

## A2. CAPE COD – GULF OF MAINE YELLOWTAIL FLOUNDER

**State of Stock:** Cape Cod yellowtail flounder were previously assessed as a unit stock, but are now combined with those in the Gulf of Maine. The stock is overfished and overfishing is occurring. Current fishing mortality is high (2001  $F_{\text{ages 3-4}}=0.75$ , Figure A2.1) and much greater than the proposed  $F_{\text{MSY}}$  proxy ( $F_{40\% \text{MSP}}=0.17$ ). Spawning stock biomass declined in the early 1990s, but began increasing in 1998, to 3,200 mt in 2001 (Figure A2.2), and is much less than the proposed  $\text{SSB}_{\text{MSY}}$  proxy (12,600 mt SSB). With the exception of the strong 1987 year class, recruitment has been relatively stable, but early indications suggest that the 2000 cohort is extremely low. The age structure of the stock is truncated in comparison to MSY conditions (Figure A2.9)

**Management Advice:** Fishing mortality should be reduced to near zero.

**Forecasts for 2003-2009:** Age-based, stochastic projections predict that landings and SSB decrease in 2003 at 85% of  $F_{\text{status quo}}$  ( $F_{2002} = 0.64$ ). Stochastic projections indicate that there is approximately a 50% probability of rebuilding to  $\text{SSB}_{\text{MSY}}$  by 2009 if  $F$  for the years 2003-2009 is reduced to 0.03.

**Forecast Table:** Basis: For age-based projections,  $F_{2002}=0.64$  (85% of status quo from VPA  $F_{2001}$ ), geometric mean 1994-2001 partial recruitment, and average 1994-2001 mean weights at age and maturation. Age-1 recruitment for 2003-2009 was estimated from the distribution of observed age-1 stock sizes from 1985 to 2000. Landings and SSB in 1,000s of mt.

2002			2003-2009 F	2003		2004	Consequences/Implications
F	Landings	SSB		Landings	SSB	SSB	
0.64	1.7	2.9	0.00 (no fishery)	0.0	2.7	4.6	79% chance of rebuilding to $\text{SSB}_{\text{msy}}$ by 2009
			0.03 ( $F_{\text{rebuild}}$ )	0.1	2.7	4.4	50% chance of rebuilding to $\text{SSB}_{\text{msy}}$ by 2009
			0.17 ( $F_{\text{msy}}$ )	0.4	2.6	3.8	1% chance of rebuilding to $\text{SSB}_{\text{msy}}$ by 2009
			0.64 (85% of $F_{\text{status quo}}$ )	1.2	2.1	2.4	0% chance of rebuilding to $\text{SSB}_{\text{msy}}$ by 2009

**Catch and Status Table: Cape Cod – Gulf of Maine Yellowtail Flounder**  
(weights in >000 mt, recruitment in millions)

	1994	1995	1996	1997	1998	1999	2000	2001	Max <sup>1</sup>	Min <sup>1</sup>	Mean <sup>1</sup>
Landings	1.3	1.3	1.2	1.1	1.2	1.2	2.4	2.5	3.2	0.8	1.5
Discards	0.3	0.3	0.2	0.3	0.3	0.1	0.2	0.5	1.2	0.1	0.4
Total catch	1.6	1.7	1.4	1.4	1.5	1.4	2.6	3.0	4.5	0.9	1.9
Biomass	5.2	3.8	3.4	3.8	4.1	5.6	6.7	5.4	7.6	2.4	4.8
SSB	3.1	2.3	2.3	1.6	2.2	2.9	3.1	3.2	3.8	0.7	2.3
Recruitment (age 1)	7.2	6.4	9.6	8.6	10.7	13.4	10.0	1.9	28.8	1.9	10.5
F (age 3-4)	0.48	0.65	0.57	0.72	0.60	0.41	0.72	0.75	1.34	0.28	0.73
Exploitation Rate	35%	44%	40%	47%	41%	31%	47%	48%	68%	22%	47%

<sup>1</sup>Over period 1985-2001

**Stock Distribution and Identification:** Yellowtail flounder inhabit relatively shallow waters (20-100 m) of the continental shelf of the northwest Atlantic from Labrador to Chesapeake Bay. An interdisciplinary evaluation of yellowtail flounder stock structure indicates that yellowtail in the Cape Cod – Gulf of Maine area constitute a single, self-sustaining resource. The Cape Cod – Gulf of Maine yellowtail stock area is defined as the western Gulf of Maine, from Nantucket Shoals to the mouth of the Bay of Fundy (U.S. statistical reporting areas 511-515 and 521).

**Catches:** Annual landings generally increased from <1,000 mt in the mid 1930s to a peak of 5,600 mt in 1980. Landings decreased to approximately 1,200 mt per year in the late 1980s, but peaked again in 1990 at 3,200 mt with recruitment of the strong 1987 year class. Landings decreased to 800 mt in 1993 and remained low through the 1990s, but rapidly increased to >2,400 mt in 2000 and 2001. Discards averaged 11% of total catch from 1985 to 2001. Discard estimates are not available for the Gulf of Maine prior to 1985.

Over the past three years, total catch has been 69% large-mesh trawl landings from the Cape Cod grounds (statistical areas 514 and 521), 13% gillnet landings in the Cape Cod area, 7% large-mesh trawl discards off Cape Cod, 5% large-mesh landings in the northern Gulf of Maine (areas 511-513 and 515), 2% discards from the scallop fishery, 1% large-mesh trawl discards in the northern Gulf of Maine, 1% gillnet landings in the northern Gulf of Maine, and 1% small-mesh trawl discards.

**Data and Assessment:** Landings in 1985-2001 were estimated from dealer records and interview information. Landings in 1994-2001 were prorated from dealer records according to vessel logbook data. US discards at age in 1985-2001 were estimated from sea sampling information.

A virtual population analyses (VPA) of commercial landings and discards at age was completed (assuming natural mortality, M, of 0.2). Indices of recruitment and stock abundance were obtained from NEFSC spring and autumn and Massachusetts spring and fall bottom trawl surveys. Estimates of uncertainty include survey measurement error, but not errors in catch. The VPA calibration was revised from previous VPAs of the Cape Cod stock to group older ages (age 5+) into a single age class to avoid inconsistent estimates in terminal years of the assessment and problematic patterns of F and trends in stock size. The revised calibration provides a different perspective on historical development of the stock and the fishery. However, an implicit assumption in the reconfiguration is that age-3 yellowtail in this area are fully vulnerable to fishing effort.

**Biological Reference Points:** The proposed  $F_{MSY}$  proxy is  $F_{40\%}$  (0.17, Figure A2.3). The  $SSB_{MSY}$  proxy is 12,600 mt, calculated as the product of 40% MSP (1.192 kg spawning biomass per recruit) and average recruitment (10.5 million). The MSY proxy is 2,300 mt, derived as the product of yield per recruit at  $F_{40\%}$  (0.213 kg) and average recruitment.

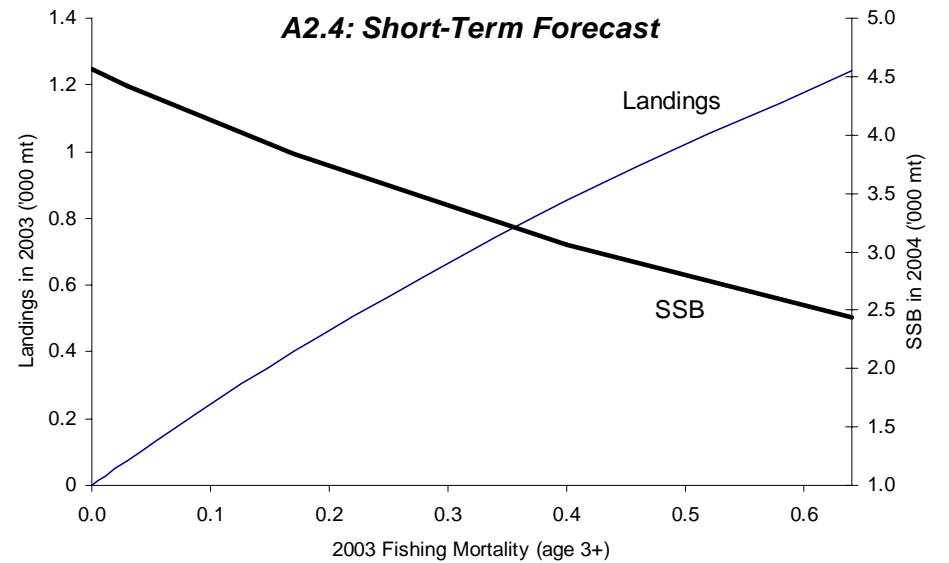
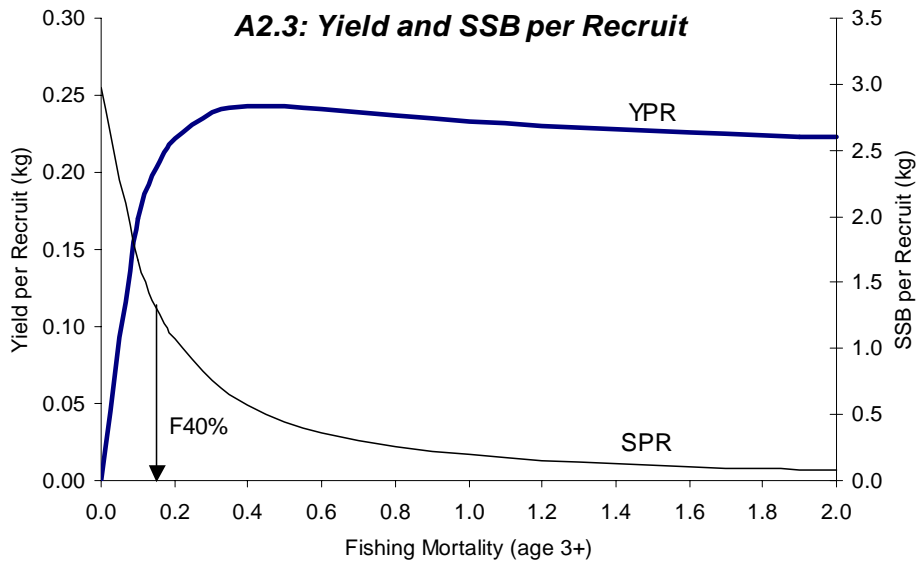
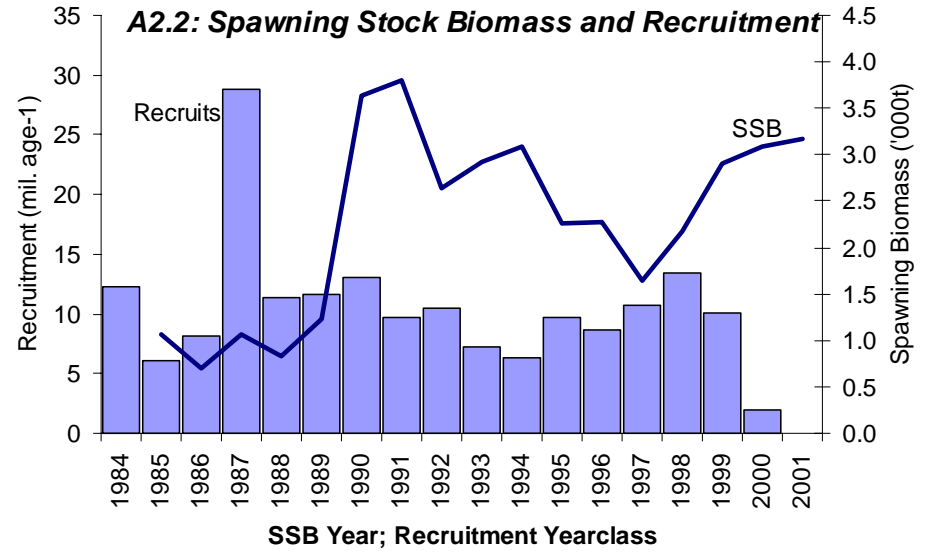
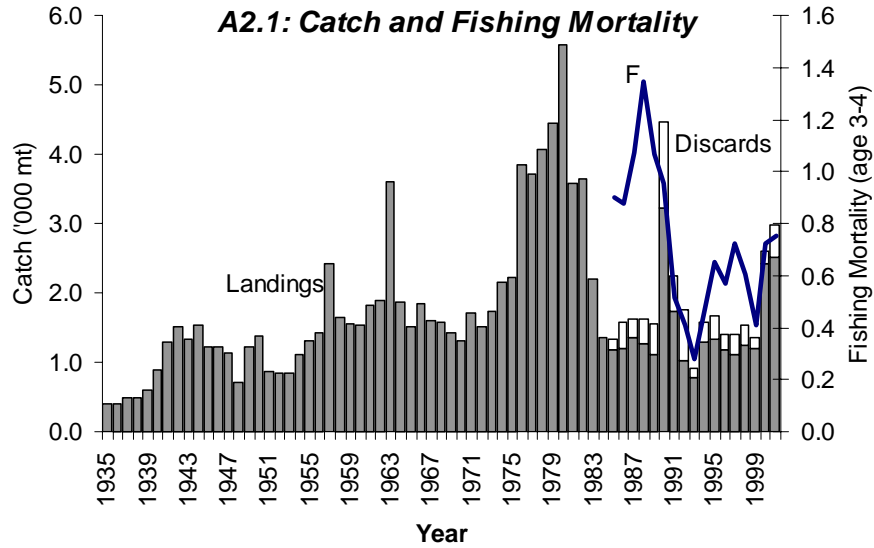
**Fishing Mortality:** Annual  $F$  declined from a peak of 1.3 in 1988 to 0.28 in 1993, then increased to an average of 0.61 from 1995 to 2000.  $F$  was 0.75 in 2001, with an 80% confidence limit of 0.59-0.95 (Figure A2.6). Retrospective analysis indicates an 18% underestimation of  $F$  in the past 5 years.

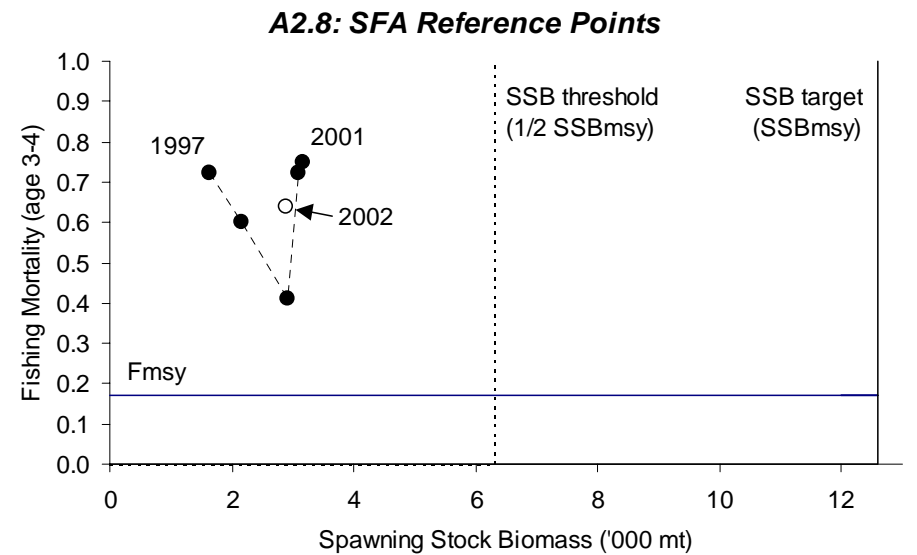
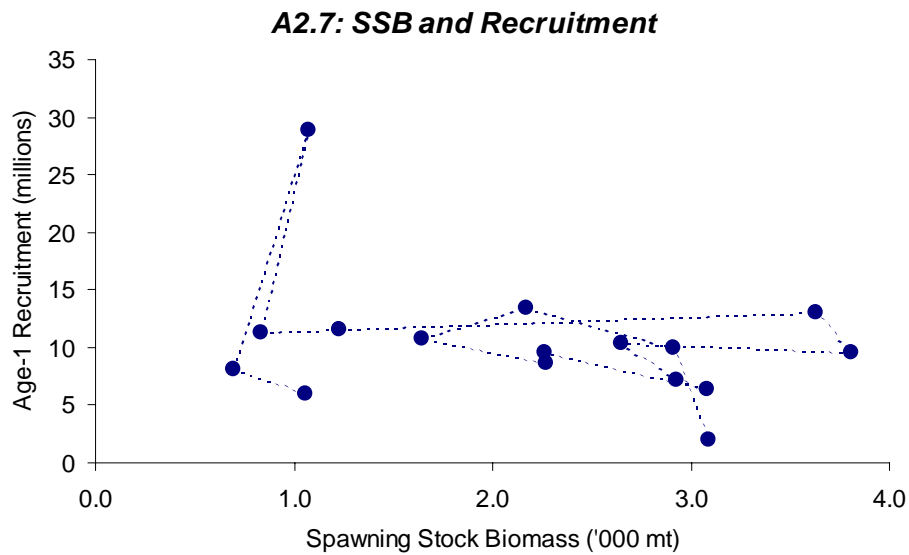
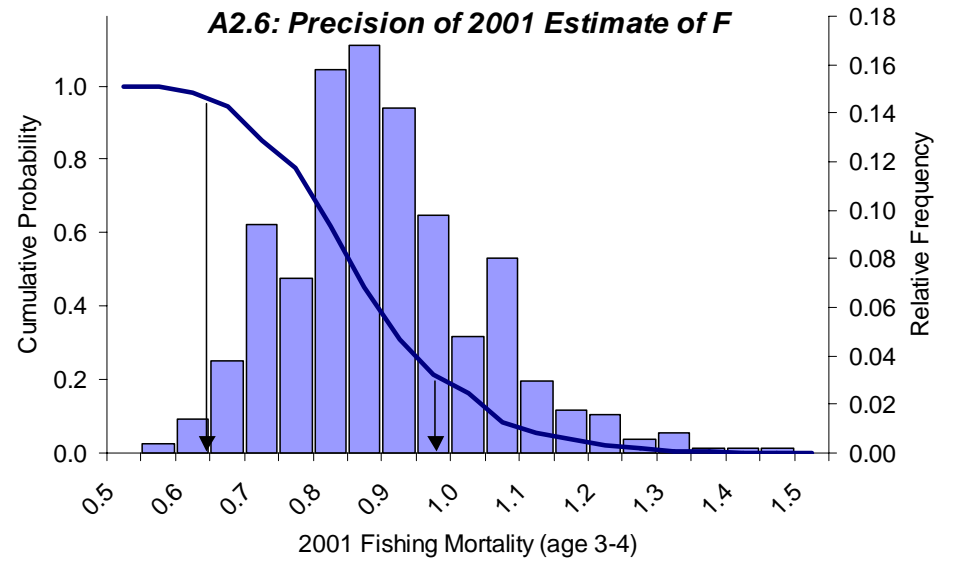
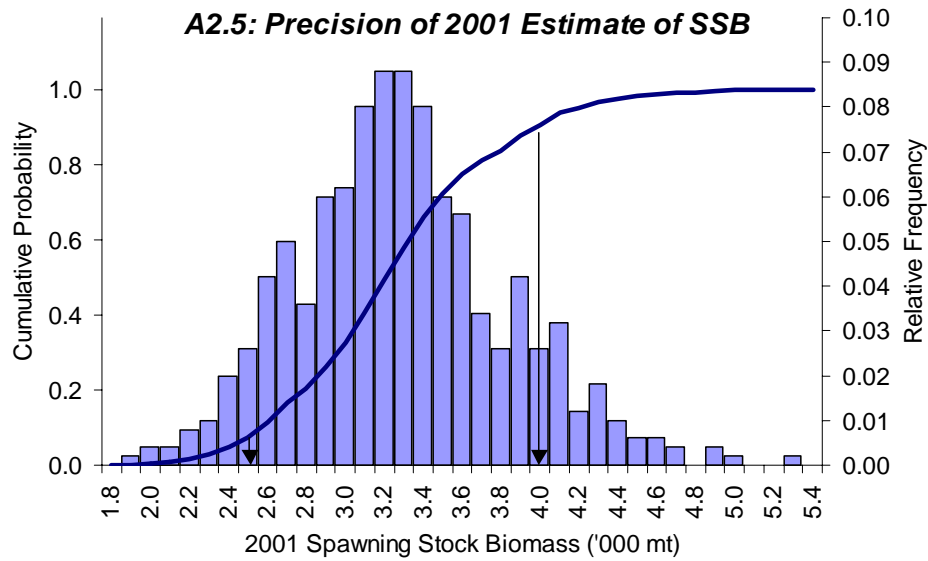
**Recruitment:** With the exception of the strong 1987 year class (29 million at age-1), recruitment appears to have been relatively stable, averaging 10.5 million at age 1. Recruitment approximately doubled between 1994 and 1998. However, early indications are that the 2000 year class is well below average (Figure A2.2).

**Spawning Stock Biomass:** SSB averaged 1,000 mt during the late 1980s, increased to 3,800 mt in 1991, and decreased to 1,600 mt in 1998. It then increased to 3,200 mt in 2001, with an 80% confidence limit of 2,500–4,000 mt (Figure A2.5). Retrospective analysis indicates a 21% overestimation of SSB in the past 5 years.

**Special Comments:** This assessment is the first for yellowtail flounder in the Cape Cod - Gulf of Maine area, and the VPA calibration was revised. Despite the data and methodology revisions, the current state of the stock and management advice are similar to those reported for the Cape Cod management area by the 28<sup>th</sup> Stock Assessment Review Committee in 1999. The Cape Cod component, which accounts for approximately 90% of landings from the combined area, was previously determined to be overfished.

**Source of Information:** S. X. Cadrin and J. King, 2002. Stock assessment of yellowtail flounder in the Cape Cod – Gulf of Maine area. NEFSC Ref. Doc. 03-03.





**A2.9 Observed and Expected Age Distribution of SSB**

