	3.1	0.0	11.3	27%
1960	8.8	3.2	0.0	12.0	27%
1961	13.0	4.7	0.0	17.7	27%
1962	13.5	5.3	0.0	18.8	28%
1963	22.6	5.4	0.2	28.2	19%
1964	21.8	9.5	0.0	31.3	30%
1965	22.5	7.0	1.4	30.9	23%
1966	22.5	5.3	0.7	28.5	19%
1967	25.1	7.7	2.8	35.6	22%
1968	25.4	6.3	3.5	35.2	18%
1969	23.7	2.4	18.3	44.4	5%
1970	21.4	4.5	2.6	28.5	16%
1971	15.9	2.2	1.3	19.3	11%
1972	17.6	1.8	3.1	22.5	8%
1973	12.44	1.71	0.40	14.55	12%
1974	8.28	8.69	0.12	17.09	51%
1975	3.83	1.90	0.00	5.73	33%
1976	1.85	1.58	0.00	3.44	46%
1977	3.34	1.89	0.00	5.22	36%
1978	3.06	5.03	0.00	8.09	62%
1979	5.45	4.43	0.00	9.88	45%
1980	6.30	1.72	0.00	8.02	21%
1981	5.40	1.21	0.00	6.61	18%
1982	10.73	5.04	0.00	15.76	32%
1983	18.50	3.71	0.00	22.21	17%
1984	10.10	1.12	0.00	11.22	10%
1985	3.60	1.22	0.00	4.82	25%
1986	3.55	1.07	0.00	4.62	23%
1987	1.77	0.88	0.00	2.65	33%
1988	0.99	1.79	0.00	2.78	64%
1989	2.90	5.45	0.00	8.35	65%
1990	8.24	9.68	0.00	17.92	54%
1991	4.11	2.32	0.00	6.43	36%
1992	1.64	1.06	0.00	2.70	39%
1993	0.67	0.10	0.00	0.77	13%
1994	0.39	0.26	0.00	0.65	40%
1995	0.19	0.09	0.00	0.28	32%
1996	0.46	0.09	0.00	0.54	17%
1997	0.78	0.04	0.00	0.82	5%
1998	0.58	0.13	0.00	0.70	18%
1999	1.16	0.15	0.00	1.31	11%
2000	0.97	0.05	0.00	1.01	5%
2001	1.05	0.07	0.00	1.12	6%
2002	0.75	0.13	0.00	0.88	14%
2003	0.42	0.08	0.00	0.50	16%
2004	0.17	0.13	0.00	0.30	45%
mean	8.56	3.07	0.49	12.12	27%

Table D2. Samples of southern New England-Mid Atlantic yellowtail flounder from port samples and the industry-based survey (bold indicates no samples; ages used to categorized pooled market categories).

year	region	half	category	landings samples			% of	
				mt	lengths	ages		kg landings
port samples								
2002	SNE	Jan-Jun	unclassified	15	0	321	0	0.00%
			large	328	749	400	0.12%	
			small	156	428	229	0.15%	
		Jul-Dec	unclassified	9	0	349	0	0.00%
			large	70	231	108	0.15%	
			small	70	329	154	0.22%	
	MA	Jan-Jun	unclassified	56	373	127	199	0.36%
			large	19	103	55	0.28%	
			small	10	105	56	0.59%	
Jul-Dec		unclassified	14	214	48	100	0.70%	
		large	4	116	54	1.27%		
		small	2	0	0	0.00%		
2003	SNE	Jan-Jun	unclassified	4	0	183	0	0.00%
			large	134	267	143	0.11%	
			small	91	397	212	0.23%	
		Jul-Dec	unclassified	10	0	87	0	0.00%
			large	47	121	57	0.12%	
			small	34	213	99	0.30%	
	MA	Jan-Jun	unclassified	35	0	0	0	0.00%
			large	15	0	0	0.00%	
			small	7	0	0	0.00%	
Jul-Dec		unclassified	21	0	0	0.00%		
		large	16	0	0	0.00%		
		small	5	0	0	0.00%		
2004	SNE	Jan-Jun	unclassified	1	0	73	0	0.00%
			large	44	203	108	0.25%	
			small	20	119	64	0.32%	
		Jul-Dec	unclassified	14	0	15	0	0.00%
			large	34	99	46	0.14%	
			small	29	0	0	0.00%	
	MA	Jan-Jun	unclassified	10	0	13	0	0.00%
			large	2	74	40	1.87%	
			small	1	0	0	0.00%	
Jul-Dec		unclassified	2	0	0	0.00%		
		large	5	0	0	0.00%		
		small	3	0	0	0.00%		
IBS samples >33cm								
2003	SNEMA	Jan-Jun		286	1375	404	291	0.10% *
	SNEMA	Jul-Dec		133	2034	109	1041	0.78%
2004	SNE	Jan-Jun		65	2543	239	1393	2.15%
		Jul-Dec		77	2378	191	1040	1.35%
	MA	Jan-Jun		13	1880	88	1164	8.81%
		Jul-Dec		10	392	100	224	2.20%

* combined port, observer & IBS samples used for landings at age.

Table D3. Discard estimates and sample sizes for southern New England-Mid Atlantic yellowtail flounder, 2002-2004.

Trawl Fishery									
year half	observed trips w/YT	observed kept (mt)	discard (mt)	d/k	landings (mt)	% observed	discards (mt)	discard lengths	observer ages all
2002 Jan-Jun	1	2.734	0.035	0.0129	578.0	0.47%	7.5	0	39 *
Jul-Dec	6	0.176	0.011	0.0645	169.5	0.10%	10.9	28	263
2003 Jan-Jun	27	33.455	1.369	0.0409	284.1	11.78%	11.6	179	229
Jul-Dec	10	2.249	0.062	0.028	132.6	1.70%	3.6	14	221 **
2004 Jan-Jun	14	1.050	0.113	0.1075	77.4	1.36%	8.3	153	449 **
Jul-Dec	28	0.739	0.911	1.2326	87.4	0.85%	107.7	375	430 **

Dredge Fishery									
year half	observed trips w/YT	effort (d) all obs trips	discard (mt)	d/e	total effort (d)	% observed	discards (mt)	discard lengths	
2002 Jan-Jun	0	0	*	0.0140	3897	0.00%	54.5	0	*
Jul-Dec	7	50	0.693	0.0140	3780	1.31%	52.9	303	
2003 Jan-Jun	16	111	1.261	0.0114	3616	3.06%	41.2	229	
Jul-Dec	8	92	0.408	0.0044	4677	1.97%	20.7	103	
2004 Jan-Jun	4	105	0.006	0.0001	4410	2.37%	0.2	0	*
Jul-Dec	24	258	1.327	0.0051	3459	7.47%	17.8	703	

*Jul-Aug estimate

** survey ages

Table D4a. Catch at age (thousands) of southern New England-Mid Atlantic yellowtail flounder.

Year	Catch at age (thousands)							sum
	1	2	3	4	5	6	7+	
1973	220	5632	11951	7978	5226	5305	917	37229
1974	861	28519	5556	7370	3687	1598	1474	49065
1975	8910	4129	1884	1130	1597	792	416	18859
1976	214	6677	1181	327	449	477	230	9554
1977	5513	5027	4891	507	278	304	167	16687
1978	8698	14191	2164	1470	247	61	70	26901
1979	205	19419	8667	1062	438	101	29	29921
1980	1006	10215	6595	3829	512	129	22	22308
1981	38	7029	7578	2926	1111	161	17	18860
1982	169	35696	14358	1858	415	79	7	52583
1983	2668	19288	42837	3601	385	146	37	68963
1984	517	6200	19990	8129	878	245	16	35975
1985	2239	8074	2175	1968	1109	204	38	15807
1986	463	9970	3326	635	356	127	21	14897
1987	1594	3437	2368	926	167	55	9	8556
1988	5899	2109	536	506	134	26	6	9217
1989	24	19920	3347	462	48	3	0	23804
1990	192	2056	42644	2209	90	5	0	47197
1991	446	1610	5169	9703	168	34	17	17147
1992	477	1453	2097	2739	297	14	4	7082
1993	13	457	447	711	145	4	0	1777
1994	154	748	312	281	309	127	4	1934
1995	7	308	180	219	31	7	5	757
1996	22	427	626	249	60	17	5	1406
1997	2	103	1166	538	62	5	3	1878
1998	3	511	635	306	81	14	4	1554
1999	6	105	2321	288	103	13	5	2841
2000	35	567	1091	447	15	3	1	2160
2001	1	275	1413	424	129	32	19	2293
2002	8	372	931	383	50	9	5	1758
2003	4	94	566	231	69	13	5	982
2004	6	101	73	133	160	50	19	541
mean	1269	6710	6221	1986	588	318	112	17203

Table D4b. Mean weight at age (kg) of southern New England-Mid Atlantic yellowtail flounder catch.

Year	Age						
	1	2	3	4	5	6	7+
1973	0.210	0.296	0.348	0.375	0.382	0.418	0.474
1974	0.203	0.308	0.352	0.396	0.439	0.431	0.477
1975	0.218	0.289	0.376	0.432	0.435	0.457	0.505
1976	0.228	0.303	0.408	0.498	0.499	0.543	0.548
1977	0.215	0.283	0.381	0.504	0.513	0.481	0.586
1978	0.234	0.293	0.383	0.536	0.662	0.686	0.636
1979	0.189	0.301	0.364	0.475	0.590	0.673	0.620
1980	0.206	0.281	0.384	0.500	0.682	0.874	1.132
1981	0.140	0.262	0.342	0.474	0.596	0.669	0.475
1982	0.226	0.263	0.353	0.499	0.660	0.822	0.956
1983	0.175	0.261	0.339	0.496	0.668	0.815	0.834
1984	0.182	0.237	0.295	0.388	0.487	0.652	0.662
1985	0.183	0.260	0.365	0.408	0.504	0.577	0.745
1986	0.186	0.284	0.331	0.463	0.587	0.614	0.804
1987	0.247	0.268	0.353	0.404	0.520	0.587	0.863
1988	0.270	0.293	0.396	0.493	0.611	0.795	0.937
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	0.900	0.599
1992	0.167	0.316	0.368	0.434	0.599	0.804	1.375
1993	0.122	0.354	0.430	0.451	0.641	1.040	
1994	0.068	0.203	0.352	0.444	0.573	0.710	0.902
1995	0.123	0.299	0.401	0.458	0.663	0.720	0.743
1996	0.148	0.373	0.408	0.466	0.592	0.710	0.780
1997	0.140	0.288	0.415	0.478	0.583	0.912	0.996
1998	0.162	0.294	0.411	0.565	0.768	0.848	0.970
1999	0.221	0.290	0.441	0.562	0.673	1.020	1.098
2000	0.034	0.352	0.475	0.606	0.756	1.090	1.040
2001	0.153	0.378	0.438	0.622	0.763	0.938	
2002	0.161	0.355	0.474	0.640	0.843	1.028	1.329
2003	0.109	0.318	0.415	0.598	0.616	0.787	0.857
2004	0.153	0.292	0.422	0.501	0.563	0.732	0.653
mean	0.184	0.298	0.385	0.487	0.614	0.755	0.807

Table D5. Survey indices of southern New England yellowtail-Mid Atlantic abundance and biomass.

Fall Survey												
year	age-0	age-1	age-2	age-3	age-4	age-5	age-6	age-7	age-8	age-9	sum	kg/tow
1963	0.030	14.778	12.274	9.972	4.944	0.683	0.059	0.082	0.000	0.000	42.822	14.023
1964	0.000	13.900	19.067	3.381	5.356	2.643	0.543	0.036	0.000	0.000	44.925	13.972
1965	0.166	22.272	12.835	4.327	1.489	1.184	0.146	0.000	0.000	0.000	42.418	10.228
1966	0.569	34.899	10.656	2.342	0.902	0.175	0.000	0.000	0.000	0.000	49.542	9.033
1967	0.177	23.579	29.045	12.719	1.212	0.260	0.047	0.124	0.000	0.000	67.164	14.018
1968	0.000	13.882	21.622	24.639	1.571	0.263	0.325	0.069	0.000	0.000	62.370	13.038
1969	0.056	10.440	11.316	33.936	4.454	0.049	0.019	0.019	0.000	0.000	60.288	14.472
1970	0.067	4.414	8.047	29.866	18.927	3.305	0.359	0.047	0.000	0.000	65.032	16.211
1971	0.000	14.540	12.485	6.886	12.452	1.909	0.162	0.123	0.000	0.000	48.556	8.975
1972	0.000	3.245	32.938	33.089	33.080	18.618	2.305	0.101	0.000	0.000	123.376	31.543
1973	0.000	1.779	1.747	4.086	2.318	1.564	0.768	0.162	0.000	0.000	12.422	3.125
1974	0.132	0.695	1.185	0.433	1.640	0.687	0.297	0.146	0.014	0.042	5.271	1.545
1975	0.000	1.533	0.416	0.136	0.217	0.213	0.048	0.070	0.000	0.000	2.634	0.602
1976	0.000	1.964	4.204	0.350	0.046	0.073	0.190	0.220	0.099	0.000	7.147	1.954
1977	0.028	2.289	1.439	0.519	0.044	0.040	0.035	0.065	0.000	0.000	4.459	1.125
1978	0.000	2.080	4.771	0.296	0.236	0.024	0.006	0.048	0.000	0.021	7.481	2.004
1979	0.000	1.493	3.283	1.579	0.241	0.026	0.026	0.000	0.000	0.000	6.646	1.818
1980	0.000	1.153	2.908	0.757	0.313	0.000	0.000	0.000	0.000	0.000	5.130	1.354
1981	0.000	9.511	9.498	1.251	0.198	0.103	0.037	0.000	0.000	0.000	20.597	4.046
1982	0.000	2.040	17.794	4.392	0.535	0.215	0.000	0.000	0.000	0.000	24.976	5.706
1983	0.000	1.920	11.278	5.593	0.458	0.038	0.000	0.026	0.000	0.000	19.314	4.490
1984	0.000	1.444	1.275	1.529	0.334	0.000	0.000	0.000	0.000	0.000	4.582	1.033
1985	0.000	0.869	0.375	0.134	0.080	0.000	0.000	0.000	0.000	0.000	1.458	0.298
1986	0.000	0.606	1.826	0.523	0.123	0.025	0.000	0.000	0.000	0.000	3.104	0.754
1987	0.073	1.067	0.451	0.359	0.030	0.024	0.000	0.024	0.000	0.000	2.028	0.401
1988	0.000	4.370	0.310	0.141	0.156	0.021	0.034	0.000	0.000	0.000	5.032	0.510
1989	0.000	0.198	10.492	1.370	0.072	0.000	0.000	0.000	0.000	0.000	12.132	2.359
1990	0.000	0.539	1.847	3.117	0.194	0.000	0.000	0.000	0.000	0.000	5.696	1.305
1991	0.000	0.588	0.243	1.516	0.367	0.000	0.000	0.000	0.000	0.000	2.713	0.755
1992	0.000	0.168	0.024	0.072	0.285	0.000	0.000	0.000	0.000	0.000	0.548	0.147
1993	0.000	0.332	0.028	0.130	0.104	0.000	0.000	0.000	0.000	0.000	0.594	0.116
1994	0.000	0.732	0.448	0.107	0.129	0.066	0.025	0.000	0.000	0.000	1.507	0.308
1995	0.000	0.139	0.645	0.257	0.115	0.000	0.000	0.025	0.028	0.000	1.209	0.304
1996	0.000	0.448	0.161	0.320	0.000	0.000	0.000	0.000	0.000	0.000	0.929	0.208
1997	0.000	0.822	0.519	1.459	0.271	0.024	0.000	0.000	0.000	0.000	3.095	0.851
1998	0.023	0.890	1.620	0.124	0.049	0.000	0.023	0.000	0.000	0.000	2.728	0.655
1999	0.000	1.238	0.392	0.279	0.028	0.028	0.000	0.000	0.000	0.000	1.964	0.468
2000	0.000	0.049	1.669	0.303	0.171	0.000	0.000	0.023	0.000	0.000	2.215	0.718
2001	0.000	0.390	0.611	0.158	0.071	0.000	0.000	0.000	0.000	0.000	1.231	0.419
2002	0.026	0.254	1.722	0.855	0.154	0.013	0.000	0.000	0.000	0.000	3.024	1.094
2003	0.588	1.170	0.000	0.302	0.204	0.000	0.050	0.000	0.000	0.000	2.313	0.433
2004	0.000	0.070	0.098	0.000	0.023	0.048	0.025	0.000	0.000	0.000	0.264	0.101
mean	0.046	4.733	6.037	4.610	2.228	0.770	0.132	0.034	0.003	0.001	18.594	4.441

Table D5 cont.

Spring Survey													
year	age-1	age-2	age-3	age-4	age-5	age-6	age-7	age-8	age-9	age-10	age-11	sum	kg/tow
1968	1.014	29.910	38.854	13.103	1.076	0.040	0.184	0.000	0.000	0.000	0.000	84.181	18.645
1969	2.941	18.796	29.464	14.069	1.599	0.147	0.048	0.000	0.000	0.000	0.000	67.064	14.311
1970	1.045	7.311	18.942	16.237	3.518	0.656	0.123	0.005	0.022	0.000	0.000	47.860	12.066
1971	0.447	7.616	8.124	20.765	3.713	0.371	0.004	0.000	0.000	0.004	0.000	41.043	9.552
1972	0.196	12.355	11.201	5.986	9.887	2.394	0.303	0.000	0.000	0.000	0.000	42.321	10.815
1973	0.838	5.467	14.753	8.335	6.432	7.987	0.852	0.230	0.083	0.000	0.000	44.977	12.115
1974	0.511	2.188	2.607	5.016	2.891	1.154	1.291	0.145	0.027	0.000	0.000	15.830	4.918
1975	0.358	1.171	0.406	0.665	0.709	0.531	0.156	0.197	0.000	0.000	0.000	4.193	1.307
1976	0.016	4.182	0.536	0.256	0.245	0.338	0.096	0.031	0.000	0.000	0.000	5.699	1.666
1977	1.618	1.557	2.758	0.242	0.154	0.189	0.093	0.080	0.006	0.046	0.000	6.743	1.963
1978	2.681	10.302	1.791	0.778	0.253	0.126	0.123	0.158	0.010	0.000	0.000	16.221	3.513
1979	1.002	2.967	1.601	0.255	0.124	0.018	0.018	0.014	0.000	0.000	0.012	6.009	1.318
1980	0.683	6.353	4.298	2.684	0.261	0.070	0.005	0.009	0.015	0.001	0.005	14.384	4.830
1981	0.810	18.598	4.817	2.502	0.580	0.113	0.000	0.000	0.000	0.000	0.000	27.420	6.930
1982	0.149	17.329	5.610	1.406	0.467	0.135	0.017	0.000	0.000	0.000	0.000	25.114	5.865
1983	0.016	5.329	8.803	0.598	0.191	0.000	0.000	0.000	0.000	0.000	0.000	14.938	4.097
1984	0.038	0.453	0.902	2.110	0.354	0.262	0.000	0.000	0.000	0.000	0.000	4.119	1.302
1985	0.267	1.613	0.406	0.480	0.714	0.135	0.019	0.000	0.000	0.000	0.000	3.634	0.948
1986	0.016	2.893	0.916	0.237	0.124	0.016	0.000	0.000	0.000	0.000	0.000	4.201	1.052
1987	0.000	0.086	0.701	0.167	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.954	0.319
1988	0.285	0.357	0.125	0.174	0.294	0.029	0.000	0.000	0.000	0.000	0.000	1.263	0.378
1989	0.162	11.211	0.537	0.113	0.000	0.000	0.000	0.000	0.000	0.000	0.000	12.022	2.090
1990	0.090	0.485	15.349	2.194	0.079	0.000	0.000	0.000	0.000	0.000	0.000	18.197	5.064
1991	0.228	0.611	2.509	4.156	0.539	0.060	0.000	0.000	0.000	0.000	0.000	8.103	2.508
1992	0.036	0.051	0.571	1.597	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.255	0.794
1993	0.016	0.253	0.112	0.441	0.071	0.000	0.000	0.000	0.000	0.000	0.000	0.894	0.341
1994	0.016	0.269	0.016	0.000	0.068	0.019	0.000	0.000	0.000	0.000	0.000	0.389	0.136
1995	0.016	1.169	0.068	0.092	0.019	0.037	0.000	0.016	0.016	0.000	0.000	1.433	0.329
1996	0.000	0.398	1.303	0.566	0.072	0.000	0.000	0.000	0.000	0.000	0.000	2.339	0.747
1997	0.053	0.885	1.144	0.327	0.067	0.000	0.000	0.000	0.000	0.000	0.000	2.475	0.789
1998	0.068	3.016	0.386	0.161	0.036	0.021	0.000	0.000	0.000	0.000	0.000	3.688	0.848
1999	0.036	0.651	1.930	0.349	0.074	0.000	0.023	0.000	0.000	0.000	0.000	3.062	1.138
2000	0.019	1.245	1.006	0.559	0.043	0.000	0.000	0.000	0.000	0.000	0.000	2.873	0.990
2001	0.000	0.069	1.158	0.240	0.082	0.023	0.000	0.000	0.000	0.000	0.000	1.572	0.657
2002	0.049	1.191	0.235	0.200	0.067	0.000	0.000	0.000	0.000	0.000	0.000	1.742	0.510
2003	0.031	0.075	0.203	0.107	0.032	0.000	0.000	0.000	0.000	0.000	0.000	0.449	0.165
2004	0.016	0.136	0.302	0.092	0.035	0.000	0.019	0.000	0.000	0.000	0.000	0.600	0.232
2005	0.147	0.205	0.097	0.067	0.152	0.000	0.016	0.000	0.000	0.000	0.000	0.684	0.222
mean	0.419	4.704	4.856	2.824	0.922	0.391	0.089	0.023	0.005	0.001	0.000	14.235	3.565

Table D5 cont.

Winter Survey

year	age-1	age-2	age-3	age-4	age-5	age-6	age-7	age-8	sum	kg/tow
1992	0.011	1.619	3.477	8.063	0.959	0.000	0.000	0.000	14.129	5.264
1993	0.596	1.924	1.057	2.487	0.292	0.000	0.000	0.000	6.357	2.118
1994	0.366	8.654	0.742	1.654	0.966	0.353	0.118	0.000	12.854	3.924
1995	0.090	10.681	2.698	0.597	0.253	0.185	0.016	0.000	14.519	3.464
1996	0.041	1.285	8.235	0.851	0.140	0.065	0.015	0.015	10.648	3.346
1997	0.156	2.380	9.785	2.958	0.529	0.000	0.038	0.000	15.846	5.720
1998	0.118	7.841	1.596	1.158	0.112	0.000	0.018	0.000	10.843	2.780
1999	0.243	2.909	10.176	0.777	0.311	0.056	0.023	0.000	14.494	5.226
2000	0.109	4.917	3.006	1.160	0.073	0.100	0.000	0.000	9.364	3.025
2001	0.028	0.895	8.542	1.615	0.254	0.096	0.046	0.000	11.475	4.786
2002	0.012	2.735	2.578	2.047	0.100	0.020	0.000	0.000	7.492	2.589
2003	0.332	0.697	2.597	0.529	0.043	0.000	0.026	0.000	4.224	1.544
2004	0.051	0.962	0.319	0.589	0.143	0.044	0.000	0.000	2.107	0.83
2005	0.402	0.769	0.616	0.519	0.586	0.032	0.043	0.000	2.967	0.95
mean	0.182	3.448	3.959	1.786	0.340	0.068	0.024	0.001	9.808	3.255

Scallop Survey

year	all	age-1
1982	3.123	0.362
1983	0.858	0.255
1984	0.309	0.180
1985	0.577	0.465
1986	0.199	0.015
1987	0.150	0.054
1988	7.482	7.359
1989	3.774	0.579
1990	0.370	0.158
1991	0.230	0.151
1992	0.169	0.108
1993	0.192	0.170
1994	0.732	0.573
1995	0.507	0.072
1996	38.479	0.120
1997	0.886	0.736
1998	0.567	0.253
1999	0.456	0.357
2000	0.432	0.082
2001	0.106	0.063
2002	0.152	0.020
2003	0.219	0.123
2004	0.137	0.054
mean	2.613	0.535

Table D6. VPA results for southern New England-Mid Atlantic yellowtail flounder.

	Abundance (thousands)			Age				
	1	2	3	4	5	6	7	Total
1973	43,474	17,865	28,167	16,418	8,974	10,043	1,857	126,798
1974	10,625	35,395	9,531	12,247	6,223	2,618	2,867	79,507
1975	31,495	7,920	3,174	2,776	3,358	1,759	1,466	51,948
1976	14,570	17,724	2,748	894	1,250	1,305	1,146	39,637
1977	50,332	11,735	8,470	1,181	436	617	701	73,472
1978	54,235	36,220	5,060	2,509	508	105	205	98,842
1979	32,063	36,533	16,814	2,184	724	193	57	88,569
1980	44,421	26,066	12,340	5,924	827	196	58	89,832
1981	138,444	35,458	12,098	4,136	1,386	214	29	191,765
1982	64,210	113,314	22,671	3,048	738	129	11	204,121
1983	16,677	52,417	60,475	5,570	814	229	72	136,254
1984	19,160	11,240	25,463	10,752	1,302	318	39	68,274
1985	20,990	15,219	3,592	2,760	1,447	271	56	44,336
1986	7,288	15,159	5,155	973	479	182	31	29,267
1987	15,034	5,548	3,390	1,211	222	70	13	25,488
1988	124,006	10,867	1,432	633	153	31	7	137,129
1989	17,618	96,190	6,989	688	60	4	-	121,548
1990	8,064	14,402	60,729	2,693	145	6	-	86,040
1991	3,901	6,429	9,931	11,135	206	37	19	31,659
1992	2,265	2,791	3,807	3,454	337	17	5	12,675
1993	2,032	1,423	970	1,219	349	7	-	6,001
1994	2,946	1,652	752	390	355	155	5	6,254
1995	3,389	2,273	676	333	65	11	12	6,759
1996	1,941	2,769	1,582	390	74	25	9	6,791
1997	5,777	1,569	1,880	729	94	7	8	10,065
1998	3,011	4,728	1,192	484	110	21	6	9,553
1999	4,278	2,463	3,409	401	120	17	6	10,694
2000	3,027	3,497	1,921	691	68	5	3	9,212
2001	1,864	2,447	2,350	586	161	42	25	7,474
2002	802	1,525	1,754	646	96	15	8	4,846
2003	1,887	649	912	594	182	33	13	4,270
2004	1,231	1,541	447	235	277	87	33	3,849
2005	---	1,002	1,170	300	72	85	37	---
mean	23,471	18,062	9,729	2,975	958	571	267	56,967

Table D6 cont.

Fishing Mortality	Age							
	1	2	3	4	5	6	7	4-6
1973	0.01	0.43	0.63	0.77	1.03	0.86	0.86	0.89
1974	0.09	2.21	1.03	1.09	1.06	1.08	1.08	1.08
1975	0.37	0.86	1.07	0.60	0.75	0.68	0.68	0.67
1976	0.02	0.54	0.64	0.52	0.51	0.51	0.51	0.51
1977	0.13	0.64	1.02	0.64	1.22	0.77	0.77	0.88
1978	0.20	0.57	0.64	1.04	0.77	0.99	0.99	0.93
1979	0.01	0.89	0.84	0.77	1.10	0.84	0.84	0.91
1980	0.03	0.57	0.89	1.25	1.15	1.24	1.24	1.21
1981	0.00	0.25	1.18	1.52	2.17	1.65	1.65	1.78
1982	0.00	0.43	1.20	1.12	0.97	1.09	1.09	1.06
1983	0.19	0.52	1.53	1.25	0.74	1.17	1.17	1.05
1984	0.03	0.94	2.02	1.81	1.37	1.75	1.75	1.64
1985	0.13	0.88	1.11	1.55	1.88	1.65	1.65	1.69
1986	0.07	1.30	1.25	1.28	1.72	1.40	1.40	1.47
1987	0.12	1.15	1.48	1.87	1.78	1.85	1.85	1.83
1988	0.05	0.24	0.53	2.15	3.38	2.30	2.30	2.61
1989	0.00	0.26	0.75	1.36	2.12	1.40	1.40	1.62
1990	0.03	0.17	1.50	2.37	1.16	2.26	2.26	1.93
1991	0.14	0.32	0.86	3.30	2.30	3.27	3.27	2.96
1992	0.26	0.86	0.94	2.09	3.65	2.16	2.16	2.63
1993	0.01	0.44	0.71	1.03	0.61	0.92	0.92	0.86
1994	0.06	0.69	0.61	1.59	3.28	2.09	2.09	2.32
1995	0.00	0.16	0.35	1.30	0.75	1.19	1.19	1.08
1996	0.01	0.19	0.57	1.22	2.21	1.33	1.33	1.59
1997	0.00	0.08	1.16	1.69	1.30	1.64	1.64	1.54
1998	0.00	0.13	0.89	1.20	1.68	1.27	1.27	1.38
1999	0.00	0.05	1.40	1.58	3.01	1.77	1.77	2.12
2000	0.01	0.20	0.99	1.26	0.28	1.12	1.12	0.88
2001	0.00	0.13	1.09	1.61	2.17	1.71	1.71	1.83
2002	0.01	0.31	0.88	1.07	0.86	1.04	1.04	0.99
2003	0.00	0.17	1.16	0.56	0.54	0.56	0.56	0.55
2004	0.01	0.08	0.20	0.99	0.99	0.99	0.99	0.99
mean	0.06	0.52	0.97	1.36	1.52	1.39	1.39	1.42

Table D6 cont.

	Spawning Biomass (mt)							Total
	1	2	3	4	5	6	7	
1973	1,089	3,012	6,789	4,110	2,052	2,705	580	20,337
1974	248	2,953	1,966	2,829	1,614	661	808	11,079
1975	702	1,090	690	860	985	558	519	5,404
1976	395	2,921	773	330	465	527	488	5,899
1977	1,227	1,731	1,905	419	124	198	279	5,883
1978	1,399	5,704	1,338	801	225	44	80	9,591
1979	723	5,177	3,883	692	248	84	23	10,830
1980	1,083	3,936	2,945	1,617	321	94	35	10,031
1981	2,318	5,706	2,283	956	307	66	7	11,643
1982	1,734	16,976	4,369	878	299	62	6	24,324
1983	322	7,494	9,782	1,507	368	105	34	19,612
1984	412	1,225	2,916	1,809	330	92	6	6,790
1985	436	1,865	746	543	307	72	17	3,986
1986	157	1,707	914	243	126	57	12	3,216
1987	422	626	583	207	51	17	4	1,910
1988	3,915	1,960	409	117	21	9	2	6,433
1989	655	19,863	1,814	199	17	2	-	22,550
1990	287	2,985	11,095	420	63	2	-	14,852
1991	91	1,002	2,112	1,073	49	8	3	4,338
1992	41	420	854	577	41	5	2	1,940
1993	30	286	280	329	160	5	-	1,090
1994	23	171	185	82	48	42	2	553
1995	50	432	211	82	29	4	5	813
1996	34	650	458	101	16	9	4	1,272
1997	97	298	435	158	29	3	5	1,025
1998	58	898	305	153	39	10	3	1,466
1999	113	477	757	108	21	8	3	1,487
2000	12	772	545	228	42	3	2	1,604
2001	34	596	589	171	46	18	11	1,465
2002	15	323	519	244	52	9	7	1,169
2003	25	131	211	259	82	19	8	735
2004	22	297	156	72	95	39	13	694
mean	568	2,928	1,963	693	271	173	93	6,688

Figure D1. Total catch of southern New England-Mid Atlantic yellowtail flounder.

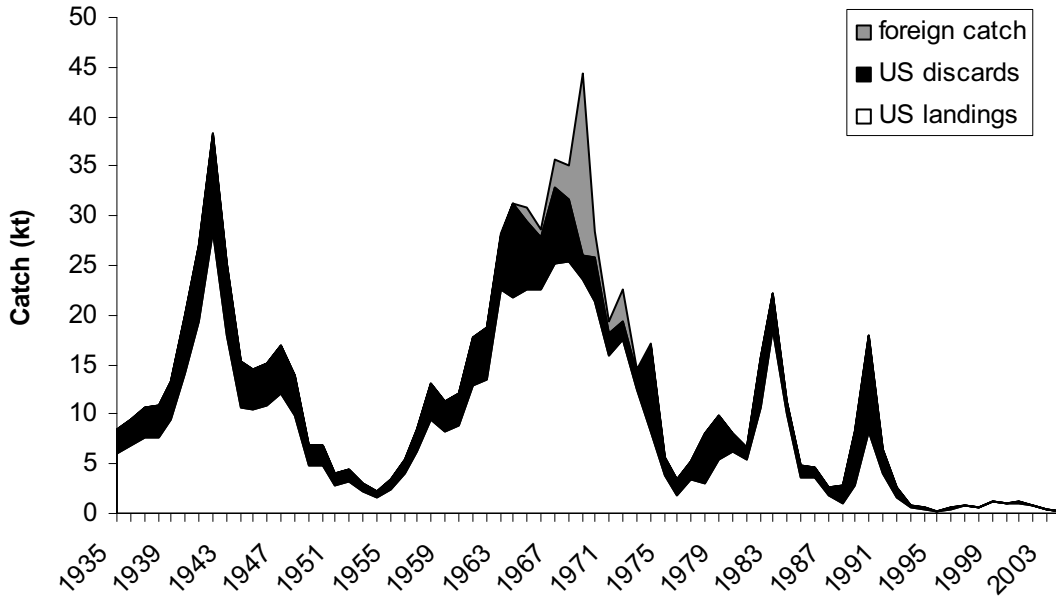


Figure D2. Geographic coverage of the southern New England-Mid Atlantic yellowtail flounder industry-based survey (labels indicate stratum numbers, random tows from the spring 2005 survey).

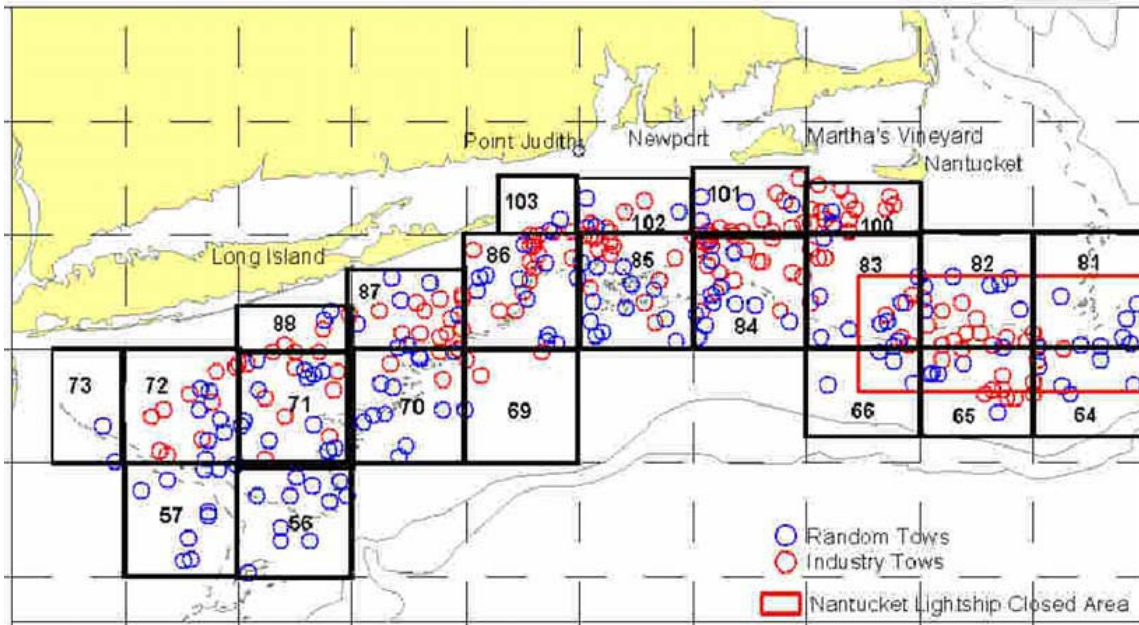


Figure D3. Age distribution of southern New England-Mid Atlantic yellowtail flounder catch.

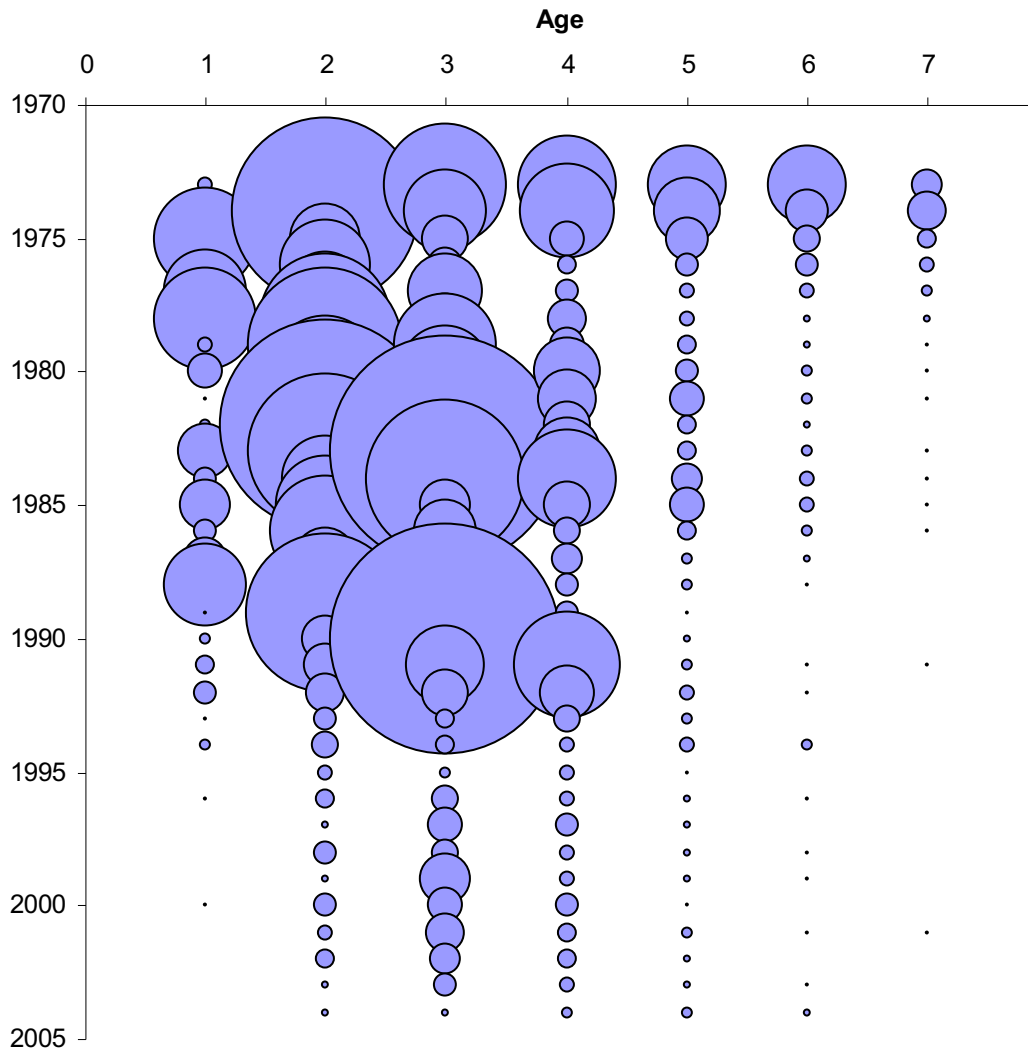


Figure D4. Survey indices of southern New England-Mid Atlantic yellowtail flounder biomass.

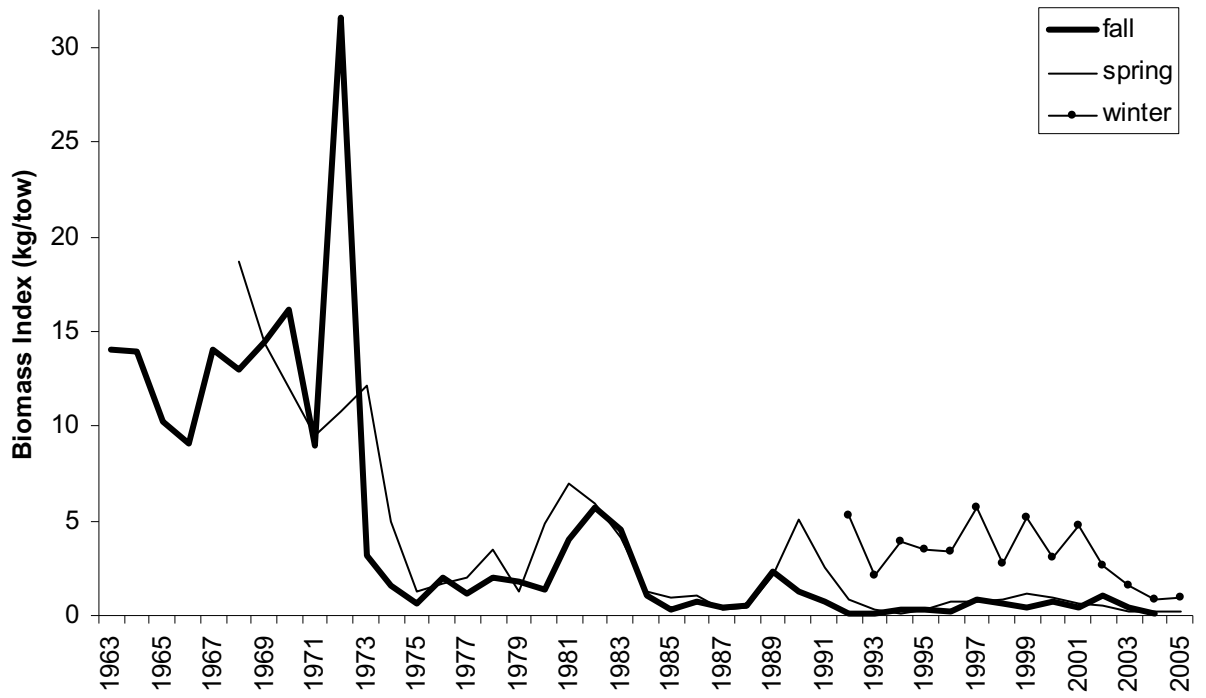


Figure D5. Survey indices of southern New England-Mid Atlantic yellowtail flounder abundance at age (relative circle size indicates relative abundance).

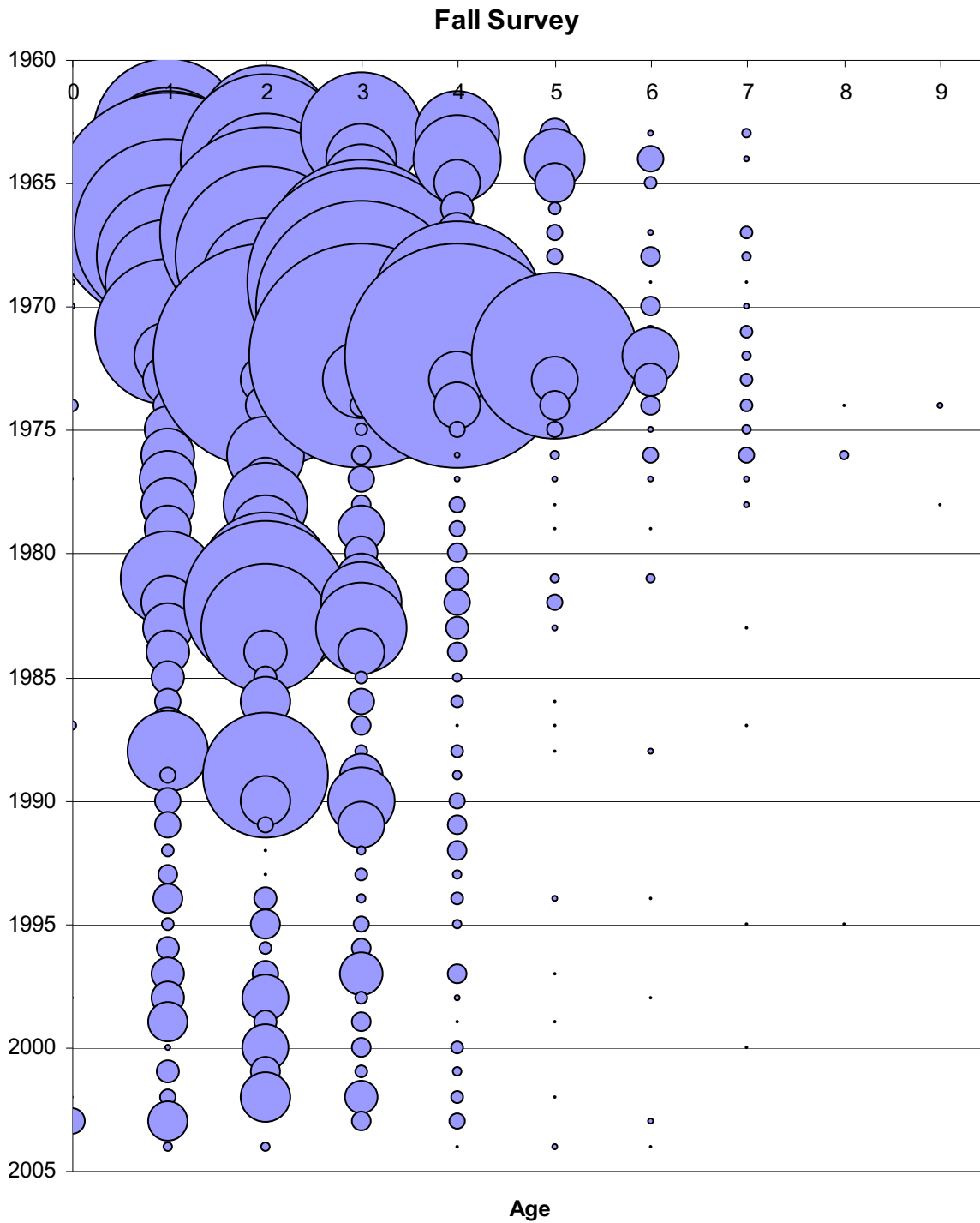


Figure D5, cont.

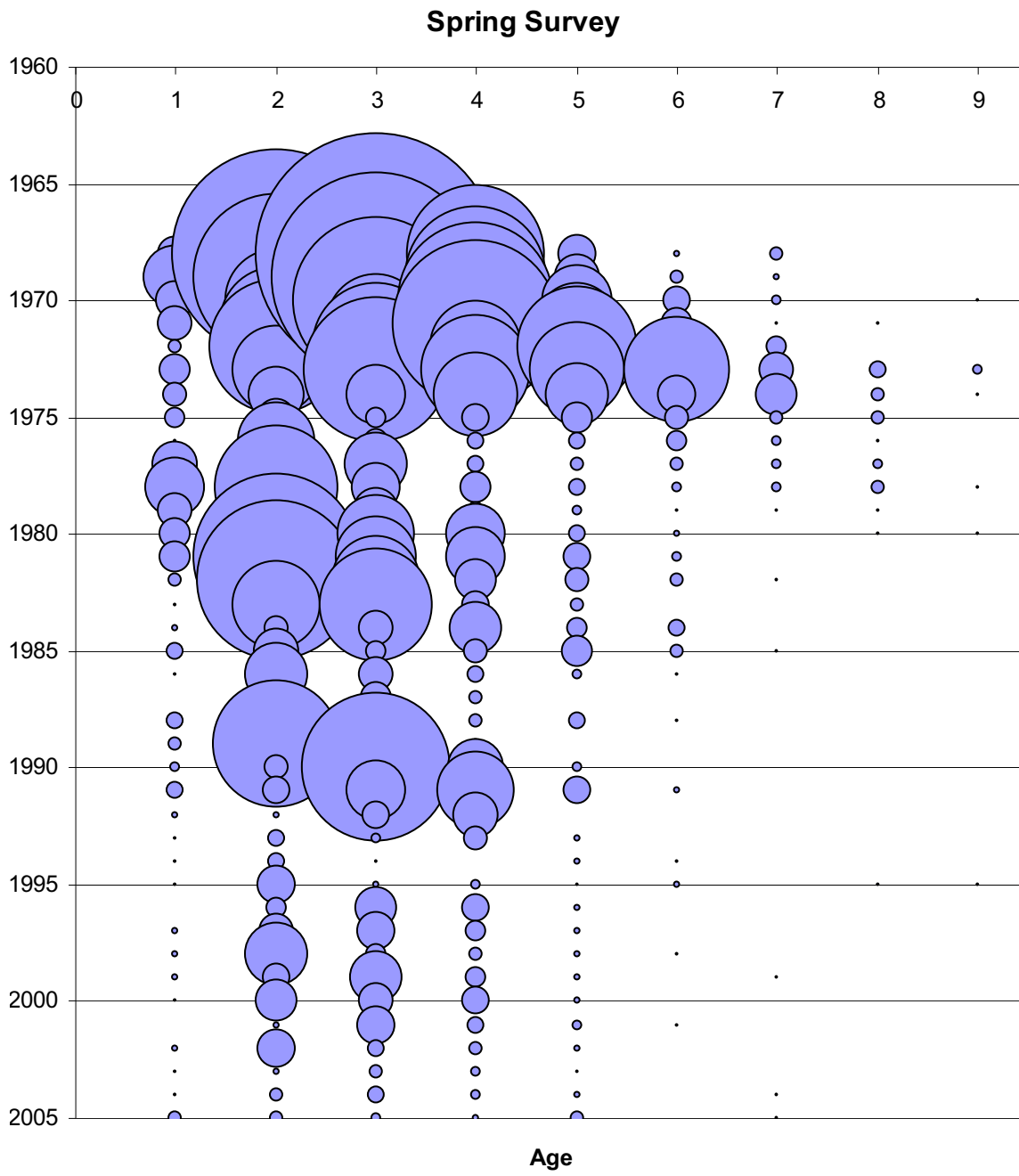


Figure D5, cont.

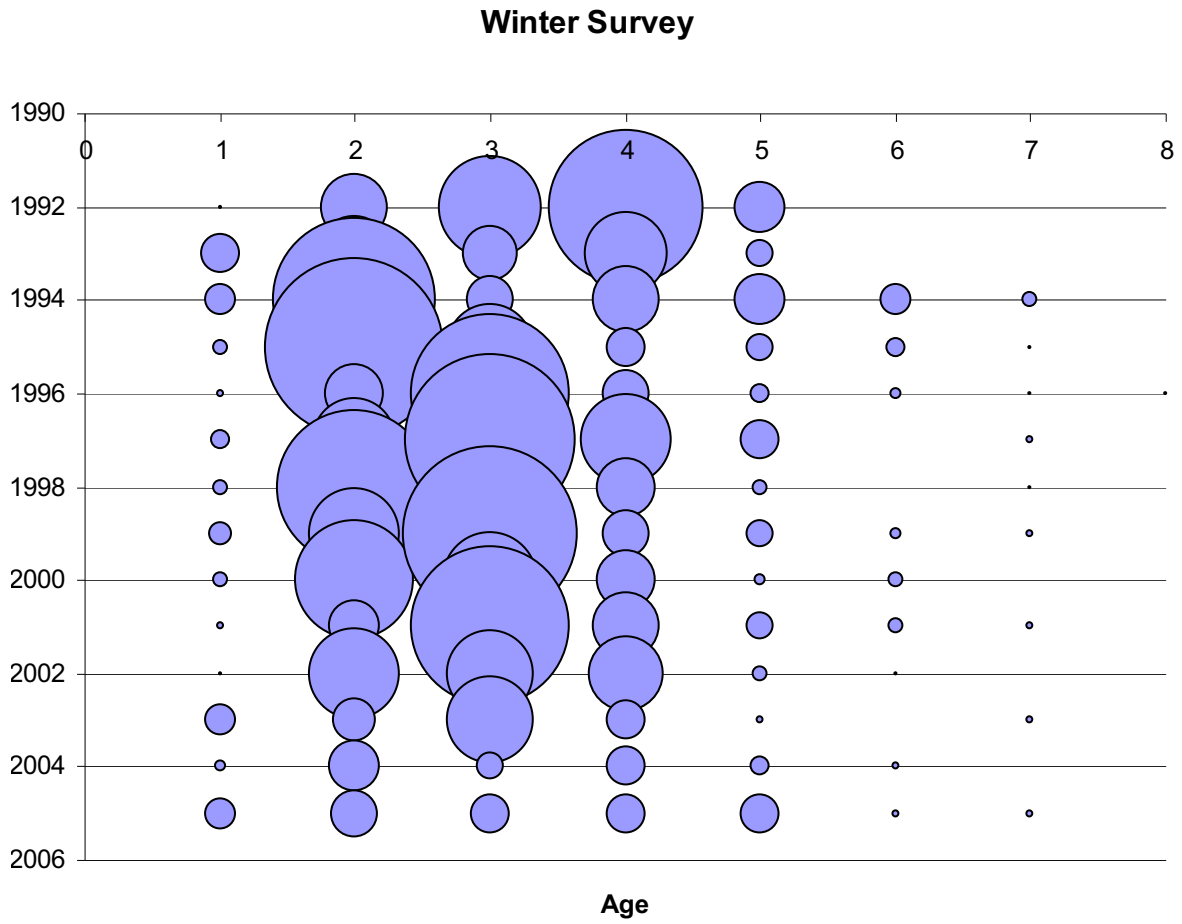


Figure D6. Summary of southern New England-Mid Atlantic yellowtail flounder VPA results.

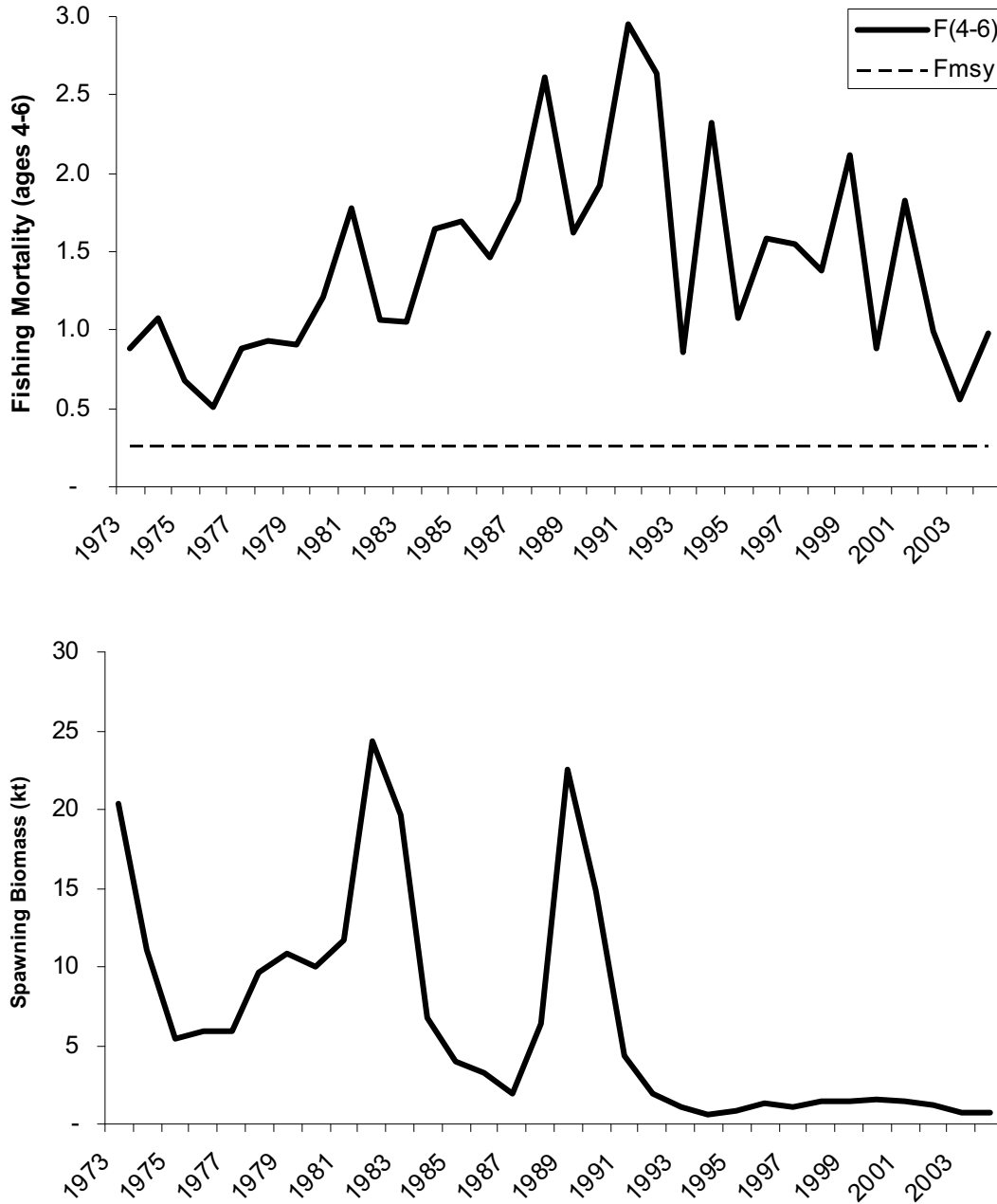


Figure D6 cont.

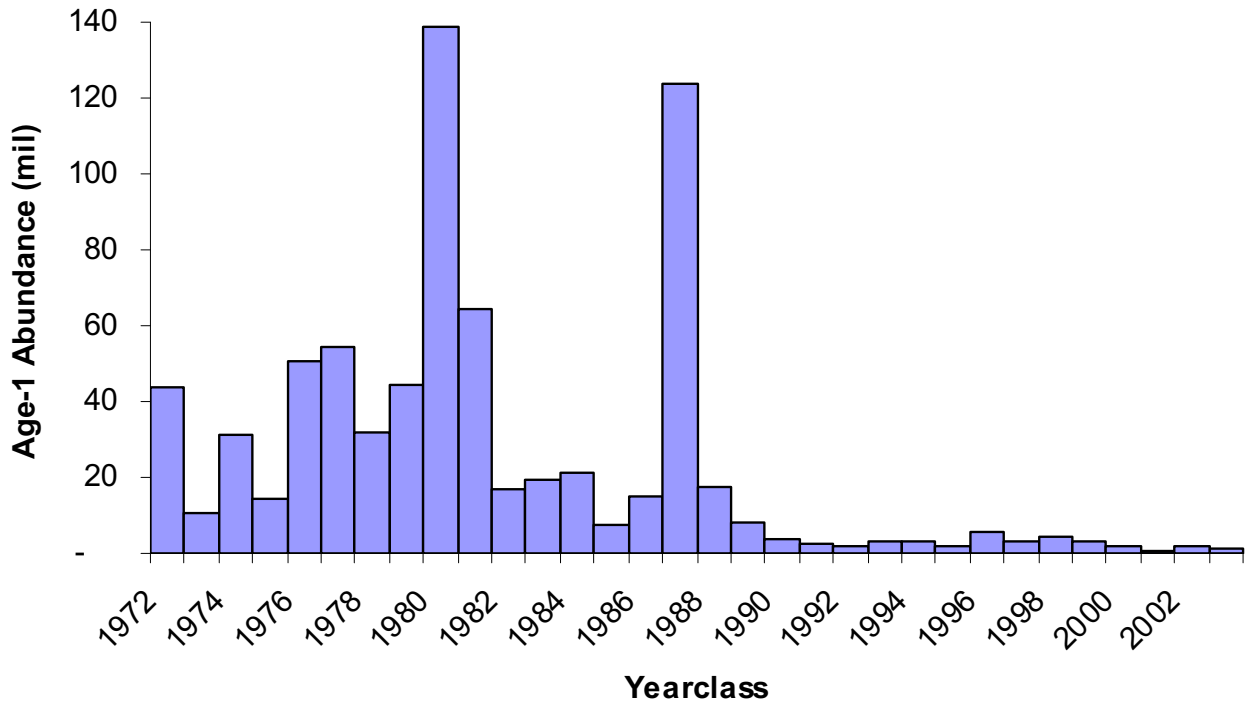


Figure D7. Retrospective analysis of the southern New England-Mid Atlantic yellowtail flounder VPA.

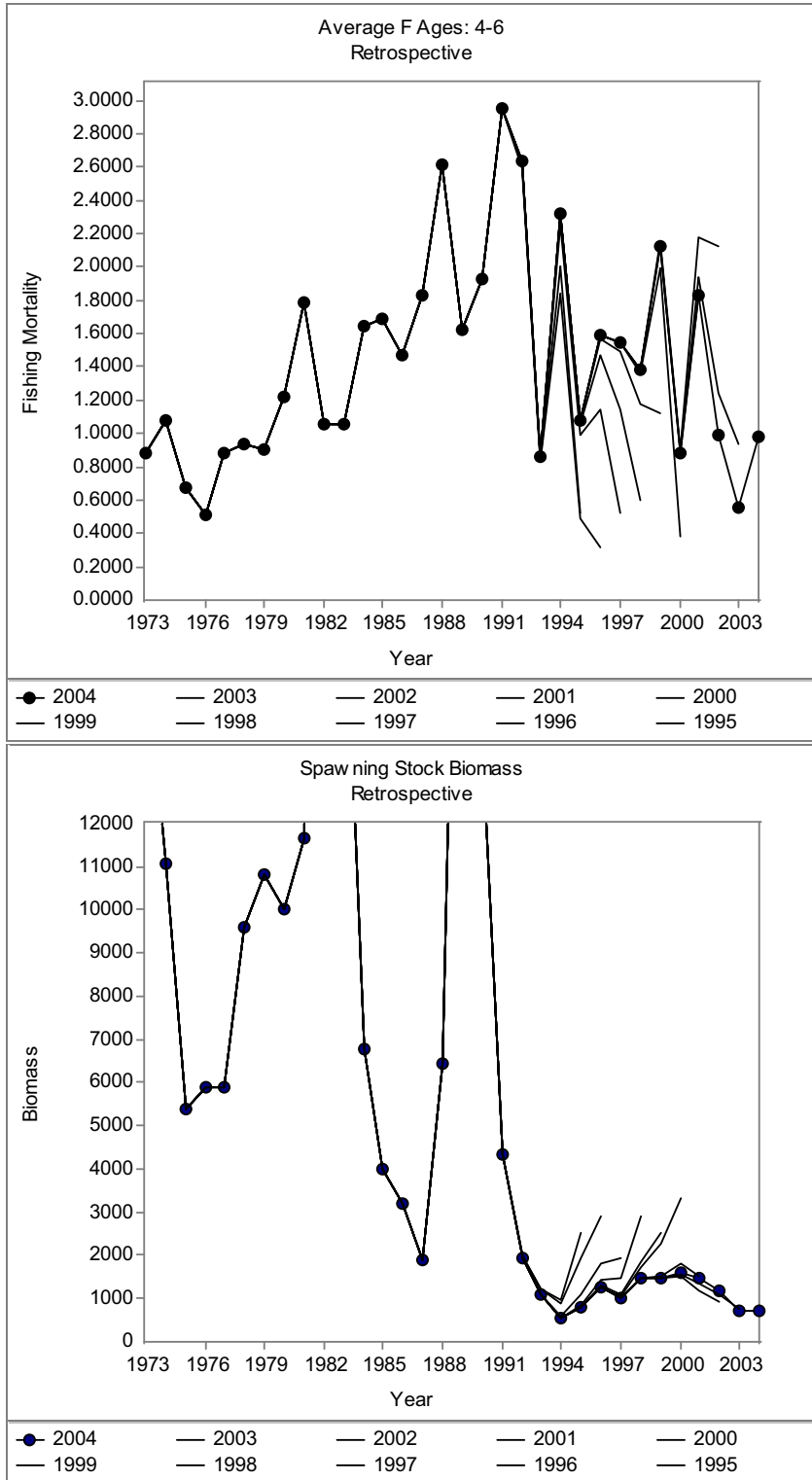


Figure D8. Rebuilding status of Southern New England-Mid Atlantic yellowtail flounder.

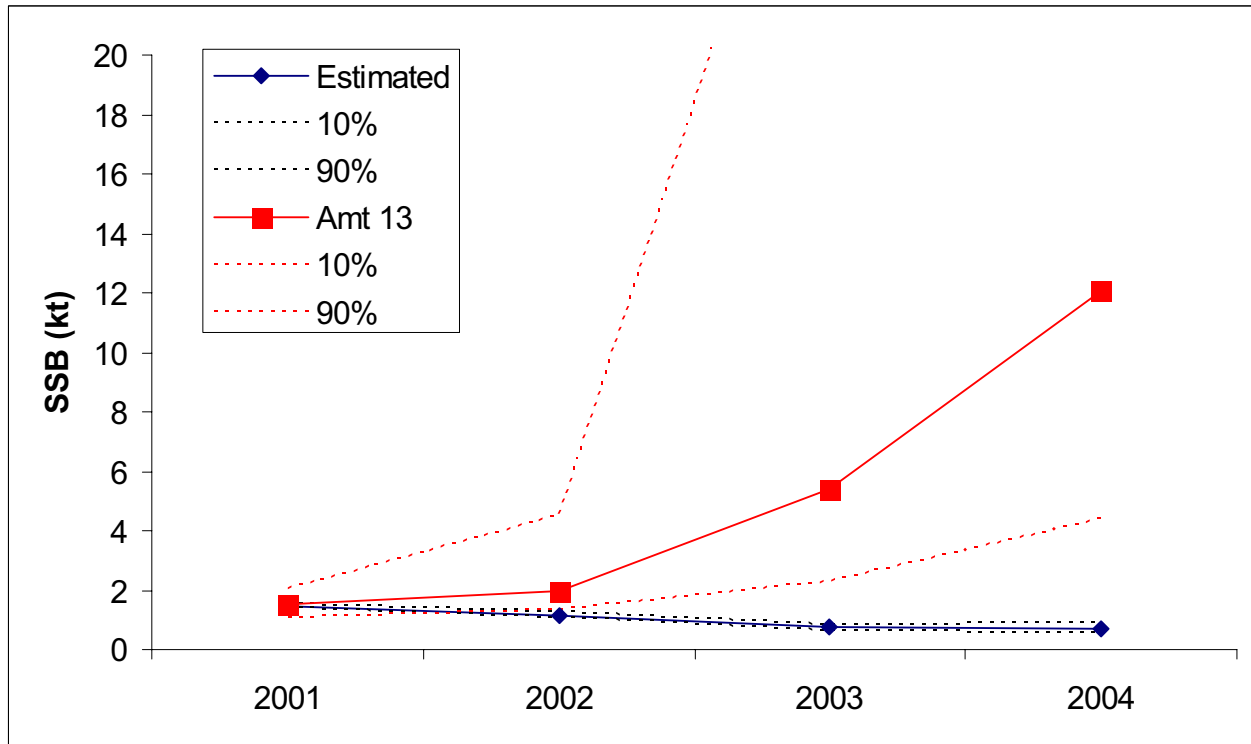


Figure D9. Comparison to rebuilding plan for Southern New England-Mid Atlantic yellowtail flounder.

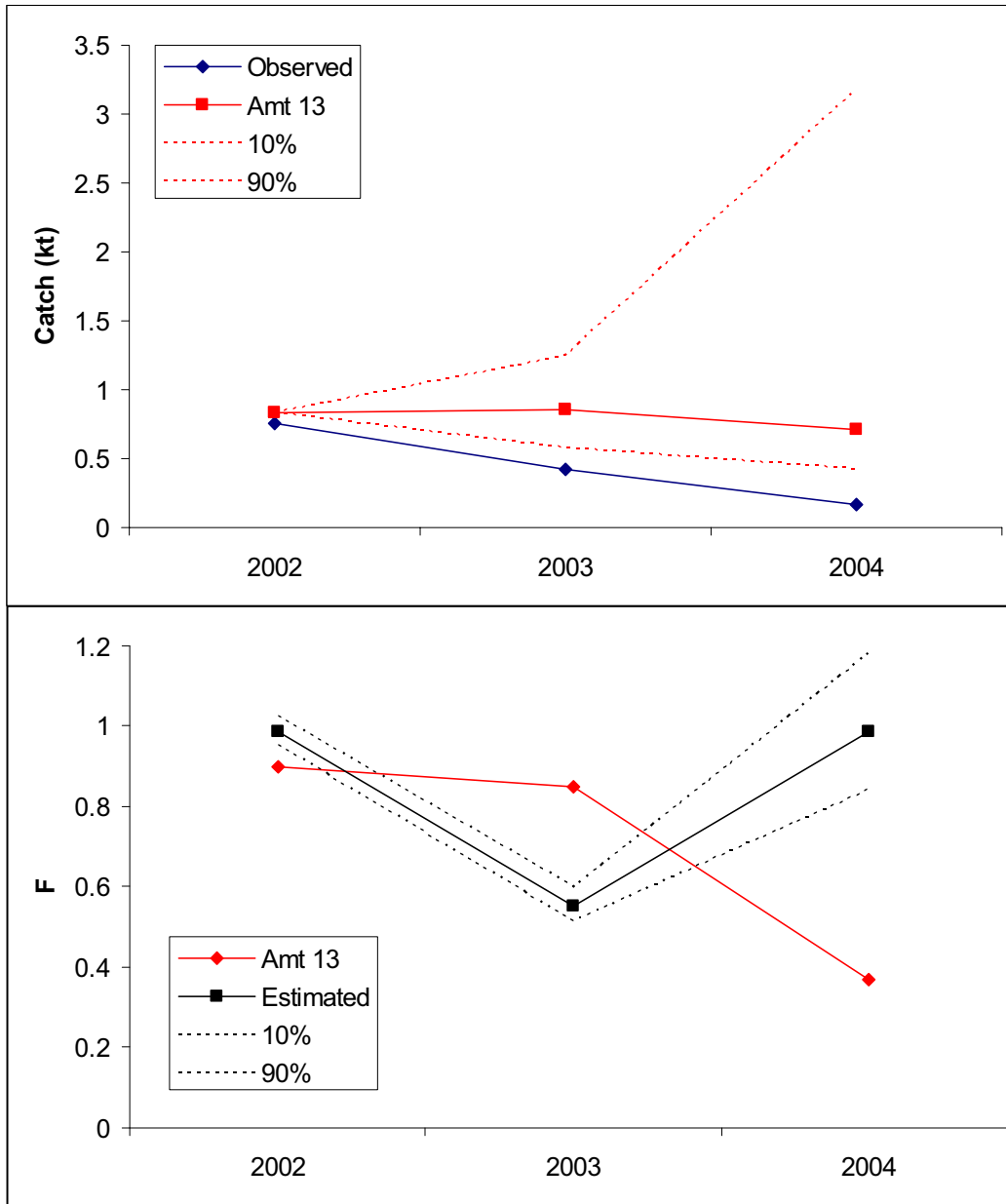


Figure D10. Mean biomass of southern New England-Mid Atlantic yellowtail flounder and fishing mortality on biomass estimated by ASPIC.

