

Supplement A to the 2005 NC Southern Flounder Fishery Management Plan
Achieving Sustainable Harvest in the Southern Flounder Recreational Fishery

See Section 10.1 in the 2005 NC Southern Flounder Fishery Management Plan

January 24, 2011

I. Issue

Establish harvest reductions that end overfishing and rebuild the southern flounder spawning stock biomass by 2015.

II. Background

The 2009 North Carolina Southern Flounder Stock Assessment indicated the stock remains overfished and overfishing is still occurring (Takade-Heumacher and Batsavage 2009). In the terminal year (2007) of the stock assessment, the fishing mortality (F) was 0.7534, the female spawning stock biomass (SSB) was estimated at 4,358,990 pounds, and the spawning potential ratio (SPR) was 19% of what would occur in an unfished population. Population improvements were apparent after the management changes in 2005 (Table 1). Both SPR and SSB increased, and F decreased. The 2005 Southern Flounder Fishery Management Plan (FMP) set the overfishing and overfished thresholds and targets at an SPR of 20% and 25%, respectively; the associated F rates with these SPRs were 0.57 (20% SPR) and 0.47 (25% SPR) (NCDMF 2005). Table 2 provides all pertinent F and SSB benchmarks under various SPR scenarios for the 2009 stock assessment. The North Carolina Division of Marine Fisheries (NCDMF) position on Amendment 1 of the Southern Flounder FMP sets the threshold at 25% SPR and target at 35% SPR. The associated F rates with these SPRs are 0.59 (25% SPR) and 0.41 (35% SPR), and the associated SSBs with these SPRs are 5,903,817 pounds (25% SPR) and 8,265,162 pounds (35% SPR).

Reductions in the overall harvest of southern flounder based on 2007 landings are necessary in order to achieve sustainable harvest. The overall harvest reduction needed under the current minimum size limit of 14 inches (20.5% in numbers and 19.7% in pounds of fish) are less than the overall harvest reduction needed under a 15-inch minimum size limit (30.6% in numbers of fish, 29.9% in pounds) due to the increased discards from the increased minimum size limit. All harvest reductions in this supplement are based on numbers of fish. A size limit increase without any gear modifications increases discards, which results in a larger harvest reduction necessary to rebuild the stock.

Table 1. Average SPR, average F, average SSB, and the actual SSB and terminal year SPR before and after the 2005 southern flounder FMP management changes, both estimates calculated using ASAP2.

Period	Average SPR	Average F	Average SSB (pounds)	Actual SSB (pounds)	Terminal year SPR
1999-2004*	12%	1.24	2,742,175	3,136,260	9%
2005-2007	20%	0.74	4,348,533	4,358,990	19%

*Terminal year is 2002

Table 2. Estimated F and SSB benchmarks (pounds) for female southern flounder from the 2009 Southern Flounder Stock Assessment.

	F	SSB (pounds)
SPR _{20%}	0.7223	4,722,588
SPR _{25%}	0.5937	5,903,817
SPR _{30%}	0.4880	7,084,845
SPR _{35%}	0.4081	8,265,162
SPR _{40%}	0.3445	9,446,797

Session Law 2010-13 amended G.S. 113-182.1 Fishery Management Plans to require that fishery management plans end overfishing within two years after they are fully adopted and achieve sustainable harvest 10 years after the original FMP implementation. The 10 year deadline for achieving sustainable harvest in the southern flounder fishery is 2015. Amendment 1 to the Southern Flounder FMP is currently under development. The North Carolina Marine Fisheries Commission (NCMFC) selected its preferred management strategies for the FMP amendment at its business meeting held on November 4, 2010. These strategies included a coast wide 15-inch minimum size limit and a 6 fish creel limit for the recreational fishery and to maintain the large mesh gill net management measures from the sea turtle lawsuit settlement agreement for the commercial fishery. Amendment 1 to the Southern Flounder FMP cannot be adopted by the North Carolina Marine Fisheries Commission (NCMFC) until it is reviewed by the Joint Legislative Commission on Seafood and Aquaculture (JLCSA), and it is currently anticipated this review will not occur until fall 2011. The commercial fishery is already achieving the necessary harvest reduction (22.2%) to end overfishing in two years and achieve sustainable harvest by 2015 from the sea turtle lawsuit settlement agreement management measures that were implemented on May 15, 2010, but management measures to achieve the necessary harvest reduction to end overfishing in two years and achieve sustainable harvest by 2015 for the recreational fishery have not been implemented due to the delay in adopting the FMP amendment. The anticipated delay in the implementation of management measures to achieve sustainable harvest in the recreational fishery decreases the likelihood of ending overfishing in two years and achieving sustainable harvest by 2015. In addition, preliminary southern flounder harvest estimates from the recreational hook and line fishery from January through October 2010 indicate the harvest has already exceeded the highest annual recreational hook and line harvest, which occurred in 2004.

As stated in the NCMFC guidelines, the FMP supplement process may be used to change management measures in an existing FMP when it is in the interest of the long-term viability of the fishery and the urgency of the issue makes it impossible to address it through the FMP amendment process. An FMP supplement would expedite the implementation of recreational management measures that end overfishing and achieve sustainable harvest. This supplement to the 2005 Southern Flounder FMP evaluates the management measures for achieving sustainable harvest in the recreational southern flounder fishery. If this supplement is approved by the NCMFC at their February 2011 business meeting, then management measures that achieve sustainable harvest for the recreational fishery could be implemented by proclamation this year before recreational fishing for southern flounder begins. Also as noted in the law, the NCMFC shall either incorporate the approved supplement management measures into the revised FMP Amendment or the supplement management measures shall expire on the date Amendment 1 to the Southern Flounder FMP is adopted.

III. Current Authority

G.S. 113-134. RULES

G.S. 113-182. REGULATIONS OF FISHING AND FISHERIES

G.S. 143B-289.52. MARINE FISHERIES COMMISSION—POWERS AND DUTIES

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IV. Discussion

The available management options are designed to reduce overall harvest and can be used individually or in conjunction with one another to meet the required reductions projected to achieve sustainable harvest. Harvest reduction calculations are based on past harvest. The ability of these calculations to predict future harvest reductions depend on environmental parameters, recruitment, and fishing effort to remain similar to past years. Any future changes to these factors can impact the actual harvest reductions that occur. These management options are detailed below.

Increased Minimum Size Limit

Increasing the minimum size limit is a common management measure used to end overfishing, rebuild the spawning stock, and to allow a greater portion of fish an opportunity to spawn before they can be harvested. The short term effects of a minimum size limit increase would diminish the pool of younger and smaller fish immediately available for harvest, which in turn would reduce the overall harvest. The decreased harvest, however, may not produce a corresponding drop in the fishing mortality rate initially, since for southern flounder, annual fishing mortality is measured from the age-2 to age-5 year classes (southern flounder are fully recruited to the fishery by the time they are age-2), and an increase in minimum size would predominately affect age-1 fish. In other words, decreasing the fishing mortality on age-1 fish may not have an immediate effect on reducing the annual fishing mortality that is based on age-2 and older fish. Therefore, the benefit to the fishery of an increase in minimum size would not be realized until the increased survival of age-1 fish contribute to the pool of older age classes.

One of the major benefits of increasing the minimum size limit is that it would allow a larger number of the age-1 fish that would normally have been harvested the opportunity to spawn at

least once prior to being harvested. Fish in the 14-inch size category comprised the greatest proportion of age-1 female southern flounder in the harvest during the late part of the year (July-December) and approximately 60% of these fish are sexually mature for the first time (Table 3). This would increase the size of the spawning stock in subsequent years.

The 2005 Southern Flounder FMP implemented a 14-inch minimum size limit for the commercial and recreational fisheries (NCDMF 2005). The expected percent reduction in catch from the size limit increase was 13.0% for the commercial fishery overall and 9.5% for the recreational fishery overall. The annual commercial landings decreased after the 14-inch minimum size limit was implemented, but it is uncertain as to how much of the reduction was from the size limit increase (Table 4). In contrast, the annual recreational harvest remained near the time series high after the 14-inch minimum size limit was implemented coast wide. However, the minimum size limit in the recreational fishery was 14 inches since October 1, 2002 for much of the coastal waters in the state; the recreational minimum size limit in western Pamlico Sound and its tributaries increased to 14 inches on April 1, 2005.

Table 3. Length frequency of age-1 female southern flounder from catches during the late part of the year (July-December), 2006 and 2007.

Size class (Inches)	Age-1 females	Percent of catch	Cumulative percent	Percent mature
9	118	0.02%	0.02%	0.00%
10	62	0.01%	0.02%	0.06%
11	124	0.02%	0.04%	0.27%
12	407	0.05%	0.09%	2.81%
13	71,795	9.49%	9.58%	23.58%
14	301,648	39.86%	49.44%	59.96%
15	208,147	27.50%	76.94%	94.12%
16	107,188	14.16%	91.10%	98.73%
17	47,122	6.23%	97.33%	99.88%
18	18,930	2.50%	99.83%	99.98%
19	1,292	0.17%	100.00%	100.00%
20		0.00%	100.00%	100.00%
21		0.00%	100.00%	100.00%
22		0.00%	100.00%	100.00%
23	22	0.00%	100.00%	100.00%
Total	756,855			

Table 4. Annual proportions of commercial landings (pounds) and recreational harvest (pounds) of southern flounder, 1991-2007.

Year	Commercial harvest (pounds)	Percent harvest	Recreational harvest (pounds)	Percent harvest	Total harvest (pounds)
1991	4,163,374	93.83%	273,674	6.17%	4,437,048
1992	3,145,020	95.49%	148,618	4.51%	3,293,638
1993	4,272,368	97.43%	112,812	2.57%	4,385,180
1994	4,878,639	94.87%	263,612	5.13%	5,142,251
1995	4,166,966	94.70%	233,238	5.30%	4,400,204
1996	3,807,009	94.29%	230,674	5.71%	4,037,683
1997	4,076,793	90.31%	437,234	9.69%	4,514,027
1998	3,952,729	95.73%	176,292	4.27%	4,129,021
1999	2,933,331	94.98%	155,010	5.02%	3,088,341
2000	3,205,792	85.53%	542,476	14.47%	3,748,268
2001	3,522,136	89.17%	427,822	10.83%	3,949,958
2002	3,436,753	87.90%	473,300	12.10%	3,910,053
2003	2,198,503	83.21%	443,614	16.79%	2,642,117
2004	2,454,577	74.27%	850,450	25.73%	3,305,027
2005	1,870,754	71.76%	736,202	28.24%	2,606,956
2006	2,287,823	75.74%	732,808	24.26%	3,020,631
2007	2,077,798	73.93%	732,618	26.07%	2,810,416
Annual average	3,320,610	89.01%	410,027	10.99%	3,730,636

To estimate the effect of an increase in the minimum size limit on future harvest, length frequency data from 2006 and 2007 were weighted to the recreational harvest and analyzed. These were the only two full years in which the 14-inch minimum size limit was in place for the recreational fishery coast wide. The harvest reduction in the recreational hook and line fishery in numbers of fish with a 15-inch minimum size limit is 16.3% (Table 5).

Table 5. Percent reductions (in numbers of fish) in harvest from an increase in the minimum size limit for the recreational fishery.

Size limit (inches)	Cumulative percent reduction (in numbers of fish)
15	16.27%
16	34.83%
17	51.76%
18	66.23%
19	80.60%
20	87.13%

Some regions of the state and certain times of the year will be more adversely affected than others from implementing an increase in the minimum size limit. Length frequency data from the commercial gill net fishery show that the impact of a minimum size limit increase is greater

in the upper estuaries where smaller, younger southern flounder are more common than the larger, older fish (Table 6). Coast wide, an increased minimum size limit will likely have a greater impact on catches in the early half of the year when many of the mature southern flounder are still offshore. The recreational length frequency data was too limited for this analysis, but it is very likely the impacts based on the size of southern flounder available by area and season would be similar to that seen in the commercial gill net fishery.

Table 6. Percent reductions (in numbers of fish) in the commercial gill net fishery at different times of the year for different parts of the coast from a 15-inch minimum size limit.

Area	Percent reduction		
	Jan-Jun	Jul-Dec	Jan-Dec
Albemarle Sound*	29.1%	41.9%	41.7%
Pamlico Sound	22.5%	16.7%	17.4%
Rivers [#]	49.5%	36.4%	43.2%
Core & Back sounds	38.4%	24.4%	29.0%
New River	41.2%	20.3%	29.6%
Beaufort Inlet to SC line	25.3%	25.8%	25.8%

* Includes Currituck, Croatan and Roanoke sounds

[#] Includes Pamlico, Pungo, Bay, and Neuse rivers

Recreational minimum size limits change on a nearly annual basis due to management measures designed to constrain recreational harvest of summer flounder to the state's recreational allocation, as mandated by the Atlantic States Marine Fisheries Commission (ASMFC) and the Mid Atlantic Fishery Management Council (MAFMC) Summer Flounder, Scup and Black Sea Bass FMP (Table 7). This has resulted in different recreational minimum size limits for flounder in different parts of the state. In general, the higher minimum size limits were implemented only for areas where summer flounder are most commonly harvested by anglers, which minimized the impacts to the recreational southern flounder fishery. Increasing the minimum size limit for southern flounder will not ensure uniform recreational size limits coast wide. Future harvest reductions for the recreational summer flounder fishery could result in an increased size limit for areas where summer flounder are most commonly harvested by anglers. In addition, any change to the minimum size limits in coastal and joint waters will result in regulations that are different than the inland North Carolina Wildlife Resources Commission (NCWRC) regulations. The NCWRC would need to change their existing flounder regulations to be compatible.

Any increase in the minimum size limit will likely increase the discards of undersized southern flounder in the recreational fishery. Gear restrictions that minimize undersized discards or reduce release mortality in the recreational fishery are difficult because southern flounder are not only caught by anglers targeting them but also are caught incidentally by anglers targeting other species. This results in the use of a wide variety of terminal tackle and fishing techniques.

Table 7. Recreational flounder regulations in North Carolina, 1993-2010.

Year	Estuarine waters			Ocean waters		
	Size limit	Bag limit	Closed season	Size limit	Bag limit	Closed season
1993	13"	----	----	13"	----	----
1994	13"	----	----	14"	8 (1/1-10/31)/ 6 (11/1-12/31)	----
1995	13"	----	----	14"	8	----
1996	13"	----	----	14"	8	----
1997	13"	----	----	14" (1/1-3/31)/ 14.5" (4/1-12/31)	8 (1/1-3/31)/ 10 (4/1-12/31)	----
1998	13"	----	----	14.5" (1/1-6/6)/ 15" (6/7-12/31)	10 (1/1-6/6)/ 8 (6/7-12/31)	----
1999	13"	----	----	15"	8	----
2000	13"	----	----	15"	8	----
2001	13"	----	----	15.5"	8	5/1-5/14
2002	13" (1/1-9/30)/ 14"* (10/1-12/31)	----	----	15.5"	8	4/3-7/4
2003	13"/14"#	----	----	15"	8	----
2004	13"/14"#	----	----	14"	8	----
2005	14"	8 (4/1-12/31)	----	14"	8	----
2006	14"	8	----	14"	8	----
2007	14"	8	----	14.5"	8	----
2008	14"/15.5"^	8	----	14"/15.5"^	8	----
2009	14"/15"^	8	----	14"/15"^	8	----
2010	14"/15"^	8	----	14"/15"^	8	----

* 13" minimum size limit remained in western Pamlico Sound and its tributaries.

13" minimum size limit in western Pamlico Sound and its tributaries; 14" minimum size limit elsewhere.

^ 14" minimum size limit in western portions of Albemarle and Pamlico sounds and its tributaries, and ocean and estuarine waters south of Brown's Inlet to the SC border; 15.5" and 15" minimum size limits in eastern estuarine and ocean waters north of Brown's Inlet to the VA border.

Minimum size limit increases are effective at reducing harvest to a certain level as long as compliance with the regulations is consistent. The percent reductions in harvest associated with a minimum size limit increase assumes the proportion of undersized fish in the catches remains constant. An increase in undersized fish harvested by the recreational fishery could be the result of insufficient enforcement, strong year classes entering the fishery or a combination of these. If the percentage of undersized southern flounder increased as the minimum size limit increased, then the expected harvest reductions will be diminished. Fortunately, the percentage of undersized southern flounder in the recreational fishery has not increased in the last several years.

Season Closures

A season closure can be used to restrict harvest and effort during certain times of the year. Since effort can be increased during the open periods of the fishery to offset the benefits of the closed season, it is best to have closures that are a minimum of two weeks in duration, but preferably longer.

To determine the effect a specific season closure would have on reducing harvest in the recreational fishery, bi-monthly harvest estimates were averaged together from 2003 to 2007. These reference years were chosen for their relatively consistent regulations (Table 7). A percent of the total annual harvest (in numbers of fish) was then attributed to each day of the year. An assumption in this approach is that daily harvest effort during years with season closures does not differ from years in which there is no limited season.

The highest percent daily harvest in the recreational fishery occurs in July and August, so it would take a longer season closure early in the year than during the time of peak harvest to achieve the same percent reductions in harvest (Figure 1). Season closures during peak harvest tend to be more effective than season closures when harvest is minimal because season closures during peak harvest leave less opportunity for recoupment by the fisheries. However, season closures during the peak harvest, particularly in the recreational fishery, are not easy to enforce because of difficulties communicating these closures to a large number of anglers and the enforcement problems associated with closures during the busy summer months. A recreational season closure during the summer would also have a greater impact on the recreational summer flounder fishery. Nonetheless, a recreational season closure could be effective at controlling recreational fishing effort and harvest that has increased despite management measures implemented in 2005.

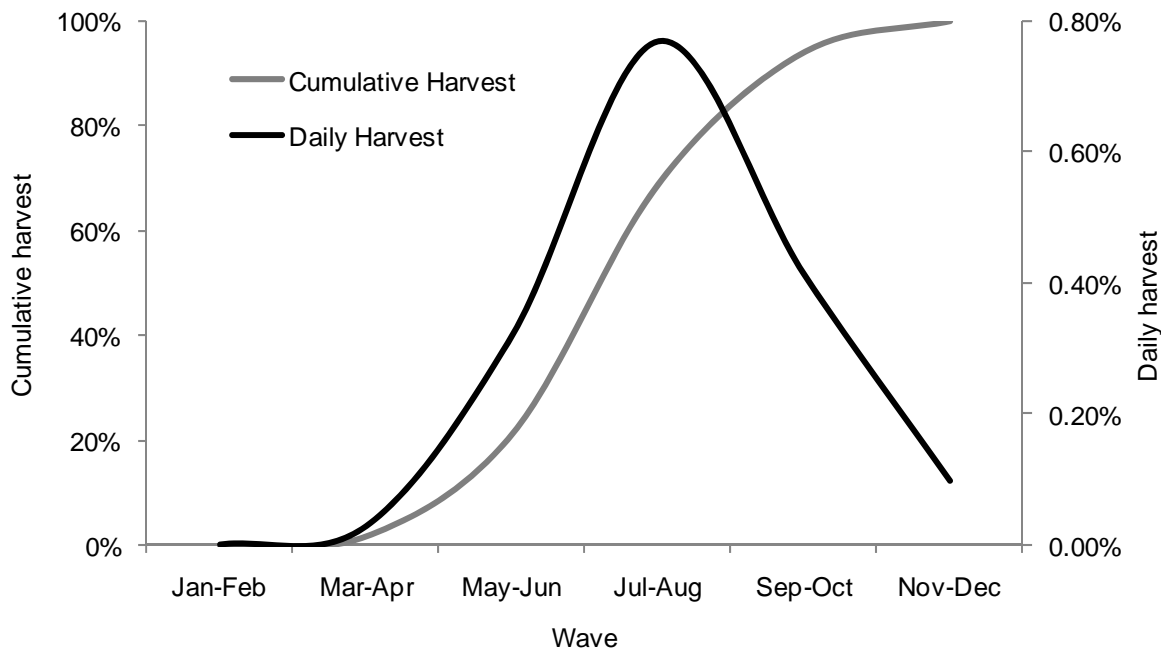


Figure 1. Daily and cumulative percent distributions of the overall annual recreational harvest, 2003-2007.

A possible result of season closures would be an increase in discards, particularly in fisheries that harvest, but do not target, southern flounder. In the recreational fishery, southern flounder that would normally be harvested would have to be released during the closed season. Consequently, the harvest that will be converted to discards during a closed season should be considered.

Another possible result of a season closure could be an increase in effort during the open seasons. A closure early in the year could lead to increased fishing effort once the season opens. Similarly, a closure late in the year could lead to more effort as fishermen try to catch as many fish as possible before the fishery closes for the year. In either instance, the effectiveness of the closed season at reducing the fishing mortality would be reduced. Another possible result of a season closure is illegal harvest occurring during the closed season, which would diminish any expected harvest reductions. These results would decrease the likelihood of ending overfishing in two years and achieving sustainable harvest by 2015.

Creel Limits

A creel or bag limit for the recreational fishery is the number of fish allowed to be kept during a trip by an individual or boat. It is another option to prevent too many fish from being harvested. The 2005 Southern Flounder FMP implemented an 8 fish creel limit for the recreational southern flounder fishery (NCDMF 2005).

Creel limits work well in the recreational fishery because the catches are less variable than the commercial fishery. The number of southern flounder harvested per trip differs between anglers and recreational giggers (Takade-Heumacher and Batsavage 2009), so the average harvest reduction for the two recreational fisheries was calculated for each creel limit (Table 8). Harvest per trip data for the recreational gig fishery was from a recreational gig survey conducted by the NCDMF in 2002 and the harvest per trip data for the hook and line fishery was from the 2006 and 2007 MRFSS data. Recreational giggers tend to harvest more fish per trip than anglers but overall, it is rare for any recreational fishermen to harvest 8 southern flounder in a trip. The creel limit would need to be reduced to at least 3 fish per trip in order to achieve a substantial reduction. However, this could result in discards of legal sized southern flounder in excess of the creel limit. To minimize potential discards, a smaller creel limit reduction could be implemented with other management measures to meet the required harvest reductions.

Reducing the creel limit to a number that results in a substantial harvest reduction could result in some recreational giggers purchasing a standard commercial fishing license (SCFL) on the open market in order to harvest more southern flounder per trip. This has been a source of decline in the number of Recreational Commercial Gear License (RCGL) holders in recent years. Fishermen have replaced their RCGL with a SCFL to fish more gear (gill nets, in particular), harvest commercial quantities of fish and crustaceans, and not be subject to the net attendance requirements of the RCGL. Many of these fishermen choose not to sell their catch but instead retain it for personal consumption. If this were to occur in the recreational gig fishery, neither the North Carolina Trip Ticket Program nor the Marine Recreational Information Program [(MRIP) formerly Marine Recreational Fisheries Statistics Survey (MRFSS)] would collect the harvest information for these fish, which would increase the amount of the undocumented harvest of southern flounder.

Table 8. Percent reduction in harvest of southern flounder from reductions in the recreational creel limit.

Creel limit	Percent reduction
1	-55.43%
2	-34.39%
3	-23.26%
4	-15.23%
5	-8.45%
6	-4.80%
7	-1.95%
8	0.00%

A creel limit reduction for southern flounder could have an effect on the recreational summer flounder fishery. The creel limit for ocean waters (where summer flounder are commonly landed) has been 8 fish since 1998 (Table 5). This creel limit would likely need to be reduced if the creel limit is reduced for southern flounder to alleviate any enforcement problems and because southern flounder are also harvested by anglers in the ocean. The inland waters also have an 8 fish creel limit, so the NCWRC would also need to change their creel limit for consistent regulations.

V. Management Options

- (+ potential positive impact of action)
- (- potential negative impact of action)

Recreational Fisheries

1) Status quo

- + No additional burden on fishermen, dealers, or Marine Patrol
- + No impact on the recreational summer flounder fishery
- Sustainable harvest for the recreational fisheries not achieved
- Trend of increased annual harvest could continue
- Stock could suffer further decline

2) Increase the minimum size limit to 15 inches

- + Increase in the spawning stock biomass and the overall yield to the fishery in the long-term
- + Allows more fish the opportunity to spawn at least once before being caught
- + Reduces harvest closer to a sustainable level
- + Results in a 16.3% reduction in numbers of fish for the overall recreational fishery
- Decrease in the yield to the fishery in the short-term
- Additional harvest reductions are needed to achieve sustainable harvest
- Some regions may be impacted more than others (i.e. Albemarle Sound and western Pamlico Sound and its tributaries)

- Impacts on catches greatest in early half of the year (January-June)
- Overfishing could still occur if fishing mortality increases on legal sized fish
- Effectiveness diminished if proportion of undersized fish in the catch increases

3) Implement a season closure

- + Reduces harvest closer to a sustainable level
- + Potentially allows more fish to survive the migration to the ocean to spawn
- Difficult to enforce if implemented during the summer months
- Greater chance for recoupment of harvest if implemented when harvest is relatively low
- Greater impact on recreational summer flounder fishery if implemented in the summer
- Discards likely to increase during closed season
- Effort could be increased during the open periods, thus reducing the effectiveness of the closure
- Effectiveness diminished if harvest occurs the during closed season

4) Reduce the 8 fish creel limit

- + Reduces effort and harvest in the fishery
- + Additional harvest reductions from a creel limit decrease would help achieve sustainable harvest for the recreational fishery
- Could result in discards of legal-sized fish if a very small creel limit is implemented
- Very small creel limit could result in recreational giggers purchasing a SCFL
- Could adversely impact some fisheries and fishermen more than others
- Does not work well as a stand alone measure

VI. Management Recommendations

MFC Preferred Management Strategy

- Increase the minimum size limit to 15 inches and decrease the creel limit to 6 fish, which results in an overall recreational harvest reduction of 20.2%

Southern Flounder Advisory Committee and NCDMF

- Increase the minimum size limit to 15 inches and decrease the creel limit to 6 fish, which results in an overall recreational harvest reduction of 20.2%

VII. Research Needs

- Annual survey of the recreational gig fishery (underway)

VIII. Literature Cited

ASMFC (Atlantic States Marine Fisheries Commission). 2006. 2006 review of the Atlantic States Marine Fisheries Commission fishery management plan for summer flounder (*Paralichthys dentatus*). Atlantic States Marine Fisheries Commission. 13 p.

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