E. Cape Cod-Gulf of Maine Yellowtail Flounder by S.X. Cadrin, C.M. Legault and J. King

1.0 Background

The Cape Cod-Gulf of Maine yellowtail flounder stock was at low biomass and was overexploited in 2001 (SSB was 3,200 mt and fully recruited F was 0.75; Cadrin and King 2003). This report updates catch and survey indices and estimates 2004 fishing mortality and 2005 abundance.

2.0 2005 Assessment

2.1 2002-2004 Landings

U.S. landings were prorated as described in Cadrin et al. (1999; Table E1; Figure E1). Landings steadily declined from 2,505 in 2001 to 829mt in 2004. Sampling intensity was similar to recent years (Table E2) and was used to derive landings at age.

2.2 2002-2004 Discards

Estimates of discarded catch for 2002-2004 were derived from observer data by fishery as described by Cadrin and King (2003). The number of observed trips, lengths and ages for 2002-2004 increased substantially (Table E3). Discard rates varied between 5% and 14% of total catch for 2002-2004 (Table E1). Discards at age were estimated from observer lengths and age-length keys and 2004 survey keys. Total catch at age and mean weights at age are reported in Table E4 and Figure E2.

2.3 2002-2005 Survey Indices

Survey abundance and biomass indices are reported in Table E5. Estimates are from valid tows in the Cape Cod-Gulf of Maine area [offshore strata 25-27, 39, 40 (stratum 27 excluded from the fall series); inshore strata 56-66; Massachusetts strata 17-36] standardized according to net, vessel, and door changes (NEFSC 1998). Survey data generally indicate a decrease in biomass since the 2003 stock assessment with weak recruitment (Figures E3 and E4).

3.0 Assessment Results

Results of an updated VPA calibration of Cape Cod yellowtail are summarized in Table E6. This analysis updates the assessment reported in Cadrin and King (2003) by including 2002-2004 landings and discards, 2002-2004 fall indices, and 2003-2005 spring indices. Results indicate that F remained high during 2002-2004 (averaging 0.87), age-1 recruitment decreased to the lowest in the time series in 2002 and 2003, and SSB decreased to 1,100mt in 2004 (Figure E5). Retrospective analysis indicates a tendency toward underestimating F and overestimating SSB in the most recent years, but improved consistency in 2003 (Figure E6). Bootstrap analysis indicates that abundance was estimated with moderate precision (CV=31-47%).

Reference points for status determination were estimated by from yield and SSB per recruit analyses and the assumption of constant recruitment (Cadrin and King 2003). Assuming that F_{MSY} is approximately $F_{40\%}$ (0.17 on fully-recruited ages) and long-term average recruitment (10.5 million at age-1), MSY=2,300 mt and SSB_{MSY}=12,600 mt. Therefore, the stock is

overfished (2004 SSB=9%SSB_{MSY}) and overfishing is occurring (2004 $F=4 \cdot F_{MSY}$). The estimate of 2004 fishing mortality (0.75) is nearly three times the F desired for the rebuilding program (0.26), and 2004 SSB is approximately 25% of the projected value (Figures E7 and E8).

5.0 Sources of Uncertainty

- Estimates of prorated landings and discard ratios are based on preliminary logbook and data and are subject to change.

6.0 GARM Discussion

The use of age data for estimation of landings at age was discussed. Given the increased number of port samples, only dedicated port samples were used to characterize age at length. Including observer and survey age data could misclassify age distribution of length distributions from port samples. There are indications that yellowtail exhibit demographic changes over small geographic areas, which could make borrowing samples for age keys problematic. The Panel supported the decision to use port samples only.

Projection Advice - An increase in weight at age in recent years was noted. The group decided to use the most recent three-year averages of weight at age for projections (excluding the 2002 weight of age-1 which is based on few fish). Similarly, the group decided to use the most recent three-year averages of partial recruitment for projections. Given the noisy relationship of stock-recruitment and production of the large 1987 cohort from low SSB, the group decided to use the entire series of recruitment observations (age-1 abundance, 1985–2004) for projections.

7.0 References

Cadrin, S.X., J. King, and L. Suslowicz. 1999. Status of the Cape Cod yellowtail flounder stock for 1998. NEFSC Ref. Doc. 99-04.

Cadrin, S.X. and J. King 2003. Stock assessment of yellowtail flounder in the Cape Cod-Gulf of Maine area. NEFSC Ref. Doc. 03-03.

Table E1. Total catch of Cape Cod-Gulf of Maine yellowtail flounder (mt).

year	landings	discards	total catch	%discard
1935	400	100	500	20%
1936	400	100	500	20%
1937	500	200	700	29%
1938	500	200	700	29%
1939	600	200	800	25%
1940	900	300	1200	25%
1941	1300	400	1700	24%
1942	1512	500	2012	25%
1943	1334	400	1734	23%
1944	1531	500	2031	25%
1945	1214	400	1614	25%
1946	1214	400	1614	25%
1947	1122	300	1422	21%
1948	710	200	910	22%
1949	1221	400	1621	25%
1950	1387	400	1787	22%
1951	862	200	1062	19%
1952	837	200	1037	19%
1953	840	200	1040	19%
1954	1114	300	1414	21%
1955	1320	400	1720	23%
1956	1426	400	1826	22%
1957	2426	700	3126	22%
1958	1639	500	2139	23%
1959	1564	500	2064	24%
1960	1539	500	2039	25%
1961	1822	600	2422	25%
1962	1900	600	2500	24%
1963	3600	1000	4600	22%
1964	1857	600	2457	24%
1965	1506	500	2006	25%
1966	1835	300	2135	14%
1967	1591	800	2391	33%
1968	1581	600	2181	28%
1969	1422	300	1722	17%
1970	1310	400	1710	23%
1971	1718	700	2418	29%
1972	1521	300	1821	16%
1973	1724	0	1724	0%
1974	2158	200	2358	8%
1975	2220	0	2220	0%
1976	3845	100	3945	3%
1977	3722	0	3722	0%
1978	4071	400	4471	9%
1979	4439	500	4939	10%
1980	5567	600	6167	10%
1981	3574	600	4174	14%
1982	3635	400	4035	10%
1983	2209	300	2509	12%
1984	1365	20	1385	1%
1985	1171	154	1326	12%
1986	1205	367	1572	23%
1987	1353	271	1624	17%
1988	1275	355	1630	22%
1989	1117	437	1555	28%
1990	3222	1239	4461	28%
1991	1737	515	2251	23%
1992	1031	715	1746	41%
1993	786	145	932	16%
1994	1299	281	1580	18%
1995	1330	349	1680	21%
1996	1171	237	1408	17%
1997	1114	283	1398	20%
1998	1243	297	1540	19%
1999	1211	147	1357	11%
2000	2413	196	2609	8%
2001	2505	483	2988	16%
2002	2024	103	2127	5%
2003	1802	165	1967	8%
2004	829	133	962	14%
mean	1706	366	2072	19%

Table E2. Samples of Cape Cod-Gulf of Maine yellowtail flounder (ages used to categorized pooled market categories).

year	half	category	landings mt	samples lengths	ages	kg	% of landings
2002	Jan-Jun	unlassified	181	304	346	131	0.07%
		large	320	295		170	0.05%
		small	194	655		277	0.14%
	Jul-Dec	unlassified	177	225	676	86	0.05%
		large	584	990		536	0.09%
		small	568	1640		651	0.11%
2003	Jan-Jun	unlassified	339	565	512	253	0.07%
		large	297	352		238	0.08%
		small	281	1194		495	0.18%
	Jul-Dec	unlassified	236	421	900	186	0.08%
		large	367	1452		776	0.21%
		small	283	1233		484	0.17%
2004	Jan-Jun	unlassified	165	263	539	107	0.06%
		large	211	338		253	0.12%
		small	156	647		281	0.18%
	Jul-Dec	unlassified	77	162	204	57	0.07%
		large	88	267		148	0.17%
		small	132	349		140	0.11%

Table E3. Discard estimates and sample sizes for Cape Cod-Gulf of Maine yellowtail flounder, 2002-2004.

Large-Mesh Trawl Fishery

year	half	observed trips w/YT	kept (mt)	discard (mt)	d/k	landings (mt)	% observed	discards (mt)	discard lengths	observer ages all
2002	Jan-Jun	53	3.059	0.257	0.0839	602.7	0.51%	50.6	250	431
	Jul-Dec	149	55.325	2.108	0.0381	1290.8	4.29%	49.2	3380	1912
2003	Jan-Jun	101	29.415	2.524	0.0858	701.6	4.19%	60.2	3208	1638
	Jul-Dec	124	15.996	1.754	0.1096	846.3	1.89%	92.8	1378	426
2004	Jan-Jun	78	13.785	2.147	0.1557	359.5	3.83%	56.0	1575	296
	Jul-Dec	211	19.767	4.358	0.2205	284.2	6.96%	62.7	4656	169

Gillnet Fishery

year	half	observed trips w/YT	observed kept (mt)	discard (mt)	d/k	landings (mt)	% observed	discards (mt)	discard lengths
2002	Jan-Jun	68	7.905	0.059	0.0075	77.3	10.23%	0.6	15
	Jul-Dec	75	1.156	0.027	0.0233	38.4	3.01%	0.9	55
2003	Jan-Jun	120	10.805	0.412	0.0382	213.4	5.06%	8.1	660
	Jul-Dec	81	0.496	0.019	0.0384	38.4	1.29%	1.5	24
2004	Jan-Jun	168	15.608	0.710	0.0455	171.0	9.13%	7.8	1742
	Jul-Dec	179	2.222	0.472	0.2124	10.3	21.51%	2.2	1010

Small Mesh Trawl Fishery

year	half	observed trips w/YT	observed kept (mt)	discard (mt)	d/k	landings (mt)	% observed	discards (mt)	discard lengths
2002	Jan-Jun	4	0.976	0.002	0.0019	0.4		0.0	0
	Jul-Dec	21	12.983	0.716	0.055	1.2		0.1	619
2003	Jan-Jun	13	0.050	0.020	0.4082	1.2	4.1%	0.5	54
	Jul-Dec	7	0.199	0.139	0.6998	0.6	35.5%	0.4	187
2004	Jan-Jun	11	0.499	0.199	0.3978	1.6	31.8%	0.6	119
	Jul-Dec	22	1.213	0.360	0.2965	2.7	45.3%	0.8	273

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	**	0.0038	312	0.00%	1.2	0	**
	Jul-Dec	4	9.03	0.034	0.0038	197	4.58%	0.7	85	
2003	Jan-Jun	3	5.24	0.032	0.0061	276	1.90%	1.7	37	
	Jul-Dec	1	14.18	0.001	0.0001	223	6.35%	0.0	0	
2004	Jan-Jun	1	0.17	0.002	0.0106	104	0.16%	1.1	5	
	Jul-Dec	14	5.47	0.194	0.0354	45	12.05%	1.6	406	

* survey ages

**Jul-Aug estimates used

Table E4. Catch at age (above) and mean weights at age (below) of Cape Cod-Gulf of Maine yellowtail flounder.

Total catch at age (thousands) age

	1	2	3	4	5	6	7	8+	sum
1985	686	1245	907	635	329	109	3	8	3924
1986	95	4225	785	304	40	7	0	1	5457
1987	19	1885	2331	309	116	34	13	6	4714
1988	452	2582	1503	744	199	41	0	0	5520
1989	118	2297	1812	298	38	4	2	2	4571
1990	84	2897	9400	493	35	18	7	4	12938
1991	465	1372	1765	1953	298	39	34	1	5927
1992	1709	3979	1961	731	191	7	6	1	8585
1993	159	425	1074	795	111	29	17	8	2619
1994	75	535	1653	1031	367	143	79	10	3893
1995	458	751	2754	1069	239	85	5	0	5361
1996	7	592	1593	1077	339	12	5	3	3628
1997	2	912	1574	889	195	14	0	1	3586
1998	108	707	2299	563	163	44	3	0	3888
1999	17	564	1549	770	122	52	3	0	3076
2000	9	1144	3059	1310	158	22	13	4	5718
2001	20	1705	3811	1261	173	29	13	1	7014
2002	47	1166	2513	1002	60	13	1	0	4802
2003	0	589	1858	1152	154	39	11	10	3814
2004	0	71	938	422	239	70	11	1	1752
mean	227	1482	2257	840	178	41	11	3	5039

Weight at age (kg) age

	1	2	3	4	5	6	7	8+
1985	0.132	0.266	0.357	0.489	0.600	0.727	1.195	1.392
1986	0.103	0.250	0.428	0.534	0.730	0.906		1.397
1987	0.056	0.232	0.393	0.548	0.652	0.821	1.036	1.193
1988	0.123	0.206	0.338	0.523	0.696	0.841		
1989	0.129	0.270	0.383	0.650	0.928	1.410	1.239	1.239
1990	0.079	0.254	0.370	0.550	0.824	0.911	0.990	1.222
1991	0.124	0.236	0.342	0.517	0.737	0.984	1.063	1.087
1992	0.053	0.135	0.325	0.498	0.602	0.741	1.524	1.908
1993	0.089	0.160	0.358	0.418	0.737	0.949	1.008	1.167
1994	0.085	0.220	0.365	0.458	0.572	0.584	0.851	1.108
1995	0.072	0.220	0.322	0.410	0.529	0.781	1.115	
1996	0.040	0.190	0.383	0.469	0.528	0.910	1.190	1.181
1997	0.093	0.302	0.381	0.459	0.569	0.779	1.303	1.306
1998	0.047	0.261	0.391	0.527	0.614	0.993	1.625	
1999	0.086	0.309	0.409	0.557	0.574	0.882	1.336	
2000	0.051	0.361	0.435	0.562	0.610	0.823	0.874	0.908
2001	0.032	0.319	0.409	0.564	0.720	1.006	0.927	1.930
2002	0.251	0.358	0.431	0.557	0.682	1.100	1.170	
2003		0.363	0.426	0.554	0.673	0.812	1.041	1.226
2004		0.338	0.393	0.505	0.641	0.815	1.048	1.599
mean	0.091	0.262	0.382	0.517	0.661	0.889	1.141	1.324

Table E5. Survey indices of Cape Cod-Gulf of Maine yellowtail abundance and biomass.

NMFS Spring Survey

year	1	2	3	4	5	6	7	8+	sum	kg/tow
1977	0.775	0.329	0.185	0.049	0.093	0.000	0.000	0.000	1.431	0.566
1978	0.000	0.057	0.247	0.036	0.088	0.000	0.000	0.000	0.427	0.209
1979	0.228	0.315	0.748	0.770	0.068	0.021	0.000	0.019	2.169	0.795
1980	0.000	4.150	2.189	0.828	0.167	0.000	0.000	0.000	7.334	2.426
1981	0.041	2.921	2.198	1.143	0.584	0.473	0.179	0.000	7.538	2.468
1982	0.016	1.195	3.009	1.519	0.416	0.232	0.219	0.099	6.705	2.814
1983	1.190	3.203	2.093	1.298	0.092	0.064	0.000	0.000	7.939	2.340
1984	0.039	1.020	0.606	0.394	0.257	0.023	0.032	0.069	2.440	0.809
1985	0.047	0.806	0.865	0.205	0.123	0.043	0.000	0.000	2.089	0.615
1986	0.024	1.786	0.198	0.137	0.100	0.000	0.000	0.000	2.245	0.470
1987	0.062	1.599	2.356	0.637	0.538	0.570	0.611	0.304	6.676	2.971
1988	0.896	3.781	0.922	0.513	0.268	0.097	0.057	0.000	6.533	1.077
1989	0.177	2.179	1.442	0.372	0.274	0.038	0.038	0.038	4.559	0.863
1990	2.285	6.144	0.210	0.000	0.099	0.000	0.000	0.000	8.739	1.948
1991	0.421	3.554	2.834	1.049	0.222	0.000	0.047	0.000	8.128	1.783
1992	0.155	0.915	1.835	0.498	0.018	0.000	0.000	0.000	3.421	0.764
1993	0.064	0.656	1.045	0.563	0.000	0.000	0.000	0.000	2.327	0.501
1994	0.347	2.631	1.578	0.951	0.593	0.208	0.000	0.000	6.308	1.201
1995	0.182	1.040	3.978	2.991	0.432	0.048	0.000	0.000	8.670	2.036
1996	0.015	0.547	1.430	2.009	0.335	0.000	0.000	0.000	4.336	1.108
1997	0.021	0.934	2.025	1.545	0.288	0.000	0.000	0.000	4.813	1.311
1998	0.000	0.748	2.934	0.887	0.144	0.000	0.000	0.000	4.712	1.155
1999	0.018	0.848	3.633	1.853	0.332	0.147	0.000	0.000	6.831	1.977
2000	0.238	3.931	17.630	5.837	0.953	0.715	0.000	0.000	29.305	9.506
2001	0.000	1.201	4.878	1.030	0.216	0.000	0.000	0.000	7.324	2.292
2002	0.015	1.563	7.071	3.262	0.213	0.026	0.000	0.026	12.176	3.694
2003	0.094	0.863	2.405	1.758	0.787	0.000	0.000	0.025	5.933	1.910
2004	0.367	0.597	2.617	0.359	0.140	0.000	0.000	0.000	4.080	1.076
2005	0.089	0.582	3.820	1.284	0.000	0.000	0.000	0.000	5.776	1.424
mean	0.279	1.848	2.621	1.168	0.266	0.104	0.046	0.021	6.353	1.835

Table E5 cont.

NMFS Fall Survey

year	1	2	3	4	5	6	7	8+	sum	kg/tow
1977	4.882	9.330	4.987	0.788	0.197	0.053	0.062	0.123	20.421	7.526
1978	0.354	3.540	2.383	0.152	0.168	0.015	0.015	0.015	6.642	2.047
1979	4.003	4.072	1.227	0.306	0.075	0.016	0.000	0.000	9.698	2.596
1980	10.534	8.937	4.115	1.556	0.340	0.000	0.037	0.000	25.518	6.557
1981	1.596	4.965	1.330	0.532	0.266	0.177	0.000	0.000	8.866	1.881
1982	0.572	2.743	2.593	0.313	0.379	0.000	0.000	0.000	6.599	2.056
1983	0.285	0.546	0.312	0.020	0.000	0.000	0.000	0.000	1.162	0.264
1984	0.320	1.124	0.443	0.763	0.546	0.151	0.075	0.075	3.497	1.380
1985	4.609	1.778	1.352	0.068	0.068	0.068	0.000	0.000	7.943	1.583
1986	1.308	3.613	0.297	0.019	0.019	0.000	0.000	0.000	5.257	0.970
1987	0.564	1.357	0.476	0.057	0.049	0.000	0.000	0.000	2.503	0.556
1988	3.128	4.587	0.443	0.134	0.000	0.000	0.000	0.000	8.292	1.126
1989	1.657	5.338	2.008	0.417	0.146	0.066	0.000	0.000	9.631	2.202
1990	3.500	6.201	2.874	0.046	0.010	0.000	0.000	0.000	12.630	2.345
1991	1.840	1.643	1.639	0.332	0.000	0.000	0.000	0.000	5.453	1.202
1992	2.537	2.758	1.878	0.948	0.183	0.142	0.000	0.000	8.447	1.932
1993	4.445	4.507	0.601	0.099	0.000	0.000	0.000	0.000	9.652	1.106
1994	2.472	7.368	2.596	0.824	0.354	0.000	0.000	0.000	13.615	2.701
1995	0.516	0.713	1.068	0.297	0.171	0.000	0.000	0.000	2.765	0.783
1996	1.058	2.907	4.928	1.179	0.133	0.000	0.000	0.000	10.205	2.614
1997	1.049	2.440	2.945	1.223	0.670	0.115	0.000	0.000	8.441	2.277
1998	1.022	2.984	1.197	0.986	0.234	0.000	0.000	0.000	6.422	1.637
1999	4.147	8.090	5.532	1.697	0.698	0.027	0.000	0.000	20.191	5.983
2000	0.955	6.729	4.455	0.260	0.000	0.000	0.000	0.000	12.399	3.472
2001	0.117	3.835	2.231	0.114	0.019	0.000	0.000	0.000	6.316	1.889
2002	0.409	1.414	0.547	0.166	0.019	0.000	0.000	0.000	2.555	0.708
2003	0.597	8.775	1.846	0.434	0.253	0.000	0.000	0.000	11.905	3.443
2004	0.237	1.154	0.628	0.024	0.000	0.000	0.000	0.000	2.044	0.488
mean	2.097	4.052	2.033	0.491	0.178	0.030	0.007	0.008	8.895	2.262

Table E5 cont.

MADMF Spring Survey	age									
	1	2	3	4	5	6	7	8+	sum	kg/tow
1978	2.71	20.69	11.82	1.60	0.63	0.54	0.10	0.13	38.22	10.16
1979	2.63	22.58	13.85	3.68	0.86	0.00	0.17	0.00	43.77	11.38
1980	2.68	17.62	10.10	2.30	0.15	0.00	0.00	0.00	32.85	10.03
1981	5.61	58.83	9.00	2.26	1.59	0.27	0.00	0.00	77.56	16.35
1982	0.69	17.06	17.04	4.45	0.94	0.06	0.04	0.00	40.28	12.85
1983	3.13	8.50	11.51	4.28	0.04	0.17	0.03	0.00	27.66	9.00
1984	0.43	18.13	7.56	2.29	0.85	0.00	0.00	0.00	29.26	7.37
1985	1.97	8.27	7.15	1.52	0.59	0.39	0.05	0.05	19.99	5.21
1986	1.73	15.39	1.74	0.24	0.21	0.04	0.00	0.00	19.36	4.52
1987	2.53	4.95	5.31	0.97	0.27	0.11	0.08	0.00	14.22	3.67
1988	3.10	14.46	2.52	0.60	0.05	0.02	0.00	0.00	20.74	3.83
1989	0.67	22.26	3.18	1.08	0.06	0.00	0.00	0.00	27.25	4.73
1990	0.63	11.77	15.57	0.63	0.14	0.01	0.02	0.01	28.77	6.60
1991	0.06	5.34	3.31	2.15	0.48	0.12	0.05	0.00	11.50	3.32
1992	1.30	11.03	9.71	2.38	1.45	0.03	0.03	0.00	25.94	6.54
1993	0.63	7.99	6.31	1.94	0.23	0.06	0.20	0.03	17.38	4.60
1994	2.67	24.02	7.53	1.49	0.33	0.12	0.00	0.00	36.15	6.23
1995	7.51	14.64	24.96	2.88	1.20	0.02	0.02	0.00	51.22	10.38
1996	1.17	18.03	14.70	6.78	1.74	0.00	0.04	0.00	42.46	9.25
1997	0.52	16.94	12.22	4.04	0.54	0.00	0.00	0.00	34.26	7.55
1998	0.55	4.96	13.50	1.25	0.19	0.02	0.00	0.00	20.46	5.17
1999	0.10	6.34	10.90	1.28	0.08	0.00	0.00	0.00	18.70	5.08
2000	0.83	21.92	33.29	11.28	1.30	0.52	0.00	0.00	69.14	20.37
2001	0.22	10.21	38.20	10.39	1.68	0.00	0.00	0.00	60.71	19.34
2002	0.36	1.29	13.84	5.34	0.26	0.17	0.00	0.00	21.27	7.43
2003	0.04	8.22	8.68	9.70	1.45	0.07	0.00	0.00	28.16	8.154
2004	0.15	2.50	8.30	4.24	0.53	0.02	0.00	0.00	15.74	4.626
2005									28.94	7.95
mean	1.65	14.59	11.92	3.37	0.66	0.10	0.03	0.01	32.21	8.27

Table E5 cont.

MADMF Fall Survey					age						
	0	1	2	3	4	5	6	7	8+	sum	kg/tow
1978	0.04	7.13	7.74	1.45	0.11	0.00	0.01	0.00	0.00	16.48	2.80
1979	0.03	24.11	22.82	1.78	0.06	0.00	0.00	0.00	0.00	48.80	7.33
1980	0.03	26.54	12.38	2.70	0.35	0.00	0.00	0.00	0.00	42.00	5.90
1981	0.00	2.93	6.54	1.54	0.23	0.17	0.00	0.00	0.00	11.41	2.76
1982	0.00	9.58	3.36	5.54	0.30	0.08	0.00	0.00	0.00	18.86	4.20
1983	0.00	9.68	6.68	1.60	0.13	0.00	0.00	0.00	0.00	18.09	3.39
1984	0.04	1.91	3.00	0.86	0.39	0.10	0.02	0.00	0.04	6.37	1.18
1985	0.04	5.70	1.63	1.03	0.00	0.00	0.00	0.00	0.02	8.42	1.17
1986	0.01	2.60	4.95	0.20	0.03	0.01	0.00	0.00	0.00	7.80	1.36
1987	0.44	5.85	2.30	0.49	0.07	0.02	0.00	0.00	0.00	9.17	1.09
1988	0.00	8.96	11.24	2.27	0.15	0.00	0.00	0.00	0.00	22.62	3.71
1989	0.00	2.64	5.22	0.96	0.10	0.00	0.00	0.00	0.00	8.92	1.52
1990	0.00	5.20	11.93	4.84	0.01	0.00	0.00	0.00	0.00	21.98	4.16
1991	0.00	3.76	5.14	5.03	0.86	0.00	0.00	0.00	0.00	14.78	3.23
1992	0.20	7.18	3.62	2.08	0.47	0.20	0.00	0.00	0.00	13.75	2.00
1993	0.00	8.39	7.29	5.80	1.43	0.00	0.00	0.00	0.00	22.91	3.99
1994	0.00	2.36	11.79	1.79	0.15	0.00	0.00	0.00	0.00	16.09	3.27
1995	0.00	8.38	15.16	5.85	0.00	0.00	0.00	0.00	0.00	29.40	5.75
1996	0.01	1.87	3.94	2.18	0.17	0.00	0.00	0.00	0.00	8.17	1.56
1997	0.00	1.01	7.38	1.14	0.16	0.10	0.00	0.00	0.00	9.79	2.10
1998	0.00	7.05	6.74	2.25	0.00	0.00	0.00	0.00	0.00	16.05	2.68
1999	0.15	4.73	11.94	4.10	0.65	0.08	0.00	0.00	0.00	21.66	4.71
2000	0.00	1.36	8.25	3.53	0.22	0.10	0.00	0.03	0.00	13.48	3.46
2001	0.00	0.57	8.06	4.23	0.14	0.00	0.00	0.00	0.00	13.00	3.55
2002	0.16	1.67	0.84	3.04	1.15	0.05	0.00	0.00	0.00	6.91	1.629
2003	0.17	0.41	7.04	3.86	3.01	0.07	0.00	0.00	0.00	14.56	4.002
2004	0.61	2.40	9.89	8.66	2.73	0.02	0.00	0.00	0.00	24.30	5.694
mean	0.07	6.07	7.66	2.92	0.48	0.04	0.00	0.00	0.00	17.25	3.27

Table E6. Results of the Cape Cod-Gulf of Maine yellowtail flounder VPA.

Abundance (thousands)			Age			
	1	2	3	4	5+	sum
1985	12,302	3,195	1,696	1,168	828	19,189
1986	6,030	9,451	1,489	568	90	17,628
1987	8,083	4,851	3,915	509	278	17,636
1988	28,835	6,600	2,266	1,096	354	39,151
1989	11,318	23,199	3,068	495	76	38,156
1990	11,618	9,160	16,915	872	113	38,678
1991	13,054	9,436	4,878	5,344	1,018	33,730
1992	9,617	10,267	6,484	2,397	672	29,437
1993	10,358	6,327	4,806	3,535	734	25,760
1994	7,120	8,336	4,796	2,963	1,721	24,936
1995	6,298	5,762	6,341	2,431	750	21,582
1996	9,352	4,742	4,038	2,700	900	21,732
1997	8,140	7,650	3,347	1,864	440	21,441
1998	9,866	6,662	5,438	1,316	493	23,775
1999	11,494	7,980	4,815	2,372	545	27,206
2000	9,912	9,395	6,023	2,541	380	28,251
2001	6,250	8,107	6,657	2,163	372	23,549
2002	3,782	5,099	5,095	2,002	148	16,126
2003	4,000	3,054	3,119	1,897	352	12,422
2004	6,158	3,275	1,967	873	664	12,937
2005	---	5,042	2,617	762	595	---
mean	9,679	7,504	4,751	1,898	549	24,666
Fishing Mortality						
	1	2	3	4	5+	4-5
1985	0.064	0.563	0.894	0.894	0.894	0.894
1986	0.018	0.681	0.873	0.873	0.873	0.873
1987	0.003	0.561	1.073	1.073	1.073	1.073
1988	0.018	0.566	1.321	1.321	1.321	1.321
1989	0.012	0.116	1.058	1.058	1.058	1.058
1990	0.008	0.430	0.952	0.952	0.952	0.952
1991	0.040	0.175	0.511	0.511	0.511	0.511
1992	0.219	0.559	0.407	0.407	0.407	0.407
1993	0.017	0.077	0.284	0.284	0.284	0.284
1994	0.012	0.074	0.480	0.480	0.480	0.480
1995	0.084	0.156	0.654	0.654	0.654	0.654
1996	0.001	0.149	0.573	0.573	0.573	0.573
1997	0.000	0.141	0.734	0.734	0.734	0.734
1998	0.012	0.125	0.630	0.630	0.630	0.630
1999	0.002	0.081	0.439	0.439	0.439	0.439
2000	0.001	0.145	0.824	0.824	0.824	0.824
2001	0.004	0.265	1.002	1.002	1.002	1.002
2002	0.014	0.291	0.788	0.788	0.788	0.788
2003	0.000	0.240	1.074	1.074	1.074	1.074
2004	0.000	0.024	0.749	0.749	0.749	0.749
mean	0.026	0.271	0.766	0.766	0.766	0.766

Table E6 cont.

Spawning Biomass (mt)

	1	2	3	4	5+	sum
1985	0	50	313	363	341	1,067
1986	0	131	332	192	44	699
1987	0	65	728	165	120	1,078
1988	0	81	331	302	135	849
1989	0	439	559	191	45	1,234
1990	0	141	3136	297	62	3,636
1991	0	155	999	2067	598	3,819
1992	0	78	1305	931	334	2,648
1993	0	72	1146	1214	492	2,924
1994	0	131	1083	1027	843	3,084
1995	0	87	1151	698	315	2,251
1996	0	62	901	920	365	2,248
1997	0	159	698	581	176	1,614
1998	0	121	1216	494	248	2,079
1999	0	176	1225	1018	284	2,703
2000	0	234	1369	929	164	2,696
2001	0	171	1340	734	176	2,421
2002	0	119	1179	739	74	2,111
2003	0	74	633	618	154	1,479
2004	0	81	422	297	311	1,111
mean	-	131	1,003	689	264	2,088

Figure E1. Total catch of Cape Cod-Gulf of Maine yellowtail flounder.

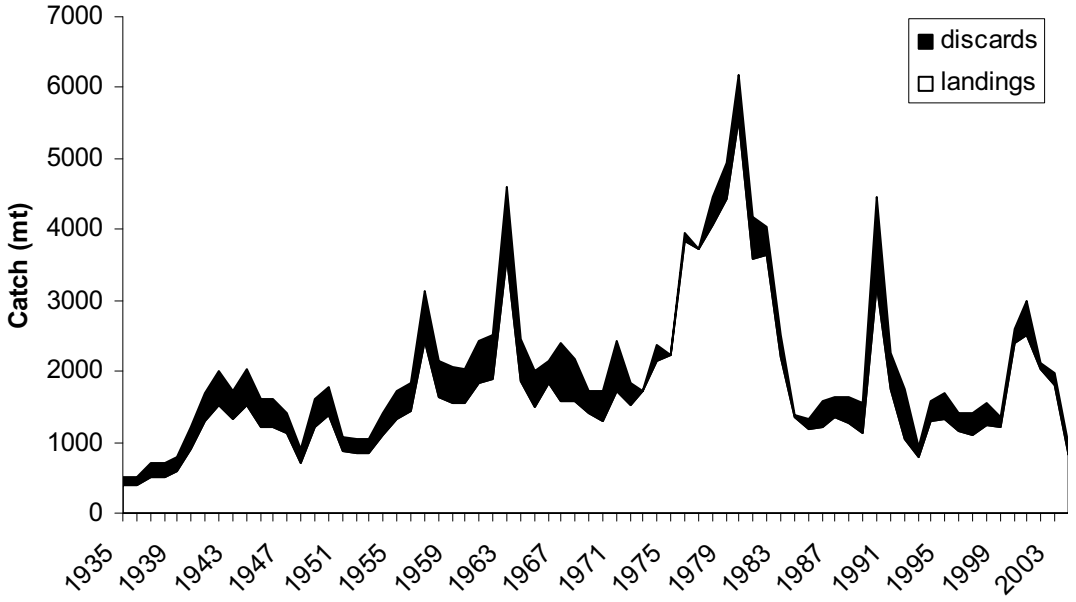


Figure E2. Age distribution of Cape Cod-Gulf of Maine yellowtail flounder catch.

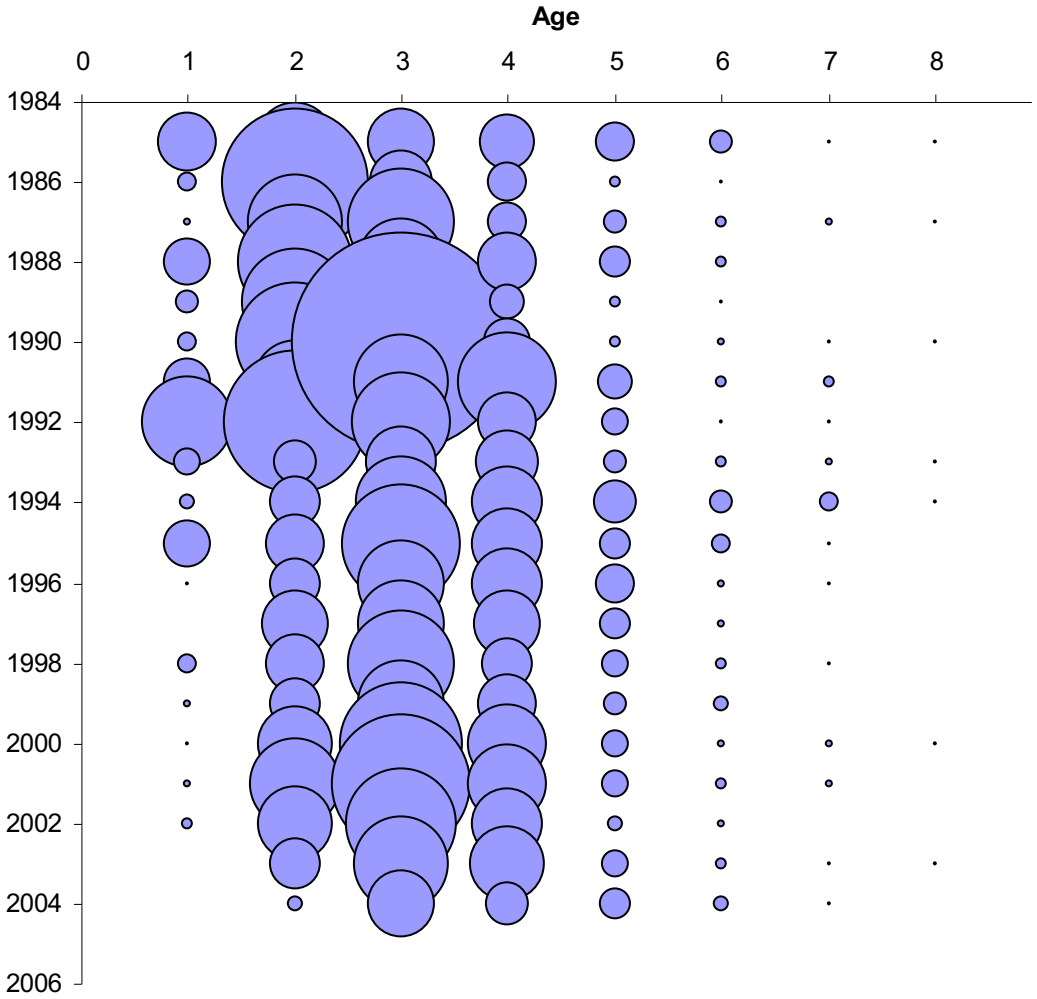


Figure E3. Survey indices of Cape Cod-Gulf of Maine yellowtail flounder biomass.

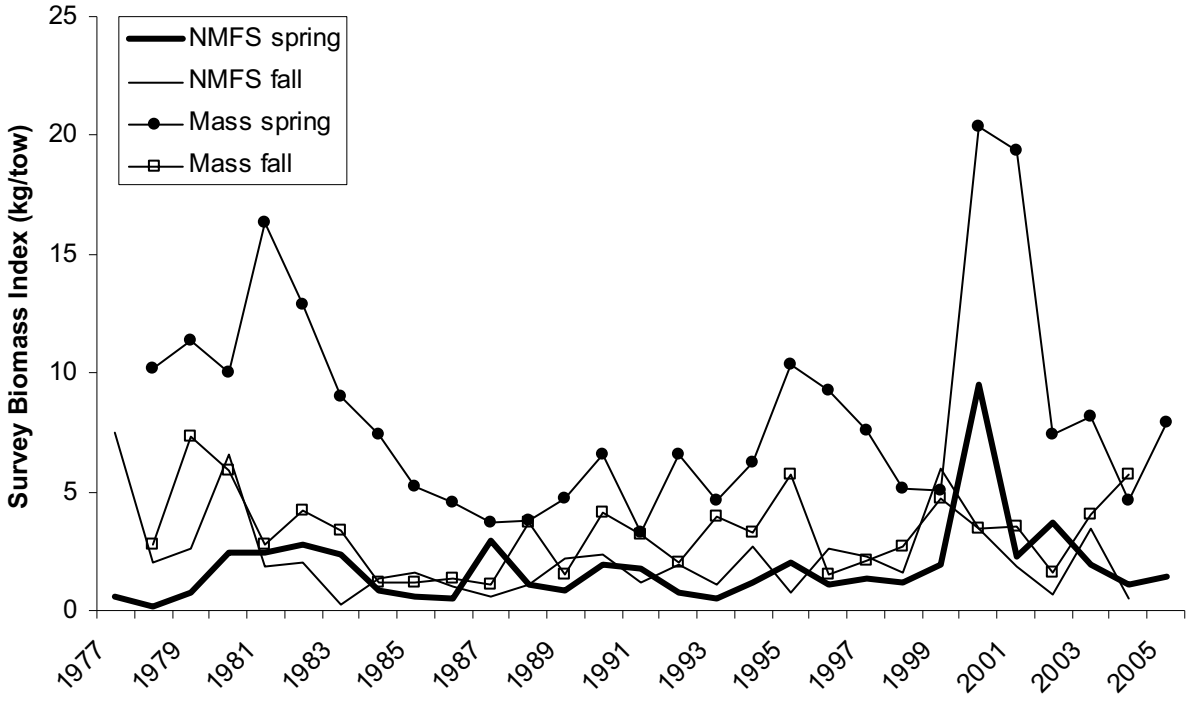


Figure E4. Survey indices of Cape Cod-Gulf of Maine yellowtail flounder abundance at age.

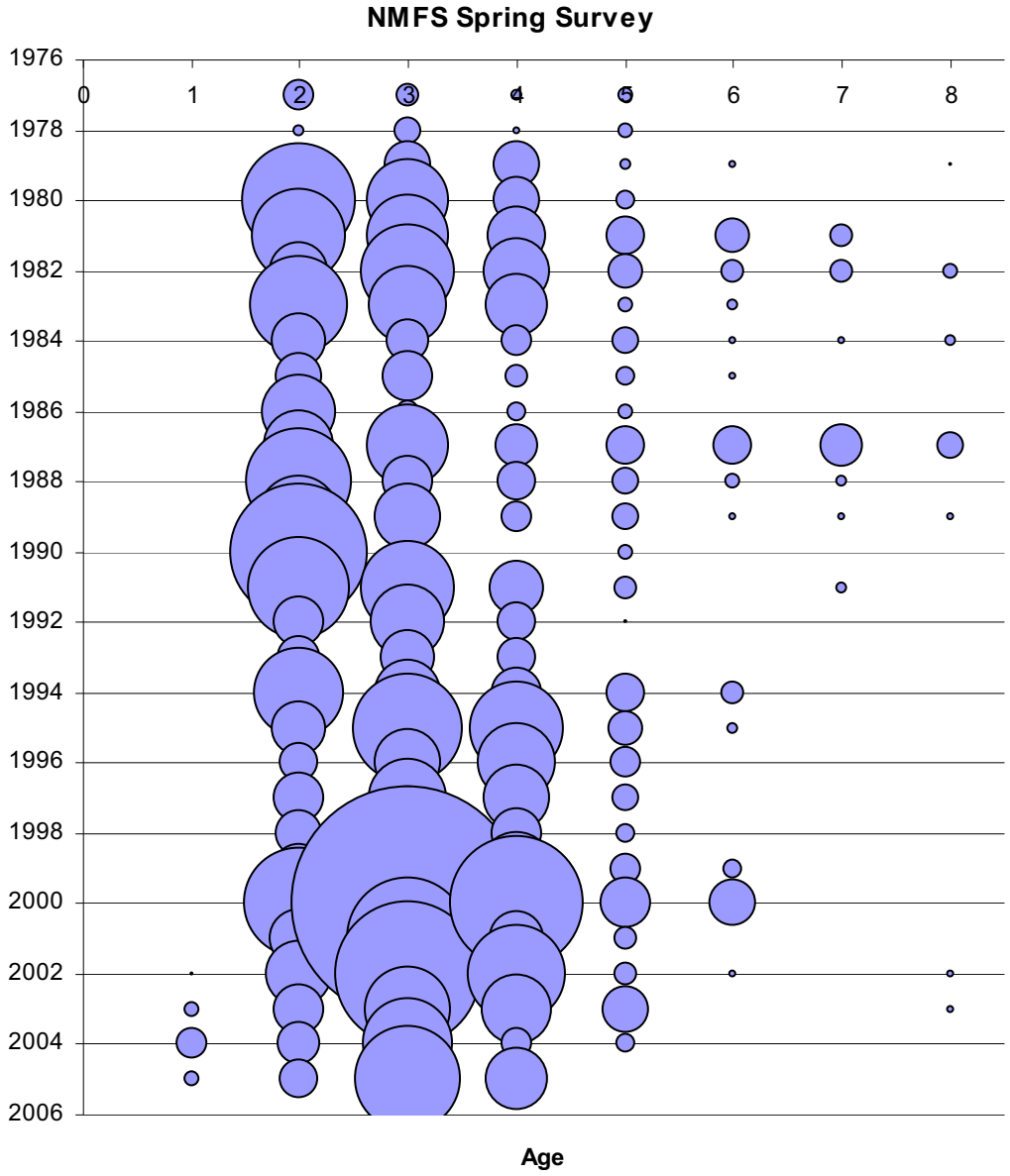


Figure E4 cont.

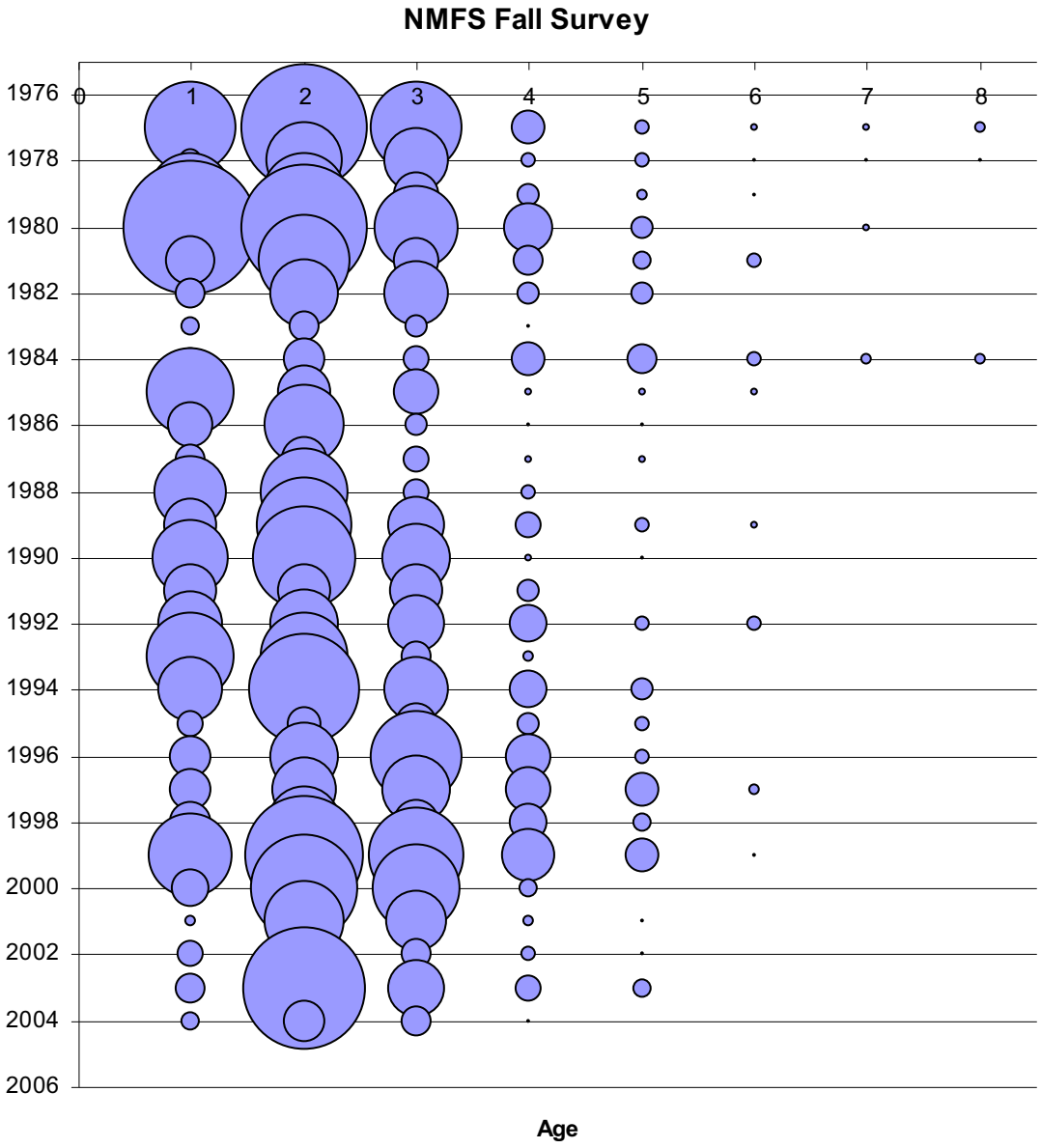


Figure E4 cont.

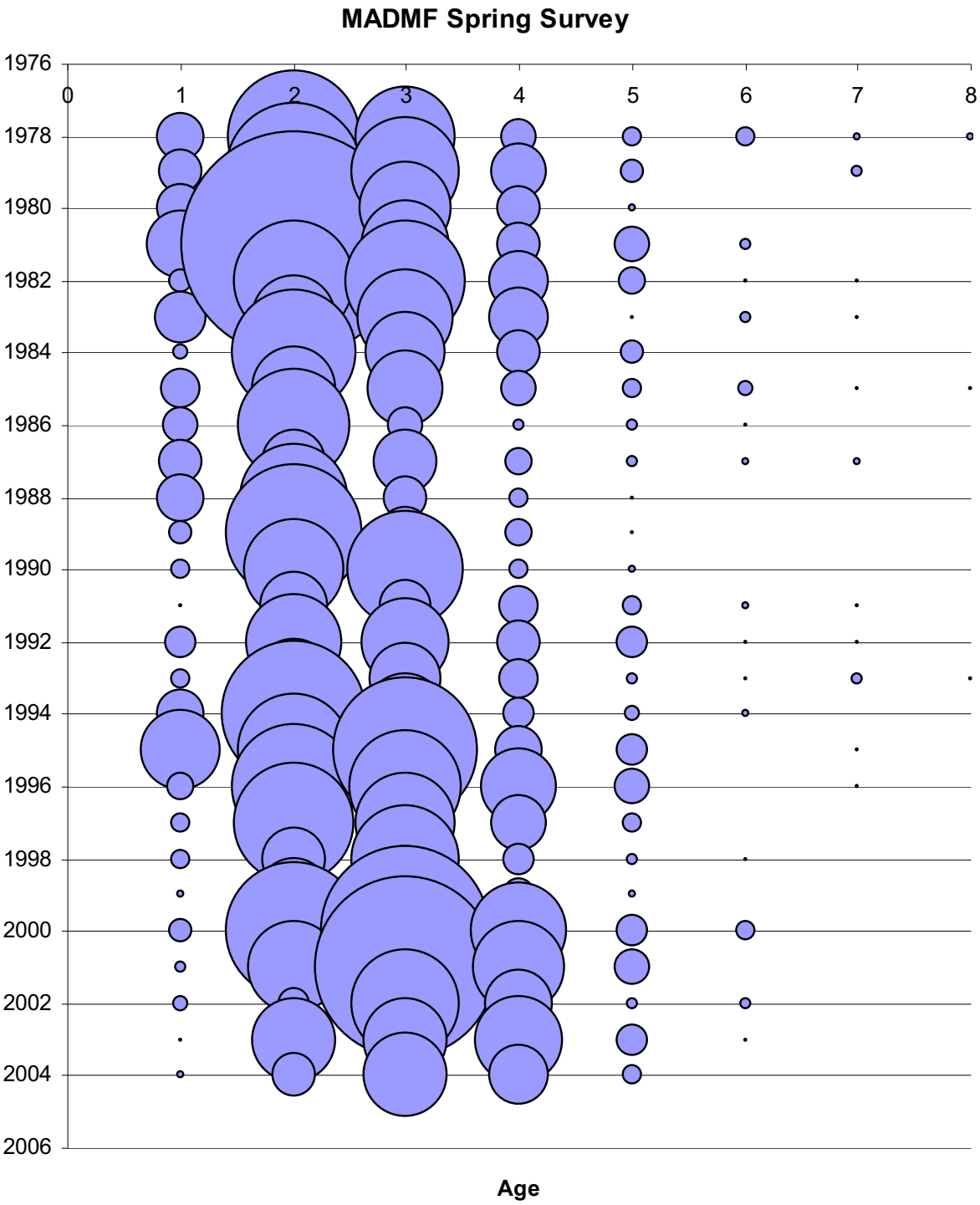


Figure E4 cont.

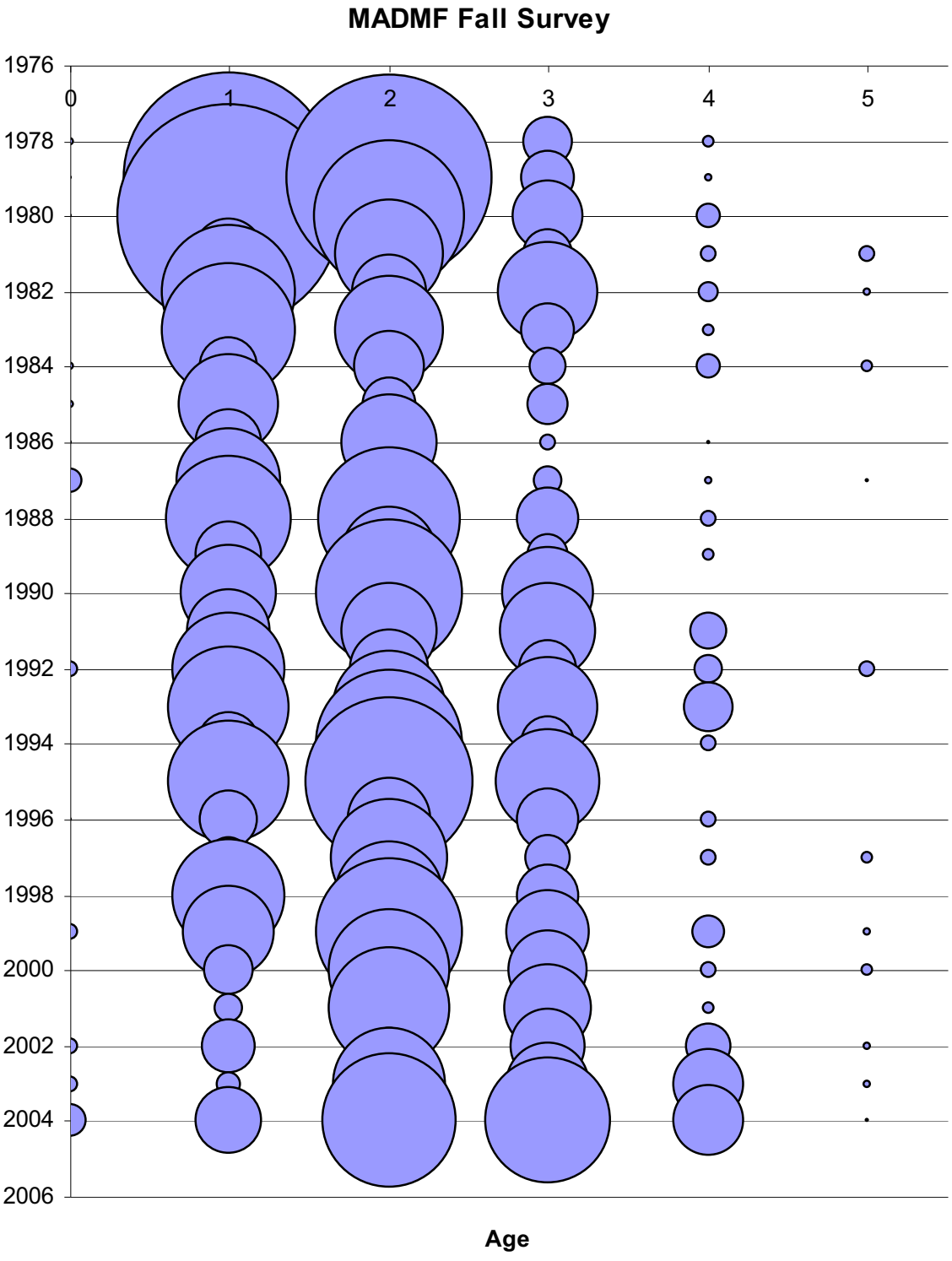
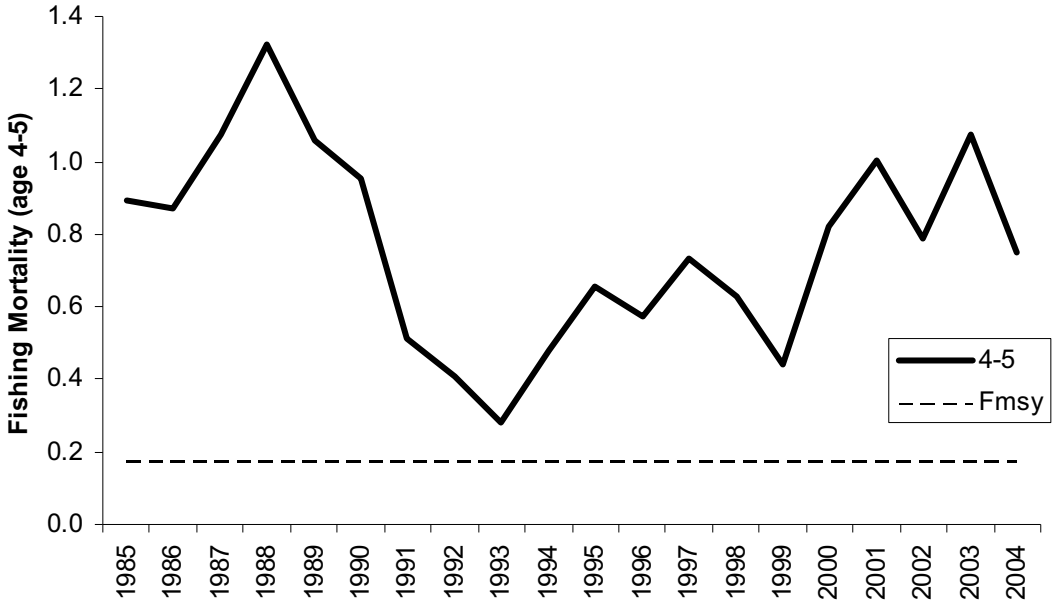


Figure E5. Cape Cod-Gulf of Maine yellowtail flounder VPA results.



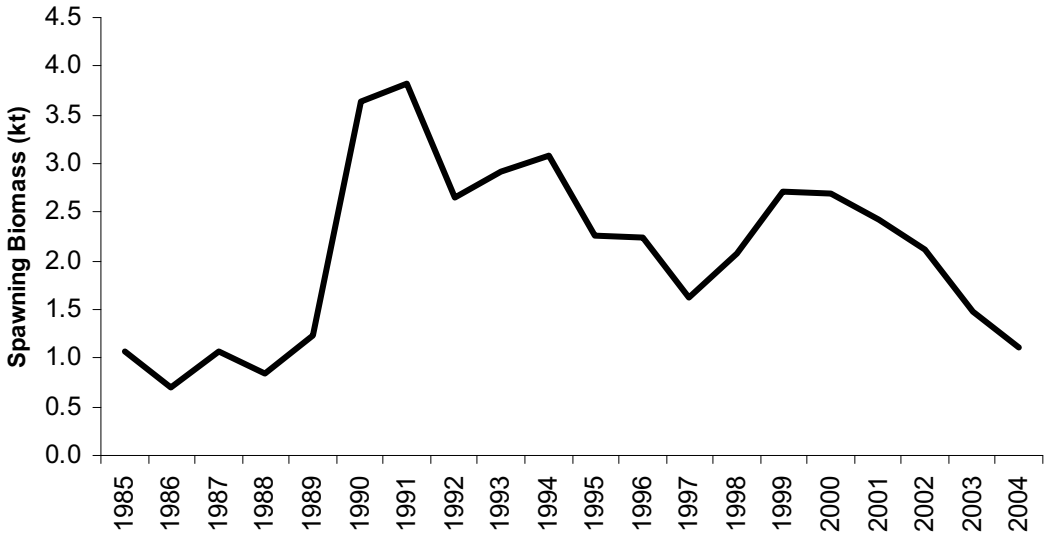


Figure E5 cont.

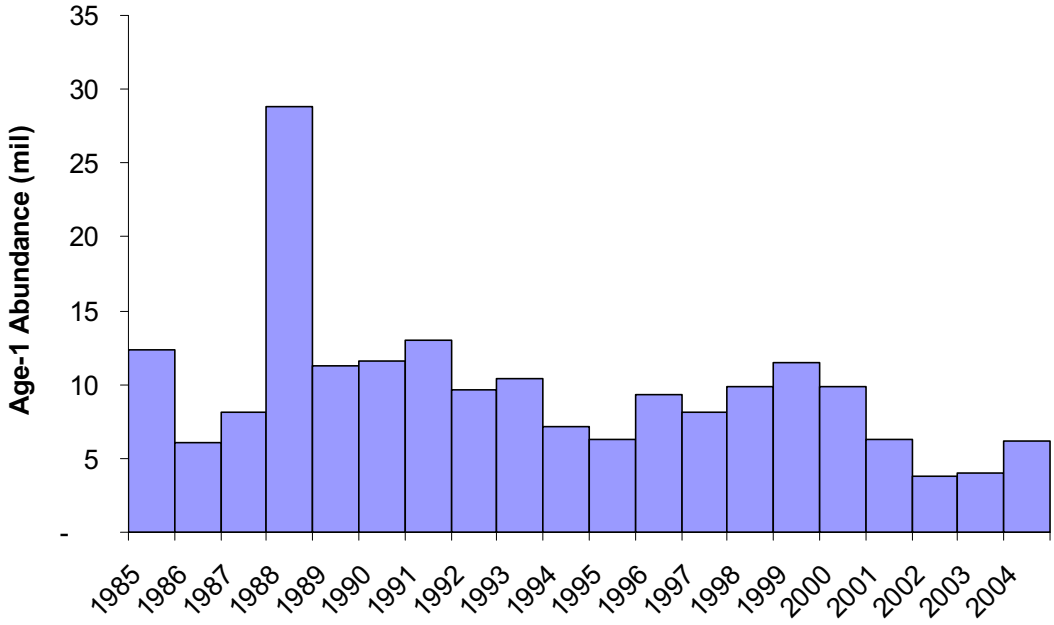
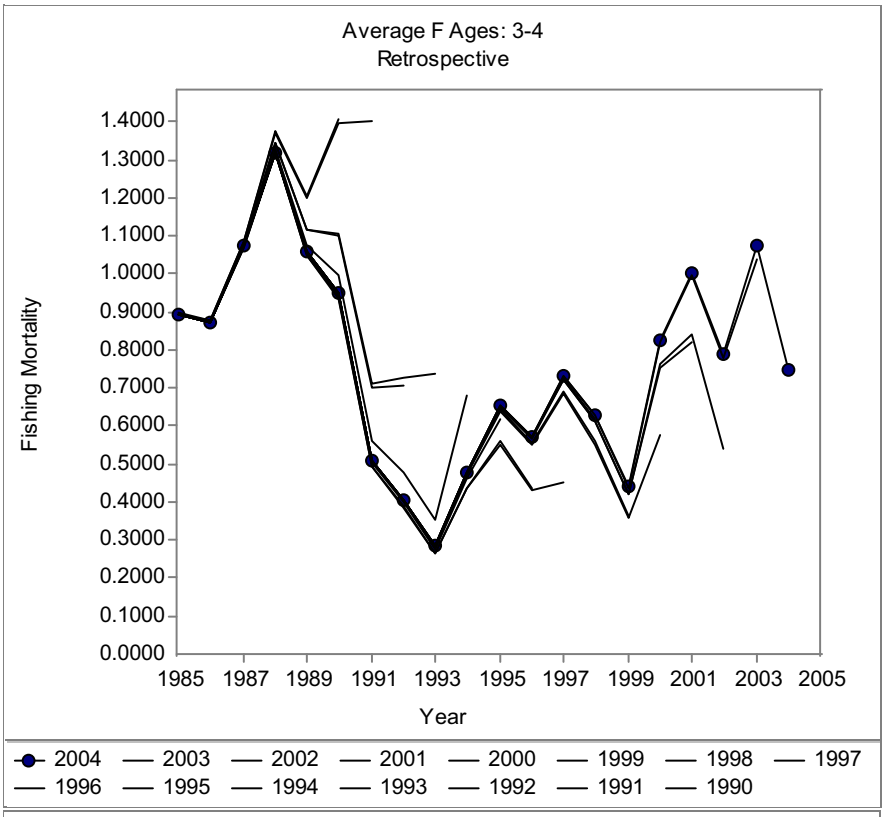


Figure E6. Retrospective analysis of the Cape Cod-Gulf of Maine yellowtail flounder VPA.



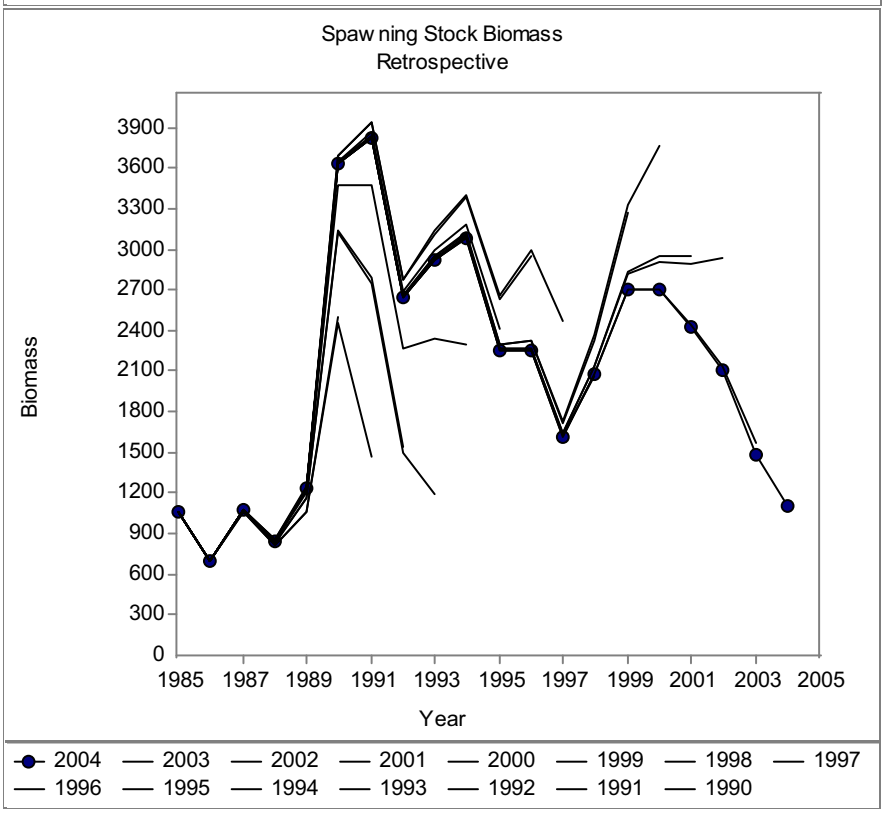


Figure E7. Rebuilding status of Cape Cod-Gulf of Maine yellowtail flounder

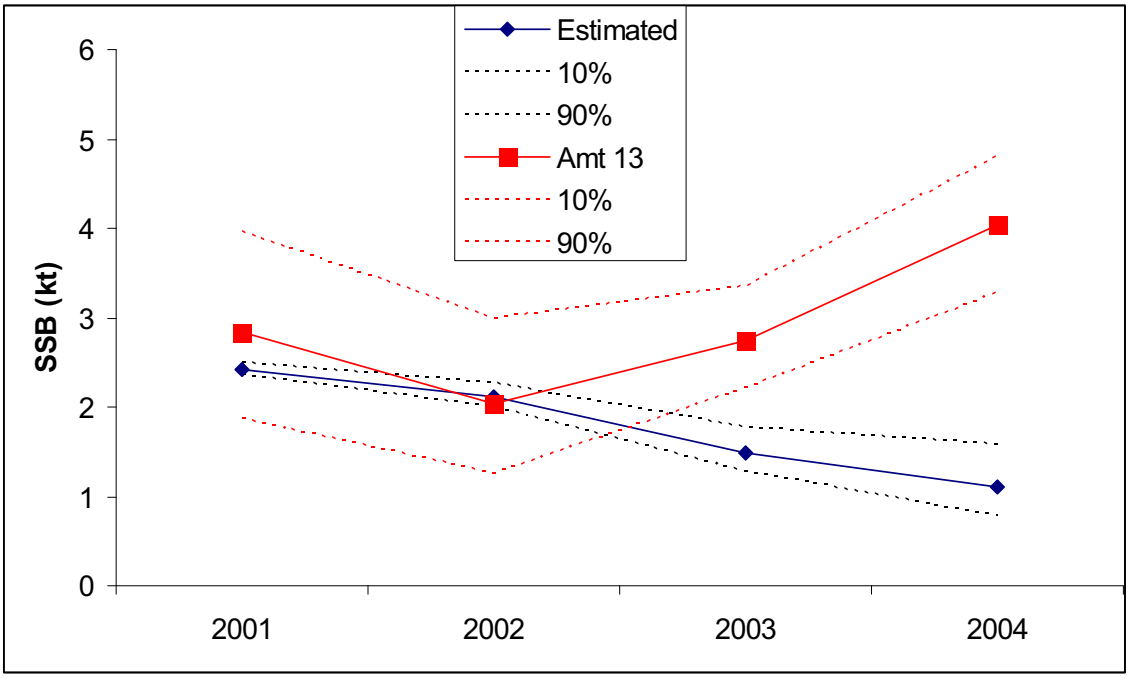


Figure E8. Comparison to rebuilding plan for Cape Cod-Gulf of Maine yellowtail flounder.