

Interim Management Measures for Achieving Sustainable Harvest

I. Issue

Establish interim harvest reductions that end overfishing and rebuild the 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 lb, and the spawning potential ratio (SPR) was 19% of a population in which no fishing occurs. The 2005 Southern Flounder Fishery Management Plan (FMP) set the overfishing and overfished thresholds and targets at an SPR of 20% and 25%, respectively (NCDMF 2005). The 2009 Stock Assessment proposed an overfishing and overfished threshold at an SPR of 30% and the target at an SPR of 35% in order to reduce the risk of recruitment overfishing. The threshold F at an SPR of 20% is 0.7223 and the target F at 25% SPR is 0.5937 (Table 1). The threshold female SSB at 20% SPR is 4,722,588 lb and the target female SSB at 25% SPR is 5,903,817 lb. The threshold F at a SPR of 30% is 0.4880 and the target F at 35% SPR is 0.4081. The threshold female SSB at 30% SPR is 7,084,845 lb and the target female SSB at 35% SPR is 8,265,162 lb. The DMF position on Amendment 1 of the Southern Flounder FMP would set the threshold at 25% SPR and target at 35% SPR.

Interim management measures that are designed to end overfishing and rebuild the SSB can be based on SPR targets of 25%, 30% or 35%. The overall harvest reductions for each target are different under the current minimum size limit of 14 inches and under a 15-inch minimum size limit (Table 2). Depending on the target chosen, stock projections under current fishing conditions (i.e. no change in the minimum size limit) determined that the overall harvest must be reduced by either 20.5% (SPR 25%), 26.5% (SPR 30%), or 32.3% (SPR 35%) in order to rebuild to the target female SSB by 2015. The harvest reductions under a 15-inch minimum size limit and no gear modifications are 30.6% (SPR 25%), 35.4% (SPR 30%), and 40.1% (SPR 35%). Larger harvest reductions are required to achieve the SSB levels associated with the larger SPR targets. A size limit increase without any gear modifications increases discards, which results in a larger harvest reduction necessary to rebuild the stock.

Table 1. Estimated F and SSB benchmarks (pounds) for female southern flounder.

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

Table 2. Overall harvest reductions at the current minimum size limit (14-inches) and at a 15-inch minimum size limit under different rebuilding targets.

Rebuilding Target	Minimum Size Limit	
	14-inch	15-inch
SPR 25%	20.5%	30.6%
SPR 30%	26.5%	35.4%
SPR 35%	32.3%	40.1%

The North Carolina Marine Fisheries Commission (NCMFC) asked the North Carolina Division of Marine Fisheries (NCDMF) at their January 2009 business meeting to evaluate Interim management measures to end overfishing in the southern flounder fishery and rebuild the SSB. This issue paper reevaluates the management options from the “Achieving Sustainable Harvest” issue paper from the 2005 North Carolina Southern Flounder FMP that could be implemented as interim management measures (NCDMF 2005). This issue paper also provides some management scenarios that will meet the required reductions

III. Discussion

The “Achieving Sustainable Harvest” issue paper explored management measures that were designed to reduce overall harvest or limit gear used in the commercial southern flounder fisheries (NCDMF 2005). For the purpose of interim management measures, this issue paper will focus on management options that reduce overall harvest. Gear related management measures will be considered during Amendment 1 of the Southern Flounder FMP. There are several management options available that reduce overall harvest, which could be used individually or in conjunction with one another to meet the required reductions projected to achieve the target F rate and rebuild the female SSB. These management options as well as some specific management scenarios at the different rebuilding targets are detailed below.

Static Quota

A quota refers to the maximum amount of fish that can be legally landed within a specified time period. A static quota is one that undergoes few changes between time periods and is usually established based on historical levels of landings to prevent over-expansion of the fishery. The intent of a static quota for the southern flounder fishery would be to establish annual landings that allow the female SSB to rebuild by 2015. The commercial and recreational fisheries heavily rely on the harvest of age-1 and age-2 southern flounder, so incoming recruitment is very important to the sustainability of the stock (Takade-Heumacher and Batsavage 2009). Due to the variability in recruitment between years, a static quota may not be sufficient in preventing overfishing during years of poor recruitment. However, the stock projections that are based on a static quota assume an average recruitment, which accounts for the variations in annual recruitment. A static quota would need a payback provision in order to rebuild the female SSB by 2015. This means that any landings exceeding the annual quota would be deducted from the following year’s quota. Rollover of unused quota would not likely be implemented while the stock is being rebuilt.

Southern flounder are commercially landed year-round with approximately 70% of the annual harvest from September to November (Table 3). Southern flounder are landed in numerous commercial fisheries but are targeted by the estuarine gill net, pound net and gig fisheries. The seasons, time and magnitude of peak harvest of southern flounder are different in these fisheries (Figure 1). Therefore, a static quota should allow all three of these targeted fisheries an opportunity to land southern flounder before the quota is reached.

A potential solution for an equitable static quota is to establish a September 1 to August 31 commercial fishing year. This would allow the fishing year to begin just before landings peak in the fall, and would decrease the likelihood of a closure when most of the directed fisheries occur. This would also eliminate the need for gear specific quotas for the pound net and gill net fisheries, as discussed in the “Achieving Sustainable Harvest” issue paper in the 2005 FMP (NCDMF 2005). The red drum commercial landings cap is currently managed on a September 1 to August 31 fishing year to coincide with the peak landings of southern flounder (NCDMF 2008). The majority of red drum landings are from bycatch in the southern flounder gill net fishery, and the majority of southern flounder landings (~57%) from this fishery occur from September to November. Over 95% of the annual southern flounder landings from pound nets occur from September to November, which makes this fishery most reliant on a September 1 start date. The peak landings of southern flounder from the gig fishery occur from June to August, which would be at the end of the fishing year. Therefore, the gig fishery would be impacted more negatively than the other directed fisheries if the quota was reached before August 31.

Quota monitoring for the commercial southern flounder fishery could be complicated due to the high variability in daily landings, and the large number of dealers and participants in the fishery. The number of dealers and participants in the commercial southern flounder fishery far exceeds the number of dealers and participants in other quota monitored fisheries in the State. Daily reporting of landings during the peak harvest season would be difficult to monitor. If the peak landings occur during the beginning of the fishing year, then daily reporting may not be needed during that time. Regardless, the NCDMF will need to implement a monitoring system that can effectively track the commercial landings. And due to the number of dealers and participants in this fishery, it is unlikely the NCDMF could implement a static quota as an interim management measure.

Managing the recreational fisheries with a static quota would be very difficult due to the lag time between the time of fishing and the time the harvest estimates become available through the Marine Recreational Fisheries Statistics Survey (MRFSS). Additionally, there are no annual harvest estimates for the recreational gig fishery. The 2009 Southern Flounder Stock Assessment assumed the annual recreational gig harvest equaled the annual hook and line harvest (Takade-Heumacher and Batsavage 2009). The Atlantic States Marine Fisheries Commission (ASMFC) manages the recreational summer flounder fishery through state specific regulations and quotas (ASMFC 2006). Annual harvest estimates that are projected from January to October harvest estimates are used to determine if a state has exceeded its recreational allocation. There is no system in place to monitor recreational landings on a real-time basis that would allow the fishery to be closed upon reaching the harvest limit. This management strategy results in many states changing their recreational size limits, creel limits and seasons on an annual basis to account for harvest overages.

Table 3. Monthly commercial landings of southern flounder by gear, 1991-2007.

Month	Gig		Estuarine Gill Net		Other Commercial Gears		Pound Net		Grand Total	
	Landings (lb)	Percent	Landings (lb)	Percent	Landings (lb)	Percent	Landings (lb)	Percent	Landings (lb)	Percent
January	645	0.82%	7,020	0.39%	7,894	4.52%	920	0.07%	16,478	0.50%
February	485	0.61%	9,126	0.51%	9,306	5.33%	103	0.01%	19,019	0.57%
March	878	1.11%	20,704	1.15%	23,207	13.29%	302	0.02%	45,092	1.36%
April	2,460	3.12%	60,862	3.39%	14,667	8.40%	1,090	0.09%	79,078	2.38%
May	7,824	9.91%	100,929	5.63%	9,394	5.38%	3,974	0.31%	122,121	3.68%
June	15,245	19.31%	131,984	7.36%	11,755	6.73%	4,375	0.34%	163,360	4.92%
July	16,233	20.56%	165,948	9.25%	14,102	8.08%	3,576	0.28%	199,859	6.02%
August	13,326	16.88%	225,168	12.55%	16,507	9.46%	8,611	0.68%	263,612	7.94%
September	8,270	10.47%	340,822	19.00%	24,448	14.00%	220,500	17.32%	594,040	17.89%
October	7,360	9.32%	424,382	23.66%	19,901	11.40%	658,372	51.70%	1,110,015	33.43%
November	5,148	6.52%	265,374	14.79%	15,822	9.06%	335,575	26.35%	621,919	18.73%
December	1,087	1.38%	41,362	2.31%	7,565	4.33%	36,001	2.83%	86,015	2.59%
Grand Total	78,961	100.00%	1,793,681	100.00%	174,568	100.00%	1,273,399	100.00%	3,320,610	100.00%

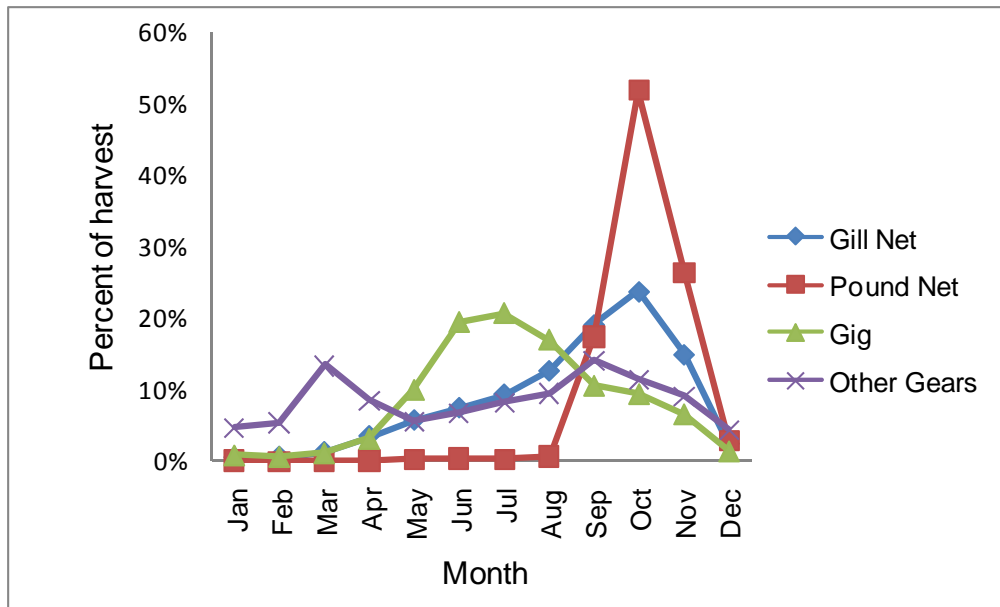


Figure 1. Monthly proportion of commercial southern flounder harvest by the gill net, pound net gig, and other commercial fisheries.

Dynamic Quota

A dynamic quota refers to a total allowable catch that fluctuates between years relative to the abundance of the resource and fishing pressure. In the case of southern flounder, the quota for a given year would be primarily driven by the strength of the year classes being subjected to fishing pressure. However, as with the static quota, all of the same drawbacks, including the issues with monitoring the landings on a daily basis and the high degree of variability in the daily landings, go along with implementing a dynamic quota. In addition, to adequately manage a dynamic quota, the NCDMF would need to determine if the fishery independent surveys used to estimate recruitment in the 2009 stock assessment can accurately predict year class strengths for quota management purposes. The terminal year estimates of recruitment from stock assessments tend to be the most uncertain, so it is not likely that a dynamic quota is a feasible possibility.

Limited Entry

A limited entry system would prevent expansion in the fishery beyond a specified level of participants. This type of system is established to prevent more fishermen from entering a fishery than the resource can support, or to reduce participants when the situation has already occurred. Eligibility for participation within the fishery is typically granted to those individuals who have demonstrated a historical utilization of and reliance on the resource. While a limited entry system could be established as a stand-alone system, it would be insufficient in preventing an increase in effort by those individuals allowed in the fishery. Therefore, overfishing may still occur. Limited entry systems work best when implemented in concert with quotas or gear restrictions. When a limited entry system and a quota are issued together, the quota ensures that the resource is not over-utilized, while the limited participation allows the fishermen remaining in the fishery a greater take in the available resource. In a limited entry system with

no quota in place, restrictions on gear amounts and/or use per individual would aid in maintaining effort at a consistent level.

There are restrictions to establishing a limited entry system for fisheries in North Carolina. Section 2.4 of the Fisheries Reform Act (G.S. 113-182.1) concerning Fishery Management Plans (FMP) states that the North Carolina Marine Fisheries Commission can only recommend that the General Assembly limit participation in a fishery if the NCDMF determines that sustainable harvest in the fishery cannot otherwise be achieved. Currently, there are other options available for achieving sustainable harvest. Therefore, limited entry is not a viable option for consideration at this time.

Increased Minimum Size Limit

In addition to other management strategies to control effort, the effects of an increase in minimum size could be considered. The short term effects of a minimum size increase would diminish the pool of younger and smaller fish immediately available for harvest, which in turn would produce a decrease in overall catch. The drop in landings, 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. This would increase the size of the spawning stock biomass in subsequent years.

To determine the effect a 15-inch minimum size limit would have on allowing a greater number of age-1 female fish an opportunity to spawn, the length frequencies of age-1 fish from catches during the late part of the year (July-December) for 2006 and 2007 were examined. Age-1 female southern flounder caught during the early part of the year (January-December) were not considered because fish that were below the minimum size during the early part of the year could be legal sized fish by the late part of the year. Fish in the 14-inch size category comprised the greatest proportion of age-1 southern flounder females in the catches, so a 1-inch increase in the minimum size limit would allow a substantial number of age-1 female southern flounder an opportunity to spawn at least once (Table 4).

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 overall commercial fishery and 9.5% for the overall recreational fishery. 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 5). In contrast, the annual recreational harvest remained near the time series high after the 14-inch minimum size limit was implemented. 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 4. Length frequency distribution 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
9	118	0.02%	0.02%
10	62	0.01%	0.02%
11	124	0.02%	0.04%
12	407	0.05%	0.09%
13	71,795	9.49%	9.58%
14	301,648	39.86%	49.44%
15	208,147	27.50%	76.94%
16	107,188	14.16%	91.10%
17	47,122	6.23%	97.33%
18	18,930	2.50%	99.83%
19	1,292	0.17%	100.00%
20	-	0.00%	100.00%
21	-	0.00%	100.00%
22	-	0.00%	100.00%
23	22	0.00%	100.00%
Total	756,855		

Table 5. Annual proportions of commercial landings (pounds) and recreational harvest (pounds) of southern flounder, 1991-2007.

Year	Commercial harvest	Percent harvest	Recreational harvest	Percent harvest	Total harvest
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
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 commercial landings and the recreational harvest and analyzed. These were the only two full years in which the 14-inch minimum size limit was in place for both fisheries. The overall reduction in commercial landings with a 15-inch minimum size limit is 31.2% (Table 6). Among the directed fisheries for southern flounder, the estuarine gill net fishery is most affected by a size limit increase. The harvest reduction in the recreational hook and line fishery with a 15-inch minimum size limit is 16.3% (Table 7). In order to reach the required harvest reductions for the recreational fishery, other management measures in conjunction with a 15-inch minimum size limit are needed.

Table 6. Percent reductions in harvest from an increase in the minimum size limit for each commercial fishery and the overall commercial fishery.

Size Limit (inches)	Cumulative Percent Reduction				All Commercial Fisheries
	Gill Net	Pound Net	Gig	Other	
15	34.30%	24.14%	24.58%	13.42%	31.20%
16	62.14%	48.13%	57.52%	58.29%	58.76%
17	76.80%	66.92%	75.34%	76.04%	74.53%
18	85.36%	79.03%	84.73%	77.94%	83.78%
19	89.21%	86.01%	90.16%	84.35%	88.45%
20	91.15%	90.01%	93.87%	85.32%	90.90%

Table 7. Percent reductions in harvest from an increase in the minimum size limit for the recreational fishery.

Size Limit (inches)	Cumulative Percent Reduction
15	16.27%
16	34.83%
17	51.76%
18	66.23%
19	80.60%
20	87.13%

Some regions of the State will be more adversely affected than others from implementing an increase in the minimum size limit for the commercial and recreational fisheries (Table 8). Commercial gill net length frequency data from 2006 and 2007 from different areas of the State were analyzed to examine the impacts of a minimum size limit increase on these areas. Gill net fishermen in Albemarle Sound and the Pamlico, Pungo, and Neuse rivers will be impacted greatest by a 15-inch minimum size limit, while gill net fishermen in Pamlico Sound will be impacted the least. Southern flounder tend to be smaller in the western portions of the estuaries than those found in the eastern portions of the estuaries. The reductions are larger

during the early part of the year for every area except Albemarle Sound and the southern part of the state (Table 8). Statewide, 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. Fewer samples were collected in the early part of the year, in general, and in particular for some areas, which may explain the lower percent reductions early in the years for some areas. The recreational length frequency data was too limited for this analysis, but it is very likely the relative impacts on this fishery in different areas of the state will be similar.

Table 8. Percent reductions in the commercial gill net fishery at different times of the year for different parts of the State.

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%
Pamlico, Pungo & Neuse 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

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 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 9). This has resulted in different recreational minimum size limits for flounder in different parts of the State. Increasing the minimum size limit for southern flounder will not ensure uniform recreational size limits statewide. In fact, 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 has the potential to increase the discards of undersized southern flounder in the commercial and recreational fisheries. For the commercial fisheries an increase in the minimum gill net mesh size used to target southern flounder and possibly an increase in the minimum mesh size for escape panels in flounder pound nets would be needed to minimize discards of undersized southern flounder. The 2005 Southern Flounder FMP implemented a minimum large mesh gill net size of 5.5 inches stretched mesh and required escape panels of 5.5 inches stretched mesh in flounder pound nets statewide in conjunction with the minimum size limit increase (NCDMF 2005). The stock recovery projections show that a higher overall harvest reduction is required with a 15-inch minimum size limit due to increased discards (Table 2). Implementing the necessary gear changes would minimize discards and increase the chance of rebuilding the spawning stock. However, implementing the necessary gear changes for the commercial fishery as an interim management measure would be problematic because many fishermen purchase their nets months before they begin fishing. The minimum mesh size increase for gill nets in the 2005 Southern Flounder FMP was delayed to allow fishermen to use the gear they already

purchased. Therefore, a minimum size limit increase as an interim management measure would result in more discards than it would as a permanent management measure with the necessary gear changes. Gear restrictions to minimize undersized discards in the recreational fishery are more difficult because southern flounder are caught by anglers targeting them and are also caught incidentally by anglers targeting other species. This results in the use of a wide variety of terminal tackle and fishing techniques. Therefore, it is possible that increased discards in the recreational fishery might be greater than in the commercial fishery.

Table 9. Recreational flounder regulations in North Carolina, 1991-2007. Note: Minimum size limit in western Pamlico Sound and its tributaries remained at 13 inches until April 1, 2005.

Year	Estuarine Waters			Ocean Waters		
	Size Limit	Bag Limit	Closed Season	Size Limit (TL)	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	14"	----	----	15"	8	----
2004	14"	----	----	14"	8	----
2005	14"	8 (4/1-12/31)	----	14"	8	----
2006	14"	8	----	14"	8	----
2007	14"	8	----	14.5"	8	----

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. However, recent data show that this is not the case. The proportion (in numbers) of undersized southern flounder in the estuarine gill net, pound net and recreational hook and line fisheries were compared for the years just prior to the minimum size limit increase (2000-2001 for the recreational fishery; 2003-2004 for the commercial fisheries) and for the first two full years (2006-2007) after the increase to the 14-inch minimum size limit. The percentage of undersized southern flounder in the estuarine gill net and pound net fisheries more than doubled (Table 10). However, the percentage of undersized southern flounder has actually decreased in the recreational fishery. The increase in the percentage of undersized southern flounder in the commercial fisheries could be the result of inadequate gear modifications in the 2005 Southern Flounder FMP, insufficient enforcement of the 14-inch minimum size limit or both. Regardless, if the percentage of undersized southern flounder continues to increase as the minimum size limit increases, then the expected harvest reductions will be diminished.

Table 10. Percentage of undersized southern flounder in the commercial and recreational catches under the 13-inch (2000-2001 and 2003-2004) and 14-inch (2006-2007) minimum size limits.

	Percent Undersized		
	Gill Net	Pound Net	Recreational
2000-2001			3.04%
2003-2004	2.91%	2.22%	
2006-2007	6.97%	5.82%	1.69%

Limited Harvest Season

A limited harvest season, or a seasonal closure, can be used to restrict harvest during certain times of the year and to reduce landings. Seasonal closures are periods of time during which no landings of the target species are permitted. Because 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. The 2005 Southern Flounder FMP implemented a season closure in December for the commercial fishery (NCDMF 2005).

To determine the effect a specific seasonal closure would have on reducing harvest in the commercial fishery, monthly landings were averaged together from 1994 to 2004. For the recreational fishery, bi-monthly harvest estimates were averaged together from 2003 to 2007. Years that had no season closures and fairly consistent minimum size limits were chosen for these analyses. A percent of the total annual harvest 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 commercial fishery occurs in October, and 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 peak harvest to achieve the same percent reductions in harvest (Figures 2 and 3). Since the temporal distributions of harvest for

the commercial and recreational fisheries are different, it is possible that season closures for these fisheries would occur at different times of the year. 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 recoument by the fisheries. However, season closures during the peak harvest, particularly in the recreational fishery, are difficult 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. The harvest seasons, time and magnitude of peak harvest of southern flounder are different for the estuarine gill net, pound net and gig fisheries, so a commercial season closure could impact one fishery more than the others. A closed season in the late summer or early fall could result in a season closure that does not disproportionately burden one commercial fishery more than the others.

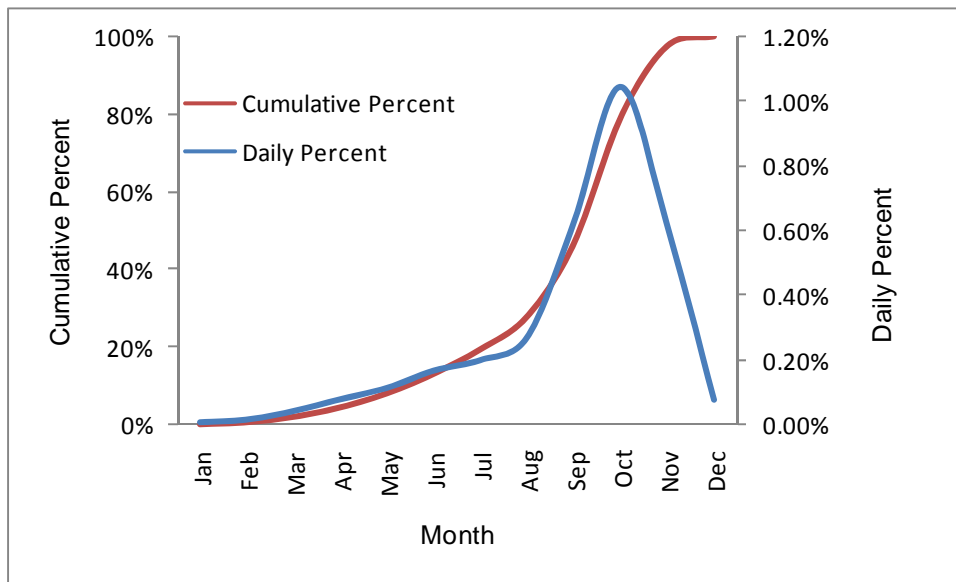


Figure 2. Daily and cumulative percent distributions of annual commercial harvest.

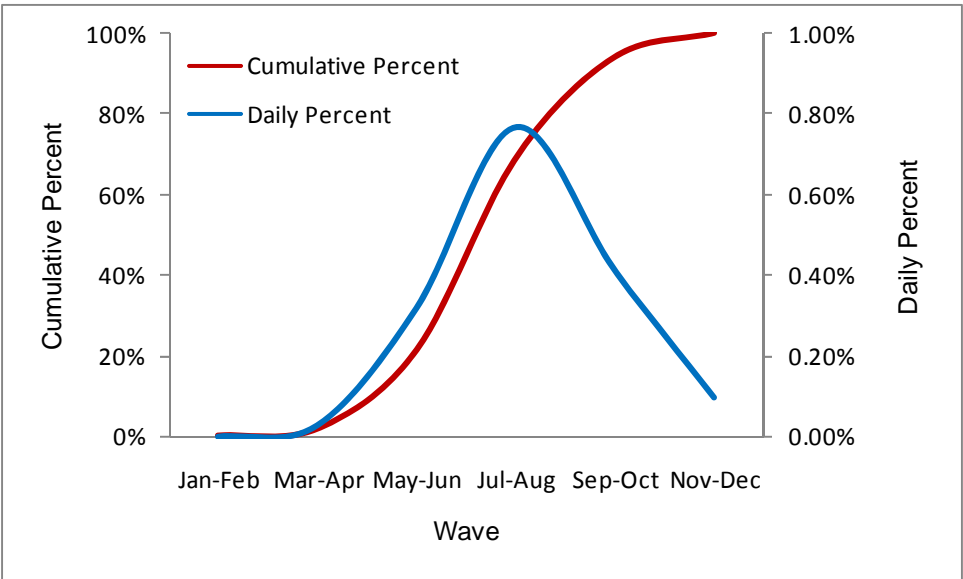


Figure 3. Daily and cumulative percent distributions of annual recreational harvest.

A likely result of a season closure would be an increase in discards, particularly in fisheries that harvest, but do not target, southern flounder. The peak landings of southern flounder from non-targeted commercial fisheries (other commercial fisheries in Table 2 and Figure 1) occur in September and October as well as March. Southern flounder harvest from these fisheries is a small (~5%) proportion of the annual commercial harvest. In the recreational fishery, southern flounder that would normally be harvested would have to be released. This would increase the number discards in this fishery as well. Consequently, the landings and harvest that will be converted to discards during a closed season should be considered.

A possible result of a season closure could be an increase in effort during the open period. 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 maintaining the fishing mortality at or below the target level 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 achieving the target SSB by 2015.

Trip/Vessel Harvest Limits

Trip or vessel harvest limits are generally used within the confines of a quota to prevent harvesting the available amount of fish too quickly and to avoid exceeding the quota. Similar to a trip limit for the commercial fishery, 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. The 2005 Southern Flounder FMP implemented an 8 fish creel limit for the recreational southern flounder fishery (NCDMF 2005).

A trip or vessel harvest limit may not work well for the southern flounder commercial fisheries primarily due to variability in the catches. Pound net and gill net catches can be quite

large in the fall as the fish migrate to the inlets. The 2009 Southern Flounder Stock Assessment found that southern flounder discards in the gill net fishery were relatively low (Takade-Heumacher and Batsavage 2009). Restrictive trip limits could result in increased discards in both the gill net and pound net fisheries on days when large catches occur.

Creel limits work well in the recreational fishery because the catches are less variable than the commercial fishery. The number of southern flounder caught 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 11). Recreational giggers tend to harvest more fish per trip than anglers but overall, it is rare for 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.

Table 11. Percent reduction in harvest 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 summer flounder has been 8 fish since 1998 (Table 8). This creel limit would likely be reduced if the creel limit is reduced for southern flounder to alleviate any enforcement problems. The NCWRC waters also have an 8 fish creel limit, so the NCWRC would also need to change their creel limit for consistent regulations.

Management Scenarios

A combination of minimum size limit increases, closed seasons and trip or creel limits can be used to reduce harvest in the commercial and recreational southern flounder fisheries. Tables 12-15 provide some examples of management scenarios that meet the required reductions for SPRs of 25%, 30% and 35%. The season closure options for any given scenario have equal harvest reductions that can be modified (i.e. starting earlier or ending later) and still have the same harvest reduction. Trip limits for the commercial fishery were not considered due to the potentially high discards, but different creel limits were explored for the recreational fishery because few trips harvest the current creel limit of 8 fish.

For the commercial fishery with the current 14-inch minimum size limit, an early season closure would last from 215 days (January 1—August 3) for the 25% SPR target and to 250 days (January 1—September 7) for the 35% SPR target (Table 12). This season closure would

have a greater impact on the gig fishery because it would occur during the peak harvest for this fishery (Figure 1). A late season closure would begin as early as October 12 for the 35% SPR target or November 2 for the 25% SPR target and would affect the pound net fishery more so than the other commercial fisheries (Figure 1). Mid season closures vary in duration and their relative impacts on fisheries depend on the time of year they begin.

Table 12. Potential management scenarios for the commercial fishery under a 14-inch minimum size limit.

SPR 25%					
Size Limit	Percent Reduction (Size Limit)	Closed Season Options	Days	Percent Reduction (Season Closure)	Total Reduction
14"	0%	Jan 1 -- Aug 3	215	20.5%	20.5%
		May 1 -- Aug 21	113	20.5%	20.5%
		Jun 1 -- Sep 1	93	20.5%	20.5%
		Jul 1 -- Sep 9	71	20.5%	20.5%
		Aug 1 -- Sep 20	51	20.5%	20.5%
		Sep 1 -- Oct 2	32	20.5%	20.5%
		Oct 1 -- Oct 20	20	20.5%	20.5%
		Nov 2 -- Dec 31	60	20.5%	20.5%
SPR 30%					
Size Limit	Percent Reduction (Size Limit)	Closed Season Options	Days	Percent Reduction (Season Closure)	Total Reduction
14"	0%	Jan 1 -- Aug 26	238	26.5%	26.5%
		May 1 -- Sep 5	128	26.5%	26.5%
		Jun 1 -- Sep 11	103	26.5%	26.5%
		Jul 1 -- Sep 19	81	26.5%	26.5%
		Aug 1 -- Sep 29	60	26.5%	26.5%
		Sep 1 -- Oct 7	37	26.5%	26.5%
		Oct 1 -- Oct 25	25	26.5%	26.5%
		Oct 27 -- Dec 31	66	26.5%	26.5%
SPR 35%					
Size Limit	Percent Reduction (Size Limit)	Closed Season Options	Days	Percent Reduction (Season Closure)	Total Reduction
14"	0%	Jan 1 -- Sep 7	250	32.3%	32.3%
		May 1 -- Sep 14	137	32.3%	32.3%
		Jun 1 -- Sep 21	113	32.3%	32.3%
		Jul 1 -- Sep 28	90	32.3%	32.3%
		Aug 1 -- Oct 5	66	32.3%	32.3%
		Sep 1 -- Oct 13	43	32.3%	32.3%
		Oct 1 -- Oct 31	31	32.3%	32.3%
		Oct 12 -- Dec 31	81	32.3%	32.3%

If the minimum size limit was increased to 15 inches, a season closure would not be required to achieve the 25% SPR target for the commercial fisheries but would be necessary to achieve the 30% and 35% SPR targets (Table 13).

Table 13. Potential management scenarios for the commercial fishery under a 15-inch minimum size limit. Note: Size limit and season closure reductions are not additive, due to the interaction between the different management measures.

SSB 25%					
Size Limit	Percent Reduction (Size Limit)	Closed Season Options	Days	Percent Reduction (Season Closure)	Total Reduction
15"	31.2%			0.0%	31.2%

SSB 30%					
Size Limit	Percent Reduction (Size Limit)	Closed Season Options	Days	Percent Reduction (Season Closure)	Total Reduction
15"	31.2%	Jan 1 -- May 12	132	6.0%	35.3%
		May 1 -- Jun 14	45	6.0%	35.3%
		Jun 1 -- Jul 5	35	6.0%	35.3%
		Jul 1 -- Jul 30	30	6.0%	35.3%
		Aug 1 -- Aug 22	22	6.0%	35.3%
		Nov 25 -- Dec 31	37	6.0%	35.3%

SSB 35%					
Size Limit	Percent Reduction (Size Limit)	Closed Season Options	Days	Percent Reduction (Season Closure)	Total Reduction
15"	31.2%	Jan 1 -- Jul 12	183	13.0%	40.1%
		May -- Jul 21	83	13.0%	40.1%
		Jun 1 -- Aug 6	67	13.0%	40.1%
		Jul 1 -- Aug 25	56	13.0%	40.1%
		Aug 1 -- Sep 7	38	13.0%	40.1%
		Sep 1 -- Sep 27	27	13.0%	40.1%
		Nov 14 -- Dec 31	48	13.0%	40.1%

For the recreational fishery, in general, season closures are longer during the early part of the year than in the summer, and longer season closures are associated with higher creel limits. For the current 14-inch minimum size limit, a season closure is necessary for every creel limit except for the 3 fish creel limit under the SPR 25% target (Table 14). Season closures are necessary for every creel limit under the SPR 30% and 35% targets. If the minimum size limit was increased to 15 inches under the 25% SPR target, lower reductions would be required for the recreational fishery than the commercial fishery to meet the overall harvest reduction because a 15-inch minimum size limit for the commercial fishery results in a slightly higher reduction than what is required (Table 15). Under the 25% SPR target, a creel limit decrease to either 3 or 4 fish could be accomplished without a season closure; a 5 fish creel limit would

require a short closed season. A season closure is necessary for every creel limit except for the 3 fish creel limit under the SPR 30% target, and season closures are necessary for every creel limit under the SPR 35% target.

Table 14. Potential management scenarios for the recreational fishery under a 14-inch minimum size limit. Note: Size limit, creel limit, and season closure reductions are not additive, due to the interaction between the different management measures.

SSB 25%								
Size Limit	Percent Reduction (Size Limit)	Creel Limit	Percent Reduction (Creel Limit)	Size/Creel Percent Reduction	Closed Season Options	Days	Percent Reduction (Season Closure)	Total Reduction
14"	0%	8	0.0%	0.0%	Jan 1 -- Jun 28	179	20.5%	20.5%
					May 1 -- Jul 1	62	20.5%	20.5%
					Jun 1 -- Jul 14	44	20.5%	20.5%
					Jul 1 -- Jul 27	27	20.5%	20.5%
					Aug 1 -- Aug 27	27	20.5%	20.5%
					Sep 1 -- Oct 20	50	20.5%	20.5%
					Oct 12 -- Dec 31	81	20.5%	20.5%
14"	0%	6	4.8%	4.8%	Jan 1 -- Jun 15	166	16.5%	20.5%
					May 1 -- Jun 22	52	16.5%	20.5%
					Jun 1 -- Jul 9	39	16.5%	20.5%
					Jul 1 -- Jul 21	21	16.5%	20.5%
					Aug 1 -- Aug 21	21	16.5%	20.5%
					Sep 1 -- Oct 10	40	16.5%	20.5%
					Oct 6 -- Dec 31	87	16.5%	20.5%
14"	0%	5	8.5%	8.5%	Jan 1 -- Jun 4	155	13.0%	20.4%
					May 1 -- Jun 10	41	13.0%	20.4%
					Jun 1 -- Jul 11	41	13.0%	20.4%
					Jul 1 -- Jul 17	17	13.0%	20.4%
					Aug 1 -- Aug 17	17	13.0%	20.4%
					Sep 1 -- Oct 1	32	13.0%	20.4%
					Oct 15 -- Dec 31	78	13.0%	20.4%
14"	0%	4	15.2%	15.2%	Jan 1 -- May 14	134	6.2%	20.5%
					May 1 -- May 19	19	6.2%	20.5%
					Jun 1 -- Jun 19	19	6.2%	20.5%
					Sep 1 -- Sep 15	15	6.2%	20.5%
					Oct 31 -- Dec 31	62	6.2%	20.5%
14"	0%	3	23.3%	23.3%				23.3%

Table 14. Continued.

SSB 30%								
Size Limit	Percent Reduction (Size Limit)	Creel Limit	Percent Reduction (Creel Limit)	Size/Creel Percent Reduction	Closed Season Options	Days	Percent Reduction (Season Closure)	Total Reduction
14"	0%	8	0.0%	0.0%	Jan 1 -- Jul 7	188	26.5%	26.5%
					May 1 -- Jul 9	70	26.5%	26.5%
					Jun 1 -- Jul 22	52	26.5%	26.5%
					Jul 1 -- Aug 4	35	26.5%	26.5%
					Aug 1 -- Sep 7	38	26.5%	26.5%
					Sep 1 -- Nov 13	74	26.5%	26.5%
					Sep 12 -- Dec 31	110	26.5%	26.5%
14"	0%	6	4.8%	4.8%	Jan 1 -- Jul 2	183	22.8%	26.5%
					May 1 -- Jul 4	65	22.8%	26.5%
					Jun 1 -- Jul 17	47	22.8%	26.5%
					Jul 1 -- Jul 30	30	22.8%	26.5%
					Aug 1 -- Aug 30	30	22.8%	26.5%
					Sep 1 -- Oct 25	55	22.8%	26.5%
					Sep 22 -- Dec 31	102	22.8%	26.5%
14"	0%	5	8.5%	8.5%	Jan 1 -- Jun 25	176	19.7%	26.5%
					May 1 -- Jul 1	62	19.7%	26.5%
					Jun 1 -- Jul 13	43	19.7%	26.5%
					Jul 1 -- Jul 26	26	19.7%	26.5%
					Aug 1 -- Aug 26	26	19.7%	26.5%
					Sep 1 -- Oct 17	47	19.7%	26.5%
					Sep 29 -- Dec 31	94	19.7%	26.5%
14"	0%	4	15.2%	15.2%	Jan 1 -- Jun 5	156	13.3%	26.5%
					May 1 -- Jun 11	42	13.3%	26.5%
					Jun 1 -- Jul 5	35	13.3%	26.5%
					Jul 1 -- Jul 17	17	13.3%	26.5%
					Aug 1 -- Aug 17	17	13.3%	26.5%
					Sep 1 -- Oct 2	32	13.3%	26.5%
					Oct 14 -- Dec 31	79	13.3%	26.5%
14"	0%	3	23.3%	23.3%	Jan 1 -- May 8	128	4.2%	26.5%
					Nov 19 -- Dec 31	43	4.2%	26.5%

Table 14. Continued.

SSB 35%								
Size Limit	Percent Reduction (Size Limit)	Creel Limit	Percent Reduction (Creel Limit)	Size/Creel Percent Reduction	Closed Season Options	Days	Percent Reduction (Season Closure)	Total Reduction
14"	0%	8	0.0%	0.0%	Jan 1 -- Jul 14	195	32.3%	32.3%
					May 1 -- Jul 17	78	32.3%	32.3%
					Jun 1 -- Jul 30	60	32.3%	32.3%
					Jul 1 -- Aug 11	42	32.3%	32.3%
					Aug 1 -- Sep 21	52	32.3%	32.3%
					Aug 31 -- Dec 31	122	32.3%	32.3%
14"	0%	6	4.8%	4.8%	Jan 1 -- Jul 10	191	29.0%	32.4%
					May 1 -- Jul 12	73	29.0%	32.4%
					Jun 1 -- Jul 25	55	29.0%	32.4%
					Jul 1 -- Aug 7	38	29.0%	32.4%
					Aug 1 -- Sep 13	44	29.0%	32.4%
					Sep 1 -- Dec 9	100	29.0%	32.4%
14"	0%	5	8.5%	8.5%	Jan 1 -- Jul 6	187	26.0%	32.3%
					May 1 -- Jul 9	70	26.0%	32.3%
					Jun 1 -- Jul 21	51	26.0%	32.3%
					Jul 1 -- Aug 4	34	26.0%	32.3%
					Aug 1 -- Sep 5	36	26.0%	32.3%
					Sep 1 -- Nov 8	69	26.0%	32.3%
14"	0%	4	15.2%	15.2%	Jan 1 -- Jun 27	178	20.1%	32.3%
					May 1 -- Jul 1	62	20.1%	32.3%
					Jun 1 -- Jul 14	44	20.1%	32.3%
					Jul 1 -- Jul 26	26	20.1%	32.3%
					Aug 1 -- Aug 26	26	20.1%	32.3%
					Sep 1 -- Oct 19	49	20.1%	32.3%
14"	0%	3	23.3%	23.3%	Jan 1 -- Jun 1	152	11.8%	32.3%
					May 1 -- Jun 7	37	11.8%	32.3%
					Jun 1 -- Jul 3	33	11.8%	32.3%
					Jul 1 -- Jul 15	15	11.8%	32.3%
					Aug 1 -- Aug 15	15	11.8%	32.3%
					Sep 1 -- Sep 29	29	11.8%	32.3%
					Oct 18 -- Dec 31	75	11.8%	32.3%

Table 15. Potential management scenarios for the recreational fishery under a 15-inch minimum size limit. Note: Size limit, creel limit, and season closure reductions are not additive, due to the interaction between the different management measures.

SSB 25%								
Size Limit	Percent Reduction (Size Limit)	Creel Limit	Percent Reduction (Creel Limit)	Size/Creel Percent Reduction	Closed Season Options	Days	Percent Reduction (Season Closure)	Total Reduction
15"	16.3%	8	0.0%	16.3%	Jan 1 -- Jun 10	161	14.7%	28.6%
					May 1 -- Jun 16	46	14.7%	28.6%
					Jun 1 -- Jul 7	37	14.7%	28.6%
					Jul 1 -- Jul 19	19	14.7%	28.6%
					Aug 1 -- Aug 19	19	14.7%	28.6%
					Sep 1 -- Oct 6	36	14.7%	28.6%
					Oct 11 -- Dec 31	82	14.7%	28.6%
15"	16.3%	6	4.8%	20.3%	Jan 1 -- May 28	148	10.5%	28.7%
					May 1 -- Jun 2	33	10.5%	28.7%
					Jun 1 -- Jul 1	31	10.5%	28.7%
					Jul 1 -- Jul 14	14	10.5%	28.7%
					Aug 1 -- Aug 14	14	10.5%	28.7%
					Sep 1 -- Sep 25	25	10.5%	28.7%
					Oct 21 -- Dec 31	72	10.5%	28.7%
15"	16.3%	5	8.5%	23.3%	Jan 1 -- May 16	136	7.0%	28.7%
					May 1 -- May 22	22	7.0%	28.7%
					Jun 1 -- Jun 22	22	7.0%	28.7%
					Sep 1 -- Sep 17	17	7.0%	28.7%
					Oct 29 -- Dec 31	64	7.0%	28.7%
15"	16.3%	4	15.2%	29.0%				29.0%
15"	16.3%	3	23.3%	35.7%				35.7%

Table 15. Continued.

SSB 30%								
Size Limit	Percent Reduction (Size Limit)	Creel Limit	Percent Reduction (Creel Limit)	Size/Creel Percent Reduction	Closed Season Options	Days	Percent Reduction (Season Closure)	Total Reduction
15"	16.3%	8	0.0%	16.3%	Jan 1 -- Jul 2	183	22.8%	35.4%
					May 1 -- Jul 4	65	22.8%	35.4%
					Jun 1 -- Jul 17	47	22.8%	35.4%
					Jul 1 -- Jul 30	30	22.8%	35.4%
					Aug 1 -- Aug 30	30	22.8%	35.4%
					Sep 1 -- Oct 25	55	22.8%	35.4%
					Sep 22 -- Dec 31	102	22.8%	35.4%
15"	16.3%	6	4.8%	20.3%	Jan 1 -- Jun 3	154	19.0%	35.4%
					May 1 -- Jun 29	60	19.0%	35.4%
					Jun 1 -- Jul 12	42	19.0%	35.4%
					Jul 1 -- Jul 25	25	19.0%	35.4%
					Aug 1 -- Aug 25	25	19.0%	35.4%
					Sep 1 -- Oct 16	46	19.0%	35.4%
					Sep 30 -- Dec 31	93	19.0%	35.4%
15"	16.3%	5	8.5%	23.3%	Jan 1 -- Jun 13	166	15.6%	35.3%
					May 1 -- Jun 18	49	15.6%	35.3%
					Jun 1 -- Jul 18	38	15.6%	35.3%
					Jul 1 -- Jul 20	20	15.6%	35.3%
					Aug 1 -- Aug 20	20	15.6%	35.3%
					Sep 1 -- Oct 7	37	15.6%	35.3%
					Oct 9 -- Dec 31	94	15.6%	35.3%
15"	16.3%	4	15.2%	29.0%	Jan 1 -- May 23	143	9.0%	35.4%
					May 1 -- May 28	28	9.0%	35.4%
					Jun 1 -- Jun 28	28	9.0%	35.4%
					Sep 1 -- Sep 22	22	9.0%	35.4%
					Oct 25 -- Dec 31	68	9.0%	35.4%
15"	16.3%	3	23.3%	35.7%				35.7%

Table 15. Continued.

SSB 35%								
Size Limit	Percent Reduction (Size Limit)	Creel Limit	Percent Reduction (Creel Limit)	Size/Creel Percent Reduction	Closed Season Options	Days	Percent Reduction (Season Closure)	Total Reduction
15"	16.3%	8	0.0%	16.3%	Jan 1 -- Jul 10	191	28.5%	40.1%
					May 1 -- Jul 12	73	28.5%	40.1%
					Jun 1 -- Jul 25	55	28.5%	40.1%
					Jul 1 -- Aug 6	37	28.5%	40.1%
					Aug 1 -- Sep 12	42	28.5%	40.1%
					Sep 1 -- Dec 4	95	28.5%	40.1%
					Sep 7 -- Dec 31	116	28.5%	40.1%
15"	16.3%	6	4.8%	20.3%	Jan 1 -- Jul 5	186	25.0%	40.2%
					May 1 -- Jul 7	68	25.0%	40.2%
					Jun 1 -- Jul 20	50	25.0%	40.2%
					Jul 1 -- Aug 2	33	25.0%	40.2%
					Aug 1 -- Sep 3	34	25.0%	40.2%
					Sep 1 -- Oct 31	61	25.0%	40.2%
					Sep 16 -- Dec 31	107	25.0%	40.2%
15"	16.3%	5	8.5%	23.3%	Jan 1 -- Jul 1	182	22.0%	40.2%
					May 1 -- Jul 3	64	22.0%	40.2%
					Jun 1 -- Jul 16	46	22.0%	40.2%
					Jul 1 -- Jul 29	29	22.0%	40.2%
					Aug 1 -- Aug 29	29	22.0%	40.2%
					Sep 1 -- Oct 23	53	22.0%	40.2%
					Sep 22 -- Dec 31	100	22.0%	40.2%
15"	16.3%	4	15.2%	29.0%	Jan 1 -- Jun 13	166	15.6%	40.1%
					May 1 -- Jun 18	49	15.6%	40.1%
					Jun 1 -- Jul 18	38	15.6%	40.1%
					Jul 1 -- Jul 20	20	15.6%	40.1%
					Aug 1 -- Aug 20	20	15.6%	40.1%
					Sep 1 -- Oct 7	37	15.6%	40.1%
					Oct 9 -- Dec 31	94	15.6%	40.1%
15"	16.3%	3	23.3%	35.7%	Jan 1 -- May 16	136	7.0%	40.2%
					May 1 -- May 22	22	7.0%	40.2%
					Jun 1 -- Jun 22	22	7.0%	40.2%
					Sep 1 -- Sep 17	17	7.0%	40.2%
					Oct 29 -- Dec 31	64	7.0%	40.2%

IV. 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
 15A NCAC 3M .0503 FLOUNDER

V. Management Options

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

- 1) Status Quo
 - + No additional burden on fishermen, dealers, or managers
 - Does not address historical trend of exceeding F_{Target}
 - Does not address dependence of fishery on year-class strength
 - Maintenance of fishing mortality at or below F_{Target} , as required by the Fisheries Reform Act, will not be achieved
 - Recovery of spawning stock biomass unlikely, stock could suffer further decline
- 2) Static Quota
 - + Controls harvest levels to projected harvest required to rebuild female SSB by 2015
 - + No confusion over quota from year to year
 - + Quota season that provides target fisheries an opportunity to land southern flounder could be established
 - Not sensitive to fluctuations in recruitment or availability of fish to the fishery
 - Additional reporting burden on commercial dealers
 - Requires a permitting system for dealers to implement
 - Requires additional resources for NCDMF to implement
 - May restrict harvest levels more or less than necessary
 - Potential to exceed the quota due to the magnitude of daily landings
 - Quota overages must be deducted from the following year
 - Potential for season to close early
 - Unable to implement for recreational fishery
- 3) Dynamic Quota
 - + Controls harvest levels
 - + Sensitive to fluctuations in recruitment or availability of fish to the fishery
 - Additional reporting burden on commercial dealers
 - Requires a permitting system for dealers to implement
 - Requires annual stock assessment update by NCDMF to implement
 - Uncertainty in data prevents its use for quota management
 - Confusion over the quota from year to year
 - Potential to exceed the quota due to the potential magnitude of daily landings
 - Unable to implement for recreational fishery
- 4) Limited Entry
 - + Prevents growth of fishery
 - + Could protect historical participants in the fishery
 - Will not prevent expansion in effort by allowed participants if implemented without other management options
 - Overfishing may still occur based on fishing mortality levels
 - Requires a license or permit system to implement
 - **Cannot be considered an option unless there is no other means of achieving the target fishing mortality level**

- 5) Increased Minimum Size Limit
 - + Increase in the spawning stock biomass and the overall yield to the fishery in the long-term
 - + Allows more immature fish the opportunity to spawn at least once before being caught
 - + Reduces harvest levels closer to the target fishing mortality level
 - + Could be applied to both the commercial and recreational fisheries
 - Decrease in the yield to the fishery in the short-term
 - Some regions may be more adversely impacted than others (i.e. Albemarle Sound and western Pamlico Sound and its tributaries)
 - Impacts on catches greatest in early half of the year
 - Overfishing could still occur if F increases on legal sized fish
 - Effectiveness diminished if proportion of undersized fish in the catch increases

- 6) Limited Harvest Season
 - + Reduces harvest levels closer to the target fishing mortality level
 - + Potentially allows more fish to survive the migration to the ocean to spawn
 - + No reporting burden on fishermen or dealers
 - + Could be applied to both the commercial and recreational fisheries
 - Increased enforcement required
 - Some fisheries may be more adversely impacted than others
 - Discards likely to increase during closed season
 - Effort may be increased during the open periods, thus reducing the effectiveness of the closure
 - Effectiveness diminished if harvest occurs during closed season

- 7) Trip/Vessel Harvest Limits
 - + Reduces effort and harvest in the fishery
 - May lead to large increases in discard mortality
 - May adversely impact some fisheries and fishermen more than others
 - Would not guarantee reduction of fishing mortality to the target level
 - Does not work well as a stand alone measure

Management Recommendations

DMF Position: Implement interim management measures by January 1, 2010.

VI. Research Needs

- Investigate the feasibility of quota monitoring for the commercial southern flounder fishery.
- Annual survey of the recreational gig fishery.

VII. Literature Cited

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