J. Southern New England/Mid-Atlantic (SNE/MA) winter flounder by Mark Terceiro

1.0 Background

The current assessment of the SNE/MA stock complex of winter flounder is an update of the previous assessments completed in 1998 at SARC 28 (NEFSC 1999). The SARC 28 assessment included catch through 1997, research survey abundance indices through 1998, catch-at-age analyzed by virtual population analysis (VPA) for 1981-1997, and biological reference points based on a production model conditioned on VPA results. The SARC 28 assessment concluded that the stock complex was fully exploited and at a medium level of biomass. Total biomass in 1997 was estimated to be 17,900 mt, spawning stock biomass was estimated to be 8,600 mt, and the fully recruited fishing mortality rate was estimated to be F = 0.31 Subsequent to the SARC 28 assessment, the status of SNE/MA winter flounder has been evaluated annually by projection methods to provide advice to the New England Fishery Management Council (NEFMC). The last such status update was provided in 2001, and projected total biomass to be 25,300 mt, spawning stock biomass to be 13,800 mt, and fully recruited F = 0.29, in 1999 (NEFSC 2001). The current assessment, conducted by the ASMFC Winter Flounder Technical Committee in September 2002, updates landings and discard estimates, research survey abundance indices, and assessment models through 2001-2002, as applicable.

2.0 2002 Assessment

The Fishery

After reaching an historical peak of 11,977 metric tons (mt) in 1966, then declining through the 1970s, total U.S. commercial landings of winter flounder again peaked at 11,176 mt in 1981, and then steadily declined to a record low of 2,159 mt in 1994. Landings have increased since 1994 to 4,448 mt in 2001 (Table J1, Figure J1). The primary gear in the fishery is the otter trawl which accounts for an average of 95% of landings since 1989. Scallop dredges account for 4%, with such gears as handlines, pound nets, fyke nets, and gill nets each accounting for about 1% of total landings.

Recreational landings reached a peak in 1984 of 5,772 mt but declined substantially thereafter (Table J2, Figure J1). Recreational landings have been less than 1,000 mt since 1991, with the lowest estimated landings in 1998 of 290 mt. Recreational landings in 2001 from the Southern New England/Mid Atlantic stock complex were 552 mt. The principal mode of fishing is private/rental boats, with most recreational landings occurring during January to June.

Input data and analyses

Length samples of winter flounder are available from both the commercial and recreational landings. In the commercial fishery, annual sampling intensity varied from 59 to 264 mt landed per 100 lengths measured during 1981-2001 (Table J3). Since 1997, port sampling has been adequate to develop the commercial fishery landings at age on a half-year, market category basis across all statistical areas.

In the recreational fishery, annual sampling intensity varied from 36 to 231 mt landed per 100 lengths measured during 1981-1997. Ages were determined using NEFSC survey spring and fall age-length keys.

Since 1995, the ASMFC Winter Flounder Technical Committee has considered NEFSC Fishery Observer data (OB), and NER vessel trip report (VTR) data as sources of information to use in the estimation of commercial fishery discards. The Committee concluded that the VTR mean discard to landed ratio aggregated over all trips in annual half-year season strata provided the most reliable data from which to estimate commercial fishery discards. VTR trawl gear fishery discards to landings ratios on a half-year basis were applied to corresponding commercial fishery landings to estimate discards in weight (Table J4, Figure J1). The Fishery Observer length frequency samples were judged adequate to directly characterize the proportion discarded at length. A discard mortality rate of 50% (Howell et al., 1992) was applied to trawl discards to produce the number of fish discarded dead at length. For 1998, discard estimates at length were made by half-year; for 1999-2001, sample lengths were applied on an annual basis due to low sample sizes. Ages were determined using NEFSC survey spring and fall age-length keys.

A discard mortality of 15% was assumed for recreational discards (B2 category from MRFSS data), as assumed in Howell et al. (1992). Discard losses peaked in 1984-1985 at 0.7 million fish. Discards have since declined, reaching a low in 1999 of 62,000 fish. In 2001, 81,000 fish were estimated to have been discarded (Table J4, Figure J1). Since 1997, irregular sampling of the recreational fisheries by state fisheries agencies has indicated that the discard is usually of fish below the minimum landing size of 12 inches (30 cm). For 1998-2001, the recreational discard has been assumed to have the same length frequency as the landed portion of the catch below 12 inches, and so is predominantly ages 1, 2, and 3 fish. The recreational discard for 1998-2001 is aged using NEFSC survey spring and fall age-length keys.

The virtual population analysis (VPA) was calibrated using the NEFSC Woods Hole Fisheries Assessment Compilation Toolbox (FACT) version 1.50 of the ADAPT VPA (Conser and Powers 1990). Abundance indices at age were available from several research surveys: NEFSC spring bottom trawl ages 1-7+, NEFSC fall ages 1-5 (advanced to tune January 1 abundance of ages 2-6), NEFSC winter ages 1-5, Massachusetts spring ages 1-7+, Rhode Island fall age 0 (advanced to tune age-1), Rhode Island spring ages 1-7+, Connecticut spring ages 1-7+, New York age 0 (advanced to tune age-1) and age-1, Massachusetts summer seine index of age-0 (advanced to tune age-1), Delaware juvenile trawl survey age-0 (advanced to tune age-1), New Jersey Ocean trawl survey ages 1-7+, and New Jersey River trawl survey ages 1-7+. Survey indices were selected for inclusion in VPA tuning based on consideration of the partial variance in a VPA trial run including all indices, residual error patterns from the trial runs, and on the significance of the correlation among indices and with VPA abundance estimates from the trial run including all indices. A conditional non-parametric bootstrap procedure (Efron 1982) was used to evaluate the precision of fishing mortality and spawning stock biomass. A retrospective analysis was performed for terminal year fishing mortality, spawning stock biomass, and age 1 recruitment.

3.0 Assessment results

Research surveys

Mean weight per tow and number per tow indices for the NEFSC spring, fall, and winter time series are presented in Table J5. Indices dropped from the beginning of the time series in the 1960s to a low point in the early to mid- 1970s, then rose to a peak by the early 1980s. Following several years of high indices, abundance once again declined to below the low levels of the 1970s. NEFSC survey indices reached near- or record low levels for the time series in the late 1980s- 1990s. Indices from the three survey series generally increased during 1993-1998/1999, but have since declined (Figure J2).

Several state survey indices were available to characterize abundance of winter flounder. The Massachusetts Division of Marine Fisheries (MADMF) spring and fall survey (1978-2001), Rhode Island Division of Fish and Wildlife (RIDFW) spring and fall survey (1979-2001), Connecticut Department of Environmental Protection (CTDEP), Long Island Sound Trawl Survey (1984-2001), and the New Jersey Division of Fish, Game and Wildlife (NJDFW) ocean survey trends are summarized in Table J6 and Figure J2. The numerous state recruitment surveys (MADMF, RIDFW, CTDEP, New York Department of Environmental Conservation (NYDEP), NJDFW, Delaware Division of Fish and Game (DEDFG)) are summarized in Table J7 and Figure J3.

Virtual Population Analysis

During 1981-1993, fishing mortality (fully recruited F, ages 4-5) varied between 0.4 (1982) and 1.4 (1988), and was as high as 1.2 as recently as 1997. Fishing mortality has been in the range of 0.5-0.6 during 1999-2001 ($F_{2001} = 0.51$; Table J8, Figure J4). SSB declined from 14,800 mt in 1983 to a record low of 2,700 mt in 1994. SSB has increased since 1994 to 7,600 mt in 2001 (Table J8, Figure J5). Recruitment declined continuously from 62.9 million age-1 fish in 1981 to 7.8 million in 1992. Recruitment then averaged 14.7 million fish during 1993-2001, below the VPA time series average of 23.9 million. The 2002 year class is estimated to be the smallest on record, at only 5.7 million fish (Table J8, Figure J5).

VPA diagnostics

The Technical Committee considered six different configurations of tuning indices. In general, tuning indices were excluded if they exhibited high partial variance (indicating a lack of fit within the VPA model) and low correlation with other indices with similar spatial and temporal characteristics and with the VPA estimates of 2002 stock size. Run W36ALL was the initial trial including all indices. Run W36_1 excluded eight indices with high partial variance within the VPA and low correlation with other indices and/or the VPA estimates of stock size, resulting in improvements both in overall fit (mean square residual (MSR) reduced by 14%) and in the precision of the stock size estimates. Run W36_2 dropped an additional seven indices from the W36_1 configuration, resulting in further improvements in fit (21% improvement over run W36_1) and precision. This was the run adopted as final by the Technical Committee, and is the basis for all further analyses.

The precision of the 2002 stock size, fishing mortality at age in 2001, and SSB estimates from VPA was evaluated using bootstrap techniques (Efron 1982). Five hundred bootstrap iterations were realized in which errors (differences between predicted and observed survey values) were resampled. Bootstrap estimates of stock size at age indicate low bias (<6%) for ages 2-7+ and bootstrap standard errors provide stock size CVs ranging from 18% at age 3 to 34% at age 1. Bootstrapped estimates of spawning stock biomass indicate a CV of 9%, with low bias (bootstrap mean estimate of spawning stock biomass of 7,705 mt compared with VPA estimate of 7,643 mt). There is an 80% probability that spawning stock in 2001 was between 6,800 mt and 8,400 mt. The bootstrap estimates of standard error associated with fishing mortality rates at age indicate good precision. Coefficients of variation for F estimates ranged from 16% at age 3 to 21% at ages 1, 6 and 7+. There is an 80% probability that fully recruited F for ages 4-5 in 2001 was between 0.44 and 0.58.

A retrospective analysis of the VPA was conducted back to a terminal catch year of 1997 (Figure J6). The SNE/MA winter flounder VPA exhibits a severe retrospective pattern of underestimation of F and overestimation of SSB during the late 1990s. The most likely cause of this pattern is the underestimation of the total catch. The analysis indicated a tendency for the significant underestimation of fully recruited F for the terminal years 1993-1999. In that period, underestimation of F ranged from 232% for 1997 to 14% for 1993. The pattern reversed for 2000 (i.e., F was overestimated), indicating that survey variability may also contribute to the retrospective pattern of the SNE/MA winter flounder VPA. Fishing mortality appears to have been overestimated for 2000 by 7%. The retrospective pattern for spawning stock biomass has been a tendency for overestimation since 1991. The overestimation of SSB was most severe for the 1997 and 1998 terminal years (115% and 198% overestimation). The retrospective estimation of age-1 recruits indicated a tendency for overestimation during 1993-2000, with recruitment apparently underestimated for 2001 (2000 year class).

Sensitivity of VPA estimates to hypothetical NEFSC survey adjustments

Sensitivity analyses of the VPA results to hypothetical changes in the recent NEFSC spring and fall survey values were conducted (Figure J7). Results are summarized in Section 5.2 (Summary of Assessment Advice).

4.0 Biological reference points

The Working Group on Re-Evaluation of Biological Reference Points for New England Groundfish (RPWG; NEFSC 2002) re-estimated the biological reference points for SNE/MA winter flounder in 2002 using yield and SSB per recruit (Thompson and Bell 1936) and Beverton-Holt stock-recruitment models (Beverton and Holt 1957, Brodziak et al. 2001, Mace and Doonan 1988) based on the SARC 28 assessment (NEFSC 1999). The yield and SSB per recruit analyses indicate that $F_{40\%} = 0.21$ and $F_{0.1} = 0.25$. The stock-recruitment model indicated that MSY = 10,600 mt, $F_{msy} = 0.32$, and B_{msy} = 30,100 mt.

Biological reference points estimated by the RPWG (NEFSC 2002) were updated by the Technical Committee with partial recruitment pattern and mean weights at age for 1998-2000 (the 2001 estimates were not included in the averages due to the retrospective variability of the partial recruitment pattern in the terminal year of the VPA). Given the stability of the input data to these analyses and the consistency of the results with the previous work, the Technical Committee elected to retain the RPWG (NEFSC 2002) estimates of biological reference points for this assessment. The assessment indicates that the stock complex is overfished and overfishing is occurring.

5.0 GARM comments

The discussion focused on 2 major issues. The first involved the research vessel surveys, and the apparent lack of consistency between the total biomass and young-of-the-year indices derived from the individual state and NEFSC time series. Several reasons for the inconsistency were discussed, however the major issue is spatial and temporal discontinuity. Each of the surveys covers different portions of the population and they are not conducted concurrently. Each of the state surveys samples a relatively small portion of the inshore range of the species while the NEFSC survey samples the broad offshore area. Due to the migratory behavior of the species, environmental variability in the inshore waters may have a strong influence on the species availability to the survey gear. The GARM recommended that the subcommittee explore methods to weight the surveys based on their area of coverage of the population.

The second major issue discussed at the GARM was the problematic retrospective pattern of underestimation of F and overestimation of SSB during the late 1990s exhibited in the VPA. The pattern in the late 1990s may have been due to a low level of samples from the commercial fishery. The GARM agreed that the VPA provides information on stock status, i.e. the stock complex is overfished and overfishing is occurring, however projections based on the current VPA should not be conducted for this assessment.

6.0 Sources of uncertainty

1) Landings data for 1994 and later years are derived by proration and are considered provisional.

2) Length frequency sampling intensity of the recreational fishery landings has been low in some recent years.

3) Length frequency sampling intensity of the commercial fishery discards has been low in some recent years.

4) Commercial fishery discard estimates are based on rates provided by fishermen in the vessel trip reports, due to inadequate fishery observer sampling.

5) The SNE/MA winter flounder VPA exhibits a severe retrospective pattern of underestimation of F and overestimation of SSB during the late 1990s.

7.0 Summary

The Southern New England/Mid-Atlantic winter flounder stock complex is overfished and overfishing is occurring. Fully recruited fishing mortality in 2001 was 0.51 (exploitation rate = 37%), about 60% above the RPWG (NEFSC 2002) re-estimate of Fmsy = 0.32. There is an 80% chance that the 2001 F was between 0.44 and 0.58. Spawning stock biomass was estimated to be 7,600 mt in 2001, about 25% of the re-estimate of Bmsy = 30,100 mt. There is an 80% chance that the spawning stock biomass was between 6,800 mt and 8,400 mt in 2001.

Spawning stock biomass declined substantially from 13,000-14,000 mt during the early 1980s to only 2,700 mt during 1994-1996, but has increased since the mid 1990s to about 7,600 mt in 2001 due to reduced fishing mortality rates since 1997. The arithmetic average recruitment from 1981 to 2001 is 23.9 million age-1 fish, with a median of 18.9 million fish. Recent recruitment to the stock has been below average since 1989. The 2001 year class, at only 5.6 million fish, is the smallest in the 22-year time series.

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Table J1. Winter flounder commercial landings (metric tons) for southern New England/Mid-Atlantic stock complex area (U.S. statistical reporting areas 521, 526, divisions 53, 61-63) as reported by NEFSC weighout, state bulletin and general canvass data.

Year	Metric Tons
1964	7,474
1965	8,678
1966	11,977
1967	9,478
1968	7,070
1969	8,107
1970	8,603
1971	7,367
1972	5,190
1973	5,573
1974	4,259
1975	3,982
1976	3,265
1977	4,413
1978	6,327
1979	6,543
1980	10,627
1981	11,176
1982	9,438
1983	8,659
1984	8,882
1985	7,052
1986	4,929
1987	5,172
1988	4,312
1989	3,670
1990	4,232
1991	4,823
1992	3,816
1993	3,010
1994	2,159
1995	2,634
1996	2,781
1997	3,441
1998	3,208
1999	3,444
2000	3,783
2001	4,448

Table J2. Estimated number (000's) and weight (mt) of winter flounder caught, landed, and discarded in the recreational fishery, Southern New England/Mid-Atlantic stock complex.

	Number (000's)				Metric tons
	Catch A+B1+B2	Landed A+B1	Released B2	15% Release Mortality	Landed A+B1
1981	11006	8089	2916	437	3050
1982	10665	8392	2273	341	2457
1983	11010	8365	2645	397	2524
1984	17723	12756	4967	745	5772
1985	18056	13297	4759	714	5198
1986	9368	6995	2374	356	2940
1987	9213	6900	2313	347	3141
1988	10134	7358	2775	416	3423
1989	5919	3682	2236	335	1802
1990	3827	2486	1340	201	1063
1991	4325	2795	1530	230	1214
1992	1360	806	555	83	393
1993	2211	1180	1031	155	543
1994	1829	1209	620	93	598
1995	1850	1390	461	69	661
1996	2679	1554	1125	169	689
1997	1901	1207	694	104	621
1998	1008	584	425	64	290
1999	1071	658	412	62	320
2000	2043	1346	697	105	831
2001	1441	901	540	81	552

Table J3. The total number of commercial lengths sampled by market category for Southern New England/Mid-Atlantic winter flounder. The landing (mt) and metric tons per 100 lengths are also shown.

	number of lengths						
year	unclass	small	medium	large	total	landing (mt)	mt/100 lengths
1981	1,904	1,542	-	784	4,230	11,176	264
1982	513	2,425	657	2,201	5,796	9,438	163
1983	927	1,790	1,044	1,840	5,601	8,659	155
1984	551	1,171	637	1,338	3,697	8,882	240
1985	716	2,632	1,663	1,396	6,407	7,052	110
1986	799	2,206	1,024	1,091	5,120	4,929	96
1987	99	2,524	670	1,978	5,271	5,172	98
1988	269	1,731	958	1,250	4,208	4,312	102
1989	106	1,224	1,220	975	3,525	3,670	104
1990	102	1,473	1,180	1,333	4,088	4,232	104
1991	-	1,220	921	917	3,058	4,823	158
1992	402	1,343	1,259	1,159	4,163	3,816	92
1993	62	1,249	401	642	2,354	3,010	128
1994	142	1,092	816	543	2,593	2,159	83
1995	79	1,182	290	325	1,876	2,634	140
1996	480	854	521	109	1,964	2,781	142
1997	201	1,327	1,176	1,301	4,005	3,441	86
1998	942	899	1,325	415	3,581	3,208	90
1999	2,381	798	607	821	4,607	3,444	75
2000	1,653	942	2,893	965	6,453	3,783	59
2001	760	897	2,301	2,297	6,255	4,448	71

Table J4. Total winter flounder recreational and commercial catch for the Southern New England/Mid-Atlantic stock complex in weight (mt) and numbers (000s).

Year	Commercial Landings		Commercial Discards		Recreational Landings		Recreational Discards		Total Catch		% Discards/Total	
	mt	000s	mt	000s	mt	000s	mt	000s	mt	000s	mt	000s
1981	11,176	20,705	1,343	5,123	3,050	8,089	88	437	15,657	34,354	9.1	16.2
1982	9,438	19,016	1,149	4,271	2,457	8,392	66	341	13,110	32,020	9.3	14.4
1983	8,659	16,312	1,311	5,251	2,524	8,365	125	399	12,619	30,327	11.4	18.6
1984	8,882	17,116	986	3,936	5,772	12,756	148	745	15,788	34,553	7.2	13.5
1985	7,052	14,211	1,534	4,531	5,198	13,297	230	714	14,014	32,753	12.6	16.0
1986	4,929	9,460	1,273	4,902	2,940	6,994	66	356	9,208	21,712	14.5	24.2
1987	5,172	10,524	950	3,545	3,141	6,899	61	347	9,324	21,315	10.8	18.3
1988	4,312	8,377	904	3,728	3,423	7,359	69	416	8,708	19,880	11.2	20.8
1989	3,670	7,888	1,404	5,761	1,802	3,684	49	335	6,925	17,668	21.0	34.5
1990	4,232	7,202	673	2,567	1,063	2,485	31	201	5,999	12,455	11.7	22.2
1991	4,823	9,063	784	2,701	1,214	2,794	51	230	6,872	14,788	12.2	19.8
1992	3,816	6,759	511	1,811	393	802	15	83	4,735	9,455	11.1	20.0
1993	3,010	5,336	457	1,580	543	1,180	31	155	4,041	8,251	12.1	21.0
1994	2,159	1,948	304	344	598	1,210	34	93	3,095	3,595	10.9	12.2
1995	2,634	2,321	121	107	661	1,390	23	69	3,439	3,887	4.2	4.5
1996	2,781	2,372	173	149	689	1,555	64	168	3,707	4,244	6.4	7.5
1997	3,441	5,834	267	1,200	618	1,204	26	85	4,352	8,323	6.7	15.4
1998	3,208	6,224	456	1,503	290	584	13	64	3,967	8,375	11.8	18.7
1999	3,444	7,356	329	1,074	320	658	14	62	4,107	9,150	8.4	12.4
2000	3,783	6,590	148	534	831	1,346	30	105	4,792	8,575	3.7	7.5
2001	4,448	7,690	83	285	552	901	19	81	5,102	8,957	2.0	4.1

Table J5. Winter flounder NEFSC survey index stratified mean number and mean weight (kg) per tow for the Southern New England- Mid-Atlantic stock complex. Spring and fall strata set (offshore 1-12, 25, 69-76 ; inshore 1-29, 45-56); winter strata set (offshore 1-2, 5-6,9-10,69,73).

	Spring				Fall			
Year	Number	N(CV)	Weight	W(CV)	Number	N(CV)	Weight	W(CV)
1963					8.554	33.2	3.284	41.4
1964					13.673	22.1	4.894	19.4
1965					15.537	32.5	4.435	28.7
1966					9.843	31.5	3.275	27.3
1967					9.109	20.6	2.745	18.7
1968	2.444	26.7	0.734	37.2	8.105	21.0	2.190	18.7
1969	5.640	34.3	3.414	53.7	6.841	34.9	1.939	29.7
1970	2.729	30.9	1.326	35.6	5.110	36.1	2.375	47.8
1971	2.035	32.9	0.756	36.2	3.861	17.5	1.231	19.1
1972	1.865	28.1	0.656	32.1	7.687	39.4	3.053	44.6
1973	7.458	19.9	2.013	20.6	2.691	26.9	0.775	25.8
1974	3.362	21.9	1.043	19.3	2.032	31.1	0.822	29.4
1975	1.135	22.6	0.354	20.8	2.196	20.3	0.688	22.1
1976	3.085	16.3	0.804	17.2	2.376	32.2	1.251	42.9
1977	4.209	17.2	1.189	18.6	4.722	22.5	1.735	25.2
1978	6.695	11.1	1.758	13.3	3.743	17.6	1.430	22.6
1979	2.966	16.8	1.069	25.0	10.058	18.4	2.606	15.4
1980	15.250	17.5	3.551	13.6	9.964	31.0	3.216	29.5
1981	18.234	20.9	4.762	16.9	10.206	20.3	3.110	19.9
1982	6.986	20.1	1.918	15.8	4.927	22.8	1.683	25.9
1983	6.262	18.4	2.469	28.0	8.757	37.6	2.690	31.7
1984	5.524	19.0	2.072	28.4	2.681	21.1	0.887	21.0
1985	5.360	17.4	1.983	16.5	2.727	21.5	0.991	21.5
1986	2.266	23.9	0.766	23.4	1.538	21.9	0.487	19.1
1987	1.763	21.3	0.568	17.9	1.167	28.9	0.419	37.8
1988	2.126	19.6	0.730	19.3	1.246	22.4	0.530	27.5
1989	2.485	33.5	0.582	29.6	1.435	40.7	0.341	30.4
1990	1.992	36.8	0.472	33.1	1.979	29.6	0.546	25.8
1991	2.473	15.6	0.692	14.7	1.950	23.6	0.708	25.6

Table J5 continued.

	Spring				Fall				Winter			
Year	Number	N(CV)	Weight	W(CV)	Number	N(CV)	Weight	W(CV)	Number	N(CV)	Weight	W(CV)
1992	1.579	23.4	0.435	22.1	2.963	32.4	0.829	31.8	3.680	27.3	0.928	26.0
1993	0.961	19.1	0.219	14.8	1.382	25.0	0.392	25.9	2.590	29.4	0.456	21.5
1994	1.510	26.4	0.329	21.9	4.134	24.8	1.482	27.3	3.797	30.8	1.183	35.5
1995	2.097	23.4	0.592	19.1	2.253	20.7	0.626	17.3	2.221	26.1	0.697	29.1
1996	1.517	14.3	0.428	15.2	3.186	39.8	1.063	45.3	3.778	28.4	0.734	25.2
1997	1.436	22.1	0.399	20.0	7.893	32.6	2.583	26.7	3.906	19.7	1.043	21.6
1998	2.774	20.6	0.845	22.1	6.597	13.6	2.232	9.9	7.169	21.6	1.830	24.1
1999	4.171	16.2	1.245	16.4	3.596	17.0	1.549	16.5	10.328	31.8	3.100	32.3
2000	3.172	26.6	1.123	31.9	6.168	25.5	2.143	26.2	5.571	32.9	1.525	29.5
2001	1.568	14.3	0.581	13.3	4.877	28.1	2.030	28.5	3.096	31.6	0.873	29.0
2002	2.043	15.7	0.782	16.3					2.901	27.7	1.188	38.3

NOTE: 1968-1972 spring index does not include inshore strata ; 1963-1971 fall index does not include inshore strata. All indices calculated with trawl door conversion factors where appropriate. Winter trawl survey began in 1992.

Table J6. SNE/MA winter flounder mean weight per tow for annual state surveys.

Year	MADMF spring	RIDFW spring	RIDFW fall	CTDEP	NJDFW Ocean (April)
1978	18.12				
1979	18.17	7.72	7.24		
1980	15.18	13.57	4.88		
1981	15.77	12.13	2.12		
1982	14.82	5.23	1.30		
1983	19.67	9.52	2.28		
1984	14.68	8.43	3.38	15.68	
1985	11.60	5.93	3.01	13.82	
1986	10.36	6.47	3.12	10.33	
1987	9.57	8.14	2.25	11.76	
1988	6.64	6.02	1.45	18.29	
1989	8.46	3.09	0.79	22.62	5.86
1990	5.38	3.07	0.71	29.02	4.78
1991	2.91	7.38	0.18	24.59	5.32
1992	7.99	0.95	0.42	12.29	2.48
1993	8.16	0.22	0.50	10.26	3.87
1994	12.59	1.67	0.33	12.20	3.25
1995	7.98	6.04	0.89	7.72	8.06
1996	9.78	4.45	0.91	20.41	3.73
1997	10.02	4.57	0.64	15.53	6.52
1998	7.99	5.00	0.32	14.66	4.17
1999	4.44	3.66	0.57	10.29	6.83
2000	6.52	4.52	0.56	12.63	5.24
2001	3.73	3.56	0.28	14.02	6.36
2002				10.90	8.80

Table J7. State survey indices (stratified mean number per tow or haul) for young-of-year winter flounder in Southern New England/Mid-Atlantic stock complex.

Year	CTDEP	RIDFW	DEDFG	MADMF	NYDEC
1975				0.30	
1976				0.32	
1977				0.60	
1978				0.34	
1979				0.49	
1980				0.40	
1981				0.32	
1982				0.37	
1983				0.23	
1984				0.32	
1985				0.34	0.75
1986		29.00	0.17	0.32	
1987		11.60	0.09	0.27	0.97
1988	15.50	8.90	0.02	0.18	0.69
1989	1.90	18.90	0.29	0.42	1.67
1990	3.10	22.10	0.63	0.33	2.71
1991	5.80	12.00	0.03	0.27	2.57
1992	13.70	33.20	0.27	0.29	11.49
1993	6.00	5.50	0.04	0.07	4.73
1994	16.60	2.60	0.31	0.15	2.44
1995	12.50	5.30	0.10	0.16	0.91
1996	19.20	2.80	0.04	0.22	3.80
1997	7.47	4.40		0.39	4.42
1998	9.38	2.50		0.16	3.11
1999	8.70	14.60		0.19	7.49
2000	4.30	52.90		0.33	0.90
2001	1.30	12.90		0.21	2.31
2002				0.10	

Table J8. Virtual Population Analysis for SNE/MA winter flounder, 1981-2001.

STOCK NUMBERS (Jan 1) in thousands

	1981	1982	1983	1984	1985	1986	1987
1	62859	52020	56503	35617	34615	32795	25973
2	52566	50232	42060	45703	28708	28090	26656
3	27768	30289	28226	27884	26945	16839	17273
4	7146	9748	13560	11068	10077	10446	5551
5	1468	2600	4606	5559	4603	2773	4738
6	363	600	1577	2148	2944	1096	1317
7	218	564	1219	1949	2228	876	730
1+	152388	146054	147751	129927	110120	92914	82238

	1988	1989	1990	1991	1992	1993	1994
1	26726	23113	17366	11355	7808	8844	8315
2	21199	21806	18504	14185	9249	6370	6993
3	17057	13790	13106	13242	8875	6212	3350
4	6000	5458	4798	5053	4381	3233	2074
5	1748	1325	1299	1276	1111	1251	1084
6	1433	339	317	369	268	300	495
7	433	312	223	165	86	218	300
1+	74596	66142	55613	45645	31778	26429	22611

	1995	1996	1997	1998	1999	2000	2001
1	12647	17632	21154	18793	13372	12710	19011
2	6753	10333	14407	16971	15341	10889	10343
3	4733	5352	7658	9864	11966	10076	7610
4	1700	2190	3070	3284	4761	6170	5082
5	1053	588	791	875	1063	2320	2830
6	606	487	171	159	254	456	1120
7	433	312	73	228	83	168	512
1+	27925	36893	47324	50174	46840	42788	46509

	2002
1	5665
2	15553
3	6671
4	2912
5	2179
6	1602
7	1057
1+	35639

Table J8 continued.

FISHING MORTALITY

	1981	1982	1983	1984	1985	1986	1987
1	0.02	0.01	0.01	0.02	0.01	0.01	0.00
2	0.35	0.38	0.21	0.33	0.33	0.29	0.25
3	0.85	0.60	0.74	0.82	0.75	0.91	0.86
4	0.81	0.55	0.69	0.68	1.09	0.59	0.96
5	0.69	0.30	0.56	0.44	1.23	0.54	1.00
6	0.81	0.50	0.67	0.60	1.18	0.59	1.00
7	0.81	0.50	0.67	0.60	1.18	0.59	1.00

	1988	1989	1990	1991	1992	1993	1994
1	0.00	0.02	0.00	0.01	0.00	0.03	0.01
2	0.23	0.31	0.13	0.27	0.20	0.44	0.19
3	0.94	0.86	0.75	0.91	0.81	0.90	0.48
4	1.31	1.24	1.12	1.31	1.05	0.89	0.48
5	1.44	1.23	1.06	1.36	1.11	0.73	0.38
6	1.41	1.29	1.15	1.39	1.10	0.86	0.45
7	1.41	1.29	1.15	1.39	1.10	0.86	0.45

	1995	1996	1997	1998	1999	2000	2001
1	0.00	0.00	0.02	0.00	0.01	0.01	0.00
2	0.03	0.10	0.18	0.15	0.22	0.16	0.24
3	0.57	0.36	0.65	0.53	0.46	0.48	0.76
4	0.86	0.82	1.06	0.93	0.52	0.58	0.65
5	0.57	1.04	1.40	1.04	0.65	0.53	0.37
6	0.76	0.88	1.16	0.98	0.55	0.57	0.23
7	0.76	0.88	1.16	0.98	0.55	0.57	0.23

Average F for 4,5

	1981	1982	1983	1984	1985	1986	1987
4,5	0.75	0.42	0.63	0.56	1.16	0.57	0.98

	1988	1989	1990	1991	1992	1993	1994
4,5	1.38	1.23	1.09	1.34	1.08	0.81	0.43

	1995	1996	1997	1998	1999	2000	2001
4,5	0.72	0.93	1.23	0.98	0.58	0.55	0.51

Table J8 continued.

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

	1981	1982	1983	1984	1985	1986	1987
1	00	00	00	00	00	00	00
2	00	00	00	00	00	00	00
3	4739	4757	3771	3557	3615	2395	2482
4	3893	4592	5119	3855	3106	3541	1958
5	1205	2157	2899	2927	1838	1374	1779
6	341	603	1387	1540	1272	634	644
7	214	900	1590	2129	1037	718	489
1+	10393	13009	14766	14008	10869	8662	7353

	1988	1989	1990	1991	1992	1993	1994
1	00	00	00	00	00	00	00
2	00	00	00	00	00	00	00
3	2282	1923	1831	1980	1414	960	600
4	1863	1642	1556	1627	1626	1242	902
5	744	576	590	526	559	667	639
6	516	169	177	200	156	203	300
7	260	248	169	140	93	206	215
1+	5663	4559	4323	4474	3848	3278	2656

	1995	1996	1997	1998	1999	2000	2001
1	00	00	00	00	00	00	00
2	00	00	00	00	00	00	00
3	849	1028	1563	1817	2128	1756	2579
4	665	857	1311	1354	1990	2548	2103
5	589	293	389	452	563	1251	1692
6	376	301	113	107	170	296	715
7	279	214	84	224	73	169	553
1+	2759	2693	3459	3954	4923	6021	7643

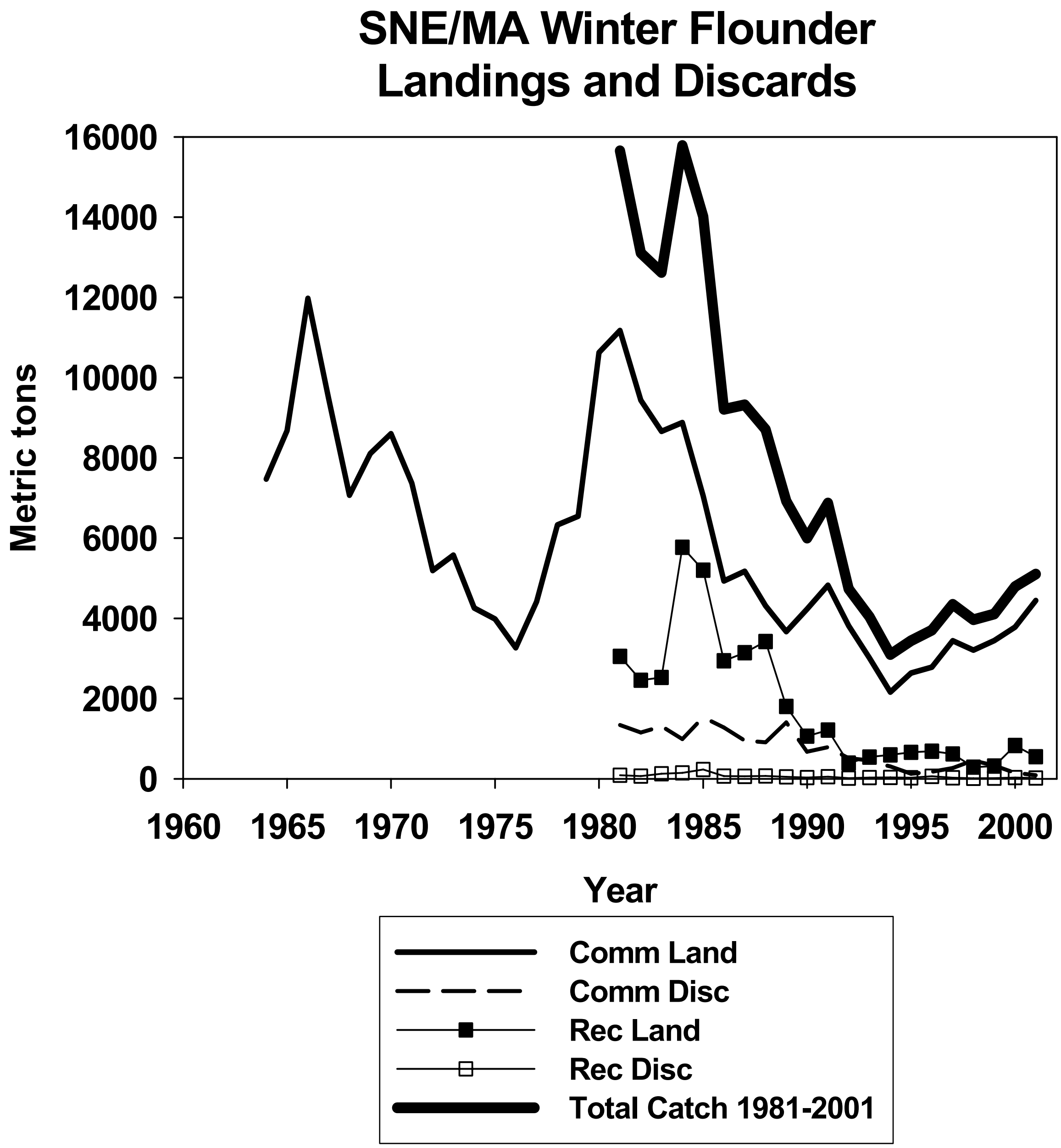

Figure J1. Commercial landings (1964-2001), commercial discards (1981-2001) recreational landings (1981-2001), recreational discards (1981-2001) and total fishery catch (198-2001) for the SNE/MA winter flounder stock complex.

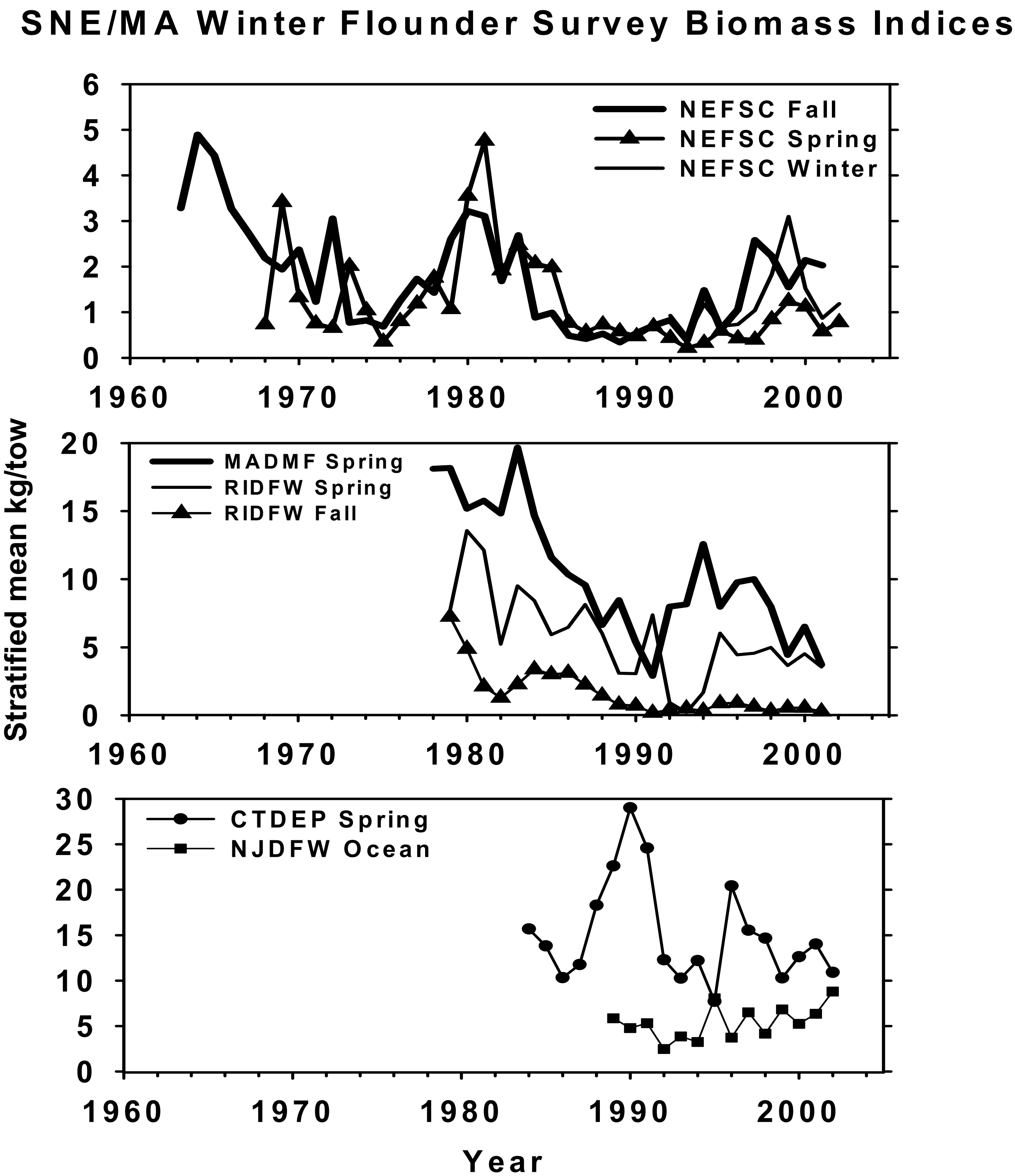

Figure J2. Trends in research survey biomass indices for SNE/MA winter flounder.

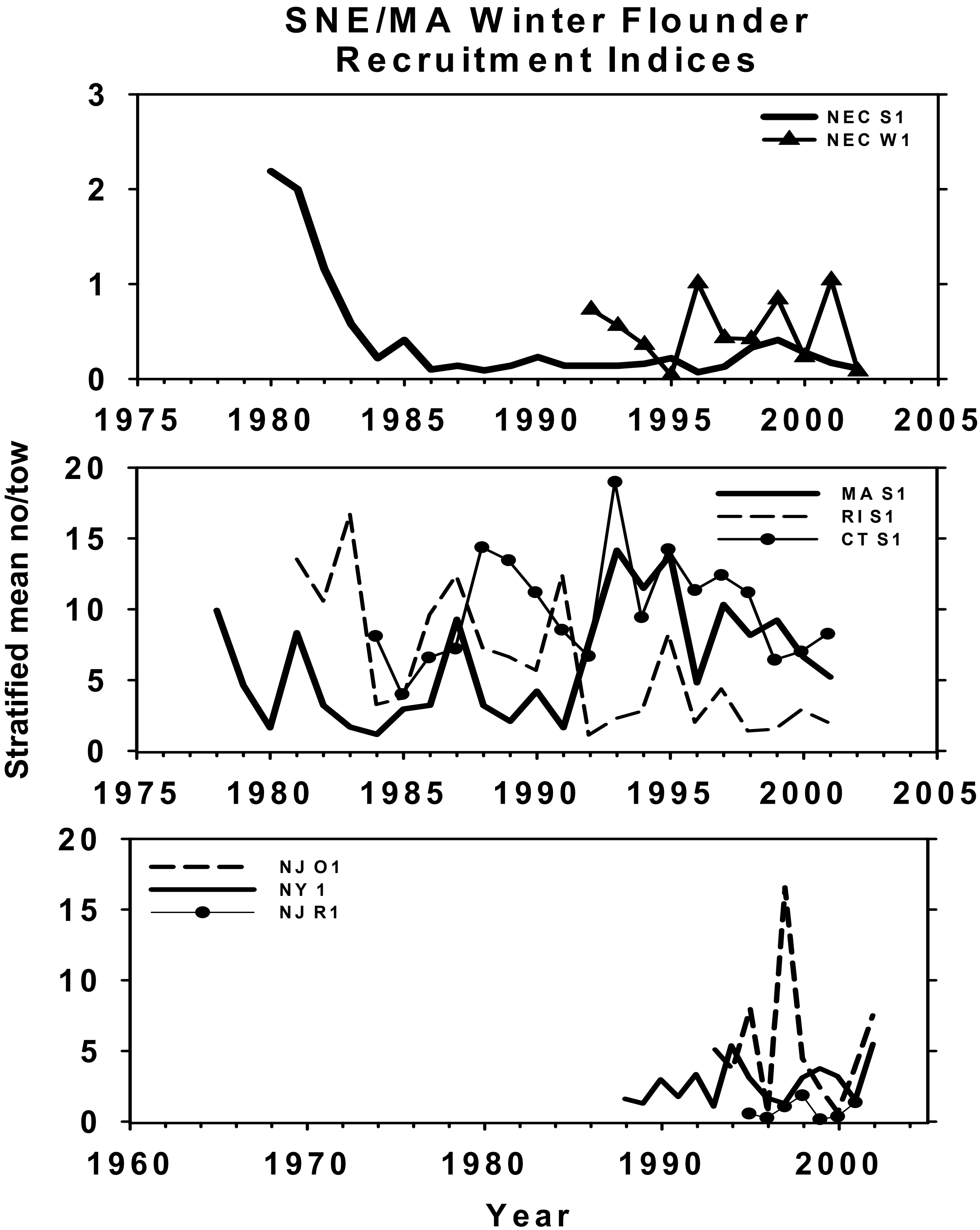

Figure J3. Trends in research survey recruitment indices for SNE/MA winter flounder. Includes spring survey age-1 indices and fall YOY indices advanced one year.

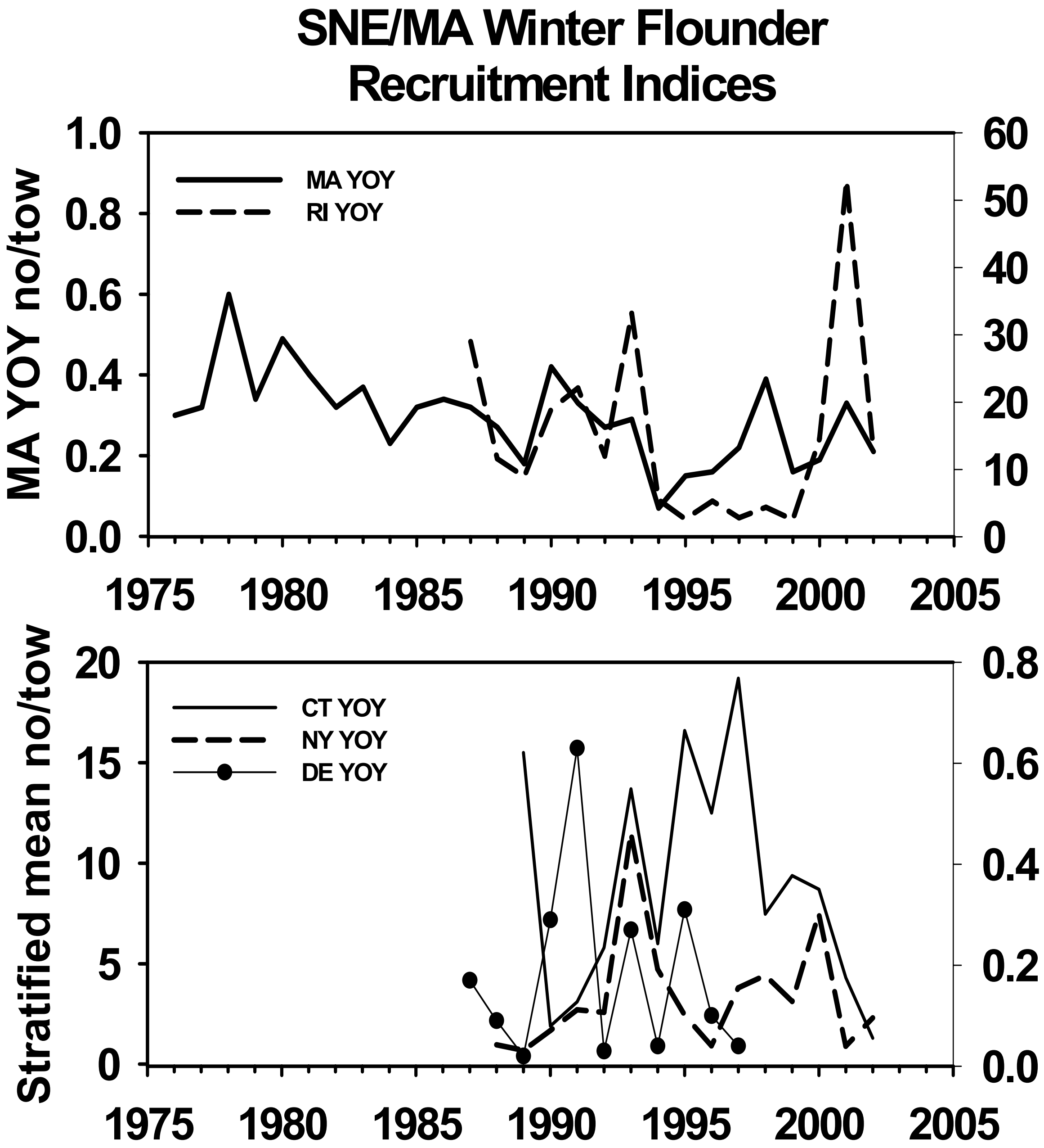

Figure J3 continued.

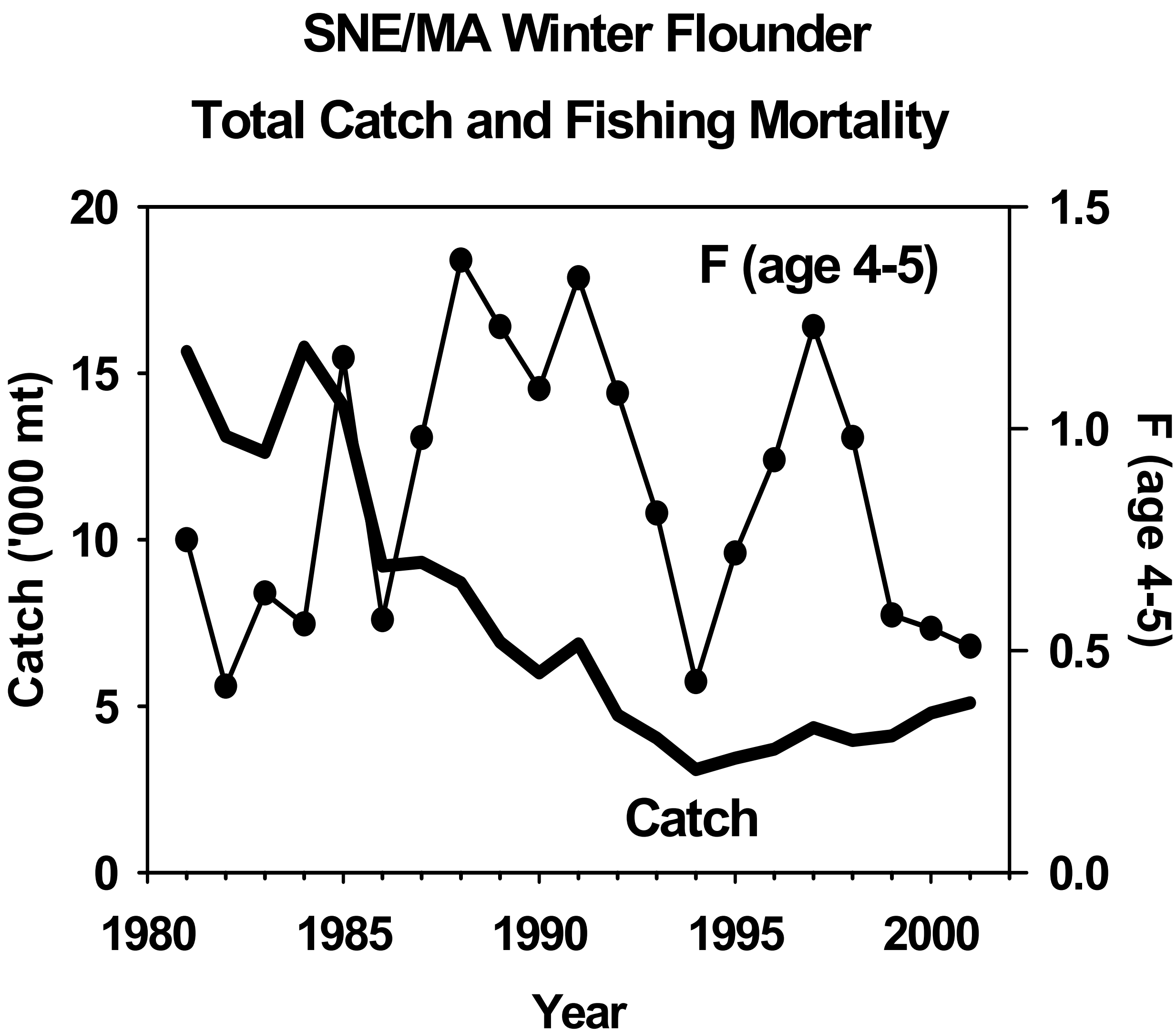

Figure J4. Total catch (landings and discards, thousands of metric tons) and fishing mortality rate (F, ages 4-5, unweighted) for SNE/MA winter flounder.

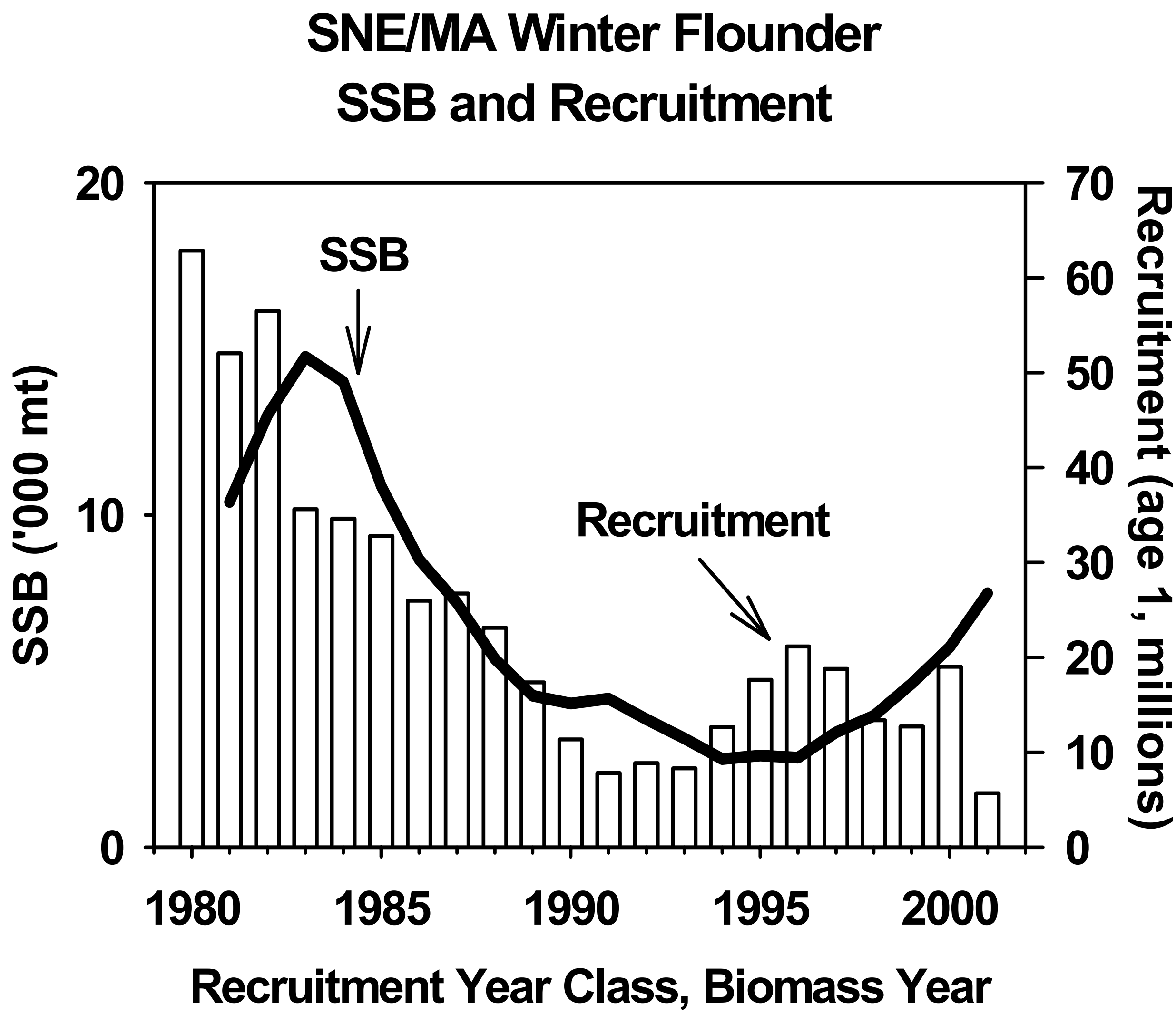

Figure J5. Spawning stock biomass (SSB, ages 3-7+, '000 mt) and recruitment (millions of fish at age-1) for SNE/MA winter flounder.

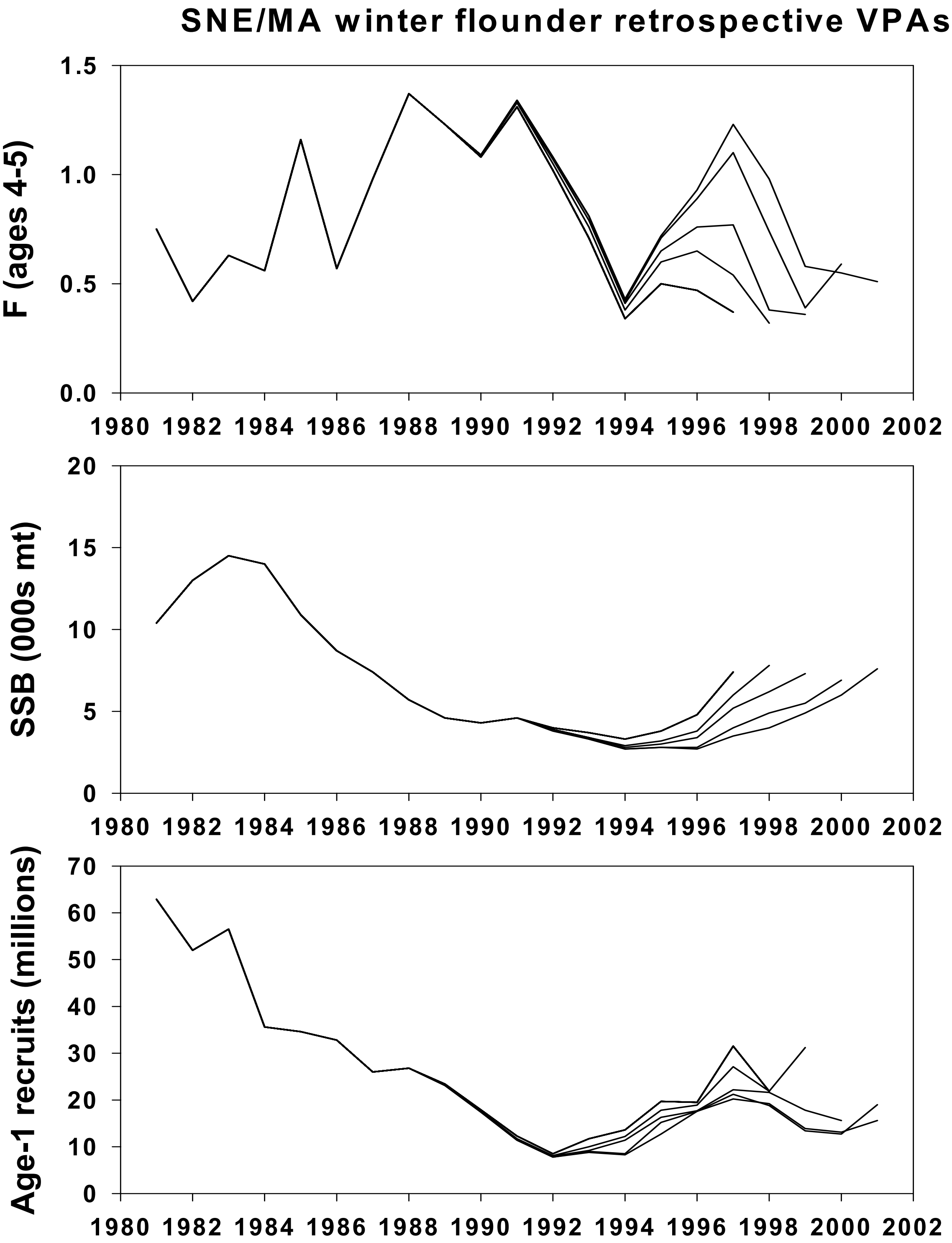

Figure J6. Retrospective VPAs for SNE/MA winter flounder.

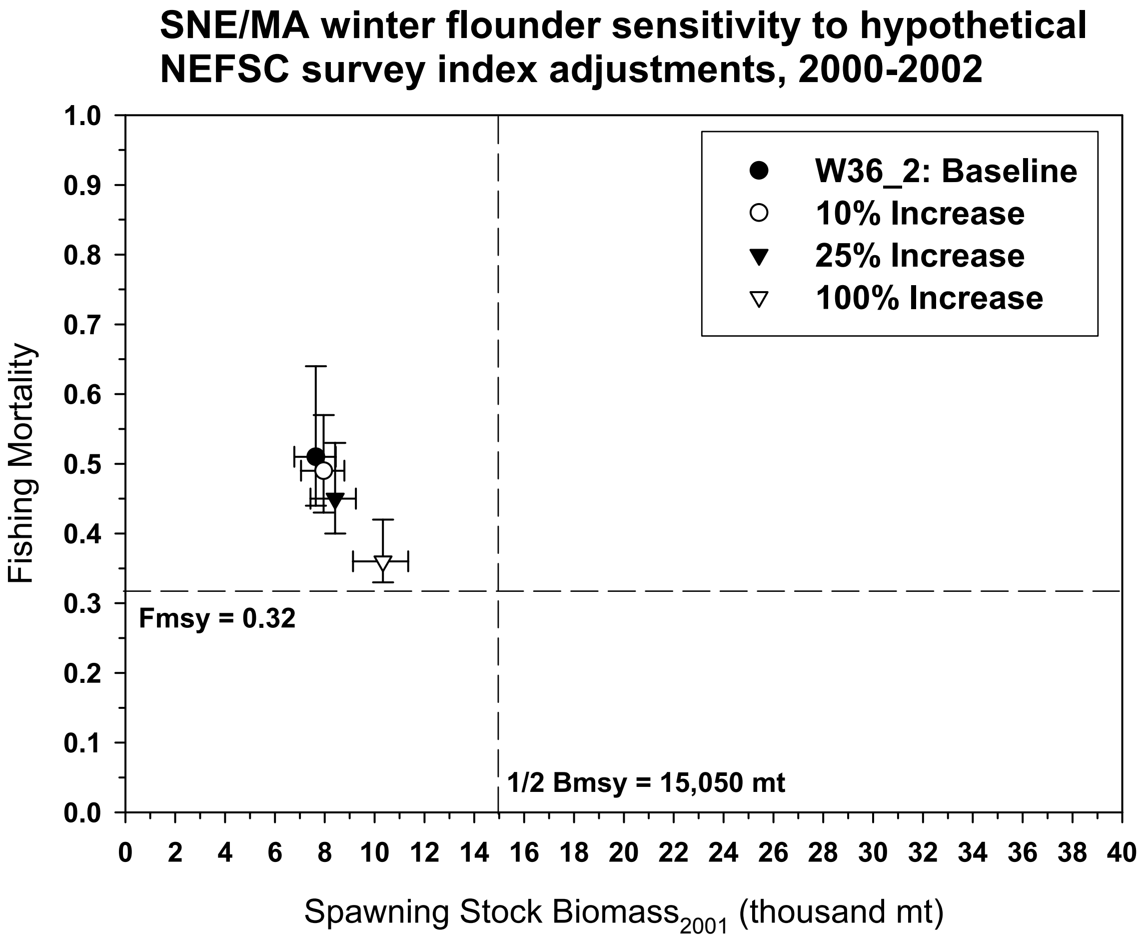

Figure J7. SNE/MA winter flounder VPA sensitivity to hypothetical NEFSC winter, spring, and fall survey index adjustments.