A. SOUTHERN NEW ENGLAND / MID-ATLANTIC (SNE/MA) WINTER FLOUNDER ASSESSMENT SUMMARY FOR 2011

State of Stock: In 2010 the SNE/MA winter flounder stock was overfished but overfishing was not occurring. The current assessment provides a new assessment model, a new assumption for the instantaneous natural mortality rate (M), and new biological reference points. The recommended biological reference points are $F_{MSY} = F_{THRESHOLD} = 0.290$, $SSB_{MSY} = B_{TARGET} =$ 43,661 mt, $1/2\ SSB_{MSY} = B_{THRESHOLD} = 21{,}831$ mt, and MSY = 11,728 mt. The 2010 estimate of Spawning Stock Biomass (SSB) is 7,076 mt, 16% of B_{TARGET} and 32% of $B_{THRESHOLD}$. The 2010 estimate of fishing mortality (F, ages 4-5) is 0.051, 18% of $F_{THRESHOLD}$ (Figures A1-A3).

Given the new model and assumptions in the current assessment, comparison of the 2010 estimates of SSB and F estimates with the existing 2008 GARM III reference points (NEFSC 2008) is not appropriate. The existing biological reference points from the 2008 GARM III assessment are $F_{40\%} = F_{THRESHOLD} = 0.248$, $SSB_{40\%} = B_{TARGET} = 38{,}761$ mt, $1/2\ SSB_{40\%} = B_{THRESHOLD} = 19{,}381$ mt, and $MSY_{40\%} = 9{,}742$ mt.

Projections: Projections of future stock status were made based on the current assessment results using mean weight, maturity, and fishery selectivity patterns at age estimated for the most recent 5 years in the assessment (2006-2010) to reflect current conditions in the stock and fishery. Recruitment was projected using the stock-recruitment model for the MSY-based BRPs. The projections assumed the FMP Framework 44 fishing year (May 1) catch of 842 mt would be landed as a calendar year (Jan 1) catch in 2011. A catch of 842 mt in 2011 is projected to provide median F in 2011 = 0.100 and median SSB in 2011 = 9,177 mt. Projections at F = 0.000 in 2012-2014 indicate less than a 1% chance that the stock will rebuild to $SSB_{MSY} = 43{,}661$ mt by 2014.

Catch: Commercial fishery landings reached an historical peak of 11,977 metric tons (mt) in 1966, then decreased through the 1970s, peaked again at 11,176 mt in 1981, and then steadily decreased to 2,128 mt in 1994. Commercial landings then increased to 4,556 mt in 2001 but have decreased since then to only 174 mt in 2010 (Figure A4). The Proportional Standard Error (PSE) of commercial landings has averaged less than 1%. Recreational fishery landings peaked in 1984 at 5,510 mt, but decreased substantially thereafter, with only 28 mt estimated for 2010. The PSE of the recreational landings has averaged about 27%. Commercial fishery discards for 1981 to 1993 were estimated from length frequency data from the NEFSC and MADMF trawl surveys, commercial port sampling of landings at length and Fishery Observer sampling of landings and discards at length. The Standardized Bycatch Reporting Method (SBRM) has been used for estimation of SNE/MA winter flounder commercial fishery discards for 1994 and later years. Commercial fishery discard losses peaked in the early 1980s at 1,000-1,500 mt per year and then decreased to less than 200 mt per year since 1997. A discard mortality rate of 50% was applied to the commercial live discard estimates. The PSE of the commercial fishery discards has averaged 27%. Recreational fishery discard losses peaked in 1984-1985 at about 700,000-750,000 fish or 150-200 mt and then decreased to less than 100,000 fish or 20 mt per year since 2000. A discard mortality rate of 15% was applied to recreational live discard estimates. The PSE of the recreational discards has averaged 30%.

Catch and Status Table (weights in 000s mt, recruitment in millions, arithmetic means): SNE/MA Winter Flounder

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Max[1]	Min[1]	Mean[1]
Commercial landings	4.6	3.1	2.3	1.6	1.3	1.7	1.6	1.1	0.3	0.2	11.1	0.2	3.9
Commercial discards	<0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.2	1.5	<0.1	0.5
Recreational landings	0.5	0.2	0.3	0.2	0.1	0.1	0.1	0.1	0.1	<0.1	5.5	<0.1	1.4
Recreational discards	<0.1	<0.1	<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	5.1	3.4	2.8	1.9	1.6	2.0	1.9	1.3	0.5	0.4	15.8	0.4	5.9
Spawning Stock Biomass[2]	8.1	6.0	5.6	4.9	4.5	5.2	6.2	5.9	5.7	7.1	20.1	3.9	8.0
Recruitment (age 1)	15.1	7.4	7.5	15.6	14.2	8.3	7.5	13.5	8.7	8.7	71.6	7.4	25.2
F (ages 4-5)	0.70	0.63	0.55	0.46	0.37	0.42	0.34	0.24	0.09	0.05	1.16	0.05	0.65

1: Over the period 1981-2010
2: On March 1 annually

Stock Distribution and Identification: Winter flounder (*Pseudopleuronectes americanus*) is a demersal flatfish species commonly found in North Atlantic estuaries and on the continental shelf. The species is distributed between the Gulf of St. Lawrence, Canada and North Carolina, U.S., although it is not abundant south of Delaware Bay. Information from tagging, meristics, and life history studies suggest extensive mixing occurs among the localized Southern New England and Mid-Atlantic populations, and so the populations in the region are combined into a single stock complex for assessment purposes. Within the SNE/MA stock complex, winter flounder undergo annual migrations from estuaries, where spawning occurs in the late winter and spring, to offshore shelf areas of less than 60 fathoms (110 meters). The current SNE/MA stock complex extends from the coastal shelf east of Provincetown, MA southward along the Great South Channel (separating Nantucket Shoals and Georges Bank) to the southern geographic limits of winter flounder off Delaware.

Data and Assessment: The age-structured assessment model for SNE/MA winter flounder has changed from an ADAPT VPA model to an ASAP SCAA model (NFT 2011). A new value for natural mortality has been adopted, changing from M = 0.20 to M = 0.30 for all ages and years. New biological reference points have therefore also been estimated, with F_{MSY}, SSB_{MSY}, and MSY now based on a stock-recruitment model. Indices of recruitment and stock abundance from the NEFSC winter, spring, and fall, Massachusetts spring, Rhode Island spring, University of Rhode Island, Connecticut spring, Delaware and New Jersey trawl surveys were used in the ASAP calibration.

Biological Reference Points (BRP): F_{MSY}, SSB_{MSY}, and MSY were estimated from a stock-recruitment model using a range of values for steepness (slope of the stock recruitment curve near the origin) which was consistent with the stock-recruitment data. It is anticipated that steepness should be similar between the three stocks. Therefore, when computing the BRPs, values of steepness were chosen which were constructed to be as similar as possible between stocks, while also providing good fits to the stock recruitment data for each stock. For the SNE/MA stock, steepness was set at 0.6. These BRP estimates are direct MSY based estimates. The recommended biological reference points for SNE/MA winter flounder are F_{MSY} = $F_{THRESHOLD}$= 0.290, SSB_{MSY} = B_{TARGET} = 43,661 mt, 1/2 SSB_{MSY} = $B_{THRESHOLD}$ = 21,831 mt, and MSY = 11,728 mt. For comparison, $F_{40\%}$ computed using the same biological and fishery characteristics is 0.327, with $SSB_{40\%}$ = 29,045 mt and $MSY_{40\%}$ = 8,903 mt (Figures A5-A7).

Fishing Mortality: During 1981-1993, fishing mortality (F ages 4-5) varied between 0.61 (1982) and 0.95 (1993) and then decreased to 0.47 by 1999. Fishing mortality then increased to 0.70 by 2001, and then decreased to 0.05 in 2010, generally tracking the decrease in fishery catch (Figure A8). The fishery selectivity pattern during 1981-1993 was estimated to be 0.01 at age 1, 0.24 at age 2, 0.75 at age 3, was fixed at 1.00 at age 4, was estimated at 1.00 at age 5, 0.99 at age 6, and 1.00 at age 7+. The pattern during 1994-2010 was estimated to be 0.01 at age 1, 0.19 at age 2, 0.70 at age 3, was fixed at 1.00 at age 4, was estimated at 0.97 at age 5, 0.89 at age 6, and 0.67 at age 7+. There is an 80% probability that F for ages 4-5 in 2010 was between 0.04 and 0.06 (Figure A9). Retrospective analysis for the 2003-2010 terminal years indicates retrospective error in fishing mortality ranged from -38% in 2006 to -13% in 2009.

Recruitment: Recruitment at age 1 decreased nearly continuously from 71.6 million age-1 fish in 1981 (1980 year class) to 7.5 million fish in 2002 (2001 year class). Recruitment has averaged 10.5 million during 2003-2010 (Figure A10). Retrospective error in recruitment at age 1 ranged from +78% in 2005 (2004 year class) to -11% in 2009 (2008 year class).

Spawning Stock Biomass: SSB decreased from 20,100 mt in 1982 to a record low of 3,900 mt in 1993 and then increased to 8,900 mt by 2000. SSB has varied between 4,500-8,000 mt during 2001-2009 and was 7,076 mt in 2010 (Figure A10). There is an 80% probability that SSB in 2010 was between 6,433 mt and 8,590 mt (Figure A11). Retrospective error in SSB ranged from +42% in 2004 to +12% in 2009.

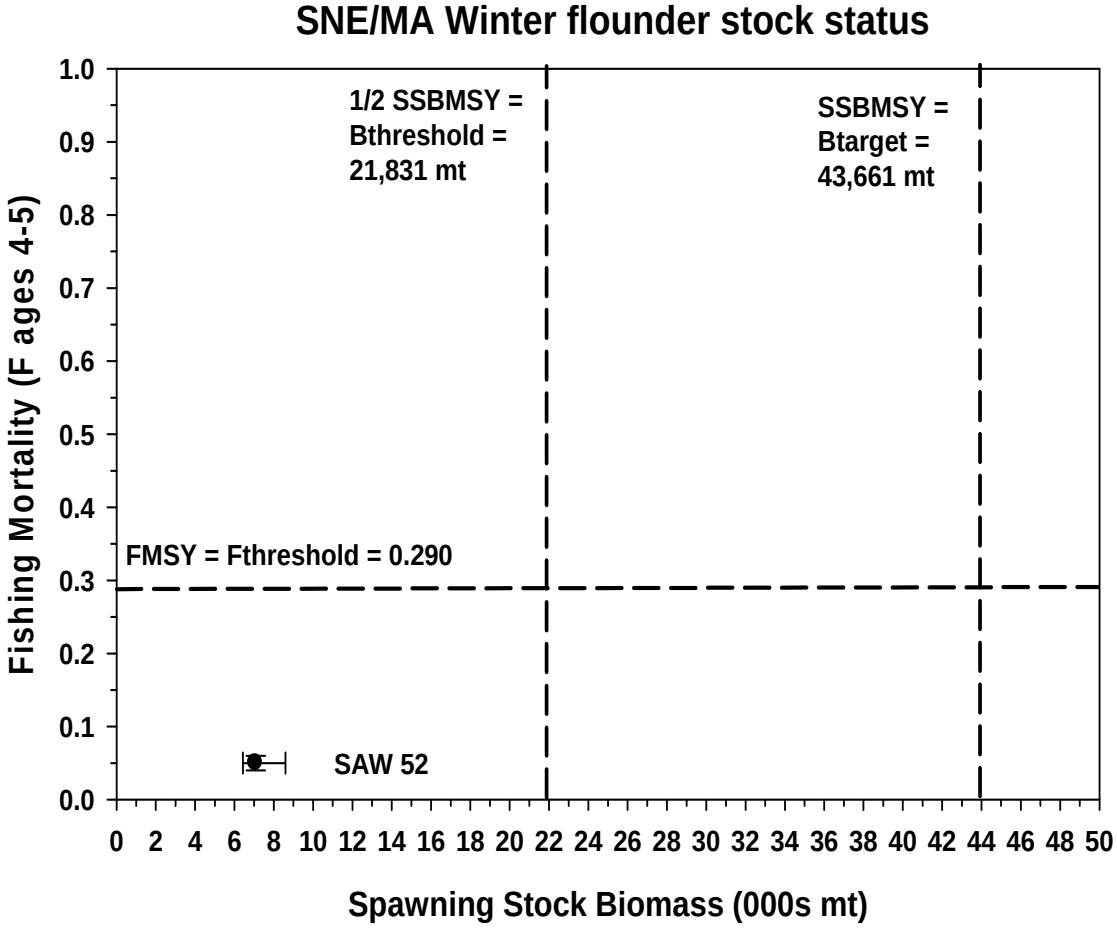
Special Comments: A considerable source of vulnerability for SNE/MA winter flounder is the continued weak recruitment and low reproductive rate (e.g., recruits per spawner). Recruitment estimates for the last decade are lower than those predicted by the stock recruitment model (Figures A5 and A12). If the weak recruitment and low reproductive rate continues, productivity and rebuilding of the stock will be less than projected.

Stock-recruit modeling suggests that warm winter temperatures can have a negative effect on recruitment of SNE/MA winter flounder.

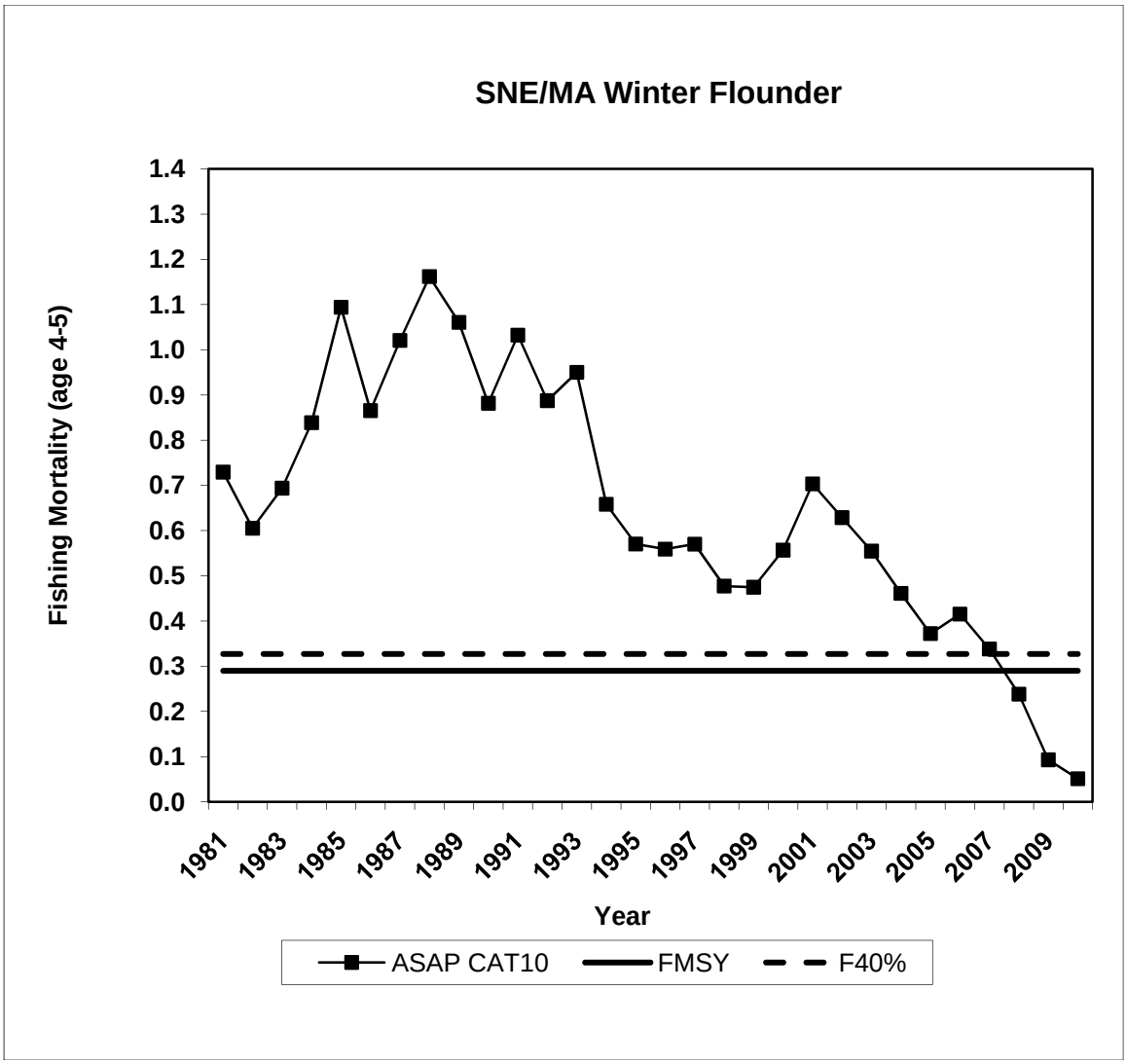
References:

NEFSC. 2008. Assessment of 19 Northeast groundfish stocks through 2007. Report of the 3rd Groundfish Assessment Review Meeting (GARM III), Northeast Fisheries Science Center, Woods Hole, Massachusetts. August 4-8, 2008. NEFSC Ref Doc. 08-15. 884 p.

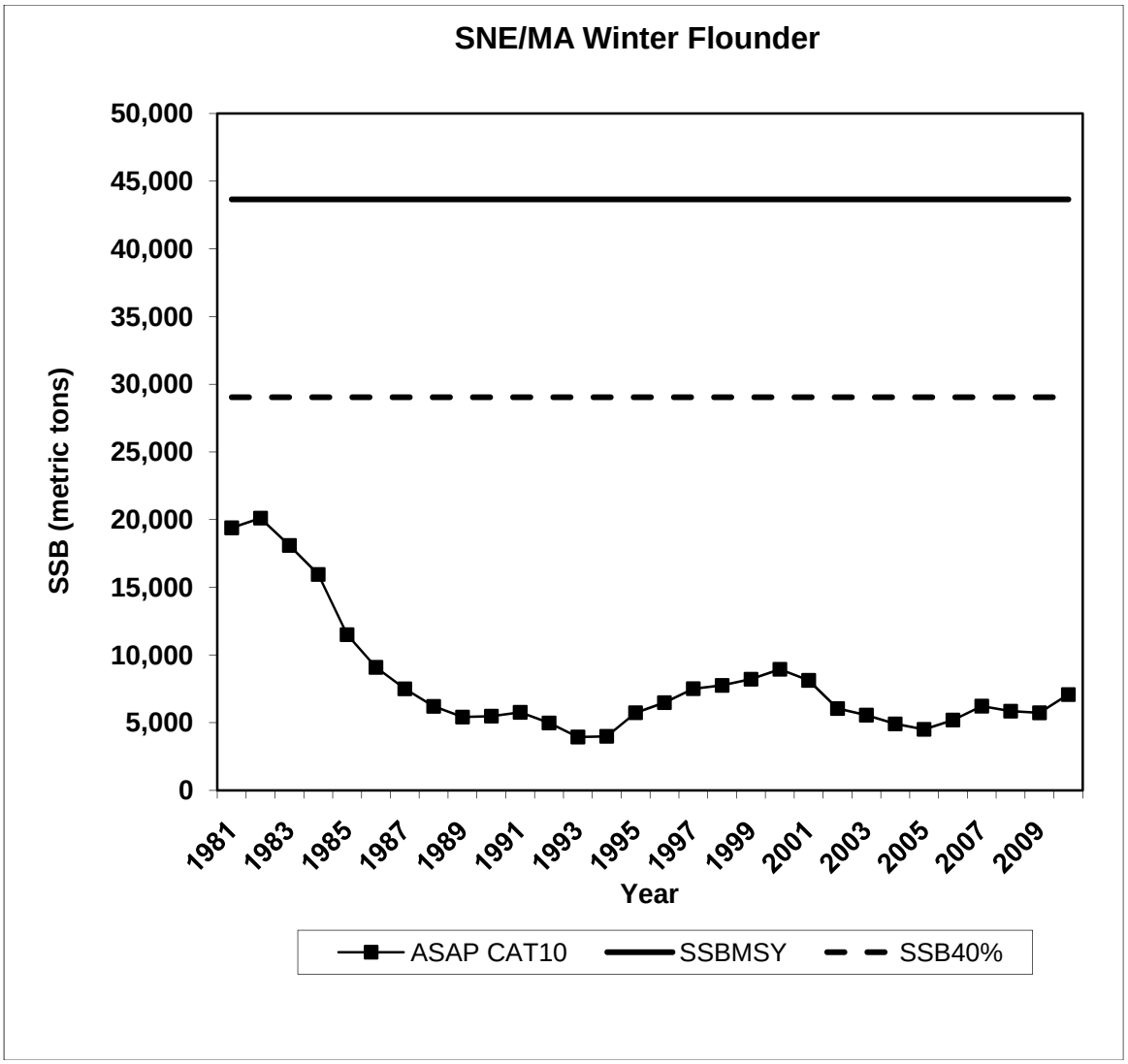
NOAA Fisheries Toolbox (NFT) 2011. Age Structured Assessment Program (ASAP), version 2.0.21. [Internet address: http://nft.nefsc.noaa.gov/ASAP.html].



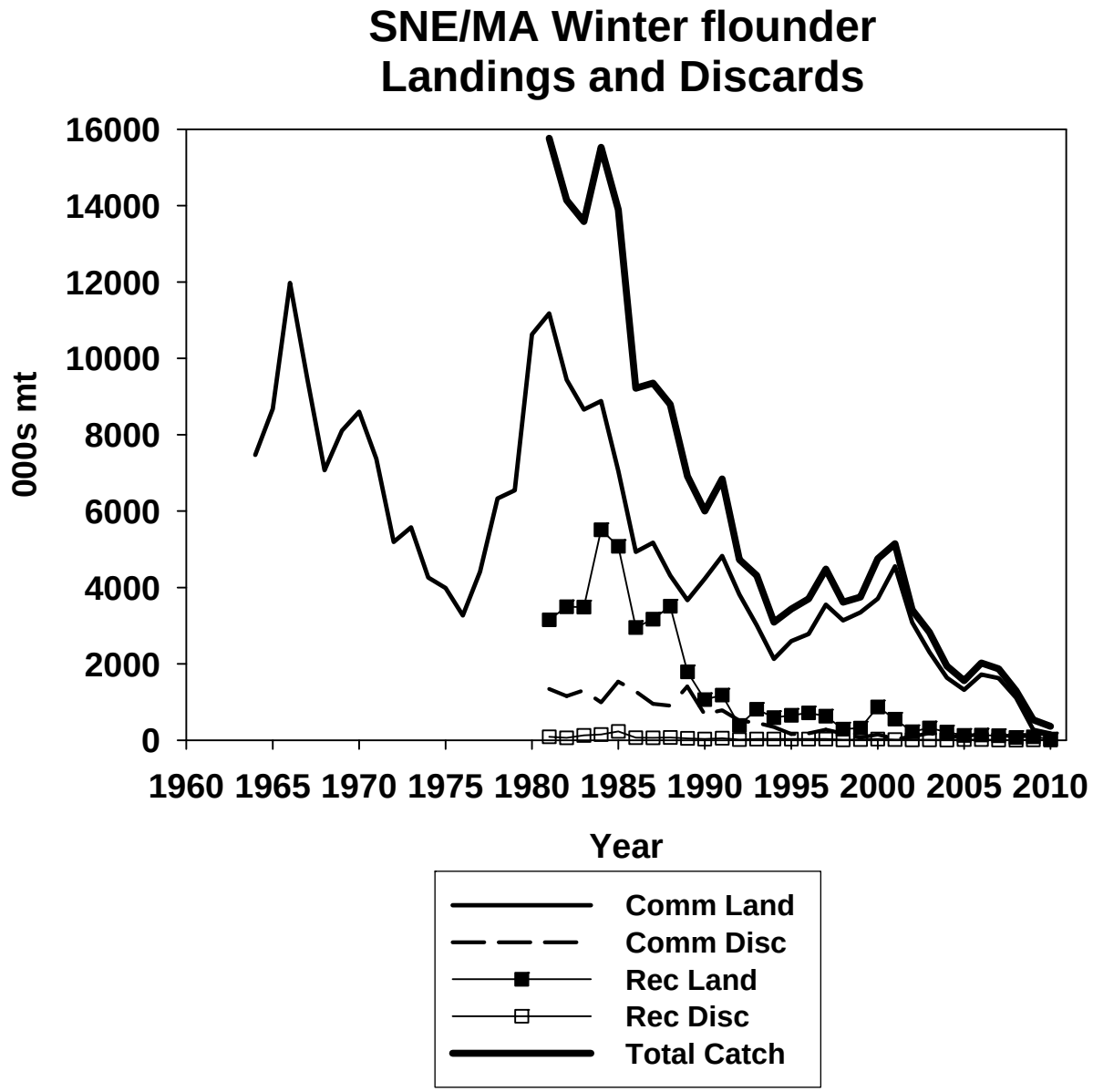
A1. 2011 SAW 52 stock status in 2010 for SNE/MA winter flounder with respect to MSY-based BRPs; error bars on SSB and F are 80% confidence intervals.



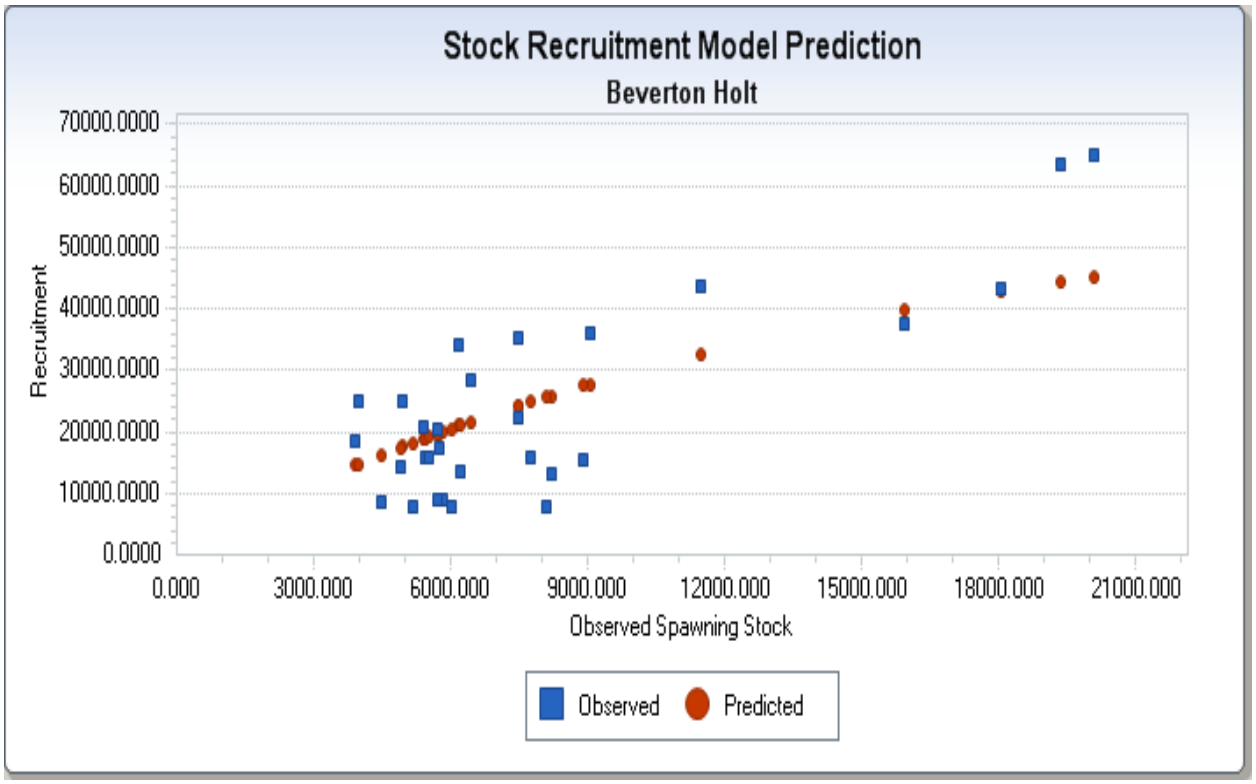
A2. Estimated trend in Fishing Mortality and associated BRPs for SNE/MA winter flounder. ASAP CAT10 is the 2011 SAW 52 final assessment model. The MSY-based BRP is recommended for stock status determination.



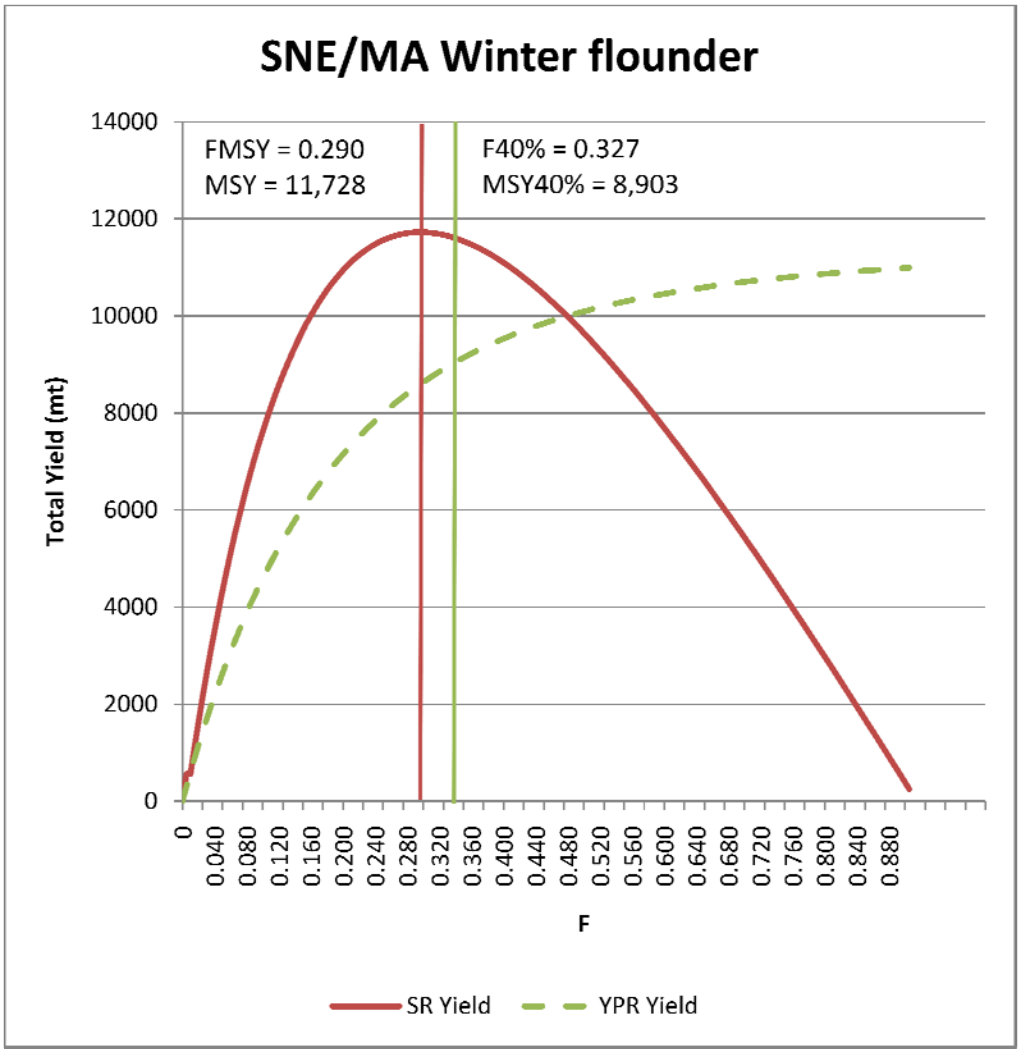
A3. Estimated trend in Spawning Stock Biomass (SSB) and associated BRPs for SNE/MA winter flounder. ASAP CAT10 is the 2011 SAW 52 final assessment model. The MSY-based BRP is recommended for stock status determination.



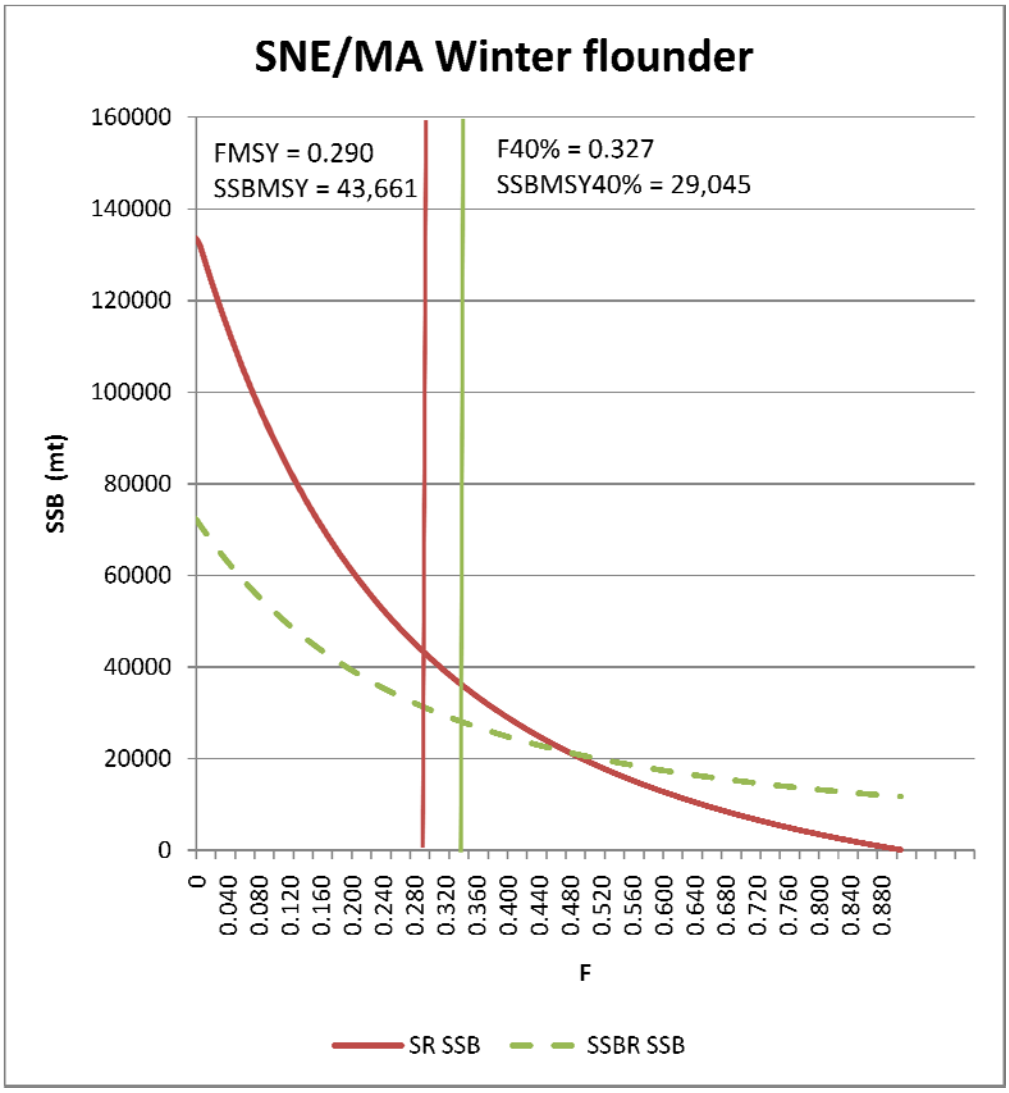
A4. Commercial landings (1964-2010), commercial discards (1981-2010), recreational landings (1981-2010), recreational discards (1981-2010), and total fishery catch (1981-2010) for SNE/MA winter flounder.



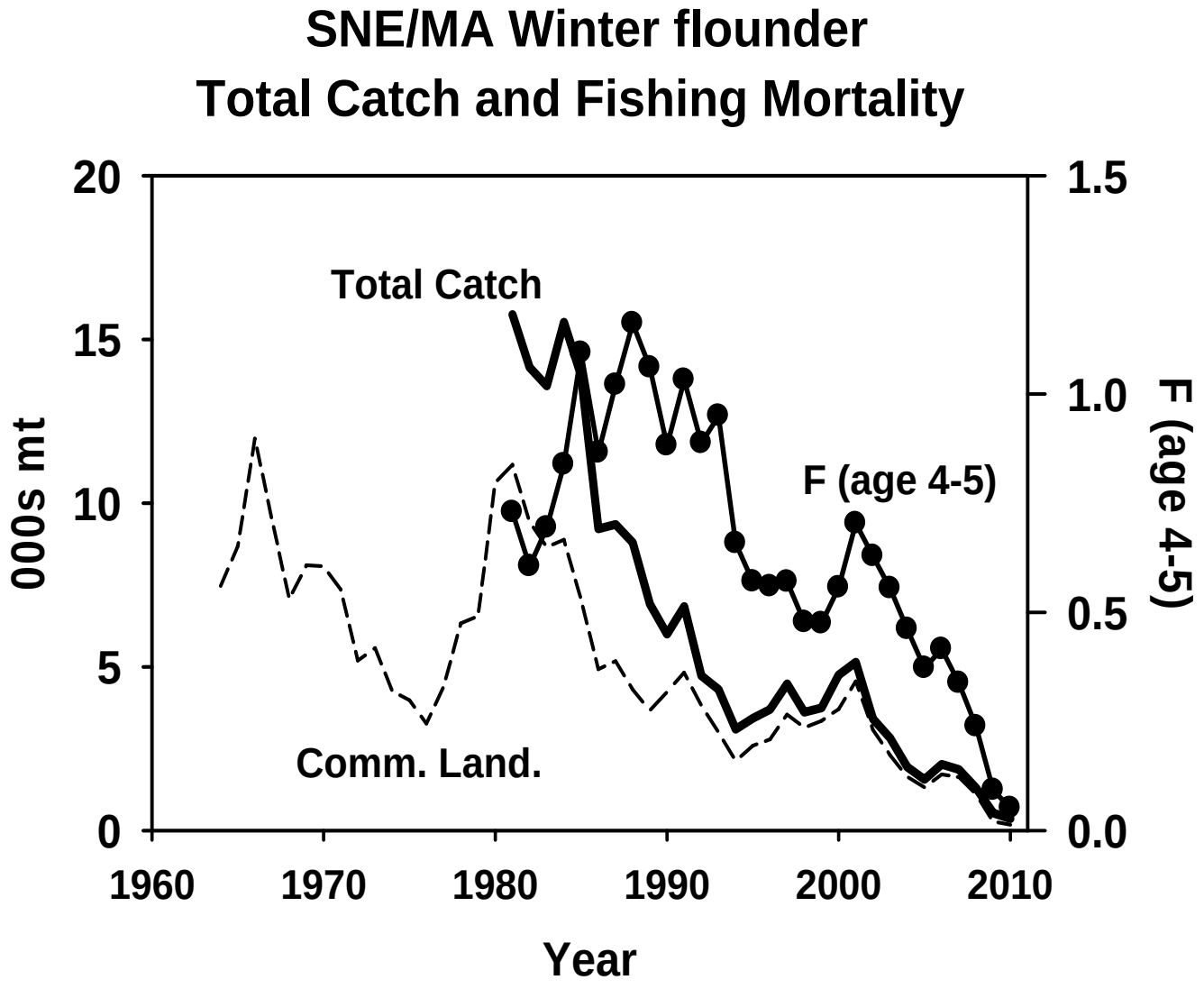
A5. Final stock-recruitment model for SNE/MA winter flounder. Spawning stock is in mt; recruitment is in thousands of age-1 fish.



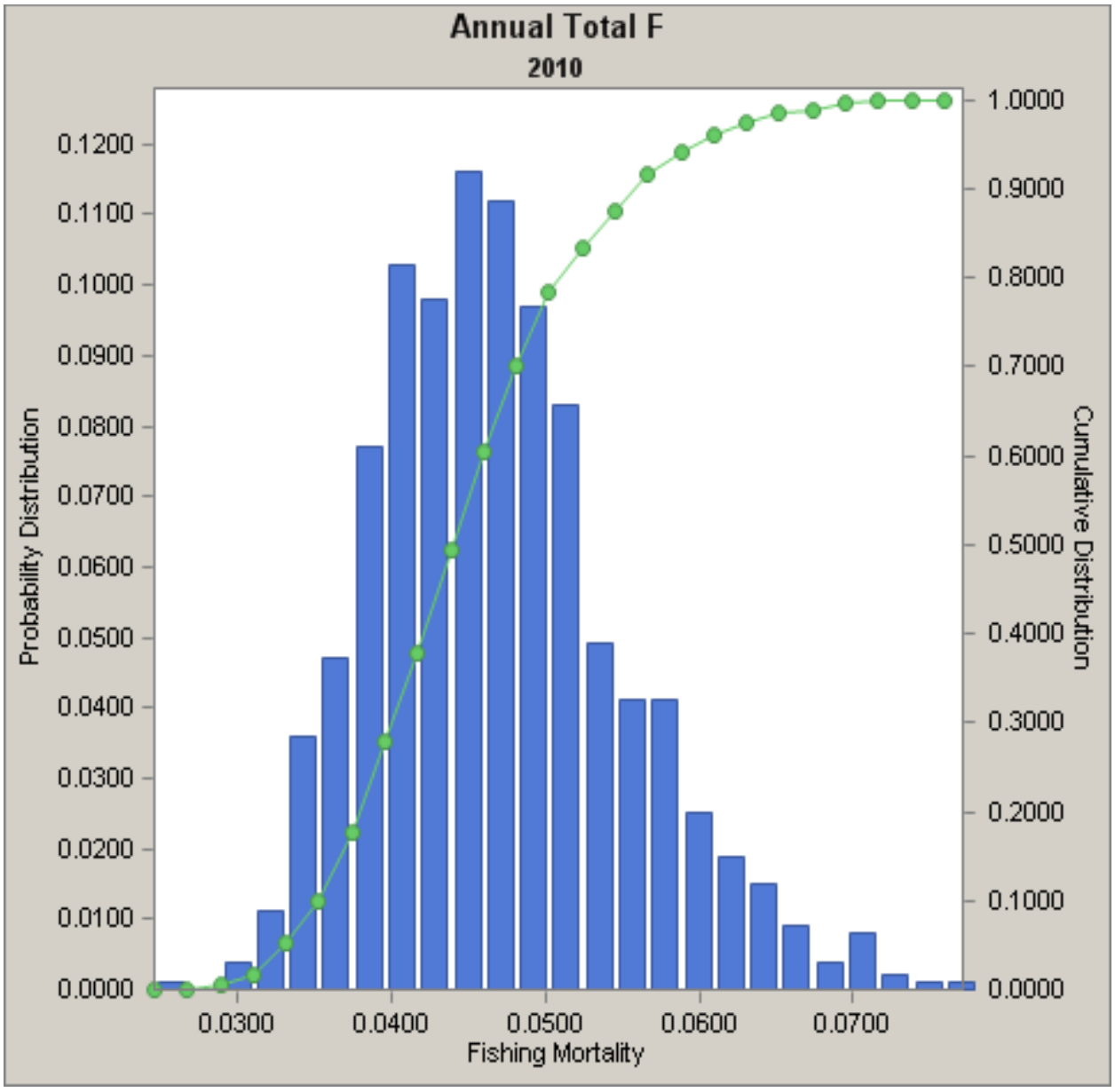
A6. Comparison of fishing mortality versus total yield relationship for stock-recruitment model based BRPs (F_{MSY}, MSY) and yield per recruit model based BRPs ($F_{40\%}$, $MSY_{40\%}$).



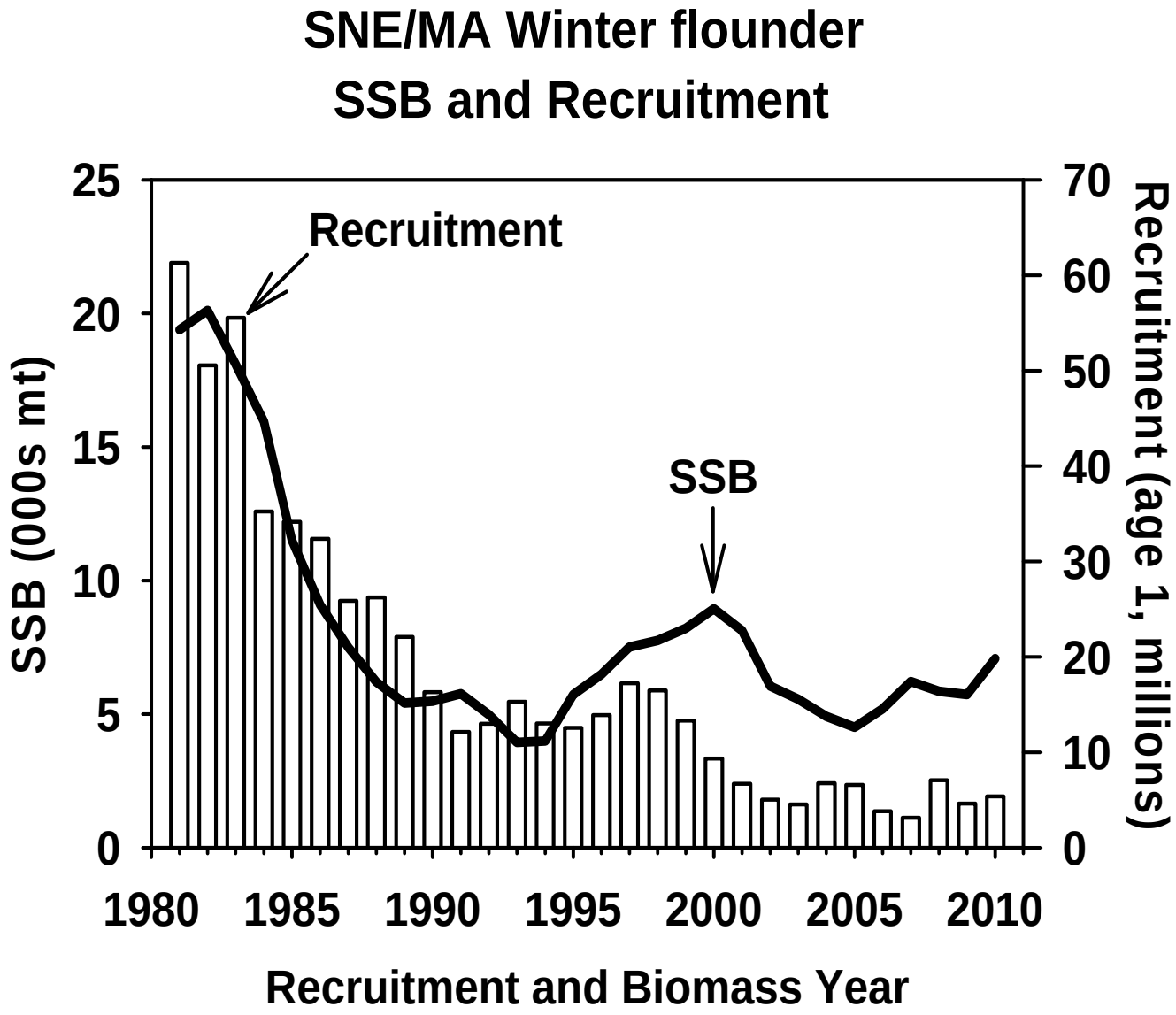
A7. Comparison of fishing mortality versus SSB relationship for stock-recruitment model based BRPs (F_{MSY}, SSB_{MSY}) and yield per recruit model based BRPs ($F_{40\%}$, $SSB_{40\%}$).



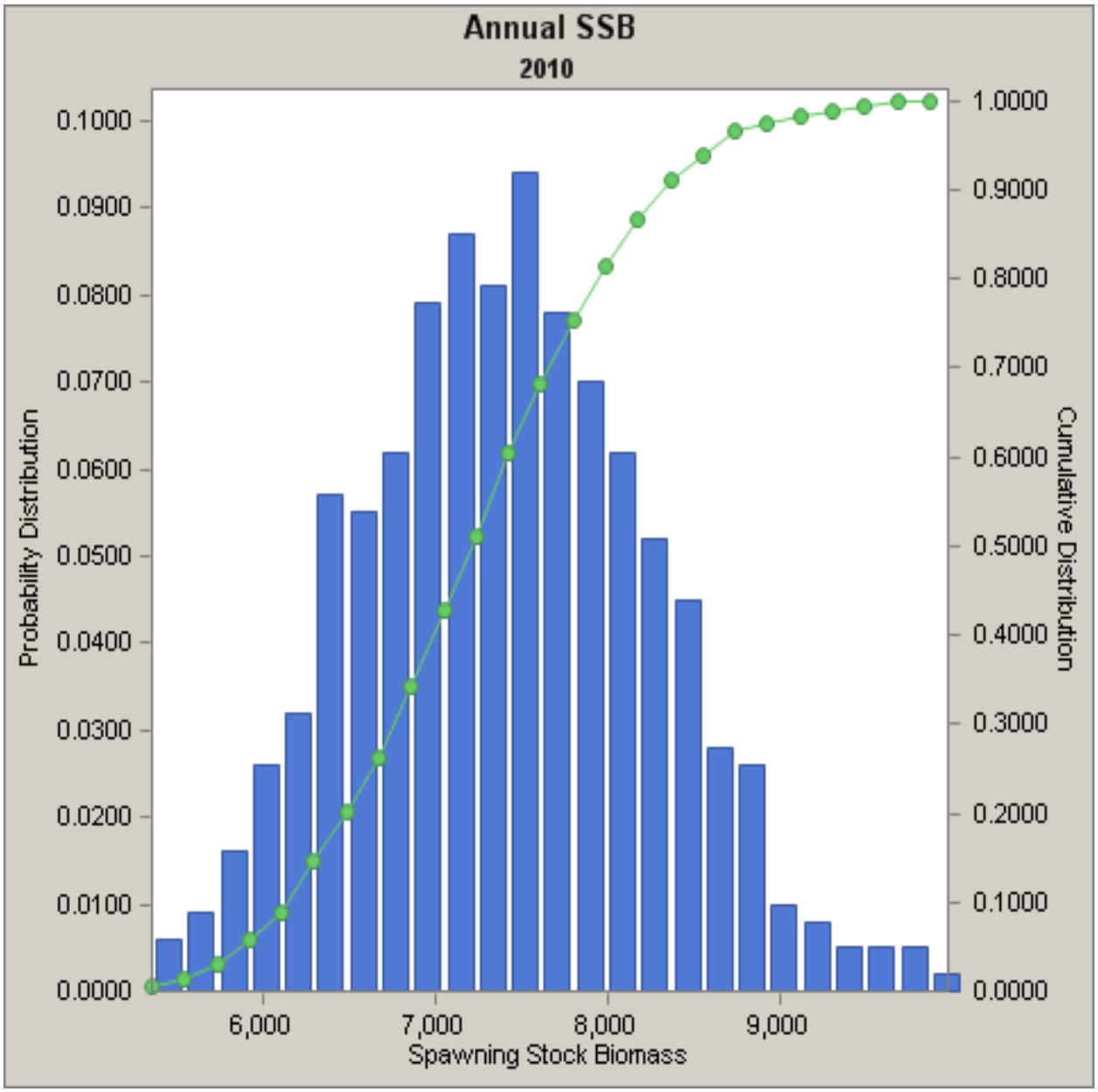
A8. Total catch (landings and discards, 000s mt), commercial landings (000s mt) and fishing mortality rate (F, age 4-5) for SNE/MA winter flounder.



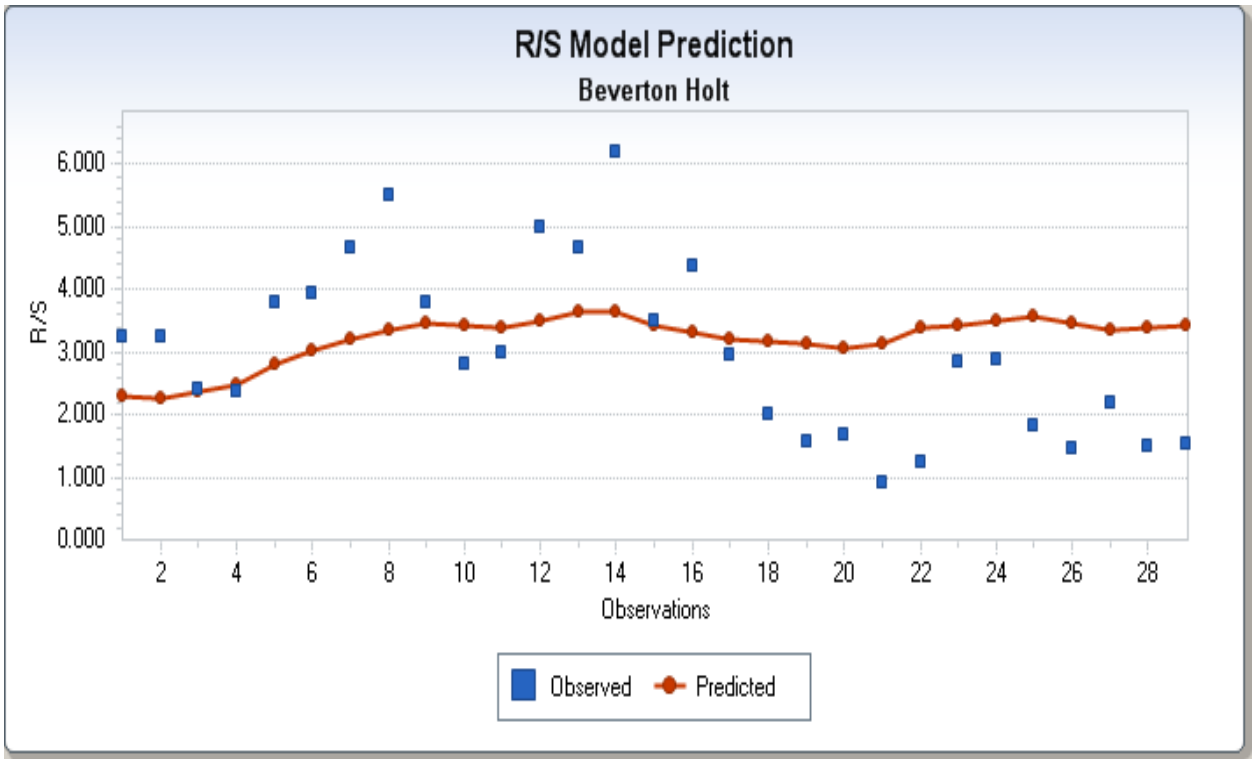
A9. MCMC distribution of the estimate of the 2010 Fishing Mortality of SNE/MA winter flounder.



A10. Spawning stock biomass (SSB, 000s mt, solid line) and recruitment (millions of fish at age-1, vertical bars) for SNE/MA winter flounder.



A11. MCMC distribution of the estimate of the 2010 Spawning Stock Biomass (SSB) of SNE/MA winter flounder.



A12. Time series trend in Recruits per Spawner (R/S) for SNE/MA winter flounder; most recent years are on the right side of the plot.