4.0 Gulf of Maine (GOM) Cod Trip Frequency Analysis

4.1 Methods

To reduce fishing mortality on GOM cod for the 1999 fishing year, Framework 27 implemented a GOM cod trip limit beginning on May 1, 1997. This measure affected vessels fishing north of the cod limit exemption area (north to 42 20' N lat., west of 69 30' W long.). Vessels subject to this measure were allowed to retain up to 200 lbs of cod per day-at-sea, or any part of a day-at-sea.

Framework 27 specified that the cod trip limit would be reduced to between 5 - 100 lbs per day-at-sea when 30 percent of the F_{max} target TAC was reached (30% TTAC = 402 mt). This was to ensure that GOM cod landings were kept below the $F_{0.1}$ TTAC (782 mt) and the F_{max} TTAC of 1340 metric ton targets. Accordingly, the GOM cod trip limit was reduced to 30 lbs per day-at-sea, or any part of a DAS, on May 28, 1999. The purpose of this analysis is to compare the Gulf of Maine daily cod catch under the 1999 200 and 30 lb/DAS catch limit to that in 1998.

In last years MSMC report, the 700 lb/DAS daily cod limit was analyzed by comparing landings from a subset of the Vessel Trip Report database for May through June 24 of 1997 with May through June 24 of 1998, by vessels greater than 30 feet in length which had reported cod landings from the Gulf of Maine (statistical areas 511 through 515) using trawl gear, gillnets, long line, or “other” gear. During the period May-June 24 1997, 15% of these trips would have exceeded the 700 lbs/DAS daily cod trip limit, had it been in effect. For this same time period in 1998, 12%, exceeded the daily limit. Although this information indicated that the majority of trips landed less than the 700 lbs./DAS trip limit, a comparison of May-June 24 1997 (when the cod trip limit was 1000 lbs./DAS) to May-June 24 1998 (700 lbs./DAS trip limit) represents a small, but statistically significant, reduction in the number of trips exceeding the trip limit.

A similar analysis was conducted last year comparing the effects of a 400 lbs./DAS trip limit for the periods June 25 through August 1997 with June 25 through August 1998. The results indicated 23% of the trips would have exceeded the limit in 1997, while 8% of the trips exceeded the 400 lbs/DAS limit in 1998. This represented almost a four-fold reduction in the number of trips exceeding the 400 lb. Daily limit. This was attributed to several factors including a decline in overall codfish abundance, changes in cod distribution or behavioral adjustments in response to the daily limit by the fishing fleet.

For this MSMC report, the same type of analysis is provided to examine the effects of the 200 lbs. DAS and 30 lbs/DAS trip limits implemented by Framework 27. Vessel Trip Reports (VTR) by vessels of thirty feet or longer which landed cod, fished in the Gulf of Maine (statistical areas 464, 465, 511, 512, 513, 514, and 515), used an otter trawl, gillnet, long-line, or a gear type entered as "other" in the database, and sailed between May 1 and June 30 of 1998 or 1999 were selected for analysis. Data collected from the VTR included: date and time sailed and landed, from which trip duration was calculated; gear code (otter trawl, gillnet, long-line), and pounds of cod kept. Trip duration was based on a 24 hour day. If a vessel left port in the afternoon and returned the next morning, the trip would be categorized as less than one day.

4.4.0 Discards in the 1998 cod fishery

The MSMC examined VTR records for discards in the 1998 cod fishery. Table 4.4.1 indicates that 79% of trips that landed Gulf of Maine cod reported no discards of cod. Cod discards were only 2% of total GOM cod landings despite a trip limit of 700 lbs. and 400 lbs. Table 4.4.2 indicate that 85% of the trips that landed Georges Bank cod did not report cod discards. Cod discards were less than 1% of the total Georges Bank cod landings. The discard rates are unreasonably low and are likely to reflect non-compliance with the requirement to report discards in the VTR. The MSMC cautions that this data may be unreliable.

The MSMC also examined the sea sampling database to estimate discards for January-June 1998 when 700 lbs. trip limit was in effect, and January-May 1999 when various trip limits were implemented (400 lbs. from January to April 30th ; 200 lbs. from May 1 to May 28; and 30 lbs. May 29th). The analysis includes only trips with kept or discarded cod in statistical areas 511 through 515 (Gulf of Maine). No trips with cod were recorded from 511 and 512.

Sea sampling trips for marine mammals do not record discard information. Of the total of 186 gillnet trips sampled in the GOM in 1998 only 26 (13%) recorded discard information. Discard rate (cod discard/cod kept) for gillnetters was around 4% for January-June 1998 and 5% for January through May 1999. Of the total 69 gillnet trips sampled January-May 1999, only 12 gillnet trips recorded discard information. Six otter trawl trips were sampled in January-June 1998 and none in January-May 1999. Discard rate for the 6 sampled otter trawls were less than 1% in January-June 1998. Sample size of complete trip coverage in either the gillnet or otter trawl fleet appear to be insufficient for estimating discards in either 1998 or 1999.

Restrictive trip limits have the potential to generate significant discarding of legal size fish. Despite implementation of more restrictive trip limits in calendar year 1999, sea sampling coverage of complete trips in 1999 declined by nearly 20% (12 complete trips (January-May 1999) from 15 (January-May 1998) and no otter trawl trips were sampled. Estimates of discards are necessary to evaluate the effectiveness of trip limits and other management options (e.g., quota and minimum size and mesh regulations). The MSMC recommends that a dedicated sea sampling program designed to collect fishery information (not just fishery-marine mammals interactions) be implemented for use in stock assessments and fishery management.

Table 4.1.1: Cod Trips in the Gulf of Maine by Vessels Greater than 30' in Length using Otter Trawl, Gillnet, or Long-line, **May 1, 1998 through May 28, 1998** with the Trips Grouped into **200** Lb Categories.
Cell shading indicates trips which exceeded an average of 200 lbs. per day.

COD LANDING (LBS.)	TRIP DURATION (24 Hour Days)																						TOTAL	
	0-1		>1-2		>2-3		>3-4		>4-5		>5-6		>6-7		>7-8		>8-9		>9-10		>10			
	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%
1-100	**384**	**27%**	**26**	**23%**	**8**	**14%**	**3**	**9%**	**4**	**14%**			**1**	**6%**									426	25%
>100-200	**215**	**15%**	**15**	**14%**	**11**	**19%**	**5**	**15%**	**2**	**7%**	**3**	**14%**			**1**	**25%**							252	15%
>200-400	**251**	**18%**	**5**	**5%**	**5**	**9%**	**7**	**21%**	**3**	**11%**	**1**	**5%**	**2**	**13%**									274	16%
>400-600	**167**	**12%**	**7**	**6%**	**7**	**12%**	**1**	**3%**	**4**	**14%**	**4**	**18%**	**2**	**13%**									192	11%
>600-800	**206**	**15%**	**8**	**7%**	**1**	**2%**	**3**	**9%**	**4**	**14%**	**2**	**9%**	**2**	**13%**									226	13%
>800-1,000	**34**	**2%**	**5**	**5%**	**1**	**2%**					**3**	**14%**	**1**	**6%**									44	3%
>1,000-1,200	**33**	**2%**	**7**	**6%**	**3**	**5%**	**2**	**6%**	**1**	**4%**	**1**	**5%**	**1**	**6%**									48	3%
>1,200-1,400	**41**	**3%**	**13**	**12%**	**2**	**3%**	**3**	**9%**	**3**	**11%**			**1**	**6%**							**1**	**33%**	64	4%
>1,400-1,600	**16**	**1%**	**5**	**5%**	**2**	**3%**															**1**	**33%**	24	1%
>1,600-1,800	**16**	**1%**	**3**	**3%**	**4**	**7%**	**1**	**3%**	**1**	**4%**													25	1%
>1,800-2,000	**9**	**1%**	**2**	**2%**	**2**	**3%**	**1**	**3%**							**1**	**25%**							15	1%
>2,000-2,200	**5**	**<1%**	**5**	**5%**	**7**	**12%**	**1**	**3%**			**1**	**5%**	**1**	**6%**									20	1%
>2,200-2,400	**6**	**<1%**	**2**	**2%**	**1**	**2%**	**1**	**3%**			**1**	**5%**											11	1%
>2,400-2,600	**5**	**<1%**	**1**	**1%**	**1**	**2%**	**1**	**3%**	**1**	**4%**													9	1%
>2,600-2,800	**6**	**<1%**	**1**	**1%**	**1**	**2%**	**1**	**3%**			**1**	**5%**											10	1%
>2,800	**13**	**1%**	**6**	**5%**	**2**	**3%**	**4**	**12%**	**5**	**18%**	**5**	**23%**	**5**	**31%**	**2**	**50%**			**1**	**100%**	**1**	**33%**	44	3%
TOTAL	1,407	100%	111	100%	58	100%	34	100%	28	100%	22	100%	16	100%	4	100%	0	-	1	100%	3	100%	1,684	100%
Under Limit	599	43%	46	41%	31	53%	19	56%	17	61%	14	64%	10	63%	1	25%	0	0%	0	0%	3	100%	740	44%
Over Limit	808	57%	65	59%	27	47%	15	44%	11	39%	8	36%	6	38%	3	75%	-		1	100%	-	0%	944	56%

Source: NMFS VTR Database (9/24/99)

Table 4.1.2: Cod Trips in the Gulf of Maine by Vessels Greater than 30' in Length using Otter Trawl, Gillnet, or Long-line,
May 1, 1999 through May 28, 1999 with the Trips Grouped into **200** Lb Categories.
Cell shading indicates trips which exceeded an average of 200 lbs. per day.

COD	TRIP DURATION (24 Hour Days)																							
LANDING	0-1		>1-2		>2-3		>3-4		>4-5		>5-6		>6-7		>7-8		>8-9		>9-10		>10		TOTAL	
(LBS.)	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%
1-100	311	46%	9	15%	7	22%	5	23%	1	4%	1	5%	1	9%									335	39%
>100-200	265	39%	8	13%	4	13%	2	9%	5	22%	1	5%											285	33%
>200-400	60	9%	31	52%	5	16%			5	22%	5	23%	4	36%									110	13%
>400-600	12	2%	2	3%	13	41%	8	36%	3	13%		0%	2	18%									40	5%
>600-800	7	1%	2	3%	1	3%	6	27%	3	13%	1	5%	3	27%									23	3%
>800-1,000	6	1%	3	5%	1	3%			1	4%	6	27%									1	50%	18	2%
>1,000-1,200	6	1%	1	2%			1	5%	4	17%	4	18%									1	50%	17	2%
>1,200-1,400	2	<1%	1	2%							2	9%	1	9%	2	100%	1	100%					9	1%
>1,400-1,600	3	<1%			1	3%			1	4%													5	1%
>1,600-1,800	2	<1%																	1	100%			3	<1%
>1,800-2,000	1	<1%																					1	<1%
>2,000-2,200	3	<1%	2	3%																			5	1%
>2,200-2,400																							-	0%
>2,400-2,600	2	<1%																					2	<1%
>2,600-2,800	1	<1%									1	5%											2	<1%
>2,800	2	<1%	1	2%							1	5%											4	<1%
TOTAL	683	100%	60	100%	32	100%	22	100%	23	100%	22	100%	11	100%	2	100%	1	100%	1	100%	2	100%	859	100%
Under Limit	576	84%	48	80%	29	91%	21	95%	18	78%	18	82%	11	100%	2	100%	1	100%	1	100%	2	100%	727	85%
Over Limit	107	16%	12	20%	3	9%	1	5%	5	22%	4	18%	-	0%	-	0%	-	0%	-	0%	-	0%	132	15%

Source: NMFS VTR Database (9/24/99)

Table 4.1.3: Cod Trips in the Gulf of Maine by Vessels Greater than 30' in Length using Otter Trawl, Gillnet, or Long-line, **May 29, 1998 through June 30, 1998** with the Trips Grouped into **30** Lb Categories.
Cell shading indicates trips which exceeded an average of 30 lbs. per day.

COD LANDING (LBS.)	TRIP DURATION (24 Hour Days)																				TOTAL	
	0-1		>1-2		>2-3		>3-4		>4-5		>5-6		>6-7		>7-8		>8-9		>9-10			
	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%
1- 30	286	17%	5	4%	3	4%	1	1%					1	6%							296	15%
>30-60	161	10%	7	5%	2	3%	2	3%	1	2%											173	9%
>60-90	101	6%	3	2%			5	7%			1	4%									110	5%
>90-120	133	8%	5	4%	2	3%	1	1%	2	4%	1	4%									144	7%
>120-150	92	6%	7	5%	2	3%	1	1%	3	6%	2	8%									107	5%
>150-180	45	3%	1	1%							1	4%									47	2%
>180-210	85	5%	7	5%	8	12%	1	1%	2	4%											103	5%
>210-240	34	2%	4	3%	1	1%	1	1%	2	4%											42	2%
>240-270	48	3%	1	1%	2	3%	2	3%	1	2%	2	8%									56	3%
>270-300	69	4%	3	2%	4	6%	2	3%	2	4%											80	4%
>300-330	27	2%	4	3%	1	1%	1	1%	2	4%	1	4%			1	13%					37	2%
>330-360	29	2%	4	3%	2	3%	1	1%	1	2%	1	4%									38	2%
>360-390	27	2%	2	2%	1	1%	1	1%	2	4%											33	2%
>390-420	80	5%	1	1%	2	3%			2	4%	1	4%									86	4%
>420	436	26%	75	58%	37	55%	48	72%	30	60%	15	60%	15	94%	7	88%	5	100%	2	100%	670	33%
TOTAL	1,653	100%	129	100%	67	100%	67	100%	50	100%	25	100%	16	100%	8	100%	5	100%	2	100%	2,022	100%
Under Limit	286	17%	12	9%	5	7%	9	13%	6	12%	5	20%	1	6%	-	0%	0	0%	-	0%	324	16%
Over Limit	1,367	83%	117	91%	62	93%	58	87%	44	88%	20	80%	15	94%	8	100%	5	100%	2	100%	1,698	84%

Source: NMFS VTR Database (9/27/99)

Table 4.1.4: Cod Trips in the Gulf of Maine by Vessels Greater than 30' in Length using Otter Trawl, Gillnet, or Long-line,
May 29, 1999 through June 30, 1999 with the Trips Grouped into **30** Lb Categories.
Cell shading indicates trips which exceeded an average of 30 lbs. per day.

COD LANDING (LBS.)	**TRIP DURATION (24 Hour Days)**																					
	0-1		>1-2		>2-3		>3-4		>4-5		>5-6		>6-7		>7-8		>8-9		>9-10		TOTAL	
	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%
1- 30	**1,079**	**93%**	**24**	**29%**	**4**	**11%**	**2**	**6%**	**1**	**3%**					**1**	**10%**			**1**	**33%**	1,112	79%
>30-60	**47**	**4%**	**50**	**61%**	**11**	**29%**	**4**	**13%**	**1**	**3%**	**2**	**6%**	**1**	**8%**	**1**	**10%**					117	8%
>60-90	**21**	**2%**	**6**	**7%**	**17**	**45%**	**4**	**13%**	**2**	**6%**	**2**	**6%**									52	4%
>90-120	**3**	**<1%**			**5**	**13%**	**20**	**63%**	**20**	**63%**	**7**	**23%**	**1**	**8%**	**1**	**10%**	**1**	**25%**			58	4%
>120-150	**5**	**<1%**					**1**	**3%**	**7**	**22%**	**7**	**23%**	**3**	**25%**	**1**	**10%**					24	2%
>150-180	**1**	**<1%**							**1**	**3%**	**10**	**32%**	**1**	**8%**	**1**	**10%**					14	1%
>180-210													**3**	**25%**	**3**	**30%**					6	<1%
>210-240	**1**	**<1%**													**2**	**20%**					3	0%
>240-270																	**2**	**50%**			2	0%
>270-300	**3**	**<1%**	**1**	**1%**	**1**	**3%**					**1**	**3%**									6	0%
>300-330																						
>330-360																						
>360-390																						
>390-420																						
>420	**2**	**<1%**	**1**	**1%**			**1**	**3%**			**2**	**6%**	**3**	**25%**			**1**	**25%**	**2**	**67%**	12	1%
TOTAL	1,162	100%	82	100%	38	100%	32	100%	32	100%	31	100%	12	100%	10	100%	4	100%	3	100%	1,406	100%
Under Limit	1,079	93%	74	90%	32	84%	30	94%	31	97%	28	90%	9	75%	10	100%	3	75%	1	33%	1,297	92%
Over Limit	83	7%	8	10%	6	16%	2	6%	1	3%	3	10%	3	25%	-	0%	1	25%	2	67%	109	8%

Source: NMFS VTR Database (9/27/99)

Table 4.1.5: Cod Trips in the Gulf of Maine by Vessels Greater than 30' in Length
using **All Gear Types,** February 1, 1999 through April 30, 1999 with the Trips Grouped into **400** Lb Categories.
Cell shading indicates trips which exceeded an average of 400 lbs. per day.

COD LANDING (LBS.)	**TRIP DURATION (24 Hour Days)**																						TOTAL	
	0-1		>1-2		>2-3		>3-4		>4-5		>5-6		>6-7		>7-8		>8-9		>9-10		>10			
	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%	TRIPS	%
1 - 30	150	27%	26	16%	12	14%	9	10%	4	5%							1	7%					202	18%
>30 - 100	156	28%	37	23%	21	24%	19	20%	13	16%	4	7%	2	8%			1	7%	1	11%			254	23%
>100-400	203	36%	47	29%	26	30%	29	31%	33	41%	9	17%	4	16%	2	14%	1	7%	1	11%	2	15%	357	32%
>400-800	33	6%	32	20%	13	15%	19	20%	10	13%	11	20%	7	28%	3	21%	3	21%	3	33%			134	12%
>800-1,200	10	2%	14	9%	12	14%	5	5%	5	6%	8	15%	3	12%	1	7%	1	7%					59	5%
>1,200-1,600	2	<1%	6	4%	2	2%	6	6%	4	5%	3	6%	3	12%			1	7%	1	11%			28	3%
>1,600-2,000	1	<1%	1	1%			4	4%	8	10%	6	11%	1	4%			3	21%	1	11%	1	8%	26	2%
>2,000-2,400	1	<1%					2	2%			3	6%					1	7%					7	1%
>2,400-2,800									1	1%	3	6%	1	4%	1	7%			1	11%			7	1%
>2,800-3,200	1	<1%									3	6%	1	4%	3	21%	2	14%	1	11%			11	1%
>3,200-3,600	2	<1%			1	1%																	3	<1%
>3,600-4,000					1	1%			1	1%			1	4%	1	7%					1	8%	5	<1%
>4,000-4,800											1	2%									3	23%	4	<1%
>4,800-5,600													1	4%							4	31%	5	<1%
>5,600-6,400											1	2%									1	8%	2	<1%
>6,400-8,000											1	2%			2	14%							3	<1%
>8,000-10,000																							-	<1%
>10,000									1	1%	1	2%	1	4%	1	7%					1	8%	5	<1%
TOTAL	559	100%	163	100%	88	100%	93	100%	80	100%	54	100%	25	100%	14	100%	14	100%	9	100%	13	100%	1,112	100%
Under Limit	509	91%	142	87%	84	95%	87	94%	77	96%	44	81%	21	84%	10	71%	14	100%	9	100%	13	100%	1,010	91%
Over Limit	50	9%	21	13%	4	5%	6	6%	3	4%	10	19%	4	16%	4	29%	-	0%	-	0%	-		102	9%

Source: NMFS VTR Database (10/1/99)

Table 4.1.6: Cod Trips and Cod Landings in the Gulf of Maine by Vessels Greater than 30' in Length
using **All Gear Types**, February 1, 1999 through April 30, 1999 with the Trips Grouped into **400** Lb Categories.
Cell shading indicates trips which exceeded an average of 400 lbs. per day.

COD LANDING (LBS.)	**TRIP DURATION (24 Hour Days)**																						TOTAL	
	0-1		>1-2		>2-3		>3-4		>4-5		>5-6		>6-7		>7-8		>8-9		>9-10		>10			
	TRIPS	LBS	TRIPS	LBS	TRIPS	LBS	TRIPS	LBS	TRIPS	LBS	TRIPS	LBS	TRIPS	LBS	TRIPS	LBS	TRIPS	LBS	TRIPS	LBS	TRIPS	LBS	TRIPS	LBS
1 - 30	150	2,463	26	449	12	213	9	138	4	92							1	11					202	3,366
>30 -100	156	9,646	37	2,354	21	1,407	19	1,299	13	1,058	4	230	2	130			1	70	1	82			254	16,276
>100-400	203	47,121	47	11,404	26	5,857	29	6,675	33	7,931	9	1,805	4	1,040	2	700	1	300	1	400	2	475	357	83,708
>400-800	33	19,278	32	20,950	13	8,138	19	11,057	10	5,749	11	5,603	7	3,992	3	1,719	3	1,960	3	1,910			134	80,356
>800-1,200	10	10,480	14	14,390	12	13,004	5	5,327	5	5,216	8	8,045	3	3,455	1	1,000	1	1,000					59	61,917
>1,200-1,600	2	2,608	6	8,665	2	2,470	6	9,028	4	5,790	3	4,190	3	4,400			1	1,500	1	1,300			28	39,951
>1,600-2,000	1	1,650	1	1,700			4	7,475	8	15,232	6	11,618	1	1,700			3	5,650	1	2,000	1	1,800	26	48,825
>2,000-2,400	1	2,300					2	4,300			3	7,070					1	2,362					7	16,032
>2,400-2,800									1	2,483	3	7,795	1	2,700	1	2,700			1	2,500			7	18,178
>2,800-3,200	1	3,046									3	9,000	1	3,200	3	9,600	2	6,095	1	3,200			11	34,141
>3,200-3,600	2	6,646			1	3,222																	3	9,868
>3,600-4,000					1	3,765			1	4,000			1	4,000	1	3,644					1	3,931	5	19,340
>4,000-4,800											1	4,200									3	13,580	4	17,780
>4,800-5,600													1	5,000							4	20,875	5	25,875
>5,600-6,400											1	5,890									1	5,707	2	11,597
>6,400-8,000											1	8,000			2	15,000							3	23,000
>8,000-10,000																								
>10,000									1	11,690	1	12,270	1	25,000	1	22,000					1	25,765	5	96,725
TOTAL	559	105,238	163	59,912	88	38,076	93	45,299	80	59,241	54	85,716	25	54,617	14	56,363	14	18,948	9	11,392	13	72,133	1,112	606,935
Under Limit	509	59,230	142	35,157	84	28,619	87	33,524	77	41,068	44	38,561	21	17,417	10	15,719	14	18,948	9	11,392	13	72,133	1,010	371,768
Over Limit	50	46,008	21	24,755	4	9,457	6	11,775	3	18,173	10	47,155	4	37,200	4	40,644	-		0		0		102	235,167

Source: NMFS VTR Database (10/1/99)

Table 4.4.1. Discards of Cod in Gulf of Maine (1998)

	Number of Vessels	Number of Fishing Trips	Trips with zero reported cod discards	Proportion of fishing trips with no reported cod discards	Total GOM cod Landings (lbs.)	Total GOM cod Discards (lbs.)	Proportion Discarded
Jan	206	880	692	0.786	581,425	7,980	0.014
Feb	203	949	730	0.769	583,570	8,654	0.015
Mar	256	1,107	917	0.828	764,498	19,665	0.025
Apr	358	2,311	1,847	0.799	1,062,514	15,684	0.015
May	340	2,058	1,539	0.748	1,137,597	13,695	0.012
Jun	331	1,956	1,512	0.773	948,251	26,411	0.027
Jul	294	1,429	1,106	0.774	377,618	18,587	0.047
Aug	250	1,009	774	0.767	290,498	6,452	0.022
Sep	251	950	763	0.803	283,838	5,956	0.021
Oct	270	1,017	797	0.784	330,941	11,253	0.033
Nov	264	1,188	976	0.822	371,784	19,706	0.050
Dec	265	1,106	909	0.822	452,840	10,978	0.024
Total		**15,960**	**12,562**	**0.787**	**7,185,374**	**165,021**	**0.022**

Table 4.4.2. Discards of Cod in Georges Bank (1998)

	Number of Vessels	Number of Fishing Trips	Trips with zero reported cod discards	Proportion of fishing trips with no reported cod discards	Total Georges Bank cod Landings (lbs.)	Total Georges Bank cod Discards (lbs.)	Proportion Discarded
Jan	237	766	672	0.877	756,673	5,490	0.007
Feb	237	825	728	0.882	721,990	5,433	0.007
Mar	233	695	611	0.879	885,503	3,672	0.004
Apr	303	769	667	0.867	1,928,351	5,528	0.003
May	267	776	637	0.821	1,985,775	8,375	0.004
Jun	286	963	807	0.838	1,201,872	28,317	0.023
Jul	258	935	760	0.813	916,884	7,471	0.008
Aug	269	844	681	0.807	861,951	10,332	0.012
Sep	246	846	694	0.820	932,870	7,251	0.008
Oct	192	455	378	0.831	559,057	3,110	0.006
Nov	231	634	559	0.882	614,511	1,880	0.003
Dec	259	924	802	0.868	1,131,272	7,040	0.006
Total		**9,432**	**7,996**	**0.848**	**12,496,709**	**93,899**	**0.007**

Table 4.4.3. Sea sampling trips in the statistical areas 511 through 515 (GOM) in which cod catch were recorded January 1998 through June 1998 (700 lbs. trip limit in effect).

Year/Month	Statistical Area	Limited Gillnet Trips	Limited Gillnet Kept	Limited Gillnet Discard	Complete Gillnet trips	Complete Gillnet Kept	Complete Gillnet discard	Otter trawl trips	Otter trawl kept	Otter trawl discard
January 98	513	0	-	-	0	-	-	0	-	-
	514	12	7,374	NM	0	-	-	0	-	-
	515	0	-	-	0	-	-	0	-	-
February 98	513	0	-	-	0	-	-	0	-	-
	514	18	9,523	NM	2	119	25	0	-	-
	515	0	-	-	0	-	-	0	-	-
March 98	513	0	-	-	0	-	-	0	-	-
	514	26	8,152	NM	2	667	21	0	-	-
	515	1	1,375	NM	0	-	-	2	1,034	18
April 98	513	0	-	-	0	-	-	1	1,094	2
	514	37	7,991	NM	4	3,204	247	0	-	-
	515	1	3,770	NM	0	-	-	0	-	-
May 98	513	10	4,290	NM	2	1,006	0	1	18	0
	514	17	7,800	NM	4	1,453	15	0	-	-
	515	0	-	-	1	4,150	268	0	-	-
June 98	513	14	9,059	NM	4	1,958	30	0	-	-
	514	24	4,827	NM	7	5,010	76	2	210	1
	515	0	-	-	0	-	-	0	-	-
Totals		160	64,161		26	17,567	682	6	2,356	21

Table 4.4.4. Sea sampling trips in the statistical areas 511 through 515 (GOM) in which cod catch were recorded January 1999 through May 1999 (trip limit changes from 400 lbs. to 200 lbs. to 30 lbs. trip limit during this time period).

Year/Month	Statistical Area	Limited Gillnet Trips	Limited Gillnet Kept	Limited Gillnet Discard	Complete Gillnet trips	Complete Gillnet Kept	Complete Gillnet discard	Otter trawl trips	Otter trawl kept	Otter trawl discard
January 99	513	0	-	-	0	-	-	0	-	-
	514	14	9,901	NM	3	758	22	0	-	-
	515	1	40	NM	0	-	-	0	-	-
February 99	513	0	-	-	0	-	-	0	-	-
	514	6	2,486	NM	1	149	0	0	-	-
	515	1	421	NM	0	-	-	0	-	-
March 99	513	0	-	-	0	-	-	0	-	-
	514	6	1,434	NM	1	415	16	0	-	-
	515	2	481	NM	1	191	1	0	-	-
April 99	513	0	-	-	0	-	-	0	-	-
	514	0	-	-	0	-	-	0	-	-
	515	3	7,378	NM	0	-	-	0	-	-
May 99	513	0	-	-	0	-	-	0	-	-
	514	24	3,206	NM	6	876	71	0	-	-
	515	0	-	-	0	-	-	0	-	-
Totals		57	25,347		12	2,389	110	0		

1) Analysis includes only trips with kept or discarded cod. Query included areas 511 through 515 (all GOM), no trips with cod were recorded from 511 and 512.
2) Limited gillnet trips are those in which observers watch for marine mammals, collect kept weights when possible and collect **no discard information** = NM.
3) Complete gillnet trips are those that collected all kept and discard data.
4) 1999 data were only available through May at the time of analysis.

During May 1, 1998 through May 28 1998, vessels in the Gulf of Maine fished under a 700 lbs./DAS daily cod limit. As of May 1, 1999 the daily cod limit was 200 pounds. As of May 28, 1999 the daily limit was reduced to 30 pounds. Vessels that were at sea before or after that date were allowed the catch limit for the date the fish were caught.

Trips that sailed before May 28 of 1998 or 1999 are considered separately here from those that sailed on or after May 28. A few trips may have occurred under both the 200 and 30 pound regulations, but are grouped strictly by date sailed.

In this analysis, the daily catch is calculated on total trip duration, and not DAS. Trips which appear to exceed the daily cod limit may have used DAS time to account for the excessive catch. Note that the data are preliminary, much of the data used have not been audited. However, data quality is generally sufficient for this type of analysis.

A total of 5,971 trips were selected. In 1998 there were 3,706 trips, and in 1999 there were 2,265 trips. During the first 4 weeks of the fishing year, that is up to May 28th, a total of 2,543 trips were selected (1,684 from 1998 and 859 from 1999). In the following 4 weeks, to the end of June, there were 3,428 trips (2,022 from 1998 and 1,406 from 1999). Typically, the first 8 weeks of a fishing year have the greatest activity in the Gulf of Maine cod fishery.

4.2 Results

Results are given in the following 4 tables. Tables 4.1.1 – 4.1.2 cover May 1 through May 28, and tables 4.1.3 – 4.1.4 cover from May 29 through June 30. Tables 4.1.1 and 4.1.3 are for 1998, and tables 4.1.2 and 4.1.4 are for 1999. Each table contains data for all gear sectors combined, otter trawl, gillnet and long-line. Shading is used in the tables to indicate trips which caught more than either 200 or 30 pounds of cod per day absent. The last column of Table 4.1.1 and 4.1.2, trips greater than 10 days, is unshaded because the catch per day is indeterminate. There are only three trips which may have exceeded the catch limit, but are included with those under the limit.

The greatest proportion of trips selected were away from port for less than 24 hours. From May 1 through May 28, 82% of the combined 1998 and 1999 trips were less than 24 hours. After May 28, 82% of the trips were less than one full day.

Examining overages indicates that during the period May 1- May 28 1998, 56% of the trips would have exceeded a daily cod trip limit of 200 pounds, if it had been in effect (Table 4.1.5). For this same time period in 1999, 15% actually exceeded the daily limit. This represents almost a four-fold reduction in the number of trips exceeding the 200 lbs/DAS trip limit. The 200 lbs/DAS daily cod limit did have an effect on reducing the number of trips exceeding the limit from 1998 to 1999.

During the period May 29- June 30 1998, 84% of the trips would have exceeded a daily GOM cod trip limit of 30 pounds, if it had been in effect. For this same time period in 1999, 8% actually exceeded the daily limit. This represents a ten-fold reduction in the number of trips exceeding the 30 lbs/DAS trip limit. The 30 lbs/DAS daily cod limit did have an effect on reducing the number of trips exceeding the limit from 1998 to 1999.

This analysis only indicates the number of trips reported using VTR data that were over or under the daily GOM cod trip limit. These results could be attributable to any number of factors including a decline in overall codfish abundance, changes in cod distribution, behavioral adjustments in response to the daily limit by the fishing fleet, or discarding of cod in excess of the daily limit.

Insert Table 4.1

Insert Table 4.1.2

Insert Table 4.1.3

Insert Table 4.1.4

Table 4.1.5. Percentage of trips reporting under and over 200 lbs and 30lbs per DAS in 1998 and 1999.

	200 lbs Trip Limit		30 lbs Trip Limit	
	1998	1999	1998	1999
% Under	44%	85%	16%	92%
% Over	56%	15%	84%	8%

4.3 Evaluation of the effects of trip limit regulations.

The MSMC did not update this section. The multiple changes in trip limits for Gulf of Maine cod over a short period makes a projection of landings for a given trip limit difficult. Since May 1998, the trip limit has changed as follows:

Start date	Ending date	Trip limit amount
May 1, 1998	June 25, 1998	700 lbs. per day
June 26, 1998	April 30, 1999	400 lbs. per day
May 1, 1999	May 28, 1999	200 lbs. per day
May 29, 1999	August 2, 1999	30 lbs. per day
August 3, 1999	January 30, 2000	100 lbs. per day
February 1, 2000	May 1, 2000	400 lbs. per day (Framework 31 proposed

Changes have also been made to the running clock and possession limits during this period. In addition, rolling closures were implemented in 1998 and 1999. The MSMC felt it could not provide an updated trip limit analysis. The MSMC used the last year's trip limit analysis to run a sensitivity analysis for estimating landings for Gulf of Maine cod in fishing year 1999 (MSMC, 1998). Last year's trip limit analysis incorporated an projected 37% decline in spawning stock biomass (as a proxy for exploitable biomass). In retrospective, spawning stock biomass is now projected to have declined by 11% (NDWG, 1999).

5.0 STATUS OF THE STOCKS and PROJECTION RESULTS

The following status of the stocks is based on updated assessments produced by the Northern Demersal Working Group (NDWG). These assessments are updates of assessments previously reviewed by Northeast Regional Stock Assessment workshop. All stock assessments were based on a calendar year, January 1 through December 31. Calendar year 1999 forecasts were completed by assuming that $F_{99} = F_{98.}$ (for witch flounder, $catch_{99}=catch_{98}$). Values for starting stock sizes on January 1, 1999, partial recruitment, maturity at age, catch mean weight, and stock mean weight at age vectors were used from the NDWG assessments in the forecasts. Recruitment for the out-years was projected using the same methodology employed by the NDWG. Three sets of projections were run for 2000 and beyond: Amendment 7 target F, the literal interpretation of the Amendment 9 control rule and the F that achieves rebuilding within the timeframe specified by the control rule (F_{MSMC}). The 2000 Target TACs and spawning stock biomass were calculated by applying the Amendment 7 target fishing mortality rates to projected January 1, 2000 stock sizes.

Evaluation of Rebuilding and TAC Projections under Amendment 7 and SFA Guidelines

The MSMC performed target TAC projections for year 2000 for stocks of Georges Bank haddock, Gulf of Maine and Georges Bank cod, and Southern New England yellowtail flounder at fishing mortality rates corresponding to F0.1 (and Fmax for Gulf of Maine cod) as specified in Amendment 7. The MSMC also discussed at length rebuilding requirements for these and other New England groundfish stocks under SFA guidelines as outlined in the report of the Overfishing Definition Review Panel (Applegate et al. 1998). In some cases, fishing mortality rates required to rebuild the above five stocks of cod, haddock and yellowtail flounder under SFA guidelines are lower than F0.1, resulting in more restrictive 2000 target TACs. The MSMC is also acutely aware of the state of other Northeast groundfish stocks in addition to those specified in Amendment 7, based on 1999 assessment results, and notes that fishing mortality rates required to rebuild many of these stocks under SFA guidelines are also quite low.

Taking account of the probability that the more restrictive SFA rebuilding requirements are likely to come into force shortly after the onset of fishing year 2000 regulations (May, 2000), the MSMC performed additional target TAC projections, and derived stock rebuilding probabilities for the five Amendment 7 stocks of cod, haddock and yellowtail flounder as well as six other Northeast groundfish stocks. Fishing mortality rates utilized in these forecasts followed either the control rule guidelines given by the Overfishing Definition Review Panel (Applegate et al. 1998) or updated values recommended in the 27th, 28th, and 29th SARC reports. These fishing mortality rates are labeled as $F_{control\ rule}$. In addition the MSMC considered, for each stock, an alternative interpretation of the control rule F which takes into account landings which are likely to occur either as unavoidable by-catch or as a result of the transboundary nature of certain stocks. These fishing mortality rates are labeled as F_{MSMC}. For example, fishing mortality for Georges Bank haddock was adjusted from F=0.0 (according to the control rule) to F=0.06 (taking into account recent improved recruitment, allowing for a 50% rebuilding probability in 5 years). Target TACs for year 2000 and stock rebuilding probabilities for all stocks considered in these analyses are provided in the following table.

Table 5.0. Stock rebuilding probabilities in 5 or 10 years, corresponding terminal year landings, and year 2000 target TACs given various fishing mortality rates based on Amendment 7 and SFA guidelines. P MB = probability that mean biomass exceeds B_{MSY}, P SSB= probability that SSB exceeds SSB_{MSY} proxy for B_{MSY}.

Part 1. Stocks specified in Amendment 7.

Georges Bank Cod

Recruitment model: Stock /Recruitment Function

F		P MB > 108 Kt @ 2004	Land (t) @ 2004	TTAC [1] (t) @ 2000
$F_{0.1}$	= 0.180	0.139	10,634	6,025
$F_{control\ rule}$	= 0.185	0.127	10,774	6,199
F_{MSMC}	= 0.093	0.528	7,071	3,247

[1]Target TTAC includes Canadian landings

Georges Bank Haddock

Recruitment. Model: 1-Stage recruitment resampling. (Low = 1966-1999)

F		P SSB > 105 Kt @ 2004	Land[1] (t) @ 2004	TTAC[1] (t) @ 2000
$F_{0.1}$	= 0.260	0.169	14,140	10,152
$F_{control\ rule}$	= 0.000	0.778	0	0
F_{MSMC}	= 0.060	0.501	5,684	2,536

[1] Target TAC includes Canadian landings.

Georges Bank Yellowtail Flounder.

Recruitment model: Stock-Recruitment function.

F		P MB > 46.85 Kt @ 2009	Land[1] (t) @ 2009	TTAC[1] (t) @ 2000
$F_{0.1}$	= 0.247	0.995	13,454	6,618
$F_{control\ rule}$	= 0.500	0.701	13,297	12,166
F_{MSMC}	= 0.375	0.912	13,839	9,564

[1] Target TAC includes Canadian landings.

Southern New England Yellowtail Flounder. (Recent Average Landings = 400 t).

Recruitment model: Spawning/Recruitment function

F		P MB > 62.87 Kt @ 2004	Land (t) @ 2004	TTAC (t) @ 2000
$F_{0.1}$	= 0.268	0.124	2,865	951
$F_{control\ rule}$	= 0.000	0.228	0	0
F_{MSMC}	= 0.166	0.157	2,154	629

Gulf of Maine Cod

Recruitment model: 3-Stage recruitment resampling.

F		P MB > 33 Kt @ 2004	Land[2] (t) @ 2004	TTAC[2] (t) @ 2000
F_{max}	= 0.27	0.003	4,049	1,918
$F_{0.1}$	= 0.15	0.200	3,105	1,118
$F_{controlrule}$	= 0.22	0.024	3,761	1,593
F_{MSMC}	= 0.10	0.529	2,388	761

[2]TTAC does not include recreational catch

Part 2. Additional stocks for which current fishing mortality is known

White Hake. (Recent Average Landings = 300 t).
Recruitment Model: 3-Stage Recruitment resampling.

F	P MB > 22.3 Kt @ 2004	Land[1] (t) @ 2004	TTAC[1] (t) @ 2000
$F_{controlrule}$ = 0.000	0.716	0	0
F_{MSMC} = 0.064	0.407	1,081	300

[1]TTAC includes Canadian landings

American Plaice.
Recruitment. Model: Stock/Recruitment Function

F	P SSB > 24.2 Kt @ 2004	Land (t) @ 2004	TTAC (t) @ 2000
$F_{control\ rule}$ = 0.020	0.959	555	254

F	P SSB > 24.2 Kt @ 2009	Land (t) @ 2009	TTAC (t) @ 2000
F_{MSMC} = 0.105	0.980	3,188	1,279

Witch Flounder.
Recruitment Model: 1-Stage Recruitment resampling.

F	P MB >25.0 Kt @ 2004	Land (t) @ 2004	TTAC (t) @ 2000
$F_{controlrule}$ = 0.110	0.987	3,610	1,734

Georges Bank Winter Flounder. (Recent Average Landings = 300 t).
Recruitment. Model: 1-Stage Recruitment resampling.

F	P MB > 11.4 Kt @ 2004	Land[1] (t) @ 2004	TTAC[1] (t) @ 2000
$F_{controlrule}$ = 0.000	0.730	0	0
F_{MSMC} = 0.085	0.225	719	300

[1] Target TAC includes Canadian landings.

Southern New England/Mid-Atlantic Winter Flounder.
Recruitment Model: 1-Stage Recruitment resampling.

F	P MB > 27.81 Kt @ 2009	Land[3] (t) @ 2009	TTAC[3] (t) @ 2000
$F_{controlrule}$ = 0.400	0.780	7,300	6,000
F_{MSMC} = 0.330	0.902	7,129	4,754

[3]TTAC includes recreational landings

Cape Cod Yellowtail Flounder.
Recruitment model: Spawning/Recruitment Function

F	P MB > 6.10 Kt @ 2004	Land (t) @ 2004	TTAC (t) @ 2000
$F_{0.1}$ = 0.210	0.979	991	424
$F_{controlrule}$ = 0.070	1.000	454	150
F_{MSMC} = 0.500	0.554	1,365	896

Caveats for medium and long-term projections.

The probability associated with achieving B_{MSY} are based on 1) starting conditions, 2) future recruitment and fishing mortality rates used in the projection model. Medium and long-term projections are especially sensitive to assumptions about future recruitment and the response of recruitment to increased biomass. Two examples of relatively short-term forecasts should provide adequate warning. SARC 24 projected 55,900 metric tons of SSB in 1998 for Georges Bank cod at 50% probability. The recent NDWG now estimates that spawning stock biomass was only 28,656 in 1998. This is 50% less than the two-year SARC 24 projection. SARC 24 projected that SSB for Georges Bank yellowtail would be 13,800 metric tons in 1998 with 50% probability. The recent NDWG estimated spawning stock biomass to be 17,297 metric tons in 1998. This is 25% more than the two-year SARC projection. SARC 24 three-year forecast projected 15,200 metric tons of spawning stock biomass in 1999 compared to the NDWG's one-year forecast of 28,032 metric tons in 1999. This is a nearly a 50% change from the SARC 24 forecast. To quote Neils Bohr, "Prediction is very difficult, especially about the future." The following bullets developed by the Northern Demersal Working Group about uncertainties inherent in these long-term projections are worth repeating:

Projection results may be optimistic and should be interpreted with the following caveats:

- *Stock-recruitment data are limited. With the short-time series available, long-term relationships are difficult to discern, especially given the inherent variability in recruitment. Further, there is a general lack of observations of recruitment levels at high spawning stock sizes and this leads to imprecise determination of maximum expected recruitment levels. It is important to note that, with the exception of GB haddock, the length of the 10-year projection period is roughly half or more of the available time series of stock-recruitment data.*

- *Measurement error in estimates of spawning stock and recruitment may have obscured patterns in stock-recruitment data. Current stock assessment models may have retrospective patterns in estimates of spawning stock and recruitment that cannot be incorporated in these analyses.*

- *Several stocks appear to have recent trends in productivity. Modeling nonstationary stock-recruitment relationships is very difficult without prior information on the magnitude and duration of trends.*

- *The possibility of compensatory changes in weight at age and maturation probability at age are not included in the 10-year projections. This implies that projection results may be optimistic because at higher stock sizes, individual growth rates may decline, and assumed future values of population mean weights at age may be biased high.*

- *Genetic diversity of some of these stocks may have been reduced through intensive* *exploitation. As a result, some stocks may be less fit to compete in portions of their historic range. Similarly, near shore components of some stocks may have been adversely affected by habitat loss and pollution. Recolonization of some near shore and estuarine areas may not be possible without improved habitat. Potential losses in genetic diversity and habitat are impossible to quantify, however, without decadal time series of baseline information.*

5.1 General summary of status of stocks through 1998

Stock status has improved for Georges Bank cod, Georges Bank haddock, Georges Bank yellowtail, and Southern New England yellowtail (Table 5.1). Fishing mortality in 1998 for these stocks are below the overfishing definitions and are near or below the Amendment 7 fishing mortality targets for rebuilding the stocks (Table 5.3, Figures 5.1-5.5). Spawning stock biomass has increased for these stocks but, with the exception of Georges Bank yellowtail, remain below Amendment 7 spawning stock biomass thresholds (Table 5.4). In general, recent recruitment remains below long term averages for Georges Bank cod, Southern New England yellowtail, and Gulf of Maine cod; is near the median for Georges Bank haddock; and is above average for Georges Bank yellowtail (Table 5.5, Figures 5.1-5.5).

The status of Gulf of Maine cod remains poor. Although fishing mortality has declined in 1998, fishing mortality rate remains well above the overfishing definition ($F_{20\%}$=0.41) and Amendment 7 mortality target (F_{max}=0.27). Spawning stock biomass is at a record low in 1998, declining 17% from 1997. Recruitment remains poor with the 1993 through 1996 yearclasses being among the lowest in the timeseries. Survival ratios (R/SSB) remain low compared to yearclasses prior to 1987.

Table 5.1. Stock status through 1998 from Northern Demersal Working Group Assessments.

Stock	1998 full F relative to Amend 7 target	SSB	Recruitment	1998 as % of Amendment 7 SSB threshold	1998 as % of Amendment 9 Threshold
GB cod	Above target	Low increasing	Poor	41%	34%
GB haddock	At target	Low increasing	Near Median	48%	36%
GB yellowtail	Below	Above average Increasing	Above Average	173%	59%
SNE yellowtail	Below	Low Increasing	Poor	36%	8%
GOM cod	Well above	Low Decreasing	Poor	Not defined	36%

5.2 Stock status and projection results for Georges Bank/Southern New England stocks

5.2.1 Georges Bank cod

A1. Georges Bank cod status relative to Amendment 7 targets

Fishing mortality increased to 0.28 and is above the Amendment 7 $F_{0.1}$ fishing mortality target of 0.18 (Figure 5.3). Fishing mortality needs to be reduced 36% to meet the Amendment 7 $F_{0.1}$ target. Recruitment in recent years has been the lowest on record with poor year classes in 1994, 1995, 1996, and 1997 (Table 5.5, Figure 5.1). Spawning stock biomass has increased after reaching a record low in 1994 (Table 5.4). Spawning stock biomass in 1998 was 28,656 metric tons, well below the 70,000 metric ton Amendment 7 threshold.

The assessment has a retrospective pattern that underestimates fishing mortality and overestimates spawning stock biomass in the terminal year. The updated assessment indicates that fishing mortality in 1997 was 0.53, substantially above Amendment 7 threshold compared to the 0.26 estimated by SARC 27 assessment. SARC 27 estimated spawning stock biomass was as 36,000 in 1997 compared with 26,480 estimated by the NDWG.

A2. Projection results for Amendment 7

The fishing mortality rate for calendar year 1999 was assumed to be 0.28 (Table 5.3). Spawning stock biomass is projected to increase to 32,461 metric tons in 1999, which is 46% of the Amendment 7 threshold of 70,000 metric ton (Table 5.4). Spawning stock biomass will increase slowly to 35,795 metric tons in 2000 at F=0.18. The increase in spawning stock biomass is being driven primarily by growth due to low fishing mortality. The probability of spawning stock biomass exceeding the 70,000 metric ton threshold in 2000 is zero.

The 2000 total target TAC for this stock is 6,045 metric tons (Table 5.6). Assuming that the 2000 Canadian quota will be 1,900 metric tons, the 2000 US TTAC will be 4145 metric tons. The 2000 USA TTAC represents a 23% decrease from the1999 US TTAC (5,354 metric tons) and a 40% decrease from 1998 USA landings (6,959 metric tons).

B1. Georges Bank cod status relative to Amendment 9 targets

Mean biomass was 36,317 metric tons in 1998 representing 36% of B_{msy}. Mean biomass is projected to increase to 43,863 metric tons in 1999 at F_{99}=0.28. This is well below the 108,000 metric ton B_{MSY} and below the 54,000 metric ton ½ B_{MSY} benchmarks. The control rule calls for rebuilding to B_{msy} within 5 years when biomass is between ¼ B_{msy} and ½ B_{msy}.

B2. Projections based on Amendment 7 fishing mortality targets.

The Amendment 7 $F_{0.1}$ target ($F_{0.1}$ = 0.18) has less than a 14% of achieving the B_{msy} by 2004 and thus is unlikely to achieve the Amendment 9's 5 year rebuilding schedule. $F_{0.1}$ rebuilds mean biomass to B_{MSY} in 2009 with 98% probability.

B3. Projections based on the Amendment 9 control rule ($F_{control\ rule}$)

The proposed control rule for the projected 1999 mean biomass recommends a biomass weighted target fishing mortality rate of 0.12 (equivalent to a fully recruited F = 0.185). $F_{control\ rule}$ is similar to the Amendment 7 $F_{0.1}$ target. The total 2000 target TTAC is 6,199. Accounting for a Canadian TTAC of 1,900 in 2000, the USA TTAC is 4,299 metric tons in 2000. This represents a 38% reduction from 1998 USA landings and a 20% reduction from the 1999 TTAC. Fishing mortality needs to be reduced 34% to achieve the Amendment 9 control rule F. $F_{control\ rule}$ has less than a 13% chance of achieving the B_{msy} target by 2004. $F_{control\ rule}$ is unlikely to achieve rebuilding within 5 years, but rebuilds mean biomass to B_{MSY} in 2009 with 97% probability.

B4. Projections based on the F that achieves rebuilding within the timeframe specified by the control rule (F_{MSMC}).

Accounting for recent recruitment and current biomass, the MSMC determined that the fishing mortality that allows mean biomass to increase to B_{msy} in 5 years at 50% probability is 0.093 (fully recruited). The TTAC for 2000 for F_{MSMC} is 3,247. Assuming a 2000 Canadian quota of 1,900 mts, the USA TTAC for 2000 is 1,347 mts. This represents an 81% reduction from 1998 landings and a 75% reduction from the 1999 TTAC. Fishing mortality needs to be reduced 67% from F_{98} to achieve F_{MSMC}. This fishing mortality rate has a 52% probability of rebuilding to B_{msy} in 2004. F_{MSMC} rebuilds mean biomass to B_{MSY} in 2009 with near 100% probability.

B5. Transboundary considerations.

Canada assesses the 5Zj,m component of the Georges Bank cod stock. Canada has adopted a rebuilding strategy that sets quotas below $F_{0.1}$, targets an increase in biomass by 5% or more, sets the risk of decline in biomass in the order of 20% or less (from a risk analysis), and establishes an appropriate ratio of cod to haddock to minimize dumping and discarding (FRCC, 1998). At this time, the fishing mortality rates associated with $F_{0.1,}$ $F_{control\ rule}$, and F_{MSMC} are close to the Canadian objective of $F < F_{0.1}$.

B6. Review of SARC 27 advice

SARC 27 recommended, "*fishing mortality be reduced to substantially less than $F_{0.1}$. Poor recruitment coupled with a truncated age structure from years of overfishing has decreased the potential for stock rebuilding at the current fishing mortality rate (0.26). Reducing fishing mortality will avoid declines in SSB and enhance the probability of long-term rebuilding*." The updated assessment and short-term projections do not contradict that advice.

5.2.2 Georges Bank Haddock

A1. Georges Bank haddock status relative to Amendment 7 targets

The fishing mortality rate slightly increased to 0.15, which is below the $F_{0.1}$ target of 0.26 (Table 5.3, Figure 5.2). The 1992 to 1997 yearclasses are at or somewhat above the median for the assessment time series (1963-1996), but below recruitment levels estimated prior to 1963 (Table 5.5). The 1998 yearclass is estimated at 61.9 million, third highest yearclass since 1964. This yearclass is determined through three survey indices. The size of this yearclass is uncertain until additional fishery dependent (catch) and independent data can be obtained. Spawning stock biomass has increased threefold since reaching a record low level in 1993 (Table 5.4). However, the 1998 estimate of 38,096 metric tons is well below the 80,000 metric ton Amendment 7 threshold and 120,000 metric ton average for 1931-1960 time period.

A2. Amendment 7 Projection results

The 1999 calendar year fishing mortality rate is assumed to be 0.15. Spawning stock biomass is projected to be 44,687 metric tons in 1999, which is 56% of the Amendment 7 threshold of 80,000 metric ton (Table 5.4). The probability that spawning stock biomass in 1999 exceeds the 80,000 metric ton threshold is less than 1%.

The total 2000 target TAC is estimated to be 10,152 metric tons (Table 5.6). Assuming that the 2000 Canadian quota is 3,900 the 1999 US target TAC will be 6,252 metric tons. The 2000 TTAC represents an increase of 12% from 1999's US target TAC and a 239% increase from 1998 USA landings.

B1. Georges Bank haddock status relative to Amendment 9 targets

Spawning stock biomass was 38,096 metric tons in 1998 representing 36% of SSB_{msy}. (105,000 metric tons). Spawning stock biomass is projected to increase to 44,687 metric tons in 1999 at F_{99}=0.15. This is well below the 105,000 metric ton SSB_{MSY} and the 52,500 metric ton ½ SSB_{MSY} benchmarks. The control rule calls for rebuilding to SSB_{MSY} as quickly as possible when spawning stock biomass is below ½ SSB_{MSY}.

B2. Projections based on Amendment 7 fishing mortality targets.

The Amendment 7 $F_{0.1}$ target has less than a 17% probability of achieving the SSB_{msy} by 2004 and is unlikely to achieve rebuilding within 5 years. $F_{0.1}$ rebuilds mean biomass to B_{MSY} in 2009 with 9% probability and thus is unlikely to achieve the SFA 10 year rebuilding guidelines.

B3. Projections based on the Amendment 9 control rule ($F_{control\ rule}$)

For the projected 1999 mean biomass, the proposed control rule recommends a target fishing mortality rate of zero ($F_{control\ rule}$=0.00). This implies closing the USA fishery. However, the assumed 2000 Canadian quota of 3,900 metric tons is based on a different rebuilding program with a non-zero fishing mortality target. The 3,900 metric ton Canadian quota and the likelihood of discards in other fishery imply that the zero fishing mortality target will not be met even if the US fishery is closed. Achieving the fishing mortality rate of zero will not be possible. The zero fishing mortality rate called for by the Amendment 9 control rule has a 77% chance of achieving the B_{msy} target by 2004. This fishing mortality rate rebuilds to B_{MSY} in 2004 with 78% probability and in 2009 with 71% probability. The higher probability in 2004 is related to the effect of the 1998 year class on the 2004 mean biomass. The 1998 yearclass will be 11 years old in 2009 and will not be as an important contributor to the biomass as it is earlier in the projection.

B4. Projections based on F that achieves rebuilding within the timeframe specified by the control rule (F_{MSMC})

The control rule calls for rebuilding as quickly as possible when mean biomass is below ½ SSB_{MSY}. The MSMC has interpreted this to mean no directed fishing, and achieve the ½ SSB_{MSY} within 5 years at 50% probability. Accounting for recent recruitment and current biomass, the MSMC projects that the F_{MSMC} that allows mean biomass to increase to SSB_{MSY} in 5 years at 50% probability is 0.06 (fully recruited). The TTAC for 2000 for F_{MSMC} is 2,536 metric tons. This total target TAC implies that the USA fishery should be closed because the assumed 2000 Canadian quota of 3,900 metric tons is greater than the total Target TAC. The 3,900 metric tons Canadian quota and the likelihood of discards in other fishery means that the 0.06 target will not be achieved even if the US fishery is closed. This fishing mortality rate has a 50% probability of achieving B_{msy} in 2004 and a 47% probability in 2009.

B5. Transboundary considerations

Canada assesses the (5Zj,m) components of the Georges Bank haddock stock. Canada has a rebuilding strategy that sets quotas below $F_{0.1}$, targets an increase in biomass by 5% or more, sets the risk of decline in biomass in the order of 20% or less (from a risk analysis), and establishes an appropriate ratio of cod to haddock to minimize dumping and discarding (FRCC, 1998). The Canadian policy for haddock is less conservative than either the Amendment 9 control rule or the MSMC's 5 year rebuilding F. Bilateral discussions with Canada will be necessary to align rebuilding goals and strategies.

B6. Review of SARC 27 advice

SARC 27 advised, "*fishing mortality should be maintained at or reduced below F_{97}=0.11 (9% exploitation) to continue to stock rebuilding and improve spawning potential. Allowing mortality to increase to the Amendment 7 target of $F_{0.1}$ (0.26) will result in a decrease in SSB.*" In the presence stronger recruitment (1997 yearclass), the stock will continue to rebuild over the short-term, but will not achieve the Amendment 9 spawning stock biomass target. The updated assessment and short-term projections do not contradict that advice.

5.2.3 Georges Bank yellowtail

A1. Georges Bank yellowtail status relative to Amendment 7 targets

Fishing mortality decreased to 0.17 in 1998 and is below the Amendment 7 target $F_{0.1}$ of 0.25 (Figure 5.3). Recent recruitment has been above average in 1996 and 1997 (Table 5.5). Spawning stock biomass has increased to 17,297 metric tons in 1998, and is above the 10,000 metric ton threshold (Table 5.4). However, current spawning biomass is well below historic levels.

A2. Projections based on Amendment 7 fishing mortality and SSB targets.

The fishing mortality rate for calendar year 1999 was assumed to be 0.17 (Table 5.3). Spawning stock biomass is projected to increase to 28,032 metric tons in 1999, which is 280% above the Amendment 7 threshold of 10,000 metric ton (Table 5.4). The probability of spawning stock biomass exceeding the 10,000 metric ton threshold in 1999 is one. The stock has achieved the Amendment 7 fishing mortality and spawning stock biomass targets.

The 2000 total target TAC for this stock is 6,618 metric tons (Table 5.6). Assuming that the 2000 Canadian quota will be 2,000 metric tons, the 2000 US TTAC will be 4,618 metric tons. This represents a 156% increase from 1998 USA landings (1,800 mts) and a 69% increase from the1999 US TTAC (2,725 mts).

B1. Georges Bank yellowtail status relative to Amendment 9 targets

Mean biomass was 27,837 metric tons in 1998 representing 59% of B_{msy}. Mean biomass is projected to increase to 43,422 metric tons in 1999 at F_{99}=0.17. This is below the 46,850 metric ton B_{MSY} but above the 21,711 metric ton ½ B_{MSY} benchmarks. The control rule calls for rebuilding to B_{msy} within 10 years when biomass is between ½ B_{MSY} and B_{MSY}.

B2. Projections based on Amendment 7 fishing mortality and Amendment 9 biomass targets.

The Amendment 7 $F_{0.1}$ target has a 99% probability of achieving the B_{msy} by 2009. $F_{0.1}$ achieves the Amendment 9 objectives, but at a lower fishing mortality rate than allowed under Amendment 9 mortality targets.

B3. Projections based on the Amendment 9 control rule ($F_{control\ rule}$)

For the projected 1999 mean biomass, the proposed control rule recommends $F_{control\ rule}$= 0.50. This target fishing mortality is much higher than the Amendment 7 $F_{0.1}$ target. The total 2000 target TTAC is 12,166 metric tons. Assuming a Canadian TTAC of 2000 metric tons, the USA TTAC is 10,166 metric tons in 2000. This represents fivefold increase from 1998 USA landings and a threefold increase from the 1999 TTAC. The fishing mortality called for by the Amendment 9 control rule has a 70% probability of achieving the B_{msy} target by 2009.

B4. Projections based on the F that achieves rebuilding within the timeframe specified by the control rule (F_{MSMC}).

The control rule calls for a 10 year rebuilding schedule when mean biomass is between ½

B_{msy} and B_{msy}. Accounting for recent recruitment and current biomass, the MSMC projected that the fishing mortality rate that allows mean biomass to increase to B_{msy} in 10 years at 90% probability is F_{MSMC}=0.38 (fully recruited). The total TTAC for 2000 for F_{MSMC} is 9,564. Assuming that the 2000 Canadian quota is equal to the 1999 Canadian quota of 2000 mts, the USA TTAC for 2000 is 7,564 metric tons. This represents a 320% increase from 1998 landings and a 177% increase from the1999 US TTAC. Fishing mortality in 2000 can be increased 44% above the Amendment 7 $F_{0.1}$ target. F_{MSMC} has a 91% probability of rebuilding to B_{msy} by 2009.

B5. Transboundary considerations

Canada uses the same assessment as the USA. Canada's rebuilding strategy sets the Georges Bank yellowtail quota below the $F_{0.1}$, target. The Canadian policy for Georges Bank yellowtail is more conservative than either the Amendment 9 control rule or the MSMC's 10 year rebuilding F_{MSMC}. Bilateral discussions with Canada will be necessary to develop consistent rebuilding goals and strategies.

B6. Review of SARC 27 advice

SARC 27 advised, "*fishing mortality should remain at or below $F_{0.1}$ to continue stock recovery and allow the age structure to expand, enhancing prospects for improved recruitment*." This advice is more conservative than either the Amendment 9 control rule (rebuilds in 2009 at 70% probability) or F_{MSMC} (rebuilds in 2007 with 90% probability) forecasts suggest is necessary to achieve rebuilding with high probability in 10 years. However, the SARC 27 advice is more prudent in the short-term considering that mean biomass is only at 59% of B_{MSY} in 1999. The projected increase in biomass and yield is heavily dependent on the strength of the 1997 yearclass, which was well above the median of the last 20 years, and on maintaining recruitment at twice the timeseries median (projected recruitment from a Beverton-Holt SR relationship). The MSMC cautions that fishing at F=0.50 is likely to result in a decline in biomass unless future recruitment continues at this high level. Given the history of recruitment on this stock, this high level of recruitment is not likely to occur.

5.2.4 Southern New England yellowtail

A1. Southern New England yellowtail status relative to Amendment 7 targets

Fishing mortality in 1998 declined to 0.20, which is below the $F_{0.1}$=0.27 rebuilding threshold (Table 5.3). Overall recruitment, with the exception of the 1996 yearclass, has been poor: the 1992 through 1995 year classes are well below the 25th percentile. The 1996 yearclass is near the median (Table 5.5). Since 1994, spawning stock biomass has slowly increased to 3,564 metric tons in 1998 (Table 5.4). This is well below the 10,000 metric ton Amendment 7 threshold.

The assessment has a retrospective pattern, which underestimates F and overestimates spawning stock biomass. The new assessment indicates that F was 0.36 in 1997, which is above the Amendment 7 $F_{0.1}$ target, compared to the SARC 27 estimate of 0.07. Spawning stock biomass in 1997 was estimated as 1,694 compared to the 4,235 estimated by SARC 27.

A2. Projections based on Amendment 7 fishing mortality and SSB targets.

The fishing mortality rate for calendar year 1999 was assumed to be 0.20 (Table 5.3). Spawning stock biomass is projected to increase to 5,510 metric tons in 1999, which is 55% of the Amendment 7 threshold of 10,000 metric ton (Table 5.4). The probabilities of spawning stock biomass exceeding the 10,000 metric ton threshold are zero in 1999 and 7% in 2000. The target TTAC for 2000 is 951 metric tons. This is similar to last year's TTAC of 1,115 metric tons.

B1. Southern New England yellowtail status relative to Amendment 9 targets

Mean biomass was 4,944 metric tons in 1998 representing 8% of B_{msy} (62,870 metric tons). Mean biomass is projected to increase to 6,607 metric tons in 1999 at F_{99}=0.20. This is well below the 62,870 metric ton B_{MSY} and the 15,718 metric ton ¼ B_{MSY} benchmarks. The control rule calls for rebuilding to B_{msy} as quickly as possible when biomass is below ¼ B_{msy}.

B2. Projections based on Amendment 7's fishing mortality rate and Amendment 9's biomass target.

The probabilities of achieving B_{MSY} with $F_{0.1}$ are less than 13% in 2004 and 29% in 2009. The stock is unlikely to achieve rebuilding within the 10 year SFA guidelines using Amendment 7 $F_{0.1}$ target.

B3. Projections based on the Amendment 9 control rule ($F_{control\ rule}$)

The proposed control rule for the projected 1999 mean biomass recommends a zero fishing mortality rate ($F_{control\ rule}$=0.0). $F_{control\ rule}$ has less than a 23% chance of achieving the B_{msy} target by 2004 and a 72% chance by 2009.

B4. Projections based on the F that achieves rebuilding within the timeframe specified by the control rule (F_{MSMC}).

The control rule calls for rebuilding as quickly as possible when mean biomass is less than ¼ B_{msy}. The MSMC interpreted this to mean no directed fishing but recognizes that bycatch may occur in other fisheries. The MSMC projected F_{MSMC} in 1999 based on an assumed bycatch of 400 metric tons. This fishing mortality rate was then used in the projections from 2000 onward. Note that this method assumes that bycatch increases proportionally as the population grows, e.g., bycatch will equal 629 tons in 2000. The TTAC for 2000 for F_{MSMC} is 629. This represents a 57% increase from 1998 landings but a 43% decrease from the 1999 TTAC. This fishing mortality rate has less than a 16% probability of achieving B_{msy} in 2004 and less than 42% chance of achieving B_{msy} by 2009.

B5. Review of SARC 27 advice

SARC 27 advised, "*fishing mortality should be kept as near zero as possible. Targeting of the 1996 yearclass, which may jeopardize the Amendment 7 rebuilding schedule, should be avoided*." The updated assessment and both short-term and long-term projections do not contradict that advice.

5.2.5 Gulf of Maine cod

A1. Gulf of Maine cod status relative to Amendment 7 targets

The fishing mortality rate on Gulf of Maine cod declined from 1996 but remains at a very high rate (F_{1998} =0.64), and must be reduced significantly (Table 5.3, Figure 5.5). The current mortality rate on GOM cod is higher than the overfishing definition ($F_{20\%}$=0.41) , and nearly 2 times the F_{max} target of 0.27. The 1993, 1994, 1995 and 1996 year classes are all below the timeseries' 25th percentile (Table 5.5). The 1998 spawning stock biomass (8,275 metric tons)is at a record low (Table 5.4).

The assessment has a retrospective pattern that underestimates fishing mortality and recruitment in the terminal year since 1995. The updated assessment indicates that fishing mortality in 1997 was 0.82 compared to the 0.75 estimated by SARC 27 assessment. Both estimates are substantially above Amendment 7 F_{max} target. The NDWG estimated 1997 spawning stock biomass to be 9,940 metric tons compared to the SARC 27 estimated spawning stock biomass of 8,628 metric tons.

A2. Projection results for Amendment 7's fishing mortality targets

The fishing mortality rate for calendar year 1999 was assumed to be 0.64 (Table 5.3). Spawning stock biomass is projected to decrease to 8,804 metric tons in 1999. Spawning stock biomass will increase slowly to 9,998 metric tons in 2000 at $F_{0.1}$ =0.15.

The 2000 total target TAC at $F_{0.1}$ is 1,118 metric tons (Table 5.6). The 2000 USA TTAC represents a 43% increase from the1999 TTAC ($F_{0.1}$ TTAC=782 metric tons in 1999) but a 73% decrease from 1998 landings (4,156 metric tons).

The 2000 target TTAC at F_{max} is 1,918 metric tons. This is 43% increase from the 1999 TTAC but a 54% decrease from 1998 landings.

B1. Gulf of Maine cod status relative to Amendment 9 targets

Mean 1^+ biomass was 11,825 metric tons in 1998 representing 36% of B_{msy}. Mean biomass is projected to slightly increase to 12,969 metric tons in 1999 at F_{99}=0.64. This is well below the 33,000 metric ton B_{MSY}. Mean 1^+ biomass is projected to be between ¼ B_{MSY} and ½ B_{MSY} metric tons in 1999. The control rule calls for rebuilding to B_{msy} within 5 years when biomass is between ¼ B_{msy} and ½B_{msy}.

B2. Projections based on $F_{0.1}$ fishing mortality rate and Amendment 9 biomass targets.

The $F_{0.1}$ fishing mortality target has a 20% probability of achieving the B_{msy} by 2004. Thus, the $F_{0.1}$ mortality rate is unlikely to achieve Amendment 9's 5 year rebuilding schedule. This fishing mortality rate rebuilds to B_{MSY} in 2009 with 99% probability.

B3. Projection results based on F_{max} fishing mortality target and MSMC targets

The F_{max} fishing mortality target has a less than 1% probability of achieving B_{MSY} by 2004. F_{max} is extremely unlikely to achieve Amendment 9's 5-year rebuilding schedule. At F_{max}, the stock has an 80% probability of rebuilding to B_{MSY} in 2009.

B4. Projections based on the Amendment 9 control rule ($F_{control\ rule}$)

The proposed control rule for the projected 1999 mean biomass recommends a fully recruited $F_{control\ rule}$ = 0.22. This target fishing mortality rate lies between the Amendment 7 $F_{0.1}$ target and F_{max} targets. The total 2000 target TTAC is 1,593 metric tons. This represents a doubling from the 1999 $F_{0.1}$ TTAC (782 metric tons) but is similar to the 1999 F_{max} TTAC (1,340 metric tons). This is a 62% reduction from 1998 USA landings. The $F_{control\ rule}$ has less than a 3% chance of achieving the B_{msy} target by 2004. The fishing mortality rate associated with a literal interpretation of the control rule is unlikely to achieve rebuilding within 5 years. $F_{control\ rule}$ rebuilds mean biomass to B_{MSY} in 10 years with 93% probability.

B5. Projections based on the F that achieves rebuilding within the timeframe specified by the control rule (F_{MSMC}).

Accounting for recent recruitment and current biomass, the MSMC projected that the fishing mortality that allows mean biomass to increase to B_{msy} in 5 years at 50% probability is F_{MSMC}= 0.10 (fully recruited). The TTAC for 2000 for $F_{5\ year\ rebuild}$ is 761 metric tons. This is similar to last year's $F_{0.1}$ TTAC and represents an 82% reduction from 1998 landings and a 43% reduction from the 1999 F_{max} TTAC. Fishing mortality needs to be reduced 84% from F_{98} to achieve F_{MSMC}. This fishing mortality rate has a 53% probability of achieving B_{msy} in 2004. F_{MSMC} rebuilds mean biomass to B_{MSY} in 2009 with near 100% probability.

B6. Review of SARC 27 advice

SARC 27 recommended, "*an immediate reduction in fishing mortality to near zero. Measures should be implemented to cease all directed fishing and minimize bycatch on this stock. Measures implemented in 1998 were only intended to achieve F_{max}. Reductions to F_{max} will be insufficient to promote rebuilding from record low spawning stock biomass. The combined effects of low spawning stock biomass, high fishing mortality, record low recruitment, and record low survival of pre-recruit fish indicate that the stock is collapsing*." The updated stock assessment has slightly higher spawning stock biomass and lower fishing mortality rate in 1998 (8275 metric tons, F_{98} =0.64) than projected by either SARC 27 (6,600 metric, F-0.75) or last year's MSMC report (6,565 metric tons, F=0.82). Recruitment remains poor although age 0 and age 1 survey indices suggest that recruitment may improve. However, these survey indices have a poor fit to historical recruitment from the VPA and have not been used to tune the VPA. The updated assessment, short-term projections and long-term projections do not contradict SARC 27 advice.

C. Sensitivity analysis of Frameworks 26, 27 and proposed Framework 31's impact on fishing mortality in fishing year 1999.

Frameworks 26 and 27 implemented several closures of areas with high cod catch in 1999 and dropped the trip limit from 400 lbs. to 200 lbs. to 30lbs to 100 lbs. Proposed Framework 31 raises the trip limit from 100 lbs. to 400 lbs. but implements a closure of 124 and 125 in February 2000. This analysis attempts to provide an estimate of the effects of the recent management measures on fishing mortality rate on Gulf of Maine cod.

As previously noted (see Chapter 4), the effectiveness of the trip limits is predicated on fishermen's behavior. Information on discarding behavior under the 400, 200, 30, and 100 pounds per day trip limits that have been implemented consecutively since June 1998 is not yet available. However, two extreme assumptions about the **relative difference** in discards under a 200 pound per day trip limit compared to the proposed 400 pounds per day limit provide bounds for a sensitivity analysis about the effect of the rolling closures and the trip limit on fishing mortality in fishing year 1999. This analysis **does not address** the potential increase of discards that may have occurred at either 400 pounds per day or 200 pounds per day trip limit.

If the change from a 200 pounds per day trip limit to 400 pounds per day trip limit only converts discards into landings, that is, the catch is the same despite a difference in landings, then fishing mortality will not change under the higher limit. No difference in fishing mortality bounds one end of the problem. If the 200 pounds per day trip limit is perfectly effective, that is, there are no additional discards beyond that generated at the 400 lbs. trip limit and catch is reduced by the lower limit, then the fishing mortality rate will be lowered by lowering the trip limit. The reduced fishing mortality rate bounds the other end of the problem.

Sensitivity analysis of the effect of 200 pounds per day trip limit and 400 pounds per day trip limit for January-April 2000.

Observed landings from January 1999 to April 1999 were 685 mts. Management measures in place were 400 pounds per day trip limit, running clock with no cap, and Framework 25 and 26 closures. Framework 31 utilizes the same measures, but with a more restrictive running clock. Under the proposed system, vessels may only land overages for a partial day at sea (on trips over 24 hours) and may not land more than 4,000 pounds under any circumstances. Vessels on trips under 24 hours may not land more than 400 pounds.

The best estimate of landings in January 2000 through April 2000 with a 400 lbs. trip limit will be the landings from January 1999 through April 1999 when similar measures were in place. To be more accurate, these landings should be modified to accommodate changes in stock size (declining stock sizes should result in lower landings if CPUE and stock size are positively correlated) and implementation of a more restrictive running clock. The running clock should lower landings, but may not have an impact on actual catches because of regulatory discards. However, this analysis assumes no change in CPUE and considers landings for January-April 2000 to be 685 mts under a 400 pounds per day trip limit, equal to the same period in 1999.

The first step is to estimate the effect of the 200 pound per day trip limit assuming that the lower limit results in no discards, compared to the 400 pound per day limit. The MSMC (1998) predicted landings for 1999 of 2058 mts at a 400 pounds per day trip limit and 1300 mts at a 200 pounds per day trip limit. These estimates are slightly higher than those shown in last years' Framework 27 because they do not include the projected 7.4 percent reduction in DAS usage that was incorporated into the Framework 27 analysis. In retrospect, that reduction did not occur. The percent difference in total landings projected by the MSMC between the 200 pounds per day trip limit and 400 pounds per day trip limit is 37% from the 1998 MSMC report. Assuming that this reduction is proportional throughout the year, decreasing the trip limit to 200 pounds per day will drop expected landings in January 2000 through April 2000 to 432 mts, from 685 mts observed. The difference in expected landings will be 253 mts. The question becomes what impact does this have on F in fishing year 1999?

The 253 mts can be compared to expected total landings in 1999. One estimate of landings for 1999 under the proposed 400 pounds per day trip limit can be calculated as follows:

> 685 mts (Jan-April 99, observed) + 267 mts (May 99, observed) + 1827 mts (June-Dec 98, observed) = **2779** mts.

This estimate assumes that landings in June-Dec 99 (under the 30-100 pounds per day trip limit; June, October-November rolling closures, and July- October closure of Cashes ledge, interim running clock) will be similar to June-Dec 98 (400 pounds per day trip limit; June closure of Cashes and blocks 145-147,152; one month northeast closure, and full running clock). This estimate may be considered pessimistic because it assumes no benefit for the additional Framework 27 measures and for purposes of this analysis may be an upper bound of landings in 1999.

The estimate for total landings with the 200 pounds per day trip limit is:

> 432 mts (Jan-April 99, from Step 1) + 267 mts (May 99, observed) + 1827 mts (June-Dec 98, observed) = **2526** mts.

These results are presented below as the “pessimistic scenario”.

A similar exercise can be done applying the ratio of Landings $_{\text{(January to May 1999)}}$/ Landings $_{\text{(January to May 1998)}}$ to total 1998 landings. This method assumes that the percent reduction in landings that occur from January-May 1999 will occur from June-December 1999. This estimate is **1668** mts under the 400 pounds per day trip limit. This estimate may be considered optimistic because it assumes the same percent reduction in the second half of the year as occurred in the first half, even though most of the closures occur in the first half of the year. Subtracting the 253 mts difference, from Step 1, produces expected landings of **1435** mts under a 200 pounds per day per day trip limit. This is presented below as the “optimistic scenario”.

The projected fishing mortality at these assumed landings can be estimated by using 1999 survivors from the Northern Demersal Working Group assessment (August, 1999) assuming 1998 partial recruitment and mean weights for 1999, and iterating F until expected landings are achieved. This uses similar methodology that the MSMC has used to estimate projected F with the exception that this calculation is deterministic and does not incorporate uncertainty in terminal year population estimates. Results are shown in Table 5.2.

Table 5.2. Results of sensitivity analysis on impact of 200 pounds per day and 400 pounds per day trip limit on F in fishing year 1999.

	Pessimistic scenario		Optimistic scenario	
Trip limit	Landings	Expected F	Landings	Expected F
200 lbs.	2,526 mts.	0.35	1,435 mts.	0.19
400 lbs.	2,779 mts.	0.39	1,668 mts.	0.22

The analysis suggests that under a range of assumptions about potential discards at the lower limit and either a 200 lbs or trip limit to 400 pounds per day in January-April 2000 landings are likely to be between 1,435 and 2,779 metric tons. These landings will result in a fishing mortality that likely to be between 0.39 to 0.19, substantially lower than the 1998 F. Averaging the pessimistic and optimistic scenarios results in landings of 2,102 and an fishing mortality rate of 0.29. This analysis suggests that Fishing mortality in fishing year 1999 may be near the F_{max} target under Frameworks 26, 27 and proposed Framework 31.

Important note: this analysis does not address the potential problem of discarding that may have occurred at either 400 pounds per day or 200 pounds per day trip limit. The fishing mortality rate may be underestimated if substantial discarding occurred (i.e., catch remains high despite a drop in landings). This analysis does not incorporate uncertainty in terminal year population estimates into the projection.

Table 5.3. Fishing mortality rates for 5 major stocks of groundfish along with target mortality rates. GB= Georges Bank, SNE= Southern New England GOM= Gulf of Maine, yt=yellowtail, hdk= haddock. F_{1997}, F_{1998} and biological reference points estimated from the NDWG assessments.

	GB cod	GB hdk	GB yt	SNE yt	GOM cod
F_{1997}	0.53	0.12	0.26	0.36	0.82
F_{1998}	0.28	0.15	0.17	0.20	0.64
Projected F_{1999}	0.28	0.15	0.17	0.20	0.64
Target F_{2000}	0.18	0.26	0.25	0.27	0.29
Overfishing F[1]	0.41	0.45	0.69	0.94	0.41

[1]Amendment 7 overfishing definitions

Table 5.4. Spawning stock biomass (000's metric tons) for 5 major stocks of groundfish. Projected SSB 1999 values assume achieving 1998 target F. GB=Georges Bank, SNE= Southern New England, GOM= Gulf of Maine, hdk= haddock, yt= yellowtail, SSB= spawning stock biomass. SSB_{1997} and SSB_{1998} values are from NDWG assessments.

	GB cod	GB hdk	GB yt	SNE yt	GOM cod
SSB_{1997}	26.4	34.6	13.1	1.7	9.9
SSB_{1998}	28.7	38.1	17.3	3.6	8.2
projected SSB_{1999}	32.5	44.7	28.0	5.5	8.8
Threshold	70.0	80.0	10.0	10.0	n/a
1999 SSB as %threshold	46%	56%	280%	55%	n/a
Projected SSB_{2000}	35.8	55.0	36.0	6.1	9.9
Mean SSB (years)	58.3 (78-98)	48.0 (63-98)	7.6 (73-98)	7.0 (73-98)	15.5 (82-98)

Table 5.5. Recent recruitment (millions) for Georges Bank cod, Georges Bank haddock and Gulf of Maine cod compared to long term means and medians.

Year class	GB cod (Age 1)	GB haddock (Age 1)	GB yt (Age 1)	SNE yt (Age 1)	GOM cod (Age 2)
1994	4.2	8.9	26.6	3.0	2.4
1995	7.6	8.2	19.2	4.3	1.6
1996	8.6	14.9	37.8	12.2	1.8
1997	2.3	8.3	79.5	7.6	x.x
Mean (94-97)	5.7	10.1	40.8	6.8	1.9
Longterm Mean	16.6	31.4	26.0	26.8	5.3
Median	15.7	8.7	20.5	14.3	4.5
year classes	(77-97)	(62-97)	(72-97)	(72-96)	(80-96)

Table 5.6. Projected 2000 US target TACs in 000's of metric tons for Georges Bank cod, Georges Bank haddock, Georges yellowtail, Southern New England yellowtail and Gulf of Maine cod based on Amendment 7 mortality targets. US TACs assume that the 2000 Canadian quota will equal the 1999 Canadian quota for GB cod, haddock and GB yellowtail. n/a= not applicable.

	GB cod	GB hdk	GB yt	SNE yt	GOM Cod
1998 US landings	7.0	1.8	1.8	0.4	4.1
2000 Target TAC (entire stock)	6.0	10.1	6.6	1.0	1.9
Assumed 2000 Canadian quota	1.9	3.9	2.0	n/a	n/a
2000 US TTAC	4.1	6.3	4.6	1.0	1.9*
Mean US landings	22.8	11.9	5.4	3.9	9.9
Metric tons (years)	(78-98)	(63-98)	(73-98)	(73-98)	(82-98)

*Target TAC for GOM cod is 1,118 metric tons based on $F_{0.1}$ target mortality rate.

Evaluation of Time-Area Closures on 5 Gulf of Maine Stocks

The MSMC also evaluated the likely impact of the primary area closure alternative specifically designed to achieve the year 2000 target TACs for Gulf of Maine cod under either Fmax or F0.1. The MSMC chose the "two-bin" effort displacement model to evaluate time/area closure impacts. The two-bin model assumes that effort from the closed areas (first bin) is displaced to the open areas (second bin). The total effort in the system is then applied to the landings per unit effort (LPUE) in open areas to obtain a projected catch, and the percent change in landings is calculated by comparing landings projected by the model against reported landings.

This time/area configuration represents a combination of time-area closures contained in Frameworks 26, 27, and 31. In its 1998 report, the MMC presented, on a comparative basis, analyses of several area closure alternatives then under consideration for Gulf of Maine cod. Noting that possible closures of areas specific to cod may affect the re-distribution of fishing effort towards other stocks, the MSMC also presented similar analyses of the impact of various Gulf of Maine cod closure alternatives on the likely catch of American plaice and white hake.

Given the present state of many Northeast groundfish stocks and the likelihood that restrictive measures may be required in the foreseeable future, in the present report the MMC performed similar impact analyses for several other groundfish stocks in the Gulf of Maine. Results of these analyses are presented below.

TABLE 5.7. Percent change in landings of 5 Gulf of Maine stocks resulting from the imposition of time-area closures as contained in Frameworks 26, 27 and 31 based on the distribution of landings and fishing effort in 1997. Negative (-) percentages indicate a projected reduction in landings and positive (+) percentages indicate a projected increase in landings .

Stock	Percent Change in Landings
Gulf of Maine cod	- 26.2 %
Cape Cod yellowtail flounder	- 25.4 %
White hake	+ 5.2 %
Witch flounder	+ 6.1 %
American plaice	+ 7.3 %

It is clear that management actions directed primarily at one stock are likely to affect other stocks in ways that are often unforeseen. The spatial CPUE analyses conducted by the MMC demonstrate that time-area closures focused on Gulf of Maine cod are likely to result in a re-distribution of fishing effort towards other stocks whose spatial distribution differs from that of cod. Specifically, white hake, American plaice, and witch flounder primarily inhabit deeper offshore regions of the Gulf of Maine, compared to cod, and effort in these areas may increase due to regulations. Given the poor state of many groundfish stocks in the Gulf of Maine (specifically, white hake and American plaice, but also others such as cusk and wolffish), and the impending SFA requirements for reductions in fishing mortality, a more systematic approach to managing fishing effort in the Gulf of Maine is required. The MMC, therefore, advises that the New England Fishery Management Council consider the ramifications of management measures on the entire Northeast groundfish complex when devising regulations for fishing year 2000. In the near future, required measures may include a reduction in Days at Sea and a reduction in overall fleet capacity.

5.8 Status of the other large mesh regulated species

Seven other large mesh regulated species are managed through Amendment 7. Updated or benchmarks assessments have been completed and reviewed for six stocks since the last MSMC report. The status of these species at the time of their last assessment is listed in Table 5.8.

Table 5.8. Most recent assessments for 10 principle groundfish species. Stock area abbreviations are SNE= Southern New England, GOM= Gulf of Maine, MA= Mid-Atlantic. N/a= not applicable. * = formal assessment does not exist or terminal year is earlier than 1990 and data are from the Status of Fishery Resources of the Northeastern United States for 1993.

Stock	Source	Assessment Type	Terminal year	Terminal Year F	Overfishing F[1]	Status[2] Biomass	Status[2] exploitation
GOM-GB white hake	SAW 28	VPA	1997	1.15	F_{MSY}= 0.27	Low	overexploited
American plaice	SAW 28	VPA	1997	0.47	F_{MSY} = 0.19	Low	overexploited
GOM-GB witch fld	SAW 29	VPA	1998	0.37	F_{MSY} = 0.11	Near B_{MSY}	Near F_{MSY}
GB winter flounder	SAW 28	VPA	1997	0.41	F[4] =1.12	Low	fully exploited
SNE -MA winter fld	SAW 28	VPA	1997	0.31	F_{MSY}[3]= 0.59	Medium	fully exploited
Cape Cod yellowtail fld	SAW 28	VPA	1997	0.44	F_{MSY}=0.54	Medium	overexploited
Pollock	SAW 16	VPA	1992	0.72	$F_{20\%}$ = 0.65	Medium	fully exploited
GOM-GB redfish	SAW 15	VPA/ index	1992	< 0.06	$F_{20\%}$ = 0.12	Low	overexploited
GOM winter flounder	SAW 21	Index	1994	1.20	unknown[2]	Low	overexploited
GOM-GB windowpane fld	*	Index	1992	unknown	unknown	Med-low	likely overexploited
SNE-MA windowpane fld	*	Index	1992	unknown	unknown	Low	overexploited

[1] Amendment 9 overfishing definitions for all stocks except pollock and GOM-GB redfish, which have Amendment 7 definitions. Overfishing definition and terminal F for witch flounder is biomass weighted, all others are scaled to fully recruited F.

[2] Status at the time of the assessment. SAW 28 status taken from Draft Advisory Report.

[3] The ASMFC plan has a rebuilding target of F40% for SNE-MA (F40%= 0.21) and Gulf of Maine (F40%=0.49) winter flounder stocks.

[4] The proxy for F_{msy} is an exploitation index (landings/autumn NEFSC index). Amendment 7 overfishing definition was $F_{20\%}$=.47.

figure 5.1

figure 5.2

figure 5.3

figure 5.4

figure 5.5

figure 5.6

figure 5.7

figure 5.8

figure 5.9

figure 5.10

5.8.1 White Hake

A. Stock status

The stock, defined as a Gulf of Maine-Georges Bank complex, was last assessed in SAW 28 using a VPA analysis with a terminal year of 1997. SARC 28 classified the stock as low in biomass and overexploited in 1997. Commercial landings have declined from 1992 to 1997, but increased slightly in 1998. The NDWG projected fishing mortality and stock sizes for 1998 using 1998 landings. Fishing mortality was estimated to be 1.09, similar to 1.15 estimated in 1997, and spawning stock biomass declined to 2,717 metric tons in 1998, a timeseries low. The projection was carried forward by assuming that $F_{1999} = F_{1998}$. Mean biomass in 1999 was projected to be 5,498 metric tons, below the 6,900 metric ton biomass threshold.

B1. Projections based on the Amendment 9 control rule ($F_{control\ rule}$)

Amendment 9's control rule calls for a zero fishing mortality when mean biomass is less than 6,900 metric tons. With $F_{control\ rule}$ =0.0, mean biomass is projected to rebuild to B_{MSY} by 2004 with greater than 50% probability. Given the small Canadian catch and unavoidable by-catch that will occur in other USA fisheries, a zero fishing mortality is unlikely to be achieved.

B4. Projections based on the F that achieves rebuilding within the timeframe specified by the control rule (F_{MSMC}).

The MSMC interpreted the control rule to mean no directed fishing and to rebuild as quickly as possible. The Canadians landed 228 tons in 1998. The MSMC assumed that 300 metric ton bycatch was unavoidable and projected F_{MSMC} based on this catch (F_{MSMC} =0.06). The stock rebuilds to B_{MSY} in 2005 with greater than 80% probability. Accounting for an assumed Canadian catch of 228 metric tons, the USA TTAC in 2000 is 72 metric tons, a 97% reduction from 1998 landings.

5.8.2 American Plaice

A. Stock status

The stock, defined as a Gulf of Maine-Georges Bank complex, was last assessed in SAW 28 using a VPA analysis with a terminal year of 1997. SARC 28 classified the stock as low in biomass and overexploited in 1997. Commercial landings have declined from 1992 to 1998. The NDWG projected fishing mortality and stock sizes for 1998 using 1998 landings. Fishing mortality in 1998 was projected to be 0.32, a decline from F_{1997} =0.47. Spawning stock biomass increased to 14,436 metric tons in 1998. The projection was carried forward by assuming that $F_{1999} = F_{1998}$. Spawning stock biomass declined to 13,755 metric tons in 1999.

B1. Projections based on the Amendment 9 control rule ($F_{control\ rule}$)

The Amendment 9 control rule calls for $F_{control\ rule}$ =0.02 for the 1999 spawning stock biomass. At $F_{control\ rule}$ =0.02, spawning stock biomass is projected to rebuild to SSB_{MSY} by 2004 with 96% probability. The total TTAC in 2000 would be 254 tons compared to 3,662 metric tons taken in 1998. Canadian landings were 65 metric tons in 1997 but averaged 23 metric tons from 1995 through 1997.

B2. Projections based on the F that achieves rebuilding within the timeframe specified by the control rule (F_{MSMC}).

The previous projections indicate that this stock can rebuild within 5 years with very high probability. Given the stock structure and recruitment, the MSMC felt that F could be liberalized from control rule and still achieve rebuilding within 5 years. The MSMC projected F_{MSMC} that rebuilds within 5 years with 50% but constrained to not exceed the F_{target} specified in Amendment 9 ($0.02<F<0.11$). At F_{MSMC} =0.11, the stock rebuilds to SSB_{MSY} by 2004 with 57% probability, and by 2009 at 98% probability. The 2000 total TTAC is 1,279 metric tons, a 65% reduction from 1998 landings.

5.8.3 Witch flounder

A. Stock status

The Gulf of Maine-Georges Bank stock was last assessed at SAW 29 using a tuned VPA with a terminal year of 1998. The SARC classified the stock as near target biomass and fishing mortality (Draft SARC 29 Advisory). Fishing mortality declined to 0.37 and spawning stock biomass increased to 8,652 metric tons in 1998. Projections for 1999 assumed that $catch_{1999}$= $catch_{1998}$ as recommended by SARC 29. Fishing mortality was projected to 0.20 in 1999 and mean 3^+ biomass was 25,701. There is a 55% probability that mean 3^+ biomass achieved B_{MSY} (25,000 metric tons) in 1999.

B1. Projections based on Amendment 9 control rule ($F_{control\ rule}$)

The Amendment 9 control rule states that when mean biomass is equal or greater than B_{MSY}, the target F is the 10^{th} percentile of F_{MSY}. F_{MSY} = 0.11 (biomass weighted) and the biomass F target is 0.09 (fully recruited F_{target} = 0.11). The 2000 target TTAC is 1,734 metric tons. The TTAC represents a 21% decrease in landings from 1998, and a 70% decrease in fishing mortality from 1998. Since the stock is projected to have achieved B_{MSY} in 1999, alternative MSMC projections were not needed.

5.8.4 Georges Bank winter flounder

A. Stock status

Georges Bank winter flounder was assessed at SAW 28 using a tuned VPA with 1997 as the terminal year. The stock was assessed as low in abundance and fully exploited. Commercial landings have generally declined since the early 1980's through 1995. Landings decreased to 1,400 metric tons in 1997. SARC 28 estimated fishing mortality to be 0.41 in 1997 and spawning stock biomass to be 3,500 metric tons. The NDWG projected 1998 status using 1998 landings. Fishing mortality was estimated at 0.42 in 1998. Projections for 1999 were run by assuming $F_{1999}=F_{1998}$. Mean 1^+ biomass was estimated to be 4,422 metric tons in 1999.

B1. Projections based on the Amendment 9 control rule ($F_{control\ rule}$)

The Amendment 9 control rule for Georges Bank winter flounder uses survey based proxies for biomass and exploitation. The 1999 autumn survey proxy was 0.90 (see NDWG report for method to convert projected mean biomass to survey indices for 1999). The control rules calls for $F_{control\ rule}$ =0.0 when the NEFSC autumn survey is less than 1.37. At $F_{control\ rule}$=0.0, mean 1^+ biomass achieves B_{MSY} in 2004 with 73% probability. Canadian landings have been around 150 tons. Given the Canadian landings and unavoidable by-catch that will occur in other USA fisheries, a zero fishing mortality is unlikely to be achieved.

B2. Projections based on the F that achieves rebuilding within the timeframe specified by the control rule (F_{MSMC}).

The MSMC interpreted the control rule to mean no directed fishing and to rebuild as quickly as possible. The MSMC assumed that 300 metric ton of bycatch was unavoidable and projected F associated with this catch (F_{MSMC} =0.09). F_{MSMC} was used in the projections. At F_{MSMC} =0.09, the stock rebuilds to B_{MSY} in 2006 with 63% probability and in 2009 with 85% probability. The 2000 total TTAC is 300 metric tons, a 74% reduction from 1998 landings.

5.8.5. Southern New England/ Mid-Atlantic winter flounder

A. Stock status

Southern New England/ Mid-Atlantic stock was assessed at SAW 28 using a tuned VPA with a terminal year of 1997. The stock was at medium biomass and fully exploited. Fishing mortality was 0.31 in 1997. Total commercial landings declined slightly to 3,240 metric tons in 1998. The NDWG projected 1998 status using 1998 landings. The NDWG estimated F= 0.33 and spawning stock biomass is 11,793 metric tons in 1998. Projections for 1999 were run by assuming F_{1999}=F_{1998}. Mean 1+ biomass was estimated to be 24,997 metric tons in 1999. Mean 1^+ biomass is between ½B_{MSY} and B_{MSY}.

B1. Projections based on the Amendment 9 control rule ($F_{control\ rule}$)

The Amendment 9 control rule for Southern New England winter flounder calls for a fully recruited $F_{control\ rule}$=0.40. The stock achieves B_{MSY} with a 57% probability in 2001 and with a 78% probability in 2009. The 2000 TTAC is 6,000 metric tons. However, this TTAC includes both recreational and commercial landings. Applying the ratio of 1998 commercial landings/1998 total landings (=0.85) gives an approximate commercial TTAC of 5,100 metric tons, a 57% increase from 1998 landings. $F_{control\ rule}$ is higher than the ASMFC's FMP rebuilding strategy of F_{40}=0.20, or the overfishing definition of $F_{25\%}$=0.35.

B2. Projections based on the F that achieves rebuilding within the timeframe specified by the control rule (F_{MSMC}).

The MSMC ran a projection to determine the fishing mortality rate that achieves B_{MSY} with 90% probability at 10 years. The F_{MSMC} was constrained to not exceed the Amendment 9's target F. The fishing mortality rate that achieves this is 0.33. F_{MSMC} achieves B_{MSY} in 2009 with 90% probability. The 2000 TTAC associated with F_{MSMC} is 4,754 metric tons. . Applying the ratio of 1998 commercial landings/1998 total landings (=0.85) gives an approximate 2000 TTAC for commercial fishery of 4,040 metric tons, a 24% increase from 1998 landings. F_{MSMC} is higher than the ASMFC's FMP rebuilding strategy of F_{40}=0.20, and is near the $F_{25\%}$=0.35 overfishing definition.

C. Reference points from the ASMFC FMP for SNE/ MA winter flounder

The ASMFC Fishery Management Plan for winter flounder uses $F_{40\%}$ (= 0.20) as a rebuilding target and $F_{25\%}$ (=0.35). $F_{control\ rule}$ is greater than the ASMFC's overfishing definition and F_{MSMC} is very close to the overfishing definition and both greatly exceed the ASMFC's rebuilding F target. The ASMFC is in the process of amending the FMP to allow fishing mortality targets and overfishing definitions consistent with NEFMC's definitions.

5.8.6 Cape Cod yellowtail stock

Stock status

Cape Cod yellowtail was assessed at SARC 28 using a tuned VPA. SARC 28 declared the stock at medium biomass and overexploited in 1997. The NDWG updated the assessment through 1998. Fishing mortality declined to 0.41 in 1998 and spawning stock biomass increased to 1,900 metric tons. A projection for 1999 assumed that F_{1999}=F_{1998}. The mean biomass increases to 3,640 in 1999. This is above ½ B_{MSY} (3,050 metric tons).

B1. Projections based on the Amendment 9 control rule ($F_{control\ rule}$)

The Amendment 9 control rule for rebuilding to B_{MSY} within 5 years when biomass is between ½B_{MSY} and B_{MSY}. The control rule calls for a $F_{control\ rule}$ =0.07. This achieves B_{MSY} in 2004 with nearly 100% probability. The 2000 TTAC is 150 metric tons. This represents an 87% increase from 1998 landings.

B2. Projections based on the F that achieves rebuilding within the timeframe specified by the control rule (F_{MSMC}).

The MSMC ran a projection to projected the fishing mortality rate that achieves B_{MSY} in 2004 with 50% probability (F_{MSMC} =0.50). F_{MSMC} achieves B_{MSY} in 2004 with 55% probability and in 2009 with 69% probability. The 2000 TTAC associated with F_{MSMC} is 896 metric tons, a 23% reduction from 1998 landings.

As a sensitivity, the MSMC also ran a projection with $F_{0.1}$ (=0.21). The stock rebuilds to B_{MSY} in 2004 with 98% probability. The 2000 TTAC is 424 metric tons, a 64% reduction in landings.

Insert figure 5.11 white hake

Insert 5.12 American plaice

Insert figure 5.13

Insert figure 5.14 gb winter flounder

Insert figure 5.15 SNE MA BB

Insert figure 5.16 (cape cod yt)

5.9 Summary of reductions in fishing mortality and landings needed for achieving Amendment 9 rebuilding schedule

Tables 5.91 shows the reduction in F_{1998} needed to achieve the Amendment 9 fishing mortality target for the five major large mesh stocks. Large reductions are needed for four of the five stocks major stocks. Similar reductions are needed for the six other groundfish stocks with assessments (Table 5.9.2). The average change in fishing mortality for all stocks combined is 48% for $F_{control\ rule}$ and 36% for F_{MSMC}. The mean reduction in F for all stocks combined is 83% for $F_{control\ rule}$ and 67% for F_{MSMC}.

Similar reductions from 1998 landings are needed to comply with Amendment 9 target fishing mortality rates. For all species combined, the reduction from 1998 landings is 19% to achieve $F_{control\ rule}$ and 36% to achieve F_{MSMC}. Landings can increase slightly for Southern New England/ Mid-Atlantic winter flounder and increase markedly for Georges Bank yellowtail for both $F_{control\ rule}$ and F_{MSMC}. A small increase can occur for Cape Cod yellowtail under F_{MSMC} but an decrease is needed under $F_{control\ rule}$. The average reduction for all stocks requiring reductions averaged 76% for $F_{control\ rule}$ and 67% for F_{MSMC} scenarios.

Table 5.9.1. Percent reduction from 1998 fishing mortality required to achieve Amendment 9 fishing mortality targets for cod, haddock Georges Bank yellowtail and Southern New England yellowtail stocks. $F_{control\ rule}$ represents Amendment 9 control rule. F_{MSMC} represents a fishing mortality that achieves rebuilding within Amendment 9's prescribed time frame. Shaded area indicates fishing mortality target in 2000 greater than 1998 fishing mortality rate.

Species	1998 F	$F_{control\ rule}$	% change from F_{1998} to $F_{control\ tule}$	F_{MSMC}	% change from F_{1998} to F_{MSMC}
GB cod	0.28	0.185	-34%	0.093	-67%
GB haddock	0.15	0.000	-100%	0.060	-60%
GB Yellowtail	0.17	0.500	+194%	0.375	+121%
SNE yellowtail	0.20	0.000	-100%	0.166	-17%
GOM cod	0.64	0.220	-66%	0.100	-84%
Mean % change[1]			-21%		-22%
Mean reduction[1]			-75%		-57%

1. Mean % change is average of both positive and negative % changes. Mean % reduction is average of only negative changes (reductions only).

Table 5.9.2. Percent reduction from 1998 fishing mortality required to achieve Amendment 9 fishing mortality targets for six large mesh stocks. $F_{control\ rule}$ represents Amendment 9 control rule. F_{MSMC} represents a fishing mortality that achieves rebuilding within Amendment 9's prescribed time frame. Shaded area indicates 2000 F is greater than 1998 fishing mortality rate.

Species	1998 F	$F_{control\ rule}$	% change from F_{1998} to $F_{control\ tule}$	F_{MSMC}	% change from F_{1998} to F_{MSMC}
White hake	1.09	0.000	-100%	0.064	-94%
American plaice	0.32	0.020	-94%	0.105	-67%
Witch fld.	0.37	0.110	-70%	0.110	-70%
GB winter fld.	0.42	0.000	-100%	0.085	-80%
SNE/ MA fld.	0.33	0.400	+21%	0.330	0%
Cape Cod YT	0.41	0.070	-83%	0.500	22%
Mean % change[1]			-71%		-48%
Mean reduction[1]			-89%		-78%

1. Mean % change is average of both positive and negative % changes. Mean % reduction is average of only negative reductions.

Table 5.9.3. Summary of percent reduction from 1998 fishing mortality required to achieve fishing mortality targets $F_{control\ rule}$ and F_{MSMC} for all stocks in Tables 5.9.1 and 5.9.2. Control rule represents literal interpretation of control rule. F_{MSMC} represents a fishing mortality that achieves rebuilding within Amendment 9's prescribed time frame.

All stocks in tables 5.9.1 and 5.9.2	1998 F		% change from F_{1998} to $F_{control\ rule}$		% change from F_{1998} to F_{MSMC}
Mean % change[1]			-48%		-36%
Mean reduction[1]			-83%		-67%

Table 5.9.4. Percent reduction from 1998 landings to achieve Amendment 9 fishing mortality target for cod, haddock, Georges Bank yellowtail and Southern New England stocks. $F_{Control\ rule}$ represents Amendment 9 control rule. F_{MSMC} represents a fishing mortality that achieves rebuilding within Amendment prescribed time frame. Shaded area indicates 2000 TTAC greater than 1998 landings.

species	USA 1998 landings	Assumed Canadian landings in 2000	2000 USA TTAC[1] to achieve $F_{Control\ rule}$	%change from 1998 landings	2000 USA TTAC[1] to achieve F_{MSMC}	% change from 1998 landings
GB cod	6,959	1,900	4,299	-38%	1,347	-81%
GB haddock	1,841	3,900	0	-100%	0	-100%
GB Yellowtail	1,800	2,000	10166	+465%	7,564	+320%
SNE yellowtail	400	0	0	-100%	629	+57%
GOM cod	4,156	0	1593	-62%	761	-82%
Total landings five stocks[2]	15,156	7,800	16,058	6%	10,301	-32%

1. USA TTAC calculated by subtracting assumed Canadian landings in 2000 from Total TTAC for stock.
2. Percent change in landings in 1998 are for combined landings and is not an average of % change column.

Table 5.9.5. Percent reduction from 1998 landings to achieve Amendment 9 biomass objectives for 11 stocks. $F_{Control\ rule}$ represents Amendment 9 control rule. F_{MSMC} represents a fishing mortality that achieves rebuilding within Amendment prescribed time frame (F_{MSMC}). Shaded area indicates 2000 TTAC greater than 1998 landings

species	USA 1998 landings	Assumed Canadian landings in 2000[1]	2000 USA TTAC[1] to achieve $F_{Control\ rule}$	% change from 1998 landings	2000 USA TTAC[1] to achieve F_{MSMC}	% change from 1998 landings
GB cod	6,959	1,900	4,299	-38%	1,347	-81%
GB haddock	1,841	3,900	0	-100%	0	-100%
GB Yellowtail	1,800	2,000	10,166	+465%	7,564	+320%
SNE yellowtail	400	0	0	-100%	629	+57%
GOM cod	4,156	0	1,593	-62%	761	-82%
White hake	2,364	228	0	-100%	72	-97%
American plaice	3,662	23	231	-94%	1,256	-66%
Witch fld.	1,849	9	1,725	-7%	1,725	-7%
GB winter fld.	1,178	151	0	-100%	149	-87%
SNE/ MA fld.	3,240	0	5,100	+57%	4,040	+25%
Cape Cod YT	1,169	0	150	-87%	896	-23%
Total landings for 11 stocks[2]	28,618	8,211	23,264	-19%	18,439	-36%

1. USA TTAC calculated by subtracting assumed Canadian landings in 2000 from Total TTAC. USA TTAC for SNE/ MA winter flounder calculated by subtracting 15% of total TAC for recreational allocation (900 metric tons for $F_{control\ rule}$ and 714 metic tons for F_{MSMC}) from the total TAC which includes both recreational and commercial landings.
2. Percent change in landings in 1998 are for combined landings and is not an average of % change column.

6.0 Status of other species without updated assessments

Assesments of Pollock, Gulf of Maine-Georges Bank redfish, Gulf of Maine winter flounder, Gulf of Maine-Georges Bank Windowpane flounder, and Southern New England/ Mid-Atlantic Windowpane have not been updated. The status of these species at the time of their last assessment is listed in Table 5.10.1. The MSMC decided to examine these stocks using a relative exploitation index consisting of catch divided by the survey biomass index. Relative exploitation does not provide the absolute magnitude of exploitation because survey catchability is unknown. Thus, relative exploitation is not useful for determining whether exploitation is above or below overfishing thresholds. However, trends in the relative exploitation index, combined with the stock status derived from the previous assessment, may allow general statements about current exploitation and stock abundance to be made.

Caution is advised in interpreting these relative exploitation indices because total survey biomass indices are used in lieu of exploitable biomass. Increases in recruitment may inflate total biomass but not exploitable biomass, and may bias the relative exploitation index low. The annual variation in survey indices due to sampling error and annual variation in catchability and availability affects the point estimates of relative exploitation. Loess (a localized weighted regression scatterplot-smoothing algorithm) was used to smooth the relative exploitation index. This smoothing technique facilitates the detection of patterns and trends in scatterplot data.

Table 5.10.1 Summary of stock status for 5 groundfish species without recent assessments.
Stock area abbreviation sare SNE= Southern New England, GOM= Gulf of Maine, MA= Mid-Atlantic. Relative exploitation = commercial landings/ survey biomass index.

Stock	Recent trends Survey biomass	Survey biomass	Recent trend in relative exploitation index
Pollock	**Slight increase**	**low**	**declines, but relatively high**
GOM-GB redfish	**fluctuates since 96**	**medium**	**declines to timeseries lows[1]**
GOM winter flounder	**Slight increase**	**medium**	**declines to timeseries low[1]**
GOM-GB windowpane fld	**increase**	**medium**	**declines to near timeseries low**
SNE-MA windowpane fld	**fluctuates since 94**	**low**	**declines to timeseries low**

[1]survey data indicates that increase in pre-recruits are contributing to increase survey biomass. Declines in relative exploitation may be exaggerating actual declines in exploitation.

6.7 Pollock

This transboundary stock, defined as a Scotian shelf-Gulf of Maine-Georges Bank complex, was last assessed at SAW 16 with a tuned VPA. The terminal year was 1992. The stock was at a medium level of abundance and fully exploited. USA commercial landings have declined from the late 1980 through 1996 (Figure 6.2). Landings increased slightly in 1997 and increased 31% in 1998. However, USA landings are an insignificant portion of total landings. Survey biomass indices show a declining trend from the late 1970's to early 1990s. They have increased slightly since 1995. The biomass index is near the 25th percentile and the stock is at a low biomass. Relative exploitation has declined in recent years, but remains near the timeseries average.

6.8 Redfish

The Gulf of Maine-Georges Bank stock was last assessed at SAW 15. The stock was characterized as low in abundance and overexploited. Commercial landings have declined greatly since 1980 (Figure 6.3). Landings have increased to 316 metric tons in 1998. Biomass indices also declined from the mid-1970's through 1982 before slowly increasing through the 1980's. The biomass index declined to near record lows in 1994 and 1995 but increased sharply in 1996, based on increased survey catches of 4-6 year old fish and has fluctuated around this level since 1996. The index is above the median, suggesting that the stock is at a medium level of abundance. Good recruitment appears to be the cause of the increased biomass. Relative exploitation appears to have declined since the early 1980's and currently is low relative to the timeseries.

Gulf of Maine winter flounder

Gulf of Maine winter flounder was also assessed at SAW 21 using an index level assessment. The stock was classified as low in abundance and overexploited. Overall landings have declined from a record high in 1982 through 1994 (Figure 6.8). Landings increased slightly after 1994 and have fluctuated without trend since 1996. The Massachusetts Division of Marine Fisheries Spring biomass index (1978-1997) declined from the early 1980's until 1988, fluctuated near this low through 1993 and increased slightly from 1994 through 1998. The 1998 biomass index is just above the median. Relative exploitation shows a declining trend since 1991, reaching a timeseries low around 1998. Examination of the MADMF survey's catch at age through 1997 indicates that much of the increase in biomass is due to increases in age 1 and 2 since 1992. It is not certain whether this is due to improved recruitment or improved survival due to restrictions on small mesh fisheries. However, the increase in the age 2 index does not follow through to older ages suggesting that exploitation is higher than suggested by the relative exploitation index.

The ASMFC Winter Flounder Technical Committee assessed this stock using the ASPIC surplus production model, relative exploitation indices, and total mortality estimates from the MADMF survey catch at age. Results were not peered review. That Committee concluded "…biomass to be relatively low and strongly suggest that the fully recruited F remains high" (ASMFC, 1998).

6.9 Windowpane flounder

The Gulf of Maine-Georges Bank stock of windowpane flounder has yet to be formally assessed. The 1994 Status of the Fishery Resources of the Northeastern United States listed the stock as in decline and likely overexploited. Commercial landings declined from a record high in 1992 to a record low in

1994 (Figure 6.9).   Landings increased in 1995 and 1996, but declined in 1997 and 1998. The NEFSC Autumn biomass survey has been highly variable throughout the timeseries. The 1997 biomass index was between the 25th and 50th percentile, suggesting that biomass was low to medium. The index increased substantially in 1998 and is between the 75th and 100th percentile, suggesting that biomass is higher than average. Relative exploitation has declined since the late 1980's.

The Southern New England/ Mid-Atlantic stock of Windowpane has not been assessed. The 1993 Status of the Fishery Resources of the Northeastern United States listed the stock as low in abundance and overexploited. The NEFSC autumn biomass index has increased slightly since reaching a record low in 1993, but remains low (Figure 6.10). The 1998 biomass index was below the 25th percentile and is amongst the lowest in the timeseries. Landings have remained low since 1993. Relative exploitation has declined since 1992 and is near a timeseries low.

Figure 6.1. Top Panel: Commercial landings (USA and Canada) and the NEFSC Autumn survey biomass index. Bottom panel: Relative exploitation index.

Figure 6.2. Top Panel: Commercial landings (USA and Canada) and NEFSC autumn survey biomass index. Bottom Panel: Relative exploitation.

Figure 6.3. Top Panel: Commercial landings (USA) and the MADMF spring survey biomass index. Bottom Panel: Relative exploitation index.

Figure 6.4. Top Panel: Commercial landings (USA) and NEFSC autumn survey biomass index. Bottom Panel: Relative exploitation index.

Figure 6.5. Top Panel: commercial landings (USA) and NEFSC autumn survey biomass index. Bottom Panel: Relative exploitation index.

Note: The MSMC did not have time to update sections 7.0, and 7.1 (shaded sections). They are included from last year's report in order to provide methodology and approximations for DAS reductions. Total DAS increased to 52,025 in 1998, a 19% increase over predicted 1998 usage of 43,854 (The MSMC only had May-August 1998 DAS at the time of last year's report). The MSMC could not determine whether this was activation of latent effort for use in the running clock to land cod overages, activation to provide a DAS history for control date, or represents an actual increase fishing effort. Table 7.1 and Appendix Table 7.1 can be used for approximating the allocation of DAS to fleet and individual vessels to achieve a % reduction in DAS. The Groundfish Plan Development Team can update these analyses if the Council decides to go forward with DAS reductions in the Annual Adjustment. Section 7.2 is updated.

7.0 FISHING MORTALITY OBJECTIVES AND DAYS-AT-SEA (DAS) REDUCTIONS

The MSMC examined DAS utilization rates in 1996 and 1997 to estimate expected DAS usage in 1999 under status quo DAS. Day-at-sea reports were also examined for the period between May 1998 and September 1998 to determine if the 1998 management adjustments had a significant influence on total fishing effort. Median fishing mortality rates for fishing year 1998 were estimated using 1997 and 1998 calendar year mortality rates. We also provided estimates of the additional mortality reductions that would be necessary to reduce fishing mortality from 1997-1998 levels to the Amendment 7 targets in the fishing year 1999 (May 1 to April 30).

7.1 DAS Utilization During 1997 and 1998

DAS allocations continue to greatly exceed the actual usage, even though the annual allocations of days for a vessel have significantly declined since the implementation of Amendment 7. These reductions in days allocated have been more constraining on the larger, more active vessels in the Individual day-at-sea permit categories. The day-at-sea restrictions have been less restraining for the greater number of vessels in the fleet permit categories, so the percent of days actually used has risen but the number of days fished has not changed. Since Amendment 7, the number of days used by vessels in the fleet category have remained around 30,000 days (Figure 7.1), while the number of days used by Individual days-at-sea vessels declined by 29 percent between 1996 and 1997. This decline is due to reductions in the amount of days available and due to the removal of vessels by the Vessel Capacity Reduction program.

In general, vessels with Individual DAS allocations utilized more of their DAS (85 percent in 1996, 82 percent in 1997) than the 1,299 Fleet DAS vessels that reported using DAS during 1996 (Figure 7.1). The fleet vessel category, on the other hand, used 27 percent of the 1996 DAS allocations, and 43 percent of the 1997 DAS allocation. The 60 percent increase in days-at-sea utilization by the fleet category almost exactly matches the percent decrease in days-at-sea allocated in 1997.

Vessel capacity reduction (buyout) program and vessel attrition

There are 80 vessels (54 Amendment 5 vessels and 26 Amendment 7 vessels) that have been bought-out by the vessel capacity reduction program. Sixty-seven (64) vessels reported DAS usage during 1997. Despite the decline in the number of vessels with Multispecies permits, the days used only declined for vessels with Individual Multispecies permits and then only by the same ratio as the reduction in the number of days allocated per vessel.

This result implies that some vessels either increased their fishing effort over previous levels or some inactive vessels began using their days. In 1996, 725 (42 percent) of the 1,718 permitted vessels reported using days-at-sea through the call-in/VMS program. In 1997, there were 1,712 vessels that received DAS allocations but the number of inactive vessels that reported no DAS use declined to 623 (36 percent of permitted day-at-sea vessels, a decline from 993 inactive vessels in 1996). The number of inactive vessels during the 1998 fishing year cannot be determined because the year is incomplete. Only 1,532 vessels are allocated 1998 DAS, but the expected DAS use is only 7.4 percent below 1997 amounts.

Of the 183 vessels that were not permitted for the 1998 fishing year, there were 101 that reported using a total of 3,979 days (39 days/vessel) during the 1997 fishing year. Of the 101 vessels, 66 were removed from the fleet due to factors other than the vessel capacity reduction program. Thus, fleet attrition accounted for 1,679 days used in 1997 being removed from the multispecies fleet, while the buyout program accounted for 2,300 days. Twenty-seven vessels had Category A (Individual day-at-sea) permits and reported using 1,818 days during 1997. Fifty-six had Category B (Fleet day-at-sea) permits and reported using 1,653 days during 1997. Removal of days via attrition (42% and due to the vessel capacity reduction program (58%) appears to have removed about eight percent of the total days used during 1997. This is consistent with the estimated 7.4 percent reduction in projected days used during 1998.

In last year's report, the MSMC estimated that the 80 buyout vessels that had been processed or enrolled in the program used 6,487 DAS during 1996. It was assumed that there would be no replacement of those DAS removed by the vessel capacity reduction program. Since the actual DAS used in 1997 declined by 2,524 days and the 1997 days removed by the program totaled 2,300, the majority of the projected benefit was dissipated by increased fishing activity by remaining vessels, some of the inactive vessels in 1996 becoming active in 1997.

Predicting DAS usage in 1999

The MSMC examined the 1997 DAS usage by multispecies vessels to estimate the efficacy of DAS caps for reducing nominal fishing effort. These estimates were calculated much like one would estimate the results of recreational bag limits.

Various DAS caps were compared with the estimated 1998 DAS usage for each vessel in the call-in data. These trial values of effort reduction (Table 7.1) ranged from 7% (100 fleet DAS, 43% reduction from 1993 baseline for individual DAS vessels) to 76% (13 fleet DAS, 92% reduction from the 1993 baseline for individual DAS vessels). A more complete version of this Table is found in Appendix VII. It was necessary to estimate the effect of higher DAS allocations than the status quo because 763 vessels were allocated up to 10 additional DAS in 1998 when they had more than 10 days unused in 1997. For comparison, five-hundred and fifteen vessels were allocated 88 days for the 1998 fishing year. It is unknown whether this additional allocation of days during 1998 will actually increase fishing effort during this fishing year. The basic assumption used by the MSMC is that the vessels with a greater allocation of days will fish the days remaining in October 1998 to April 1999 in the same ratio as the vessel demonstrated during the same period of time for the 1997 fishing year. This assumption results in a very small increase in the projected days used and appears to be consistent with fishing effort patterns during May to September 1998.

Unlike last year's review, the MSMC was able to use monthly days-at-sea reports to estimate seasonal changes in fishing effort in the current fishing year. The ratio of days-at-sea in May 1, 1998 to September 30, 1998 compared to May 1, 1997 to September 30, 1997 was estimated and applied to the October 1, 1997 to April 30, 1998 days-at-sea use for each vessel in the data to estimate the expected days-at-sea that will be used during the 1998 fishing year. This procedure was necessary to account for the effects of the new management restrictions in place for the first time in 1998, especially the running clock. For some vessels, the expected days-at-sea use would equal the 1998 day-at-sea allocation and the MSMC assumed that fishing by this vessel would stop for the remainder of the fishing year.

Vessels that used few of their 1997 DAS, would be unaffected by the 1999 DAS limits, as long as the fishermen did not increase their groundfish fishing effort. The MSMC assumed no increases in effort for vessels that used a small proportion of their allocated DAS, even though increased effort might be expected in response to higher prices and/or decrease competition from more active vessels. The 1999 DAS effort estimates are, therefore, not very conservative in this regard, although there is evidence that some vessels did increase their fishing activity during 1997 compared to 1996.

Fleet or individual DAS vessels that fished for more days in 1997 than those examined in Table 7.1 were assumed to fish at the limit. As indicated above, this procedure also applied to the projected days-at-sea use by individual vessels during 1998. A vessel that fished for 88 days in 1997, for example, was assumed to fish for 88 days in 1999 if the limit on DAS use will be 88 DAS. Vessels that fished less during May to September of 1998 than in 1997 were estimated to fish at lower levels in 1999.

Results

Across all fleets, the MSMC expects a 7.4 percent reduction in nominal fishing effort from 47,477 DAS[1] in fishing year 1997 to 43,854 expected DAS in 1998 based on a cap of 88 fleet DAS in 1998 and a 50 percent reduction in DAS allocations for individual and combination DAS vessels from the baseline (Table 7.1). This table shows expected total DAS in 1999 for a various combinations of DAS reductions for fleet and individual DAS vessels. The estimated effects of total groundfish day-at-sea allocations ranges from 47,477 DAS to 17,252 days-at-sea with an 88 percent reduction in individual days-at-sea relative to the 1993 baseline and 22 Fleet days-at-sea. The status quo allocation of days-at-sea, including the effects of carry-forward days (up to 10 unused days-at-sea can be carried into the next fishing year by active vessels), is shaded and is expected to generate 43,959 days used in 1999, a 7.4 percent reduction from fishing year 1997.

The MSMC also discussed the relative contribution to fishing mortality of a DAS by a fleet versus an individual DAS vessel. The MSMC could not, however, make the appropriate linkage between call-in and dealer data to investigate this possibility. Although presented side-by-side in Table 7.1 so that the status quo day-at-sea allocations coincide, there are many permutations of days-at-sea allocations to fleet and individual days-at-sea vessels. Alternative combinations of days-at-sea allocations for fleet and individual day-at-sea vessels are given in Appendix VII.

1 Excludes DAS used by hook vessels.

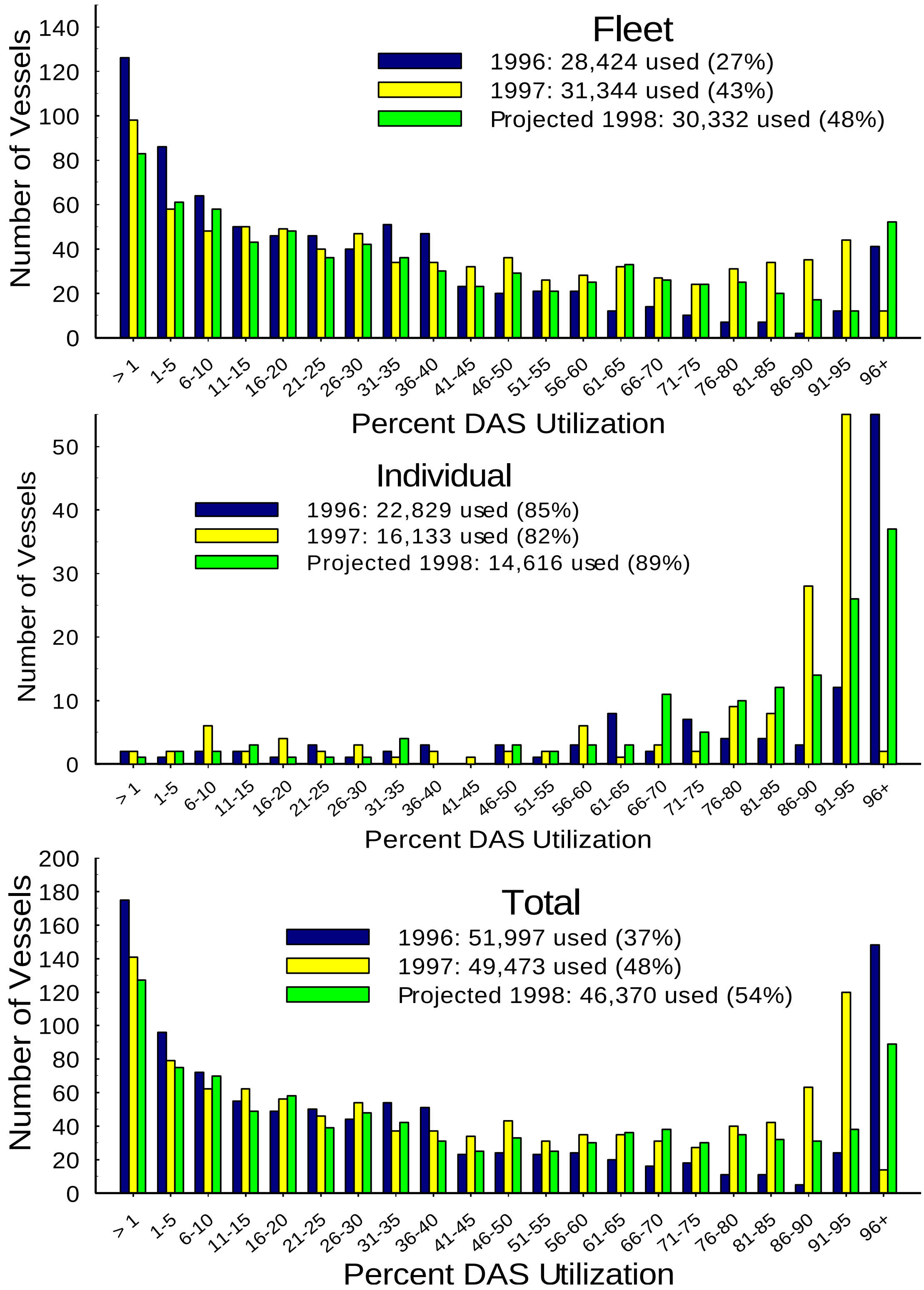

Figure 7.1. Percent of allocated DAS used by multispecies vessels in each permit category, 1996-1998, derived from NMFS VMS/call-in data. DAS for 1998 were expanded to an annual total based on DAS reports from May 1 to September 30, compared to the seasonal DAS data for each vessel during 1997.

Table 7.1. Expected change in DAS usage for 1999 DAS allocation options based on 1997 VMS/call-in data. Shaded areas represent the status quo allocation of DAS. Hook vessels not included in total.

Total[1]		Individual			Fleet			
Expected DAS usage	Effective reduction from 1997	Nominal reduction from 1993	Expected 1999 DAS	Effective reduction from 1997	Nominal Effort Reduction from 1997	DAS Allocation	Expected 1999 DAS	Effective effort reduction
47,477	0%	1997 DAS Used	16,133	0%	1997 DAS used		31,344	0%
43,996	7%	43%	14,636	9%	114%	100	29,360	6%
43,989	7%	45%	14,636	9%	110%	97	29,353	6%
43,982	7%	47%	14,636	9%	106%	93	29,346	6%
43,959	7%	50%	14,631	9%	100%	88	29,328	6%
43,601	8%	53%	14,427	11%	95%	84	29,173	7%
42,841	10%	55%	13,987	13%	90%	79	28,854	8%
41,778	12%	58%	13,411	17%	85%	74	28,367	9%
40,813	14%	60%	12,911	20%	81%	71	27,902	11%
39,373	17%	62%	12,193	24%	75%	66	27,180	13%
37,782	20%	65%	11,433	29%	70%	62	26,349	16%
36,038	24%	67%	10,651	34%	65%	57	25,387	19%
34,159	28%	70%	9,864	39%	60%	53	24,295	22%
32,121	32%	73%	9,050	44%	55%	48	23,072	26%
30,494	36%	75%	8,433	48%	51%	45	22,061	30%
28,181	41%	77%	7,600	53%	46%	40	20,582	34%
25,699	46%	80%	6,757	58%	40%	35	18,942	40%
23,056	51%	82%	5,901	63%	35%	31	17,155	45%
20,240	57%	85%	5,039	69%	30%	26	15,201	52%
17,252	64%	87%	4,176	74%	25%	22	13,076	58%
14,061	70%	90%	3,307	80%	20%	17	10,755	66%
11,535	76%	92%	2,654	84%	15%	13	8,882	72%

7.2 Fishing Mortality Reduction to Achieve the 2000 Targets

The mortality estimates for the five critical groundfish stocks were compared to the Amendment 7 targets for 2000 by the MSMC. Unlike previous MSMC reports, mortality was not projected for the current calendar year (January 1 through December 31, 1999). This was due to advancing the timing of the report by one month (only January through May landings were available to the MSMC). In addition to limited availability of landings, the implementation of many area closures and trip limits changes in the early portion of 1999 makes the projection of 1999 landings for Gulf of Maine cod suspect. The MSMC could not therefore estimate the fishing mortality for either calendar year 1999 (January 1999 through December 31, 1999) or fishing year 1998 (May 1, 1998 through April 30, 1999). The percent reductions in DAS are from DAS used in fishing year 1998.

Table 7.2. Percent reductions in fishing mortality and DAS.

Stock	Calendar 1998 F	Assumed Calendar 1999 F	Amendment 7 F targets	reduction needed	DAS Equivalent[2]
Georges Bank cod	0.28	0.28	0.18	36%	33,296
Georges Bank haddock	0.15	0.15	0.26	0%	52,025
Georges Bank yellowtail	0.17	0.17	0.25	0%	52,025
SNE Yellowtail	0.20	0.20	0.27	0%	52,025
Gulf of Maine cod F_{max}	0.64	0.64	0.27	58%	21,850
Gulf of Maine cod $F_{0.1}$	0.64	0.64	0.15	77%	11,966
Gulf of Maine cod F_{max}	0.64	0.29[1]	0.27	7%	48,383
Gulf of Maine cod $F_{0.1}$	0.64	0.29[1]	0.15	48%	27,053

1. Based on sensitivity analysis.

2. Reduction from fishing year 1998 (May 1, 1998- April 30, 1999) DAS use of 52,025. Estimates of fishing year 1998 fishing mortality rates are not available.

Georges Bank cod

Georges Bank cod require a 36 percent reduction in F from calendar year 1998 fishing mortality rate of 0.28 to the Amendment 7 mortality target, $F_{0.1}$=0.18 (Table 7.2). A 36% reduction is needed to achieve the Amendment 7 target F. This translates into 33,296 DAS in 2,000.

Georges Bank haddock

Fishing mortality was 0.15 in calendar year 1998, which is below the $F_{0.1}$ target of 0.24. No reductions are needed to achieve the Amendment 7 target.

Georges Bank yellowtail

Fishing mortality was 0.17 in calendar year 1998 (Table 7.2). Mortality for Georges Bank yellowtail flounder is below the target. No reductions in mortality are needed to achieve the Amendment 7 target

Southern New England yellowtail

Fishing mortality was 0.20 in calendar year 1998 (Table 7.2). Mortality for Southern New England yellowtail flounder is below the target. No reductions in mortality are needed to achieve the Amendment 7 target

Gulf of Maine cod

Fishing mortality was estimated as 0.64 in calendar year 1998. A 58% reduction is needed to achieve F_{max} and a 77% is needed to achieve $F_{0.1}$. This is equivalent to 21,850 DAS for F_{max} and 11,966 DAS for $F_{0.1}$.

The MSMC provided a sensitivity analysis that bounds the estimates of fishing mortality in calendar year 1999. This sensitivity analysis is based on observed landings from January to May and various projections for June through December. The analysis does not account for increased in discarding that may have occurred under the 400 lbs. trip limit. If discarding **did not appreciably increase** in 1999, then fishing mortality in 1999 may approach F_{max} in calendar year 1999. A reduction of 7% is needed to achieve F_{max} and 48% to achieve $F_{0.1}$. This is equivalent to 48,383 DAS for F_{max} and 27,053 DAS for $F_{0.1}$.

8.0 MSMC Options for Fishing Year 2000

The MSMC has developed the following four options to achieve the plan objectives for the 2000 fishing year. Included are options based on various combinations of the primary management measures: DAS, trip limits and area closures. Also included is a discussion of some pros and cons of each alternative. All options continue the measures contained in Frameworks 26, 27 and (proposed in) 31. Options 1 and 2 do not retain the 2,000 pounds per day Georges Bank cod trip limit, but include DAS reductions to achieve the plan goals. DAS allocations necessary to achieve the reduction goals are based on 1997 DAS usage patterns as analyzed in the 1998 MSMC Report. Options 3 and 4 include the GB cod trip limit plus area closures to achieve GB cod objectives. Option 3 uses modifications to the DAS system so that each per-day trip limit is based on a full 24 hours against the DAS allocation, and other measures to minimize the "pulse fishing" during high catch rate times when the rolling closures are re-opened. Option 4 uses addition backstop area closures in the Gulf of Maine to protect against the target TAC from being exceeded.

All options continue the Gulf of Maine cod measures contained in Frameworks 26, 27 and proposed in 31. Including, but not limited to a trip limit of 400 pounds per day/4,000 pounds maximum possession for Gulf of Maine cod with modified running clock (see Section 1.2.5), and area closures as shown in Figure (area closure maps).

<u>Option 1</u>

Reduce DAS by 36% overall (reduction to 33,296 DAS overall, e.g. Allocated DAS: 35 Fleet DAS, 70% reduction in DAS from the baseline for Individual) and maintain FW 26, 27, 31 measures for Gulf of Maine cod

A) Pros:

- Achieves an F between $F_{0.1}$ and F_{MAX} for Gulf of Maine cod
- Achieves $F_{0.1}$ for Georges Bank cod
- Reduces potential cod discards
- Reduces mortality but may not achieve fishing mortality targets on other regulated species that need rebuilding under Amendment 9
- No additional enforcement or administrative burden

B) Cons:

- Probably does not achieve $F_{0.1}$ for GOM cod
- Increases pressure on species not managed by groundfish DAS
- Lost yield from regulated species not in need of fishing mortality reduction (under Amendment 9 rebuilding timetable, that includes southern New England winter flounder, Georges Bank and Cape Cod yellowtail flounder)

Option 2

Reduce DAS by 50% overall (reduction to 27,053 DAS overall, e.g. Allocated DAS: 22 Fleet DAS, 77% reduction in DAS from the baseline for Individual) and maintain FW 26, 27, 31 measures for Gulf of Maine cod

A) Pros:

- May achieve $F_{0.1}$ for Gulf of Maine cod.
- Achieves $F_{0.1}$ for Georges Bank cod .
- Reduces potential cod discards
- Reduces mortality but may not achieve fishing mortality targets on other regulated species that need rebuilding under Amendment 9
- No additional enforcement or administrative burden

B) Cons:

- Increases pressure on species not managed by groundfish DAS
- Lost yield from regulated species not in need of fishing mortality reduction (under Amendment 9 rebuilding timetable, that includes southern New England winter flounder, Georges Bank and Cape Cod yellowtail flounder)

Option 3

All multispecies vessels:

- **any vessel that calls the DAS line to start a multispecies trip may not call out to end the trip until 24 hours have elapsed**
- **a vessel that is calling in to end a trip after 24 hours may also start another trip at that time**
- **the 24-hour minimum requirement does not apply to vessels that return to port within three hours of starting the trip**
- **this provision applies to all vessels using multispecies DAS regardless of species landed.**

Vessels in the Gulf of Maine:
Maintain FW 26, 27, 31 plus measures to minimize discards:

- **Vessels not enrolled in the Gulf of Maine Cod Trip Limit Exemption Program (except Day gillnet vessels) would be required to take layover days during (May, June, July, November and December); layovers would be equal in length to preceding trip length, minimum of 24 hours, time must be in port (not in other fisheries)**
- **Day Gillnet vessels would be limited 80 tags (must be able to show 80 tags at any time during the month) during any month following the re-opening of any rolling closure (May, June, July, November and December).**

Maintain 2,000 pound per day GB cod trip limit, plus additional closures primarily adjacent to existing permanent closures as proposed in Options 1-4 in Framework 30. (see Appendix VI)

A) Pros:

- May achieve F_{MAX} for Gulf of Maine cod
- Achieves $F_{0.1}$ for Georges Bank cod
- Reduces "pulse fishing" after opening of rolling closures when catch rates are highest
- Counts per-day trip limits as per-DAS for all vessels (currently day boats may land a per-day limit for less than a full DAS counted against the vessel allocation, and Day Gillnet vessels are only charged 15 hours but may land a full per-day limit)

B) Cons:

- Does not achieve $F_{0.1}$ for Gulf of Maine cod
- Not likely to achieve fishing mortality targets on other regulated species that need rebuilding under Amendment 9
- Reactivation of latent effort (unused DAS)
- Layover days are difficult to enforce
- Would also limit monkfish nets to 80 tags

Option 4

Maintain FW 26, 27, 31 for Gulf of Maine cod plus additional backstop closures if 50 percent of TAC has been landed by July 31 as follows:

- **Cashes Ledge Closed Area in November**
- **Blocks 124 and 125 in January.**

Maintain 2,000 pound per day GB cod trip limit, plus additional closures primarily adjacent to existing permanent closures as proposed in Options 1-4 in Framework 30. (see Appendix VI)

A) Pros:

- Provides a backstop to prevent exceeding the target TAC that does not rely on trip limits
- May achieve F_{MAX} for Gulf of Maine cod
- Achieves $F_{0.1}$ for Georges Bank cod

B) Cons:

- Does not achieve $F_{0.1}$ for Gulf of Maine cod
- Not likely to achieve fishing mortality targets on other regulated species that need rebuilding under Amendment 9
- May encourage pulse fishing before reaching the 50 percent threshold
- Backstop has disproportional effects on vessels that fish in Cashes Ledge and Blocks 124 and 125.

Recreational fishing options

The MSMC indicates that the stock of concern at this time with respect to recreational catch is Gulf of Maine cod. The MSMC compared the trends in landings for the recreational fishery and commercial fishery for Gulf of Maine cod. Overall, commercial landings have declined 47 percent from 1994 to 1998 and recreational landings have declined by 12 percent. If proportionality of decline in landings is used as the criterion for imposing further regulations on the recreational fishery, then the recreational fishery requires further restrictions. Recreational landings now represent 16 percent of the total landings compared to 10-11 percent in recent years.

Historically, the recreational landings averaged 13 percent of the total landings. Maintaining this proportion of landings in 2000, recreational landings should be 167 mt based on a commercial target TAC, at F0.1, of 1,118 mt, and 287 mt based on a commercial target TAC, at Fmax, of 1,918 mt, These are the recreational landings associated with achieving the target F in 2000.

In 1997 and 1998 recreational landings were 250 and 824 mt, respectively, according to the MRFSS. 1999 recreational landings are not yet available. Given the apparent disparity between recent recreational landings and the landings associated with achieving target fishing mortality rates in 2000, the MSMC recommends that the Council apply comparable conservation measures to both commercial and recreational sectors. For example, possession of cod in closed areas could be prohibited when the closure is in effect, and/or a bag limit could be imposed on party/charter vessels.

Haddock trip limit

The MSMC did not evaluate the effectiveness of the haddock trip limit liberalization . However, USA landings doubled in 1998 from 1997 and fishing mortality remained about the same in the range of 0.15. Although fishing mortality is below the Amendment 7 F0.1 target, spawning stock biomass is not projected to reach Amendment 9 threshold, ½ SSBmsy, in 1999. According to the projection based on Amendment 7 fishing mortality target, F0.1=0.26, the U.S. target TAC would be 6252 mt in 2000. However, according to the Amendment 9 control rule and the MSMC adjusted control rule, the projected SSB in 1999 and 2000 indicate a fishing mortality rate of either 0.0 or 0.06, respectively. This would result in either a total stock target TACs of zero, or 2,536 mt which is less than the 1999 Canadian TAC of 3,900 mt.

The MSMC recommends against any measure that would raise the fishing mortality rate on haddock from the 1998 value. Therefore, the MSMC recommends no increase in the trip limit for 2000.

Other recommendations

30-day blocks

The Council initially considered this proposal in Framework 30 but deferred to the annual plan adjustment framework to provide for additional analysis. The number of vessels that will be constrained by a block of time out of the fishery will be small unless the block is longer than 30 days. As the block of time becomes larger, the ability of fishermen to change the characteristics of trips without reducing DAS diminishes. This may result in safety concerns as the block increases. Fishermen may decide to fish during bad weather because that may be the only time available.

The impact of this proposal is highly dependent on the response of fishermen as requiring groundfish vessels to take a required block of time out of the fishery may cause fishermen to change their fishing behavior. Permit holders may just change the length of trips, the time of trips, or the number of trips they take, or may move fishing effort into other quarters. The number of alternative ways fishermen can react to the block of time out makes it impossible to estimate of the reduction in effort (if any) that will result.

The MMC recommends against using a 30-day block of time out of the fishery because the impacts cannot be measured. Qualitatively, it does not appear a 30-day block will result in a significant reduction in effort. Increasing the size of the block to a length that will result in effort reductions may raise safety concerns.

Georges Bank Yellowtail Flounder

The MSMC recommends that fishing mortality on Georges Bank yellowtail flounder in 2000 be held at F0.1. The A9 control rule from which the fishing mortality rate of 0.5 was derived is based on the conversion of a biomass weighted F to a fully recruited F under equilibrium age structure. The age-based projection under F=0.50 which resulted in a 12,166 mt target TAC (total stock), however, is heavily influenced by the strength of the single 1997 year class which was well above the median of the last twenty years. The projected increase in biomass and yield is dependent on maintaining recruitment levels at twice the median observed during the same period. The MSMC, therefore, cautions that fishing at F=0.5 is likely to result in a decline in biomass unless future recruitment continues at this very high level. Given the history of recruitment on this stock, this high level of recruitment is not likely to occur.

Scallop vessel access to closed areas

The MSMC notes that information on fish distribution and bycatch in closed areas is based on limited sampling during narrow time periods. Information on the seasonal changes in the distribution of bycatch species in necessary before expanding any access program beyond the time periods observed in the experimental fisheries. Any program that provides access to closed areas should begin conservatively and include a mechanism for relaxing restrictions based on observed bycatch levels.

The MSMC recommends against increasing fishing mortality on Southern New England and Cape Cod yellowtail flounder. Southern New England yellowtail, in particular, does not rebuild, according to the projections, to Bmsy in 10 years or less at fishing mortality rates barely above 0.0. Any program to provide access to the Nantucket Lightship Closed Area and Closed Area I should be demonstrated as conservation neutral with respect to scallop vessel bycatch of these stocks.

The MSMC recommends that any program to allow scallop vessel access be done with sufficient monitoring of bycatch to insure that fishing mortality does not increase. Since data on current bycatch levels outside the closed areas is limited or is non-existent, making the determination that catches are not increasing will be extremely difficult.

For Georges Bank yellowtail, the MSMC notes that the target TAC will approximately double from 1999 to 2000. It does not have a recommendation on what portion of that TAC should or could be allocated to the scallop vessels.

General Recommendations:

The NEFMC **should continue to monitor technological improvements** in the fishery, and the potential that these improvements could compromise management based on Days at Sea. Technological improvements that increase fishery catch per unit effort will require more restrictive management measures to achieve and maintain mortality rates at or below rebuilding targets.

The MSMC **supports further experimentation of gear configuration** to improve size and species selectivity. Size-selectivity will become more important as stock biomass and recruitment improves. Current gear is capable of generating significant discards of pre-recruits. Regulatory discarding will increase as recruitment improves, leading to loss of potential yield and revenue. Improvements in species selectivity may also prove useful for providing protection to a “weak stock” while simultaneously allowing exploitation on species with co-occurring distributions. Additionally, small mesh fisheries may have a more difficult time achieving certification as the large mesh regulated species’ distribution expands and recruitment improves.

The MSMC **recommends that additional at-sea sampling be conducted** to provide estimates of discarding. This is especially important if the Council continues to rely on very restrictive trip limits to achieve target fishing mortality rates.

Option submitted by David Goethel 10/19/99

The MSMC reviewed a proposal submitted by David Goethel for Council consideration in the annual adjustment framework. One of the elements of this proposal is the area closures that were considered by the Council in Framework 31 under Option 2, as modified at the September 21-23 Council meeting. The size and configuration of the area closures precludes the use of the same analysis method that is used for area closures based on quarter-degreee squares. Qualitatively, the proposal opens inshore areas to fishing for other regulated species, especially yellowtail flounder and withc flounder, that will require significant reductions in fishing mortality to comply with SFA overfishing definitions. The rationale for the area closure proposal is to open areas to other fisheries while retaining closure of the important cod areas. The MSMC does not support this approach because of the status of the other regulated species relative to SFA biomass thresholds, and the anticipated reductions in fishing mortality that will be needed.

Regarding the night closure proposal, the MSMC cannot estimate the impacts because we do not have the information to determine day/night differences in current effort and catchability in the fishery. Even if catch rates are significantly higher at night, if most of the effort is expended during the day, then a night closure would not have a significant overall effect. If a per-day trip lmit can be caught during the day, then the effect of a night closure would be minimal.

In 1997, vessels fishing under a 700-pound per day trip limit caught 50 percent of the target 2,605 mt TAC by June 24. The MSMC feels that this trip lmit may offer an incentive for some vessels to target cod.

While the reduction to 20 gillnets is a significant reduction from the 80 nets that is currently allowed, the MSMC cannot determine if this reduction in gear is comparable to any reduction in catches that might be achieved by the mobile gear night fishing ban.

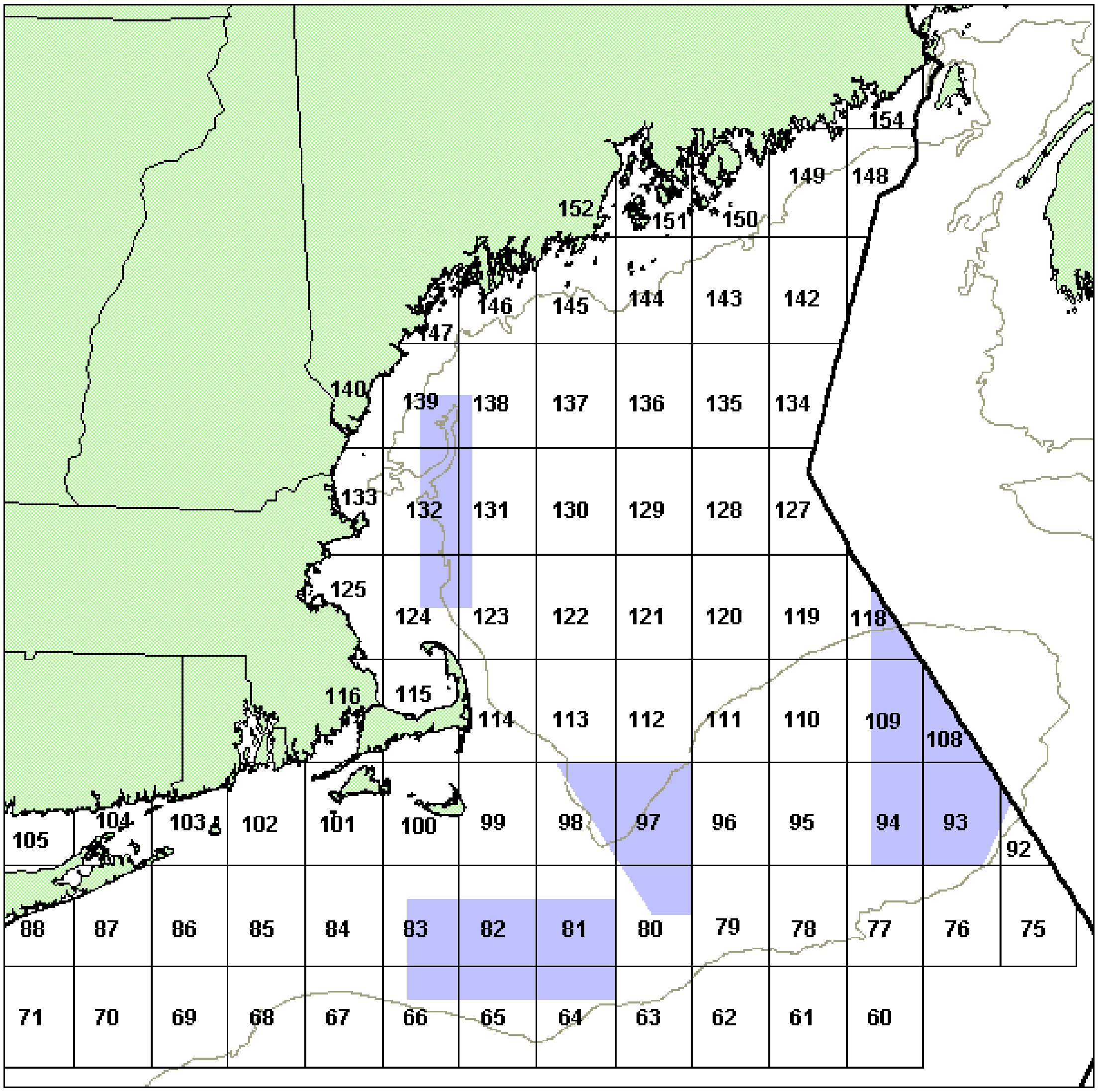

Figure 8.1. Gulf of Maine, Georges Bank and Southern New England divided into 30 minute squares used to described area closures alternatives. Year round closures are shaded.