E. Cape Cod Yellowtail Flounder by **S.X. Cadrin** and **J. King**

1.0 Background

The Cape Cod yellowtail flounder stock was at low biomass (50% of B_{MSY}) and was overexploited (fully recruited F was 0.41) in 1998 (Cadrin 2000). This report updates catch and survey indices and estimates 1999 fishing mortality and 2000 stock size.

2.0 2000 Assessment

2.1 1999 Landings

U.S. landings were prorated as described in Cadrin et al. (1999; Table E1; Figure E1). Landings from the Cape Cod stock decreased by 7% from 1998 to 1999.

Sampling intensity of landings in 1999 was poor. Only eight trips from the 1999 Cape Cod yellowtail fishery were sampled, and no samples were taken during the third quarter, when 16% of annual landings were taken. Landings at length were estimated by half year and market category. Landings at age and mean weights at age are reported in Table E2.

2.2 1999 Discards

Discarded catch was estimated from logbook information on discard to kept ratios by half-year and gear. However, discards of Cape Cod yellowtail are substantially less than those estimated in recent years, presumably because previous estimates were based on observer data by fishery (Cadrin et al. 1999). Therefore, the level of discards for Cape Cod yellowtail may be underestimated and should be considered preliminary. Discards at age were estimated from sea sampled lengths and pooled commercial-survey age-length keys. Discards at age and recent mean weights at age are reported in Table E3.

2.3 1999-2000 Survey Indices

Survey abundance and biomass indices are reported in Table E4. Estimates are from valid tows on the Cape Cod grounds (offshore strata 25, 26; inshore strata 56-66; Massachusetts strata 17-36) standardized according to net, vessel, and door changes (NEFSC 1998). Recent survey indices of Cape Cod yellowtail greatly increased (Figure E2).

3.0 Assessment Results

3.1 Age-Based Analysis

An updated VPA calibration of Cape Cod yellowtail is summarized in Table E5. This analysis updates the assessment reported in Cadrin (2000) by including 1999 landings and provisional

discards, 1999 fall indices, and 2000 NEFSC spring indices. Results indicate that F decreased ($F_{4-5} = 0.59$, F on biomass = 0.31) and biomass increased in 1999 (1,900 mt of spawning biomass and 3,900 mt of mean total biomass; Figures 3 and 4). Retrospective analysis indicated a strong tendency for terminal year estimates of F to be less than converged estimates since 1996, and terminal year estimates of biomass to be greater than converged estimates since 1994. Bootstrap analysis indicates that abundance was estimated with moderate precision (CV=29-41%), F_{4-5} was 0.43-0.90 with 80% confidence, SSB was 1,500-2,400 mt. Mean biomass had an 80% confidence interval of 3,100-4,700.

The value of F assumed for 1999 by the previous assessment ($F_{4-5} = 0.41$; Cadrin 2000) was substantially less than that estimated by this updated analysis ($F_{4-5} = 0.59$). The projected SSB in 1999 (1,900 mt) is similar to the estimate from this updated analysis, but the projected mean biomass in 1999 (3,600 mt) is less than indicated by this analysis (3,900 mt).

4.0 Harvest Control Rule

The SFA control rule specifies a biomass threshold of 50% B_{MSY}, a maximum F threshold of F_{MSY}, and F on biomass (1+,wb) as the metric for fishing mortality . When biomass is less than B_{MSY}, threshold F is the maximum F that allows rebuilding to B_{MSY} in 5 years. When biomass is below 1/4Bmsy, threshold F = 0. When biomass exceeds B_{MSY}, target F is the tenth percentile of the F_{MSY} estimate. When biomass is less than B_{MSY}, target F is based on rebuilding to B_{MSY} at the tenth percentile of the intrinsic rate of increase estimate (Figure E4). The estimate of mean biomass in 1999 was greater than the biomass threshold (1/2 B_{MSY} proxy = 3,050 mt) with greater than 90% probability, but F exceeded the rebuilding threshold.

5.0 Sources of Uncertainty

- Estimates of catch at age may not be reliable due to poor sampling intensity. Therefore VPA results may be misleading. Extreme estimates of mean weights (e.g. ages 2-3), odd exploitation patterns, and retrospective patterns may indicate inadequate sampling and mis-allocation of catch at age.
- Retrospective patterns since the mid 1990s indicate that VPA estimates of biomass and F may be overly optimistic. Updated VPAs may indicate that 1999 biomass levels are substantially lower, and 1999 F was substantially greater than reported here.
- Estimates of prorated landings and discard ratios are based on preliminary logbook data and are subject to change.
- The magnitude of discards in 1999 are probably underestimated.

6.0 References

Cadrin, S.X. 2000. Cape Cod yellowtail flounder. In Assessment of 11 Northeast Groundfish Stocks through 1999. NEFSC Ref. Doc. 00-05: 83-98.

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

Table E1. Landings of Cape Cod yellowtail flounder (mt).

	Landings (mt)	Discards (mt)	Percent Discard	Total (mt)
1960	1,500	500	32	2,000
1961	1,800	600	32	2,400
1962	1,900	600	32	2,500
1963	3,600	1,000	28	4,600
1964	1,851	600	32	2,451
1965	1,498	500	33	1,998
1966	1,808	300	17	2,108
1967	1,542	800	52	2,342
1968	1,569	600	38	2,169
1969	1,346	300	22	1,646
1970	1,185	400	34	1,585
1971	1,662	700	42	2,362
1972	1,364	300	22	1,664
1973	1,662	0	0	1,662
1974	2,054	200	10	2,254
1975	2,027	0	0	2,027
1976	3,587	100	3	3,687
1977	3,469	0	0	3,469
1978	3,683	400	11	4,083
1979	4,163	500	12	4,663
1980	5,106	600	12	5,706
1981	3,149	600	19	3,749
1982	3,150	400	13	3,550
1983	1,884	300	16	2,184
1984	1,121	20	2	1,141
1985	967	77	8	1,044
1986	1,041	305	29	1,346
1987	1,159	198	17	1,357
1988	1,085	283	26	1,368
1989	909	390	43	1,299
1990	2,984	1,141	38	4,125
1991	1,472	405	28	1,877
1992	828	637	77	1,465
1993	628	90	14	718
1994	978	192	20	1,170
1995	1,207	233	19	1,440
1996	1,064	182	17	1,246
1997	1,040	257	25	1,297
1998	1,169	75	6	1,244
1999	1,089	115	11	1,204
mean	1,882	373	22	2,255

Table E2. Landings at age (above) and mean weight at age (below) of Cape Cod yellowtail flounder.

Landings at age (thousands)				age					
	1	2	3	4	5	6	7	8+	sum
1985	5	738	700	522	268	89	3	7	2,332
1986	0	1,998	579	223	32	6	0	1	2,838
1987	0	609	1,786	268	100	29	12	5	2,808
1988	1	802	1,043	625	172	36	0	0	2,679
1989	0	726	989	231	31	3	2	2	1,986
1990	0	692	6,191	416	32	16	7	3	7,357
1991	0	311	903	1,455	249	33	27	1	2,978
1992	0	338	807	514	150	6	5	1	1,821
1993	0	25	684	573	90	24	15	7	1,418
1994	0	87	1,023	650	236	65	38	9	2,109
1995	0	233	1,730	808	152	78	5	0	3,006
1996	0	150	1,097	798	287	11	5	2	2,349
1997	0	481	1,086	702	160	13	0	1	2,443
1998	0	257	1,681	472	141	41	3	0	2,595
1999	0	328	1,134	646	106	43	1	0	2,258
mean	0	518	1,429	594	147	33	8	3	2,732

Landed weight at age (kg)				age				
	1	2	3	4	5	6	7	8+
1985	0.19	0.32	0.37	0.49	0.60	0.73	1.20	1.39
1986		0.32	0.46	0.57	0.73	0.90		1.40
1987		0.31	0.42	0.55	0.65	0.81	1.03	1.18
1988	0.11	0.31	0.37	0.53	0.70	0.85		
1989		0.38	0.45	0.65	0.92	1.41	1.24	1.24
1990		0.31	0.41	0.56	0.82	0.90	0.99	1.17
1991		0.35	0.39	0.54	0.74	0.99	1.06	1.01
1992		0.32	0.41	0.53	0.61	0.73	1.53	1.91
1993		0.31	0.38	0.43	0.74	0.95	1.01	1.17
1994		0.29	0.38	0.50	0.62	0.68	1.04	1.11
1995		0.35	0.36	0.43	0.61	0.78	1.11	
1996		0.32	0.42	0.50	0.53	0.91	1.19	1.18
1997		0.39	0.41	0.47	0.57	0.78	1.30	1.31
1998		0.33	0.41	0.55	0.63	1.00	1.62	
1999		0.36	0.45	0.56	0.58	0.88	1.62	
mean	0.15	0.33	0.41	0.52	0.67	0.89	1.23	1.28

Table E3. Discards at age (above) and mean weights at age (below) of Cape Cod yellowtail flounder.

Discards at age (thousands)				age			
	1	2	3	4	5	6	sum
1985	340	184	34	0	0	0	558
1986	79	1,657	75	26	0	0	1,837
1987	14	877	168	0	0	0	1,059
1988	360	1,328	177	0	0	0	1,864
1989	114	1,405	396	1	0	0	1,917
1990	81	2,047	2,501	19	0	0	4,648
1991	460	895	561	100	7	0	2,023
1992	1,688	3,543	731	29	3	0	5,994
1993	138	324	173	30	0	0	665
1994	60	383	279	49	4	1	776
1995	453	469	652	50	2	0	1,627
1996	7	397	327	94	11	0	837
1997	1	399	351	117	22	1	891
1998	8	39	171	29	6	0	253
1999	2	202	170	22	3	4	255
mean	254	943	451	38	4	0	1,680

Discarded weight at age (kg)				age		
	1	2	3	4	5	6
1985	0.13	0.15	0.15			
1986	0.10	0.17	0.19	0.18		
1987	0.06	0.19	0.19			
1988	0.12	0.15	0.20			
1989	0.13	0.21	0.25	0.36		
1990	0.08	0.24	0.27	0.33		
1991	0.12	0.19	0.27	0.37	0.54	
1992	0.05	0.11	0.22	0.31	0.36	
1993	0.09	0.15	0.27	0.33	0.63	
1994	0.08	0.20	0.29	0.32	0.38	0.34
1995	0.07	0.16	0.23	0.33	0.48	
1996	0.04	0.15	0.28	0.36	0.50	
1997	0.03	0.21	0.29	0.39	0.54	0.65
1998	0.03	0.26	0.35	0.44	0.56	0.59
1999	0.03	0.24	0.28	0.49	0.50	0.99
mean	0.08	0.19	0.25	0.35	0.50	0.64

Table E4a. Survey indices of Cape Cod yellowtail abundance and biomass.

MADMF Spring Survey

year	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*									69.11	20.37
mean	1.96	15.90	9.98	2.28	0.57	0.09	0.04	0.01	32.48	8.01

* preliminary

MADMF Fall Survey

year	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
mean	0.04	7.29	7.71	2.46	0.26	0.03	0.00	0.00	0.00	17.79	3.12

Table E4b. Survey indices of Cape Cod yellowtail abundance and biomass.

NEFSC Spring Survey

year	1	2	3	4	age 5	6	7	8+	sum	kg/tow
1979	0.55	0.71	1.33	0.85	0.04	0.03	0.00	0.00	3.51	1.20
1980	0.00	7.14	4.08	1.43	0.29	0.00	0.00	0.00	12.94	4.89
1981	0.10	6.30	4.27	0.93	1.06	0.51	0.66	0.00	13.83	4.41
1982	0.08	2.79	7.23	3.71	1.00	0.57	0.63	0.16	16.17	7.16
1983	2.36	6.33	5.09	2.09	0.22	0.15	0.00	0.00	16.24	4.78
1984	0.09	2.39	1.42	0.92	0.60	0.05	0.07	0.16	5.70	1.99
1985	0.13	1.86	1.81	0.43	0.25	0.10	0.00	0.00	4.58	1.37
1986	0.03	3.55	0.30	0.08	0.20	0.00	0.00	0.00	4.16	0.81
1987	0.12	2.82	4.22	0.69	1.07	1.07	1.25	0.61	11.84	5.57
1988	1.75	7.47	1.53	1.00	0.39	0.15	0.07	0.00	12.34	1.96
1989	0.43	5.19	3.18	0.29	0.14	0.00	0.00	0.00	9.23	1.50
1990	0.00	4.52	10.94	0.29	0.00	0.20	0.00	0.00	15.94	3.42
1991	0.79	6.75	4.65	1.48	0.34	0.00	0.09	0.00	14.09	2.94
1992	0.30	1.84	2.89	0.80	0.03	0.00	0.00	0.00	5.87	1.31
1993	0.12	1.24	1.43	0.71	0.00	0.00	0.00	0.00	3.51	0.73
1994	0.66	4.62	1.91	0.74	0.27	0.16	0.00	0.00	8.35	1.40
1995	0.26	1.72	6.01	3.89	0.38	0.09	0.00	0.00	12.34	2.87
1996	0.02	0.70	0.97	0.52	0.00	0.00	0.00	0.00	2.20	0.49
1997	0.04	1.62	2.58	2.08	0.46	0.00	0.00	0.00	6.79	1.90
1998	0.00	1.40	4.12	1.50	0.34	0.00	0.00	0.00	7.36	1.81
1999	0.03	1.29	4.14	2.96	0.58	0.22	0.00	0.00	9.21	2.85
2000*	0.17	16.53	26.68	2.45	0.40	0.16	0.00	0.00	46.39	15.15
mean	0.37	4.04	4.58	1.36	0.37	0.16	0.13	0.04	11.03	3.21

* preliminary

NEFSC Fall Survey

year	1	2	3	4	age 5	6	7	8+	sum	kg/tow
1979	7.87	8.02	2.41	0.60	0.11	0.03	0.00	0.00	19.04	5.34
1980	20.70	17.63	8.00	3.04	0.67	0.00	0.07	0.00	50.11	13.52
1981	6.34	9.64	1.74	0.45	0.29	0.00	0.00	0.00	18.46	4.11
1982	1.13	5.39	5.18	0.63	0.70	0.06	0.00	0.00	13.09	4.32
1983	0.66	0.88	0.55	0.04	0.00	0.00	0.00	0.00	2.13	0.49
1984	0.64	2.25	1.04	1.31	0.93	0.30	0.15	0.15	6.77	2.79
1985	9.03	3.48	2.65	0.40	0.00	0.00	0.00	0.00	15.56	3.25
1986	2.15	5.85	0.49	0.00	0.00	0.00	0.00	0.00	8.49	1.55
1987	0.89	2.13	0.75	0.09	0.07	0.00	0.00	0.00	3.93	0.87
1988	5.05	7.39	0.73	0.14	0.00	0.00	0.00	0.00	13.30	1.79
1989	2.89	9.34	3.43	0.61	0.00	0.00	0.00	0.11	16.39	3.68
1990	5.75	9.75	4.57	0.07	0.02	0.00	0.00	0.00	20.16	3.72
1991	2.93	2.73	2.36	0.48	0.00	0.00	0.00	0.00	8.50	1.83
1992	3.95	4.34	3.02	1.25	0.30	0.22	0.00	0.00	13.07	2.98
1993	7.18	7.05	0.83	0.12	0.00	0.00	0.00	0.00	15.18	1.68
1994	3.92	11.70	4.20	1.15	0.35	0.00	0.00	0.00	21.32	4.20
1995	0.97	1.34	1.29	0.28	0.07	0.00	0.00	0.00	3.94	1.17
1996	1.70	4.39	7.20	1.89	0.21	0.00	0.00	0.00	15.39	4.00
1997	1.70	3.93	4.47	2.02	1.09	0.19	0.00	0.00	13.39	3.62
1998	1.60	4.59	1.93	1.40	0.39	0.00	0.00	0.00	9.92	2.53
1999	6.38	12.77	8.33	2.57	1.13	0.04	0.00	0.00	31.23	9.28
mean	4.45	6.41	3.10	0.88	0.30	0.04	0.01	0.01	15.21	3.65

Table E5a. Estimates of abundance at age of Cape Cod yellowtail flounder.

	1985	1986	1987	1988	1989	1990	1991
1	9891	4712	6755	21229	7697	6280	9144
2	2702	7787	3786	5518	17054	6199	5068
3	1443	1378	3068	1756	2590	12034	2598
4	657	517	536	744	334	868	1988
5	326	65	197	196	43	63	317
6	116	14	89	39	11	50	73
1+	15133	14473	14432	29482	27730	25494	19187

	1992	1993	1994	1995	1996	1997	1998
1	7159	7099	5579	5218	7263	5652	8114
2	7070	4334	5688	4514	3862	5940	4626
3	3058	2277	3232	4230	3060	2667	4067
4	802	1112	1089	1469	1308	1216	883
5	221	165	366	259	427	264	255
6	17	82	168	137	25	20	75
1+	18327	15070	16122	15827	15945	15758	18020

	1999	2000
1	7973	
2	6636	6526
3	3521	4954
4	1654	1703
5	270	750
6	120	177
1+	20174	

Table E5b. Estimates of fishing mortality at age of Cape Cod yellowtail flounder.

	1985	1986	1987	1988	1989	1990	1991
1	0.04	0.02	0.00	0.02	0.02	0.01	0.06
2	0.47	0.73	0.57	0.56	0.15	0.67	0.31
3	0.83	0.74	1.22	1.46	0.89	1.60	0.98
4	2.11	0.76	0.80	2.64	1.47	0.81	2.00
5	2.40	0.78	0.82	3.43	1.56	0.83	2.24
6	2.40	0.78	0.82	3.43	1.56	0.83	2.24
F4,5	2.25	0.77	0.81	3.03	1.52	0.82	2.12
Fwb	0.48	0.61	0.72	0.40	0.24	1.09	0.66

	1992	1993	1994	1995	1996	1997	1998
1	0.30	0.02	0.01	0.10	0.00	0.00	0.00
2	0.93	0.09	0.10	0.19	0.17	0.18	0.07
3	0.81	0.54	0.59	0.97	0.72	0.91	0.70
4	1.38	0.91	1.24	1.04	1.40	1.36	0.99
5	1.45	0.94	1.29	1.07	1.48	1.44	1.02
6	1.45	0.94	1.29	1.07	1.48	1.44	1.02
F4,5	1.42	0.92	1.26	1.05	1.44	1.40	1.00
Fwb	0.86	0.35	0.43	0.62	0.62	0.50	0.42

	1999
1	0.00
2	0.09
3	0.53
4	0.59
5	0.59
6	0.59
F4,5	0.59
Fwb	0.31

Table E5c. Estimates of mean biomass and spawning biomass of Cape Cod yellowtail flounder.

```
MEAN BIOMASS (using catch mean weights at age)

           1985      1986      1987      1988      1989      1990      1991
     ------------------------------------------------------------------------
1          1144       423       367      2288       900       452       968
2           551      1267       634       813      3888      1077       915
3           325       383       656       291       614      2064       520
4           126       176       186       131       106       301       426
5            70        30        80        37        19        32        87
6            33        09        51        09        07        30        28
     ------------------------------------------------------------------------
1+         2247      2288      1974      3569      5533      3956      2943

           1992      1993      1994      1995      1996      1997      1998
     ------------------------------------------------------------------------
1           281       573       402       315       263       154       221
2           550       601      1083       823       613      1533      1296
3           616       580       805       822       779       613      1100
4           210       289       283       354       320       283       279
5            66        73       118        89       110        74        93
6            10        49        73        62        12        08        45
     ------------------------------------------------------------------------
1+         1732      2165      2764      2465      2098      2665      3033

           1999
     ------------------------------------------------------------------------
1           217
2          1841
3          1051
4           640
5           106
6            75
     ------------------------------------------------------------------------
1+         3931        00

SSB AT THE START OF THE SPAWNING SEASON -MALES AND FEMALES (MT) (using SSB mean weights)

           1985      1986      1987      1988      1989      1990      1991
     ------------------------------------------------------------------------
1            00        00        00        00        00        00        00
2            46       106        53        68       319        90        76
3           274       324       551       242       519      1703       438
4           123       183       194       121       108       314       422
5            66        32        84        30        19        34        84
6            31        09        53        07        07        31        27
     ------------------------------------------------------------------------
1+          540       654       934       468       972      2172      1046

           1992      1993      1994      1995      1996      1997      1998
     ------------------------------------------------------------------------
1            00        00        00        00        00        00        00
2            46        49        88        68        50       126       106
3           520       488       679       693       658       518       928
4           216       301       293       369       329       292       291
5            68        76       122        93       112        76        97
6            10        51        75        64        13        08        47
     ------------------------------------------------------------------------
1+          859       966      1257      1287      1163      1020      1469

           1999
     ------------------------------------------------------------------------
1            00
2           150
3           885
4           666
5           111
6            78
     ------------------------------------------------------------------------
1+         1890
```
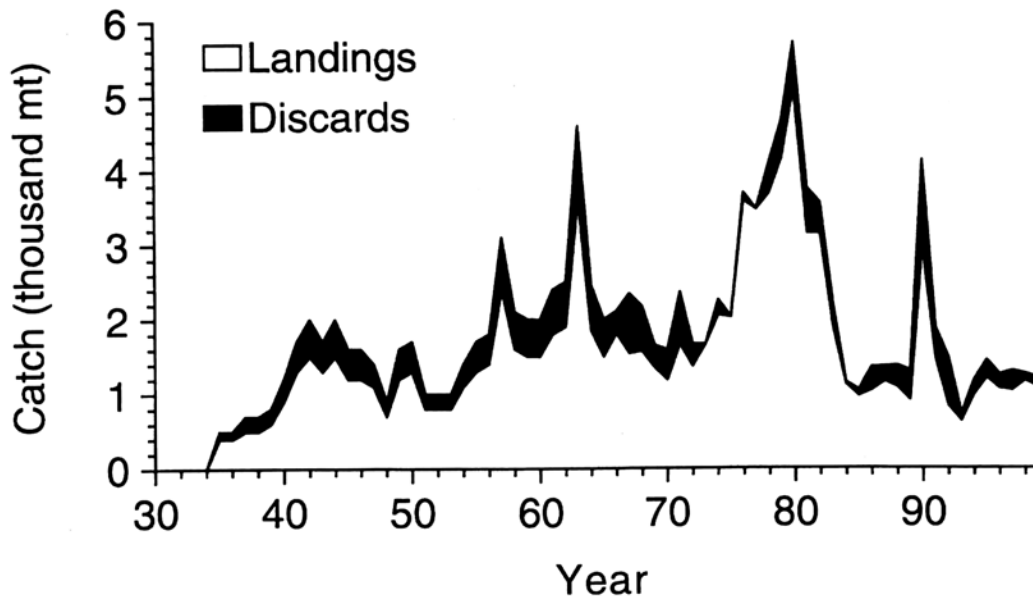
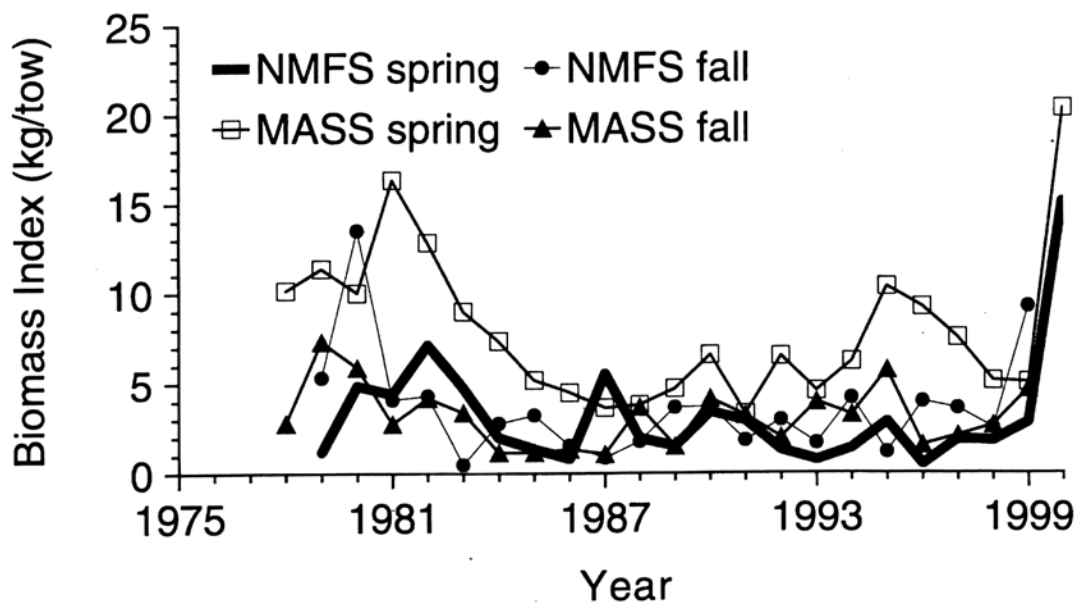Figure E1. Total catch of Cape Cod yellowtail flounder.

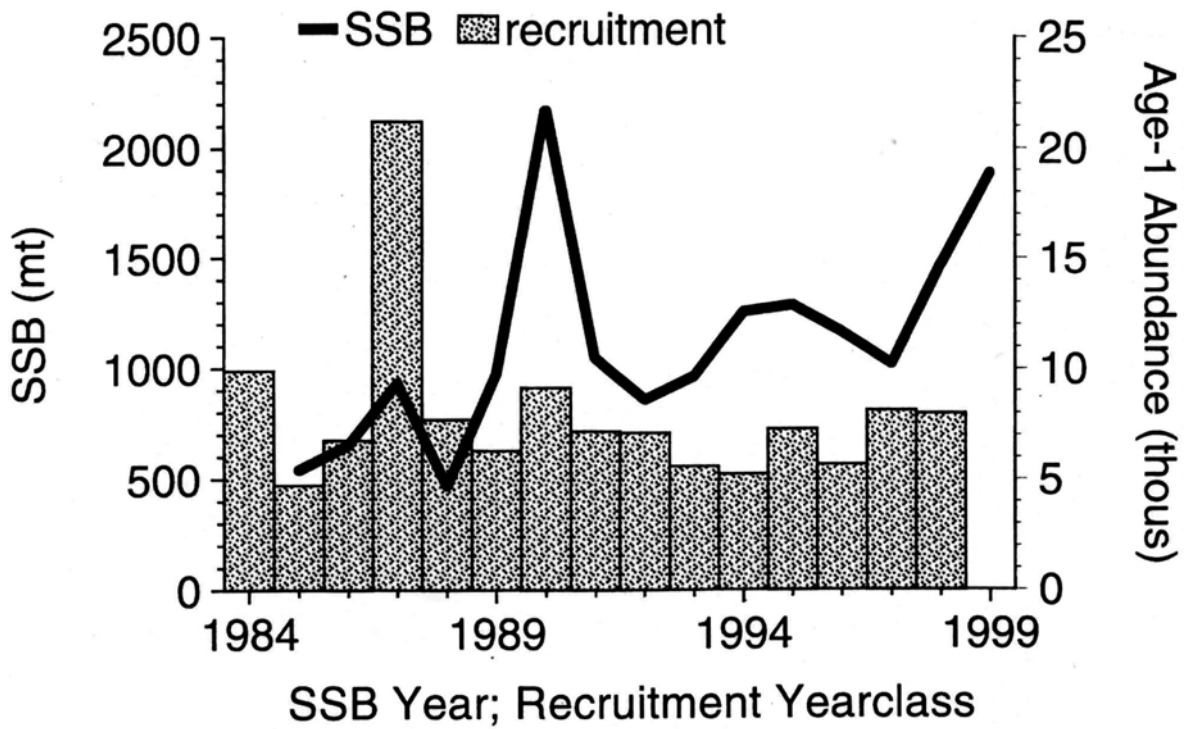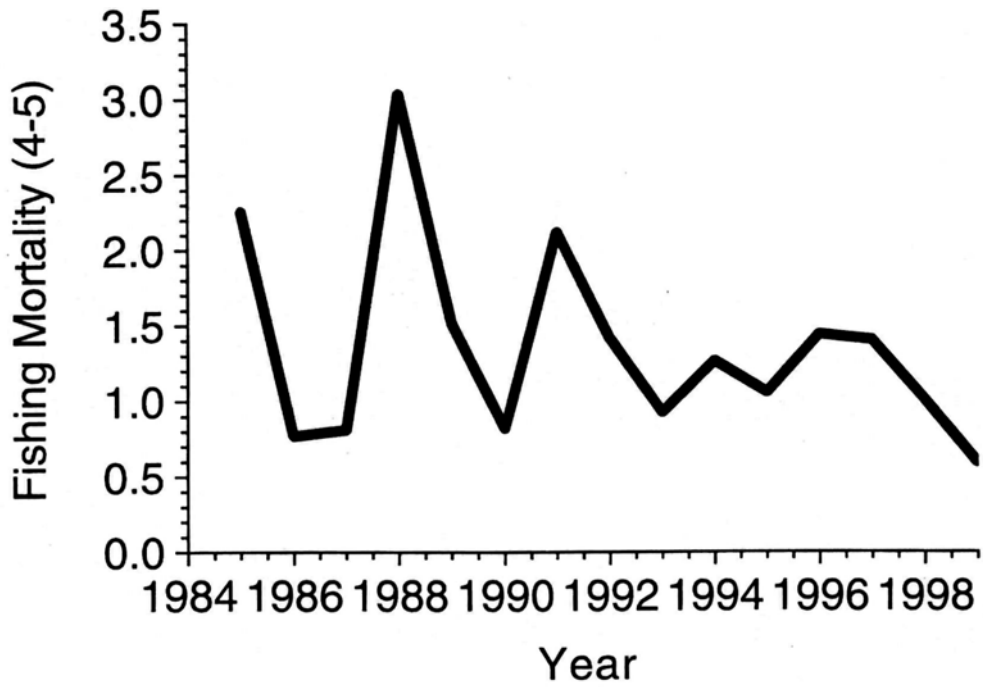Figure E2. Survey indices of Cape Cod yellowtail flounder biomass.

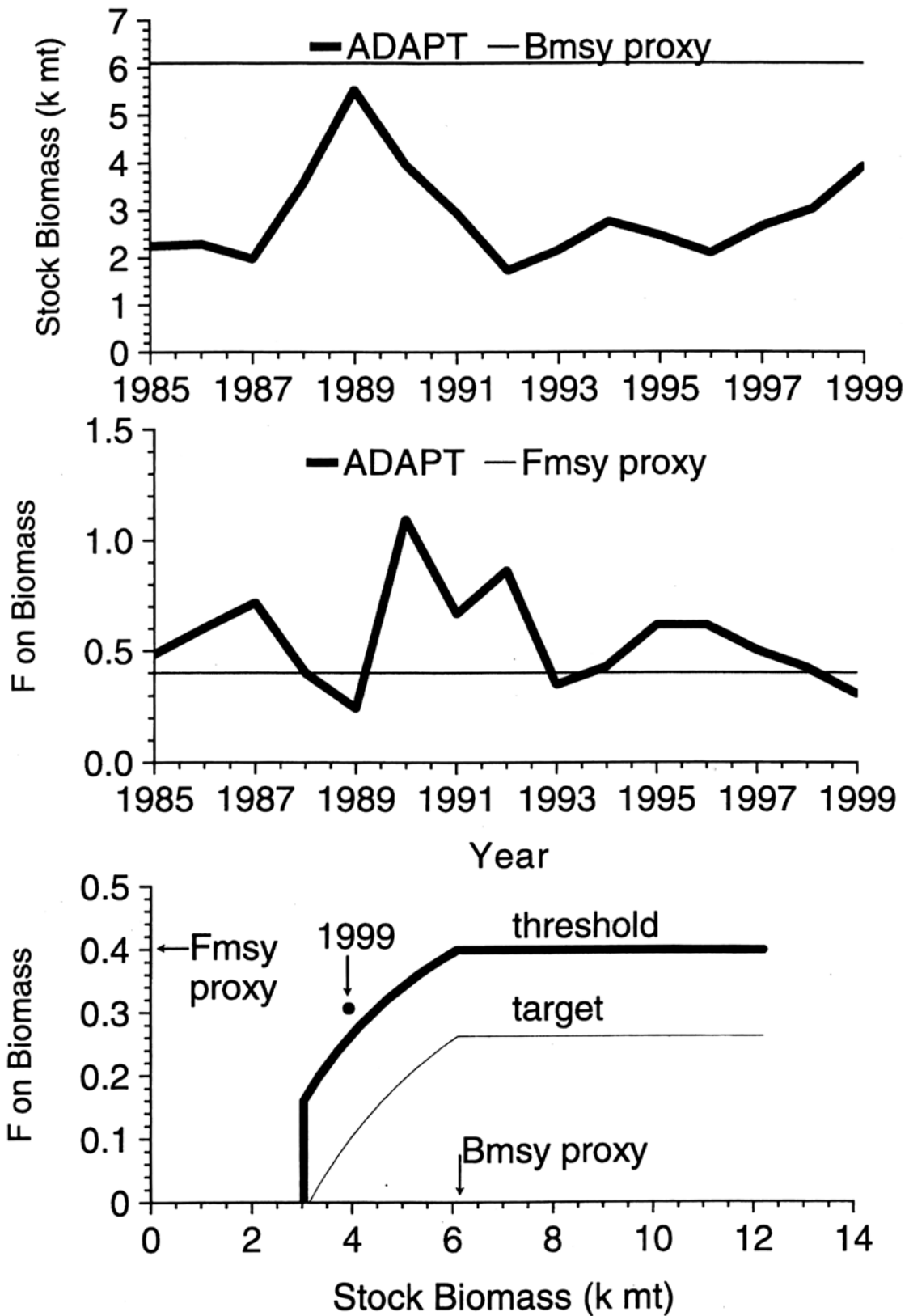Figure E3. Summary of Cape Cod yellowtail VPA results.

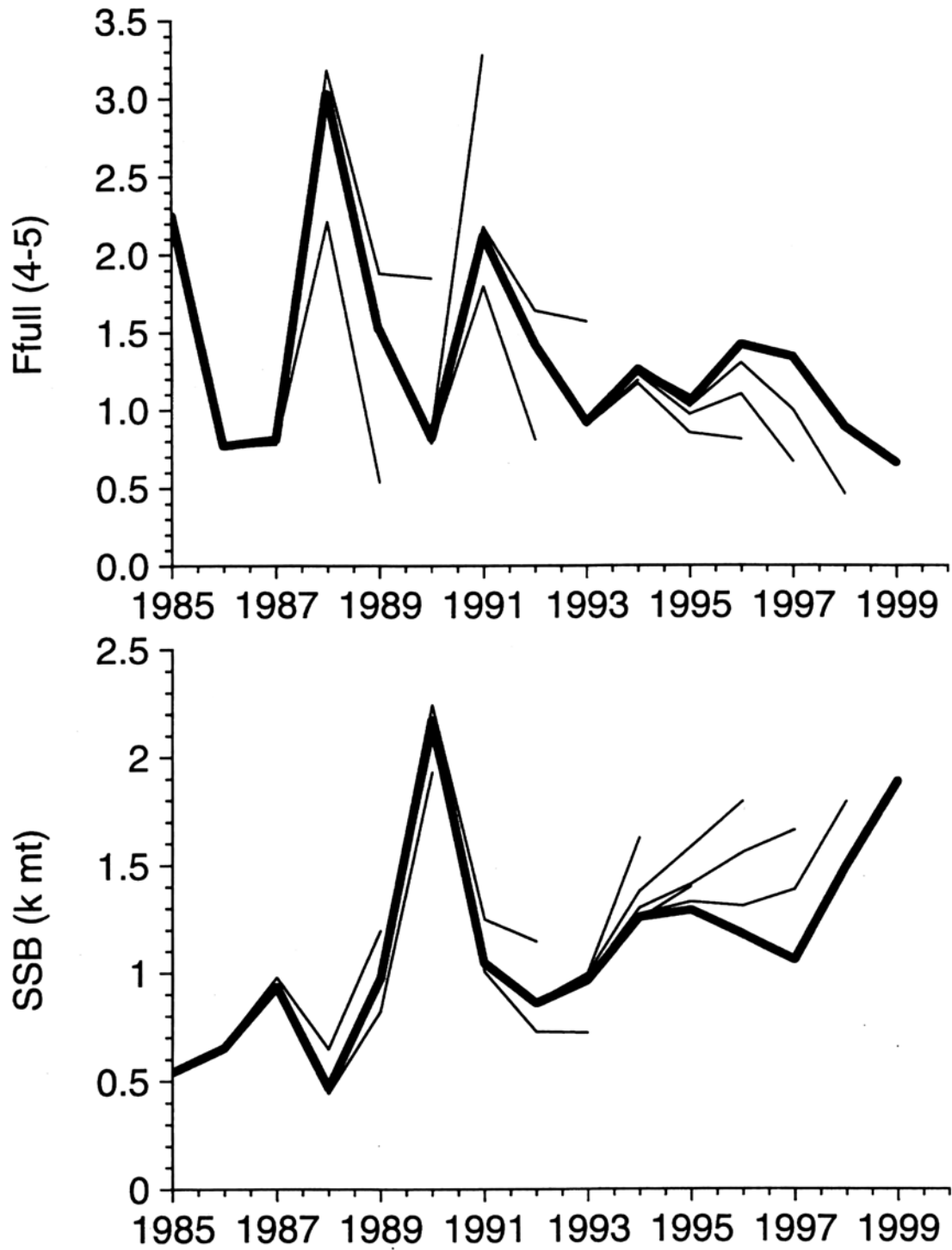Figure E4. Status of the Cape Cod yellowtail flounder stock.

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Figure E5. Retrospective analysis of the Cape Cod yellowtail flounder VPA.