A. SUMMER FLOUNDER ADVISORY REPORT

State of Stock: The summer flounder stock is overfished and overfishing is occurring relative to the current biological reference points. The fishing mortality rate has declined from 1.32 in 1994 to 0.27 in 2001 (Figure A1) marginally above the current overfishing definition reference point ($F_{threshold} = F_{target} = F_{max} = 0.26$; Figure A7). There is an 80% chance that the 2001 F was between 0.24 and 0.32 (Figure A6). The estimate of F for 2001 may understate the actual fishing mortality as retrospective analysis shows that the current assessment method tends to underestimate recent fishing mortality rates (e.g., by about 1/3 over the last three years).

Total stock biomass has increased substantially since 1989, and in 2001 was estimated to be 42,900 mt, 19% below the current biomass threshold (53,200 mt) (Figures A2, A7). There is an 80% chance that total stock biomass in 2001 was between 39,300 and 46,900 mt (Figure A5).

Spawning stock biomass (SSB; Age 0+) declined 72% from 1983 to 1989 (18,800 mt to 5,200 mt), but has increased seven-fold, with improved recruitment and decreased fishing mortality, to 38,200 mt in 2001 (Figure A2). Comparison with previous assessments shows a tendency to slightly overestimate the SSB in recent years. The age structure of the spawning stock has expanded, with 72% at ages 2 and older, and 14% at ages 5 and older (Figure A9). Under equilibrium conditions at F_{max}, about 85% of the spawning stock biomass would be expected to be ages 2 and older, with 50% at ages 5 and older.

The arithmetic average recruitment from 1982 to 2001 is 40 million fish at age 0, with a median of 36 million fish. The 2000 year class is estimated at 39 million fish. The 2001 year class is currently estimated to be below average, at 27 million fish (Figure A2). It should be noted that retrospective analysis shows that the current assessment method tends to underestimate the abundance of age 0 fish in recent years (e.g., by about 20% over the last three years). Recent recruitment per unit of SSB has been lower than that observed during the early 1980s (Figure A8).

Management Advice: If the landings for 2002 do not exceed the total allowable landings (TAL) and the proportion of catch discarded does not increase, the TAL in 2003 would need to be 10,580 mt (23.3 million lbs) to meet the target F rate of $F_{max} = 0.26$ with 50% probability (Figure A4). As noted above, retrospective analysis suggests that the assessment tends to underestimate fishing mortality rates and the abundance of age 0 fish in the most recent years.

Forecasts for 2002-2004: Stochastic forecasts only incorporate uncertainty in 2002 stock sizes due to survey variability and assume current discard to landings proportions. If landings in 2002 are equal to the 2002 TAL of 10,991 mt (24.2 million lbs) and discards are 1,700 mt (3.7 million lbs), the forecast estimates a median (50% probability) F in 2002 = 0.32 and a median total stock biomass on January 1, 2003 (equivalent to December 31, 2002) of 57,600 mt, above the biomass threshold of ½ B_{MSY} = 53,200 mt. (Figure A7). Landings of 10,580 mt (23.3 million lbs) and discards of 1,508 mt (3.3 million lbs) in 2003 provide a median F in 2003 = 0.26 and a median total stock biomass level on January 1, 2004 of 65,600 mt (Figures A4, A7). Landings of 12,179 mt (26.9 million lbs) and discards of 1,692 mt (3.7 million lbs) in 2004 provide a median F in 2004 = 0.26 (Figure A7.)

Forecast Table: 2002 Landings = 10,991 mt; 2002-2004 median recruitment from 1982-2001 VPA estimates (35.6 million)

Forecast medians (50% probability level) (landings, discards, and total stock biomass (TB) in '000 mt)

2002				2003				2004			
F	Land.	Disc.	TB	F	Land.	Disc.	TB	F	Land.	Disc.	TB
0.32	**11.0**	**1.7**	**51.4**	**0.26**	**10.6**	**1.5**	**57.6**	**0.26**	**12.2**	**1.7**	**65.6**

Summer Flounder Catch and Status Table *(weights in '000 mt, recruitment in millions, arithmetic means)*

Year	1995	1996	1997	1998	1999	2000	2001	Max[1]	Min[1]	Mean[1]
Commercial landings	7.0	5.8	4.0	5.1	4.8	5.1	4.9	17.1	4.0	8.5
Commercial discards[2]	0.3	0.5	0.3	0.4	1.5	0.7	0.6	1.5	0.3	0.8
Recreational landings	2.5	4.7	5.4	5.7	3.8	7.1	5.3	12.7	1.4	5.4
Recreational discards[2]	0.7	0.6	0.6	0.5	0.7	0.9	1.2	1.2	0.1	0.5
Catch used in assessment	10.5	11.6	10.3	11.7	10.8	13.8	12.0	26.5	8.0	14.9
Commercial quota	6.6	4.9	3.8	4.8	4.9	4.9	4.9			
Recreational harvest limit	3.5	3.2	3.4	3.4	3.4	3.4	3.3			
Spawning stock biomass[3]	15.8	16.7	17.6	22.3	22.9	30.0	38.2	38.2	5.2	15.7
Recruitment (age 0)	39.6	32.9	35.6	39.8	30.8	39.5	26.6	80.3	13.0	39.7
Total stock biomass[4]	35.7	37.0	32.3	37.9	36.4	37.1	42.9	48.3	16.1	32.7
F (ages 3-5, u)	1.23	1.14	1.19	0.86	0.73	0.47	0.27	2.15	0.27	1.26
Exploitation rate	66%	63%	65%	53%	48%	35%	22%	83%	22%	66%

[1] Over the period 1982-2001. [2]Released fish that die. 3At the peak of the spawning season (i.e., on November 1), ages 0-7+. [4] On January 1.

Stock Distribution and Identification: The Mid-Atlantic Fishery Management Council (MAFMC) and Atlantic States Marine Fisheries Commission (ASMFC) Fishery Management Plan for summer flounder defines the management unit as all summer flounder from the southern border of North Carolina northeast to the US-Canada border. A recent summer flounder genetics study, which revealed no population subdivision at Cape Hatteras (Jones and Quattro, 1999), is consistent with the definition of the management unit.

Catches: Total landings peaked in 1983 at 26,100 mt. Landings declined markedly during the late 1980s, reaching 4,200 mt in the commercial fishery in 1990 and 1,400 mt in the recreational fishery in 1989. Total landings were only 6,500 mt in 1990. Reported 2001 landings in the commercial fishery were 4,916 mt, about 1% over the commercial quota. Commercial discards are estimated from sea sampling data and represent about 10% of the commercial catch assuming a discard mortality of 80%. Estimated 2001 landings in the recreational fishery were 5,250 mt, about 62% over the recreational harvest limit. Recreational discard losses increased to about 18% of the recreational catch in 2001 (the discard mortality rate is assumed to be 10% based on three recent studies). Total commercial and recreational landings in 2001 were 10,166 mt.

Data and Assessment: An analytical assessment (VPA) of commercial and recreational total catch at age (landings plus discards) was conducted. The natural mortality rate (M) was assumed to be 0.2. Indices of recruitment and stock abundance from NEFSC winter, spring, and autumn; Massachusetts spring and autumn; Rhode Island, Connecticut spring and autumn; Delaware, and New Jersey trawl surveys were used in VPA tuning in an ADAPT framework. Recruitment indices from surveys conducted by the states of North Carolina, Virginia, and Maryland were also used in the VPA tuning. The current VPA tuning configuration is very similar to those used in the 2000 SARC 31 VPA (NEFSC 2000) and in the 2001 SAW Southern Demersal Working Group VPA (MAFMC 2001a). The uncertainty associated with the estimates of fishing mortality and stock biomass in 2001 was evaluated only with respect to research survey variability (Figures A5, A6).

Biological Reference Points: Biological reference points for summer flounder are based on a yield per recruit model (Thompson-Bell). The yield per recruit analysis conducted for the 1999 assessment (Terceiro 1999) indicated that F_{max} = 0.26, which was used as a proxy for F_{target} and $F_{threshold}$. FMP Amendment 12 SFA stock biomass reference points were estimated as the product of yield per recruit (0.552 kg per recruit) and total stock biomass per recruit (2.813 kg per recruit) at F_{max} = 0.26, and median recruitment of 37.8 million fish per year (1982-1998; from Terceiro (1999)). Yield at F_{max}, used as a proxy for MSY, was estimated to be 20,900 mt (46 million lbs), and the corresponding biomass, used as a proxy for $B_{MSY,}$ was estimated to be 106,400 mt (235 million lbs; Figure A7).

The SARC concluded that updating these reference points is not warranted at this time.

Fishing Mortality: Fishing mortality calculated from the average of the currently fully recruited ages (3-5) has been high, varying between 0.9 and 2.2 during 1982-1997 (55%-83% exploitation), far in excess of the revised FMP Amendment 12 overfishing definition, $F_{threshold}$ = F_{target} = F_{max} = 0.26 (21% exploitation). The fishing mortality rate has declined substantially since 1997 and was estimated to be 0.27 (22% exploitation) in 2001, the lowest observed in the 20-year time series (Figures A1, A7). There is an 80% probability that the fishing mortality rate in 2001 was between 0.24 and 0.32. The annual partial recruitment of age-1 fish has decreased from near 0.50 during the first half of the VPA series to about 0.20 since 1994; the partial recruitment of age-2 fish has decreased from 1.00 in 1993 to 0.78 during 1999-2001. These decreases in partial recruitment at age are in line with expectations given recent changes in commercial and recreational fishery regulations. The estimate of F for 2001 may understate the actual fishing mortality as retrospective analysis shows that the current assessment method tends to underestimate recent fishing mortality rates (e.g., by about 1/3 over the last three years).

Total Stock Biomass: Total stock biomass has increased substantially since 1989, and in 2001 total stock biomass was estimated to be 42,900 mt, near the level of the early 1980s, although still 19% below the current biomass threshold (Figures A2, A7). There is an 80% chance that total stock biomass in 2001 was between 39,300 and 46,900 mt (Figure A5). The current biomass target (B_{MSY}) required to produce maximum sustainable yield (MSY=20,900 mt) is estimated to be B_{MSY} = 106,400 mt, and the current biomass threshold of one-half B_{MSY} = 53,200 mt (Figure A7).

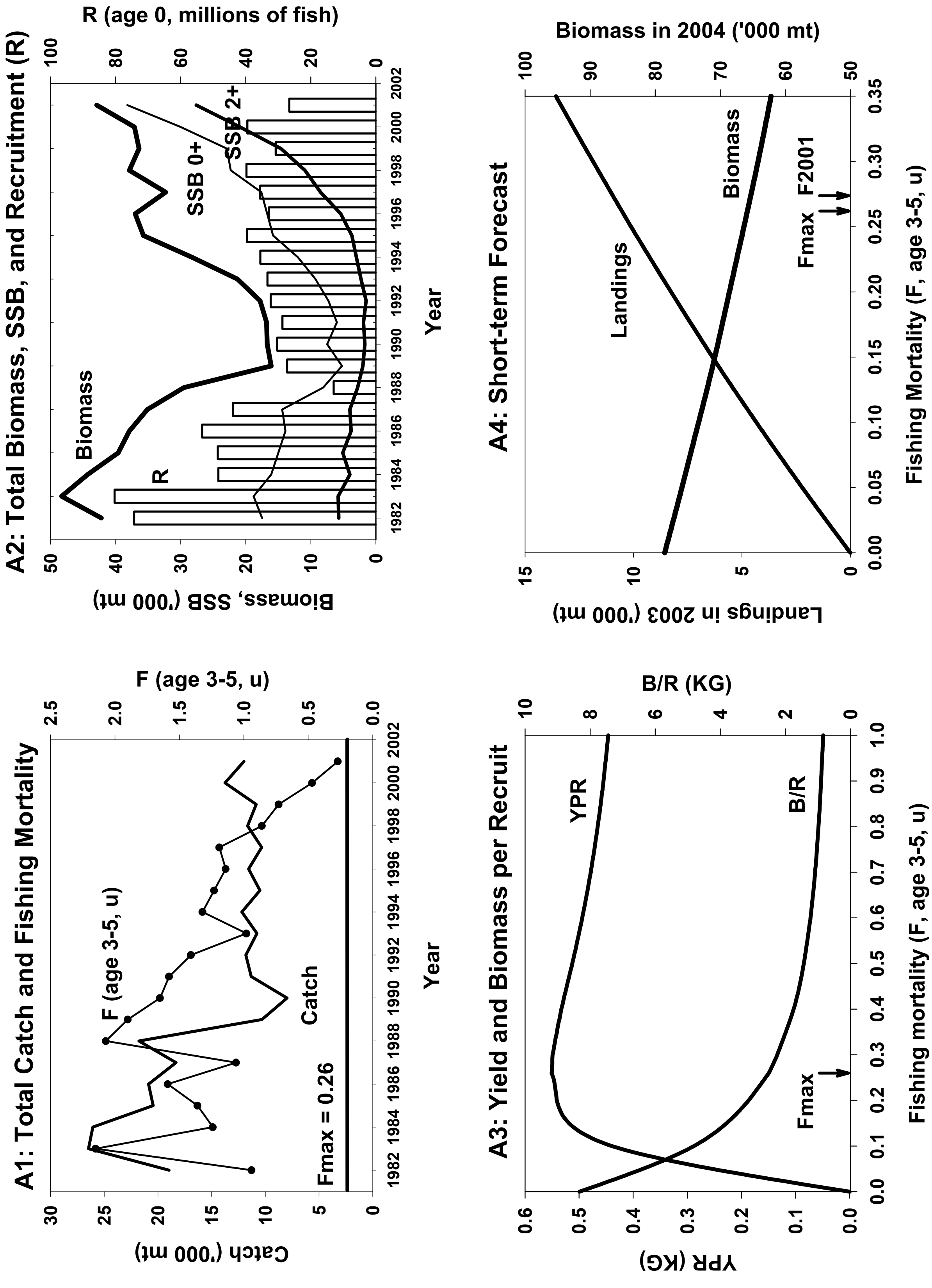
Recruitment: The arithmetic average recruitment from 1982 to 2001 is 40 million fish at age 0, with a median of 36 million fish. The 1982 and 1983 year classes are the largest in the VPA time series, at 74 and 80 million fish (Figure A2). Recruitment declined from 1983 to 1988, with the 1988 year class the weakest at only 13 million fish. Recruitment since 1988 has generally improved. The 2000 year class is estimated at 39 million fish, above the 1982-2001 median. The 2001 year class is currently estimated to be below average, at 27 million fish (Figure A2). It should be noted that retrospective analysis shows that the current VPA tends to underestimate the abundance of age 0 fish for recent year classes. Recent recruitment per unit of SSB has been lower than that observed during the early 1980s (Figure A8).

Spawning Stock Biomass: Spawning stock biomass (SSB; Age 0+) declined 72% from 1983 to 1989 (18,800 mt to 5,200 mt), but has increased seven-fold, with improved recruitment and decreased fishing mortality, to 38,200 mt in 2001 (Figure A2). Comparison with previous assessments shows a tendency to slightly overestimate the SSB in recent years. The age structure of the spawning stock has expanded, with 72% at ages 2 and older, and 14% at ages 5 and older. Under equilibrium conditions at F_{max}, about 85% of the spawning stock biomass would be expected to be ages 2 and older, with 50% at ages 5 and older (Figure A9).

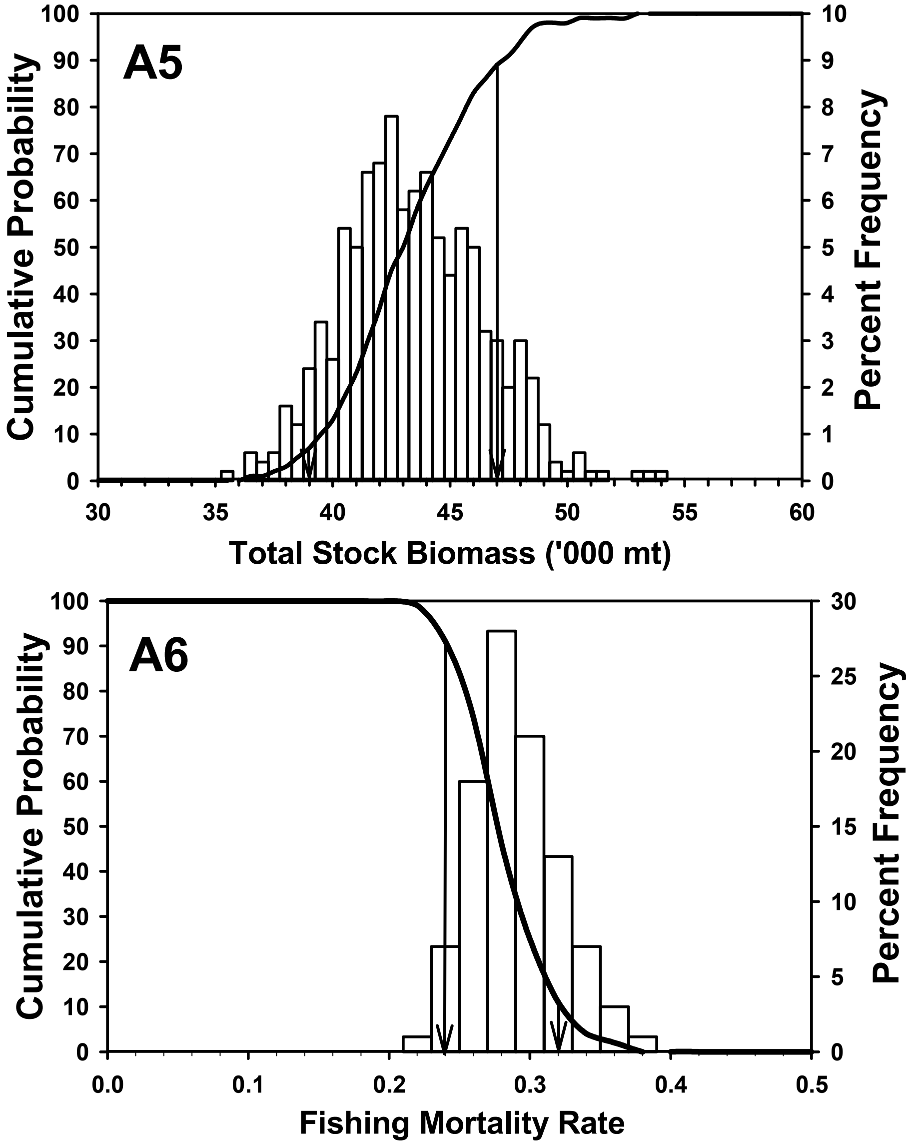
Special Comments: During each of the past six years the recreational fishery has exceeded its harvest limit and, for the entire period, exceeded the limit by 58%. During the same period the commercial fishery exceeded its harvest limit by 5%. These excesses result in a fishing mortality that exceeded the target.

Given that there is a persistent retrospective underestimation of fishing mortality, managers should consider adopting a lower TAL than that implied by the current overfishing threshold.

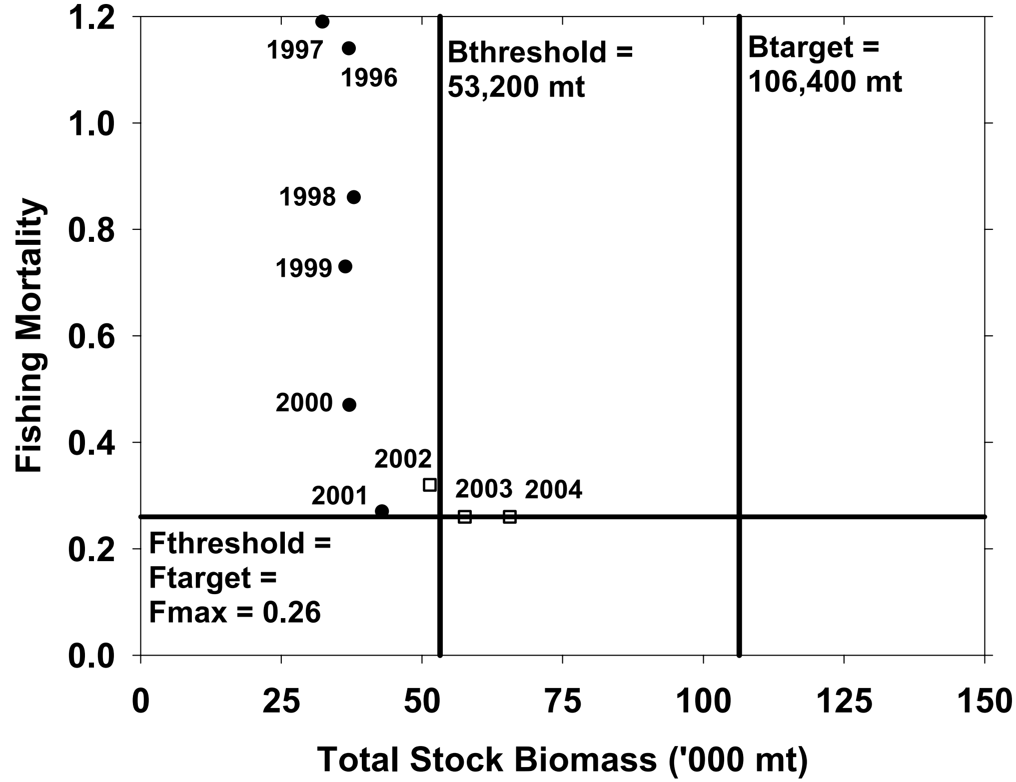
Sources of Information: Jones, W.J., and J.M. Quattro. 1999. Genetic structure of summer flounder (*Paralichthys dentatus*) populations north and south of Cape Hatteras. Marine Biology 133(129-135); Mid-Atlantic Fishery Management Council. (MAFMC). 2001a. SAW Southern Demersal Working Group 2001 Advisory Report: Summer Flounder. 12 p.; Mid-Atlantic Fishery Management Council. (MAFMC). 2001b. SSC Meeting - Overfishing Definition. July 31-August 1, 2001. Baltimore, MD. 10 p.; Northeast Fisheries Science Center (NEFSC). 2000. Report of the 31st Northeast Regional Stock Assessment Workshop (31st SAW): SARC Consensus Summary of Assessments. NEFSC Reference Document 00-15. 400 p.; Northeast Fisheries Science Center (NEFSC). 2002. DRAFT Report of the 35th Northeast Regional Stock Assessment Workshop (35th SAW): SARC Consensus Summary of Assessments. NEFSC Working Document; Terceiro, M. 1999. Stock assessment of summer flounder for 1999. NEFSC Reference Document 99-19. 178 p.


A1: Total Catch and Fishing Mortality
Catch ('000 mt)
F (age 3-5, u)
Catch
Fmax = 0.26
Year
A2: Total Biomass, SSB, and Recruitment (R)
Biomass, SSB ('000 mt)
R (age 0, millions of fish)
Biomass
R
SSB 0+
SSB 2+
Year
A3: Yield and Biomass per Recruit
YPR (KG)
B/R (KG)
YPR
B/R
Fmax
Fishing mortality (F, age 3-5, u)
A4: Short-term Forecast
Landings in 2003 ('000 mt)
Biomass in 2004 ('000 mt)
Landings
Biomass
Fmax
F2001
Fishing Mortality (F, age 3-5, u)

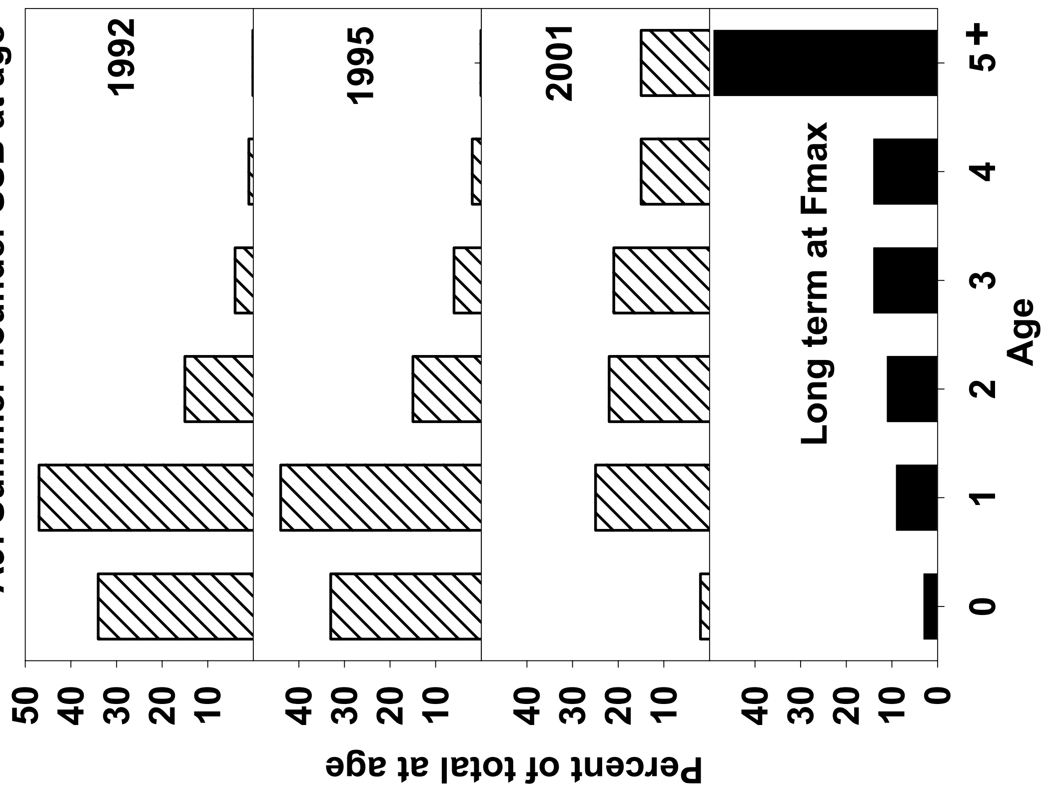
A5-A6: Precision of 2001 Estimates of Stock Biomass and F



A7: SFA Reference Points for Summer flounder



A9: Summer flounder SSB at age



A8: SSB - RECRUIT DATA FOR 1983-2001 YEAR CLASSES