I. Gulf of Maine Winter Flounder by P. Nitschke

1.0 Background

The current assessment for Gulf of Maine winter flounder is an update of the SARC 36 VPA assessment that included catch through 2001 (NEFSC 2002). The SARC 36 assessment concluded that the stock is not overfished and overfishing is not occurring. Spawning stock biomass was estimated to be at 5,900 mt and fully recruited F = 0.14 in 2001. SSB at Bmsy was estimated to be at 4,100 mt and Fmsy = 0.43.

2.0 Fishery

Commercial landings were near 1,000 mt from 1964 to the mid 1970s. Thereafter commercial landings increased to a peaked of 2,793 mt in 1982, and then steadily declined to a record low of 253 mt in 1999. Landings have remained near 500 mt since 2000 (Table I1, Figure I1). The primary gear used was the otter trawl from 1964-1985 that accounted for an average of 95% of the landings. Otter trawl accounted for an average of 75% of the landings from 1986- 2001 with an increase in the proportion of the landings coming from gillnets (average of 20% from 1986-2001). Since 2001 the gillnet proportion has decreased slightly with an average of 15% of the landings (Figure I2). Since 1999 around 95% percent of the landings are taken in Massachusetts from statistical area 514 (Figure I3).

Recreational landings reached a peak in 1981 with 2,554 mt but declined substantially thereafter (Table I2, Figure I4). Landings have been less than 100 mt since 1995, with the lowest estimated landings in 2004 of 18 mt. Only one fish was measured in the second half of 2004. Lengths from the second half of 2003 were used for characterizing the length distribution to estimate the landed weight in the second half of 2004.

In the commercial fishery, annual sampling intensity varied from 4 to 310 mt landed per sample during 1982-2004. Overall sampling intensity was adequate, however temporal and market category coverage in some year was poor (Table I3). Samples were pooled by halfyear when possible. In 1982 mediums were pooled with unclassified by halfyear, in 1985 and 1995 smalls were pooled with mediums, the large sample from 1998 was also used to characterize 1999, in 2001 large samples were used to characterize 1999, and both 2001 and 2003 were used to supplement the 28 lengths taken in 2002. Sampling coverage may have been poor but length frequency samples appeared relatively constant over time and there was a substantial amount of overlap between market categories which help justify the pooling used in the assessment. Lengths of kept fish from observer data were used to supplement length data of unclassified fish. Lengths taken from gillnet trips in the observer data were used to characterize the gillnet proportion of the landings (Table I4).

Discards were estimated for the large mesh trawl (1982-2004), gillnet (1986-2004), and northern shrimp fishery (1982-2004) (Table I5 and I6). The survey method was used in estimating both the discard and proportion discards at length for the large mesh trawl fishery from 1982-1993

(Mayo et al. 1992). VTR large mesh otter trawl discards to landings ratios were applied to corresponding commercial fishery landings to estimate discards in weight from 1994 to 2004. The Fishery Observer length frequency samples were judged inadequate to characterize the proportion discarded at length from 1982 to 2000 for the large mesh trawl fishery and the length proportion from the survey method was used to characterize the size distribution of discarded fish. Observer length sampling increased in 2001 and were used to characterize the large mesh trawl discards from 2001 to 2004. The Fishery Observer sum discarded to landing ratios were used for estimating gillnet discard rates. Observer sum discarded to days fished ratios were used of the northern shrimp fishery since landing of winter flounder in the shrimp fishery is prohibited. The observer length frequency data for gillnet and the northern shrimp fishery were used to characterize the proportion discarded at length. The sample proportion at length, converted to weight, was used to convert the discard estimate in weight to numbers at length. As in the southern New England stock (NEFSC 1999), a 50% mortality rate was applied to all commercial discard data (Howell et al., 1992). Numbers at ages were determined using NEFSC/MDMF spring and NEFSC fall survey age-length keys (Table I5).

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 1982 at 140,000 fish. Discards have since declined reaching a low in 2004 of 3,000 fish (Table I2, Figure I4). 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 1982-2004, the recreational discard has been assumed to have the same length frequency as the catch in the MDMF survey below the legal size and above an assumed hookable fish size (13 cm). The recreational discard for 1982-2001 is aged using NEFSC/MDMF spring and NEFSC fall survey age-length keys.

A summary of how the catch at age was constructed can be seen in Table I7. Decreases in the catch at age components are shown in Table I8 and Figure I5 and I6. Mean weights at age and the total catch at age are given in Tables I9 and I10 and Figures I7 and I8.

3.0 Research Surveys

Mean number per tow indices for the NEFSC and the Massachusetts Division of Marine Fisheries (MDMF) spring and fall time series are presented in Table I11 and Figures I9 through I12. All of the indices generally show a decrease in the population in the late 1980s from a high in the early 1980s with low abundance remaining through the early 1990s. All of the indices show signs of increase abundance starting in 1998 and 1999. Since 2001 the indices indicate a decrease in abundance. Age data for the MDMF fall survey are not available. The NEFSC fall ages where used to age the MDMF fall index.

The Seabrook Nuclear Power Plant in New Hampshire has conducted a monthly bottom trawl survey since 1985. The monthly survey was broken down to a spring and fall survey. No survey was conducted in 1993. This survey also shows an increase in the number of fish in the late 1990s (Figure I13). The MDMF spring survey was used to age the Spring Seabrook index. The

2004 Seabrook index is not available. The Seabrook fall index is not used in for tuning due to a lack of sampling in more recent years at one of the three stations because of the presences of lobster gear.

The MDMF and Seabrook survey catch a greater proportion of smaller fish than the NEFSC surveys. The two MDMF surveys and the Seabrook spring survey show strong recruitment in 2004 and 2005 (Figures I14 through I18).

4.0 Assessment Results

Abundance indices at age were available from several research surveys: NEFSC spring bottom trawl ages 1-8+, NEFSC fall ages 1-8+ (advanced to tune January 1 abundance of ages 2-8+), 1-5, Massachusetts spring ages 1-8+, Massachusetts fall ages 0-8+ (advanced to tune January 1 abundance of ages 1-8+), and Seabrook spring trawl survey ages 1-8+. SARC 36 assessment 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 various trail runs, and on the significance of the correlation among indices and with VPA abundance estimates from the trail run including all indices. The 2001 VPA assessment was done using the NEFSC Woods Hole Fisheries Assessment Compilation Toolbox (FACT) version 1.5 of the ADAPT VPA. Comparison of the FACT version to the new NOAA Fisheries Toolbox (NFT v2.3) VPA with a terminal year 2001 did not produce large changes in overall VPA results. However the change in software did result in a decrease in the terminal year +1 population estimate for 8+ from 1.1 to 0.2 million and increase in the cv for the 8+ abundance from 0.17 to 0.6 (Table I12). The same VPA configuration used in the SARC 36 2001 assessment was used for the updated assessment. Patterns in the residual plots did not change greatly from the SARC 36 assessment (Figure I19). Three additional runs with different configurations were looked at for sensitivity of the VPA results (no estimation of age 8+ abundance, all indices included, and indices with the highest partial variance excluded). Results from the three different VPA configurations did not vary greatly. However, the run which excluded the indices with the highest partial variance did result in higher recruitment in the terminal + 1 year (increase from 17.6 to 31.5 million).

During 1982-1995, fishing mortality (fully recruited F, ages 5-6) has varied between 0.5 (1983) and 2.1 (1995). Fishing mortality declined to a range of 0.3-0.6 during 1999-2001. Fishing mortality has declined to 0.13 in 2004 (Table I13, Figure I20). Accounting for the uncertainty of the 2004 estimate, the 80% confidence interval for F in 2004 ranged from 0.11 to 0.16 (Figure I21). Fishing mortality in 2004 was estimated at 30 percent of Fmsy (0.43). Spawning stock biomass (SSB) declined from 4,776 mt in 1982 to a record low of 529 mt in 1996. SSB has increased since 1995 to 3,436 mt in 2004 (Table I13, Figure I22). The 80% confidence interval for SSB in 2004 ranged between 2,899 and 4,048 mt (Figure I21). SSB in 2004 was estimated at 84 percent of Bmsy (Figure I23). Recruitment declined continuously from 11.6 million age-1 fish in 1982 to 2.5 million in 1993. Recruitment then increased to 6.1 million in 2003 (Figure I22). Record high recruitment was estimated for 2004 and 2005 (15.0 and 17.6 million retrospectively).

A retrospective analysis of the VPA was conducted back to a terminal catch year 2000 (Figure I24). The Gulf of Maine winter flounder VPA exhibits a severe retrospective pattern in F and a large overestimation of SSB since 2000. Fishing mortality in the 2001 SARC 36 assessment was estimated to be 0.14 and 2001 SSB at 5,900 mt. The updated assessment estimates F in 2001 at 0.58 and 2001 SSB at 1,739 mt. Estimated 1995 to 2001 recruitment in the updated assessment has also declined from the SARC 36 assessment.

Patterns in the survey residuals were observed for all ages in the VPA fit. Positive residuals are seen at the beginning of the time series whereas large negative residuals are present in the fully recruited ages in 2004 and 2005. The VPA could not fit the decline in the fully recruited ages in the surveys at the end of the time series when the catch is low. However it appears recruitment in inshore surveys (MDMF spring/fall and Seabrook spring) has increased in 2004 and 2005. The NEFSC spring, NEFSC fall, MADMF spring, and MADMF fall biomass indices generally increase from 1999-2000 and are consistent with trend in biomass estimated from the VPA over the same period. Since 2000, spring biomass indices have declined although the VPA biomass has increased. The NEFSC fall biomass index did not decline until 2004. The age distribution in NEFSC and MADMF survey indices has expanded during the 1999-2002. However, in recent years, older fish have declined in the MADMF spring survey. A similar expansion is seen in the catch at age.

Recreational landings have remained low despite perceived increases in stock size. However, recreational effort on this stock is also low. Survey indices and current distribution of landings indicated that the stock's distribution is truncated. The increase in survey biomass is concentrated in the Cape Cod area and commercial landings are concentrated in area 514. NEFSC survey indices from offshore strata located north of New Hampshire do not show the recovery seen in strata found in waters south of New Hampshire. Currently, landings are predominately from statistical area 514 (95% of total landings). Landings from statistical areas (513, 512, 511) that contributed substantial landings during the mid-1980s have been low during recent years. Overall, the condition of the stock appears to have improved since the late 1990s.

4.0 Sources of uncertainty

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

2) The lack of survey coverage in inshore New Hampshire and Maine where winter flounder are abundant is a source of uncertainty. Low number of tows taken per strata in inshore Massachusetts strata in the NEFSC survey is a source of variability in the index.

3) The use of NEFSC fall survey ages to age the MDMF fall index.

4) Length frequency sampling coverage of the commercial fishery has been poor in some years.

5) Observer sampling intensity of the commercial large mesh and shrimp fishery were low in some years.

6) The Gulf of Maine winter flounder VPA exhibits a severe retrospective pattern of underestimation of F and overestimation of SSB.

5.0 GARM comments

The current assessment model exhibits a severe retrospective pattern of underestimation of recent F and overestimation of recent SSB. The previous assessment indicated that the stock was rebuilt and overfishing was not occurring. The updated assessment indicates that the stock was overfished and overfishing was occurring in 2001. The updated assessment indicates that the stock was not overfished and overfishing was not occurring in 2004. However, if the current retrospective pattern persists then current fishing mortality may be above the Fmsy reference point and SSB may be below one half Bmsy. Given this uncertainty, the GARM recommends against conducting short-term projections. The GARM recommends exploring the use of a forward projecting statistical catch at age model for the next stock assessment.

In addition to the severe retrospective pattern, diagnostics indicate poor fit in the VPA. Age 1 estimate has a high CV (60%) with 19% bias. The VPA has a pattern of negative residuals in recent years and this pattern is most pronounced on age 5, 6, and 7 tuning indices. Poor length frequency sampling of the commercial landings and low observer sampling intensity in the large mesh and shrimp fishery in some years contributes to uncertainty in the catch at age. Survey coverage in inshore Maine and New Hampshire waters, an area where winter flounder catches occurred historically, is poor.

6.0 Summary

The Gulf of Maine winter flounder stock is not overfished and overfishing is not occurring. Spawning stock biomass was estimated at 43 percent above Bmsy in the SARC 36 assessment but has dropped below Bmsy (83% of Bmsy) in the updated assessment due to a large retrospective pattern in the updated VPA. The very large retrospective pattern in fishing mortality, spawning stock biomass, and recruitment results in high uncertainty in current estimates of fishing mortality and spawning stock biomass in the updated VPA assessment. VPA results are too uncertain as a basis for performing projections. Surveys show decreases in abundance of fully recruited ages since the 2001 assessment. However in general all the surveys show some expansion of the age structure since the late 80s and early 90s. The MDMF and Seabrook surveys also show recruitment increasing in 2004 and 2005.

References

Howell, P., A. Howe, M. Gibson and S. Ayvasian. 1992. Fishery management plan for inshore stocks of winter flounder. Atlantic States Marine Fisheries Commission. Fisheries Management Report No. 21. May, 1992.

Mayo, R.K., L. O'Brien, and N. Buxton. 1992. Discard estimates of American plaice, *Hippoglossoides platessoides*, in the Gulf of Maine northern shrimp fishery and the Gulf of Maine-Georges Bank large-mesh otter trawl fishery. SAW 14 Res. Doc. 14/3. 40 pp.

NEFSC. 2003 Report of the 36th Northeast Regional Stock Assessment Workshop (36th SAW): Stock Assessment Review Committee (SARC) consensus summary of assessments. Ref. Doc 03-06. February 2003.

Table I1. Winter flounder commercial landings (metric tons) for Gulf of Maine stock (U.S. statistical reporting areas 512 to 515). Landings from 1964-1981 is taken from SARC 21, 1982-1993 is re-estimated from the wodets data, 1994-2003 is estimated using prorated dealer and VTR data, and 2004 is estimated using prorated dealer electronic reported and VTR data.

Year	metric tons	Year	metric tons
1964	1,081	1990	1,116
1965	665	1991	1,008
1966	785	1992	825
1967	803	1993	611
1968	864	1994	552
1969	975	1995	796
1970	1,092	1996	600
1971	1,113	1997	618
1972	1,085	1998	637
1973	1,080	1999	253
1974	885	2000	382
1975	1,181	2001	588
1976	1,465	2002	631
1977	2,161	2003	680
1978	2,194	2004	477
1979	2,021		
1980	2,437		
1981	2,406		
1982	2,793		
1983	2,096		
1984	1,699		
1985	1,582		
1986	1,188		
1987	1,140		
1988	1,250		
1989	1,253		

Table I2. Estimated number (000's) and weight (mt) of winter flounder caught, landed, and discarded in the recreational fishery, Gulf of Maine stock. * uses 2003 & 2004 2nd half lengths to estimate weight landed due to limited length sampling in 2004.

	Number (000's)				Metric tons
	Catch A+B1+B2	Landed A+B1	Released B2	15% Release Mortality	Landed A+B1
1981	6,200	5,433	767	115	2,554
1982	8,207	7,274	933	140	1,876
1983	2,169	1,988	181	27	868
1984	2,477	2,285	191	29	1,300
1985	3,694	3,220	474	71	1,896
1986	946	691	255	38	523
1987	3,070	2,391	679	102	1,809
1988	953	841	111	17	345
1989	1,971	1,678	294	44	620
1990	786	652	134	20	370
1991	213	154	59	9	91
1992	186	137	48	7	90
1993	396	249	147	22	140
1994	232	145	87	13	83
1995	150	82	68	10	39
1996	184	98	86	13	56
1997	192	64	129	19	43
1998	109	65	44	7	30
1999	115	67	48	7	34
2000	177	75	102	15	42
2001	172	72	100	15	43
2002	100	61	39	6	43
2003	85	51	34	5	32
2004	49	29	20	3	*18

Table I3. Number of lengths, samples, and metric tons per sample for Gulf of Maine winter flounder. Number of samples and calculations of metric tons per samples does not include observer data or gillnet landings from 1990-2004. * = redistributed according to market category and halfyear proportions. Bold numbers have additional lengths from observer trawl data but are not included in the number of samples.

		Number of lengths.					Number of samples					mt/samples				
year	Qtr	lg	sm	med	un	total	Lg	sm	med	un	total	lg	Sm	med	un	total
1982	1				296		1			3						
	2	102	101		159		2	1	1	1		838	453		46	
	3	84	81		106		3	1	1	1						
	4					929	4				9	396	691		231	310
1983	1	80		99			1	1		1						
	2	300	100		407		2	3	1		4	120	510		53	
	3	108	388				3	1	3							
	4	107	956		106	2651	4	1	8		1	125	44	64	95	87
1984	1	201	209				1	2	2							
	2	237	294		221		2	3	2		2	74	95			
	3		123				3		1							
	4	126	690	100		2201	4	1	5	1	19	189	67	114	124	89
1985	1	273	565				1	3	3							
	2	392	170				2	3	2			54				
	3	105					3	1								
	4	116			80	1701	4	1			1	87		182	176	113
1986	1				266		1				3					
	2	237	109	109			2	3	1	1			242	126	48	
	3		111	86			3		1	1						
	4		389	107	89	1503	4		5	1	1	113	37	31	56	70
1987	1				113		1				1					
	2						2									
	3		95				3		1							
	4	47	156	272		683	4	1	2	3	8	257	137	75	249	143
1988	1		258	311			1		3	3						
	2	102		395	*		2	1		4	*		108	23		
	3						3									
	4		169	107	*	1342	4		2	1	*	14	340	164	96	89
1989	1				100		1				1					
	2	113		91	**134**		2	1		1				168		
	3		95	120	**32**		3		1	1						
	4			100		785	4			1	6	313	435	42	254	209
1990	1	328	301				1	3	4							
	2				102		2				1	64	48			
	3						3									
	4	117	197	97		1142	4	1	2	1	12	83	90	138	118	75

Table I3. Continued.

Year	qtr	Number of lengths. lg	Sm	med	un	total	Number of samples lg	sm	med	un	total	mt/samples lg	sm	med	un	total
1991	1	100	51	105	101		1	1	1	1						
	2	88	203	100	**42**		1	2	1			92	72			
	3		95					1								
	4	236	254			1375	3	3			15	32	47	95	115	65
1992	1	110			**107**		1									
	2	136	100	93			2	1	1			47	119	84		
	3															
	4	57	74	253		930	1	1	3		10	75	134	19		67
1993	1	100					1									
	2			288					3			83		16		
	3		55		**91**			1								
	4	80		157	**51**	822	1		2		8	47	177	30		59
1994	1															
	2		71	92	102			1	1	1				75		
	3															
	4	94		235		594	1		3		7	112	143	15	60	62
1995	1	101		175	**63**		1		2							
	2			299					3					37		
	3			414					4							
	4				**609**	1661					10	134		42		55
1996	1		77					1								
	2		231					2					44			
	3		355	252				2	3							
	4	84	440	86	**112**	1637	1	5	1		15	80	16	18		29
1997	1		204					2								
	2		127	75*				2	1*				28	66		
	3		220	218				2	3							
	4	307	502	56*		1709	4	8	1*		23	25	11	14		19
1998	1		148	79				2	1							
	2		151	201*				3	2*				34	29		
	3		583					7								
	4	69	163	110*		1504	1	2	1*		19	65	14	30		25
		↑					↑									
1999	1			104					1							
	2			171					2							
	3		28					1								
	4		52		**408**	763		1			5		26	10		34

Table I3. Continued.

Year	qtr	Number of lengths. lg	Sm	med	un	total	Number of samples lg	sm	med	un	total	mt/samples lg	sm	med	un	total
2000	1		866	143	**480**		1	12	2							
	2		3441	51	**554**		2	45	1				1			
	3		102		**50**		3	2								
	4		114		**26**	5827	4	2			64		12	13		4
↓																
2001	1			187	**172**		1		2							
	2	99	157	189	**630**		2	1	2	3			38	10		
	3		100	52	**399**		3		1	1						
	4		154	198	**1307**	3644	4		2	2	14	26	22	26		33
↑																
2002	1		74	173	**641**		1		2	2	2					
	2	28	433		**32**		2	1	5				7	25	54	
	3		530	73	**1519**		3		8	1	2					
	4		389	60	**1215**	5167	4		5	1	29	33	15	28	49	20
↓																
2003	1		578		**1538**		1		7		2					
	2		298	41	**996**		2		5	1	1		9		43	
	3	166	452	69	**473**		3	5	12	1	4					
	4	142	195		**447**	5395	4	7	4		3	52	2	7	20	21	11
2004	1	19	181	86	**1052**		1	2	6	1	4					
	2	72	222		**788**		2	1	4		2		6		15	
	3		566		**908**		3		8		2					
	4	7	123		**2146**	6170	4	4	2		2	38	16	7	47	5	10

Table I4. Number of kept observer lengths, trips, and gillnet metric tons landed per 100 lengths sampled for Gulf of Maine winter flounder.

year	half	lengths	trips	gillnet landings	Mt/100 lengths
1990	1	539	90	184	
	2	78	1	29	
		617	91	214	35
1991	1	126	6	81	
	2	30	8	13	
		156	14	94	60
1992	1	1950	39	134	
	2	172	25	26	
		2122	64	160	8
1993	1	2004	63	96	
	2	375	20	42	
		2379	83	138	6
1994	1	330	22	101	
	2	206	10	15	
		536	32	115	21
1995	1	1116	20	217	
	2	306	23	35	
		1422	43	253	18
1996	1	1275	26	146	
	2	118	17	19	
		1393	43	164	12
1997	1	793	18	139	
	2	42	4	27	
		835	22	166	20
1998	1	1162	19	141	
	2	431	8	32	
		1593	27	173	11
1999	1	747	5	78	
	2	526	12	7	
		1273	17	85	7
2000	1	911	8	85	
	2	261	4	15	
		1172	12	100	9
2001	1	862	15	129	
	2	42	2	23	
		904	17	152	17
2002	1	237	13	33	
	2	693	31	12	
		930	44	44	5
2003	1	1704	42	80	
	2	3052	50	45	
		4756	92	126	3
2004	1	2256	59	58	
	2	4645	164	24	
		6901	223	82	1

Table 15. Gulf of Maine winter flounder discard ratios and number of trips/tows in the observer and VTR data for the large mesh, small mesh and gillnet fishery. Bold numbers indicate the data used in the VPA assessment.

		Large Mesh Otter Trawl					Small Mesh Otter Trawl					Gillnet				
Year	Half-year	# trips	#tows	SS ratio	VTR trips	VTR ratio	# trips	#tows	SS ratio	VTR trips	VTR ratio	# trips	#tows	SS ratio	VTR trips	VTR ratio
1989	Jan-Jun	15	44	0.130			2	3	0.200							
	Jul-Dec	7	16	0.071			10	25	0.290			26	62	**0.084**		
1990	Jan-Jun	5	6	0.167								50	164	**0.166**		
	Jul-Dec	6	14	0.287			2	3	0.333			33	63	**0.223**		
1991	Jan-Jun	8	25	0.072			4	14	0.029			73	164	**0.164**		
	Jul-Dec	23	103	0.055			8	18	1.152			321	618	**0.142**		
1992	Jan-Jun	21	48	0.098			1	1	0.000			257	617	**0.130**		
	Jul-Dec	6	22	0.039			3	11	0.068			224	397	**0.114**		
1993	Jan-Jun	1	1	0.600								196	576	**0.150**		
	Jul-Dec	4	12	0.080			3	10	0.153			97	198	**0.107**		
1994	Jan-Jun	1	1	0.000	445	**0.053**				23	0.151	43	101	**0.174**	249	0.229
	Jul-Dec				1422	**0.062**				524	0.092	15	35	**0.103**	648	0.091
1995	Jan-Jun	4	15	1.101	2417	**0.048**				229	0.217	18	54	**0.285**	907	0.150
	Jul-Dec	3	52	0.011	1149	**0.037**	22	57		123	0.322	19	52	**0.201**	548	0.388
1996	Jan-Jun	2	5	0.068	2196	**0.044**	1	1		60	0.254	17	62	**0.128**	589	0.159
	Jul-Dec	2	19	0.013	1227	**0.035**	26	93	3.344	219	1.807	18	39	**0.066**	364	0.553
1997	Jan-Jun	3	13	0.231	1700	**0.034**	1	4	0.218	22	0.064	18	56	**0.245**	470	0.112
	Jul-Dec				887	**0.023**				149	0.136	10	22	**0.272**	291	0.087
1998	Jan-Jun	5	16	0.233	1809	**0.046**				17	0.046	27	87	**0.109**	543	0.144
	Jul-Dec				939	**0.030**				129	0.024	35	66	**0.049**	329	0.117
1999	Jan-Jun				942	**0.038**				15	0.034	14	41	**0.141**	285	0.136
	Jul-Dec	15	35	0.015	1148	**0.038**	13	35		123	0.516	23	60	**0.100**	359	0.090
2000	Jan-Jun	35	78	0.041	1240	**0.060**	7	10	0.123	28	0.192	27	74	**0.137**	378	0.094
	Jul-Dec	6	8	0.000	1418	**0.032**	6	13	0.170	52	0.165	18	39	**0.098**	472	0.088
2001	Jan-Jun	27	61	0.970	1278	**0.029**				3	0.054	14	27	**0.061**	351	0.096
	Jul-Dec	61	144	0.036	1281	**0.044**	2	3	0.000	105	0.060	10	21	**0.109**	523	0.107
2002	Jan-Jun	19	52	0.062	986	**0.028**	1	1	0.000	2	0.156	15	37	**0.022**	192	0.075
	Jul-Dec	104	222	0.081	1483	**0.052**	20	59	3.875	88	0.023	38	86	**0.037**	400	0.134
2003	Jan-Jun	84	247	0.050	870	**0.061**	1	1	0.200			69	209	**0.037**	290	0.037
	Jul-Dec	91	193	0.089	1575	**0.061**	5	14	0.304	19	0.280	113	282	**0.014**	541	0.075
2004	Jan-Jun	47	115	0.061	801	**0.047**	5	14	0.023	23	0.501	101	303	**0.051**	240	0.068
	Jul-Dec	161	404	0.076	1332	**0.046**	22	51	1.578	55	0.051	318	816	**0.035**	470	0.049

Table I6. Gulf of Maine winter flounder estimated discard ratios in the shrimp fishery (total discard kg / total days fished estimated from NEFSC and MA Observer data by shrimp season). Ratio for 1982-1988 is the average ratio from 1989-1992. Total shrimp fishery days fished estimated by Wigley et al 1999 and estimated discards are also shown. A 50% mortality is used for estimating dead discards. Dotted line indicates the introduction of the Nordmore grate. * uses the average ratio between 2001 and 2003 due to the lack of sampling.

Year	trips	tows	ratio	Shrimp df	discard wt (kg)	dead discards (kg)
1982			*22.225*	970.1	21,560	10,780
1983			*22.225*	1156.9	25,712	12,856
1984			*22.225*	1754.0	38,983	19,491
1985			*22.225*	2081.4	46,259	23,129
1986			*22.225*	2395.1	53,231	26,615
1987			*22.225*	3708.2	82,414	41,207
1988			*22.225*	2815.2	62,568	31,284
1989	12	24	13.361	2839.5	37,939	18,969
1990	25	53	24.070	3204.6	77,136	38,568
1991	38	94	27.720	2587.7	71,730	35,865
1992	72	225	23.749	2313.3	54,938	27,469
1993	63	178	10.730	1902.2	20,411	10,206
1994	63	183	7.320	1982.3	14,511	7,256
1995	58	136	7.382	3375.7	24,918	12,459
1996	40	92	6.290	3242.9	20,398	10,199
1997	21	55	12.511	3661.2	45,804	22,902
1998	3	6	10.559	2204.0	23,273	11,636
1999	4	5	5.645	1217.4	6,872	3,436
2000	4	10	10.927	792.9	8,664	4,332
2001	4	6	9.466	673.4	6,375	3,187
2002	1	2	*9.912	245.5	2,433	1,217
2003	18	36	10.358	531.9	5,509	2,755
2004	11	47	9.571	243.2	2,328	1,164

Table I7. Gulf of Maine winter flounder catch at age component summary.

Catch at age component	years	halfyear	length data	age data
trawl and other commercial landings	82-04	mix	commercial and observer (unclassified)	commercial
gillnet commercial landings	90-04	whole year	observer (kept)	commercial
recreational landings	82-04	halfyear	MRFSS	combine NEFSC and MA DMF ages by halfyear
recreational discards	82-04	halfyear	spr & fall MA DMF	combine NEFSC and MA DMF ages by halfyear
large mesh trawl discards (survey)	82-93	whole year	survey method (spr & fall MA DMF)	combine NEFSC spr & fall survey
large mesh trawl discards (vtr/survey)	94-04	whole year	survey method (94-00) observer (01-04)	combine NEFSC spr & fall survey
gillnet discards	86-04	whole year	observer (discards)	combine spr NEFSC and MA DMF ages
shrimp discards	82-04	shrimp season	observer (discards)	combine spr NEFSC and MA DMF ages

Table I8. Gulf of Maine winter flounder composition of the catch by number.

	Landings		Discards				
year	recreational	commercial	recreational	gillnet	lg mesh	shrimp	Total
1982	7,274	5,282	140	0	1,397	96	14,188
1983	1,988	3,842	27	0	428	120	6,406
1984	2,285	3,992	29	0	249	174	6,729
1985	3,220	2,965	71	0	340	197	6,793
1986	691	2,055	38	41	253	240	3,318
1987	2,391	2,086	102	34	308	346	5,266
1988	841	2,210	17	40	406	262	3,775
1989	1,678	2,329	44	21	321	227	4,620
1990	652	1,922	20	70	315	214	3,193
1991	154	1,799	9	26	315	257	2,559
1992	137	1,567	7	36	216	256	2,220
1993	249	1,384	22	36	45	127	1,863
1994	145	1,116	13	36	49	116	1,475
1995	82	1,609	10	85	42	134	1,963
1996	98	1,224	13	35	31	123	1,524
1997	64	1,198	19	70	23	257	1,630
1998	65	1,166	7	29	33	123	1,423
1999	67	437	7	9	11	39	571
2000	75	516	15	22	20	54	701
2001	72	1,047	15	16	26	40	1,215
2002	61	1,072	6	2	51	13	1,205
2003	51	1,128	5	4	69	30	1,288
2004	29	710	3	5	41	13	802

Table I9. Gulf of Maine winter flounder mean weight at age (kg) from age 1 to 8+.

year	1	2	3	4	5	6	7	8+
1982	0.081	0.223	0.375	0.487	0.595	0.802	0.943	2.037
1983	0.115	0.252	0.357	0.502	0.644	0.795	0.946	1.164
1984	0.059	0.257	0.305	0.400	0.543	0.708	0.855	1.115
1985	0.041	0.169	0.311	0.447	0.584	0.809	0.927	1.122
1986	0.045	0.291	0.408	0.510	0.664	0.813	1.005	1.221
1987	0.034	0.240	0.390	0.527	0.690	0.858	1.070	1.284
1988	0.034	0.376	0.421	0.487	0.648	0.753	1.022	1.204
1989	0.036	0.197	0.412	0.570	0.623	0.989	1.175	1.397
1990	0.040	0.271	0.398	0.538	0.631	0.778	1.003	1.247
1991	0.048	0.256	0.429	0.563	0.609	0.722	0.771	0.965
1992	0.031	0.229	0.405	0.539	0.638	0.799	1.064	1.468
1993	0.031	0.226	0.380	0.454	0.658	0.680	1.148	1.453
1994	0.029	0.096	0.379	0.481	0.637	0.790	1.128	1.052
1995	0.043	0.127	0.345	0.431	0.552	0.651	0.929	1.186
1996	0.029	0.279	0.437	0.520	0.593	0.768	0.851	1.381
1997	0.043	0.191	0.415	0.514	0.630	0.802	0.798	0.859
1998	0.036	0.170	0.384	0.471	0.594	0.749	0.984	1.814
1999	0.035	0.088	0.391	0.490	0.559	0.713	0.907	1.062
2000	0.039	0.108	0.345	0.470	0.549	0.676	0.869	1.187
2001	0.033	0.085	0.318	0.456	0.544	0.687	0.847	1.050
2002	0.038	0.165	0.409	0.491	0.583	0.688	0.855	1.280
2003	0.035	0.149	0.367	0.481	0.567	0.698	0.891	1.317
2004	0.033	0.185	0.363	0.486	0.614	0.754	0.947	1.559

Table I10. Gulf of Maine winter flounder numbers at age (000's) from age 1 to 8+.

year	1	2	3	4	5	6	7	8+
1982	118	2,909	5,274	3,487	1,402	617	276	104
1983	146	941	1,970	1,839	857	362	158	133
1984	36	949	2,097	1,907	856	348	312	225
1985	54	320	1,617	2,124	1,925	398	218	136
1986	83	557	936	852	373	353	102	62
1987	78	553	2,031	1,224	794	311	138	136
1988	52	507	1,215	1,179	361	248	123	89
1989	56	439	1,480	1,545	793	218	51	38
1990	39	366	997	1,037	509	170	48	29
1991	43	405	995	674	232	116	55	40
1992	52	436	802	615	208	67	24	16
1993	46	220	725	647	147	66	9	3
1994	33	98	477	638	166	44	14	5
1995	43	95	367	749	488	174	27	18
1996	57	174	758	413	83	23	8	9
1997	37	279	605	519	139	32	9	11
1998	44	100	283	511	335	109	36	5
1999	18	23	70	188	162	71	24	16
2000	23	33	97	251	206	62	18	11
2001	19	23	61	349	438	206	82	37
2002	6	29	135	374	402	182	54	23
2003	11	45	159	349	386	219	73	45
2004	6	30	88	245	189	143	51	51

Table I11. NEFSC and MDMF survey indices of abundance for Gulf of Maine winter flounder. Indices are stratified mean number and mean weight (kg) per tow. NEFSC indices are for inshore strata (58,59,60,61,65,66) and offshore strata (26,27,38,39,40). NEFSC indices are calculated with trawl door conversion factors where appropriate. MA DMF uses strata 25-36.

	NEFSC spring		NEFSC fall		MDMF spring		MDMF fall	
Year	number	weight	number	weight	number	weight	number	Weight
1978					86.805	18.373	43.360	9.887
1979	9.063	3.218	6.003	2.602	64.952	14.407	119.506	28.978
1980	11.284	4.447	13.141	6.553	66.231	17.494	74.684	15.940
1981	13.051	3.946	4.179	3.029	100.569	28.370	47.342	13.228
1982	7.670	3.022	4.201	1.924	60.719	14.687	106.053	23.635
1983	12.367	5.653	10.304	3.519	108.508	27.233	88.143	15.772
1984	5.155	1.979	7.732	3.106	66.271	15.977	35.956	10.817
1985	3.469	1.418	7.638	2.324	48.651	13.594	44.564	7.381
1986	2.343	0.998	2.502	0.938	62.356	14.724	41.914	6.603
1987	5.609	1.503	1.605	0.488	83.171	17.648	50.426	7.227
1988	6.897	1.649	3.000	1.031	52.733	10.617	33.063	7.173
1989	3.717	1.316	6.402	2.013	63.595	13.317	33.983	7.462
1990	5.415	2.252	3.527	1.177	74.131	12.966	67.874	13.452
1991	4.517	1.436	7.035	1.467	49.265	11.587	88.777	15.473
1992	3.933	1.160	10.447	3.096	74.146	13.938	77.350	13.471
1993	1.556	0.353	7.559	1.859	80.133	12.390	92.476	14.996
1994	3.481	0.891	4.870	1.319	71.710	10.036	67.351	13.560
1995	12.185	3.149	4.765	1.446	87.848	14.560	84.768	17.250
1996	2.736	0.732	10.099	3.116	77.249	12.823	74.295	13.031
1997	2.806	0.664	10.008	2.950	95.918	14.796	74.347	14.316
1998	2.001	0.528	3.218	0.987	91.466	15.756	93.889	14.934
1999	6.510	1.982	10.921	3.269	77.941	14.198	117.648	22.672
2000	10.383	2.885	12.705	5.065	169.291	35.453	101.633	25.693
2001	5.242	1.666	8.786	3.131	90.153	23.891	80.978	18.367
2002	12.066	3.693	10.691	4.003	87.376	21.404	68.024	18.401
2003	7.839	2.543	10.182	4.312	85.355	17.693	89.367	16.803
2004	3.879	1.097	2.763	0.868	81.299	12.215	112.014	16.194
2005	6.920	2.056			100.819	13.744		

Table I12. Comparative Results from ADAPT/VPA runs incorporating data and software updates since SARC 36.

	SARC/FACT	GARM/NFT	update/NFT	no 8+/NFT	all indices/NFT	limited indices/NFT
Terminal Year	2001	2001	2005	2005	2005	2005
Indices	N_F2, N_F8	N_F2, N_F8	N_F2, N_F8	N_F2, N_F8	none	N_S1, N_F2, N_F6
Excluded	M_F6, M_F7	M_F6, M_F7	M_F6, M_F7	M_F6, M_F7		N_F7, N_F8, M_F6
	M_F8, S_S8	M_F8, S_S8	M_F8, S_S8	M_F8, S_S8		M_F7, M_F8
Number	33	33	33	33	39	31
RSS	419.74	423.94	618.83	637.24	894.51	523.01
N t+1 age 1 (cv)	6.3 (0.50)	6.2 (0.49)	17.6 (0.55)	17.1 (0.55)	17.4 (0.61)	31.5 (0.64)
N t+1 age 2 (cv)	6.0 (0.33)	6.0 (0.32)	12.3 (0.36)	12.0 (0.36)	10.1 (0.37)	11.2 (0.37)
N t+1 age 3 (cv)	5.0 (0.25)	4.9 (0.25)	4.0 (0.28)	3.9 (0.27)	4.0 (0.29)	4.1 (0.28)
N t+1 age 4 (cv)	5.4 (0.21)	5.4 (0.21)	2.4 (0.24)	2.3 (0.24)	2.5 (0.26)	2.3 (0.24)
N t+1 age 5 (cv)	3.6 (0.20)	3.6 (0.20)	1.4 (0.24)	1.3 (0.24)	1.4 (0.26)	1.4 (0.23)
N t+1 age 6 (cv)	2.0 (0.21)	2.7 (0.18)	1.2 (0.23)	0.9 (0.24)	1.1 (0.24)	1.2 (0.23)
N t+1 age 7 (cv)	1.6 (0.19)	2.0 (0.16)	1.0 (0.22)	0.7 (0.24)	1.0 (0.22)	1.0 (0.22)
N t+1 age 8 (cv)	1.1 (0.17)	0.2 (0.60)	<0.1 (0.69)	- (-)	0.1 (0.53)	< 0.1 (0.64)
F age 1	0	0	0	0	0	0
F age 2	0	0	0.01	0.01	0.01	0.01
F age 3	0.01	0.01	0.03	0.03	0.03	0.03
F age 4	0.08	0.08	0.15	0.15	0.15	0.15
F age 5	0.17	0.13	0.13	0.16	0.14	0.13
F age 6	0.1	0.09	0.12	0.16	0.12	0.12
F age 7	0.06	0.11	0.12	0.16	0.13	0.12
F (ages 5-6)	0.14	0.11	0.13	0.16	0.13	0.12
SSB (mt)	5,866	5,866	3,436	2,838	3,388	3,542

Table I13. VPA estimation results for Gulf of Maine winter flounder, 1982-2004.
Jan-1 Population Numbers

AGE	1982	1983	1984	1985	1986	1987
1	11634	8679	6193	9162	7576	6031
2	14256	9418	6974	5038	7453	6128
3	10961	9055	6863	4855	3836	5599
4	6122	4268	5642	3737	2525	2299
5	3038	1912	1850	2910	1171	1303
6	1170	1236	800	751	678	624
7	575	408	687	344	260	241
8	217	344	495	214	158	237
Total	47973	35319	29503	27011	23657	22463

AGE	1988	1989	1990	1991	1992	1993
1	4422	3984	4162	4408	3116	2524
2	4867	3573	3211	3372	3570	2504
3	4518	3528	2530	2299	2396	2530
4	2765	2608	1565	1179	993	1243
5	792	1210	763	363	366	267
6	362	326	288	174	92	115
7	234	77	74	85	40	16
8	169	58	45	62	27	5
Total	18130	15364	12638	11943	10600	9205

AGE	1994	1995	1996	1997	1998	1999
1	3705	3590	3024	3566	4116	5573
2	2025	3004	2900	2424	2886	3330
3	1852	1570	2374	2217	1733	2272
4	1421	1088	955	1263	1272	1164
5	441	593	228	413	570	584
6	88	212	59	113	214	169
7	35	33	22	28	64	78
8	13	22	24	34	9	52
Total	9580	10111	9586	10058	10864	13223

AGE	2000	2001	2002	2003	2004	2005
1	4675	3857	4595	6084	15017	17607
2	4546	3807	3141	3757	4971	12289
3	2706	3692	3096	2545	3035	4043
4	1797	2128	2968	2413	1940	2405
5	784	1245	1428	2093	1661	1368
6	333	457	627	808	1366	1190
7	75	217	190	350	465	990
8	46	98	81	216	467	27
Total	14962	15501	16126	18266	28923	39919

Table I13. Continued.
Fishing Mortality Calculated

AGE	1982	1983	1984	1985	1986	1987
1	0.0113	0.0187	0.0064	0.0065	0.0122	0.0144
2	0.2539	0.1166	0.1622	0.0726	0.0859	0.1047
3	0.7432	0.2731	0.4078	0.4537	0.3117	0.5056
4	0.9639	0.6357	0.4622	0.9606	0.4612	0.8652
5	0.6997	0.6717	0.7022	1.2562	0.4292	1.08
6	0.8529	0.3874	0.6445	0.8599	0.8356	0.7826
7	0.74	0.5503	0.6845	1.1612	0.5599	0.9737
8	0.74	0.5503	0.6845	1.1612	0.5599	0.9737

AGE	1988	1989	1990	1991	1992	1993
1	0.0131	0.0156	0.0104	0.0108	0.0186	0.0203
2	0.1218	0.1453	0.1341	0.1418	0.1443	0.1018
3	0.3495	0.6129	0.5635	0.6396	0.4565	0.3771
4	0.6266	1.0292	1.2602	0.9696	1.1121	0.8361
5	0.6871	1.2343	1.2768	1.1751	0.9601	0.9106
6	1.3427	1.2797	1.0216	1.2717	1.5386	0.9795
7	0.8506	1.2438	1.2001	1.2054	1.0523	0.9308
8	0.8506	1.2438	1.2001	1.2054	1.0523	0.9308

AGE	1994	1995	1996	1997	1998	1999
1	0.0099	0.0133	0.021	0.0115	0.0119	0.0036
2	0.0548	0.0355	0.0684	0.1355	0.039	0.0076
3	0.3322	0.2966	0.4305	0.3556	0.1979	0.0346
4	0.6734	1.3603	0.6386	0.5956	0.578	0.1955
5	0.5305	2.109	0.5066	0.4597	1.015	0.3625
6	0.7858	2.0816	0.5562	0.373	0.8115	0.6131
7	0.5687	2.1017	0.5166	0.4405	0.9553	0.4136
8	0.5687	2.1017	0.5166	0.4405	0.9553	0.4136

AGE	2000	2001	2002	2003	2004
1	0.0054	0.0054	0.0014	0.002	0.0004
2	0.008	0.0067	0.0102	0.0133	0.0067
3	0.0403	0.0184	0.0493	0.0713	0.0325
4	0.1668	0.1989	0.1493	0.1733	0.1496
5	0.3401	0.486	0.3692	0.2265	0.1338
6	0.229	0.6772	0.3829	0.3528	0.1224
7	0.3056	0.5338	0.3734	0.2601	0.1281
8	0.3056	0.5338	0.3734	0.2601	0.1281

Table I13. Continued.

Average Fishing Mortality For Ages 5-6

Year	Average F	N weighted	Biomass wtd	Catch Wtd
1982	0.7763	0.7423	0.7542	0.7465
1983	0.5295	0.5601	0.5458	0.5872
1984	0.6734	0.6848	0.6816	0.6856
1985	1.0581	1.1750	1.1526	1.1883
1986	0.6324	0.5783	0.6010	0.6268
1987	0.9313	0.9837	0.9673	0.9963
1988	1.0149	0.8928	0.9236	0.9540
1989	1.2570	1.2440	1.2471	1.2441
1990	1.1492	1.2068	1.1990	1.2129
1991	1.2234	1.2064	1.2100	1.2073
1992	1.2493	1.0761	1.0909	1.1010
1993	0.9450	0.9313	0.9328	0.9319
1994	0.6581	0.5730	0.5844	0.5840
1995	2.0953	2.1018	2.1005	2.1018
1996	0.5314	0.5168	0.5190	0.5174
1997	0.4163	0.4411	0.4382	0.4435
1998	0.9132	0.9595	0.9504	0.9650
1999	0.4878	0.4188	0.4298	0.4389
2000	0.2845	0.3070	0.3029	0.3144
2001	0.5816	0.5373	0.5449	0.5472
2002	0.3761	0.3734	0.3739	0.3735
2003	0.2897	0.2617	0.2667	0.2722
2004	0.1281	0.1287	0.1282	0.1289

Table I13. Continued.

Spawning Stock Biomass

AGE	1982	1983	1984	1985	1986	1987
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	449	363	261	187	142	253
4	1669	1293	1554	887	733	703
5	1250	861	771	977	545	561
6	664	734	437	382	361	369
7	396	295	454	198	194	168
8	349	332	443	171	160	227
Total	4776	3877	3920	2802	2134	2281

AGE	1988	1989	1990	1991	1992	1993
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	200	181	94	102	105	103
4	843	808	440	358	296	354
5	371	466	316	147	164	121
6	178	181	148	81	42	56
7	168	51	52	46	26	12
8	157	56	39	42	29	6
Total	1917	1743	1090	777	660	652

AGE	1994	1995	1996	1997	1998	1999
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	76	40	77	105	68	88
4	420	256	282	422	398	394
5	198	172	97	200	233	260
6	50	77	32	67	114	90
7	26	16	13	18	42	55
8	11	15	28	25	12	47
Total	780	576	529	838	867	934

AGE	2000	2001	2002	2003	2004
1	0	0	0	0	0
2	0	0	0	0	0
3	71	103	88	98	110
4	605	658	926	852	654
5	356	531	638	993	830
6	184	225	331	448	823
7	52	137	126	244	347
8	48	85	90	254	671
Total	1315	1739	2199	2890	3436

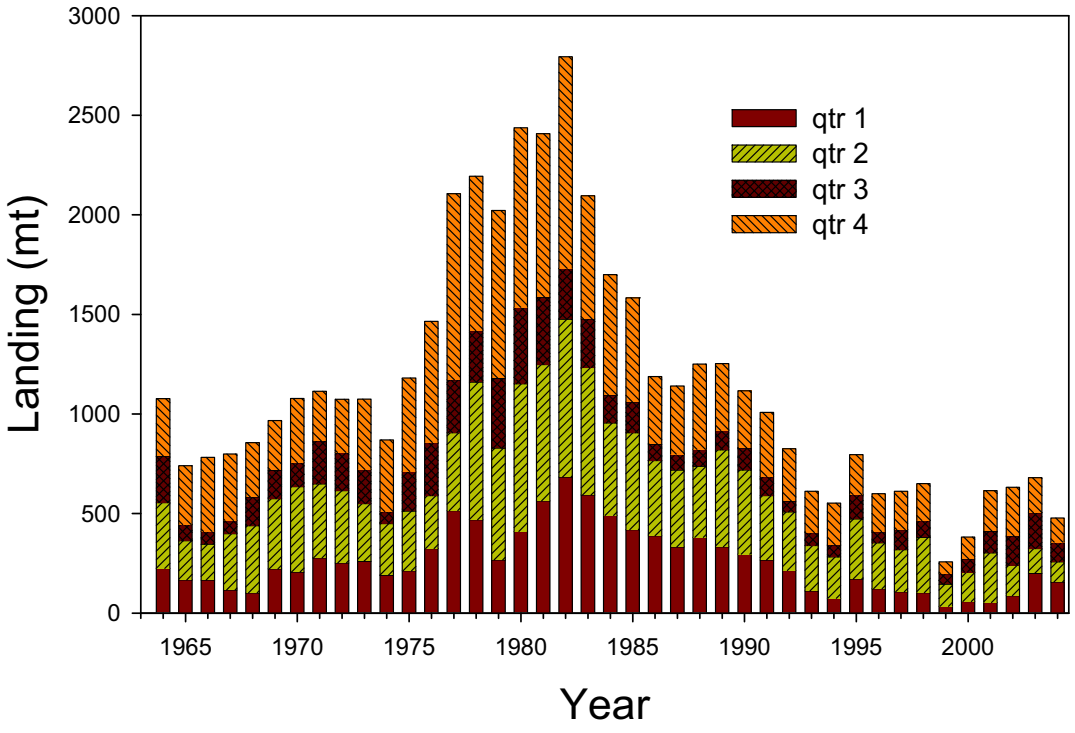

Figure I1. Gulf of Maine winter flounder landings by quarter from 1964-2004.

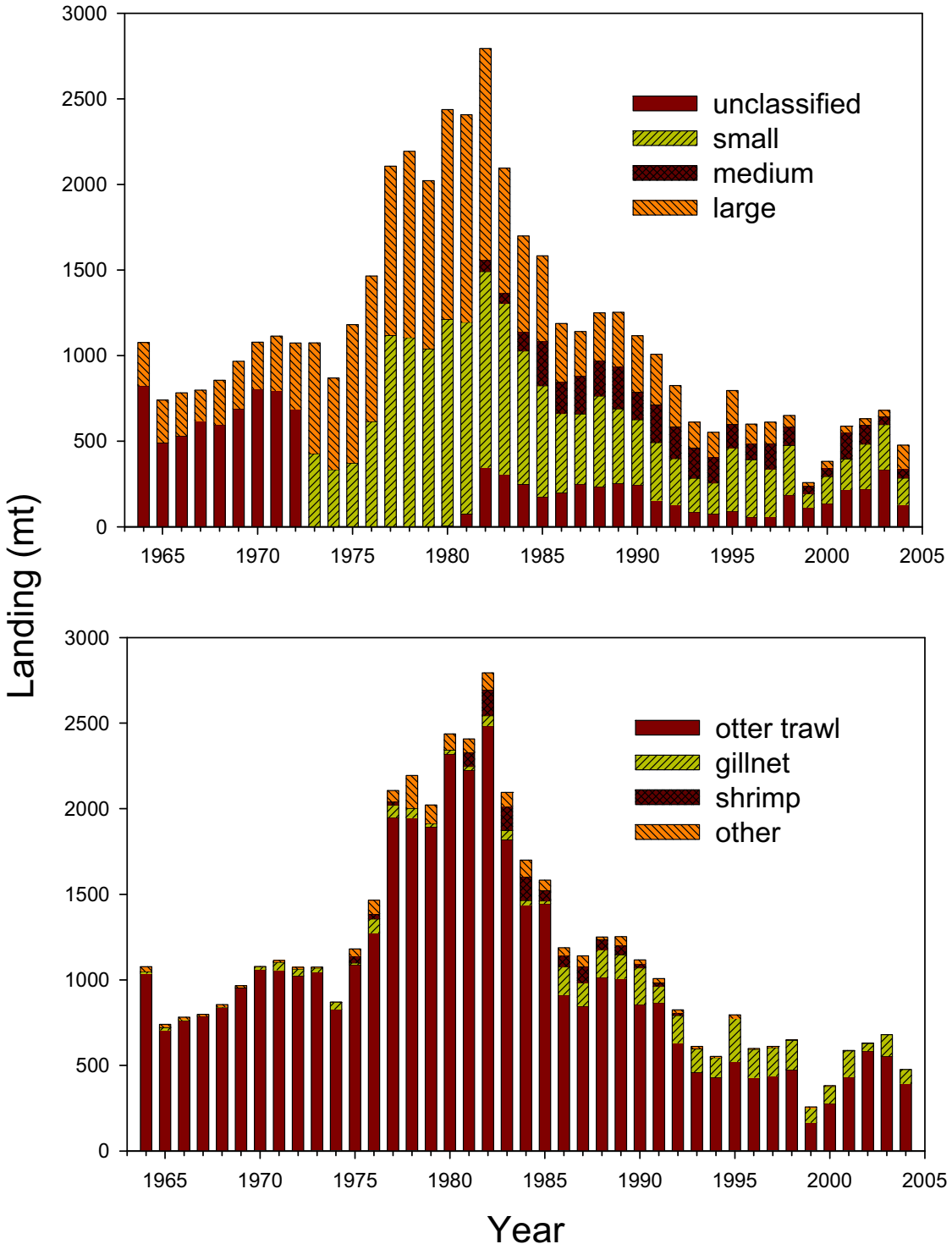

Figure I2. Gulf of Maine winter flounder landings in metric tons by market category (top panel) and gear (bottom panel).

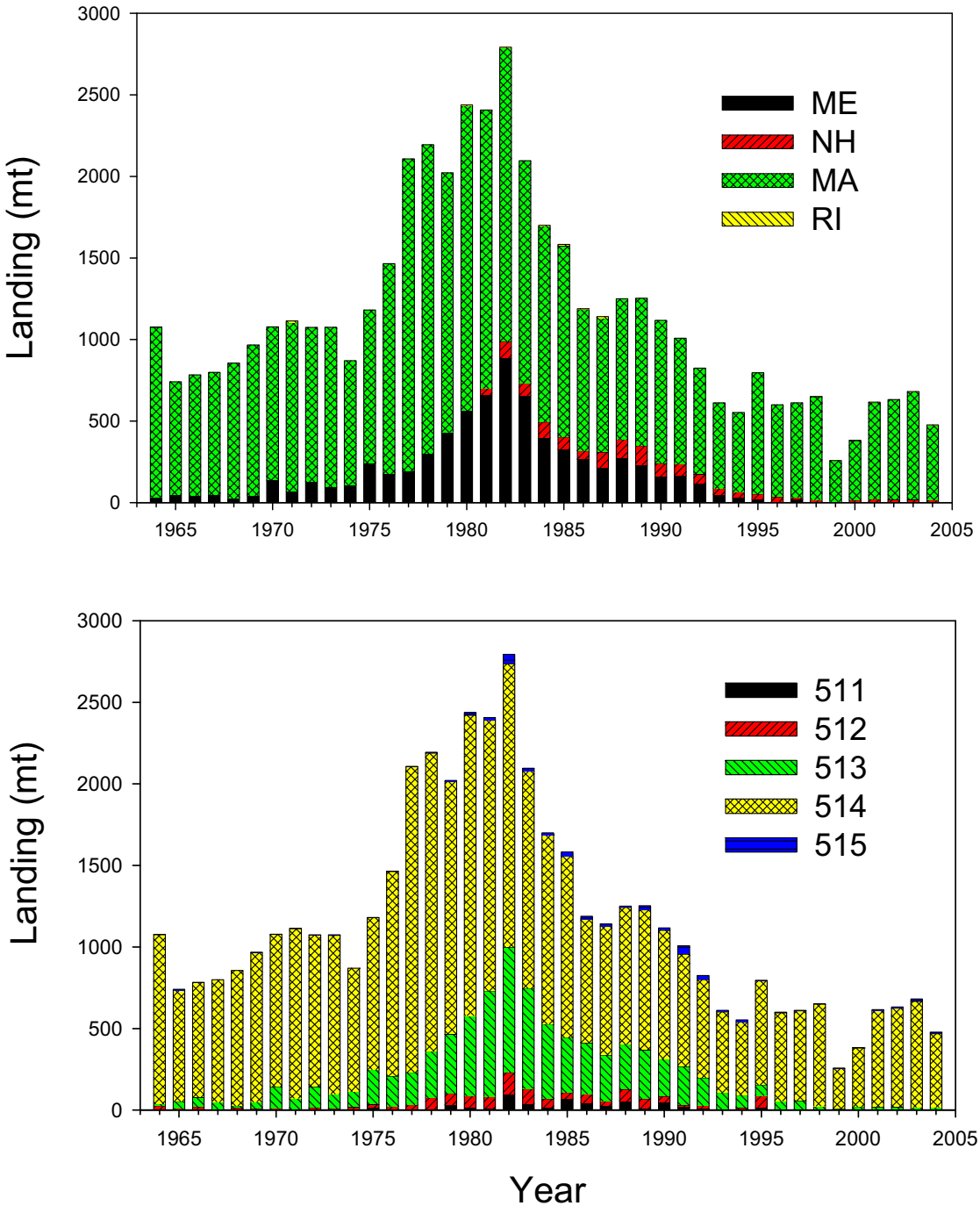

Figure I3. Gulf of Maine winter flounder landings by state (top panel) and statistical area (bottom panel) from 1964-2004.

Gulf of Maine Winter Flounder Recreational landings and b2 Catch

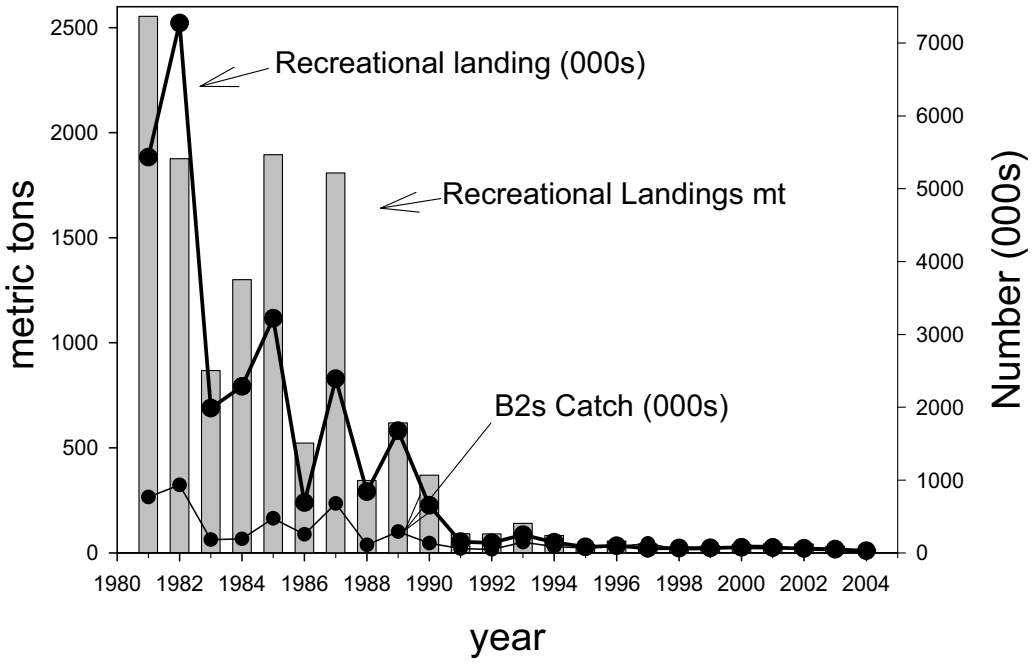

Figure I4. Recreational landings in numbers and metric tons for Gulf of Maine winter flounder. B2 catch in numbers is also shown.

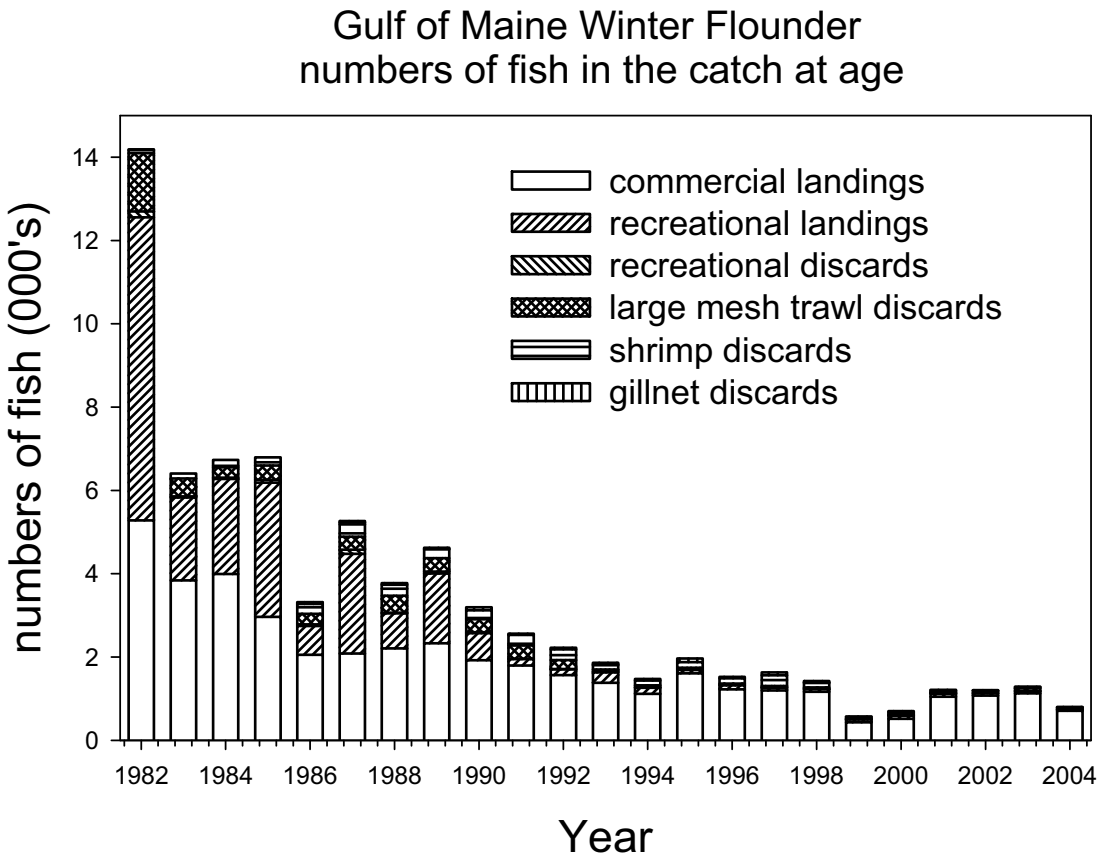

Figure I5. Gulf of Maine winter flounder catch composition in numbers.

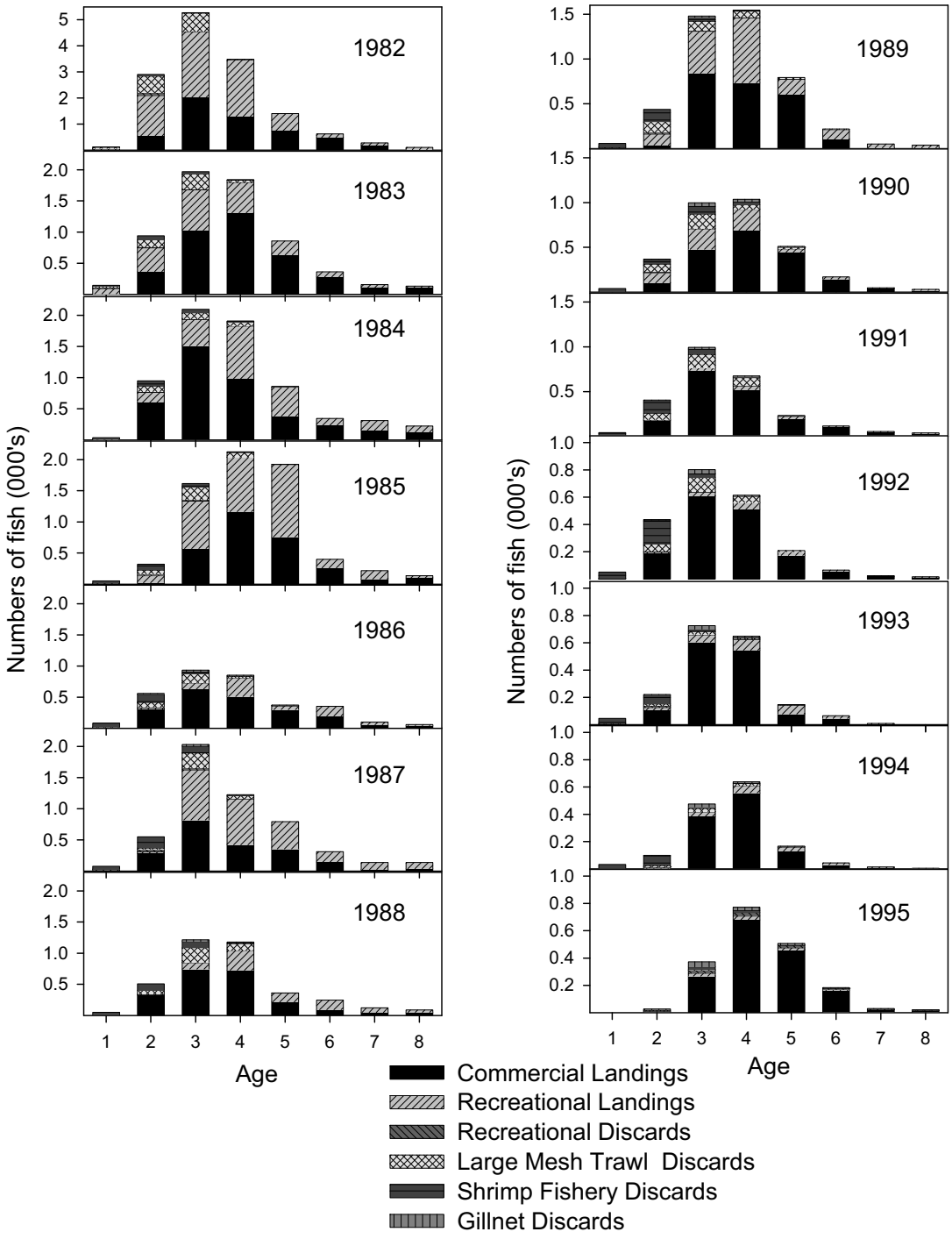

Figure I6. Gulf of Maine winter flounder catch at age composition from 1982-2004.

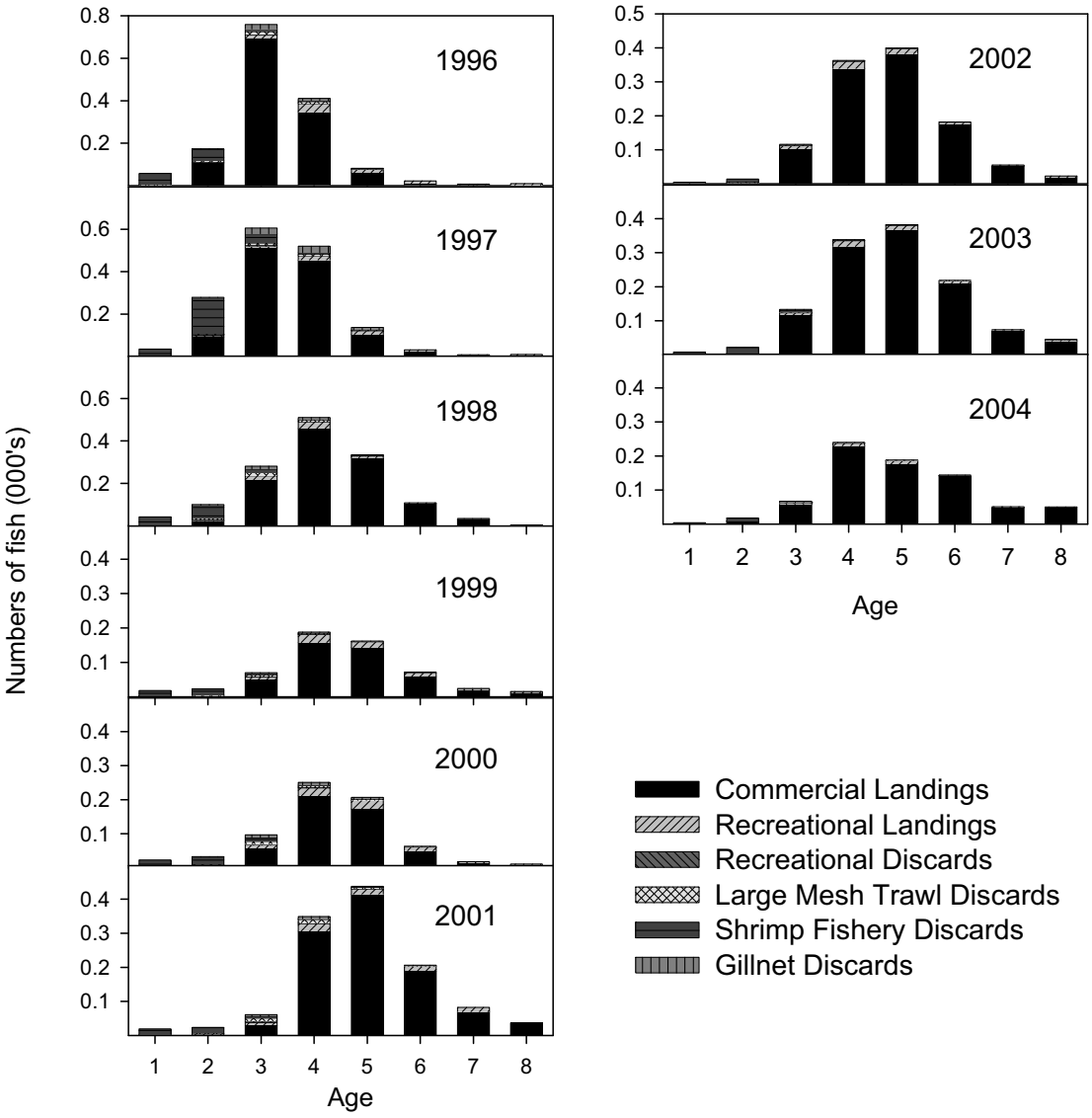

Figure I6. Continued.

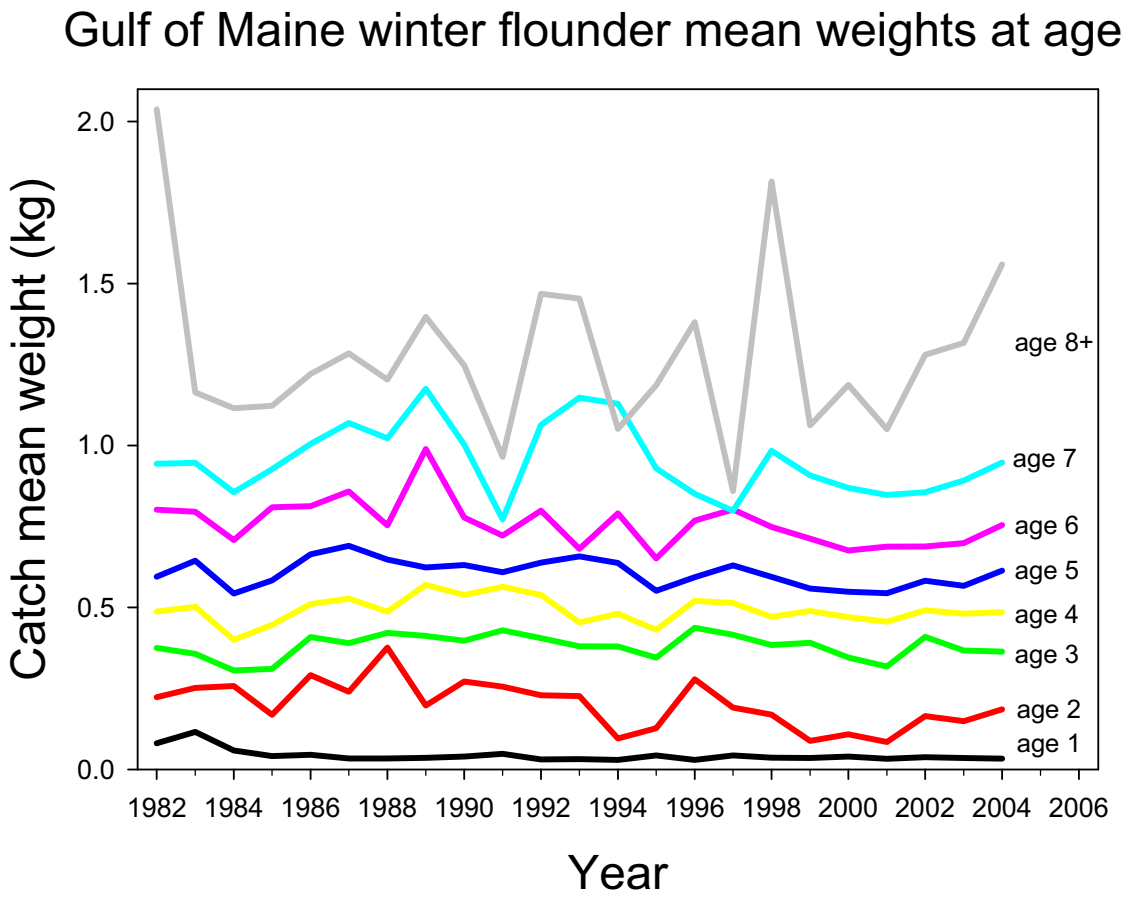

Figure I7. Gulf of Maine winter flounder catch mean weights at age.

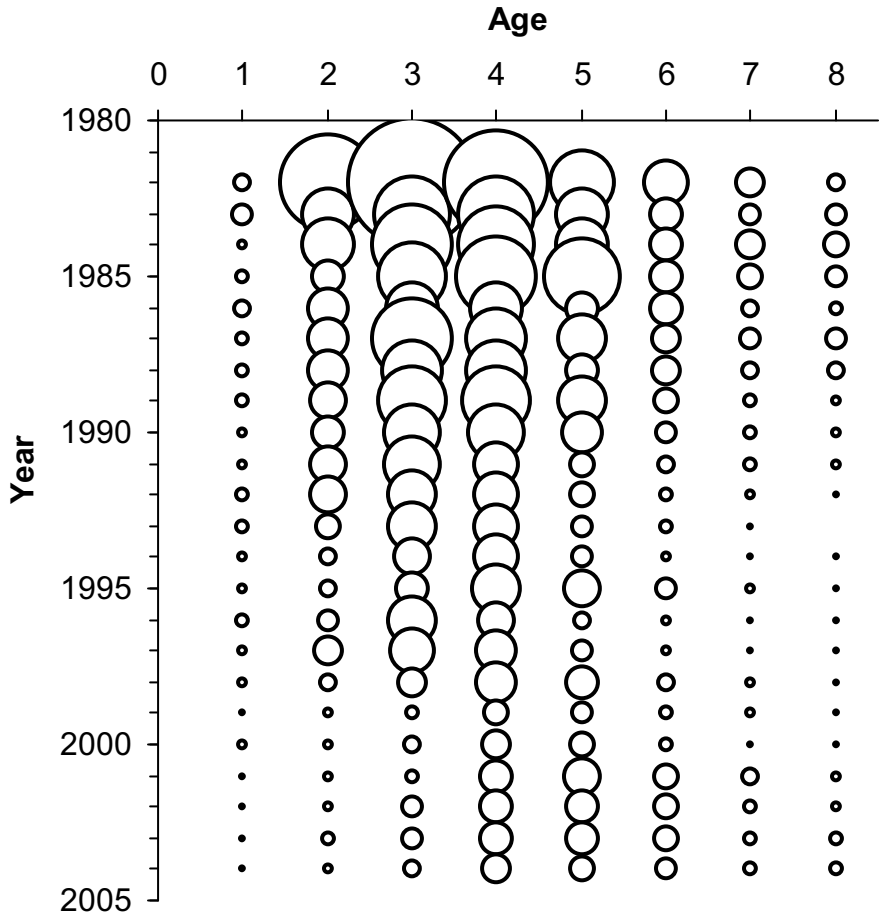

Figure I8. Gulf of Maine winter flounder bubble plot of the catch at age.

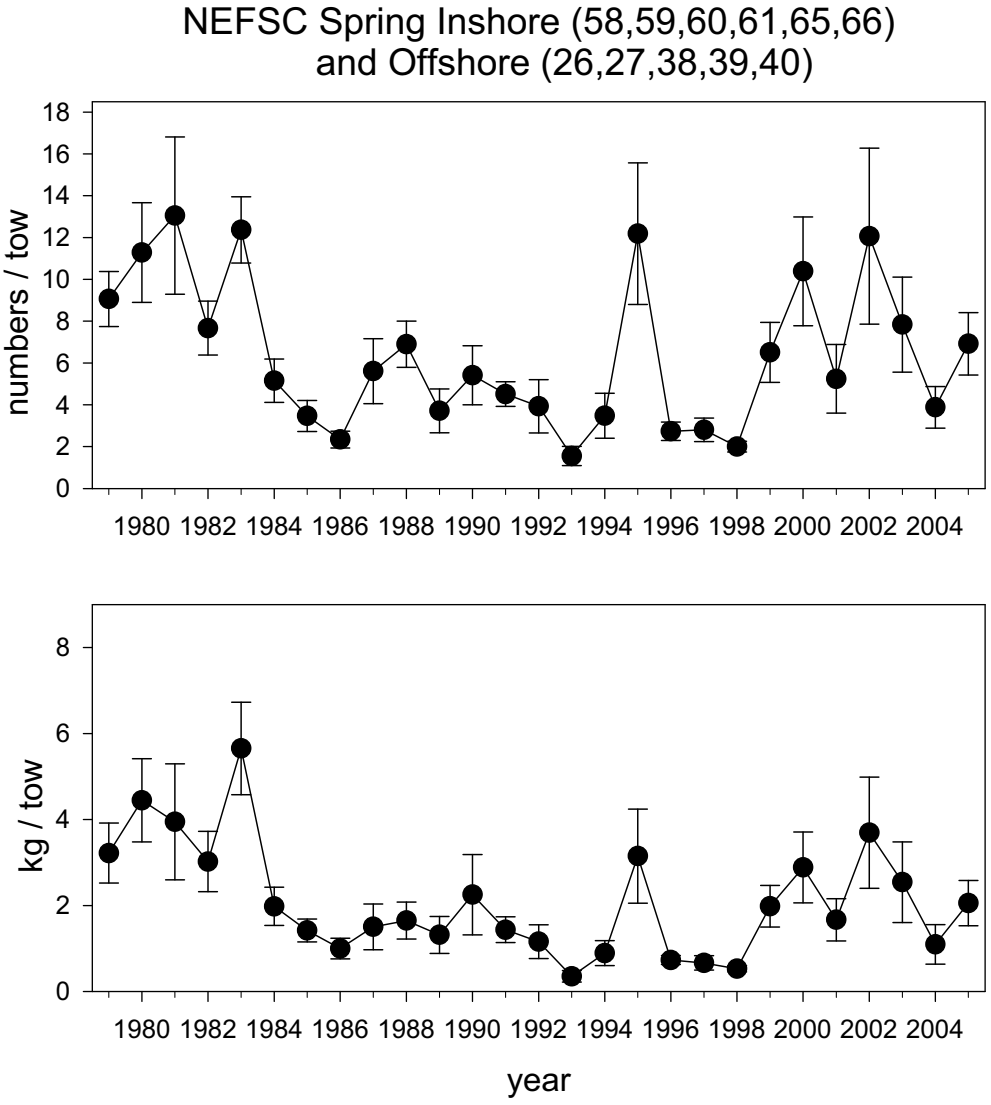

Figure I9. NEFSC Spring survey stratified mean numbers and mean weight (kg) per tow for Gulf of Maine winter flounder. Trawl door conversion factors are use where appropriate.

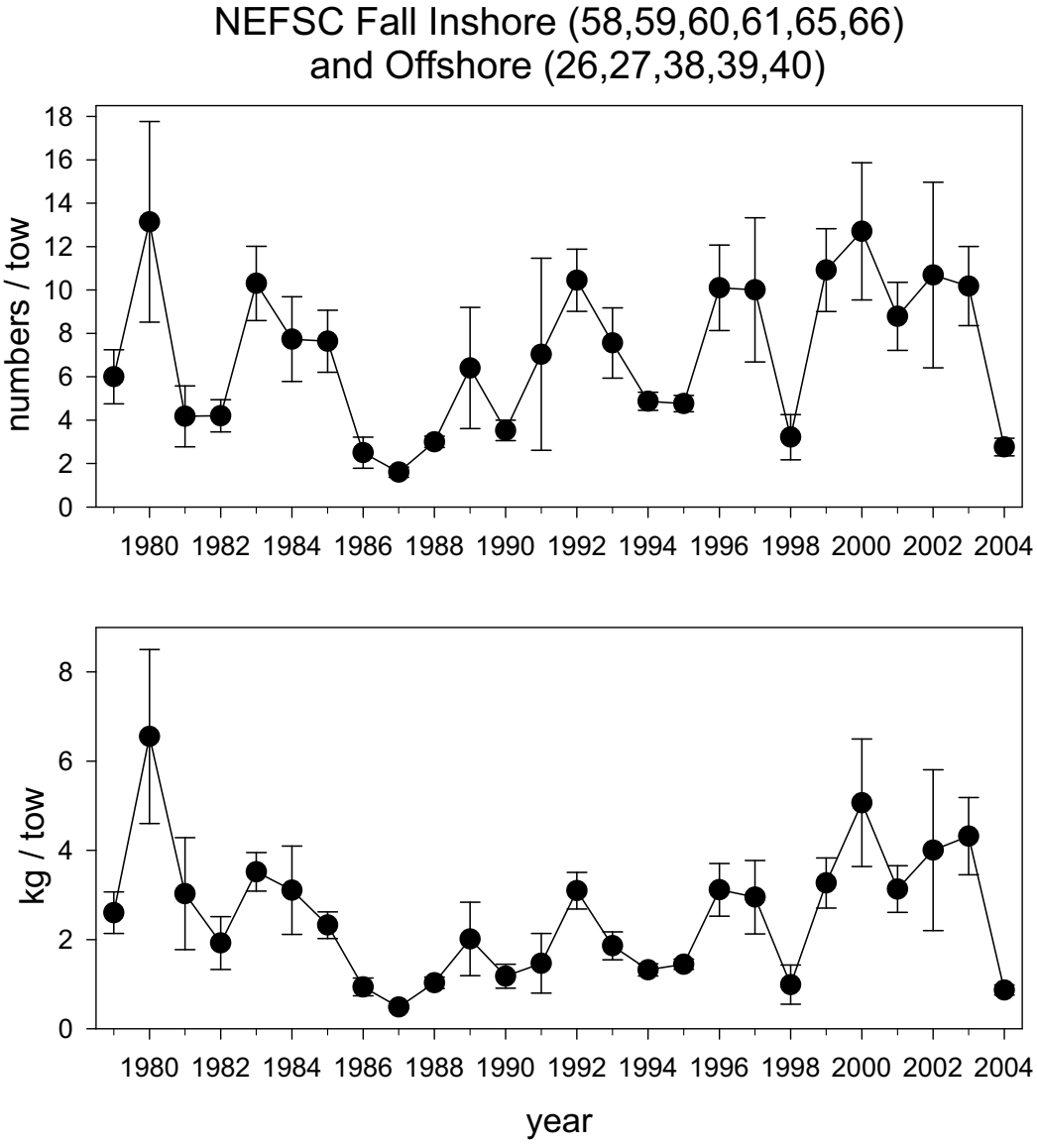

Figure I10. NEFSC Fall survey stratified mean numbers and mean weight (kg) per tow for Gulf of Maine winter flounder. Trawl door conversion factors are use where appropriate.

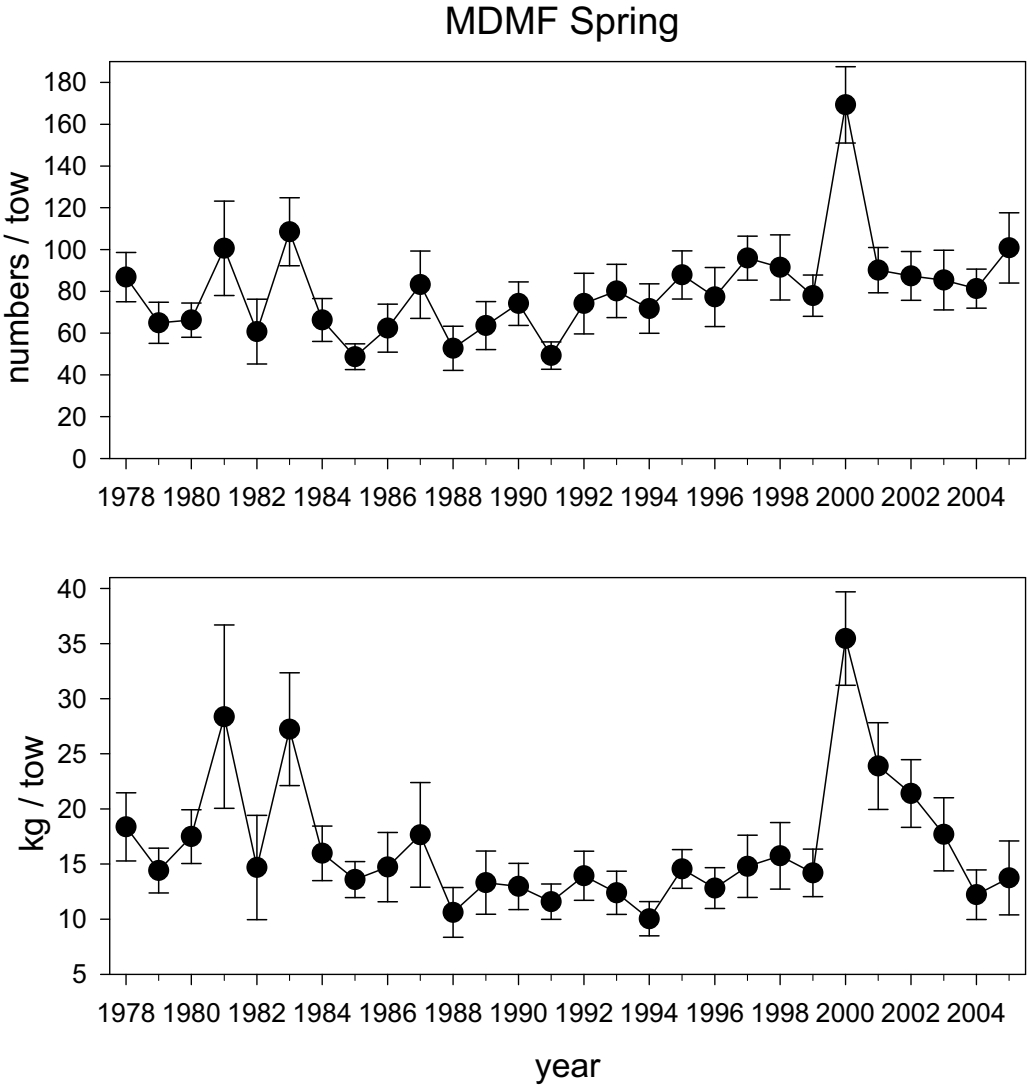

Figure I11. Massachusetts Division of Marine Fisheries (MDMF) Spring survey stratified mean numbers and mean weight (kg) per tow for Gulf of Maine winter flounder.

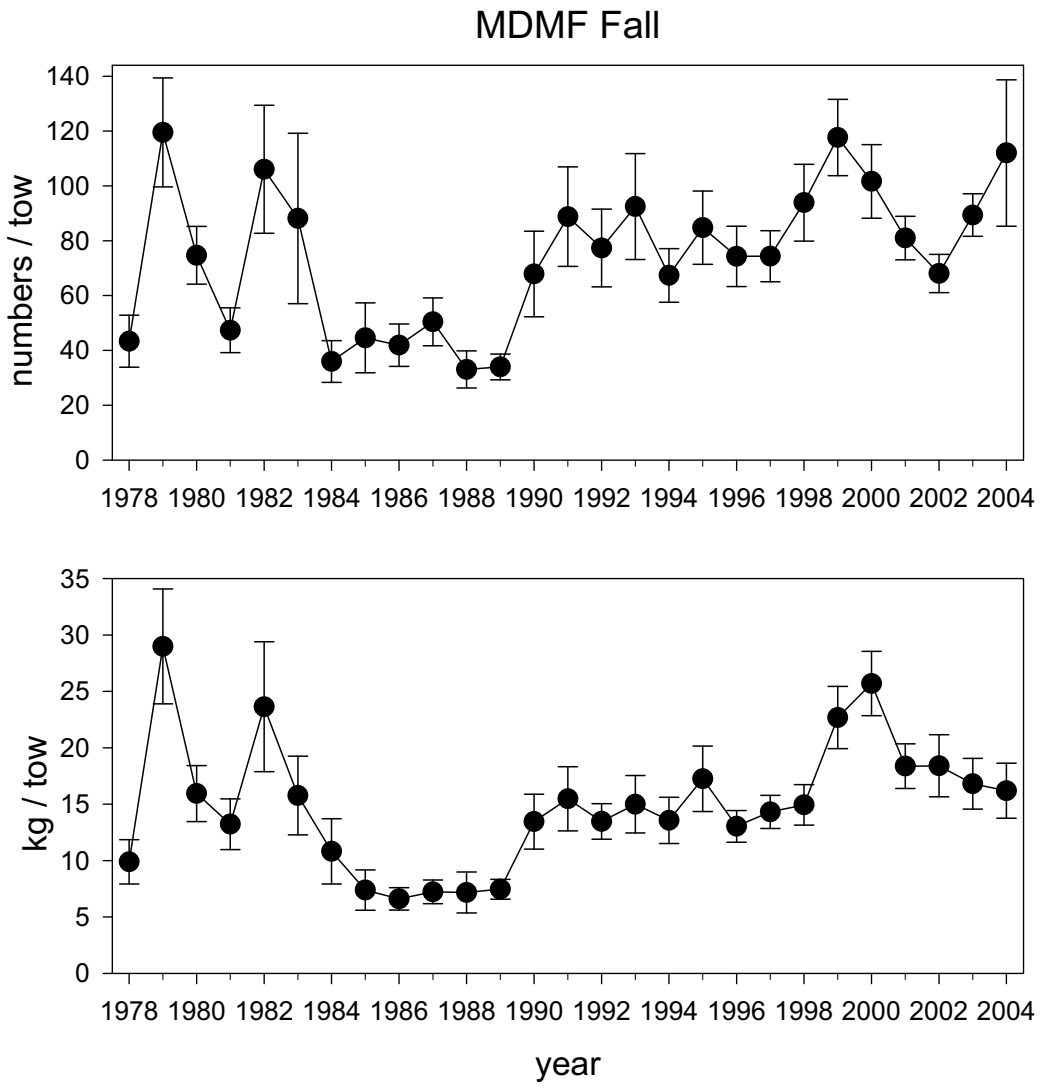

Figure I12. Massachusetts Division of Marine Fisheries (MDMF) Fall survey stratified mean numbers and mean weight (kg) per tow for Gulf of Maine winter flounder.

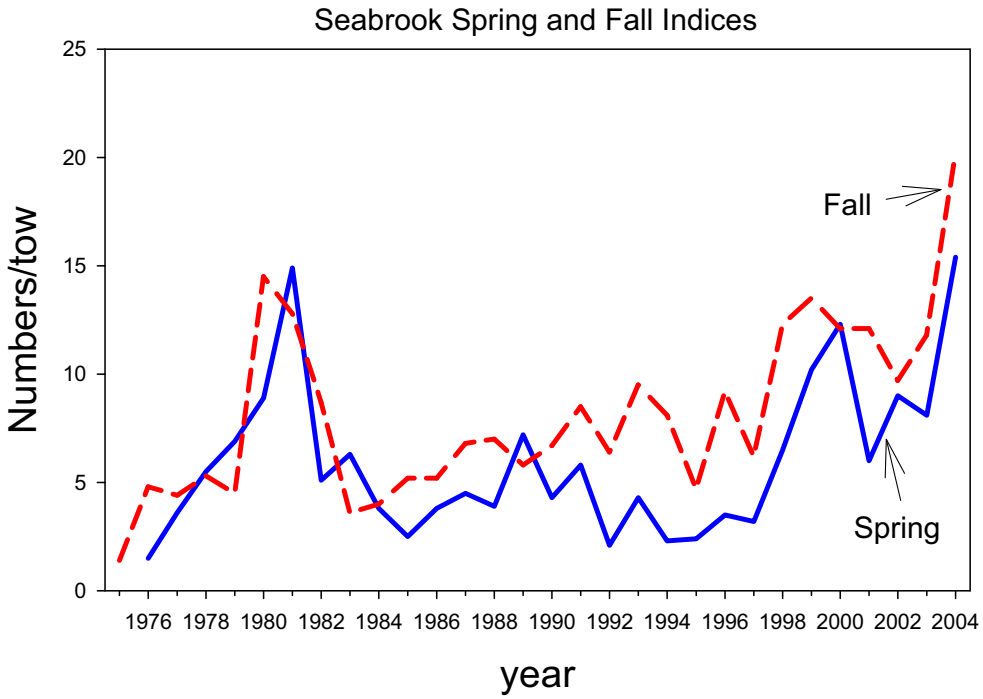

Figure I13. Seabrook Nuclear Power Plant in New Hampshire Spring and Fall survey mean numbers per tow for Gulf of Maine winter flounder. No length data exists from 1975 through 1984 and for 1993. The spring index is used in tunning the VPA.

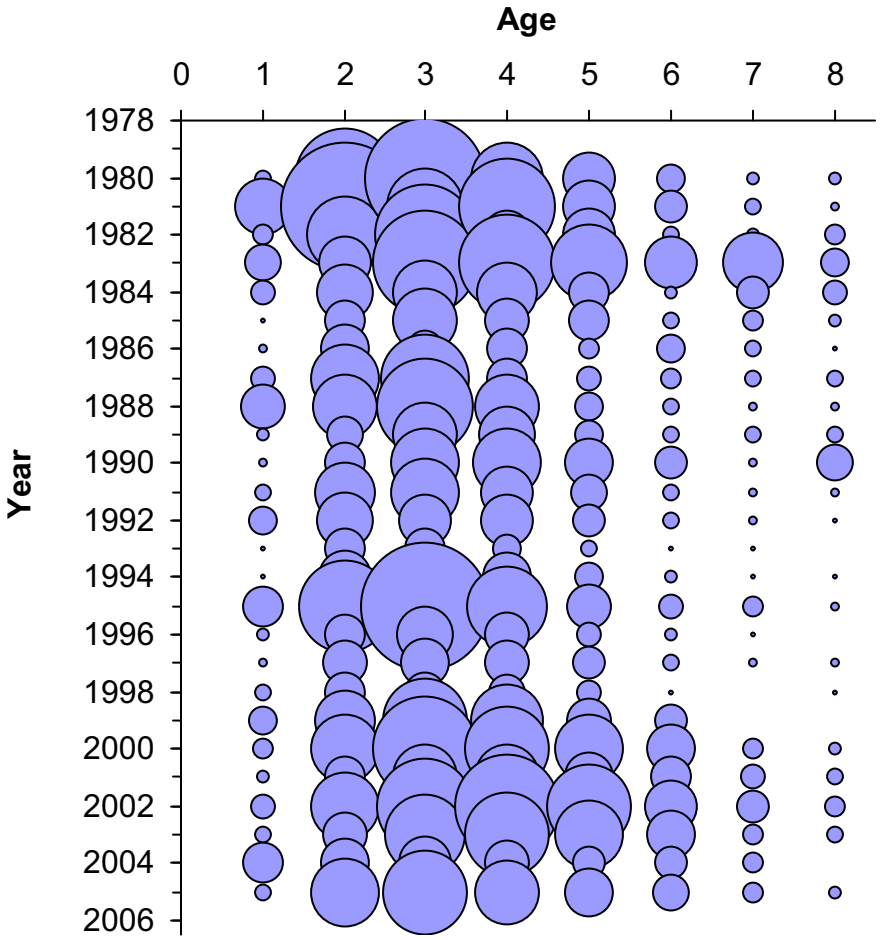

Figure I14. NEFSC Spring bubble plot by age.

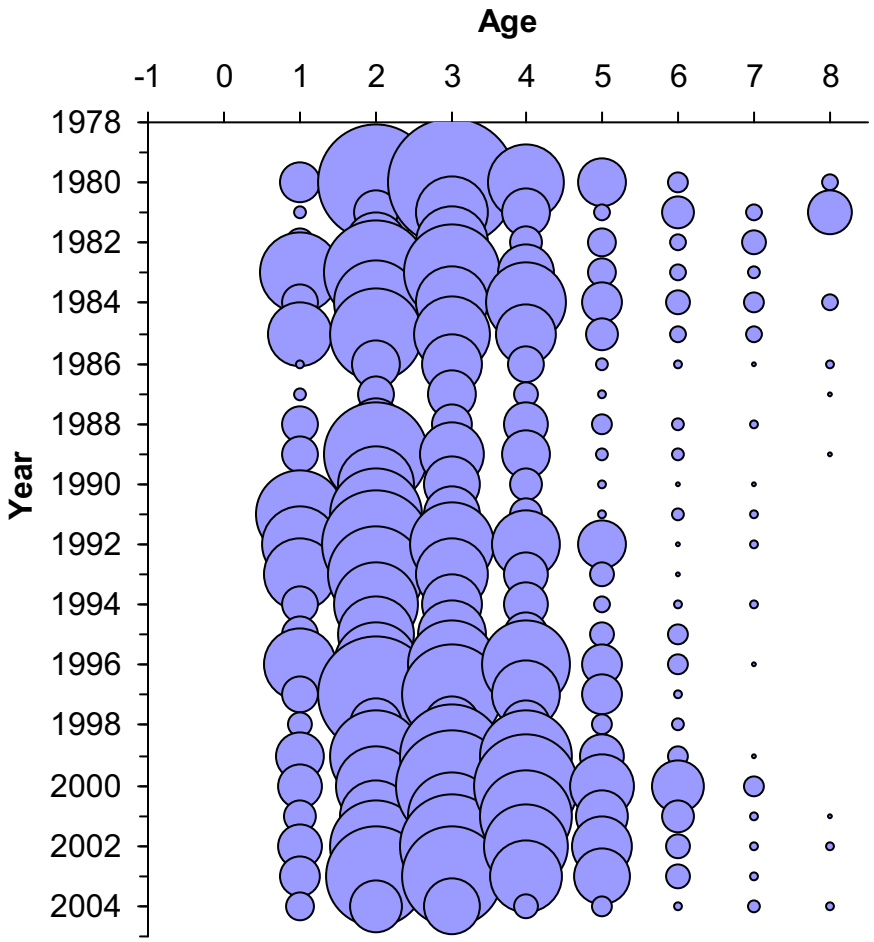

Figure I15. NEFSC Fall bubble plot by age.

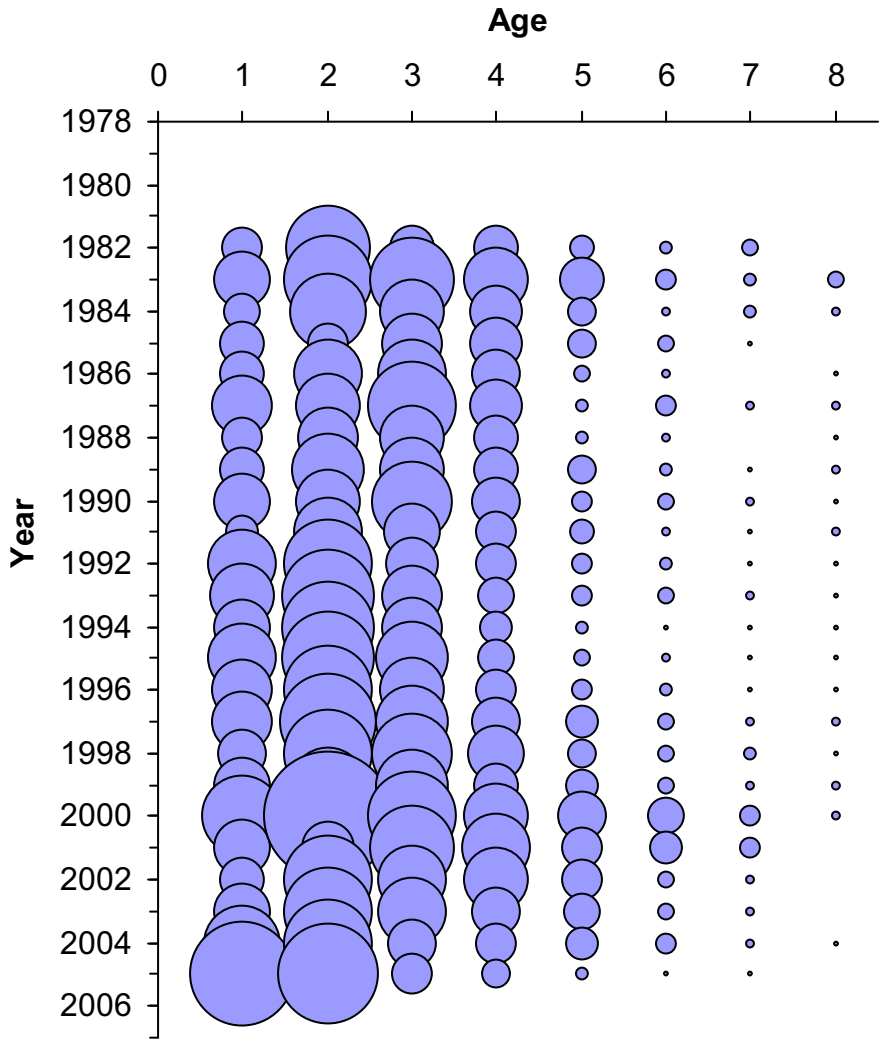

Figure I16. MDMF spring bubble plot by age.

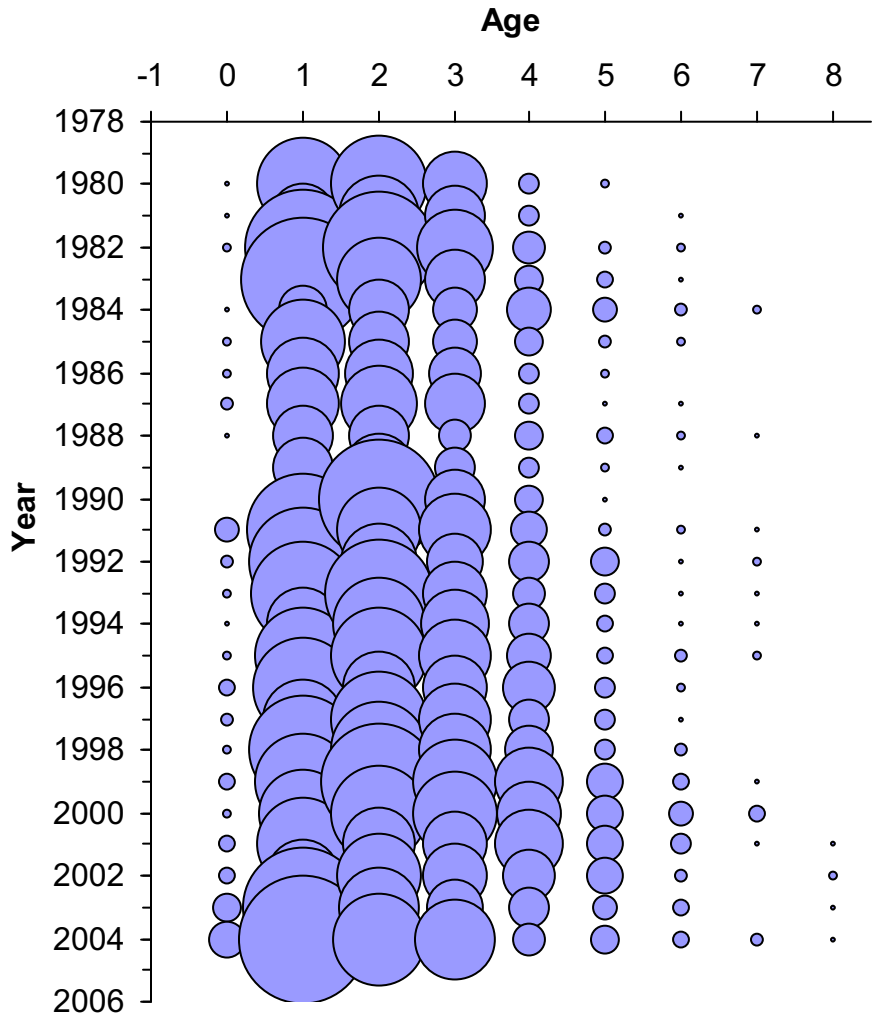

Figure I17. MDMF Fall bubble plot by age.

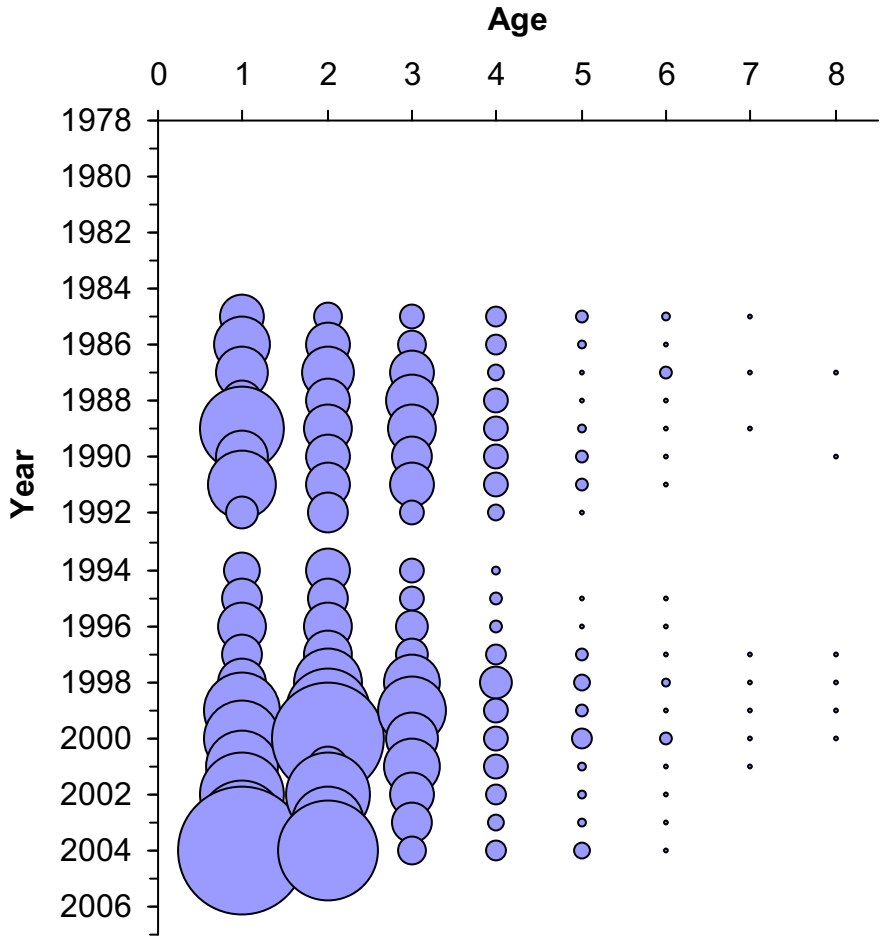

Figure I18. Seabrook Spring bubble plot by age.

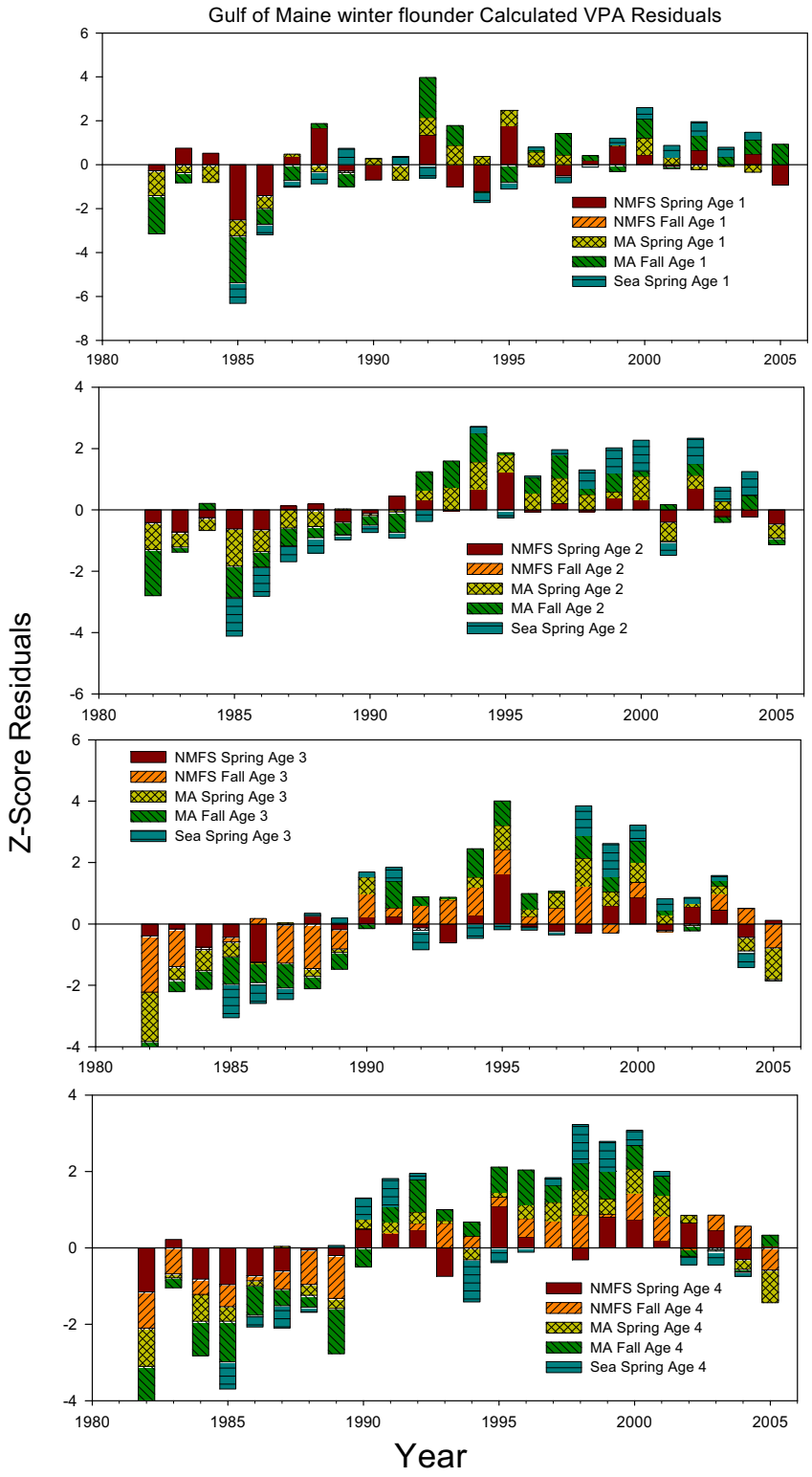

Figure I19. Gulf of Maine winter flounder VPA residual plots.

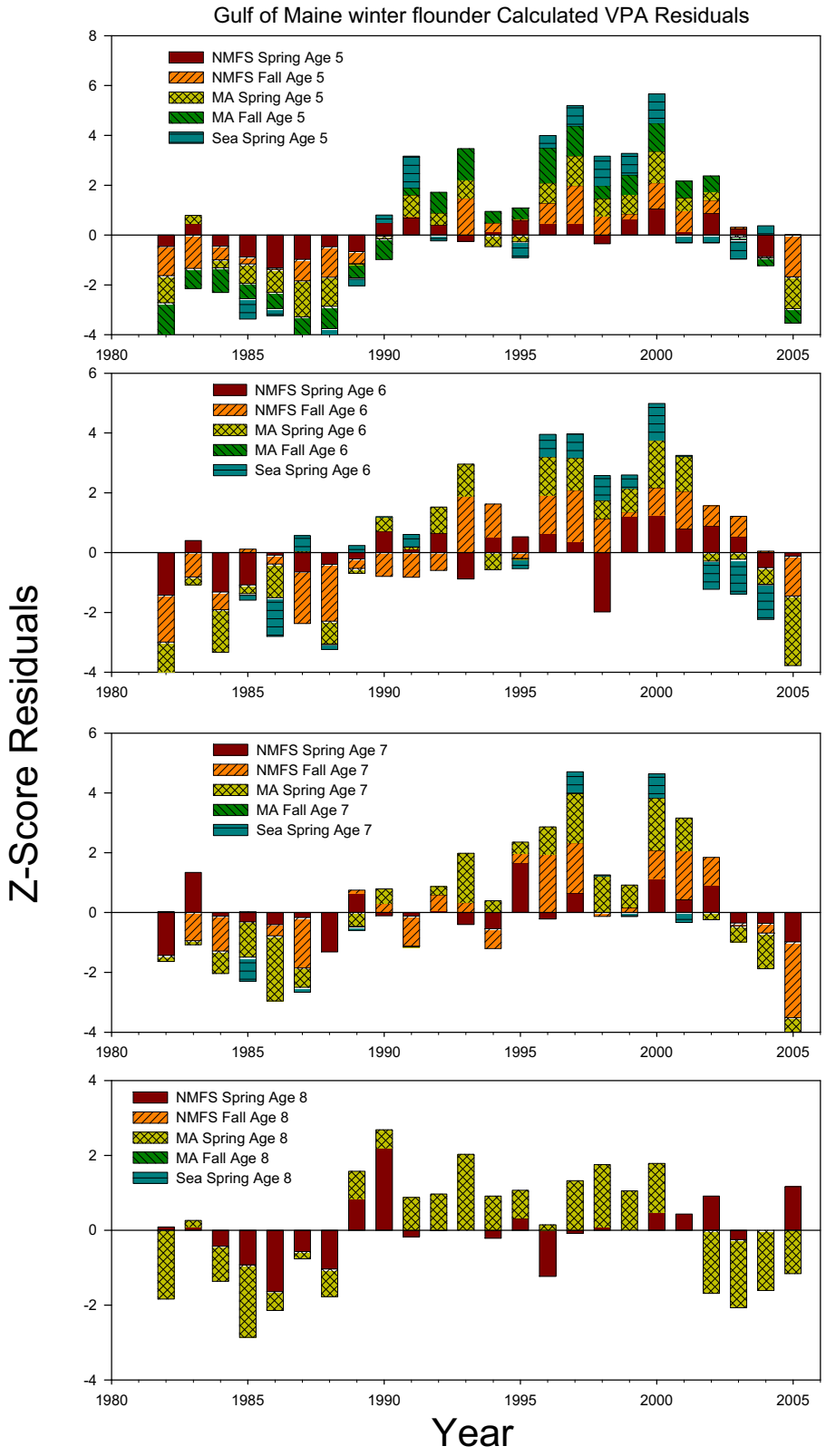

Figure I19. Continued.

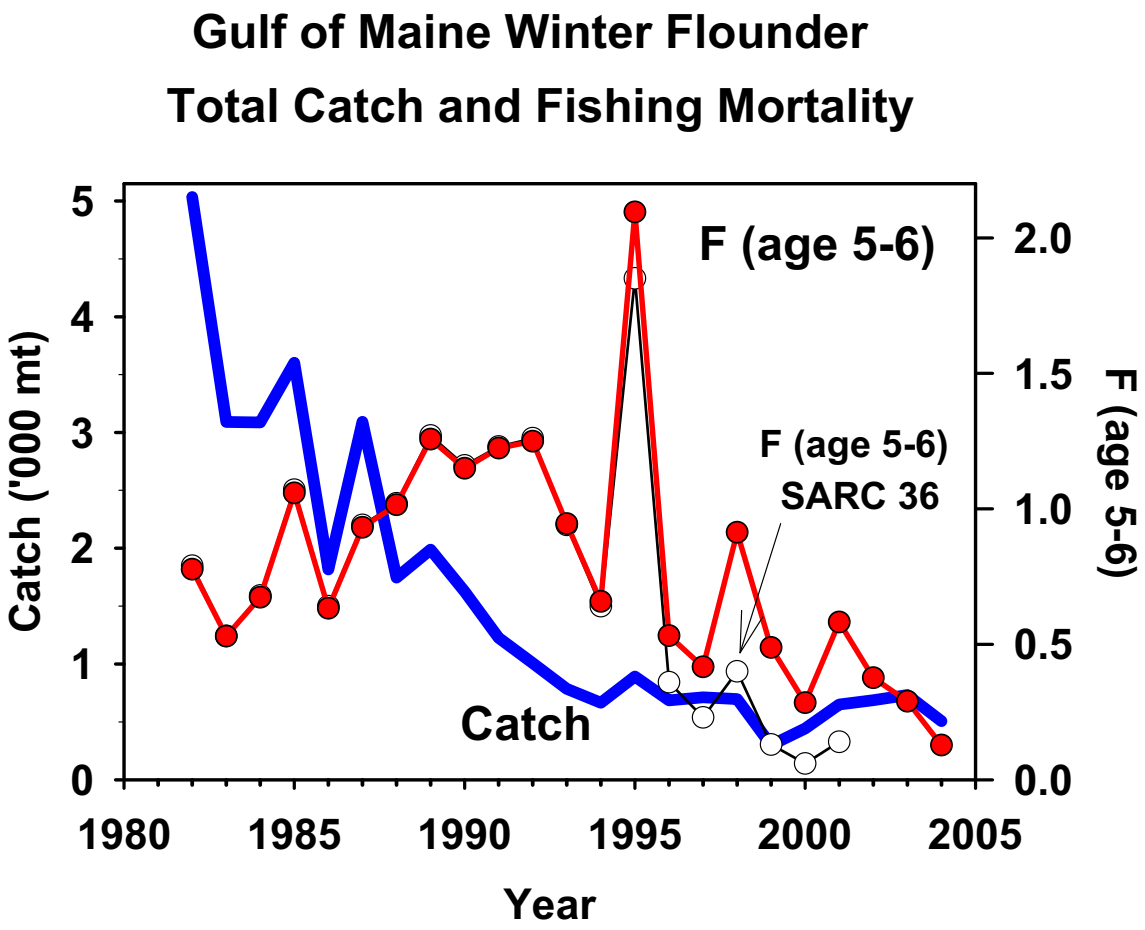

Figure I20. Total catch (landings and discards, thousands of metric tons) and fishing mortality rate (F, ages 5-6, unweighted) for Gulf of Maine winter flounder.

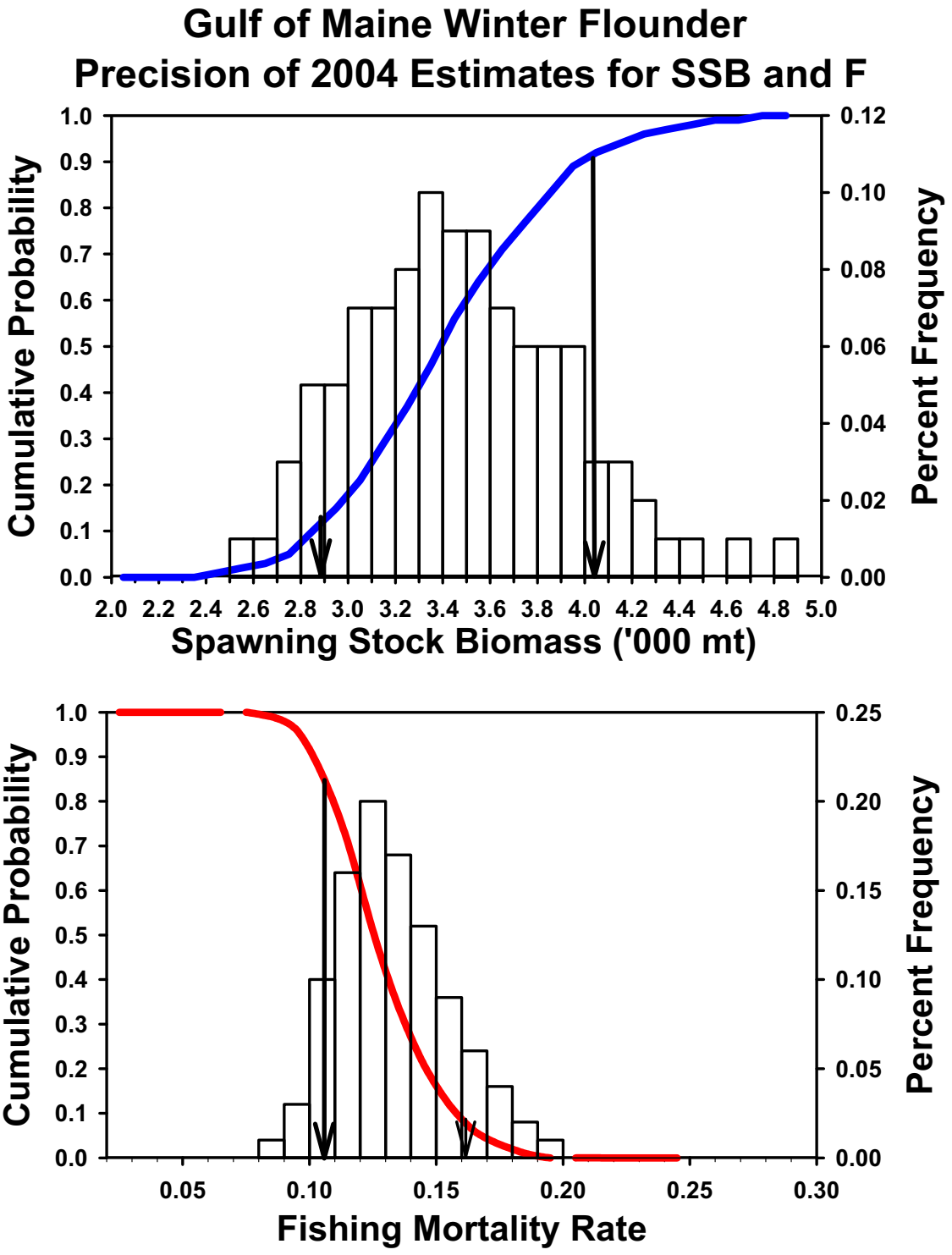

Figure I21. Precision of estimates of spawning stock biomass ('000 mt) and fishing mortality rate (F, ages 5-6, unweighted) in 2004 for Gulf of Maine winter flounder. Vertical bars display the range of the bootstrap estimates and the probability of individual values in the range. The solid curve gives the probability of SSB that is less or fishing mortality that is greater than any value along the X axis.

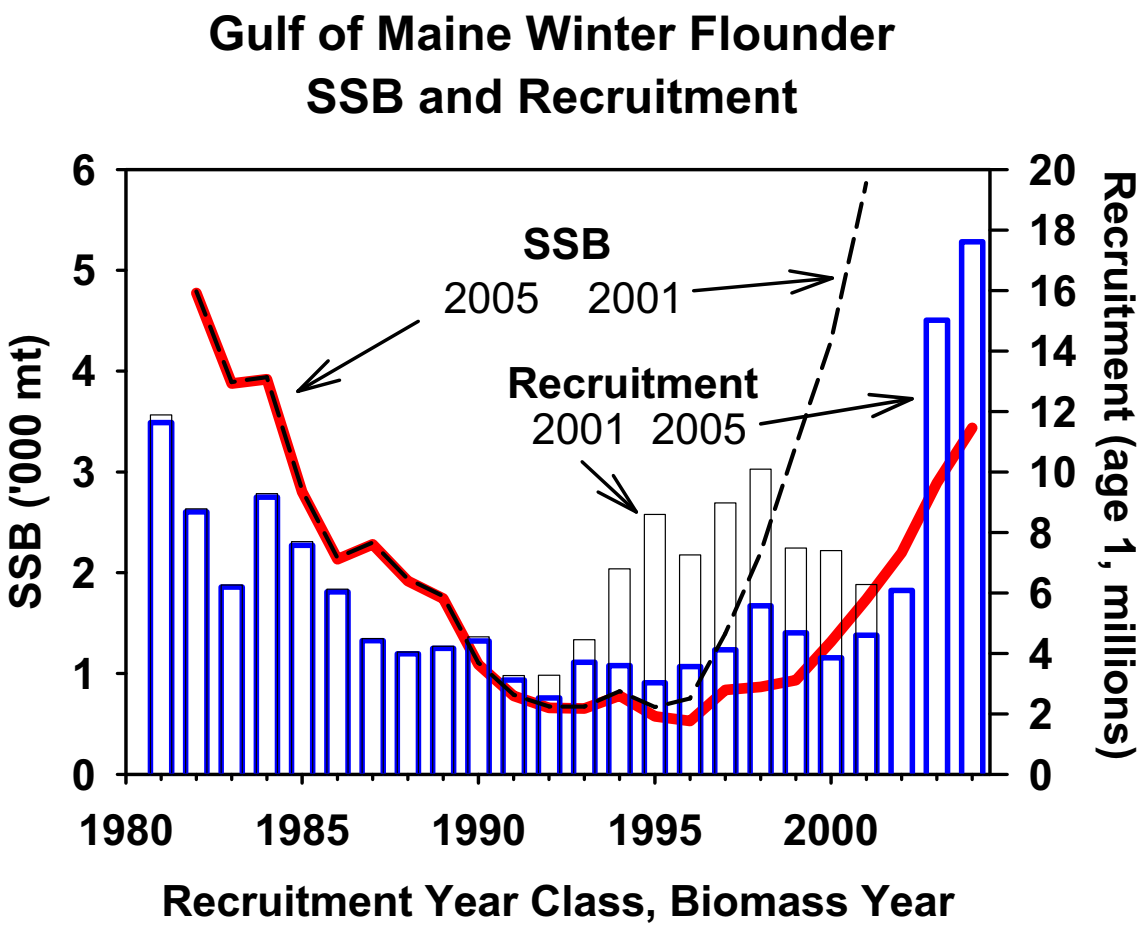

Figure I22. Updated VPA and SARC 36 (2001) spawning stock biomass (SSB, '000 mt) and recruitment (millions of fish at age-1) for Gulf of Maine winter flounder.

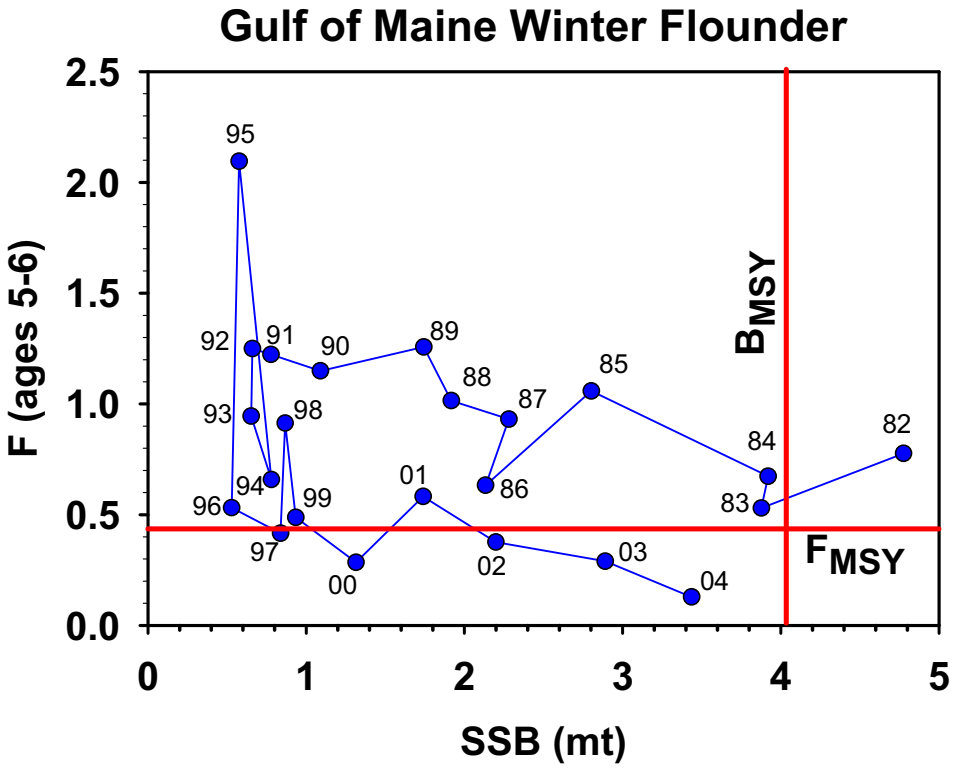

Figure I23. SSB and F (ages 5-6) for Gulf of Maine winter flounder. Biological references points calculated from the Beverton-Holt model in SARC 36 are also shown.

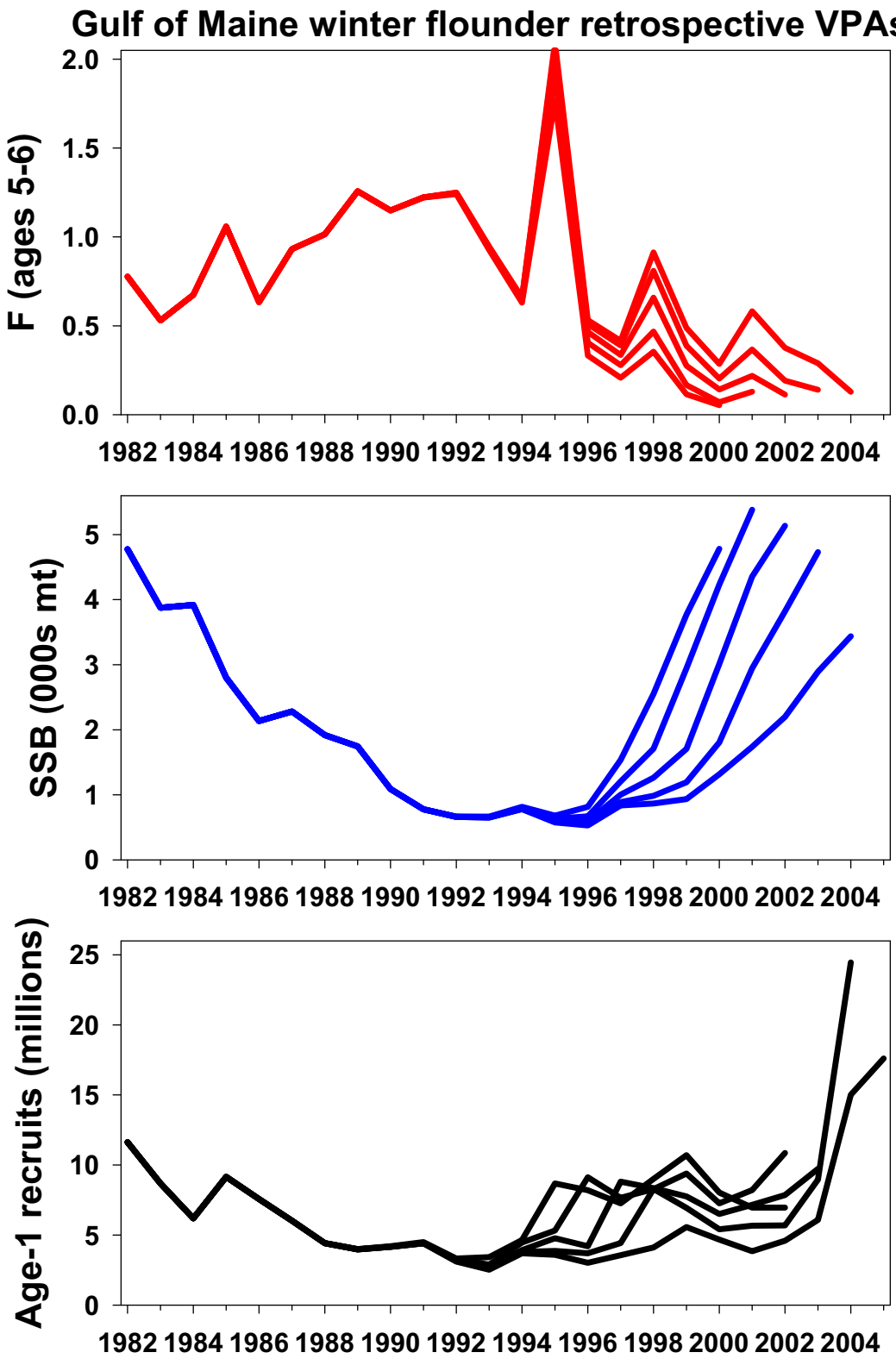

Figure I24. Retrospective VPAs for Gulf of Maine winter flounder.