B2. Gulf of Maine Winter Flounder

State of Stock: The Gulf of Maine winter flounder stock is not overfished and overfishing is not occurring (Figure 5). Fully recruited fishing mortality in 2001 was 0.14, about 67% below F_{msy} = 0.43 (Figures B2.1 and B2.3). There is an 80% chance that the F_{2001} was between 0.12 and 0.16 (Figure B2.4). Spawning stock biomass was estimated to be 5,900 mt in 2001, about 44% above B_{msy} = 4,100 mt (Figures B2.2 and B2.4). There is an 80% chance that the spawning stock biomass was between 5,200 mt and 6,600 mt in 2001 (Figure B2.4).

Spawning stock biomass declined substantially from 4,800 mt in 1982 to 700 mt in 1995, but has increased to about 5,900 mt in 2001 as a consequence of reduced fishing mortality since 1996 (Figure B2.2). Recruitment to the stock has been near or above average since 1995 (Figure B2.2).

Management Advice: Maintain fishing mortality at a target level below F_{msy} = 0.43 to ensure that SSB remains near B_{msy}.

Forecast for 2003-2013: If F_{2002} is assumed to be 85% of F_{2001} (F_{2002} = 0.12), due to the impact of additional management measures implemented in 2002, landings in 2002 are expected to be about 800 mt. At this reduced F, spawning stock biomass is projected to increase to 7,700 mt in 2002 (Figure B2.6).

Forecast Table: 2003-2013 recruitment estimated from a Beverton-Holt stock-recruitment relationship.

F2002 is assumed 0.85*F_{2001}; F during 2003-2013 = Fmsy = 0.43

Forecast Medians (50% probability level); 1,000s of mt

2002				2003				2013			
F	Land	Disc	SSB	F	Land	Disc	SSB	F	Land	Disc	SSB
0.12	0.8	< 0.1	7.7	F_{msy}= 0.43	2.9	0.1	7.9	F_{msy}= 0.43	1.6	0.1	4.3

Catch and Status Table: Gulf of Maine winter flounder
(weights in '000 mt, recruitment in millions)

Year	1994	1995	1996	1997	1998	1999	2000	2001	Max[1]	Min[1]	Mean[1]
Commercial landings	0.6	0.8	0.6	0.6	0.6	0.3	0.4	0.6	2.8	0.3	1.0
Commercial discards[2]	< 0.1	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.4	< 0.1	0.1
Recreational landings	0.1	< 0.1	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	1.9	< 0.1	0.5
Recreational discards[3]	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Catch used in assessment	0.7	0.9	0.7	0.7	0.7	0.3	0.4	0.6	5.0	0.3	1.7
Spawning stock biomass	0.8	0.7	0.8	1.4	2.2	3.3	4.3	5.9	5.9	0.7	2.3
Recruitment (Age 1)	4.5	7.5	7.6	7.2	9.0	10.1	7.5	7.4	11.8	3.2	6.7
Fully recruited F (age 5-6)	0.64	1.85	0.36	0.23	0.40	0.13	0.06	0.14	1.85	0.06	0.8
Exploitation rate (age 5-6)	43%	79%	28%	19%	30%	11%	05%	12%	79%	05%	45%

[1] Over period 1982-2001; [2] Assuming 50% discard mortality; [3] Assuming 15% release mortality.

Stock Distribution and Identification: Winter flounder are distributed from Labrador to North Carolina. Localized stocks are found in the region=s estuaries. Because the fishery exploits a mixture of these stocks, for assessment purposes a Gulf of Maine stock has been defined as extending from the waters of Cape Cod Bay and north, including NEFSC statistical areas 511-515.

Catches: Commercial landings were near 1,000 mt from 1964 to the mid 1970s,.increased to a peak of 2,800 mt in 1982 and then steadily declined to a record low of 300 mt in 1999. Landings have remained near 500 mt since 1999. Recreational landings peaked in 1981 at 2,600 mt but declined substantially thereafter. Recreational landings have been <100 mt since 1995. Total discards (commercial plus recreational, by weight) as a percentage of total catch ranged from 3 to 10% of the catch. with an average of 6%. Total catches (including discards) declined from 6,100 mt in 1981 to 300 mt in 1999 and have since increased to 600 mt in 2001 (Figure B2.1).

Data and Assessment: Gulf of Maine winter flounder were last assessed at SAW-21 in 1995, with an index-based assessment. The current assessment includes estimated total catch for the period 1982-2001, survey indices through 2002, estimates of fishing mortality and stock size by VPA for 1982-2001/2002, and biological reference points estimated by YPR and stock-recruitment analyses. The SARC reviewed new analyses on maturity, but concluded that more analyses are needed before a change in the maturity schedule is adopted.

Biological Reference Points: Biological reference points for Gulf of Maine winter flounder were estimated using empirical, non-parametric and parametric stock-recruit modeling approaches. The yield and SSB per recruit analyses indicate that $F_{40\%} = F_{0.1} = 0.26$ and $F_{max} = 0.69$ (Figure 3). A parametric stock-recruitment model estimated values of $F_{msy} = 0.43$, $B_{msy} = 4,100$, and MSY = 1,500 mt (Figure 7). The SARC recommends that the parametric model reference points be the basis for the ASMFC and NEFMC FMP overfishing definitions.

Fishing Mortality: During the years 1982-1995, fishing mortality (fully recruited F, ages 5-6, unweighted) varied between 0.5 (1983) and 1.9 (1995). Fishing mortality declined to 0.14 in 2001 (Figure B2.1). Accounting for the uncertainty of the 2001 estimate, there is an 80% probability that F_{2001} was between 0.12 and 0.16 (Figure B2.4). For the period 1993-1998, retrospective fishing mortality rates underestimate the current values by an average of 56%. The most likely cause of this pattern is a

combination of factors including under-reporting of the landings, misclassification of the landings by stock area, and underestimation of the discards.

Recruitment: Recruitment declined from 11.8 million age-1 fish in 1982 to 3.3 million in 1992. The arithmetic average recruitment from 1982 to 2001 is 6.7 million age-1 fish. Recruitment to the stock has been near or above average since 1995 (average of 7.8 million age-1 fish from 1995 to 2002; Figure B2.2).

Spawning Stock Biomass: Spawning stock biomass (SSB) declined from 4,800 mt in 1982 to a record low of 700 mt in 1995, and then increased to 5,900 mt in 2001 (Figure B2.2). Accounting for the uncertainty of the 2001 estimate, there is an 80% probability that SSB in 2001 was between 5,200 mt and 6,600 mt (Figure B2.4). For the period 1993-1998, retrospective SSB levels overestimate current values by an average of 92%.

Special Comments: While the Gulf of Maine winter flounder VPA provides uncertain estimates of current F and SSB, it provides a better determination of stock status than reliance on survey indices alone. However, recent spatial distribution of both commercial landings and survey catches indicates that most of the recent stock rebuilding has taken place off the Massachusetts coast, with little evidence of rebuilding off the Maine coast.

Source of Information: NEFSC. 1996. Report of the 21th Northeast Regional Stock Assessment Workshop (21th SAW) Stock Assessment Review Committee (SARC) Consensus Summary of Assessments. Northeast Fisheries Science Center Ref. Doc 96-05d. Northeast Fisheries Science Center (NEFSC). 2002. Final Report of the Working Group on Re-Evaluation of Biological Reference Points for New England Groundfish. NEFSC Ref. Doc. 02-04 123 pp. NEFSC. 2002. Report of the 36th Northeast Regional Stock Assessment Workshop (36th SAW) Stock Assessment Review Committee (SARC) consensus summary of assessments. Northeast Fisheries Science Center Ref. 03-xx.

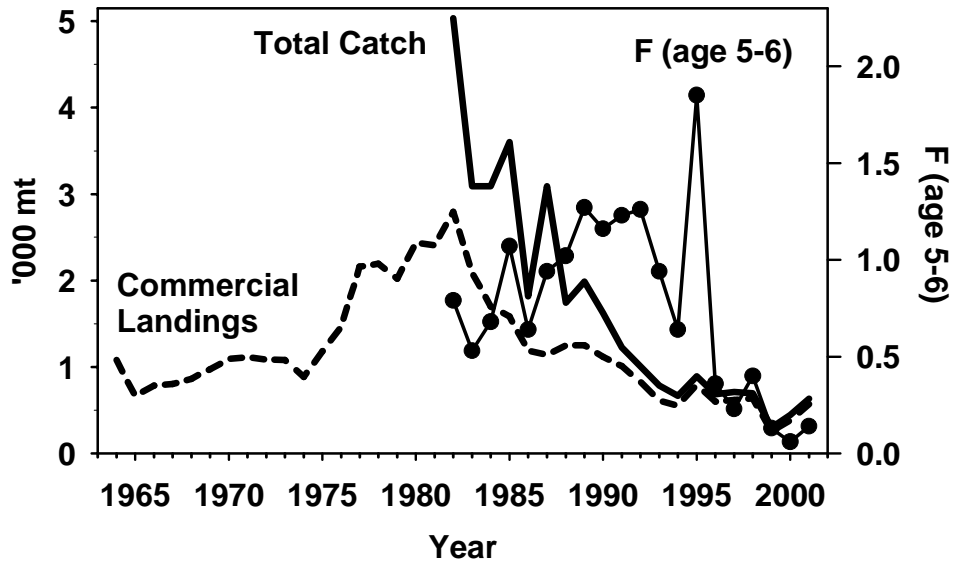## Gulf of Maine Winter Flounder
Total Catch and Fishing Mortality

Figure B2.1. Total catch (landings and discards, '000 mt), commercial landings ('000 mt), and fishing mortality rate (F, ages 5-6, unweighted) for Gulf of Maine winter flounder.

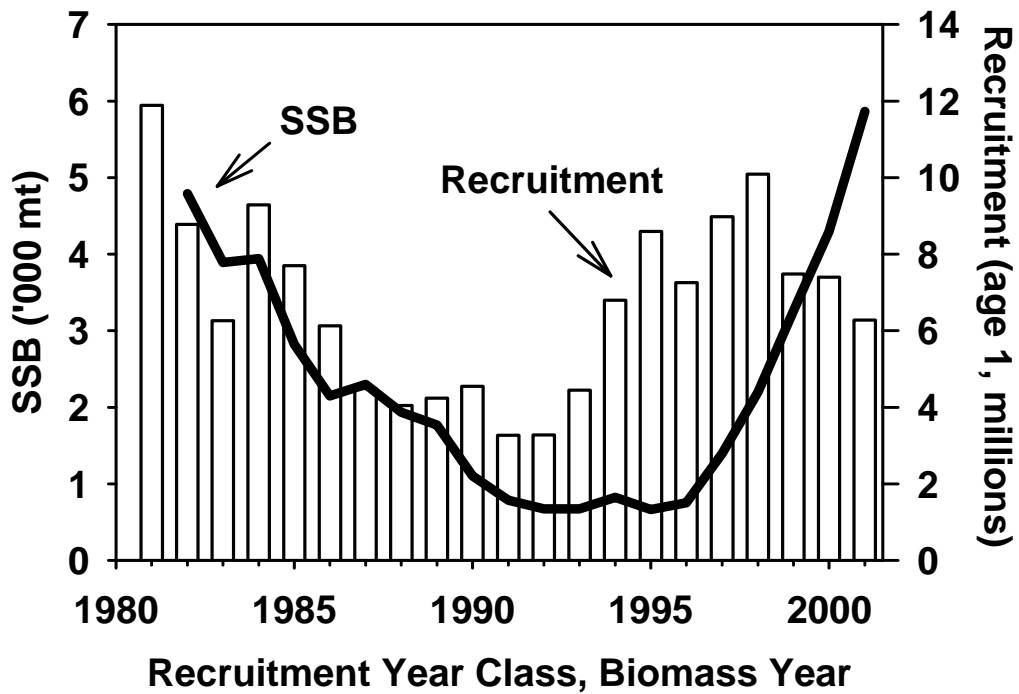## Gulf of Maine Winter Flounder
SSB and Recruitment

Figure B2.2. Spawning stock biomass (SSB, '000 mt) and recruitment (millions of fish at age-1) for Gulf of Maine winter flounder.
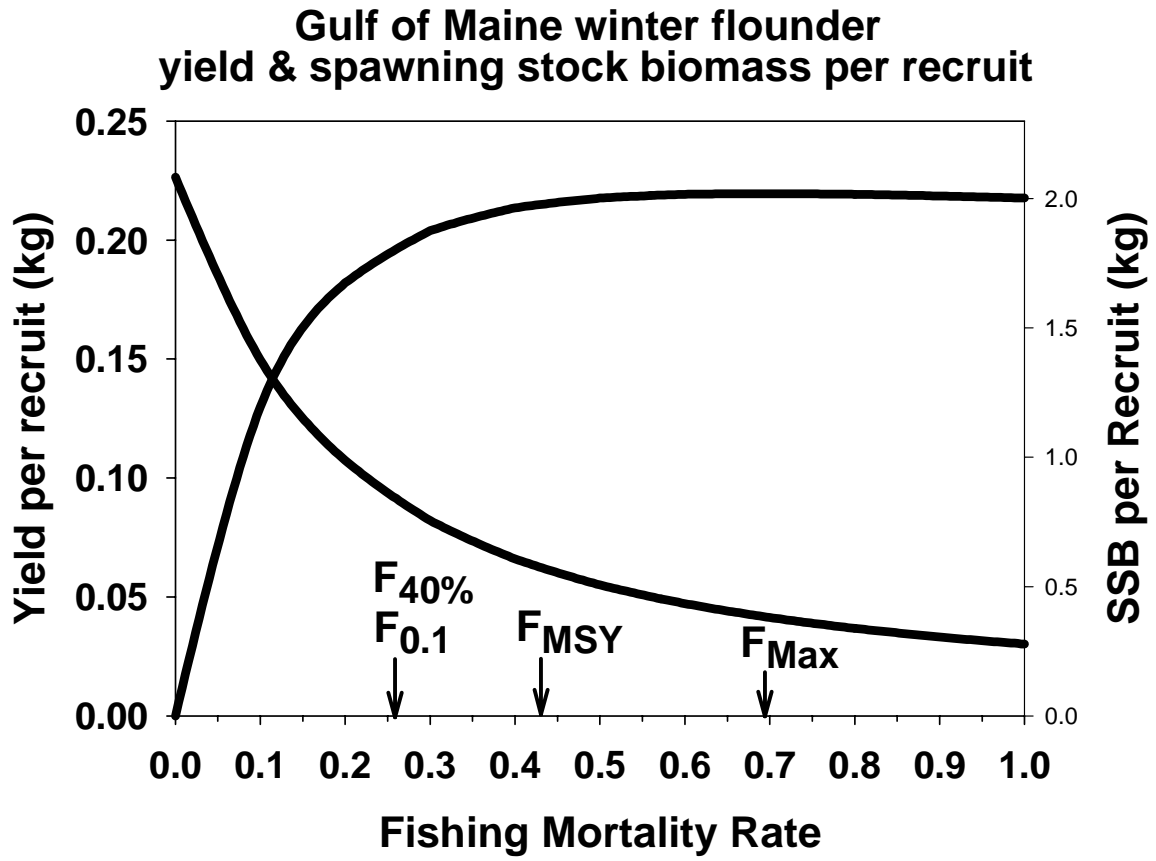
Figure B2.3. Yield and spawning stock biomass per recruit estimates for Gulf of Maine winter flounder.

Gulf of Maine Winter Flounder
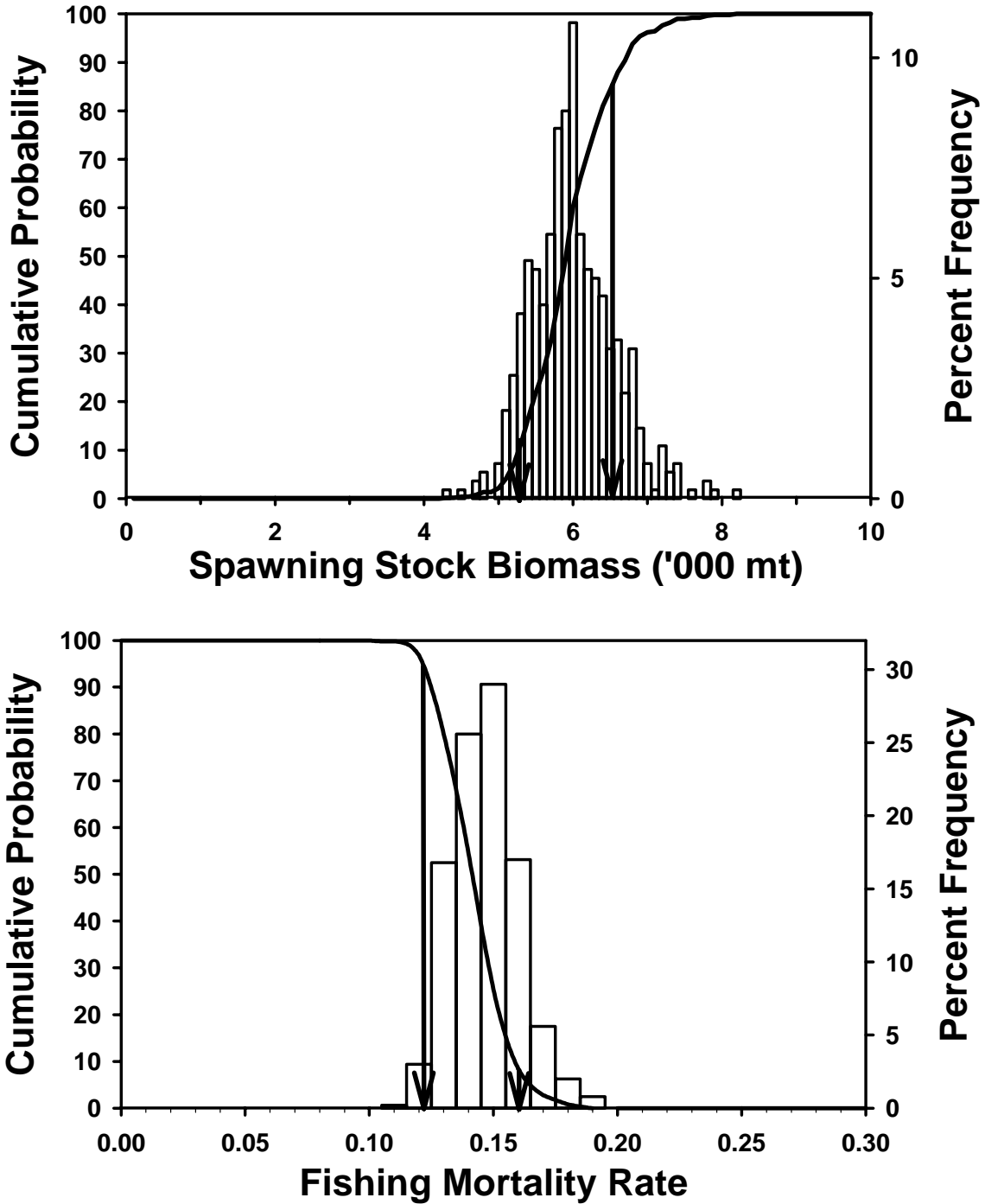## Precision of 2001 Estimates for SSB and F

Figure B2.4. Precision of estimates of spawning stock biomass ('000 mt) and
fishing mortality rate (F, ages 5-6, unweighted) in 2001 for Gulf of Maine winter flounder.
Vertical bars display the range of the bootstrap estimates and the probability of
individual values in the range. The solid curve gives the probability of SSB that is less
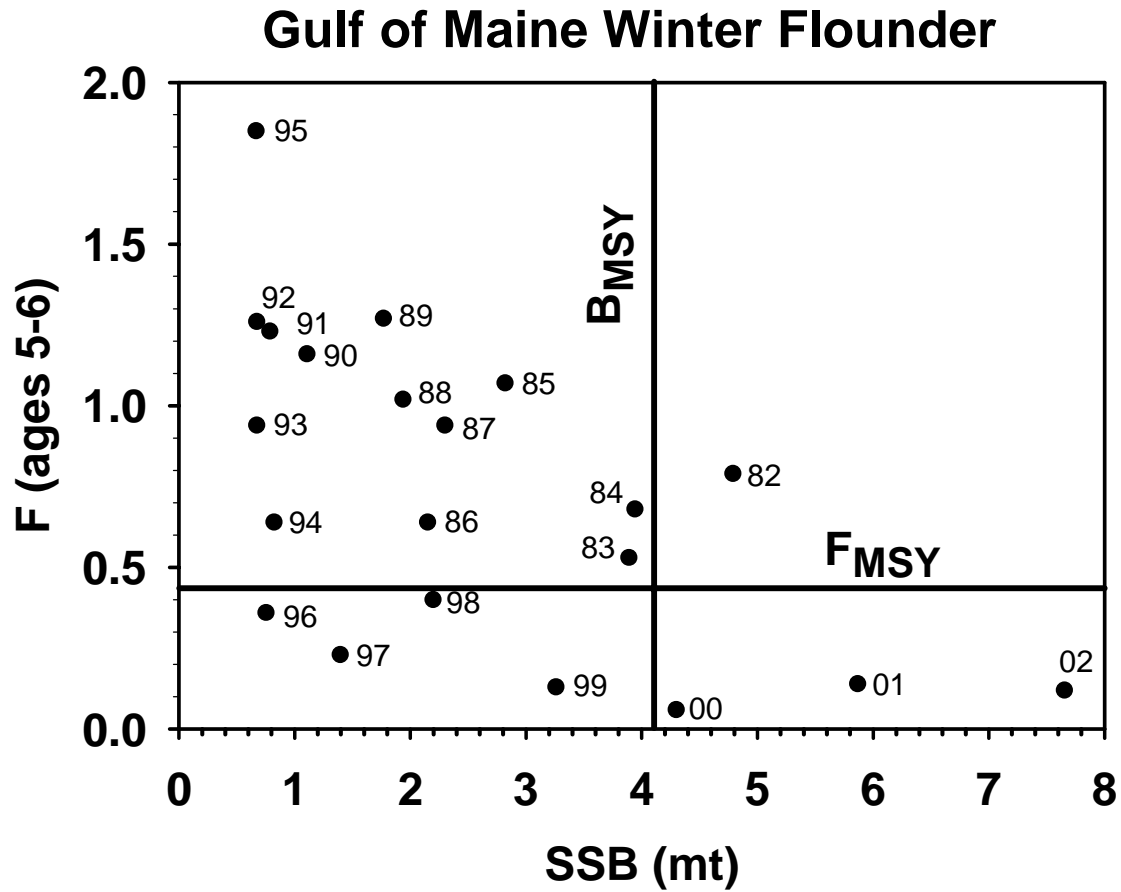or fishing mortality that is greater than any value along the X axis.

Figure B2.5. SSB and F (ages 5-6) for Gulf of Maine winter flounder. Biological references points calculated from the Beverton-Holt model are also shown.
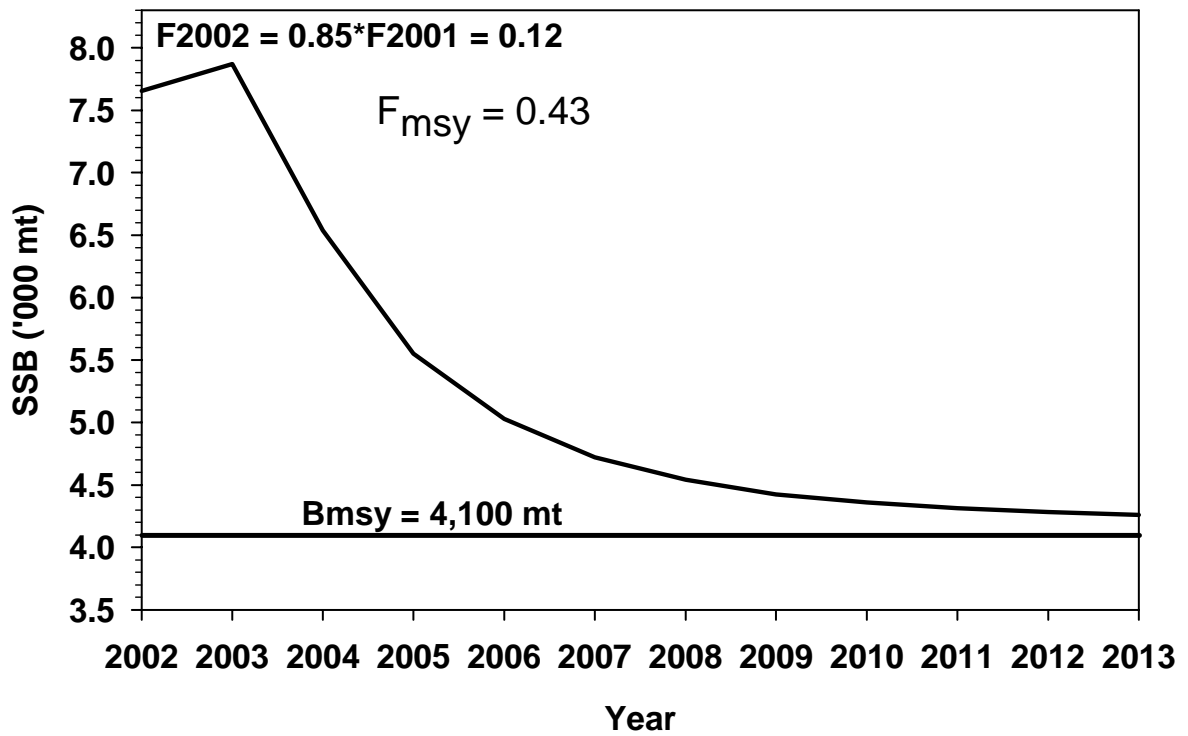
Figure B2.6. Median (50% probability) of forecast spawning stock biomass (SSB, mt) for Gulf of Maine winter flounder assuming F2002 = 0.85*F2001 = 0.12 and Fmsy fishing mortality rates during 2003-2013.

Gulf of Maine Winter Flounder
Beverton-Holt Model
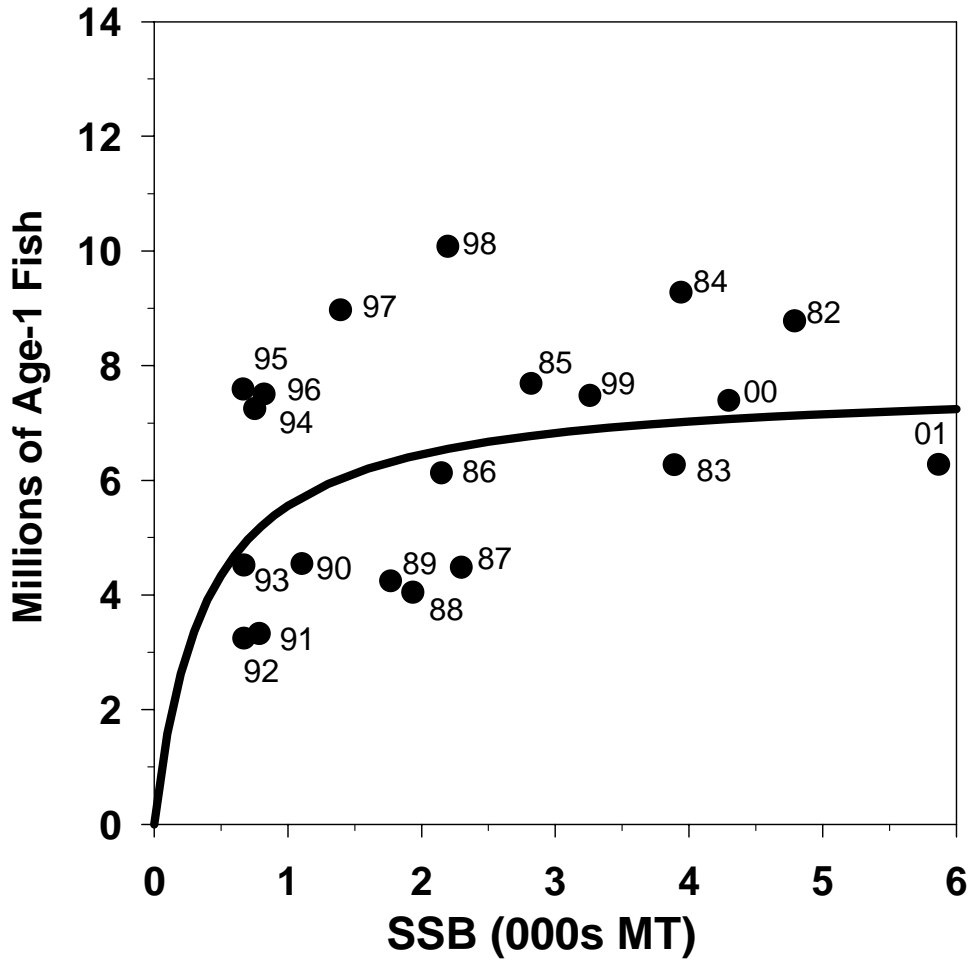### SSB - RECRUIT DATA FOR 1982-2001 YEAR CLASSES

Figure B2.7. Beverton-Holt stock-recruitment model for Gulf of Maine winter flounder.