Issues/Reports

N.C. FISHERY MANAGEMENT PLANS

May 2015

Kingfishes
- Review Goal/Objectives
- Review Timeline

Inter-jurisdictional, Hard Clam, Oyster
- Draft Developed by Division/Advisory Committee

- Approve Draft for Public Meetings/Advisory Committee Review

- Select Preferred Management Options/Approve Draft

- Review by DENR and Gov Ops

- Approve Sending FMP Forward for Rulemaking

Striped Mullet
- Approve Notice of Text for Rulemaking/Public Hearings

- Final Approval/Final Approval of Rules

Shrimp
- Implement Strategies/Recommendations

TIMELINE FOR OYSTER FISHERY MANAGEMENT PLAN AMENDMENT 4 AND HARD CLAM FISHERY MANAGEMENT PLAN AMENDMENT 2 (June 2, 2014; Revised March 30, 2015)			
MILESTONES	**INTERNAL GUIDELINES**	**TABLES 1&2 STEP**	**PROJECTED COMPLETION DATE**
1. Orient AC and Discuss Issues, Goal and Objectives	III. B.	9/5	June 2014
2. Present Timeline and Goal and Objectives to MFC; Solicit MFC Input on Issues	III. D.	11/7	August 2014
3. Issue News Release to Solicit Public Input on Issues	III. D.	12-15/8-11	September 2014
4. Draft/Revise and Review Informational Sections and Issue Papers in the FMP and Establish DMF/AC Positions	III. D - F	16-19/12-14	September 2014 -September 2015
5. Obtain MFC Approval for Review of FMP	III. F.	20/15	November 2015
6. Public and Committee Review of FMP	III. F.	21-24/16-18	December 2015-January 2016
7. Present Revised FMP to MFC for Selection of Preferred Management Options	IV. A.	25/20	February 2016
8. Review of FMP by DENR and JLCGO	IV. A.	26-29/21-24	March 2016
9. Procedural Approval of FMP; Approval of Notice of Text for Rules by MFC	IV. A.	30-32/25-27	May 2016
10. Direct Rules through APA Process	IV. B.	33/28	August-October 2016
11. Final FMP and Rule Approval by MFC	IV. C.	34-35/29-30	November 2016
12. Selected Management Measures Effective Date	N/A	N/A	48 Hours if proclamation; April 1, 2017 if rule

Initial approval by DMF Director: Signature:__________ Date:__________

Presented to MFC: Date:__________

Revision approved by DMF Director: Signature: [signature] Date: 4/27/15

Presented to MFC: Date:__________

Revision(s) and reason(s): Additional time is needed for milestones 4-7 to await the outcome of draft legislation introduced in the 2015 long session that potentially affects issues in the Oyster and Hard Clam fishery management plan amendments.

This document is in DRAFT form and all parts are subject to change.

Supplement A to Amendment 1 of the N.C. Southern Flounder Fishery Management Plan

Implement Short-Term Management Measures to Address Stock Concerns

See Sections 5.3, 10.1, 10.1.1 of the 2013 Amendment 1 to the N.C. Southern Flounder Fishery Management Plan

May 4, 2015

Executive Summary

Southern flounder (*Paralichthys lethostigma*) is one of the most economically important estuarine finfish species for commercial and recreational fisheries in North Carolina. Stock assessments completed by the North Carolina Division of Marine Fisheries (NCDMF) in 2004 and 2009 determined the southern flounder stock was overfished and overfishing was occurring throughout the time-series, beginning in 1991. Since the adoption of the Southern Flounder Fishery Management Plan (FMP) in 2005, numerous management actions were put in place intended to end overfishing and rebuild the stock. In 2014, a new stock assessment was completed for southern flounder in North Carolina waters. It was not accepted for management by the NCDMF due to legitimate and substantial concerns raised by the peer reviewers, concerns with which the NCDMF agrees. NCDMF determined the assessment could not be used to define stock status due to mixing of the stock on a regional scale. Without an approved stock assessment it was not possible to determine if the stock is overfished or overfishing is occurring; however, data inputs used in the stock assessment were determined to be valid. It was noted that a high fraction of the harvest consisted of immature fish. Regional data also showed a generally consistent pattern of coast-wide, multi-decadal decline in recruitment and abundance. These concerns prompted the Marine Fisheries Commission (MFC) to pass a motion to pursue a supplement to reduce catch of southern flounder by no less than 25% and no greater than 60%.

The supplement process is a temporary, fast-acting mechanism to address an urgent issue before the usual five-year scheduled review period of a FMP. A supplement is not intended to be a review of all measures that can potentially be used to manage the southern flounder fishery, thus a subset of options was chosen to calculate estimated reductions based on feasibility of implementation in the short-term. Catch reductions provided were based on an average of 2011-2014 commercial and recreational data; however, 2014 harvest data were not finalized, 2014 gill net discards estimates were not available, and 2014 recreational gig data were not available at the time this report was developed. Catch was defined as the number of southern flounder harvested and estimated dead discards. Catch reductions are only estimates that include many assumptions about harvest, discards and population dynamics.

Catch reductions were estimated for five proposed management options to reduce annual catch and increase escapement of southern flounder: (1) implement a season closure, (2) increase the minimum size limit, (3) decrease the recreational bag limit, (4) implement a season closure and also increase the minimum size limit, (5) implement a season closure, increase the minimum size limit and decrease the recreational bag limit. The first option is a season closure, which allows

for more escapement of southern flounder, assuming harvest is not recouped and discards do not increase substantially. Season closures at the end of the season will have different impacts geographically and for each gear. Estimates indicated a season closure for the total fishery (commercial and recreational) will need to begin Oct. 16 for a 25% reduction and begin Sept. 1 for a 60% reduction. To achieve approximately the same reduction between sectors, the recreational fishery will require a much longer season closure than the commercial fishery because the peak catch occurs earlier in the season. The second option, an increase in the size limit, will allow harvest to continue throughout the current season and also increase escapement. Commercial gear modifications will be important to help mitigate expected discard increases. Estimated reductions from increasing the minimum size limit to 15 or 16 inches for the total fishery are 14% and 28%, respectively. The third option, decreasing the recreational bag limit, was estimated to not achieve at least the minimum requested catch reduction. The fourth option, combining a season closure with an increase in the minimum size limit, will reduce total fishery catch by an estimated 25% with a season closure starting Nov. 1 and a 15-inch minimum size limit. The fifth option includes a season closure, an increase in the minimum size limit and a decrease in the recreational bag limit. To achieve an estimated 25% reduction with a minimum size limit of 15 inches and a one-fish recreational bag limit, a season closure for the total fishery of Nov. 16-May 15 will be needed. Catch reductions for Options 2, 4 and 5 (those with a size limit increase) do not include further reductions that would be expected from an increase in gill net and pound net escape panel mesh sizes. Determining reductions levels and methods that are equitable within the requested range among sectors, gears, and geographic regions will be difficult due to the nature of the southern flounder fishery.

Some portions of the approach and conclusions discussed in this supplement differ from previous NCDMF management documents for southern flounder. Since there is not an approved stock assessment to determine sustainable harvest levels, any level of reduction selected can only be based on the degree of concern about the current state of the southern flounder stock as understood by data trends. Regardless of the reduction level and management measures chosen, it will be difficult to determine if the estimated catch reductions are actually achieved due to current data limitations (i.e., uncertainty about discards). In previous documents developed by the NCDMF for southern flounder fishery management, reductions from new measures were based on harvest rather than catch (although discards were included in stock assessments). Catch reductions are considerably lower than harvest reductions for most options due to expected discards. Harvest reduction estimates required fewer assumptions, but do not take discards into account. Lastly, due to evidence the stock is mixing on a regional scale, it should be understood that southern flounder fishery trends in other South Atlantic states will impact the likelihood of achieving estimated reductions due to management measures used in N.C. waters.

The draft supplement will be presented to the MFC at its May 20-22 business meeting, at which time, the MFC has three options: reject the draft supplement (ending the process), approve the draft supplement as presented for public comment, or modify the draft supplement and approve the modified version for public comment. If the process continues, the draft supplement will be available at an announced time for public comment. All public comments received will be provided to the MFC for its Aug. 19-21 business meeting, at which time, the MFC will select its preferred management option. Selection of the preferred management option is final approval of the supplement. If the supplement is approved, management measures would be implemented by proclamation and would likely be effective Sept. 1.

I. ISSUE AND ORIGINATION

At the Feb. 19, 2015 MFC business meeting, the MFC passed a motion to pursue a supplement to reduce catch of southern flounder by no less than 25% and no greater than 60%. This motion was based on discussions by the MFC that the purpose of reducing catch was to increase overall escapement of southern flounder.

II. BACKGROUND

Management History

The original N.C. Southern Flounder FMP, adopted in 2005, set overfishing and overfished thresholds and targets using a spawning potential ratio (SPR) of 20% and 25%, and implemented management measures intended to end overfishing and rebuild the stock. Management actions were developed to expand spawning stock biomass while allowing for sustainable harvest. Through the FMP, several steps were taken to better manage southern flounder for a sustainable harvest including a 14-inch minimum size limit for commercial and recreational fisheries statewide and an eight-fish recreational bag limit for the recreational fishery as recommended by the NCDMF and adopted by the MFC in February 2005 to enable a greater percent of southern flounder to spawn at least once. Other measures implemented with the adoption of the 2005 FMP included a December commercial closure period, prohibiting the use of gill nets with a mesh length of 5.0 to 5.5 inches from April 15 – Dec. 15, establishing a 3,000-yard limit for gill nets with a mesh length of five inches or greater statewide, requiring 5.5-inch escapement panels in pound nets statewide, and a four-inch minimum tail bag requirement for crab trawls in western Pamlico Sound.

The 2009 N.C. Southern Flounder Stock Assessment (Takade-Heumacher and Batsavage 2009) proposed increasing the threshold SPR from 20% to 30% and increasing the target SPR from 25% to 35% to reduce the risk of recruitment overfishing. The assessment results indicated that under these new reference points the stock in North Carolina was overfished and overfishing had been occurring throughout the entire time series (1991-2007). While the stock assessment indicated the stock status was improving with decreases in fishing mortality, increases in spawning stock biomass, and expansion of age classes, a reduction in the overall harvest was still needed to achieve sustainable harvest. Thus, the NCDMF began developing Southern Flounder FMP Amendment 1 in 2010. During the development of Amendment 1, the NCDMF reached a settlement agreement concerning sea turtle interactions in the commercial gill net fishery which enacted management measures on May 15, 2010 to reduce these interactions (Proclamation M-8-2010). Upon analysis of these measures, it appeared they would result in the necessary harvest reduction (22.2%) to end overfishing in two years and achieve sustainable harvest in the commercial fishery. In November 2010, the MFC approved sending the draft of Amendment 1 to the Southern Flounder FMP to the Department of Environment and Natural Resources (DENR) Secretary and Joint Legislative Commission on Seafood and Aquaculture for review. Delays in the review of Amendment 1 caused by the legislative schedule resulted in the NCDMF requesting approval to begin the supplement process in January 2011 so management measures could be implemented in the recreational fishery to end overfishing and achieve sustainable harvest. For the required reductions to the commercial fishery, the approach was to wait and assess the impacts to harvest from measures implemented in 2010 for large mesh gill nets in conjunction with the settlement agreement.

In February 2011, the MFC adopted Supplement A to the Southern Flounder FMP to implement recreational harvest restrictions due to the delay in legislative review of Amendment 1. Supplement A to the 2005 Southern Flounder FMP implemented a 15-inch minimum size limit statewide and six-fish recreational bag limit for the recreational fishery (Proclamation FF-29-2011). In February 2013, Amendment 1 to the Southern Flounder FMP was adopted by the MFC. Amendment 1 established the threshold SPR of 25% and the target SPR of 35% and implemented management measures for the commercial and recreational fisheries. For the recreational fishery, the management measures established in Supplement A were incorporated into Amendment 1 (a coast-wide 15-inch minimum size limit and a six-fish recreational bag limit). For the commercial fishery, some of the measures intended to reduce sea turtle interactions were adopted as management measures for southern flounder. These included limiting the number of fishing days each week and establishing maximum yardage limits for gill nets with a mesh size from 4.0 through 6.5 inches stretch mesh (NCDMF 2013).

In December 2014, the NCDMF completed a new stock assessment. The 2014 assessment used the same type of model as the 2009 assessment (i.e., catch-at-age model), but used a new computer program with new and updated data and accounted for new research related to reproductive ecology. Upon review of the 2014 assessment, the external peer reviewers and the NCDMF determined the model could not fully account for stock mixing during spawning and quantify migration of southern flounder to and from North Carolina waters. Sustainability benchmarks could not be developed for southern flounder using the statistical catch-at-age model used in the 2014 Southern Flounder Stock Assessment. Subsequently, the 2014 Southern Flounder Stock Assessment was not accepted for management use by the NCDMF due to legitimate and substantial concerns raised by the external peer reviewers, concerns with which the NCDMF agreed. The fact the stock assessment was not accepted provides no answer as to whether the 2005 threshold and target or the more risk adverse threshold and target from Amendment 1 (2013) were appropriate or met.

<u>Stock Concerns</u>

The NCDMF cannot quantify levels of sustainable harvest without a valid stock assessment; however, certain patterns in the southern flounder fishery and population are concerning and may warrant management action. Many of the data inputs for the stock assessment were considered valid by peer-reviewers for use in analyzing trends. A pattern that was noted in the first southern flounder stock assessment (NCDMF 2005) is the high fraction of immature fish in the harvest. Based on the recent maturity schedule published by Midway et al. (2013) and the catch-at-length data from commercial and recreational fisheries, 46%-73% of southern flounder harvested in North Carolina waters were below the length at 50% maturity (L50; Figure 1). This provides an estimate of immature fish in the harvest, although some fish above the L50 are immature and some below the L50 are mature. This proportion has decreased only slightly since 2005, despite increases in the minimum size limit.

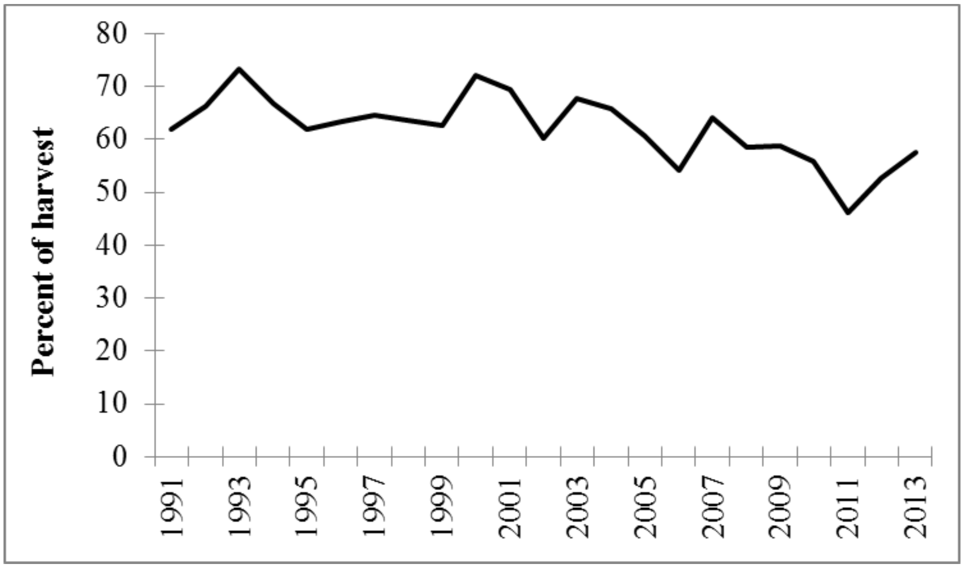

Figure 1. Percent of the annual harvest less than the length at 50% maturity (L50) for southern flounder. The L50 was approximated at 400 mm (15.8 inches) total length for this analysis. Note: all harvest, including sublegal harvest, except recreational gig harvest was included in this analysis.

Based on genetic, otolith morphometric, and tagging data, southern flounder appear to form a single South Atlantic population, from North Carolina to Florida (Anderson and Karel 2012; Anderson et al. 2012; Midway et al. 2014; Craig et al. *In review*; Wang et al. *In press*). As such, population trends in different states are likely coupled via spawning, recruitment, and migration. Therefore, it may be appropriate to consider population trends from other South Atlantic states as indicators of what may be occurring with the overall southern flounder population in the South Atlantic, including North Carolina waters. Indices of abundance from North Carolina, South Carolina, and Georgia, derived from fishery-independent surveys in state waters and analyzed by their respective marine fisheries management agencies, show a generally consistent pattern of coast-wide, multi-decadal decline in recruitment and general abundance of sub-adults and adults (Figures 2 and 3). While some uncertainty in the magnitude or timing of population decline exists, none of the seven indices were interpreted as indicative of improving population status.

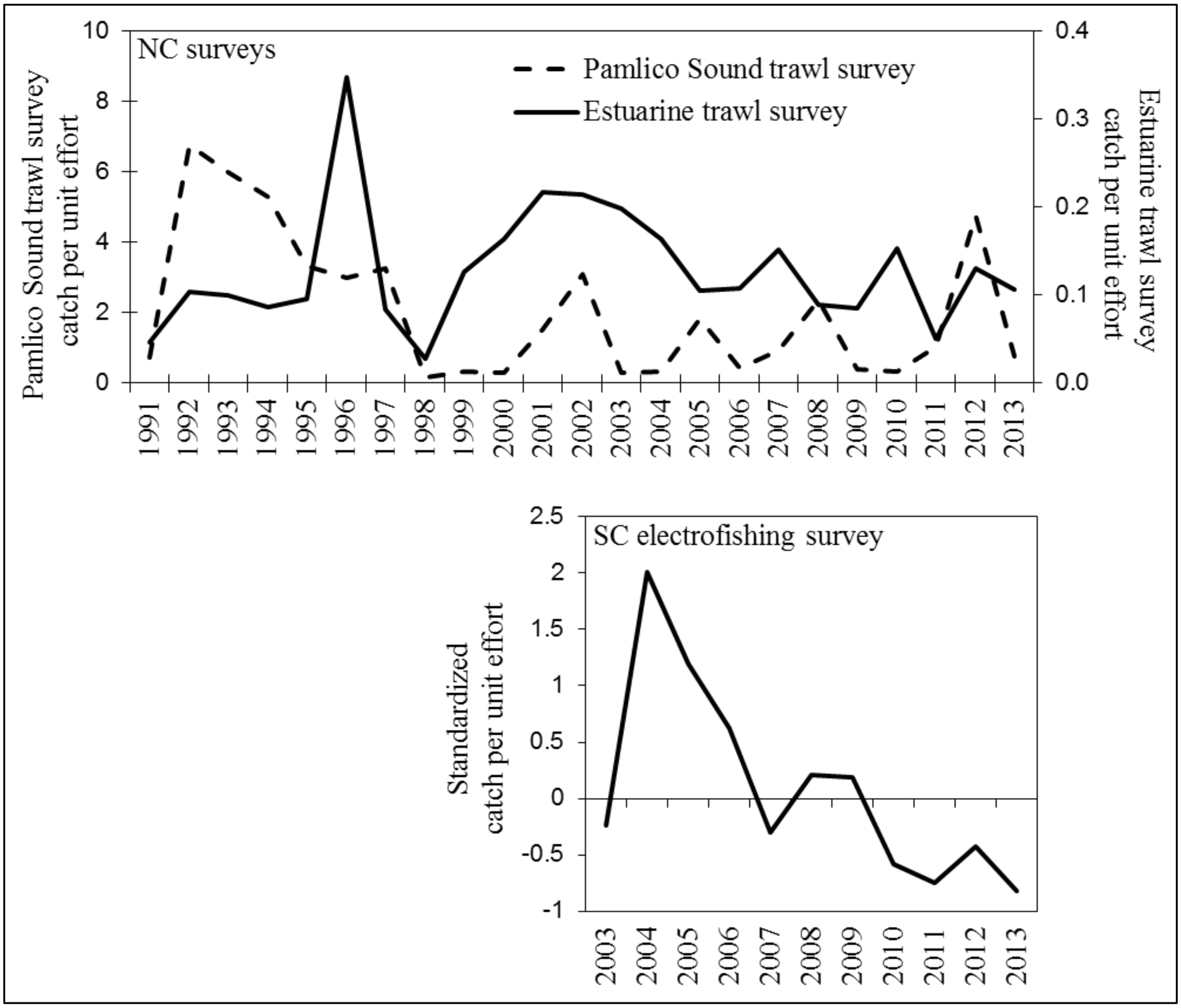

Figure 2. Indices of juvenile abundance developed from North Carolina Pamlico Sound and Estuarine Trawl Surveys and South Carolina Electrofishing Survey. North Carolina indices were developed by North Carolina Division of Marine Fisheries and the South Carolina index was developed by South Carolina Department of Natural Resources.

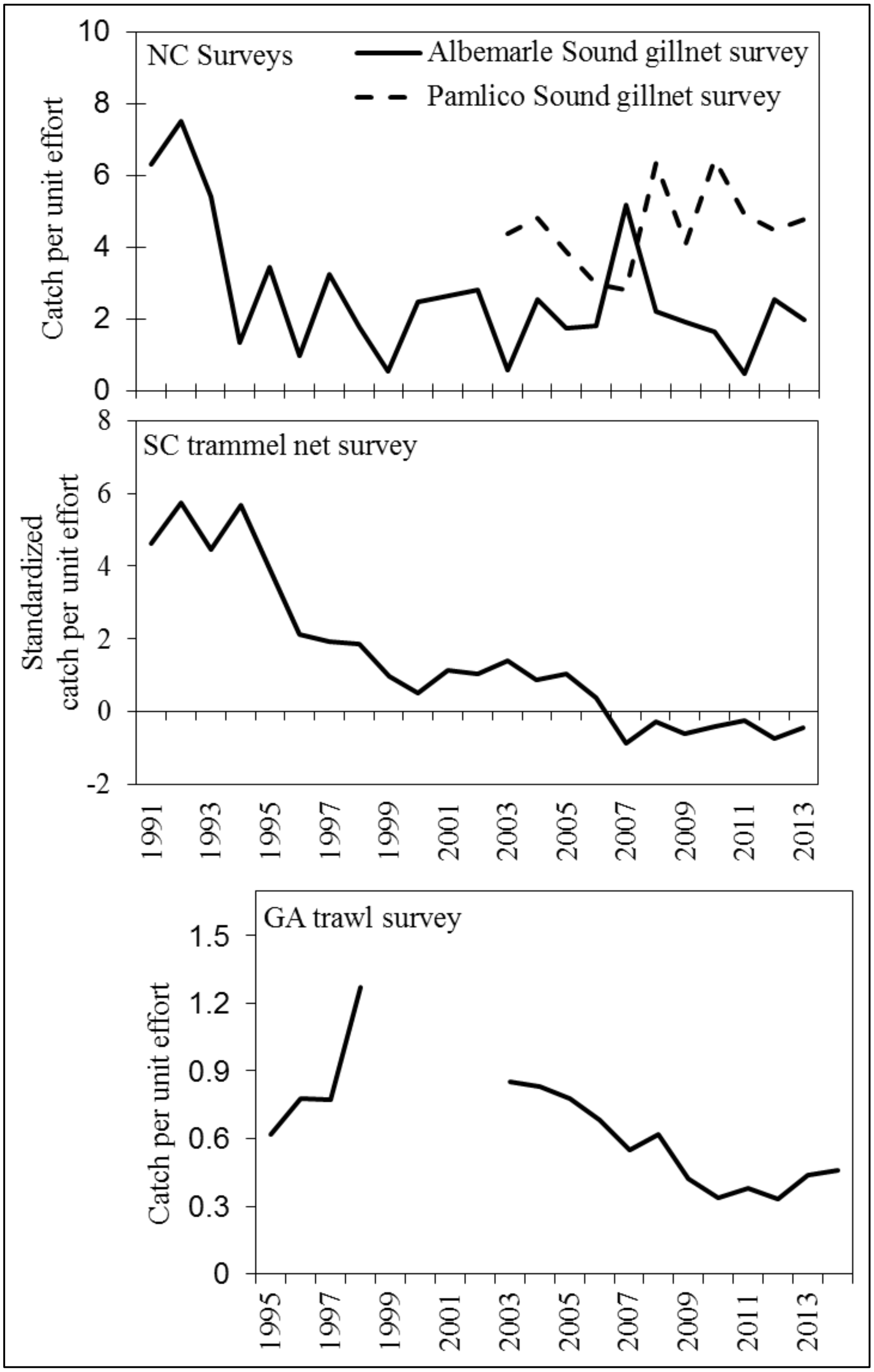

Figure 3. Indices of abundance of sub-adults and adults developed from North Carolina Albemarle Sound and Pamlico Sound Independent Gill Net Surveys, South Carolina Trammel Net Survey, and Georgia Ecological Monitoring Survey (GA Trawl). North Carolina indices were developed by NCDMF staff; the South Carolina index was developed by South Carolina Department of Natural Resources staff; and the Georgia index was developed by Georgia Department of Natural Resources staff.

A regional stock assessment is needed to account for migration and mixing throughout the South Atlantic and to quantify the offshore component of the southern flounder stock. However, pursuing a regional stock assessment would change the current management unit of the fishery and would not be appropriate for a supplement (based on long-term viability and urgency), as it constitutes a wholesale change in management strategy that would require an amendment to the FMP. For the purpose of this supplement and consistent with Amendment 1, the current management unit is defined as southern flounder in all coastal and joint waters throughout North Carolina.

Supplement Process

N.C. General Statute 113-182.1 and the MFC FMP Guidelines (NCMFC 2010) provide a supplement mechanism to modify a plan between the usual five-year scheduled reviews when the Secretary of the DENR determines an issue 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. The draft supplement must contain analysis of the proposed management change including pertinent data with projected outcomes, and proposed rules or proclamation measures necessary to implement that position. Supplement management measures are temporary (interim) and must be incorporated into the FMP at the time of the next review (currently scheduled for 2018) or they expire on the date the revised FMP is adopted. Also, the MFC may only consider a single management issue for each draft supplement. For Supplement A, the single management issue is to reduce catch in order to improve escapement. Uncertainty over whether the stock is overfished or overfishing is occurring, concerns that immature fish make up a large portion of the catch, and coast-wide indices of abundance that have declined since the 1990s support the urgency of the issue.

Characterization of the Fishery

Recreational

Most of the recreational harvest of southern flounder occurs inshore in North Carolina's estuaries and coastal rivers; however, the ocean harvest near reefs is an important component of the recreational hook and line fishery. The hook and line fishery occurs year-round but the majority of the harvest is during summer months. Data from the National Marine Fisheries Service's Marine Recreational Information Program (MRIP) were used to estimate hook and line harvest because that is the primary gear intercepted by MRIP creel clerks. In 2012, the Marine Recreational Fishing Statistics Survey (MRFSS) was replaced by MRIP to improve the methodology used to generate recreational estimates of catch and effort. Hook and line anglers harvested approximately 79% of the known recreational harvest and 17% of the total recreational and commercial harvest (Table 1). The recreational gig fishery harvests less southern flounder but harvests them more consistently throughout the year than the hook and line fishery, typically peaking in late-summer and early-fall. Because MRIP rarely intercepts fishermen using gigs (due to fishing at night), the NCDMF began a mail-based survey of recreational gigging in 2010. Based on responses to the mail-based survey and the number of Coastal Recreational Fishing

License (CRFL) holders, the NCDMF estimated the harvest and trips taken by the recreational gig fishery in North Carolina. Recreational gigs accounted for 21% of the known recreational harvest and 5% of the total harvest. In 2011-2013, recreational anglers and giggers together averaged 495,685 trips and 459,177 pounds of southern flounder annually (Table 1), with the majority of the harvest occurring in the southeastern part of the state from Onslow through Brunswick counties.

Table 1. Average annual effort and landings for the North Carolina recreational southern flounder fishery from 2011-2013. Recreational gig harvest data were not available for 2014, so 2014 was excluded from the average presented in this table.

Gear	Trips	Pounds	% of Recreational harvest	% of Total harvest
Gig	24,477	96,748	21.1	4.5
Hook and Line	471,208	362,429	78.9	16.9
Total	495,685	459,177	100.0	21.4

Additionally, Recreational Commercial Gear License (RCGL) holders are allowed to use limited amounts of commercial gears such as gill nets, trawls, pots, and seines. Recreational Commercial Gear License holders are not allowed to sell their catch and must abide by the same size and creel limits as all recreational anglers. Due to the discontinuation of the survey used to estimate RCGL-holder harvest, the amount of southern flounder caught by RCGL holders is unknown, but is assumed to be small based on RCGL harvest in the last years of the survey. On average, RCGL holders made 18,296 trips (all gears) and landed 68,826 pounds of southern flounder annually from 2002-2007. Roughly 73% of the southern flounder landed by RCGL gear was landed by gill nets.

The recreational hook and line fishery harvest of southern flounder peaked in 2010 (Figure 4). Harvest generally increased after the 2005 Southern Flounder FMP, but generally declined since 2011 when Supplement A implemented a 15-inch minimum size limit and six-fish bag limit for the recreational fishery. However, inshore recreational harvest was extremely variable since 2008, suggesting other factors besides regulations are influencing harvest levels. The recreational ocean harvest of southern flounder steadily decreased since the 2005 Southern Flounder FMP was implemented; however because regulations did not become stricter in ocean waters in 2005 the reason for this is unclear (Figure 4). Preliminary 2014 data indicates the lowest recreational southern flounder hook and line harvest since 1999. Due to the short amount of time data were collected from the recreational gig fishery (since May 2010), trends in harvest by this fishery are not clear.

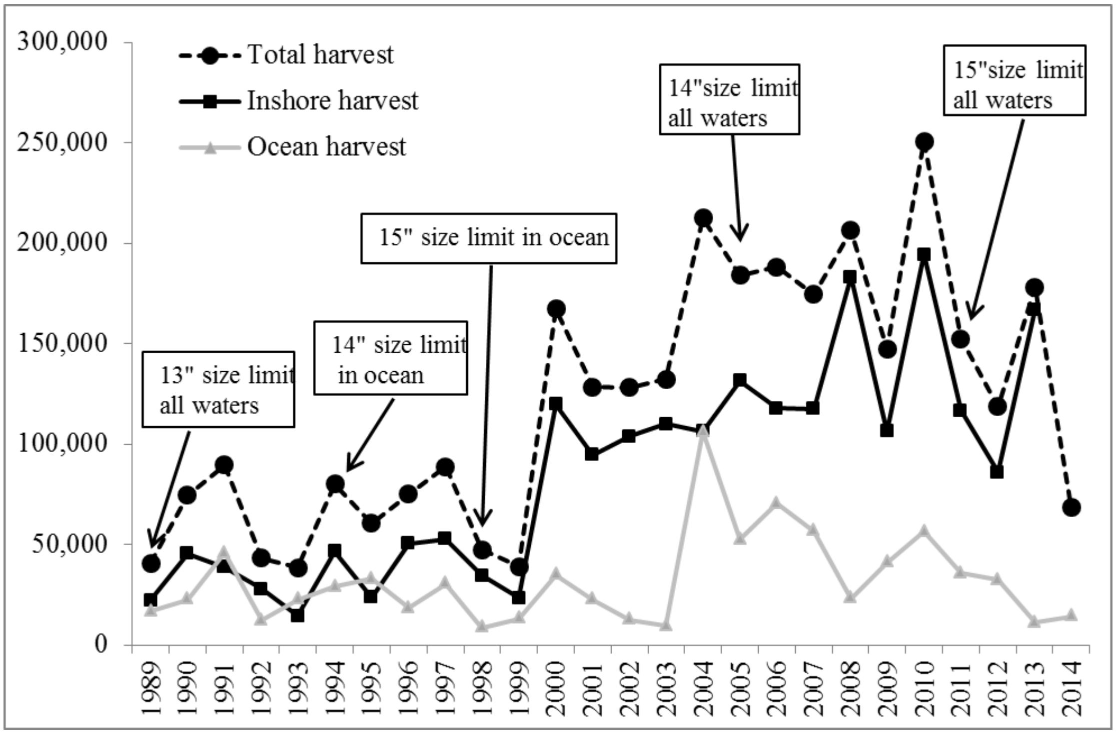

Figure 4. Recreational hook and line harvest from MRIP data 1989-2014 (2014 data are preliminary) and major fishery regulation changes.

Commercial

Commercially, southern flounder are harvested by pound nets, gill nets, gigs, and various other commercial gears such as shrimp trawls, crab trawls, seines, and crab pots. The majority of the commercial harvest occurs by gill nets and flounder pound nets, although the harvest by gigs has increased in recent years. Approximately 70% of North Carolina's commercial landings came from the Albemarle and Pamlico sounds in 2011-2013. Data from the North Carolina Trip Ticket Program (NCTTP) were used to estimate the harvest, trips, participants, dealers and ex-vessel value for the commercial fishery (Table 2). The NCTTP considers all flounder caught in inshore waters as southern flounder and all flounder caught in the ocean as summer flounder; as such, only flounder caught inshore were considered for commercial harvest. The NCTTP defines large mesh gill nets as ≥ five inches and small mesh gill nets as < five inches stretched mesh. Small mesh gill nets accounted for a relatively small portion (approximately 6%) of landings in the commercial southern flounder gill net fishery. The large mesh gill net fishery operates year-round, but most of the southern flounder harvest occurred in May-November, peaking in October in 2011-2013. Gill nets are used in most estuarine waters where regulations allow. Gill nets accounted for roughly 55% of the commercial harvest and 43% of the total recreational and commercial fishery harvest. Flounder pound nets are used mainly in eastern portions of the estuaries and are currently not used south of Beaufort Inlet. Southern flounder harvest by pound nets occurs almost exclusively in September-November when fish are migrating toward ocean inlets. Pound nets accounted for 36% of the commercial harvest and 29% of the total harvest. Commercial gigs accounted for 8% of the commercial harvest and 6% of the total harvest, with other commercial gears accounting for just less than 1% of each category, respectively. On average, there were 20,069 commercial trips landing 1,689,645 pounds of southern flounder annually with an ex-vessel value of $4,283,451 in 2011-2013. A variety of regulations have been put in place via proclamation or rule for the commercial and recreational fisheries that target flounder species (Appendix 1).

Table 2. Average effort, participants, and landings for the North Carolina commercial southern flounder fishery from 2011-2013. Commercial value data were not available for 2014, so 2014 was excluded from the average presented in this table.

Gear	Trips	Participants	Dealers	Ex-vessel value	Pounds	% of commercial harvest	% of total harvest
Gill Net	14,638	854	165	$2,305,055	932,792	55.2	43.4
Pound Net	1,649	75	34	$1,621,415	614,899	36.4	28.6
Gig	2,503	258	100	$322,605	127,413	7.5	5.9
Other	1,282	282	98	$34,377	14,541	0.9	0.7
Total	20,069	1,175	237	$4,283,451	1,689,645	100.0	78.6

The commercial fishery harvest of southern flounder peaked in 1994 (Figure 5). Harvest by gill nets peaked in 1998, whereas harvest by pound nets peaked in 1993. Regulations implemented by the 2005 Southern Flounder FMP appear to not have impacted commercial landings, which increased until 2009 before decreasing in 2010 and 2011 and increasing again in 2012-2014. Analysis of commercial landings by area suggests lower availability of southern flounder in the Albemarle Sound Management Area (ASMA; where much of southern flounder harvest occurs), rather than regulations was the main reason for the decline in statewide harvest in 2010 and 2011. This is further supported by reductions across multiple gears in the ASMA in 2010-2011 and substantial increases in harvest in 2013.

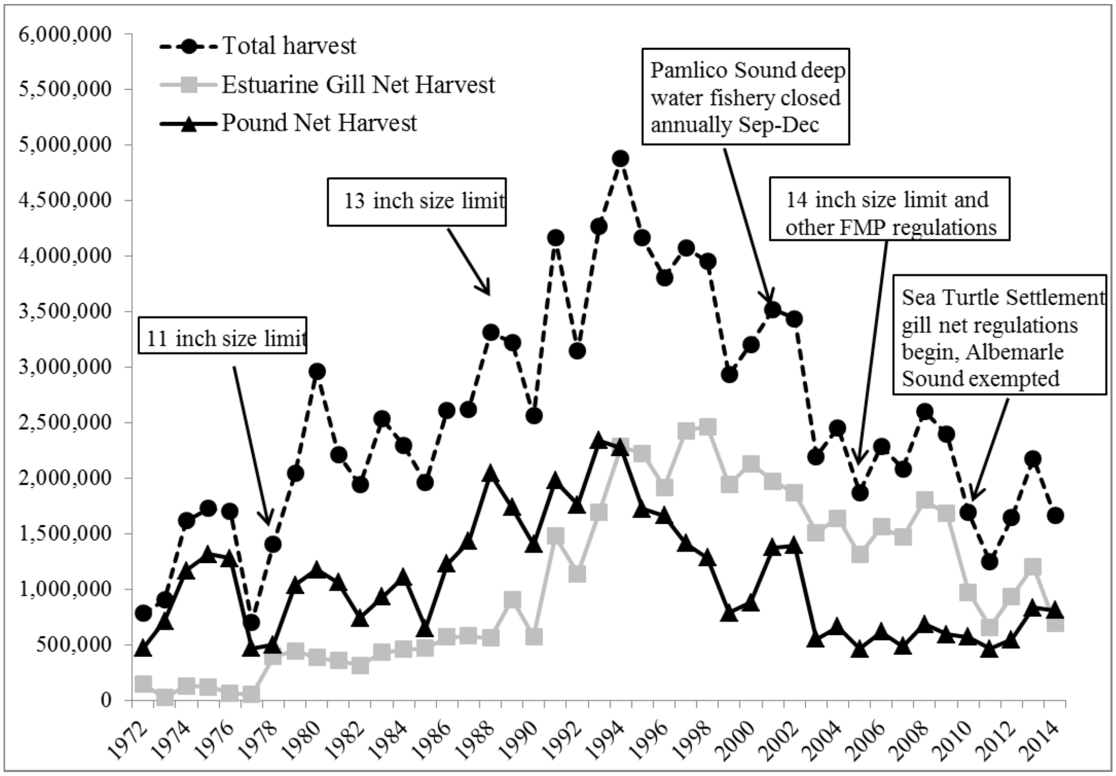

Figure 5. Commercial landings (lbs) from NCTTP 1972-2014 (2014 data are preliminary) and major fishery regulation changes

III. AUTHORITY

North Carolina General Statutes

113-134.	Rules.
113-182.	Regulation of fishing and fisheries.
113-182.1.	Fishery Management Plans.
113-201.	Legislative findings and declaration of policy; authority of Marine Fisheries Commission.
113-221.1.	Proclamations; emergency review.
143B-289.52.	Marine Fisheries Commission – powers and duties.

North Carolina Marine Fisheries Commission Rules (15A NCAC)

03M .0503 Flounder

IV. DISCUSSION

The discussion below includes management alternatives that were discussed by the Southern Flounder Plan Development Team as methods for achieving the reductions requested by the MFC. Because a supplement is not intended to be a review of all measures that can potentially be used to manage the southern flounder fishery, a subset of options was chosen to calculate estimated reductions based on feasibility and likelihood of being implemented in the short-term. Other potentially viable options for long-term management requiring further review by the NCDMF and stakeholders would be appropriate to be addressed in an amendment to the Southern Flounder FMP.

Management Measures Not Analyzed For Requested Reductions

Total Allowable Catch (TAC) and Quota implementation

Permits are required for any seafood dealer who wishes to participate in fisheries managed under a quota due to the need to know the level of compliance in reporting. As part of the permitting conditions under the dealer quota monitoring rule (15A NCAC 03O .0503(b)), seafood dealers are required to report their landings by noon daily for the previous day's landings (including zero landings) as long as the fishery remains open. Seafood dealers can report their daily landings via email, fax, or phone. Managing southern flounder under a quota would be difficult using this current process. For instance, in 2014, there were 231 seafood dealers reporting landings of southern flounder. This is more than double the current number of dealers who hold quota monitoring permits for other species and would require additional staff to enter quota monitoring logs, verify these logs, monitor compliance, summarize data and conduct analysis. In addition, the southern flounder fishery is unique when compared to other quota monitored species in the state because it occurs January-November from the North Carolina/Virginia border to the South Carolina/North Carolina border. This would require staff to monitor the quota and, more importantly, track compliance for landing reports for the entire open season throughout the state.

An advantage and possible option the NCDMF has when it comes to implementing a quota on a species such as southern flounder is the use of electronic reporting. Due to the nature of the southern flounder fishery (occurring most of the year, covering nearly all estuarine waters, large number of seafood dealers), tracking the quota via logs is inefficient. A more efficient method would be for seafood dealers to submit their southern flounder landings with the NCDMF Trip Ticket software program. This would allow access to landings data for southern flounder directly from the trip ticket database as opposed to the quota monitoring database and would not require data entry. In 2014, 86% of southern flounder trip ticket landings were reported using the software program. From a quota monitoring standpoint, 86% of the landings may be adequate to determine the status of the quota. Although the majority of the landings were reported with the software, only 31% of seafood dealers landing southern flounder reported with the software. One issue to overcome with monitoring a southern flounder quota using the software program is the NCDMF cannot legally require landings to be submitted more frequently than once a month. A request for the authority to require trip ticket reports be submitted at less than monthly intervals has been submitted to the N.C. General Assembly, but to date, no bill has been introduced to implement this change.

Managing the southern flounder fishery via a quota or TAC would be better accomplished through the amendment process because statute and rule changes and additional staff would be required prior to implementation. If considered in an amendment, the NCDMF would be able to investigate a combination of the trip ticket reporting requirements (monthly reporting) with the permit quota monitoring requirements (gear and effort information) to address obstacles to implementing a quota. The public would also have the opportunity to provide ample input. Methods to effectively determine the level of use and correlation of electronic reporting to the overall harvest, taking into account NCDMF resource limitations could be evaluated. Since a supplement is to be implemented quickly and remain in place until the time of the next adoption of the FMP, a quota is not a viable option for consideration at this time. This issue could be further explored in an amendment.

Maximum size limit

A maximum size limit is typically used to protect large, mature fish from harvest, thereby increasing the spawning stock biomass. In the Southern Flounder FMP Amendment 1, a maximum size limit was considered. If used in combination with a minimum size limit, this effectively serves as a slot limit. At that time, a 24-inch maximum size limit was used to explore this idea. The findings were that in 1991-2007, approximately 0.3% of flounder in the commercial fishery and 2.3% in the recreational fishery were harvested above 24 inches. In 2011-2014, approximately 0.1% of flounder in the commercial fishery and 0.6% in the recreational fishery were harvested above 24 inches. Therefore, to reduce harvest substantially the maximum size would need to be considerably lower than 24 inches. Approximately 87% of harvest occurs between 14 and 18 inches and 93% occurs between 14 and 20 inches. A maximum size limit would increase discards due to fish caught and discarded above the maximum size. To reduce discards in the commercial fishery due to the minimum size limit, minimum mesh sizes for gill nets and pound net escape panels are currently in place; however it is unlikely a minimum mesh size chosen to reduce catch below a minimum size limit would also reduce catch above a maximum size limit. Therefore, discards in the commercial fishery would increase for fish above the maximum size limit. In the recreational hook and line fishery, fish above the maximum size would also continue to be caught, thus increasing discards. Due to the small number of large fish caught and the likelihood of increased discards, a maximum size limit was not recommended by the NCDMF or the MFC in the past as a method of reducing harvest. Because the largest flounder are often the most valuable to the commercial fishery, and most sought after by the recreational fishery, there would likely be an economic impact to this measure. Lastly, growth of southern flounder is quite variable and although larger fish are more likely to be mature females, some mature at 14-15 inches. Because a large percentage of the current harvest is from fish 14-15 inches, protection of fish at these sizes would be beneficial to the spawning stock biomass. Although reductions resulting from a maximum size limit are not included in this supplement, this issue could be further explored in an amendment.

Area closures

Area closures would involve closing portions of the inshore or ocean water to protect southern flounder during a particular life stage. Upper portions of the Neuse, Pamlico and Pungo Rivers were closed to shrimp trawling beginning in 2006 to minimize juvenile southern flounder bycatch. Southern flounder use a wide variety of inshore habitats and selecting a specific habitat that will protect large numbers of fish may be difficult due to the mobility of fish. During the fall migration, southern flounder rapidly pass through various estuarine areas, concentrating at inlets on their way to the ocean. Inlet corridors are already closed to large mesh gill nets in Pamlico Sound from Sept. 1 through Dec. 15 to minimize sea turtle interactions; however, closing areas will likely result in fishermen targeting flounder just outside the closed area and possibly recouping most of the harvest. Additionally, exact migratory corridors are not known and would require extensive research to determine. This issue could be further explored in an amendment.

Management Measures Analyzed As Options For Requested Reductions

The reductions in catch provided below are based on an average of 2011-2014 data. These years were chosen because the most recent major regulation change for southern flounder occurred early in 2011. In February 2011, the minimum size limit was increased to 15 inches for the recreational fishery. There have been various regulation changes to the commercial gill net fishery (gear modifications, area exemptions, area closures, etc.) since 2011; however, many of these measures began in 2010 as part of the sea turtle lawsuit settlement agreement. Some of these measures were adopted for southern flounder management in Amendment 1 to the Southern Flounder FMP in February 2013. It is important to note, harvest data from 2014 is still preliminary and is likely to change. Recreational gig harvest and discard estimates were not yet available for 2014. Commercial gill net discard estimates were also not available for 2014 to include in the reduction calculations.

The reductions presented are estimates that assume consistent fishery catch, southern flounder length distributions and year class strength. If any of these assumptions are incorrect, it can affect the accuracy of estimated reductions. Catch reductions were calculated using estimates of dead discards that are only available for commercial gill nets and recreational hook and line and gig fisheries. Due to assumptions made in calculating hook and line discards and lack of estimates for other important fisheries (commercial pound nets and gigs), confidence in estimated harvest reductions was higher than catch reductions. Importantly, due to the uncertainty about estimates of dead discards, it will be difficult to determine if estimated catch reductions are actually achieved; however, accurate catch reduction estimates would provide the best indication of the benefits of management measures for the stock. Regardless of the approach taken for estimating reductions - catch or harvest - the impact of discards should be considered when evaluating any new management measure. Although the discussion focuses on catch reductions as requested by the MFC, harvest reductions were also calculated for each option (see Appendix 2). In previous documents developed by the NCDMF for southern flounder fishery management, reductions from new measures were based on harvest rather than catch (although discards were included in stock assessments).

The first step in estimating reductions was to calculate the number of fish harvested by recreational and commercial fisheries. Harvest is defined as the number of fish kept. All reductions were calculated in numbers of fish rather than weight because the request was for reductions in catch (including discards). The NCDMF collects data on discards for some fisheries (commercial gill net, recreational hook and line and gig fisheries), but only in numbers of fish rather than weight. The NCTTP commercial fishery inshore flounder harvest data in weight was converted to numbers of fish using data collected by NCDMF fish house sampling programs by market grade, gear, month and year (Table 3). Available fish house sampling data for 2014 was used but a small percentage of the data were not yet complete at the time of this report. Recreational harvest is reported in numbers of fish by MRIP and the NCDMF mail-based survey of gigging. Recreational data included inshore and ocean areas.

To calculate catch reductions, discards were also estimated. For the purposes of this supplement, catch was defined as the number of southern flounder that die as a result of being captured including those kept, discarded dead and those released alive that later die due to injuries sustained by capture (post-release discard mortality). Recreational releases of flounder were rarely recorded by MRIP beyond the genus (*Paralichthys*) level. Releases were not observed by interviewers and most recreational fishermen are not able to report flounder to the species level. In other words, recreational releases of flounder in MRIP are only recorded as "flounder" and do not differentiate between summer flounder, southern flounder or Gulf flounder. To estimate the number of southern flounder released, the proportion of southern flounder estimated by MRIP as harvested (relative to other *Paralichthys* species) was applied to the number of reported released flounder (*Paralichthys*) from the same Wave (1-6), Mode (type of fishing) and Area (inshore vs. ocean). This method relies on an important assumption that the flounder discard species ratio is the same as the harvest species ratio. The NCDMF mail-based survey was used to estimate the number of southern flounder discarded by the recreational gig fishery. Estimates of discards were also calculated for the estuarine commercial gill net fishery based on NCDMF observer data. For the remaining commercial gears it was assumed that no dead discards occurred during 2011-2014 because sufficient data were not available to estimate discards. Based on studies of post-release discard mortality, seasonal mortality rates were applied to available estimates of discards by gear to estimate numbers of discard mortalities (i.e., dead discards). Detailed methods used to calculate reductions for each option discussed in this supplement are available in Appendix 3. All reductions presented in the Discussion were from the total sector (commercial or recreational) catch or total fishery (commercial and recreational) catch. To show the impacts to each gear, reductions from gear totals were also calculated and are available in Appendix 4.

Table 3. Numbers of southern flounder by gear and sector used for calculating reductions based on 2011-2014* average. ND = no data available

	Commercial					Recreational			All
Estimate Type	Gill net	Pound net	Gig	Other	Total	Hook & line	Gig	Total	Total
Harvest	466,646	306,565	71,753	10,249	855,212	129,536	50,903	180,439	1,035,651
Dead Discards	11,339	ND	ND	ND	11,339	80,954	2,758	83,713	95,051
Catch	477,984	306,565	71,753	10,249	866,551	210,490	53,661	264,152	1,130,703

*2014 data are preliminary, 2014 commerical discard and all recreational gig data were not available

Option 1: Implement a season closure

A season closure is used to restrict harvest during certain times of the year, reduce annual landings and discards, and increase spawning stock biomass. The 2005 Southern Flounder FMP implemented a month-long season closure in December for the commercial fishery (NCDMF 2005). The recreational fishery is currently open year round. The effect of additional season closures on catch was examined in half-month intervals starting Aug. 1. This date was chosen to encompass the range (25% to 60%) of reductions requested by the MFC. The current commercial inshore flounder season is Jan. 1 – Nov. 30 and the recreational season is open all year.

Tagging and maturity data indicate southern flounder remain in estuarine waters until they mature, beginning their spawning migration to ocean waters in fall months. As a result, any split season closure to the fishery (closing and then reopening before the end of the year) will be unlikely to realize the estimated reduction. This is because southern flounder could be caught once the fishery is reopened and before they emigrate from estuaries. Due to this potential for recoupment of harvest, the season closures presented here are cumulative starting at the end of the season (without a split season option). Since the temporal distribution of harvest for the commercial and recreational fisheries are different, achieving the same reduction for each sector would require closures of different length by sector.

There are multiple potential advantages and disadvantages to season closures. A season closure for southern flounder in the fall will allow for more escapement (number of mature individuals leaving estuaries to spawn) assuming harvest does not increase dramatically prior to the closure. The longer the season closure, the less likely the fishery could recoup landings by increasing harvest prior to the closure. If harvest is allowed for any gear that typically harvests southern flounder during the closure period, there is a high likelihood for recoupment of some or all harvest. If harvest is closed, but any commercial or recreational gear that regularly catches flounder is allowed to continue fishing during the closure period there will be discards, thus diminishing the estimated catch reduction. For these reasons, the best chance to achieve the estimated reductions is to remove all gears regularly catching flounder from the water and prohibit the sale of flounder caught in inshore waters during a closed. Nevertheless, in some cases, stopping all fishing by gears that catch flounder will not be reasonable or practical and this must be considered when implementing a season closure. While most gears that harvest flounder also target other species, some gears such as hook and line and small mesh gill net fisheries that harvest flounder often do not target flounder. If the closure occurs at the end of the season, fish are more likely to be larger and mature and the ratio of immature fish in the annual harvest may well increase; however, if catch is reduced by an end of the season closure this would increase escapement and the spawning stock biomass. Not all southern flounder protected from harvest or discard by a closed season will mature and spawn each year. Many may remain in the estuaries through the following year, thus making them vulnerable to fishing pressure in the subsequent fishing season. An assumption in calculating reductions due to a closed season is harvest during open months will not differ from the 2011-2014 average harvest during those same months. It should be noted, however, that landings for both sectors have been quite variable from year to year and should not be expected to match the 2011-2014 average in future years. Additionally, effort and catch may increase prior to a closure, resulting in a lower reduction than estimated.

Reductions for the commercial fishery

The timing and magnitude of peak southern flounder landings are different for the gill net, pound net and gig fisheries, so a season closure will impact each gear differently. In closure periods beginning prior to Sept. 1, gill nets contributed the largest reduction from the overall fishery but pound nets contributed the largest reduction with closure periods starting Sept. 1 (Table 4, Figure 6). This is due to concentration of pound net harvest in September-November. To achieve an estimated 25% catch reduction for the commercial fishery, a season closure will need to start in late-October. A closure beginning in late-September will be needed to achieve an estimated 60% reduction in the commercial fishery. An end of season closure will impact the pound net fishery most among commercial gears; a closure Oct. 1 – Nov. 30 will reduce the pound net catch by an estimated 81% (see Appendix Table A4.1 and Figure A4.1). In comparison, this closure would reduce the gig and gill net catch by approximately 18% and 37%, respectively.

Season closures will have different impacts geographically for the commercial fishery. Harvest peaks in areas at different times due to variation in gear used and southern flounder availability. Late in the year, the harvest tends to concentrate on the eastern side of estuaries as flounder migrate toward ocean inlets. A late-season closure may shift gill net and gig effort to areas that produce higher numbers of southern flounder earlier in the season (e.g., western sides of estuaries), thus recouping some harvest. Pound nets are stationary gear and could not easily be moved from eastern sides of estuaries to recoup landings, so this fishery would likely be greatly impacted by a late-season closure.

It was assumed that commercial harvest of flounder would cease during a season closure, which would be expected to decrease fishery harvest in the short-term. It is possible that effort will increase prior to the closure, especially in the gill net and gig fisheries, resulting in recoupment of some harvest expected to be lost due to the closure. This shift in peak effort may be mitigated by seasonal gill net closures due to protected species interactions or availability of fish but these impacts are difficult to predict. Migration of flounder during the fall months produces the highest catches of the year for the gill net and pound net fisheries. As these gears are the primary methods of harvesting flounder, a closure of fall months would be likely to produce reductions that could not be recouped by shifting effort earlier in the season. Other commercial gears that catch flounder include gigs, small mesh gill nets, crab trawls, shrimp trawls and crab pots. If any gear that catches flounder is allowed to operate during a closed season, the estimated reduction will be diminished due to any dead southern flounder discards produced (and any harvest that is allowed). Additionally, shifting harvest earlier in the season will likely increase the proportion of smaller fish in the harvest.

The only available discard or discard mortality estimates for commercial gear used for harvesting southern flounder was for estuarine gill nets. With no estimates of dead discards for the remaining commercial gears, the total average commercial catch used in this supplement is likely lower than the actual catch for 2011-2014. This likely makes the calculated catch reduction somewhat higher than it would be if discards were known for all gears. It was assumed there would be no discard mortality during a closed season; however, this assumption would be incorrect if any gear that catches flounder is left in the water. Because there were no estimates of discards available for most commercial gears and gill net discards represent a small component of the commercial catch, the estimated commercial catch and harvest reductions due to a season closure are very similar.

Table 4. Commercial catch reductions (percent) from the total commercial catch for season closures based on a 2011-2014* average. Bolded rows include a reduction within the requested range for the total commercial fishery. See harvest reductions in Table A2.1.

Closure	Gill net	Pound net	Gig	Other gears	Total
Nov 16-Dec 31	1	3	<1	<1	5
Nov 1-Dec 31	5	10	1	<1	16
Oct 16-Dec 31	12	20	1	<1	**33**
Oct 1-Dec 31	20	29	2	<1	**50**
Sept 16-Dec 31	30	35	2	<1	67
Sept 1-Dec 31	34	35	3	<1	72
Aug 16-Dec 31	38	35	3	1	77
Aug 1-Dec 31	41	35	4	1	81
Jan 1-Dec 31	55	35	8	1	100

*2014 data are preliminary, 2014 discard estimates were not available

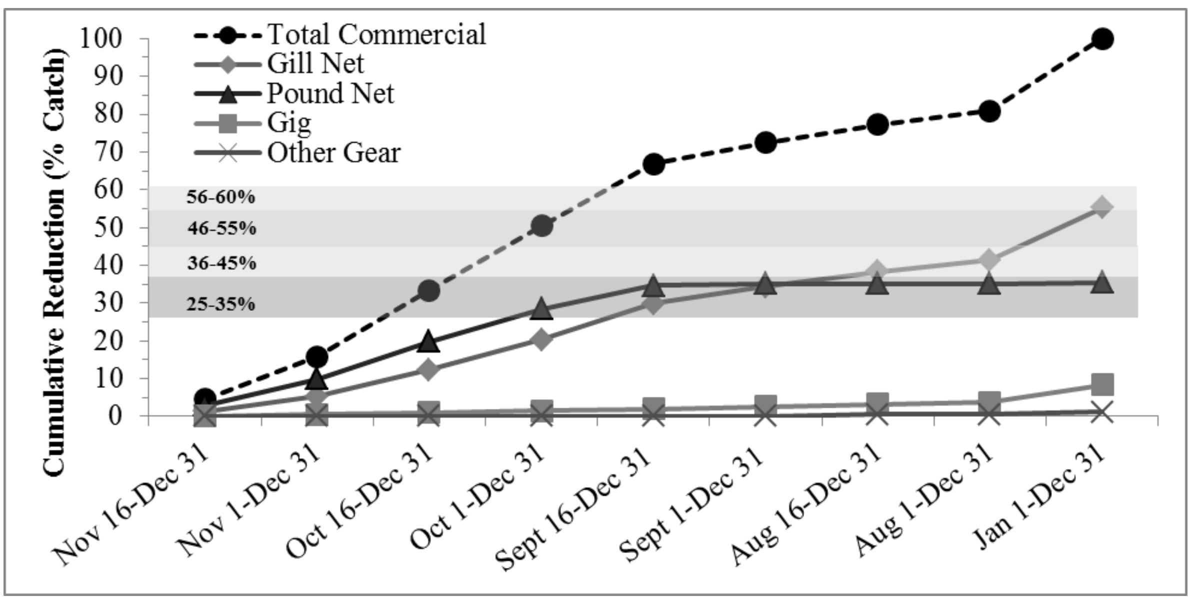

Figure 6. Commercial catch reductions (percent) from the total commercial catch for season closures based on a 2011-2014 average.

Reductions for the recreational fishery

For closures starting prior to Oct. 1, hook and line contributed more than gigs to reductions from the total recreational fishery (Table 5, Figure 7). This is due to the greater harvest and discards for hook and line for most of the year; however, in fall the gig harvest is greater than hook and line, thus more of the total recreational fishery reduction comes from gigs after Oct. 1. A closure beginning Aug. 16 was estimated to be needed for the recreational fishery to meet the minimum reduction requested by the MFC. Estimates indicate a complete shutdown of the recreational flounder fishery would be required to achieve the maximum catch reduction in the range requested by the MFC. Catch reductions were considerably lower than harvest reductions for this option due to the expected increase in dead discards (see Appendix 2 for harvest reductions).

Catch reductions from season closures were greater for the recreational gig fishery than for the hook and line fishery. A complete year closure would only result in an estimated 55% catch reduction for hook and line gear, whereas this would result in a 100% reduction for gig catch (see Appendix Table A4.2 and Figure A4.2). This is based on the assumption that hook and line gear would continue to be used during a season closure and gigs would not be used. While hook and line gear is used to target many different species other than flounder, gigs are primarily used for flounder. Because flounder are often caught when targeting other species with hook and line, and additional flounder may be available in the system if other gears are closed, it was assumed that southern flounder harvested on average in 2011-2014 would be caught and released during a closed season. Therefore, seasonal discard mortality rates were applied to average hook and line harvest plus discards from 2011-2014 for each closed period to estimate expected dead discards. Although this is likely an overestimate of the number of dead discards from hook and line gear that would occur during a season closure, this method was determined to provide the best estimate with available data. In the recreational gig fishery, all discards were assumed to be dead due to injuries sustained by this gear. If this assumption is incorrect, the estimated reduction will change only slightly since gig discards are a small component of the recreational catch.

Table 5. Recreational catch reductions (percent) from the total recreational catch for season closures based on a 2011-2014* average. Bolded rows include a reduction within the requested range for the total recreational fishery. See harvest reductions in Table A2.2.

Closure	Hook & Line	Gig	Total
Dec 16 - Dec 31	<1	1	1
Dec 1 - Dec 31	<1	2	2
Nov 16 - Dec 31	<1	3	3
Nov 1 - Dec 31	2	4	5
Oct 16 - Dec 31	4	5	9
Oct 1 - Dec 31	6	6	13
Sep 16 - Dec 31	11	8	18
Sep 1 - Dec 31	14	9	23
Aug 16 - Dec 31	**22**	**11**	**33**
Aug 1 - Dec 31	**26**	**12**	**38**
Jan 1 - Dec 31	44	20	64

*2014 data are preliminary, 2014 gig harvest and discard data were not available

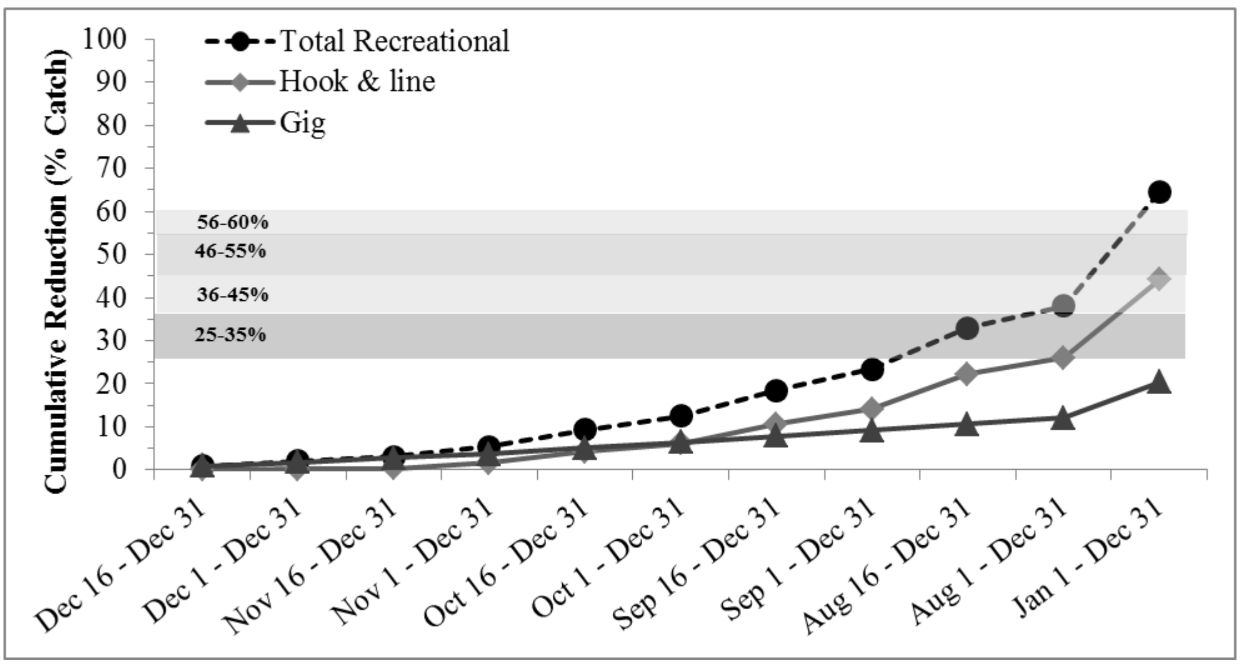

Figure 7. Recreational catch reductions (percent) from the total recreational catch for season closures based on a 2011-2014 average.

Reductions for the combined fishery

Reductions from various season closures were also explored for the combined fishery (commercial and recreational). The total catch in numbers of fish was calculated and all reductions were relative to these totals. To reach the lower end of the catch reduction range requested for this supplement a season closure would need to begin Oct. 16 (28%; Table 6, Figure 8). The closure would need to start Sept. 1 for a catch reduction that reached 60%. Because the peak harvest occurs at different times for the commercial and recreational fisheries, different closure periods were examined for the two sectors. For example, a reduction at the lower end of the requested range could be achieved by an Oct. 16-Dec. 31 commercial closure and a Nov. 16-Dec. 31 recreational closure (26%; Table 7). A similar reduction could be achieved by a commercial closure from Nov. 1-Dec. 31 and a complete recreational season closure (24%; Table 7). This analysis demonstrates closures for the recreational fishery must be much longer than for the commercial fishery to achieve an equal reduction for each sector. The reason is recreational harvest peaks much earlier in the year than the commercial harvest. Catch reductions were considerably lower than harvest reductions for this option due to the expected increase in dead discards (see Appendix 2 for harvest reductions).

Table 6. Catch reductions (percent) from the combined fishery catch for season closures based on a 2011-2014* average. Bolded rows include a reduction within the requested range for the combined fishery total. See harvest reductions in Table A2.3.

	Commercial					Recreational			All
Closure	Gill net	Pound net	Gig	Other	Total	Hook & line	Gig	Total	Total
Nov 16-Dec 31	1	2	< 1	< 1	3	< 1	1	1	4
Nov 1-Dec 31	4	8	< 1	< 1	12	< 1	1	1	13
Oct 16-Dec 31	9	15	1	< 1	**26**	1	1	2	**28**
Oct 1-Dec 31	16	22	1	< 1	**39**	2	2	3	**42**
Sept 16-Dec 31	23	27	1	< 1	**51**	2	2	4	**55**
Sept 1-Dec 31	26	27	2	< 1	**55**	2	2	4	**60**
Aug 16-Dec 31	29	27	2	< 1	59	3	2	5	64
Aug 1-Dec 31	32	27	3	< 1	62	3	3	6	68
Jan 1-Dec 31	42	27	6	1	77	7	5	12	89

*2014 data are preliminary, 2014 commercial gill net discard estimates were not available, 2014 recreational gig data were not available

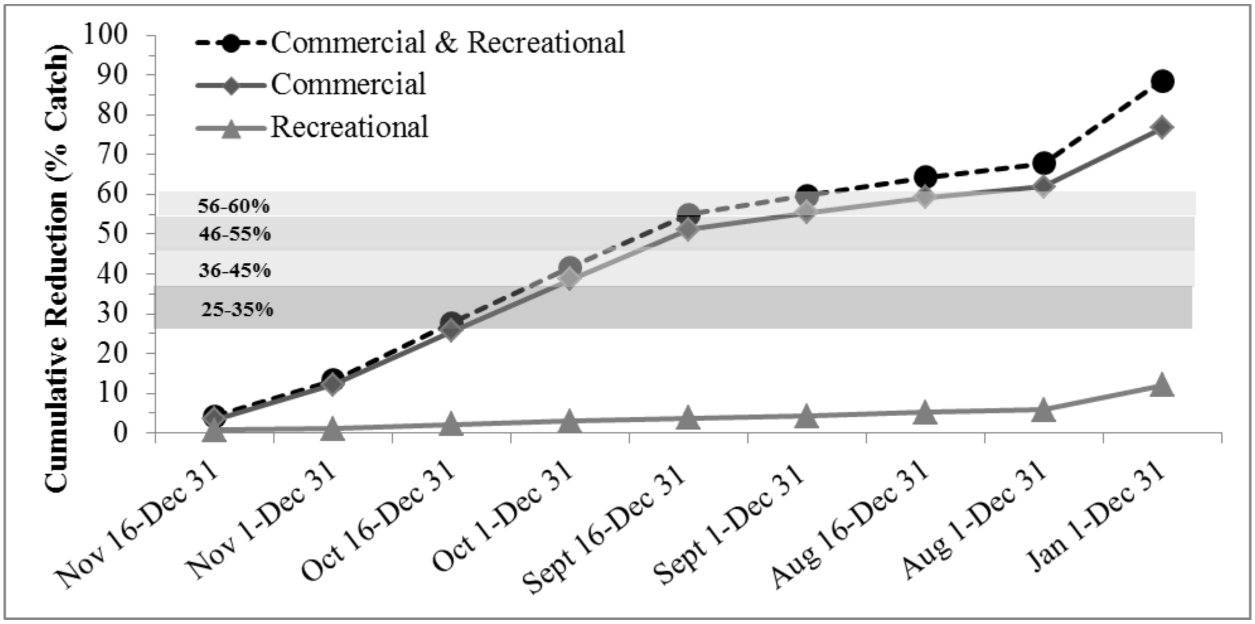

Figure 8. Catch reductions (percent) from the combined fishery catch for season closures based on a 2011-2014 average.

Table 7. Catch reductions (percent) from combined fishery catch for season closures by sector based on 2011-2014* average. Closures start on the dates shown and end on Dec 31. Bolded reductions were within the requested range. See harvest reductions in Table A2.4

	Recreational closure								
Commercial closure	1-Jan	1-Aug	16-Aug	1-Sep	16-Sep	1-Oct	16-Oct	1-Nov	16-Nov
1-Jan	89	82	82	81	80	80	79	78	77
1-Aug	74	68	67	66	66	65	64	63	63
16-Aug	71	65	64	63	63	62	61	**60**	**60**
1-Sep	67	61	61	**60**	**59**	**59**	**58**	**57**	**56**
16-Sep	63	**57**	**56**	**55**	**55**	**54**	**53**	**52**	**52**
1-Oct	**51**	**45**	**44**	**43**	**42**	**42**	**41**	**40**	**39**
16-Oct	**38**	**31**	**31**	**30**	**29**	**29**	**28**	**27**	**26**
1-Nov	24	18	17	16	16	15	14	13	13
16-Nov	15	9	9	8	7	6	6	5	4

*2014 data are preliminary, 2014 commercial gill net discard estimates were not available, 2014 recreational gig data were not available

<u>Option 2: Minimum size limit increase</u>

Increasing the minimum size limit is a management measure used to help end overfishing, rebuild the spawning stock, and allow a greater portion of fish an opportunity to spawn before they can be harvested. Based on southern flounder maturity at size derived from Midway and

Scharf (2012), the size at 50% maturity (L50) is approximately 15.75 inches (Table 8). Reductions are presented for increasing the minimum commercial minimum size limit to 15 inches or 16 inches for both sectors. While increasing the minimum size limit above 16 inches is possible, this was not examined in the supplement due to the expected level of discards.

Minimum size limit increases can be effective at reducing harvest as long as compliance with the regulations is consistent. The reductions associated with a minimum size limit increase assume the proportion of undersized fish in the harvest remains similar to the current proportion. Data from before and after the commercial minimum size limit change in 2005 indicate that the percentage of undersized fish in the harvest remained relatively similar and without trend (Table 9). Although there is a slight increasing trend in the percentage of undersized southern flounder in the recreational harvest since the minimum size limit change in 2011 (Table 10), more years of complete data are needed to fully assess this potential trend.

Increasing the minimum size limit may have the effect of increasing the total harvest of fish above the new minimum size limit. Due to the relatively greater fecundity (the number of eggs released by a female) of larger individuals, increased harvest of larger individuals would not be beneficial for spawning stock biomass; however, it is not clear that harvest of larger individuals would increase. If a larger minimum gill net mesh size was implemented it is possible that harvest of larger individuals would increase for that gear since larger mesh sizes tends to catch larger fish; however, some gill net fishermen already use nets with mesh size above the current minimum. More importantly, harvest of larger southern flounder by other commercial and recreational gears would likely not increase since they already target all size classes. Although it is possible the distribution of harvest of larger individuals may change among gears, the total harvest of these fish may not change substantially as a result of a minimum size limit increase; however, if the spawning stock biomass increases, there may well be increased catches of large fish in the future.

There are multiple potential advantages and disadvantages to raising the minimum size limit. This would potentially allow a larger number of fish the opportunity to leave estuaries to spawn prior to being harvested, thus increasing the size of the spawning stock. Increasing the minimum size limit would also be consistent with NCDMF strategies for setting minimum size limits for other managed species, based on maturity information. However, not all discarded undersized southern flounder will survive to spawn; some will die after release. Some will survive release but will subsequently grow to legal size and be harvested at a later date within the year, thus decreasing the impact of the minimum size limit change on fishery harvest. Some fish that survive after being discarded may not mature until the next year, remaining in estuaries where they could be caught by the fishery the following season. Although this would not decrease the reduction in catch for the first year, it could make estimated reductions less likely to be achieved in the following year and decrease the benefit to spawning stock biomass in subsequent years. In the short term, a minimum size limit increase would diminish the pool of fish available for harvest, which in turn would produce a decrease in overall catch and harvest. However, increasing the minimum size limit would allow harvest to continue throughout the currently open season. The relative percentage reduction to the fishery will be greatest in the first half of the year because growth of southern flounder is rapid during the summer and more fish will be legal size by the fall compared to the spring.

Table 8. Percent of females mature by length based on 2014 southern flounder stock assessment.

Total length (inches)	% Mature
10	1
11	1
12	3
13	8
14	17
14.5	24
15	34
15.5	45
15.75	50
16	55
17	76
18	89
19	95
20	98
21	99
22	100

Table 9. Annual percentage of undersized southern flounder in annual commercial harvest.

Year	Size limit	% undersized
2003	13"	3
2004	13"	4
2005	14"*	9
2006	14"	6
2007	14"	7
2008	14"	7
2009	14"	7
2010	14"	6
2011	14"	3
2012	14"	8
2013	14"	6
2014	14"	4

* implemented April 2005

Table 10. Annual percentage of undersized southern flounder in annual recreational harvest.

Year	Size limit	% undersized
2009	14"/15"*	2
2010	14"/15"*	3
2011	15"	4
2012	15"	6
2013	15"	9

* 14" 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" size limit north of Brown's Inlet in eastern estuarine and ocean waters

Reductions for the commercial fishery

The impact to each gear due to a minimum size limit change was variable. Gill nets contributed the most to the overall commercial fishery reduction (Table 11). The reason is gill nets caught the most southern flounder and a relatively high proportion of 14- and 15-inch fish. An increase in the minimum size limit to 15 inches was estimated to reduce the total commercial catch by 18%. Increasing the minimum size limit to 16 inches would reduce commercial catch by an estimated 32%, which would achieve the minimum catch reduction requested by the MFC. While the ‘other gear’ category had the greatest reduction by gear (see Appendix Table A4.3), the reduction from this category contributed very little to the overall commercial fishery reduction due to the small amount of harvest (Table 11). The second highest reduction by gear was for gill nets.

Catch reductions were calculated for the commercial fishery based on increasing the minimum size limit to 15 inches and 16 inches from the current 14-inch limit. Catch reductions do not include further reductions that would be expected from an increase in gill net and pound net escape panel mesh sizes. Catch reductions were considerably lower than harvest reductions for this option due to the expected increase in dead discards (see Appendix 2 for harvest reductions). An increase in gill net and pound net escape panel mesh sizes would likely result in larger catch reductions than those shown below due to the expected smaller number of dead discards.

Estimates of discard percentages at 14-, 15- and 16-inch minimum size limits using gill net stretched mesh sizes of 5.5 (the current minimum for large mesh nets), 5.75, 6.0 and 6.5 inches from the NCDMF observer program are provided (Table 12). Mesh sizes above 6.5 inches were seldom observed and would not be considered viable options because they are not allowed in accordance with the division’s Federal Sea Turtle Incidental Take Permit (ITP). Analysis of NCDMF observer data indicates that increasing mesh size reduces the number of undersized fish retained in gill nets. The majority of the observations occurred in Pamlico Sound, which is an important area for the fishery, but the majority of large mesh gill net landings of flounder are typically from the ASMA. It is important to consider the ASMA typically has a higher proportion of smaller southern flounder in catches, and thus would be expected to produce more discards, than Pamlico Sound. A study by Kimel et al (2008) had similar results to NCDMF observer data regarding percentages of discards at different mesh sizes and minimum size limits. Due to the geographic and temporal range of data, and measurements of all sizes of flounder caught, NCDMF observer data were determined to be the most appropriate for characterizing the percentage of discards at various mesh sizes. Nevertheless, this approach and results have not been through the typical NCDMF review process and further analysis may yield different results.

Estimates of discard percentages at 14-, 15- and 16-inch minimum size limits using pound net escapement (escape) panel stretched mesh sizes of 5.5 (the current minimum size), 5.75 and 6.0 inches from NCDMF studies are provided (Table 13). Analysis of data from NCDMF studies testing pound net escape panels in Albemarle Sound, Pamlico Sound and Back Sound indicates increasing escape panel mesh size reduces the number of undersized fish retained in pound nets (Brown 2014, unpublished NCDMF data). NCDMF studies did not test escape panels with mesh sizes above six inches, but it is assumed that larger mesh sizes would further reduce discards. However, it should be noted that the MFC rule defining pound net sets indicates that six inches is the maximum mesh size for escape panels that the NCDMF Director can require (15A NCAC 03J .0501 (e)(1)). Most of the samples from NCDMF studies came from Albemarle Sound and Back Sound. Although these areas are important areas of pound net harvest, the majority of pound net landings typically come from Pamlico Sound. The dataset used for this analysis may be the best available; however, due to time constraints this approach and results may require additional review and further analysis may yield different results.

Reductions presented here were based on catch for the whole year. If the minimum size limit increase was implemented late in the year, reductions would likely be smaller than those presented here during the first year of the change. However, because southern flounder grow quickly throughout the year, estimating commercial fishery reductions based on data from fall months may be more accurate. Reductions based on annual data will most likely be overestimates due to the likelihood of discards in the first half of the year growing into the legal limit and being caught by the end of the year.

Dead discards were estimated for each commercial gear for calculating catch reductions. Because there were no available discard mortality estimates for commercial gears aside from gill nets, the seasonal gill net post-release discard rates were also applied to the expected discards for all commercial gears resulting from raising the minimum size limit. There is no reason to expect this rate to be the same for all commercial gears, but this method was used to account for discard mortality in a consistent manner using the only available data. If the applied post-release discard rate is lower or higher than the true rate for any of the gears, the estimated catch reductions will be correspondingly higher or lower than reality.

Some positive and negative impacts due to increasing the minimum size limit are specific to the commercial fishery. Most commercial gears will have increased discards without gear modifications to allow southern flounder to avoid being caught. The expected increase in discards from the commercial fishery could be mitigated by modifying gear to allow fewer sublegal fish to be caught. 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 coast wide in conjunction with the minimum size limit increase (NCDMF 2005). NCDMF data indicate increasing the mesh size for these gears will decrease the percentage of flounder caught at 14 and 15 inches. Although some fishermen already use mesh sizes greater than the minimum, many do not and would need to order new nets and/or panels. An increase in the minimum size limit would impact some fishing areas more than others due to southern flounder life history patterns and habitat use. NCDMF gill net observer data indicate the Albemarle Sound Management Area (ASMA) could be most impacted by the minimum size limit increase, followed by Core/Back sounds (Table 14). Because the discard post-release mortality rate for gill nets is much higher in summer compared to other months, a closure of especially the large gill net fishery during summer months would greatly reduce discard mortality.

Table 11. Catch reductions (percent) from total commercial catch for minimum size limit increases based on 2011-2014* commercial catch average. Bolded row includes a reduction within the requested range for the total commercial fishery. See harvest reductions in Table A2.5.

Size limit	Gill net	Pound net	Gig	Other	Total
15 inch	11	6	1	0	18
16 inch	18	12	2	0	**32**

*2014 data are preliminary

Table 12. Percent of flounder below potential minimum size limits by gill net mesh size in 2004-2006, 2008, and 2012-2013* from NCDMF observer program.

	Streched mesh size (inches)				
Criteria	5.5	5.75	6	6.25	6.5
% below 14 inch	26	15	7	5	4
% below 15 inch	59	41	20	12	11
% below 16 inch	81	68	46	35	31
Total fish measured	26,245	13,967	31,751	3,293	3,175

*Years chosen due to statewide observer coverage

Table 13. Percent of flounder below potential minimum size limits by pound net escape panel mesh size from NCDMF studies in 1994, 1995, 1998 and 2011*.

	Streched mesh size (inches)		
Criteria	5.5	5.75	6.0
% below 14 inch	39	15	5
% below 15 inch	55	30	25
% below 16 inch	75	53	56
Total fish measured	937	634	121

*Years of the NCDMF escape panel studies with consistent methodology

Table 14. Percentage by length grouping of total southern flounder 14 inches and above in the commercial gill net fishery as measured in 2012-2013 by the NCDMF Observer Program.

Criteria (inches)	ASMA	Pamlico Sound	Pamlico Sound tributaries	Core/Back sounds	Southern areas	Total
14.0-14.9	41	23	35	39	30	31
14.0-15.9	74	53	60	65	60	61
Number 14.0+	5,935	10,975	1,413	2,643	2,693	23,724

Reductions for the recreational fishery

The current recreational minimum size limit is 15 inches, therefore only the reduction from a 16-inch minimum size limit was examined for the recreational fishery. The reduction at 16 inches was below the minimum range requested by the MFC (Table 15). Most of the estimated reduction from the total recreational fishery came from hook and line gear. Western counties had the greatest reduction for the hook and line fishery resulting from a 16-inch minimum size limit relative to northern and southern regions of the state (Figure 9). The NCDMF mail-based gig survey does not provide fish length data, but the MRIP collects length data for hook and line-harvested southern flounder. Lengths of fish harvested by gigs were assumed to be similar to those harvested by hook and line, but there are likely differences in length distributions between the gears that could impact the estimated reductions due to a minimum size limit increase. Catch reductions were considerably lower than harvest reductions for this option due to the expected increase in dead discards (see Appendix 2 for harvest reductions). It was assumed that all recreational harvest 15.0-15.9 inches from the 2011-2014 average would be caught and discarded with a minimum size limit increase to 16 inches. Unlike commercial gill nets and pound nets, hook and line gear cannot be modified to mitigate increases in discards that could result from increasing the minimum size limit. In contrast, recreational gigs operate by visually targeting flounder so it would be possible to avoid undersized flounder. The catch reductions presented here may be underestimates if gigs are able to avoid some undersized fish. Another likely outcome of increasing the minimum size limit is more discards of summer flounder and Gulf flounder, two species in the same genus as southern flounder. Summer flounder is more common north of Cape Hatteras, while Gulf flounder is mostly found in ocean waters south of Cape Hatteras. These species tend to be smaller than southern flounder in North Carolina so are more likely to be undersized. Although these flounder species are often caught in North Carolina, in recent years southern flounder has dominated the recreational flounder harvest. Catch reductions were considerably lower than harvest reductions for this option due to the expected increase in dead discards, but still did reach the MFC requested range (see Appendix 2 for harvest reductions).

Table 15. Catch reductions (percent) from total recreational catch with a 16-inch size limit based on 2011-2014* recreational catch average. See harvest reductions in Table A2.6.

Size Limit	Hook & Line	Gig	Total
16 inch	10	2	12

*2014 data are preliminary, 2014 gig data were not available

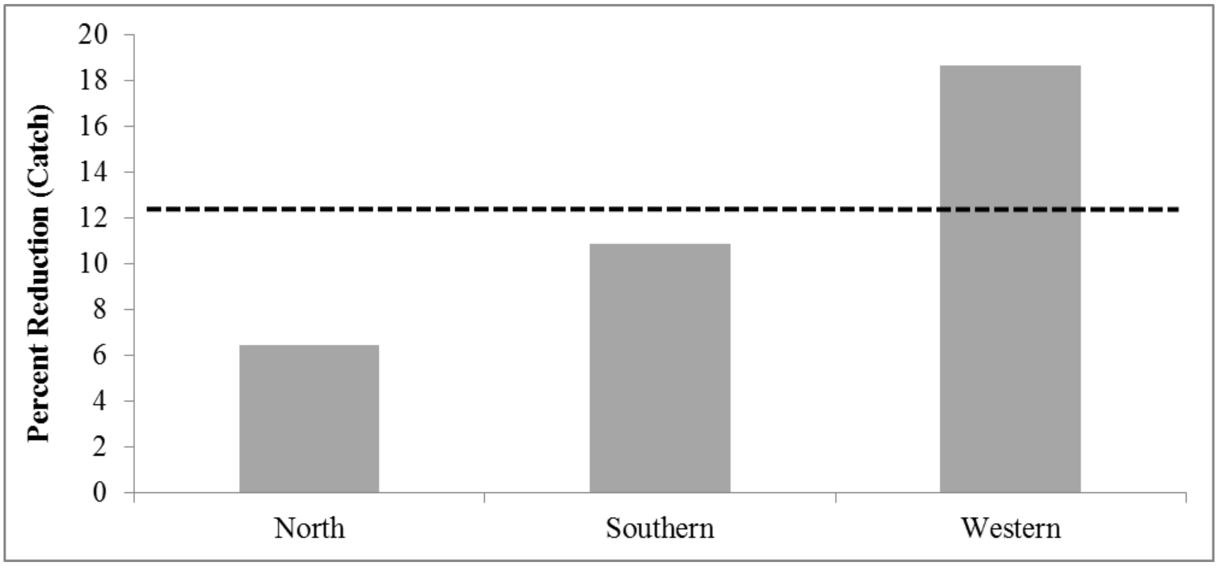

Figure 9. Reduction for recreational southern flounder hook and line fishery with 16-inch minimum size by region (North = Currituck-Carteret counties, Southern = Onslow-Brunswick counties, Western= counties on west side of Pamlico Sound). The dotted line is the mean reduction.

Reductions for the combined fishery

Reductions from a minimum size limit increase to 15 or 16 inches were also estimated for the combined fishery. The total catch in numbers of fish was calculated and all reductions were relative to this total. An increase to 15 inches (for the commercial fishery) would result in catch reductions below 25% (Table 16). Increasing the minimum size limit to 16 inches for both sectors resulted in a catch reduction above the minimum requested by the MFC (28%). Catch reductions do not include further reductions that would be expected from an increase in gill net and pound net escape panel mesh sizes. Catch reductions were considerably lower than harvest reductions for this option due to the expected increase in dead discards (see Appendix 2 for harvest reductions). An increase in gill net and pound net escape panel mesh sizes would likely result in larger catch reductions than those shown below due to the expected smaller number of dead discards.

Table 16. Catch reductions (percent) from the combined fishery catch for minimum size limit increases based on 2011-2014* combined fishery average. Bolded row includes a reduction within the requested range for the combined fishery total. See harvest reductions in Table A2.7.

	Commercial					Recreational			All
Size limit	Gill net	Pound net	Gig	Other gears	Total	Hook & line	Gig	Total	Total
15 inch	9	4	1	< 1	14	0	0	0	14
16 inch	14	9	2	< 1	**25**	2	< 1	3	**28**

*2014 data are preliminary, 2014 commercial gill net discard estimates were not available, 2014 recreational gig data were not available

Option 3: Decrease the recreational bag limit

A creel or recreational 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 eight-fish recreational bag limit for the recreational southern flounder fishery (NCDMF 2005). Supplement A to the Southern Flounder FMP decreased the recreational bag limit to six fish for the recreational flounder fishery in 2011. A similar management measure for the commercial fishery, trip limits, was not included as an option in this supplement because of drastic differences in trip level harvest by gear and month.

The reduction from decreasing to a one-fish recreational bag limit was estimated at less than 25% (Table 17, Figure 10). The hook and line fishery contributed the most to reductions from recreational bag limit decreases because of the greater harvest from this gear; however, reduction by gear was greater for the recreational gig fishery than for hook and line at any recreational bag limit because more flounder are caught on average per trip by gigging than by hook and line (see Appendix Table A4.5). Catch reductions were considerably lower than harvest reductions for this option due to the expected increase in dead discards (see Appendix 2 for harvest reductions).

Table 17. Catch reductions (percent) from total recreational catch for recreational bag limit decreases based on 2011-2014* average. See harvest reductions in Table A2.8.

Bag Limit	Hook & Line	Gig	Total
1 fish	15	7	23
2 fish	6	3	10
3 fish	3	1	5
4 fish	1	1	3
5 fish	1	<1	2

*2014 data are preliminary, 2014 gig data were not available

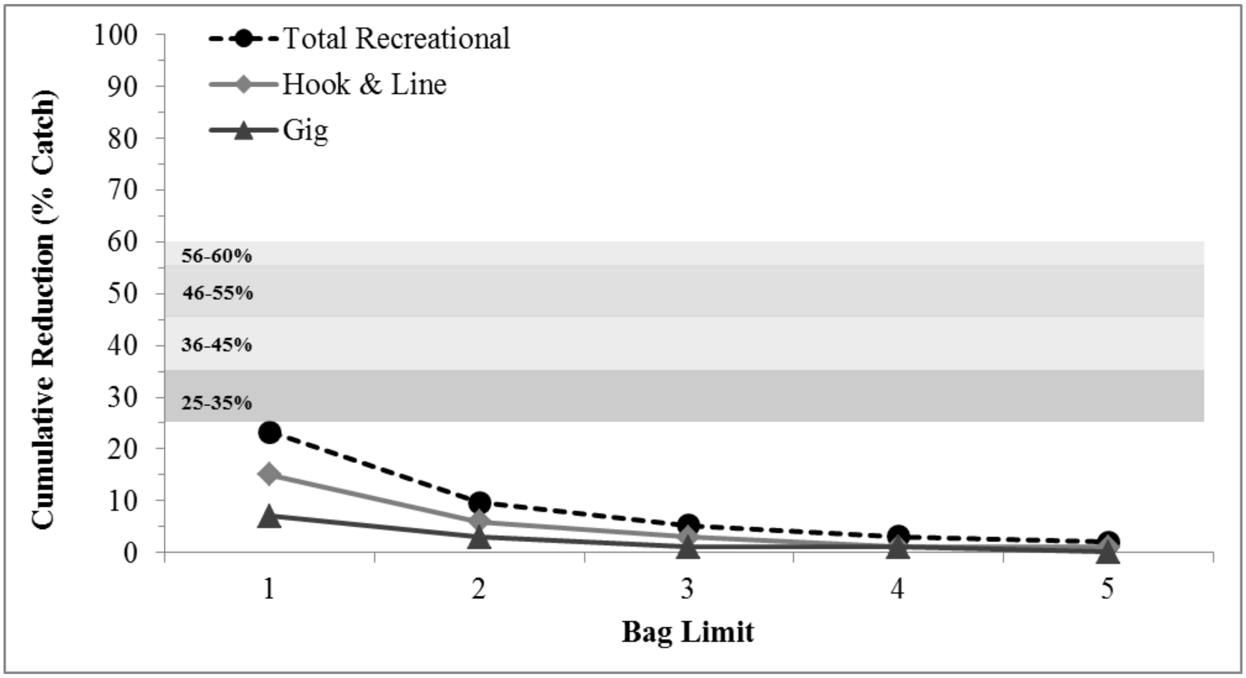

Figure 10. Catch reductions (percent) from recreational catch by gear for recreational bag limit decreases based on 2011-2014 average.

<u>Option 4: Implement a season closure and increase the minimum size limit</u>

Another option for reducing catch is to combine a season closure with a minimum size limit increase. This option has the potential to increase the benefits to the stock compared to implementing one type of measure alone. The reductions provided by an increase in the minimum size limit will allow the same reduction to be achieved, but with a shorter season closure than with a season closure alone. This would enable fishing to continue for more days. Increasing the minimum size limit would also reduce the likelihood of the fishery recouping landings by increasing effort prior to a season closure. A season closure will reduce the number of discards that might occur if the only management change was a minimum size limit increase. Both measures should increase escapement. A minimum size limit increase would increase escapement for fish below that limit, whereas a season closure at the end of the year would increase escapement for fish above and below the minimum size limit. Despite these benefits, all of the potential negative impacts discussed for season closures (Option 1) and increased minimum size limits (Option 2) will also need to be considered for this option. The impact of a combined approach on the percentage of immature fish in the harvest is unclear. A minimum size limit increase would reduce the percentage of immature fish in the harvest, while a season closure at the end of the year is likely to increase the percentage of immature fish in the harvest.

Reductions for the commercial fishery

If the minimum size limit was increased to 15 inches for the commercial fishery, a reduction above 25% was estimated to be achievable with a season closure two weeks shorter than with a season closure alone. A season closure would not be needed for a reduction above 25% with a 16-inch minimum size limit. Increasing the minimum size limit to 15 inches combined with a season closure starting Nov. 1 would result in an estimated reduction of 31% (Table 18, Figure 11). To achieve an estimated 60% catch reduction, a closure beginning Oct. 1 would be needed. Alternatively, a 16-inch minimum size limit and a closure starting Nov. 16 would result in an estimated 36% reduction. Starting the season closure Oct. 16 with a 16-inch minimum size limit resulted in an estimated 55% catch reduction. Catch reductions do not include further reductions that would be expected from an increase in gill net and pound net escape panel mesh sizes. Catch reductions were considerably lower than harvest reductions for this option due to the expected increase in dead discards (see Appendix 2 for harvest reductions). An increase in gill net and pound net escape panel mesh sizes would likely result in larger catch reductions than those shown below due to the expected smaller number of dead discards.

Table 18. Catch reductions (percent) from the total commercial catch for season closures and minimum size limit increases based on 2011-2014* commercial average. Bolded rows include a reduction within the requested range for the total commercial fishery. See harvest reductions in Table A2.9.

Closure	15 inch limit	16 inch limit
Nov 16-Dec 31	22	**36**
Nov 1-Dec 31	**31**	**43**
Oct 16-Dec 31	**46**	**55**
Oct 1-Dec 31	**59**	67
Sept 16-Dec 31	73	78
Sept 1-Dec 31	77	81
Aug 16-Dec 31	81	85
Aug 1-Dec 31	84	87
Jan 1 - Dec 31	100	100

*2014 data are preliminary, 2014 discard estimates were not available

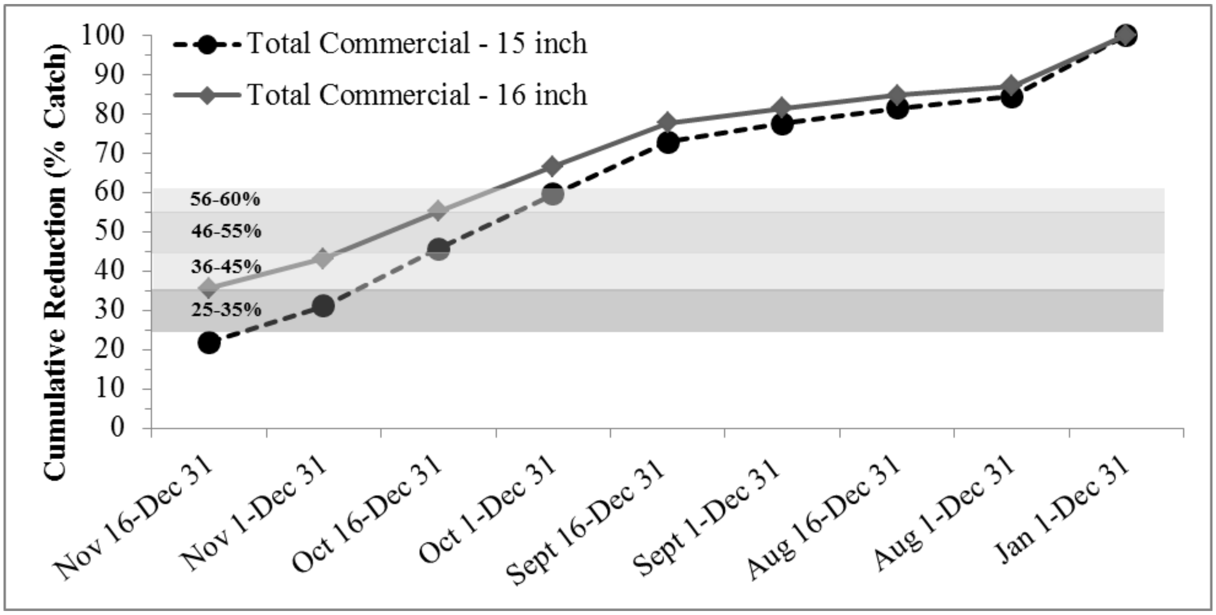

Figure 11. Commercial catch reductions (percent) from the total commercial fishery catch for season closures and minimum size limit increases based on 2011-2014 average.

Reductions for the recreational fishery

A season closure beginning Sept. 16 and a 16-inch minimum size limit resulted in an estimated catch reduction for the recreational fishery above the minimum requested by the MFC (28%; Table 19, Figure 12). Estimates indicated closing the entire season would be required to achieve a catch reduction above 60% for the recreational fishery. Combining a minimum size limit increase with a season closure achieved a reduction above 25% with a season closure one month less than with a season closure alone. Catch reductions were considerably lower than harvest reductions for this option due to the expected increase in dead discards (see Appendix 2 for harvest reductions).

Table 19. Catch reductions (percent) from the total recreational catch for season closures and a 16-inch minimum size limit based on 2011-2014* recreational average. Bolded rows include a reduction within the requested range for the total recreational fishery. See harvest reductions in Table A2.10.

Closure	16 inch limit
Dec 16 - Dec 31	13
Dec 1 - Dec 31	14
Nov 16 - Dec 31	15
Nov 1 - Dec 31	17
Oct 16 - Dec 31	20
Oct 1 - Dec 31	23
Sep 16 - Dec 31	**28**
Sep 1 - Dec 31	**32**
Aug 16 - Dec 31	**41**
Aug 1 - Dec 31	**45**
Jan 1 - Dec 31	69

*2014 data are preliminary, 2014 gig data were not available

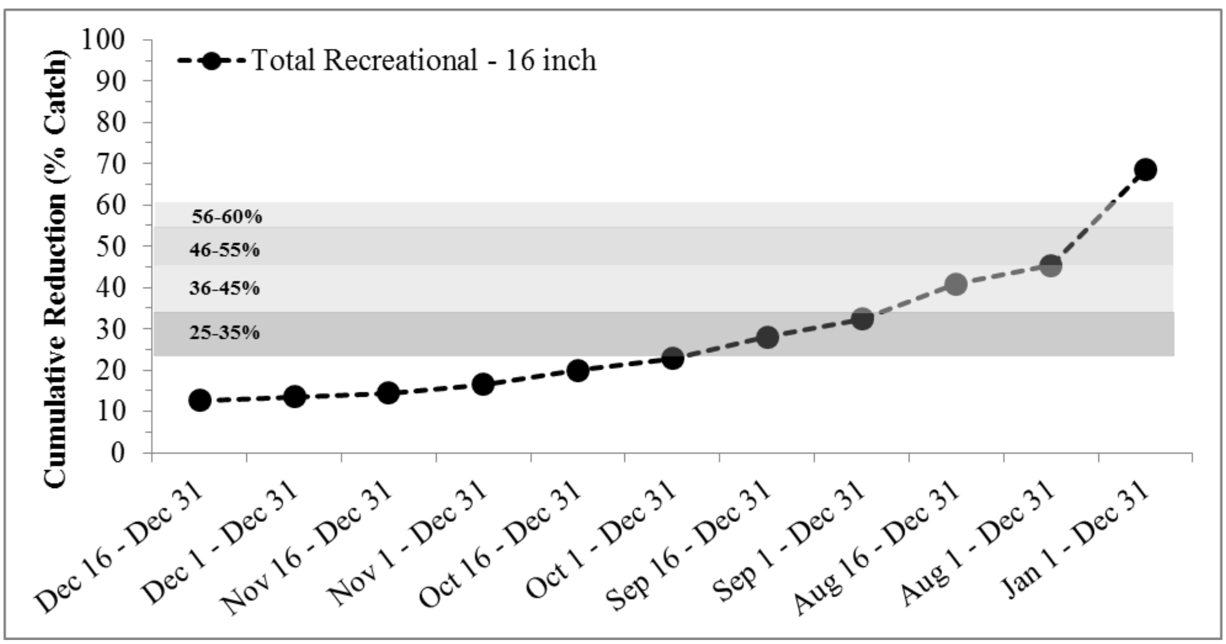

Figure 12. Catch reductions (percent) from the total recreational catch for season closures and a 16-inch minimum size limit based on 2011-2014 recreational average.

Reduction for the combined fishery

Reductions from a minimum size limit increase to 15 or 16 inches combined with season closures were also estimated for the combined southern flounder fishery. An increase to 15 inches (for the commercial fishery) combined with a closure Nov. 16 – Dec. 31 resulted in an estimated reduction of 18% (Tables 20, Figure 13). With a closure Nov. 1-Dec. 31 the estimated reduction increased to 25%. A closure period of Oct. 1-Dec. 31 combined with a 15-inch minimum size limit resulted in an estimated reduction of 50%. Increasing the minimum size limit to 16 inches combined with a closure Nov. 16-Dec. 31 resulted in an estimated reduction of 31%. An Oct. 1-Dec. 31 closure and a 16-inch minimum size limit resulted in an estimated 58% reduction. Catch reductions do not include further reductions that would be expected from an increase in gill net and pound net escape panel mesh sizes. Catch reductions were considerably lower than harvest reductions for this option due to the expected increase in dead discards (see Appendix 2 for harvest reductions). An increase in gill net and pound net escape panel mesh sizes would likely result in larger catch reductions than those shown below due to the expected smaller number of dead discards.

Table 20. Catch reductions (percent) from the combined fishery catch for season closures and size limit increases based on 2011-2014* combined fishery average. Bolded rows include a reduction within the requested range. See harvest reductions in Table A2.11.

Closure	15 inch limit	16 inch limit
Nov 16-Dec 31	18	**31**
Nov 1-Dec 31	**25**	**37**
Oct 16-Dec 31	**38**	**48**
Oct 1-Dec 31	**50**	**58**
Sept 16-Dec 31	61	67
Sept 1-Dec 31	65	71
Aug 16-Dec 31	69	74
Aug 1-Dec 31	72	77
Jan 1 - Dec 31	90	92

*2014 data are preliminary, 2014 commercial gill net discard estimates were not available,

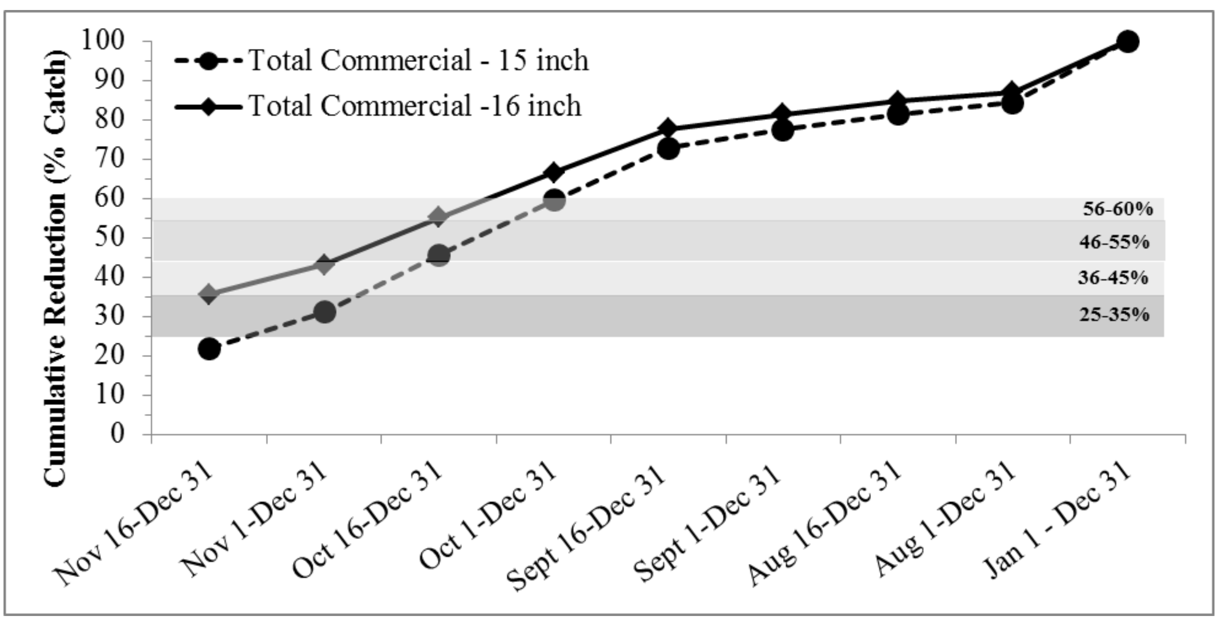

Figure 13. Catch reductions (percent) from the combined fishery catch for season closures and minimum size limit increases based on 2011-2014 combined fishery average.

Option 5: Implement a season closure, increase the minimum size limit and decrease recreational bag limit

The final option included in this supplement for reducing catch is to combine a season closure, a minimum size limit increase and a recreational bag limit decrease. The recreational bag limit is a regulation for the recreational fishery only and therefore no additional commercial reduction is gained by adding this reduction. However, a decrease in the recreational bag limit does impact the total fishery reduction. This option includes all the advantages and disadvantages of implementing each management measure alone. A major advantage to combining measures in this way is to shorten the season closure but still maintain the requested fishery reduction. Also, reducing the recreational bag limit could make reductions more equitable between sectors for this option.

Recreational fishery reductions

Reductions within the target range (25-60%) can potentially be obtained through many potential combinations of minimum size limit, recreational bag limit, and season closures (Table 21). Although a reduction within the requested range is possible without reducing the recreational bag limit, this measure would reduce the needed season closure length at either the current minimum size limit or with a 16-inch minimum size limit. Reducing the recreational bag limit to one fish was estimated to reduce the fishery by less than 25% at the current minimum size limit unless a closure starting Nov. 16 is implemented (Table 21, Figure 14). With a two-fish recreational bag limit, the closure would need to start Sept. 16 to reach an estimated 25% reduction. With a minimum size limit of 16 inches it would be possible to reduce the recreational bag limit to one fish and avoid a season closure. A closure beginning Dec. 16, increasing the minimum size to 16 inches and reducing to a one-fish recreational bag limit resulted in an estimated reduction of 32%. A closure beginning Nov. 1, a minimum size limit increase to 16 inches and a recreational bag limit of two fish per angler would achieve an estimated reduction of 24%. Catch reductions were considerably lower than harvest reductions for this option due to the expected increase in dead discards (see Appendix 2 for harvest reductions).

Table 21. Catch reductions (percent) from the total recreational catch for season closures, recreational bag limit decreases and a minimum size limit increase to 16 inches based on 2011-2014* recreational average. Bolded rows include a reduction within the requested range for the total recreational fishery. See harvest reductions in Table A2.12.

	15 inches						16 inches					
Closure	1 fish	2 fish	3 fish	4 fish	5 fish	6 fish	1 fish	2 fish	3 fish	4 fish	5 fish	6 fish
Dec 16 - Dec 31	24	11	6	4	3	1	**33**	21	17	15	14	13
Dec 1 - Dec 31	**25**	12	7	5	4	2	**34**	22	18	16	15	14
Nov 16 - Dec 31	**26**	12	8	6	5	3	**34**	23	19	17	16	15
Nov 1 - Dec 31	**27**	15	10	8	7	5	**36**	**25**	21	19	18	17
Oct 16 - Dec 31	**30**	18	14	12	11	9	**39**	**28**	24	22	22	20
Oct 1 - Dec 31	**33**	21	17	15	14	13	**41**	**30**	**27**	**25**	24	23
Sep 16 - Dec 31	**37**	**26**	23	21	20	18	**45**	**35**	**32**	**30**	**29**	**28**
Sep 1 - Dec 31	**41**	**31**	**27**	**26**	**25**	23	**48**	**39**	**36**	**34**	**34**	**32**
Aug 16 - Dec 31	**49**	**39**	**36**	**35**	**34**	**33**	**55**	**47**	**44**	**43**	**42**	**41**
Aug 1 - Dec 31	**53**	**44**	**41**	**40**	**39**	**38**	**58**	**51**	**48**	**47**	**46**	**45**
Jan 1 - Dec 31	73	68	66	66	65	64	76	72	70	70	69	69

*2014 data are preliminary, 2014 gig data were not available

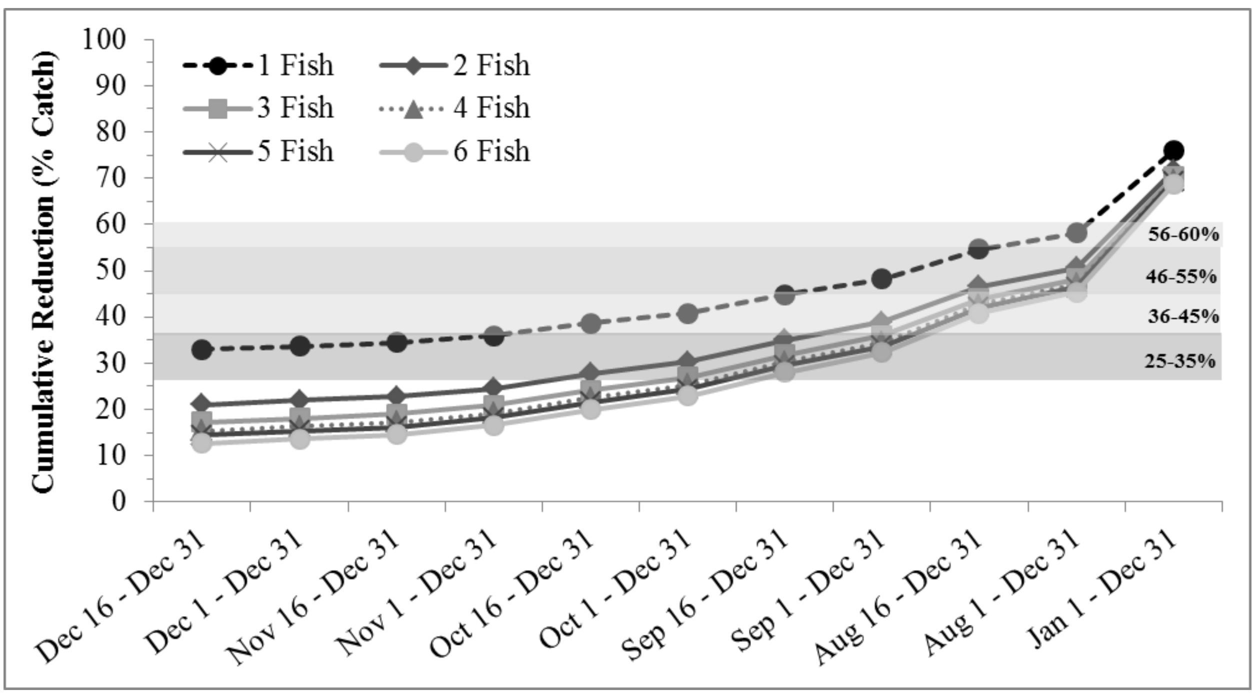

Figure 14. Catch reductions (percent) from the recreational catch by gear for season closures, recreational bag limit decreases and a 16-inch minimum size limit based on 2011-2014 recreational average.

Combined fishery reductions

Reduction from a season closure, minimum size limit increase and recreational bag limit decrease were estimated for the total fishery. Due to the small additional reduction gained by decreasing the recreational bag limit, only a one- or two-fish recreational bag limit were included in reduction estimates. Increasing the commercial fishery size limit to 15 inches, implementing a closure Nov. 16-Dec. 31 and decreasing the recreational bag limit to one fish would result in an estimated 22% reduction (Table 22, Figure 15). To achieve an estimated 25% reduction with a minimum commercial size limit of 15 inches and one-fish recreational bag limit, a season closure of Nov. 16-May 15 would also be needed. Reductions gained from a season closure in winter and early-spring are small due to minimal flounder fishing during that time relative to other seasons. A closure period of Oct. 1-Dec. 31 combined with a 15-inch minimum size limit and a one-fish recreational bag limit was estimated to reduce catch by 52%. Increasing the minimum size limit to 16 inches with a closure Nov. 16-Dec. 31and a two-fish recreational bag limit resulted in an estimated reduction of 32% (Table 22, Figure 16). An Oct. 1-Dec. 31 closure with a 16-inch minimum size limit and a one-fish recreational bag limit resulted in an estimated 60% reduction. Reductions were only slightly lower with a two-fish recreational bag limit instead of a one-fish recreational bag limit due to the small number of catches with more than one southern flounder. Catch reductions do not include further reductions that would be expected from an increase in gill net and pound net escape panel mesh sizes. Catch reductions were considerably lower than harvest reductions for this option due to the expected increase in dead discards (see Appendix 2 for harvest reductions). An increase in gill net and pound net escape panel mesh sizes would likely result in larger catch reductions than those shown below due to the expected smaller number of dead discards.

Table 22. Catch reductions (percent) from the combined fishery for season closure, minimum size limit increase and a one- or two-fish recreational bag limit based on 2011-2014* combined fishery average. Bolded rows include a reduction within the requested range. See harvest reductions in Table A2.13.

	15 inch limit		16 inch limit	
Closure	1 fish bag limit	2 fish bag limit	1 fish bag limit	2 fish bag limit
Nov 16-Dec 31	22	19	**34**	**32**
Nov 1-Dec 31	**29**	**27**	**41**	**39**
Oct 16-Dec 31	**41**	**39**	**50**	**49**
Oct 1-Dec 31	**52**	**51**	**60**	**59**
Sept 16-Dec 31	63	62	69	68
Sept 1-Dec 31	67	66	72	71
Aug 16-Dec 31	71	70	76	75
Aug 1-Dec 31	74	73	78	77
Jan 1 - Dec 31	91	90	92	92

*2014 data are preliminary, 2014 commercial gill net discard estimates were not available, 2014 recreational gig data were not available

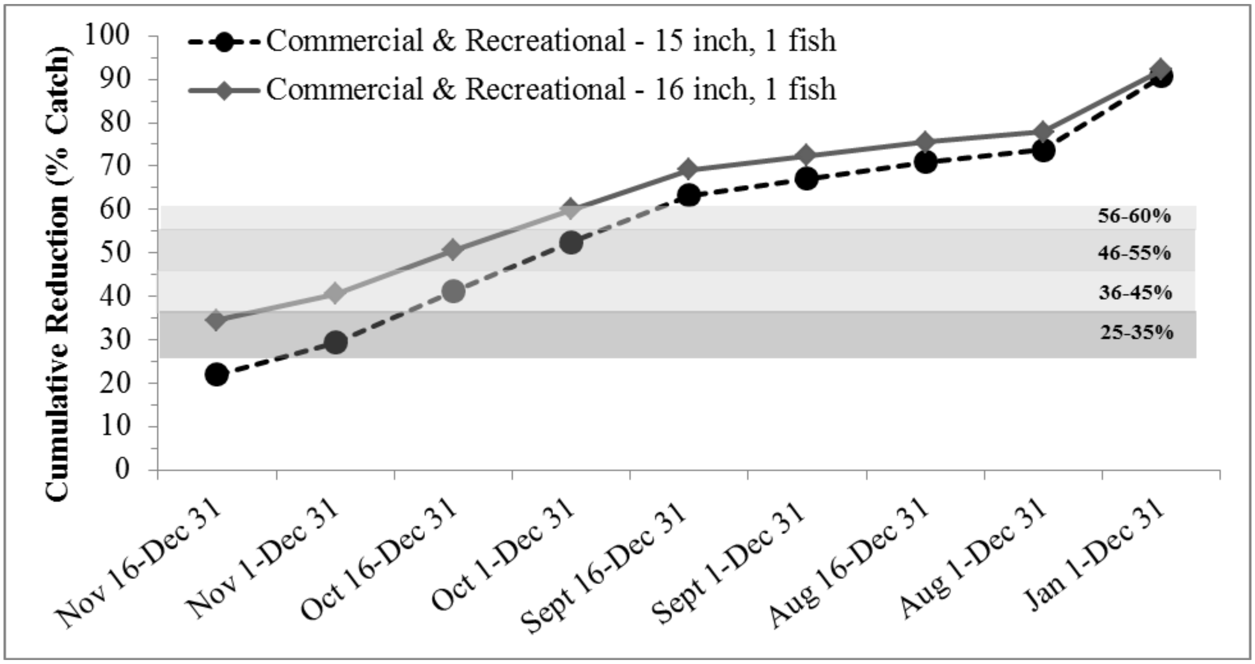

Figure 15. Catch reductions (percent) from the combined fishery catch for season closures, minimum size limit increases and a one-fish recreational bag limit based on 2011-2014 combined fishery average.

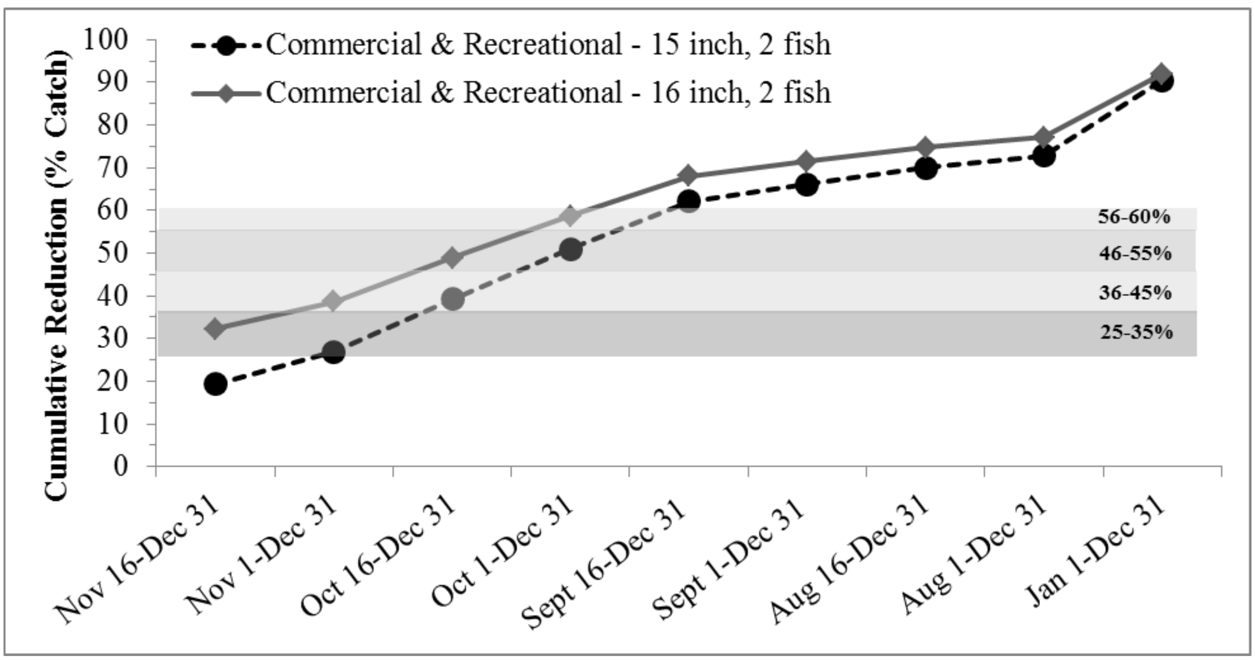

Figure 16. Catch reductions (percent) from the combined fishery catch for season closures, minimum size limit increases and a two-fish recreational bag limit based on 2011-2014 combined fishery average.

The goal of the management options discussed in this supplement is to reduce catch within the range requested by the MFC such that southern flounder spawning stock biomass is increased. Increasing escapement directly impacts the spawning stock biomass in the short-term and may have even greater benefits in the long-term. Because there is not an approved southern flounder stock assessment to use for setting sustainable harvest levels, the reduction chosen can only be based on the degree of concern about the current state of the southern flounder stock as understood by data trends. Additionally, until a stock assessment is developed that is deemed acceptable for management of southern flounder it will not be possible to determine whether any new management measures implemented through a supplement to reduce catch have resulted in sustainable harvest levels. Further confounding appropriate harvest levels, evidence suggests southern flounder is likely one stock within the South Atlantic. Southern flounder migrating from N.C. estuarine waters often enter waters south of North Carolina's southern border where they will be susceptible to harvest in the other states' waters, possibly prior to spawning the first time. Therefore, the benefits to the spawning stock biomass achieved by reducing catch in N.C. waters will be mitigated by fishing effort and regulations in other South Atlantic states.

V. PROPOSED MANAGEMENT OPTIONS

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

Commercial Fisheries:

1. Implement a season closure (half-month periods starting at the end of the season)
   - \+ Achieves reductions throughout requested range
   - \+ May increase the spawning stock biomass
   - \+ May increase harvest with possible improvements in the economic performance of the fishery in the long-term
   - \+ No discard mortality if all gear is removed from water
   - \+ Increases escapement (number of mature individuals able to spawn)
   - \+ Decreases opportunity for recoupment (relative to mid-season closures)
   - \- To avoid recoupment, harvest from any gear must cease during closure.
   - \- Decreases harvest with possible economic losses to the fishery
   - \- Continues harvest of primarily immature fish
   - \- Inequity in reductions by gear and area
   - \- Effort may increase during open seasons, diminishing the reductions
   - \- If any gears that catch flounder are left in the water, this will result in discard mortality.
   - \- If harvest is allowed for any gears during closed seasons, this will result in recoupment. Effort may increase in other fisheries resulting in unsustainable harvest levels.
   - \- Rule 15A NCAC 03J. 0501 states a pound net must be set 30 consecutive days to be a valid permit, potentially requiring additional NCDMF action if a season closure reduces pound net sets to less than 30 days.
   - \- Additional regulations will make data trends more difficult to interpret.

2. Increase the minimum size limit (15” and 16”) with gear modifications

+ Achieves reduction within requested range at 16-inch minimum size limit
+ May increase the spawning stock biomass
+ May increase harvest with possible improvements in the economic performance of the fishery in the long-term
+ Increases the proportion of fish that are mature before they can be harvested
+ Increases escapement
+ Fishing can continue throughout year (except current December closure)
+ If proper modifications to gill nets and pound nets are made, discards will not increase.
- If minimum mesh sizes for large mesh gill nets and pound net escape panels are not increased enough, discards will increase.
- Decreases harvest with possible economic losses to the fishery
- Some regions may be impacted more than others (i.e., Albemarle Sound, Core/Back Sound, western Pamlico Sound and its tributaries).
- Some gears may be impacted more than others.
- Impacts on catches greatest in early half of the year (January-June)
- Predicted reduction may be less than actual due to recoupment once fish reach legal size
- Effort may increase in other fisheries resulting in unsustainable harvest levels.
- Additional regulations will make data trends more difficult to interpret.

3. Implement a season closure and increase the minimum size limit with gear modifications

+ Achieves reductions throughout requested range
+ May increase the spawning stock biomass
+ May increase harvest with possible improvements in the economic performance of the fishery in the long-term
+ Increases escapement
+ Shorter season closure needed to achieve similar reduction than season closure alone
+ Smaller increase in discards than minimum size limit increase alone
+ Likely smaller percentage of immature fish in the harvest
+ If proper modifications to gill nets and pound nets are made, discards will not increase.
+/- May result in more equitable reduction among gear types than Options 1 and 2
- Decreased harvest with possible economic losses to the fishery
- Effort may increase during open seasons, diminishing the reductions
- If minimum mesh sizes for large mesh gill nets and pound net escape panels are not increased enough, discards will increase.
- Some regions may be impacted more than others (i.e., Albemarle Sound and western Pamlico Sound and tributaries).
- Impacts on catches greatest in early half of the year (January-June)
- Predicted reduction may be less than actual due to discards growing to legal size
- Fishing activity must cease during closed periods.
- If any gears that catch flounder are left in the water, this will result in discard mortality or harvest if sale of flounder is allowed.
- If the closure does not extend through the end of the season, recoupment will occur.
- Effort may increase in other fisheries resulting in unsustainable harvest levels.
- Additional regulations will make data trends more difficult to interpret.

Recreational Fisheries:

1. Implement a season closure (half-month periods starting at the end of the season)
    - \+ Achieves reductions within most of requested range (complete closure required for 60%)
    - \+ May increase the spawning stock biomass
    - \+ May increase harvest with possible improvements in the economic performance of the fishery in the long-term
    - \+ Aug. 1 through Dec. 31 and Aug. 16 through Dec. 31 achieve requested reduction range.
    - \+ Closures at the end of the season (i.e., fall months) allow for escapement (number of mature individuals emigrating from estuaries to spawn).
    - \- Decreased harvest with possible economic losses to the fishery
    - \- Possible increase in catch of other managed species
    - \- Increased discards of southern, summer, and Gulf flounder
    - \- Additional regulations will make data trends more difficult to assess effectiveness.

2. Increase the minimum size limit (16”)
    - \+ May increase the spawning stock biomass
    - \+ May increase harvest with possible improvements in the economic performance of the fishery in the long-term
    - \+ Reduces the percentage of immature fish in the harvest
    - \+ Increases escapement
    - \- Does not achieve a reduction within requested range
    - \- Decreased harvest with possible economic losses to the fishery
    - \- Increased discards of southern, summer, and Gulf flounder
    - \- Disproportionate impact for western Pamlico Sound and tributaries
    - \- Adds complexity to current regulations
    - \- Possible increase in catch of other managed species
    - \- Additional regulations will make data trends more difficult to assess effectiveness.

3. Decrease the recreational bag limit (1-5 fish per person per trip)
    - \+ May increase the spawning stock biomass
    - \+ May increase harvest with possible improvements in the economic performance of the fishery in the long-term
    - \- Does not achieve a reduction within requested range
    - \- Increased discards of southern, summer, and Gulf flounder
    - \- Decreased harvest with possible economic losses to the fishery
    - \- Possible increase in catch of other managed species
    - \- Additional regulations will make data trends more difficult to assess effectiveness.

2. Implement a season closure, increase the minimum size limit and decrease the recreational bag limit
    - \+ Achieves reductions within most of requested range
    - \+ May increase the spawning stock biomass
    - \+ May increase harvest with possible improvements in the economic performance of the fishery in the long-term
    - \+ Many possible combinations of reductions within requested range

+ Shorter season closure needed to achieve similar reduction than season closure alone
- Disproportionate impact for western Pamlico Sound and tributaries
- Increased discards of southern, summer, and Gulf flounder
- Decreased harvest with possible economic losses to the fishery
- Possible increase in catch of other managed species
- Adds complexity to current regulations
- Additional regulations will make data trends more difficult to assess effectiveness.

VI. MANAGEMENT RECOMMENDATIONS

MFC Selected Management Strategy

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NCDMF

- No recommendation at this time

VII. RESEARCH RECOMMENDATIONS (From NCDMF 2014 Southern Flounder Stock Assessment)

- Retain mail survey of recreational gig survey harvest and discards. Develop methodology to validate mail survey results, possibly using dockside survey.
- Collect discard data (ages, species ratio, lengths, fates) from gears targeting southern flounder (pound net, gigs, hook and line, trawls).
- Develop and implement consistent strategies for collecting age and sex samples from commercial/recreational fisheries and independent surveys to achieve desired precision for stock assessment.
- Collect age data from estuarine trawl survey and Pamlico Sound survey to more accurately estimate YOY abundance (instead of using length cutoffs based on length frequency plot interpretations).
- Tagging study to estimate emigration (unit stock) and mortality rates.
- Expand, improve, or add inshore surveys of southern flounder to develop indices that we can be confident in for future stock assessments.
- Expand, improve or add fishery-independent surveys of the ocean component of the stock.
- Conduct studies to better understand ocean residency of southern flounder.
- Determine locations of spawning aggregations of southern flounder.
- Conduct sampling of the commercial/recreational ocean spear fishery harvest/discards.
- Re-establish a RCGL survey to obtain harvest, discard, and effort information.
- Develop spatial model to account for inshore and ocean components of the stock.

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Appendix 1. Fishery regulations by sector

Table A1.1. Recreational flounder fishery regulations

	Inland Waters			Ocean Waters		
Year	Size Limit	Bag Limit	Season	Size Limit	Bag Limit	Season
1989	13"	----	----	13"	----	----
1990	13"	----	----	13"	----	----
1991	13"	----	----	13"	----	----
1992	13"	----	----	13"	----	----
1993	13"	----	----	13"	----	----
1994	13"	----	----	14"	8	----
1995	13"	----	----	14"	8	----
1996	13"	----	----	14"	8	----
1997	13"	----	----	14.5"	10	----
1998	13"	----	----	15"	8	----
1999	13"	----	----	15"	8	----
2000	13"	----	----	15"	8	----
2001	13"	----	----	15.5"	8	5/1-5/14
2002	13"/14"*	----	----	15.5"	8	4/3-7/4
2003	13"/14"**	----	----	15"	8	----
2004	13"/14"**	----	----	14"	8	----
2005	14"	8	----	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	----
2011	15"	6	----	15"	6	----
2012	15"	6	----	15"	6	----
2013	15"	6	----	15"	6	----
2014	15"	6	----	15"	6	----

* 14 inch size limit implemented October 1st

** Smaller minimum size limit in western portions of Albemarle and Pamlico sounds and tributaries, and ocean and estuarine waters south of Brown's Inlet; larger minimum size limit north of Brown's Inlet in eastern estuarine and ocean waters.

Table A1.2. Commercial flounder fishery regulations

Year	Month(s) / Day(s)	Regulation change
1979	Jan -	11-inch TL minimum size
1988	Sep -	13-inch TL minimum size
1992	Sep 1 -	Escapement panels required in pound nets in Core Sound and southeast Pamlico Sound (four panels at least six meshes high and eight meshes long)
1998	Sep 1 -	Escapement panels required in flounder pound nets statewide with a minimum mesh size of 5.5 inches, Albemarle Sound west of Alligator River exempted (NCAC 03J .0107)
1999	Dec 16 -	NMFS emergency rule closed southeastern Pamlico Sound to large mesh* gill nets due to interactions with sea turtles for the season
2000	Oct 28–Dec 31	Deep-water large mesh* gill net fishery in Pamlico Sound closed by NMFS due to sea turtle mortalities
2000	Nov 2 -	NMFS issued Incidental Take Permit (ITP) to the NCDMF for the gill net fishery. Established the Pamlico Sound Gill Net Restricted Area (PSGNRA) and imposed gill net fishery management measures.
2000	Oct 27 -	The NCDMF closed the PSGNRA to the use of large mesh* gill nets due to sea turtle interactions
2001	Sep 1–Dec 15	NMFS closed the Pamlico Sound deep water large mesh* gill-net fishery annually. The PSGNRA continued to operate under an ITP that included: permitted entry, restricted areas, a 2,000 yard limit for all gill-net operations, weekly fishermen reporting, and mandatory scientific observer coverage (Federal Rule 50 CFR Part 223).
2002	Sep 1–Dec 15	Reoccurring closure of Pamlico Sound deep water area established by NMFS (Federal Rule 50 CFR Part 223)
2002		Reoccurring regulations established for PSGNRA: open under ITP regulations until Sept 1, closed until mid-Sept, then open to 24/7 fishing for the remainder of the season unless interactions with sea turtles exceed ITP thresholds. Three inlet corridors established where large mesh* gillnets were prohibited: Oregon Inlet (OIC), Ocracoke Inlet (OC) and Hatteras Inlet Corridors (HC). Two new mainland restricted areas established. Small mesh gill nets were exempted from the permitting requirements.
2003		Three-year ITP granted for the gill-net fishery. Implemented a sea turtle observer and characterization program in PSGNRA September through December.
2005		NCDMF received a six-year ITP for the gill-net fishery with changes including increased observer coverage. The mainland portion of the Pamlico Sound was no longer required to have a permit

*large mesh gill nets are defined as ≥ 5 inch stretched mesh in the North Carolina Trip Ticket Program; beginning in 2010 with the Sea Turtle Settlement large mesh was defined as 4.5 to 6.5 inches stretched mesh

Table A1.2 continued

Year	Month(s) / Day(s)	Regulation change
2005	Apr -	14-inch minimum size limit in estuarine waters
2005	Apr 15 -	Minimum mesh size of 5.5- inch stretched mesh for large mesh* gill nets (rule 15A NCAC 03J. 0103(a)(2))
2005	Sep 1 -	3,000-yard limit on gill nets (rule 15A NCAC 03J .0103(i)(1))
2005	Sep 1 -	Escape panels of 5.5-inch stretched mesh required in pound nets statewide (ended exemption in Albemarle Sound west of the Alligator River) (rule 15A NCAC 03J .0501(e)(2))
2005	Oct 24 -	A minimum tailbag mesh size of 4-in stretched mesh in crab trawls in western Pamlico Sound to minimize bycatch of undersized southern flounder.
2005	Dec 1–31	Reoccurring commercial flounder fishery closure (except where noted)
2006	July 1 -	Upper portions of the Neuse, Pamlico, and Pungo rivers closed to shrimp trawling and implemented a maximum combined 90 foot headrope length in the mouths of the Pamlico and Neuse rivers and all of the Bay River to minimize southern flounder bycatch (Rules 15A NCAC 03R .0114)
2007	Nov 15–Dec 15	The PSGNRA season closed due to sea turtle interactions surpassing thresholds (proclamation M-19-2007).
2007	Dec 1–15	Commercial fishery open due to multiple significant variable conditions, except gill nets 4 to 6.5 inches stretch mesh remained closed in the PSGRNA
2009	Oct 22 - Nov 30	The PSGNRA season closed due to sea turtle interactions surpassing authorized thresholds (proclamation M-24-2009).
2009	Dec 1–15	Commercial pound net fishery open due to multiple significant variable conditions
2010	May 15 -	Due to Sea Turtle Lawsuit Settlement, large mesh* gill nets were limited to use: four nights per week (Tuesday - Friday) with 15 meshes deep, a maximum of 2,000 yards north of and 1,000 yards south of Hwy 58 Bridge with 100-yards of continuous net. They are also required to have leaded bottom lines, prohibited to use floats north of the Highway 58 Bridge and must leave a space of 25-yards between sections of net. Excempted areas included western Albemarle Sound, Currituck Sound and the PSGNRA from September through November (proclamation M-8-2010)
2010	Sep 3-Oct 6	South Core Sound, Back Sound, North River and tributaries (area D1) closed to large mesh* gill nets due to sea turtle interactions with gill nets (proclamation M-16-2010)
2011	Jan 20-Mar 28	Albemarle Sound Management Area (ASMA), Pamlico Sound, Pamlico, Pungo, Bay, and Neuse Rivers and the Cape Fear River exempted from Sea Turtle Settlement measures (four day fishing week, the mesh height, lead line and float requirements, and the 100 yard continuous length limit) for large mesh* gill nets to allow for a shad harvest season (proclamation M-2-2011)

*large mesh gill nets are defined as ≥ 5 inch stretched mesh in the North Carolina Trip Ticket Program; beginning in 2010 with the Sea Turtle Settlement large mesh was defined as 4.5 to 6.5 inches stretched mesh

Table A1.2 continued

Year	Month(s) / Day(s)	Regulation change
2011	Sep 12 -	Restrictions on large mesh* gill nets no longer required in Albemarle, Croatan, and Roanoke sounds north and west of Highway 64/264 bridges as well as Pamlico, Bay, and Neuse rivers (proclamation M-27-2011)
2011	Sep 18 -	An extra day was allowed for large mesh* gill nets south of Beaufort Inlet (proclamation M-30-2011)
2011	July 18-Oct 3	Area D1 closed to large mesh* gill nets due to turtle interactions (proclamation M-24-2011)
2012	Feb 2-Mar 28	The ASMA, Pamlico Sound, Pamlico, Pungo, Bay, and Neuse Rivers and the Cape Fear River exempted from Sea Turtle Settlement measures (four day fishing week, the mesh height, lead line and float requirements, and the 100 yard continuous length limit) for large mesh* gill nets to allow for a shad harvest season (proclamation M-6-2012).
2012	May 20 -	1,000 yards maximum large mesh* gill-net length, Beaufort Inlet to Hwy 58 Br (proclamation M-23-2012).
2012	May 20-Oct 14	Area D1 closed to large mesh* gill nets due to turtle interactions (proclamation M-23-2012). Annual closure of May 8-Oct 14 to be used for this area in future to avoid sea turtle interactions.
2012	Sep 26–Oct 15	PSGNRA closed to large mesh* gill nets due to sea turtle interactions
2012	Oct 15-Nov 30	Area D1 open to large mesh* gill nets (proclamation M-52-2012)
2012	Oct 8-Nov 30	2,000 yards maximum large mesh* gill-net length and must be present at nets by noon each day in Albemarle Sound and its tributaries (to limit sturgeon interactions and mortalities; proclamation M-49-2012)
2012	Oct 4-Nov 30	Southern portions of Croatan/Roanoke sounds subject to M-8-2010 due to turtle interactions
2013	Mar 7-	Albemarle, Currituck, Croatan, and Roanoke sounds north and west of Highway 64/264 bridges, Pamlico, Pungo, Bay, and Neuse rivers, and only in January-April for upper New and Cape Fear rivers, limit the use of large mesh* gill nets to four nights/week and 2,000 yards, except south of Beaufort Inlet allow five nights/week and maximum 1,000 yards (proclamation M-7-2013)
2013	May 8-Oct 14	Annual closure for large mesh* gill nets in area D1 (proclamation M-17-2013).
2013	Feb 7, Mar 7	Large mesh* gill net shad exemptions for the ASMA Feb 7 (proclamation M-2-2013) and Pamlico Sound and tributaries March 7 (proclamation M-7-2013).
2013	July 14–Oct 1	Use of large mesh* gill nets prohibited south of Highway 58 Bridge (area E) via proclamation M-20-2013 due to sea turtle interactions
2013	July 24–Oct 1	Use of large mesh* gill nets prohibited in Pamlico Sound/northern Core Sound due to sea turtle interactions (proclamation M-21-2013)

*large mesh gill nets are defined as ≥ 5 inch stretched mesh in the North Carolina Trip Ticket Program; beginning in 2010 with the Sea Turtle Settlement large mesh was defined as 4.5 to 6.5 inches stretched mesh

Table A1.2 continued

2013	Sep 1–Sep 11	Areas B and E closed until ITP approved (due to PSGNRA ITP not being extended another year)
2013	Oct 15 - Nov 30	Area D1 open to large mesh* gill nets (proclamation M-33-2013).
2014	Mar 18 -	Gill nets with mesh length greater than 5 inches must be equiped with tie downs 10 yards apart and can not be within 50 yards of the shore in the Neuse, Pamlico, and Pungo Rivers. Use of gill nets 5 inches or greater is prohibited within 10 feet of any point on the shoreline while set or deployed from June to October (proclamation M-10-2014)
2014	May 5 - Sept 15	Use of large mesh* gill-nets prohibited in Internal Coastal Waters to avoid discards of red drum. Major portions of areas A and C and the New River were
2014	Sept 1 -	The remainder of area A is reopened from the red drum closure (proclamation M-25-2014).
2014	Sept 15-	The remainder of management unit C is reopened and all of management unit D2 is reopened from the red drum closure (proclamation M-29-2014).
2014	Sept 22	Management units B and E are opened to large mesh* gill nets (proclamation M-30-2014)
2014	Sep 24-Nov 2	Area E closed to large mesh* gill nets due to turtle interactions (proclamation M-31-2014), reopened via proclamation M-39-2014
2014	Oct 1-Oct 27; Oct 1-Nov 6	Area A closed to large mesh* gill nets due to turtle interactions (proclamation M-33-2014). Portions of western Albemarle Sound and Currituck reopened on Oct 27 (proclamation M-36-2014). Remainder of area A reopened Nov 6 (proclamation M-41-2014)
2014	Oct 15 - Nov 30	Area D1 open to large mesh* gill nets (proclamation M-34-2014).
2014	Oct 26-Nov 6	Shallow water portions of area B (PSGNRA) closed to large mesh* gill nets due to turtle interactions (proclamation M-37-2014), reopened via proclamation M-40-2014

*large mesh gill nets are defined as ≥ 5 inch stretched mesh in the North Carolina Trip Ticket Program; beginning in 2010 with the Sea Turtle Settlement large mesh was defined as 4.5 to 6.5 inches stretched mesh

Appendix 2. Harvest reductions

Table A2.1 Commercial harvest reductions (percent) from the total commercial harvest for season closures based on 2011-2014* average. Bolded rows include a reduction within the requested range for the total commercial fishery.

Closure	Gill net	Pound net	Gig	Other gears	Total
Nov 16-Dec 31	1	3	<1	<1	5
Nov 1-Dec 31	5	10	1	<1	16
Oct 16-Dec 31	12	20	1	<1	**34**
Oct 1-Dec 31	20	29	2	<1	**51**
Sept 16-Dec 31	30	35	2	<1	67
Sept 1-Dec 31	34	36	3	<1	73
Aug 16-Dec 31	38	36	3	1	77
Aug 1-Dec 31	41	36	4	1	81
Jan 1-Dec 31	55	36	8	1	100

*2014 data are preliminary

Table A2.2 Recreational harvest reductions (percent) from the total recreational harvest for season closures based on 2011-2014* average. Bolded rows include a reduction within the requested range for the total recreational fishery.

Closure	Hook & Line	Gig	Total
Dec 16-Dec 31	< 1	1	1
Dec 1 - Dec 31	< 1	2	3
Nov 16 - Dec 31	1	4	4
Nov 1 - Dec 31	3	5	8
Oct 16 - Dec 31	7	7	14
Oct 1 - Dec 31	10	9	19
Sep 16 - Dec 31	17	11	**28**
Sep 1 - Dec 31	23	13	**36**
Aug 16 - Dec 31	37	15	**51**
Aug 1 - Dec 31	43	17	**59**
Jan 1 - Dec 31	72	28	100

*2014 data are preliminary, 2014 gig data were not available

Table A2.3 Harvest reductions (percent) from the combined fishery harvest for season closures based on a 2011-2014* average. Bolded rows include a reduction within the requested range for the combined fishery total.

	Commercial					Recreational			All
Closure	Gill net	Pound net	Gig	Other	Total	Hook & line	Gig	Total	Total
Nov 16-Dec 31	1	3	< 1	< 1	4	< 1	1	1	5
Nov 1-Dec 31	4	8	< 1	< 1	13	< 1	1	1	15
Oct 16-Dec 31	10	17	1	< 1	**28**	1	1	2	**30**
Oct 1-Dec 31	17	24	1	< 1	**42**	2	2	3	**45**
Sept 16-Dec 31	25	29	2	< 1	**55**	3	2	5	**60**
Sept 1-Dec 31	28	29	2	< 1	60	4	2	6	66
Aug 16-Dec 31	31	29	3	< 1	64	6	3	9	73
Aug 1-Dec 31	34	29	3	< 1	67	7	3	10	77
Jan 1-Dec 31	45	30	7	1	83	13	5	17	100

*2014 data are preliminary

Table A2.4 Harvest reductions (percent) from combined fishery harvest for season closures by sector based on 2011-2014 average. Closures start on the dates shown and end on Dec. 31. Bolded reductions were within the requested range.

	Recreational closure								
Commercial closure	1-Jan	1-Aug	16-Aug	1-Sep	16-Sep	1-Oct	16-Oct	1-Nov	16-Nov
1-Jan	100	93	92	89	87	86	85	84	83
1-Aug	84	77	76	73	72	70	69	68	68
16-Aug	81	74	73	70	69	67	66	65	65
1-Sep	77	70	69	66	65	63	62	61	61
16-Sep	73	66	64	62	**60**	**59**	**58**	**57**	**56**
1-Oct	**60**	**52**	**51**	**48**	**47**	**45**	**45**	**43**	**43**
16-Oct	**45**	**38**	**37**	**34**	**33**	**31**	**30**	**29**	**29**
1-Nov	**31**	24	22	19	18	16	16	15	14
16-Nov	21	14	13	10	9	7	6	5	5

*2014 data are preliminary, 2014 recreational gig data were not available

Table A2.5 Harvest reductions (percent) from total commercial harvest for minimum size limit increases based on 2011-2014* commercial catch average. Bolded rows include a reduction within the requested range for the total commercial fishery.

Size limit	Gill net	Pound net	Gig	Other	Total
15 inch	16	7	2	1	**27**
16 inch	32	15	5	1	**53**

*2014 data are preliminary

Table A2.6 Harvest reductions (percent) from total recreational harvest for minimum size limit increases based on 2011-2014* recreational catch average.

Size limit	Hook & Line	Gig	Total
16 inch	16	6	22

*2014 data are preliminary, 2014 gig data were not available

Table A2.7. Harvest reductions (percent) from the combined fishery harvest for minimum size limit increase based on 2011-2014* combined fishery average. Bolded row includes a reduction within the requested range for the combined fishery total.

	Commercial					Recreational			All
Size limit	Gill net	Pound net	Gig	Other gears	Total	Hook & line	Gig	Total	Total
15 inch	13	6	2	< 1	22	0	0	0	22
16 inch	26	13	4	1	**44**	3	1	4	**47**

*2014 data are preliminary

Table A2.8 Harvest reductions (percent) from total recreational harvest for recreational bag limit decreases based on 2011-2014* recreational catch average. Bolded row includes a reduction within the requested range for the total recreational fishery.

Bag limit	Hook & Line	Gig	Total
1 fish	24	9	**33**
2 fish	10	4	14
3 fish	5	2	7
4 fish	2	1	3
5 fish	1	0	1

*2014 data are preliminary, 2014 gig data were not available

Table A2.9 Harvest reductions (percent) from the total commercial harvest for season closures and minimum size limit increases based on 2011-2014* commercial average. Bolded rows include a reduction within the requested range for the total commercial fishery.

Closure	15 inch limit	16 inch limit
Nov 16-Dec 31	**26**	**46**
Nov 1-Dec 31	**35**	**53**
Oct 16-Dec 31	**49**	63
Oct 1-Dec 31	62	72
Sept 16-Dec 31	75	82
Sept 1-Dec 31	79	85
Aug 16-Dec 31	82	87
Aug 1-Dec 31	85	89
Jan 1 - Dec 31	100	100

*2014 data are preliminary

Table A2.10 Harvest reductions (percent) from the total recreational harvest for season closures and 16-inch minimum size limit based on 2011-2014* recreational average. Bolded rows include a reduction within the requested range for the total recreational fishery.

Closure	16 size limit
Dec 16-Dec 31	1
Dec 1 - Dec 31	3
Nov 16 - Dec 31	4
Nov 1 - Dec 31	8
Oct 16 - Dec 31	14
Oct 1 - Dec 31	19
Sep 16 - Dec 31	**28**
Sep 1 - Dec 31	**36**
Aug 16 - Dec 31	**51**
Aug 1 - Dec 31	**59**
Jan 1 - Dec 31	100

*2014 data are preliminary, 2014 gig data were not available

Table A2.11. Harvest reductions (percent) from the combined fishery harvest for season closures and minimum size limit increases based on 2011-2014* combined fishery average. Bolded rows include a reduction within the requested range.

Closure	15 inch limit	16 inch limit
Nov 16-Dec 31	**25**	**50**
Nov 1-Dec 31	**33**	**55**
Oct 16-Dec 31	**46**	63
Oct 1-Dec 31	**57**	71
Sept 16-Dec 31	69	79
Sept 1-Dec 31	74	82
Aug 16-Dec 31	79	86
Aug 1-Dec 31	82	88
Jan 1 - Dec 31	100	100

*2014 harvest data are preliminary, 2014 recreational gig data were not available

Table A2.12 Harvest reductions (percent) from the recreational fishery harvest for season closures, a minimum size limit increase to 16 inches, and a recreational bag limit decrease based on 2011-2014* recreational fishery average. Bolded rows include a reduction within the requested range for the total recreational fishery.

	15 inches						16 inches					
Closure	1 fish	2 fish	3 fish	4 fish	5 fish	6 fish	1 fish	2 fish	3 fish	4 fish	5 fish	6 fish
Dec 16 - Dec 31	23	10	5	3	2	1	**40**	**29**	**26**	24	24	23
Dec 1 - Dec 31	24	11	7	5	4	3	**41**	**31**	**27**	**26**	**25**	24
Nov 16 - Dec 31	**26**	13	8	6	5	4	**42**	**32**	**28**	**27**	**26**	**25**
Nov 1 - Dec 31	**28**	16	12	10	9	8	**44**	**34**	**31**	**29**	**29**	**28**
Oct 16 - Dec 31	**33**	21	17	16	15	14	**48**	**38**	**35**	**34**	**33**	**33**
Oct 1 - Dec 31	**37**	**26**	22	21	20	19	**51**	**42**	**39**	**38**	**37**	**37**
Sep 16 - Dec 31	**44**	**34**	**31**	**30**	**29**	**28**	**56**	**49**	**46**	**45**	**44**	**44**
Sep 1 - Dec 31	**50**	**41**	**39**	**37**	**37**	**36**	**61**	**54**	**52**	**51**	**50**	**50**
Aug 16 - Dec 31	62	**56**	**53**	**52**	**52**	**51**	70	65	64	63	62	62
Aug 1 - Dec 31	68	63	61	**60**	**60**	**59**	75	71	70	69	69	68
Jan 1 - Dec 31	100	100	100	100	100	100	100	100	100	100	100	100

*2014 data are preliminary, 2014 gig data were not available

Table A2.13 Harvest reductions (percent) from the combined fishery catch for season closures, minimum size limit increases and a one- or two-fish recreational bag limit based on 2011-2014* combined fishery average. Bolded rows include a reduction within the requested range.

	15 inch limit		16 inch limit	
Closure	1 fish bag limit	2 fish bag limit	1 fish bag limit	2 fish bag limit
Nov 16-Dec 31	**30**	**27**	**53**	**51**
Nov 1-Dec 31	**37**	**35**	**58**	**56**
Oct 16-Dec 31	**49**	**47**	65	64
Oct 1-Dec 31	**60**	**58**	73	72
Sept 16-Dec 31	71	70	80	80
Sept 1-Dec 31	75	74	83	83
Aug 16-Dec 31	80	79	87	86
Aug 1-Dec 31	83	83	89	88
Jan 1 - Dec 31	100	100	100	100

*2014 harvest data are preliminary, 2014 recreational gig data were not available

Appendix 3. Reduction calculation methods for each option

Option 1: Implement a season closure

Commercial fishery

NC Trip Ticket daily landings were used to split monthly estimated numbers of harvested southern flounder into half-month closure periods. To calculate the catch reduction percentage, estimated average harvest and dead discards for each closed period were divided by the average annual estimated harvest and discard mortalities. The harvest reduction percentage was calculated by dividing the estimated harvest during a closed period by the average annual harvest. The only available discard or discard mortality estimates for a major commercial gear used for harvesting southern flounder was for estuarine gill nets. A generalized linear model (GLM) framework was used to predict southern flounder gill net discards by season based on NCDMF observer data. Data limitations prevented discard estimates at two week intervals (the minimum season closure period analyzed). Instead, a ratio of gill net harvest to discards was applied to harvest numbers for each potential closure period to estimate discards at two week intervals. Seasonal post-release discard mortality rates for sublegal southern flounder were derived from Smith and Scharf (2011) and adapted for use here by NCDMF staff. Post-release discard mortality rates were applied to averaged numbers of discards with a different rate used for October - June (12%) and July - September (64%). These estimates were based on gill nets fished for approximately 24 hours before removing flounder; however, portions of the state were only allowed to fish nets from one hour before sunset until one hour after sunrise to mitigate protected species interactions. It is likely discard morality rates will be lower for nets fished for fewer hours during nighttime only. Despite this, the available rates were used because much of the gill net harvest occurs in areas that were allowed to fish nets for 24 hours during most of 2011-2014. Additionally, although sublegal discards released dead were included in calculating the discard ratio, the discard mortality rate only accounted for fish that became mortalities after being released alive (i.e., post-release) due to the inability to accurately estimate the portion of the mortality rate. The numbers of dead discards were added to the annual harvest and any time-periods that were closed to calculate the reduction in catch for each period. Because there were no estimates of discards available for other commercial fisheries, the only change from harvest reductions was due to the addition of gill net discards.

Recreational Fishery

Weighted post-stratified data from MRIP were placed into half month domains to estimate hook and line harvest and discards. Seasonal post-release discard morality rates of 7% (January-June) and 11% (July-December) were applied to MRIP derived estimates of hook and line discards. These rates were based on NCDMF studies of hook and line post-release mortality of southern flounder, but were further developed by the NCDMF for the draft 2014 southern flounder stock assessment. It was assumed that the hook and line fishery would continue to operate during a season closure. It was also assumed that all southern flounder harvested on average in 2011-2014 would be caught and released during a closed season. Therefore, seasonal discard morality rates were applied to average hook and line harvest and discards from 2011-2014 for each closed period and divide by total catch to estimate catch reductions. For the recreational gig fishery, all discards were assumed to be dead due to injuries sustained by this gear. Consequently, a discard mortality rate was not applied to gig discard estimates, instead all discards were added to gig harvest for a potential closure period and divided by total catch to estimate catch reductions.

<u>Option 2: Increase the minimum size limit</u>

Reductions in catch were calculated by first subtracting the estimated dead discards at size from the average harvest at size to yield the live discards resulting from an increase in the minimum size limit (Tables A3.1 and A3.2). Although the number of discards was unknown for some gears in the 2011-2014 average catch, the expected increase in discards can be estimated based on the average numbers of fish at size in 2011-2014. For example, when increasing to a 15-inch limit, the fish currently harvested at 14 inches would be caught and discarded in the future assuming no attempt is made to modify gear to reduce discards. The number of dead discards was calculated by applying a seasonal post-release discard mortality rate to these expected discards. The number of live discards was divided by the average annual catch (harvest plus dead discards) to provide the catch reduction percentage. Harvest reductions were simply the harvest that would be avoided by increasing the minimum size limit (Tables A3.1 and A3.2) divided by the annual average harvest.

Table A3.1. Harvest and discards used to calculate catch and harvest reductions as a result of increasing minimum size limit to 15 inches. Live and dead discard estimates were calculated assuming no gear modifications to reduce discards. NA indicates gears that would not be impacted by a minimum size limit increase to 15 inches.

	Commercial					Recreational			All
Estimate Type	Gill net	Pound net	Gig	Other	Total	Hook & line	Gig	Total	Total
Harvest	138,237	62,777	21,371	4,302	226,688	NA	NA	NA	226,688
Dead Discards	42,040	14,189	10,648	2,130	69,008	NA	NA	NA	69,008
Live Discards	96,197	48,588	10,724	2,172	157,680	NA	NA	NA	157,680

*2014 data are preliminary, 2014 commerical discard and all recreational gig data were not available

Table A3.2. Harvest and discards used to calculate catch and harvest reductions as a result of increasing minimum size limit to 16 inches. Dead discard estimates were calculated assuming no gear modifications to reduce discards.

	Commercial					Recreational			All
Estimate Type	Gill net	Pound net	Gig	Other	Total	Hook & line	Gig	Total	Total
Harvest	270,876	130,735	42,479	7,191	451,281	29,168	10,215	39,382	490,664
Dead Discards	116,146	28,925	21,109	3,541	169,721	2,973	5,365	8,338	178,059
Live Discards	154,731	101,810	21,370	3,651	281,561	26,195	4,850	31,044	312,605

*2014 data are preliminary, 2014 commerical discard and all recreational gig data were not available

Commercial fishery

To calculate the catch reduction, the numbers of fish in 1-inch size bins were calculated and averaged for 2011-2014. Catch and harvest reductions were calculated for the commercial fishery based on increasing the minimum size limit to 15 inches and 16 inches from the current 14 inch limit, assuming no gear modifications to reduce discards. Expected dead discards were estimated for each commercial gear for calculating catch reductions. The seasonal post-release discard mortality rates developed for gill nets were based on fish below 14 inches (the current commercial minimum size limit); however, evidence suggests no relationship between fish size and post-release mortality rate (at least below 14 inches) (Smith and Scharf 2011). Therefore, an assumption was made that the rates would not change for fish discarded above 14 inches and the available rates were used to predict post-release discard mortality due to a minimum size limit increase. Because there were no available discard mortality estimates for other commercial gears, the seasonal gill net post-release discard rates were also applied to the expected discards for other fisheries to calculate dead discards for the entire commercial fishery as a result of raising the minimum size limit.

Recreational Fishery

Preliminary analyses demonstrate highly comparable percent reductions of southern flounder harvest for both hook and line and flounder gigging for various harvest sizes and recreational bag limits. As such, a cumulative approach is appropriate for investigating proportional harvest reduction within the recreational sector. Reductions for an imposed 16-inch minimum size limit were calculated by dividing the portion of catch at 15 inches by the total catch from 15 inches to the maximum size observed. Unlike the MRIP recreational hook and line survey, catches are not reported back to DMF's Mail-based Recreational gigging survey at the individual trip level but rather two-month summarizations are given. Furthermore, individual fish sizes are not collected precluding the analyses for these scenarios in the manner they were done for hook and line. To overcome the granularity issues of the mail-based survey, recreational hook and line size frequencies and catch frequencies were used as proxies for minimum size limit reductions for the gig catch.

Option 3: Decrease the recreational bag limit

Recreational fishery

Recreational bag limit analysis was calculated by determining the frequency of angler trips with each of the potential recreational bag limits below the current six-fish recreational bag limit. For each recreational bag limit option, all catch frequencies with catches higher than the recreational bag limit of interest were converted to discards. The total catch for each specific recreational bag limit was recalculated and divided by the original harvest estimate to determine the number of fish discarded due to each recreational bag limit. Unlike the MRIP recreational hook and line survey, catches are not reported back to the NCDMF mail-based recreational gigging survey at the individual trip level but rather two-month summarizations are given. Furthermore, individual fish sizes are not collected precluding the analyses for these scenarios in the manner they were done for hook and line. To overcome the granularity issues of the mail-based survey, recreational hook and line size frequencies and catch frequencies were used as proxies for recreational bag limit reductions for the gig catch. Preliminary analyses demonstrate highly comparable percent reductions of southern flounder harvest for both hook and line and flounder gigging for various harvest sizes and recreational bag limits. Because hook and line contribute much more to the recreational fishery, a cumulative approach is appropriate for investigating proportional harvest reduction within the recreational sector.

Option 4: Implement a season closure and increase the minimum size limit

Reductions for this option were calculated within each sector by using reductions from each separate measure as inputs in the following formula: $Z= X + [(1 – X) * Y]$ where X= the reduction fraction due to one measure (e.g., season closure) and Y= reduction fraction due to the other measure (e.g., minimum size limit increase), and Z = the resulting combined reduction.

Option 5: Season closure, increase the minimum size limit and decrease the recreational bag limit

Reductions for this option were calculated within each sector by using reductions from each separate measure as inputs in the following formula: $Z= X+((1-X)*Y) +(1-X+((1-X)*Y)))*W$ where W= the reduction fraction due the one new measure (e.g., recreational bag limit decrease), X= the reduction fraction due to a second measure (e.g., season closure),Y= reduction fraction due to a third measure (e.g., minimum size limit increase), and Z = the resulting combined reduction.

Appendix 4. Catch reductions by gear (using catch total by gear rather than by sector or fishery)

Table A4.1 Commercial catch reductions (percent) from the catch by gear for season closures based on a 2011-2014 average. Bolded rows include a reduction within the requested range for the total commercial fishery.

Closure	Gill net	Pound net	Gig	Other gears	Total
Nov 16-Dec 31	2	9	2	1	5
Nov 1-Dec 31	10	28	7	5	16
Oct 16-Dec 31	22	56	13	9	**33**
Oct 1-Dec 31	37	81	18	18	**50**
Sept 16-Dec 31	54	98	23	25	67
Sept 1-Dec 31	62	99	31	34	72
Aug 16-Dec 31	70	99	39	42	77
Aug 1-Dec 31	75	99	46	48	81
Jan 1-Dec 31	100	100	100	100	100

*2014 data are preliminary, 2014 discard estimates were not available

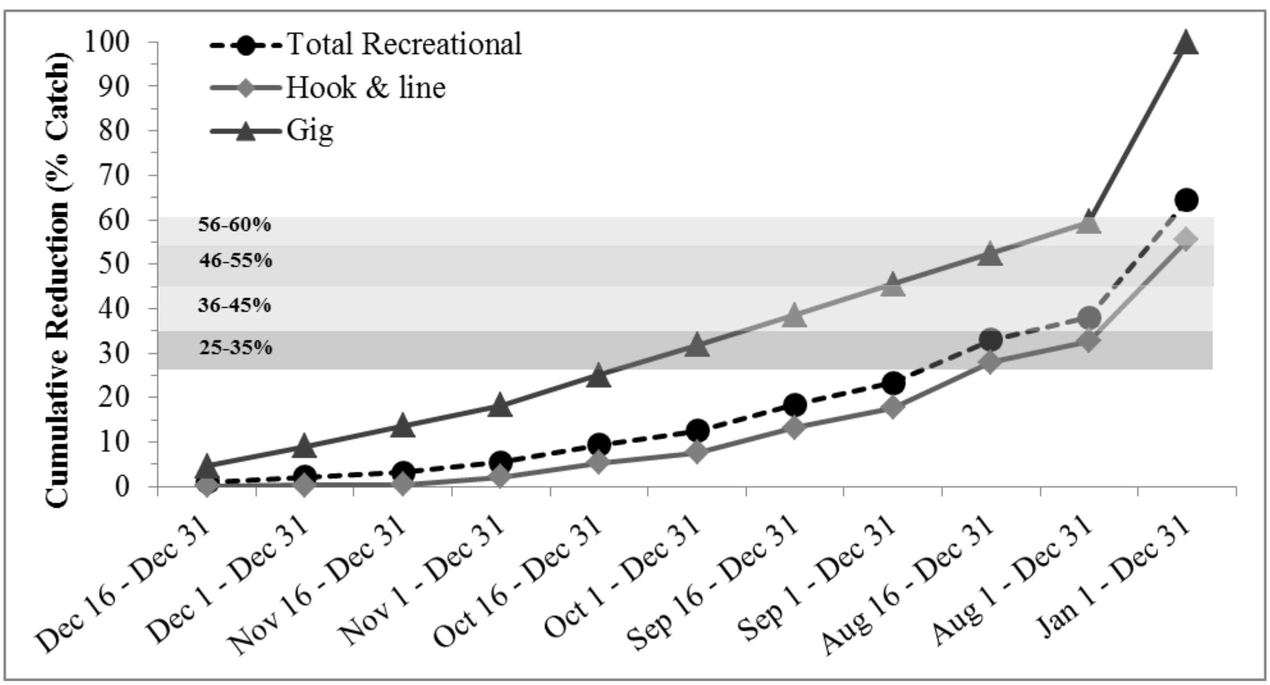

Figure A4.1. Commercial catch reductions (percent) from the catch by gear for season closures based on a 2011-2014 average.

Table A4.2. Recreational catch reductions (percent) from recreational catch by gear for season closures based on a 2011-2014* average. Bolded rows include a reduction within the requested range for the total recreational fishery.

Closure	Hook & Line	Gig	Total
Dec 16 - Dec 31	<1	5	1
Dec 1 - Dec 31	<1	9	2
Nov 16 - Dec 31	<1	14	3
Nov 1 - Dec 31	2	18	5
Oct 16 - Dec 31	5	25	9
Oct 1 - Dec 31	8	32	13
Sep 16 - Dec 31	13	39	18
Sep 1 - Dec 31	18	45	23
Aug 16 - Dec 31	**28**	**52**	**33**
Aug 1 - Dec 31	**33**	**60**	**38**
Jan 1 - Dec 31	55	100	64

*2014 data are preliminary, 2014 gig harvest and discard data were not available

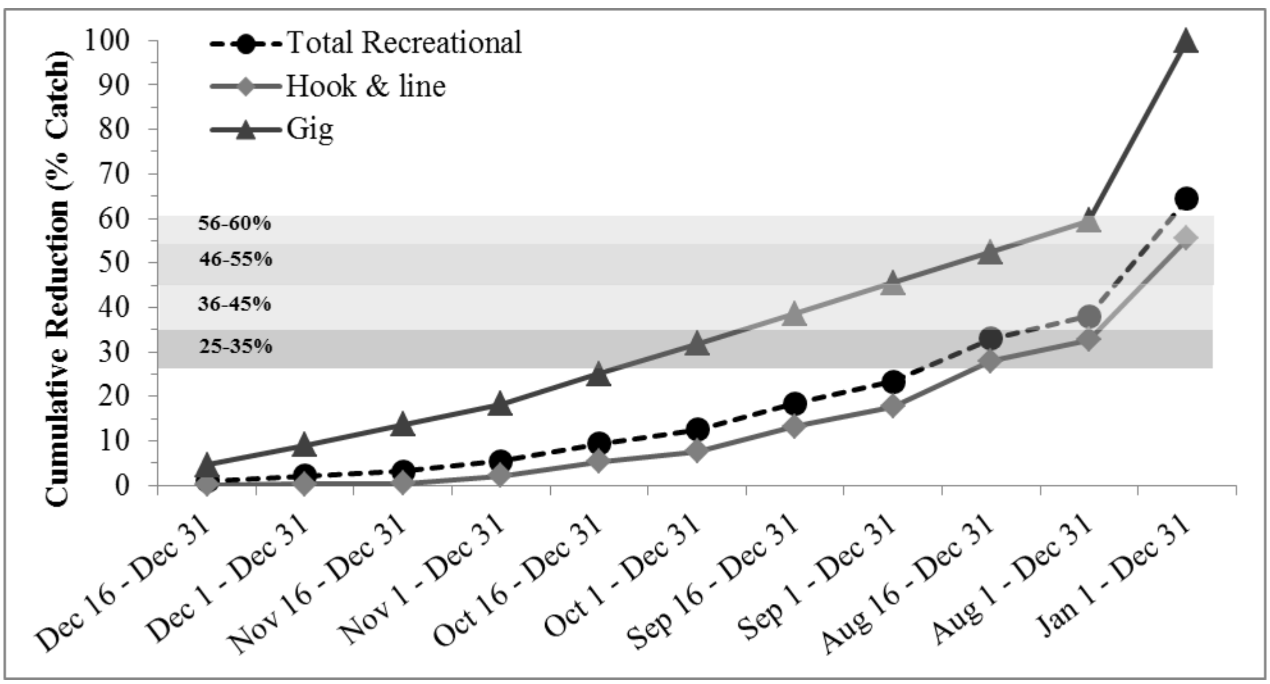

Figure A4.2. Catch reductions (percent) from recreational catch by gear for season closures based on a 2011-2014 average.

Table A4.3. Catch reductions (percent) from catch by gear for a minimum size limit increase based on 2011-2014* commercial catch average. Bolded row includes a reduction within the requested range for the total commercial fishery.

Size limit	Gill net	Pound net	Gig	Other	Total
15 inch	20	16	15	21	18
16 inch	32	33	30	36	**32**

*2014 data are preliminary

Table A4.4. Catch reductions (percent) from recreational catch by gear with a 16-inch minimum size limit based on 2011-2014* recreational catch average.

Size Limit	Hook & Line	Gig	Total
16 inch	12	9	12

*2014 data are preliminary, 2014 gig data were not available

Table A4.5. Catch reductions (percent) from recreational catch by gear for recreational bag limit decreases based on 2011-2014* recreational catch average.

Bag Limit	Hook & Line	Gig	Total
1	19	37	23
2	8	13	10
3	4	6	5
4	2	3	3
5	1	1	2

*2014 data are preliminary, 2014 gig data were not available

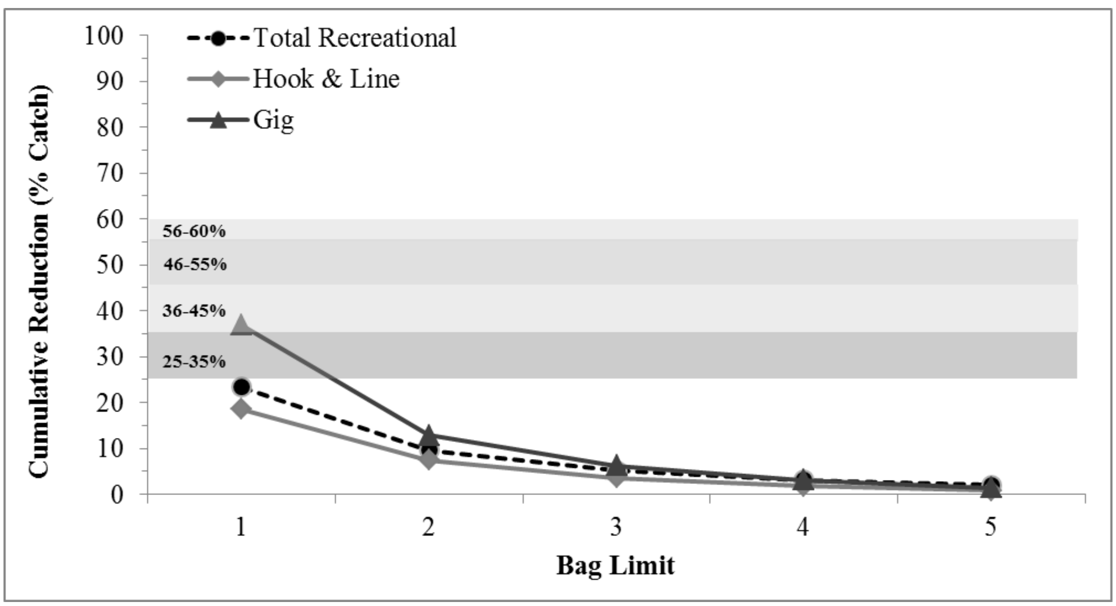

Figure A4.3. Catch reductions (percent) from recreational catch by gear for recreational bag limit decreases based on 2011-2014 average.

FISHERY MANAGEMENT PLAN REVIEW SCHEDULE (July 2014 – June 2019) Revised August 2014					
SPECIES (Last FMP)	**2014-2015**	**2015-2016**	**2016-2017**	**2017-2018**	**2018-2019**
INTERJURISDICTIONAL (6/08)					
SHRIMP (4/06)					
RIVER HERRING (9/07)					
BAY SCALLOP (11/07)					
STRIPED MULLET (4/06)					
KINGFISHES (11/07)					
HARD CLAM (6/08)					
OYSTER (6/08)					
SPOTTED SEA TROUT (2/12)					
RED DRUM (11/08)					
SOUTHERN FLOUNDER (2/13)					
ESTUARINE STRIPED BASS (2/13)					
BLUE CRAB (11/13)					

Stock Assessment of Spotted Seatrout, *Cynoscion nebulosus*, in Virginia and North Carolina Waters

2014

Prepared by

North Carolina Division of Marine Fisheries
Spotted Seatrout Plan Development Team

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We are especially grateful to the external peer reviewers for offering their time and effort to review the spotted seatrout stock assessment.

EXECUTIVE SUMMARY

The North Carolina Fisheries Reform Act requires that fishery management plans be developed for the state's commercially and recreationally significant species to achieve sustainable harvest. Stock assessments are the primary tools used by managers to assist in determining the status of stocks and developing appropriate management measures to ensure their long-term viability.

An assessment of the spotted seatrout in North Carolina and Virginia was conducted using a Stock Synthesis model that incorporated data (1991–2013) collected from commercial and recreational fisheries, two fishery-independent surveys, and a tagging study. This approach differs from the previous NCDMF assessment of spotted seatrout, which was applied to data available from 1991 through 2008. The previous assessment utilized the ASAP2 statistical catch-at-age model and used data more limited in both area and time. The previous model relied primarily upon fishery-dependent data, one fishery-independent index, and also included age data from the North Carolina portion of the stock only.

The time period for the new assessment is 1991 through 2012. The Stock Synthesis model has been thoroughly vetted through the stock assessment community and peer reviewed literature. This assessment relied on expanded fishery-independent data sources, included age data from the Virginia portion of the stock, a juvenile abundance index, and tag-return data from research conducted by Tim Ellis with North Carolina State University. The fishing year was changed from a calendar year to a biological year (defined as March 1 through February 28) to allow the model to incorporate cold stun mortalities within a single fishing year instead of across two calendar years. The maximum age was decreased from 12 years (previous assessment) to nine as the 12 year maximum was based on scale ages not otoliths. Only ages derived from otoliths were used in the current assessment.

Tagging data provided by Tim Ellis were included in the model but did not have a significant influence on results. Multiple model configurations were attempted to account for varying natural mortality based on everything from direct tagging estimates to estimates based on water temperature correlations: however, no model configuration incorporating varying natural mortality would produce results (converge). Tim Ellis' data did provide further evidence of the highs and lows associated with spotted seatrout natural mortalities and the need for a custom model that can incorporate these highly variable mortality rates. The division recognized the need to develop a model that will accept variable natural mortality estimates. Developing a custom model that can incorporate variable natural mortality was added as a research recommendation and the division will continue to investigate this during the next assessment.

The results of this assessment suggest the age structure of the spotted seatrout stock has been expanding during the last decade. However, an abrupt decline is evident in the models estimate of recruitment after 2010, although this is not mirrored in the empirical survey data. Spawning stock biomass increased to its maximum in 2007 but has since declined to close to the time series average. In 2012, the estimate of spawning stock biomass was 1,140 mt (2,513,270 lbs), which is greater than the currently defined threshold for spawning stock biomass (394 mt or 868,621 lbs); this suggests the stock is not currently overfished. Fishing mortality has varied without apparent trend, but periods of high fishing mortality seem to coincide with the decline in spawning stock biomass and may be attributed to cold stun events. The 2012 estimate of fishing mortality was 0.40, which is less than the fishing mortality threshold (0.66), indicating that the stock is not experiencing overfishing; however, the 2012 estimate of fishing mortality (0.40) is very near the target fishing mortality of 0.42.

The stock assessment was reviewed by a panel of three independent reviewers, representing experts in stock assessment or spotted seatrout biology. The peer reviewers agreed that the assessment provided a valid basis for management for at least the next five years, given the available data and current knowledge of the species stock dynamics and fisheries. Concern was raised by one reviewer who stated "periodic mass mortalities have the potential to lead to population bottlenecks where added protections might be wise to let the population recover." In March 2015, the NCDMF agreed that the stock assessment provided a valid basis for management.

The current 2012 spotted seatrout fishery management plan gives the N.C. Division of Marine Fisheries Director proclamation authority to close the fishery if certain conditions are met due to cold stun events. Since the completion of this recent stock assessment, two cold stun events have occurred creating uncertainty about the current status of the stock.

While the current spotted seatrout stock assessment was deemed useable for management, concern remains due to the terminal year fishing mortality level being near the target and two post assessment cold stun events (2014 and 2015). The division's Spotted Seatrout Plan Development Team will continue to investigate modeling techniques that will potentially accommodate variable natural mortality estimates and provide more precise fishing mortality estimates.

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1 INTRODUCTION

1.1 The Resource

Spotted seatrout (*Cynoscion nebulosus*), also known as speckled trout, is a member of the family Sciaenidae (drums), which includes weakfish (*C. regalis*), spot (*Leiostomus xanthurus*), kingfishes or sea mullet (*Menticirrhus* spp.), Atlantic croaker (*Micropogonias undulatus*), black drum (*Pogonias cromis*), and red drum (*Sciaenops ocellatus*). This family of fishes is highly sought after in commercial and recreational fisheries. Spotted seatrout have two other species within its genus found in Virginia's and North Carolina's waters, weakfish (grey trout) and silver seatrout (*C. nothus*). Spotted seatrout can be distinguished from the other two species by the circular specks or spots on its body, dorsal fin, and caudal fin.

Spotted seatrout are found from Massachusetts to Mexico (Manooch 1984). Spotted seatrout have distinct stocks along Florida's Atlantic Coast and in the Gulf of Mexico (GOM; Wilson et al. 2002; Wiley and Chapman 2003; Ward et al. 2007; Anderson and Karel 2009, 2010; Seyoum et al. 2014); however, no studies on stock discrimination have been conducted in North Carolina. The Florida and GOM stocks are managed as distinct units and were established based on tagging and genetic studies. A tagging program for spotted seatrout was completed by North Carolina State University in 2013 and showed movement of fish between North Carolina and Virginia (Ellis 2013). North Carolina State University is furthering research on stock structure with a genetic component that began on July 1, 2014. The NCDMF is continuing the tagging program as well.

1.2 Life History

1.2.1 Stock Definitions

It is widely believed that most spotted seatrout remain in their natal estuary throughout their life cycle, particularly in the southern part of their range (Iversen and Tabb 1962; Music 1981; Baker et al. 1986; Bryant et al. 1989; Baker and Matlock 1993; Wiley and Chapman 2003). Unfortunately, there have been no otolith microchemistry or genetic studies in North Carolina to examine this; however, there has been an increase in tagging efforts to verify this trend and determine migration patterns. Results from two spotted seatrout tagging projects conducted in bordering states showed that 64% of fish tagged in Virginia and 79% of those tagged in South Carolina were recaptured within the same general area (Bain and Lucy 1996, 1997; Bain et al. 1998; Lucy et al. 1999, 2000; Lucy and Bain 2001, 2002, 2003, 2005, 2006, 2007; R. Wiggers, SCDNR, personal communication). However, Virginia's data also indicated that an average of 15% of the spotted seatrout that were recaptured from 1995 to 2006 were recaptured along the North Carolina coast as far south as Wrightsville Beach. The South Carolina study had less than one percent of the recaptured fish caught in North Carolina. Ellis (2013) tagged 6,582 spotted seatrout in Virginia and North Carolina during 2009–2013; a total of 553 tags were returned resulting in an 8.4% reporting rate. Ellis found less than 10% of fish tagged in North Carolina were recaptured outside of North Carolina; most recaptures outside of North Carolina occurred in Chesapeake Bay, Virginia (9.4%) and fewer were recaptured in South Carolina (0.4%). Information from genetic stock identification is not available at this time. The apparent migration of spotted seatrout from Virginia to North Carolina may indicate a tendency for spotted seatrout to travel south to avoid colder winter temperatures since most recaptures in North Carolina occurred in the fall. Given the relatively high mixing rate of spotted seatrout between North Carolina and Virginia, the unit stock for this assessment encompassed all spotted seatrout within North Carolina and Virginia waters. South Carolina was not included due to the low mixing rates with North Carolina.

1.2.2 Movements & Migration

As with many estuarine and marine fish in North Carolina, spotted seatrout have distinct seasonal migrations. During the winter, spotted seatrout migrate to deeper, warmer water. As the waters warm in the summer, seatrout return to oyster beds and shallow bays and flats (Daniel 1988). Although there is distinct seasonal migration, movements north in the spring and southern movements in the fall, spotted seatrout have considerable residency based on tag return studies, with individuals usually traveling less than 20 miles (Brown-Peterson et al. 2002; Ellis 2013). A coast-wide stock assessment of spotted seatrout has not been conducted given the largely non-migratory nature of the species and the lack of data on migration where it does occur (ASMFC 2008). Due to its recreational importance, spotted seatrout were selected as a species for recreational tagging programs in Virginia and South Carolina. Although South Carolina continues to tag spotted seatrout, fishermen are discouraged from tagging these fish due to low tag return numbers. Virginia still tags spotted seatrout but continues to accumulate returns at the low reporting rate of only 3% (Lucy et al. 2007). Most spotted seatrout tagged by the South Carolina Marine Game Fish Tagging Program and Virginia Game Fish Tagging Program remained within the same estuary (R. Wiggers, South Carolina Department of Marine Resources, personal communication; J. Lucy, Virginia Institute of Marine Science, personal communication). Only two fish out of the 350 recaptured spotted seatrout migrated from South Carolina to North Carolina (R. Wiggers, personal communication). Spotted seatrout tagged in Virginia had a higher portion of the recaptures in North Carolina (15% of the 227 recaptured; J. Lucy, personal communication). This led to the decision to incorporate Virginia in the unit stock for this spotted seatrout fishery management plan. The spotted seatrout that were recaptured in North Carolina were generally captured during the fall and winter when the fish had a distinct southerly migration. Ellis (2013) tagged 6,582 spotted seatrout in Virginia and North Carolina during 2009–2013; a total of 553 tags were returned resulting in an 8.4% reporting rate. Ellis found less than 10% of fish tagged in North Carolina travelled outside of North Carolina; most of those recaptured outside of North Carolina occurred in Chesapeake Bay, Virginia (9.4%) and fewer were recaptured in South Carolina (0.4%).

1.2.3 Age/Size

Spotted seatrout are medium-sized fish with a maximum size of 102 cm (40.0 inches) and 7.71 kg (17.0 lb; Froese and Pauly 2008). North Carolina's state record was a 5.56-kg (12-lb 4-ounce) fish caught in 1961. The annual average size of spotted seatrout landed in the North Carolina recreational fishery between 1991 and 2013 ranged from 36.1 to 44.7 cm (14.2 to 17.6 inches); in the commercial fishery, annual average length ranged from between 38.1 and 45.7 cm (15.0 to 18.0 inches). The maximum observed length in North Carolina's recreational fishery was 91.4 cm (36.0 inches) while the maximum observed length in the commercial fishery was 78.8 cm (31.0 inches). The maximum otolith-based age of spotted seatrout has been reported to be 9 years old in Virginia (Ihde and Chittenden 2003), 9 years old in North Carolina, 7 years old in South Carolina (de Silva, unpublished), 8 years old in

Georgia (GACRD 2003), and 9 years old in Florida (Murphy et al. 2006). Although the oldest individual spotted seatrout observed in many studies was male (Moffett 1961; Maceina et al. 1987; Colura et al. 1994; Murphy and Taylor 1994; DeVries et al. 1997), both female and male spotted seatrout have been aged up to age 9 in North Carolina.

1.2.4 Growth

Following the first winter, male spotted seatrout attain an average of 24.6 cm (9.70 inches) in length and females reach an average of 32.5 cm (12.8 inches) in length. Growth rate begins to decrease with age in North Carolina reaching an asymptote by age 4. The predicted average maximum size for spotted seatrout in North Carolina is 67.1 cm (26.4 inches) for males and 77.5 cm (30.5 inches) for females.

Available otolith-based annual age data (raw data) were fit with a von Bertalanffy age-length model to estimate the model parameters for both male and female spotted seatrout. Estimates of L_∞, K, and t_0 were within the range of estimates from previous studies for both sexes (Table 1.1; Figure 1.1).

Parameters of the allometric length-weight relationship were also estimated in this study. The relation of fork length in centimeters to weight in kilograms (raw data) was modeled for males and females separately. The estimated parameters from this and previous studies are presented in Table 1.2. Plots of the observed and predicted values from this study are shown in Figure 1.2.

1.2.5 Reproduction

The spawning season for spotted seatrout varies depending on location (Texas: Brown-Peterson et al. 1988; Mississippi: Brown-Peterson et al. 2001; Gulf of Mexico estuaries: Brown-Peterson et al. 2002; South Carolina: Roumillat and Brouwer 2004; Florida: Lowerre-Barbieri et al. 2009) and peaks around the full moon (Tucker and Faulkner 1987; McMichael and Peters 1989). Virginia spotted seatrout spawn from May through August with peaks in the gonadosomatic index in May and July (Brown 1981). The spawning season in North Carolina is from April to October with a peak in May through June (Burns 1996). Spotted seatrout spawning season in Florida varies by location but generally runs from March to October with a peak in May (Brown-Peterson et al. 2002; Lowerre-Barbieri et al. 2009). The spawning period is generally within the first few hours after sunset (Luczkovich et al. 1999). During the peak of the season, older spotted seatrout (>3 years old) spawn approximately every two days while younger spotted seatrout (ages 0 and 1) spawn approximately every 4 days (Roumillat and Brouwer 2004), though spawning frequency can vary by location and time of year (Brown-Peterson et al. 2001, 2002). Estimates of fecundity for spotted seatrout range from 3 to 20 million ova per year depending on age, length, and water temperature (Nieland et al. 2002; Roumillat and Brouwer 2004; Murphy et al. 2011); however, fecundity estimates specific to North Carolina are not available at this time. Spawning takes place on or near seagrass beds, sandy banks, natural sand, shell reefs, near the mouths of inlets, and off the beach (Daniel 1988; Brown-Peterson et al. 2002).

Temperature and salinity have an influence on the reproductive output of female spotted seatrout. Temperature and salinity in spawning areas can vary, with temperature ranging from 15 to 31˚C and salinity ranging from 18 to 35 ppt (Brown-Peterson et al. 1988; McMichael and Peters 1989; Walters 2005). When water temperatures exceed 30°C, the spawning season can be reduced (Jannke 1971). However, more recent work determined salinity was the most probable factor for differences in spawning season, spawning frequency, and batch fecundity between GOM estuaries, particularly low salinity may shorten spawning seasons and decrease spawning frequency and batch fecundity (Brown-Peterson et al. 2002).

Maturity of female spotted seatrout was estimated using data collected from various NCDMF fisheries-dependent and -independent programs. Maturity at length (M_l) was modeled as:

$$M_l = \frac{1}{1 + e^{\alpha(l-\beta)}}$$

where l is length, α is the slope, and β is the inflection point.

The parameters α and β were estimated via logistic regression. The estimated value for α was -0.044 and the estimated value for β was 27.0 cm (Figure 1.3).

1.2.6 Mortality

1.2.6.1 Natural Mortality

Ellis (2014) conducted the first comprehensive spotted seatrout tag-return study in North Carolina waters with the objective of quantifying mortality and movement. Estimates of bimonthly natural mortality ranged from 0.062 to 2.527 and varied by season, while annual estimates of natural mortality ranged from 1.109 to 3.837. Ellis (2014) found natural mortality was responsible for 49.1%–96.9% of total mortality based on bimonthly estimates and 81%-92% of total mortality based on annual estimates. The importance of natural mortality compared to fishing mortality was further supported by an acoustic telemetry study. Natural mortality was generally highest during periods of cold temperatures when water temperatures were below 5˚C, with the highest estimate of natural mortality (M = 2.527) occurring in November/December 2010 (Ellis 2014). Estimates of M from Ellis (2014) were particularly high during the winters of 2009/2010 and 2010/2011, periods which coincided with reports of cold-stunned spotted seatrout following rapid decreases in temperature throughout the state.

1.2.6.2 Discard Mortality

Commercial

An extensive literature review revealed limited existing information on mortality estimates from gill-net fisheries. However, there has been some research from the NCDMF examining the mortality of spotted seatrout in North Carolina associated with small mesh gill nets (Price and Gearhart 2002).

During the time period covered by the previous assessment, the size limit was 12 inches. Given the mesh sizes in gears used by the commercial fishery, it was assumed that all spotted seatrout caught were kept and there were no discards. However, the size limit was increased to 14 inches following the last assessment, and a discard mortality of 60% was estimated for the calculation of harvest reduction scenarios based on results reported by Price and Gearhart (2002). Total mortalities reported by Price and Gearhart (2002) were between 66 and 90% depending on mesh size, season, and salinity (Table 1.3). Set gill nets make up a large portion of the landings in the spotted seatrout commercial fishery, but other major gears such as runaround gill nets may not have as high mortality, so the previous PDT decided to use an adjusted rate of 60% to account for this.

Price and Gearhart (2002) and additional NCDMF data from the NCDMF Fishery-Independent Gill-Net Survey (Program 915; NCDMF 2012a) also showed that time of year may be a significant factor affecting mortality of spotted seatrout (Tables 1.4 and 1.5). Mortalities appear higher during spring/summer when water temperatures are warmer and dissolved oxygen levels are lower than in the fall/winter months.

Results of the Price and Gearhart (2002) study suggest that salinity (outer banks or river sites), dissolved oxygen (correlated with time of year), and mesh size significantly affect the survivability of spotted seatrout captured in gill nets (Table 1.6). Average salinity was 19 ppt for the outer banks and 10 ppt for the river sites. Total gill-net mortality was calculated as at-net mortality plus delayed mortality. Unfortunately, the study only reported delayed mortality for the different salinity areas, so it is not possible to get an estimate of total mortality necessary for assessment use.

Mortality was higher at outer banks sites, which suggests a decreased salinity tolerance for these fish (Table 1.6). Overall delayed mortality averaged 30% in the study, but these are likely overestimates due to the confounding factors of handling, transport, confinement, and tagging stress that may play a role in the observed mortality of these fishes (Price and Gearhart 2002).

Recreational

Release mortality is likely a significant source of mortality on spotted seatrout in North Carolina since Type B2 releases have accounted for an increasing percentage of the overall catch in recent years (Jensen 2009). Several hook-and-line release mortality studies have been conducted on spotted seatrout throughout the Atlantic and Gulf coasts where estimates of mortality varied greatly and ranged from 4.6% up to 55.6% (Matlock and Dailey 1981; Hegen et al. 1983; Matlock et al. 1993; Murphy et al. 1995; Duffy 1999; Duffy 2002; Gearhart 2002; Stunz and McKee 2006; Brown 2007; Table 1.7).

Two of the studies were conducted by NCDMF in North Carolina waters: Gearhart (2002) found a hooking mortality rate of 14.8%, whereas Brown (2007) arrived at a rate of 25.2%. It was noted that Brown (2007) was limited geographically having fished only in the Neuse River. In addition, this study had problems with low dissolved oxygen in the holding pens resulting in deaths not associated with hooking. It was found that these fish were included in the calculation of hooking mortality, causing an inflated rate. In comparison, Gearhart (2002) covered a wider geographic range in North Carolina at river (low salinity) and outer banks (high salinity) sites from Pamlico, Core, and Roanoke sounds between June 2000 and August 2001.

The previous spotted seatrout PDT felt that the hooking mortality rate of 25.2% from Brown (2007) was too high, particularly given the dissolved oxygen problems and questioned whether the overall rate of 14.8% from Gearhart (2002) was also too high. Gearhart (2002) stated that there may be a regional or salinity effect, and future stock assessments may want to consider applying separate mortality rates to fish caught in low versus high salinity areas; although neither location nor salinity were significant factors in the presence or level of bleeding and length in the resulting logistic equation used to identify significant factors associated with hooking mortality.

Ultimately, the previous spotted seatrout assessment (Jensen 2009) applied separate rates to fish caught in low versus high salinity areas based on MRFSS data. The MRFSS estimates cannot be directly separated into regions based on salinity; therefore, raw intercept data from the MRFSS survey were used to calculate a ratio of observed catch based on county of landing in low salinity areas (Pamlico, Craven, Hyde—excluding Ocracoke, Beaufort, and Currituck counties) versus high salinity areas (Dare, Carteret, Onslow, Pender, New Hanover, and Brunswick counties). The total catch was weighted by the unadjusted mortality rates for low (19.4%) and high (7.3%) salinity sites as reported by Gearhart (2002) and divided by the combined total catch to obtain an overall release mortality rate of 10% for use in the last stock assessment. This rate is consistent with the rates used in previous spotted seatrout stock assessments from South Carolina (Zhao and Wenner 1995) and Georgia (Zhao et al. 1997)

1.2.7 Food & Feeding Habits

Spotted seatrout have ontogenetic changes in their diet (Holt and Holt 2000). Spotted seatrout less than 1.5 inches consume copepods as the primary prey. Fish between 1.5 and 5.5 inches consume mysids, amphipods, polychaetes, and shrimp. These juvenile spotted seatrout have considerable dietary overlap with juvenile red drum and tend to inhabit similar areas. Spotted seatrout larger than 5.5 inches become one of the top predators in estuaries where they feed on a variety of fishes and shrimp (Daniel 1988; McMichael and Peters 1989).

1.3 Habitat

1.3.1 Overview

Spotted seatrout make use of a variety of habitats during their life history with variations in habitat preference due to location, season, and ontogenetic stage. Although primarily estuarine, spotted seatrout use habitats throughout estuaries and occasionally the coastal ocean. Spotted seatrout are found in most habitats identified by the North Carolina Coastal Habitat Protection Plan (CHPP) including water column, wetlands, submerged aquatic vegetation (SAV), soft bottom, and shell bottom (Street et al. 2005). Each habitat is part of a larger habitat mosaic, which plays a vital role in the overall productivity and health of the coastal ecosystem. Additionally, these habitats function to provide the appropriate physicochemical and biological conditions necessary to maintain and enhance the spotted seatrout population. Protection of each habitat type is therefore critical to the sustainability of the spotted seatrout stock. Information on the ecological value of each of these habitats to spotted seatrout and their current condition is provided below.

1.3.2 Spawning Habitat

Spotted seatrout spawning is generally limited to the waters within the confines of the estuary. Peak spawning activity occurs at temperatures between 21 and 29°C and at salinities typically greater than 15 ppt (ASMFC 1984; Mercer 1984; Saucier and Baltz 1992, 1993; Holt and Holt 2003; Kupschus 2004). Spawning sites have been noted to include tidal passes, channels, river mouths, and waters in the vicinity of inlets with depths of spawning locations ranging from 2 to 10 m (Saucier and Baltz 1992, 1993; Roumillat et al. 1997; Luczkovich et al. 1999). In North Carolina, spotted seatrout in spawning condition have been collected in southern Albemarle, Pamlico, and Core/Bogue sounds, as well as in the southern estuaries (Burns 1996). Spawning in the Pamlico Sound area has been confirmed using hydrophone and sonobuoy surveys (Luczkovich et al. 1999). Luczkovich et al. (1999) detected spotted seatrout spawning on both the eastern and western sides of Pamlico Sound including Rose Bay, Jones Bay, Fisherman’s Bay, Bay River, and near Ocracoke and Hatteras inlets from

May through September with peak activity in July. These spawning aggregations were primarily located in areas with depths less than 3 m. When spotted seatrout aggregations co-occurred with aggregations of weakfish at Ocracoke Inlet, the habitat was partitioned with each species occupying different depth ranges: weakfish in waters greater than 3 m and spotted seatrout in waters less than 3 m.

Additional hydrophone surveys conducted from 2003 to 2005 in the Neuse River estuary noted large spawning aggregations of spotted seatrout in this area (Barrios et al. 2006; A. Barrios, unpublished data). Although the survey was directed to locate spawning aggregations of red drum, spawning aggregations of spotted seatrout were also detected at sites ranging from Oriental to the mouth of the Neuse River (A. Barrios, unpublished data). The locations of these aggregations were generally associated with moderate salinities (12–20 ppt), temperatures between 27 and 29°C, saturated dissolved oxygen levels (>5 mg/L O_2), and water depths less than 5 m. Spawning was also reported to occur over both mud and subtidal shell bottoms in these areas. In areas south of Pamlico Sound, such as Beaufort Inlet, spotted seatrout larvae have been collected in moderate numbers indicating localized spawning (Hettler and Chester 1990). Information on spotted seatrout spawning from other areas in North Carolina is generally lacking.

1.3.3 Nursery & Juvenile Habitat

The water column provides a transport mechanism for spotted seatrout eggs and larvae. Eggs of spotted seatrout are positively buoyant at spawning salinities allowing for wind- and tidally-driven distribution throughout the estuary (Churchill et al. 1999; Holt and Holt 2003). However, sudden salinity reductions cause spotted seatrout eggs to sink, thus reducing dispersal and survival (Holt and Holt 2003). Larval spotted seatrout have been collected in surface and bottom waters of estuaries in North Carolina, Florida, and Texas (McMichael and Peters 1989; Hettler and Chester 1990; Holt and Holt 2000). In North Carolina, larval transport studies in the vicinity of Beaufort Inlet indicated that ocean- and inlet-spawned larvae are dependent on appropriate wind and tidal conditions to pass through inlets and be retained in the estuary (Churchill et al. 1999; Luettich et al. 1999; Hare et al. 1999). Although spotted seatrout spawning generally occurs within the confines of the estuary (ASMFC 1984; Mercer 1984; Saucier and Baltz 1992, 1993), spawning aggregations have been located near inlets in North Carolina (A. Barrios, unpublished data). Therefore, these physical processes appear to directly influence the retention and recruitment success of spotted seatrout to high salinity nursery areas (McMichael and Peters 1989). Behaviors such as directional swimming and movement throughout the water column also provide mechanisms for estuarine dispersal and retention of larvae within the estuary (Rowe and Epifanio 1994; Churchill et al. 1999; Hare et al. 1999).

Wetlands are particularly valuable as nurseries and foraging habitat for spotted seatrout as well as other fishes and shellfish (Graff and Middleton 2003). The combination of shallow water, thick vegetation, and high primary productivity provides juvenile and small fishes with appropriate physicochemical conditions for growth, refuge from predation, and abundant prey resources (Boesch and Turner 1984; Mitsch and Gosselink 1993; Beck et al. 2001).

Juvenile spotted seatrout appear to use estuarine wetlands, principally salt/brackish marshes, as nurseries (Tabb 1966; ASMFC 1984; Mercer 1984). In North Carolina, juvenile spotted seatrout have been found to be abundant in tidal marshes and marsh creeks in eastern and western Pamlico Sound and Bogue Sound (Epperly 1984; Ross and Epperly 1985; Hettler 1989; Noble and Monroe 1991). Additionally, juvenile spotted seatrout have been found using salt marsh habitats in the Cape Fear River, although in less abundance than more northern estuaries (Weinstein 1979). Documentation of juveniles in wetlands in other North Carolina estuaries is somewhat sparse. Of particular importance to juvenile spotted seatrout is the marsh edge habitat (Hettler 1989; Rakocinski et al. 1992; Baltz et al. 1993; Peterson and Turner 1994).

In Tampa Bay, McMichael and Peters (1989) found that seagrass was the primary habitat for juvenile spotted seatrout. Habitat suitability models have indicated that spotted seatrout abundance is linearly related to percent seagrass cover until a plateau is reached at 60% coverage (Kupschus 2003). The composition of species in the seagrass beds may also influence the use of these habitats by juvenile spotted seatrout (Rooker et al. 1998). Additionally, meta-analyses indicated that juvenile spotted seatrout abundances were found to be greater in SAV than soft bottom and oyster reef and were greater than or equivalent to abundances in wetland habitats (Minello 1999; Minello et al. 2003).

Soft bottom habitats also function as important nurseries for juvenile spotted seatrout (Ross and Epperly 1985; Noble and Monroe 1991). These areas generally are located adjacent to wetlands and function to provide juveniles with abundant prey resources and appropriate physicochemical conditions for growth and survival.

In North Carolina, SAV is used extensively by spotted seatrout as important nurseries and foraging grounds. Historical data collected by the NCDMF through otter trawl and seine surveys have indicated that juveniles are abundant in high salinity SAV in both Pamlico and Core sounds (Purvis 1976; Wolff 1976; NCDMF 1990).

1.3.4 Adult Habitat

Collections with long haul seines in eastern Pamlico Sound have documented an abundance of adult spotted seatrout in SAV from Oregon Inlet to Ocracoke Inlet (NCDMF 1990). Furthermore, the NCDMF Fisheries-Independent Gill-Net Survey (Program 915), Red Drum Juvenile Survey (Program 123), and Estuarine Trawl Survey (Program 120) have found that relative abundance of spotted seatrout was generally greatest over high salinity SAV in eastern Pamlico Sound (NCDMF, unpublished data).

The complex three-dimensional structure of shell bottom habitats provides juvenile and adult spotted seatrout with areas for refuge, foraging, and growth. Juvenile and adult spotted seatrout have been documented using shell bottom habitats in Virginia (Harding and Mann 2001), North Carolina (Lenihan et al. 2001; Grabowski 2002), South Carolina (Daniel 1988), and Louisiana (MacRae 2006).

1.3.5 Habitat Issues & Concerns

Although this species is euryhaline, salinity plays an important role in the buoyancy of eggs and larvae, which are negatively buoyant at salinities less than 20 ppt (Holt and Holt 2003). Documented spawning activity of spotted seatrout in western Pamlico Sound tributaries, such as Bay River, Jones Bay, and Neuse River, frequently experience salinities less than 20 ppt (Luczkovich et al. 1999; A Barrios, unpublished data), which could result in the failed survival of eggs spawned in these areas. Dissolved oxygen concentrations also affect spotted seatrout distribution, with decreasing abundance at concentrations less than saturation

(Gelwick et al. 2001). Human activities that alter the preferred environmental conditions of spotted seatrout, as well as introductions of excessive nutrients, toxins, and sediment loads, can severely impact the habitat value for spotted seatrout.

Most demersal fishes experience low-oxygen induced mortality in waters having 1–2 mg/L O_2 and altered metabolism at concentrations less than 4 mg/L O_2 (Miller et al. 1985; Gray et al. 2002). Some estuarine organisms are capable of detecting and avoiding these low dissolved oxygen concentrations, but thresholds vary among species (Wannamaker and Rice 2000). There are no reported oxygen thresholds for spotted seatrout; however, this species is often reported to be associated with habitats with saturated dissolved oxygen concentrations (Gelwick et al. 2001).

Increased sedimentation in water column habitats can have significant impacts on aquatic life. Increased turbidity can shade out productive flora such as phytoplankton and SAV (North Carolina Sea Grant 1997), resulting in trophic impacts for secondary and tertiary consumers. In addition, the increased sediment load in the water column can clog gills and pores of fish and invertebrates, resulting in reduced feeding capacities or even mortality (Ross and Lancaster 1996; NCDWQ 2000a). Tabb et al. (1962) reported that excessively turbid waters in Everglades National Park following Hurricane Donna resulted in mass mortalities of spotted seatrout when their gill chambers became packed with suspended sediments.

Winter water temperature dynamics are of particular importance to habitat quality for spotted seatrout. Generally, spotted seatrout overwinter in estuaries, only moving to deeper channels or to nearshore ocean habitats in response to water temperatures below 10°C (Tabb 1966; ASMFC 1984). However, extreme cold waves accompanied by strong winds mix and chill the water column, causing sudden drops in water temperature. The abrupt temperature decline numbs spotted seatrout and can result in mass mortality (Tabb 1966). Many estuarine temperature refuges, such as deep holes and channels, are often far from inlets and become death traps as spotted seatrout are cold stunned before they can escape. This suggests that the severity and duration of cold weather events can have profound effects on the spotted seatrout population in North Carolina’s estuaries.

1.4 Description of Fisheries

1.4.1 Commercial Fishery

Spotted seatrout have been commercially harvested in North Carolina using a variety of gears, but four gear types are most common: estuarine gill net, long haul seine, beach seine, and ocean gill net. Estuarine gill nets are the predominant gear. Historically, long haul seines (swipe nets) used in estuarine (inshore) waters were the dominant gear, but effort and landings by this gear have diminished in recent years.

Monthly landings of spotted seatrout by estuarine set gill nets occur year round but mostly occur during the late fall and winter (October–February), with slight increases in the spring (April–May).

The importance of runaround gill nets in North Carolina has steadily increased since 1972 and a continued surge in the mid 1990s may have been caused by the 1995 gill-net closure in Florida state waters (NCDMF 2006) as some of Florida’s commercial fishermen moved their operations to North Carolina. More jet drive boats, spotting towers, night fishing, and runaround gill netting were reported by the mid-1990s. A shift from set nets to runaround fishing techniques may have been prompted by expanded fishery rules requiring gill-net attendance for small mesh (<5 inches stretch mesh) beginning in 1998.

Monthly landings of spotted seatrout by estuarine runaround gill nets are highest in November and December. A large spike in the number of positive trips occurs during October without a corresponding spike in catch. This could be indicative of spotted seatrout bycatch in other fisheries that are active during October such as the striped mullet fishery.

The long haul season starts in the spring and continues through the fall. The majority of trips occur in July; however, the best catches occur in November and December.

The small mesh beach seine fishery operates predominantly during the spring (April-May) and fall (September-October). Beach seine landings of spotted seatrout typically occur during the spring (April-May) and fall (October-November) months. If conditions are favorable, fishermen along the northern Outer Banks particularly target spotted seatrout during the full moon in May.

Landings of spotted seatrout by ocean set nets are most active from October through February, but good catches occur in April and May.

1.4.2 Recreational Fishery

Spotted seatrout are taken by a variety of methods throughout the coastal zone. Depending on the time of year, anglers fish for spotted seatrout from the surf, inlets, piers and jetties, bays and rivers, and inland creeks. The fall season produces the largest portion of the catch and offers the most widespread fishing opportunities. Anglers catch spotted seatrout using an array of artificial and natural baits. Preferred artificial baits include soft and hard bodied lures of various colors and shapes fished on the bottom, mid-water, and top water. Bottom fishing using natural baits (including live shrimp, mullet, and mud minnows) is also very popular and can be very productive as well.

While lures and fishing techniques are constantly evolving, the past few years have seen significant changes and improvements in lures and other tackle available to anglers that target and catch spotted seatrout. There is anecdotal evidence that these improvements have had a positive impact on catch rate and overall fishing success. In the early 2000s, bait manufacturers introduced “scented” soft-bodied lures that have become very popular and lead to increased success of anglers targeting spotted seatrout. “GULP” fishing baits have become a basic component of every spotted seatrout angler’s tackle box. Hard-bodied artificial baits such as those from MirrOlure®, Yo-Zuri, and Rapala have also undergone design and color pattern changes increasing their effectiveness. Spotted seatrout are often selective requiring anglers to utilize a variety of baits and different fishing techniques. Many anglers also attest to better catch rates due to the widespread use of braided fishing lines. Braided lines along with new graphite rod building technology provide increased sensitivity improving strike detections resulting in more fish caught.

In addition to hook and line catches, some spotted seatrout are taken by gig and recreational commercial gear (gill nets) where permitted (ASMFC 1984; Watterson 2003).

1.5 Fisheries Management

1.5.1 Management Authority

The NCDMF is responsible for the management of estuarine and marine resources occurring in all state coastal fishing waters extending to three miles offshore. The VMRC is responsible for tidal waters of Virginia and the ocean waters extending to three miles offshore.

Spotted seatrout have been managed along the Atlantic Coast through an Interjurisdictional FMP developed by the Atlantic States Marine Fisheries Commission (ASMFC). The ASMFC Spotted Seatrout FMP was initially approved in 1984 (ASMFC 1984), and has been reviewed annually since 2001. Amendment 1, approved by the ASMFC Policy Board in November 1990, developed a list of goals for coast-wide management but allowed each state that had an interest in the spotted seatrout fishery (Florida through Maryland) to manage their stocks independently (ASMFC 1990). The adoption of the Omnibus Amendment 2 (ASMFC 2011) to the Interstate Fishery Management Plan for spotted seatrout requires states to comply with Atlantic Coastal Fisheries Cooperative Management Act (1993) and the ASMFC Interstate Fishery Management Program Charter. North Carolina currently is in compliance with the minimum size limit for both recreational and commercial sectors and has adopted the recommended 20% spawning potential ratio (SPR) threshold.

1.5.2 Management Unit Definition

The management unit includes spotted seatrout and its fisheries in all of Virginia and North Carolina's fishing waters.

1.5.3 Regulatory History

<u>VMRC</u>

On July 1, 1992, the VMRC established a 14-inch minimum size limit for both the commercial and recreational fisheries, as well as a 10-fish possession limit for the recreational fishery, as well as commercial hook and line. On August 1, 1995, a commercial quota of 51,104 pounds was established with a season running from September 1 through August 31 of the following year. Beginning April 1, 2011, the VMRC lowered the commercial hook and line and the recreational possession limit to 5 fish from December 1 through March 31, with only 1 fish 24 inches or greater. As of April 1, 2014, the VMRC established the 5 fish commercial hook and line and recreational possession limit, with only 1 fish 24 inches or greater as a year round regulation. Also effective April 1, 2014 a trigger was established that once 80% of the commercial quota was harvested the commercial possession limit will be no greater than 100 pounds of spotted seatrout with an equal amount of other species on board.

Regulatory history since 1992 is listed in Tables 1.8 and 1.9.

<u>NCDMF</u>

The size limit rule for spotted seatrout was effective September 1989 (12 inches). The first harvest restriction (10-fish recreational bag limit or taken by hook and line) was established through proclamation authority of hook-and-line regulated species (1994). This was put into rule in 1997. The rules remained the same until 2009 when the size limit was increased by proclamation (14 inches).

Rules for spotted seatrout management from 1991 to 2009 were:

(a) It is unlawful to possess spotted seatrout less than 12 inches total length.

(b) It is unlawful to possess more than 10 spotted seatrout per person per day taken by hook-and-line or for recreational purposes.

Since 2009, there have been several changes to the management of spotted seatrout.

Proclamation history since 2009 is listed in Tables 1.10 and 1.11.

1.5.4 Current Regulations

VMRC

In Virginia, A 14-inch minimum size limit exists for both the commercial and recreational fisheries. If caught by pound net or haul seine, up to 5.0% (by weight) of the fish can be undersized. A commercial quota of 51,104 pounds was established with a season running from September 1 through August 31 of the following year. Once 80% of the commercial quota is harvested, the commercial possession limit will be no greater than 100 pounds of spotted seatrout with an equal amount of other species on board. The VMRC will close the fishery based on weekly dealer reporting when it is projected that the quota has been attained. The commercial hook and line and the recreational possession limit is five fish, with only one fish 24 inches or greater.

NCDMF

The NCDMF currently allows the recreational harvest of spotted seatrout seven days per week with a minimum size limit of 14 inches total length and a daily bag limit of four fish. The commercial harvest is limited to a daily limit of 75 fish with a minimum size limit of 14 inches total length. It is unlawful for a commercial fishing operation to possess or sell spotted seatrout for commercial purposes taken from Joint Fishing Waters of the state from midnight on Friday to midnight on Sunday each week, the Albemarle and Currituck sounds are exempt from this weekend closure.

1.6 Assessment History

1.6.1 Review of Previous Methods & Results

The 2009 NCDMF spotted seatrout assessment applied a forward-projecting age-structured model (ASAP version 2.0.17) to data collected from 1991 to 2008 (Jensen 2009). The inputs included commercial landings at age, recreational catch at age, and three indices of abundance. An index based on the NCDMF Fishery-Independent Gill-Net Survey (Program 915) in Pamlico Sound served as the only fisheries-independent index. Data from the North Carolina Trip Ticket Program were used to develop a fisheries-dependent index for 1994 to 2008. Another fisheries-dependent index was developed based on data collected in the MRFSS program. Based on the results of the stock assessment, the stock was overfished and overfishing was occurring at the time of the last assessment (Jensen 2009; NCDMF 2012b).

1.6.2 Progress on Research Recommendations

The following research recommendations were listed in the 2009 NCDMF assessment of spotted seatrout (Jensen 2009). Progress on individual recommendations is also noted if information was available.

1. This assessment is based on the assumption that spotted seatrout in both Virginia and North Carolina waters can be treated as a unit stock. Microchemistry, genetic, or tagging

studies are needed to verify migration patterns, mixing rates, or origins of spotted seatrout between North Carolina and Virginia. In addition, tagging studies can also be designed to verify estimates of natural and fishing mortality used in this assessment. Given the nature of seatrout to remain in their natal estuary, it is also possible that there are localized populations within the state of North Carolina (e.g., a southern and northern stock) that could confound the assessment results.

Progress: Ellis (2013) conducted a tag-return study to estimate fishing and natural mortality of spotted seatrout in North Carolina waters during 2010–2013. The spatial distribution of tag recoveries was also used to infer movement patterns of the adult stock. Most recoveries occurred near the location of tagging, indicating year-round residence in estuarine waters and little long distance movement; however, fish tagged in the northern Outer Banks were more frequently recovered at great distances from the tagging location, indicating less closure of the population in this area. Most interstate movement (9.8% of all recoveries) was in a northwards direction and/or in Chesapeake Bay. Fall movements tended to be southwards, and spring and summer movements tended to be northwards. While Ellis (2013) reported the fraction of extra-jurisdictional recoveries, movement rates could not be quantified within the tag-return model because fish were not tagged in all areas (Virginia and South Carolina).

2. Development of a juvenile abundance index would enhance the ASAP's ability to model recruitment.

   Progress: An index of juvenile spotted seatrout abundance was developed from the NCDMF Estuarine Trawl Survey (Program 120) data for use in the current assessment (see section 2.2.1).

3. Batch fecundity estimates are needed for spotted seatrout in North Carolina. Estimates of batch fecundity are variable from spotted seatrout populations in other states (Bortone 2003) and were therefore not used in this assessment. Estimates of batch fecundity from North Carolina could result in a clearer stock recruitment relationship, and may provide better estimates of spawning potential ratios.

   Progress: No further research into spotted seatrout batch fecundity has been conducted since the time of the last stock assessment. The current assessment uses spawning stock biomass as a proxy for egg production.

4. A longer time series and additional sources of fishery-independent information would enhance the accuracy of the model. The current model relies heavily upon fishery-dependent information.

   Progress: The current assessment model incorporates five fisheries-independent survey indices. Additionally, four years of data have been added to the model.

5. There was some question about the precision of the MRFSS index used in this assessment, particularly since the trend of the index did not follow those of the rest of the data inputs. Application of the Stephens and MacCall (2004) method, used to develop the commercial trip ticket index, to the MRFSS data may result in a more reliable index.

   Progress: Indices of relative spotted seatrout abundance were not developed from fisheries-dependent data because fisheries-dependent indices are associated with numerous biases. Relative indices are assumed to be proportional to stock size. In order for a fisheries-dependent index to be proportional to abundance, fishing effort must be random with respect to the distribution of the population and catchability must be constant over space and time. This is one of the benefits of fisheries-independent surveys for use as indices of abundance—they are designed to provide unbiased estimators and employ a standard methodology over time and space. Other factors affecting the proportionality of fisheries-dependent indices to stock size include changes in fishing power, gear selectivity, gear saturation and handling time, fishery regulations, gear configuration, fishermen skill, market prices, discarding, vulnerability and availability to the gear, distribution of fishing activity, seasonal and spatial patterns of stock distribution, changes in stock abundance, and environmental variables. Additionally, it is often difficult to define a standard unit of effort for fisheries-dependent data. Many agencies, including the NCDMF, don't require fishermen to report records of positive effort with zero catch; lack of these "zero catch" records in the calculation of indices can introduce further bias. Furthermore, fisheries-dependent indices are, at most, only reflective of trends in fished areas and apply only to individuals within the size range that is capable of being caught by the fishing gear. Both fisheries-dependent and fisheries-independent indices can be standardized to account for factors other than changes in abundance that affect the indices (Maunder and Punt 2004). This requires the collection of auxiliary data at the time of harvest or sampling event. Often, such data are not available for fisheries-dependent indices. Finally, fisheries-dependent indices tend to exhibit hyperstability (Harley 2001); that is, the index remains high while the population declines.

6. Increased observer coverage in a variety of commercial fisheries over a wider area would help to confirm whether discards of spotted seatrout in the commercial fishery are indeed negligible.

   Progress: Observer coverage in the gill-net fishery has increased following litigation under the U.S. Endangered Species Act to protect sea turtles from illegal takes within North Carolina waters.

7. If spotted seatrout from Virginia continue to be included in future spotted seatrout stock assessments for North Carolina, it would be beneficial to compare maturity ogives from both states. Currently, Virginia's maturity data are not collected in a way that allows for development of these ogives.

   Progress: No progress has been made in comparing Virginia and North Carolina maturity schedules, because Virginia data is not suitable for the development of a maturity ogive. The VMRC collects maturity data from fisheries-dependent sources only, which would result in a biased estimate of maturity parameters because only larger, presumably more mature, fish would be included. Additionally, their data are not collected in a way that allows for development of maturity ogives.

8. Further research on the possible influences of salinity on release mortality of spotted seatrout would confirm the strategy of applying different release mortalities to fish caught in areas of differing salinity.

   Progress: No further research into spotted seatrout catch-and-release or discard mortality has been conducted since the time of the last stock assessment.

9. Investigation of the relationship of temperature with both adult and juvenile mortality could contribute more information to the model. The feasibility of including measures of temperature or salinity into the stock-recruitment relationship could be researched; although, these comparisons should be attempted with caution to avoid spurious correlations between environmental variables and resulting recruitment.

   Progress: Ellis (2013) conducted a large-scale tag-return study to estimate adult fishing and natural mortality in North Carolina waters. The results demonstrated that spotted seatrout in North Carolina experience relatively low levels of fishing mortality and episodically high natural mortality during "cold stun" years. A "cold stun" event appeared to occur when water temperatures dropped below 5°C during the winter of 2010/2011, when bimonthly natural mortality was estimated to be as high as 2.6. In contrast, the highest level of bimonthly fishing mortality was estimated to be 0.14. Separate experiments, telemetry and laboratory, confirmed the approximate temperature threshold identified in the tag-return study. Estimates of total mortality were corroborated by fitting a catch curve to Program 915 spotted seatrout data during the same time periods as the tag-return study.

2 DATA

Note that all data were summarized by fishing year (March to February) to correspond with the life history of the species (a March 1 birth date was assumed). Data were summarized for fishing years 1991 (March 1991) to 2012 (February 2013), where available, to coincide with the time series used in the stock assessment model. The year 1991 was the first year in which age data were available.

2.1 Fisheries-Dependent

2.1.1 Commercial Landings

2.1.1.1 Survey Design and Methods

<u>VMRC</u>

The VMRC's commercial fisheries records include information on both commercial harvest (fish caught and kept from an area) and landings (fish offloaded at a dock) in Virginia. Records of fish harvested from federal waters and landed in Virginia have been provided by the NMFS and its predecessors since 1929 (NMFS, pers. comm.). The VMRC began collecting voluntary reports of commercial landings from seafood buyers in 1973. A mandatory harvester reporting system was initiated in 1993 and collects trip-level data on harvest and landings within Virginia waters. Data collected from the mandatory reporting program are considered reliable starting in 1994, the year after the pilot year of program. The Potomac River Fisheries Commission has provided information on fish caught in their jurisdiction and landed in Virginia since 1973.

<u>NCDMF</u>

Prior to 1978, North Carolina's commercial landings data were collected by the National Marine Fisheries Service (NMFS). In 1978, the NCDMF entered into a cooperative program with the NMFS to maintain and expand the monthly surveys of North Carolina's major commercial seafood dealers. Beginning in 1994, the NCDMF instituted a mandatory trip-ticket system to track commercial landings.

On January 1, 1994, the NCDMF initiated a Trip Ticket Program (TTP) to obtain more complete and accurate trip-level commercial landings statistics (Lupton and Phalen 1996). Trip ticket forms are used by state-licensed fish dealers to document all transfers of fish sold from coastal waters from the fishermen to the dealer. The data reported on these forms include transaction date, area fished, gear used, and landed species as well as fishermen and dealer information.

The majority of trips reported to the NCDMF TTP only record one gear per trip; however, as many as three gears can be reported on a trip ticket and are entered by the program's data clerks in no particular order. When multiple gears are listed on a trip ticket, the first gear may not be the gear used to catch a specific species if multiple species were listed on the same ticket but caught with different gears. In 2004, electronic reporting of trip tickets became available to commercial dealers and made it possible to associate a specific gear for each species reported. This increased the accuracy of reporting by documenting the correct relationship between gear and species.

2.1.1.2 Sampling Intensity

VMRC

All registered licensees are required to report daily harvest from Virginia tidal and federal waters to the VMRC on a monthly basis.

NCDMF

North Carolina dealers are required to record each transaction with a fisherman and report trip-level data to the NCDMF on a monthly basis.

2.1.1.3 Biological Sampling

VMRC

Field sampling at fish processing houses or dealers involves multi-stage random sampling. Targets are set based on mandatory reporting of harvest data by harvesters from the previous years. A three-year moving average of landings by gear and by month (or other temporal segment) provides a preliminary goal for the amount of length and weight samples to be collected. Real time landings are used to adjust the preliminary targets. Targets for ageing samples (see below for criteria) are tracked and collection updates are done weekly. Sampling data are recorded on electronic measuring boards. Weights of individual fish are recorded on electronic scales and downloaded directly to the electronic boards. A fish identification number unique to each specimen is created as well as a batch number for a subsample from a specific trip.

Subsamples of a catch or batch are processed for sex information (gender and gonadal maturity or spawning condition index). Such subsamples are indexed by visual inspection (macroscopic) of the gonads. Females are indexed as gonadal stage I–V and males I–IV, with stage I representing an immature or resting stage of gonadal development and stages IV (males) and V (females) representing spent fish. Fish that cannot be accurately categorized in terms of spawning condition are not assigned a gonadal maturity stage.

The goal of otolith collection is to correspond to the frequency distribution in lengths from past seasons, according to 1-inch length bins. The age sampling is designed to achieve a coefficient of variation equal to 0.2 (Quinn and Deriso 1999) at each length interval. Fish are then randomly selected from each length interval (bin) to process. It is important to note that samples collected for ageing do not fall into a random sampling regime and are treated accordingly (i.e., are not included in analyses dependent on random sampling).

Ancillary data for fish sampled at dealers are collected and include date harvested, harvest area, gear type used, and total catch (recorded if only a subsample was measured). This information would allow for expansion of the sample size to the total harvest reported for a species. Estimates of effort are not typically recorded by this program but can be extrapolated from mandatory harvest reports sent to the VMRC on a monthly basis by harvesters, sometime after a sampling event.

The Virginia Recreational Assessment Program, funded by the Virginia Saltwater Development Fund, began in late June 2007. Chest freezers are located throughout the Tidewater area of Virginia. Anglers can leave whole or filleted fish in the freezers. They fill out a form giving the date and general location when and where the fish was caught and the weight if known (all of the sites are Virginia Saltwater Fishing Tournament Sites with certified scales). Anglers who complete the form receive a t-shirt or hat as a reward for donating the fish. It should be noted that although some weights are recorded by anglers at the time of donation, the majority of samples to the Recreational Assessment Program do not include weights, and the fish were already filleted when processed by VMRC technicians. As such, although these data are exceptionally valuable for length-at-age analysis, no average weight data are provided from the recreational fisheries.

The numbers of spotted seatrout lengths and ages sampled from commercial landings by the VMRC are summarized in Table 2.1.

NCDMF

Commercial length-frequency data were obtained by the NCDMF commercial fisheries-dependent sampling program. Spotted seatrout lengths are collected at local fish houses by gear, market grade, and area fished. Random samples of culled catches are taken to ensure adequate coverage of all species in the catches. Length frequencies obtained from a sample were expanded to the total catch using the total weights from the trip ticket. All expanded catches were then combined to describe a given commercial gear for a specified time period.

In cases where the weight of particular species' market grades were included on the trip ticket but were not sampled, an estimate of the number of fish landed for the grade was made by using the mean weight per individual from samples of that species and grade from the same year. Species numerical abundance was calculated by determining the number of individuals/market grade and then summing all the market grades for each species. Catches were analyzed by gear type, year and semi-annually by "fishing season" (i.e., March–August and September–February).

The NCDMF collects spotted seatrout age samples monthly beginning January 1st of each year and continuing through the end of December. A target of 10 age samples per 50-mm size bin is set for each month. Samples are collected through both fishery-independent and fishery-dependent sampling. If fish are not able to be sampled at a fish house, funds have been intermittently available to purchase fish from seafood dealers for later processing. Once all age structures are processed they are transferred to the ageing lab in Morehead City where they are sectioned and mounted on slides. The ageing lab biologist and technicians complete the first read of each otolith and records the age. The otoliths are then transferred to the species lead for a second read. This second read is done independently of the first with no knowledge of the first read. The only information provided to the reader is the date of collection to minimize bias. Annuli formation for spotted seatrout is between April and June. Each annuli is counted to determine the appropriate age (year class); if the sample was collected prior to April and there is no evidence of annuli formation on the edge, the edge is counted as an additional age; if the sample is after April and there is evidence of new annuli formation on the edge, the edge is counted as plus growth, not as an additional age. The species lead then transfers the second reads to the age lab where the ages are compared. If there is a discrepancy in ages, the two readers discuss the section and either agree to an age or remove the sample from the analysis. Once the ages are finalized the ageing lab transfers the ages to the Biological Database Analyst for upload to the state mainframe.

The numbers of spotted seatrout lengths and ages sampled from commercial landings by the NCDMF are summarized in Table 2.2.

2.1.1.4 Potential Biases & Uncertainty

Because trip tickets are only submitted when fish are transferred from fishermen to dealers, records of unsuccessful fishing trips are not available for both the VMRC and the NCDMF. As such, there is no direct information regarding trips where a species was targeted but not caught. Information on these unsuccessful trips is necessary for calculating a reliable index of relative abundance for use in stock assessments.

Another potential bias for NCDMF data relates to the reporting of multiple gears on a single trip ticket. It is not always possible to identify the gear used to catch a particular species on a trip ticket that lists multiple gears and species.

2.1.1.5 Development of Estimates

Commercial landings were categorized into estuarine and ocean areas based on gear types. Annual commercial landings statistics were calculated by year and area (estuarine and ocean) for both states combined and separately by state.

Length data were summarized by 2-cm length bins and year. Age data were summarized by year and sex. Both length and age data were pooled over states and summarized for the commercial estuarine and commercial ocean fisheries separately.

2.1.1.6 Estimates of Commercial Landings Statistics

Total commercial landings for Virginia and North Carolina combined have ranged from 44.9 to 345 mt between 1991 and 2012 (Figure 2.1). During the early to mid-1990s, landings in the ocean and estuarine areas were more similar than in the remainder of the time series in which estuarine landings have dominated. Commercial landings of spotted seatrout have been consistently higher for North Carolina than Virginia for both the estuarine and ocean areas (Table 2.3).

Commercial length-frequency data are summarized in Figures 2.2–2.5. Commercial estuarine landings have been dominated by age-1 and age-2 spotted seatrout (Figures 2.6 and 2.7). The commercial ocean fishery is predominantly comprised of age-1 fish (Figures 2.8 and 2.9).

2.1.2 Commercial Discards

2.1.2.1 Survey Design and Methods

The Sea Turtle Bycatch Monitoring Program (Program 466) was designed to monitor bycatch in the gill-net fishery, providing onboard observations to characterize effort, catch, and finfish bycatch by area and season. Additionally, this program monitors fisheries for protected species interactions. The onboard observer program requires the observer to ride onboard the commercial fishermen's vessel and record detailed gill-net catch and discard information for all species encountered. Observers contact licensed commercial gill-net fishermen throughout the state in order to coordinate observed fishing trips. Observers may also observe fishing trips from NCDMF vessels under Program 467 (alternate platform observations), but these data were not used in this stock assessment.

2.1.2.2 Sampling Intensity

Fishing trips are observed throughout the year; however, most observed trips occur during the fall when landings were the greatest in areas with a history of sea turtle interactions.

2.1.2.3 Biological Sampling

Data collected from each species include length, weight, and fate (landed, live discard, dead discard).

2.1.2.4 Potential Biases & Uncertainty

Program 466 began sampling statewide in May 2010. To provide optimal coverage throughout the state, management units were created to maintain proper coverage of the fisheries. Management units were delineated on the basis of four primary factors: similarity of fisheries and management; extent of known protected species interactions in commercial gill net fisheries; unit size; and the ability of the NCDMF to monitor fishing effort. Total effort for each management unit can vary annually based on fishery closures due to protected species interactions or other regulatory actions. Therefore, the number of trips and effort sampled each year by management unit varies both spatially and temporally.

Program 466 data do not span the entire time series for the assessment (no data are available for 1991–2000 and spatially limited data are available 2000–2003). Since 2004, observed trips were sparse for some seasons and management areas for several years despite widespread fishing effort. However, observations were likely adequate to determine whether discards in this fishery were a significant source of removals from the population. Observer data have been collected throughout the Pamlico Sound since 2000 and outside the Pamlico Sound since 2004. Data from 2000 to 2003 were not included due to spatial limitations.

2.1.2.5 Development of Estimates

A generalized linear model (GLM) framework was used to predict spotted seatrout discards in North Carolina's estuarine gill-net fishery based on data collected during 2004 through 2012. Only those variables available in all data sources were considered as potential covariates in the model. Available variables were year, season, and mesh category (large: ≥5 inches and small: <5 inches), all of which were treated as categorical variables in the model. Effort was measured as soak time (days) multiplied by net length (yards). Live and dead discards were modeled together as total discards; attempts at modeling live and dead discards separately resulted in convergence issues.

All available covariates were included in the initial model and assessed for significance using the appropriate statistical test. Non-significant covariates were removed using backwards selection to find the best-fitting predictive model. The offset term was included in the model to account for differences in fishing effort among observations (Crawley 2007; Zuur et al. 2009, 2012). Using effort as an offset term in the model assumes the number of spotted seatrout discards is proportional to fishing effort (A. Zuur, Highland Statistics Ltd., personal communication).

A score test confirmed the discard data were significantly zero-inflated, so zero-inflated models appropriate for count data were considered. There are two types of models commonly used for count data that contain excess zeros. Those models are zero-altered (two-part or hurdle models) and zero-inflated (mixture) models (see Minami et al. 2007 and Zuur et al. 2009 for detailed information regarding the differences of these models). Minami et al. (2007) suggests that zero-inflated models may be more appropriate for catches of rarely encountered species; therefore, zero-inflated models were initially considered.

Estimates of the total number of discards were generated using the zero-inflated GLM. The observed ratio of live to dead discards was computed from the raw data and applied to the GLM estimates to calculate the number of dead discards. A discard mortality rate of 60% (see section 1.2.6) was applied to the estimates of live discards to estimate those live discards that were not expected to survive. This number was added to the number of dead discards to estimate the total number of dead discards.

Length data were summarized by 2-cm length bins and year.

2.1.2.6 Estimates of Commercial Discard Statistics

Estimates of dead commercial discards for North Carolina were variable for the gill-net estuarine fishery during 2004 through 2012 (Figure 2.10). Estimates were minimal compared to the magnitude of all fisheries overall. Though estimates of discards from Virginia were not available, they were assumed minimal as well.

Annual length-frequency distributions of commercial gill-net estuarine fishery discards are shown in Figure 2.11.

2.1.3 Recreational Fishery Monitoring

Information on commercial fisheries has long been collected by the National Marine Fisheries Service (NMFS). However, data on marine recreational fisheries were not collected in a systematic manner by NMFS on a continuing basis until 1979. The purpose of the NMFS Marine Recreational Information Program (MRIP) is to establish a reliable database for estimating the impact of marine recreational fishing on marine resources. A detailed overview of the program can be found online at http://www.st.nmfs.noaa.gov/recreational-fisheries/index.

2.1.3.1 Survey Design and Methods

Data collection consists primarily of two complementary surveys: a telephone household survey and an angler-intercept survey. In 2005, the MRIP began at-sea sampling of headboat (party boat) fishing trips. Data derived from the telephone survey are used to estimate the number of recreational fishing trips (effort) for each stratum. The intercept and at-sea headboat data are used to estimate catch-per-trip for each species encountered. The estimated number of angler trips is multiplied by the estimated average catch-per-trip to calculate an estimate of total catch for each survey stratum.

The MRIP estimates are divided into three catch types depending on availability for sampling. The MRIP classifies those fish brought to the dock in whole form, which are identified and measured by trained interviewers, as landings (Type A). Fish that are not in whole form (bait, filleted, released dead) when brought to the dock are classified as discards (Type B1), which are reported to the interviewer, but identified by the angler. Fish that are released dead during at-sea headboat sampling, which began in 2005, are also classified as Type B1 discards. The sum of Types A and B1 provides an estimate of total harvest for the recreational fishery. Anglers also report fish that are released live (Type B2) to the interviewer. Those fish that are released alive during the at-sea headboat survey are also considered Type B2 catch. Total recreational catch is considered the sum of the three catch types (A+B1+B2). The numbers of spotted seatrout sampled in Virginia and North Carolina are presented in Table 2.4.

2.1.3.2 Sampling Intensity

Creel clerks collect intercept data year round (in two-month waves) by interviewing anglers completing fishing trips in one of four fishing modes (man-made structures, beaches, private boats, and for-hire vessels). Results from both component surveys are combined at the state, area, fishing mode, and wave level to provide estimates of the total number of fish caught, released, and harvested; the weight of the harvest; the total number of trips; and total participation in marine recreational fishing. All estimates generated through MRIP include the proportional standard error (PSE), which is a measure of the precision of the estimates. The PSE is calculated by dividing the standard error of the estimate by the estimate to express the standard error as a percentage.

2.1.3.3 Biological Sampling

The MRIP interviewers routinely sample fish of Type A catch that are encountered during the angler-intercept survey. Fish discarded during the at-sea headboat survey are also sampled—the headboat survey is the only source of biological data characterizing discarded catch that are collected by the MRIP. The sampled fish are weighed to the nearest five one-hundredth (0.05) of a kilogram or the nearest tenth (0.10) of a kilogram (depending on scale used) and measured to the nearest millimeter for the length type appropriate to the morphology of the fish. The numbers of spotted seatrout measured in Virginia and North Carolina by the MRIP are summarized in Table 2.4.

The VMRC collects ages from its recreational fisheries through the Virginia Recreational Assessment Program (see section 2.1.1.3). All age structures are sent to Old Dominion University for processing. The numbers of spotted seatrout age samples collected by the VMRC are summarized in Table 2.5.

2.1.3.4 Potential Biases & Uncertainty

The MRIP estimates are based on a stratified random sampling design and so are designed to be unbiased. There have been a few instances when the random telephone survey was found to be unrepresentative and an average estimate of trips was substituted. Most recently, the 2002 telephone survey data were discarded for waves 2 and 3 and effort estimates were instead based on a three-year average (1999–2001) for those waves. The MRIP advises that the weight estimates are minimum values and so may not accurately reflect the actual total weight of fish harvested.

Recent concerns regarding the timeliness and accuracy of the MRFSS (precursor to MRIP) program prompted the NMFS to request a thorough review of the methods used to collect and analyze marine recreational fisheries data. The National Research Council (NRC) convened a committee to perform the review, which was completed in 2006 (NRC 2006).

The review resulted in a number of recommendations for improving the effectiveness and utility of sampling and estimation methods. In response to the recommendations, the NMFS initiated the current program, MRIP—a program designed to improve the quality and accuracy of marine recreational fisheries data. The objective of the MRIP program is to provide timely and accurate estimates of marine recreational fisheries catch and effort and provide reliable data to support stock assessment and fisheries management decisions. The program will be reviewed periodically and undergo modifications as needed to address changing management needs.

2.1.3.5 Development of Estimates

The methods for estimating recreational catch were modified in 2011 to eliminate bias while improving precision. The new MRIP method for producing estimates has been in place since 2012, replacing the previous MRFSS method. Taking advantage of the new methodology, NOAA analysts produced new estimates of catch from 2004 through 2011. In March 2012, a MRFSS/MRIP calibration workshop was held and the panel recommended that stock assessments use estimates calculated using the MRIP methodology. A follow-up workshop further recommended that estimates for years prior to 2004—years for which the data do not allow application of the MRIP methodology—should be calibrated to the MRIP estimates using a ratio of means estimator (Salz et al. 2012). The ratio of means estimator was applied to recreational fishery statistics prior to 2004. A discard mortality rate of 10% (see section 1.2.6) was applied to the numbers of spotted seatrout released alive to estimate numbers of dead discards for the recreational fishery. Recreational fishery statistics were calculated by year for both states combined and separately by state.

Length data were pooled across states and summarized by 2-cm length bins and year. Age data collected from Virginia's recreational fishery were summarized by year and sex for the years in which data were available.

2.1.3.6 Estimates of Recreational Fishery Statistics

Recreational harvest (Type A + B1) in terms of weight ranged from 112 to 593 mt between 1991 and 2012 (Figure 2.12). In terms of numbers, recreational harvest (Type A + B1) has ranged from 208,109 to 727,714 fish during the same time period (Figure 2.13). Estimates of live releases (Type B2) usually exceeded harvest (Type A + B1), especially in recent years. Like live releases (Type B2), estimates of dead discards (dead B2) have shown a general increase from 1991 through 2012 (Figure 2.14). Recreational catch statistics have been generally smaller for Virginia (Table 2.6) as compared to North Carolina (Table 2.7), though estimates of recreational harvest (Type A + B1) are associated with higher uncertainty (generally higher proportional standard error—PSE—values).

Annual length-frequency data for the recreational fishery are presented in Figures 2.15 and 2.16. Plots of age data for the recreational fishery indicate ages 0 through 6+ have occurred in the fishery (Figure 2.17).

2.2 Fisheries-Independent

All the available fisheries-independent data come from North Carolina as there are currently no fisheries-independent sampling programs in Virginia that catch sufficient numbers of spotted seatrout to develop a reliable index.

2.2.1 Estuarine Trawl Survey (Program 120)

2.2.1.1 Survey Design and Methods

In 1971, the NCDMF initiated a statewide Estuarine Trawl Survey, also known as Program 120 (P120). The initial objectives of the survey were to identify the primary nursery areas and produce annual recruitment indices for economically important species. Other objectives included monitoring species distribution by season and by area and providing data for evaluation of environmental impact projects.

The survey samples shallow-water areas south of the Albemarle Sound system including Pamlico Sound, Pamlico River, Neuse River, New River, and Cape Fear River (Figure 2.18). Major gear changes and standardization in sampling occurred in 1978 and 1989. In 1978, tow times were set at one minute during the daylight hours. In 1989, an analysis was conducted to determine a more efficient sampling time frame for developing juvenile abundance indices with acceptable precision levels for the target species. A fixed set of 105 core stations was identified and sampling was to be conducted in May and June only, except for July sampling for weakfish (dropped in 1998, Program 195 deemed adequate), and only the 3.2-m headrope, 0.64-cm bar mesh trawl would be used.

The current gear is a 3.2-m otter trawl with 6.4-mm bar mesh body netting of 210/6 size twine and a tailbag mesh of 3.2-mm Delta-style knotless nylon with a 150-mesh circumference and 450-mesh length. The gear is towed for one minute during daylight hours during similar tidal stages and covers 75 yards.

Environmental data are recorded, including temperature, salinity, dissolved oxygen, wind speed, and direction. Additional habitat fields were added in 2008.

2.2.1.2 Sampling Intensity

Prior to 1989, sampling was monthly. From 1989 to 2003, a fixed set of 105 core stations was identified and sampling was conducted in May and June only. Since 2004, additional July sampling of a subset of the core stations has been conducted.

2.2.1.3 Biological Sampling

Catch is sorted by species and total number of individuals for each species is recorded. A subset of at least 30–60 individuals of all target species (economically important species) is measured for total length.

2.2.1.4 Potential Biases & Uncertainty

Spotted seatrout are a target species of this survey. Fixed sampling stations are located in primary nursery areas. Sampling does not occur in deeper open water areas where juvenile spotted seatrout may occur. Sampling is limited to May, June, and July and sampling in July only occurs at a subset of stations. Because of the fixed sampling design, if spotted seatrout abundance shifts it is less likely to be reflected in the July sampling.

A fixed-station survey can run the risk of bias if the sites selected do not adequately represent the sampling frame. Additionally, even if the sites adequately cover the sampling frame, the increased variation that would come about from sampling randomly is not accounted for and is therefore neglected in the calculation of variance.

2.2.1.5 Development of Estimates

The Program 120 data were used to develop an index of age-0 relative abundance for spotted seatrout starting in 2004. To provide the most relevant index, data were limited to those collected during June and July when the majority of age-0 spotted seatrout occur in the survey. A generalized linear model (GLM) framework was used to develop the index. The response variable included both positive and zero catches. Effort was consistent across tows so there was no need for an offset variable. Potential covariates were evaluated for collinearity by calculating variance inflation factors, applying a correlation analysis, or both. Collinearity exists when there is correlation between covariates and its presence causes inflated p-values. All available covariates were included in the initial model and assessed for significance using likelihood ratio statistics. Non-significant covariates were removed using backwards selection to find the best-fitting predictive model for each species. AIC was used to confirm the choice of the final model. The model chi-square statistic was calculated for the best-fitting model to determine if the overall model was statistically significant.

2.2.1.6 Estimates of Program 120 Survey Statistics

The best-fitting GLM for the Program 120 index of age-0 abundance for spotted seatrout included year, sampling location, bottom temperature, and bottom salinity as significant covariates. The resulting index varied without trend over the time series (Table 2.8; Figure 2.19). Peaks in age-0 relative abundance were observed in 2008 and 2012, suggesting relatively higher recruitment in those years.

2.2.2 Fisheries-Independent Gill-Net Survey (Program 915)

2.2.2.1 Survey Design and Methods

The Fisheries-Independent Gill-Net Survey, also known as Program 915 (P915), began on March 1, 2001 and includes Hyde and Dare counties (Figure 2.20). In July 2003, sampling was expanded to include the Neuse, Pamlico, and Pungo rivers (Figures 2.21, 2.22). Additional areas in the Southern District were added in April 2008 (Figure 2.23).

Floating gill nets are used to sample shallow strata while sink gill nets are fished in deep strata. Each net gang consists of 30-yard segments of 3-, 3.5-, 4-, 4.5-, 5-, 5.5-, 6-, and 6.5-inch stretched mesh, for a total of 240 yards of nets combined. Catches from an array of gill nets comprise a single sample; two samples (one shallow, one deep)—totaling 480 yards of gill net—are completed each trip. Gill nets are typically deployed within an hour of sunset and fished the following morning. Efforts are made to keep all soak times within 12 hours. All gill nets are constructed with a hanging ratio of 2:1. Nets constructed for shallow strata have a vertical height between 6 and 7 feet. Prior to 2005, nets constructed for deep and shallow strata were made with the same configurations. Beginning in 2005, all deepwater nets were constructed with a vertical height of approximately 10 feet. With this configuration, all gill nets were floating and fished the entire water column.

A stratified random sampling design is used, based on area and water depth. Each region is overlaid with a one-minute by one-minute grid system (equivalent to one square nautical mile) and delineated into shallow (<6 feet) and deep (>6 feet) strata using bathymetric data from NOAA navigational charts and field observations. Beginning in 2005, deep sets have been made along the 6-ft contour. Sampling in Pamlico Sound is divided into two regions: Region 1, which includes areas of eastern Pamlico Sound adjacent to the Outer Banks from southern Roanoke Island to the northern end of Portsmouth Island; and Region 2, which includes Hyde County bays from Stumpy Point Bay to Abel's Bay and adjacent areas of western Pamlico Sound. Each of the two regions is further segregated into four similar sized areas to ensure that samples are evenly distributed throughout each region. These are denoted by either Hyde or Dare and numbers 1 through 4. The Hyde areas are numbered south to north, while the Dare areas are numbered north to south. The rivers are divided into four areas in the Neuse River (Upper, Upper-Middle, Lower-Middle, and Lower), three areas in the Pamlico River (Upper, Middle, and Lower), and only one area for the Pungo River. The upper Neuse area was reduced to avoid damage to gear from obstructions, and the lower Neuse was expanded to increase coverage in the downstream area. The Pungo area was expanded to include a greater number of upstream sites where a more representative catch of striped bass may be acquired.

2.2.2.2 Sampling Intensity

Initially, sampling occurred during all 12 months of the year. In 2002, sampling during December 15 to February 14 was eliminated due to extremely low catches and unsafe working conditions. Sampling delays were extensive in 2003, so this year was excluded from analysis because of the lack of temporal completeness. Sampling in the Pamlico, Pungo, and Neuse rivers did not begin until July 2003. Each of the sampling areas within each region is sampled twice a month. Within a month, a total of 32 samples are completed (eight areas × twice a month × two samples) in both the Pamlico Sound and the river systems.

2.2.2.3 Biological Sampling

All fish are sorted by species. A count and a total weight to the nearest 0.01 kg, including damaged (partially eaten or decayed) specimens, are recorded. Length, age, and reproductive samples are taken from selected target species, including spotted seatrout. Samples are processed according to the ageing project protocols. The sex of all aged fish is also recorded. The numbers of biological samples collected in Program 915 is summarized in Table 2.9.

2.2.2.4 Potential Biases & Uncertainty

Spotted seatrout are a target species in Program 915. The survey is designed to collect data of fish using estuarine habitats but nearshore ocean areas, which may be utilized by spotted seatrout, are not sampled. In addition, shallow creeks, which are often utilized by spotted seatrout as overwintering habitat and many deepwater areas of Pamlico Sound, potentially used for spawning, are not sampled in Program 915. Despite being utilized by spotted seatrout and being areas of high fishery activity, Albemarle Sound and estuarine areas from Core Sound to New River are not sampled by this program. Ellis (2014) noted acoustic tagged spotted seatrout seemed to avoid anchored gill nets, indicating catchability of this species using Program 915 gear may be an issue.

While sample design has been largely consistent some adjustments have been made with the goal of reducing sea turtle interactions. In 2005, some deep water grids were dropped in Pamlico Sound, and in 2011 one area strata in eastern Pamlico Sound was not sampled for a three-month period from June–August to reduce sea turtle interactions. This change eliminated 16 samples per year. In addition, sampling in the southern district varies slightly from sampling in the Pamlico Sound. Only shallow water sets in the Cape Fear River below the downstream junction of the Cape Fear and Brunswick rivers are used. New River has shallow and deep water sets with areas separated by a line going form Rhodes Point to the northern bank of French’s Creek and an upper boundary at the 17 bridge in Jacksonville. In

2007, soak times in the southern district were reduced to four hours for sets made from April–September in order to reduce sea turtle interactions.

2.2.2.5 Development of Estimates

Four indices of relative abundance were developed from the Program 915 data—spring, summer, fall, and southern indices. The southern index is important as it includes areas of known high abundance for the recreational fishery in the New River as well as the Cape Fear River. The addition of the southern index also expands collection of biological information to all coastal areas of North Carolina. The spring index was based on data from May and June. The summer index used data from July and August. The fall index was based on data collected from September through November. The southern index was based on data collected in May and June from the southern sampling stations that were added in 2008. For Stock Synthesis, the assessment model used here, it is important to associate each index with the time of year it occurs so the model can account for the growth and mortality that occurs before the index operates.

A GLM approach similar to the one used to develop the Program 120 age-0 index was used (see section 2.2.1.5). For the Program 915 indices, stratified GLMs were applied to take into account the stratified design of the survey. Because there was some variability in effort (soak time in hours) among hauls, effort was included as an offset variable in the GLM.

Length data were summarized by 2-cm length bins and year. Age data were summarized by year and sex. Length and age data were summarized for each index; that is, they are based on collections from the same months of the associated index.

2.2.2.6 Estimates of Program 915 Survey Statistics

The best-fitting GLM for the spring index included year, depth, bottom temperature, and bottom DO as significant covariates. The final model for the summer index included year, depth, bottom temperature, and bottom salinity. The best model for the fall index included year, depth, and bottom salinity. The GLM analysis indicated that year was the only significant covariate for the southern index so this index was instead calculated using the traditional estimator for a random stratified average.

All four Program 915 indices varied without trend over the respective time series (Table 2.8; Figures 2.24–2.27). A peak was observed in 2009 in the spring (Figure 2.24), summer (Figure 2.25), and southern (Figure 2.27) indices. This corresponds with the peak observed in 2008 in the Program 120 age-0 index (Figure 2.19). The fall index exhibited a peak in 2006 (Figure 2.26). All the Program 915 indices suggest an increase in 2012 to varying degrees.

Annual length-frequency distributions for the Program 915 survey indices are shown in Figures 2.28–2.31. Age-frequency plots for Program 915 are presented in Figures 2.32–2.35.

2.3 Evaluation of Observed Data Trends

2.3.1 Analyses

The Mann-Kendall test was performed to evaluate trends in the indices. The Mann-Kendall test is a non-parametric test for monotonic trend in time-ordered data (Gilbert 1987). The test was applied to the Program 120 age-0 index and the four indices (spring, summer, fall, southern) derived from the Program 915 survey. Trends were considered statistically significant at $\alpha = 0.025$.

Correlation analyses—both Pearson's and Spearman's rank—were also applied to the five fisheries-independent surveys for spotted seatrout. An additional index was created by lagging the Program 120 by one year for inclusion in these analyses.

2.3.2 Results

The Mann-Kendall test was applied to the five survey indices independently. The results showed no detectable trends in relative abundance over the respective time series (Table 2.10).

The Pearson's correlation analysis showed significant and positive correlations between the Program 915 spring and summer indices and between the lagged Program 120 age-0 index and both the Program 915 spring and summer indices (Table 2.11). The Spearman's rank analysis detected significant and positive correlations among the Program 915 spring, summer, and fall indices (Table 2.11). Significant correlations were found between the unlagged Program 120 age-0 index and both the Program 915 summer and fall indices. The Spearman's rank analysis also showed significant positive correlations between the lagged Program 120 age-0 index and both the Program 915 spring and south indices.

3 ASSESSMENT

3.1 Overview

3.1.1 Scope

The unit stock for the current assessment is considered all spotted seatrout occurring within Virginia and North Carolina waters.

3.1.2 Summary of Methods

The current assessment applied two methods to the available data. First, catch curves were used to estimate total mortality. Second, the Stock Synthesis model was used to estimate fishing mortality (F), spawning stock biomass (SSB), and associated reference points.

3.1.3 Current vs. Previous Method

The 2009 NCDMF spotted seatrout assessment modeled population dynamics using data collected from 1991 to 2008 (Jensen 2009). ASAP (version 2.0.17)—a forward-projecting age-structured model—was applied to the available data. The inputs included commercial landings at age, recreational catch at age, and three indices of abundance. An index based on the NCDMF Fishery-Independent Gill-Net Survey (Program 915) in Pamlico Sound served as the only fisheries-independent index. Data from the North Carolina Trip Ticket Program were used to develop a fisheries-dependent index for 1994 to 2008. Another fisheries-dependent index was developed based on data collected in the MRFSS program.

The current assessment uses a length-based, age-structured model that accounts for sex-specific differences in mortality and growth. This model requires less preprocessing (i.e., manipulating of data into a simpler format) of data than the ASAP model, keeping the input close to the natural basis of the observations. Only fisheries-independent surveys were used to derive indices of relative abundance in the current assessment. Unlike the previous assessment, an index of age-0 abundance was available for this assessment. The current assessment incorporates tag-recapture information and also had access to data from 2009 through 2012.

3.2 Catch Curve Analysis

Total mortality rates were also estimated using linearized catch curves. All (both fisheries-dependent and fisheries-independent) available age data collected by the NCDMF and the VMRC from 1998 through 2012 were used. Sample numbers at age were plotted on a logarithmic scale and a straight line was fit to points corresponding to the fully recruited age-classes. The instantaneous total mortality rate was estimated as the slope of the fitted line. Age of full recruitment was determined to be one year based on the catch curve plots.

The catch curve analysis was applied to synthetic cohorts and true cohorts. Catch curves of synthetic cohorts were based on the estimated abundance of successive age-classes within a particular year. The synthetic cohort represents multiple year-classes observed in a single year. This approach assumes recruitment is constant across years, fishing and natural mortality rates are constant, and vulnerability to the sampling gear is constant for fully recruited age-classes. The assumption of constant recruitment can be avoided by applying the catch curves to individual year-classes over time (i.e., true cohorts). Catch curves were also developed for true cohorts. This approach still assumes constant mortality and equal vulnerability to the sampling gear above a certain age.

Catch curve estimates of total mortality were calculated for each year based on synthetic cohorts and for all year-classes based on true cohorts. Total mortality rates for true cohorts were estimated only for cohorts that have passed completely through the survey.

Total mortality rates were also estimated using Heincke's method (1913, cited in Ricker 1975) for comparison. In Heincke's method, successive ages are weighted by their abundance. This method can be useful if the ages of older fish are unreliable; as older fish tend to be less common in a sample, their numbers would be given less weight.

3.3 Stock Synthesis

3.3.1 Description

The spotted seatrout assessment is based on a forward-projecting length-based, age-structured model that can incorporate tag-recapture data. A two-sex model is assumed. The stock was modeled using Stock Synthesis text version 3.24f software (Methot 2000, 2012; NFT 2011; Methot and Wetzel 2013). Stock Synthesis was also used to calculate reference points. The Stock Synthesis model can incorporate information from multiple fisheries, multiple surveys, and a variety of biological data. The structure of the model allows for a wide range of model complexity depending upon the data available. The strength of the synthesis approach is that it explicitly models both the dynamics of the population and the processes by which one observes the population and its fisheries. That is, the comparison between the model and the data is kept close to the natural basis of the observations, instead of manipulating the observations into the format of a simpler model. Another important advantage is that the Stock Synthesis model can allow for (and estimate) selectivity patterns for each fishing fleet and survey. Please refer to the model documentation for details on model assumptions and equations (see Methot 2000, 2012; Methot and Wetzel 2013).

The input files for the base model run are available upon request.

3.3.2 Dimensions

The time period modeled was 1991 through 2012. In the model, years are defined as fishing years where the year starts in March and ends in February of the following year; that is, the actual time period modeled was March 1991 through February 2013. The start year of 1991 was selected because this was the first year that age data for spotted seatrout were available. The end year was chosen due to the unavailability of final landings data for the latter half of 2013 at the time of the assessment.

The initial model was set up as a seasonal model, but that model would not converge on biologically realistic results. As such, an annual time step was used.

3.3.3 Structure / Configuration

The model incorporated three fishing fleets—commercial estuarine, commercial ocean, and recreational—and five fishery-independent surveys. The Program 120 survey was assumed to index age-0 recruitment in the model. The four components (spring, summer, fall, and south) of the Program 915 survey were treated as indices of total relative abundance.

3.3.3.1 Catch

Annual landings were entered for each of the three fishing fleets. Dead discards were available and input for the commercial estuarine fishery and the recreational fishery.

3.3.3.2 Survey Indices

Changes in indices over time can occur due to factors other than changes in abundance; indices were standardized using a GLM approach in order to attempt to remove the impact of some of these factors (Maunder and Punt 2004; see section 2). Catchability (q) was estimated for each survey and allowed to vary over time via a random walk (see Wilberg et al. 2010). Annually variable catchability is especially likely for fishery-independent data when a survey does not cover the full area of the stock, as is the case for NCDMF Programs 120 and 915. All survey indices were assumed to have a linear relation to abundance.

3.3.3.3 Selectivity

The selectivity for both commercial fleets was assumed to be dome shaped. The selectivity for the recreational fishery and Program 915 multi-mesh gill-net survey was assumed to follow an asymptotic pattern.

3.3.3.4 Length Composition

Annual length frequencies were input for the commercial estuarine fishery, commercial ocean fishery, recreational fishery, and each component of the Program 915 survey (see section 2). Length frequencies for the surveys were calculated using the same reference data used to develop the indices. That is, the length frequencies for spring component of Program 915 were calculated from data collected during May and June. Length frequencies for the summer component of Program 915 were calculated from data collected during July and August. Length frequencies for the fall component of Program 915 were calculated from data collected during September and November. Finally, length frequencies for the southern component of Program 915 were calculated from data collected from southern sampling stations during May and June.

3.3.3.5 Age Data

Annual sex-specific age compositions were input for the commercial estuarine fishery, commercial ocean fishery, recreational fishery, and each component of the Program 915 survey. The age data were input as raw age-at-length data, rather than age compositions generated from applying age-length keys to the catch-at-length compositions. The input compositions are therefore the distribution of ages obtained from samples in each length bin (conditional age-at-length). This is considered a superior approach because: (1) it avoids the double use of fish for both age and size information because the age information is considered conditional on the length information; (2) it contains more detailed information about the relationship between size and age so provides stronger ability to estimate growth parameters, especially the variance of size at age; and (3) the conditional age-at-length approach can directly match the protocols of the sampling program when age data are collected using a length-stratified approach (Methot 2012).

As with the length frequencies, the survey age compositions were calculated using the same reference data used to develop the indices. Age 6 was treated as a plus group that included ages 6 through 9.

There have been no true age validation studies conducted for spotted seatrout. Comparison of multiple reads suggests negligible between-reader bias (NCDMF, unpublished data). Ageing error was assumed minimal in the model.

3.3.3.6 Biological Parameters

Natural Mortality

Natural mortality (*M*) is one of the most important, and often most uncertain, parameters used in stock assessments. This is an especially important parameter for spotted seatrout as work by Ellis (2013, 2014) has demonstrated high inter-annual variability in natural mortality; during periods of cold stuns, natural mortality can greatly increase.

Based on relation to winter temperature and availability of temperature data, Ellis (2014) was able to derive *M* estimates for the 1994 through 2012 time period. The original base model developed for this assessment incorporated these annual estimates of natural mortality. This model and similar configurations failed to converge. Attempts were also made to incorporate winter-only temperatures and these models also failed to converge. Model configurations in which the natural mortality was set at a constant lower value during non-cold-stun years and set at a constant higher value during cold-stun years—dubbed the “hi-lo” model scenarios—also failed to converge. Attempts to build the relation between *M* and temperature directly into the model were also unsuccessful.

After exhaustive attempts to incorporate varying *M*, the working group was forced to abandon this option and rely on an alternative method for assuming natural mortality. The choice was to use a life history-based method to derive age- and sex-specific estimates of *M* (instead of assuming an age-constant *M*). Lorenzen’s (1996) approach, used here, requires estimates of parameters from the von Bertalanffy age-length growth function, estimates of parameters from the allometric length-weight relationship, and the range of ages over which *M* will be estimated (Table 3.1).

Growth

The von Bertalanffy age-length growth option in Stock Synthesis is parameterized in terms of length at a given reference age, L_∞, and K. The selected reference age was age 1. The von Bertalanffy parameters were assumed to be sex-specific and fixed in the model at the values estimated in this report (see section 1.2.4; Table 1.1; Figure 1.1).

Parameters of the allometric length-weight relationship were fixed for both males and females. The assumed values were those estimated in this report as described in section 1.2.4 (Table 1.2; Figure 1.2).

Maturity

The length logistic maturity option in Stock Synthesis was selected for defining female maturity. The maturity parameters were fixed in the model at the values estimated in section 1.2.5.

Fecundity

The selected fecundity option in Stock Synthesis was that which causes eggs to be equivalent to spawning biomass.

3.3.3.7 Stock-Recruitment

A Beverton-Holt stock-recruitment relationship was assumed. Recruitment varied log-normally about the curve. The steepness parameter (*h*) was fixed at 0.9 because there was not enough contrast in the time series to estimate this value reliably (R. Methot, NOAA Fisheries, personal communication). Virgin recruitment (R_0) was estimated by the model.

3.3.3.8 Initial Conditions

Non-equilibrium conditions were assumed for the initial age structure.

3.3.3.9 Tag-Recapture Data & Parameters

The tag-recapture data are entered as the number of releases by group and year and the number of returns by group, year, and fleet (fishery). Annual releases of tagged fish were considered to belong to the same tag group. Over 6,500 hundred spotted seatrout were tagged and released between 2008 and 2012 (Table 3.2; Ellis 2013, 2014). Over 500 spotted seatrout that were tagged were recaptured during the same time period (Table 3.3). The majority of recaptures occurred in the recreational fishery.

In Stock Synthesis, fish belonging to a tagged group are all assumed to consist of a single age class (Methot 2012). The majority of tagged fish were age 1 (Ellis, NCSU, personal communication). For the current assessment, the age of spotted seatrout in all tag groups was set at 1.

Initial and chronic tag loss were assumed equal for all fleets and set at the values estimated by Ellis (2013, 2014). Reporting rates also came from the work of Ellis (2013, 2014) but separate values were available for commercial (estuarine and ocean assumed the same) and recreational fleets. The exponential decay rate in reporting rate for each fleet was assumed negligible. A mixing latency period of 1 (1 year) was assumed; this is the time that elapses before comparing observed to expected recoveries.

Use of the tag-recapture component of Stock Synthesis allows for estimation of an overdispersion parameter. Setting this parameter to 1 assumes the distribution of recaptures is random (Poisson). Assuming larger values (>1) allows for departure from this assumption via the negative binomial; the value assumed describes the degree of departure from the Poisson assumption. A likelihood profile technique was applied to the base model to determine the best value for the overdispersion parameter. A range of values from 1 through 10 were examined and a value of 5 resulted in the best likelihood.

3.3.4 Optimization

Stock Synthesis assumes an error distribution for each data component and assigns a variance to each observation. Commercial landings were assumed well known and fit in the model assuming a lognormal error structure with a minimal observation error (SE = 0.05). Recreational harvest was also fit assuming a lognormal error structure with a minimal observation error (SE = 0.10). Composition information was fit assuming a multinomial error structure with variance described by the effective sample size. For each fleet and survey, the effective sample size was the number of sampled trips assuming a maximum of 200. Survey indices were fit assuming a lognormal error distribution with variance estimated during the GLM standardization.

The objective function for the base model included likelihood contributions from the landings, discards, survey indices, length compositions, age data, initial equilibrium catch, recruitment deviations, and tag composition data. The total likelihood is the weighted sum of the individual components. All likelihood components were given equal weight in the base model (assigned a lambda weight of 1.0).

No prior assumptions were made regarding the estimated parameters (i.e., no priors were used); however, bounds were established on all parameters to prevent estimation of unrealistic parameter values and convergence problems.

3.3.5 Diagnostics

Standardized residuals provide an indication of how well the data fit the model. Standardized residuals were calculated for the fishery-independent indices. In a perfectly fit model, the standardized residuals are normally distributed with mean 0 and standard deviation 1. Normal quantile plots (Q-Q plots) and distribution tests were applied to the survey index residuals to determine whether the standardized residuals were normally distributed.

3.3.6 Uncertainty & Sensitivity Analyses

In the base model, each component of the likelihood function was given a weight of one. The contribution of a data source can be manipulated by changing this value. Here, the uncertainty of the base model results was explored by assessing the contribution of different sources of information using this approach. In a series of runs, the contribution of each survey was examined by reducing the emphasis (assigned a lambda weight of 0.0001) of all inputs (index, length compositions, age data) derived from the particular survey. The contribution of each type of biological data (length compositions, age data) from all sources was also explored through this approach. The tagging data were down-weighted in another sensitivity run.

The sensitivity of the base model to assumptions about the stock-recruitment relationship was also investigated. The base model run assumed steepness was equal to 0.9. Additional runs were performed for a range of steepness values from 0.5 to 1.0.

The sensitivity to the base model's assumption of dome-shaped selectivity for the commercial estuarine and commercial ocean fisheries was evaluated by running a model in which the selectivity of both commercial fisheries was fixed to an asymptotic shape.

The base model assumed time-varying catchability for each of the survey indices. This assumption was investigated by running a model in which catchability was assumed time-invariant for each of the survey indices.

Finally, a retrospective analysis was run to examine the consistency of estimates over time. This type of analysis gives an indication of how much recent data have changed our perspective of the past (Harley and Maunder 2003).

3.3.7 Results

3.3.7.1 Catch Curve Analysis

Catch curve estimates of total mortality ranged from 0.69 to 1.5 based on true cohorts (Figure 3.1) and ranged from 0.75 to 1.3 based on synthetic cohorts (Figure 3.2). The catch curve applied to true cohorts indicated that total mortality was highest for the 1998, 2001, 2007, 2008 and 2009 year classes (Figure 3.1). Total mortality rates were highest in 1992, 2004, and 2005 based on the analysis of synthetic cohorts (Figure 3.2). The estimates produced by the linearized catch curve approach were similar in trend and magnitude to the estimates computed using Heincke's approach for both true (Figure 3.3) and synthetic cohorts (Figure 3.4). The results of both the catch curve analysis and Heincke's method suggest that total mortality is variable across time, consistent with the results of Ellis (2013, 2014).

3.3.7.2 Stock Synthesis Model

A summary of the data that was input into the Stock Synthesis model base run is summarized in Table 3.4.

The base assessment model estimated that recruitment was variable without trend over the time series (Table 3.5; Figure 3.5). A decrease in recruitment was estimated in the final years of the time series. Estimated SSB was also variable over the time series (Table 3.5; Figure 3.6). There was a pronounced increase in SSB that occurred from the early to late 2000s. Virgin SSB was predicted to equal 2,223 mt.

Stock Synthesis allows several options for reporting *F*. Based on a recommendation from the model developer (R. Methot, pers. comm.), the *F* values reported here represent a real annual *F* calculated as a numbers-weighted *F* (see Methot 2012) for ages 1–4, the age range that comprises the majority (92.8%) of the total catch. Note that the *F* that is traditionally reported is apical *F*—the maximum *F* over all ages. Predicted *F* values ranged from a low of 0.134 in 2010 to a high of 0.638 in 1999 (Table 3.5; Figure 3.7). The highest estimated *F* values matched up with known cold-stun years in 1995, 1999, 2000, and 2009.

Estimated population numbers at age for females and males are presented in Tables 3.6 through 3.9. There is some indication that the age and length distributions may be showing evidence of an expansion in recent years.

The fitted selectivity patterns suggest the commercial estuarine fishing gear selects for larger size spotted seatrout than the commercial ocean gear (Figure 3.8). The estimated selectivity patterns for the various components of the Program 915 survey are nearly identical (Figure 3.9). Recall that the index derived from Program 120 was input as an index of age-0 relative abundance so selectivity for age-0 fish was equal to 1.0 for this survey.

The assessment model provided near perfect fits to the survey indices (Figures 3.10–3.14); for this reason, standardized residuals and normal quantile plots were not developed. The extremely good fits are attributed to the time-varying catchability (Figures 3.15–3.19). When catchability was not allowed to vary over time, the fits were reasonable but not as good as in the base run.

The model performed well in predicting the length-frequency distributions of the fisheries (Figures 3.20–3.23) and the surveys (Figures 3.24–3.27). The fit to the tag-recapture data was considered poor (Figure 3.28).

The model estimates of SSB and *F* were relatively insensitive to removal of various sources of survey data (Figure 3.29). Removal of the length data had the most impact of all the sensitivity analysis and resulted in dramatic changes in the magnitude of estimated SSB and *F* (Figure 3.30). The model did not converge when the age data were removed. De-emphasizing the tagging data essentially had no impact on the model results (Figure 3.31). Changing the assumption regarding the shape of the selectivity curve for the commercial fisheries from dome-shaped (base run) to asymptotic slightly impacted the magnitude of results and resulted in a much higher terminal *F* (Figure 3.32). Changing the assumption of time-varying catchability coefficients to time-constant catchabilities had a minor impact on estimated *F* and SSB in the most recent years (Figure 3.33); though not shown here, the fit to the survey indices degraded when catchabilities were fixed over time. The model appeared insensitive to changing assumptions about the steepness value (Figure 3.34), though an error message indicated poor convergence when steepness was equal to 1.

For the retrospective analysis, the model would not converge when "peeled" back to 2011 and 2008. Based on the runs that did converge, there is indication of overestimation of SSB in the terminal year (Figure 3.35). There is no clear pattern of over- or underestimation in terminal *F*.

3.4 Discussion of Results

The results of the catch curve analyses and Stock Synthesis suggest that mortality of spotted seatrout is variable over time. This result is consistent with the results of work by Ellis (2013, 2014). The estimates of fishing mortality from the base run of the assessment model were lower than those estimated by Ellis (2013, 2014) for the years in which comparisons could be made (Figure 3.36).

The spotted seatrout resource is a difficult stock to assess. The population is subject to intermittent cold-stun events, which greatly increases the variance in natural mortality experienced by the stock during these episodes. Despite exhaustive efforts, it was not possible to get a working model that incorporated annual variation in natural mortality for the current assessment. Future assessment work should continue to attempt to account for these cold-stun events and the associated increases in natural mortality. Most stock assessments do not have such strong evidence for such variation in natural mortality, a critical factor to consider in a stock assessment.

There is evidence from the last decade of the assessment that there are a higher proportion of larger (Figures 2.28–2.31) and older (Figures 2.32–2.35) individuals, suggesting that the age structure of the stock is likely to be expanding. However, an abrupt decline is evident in the estimated recruitment after 2010 (Table 3.5; Figure 3.5), although this is not mirrored in the survey data (Figure 2.19). Spawning stock biomass increased to its maximum in 2007 but has since declined to close to the average (Table 3.5; Figure 3.6). Fishing mortality has varied without apparent trend, but periods of high fishing mortality seem to coincide with SSB decline and this is probably related to cold stun events (Table 3.5; Figures 3.6 and 3.7).

Results from the current assessment were considerably different than the previous assessment (Figure 3.37; Jensen 2009). The F reported in the previous assessment represented a numbers-weighted fishing mortality for ages 1 to 6+ while the F reported in this assessment represents a numbers-weighted fishing mortality for ages 1 to 4; however, this minor difference does not explain the on average 4-fold difference in predicted values between the two assessments. Likewise, estimates of SSB in the current assessment are on average 4.5 times higher than SSB estimates from the previous assessment. These differences are in part, at least, attributable to the difference in the model inputs. The previous assessment used two fisheries-dependent indices of abundance, which are associated with numerous biases (see section 1.6.2, number 5). There was no index of juvenile abundance available for the previous model. The current model incorporates both length and age data, which includes thousands of length samples. Estimates of growth and maturity are slightly improved and the current model incorporates tagging data. The current model is sex-specific, which can account for differences in growth and mortality between the sexes. Some differences may also result from differences in how the assessment models operate. For example, the Stock Synthesis performs better with regard to accounting for errors in the observation process and so likely produces more realistic estimates of error. Both assessments used the best available data at the time and should be considered the best available science when conducted.

4 STATUS DETERMINATION CRITERIA

The General Statutes of North Carolina define overfished as "the condition of a fishery that occurs when the spawning stock biomass of the fishery is below the level that is adequate for the recruitment class of a fishery to replace the spawning class of the fishery" (NCGS § 113-129). The General Statues define overfishing as "fishing that causes a level of mortality that prevents a fishery from producing a sustainable harvest."

The NCDMF FMP for spotted seatrout defines the stock's thresholds in terms of 20% spawning potential ratio (SPR; NCDMF 2012b). Targets for the stock are based on 30% SPR. The Stock Synthesis model was used to estimate reference points for the stock. The model estimated $SSB_{20\%}$ at 394 mt and $SSB_{30\%}$ at 623 mt. The estimate of SSB for 2012—the terminal year of the assessment—was 1,140 mt. Based on these results, the stock is not currently overfished ($SSB_{2012} < SSB_{20\%}$) and has not been overfished during the 1991 to 2012 time period (Figure 4.1).

Estimated $F_{20\%}$ is 0.656 and $F_{30\%}$ is 0.422. The estimate of terminal year F was 0.401, suggesting the stock is not experiencing overfishing ($F_{2012} < F_{20\%}$). Evaluation of the time series indicates the stock has not experienced overfishing during the assessment time period (Figure 4.2).

5 SUMMARY OF PEER REVIEW COMMENTS

Stocks assessments performed by the NCDMF in support of management plans are subject to an extensive review process. Internal reviews are conducted by various groups within the NCDMF including the species Plan Development Team, the Biological Review Team Technical Committee, and the Management Review Team. External reviews are designed to provide an independent peer review and are conducted by experts in stock assessment science and experts in the biology and ecology of the species. The goal of the external review is to ensure the results are based on sound science and provide a valid basis for management.

The stock assessment was reviewed by a panel of three independent reviewers, representing experts in stock assessment or spotted seatrout biology. The peer reviewers agreed that the assessment provided a valid basis for management for at least the next five years, given the available data and current knowledge of the species stock dynamics and fisheries. One reviewer added the caveat that periodic mass mortalities have the potential to lead to population bottlenecks where added protections might be wise to let the population recover. He added that he didn't see anything in the SSB trajectory that suggests this problem occurred during the fairly frequent freeze events in the 1990s and 2000s. Another reviewer stated that, in general, using the terminal year of an assessment for status determination may be a requirement, but the terminal estimates of stock size, and especially recruitment estimates, tend to change after those cohorts have a stanza or two exposed to the fisheries. He continued that as the only index of recruitment is relatively short, there will be additional likelihood of variation in those estimates of recruitment with more time and data.

In March 2015, the NCDMF agreed that the stock assessment provided a valid basis for management.

6 RESEARCH RECOMMENDATIONS

The following research recommendations are offered (ranked by priority) to improve the next assessment of the North Carolina spotted seatrout stock:

High

- Histological maturity; fecundity evaluation/batch fecundity
- Validate juvenile abundance survey; improve juvenile abundance survey through expansion and addition of random stations (or replace fixed design with random or random stratified)
- Continue and expand tagging studies for estimating natural and fishing mortality, understanding stock structure, and examining migration (e.g., ocean vs. creeks)
- Collect data to characterize the length distribution of recreational releases
- Conduct further studies to identify appropriate unit stock
- Develop a custom model that allows for incorporation of variable natural mortality rates
- Develop a fishery-independent survey for Virginia waters

Medium

- Initiate surveys that assess spotted seatrout winter and spawning habitats
- Compare maturity ogives between North Carolina and Virginia
- Improve discard estimates
- Conduct further studies to estimate discard mortality by gear and sector
- Investigate relationship between environmental variables and adult and juvenile mortality
- Selectivity of program 915 indices—gear/availability

Low

- Collect more age and sex samples from the recreational fishery
- Evaluate influences of salinity on release mortality
- Conduct marginal increment analysis
- Conduct an age validation study

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8 TABLES

Table 1.1. Estimated parameter values of the von Bertalanffy age-length model fit to spotted seatrout data from this and previous studies, where length is measured in centimeters.

Location	**Collection Dates**	**Gear**	**Structure**	**Sex**	**n**	L_∞	K	t_0	**Reference**
Galveston Bay, Texas	October 1981–September 1982	exp gill nets (most) and hook and line	sectioned otoliths	Male		66.4	0.179	1.939	Maceina et al. 1987
Galveston Bay, Texas	October 1981–September 1982	exp gill nets (most) and hook and line	sectioned otoliths	Female		68.7	0.512	-0.260	Maceina et al. 1987
Charlotte Harbor, Florida	February 1986–January 1988	hook and line, seine, gill and trammel nets	sectioned otoliths	Female	1,102	69.8	0.363	0.39	Murphy and Taylor 1994
Indian River Lagoon, Florida	February 1986–January 1988	hook and line, seine, gill and trammel nets	sectioned otoliths	Female	1,195	83.9	0.362	0.74	Murphy and Taylor 1994
Apalachicola Bay, Florida	March 1986–Janaury 1988	hook and line, seine, gill and trammel nets	sectioned otoliths	Female	797	81.8	0.350	0.68	Murphy and Taylor 1994
Virginia/North Carolina	1991–2013	various	otolith	Male	6,764	66.9	0.3142	-0.938	This study
Virginia/North Carolina	1991–2013	various	otolith	Female	10,914	79.4	0.3406	-0.588	This study

Table 1.2. Estimated parameter values of the allometric length-weight function fit to spotted seatrout data from this and previous studies, where length is measured in centimeters and weight is measured in kilograms.

Location	**Collection Dates**	**Gear**	**Sex**	**n**	***a***	***b***	**Reference**
Indian River Lagoon, Florida	February 1986-January 1988	hook and line, seine, gill and trammel nets	Female	1,194	5.75E-06	3.12	Murphy and Taylor 1994
Indian River Lagoon, Florida	February 1986-January 1988	hook and line, seine, gill and trammel nets	Male	605	4.76E-06	3.17	Murphy and Taylor 1994
Apalachicola Bay, Florida	March 1986-Janaury 1988	hook and line, seine, gill and trammel nets	Female	1,229	1.47E-05	2.86	Murphy and Taylor 1994
Apalachicola Bay, Florida	March 1986-Janaury 1988	hook and line, seine, gill and trammel nets	Male	608	1.68E-05	2.81	Murphy and Taylor 1994
southeastern Louisiana coastal areas	January 1975-December 1978	trawl, cast net, hook and line, hoop net, gill net, seine, and trammel net	All	1,208	5.40E-06	3.15	Hein et al. 1980
Virginia/North Carolina	1991-2013	various	Male	6,909	8.59E-06	3.05	This study
Virginia/North Carolina	1991-2013	various	Female	10,242	1.07E-05	3.00	This study

Table 1.3. Total mortality of spotted seatrout in commercial gill nets by mesh size reported in Price and Gearhart (2002).

Mesh Size (in)	**n**	**Mortality**
2.5	48	90.0%
3.0	70	90.0%
3.5	71	77.0%
4.0	57	67.0%
4.5	29	66.0%

Table 1.4. Total, at-net, and delayed mortality of spotted seatrout in commercial small-mesh gill nets by season reported in Price and Gearhart (2002).

	Spring/Summer	Fall/Winter
Total Mortality	82.7%	73.8%
At-Net Mortality	76.2%	61.7%
Delayed Mortality	28.9%	31.7%

Table 1.5. At-net mortality of spotted seatrout caught in Program 915 (mesh sizes 3"-4.5" combined) by month reported in NCDMF (2012a).

Month	Mortality	n
February	20.0%	15
March	35.0%	31
April	40.0%	95
May	53.0%	185
June	75.0%	134
July	76.0%	110
August	74.0%	99
September	87.0%	224
October	64.0%	198
November	37.0%	186
December	17.0%	63
Total	60.0%	1,340

Table 1.6. Delayed mortality rates of spotted seatrout for high salinity (Outer Banks) and low salinity (rivers) areas reported in Price and Gearhart (2002).

	Outer Banks	Rivers
Spring/Summer	41.7%	23.1%
Fall/Winter	36.4%	26.3%

Table 1.7. Summary of recreational fishery release mortality estimates from a review of the literature.

Location	**Mortality Estimate**	**Notes**	**Reference**
Texas	up to 55.6%	artificial and natural baits	Matlock and Dailey 1981
Texas	7.30%	artificial and natural baits	Matlock et al. 1993
Texas	37.0%	artificial and natural baits	Hegen and Green 1983
Texas	11.0%	artificial and natural baits	Stunz and McKee 2006
Florida	4.60%	hook and line	Murphy et al. 1995
Louisianna	17.5%	artificial and natural baits	Thomas et al. 1997
Alabama	14.1%	treble hooks (1994)	Duffy 2002
Alabama	16.3%	single hooks (1994)	Duffy 2002
Alabama	9.10%	treble hooks (1995)	Duffy 2002
Alabama	14.6%	single hooks (1995)	Duffy 2002
North Carolina (River & Outer Banks sites in Pamlico, Core, & Roanoke sounds)	14.8%	artificial and natural baits	Gearhart 2002
North Carolina (Neuse River)	25.2%	artificial and natural baits	Brown 2007

Table 1.8. Regulatory history for the management of spotted seatrout in Virginia's commercial fishery since 1992 (as of March 2015).

Regulation	Date	Measures
450-01-0037	5/1/1992	Established 14-inch minimum size
450-01-0037	7/25/1995	Established commercial quota of 51,104 pounds
		Established seasonal management as Sept 1 through Aug 31

Table 1.9. Regulatory history of the management of spotted seatrout in Virginia's recreational fishery since 1992 (as of March of 2015).

Regulation	Date	Measures
450-01-0037	5/1/1992	Established 14-inch minimum size
		10-fish bag limit
4VAC20-280-10	4/1/2011	Bag limit of 10 fish April 1 though November 30.
		Bag limit of 5 fish December 1 through March 31 with one 24 inches or greater.
4VAC20-280-10	4/1/2014	Bag limit of 5 fish with one greater than 24 inches.
		Seasonal closure from March 1, 2014 through July 31, 2014.

Table 1.10. Proclamation history for management of spotted seatrout in North Carolina's commercial fishery since 2009 (as of February 2014).

Proclamation	Date	Measures
FF-53-2009	9/29/2009	14-inch size limit
		10-fish hook-and-line limit
		10-12-2009 deadline for dealers to be rid of unfrozen spotted seatrout
FF-82-2010	11/23/2010	Year-round weekend restriction for possession or sale
		Dealers exempted
FF-7-2011	1/12/2011	No possession
		1-20-2011 deadline for dealers to be rid of unfrozen spotted seatrout taken in the fishery, pre-closure
FF-30-2011	2/14/2011	Bycatch allowance of 10% up to 50 pounds
		Year-round weekend restriction for possession or sale
FF-56-2011	6/6/2011	14-inch size limit
		Year-round weekend restriction for possession or sale
		Dealers exempted from weekend restriction
FF-74-2011	11/10/2011	14-inch size limit
		75-fish trip limit
		Year-round weekend restriction for possession or sale in joint fishing waters
		Unlawful to set gill nets in joint fishing waters on weekends
		Albemarle and Currituck sounds exempt from both weekend restrictions
FF-9-2014	2/5/2014	No possession February 5–June 15

Table 1.11. Proclamation history for management of spotted seatrout in North Carolina's recreational fishery since 2009 (as of February 2014).

Proclamation	Date	Measures
FF-53-2009	9/29/2009	14-inch size limit
		10-fish bag limit
FF-81-2010	11/23/2010	14-inch size limit
		6-fish bag limit
		Of the six fish, only two greater than 24 inches
FF-7-2011	1/12/2011	No possession
FF-30-2011	2/14/2011	No possession
FF-57-2011	6/6/2011	14-inch size limit
		6-fish bag limit
		Of the six fish, only two greater than 24 inches
FF-75-2011	11/10/2011	14-inch size limit
		4-fish bag limit
FF-9-2014	2/5/2014	No possession February 5–June 15

Table 2.1. Number of spotted seatrout biological samples taken from Virginia's commercial fisheries by area, 1991–2012.

Biological Year	Estuarine		Ocean	
	Lengths	Ages	Lengths	Ages
1991	4	0	0	0
1992	283	0	28	0
1993	231	0	23	0
1994	668	0	20	0
1995	257	0	0	0
1996	70	0	10	0
1997	103	0	92	0
1998	373	173	3	0
1999	770	140	10	4
2000	178	63	5	5
2001	192	192	15	14
2002	452	315	2	1
2003	63	63	34	34
2004	183	182	1	1
2005	187	186	24	24
2006	794	304	18	2
2007	276	129	8	7
2008	204	192	1	1
2009	347	227	1	1
2010	230	173	1	1
2011	500	256	2	2
2012	742	252	34	3

Table 2.2. Number of spotted seatrout biological samples taken from North Carolina's commercial fisheries by area, 1991–2012.

Biological Year	Estuarine		Ocean	
	Lengths	Ages	Lengths	Ages
1991	53	67	106	105
1992	80	159	105	60
1993	79	253	136	80
1994	37	196	67	237
1995	64	246	58	27
1996	15	55	66	20
1997	83	141	70	13
1998	106	141	74	31
1999	213	150	77	29
2000	147	34	76	64
2001	122	65	61	0
2002	151	89	65	16
2003	129	38	47	19
2004	161	195	63	94
2005	180	159	67	109
2006	386	224	79	87
2007	355	197	90	8
2008	320	71	76	0
2009	384	29	47	1
2010	241	17	48	3
2011	177	51	37	29
2012	452	89	32	38

Table 2.3. Annual commercial fishery landings (metric tons) of spotted seatrout by state and area, 1991–2012.

Biological Year	Virginia		North Carolina	
	Estuarine	Ocean	Estuarine	Ocean
1991	2.48	7.57	145	190
1992	0.965	3.04	101	118
1993	2.79	13.7	127	94.5
1994	3.78	16.0	129	88.4
1995	1.71	10.8	131	114
1996	0.548	1.25	46.2	18.5
1997	0.521	4.76	67.2	36.7
1998	0.504	9.21	128	41.3
1999	2.86	13.1	221	85.3
2000	2.98	3.85	59.6	27.5
2001	7.55	1.36	31.0	9.72
2002	0.0830	3.62	85.1	15.9
2003	0.117	2.29	46.9	18.5
2004	1.47	3.43	44.6	13.3
2005	0.938	2.36	42.6	13.5
2006	2.42	12.0	140	34.8
2007	2.03	13.0	115	32.3
2008	4.42	15.6	123	21.7
2009	1.53	9.50	150	14.5
2010	1.95	5.52	44.4	5.88
2011	2.80	4.07	35.0	3.02
2012	8.61	26.0	135	7.59

Table 2.4. Numbers of spotted seatrout sampled and measured by MRIP by state, 1991–2012.

Biological Year	North Carolina		Virginia	
	Number Sampled	Number Measured	Number Sampled	Number Measured
1991	1,318	742	53	46
1992	930	543	62	57
1993	672	485	93	69
1994	1,569	1,076	311	195
1995	1,308	853	190	152
1996	642	307	93	72
1997	880	622	164	109
1998	923	551	52	46
1999	934	699	121	97
2000	535	330	87	75
2001	478	326	19	18
2002	414	283	29	23
2003	211	130	117	80
2004	582	294	77	71
2005	1,143	712	21	17
2006	1,417	658	47	30
2007	1,328	529	168	103
2008	1,099	792	152	108
2009	1,045	772	56	45
2010	441	333	42	32
2011	770	652	86	67
2012	1,473	988	164	85

Table 2.5. Numbers of spotted seatrout ages sampled from Virginia's recreational fisheries, 2004–2012.

Biological Year	Ages
2004	272
2008	8
2009	35
2010	84
2011	13
2012	12

Table 2.6. Annual recreational fishery catches of spotted seatrout in Virginia, 1991–2012.

Biological Year	Harvest (A+B1) Number	PSE[Num]	Metric Tons	PSE[mt]	Released Alive (B2) Number	Dead Discards Number
1991	72,587	41.6	61.6	42.9	33,420	3,342
1992	31,641	46.3	28.7	50.4	16,364	1,636
1993	108,442	41.8	102	44.1	54,564	5,456
1994	120,949	28.1	88.7	30.0	202,345	20,235
1995	95,516	35.6	75.2	36.3	270,877	27,088
1996	48,472	47.1	39.1	47.0	136,363	13,636
1997	97,500	41.7	133	46.6	139,255	13,926
1998	36,406	46.9	31.3	50.3	61,458	6,146
1999	145,624	46.7	147	47.9	125,373	12,537
2000	94,777	44.9	99.0	45.9	218,034	21,803
2001	14,140	66.7	13.5	43.6	90,974	9,097
2002	17,143	51.1	14.6	64.3	112,306	11,231
2003	107,762	42.2	110	42.7	170,826	17,083
2004	68,409	32.1	63.0	33.2	257,996	25,800
2005	22,062	55.8	25.4	55.2	197,904	19,790
2006	43,530	42.2	48.9	47.9	82,935	8,294
2007	159,244	26.4	172	27.1	362,936	36,294
2008	103,880	39.2	109	33.1	366,734	36,673
2009	22,635	28.8	20.3	28.0	171,028	17,103
2010	17,417	32.5	13.7	33.1	550,118	55,012
2011	247,736	38.2	250	39.3	1,214,620	121,462
2012	125,627	26.8	103	27.2	428,540	42,854

Table 2.7. Annual recreational fishery catches of spotted seatrout in North Carolina, 1991–2012.

Biological Year	Harvest (A+B1)				Released Alive (B2)	Dead Discards
	Number	PSE[Num]	Metric Tons	PSE[mt]	Number	Number
1991	336,164	18.7	216	17.9	227,412	22,741
1992	355,713	20.2	234	18.6	149,528	14,953
1993	219,955	16.2	141	14.5	173,675	17,368
1994	487,401	14.4	312	13.9	274,411	27,441
1995	347,126	17.3	220	17.3	296,580	29,658
1996	161,226	28.4	90.6	23.6	243,110	24,311
1997	273,416	19.8	143	18.1	216,508	21,651
1998	313,656	21.4	204	20.2	171,519	17,152
1999	437,009	21.8	317	20.4	429,254	42,925
2000	266,740	25.8	177	25.7	305,307	30,531
2001	193,970	24.4	98.0	21.7	424,078	42,408
2002	210,329	26.7	126	25.8	480,684	48,068
2003	113,336	31.5	67.0	28.6	179,054	17,905
2004	288,603	20.1	176	20.9	436,780	43,678
2005	629,683	19.6	327	17.0	1,362,962	136,296
2006	541,606	14.2	360	14.3	933,433	93,343
2007	547,312	14.8	421	15.0	1,413,350	141,335
2008	623,834	15.0	425	16.5	1,546,601	154,660
2009	602,096	16.2	427	16.5	1,409,926	140,993
2010	193,275	23.7	183	24.9	1,792,190	179,219
2011	229,184	12.1	198	12.7	1,995,717	199,572
2012	503,592	9.75	368	10.0	1,609,133	160,913

Table 2.8. GLM-standardized indices of abundance used as input into the stock assessment model.

	Program 120 (age-0)	Program 915	Program 915	Program 915	Program 915 (southern)
Year	**June–July**	**May–June**	**July–August**	**September–November**	**May–June**
2003		0.0368	0.0163	0.0459	
2004	0.188	0.0169	0.0242	0.0361	
2005	0.539	0.0125	0.0188	0.0342	
2006	1.57	0.0482	0.0295	0.0979	
2007	1.26	0.0535	0.0273	0.0432	
2008	3.55	0.0471	0.0307	0.0558	0.442
2009	1.31	0.0818	0.0395	0.0590	1.18
2010	0.435	0.0370	0.0271	0.0484	0.984
2011	0.875	0.0151	0.0270	0.0387	0.162
2012	3.05	0.0644	0.0291	0.0761	0.560

Table 2.9. Number of biological samples collected in Program 915, 2001–2012.

Biological Year	Spring (May–Jun)		Summer (Jul–Aug)		Fall (Sep–Nov)		Southern (May–Jun)	
	Lengths	Ages	Lengths	Ages	Lengths	Ages	Lengths	Ages
2001		8		6		8		
2002		15		16		29		
2003	26	18	13	9	74	31		
2004	17	10	26	10	65	31		
2005	18	12	23	13	58	26		
2006	82	39	51	25	204	79		
2007	87	41	50	21	127	64		
2008	90	63	70	42	166	100	32	28
2009	164	80	70	41	197	109	29	27
2010	51	41	41	22	126	86	24	23
2011	15	12	37	19	84	57	4	4
2012	102	81	40	27	176	157	13	13

Table 2.10. Results of Mann-Kendall trend analyses applied to the full time period for each index. *P*-value is the one-tailed probability for the trend test. Trend indicates the direction of the trend if a statistically significant temporal trend was detected (two-tailed test: *P*-value $< \alpha/2$; $\alpha = 0.05$); NS = not significant.

Survey Index	n	*P*-value	Trend
P120	9	0.179	NS
P915 Spring	10	0.190	NS
P915 Summer	10	0.0779	NS
P915 Fall	10	0.190	NS
P915 South	5	0.408	NS

Table 2.11. Results of correlation analyses applied to the five fisheries-independent surveys used in the spotted seatrout stock assessment. An asterisk (*) indicates a significant correlation for the associated analysis ($\alpha = 0.05$).

Variable	**by Variable**	**Pearson's *r***	***P*-value**	**Spearman *r***	**Prob>|*r*|**
P915 Spring	P120	0.535	0.137	0.617	0.0769
P915 Summer	P120	0.407	0.277	0.800	0.00963*
P915 Summer	P915 Spring	0.732	0.0160*	0.806	0.00486*
P915 Fall	P120	0.516	0.155	0.750	0.0199*
P915 Fall	P915 Spring	0.584	0.0762	0.794	0.00610*
P915 Fall	P915 Summer	0.452	0.189	0.758	0.0111*
P915 South	P120	-0.329	0.589	-0.200	0.747
P915 South	P915 Spring	0.685	0.202	0.700	0.188
P915 South	P915 Summer	0.631	0.254	0.600	0.285
P915 South	P915 Fall	0.252	0.683	0.500	0.391
P120 (lag 1)	P915 Spring	0.787	0.0205*	0.714	0.0465*
P120 (lag 1)	P915 Summer	0.842	0.00879*	0.619	0.102
P120 (lag 1)	P915 Fall	0.016	0.969	0.310	0.456
P120 (lag 1)	P915 South	0.827	0.0840	0.900	0.0374*

Table 3.1. Sex-specific estimates of age-specific, instantaneous natural mortality for spotted seatrout calculated using the method of Lorenzen (1996).

Age	Male	Female
0	0.948	1.09
1	0.585	0.546
2	0.464	0.412
3	0.405	0.353
4	0.371	0.321
5	0.350	0.302
6	0.336	0.290
7	0.327	0.282
8	0.320	0.277
9	0.316	0.273

Table 3.2. Number of spotted seatrout released in the Ellis (2013, 2014) tagging study, 2008–2012.

Tag Group	Year	n Released
1	2008	818
2	2009	975
3	2010	2,006
4	2011	2,209
5	2012	574

Table 3.3. Number of spotted seatrout recaptured in the Ellis (2013, 2014) tagging study.

Tag Group	Year	Fleet	n Recaptured
1	2008	Commercial Estuarine	6
1	2008	Recreational	16
1	2009	Commercial Estuarine	13
1	2009	Recreational	31
1	2010	Recreational	1
2	2009	Commercial Estuarine	23
2	2009	Commercial Ocean	1
2	2009	Recreational	30
2	2010	Commercial Estuarine	3
2	2010	Recreational	13
2	2011	Recreational	1
3	2010	Commercial Estuarine	11
3	2010	Recreational	62
3	2011	Commercial Estuarine	4
3	2011	Commercial Ocean	3
3	2011	Recreational	9
3	2012	Commercial Estuarine	1
3	2012	Recreational	1
4	2011	Commercial Estuarine	29
4	2011	Recreational	105
4	2012	Commercial Estuarine	25
4	2012	Commercial Ocean	3
4	2012	Recreational	89
5	2012	Commercial Estuarine	12
5	2012	Commercial Ocean	1
5	2012	Recreational	36

Table 3.4. Summary of spotted seatrout fisheries and survey data used in the base run of the assessment model.

	Removals	Index	Length	Age
Commercial Estuarine Fishery				
Landings	1991–2012		1991–2012	1991–2012
Discards	1994–2012		1992–2012	
Commercial Ocean Fishery				
Landings	1991–2012		1992–2012	1991–2012
Discards	1994–2012		1991–2009	
Recreational Fishery				
Landings	1991–2012		1991–2012	2004–2012
Discards	1991–2012			
Program 120				
Age-0 Abundance		2004–2012		
Program 915				
Abundance--Spring		2003–2012	2003–2012	2001–2012
Abundance--Summer		2003–2012	2003–2012	2001–2012
Abundance--Fall		2003–2012	2003–2012	2001–2012
Abundance--Southern		2008–2012	2008–2012	2008–2012

Table 3.5. Annual predicted recruitment, SSB, and fishing mortality (numbers-weighted, ages 1–4) from the base run of the assessment model.

Year	Age-0 Recruits (000s of fish)	SSB (mt)	*F*
1991	3,742	885	0.401
1992	3,349	983	0.278
1993	1,879	1,096	0.263
1994	1,688	1,105	0.400
1995	3,073	933	0.490
1996	3,135	829	0.139
1997	2,635	974	0.225
1998	1,440	1,037	0.255
1999	1,750	998	0.638
2000	1,904	710	0.368
2001	2,114	635	0.153
2002	3,872	717	0.207
2003	2,876	868	0.141
2004	5,089	1,063	0.147
2005	3,392	1,315	0.152
2006	4,041	1,504	0.229
2007	2,652	1,564	0.282
2008	1,891	1,450	0.304
2009	3,119	1,257	0.347
2010	3,640	1,108	0.134
2011	1,039	1,223	0.214
2012	902	1,140	0.401

Table 3.6. Predicted numbers (thousands) of females at age at the beginning of the year from the base run of the assessment model.

Biological Year	Age									
	0	1	2	3	4	5	6	7	8	9
1991	1,871	805	456	46	11	6	5	15	9	16
1992	1,675	791	301	207	24	6	4	3	9	16
1993	939	710	336	149	114	14	4	2	2	16
1994	844	399	305	168	83	67	8	2	1	11
1995	1,537	357	146	133	83	44	37	5	1	7
1996	1,567	648	115	59	63	43	24	21	3	5
1997	1,318	667	323	64	35	39	28	16	14	5
1998	720	560	304	166	36	20	24	17	10	12
1999	875	306	244	152	91	21	12	14	10	13
2000	952	368	84	84	62	42	10	6	7	12
2001	1,057	403	143	37	41	32	22	5	3	11
2002	1,936	450	198	78	22	25	20	14	4	9
2003	1,438	824	208	104	45	13	16	13	9	8
2004	2,545	612	411	115	61	28	8	10	8	11
2005	1,696	1,083	304	226	68	37	17	5	6	13
2006	2,021	722	535	166	131	41	23	11	3	12
2007	1,326	859	326	273	92	76	24	14	7	10
2008	946	563	367	157	142	50	43	14	8	9
2009	1,560	401	234	173	81	77	28	24	8	10
2010	1,820	662	159	106	86	43	42	16	14	10
2011	519	775	332	88	63	53	27	27	10	16
2012	451	221	360	170	48	35	31	16	16	15

Table 3.7. Predicted numbers (thousands) of males at age at the beginning of the year from the base run of the assessment model.

Biological Year	Age									
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1991	1,871	777	435	40	9	4	3	9	5	8
1992	1,675	766	287	174	18	4	2	2	5	7
1993	939	686	320	130	86	10	2	1	1	7
1994	844	385	290	146	65	46	5	1	1	5
1995	1,537	346	140	113	63	30	22	3	1	3
1996	1,567	628	111	49	45	28	14	11	1	2
1997	1,318	644	305	59	27	26	17	9	7	2
1998	720	541	288	147	30	15	15	9	5	5
1999	875	295	233	133	73	16	8	8	5	6
2000	952	357	84	68	45	27	6	3	4	5
2001	1,057	390	138	34	30	21	13	3	2	5
2002	1,936	434	187	71	19	17	12	8	2	4
2003	1,438	795	198	91	37	10	10	7	5	4
2004	2,545	590	386	104	51	22	6	6	4	5
2005	1,696	1,045	286	202	57	29	13	4	4	6
2006	2,021	696	504	148	111	33	17	8	2	6
2007	1,326	829	310	239	76	59	18	10	4	5
2008	946	544	351	139	115	38	31	10	5	5
2009	1,560	388	225	154	66	57	20	16	5	6
2010	1,820	639	154	93	69	31	28	10	8	6
2011	519	747	313	81	52	40	19	17	6	9
2012	451	213	341	152	42	28	22	10	10	9

Table 3.8. Predicted numbers (thousands) of females at age at mid-year from the base run of the assessment model.

Biological Year	Age									
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1991	1,216	492	307	33	8	5	4	12	7	13
1992	1,091	516	212	153	18	5	3	2	7	13
1993	612	465	238	111	87	11	3	2	1	12
1994	549	241	201	118	60	50	6	2	1	8
1995	997	203	93	92	60	33	28	4	1	5
1996	1,023	457	86	46	50	35	19	17	2	4
1997	859	451	231	48	27	30	22	12	11	4
1998	469	370	215	123	27	16	18	13	8	9
1999	568	160	143	97	62	14	9	10	7	10
2000	620	229	56	58	45	30	7	5	5	9
2001	690	283	106	29	32	26	18	4	3	9
2002	1,263	306	143	59	17	20	16	11	3	8
2003	938	582	155	80	35	11	12	10	7	7
2004	1,660	431	305	88	48	22	7	8	7	9
2005	1,107	761	224	172	52	29	14	4	5	10
2006	1,317	485	382	123	100	31	18	8	3	10
2007	864	562	226	197	68	57	18	11	5	7
2008	616	363	252	112	104	37	32	10	6	7
2009	1,016	252	157	122	59	57	21	18	6	8
2010	1,188	469	118	81	68	34	34	13	11	8
2011	339	528	237	65	47	40	21	21	8	12
2012	293	135	235	117	34	26	22	12	12	11

Table 3.9. Predicted numbers (thousands) of males at age at mid-year from the base run of the assessment model.

Biological Year	Age 0	1	2	3	4	5	6	7	8	9
1991	1,197	472	275	27	6	3	2	7	4	6
1992	1,072	495	193	123	13	3	2	1	4	6
1993	602	446	216	92	63	7	2	1	1	6
1994	540	232	181	96	44	32	4	1	1	4
1995	982	196	83	71	42	21	16	2	0	2
1996	1,004	438	81	36	34	21	11	9	1	2
1997	844	430	212	42	20	20	13	7	5	2
1998	461	355	196	104	22	11	11	7	4	4
1999	559	157	126	77	45	10	5	5	4	4
2000	609	222	53	46	31	19	5	2	3	4
2001	677	270	99	25	23	16	10	3	1	4
2002	1,240	293	131	52	14	13	9	6	2	3
2003	921	554	143	68	28	8	8	6	4	3
2004	1,630	411	279	77	39	17	5	5	3	4
2005	1,087	725	206	149	43	22	10	3	3	5
2006	1,294	464	347	106	81	24	13	6	2	4
2007	849	539	208	166	54	43	13	7	3	4
2008	605	350	232	96	81	27	22	7	4	4
2009	999	244	145	103	45	40	14	12	4	4
2010	1,166	447	112	70	53	24	22	8	7	5
2011	333	505	218	58	38	30	14	13	5	7
2012	289	131	213	99	28	19	15	7	7	6

9 FIGURES

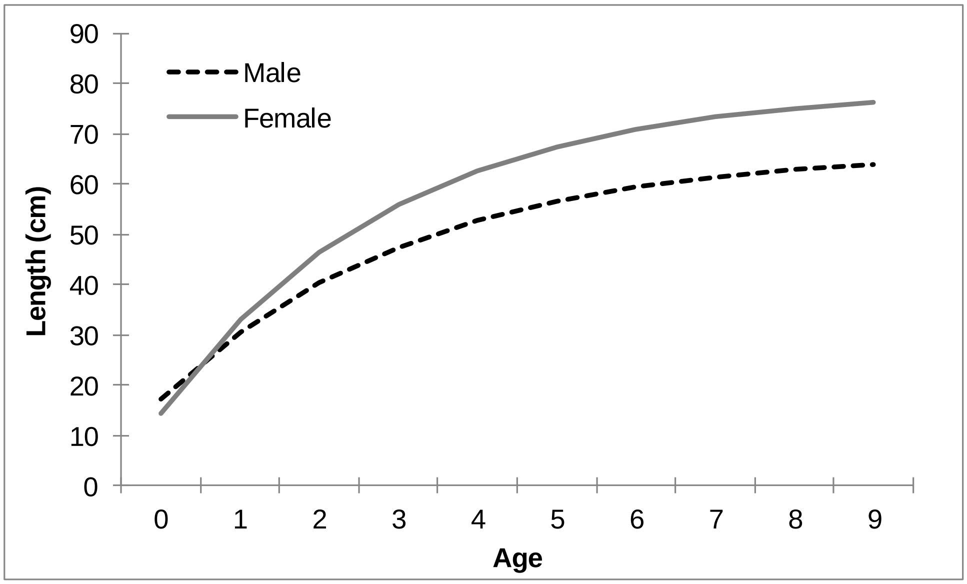

Figure 1.1. Predicted von Bertalanffy age-length relation for spotted seatrout by sex.

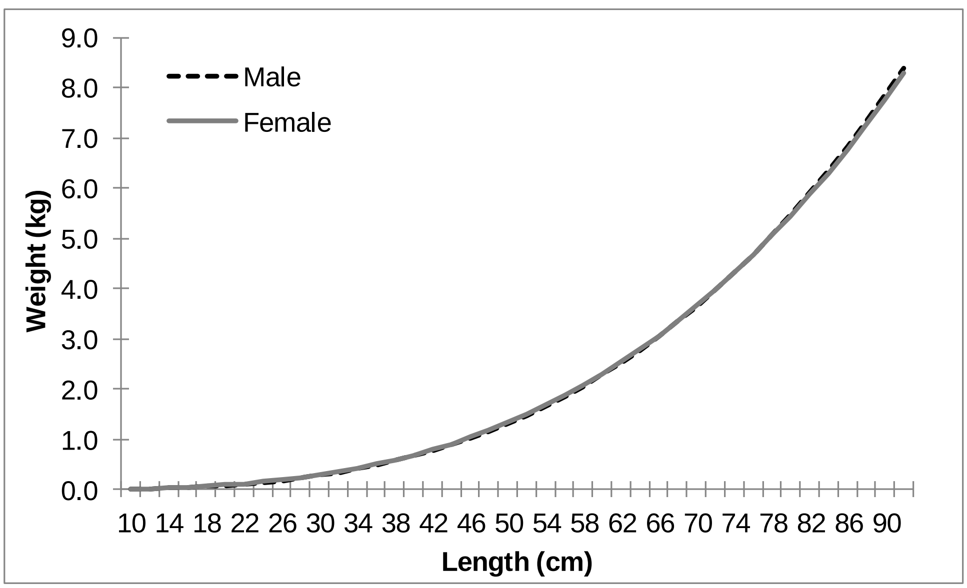

Figure 1.2. Predicted allometric length-weight relation for spotted seatrout by sex.

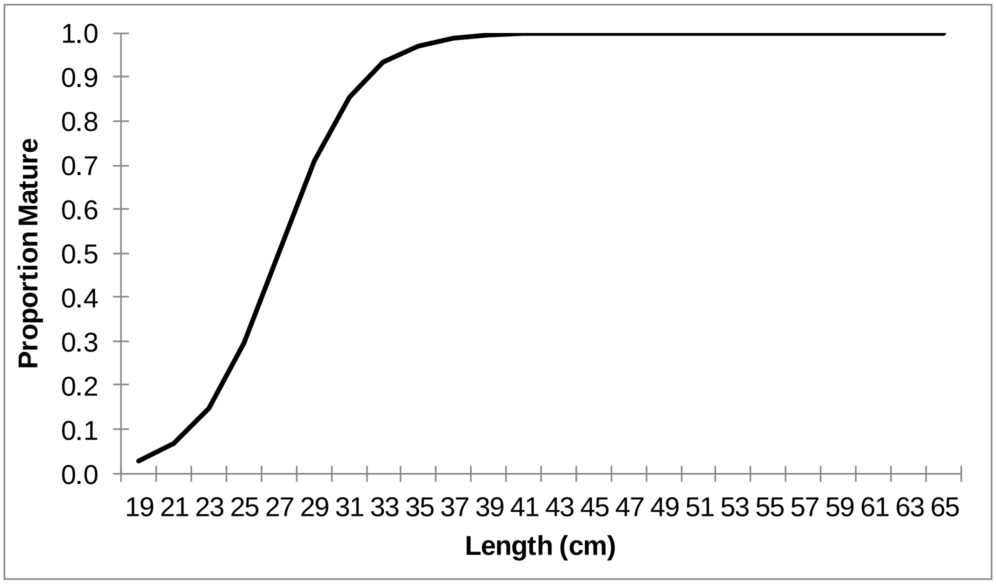

Figure 1.3. Predicted maturity curve for female spotted seatrout collected in North Carolina.

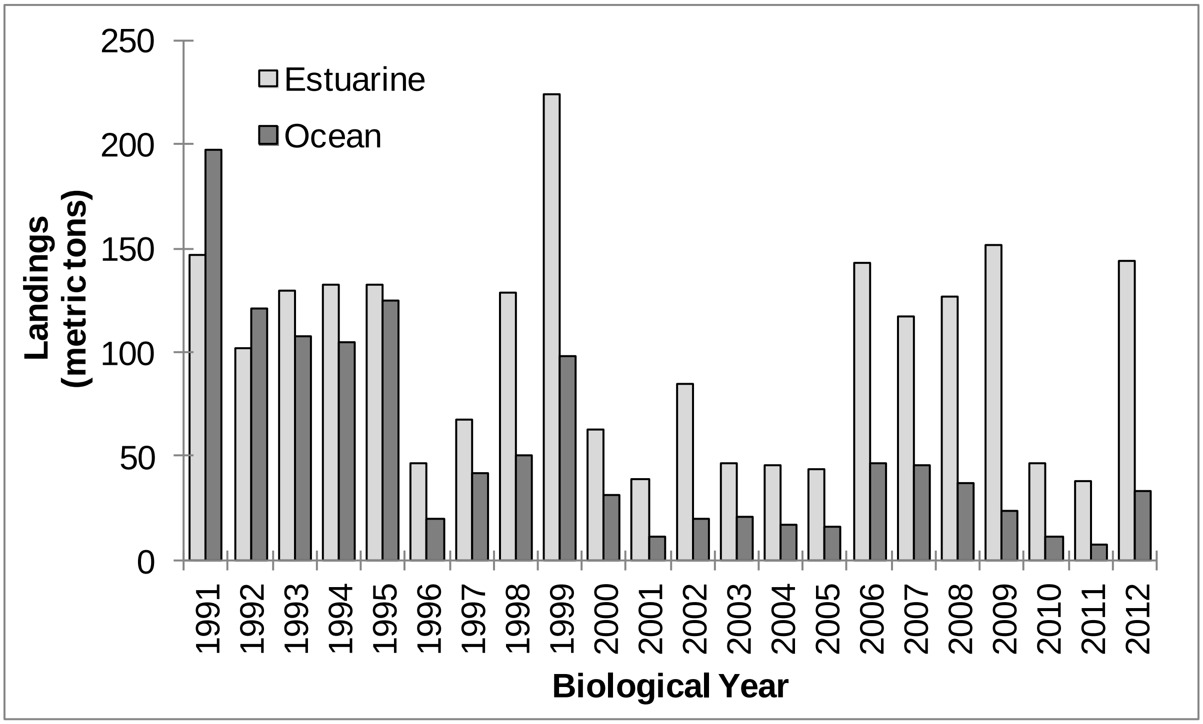

Figure 2.1. Annual commercial fishery landings of spotted seatrout in Virginia and North Carolina by area, 1991–2012.

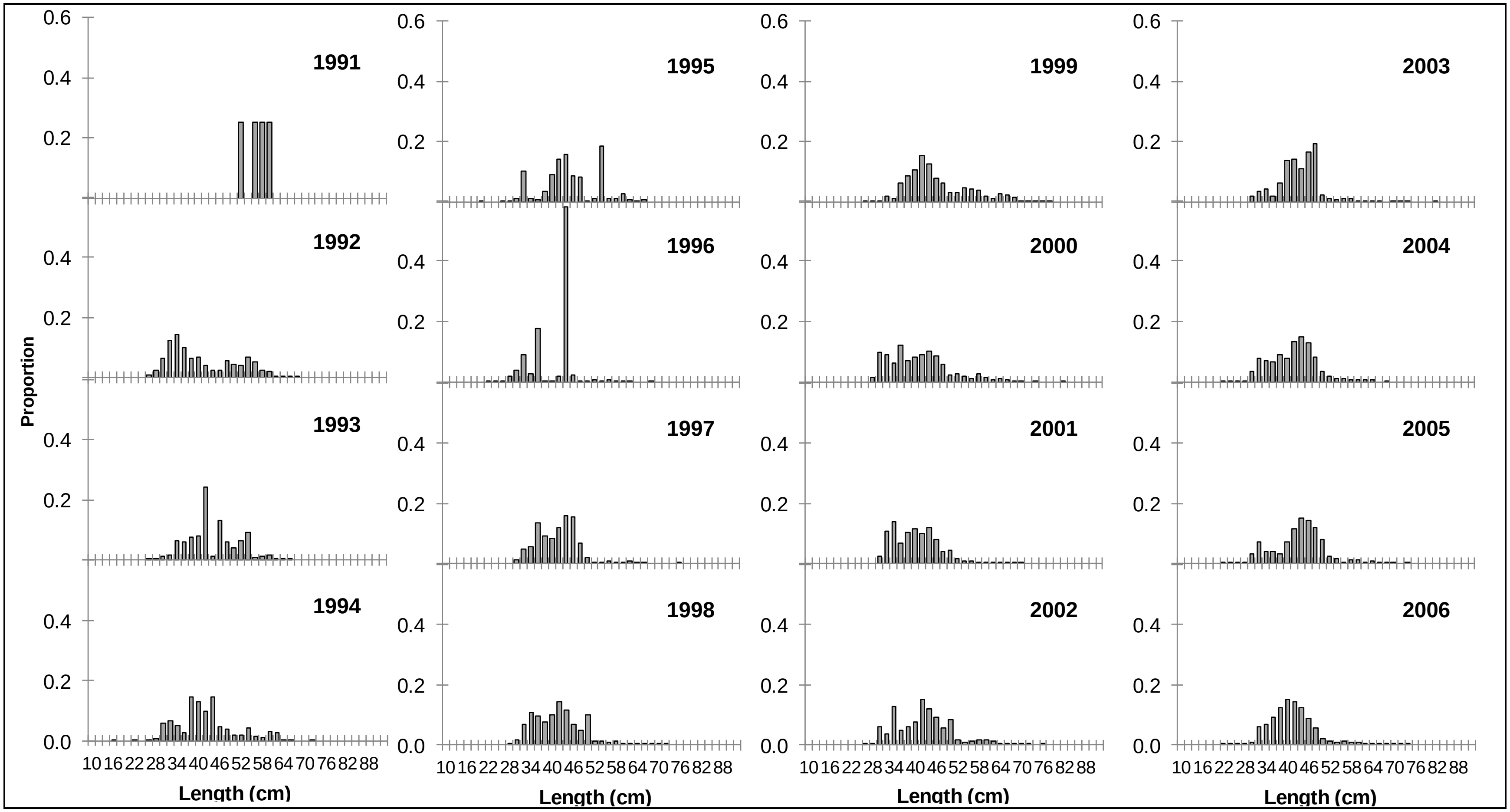

Figure 2.2. Annual length-frequency distributions of spotted seatrout sampled from Virginia and North Carolina commercial estuarine fishery landings, 1991–2006.

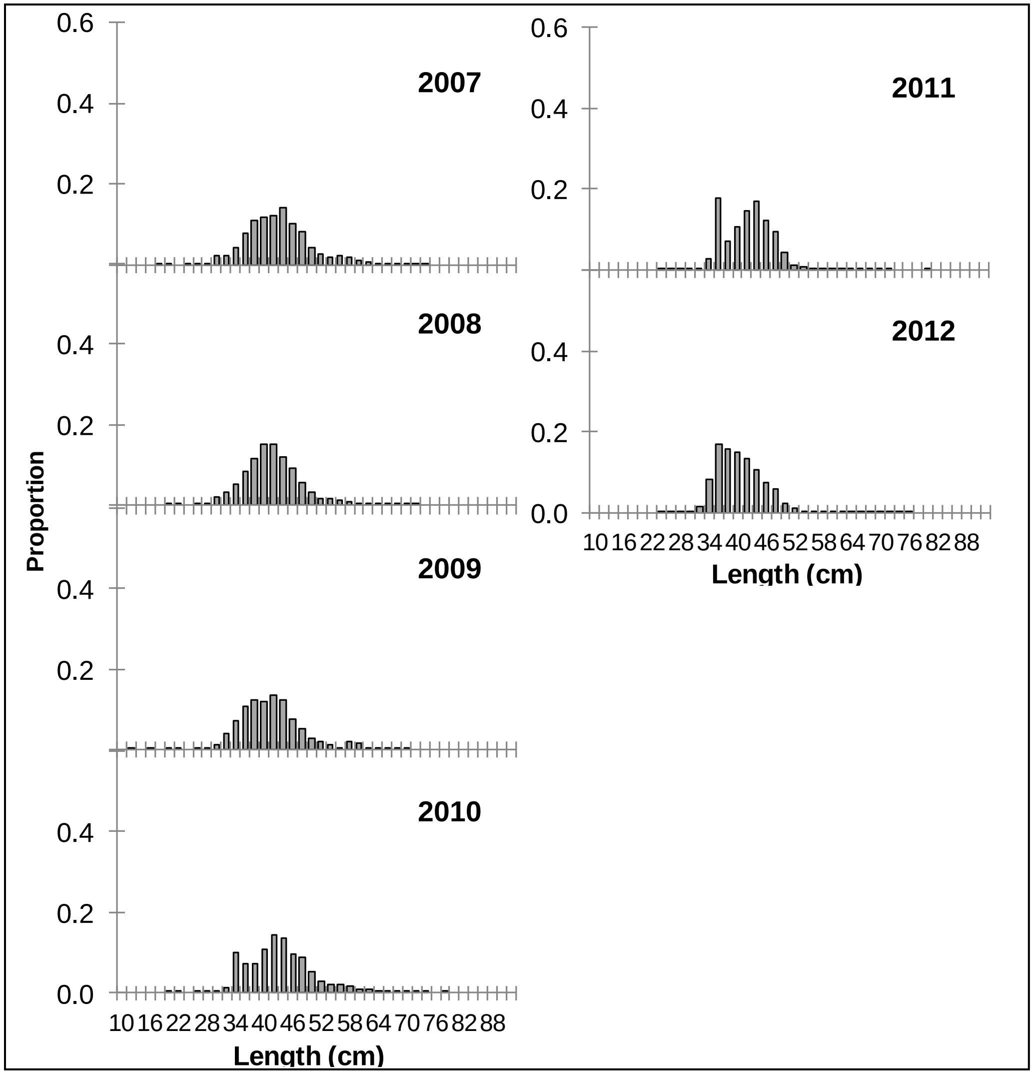

Figure 2.3. Annual length-frequency distributions of spotted seatrout sampled from Virginia and North Carolina commercial estuarine fishery landings, 2007–2012.

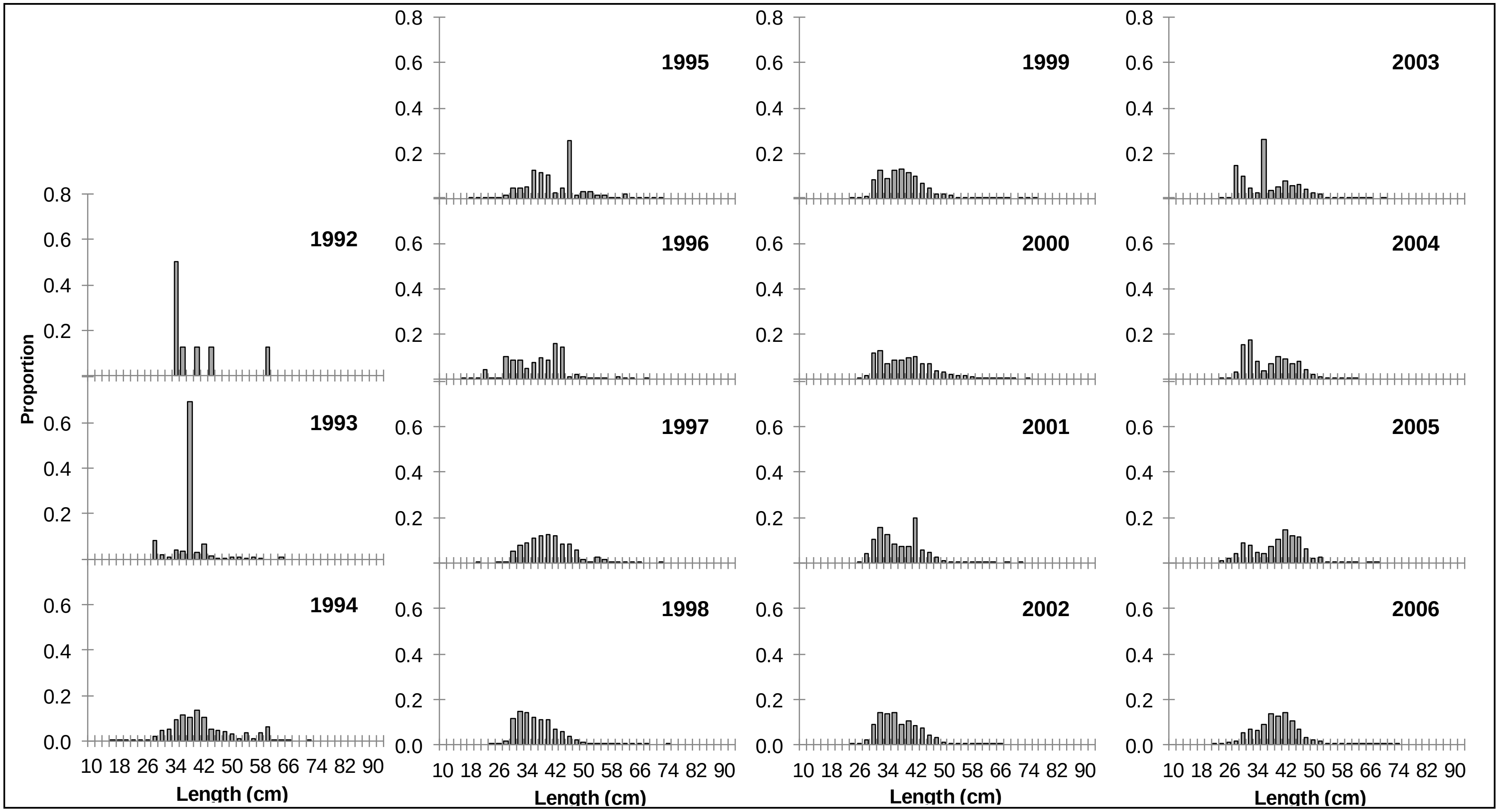

Figure 2.4. Annual length-frequency distributions of spotted seatrout sampled from Virginia and North Carolina commercial ocean fishery landings, 1992–2006. No spotted seatrout were available for sampling from the commercial ocean fishery in 1991.

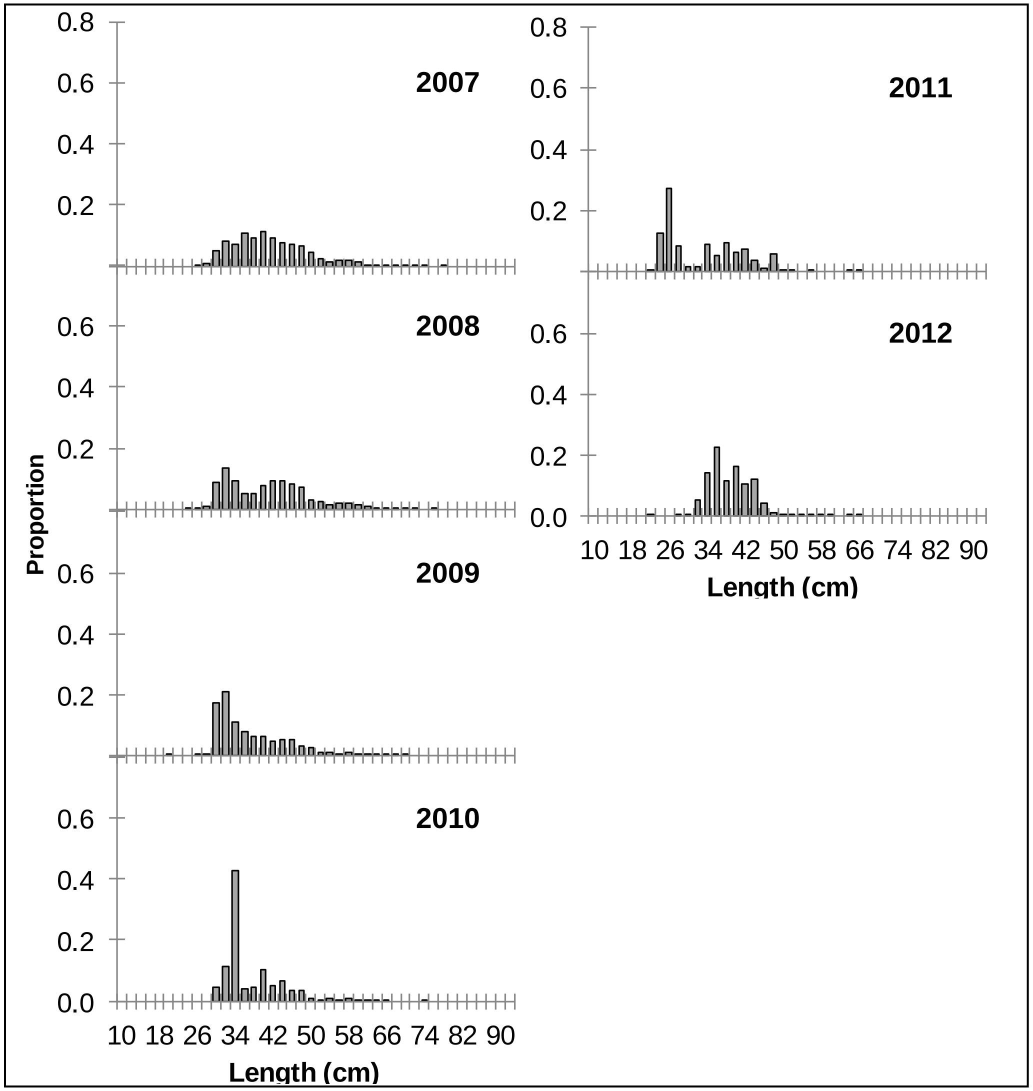

Figure 2.5. Annual length-frequency distributions of spotted seatrout sampled from Virginia and North Carolina commercial ocean fishery landings, 2007–2012.

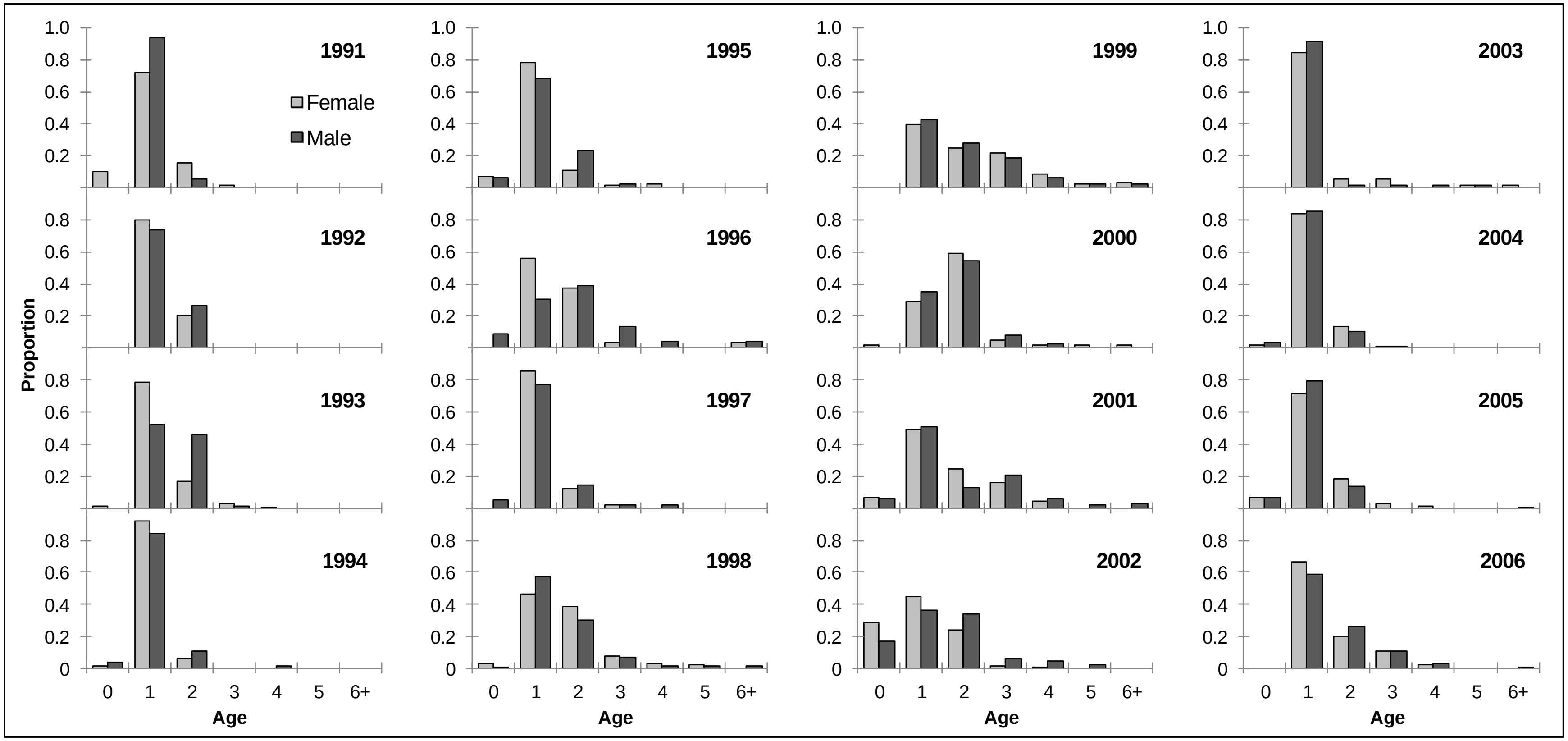

Figure 2.6. Annual age-frequency distributions of spotted seatrout sampled from Virginia and North Carolina commercial estuarine fishery landings by sex, 1991–2006.

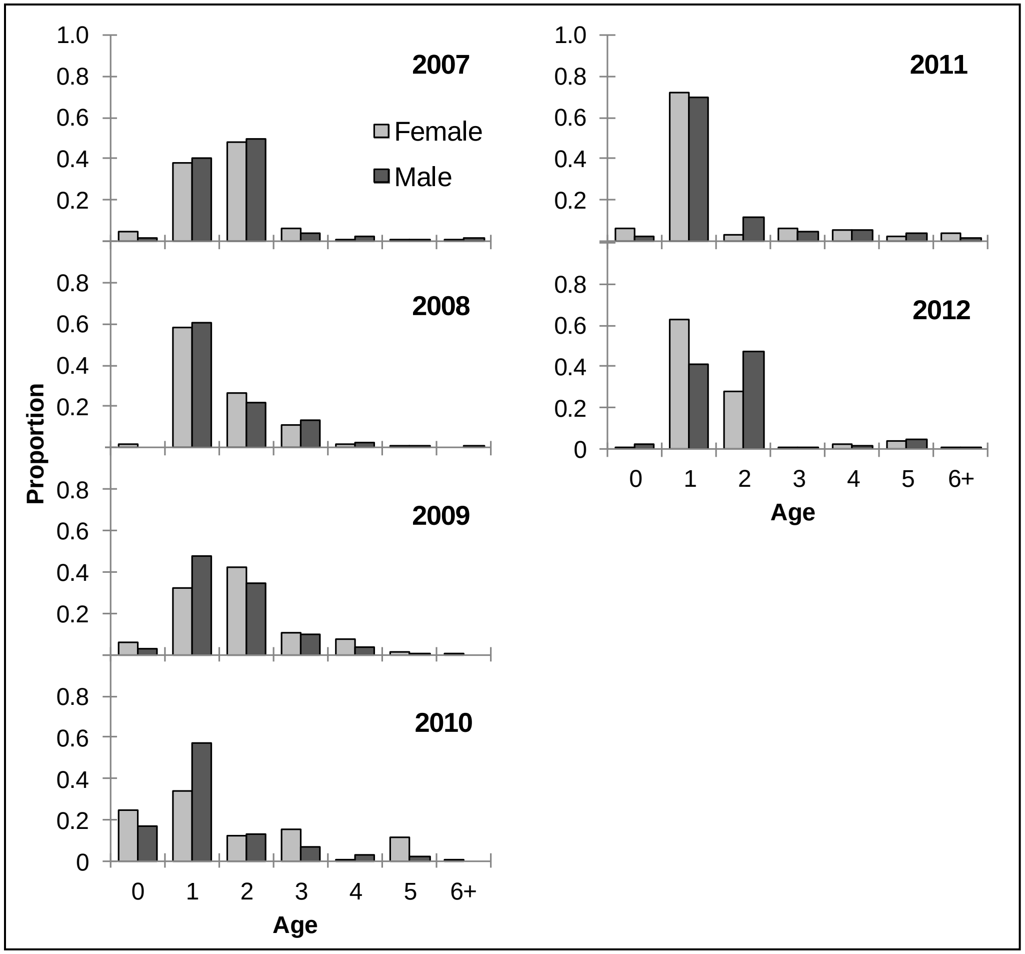

Figure 2.7. Annual age-frequency distributions of spotted seatrout sampled from Virginia and North Carolina commercial estuarine fishery landings by sex, 2007–2012.

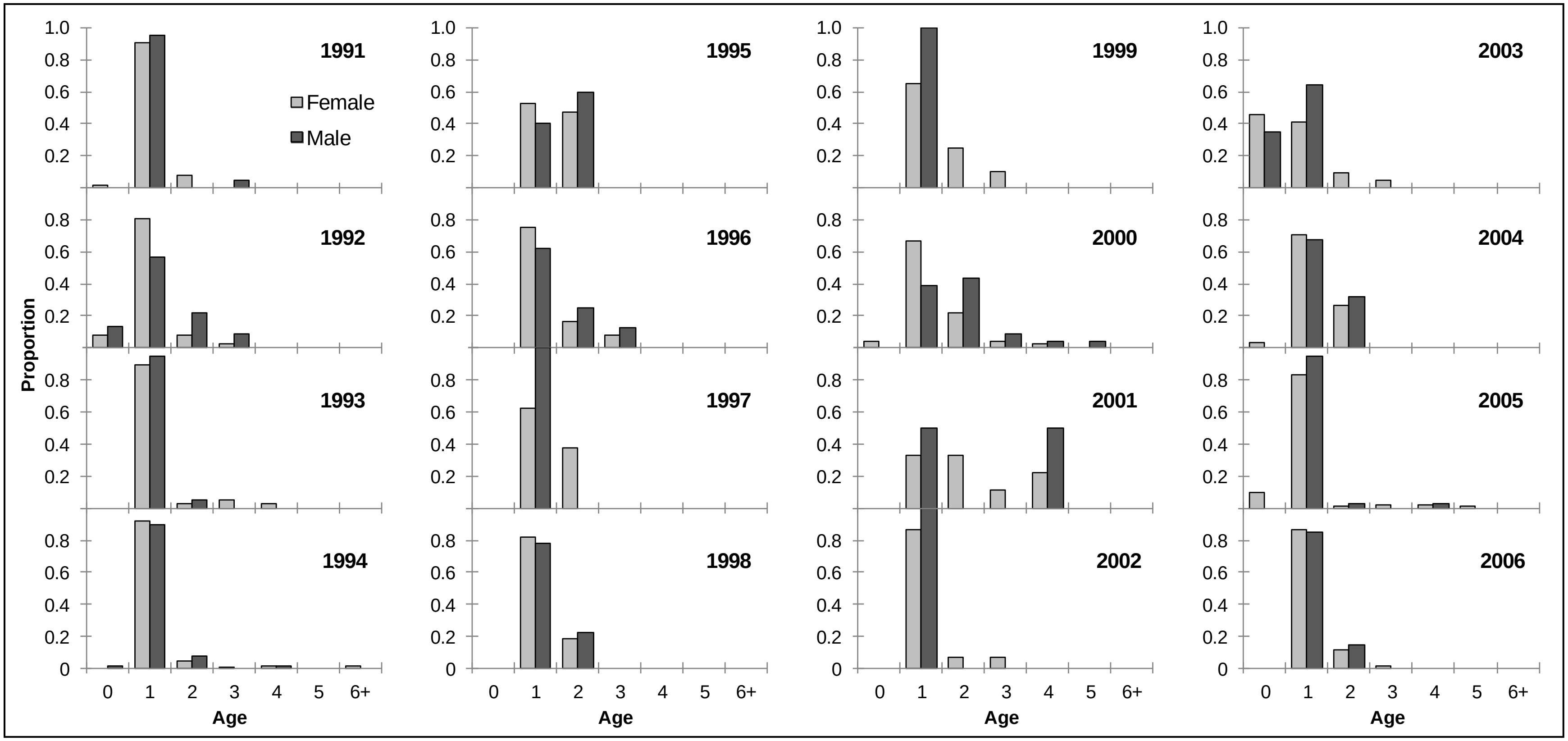

Figure 2.8. Annual age-frequency distributions of spotted seatrout sampled from Virginia and North Carolina commercial ocean fishery landings by sex, 1991–2006.

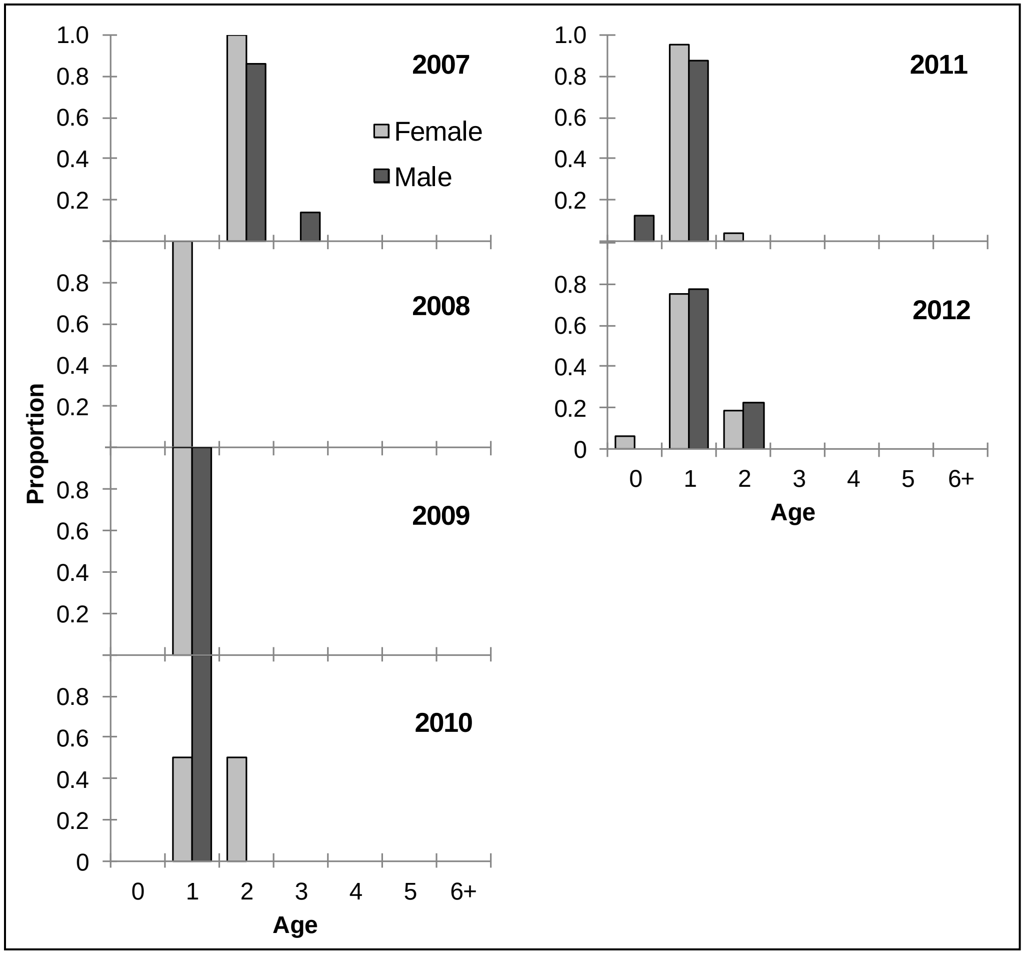

Figure 2.9. Annual age-frequency distributions of spotted seatrout sampled from Virginia and North Carolina commercial ocean fishery landings by sex, 2007–2012.

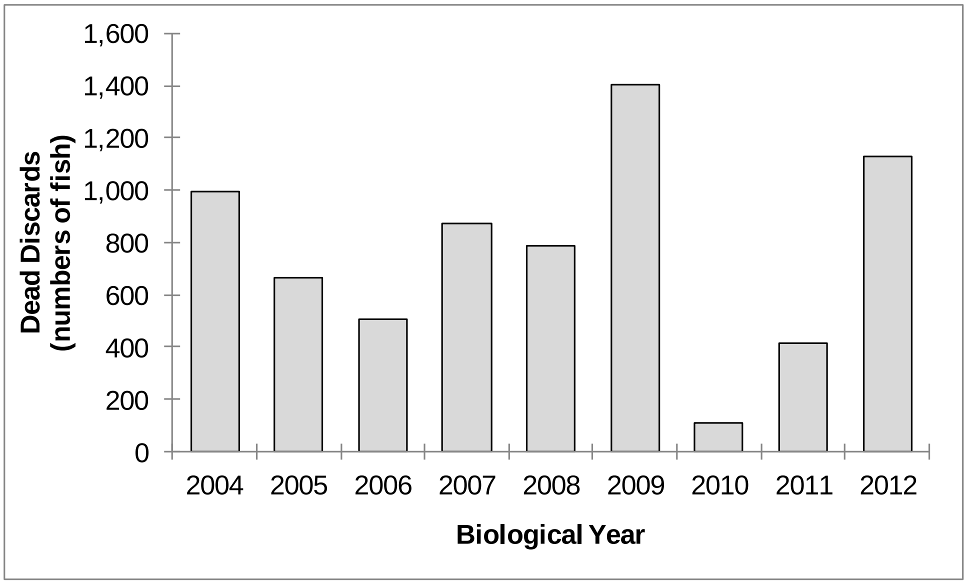

Figure 2.10. Annual commercial gill-net estuarine fishery dead discards of spotted seatrout in North Carolina, 2004–2012.

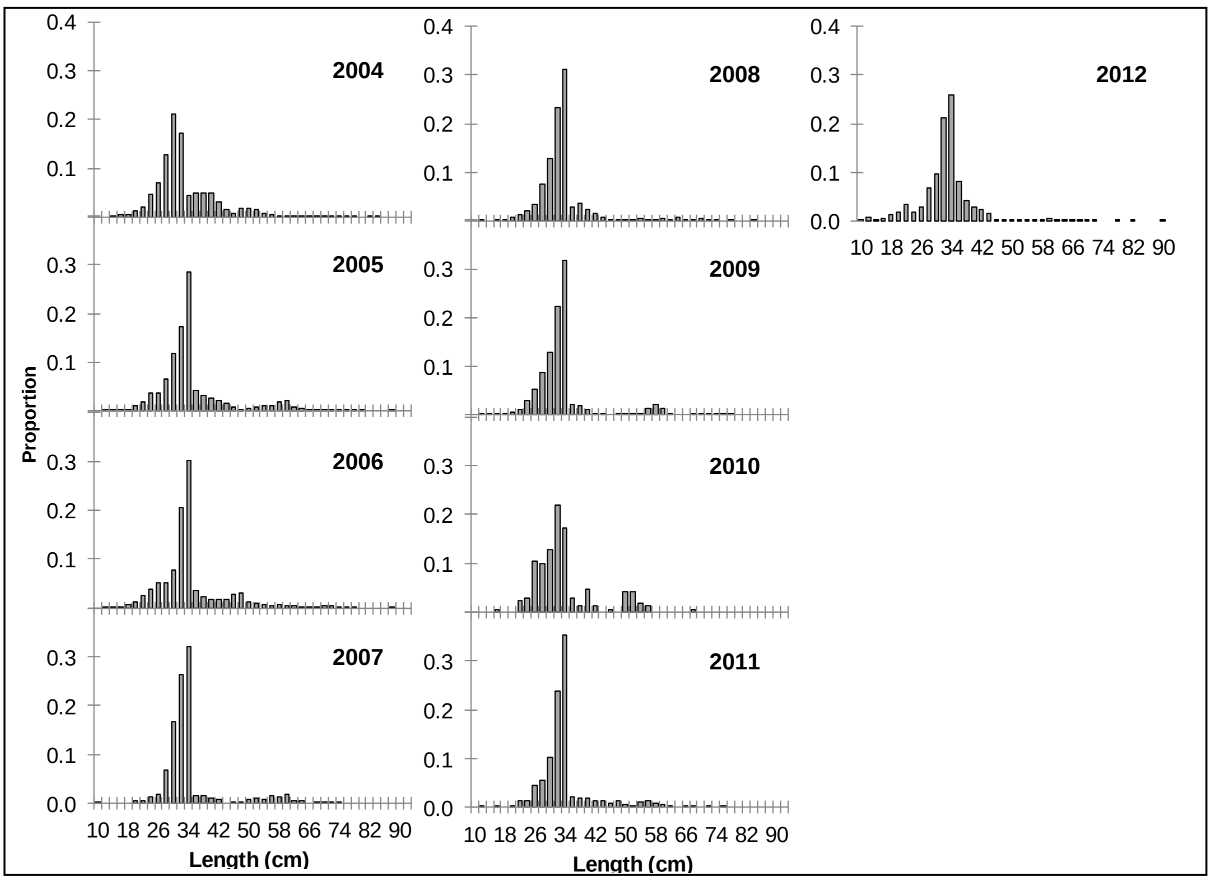

Figure 2.11. Annual length-frequency distributions of spotted seatrout sampled from North Carolina commercial gill-net estuarine fishery discards, 2004–2012.

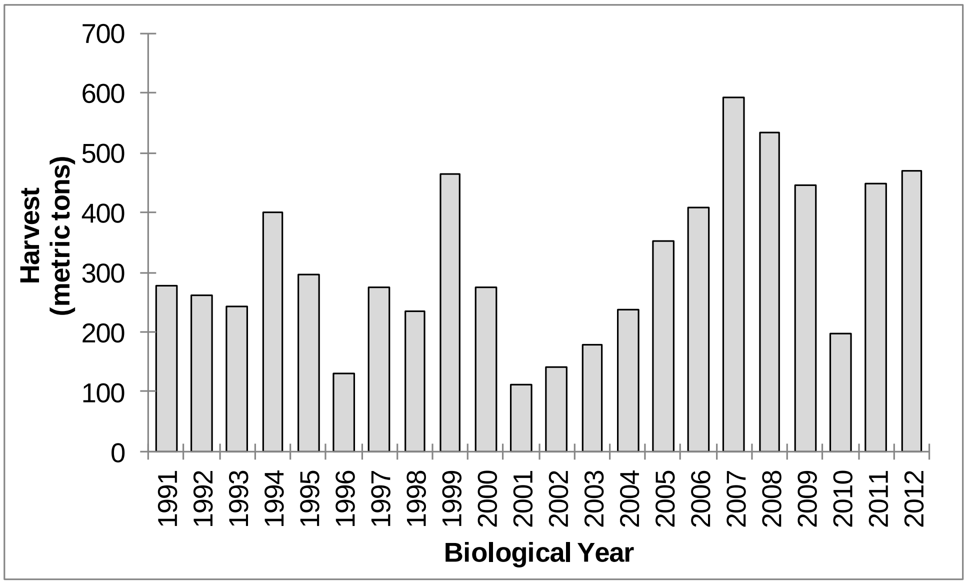

Figure 2.12. Annual recreational fishery harvest (Type A+B1) of spotted seatrout in Virginia and North Carolina, 1991–2012.

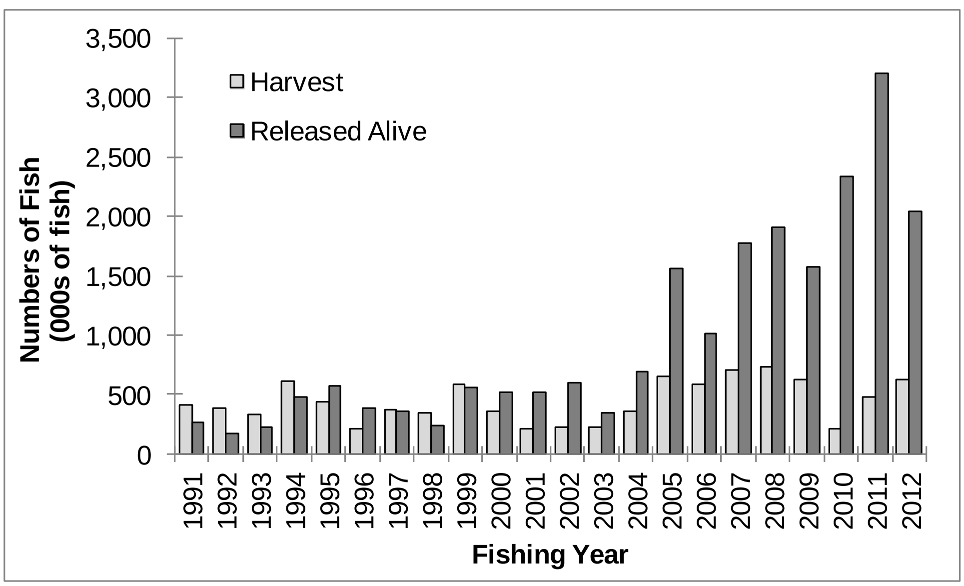

Figure 2.13. Annual recreational fishery harvest (Type A+B1) and live releases (Type B2) of spotted seatrout in Virginia and North Carolina, 1991–2012.

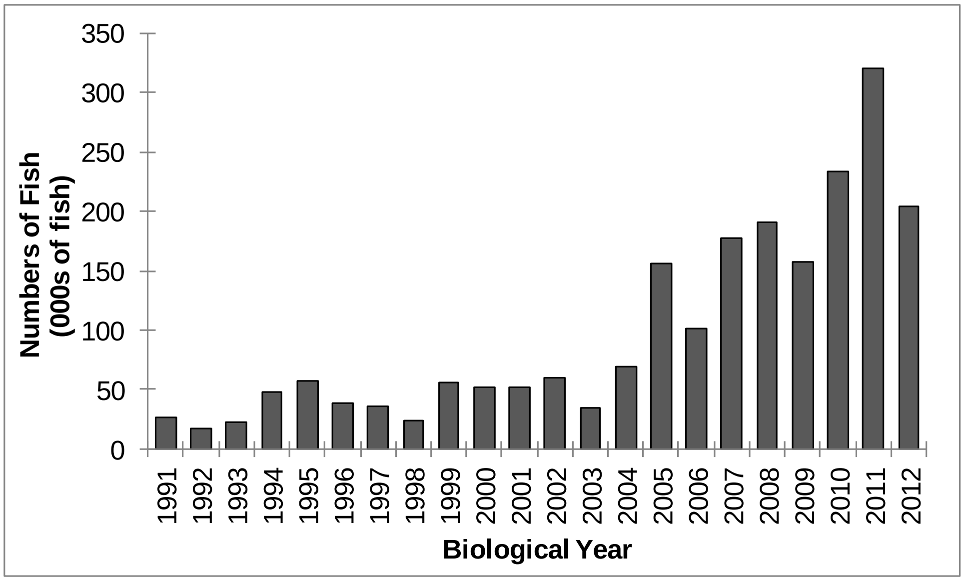

Figure 2.14. Annual recreational fishery dead discards of spotted seatrout in Virginia and North Carolina, 1991–2012.

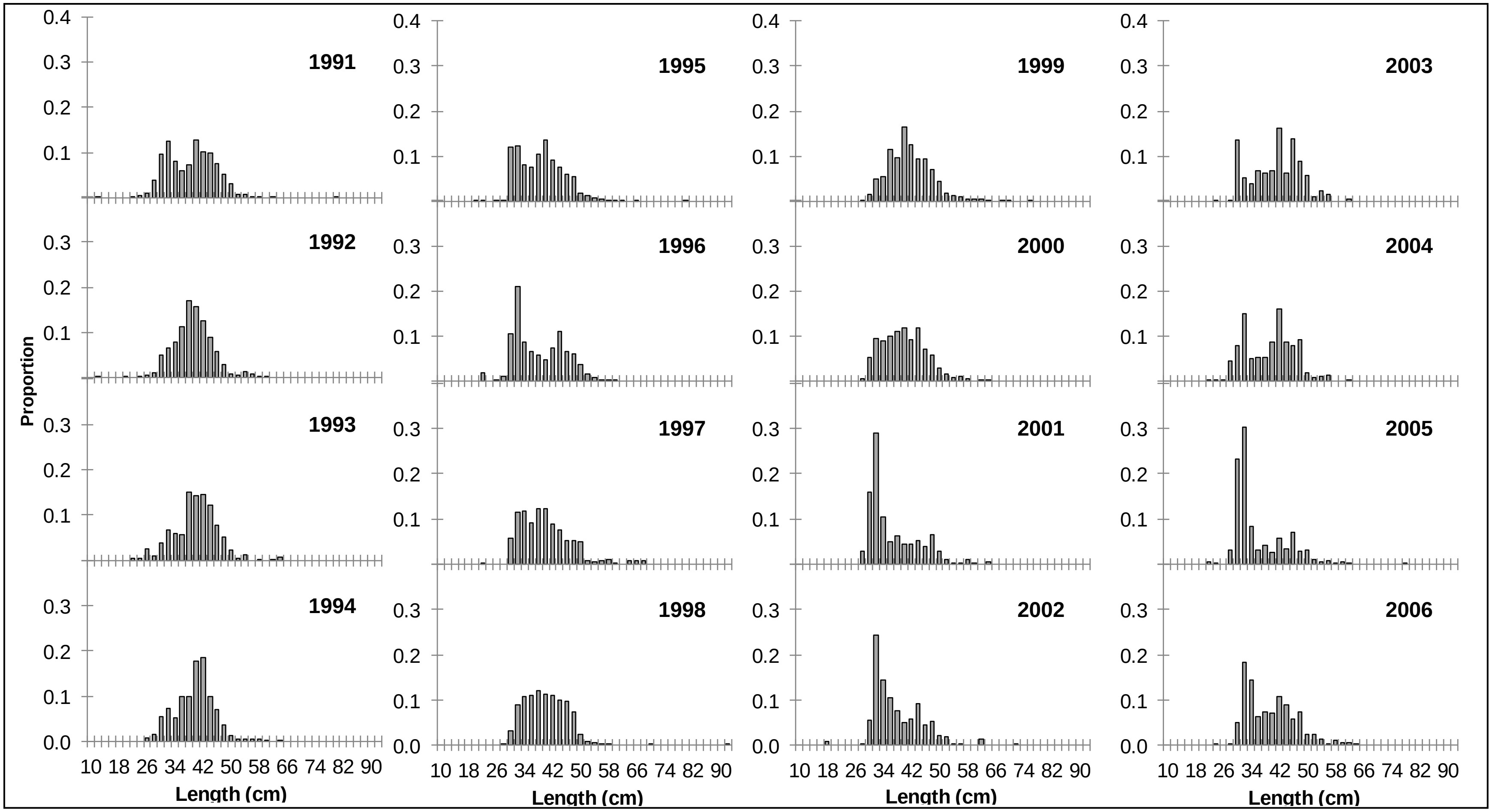

Figure 2.15. Annual length-frequency distributions of spotted seatrout sampled from Virginia and North Carolina recreational fishery landings, 1991–2006.

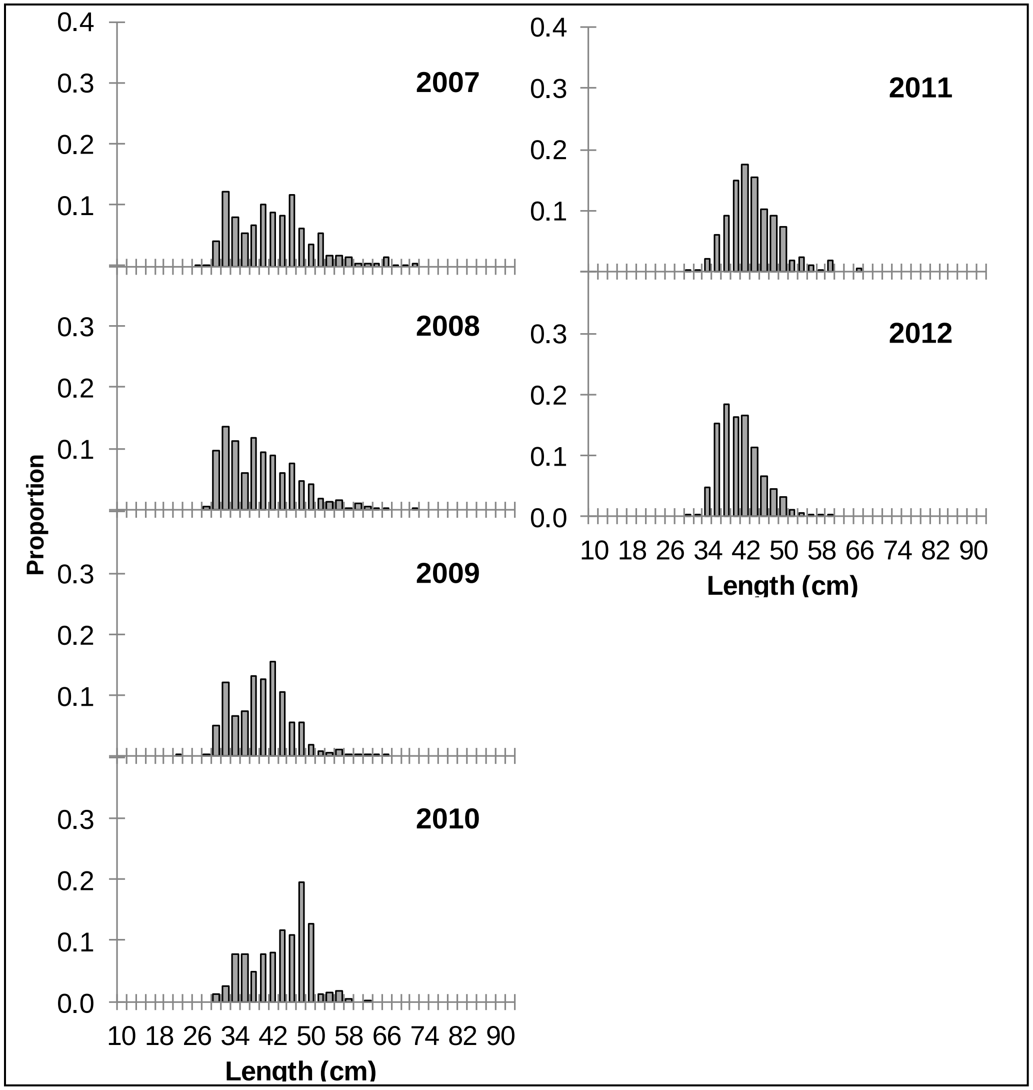

Figure 2.16. Annual length-frequency distributions of spotted seatrout sampled from Virginia and North Carolina recreational fishery landings, 2007–2012.

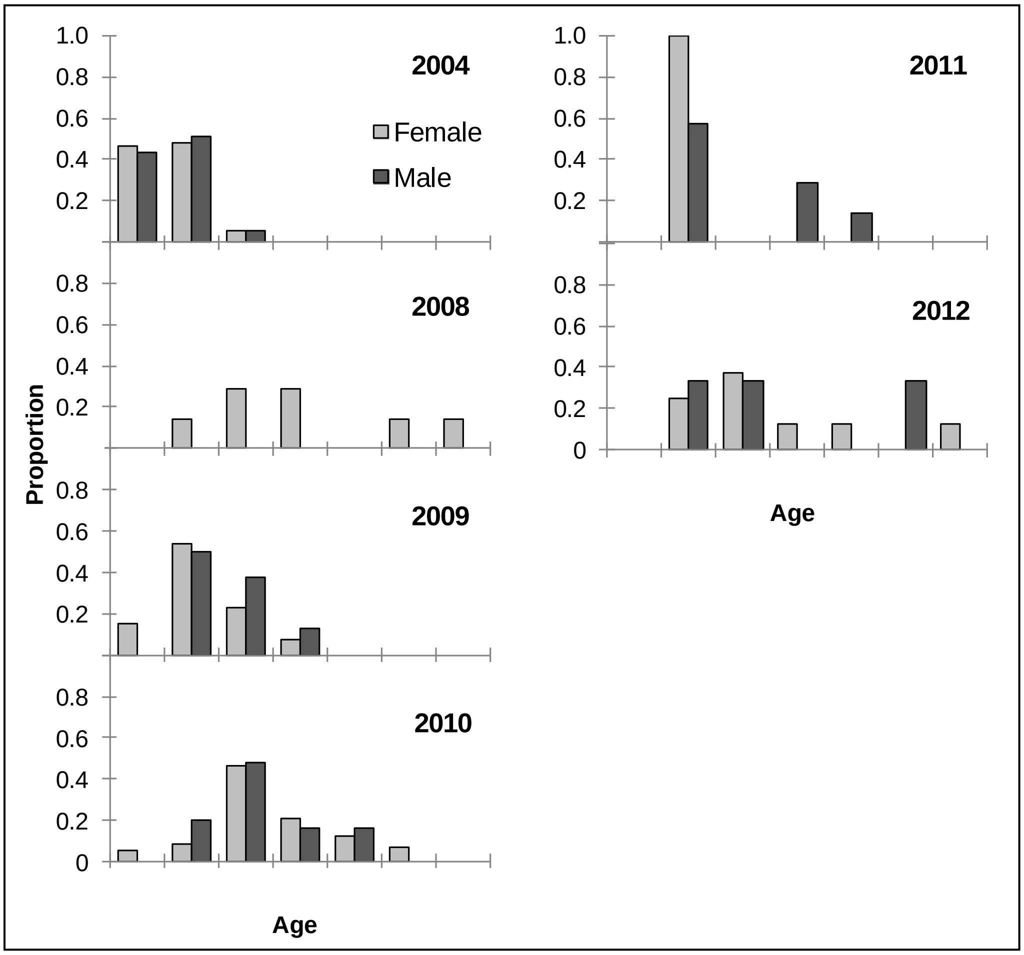

Figure 2.17. Annual age-frequency distributions of spotted seatrout sampled from Virginia's recreational fishery landings by sex, 2004–2012.

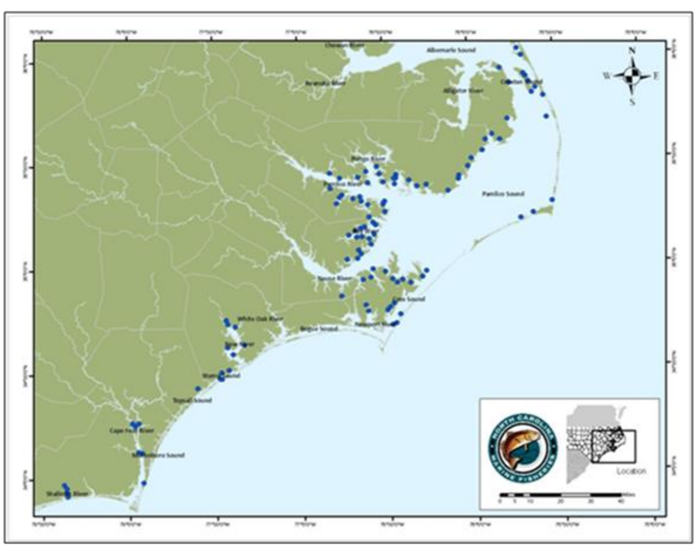

Figure 2.18. Locations of core stations sampled by NCDMF Program 120.

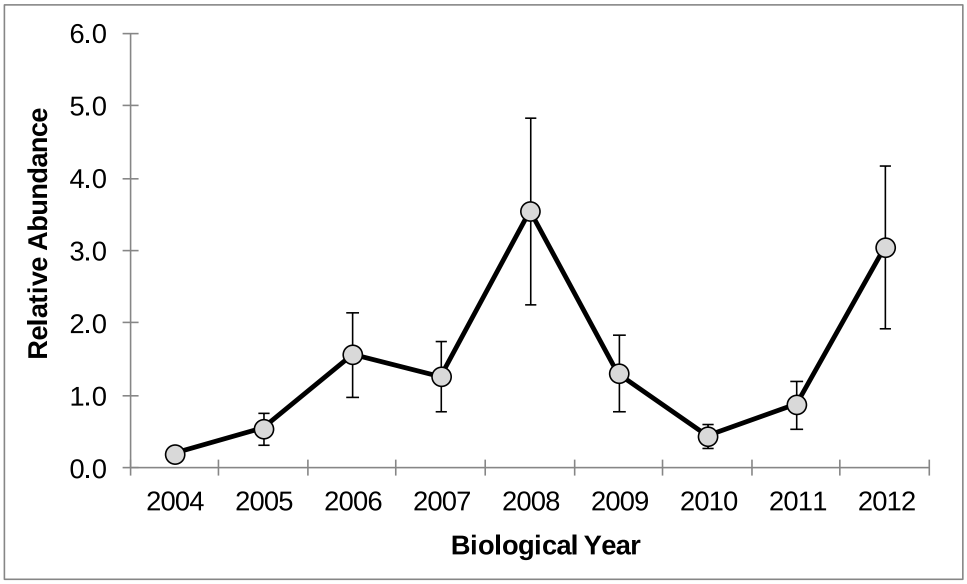

Figure 2.19. GLM-standardized index of relative abundance for age-0 spotted seatrout collected from Program 120 during June and July, 2004–2012. Error bars represent ± 1 standard error.

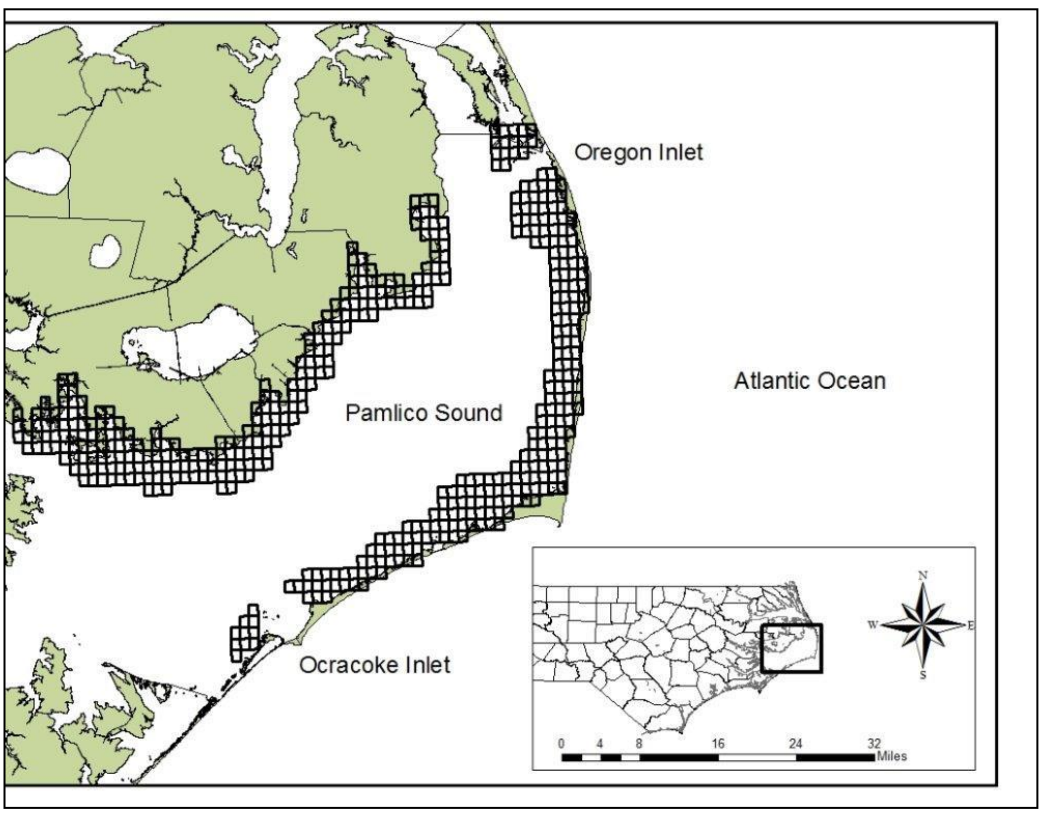

Figure 2.20. The sample regions and grid system for the Pamlico Sound portion of NCDMF Program 915.

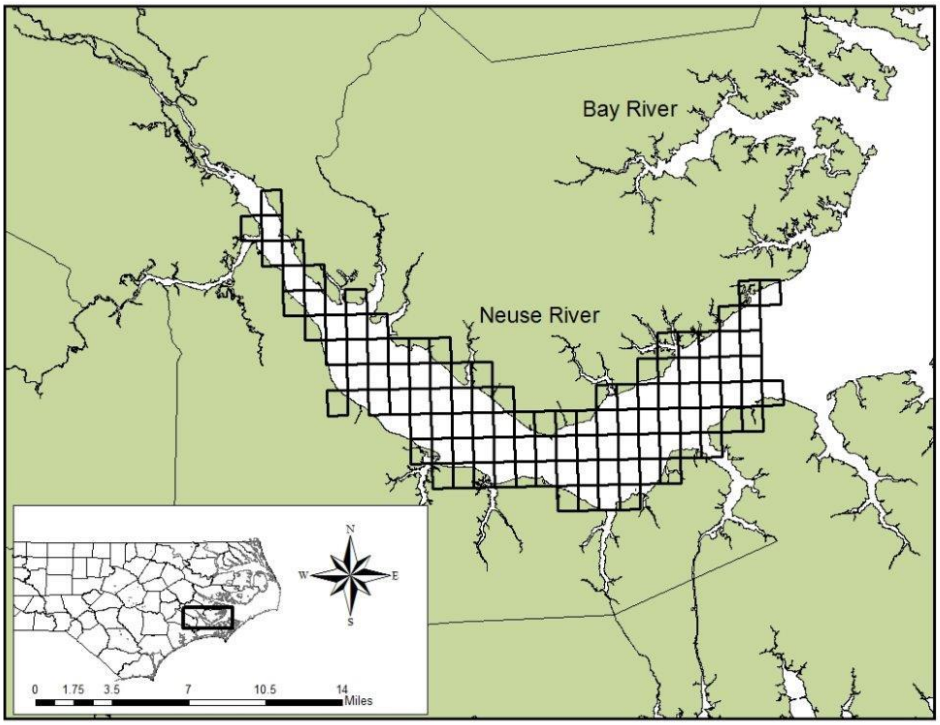

Figure 2.21. The sample regions and grid system for the Neuse River portion of NCDMF Program 915.

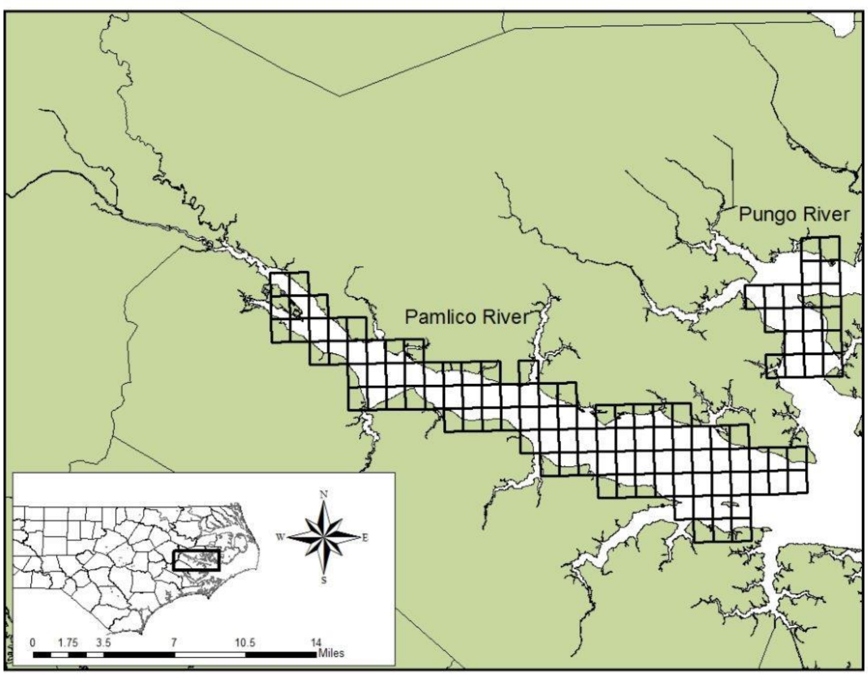

Figure 2.22. The sample regions and grid system for the Pamlico and Pungo river portions of NCDMF Program 915.

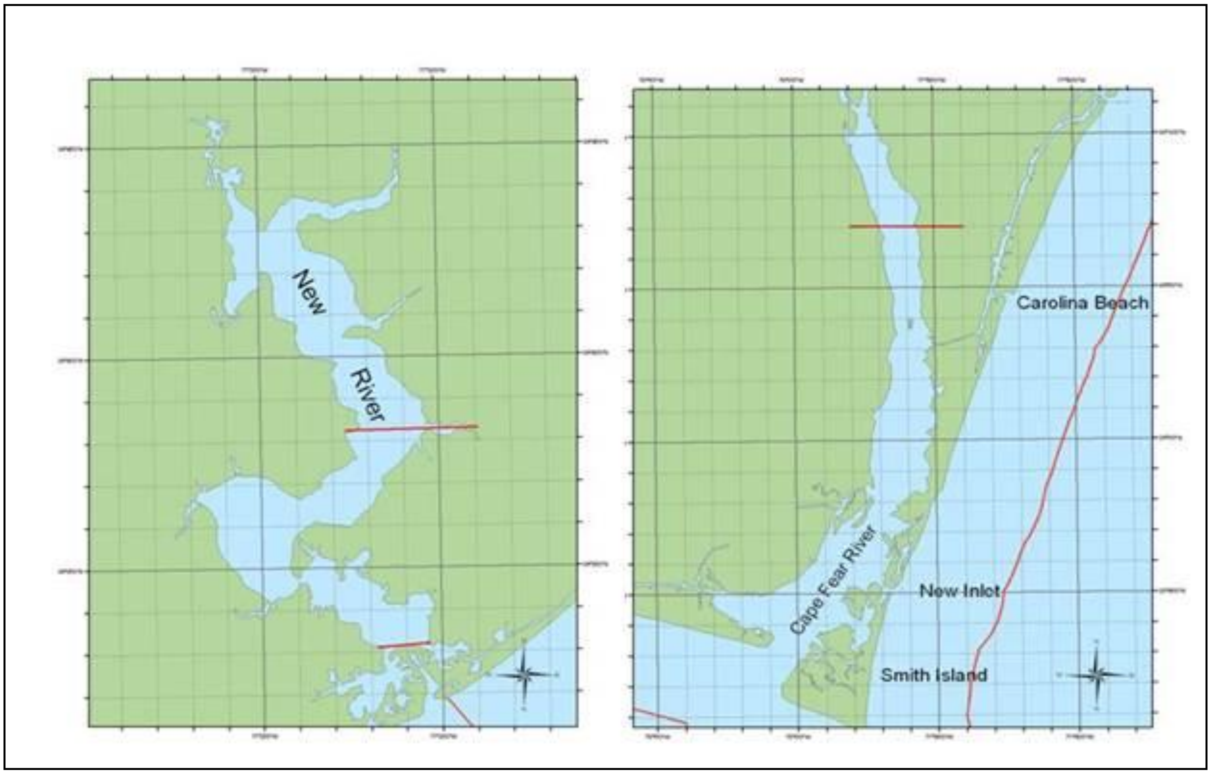

Figure 2.23. The sample regions and grid system for the Southern District portion of NCDMF Program 915.

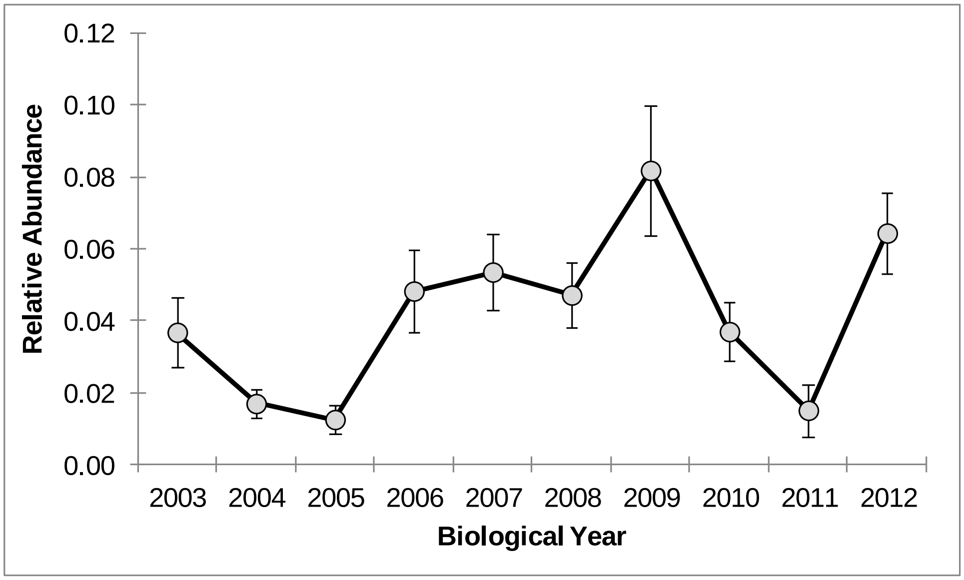

Figure 2.24. GLM-standardized index of relative abundance for spotted seatrout collected from Program 915 during spring (May–June), 2003–2012. Error bars represent ± 1 standard error.

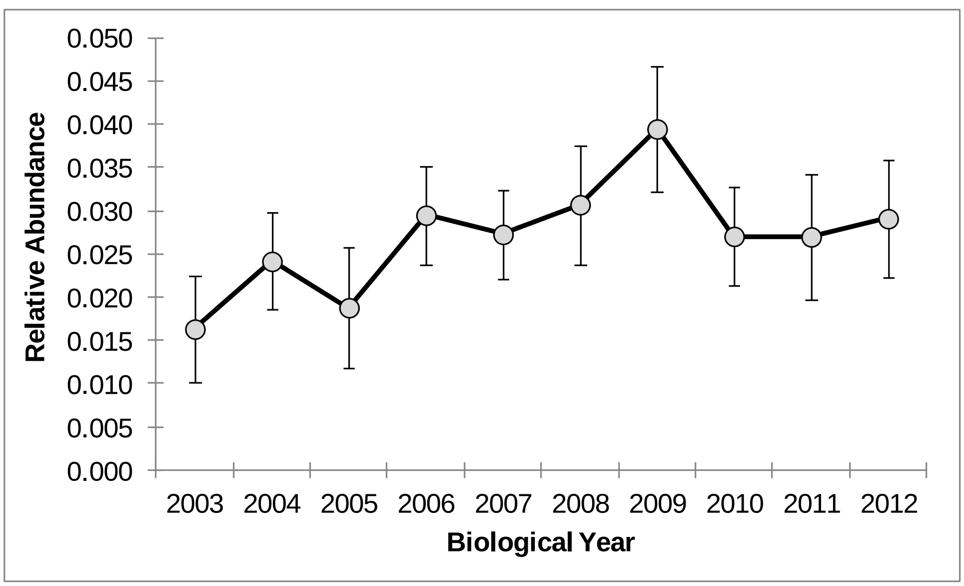

Figure 2.25. GLM-standardized index of relative abundance for spotted seatrout collected from Program 915 during summer (July–August), 2003–2012. Error bars represent ± 1 standard error.

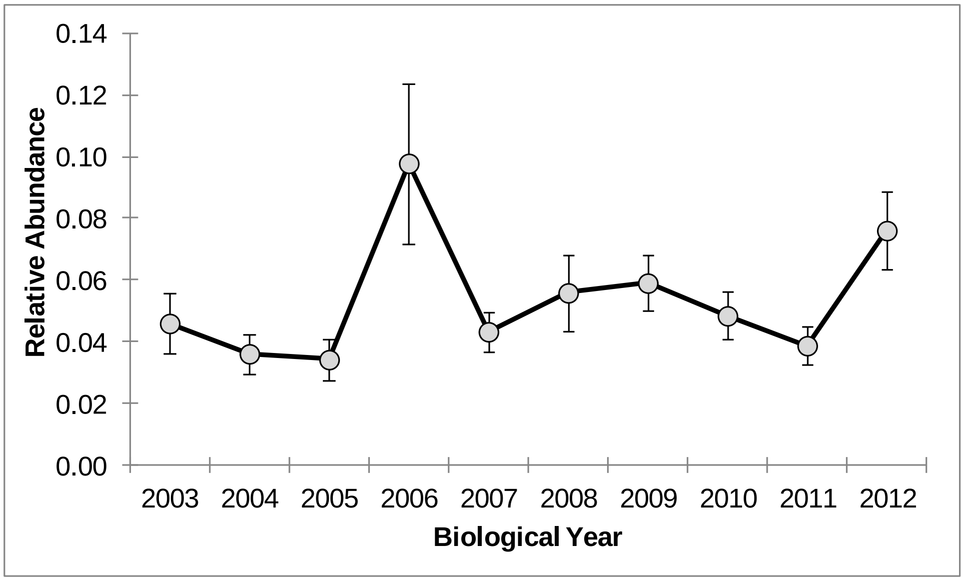

Figure 2.26. GLM-standardized index of relative abundance for spotted seatrout collected from Program 915 during fall (September–November), 2003–2012. Error bars represent ± 1 standard error.

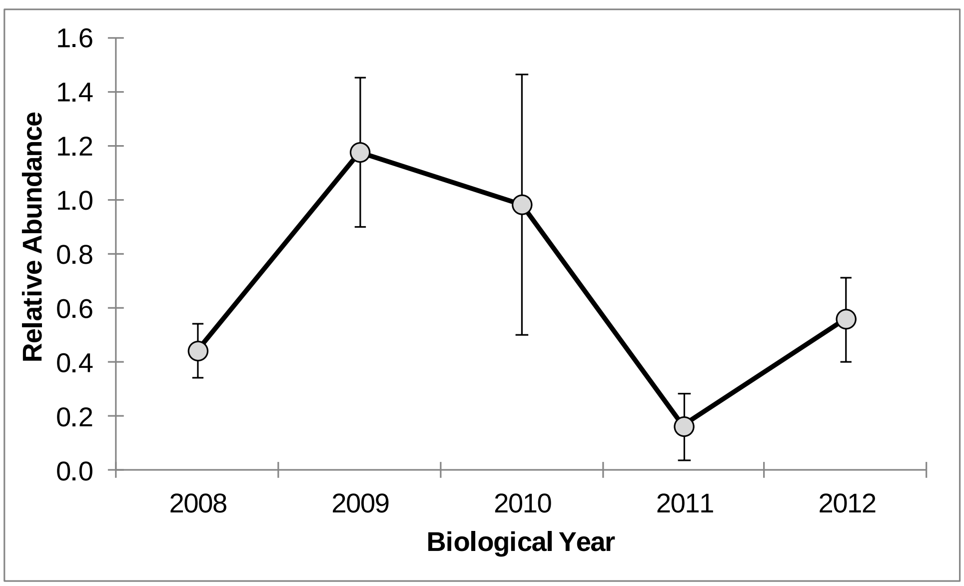

Figure 2.27. GLM-standardized index of relative abundance for spotted seatrout collected from Program 915 during spring (May–June) in the southern sampling stations, 2008–2012. Error bars represent ± 1 standard error.

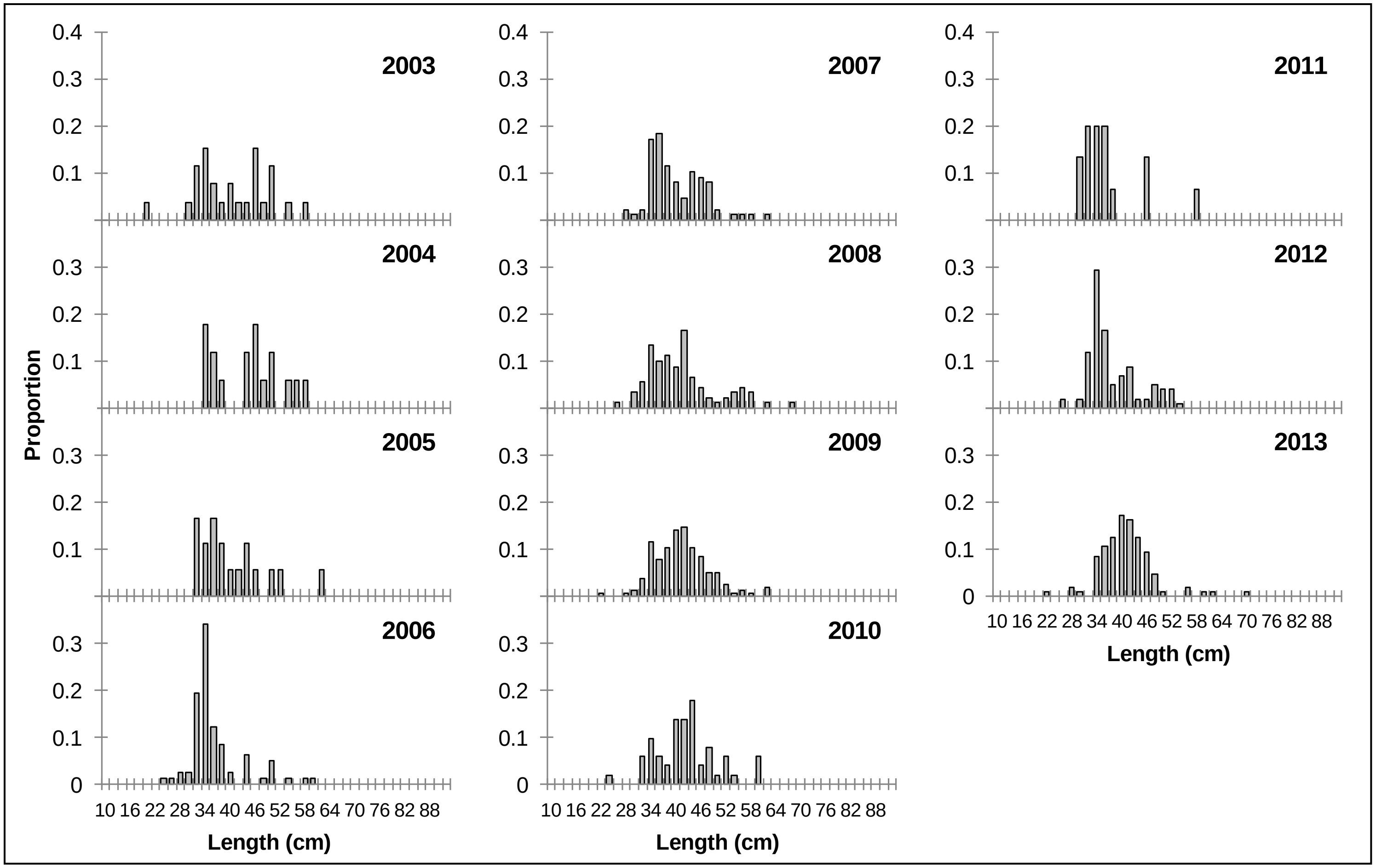

Figure 2.28. Annual length-frequency distributions of spotted seatrout collected by NCDMF Program 915 during spring (May–June), 2003–2012.

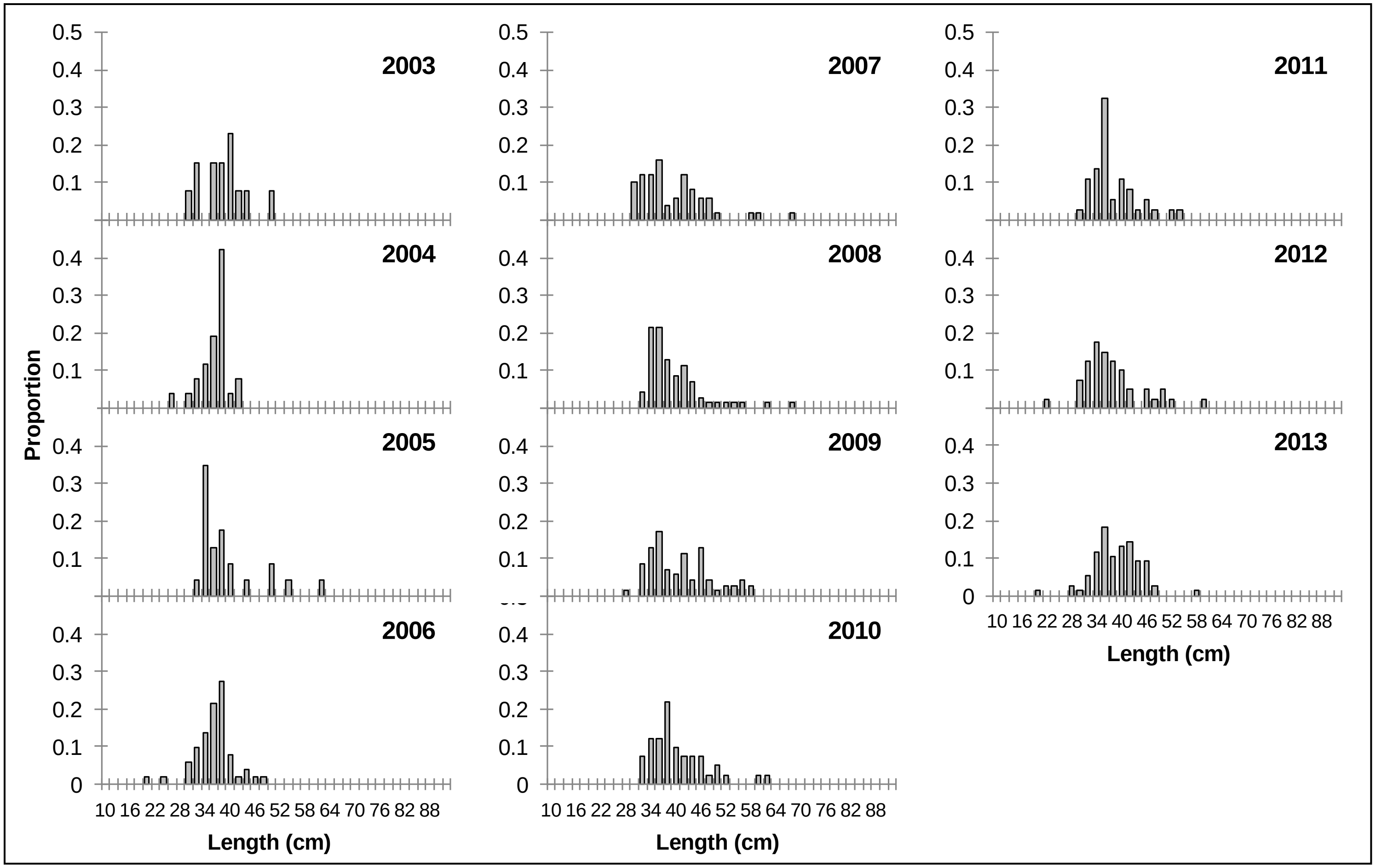

Figure 2.29. Annual length-frequency distributions of spotted seatrout collected by NCDMF Program 915 during summer (July–August), 2003–2012.

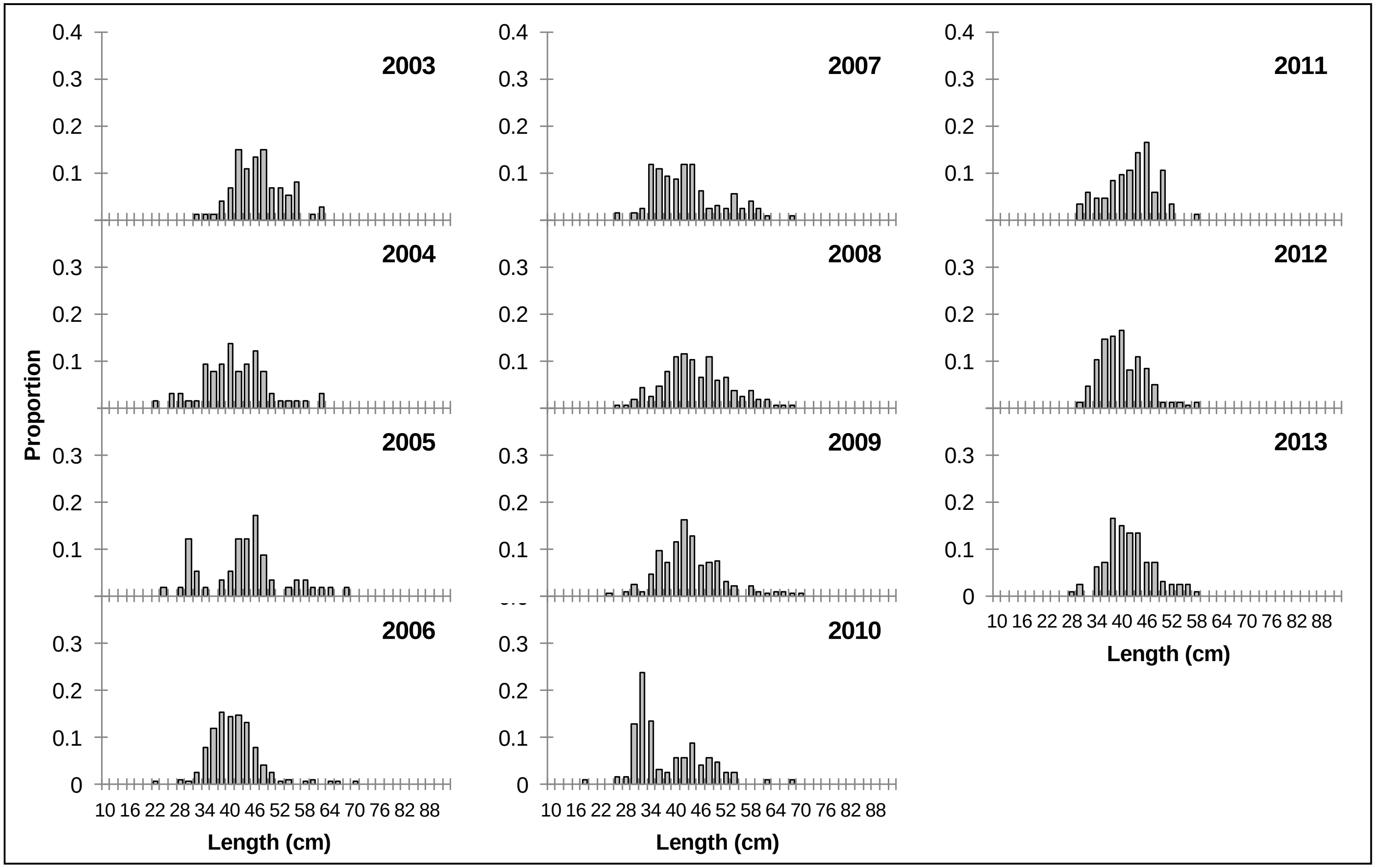

Figure 2.30. Annual length-frequency distributions of spotted seatrout collected by NCDMF Program 915 during fall (September–November), 2003–2012.

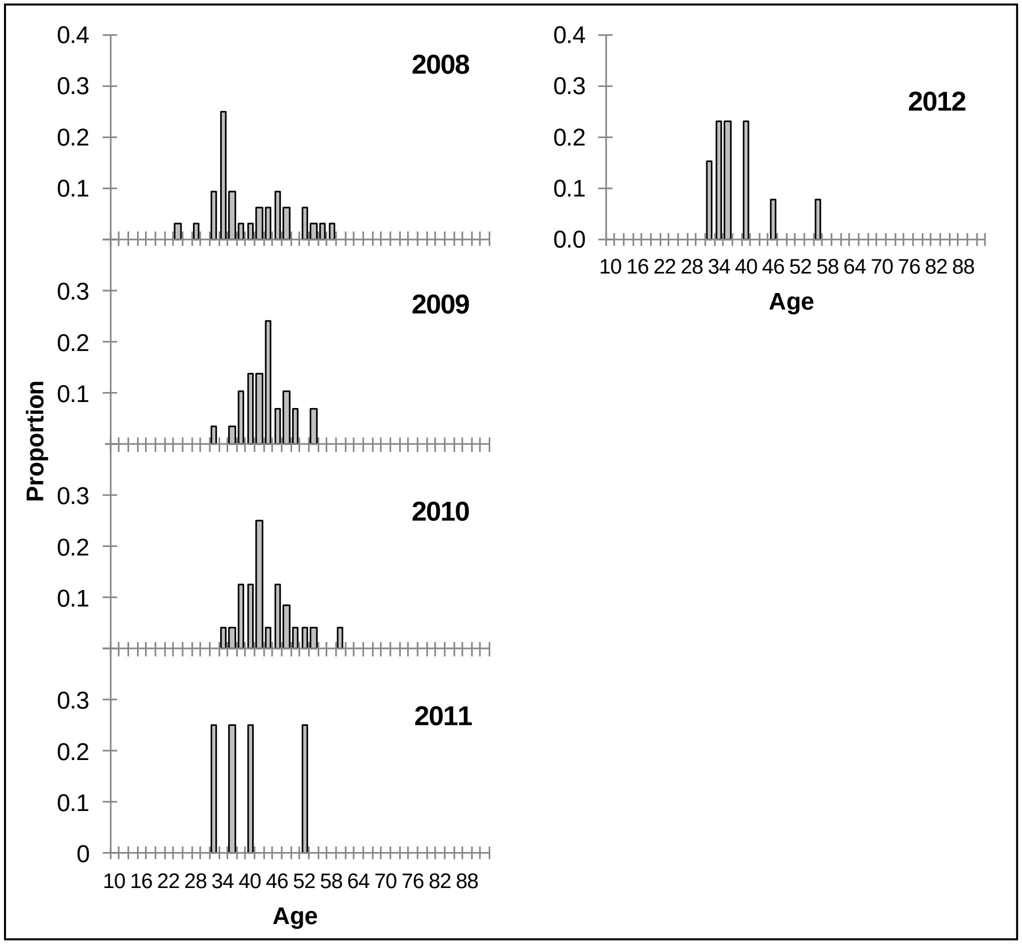

Figure 2.31. Annual length-frequency distributions of spotted seatrout collected by NCDMF Program 915 during spring (May–June) in the southern sampling stations, 2008–2012.

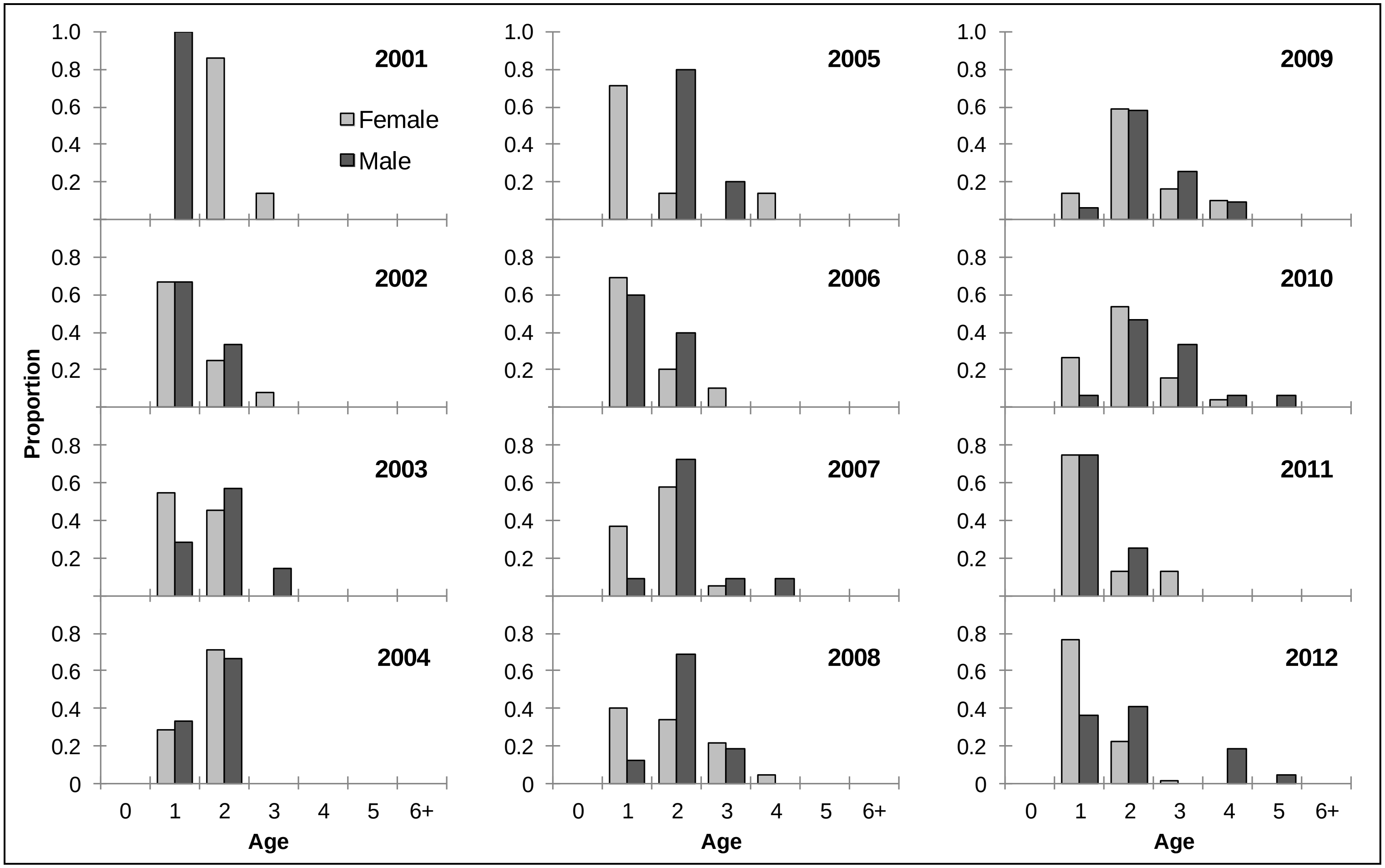

Figure 2.32. Annual age-frequency distributions of spotted seatrout collected by NCDMF Program 915 during spring (May–June) by sex, 2001–2012.

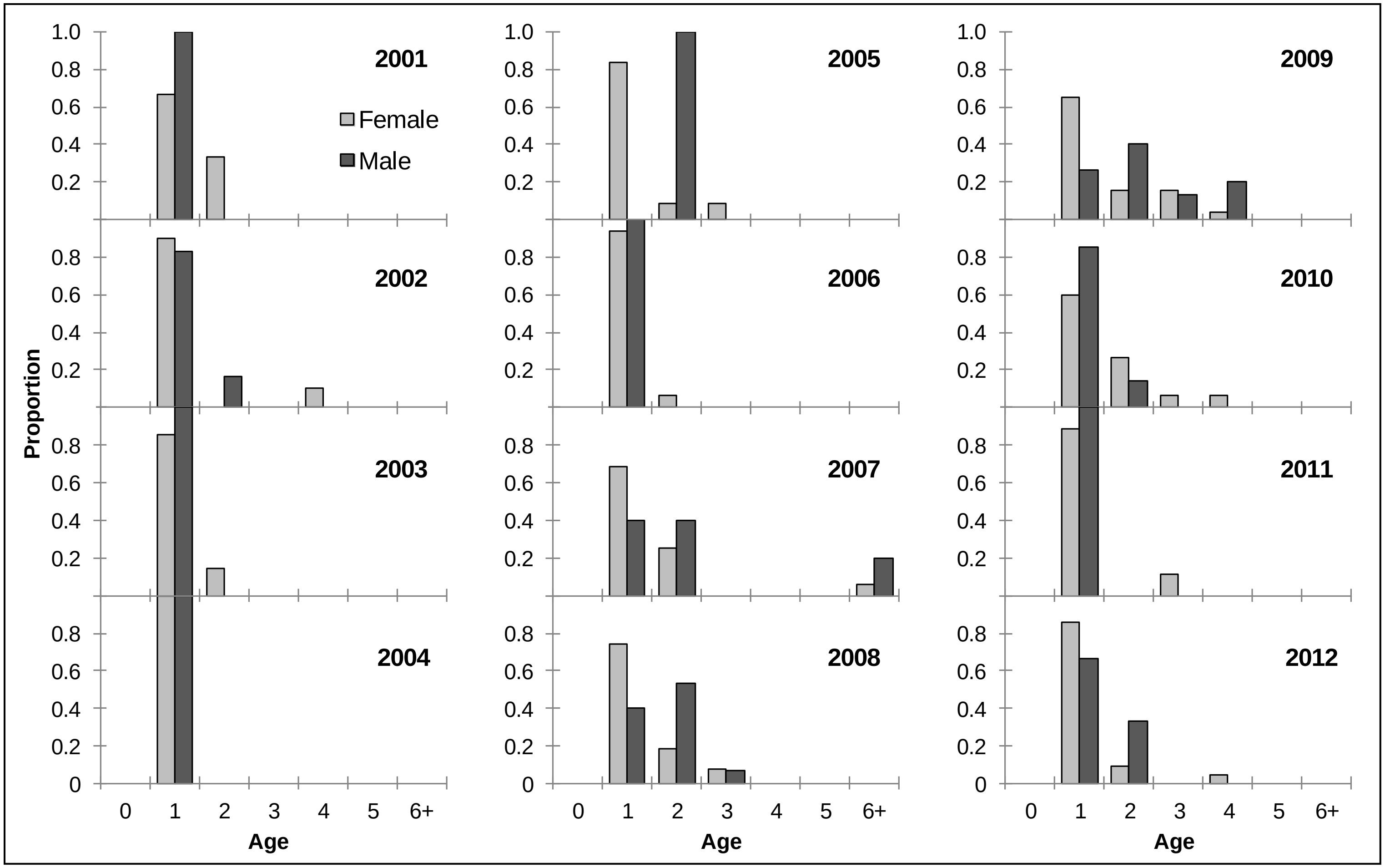

Figure 2.33. Annual age-frequency distributions of spotted seatrout collected by NCDMF Program 915 during summer (July–August) by sex, 2001–2012.

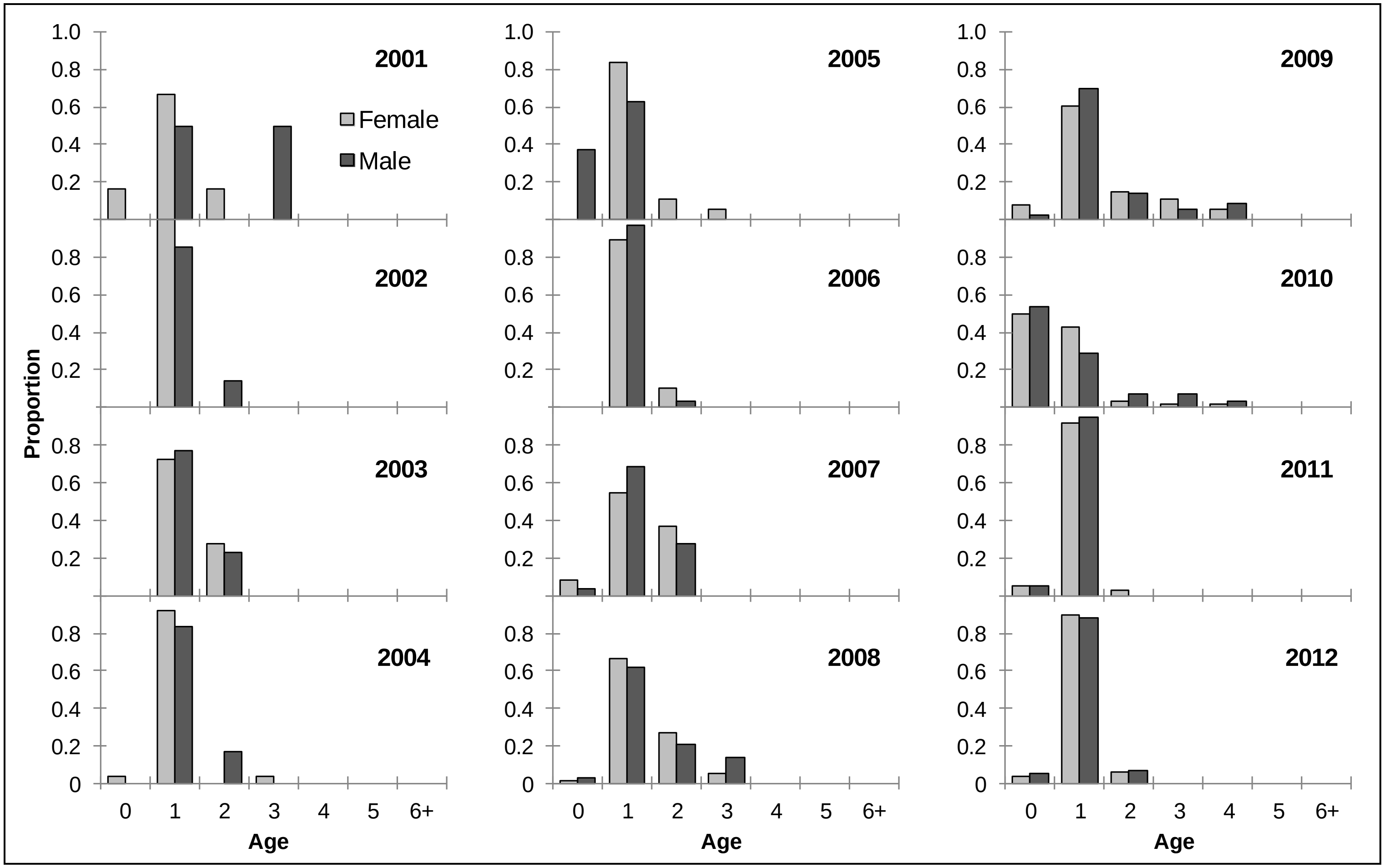

Figure 2.34. Annual age-frequency distributions of spotted seatrout collected by NCDMF Program 915 during fall (September–November) by sex, 2001–2012.

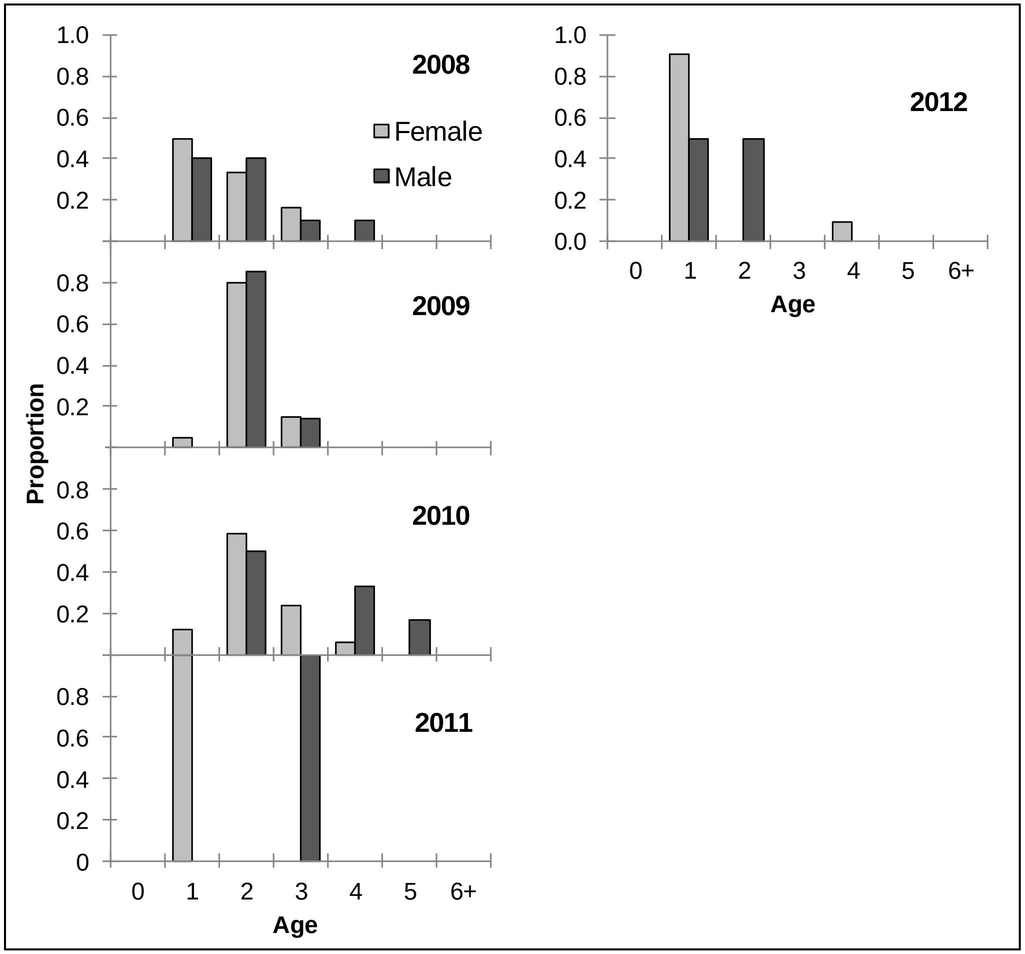

Figure 2.35. Annual age-frequency distributions of spotted seatrout collected by NCDMF Program 915 during spring (May–June) in the southern sampling stations by sex, 2008–2012.

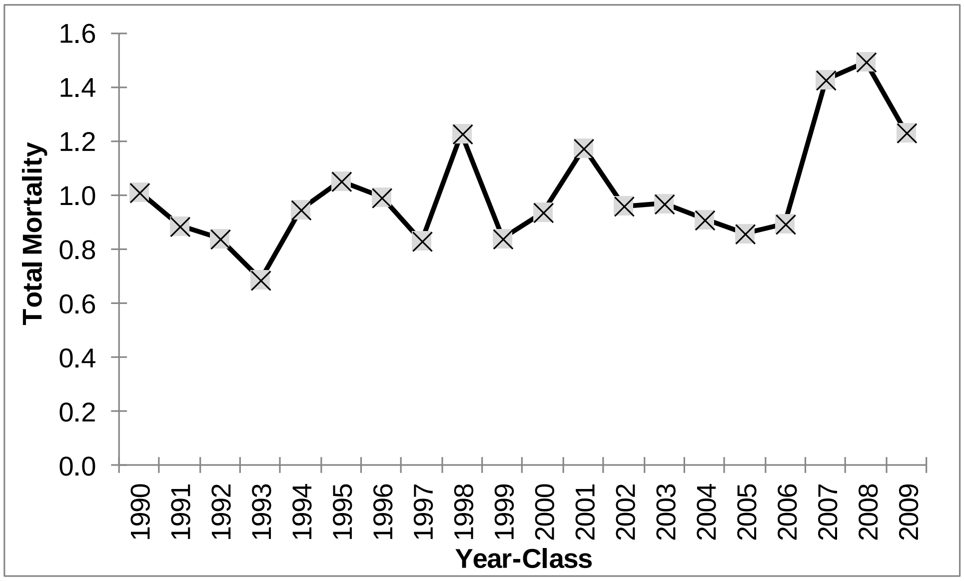

Figure 3.1. Catch curve estimates of instantaneous total mortality for true cohorts.

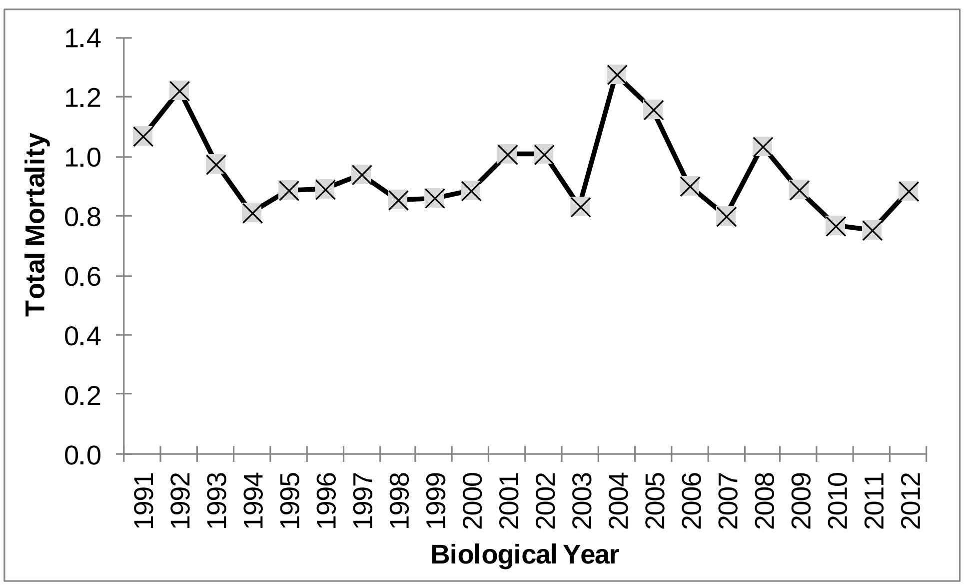

Figure 3.2. Catch curve estimates of instantaneous total mortality for synthetic cohorts.

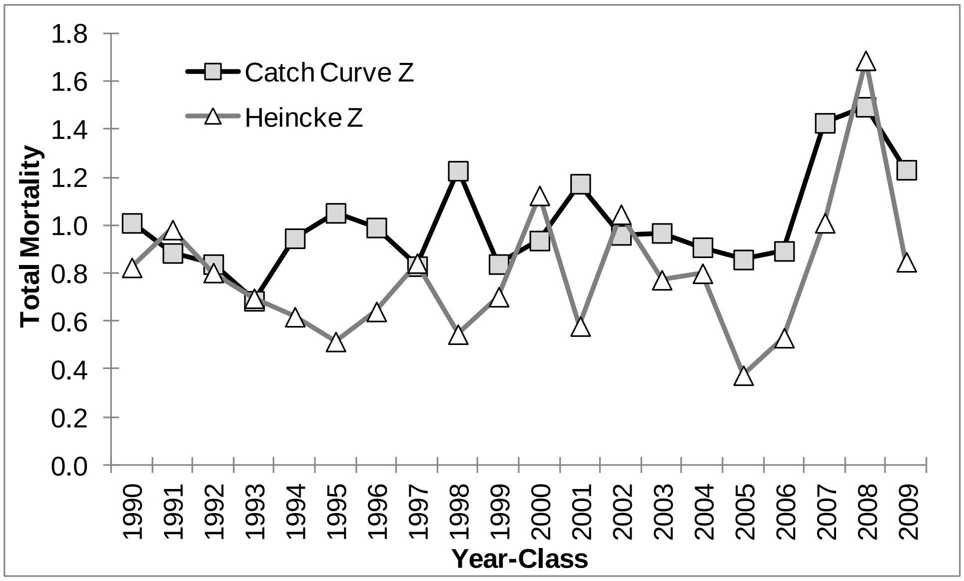

Figure 3.3. Comparison of total mortality rates estimated by catch curves and Heincke's method for true cohorts.

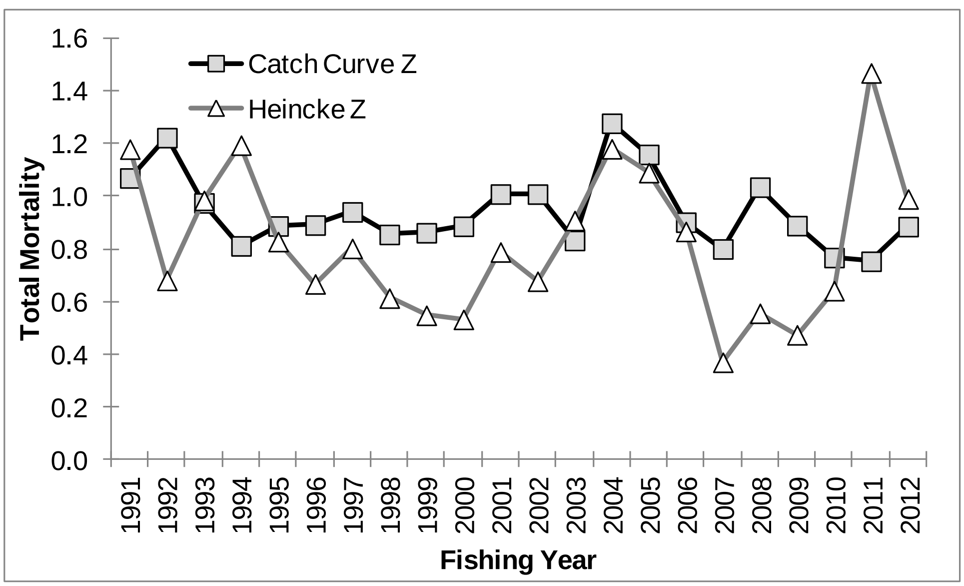

Figure 3.4. Comparison of total mortality rates estimated by catch curves and Heincke's method for synthetic cohorts.

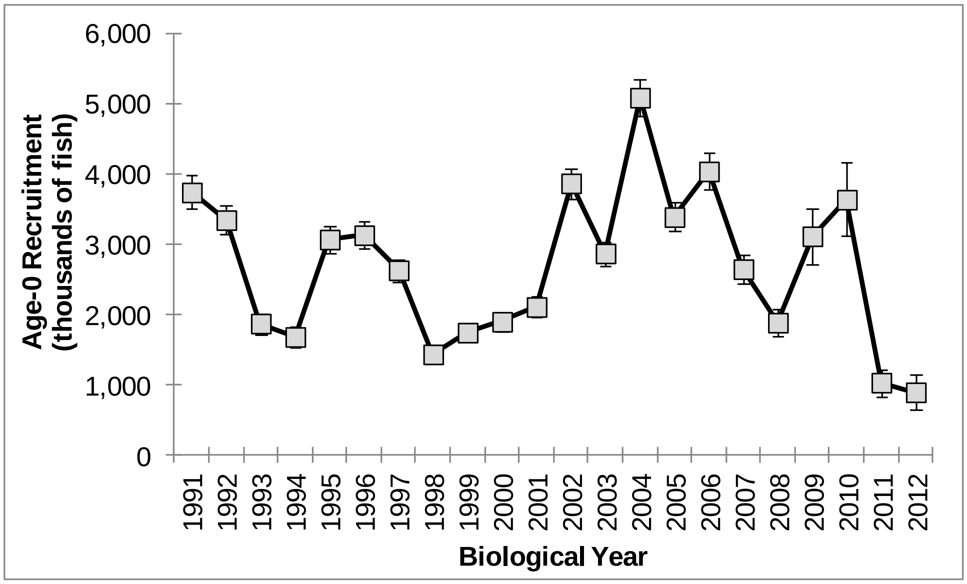

Figure 3.5. Annual estimates of age-0 recruitment from the base run of the assessment model, 1994–2012. Error bars represent +/- 1 standard deviation.

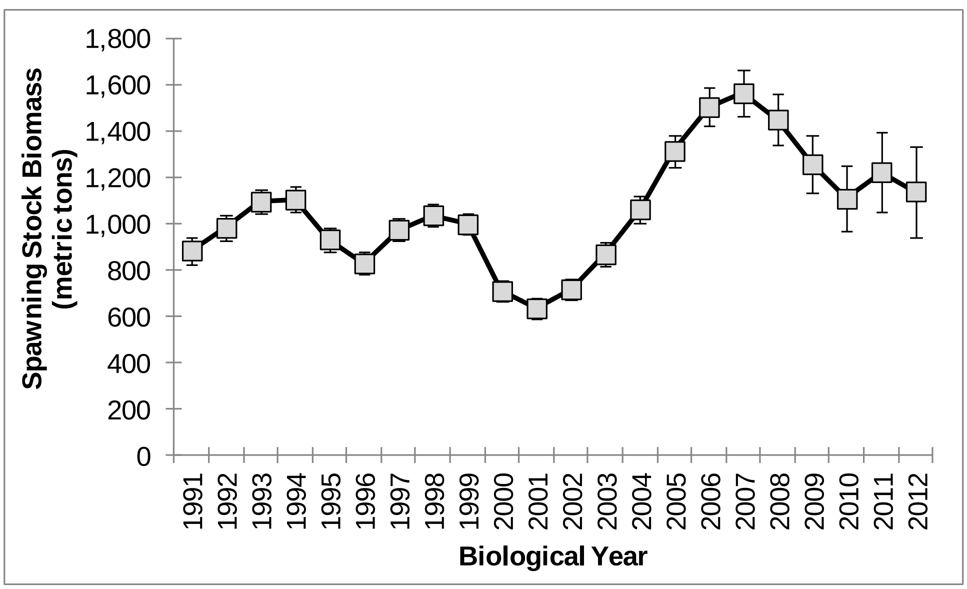

Figure 3.6. Annual estimates of spawning stock biomass from the base run of the assessment model, 1994–2012. Error bars represent +/- 1 standard deviation.

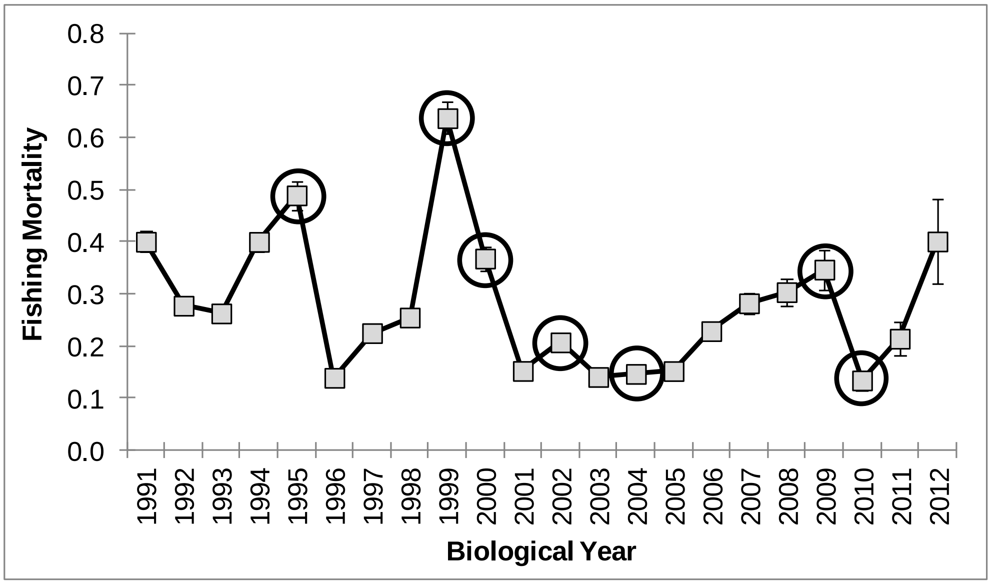

Figure 3.7. Annual estimates of fishing mortality (numbers-weighted, ages 1–4) from the base run of the assessment model, 1994–2012. Error bars represent +/- 1 standard deviation. Circles indicate years associated with known cold-stun events.

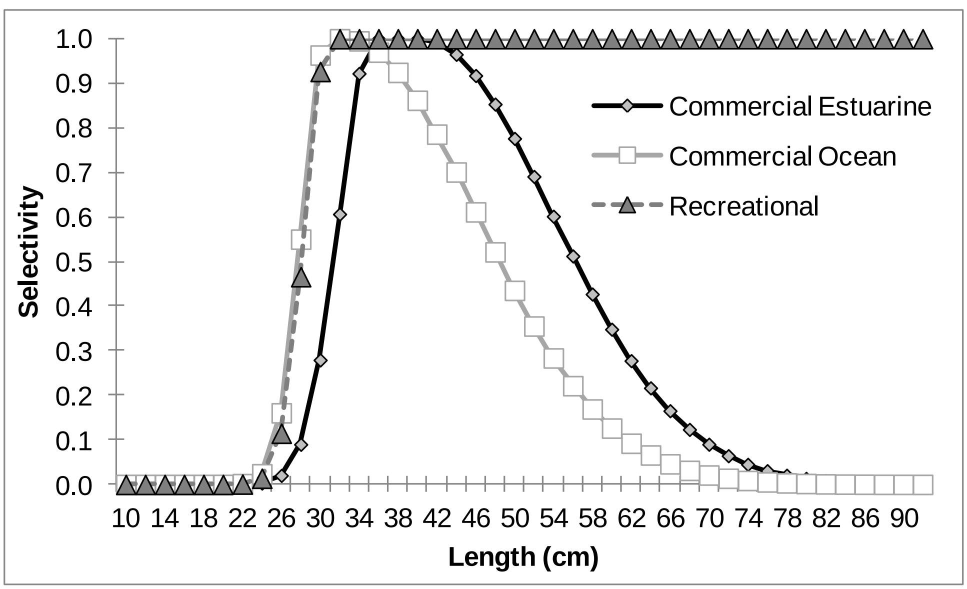

Figure 3.8. Predicted selectivity curves for the fishing fleets from the base run of the assessment model.

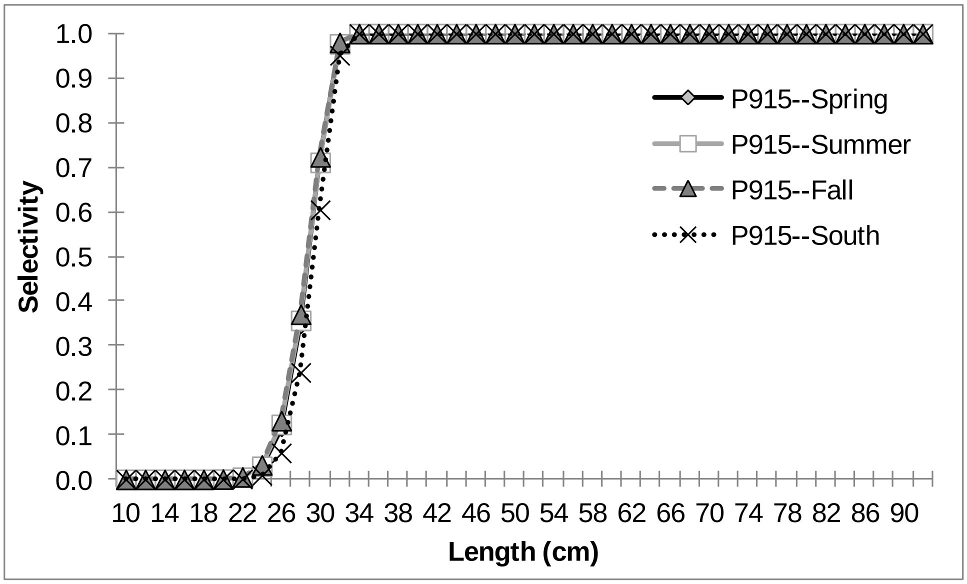

Figure 3.9. Predicted selectivity curves for the fisheries-independent surveys from the base run of the assessment model.

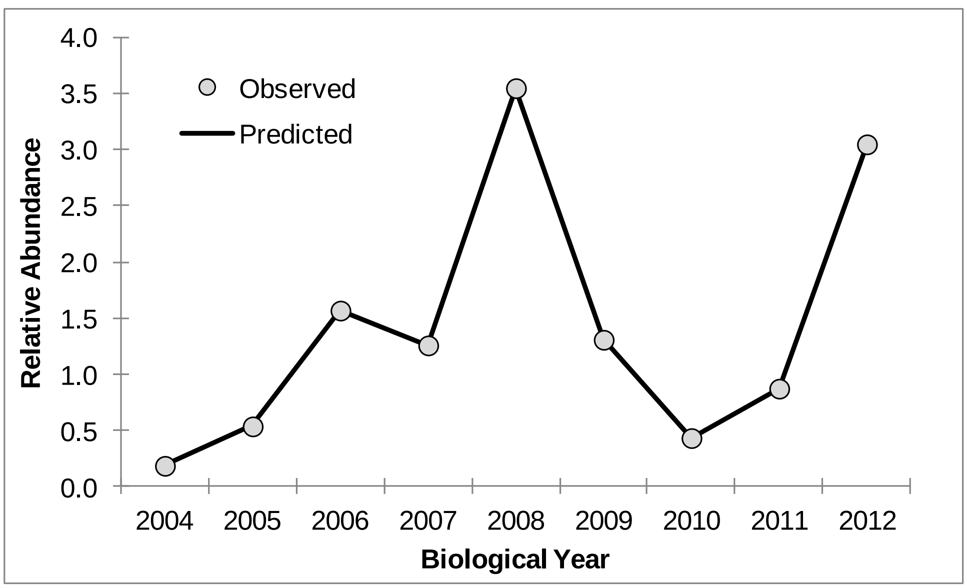

Figure 3.10. Observed and predicted values for the Program 120 index of age-0 relative abundance from the base run of the assessment model.

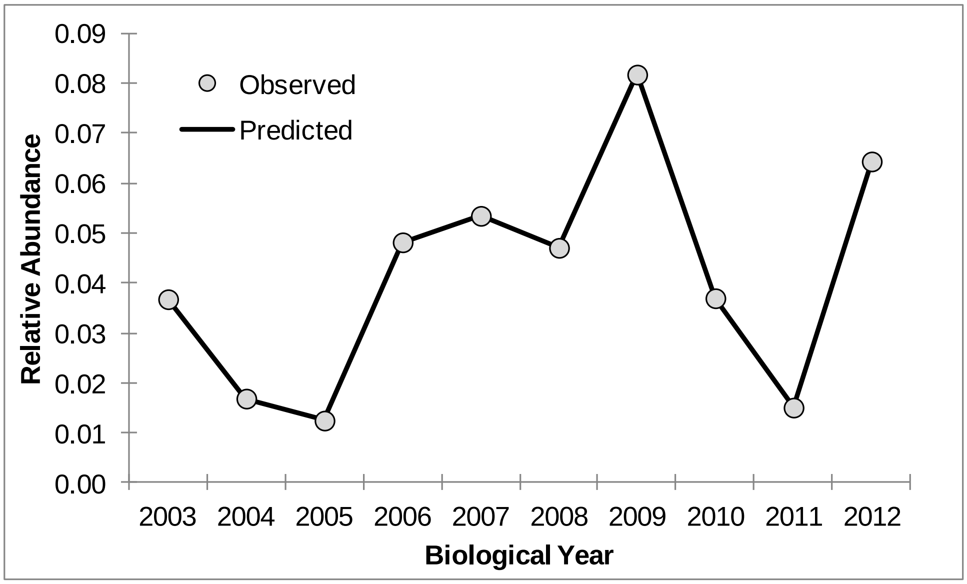

Figure 3.11. Observed and predicted values for the Program 915 spring (May–June) index of relative abundance from the base run of the assessment model.

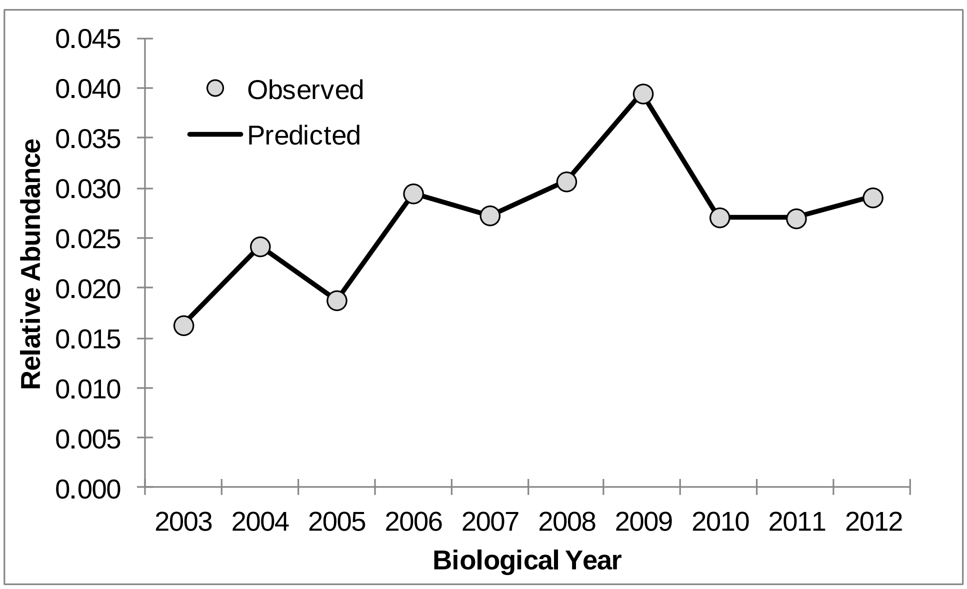

Figure 3.12. Observed and predicted values for the Program 915 summer (July–August) index of relative abundance from the base run of the assessment model.

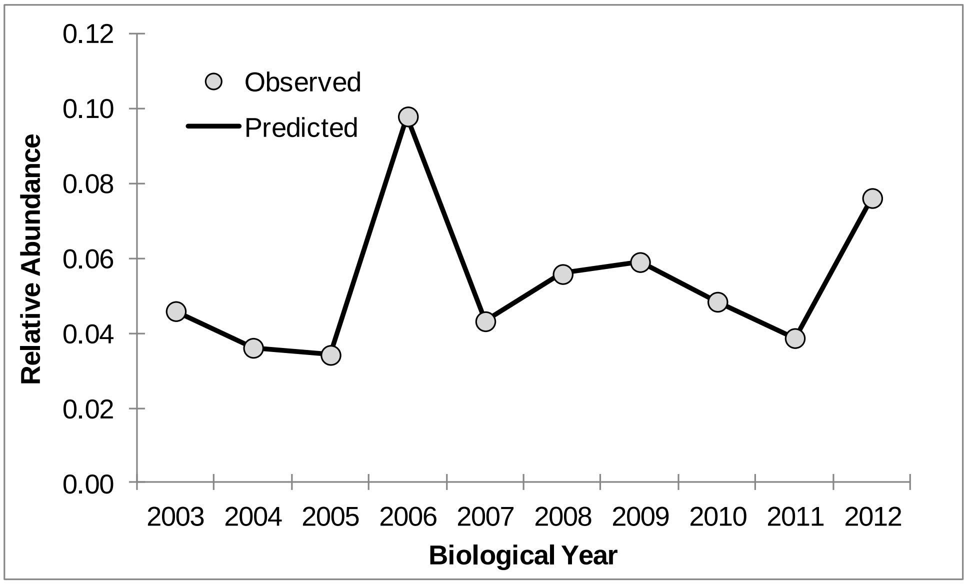

Figure 3.13. Observed and predicted values for the Program 915 fall (September–November) index of relative abundance from the base run of the assessment model.

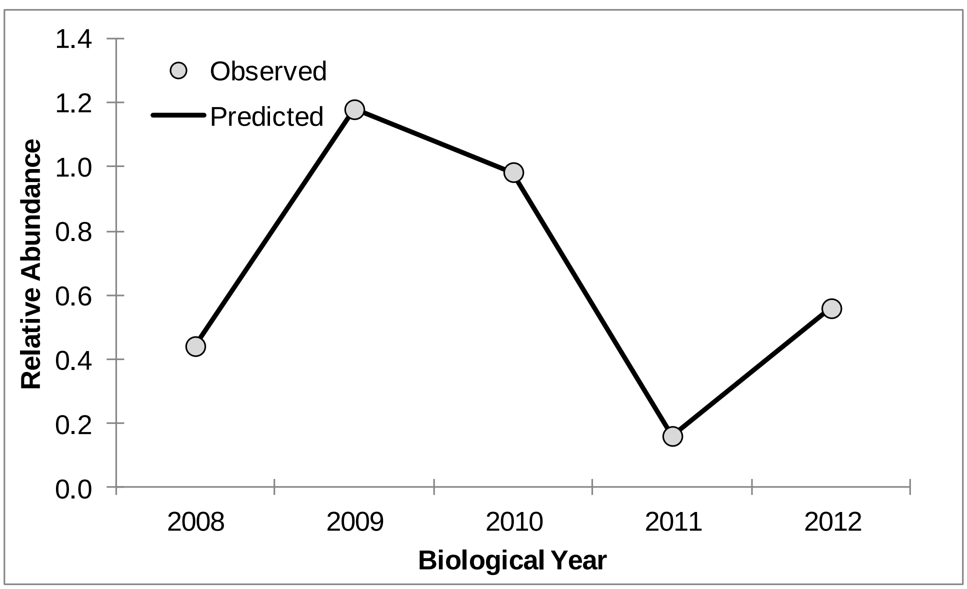

Figure 3.14. Observed and predicted values for the Program 915 southern (May–June) index of relative abundance from the base run of the assessment model.

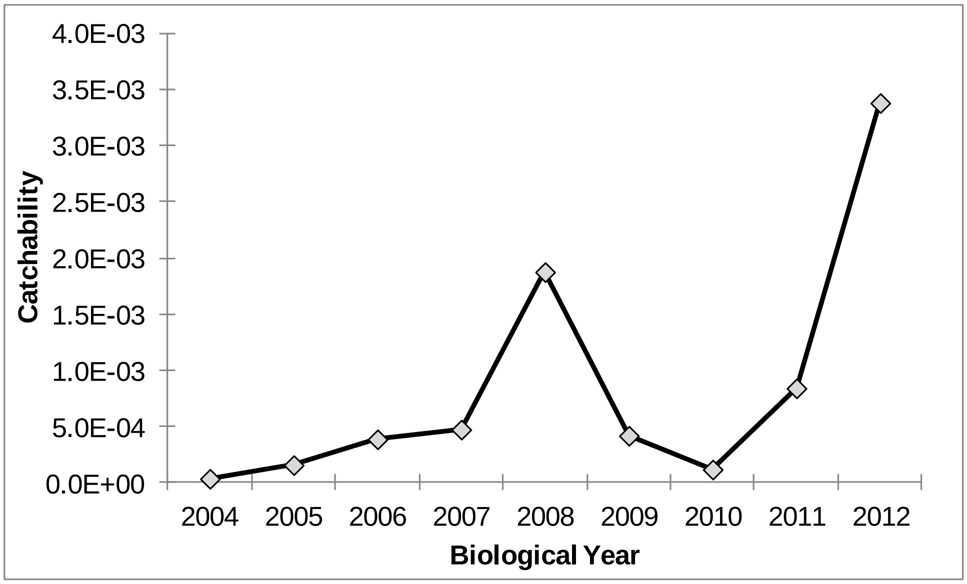

Figure 3.15. Annual predicted catchability for the Program 120 index of age-0 relative abundance from the base run of the assessment model.

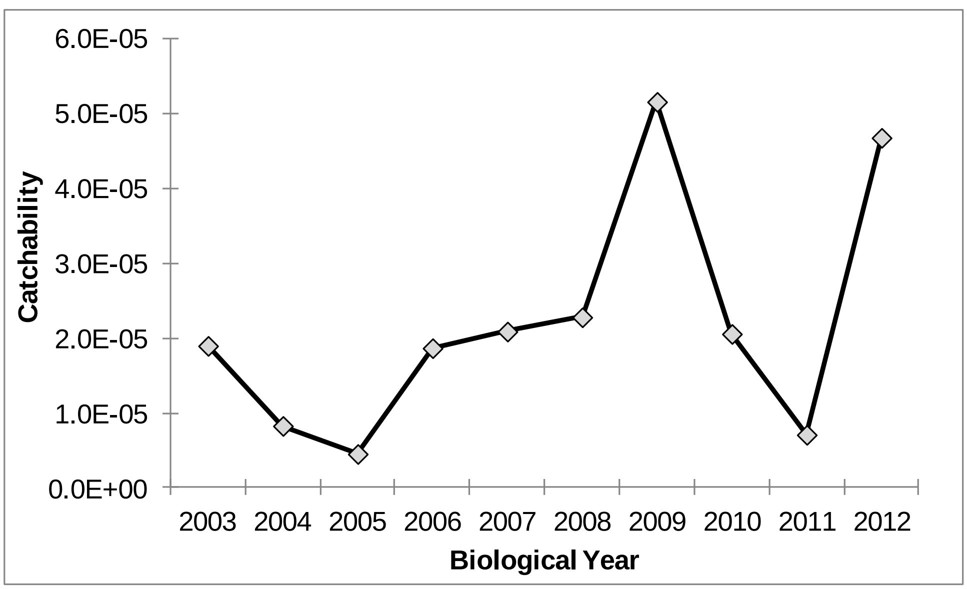

Figure 3.16. Annual predicted catchability for the Program 915 spring (May–June) index of relative abundance from the base run of the assessment model.

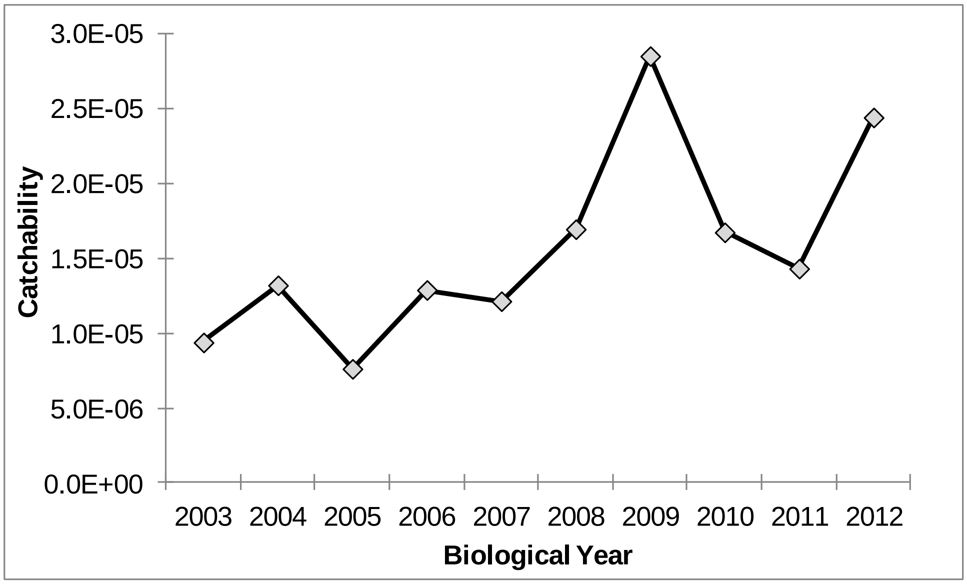

Figure 3.17. Annual predicted catchability for the Program 915 summer (July–August) index of relative abundance from the base run of the assessment model.

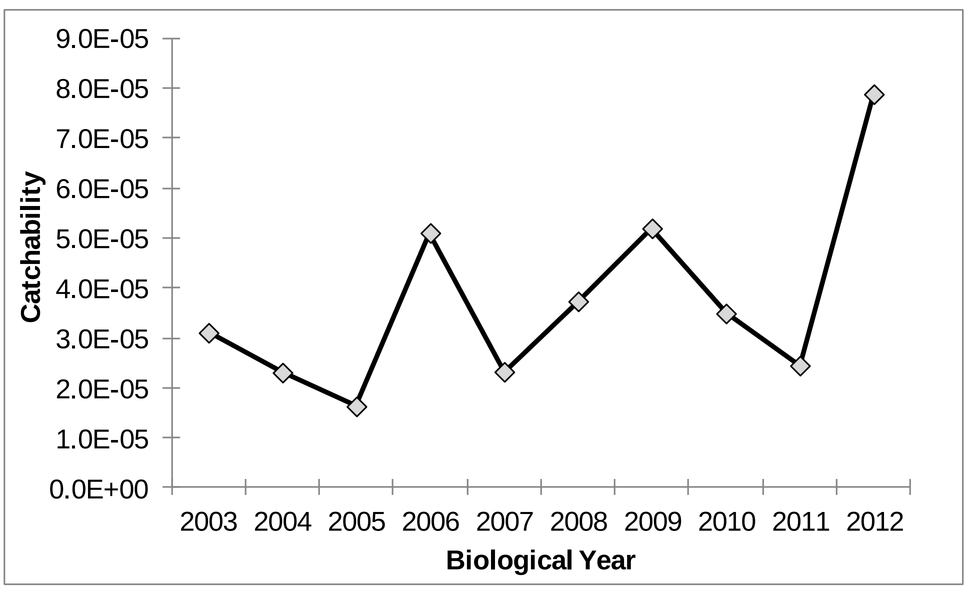

Figure 3.18. Annual predicted catchability for the Program 915 fall (September–November) index of relative abundance from the base run of the assessment model.

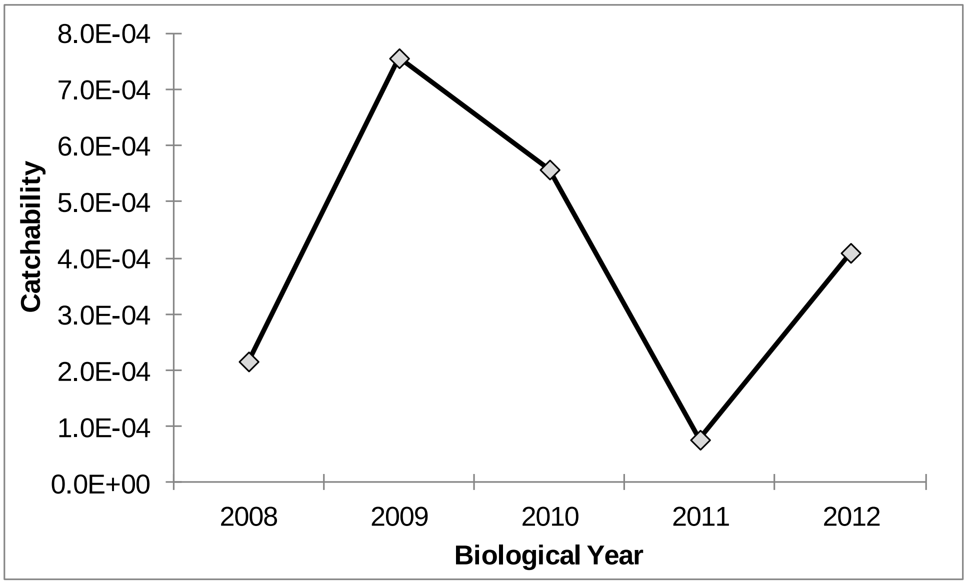

Figure 3.19. Annual predicted catchability for the Program 915 southern (May–June) index of relative abundance from the base run of the assessment model.

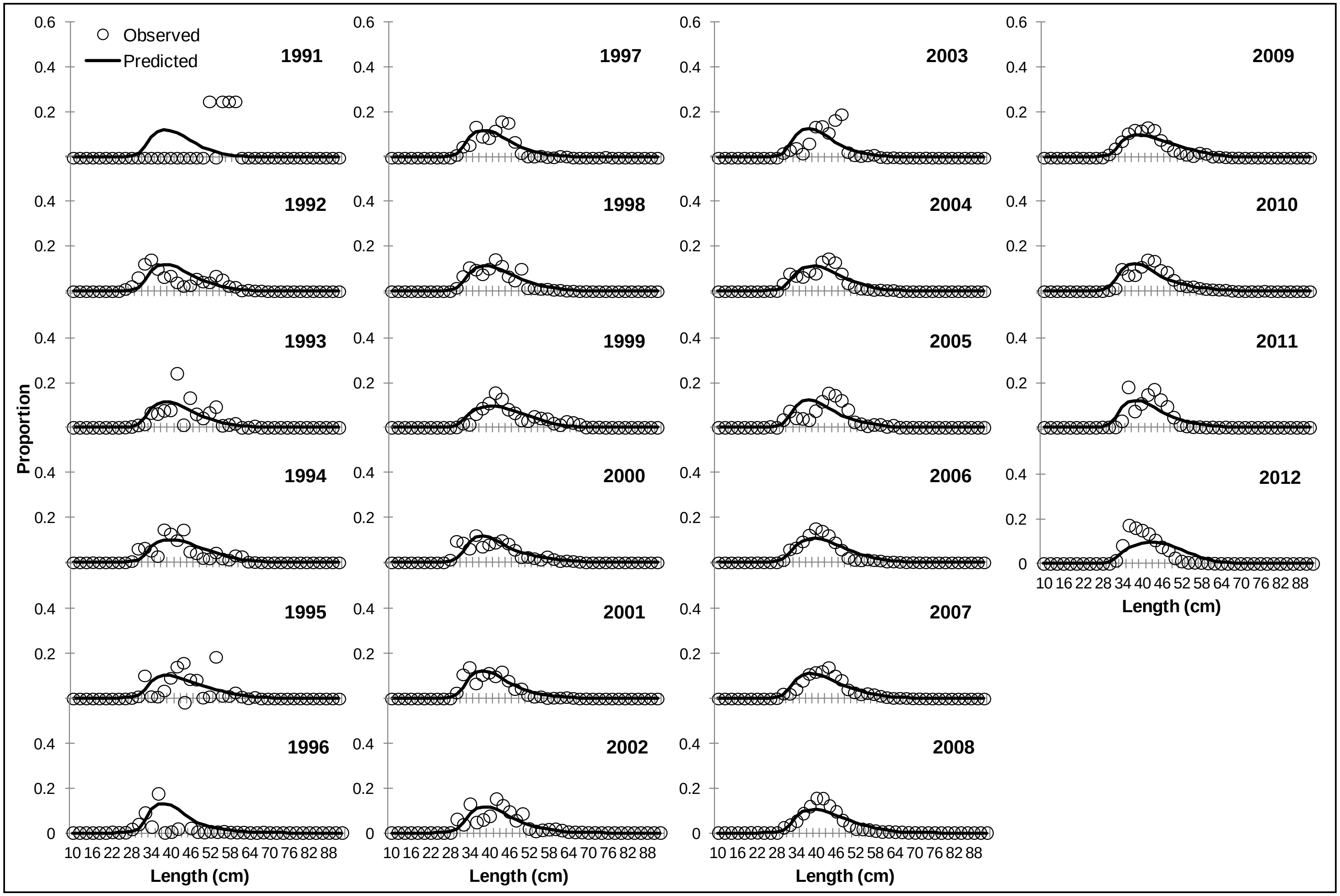

Figure 3.20. Observed and predicted length-frequency distributions for commercial estuarine landings from the base run of the assessment model.

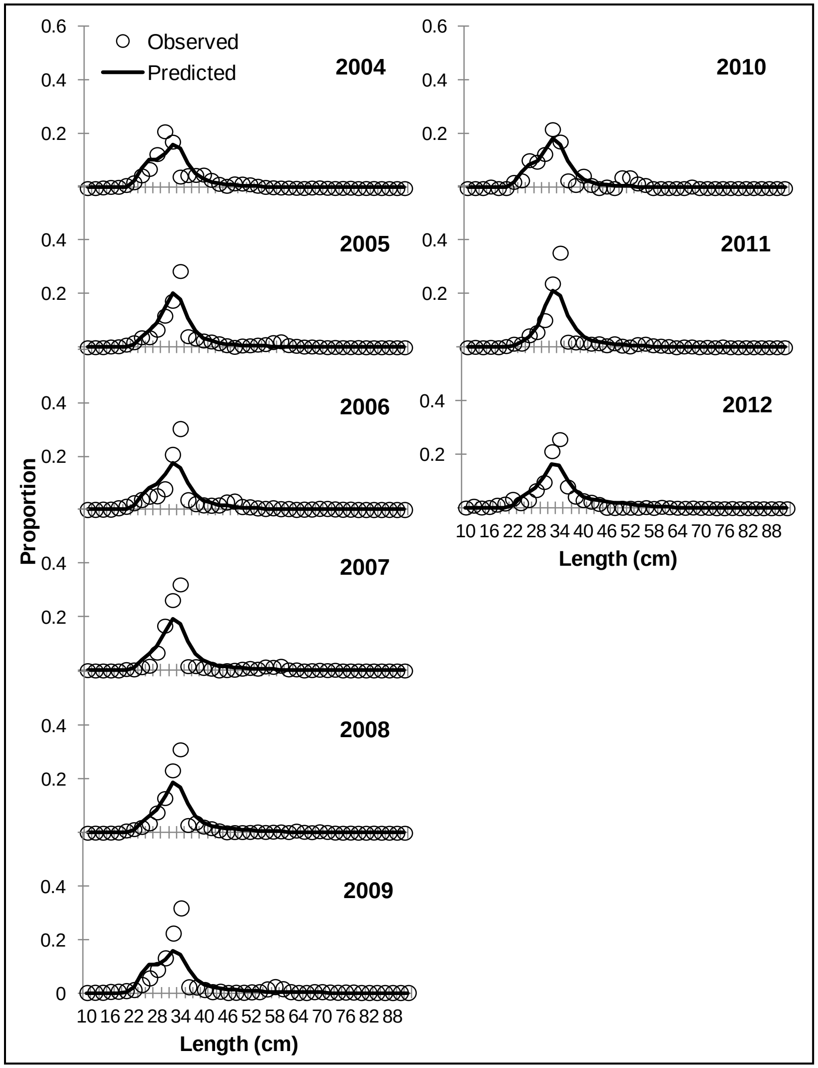

Figure 3.21. Observed and predicted length-frequency distributions for commercial estuarine dead discards from the base run of the assessment model.

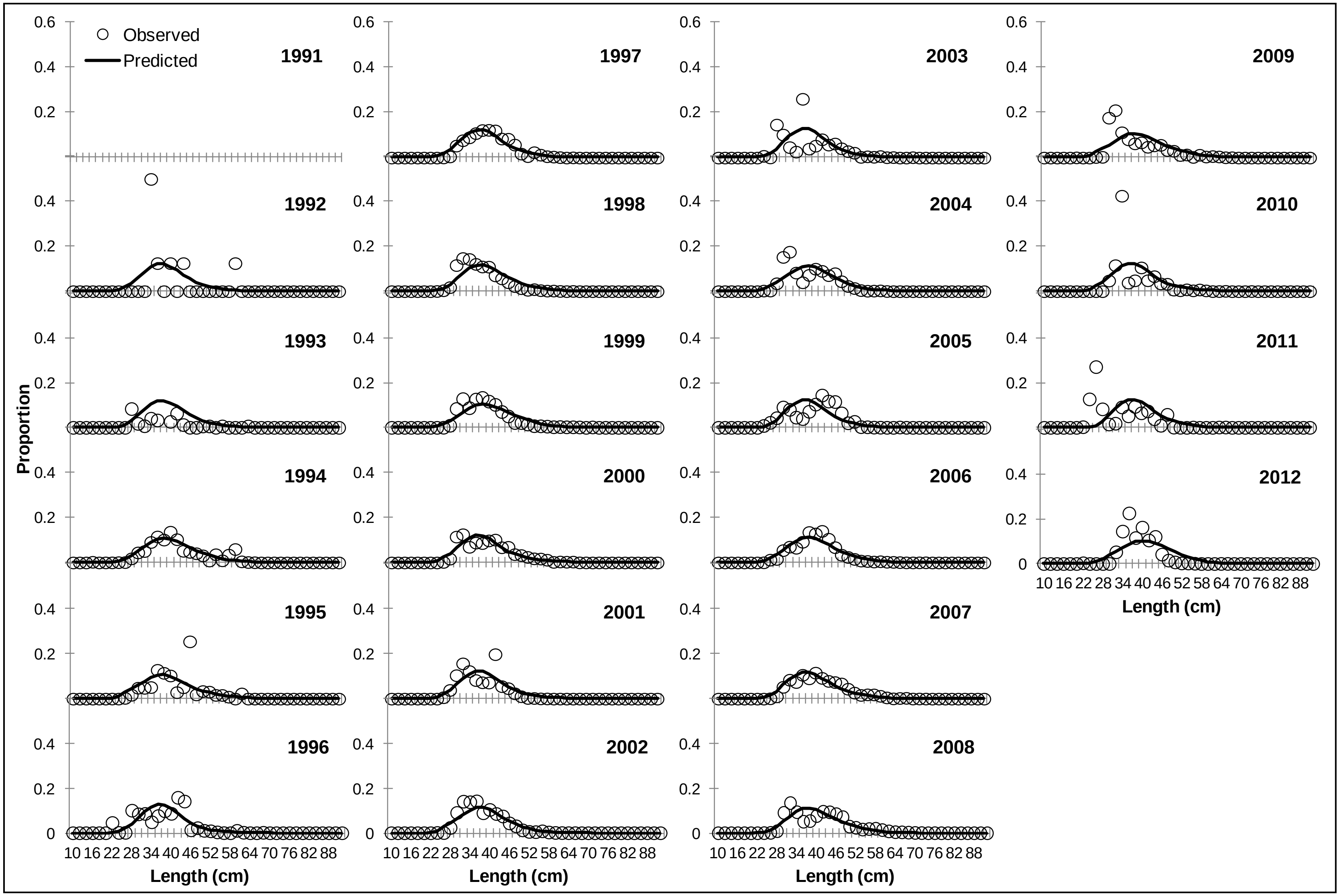

Figure 3.22. Observed and predicted length-frequency distributions for commercial ocean landings from the base run of the assessment model.

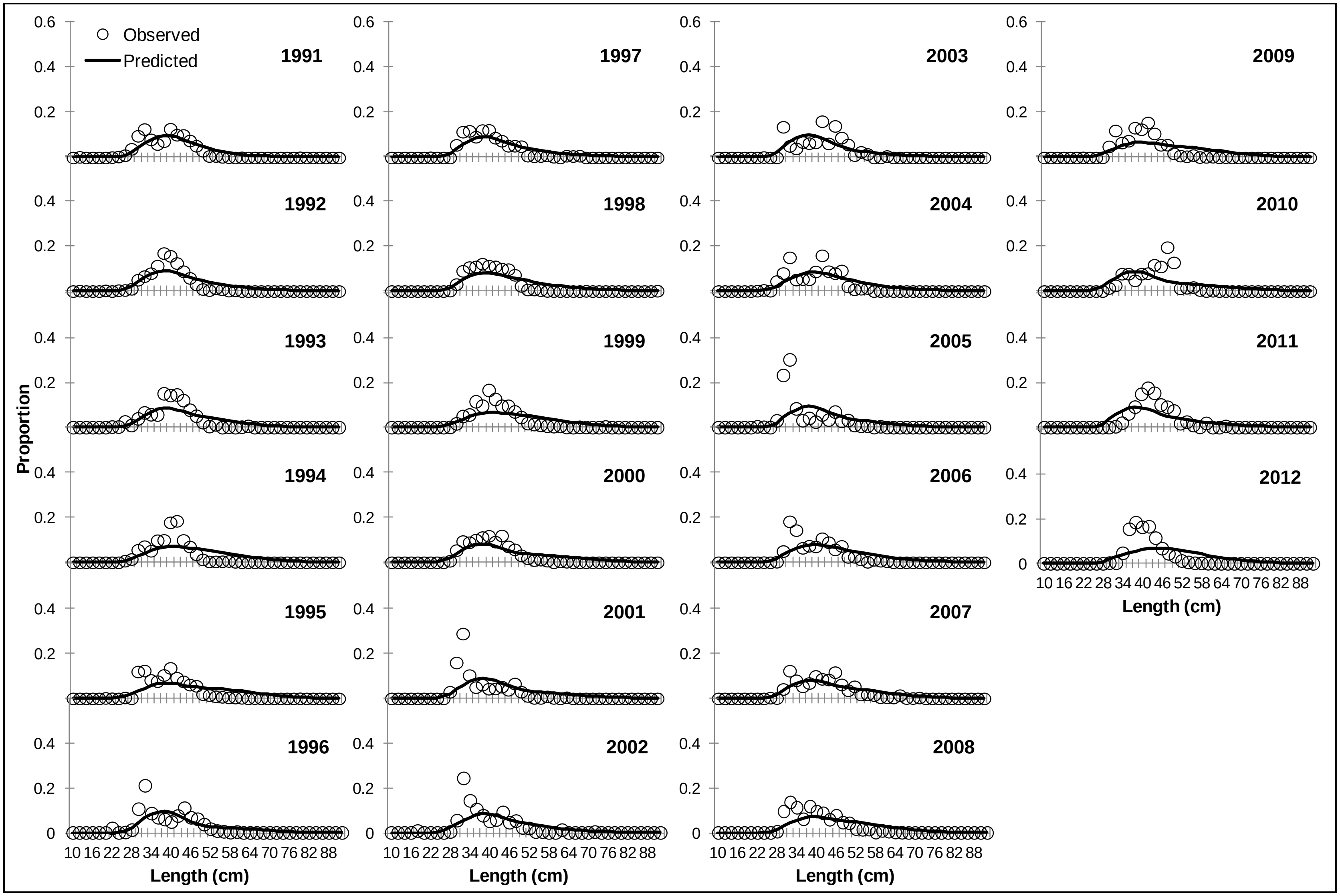

Figure 3.23. Observed and predicted length-frequency distributions for recreational landings from the base run of the assessment model.

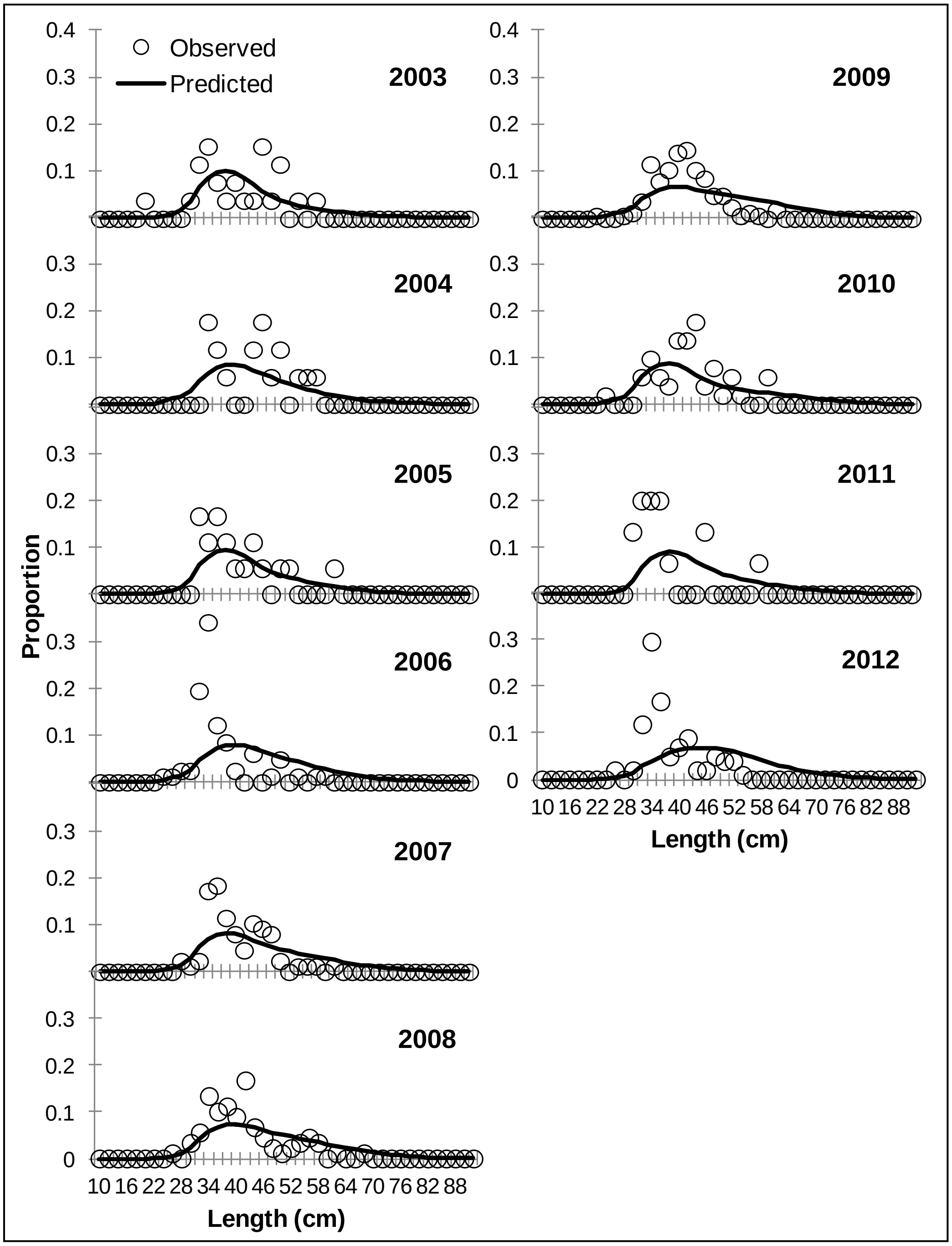

Figure 3.24. Observed and predicted length-frequency distributions for the spring component of Program 915 from the base run of the assessment model.

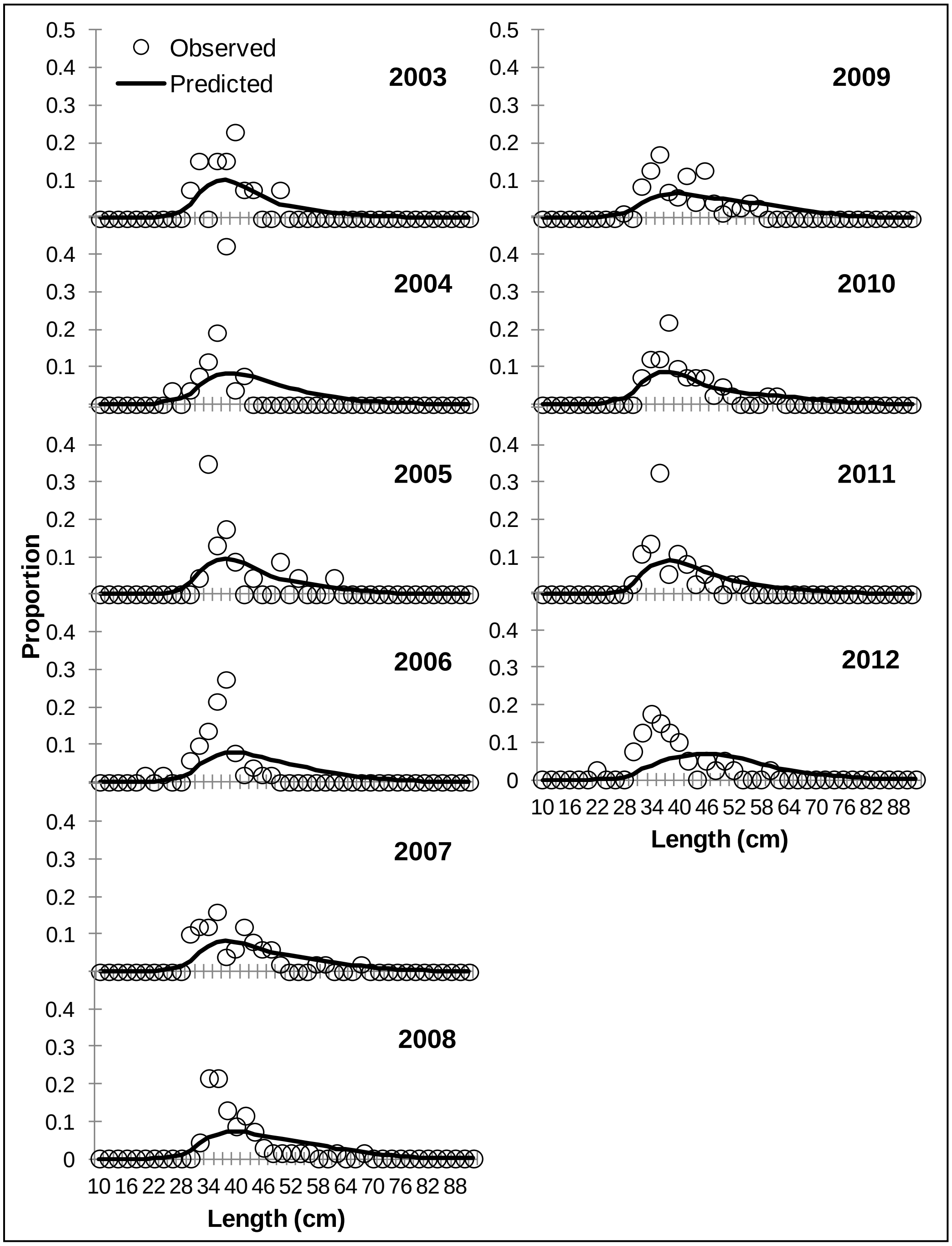

Figure 3.25. Observed and predicted length-frequency distributions for the summer component of Program 915 from the base run of the assessment model.

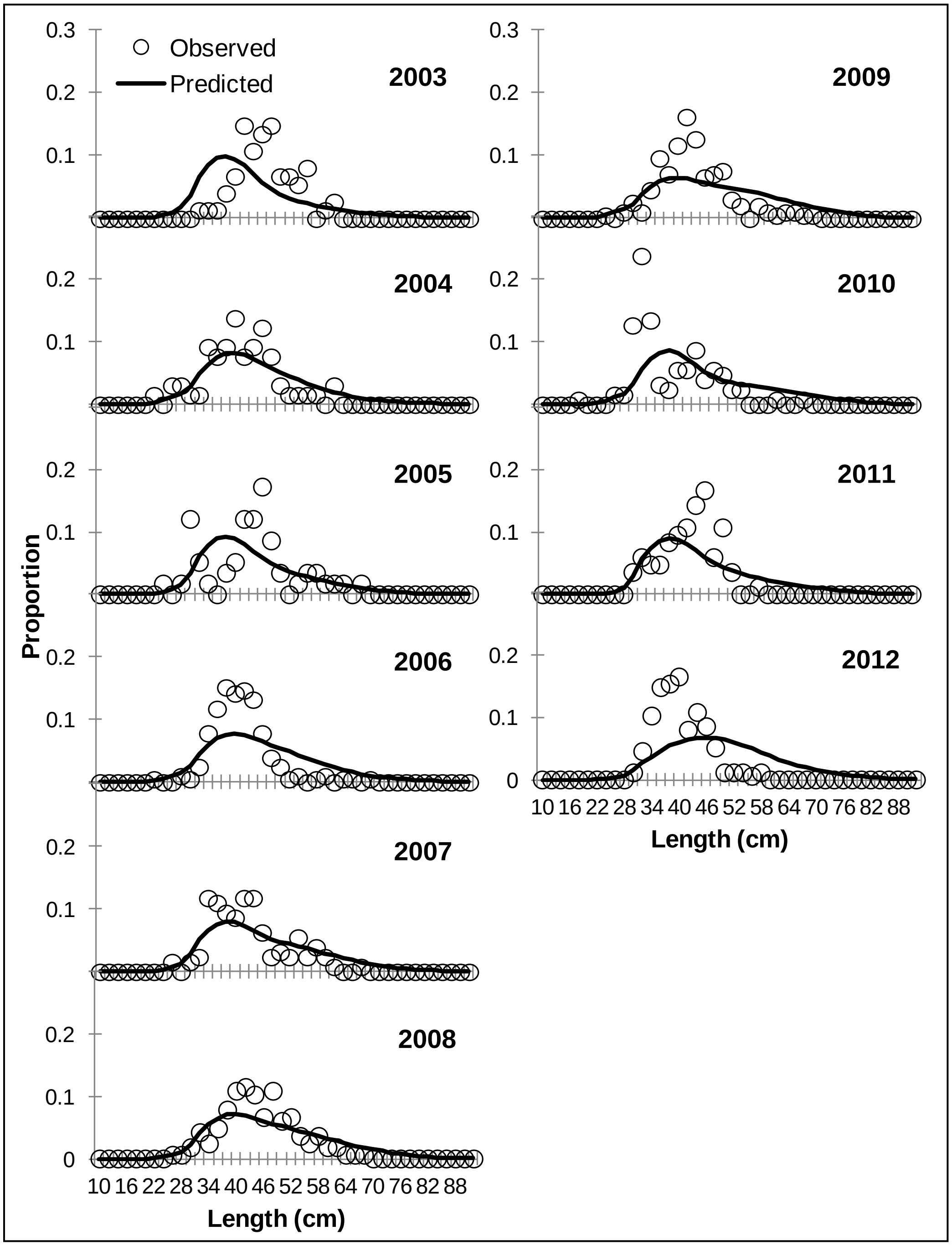

Figure 3.26. Observed and predicted length-frequency distributions for the fall component of Program 915 from the base run of the assessment model.

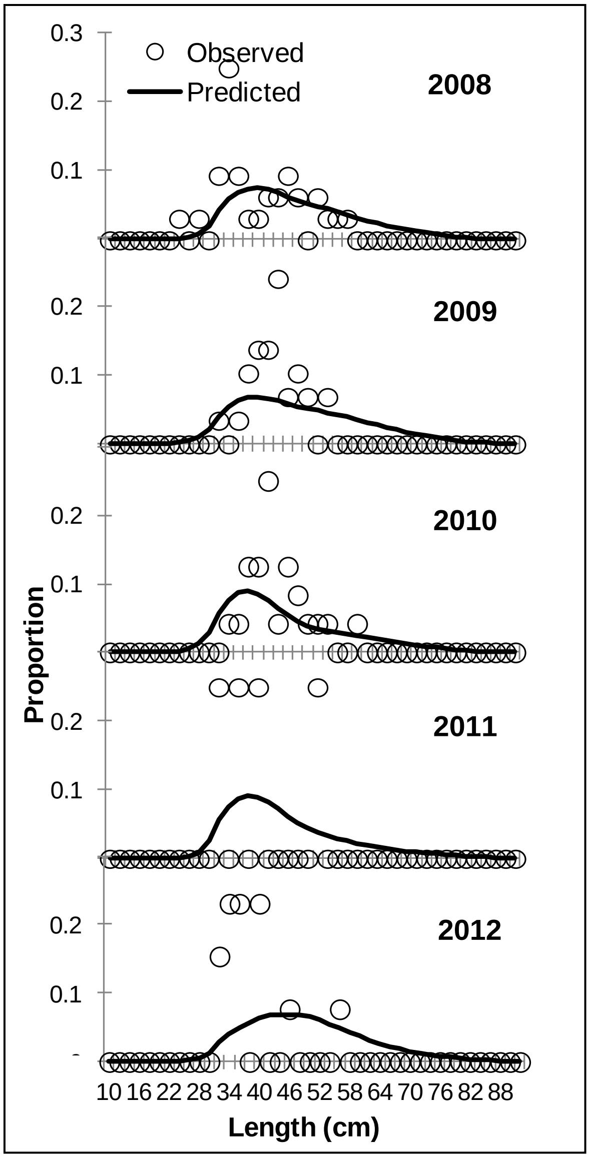

Figure 3.27. Observed and predicted length-frequency distributions for the southern component of Program 915 from the base run of the assessment model.

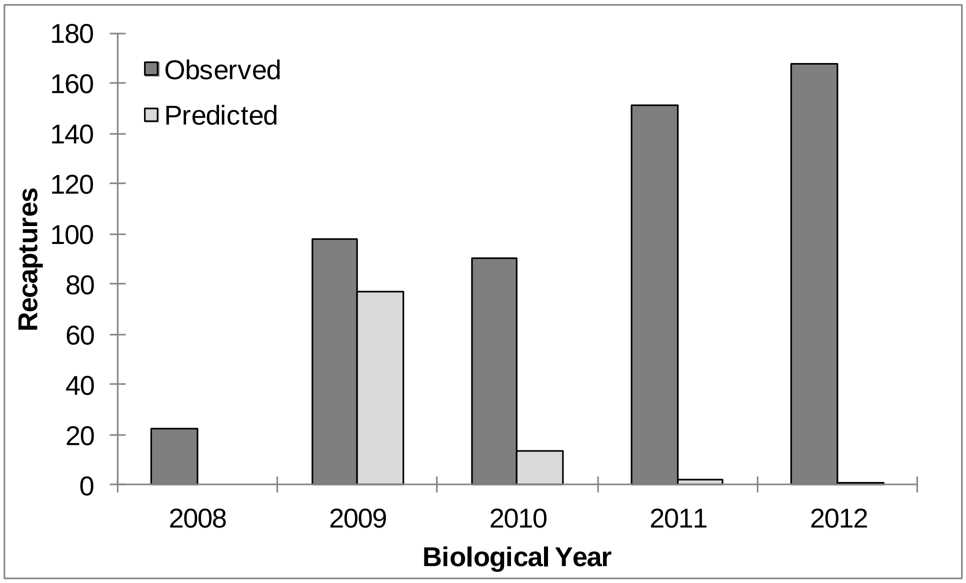

Figure 3.28. Observed and predicted tag recaptures aggregated across tag groups.

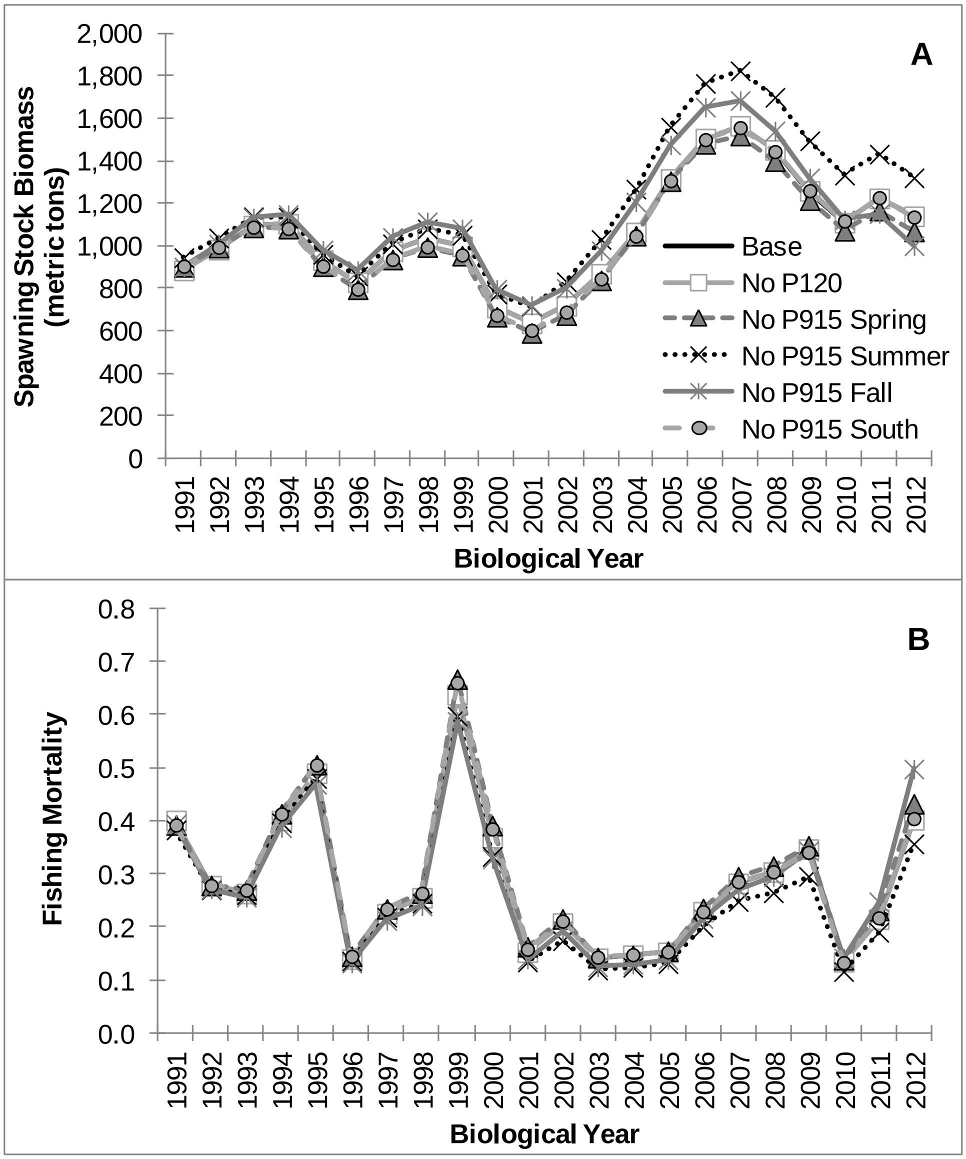

Figure 3.29. Sensitivity of model-predicted (A) SSB and (B) fishing mortality to removal of survey data (indices and associated biological data).

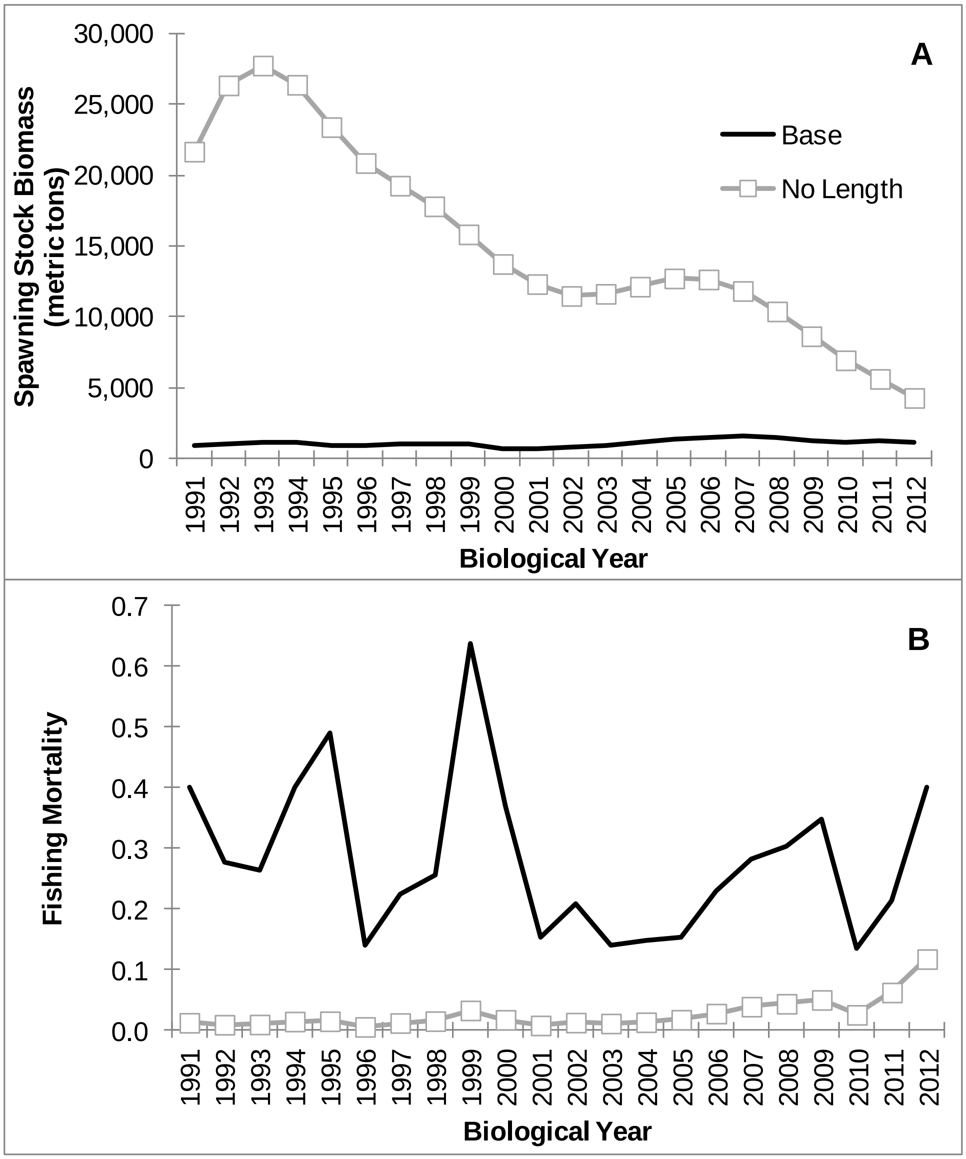

Figure 3.30. Sensitivity of model-predicted (A) SSB and (B) fishing mortality to removal of length data.

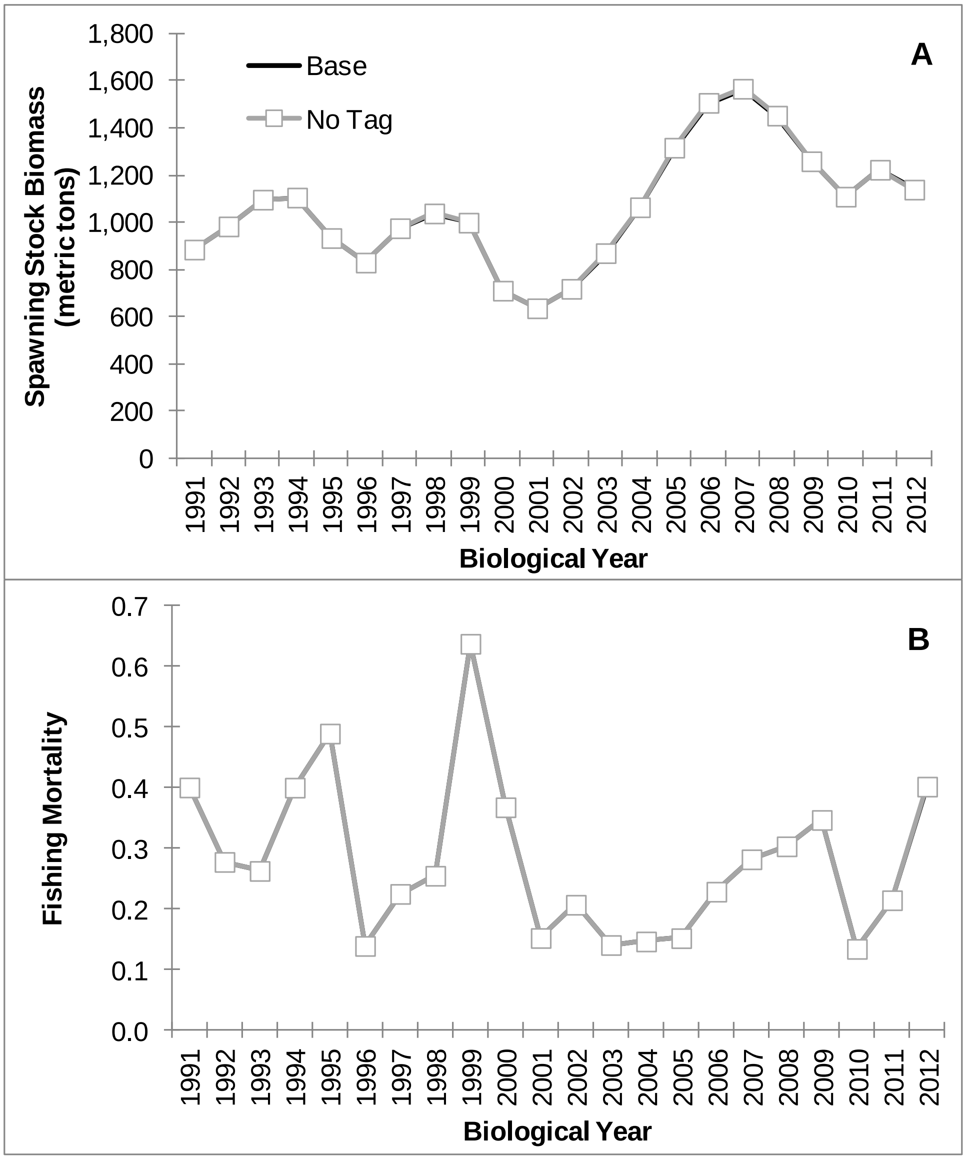

Figure 3.31. Sensitivity of model-predicted (A) SSB and (B) fishing mortality to removal of tag-recapture data.

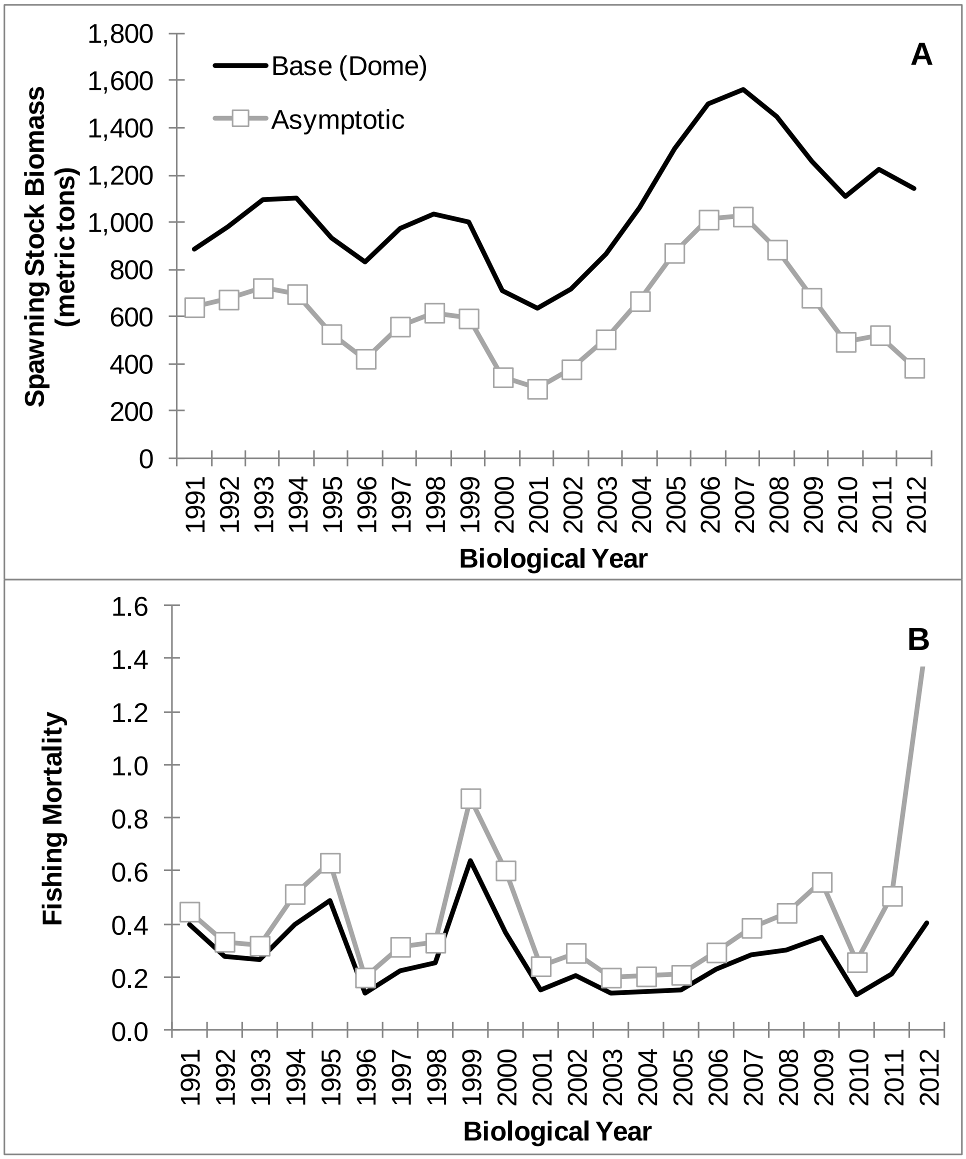

Figure 3.32. Sensitivity of model-predicted (A) SSB and (B) fishing mortality to shape of selectivity curve for the commercial fisheries.

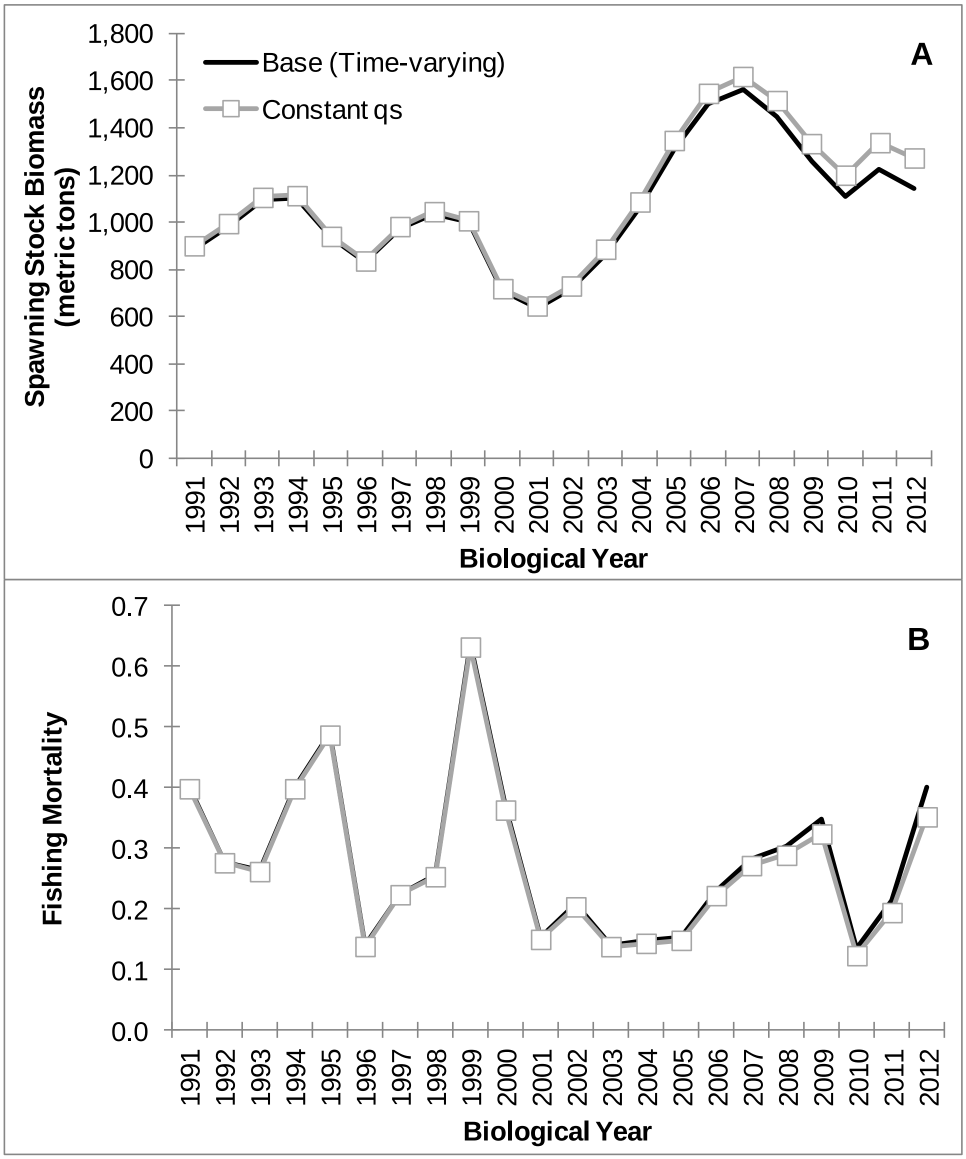

Figure 3.33. Sensitivity of model-predicted (A) SSB and (B) fishing mortality to assumption of survey catchabilities.

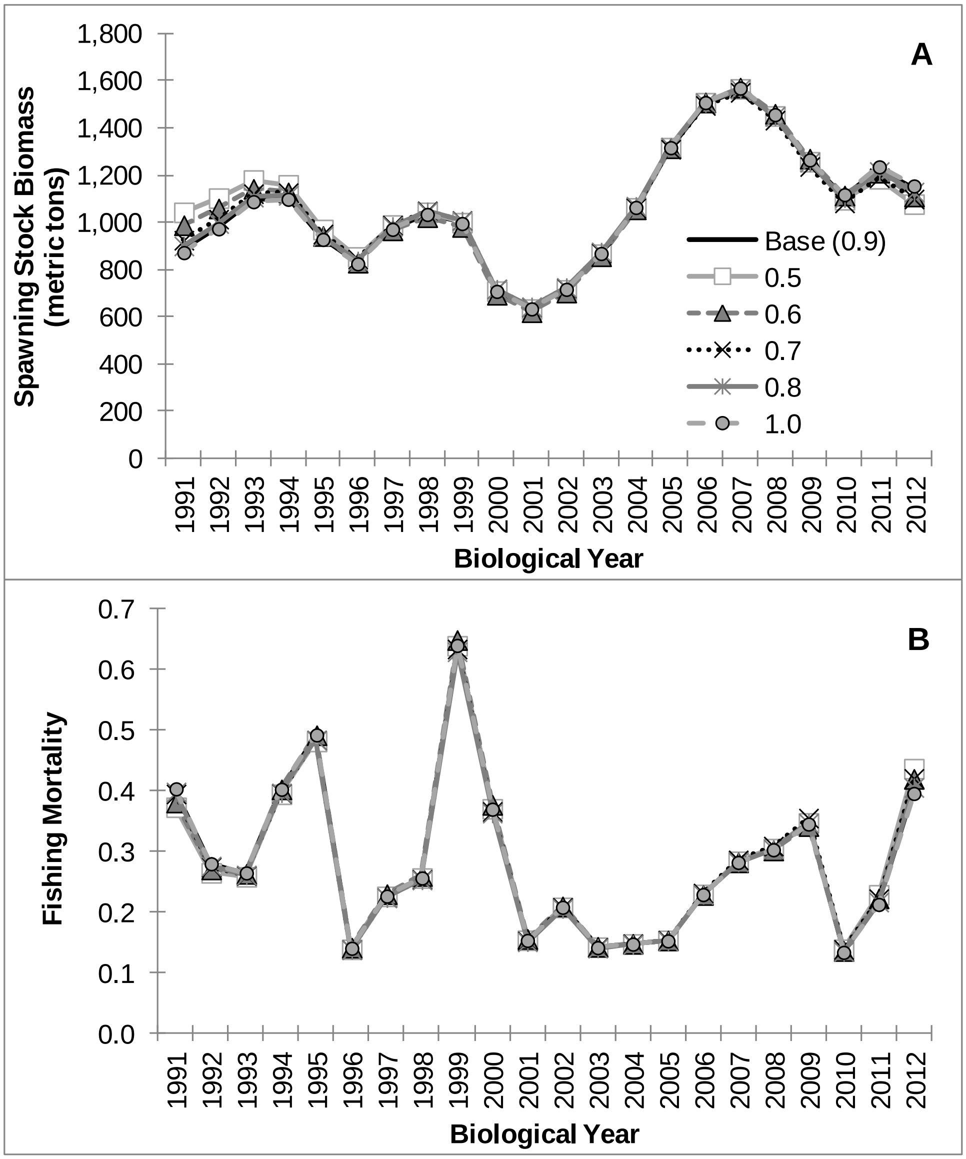

Figure 3.34. Sensitivity of model-predicted (A) SSB and (B) fishing mortality to a range of steepness values.

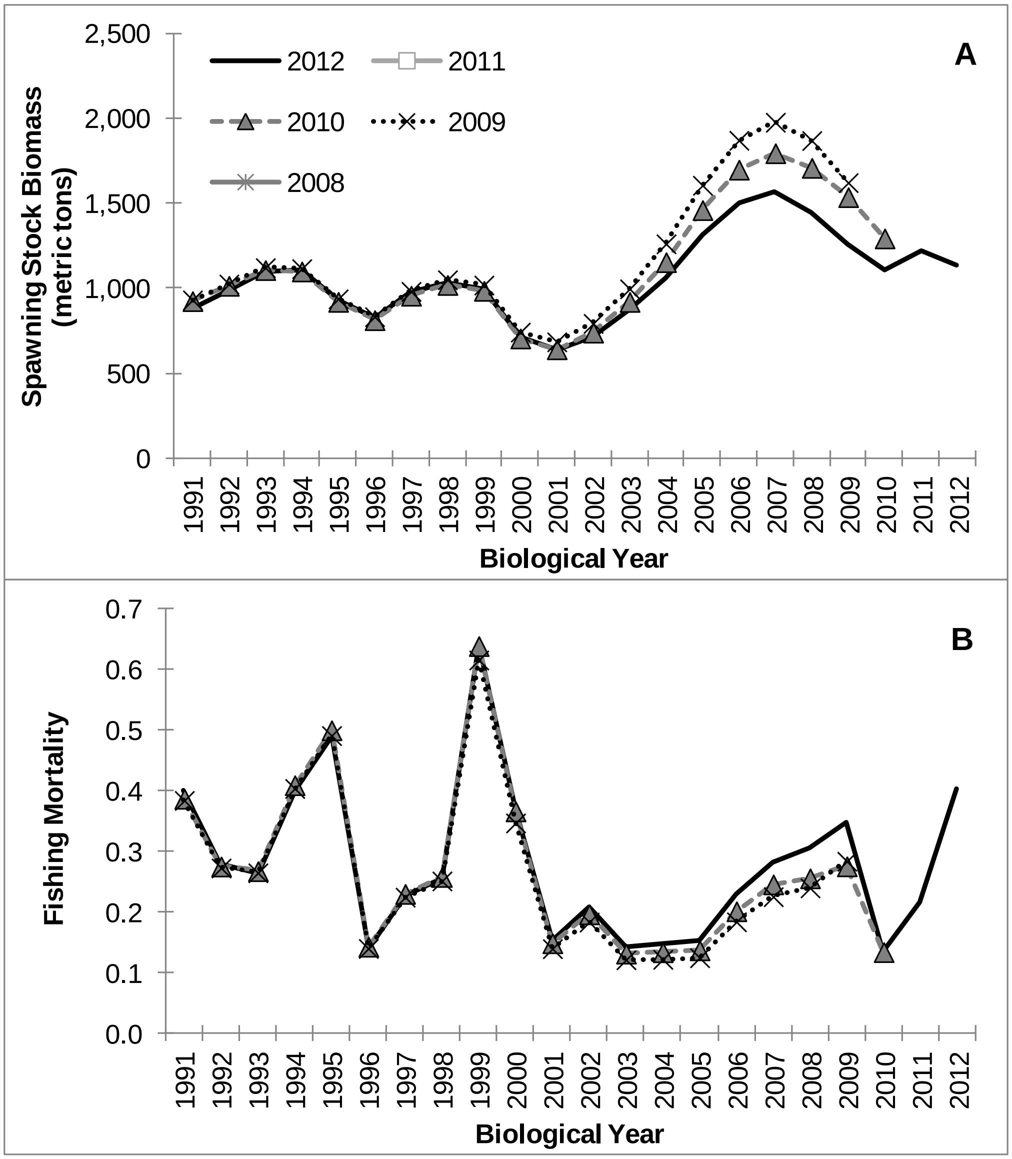

Figure 3.35. Model-predicted (A) SSB and (B) fishing mortality from the retrospective analysis.

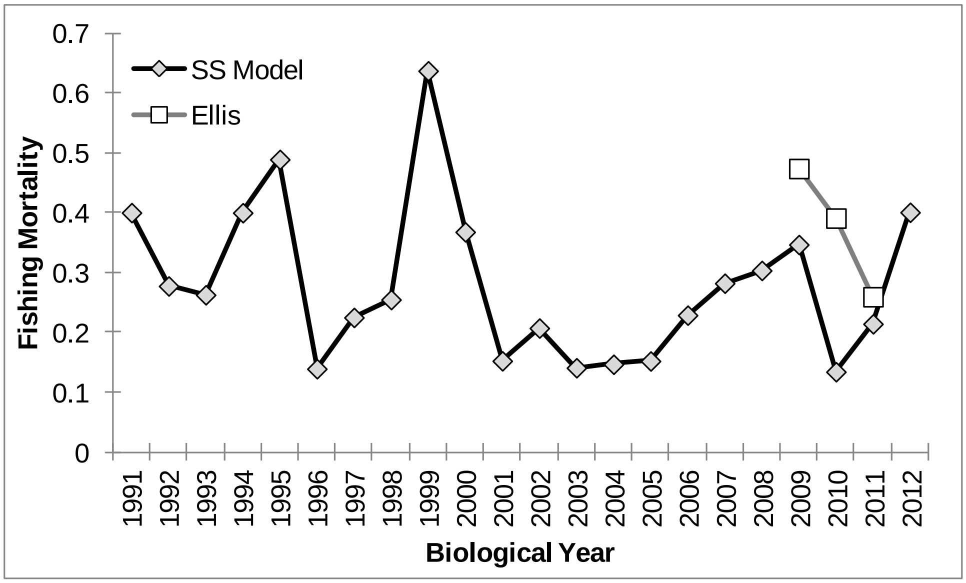

Figure 3.36. Comparison of fishing mortality rates estimated from the base run of the assessment model to those estimated by Ellis (2013, 2014).

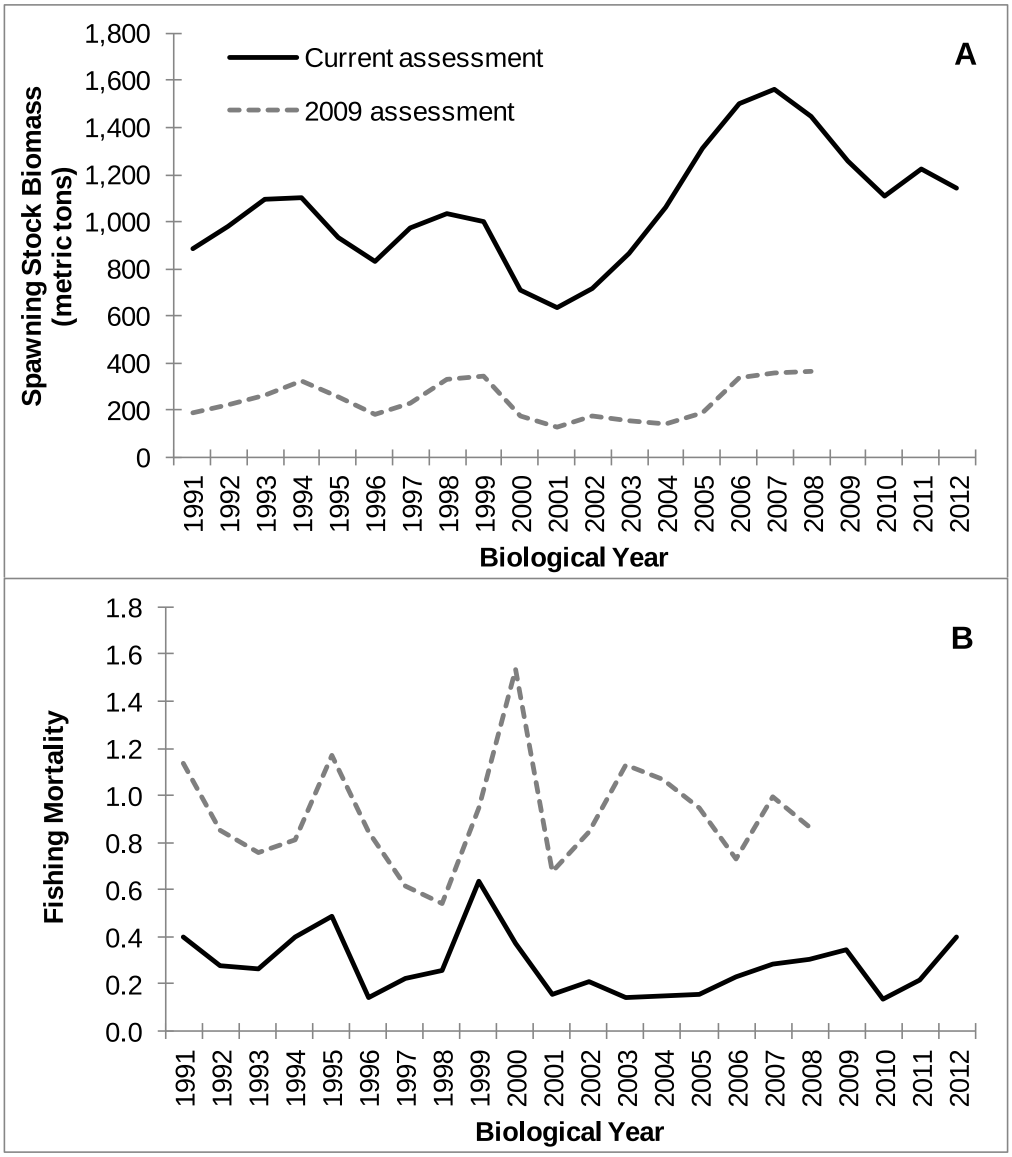

Figure 3.37. Comparison of predicted (A) SSB and (B) fishing mortality from this and previous (2009) assessment.

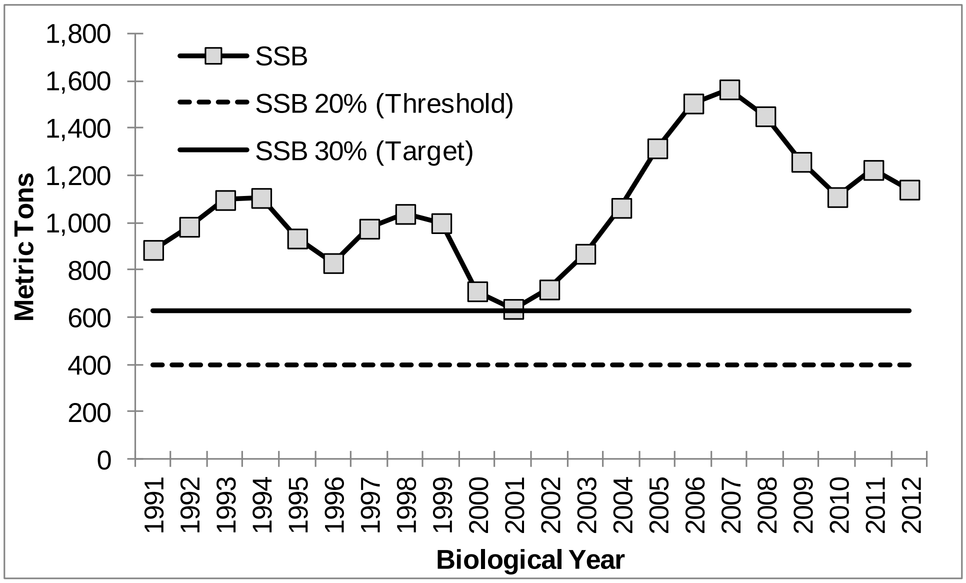

Figure 4.1. Annual predicted spawning stock biomass compared to estimated $SSB_{Threshold}$ ($SSB_{20\%}$) and SSB_{Target} ($SSB_{30\%}$).

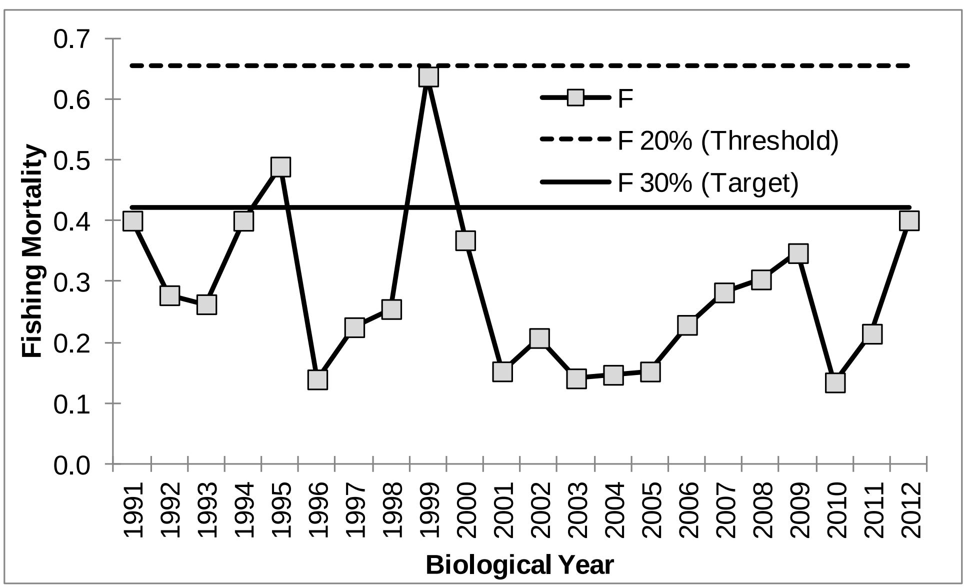

Figure 4.2. Annual predicted fishing mortality rates (numbers-weighted, ages 1–4) compared to estimated $F_{Threshold}$ ($F_{20\%}$) and F_{Target} ($F_{30\%}$).

NCDMF Stock Assessment Program
External Peer Review

Assessment Information

Assessment Species:	Spotted seatrout (*Cynoscion nebulosus*)
Stock Assessment Report:	Stock Assessment of Spotted Seatrout, *Cynoscion nebulosus*, in Virginia and North Carolina Waters—2014
Date Sent:	January 5, 2015

Dear Reviewer-

Thank you for agreeing to review the 2014 stock assessment of the Virginia-North Carolina spotted seatrout stock. The purpose of the external peer review process is to ensure that the assessment and results presented are scientifically sound and that decision makers are provided adequate advice. Peer reviewers are asked to address the terms of reference in the terms of reference report that follows. Please be as specific as possible in recording your comments and suggestions for revision and improvement. Any additional suggestions to improve the stock assessment are appreciated. Reviewers are also welcome to make comments directly in the assessment report using the Track Changes feature in Microsoft Word.

Please return this form, the terms of reference report, and any additional comments to laura.lee@ncdenr.gov. We would like to have your review by February 2, 2015. A copy of the final report will be provided after it has been presented to the North Carolina Marine Fisheries Commission.

Thank you,

Laura M. Lee
Senior Stock Assessment Scientist
North Carolina Division of Marine Fisheries

TERMS OF REFERENCE REPORT FOR EXTERNAL PEER REVIEW

Reviewer Information

Reviewer Name: Harry Blanchet

Business Mailing Address: La. Dept. of Wildlife & Fisheries, 2000 Quail Dr., Baton Rouge LA 70808

Business E-Mail: hblanchet@wlf.la.gov

Business Phone: 225-765-2889

1) Evaluate the thoroughness of data evaluation and presentation including:
   a) Justification for inclusion or elimination of available data sources

      Good description of the rationale. However, as there were no FI IOA available for VA, it would have been informative if a sensitivity run could have been at least evaluated for development that included FD indices from both regions. There are ways to minimize the weaknesses of FD indices (that were well-described in the document), such as allowing catchability to change over time, using stanzas where fishing regulations were constant, etc. Given the high CV on the recreational harvest data from VA (and the implied low number of intercepts), there may have been no real information to be derived from that, but without a FI index, you must assume that the stock responds the same over the entire range.

   b) Consideration of survey and data strengths and weaknesses (e.g., temporal and spatial scale, gear selectivities, sample size)

      I found no major issues with the presentation, but for the "Project 915" data, it was not clear which data were used in derivation of the indices. For instance, there was note made of a change in duration of the net soaks in some areas. If CPUE is based on catch per hour per net, that would not be as significant an issue as if it were in catch per net. I could not find adequate description of the CPUE index to determine that this was done. I also did not see any discussion to determine if null catches were appropriately incorporated in the development of the indices. Expansion of that section of the report to better capture index development could be useful.

   c) Calculation and standardization of indices and other statistics

      Standardization of indices and derivation of values seemed appropriate in general. Some aspects could be clarified (see note for (b) above). Allowing unrestricted variation in catchability in the FI indices has the effect of increasing the ability of the model to fit the estimates by assigning the variation to the catchability factor. That has the potential to "explain away" a lot of real variation in the model. Variation in catchability in FI surveys should be constrained, or explained. The variations seen in this assessment are significant, and could have an impact on the outputs of the model.

2) Evaluate the adequacy, appropriateness, and application of data used in the assessment.

   In general, data were substantial, adequate and appropriate for the assessment. As there were no FI IOA available for VA, consideration of a FD IOA should have been included in the evaluation of potential indices. Both recreational and commercial data are available, and while both have significant issues, incorporating those types of data is a fairly common practice in similar stock assessments. If you have less confidence in them, you may have your final model without them, but they should be tested to see if they provide any additional information to the model, or more importantly, if they show some unexplained trend that is contrary to other data that may signal a different trend in that portion of the range. Given the relatively low harvest values, I do understand that there may not be much information there, but the effort should be made, and evaluation outlined. There was a mention made of collecting opercula for age determination. However there was no further discussion of whether these data were used in the assessment, or if there were any comparison between otolith and operculum-derived age estimates, if they were. If the reference was to collecting opercula of other species in that program, it needs to be re-stated for clarity. Brevity is appreciated, but there are no page charges here. I noted several places where a bit of expansion on the description of index derivation, etc. would have been useful.

   I noted the very narrow SE given to the harvest value inputs to the model. As the reported PSE for MRIP data (as provided in the landings tables) is higher than the input variance, that input should be better explained in the text, or reconsidered in the model.

3) Evaluate the adequacy, appropriateness, and application of method(s) used to assess the stocks.

   SS3 is becoming widely used in US assessments. However, it is extraordinarily difficult to create a model for a new species due to the many options available in the package. I give full credit to the assessment team for taking on this task. I would like to have seen some comparison of the results to those from the prior assessment, and some discussion of the changes found between them (having a continuity case would have been very nice, but would have required even more work).

4) Evaluate the methods used to estimate stock status determination criteria. Evaluate the adequacy and appropriateness of recommended stock status determination criteria.

   Methods in general seem appropriate, consistent with generally accepted methods. Criteria also seem appropriate. Lack of S/R relationship is not unexpected in this species.

5) Does the stock assessment provide a valid basis for management for at least the next five years given the available data and current knowledge of the species stock dynamics and fisheries?

   ● Yes

   ● No

Comment on response.

In general, using the terminal year of an assessment for status determination may be a requirement, but the terminal estimates of stock size, and especially recruitment estimates, tend to change after those cohorts have a stanza or two exposed to the fisheries. As your only index of recruitment is relatively short, there will be additional likelihood of variation in those estimates of recruitment with more time and data.

6) Evaluate appropriateness of research recommendations. Suggest additional recommendations warranted, clearly denoting research and monitoring needs that may appreciably improve the reliability of future assessments.

   In general, research recommendations are appropriate, and seem to be categorized in a reasonable order. Some of the recommendations were not clearly characterized in terms of the expected benefits to the stock management. Lack of a "true age validation" study noted in text but not in research recommendations. Also noted was lack of a fishery-independent index of abundance for Virginia stocks. While not a research recommendation per se, it would seem appropriate as a management consideration, at least to examine the potential for developing such. It need not be a monitoring program directed specifically at spotted seatrout, but could be more generalized but obtaining enough SST to provide FI data to future assessments. Non-traditional methods (acoustic surveys, etc.) may also be considered.

7) Are you aware of any reference material not cited in this report that should be included?

   Information in section 1 related to life history, etc. did not seem to be updated since the last assessment to any degree. I saw VERY few references to literature after the 2008 assessment. I suggest removing sections 1.2 – 1.3 from future assessments into separate species profile document that can be updated independently.

8) Would you be willing to act as an external peer reviewer for a future NCDMF stock assessment?

   ● Yes

   ● No

9) Do you have any additional comments?

   I would strongly encourage use of additional tables of input data (actual indices of abundance, age sample distribution by fishery and year, CAA, etc.). It makes the process more transparent. I appreciate the numerous graphics, but they do not replace tables. Lacking those tables of input values, inclusion of the SS input file may have helped, but unless the reviewer is comfortable with those files, that may not help. I also made notes in the body of the document, to clarify or highlight notes in this review.

NCDMF Stock Assessment Program
External Peer Review

Assessment Information

Assessment Species: Spotted seatrout (*Cynoscion nebulosus*)

Stock Assessment Report: Stock Assessment of Spotted Seatrout, *Cynoscion nebulosus*, in Virginia and North Carolina Waters—2014

Date Sent: January 5, 2015

Dear Reviewer-

Thank you for agreeing to review the 2014 stock assessment of the Virginia-North Carolina spotted seatrout stock. The purpose of the external peer review process is to ensure that the assessment and results presented are scientifically sound and that decision makers are provided adequate advice. Peer reviewers are asked to address the terms of reference in the terms of reference report that follows. Please be as specific as possible in recording your comments and suggestions for revision and improvement. Any additional suggestions to improve the stock assessment are appreciated. Reviewers are also welcome to make comments directly in the assessment report using the Track Changes feature in Microsoft Word.

Please return this form, the terms of reference report, and any additional comments to laura.lee@ncdenr.gov. We would like to have your review by February 2, 2015. A copy of the final report will be provided after it has been presented to the North Carolina Marine Fisheries Commission.

Thank you,

Laura M. Lee
Senior Stock Assessment Scientist
North Carolina Division of Marine Fisheries

TERMS OF REFERENCE REPORT FOR EXTERNAL PEER REVIEW

Reviewer Information

Reviewer Name: Christopher J. McDonough

Business Mailing Address: SCDNR, 217 Fort Johnson Rd. Charleston, SC 29412

Business E-Mail: mcdonoughc@dnr.sc.gov

Business Phone: (843)953-9231

1) Evaluate the thoroughness of data evaluation and presentation including:
   a) Justification for inclusion or elimination of available data sources

      Were there any instate surveys (for both NC and VA) that were considered for the assessment that were not included? I'm wondering about NCDMF Survey program 195 (Pamlico Sound Survey) and possibly some of the long term Chesapeake surveys (CHESMMAP, VIMS striped bass juvenile seine survey, etc). I would like to know what surveys (if any) were not included and why.

   b) Consideration of survey and data strengths and weaknesses (e.g., temporal and spatial scale, gear selectivities, sample size)

      The coverage of areas, data types (FD and FI) and the particular strengths and weaknesses, given how the data was examined through the different indices, seemed adequately covered.

   c) Calculation and standardization of indices and other statistics

      I think using the GLM standardization worked well. While there are other more expansive models and techniques, keeping the standardization as simple as possible while retaining fewer steps between standardization for the model and the actual raw data provides a better view of what may be really happening. I do have a question on how the Program 915 data was broken up into 4 different indices. I would expect a degree of collinearity with these indexes, why do it that way as opposed to using a single index with season as a covariate and then running the different seasons as sensitivity runs in the model?

2) Evaluate the adequacy, appropriateness, and application of data used in the assessment.

   Data used in the model appear to be appropriate as well as treatment and standardization procedures.

3) Evaluate the adequacy, appropriateness, and application of method(s) used to assess the stocks.

   The methods used and the descriptions of how they were used in the applied Stock Synthesis model appeared detailed and appropriate for the different data types and followed the accepted procedures for how this method should be carried out. Not being a modeler in a strict sense, I think the stock synthesis model worked well with this data but don't feel I can comment on whether some other models (VPA, Statistical Catch at Age, etc) might have been appropriate as well. However, I do feel that the method used was a good fit.

4) Evaluate the methods used to estimate stock status determination criteria. Evaluate the adequacy and appropriateness of recommended stock status determination criteria.

   The stock status threshold criteria, as set out by the FMP, seem to work with the variability in recruitment, SSB, and F levels during the time of the assessment. The absence of any clear long term trends and the fact that the estimates of SSB were well below both the threshold and target SPR levels indicate the model outputs are reasonable as is the conclusion that the stock was not being overfished. F levels were a bit closer to the reference and target levels (at the 20% and 30% levels) but the high degree of variability in natural mortality owing to both recruitment variability and susceptibility to winter cold kill events likely exacerbate general F levels and the actual levels of F are probably lower. So, the conclusion that the stock is not experiencing overfishing seems reasonable.

5) Does the stock assessment provide a valid basis for management for at least the next five years given the available data and current knowledge of the species stock dynamics and fisheries?

   ● Yes

   ● No

   Comment on response.

   I would agree with this but as the authors state, further work on getting better estimates of natural mortality are needed.

6) Evaluate appropriateness of research recommendations. Suggest additional recommendations warranted, clearly denoting research and monitoring needs that may appreciably improve the reliability of future assessments.

   Current recommendations cover all of the areas that would be helpful for improving the assessment in the future. The only thing I might add (as a medium priority) would be genetic studies across NC and VA and comparisons with work done in the rest of the south Atlantic.

7) Are you aware of any reference material not cited in this report that should be included?

   SC has not published a citable age validation for spotted seatrout, however, we have extensive age data and have on occasion produced what amounts to one for some other work.

8) Would you be willing to act as an external peer reviewer for a future NCDMF stock assessment?

   ● Yes

   ● No

9) Do you have any additional comments?

One issue I would bring up more for future consideration rather than as part of this assessment is the issue of hybridization amongst *Cynoscion* species. This topic came up during the ongoing weakfish assessment and appears to be more of an issue in GA and FL, however there is some evidence of C. nebulosis and C. regalis hybrids from the SEAMAP program. This is ongoing work that I am not directly involved with, but it is information that is good to know. I do believe they are currently working on a publication on this topic.

NCDMF Stock Assessment Program
External Peer Review

Assessment Information

Assessment Species:	Spotted seatrout (*Cynoscion nebulosus*)
Stock Assessment Report:	Stock Assessment of Spotted Seatrout, *Cynoscion nebulosus*, in Virginia and North Carolina Waters—2014
Date Sent:	January 5, 2015

Dear Reviewer-

Thank you for agreeing to review the 2014 stock assessment of the Virginia-North Carolina spotted seatrout stock. The purpose of the external peer review process is to ensure that the assessment and results presented are scientifically sound and that decision makers are provided adequate advice. Peer reviewers are asked to address the terms of reference in the terms of reference report that follows. Please be as specific as possible in recording your comments and suggestions for revision and improvement. Any additional suggestions to improve the stock assessment are appreciated. Reviewers are also welcome to make comments directly in the assessment report using the Track Changes feature in Microsoft Word.

Please return this form, the terms of reference report, and any additional comments to laura.lee@ncdenr.gov. We would like to have your review by February 2, 2015. A copy of the final report will be provided after it has been presented to the North Carolina Marine Fisheries Commission.

Thank you,

Laura M. Lee
Senior Stock Assessment Scientist
North Carolina Division of Marine Fisheries

TERMS OF REFERENCE REPORT FOR EXTERNAL PEER REVIEW

Reviewer Information

Reviewer Name: Michael Murphy

Business Mailing Address: FWC-FWRI, 100 Eighth Ave SE, St. Petersburg, FL 33701

Business E-Mail: mike.murphy@myfwc.com

Business Phone: 727-502-4928

1) Evaluate the thoroughness of data evaluation and presentation including:

   a) Justification for inclusion or elimination of available data sources

      It may be important to extend the data back in time to develop more contrast in the estimated size of the stock. Though I couldn't find the outputs needed to calculate the initial depletion (virgin SSB and SSB_1991), if most of the depletion occurred before the start of the analysis that would hamper your efforts to estimate MSY-based reference points.

      As you discussed, I think it's important to find a way to link the natural mortality to cold-weather events, probably through an environmental link in the parameter. It might be necessary to do away with the Lorenzen and go to a simpler two-state natural mortality for this to work correctly.

      I believe the MRIP total catch data may be a valid index of abundance, especially if you treat it with a random-walked catchability as you did for the fishery-independent indices.

   b) Consideration of survey and data strengths and weaknesses (e.g., temporal and spatial scale, gear selectivities, sample size)

      I am not convinced that it is necessary to break the gill-net survey into seasonal and area components to create multiple indices. Why not include these variables in the standardization if you think they may influence the catch-rate signal used as the index of abundance?

      Is the within-year spatial scale (two months) of the yoy trawl data too short? You mention the effect of salinity on spawning activity and, though salinity can be included in standardization, isn't it important to include the more complete period of yoy recruitment?

   c) Calculation and standardization of indices and other statistics

      This is well thought out and complete.

2) Evaluate the adequacy, appropriateness, and application of data used in the assessment.

   Major issues are the random walk component of the fishery independent index catchability and the lack of change in natural mortality over time. It seems that the random walk would dilute (or eliminate) any guidance from the indices as to changes in abundance. The prime example is the large yoy index in 2012, where a large increase in catchability renders this signal as an actual decrease in yoy abundance. I assume this is because the raw index conflicts with the age-0 catch, fishery selectivity, and F for the last year's data.

The use of constant natural mortality (despite direct tag evidence for large fluctuations) likely makes the estimates of F during cold-kill years highly positively biased. The change in estimated abundance from year-to-year correctly implies a high Z but this can only be mostly attributed to F given the constant M…..then given an input level of harvest, the estimated abundance implied by this catch and abundance must be biased low.

The discrepancy between the tag-measured F's and the SS3 F's weren't large in 2011 (Fig 3.36) but the observed and predicted numbers recaptured was quite different. Is there a good explanation for this?

3) Evaluate the adequacy, appropriateness, and application of method(s) used to assess the stocks.

   I think the SS3 platform choice is a good one though its flexibility can make understanding the implications of different inputs scenarios very challenging.

4) Evaluate the methods used to estimate stock status determination criteria. Evaluate the adequacy and appropriateness of recommended stock status determination criteria.

   The methods used are correct though I believe the biases created by the constant M assumption would lead to a stock status determination that was probably worse than what actually is occurring in nature.

5) Does the stock assessment provide a valid basis for management for at least the next five years given the available data and current knowledge of the species stock dynamics and fisheries?

   ● Yes

   ● No

   Comment on response.

   My only caveat is that periodic mass mortalities have the potential to lead to population bottlenecks where added protections might be wise to let the population recover. I don't see anything in the SSB trajectory that suggests this problem occurred during the fairly frequent freeze events in the 1990's and 2000's.

6) Evaluate appropriateness of research recommendations. Suggest additional recommendations warranted, clearly denoting research and monitoring needs that may appreciably improve the reliability of future assessments.

   A clear area of research should be to evaluate and develop methods to incorporate periodic natural mortalities into the analysis. This would be research activity because it is not clear how this can be done. It might also be nice to use simulation analyses to determine whether some buffer to the SPR threshold of 20% is necessary to keep the population at these levels under the current periodicity of freeze-induced spikes in M.

7) Are you aware of any reference material not cited in this report that should be included?

   There is information on gill-net release mortality in Murphy et al. 1995.

8) Would you be willing to act as an external peer reviewer for a future NCDMF stock assessment?

   ● Yes

   ● No

9) Do you have any additional comments?

   I concentrated on the base runs and did not evaluate the sensitivities or retrospective but they were clearly presented in the text.

NCDENR
North Carolina Department of Environment and Natural Resources

Pat McCrory
Governor

Donald R. van der Vaart
Secretary

MEMORANDUM

TO: N.C. Division of Marine Fisheries Management Review Team

FROM: Beth Egbert and Kevin Brown
N.C. Division of Marine Fisheries

DATE: March 9, 2015

SUBJECT: Plan Development Team Recommendation from Kingfish Fishery Management Plan Review

On Jan. 7, 2015 the Kingfish Fishery Management Plan (FMP) Plan Development Team (PDT) met at the Washington Regional Office to discuss the ongoing review of the Kingfish FMP. A primary purpose of the meeting was to discuss and consider if any refinement should be made to the prior management triggers included in the 2007 Kingfish FMP. While the PDT selected updated and improved triggers expanding the reference timeframe through 2013, the team did not think these changes alter the basic strategic concept of the trigger management set forth by the 2007 FMP. The consensus of the PDT on the outcome of the FMP review was to recommend a revision.

The Kingfish PDT met again Jan. 15, 2015 to finalize their management trigger recommendations and discuss and clarify the definition of tripping of management triggers. The PDT recommended reducing the number of triggers from 10 to seven, and specified that any two triggers would have to be tripped for two sequential years, the same two triggers, for data to be reevaluated and potential management action to be considered.

On Jan. 20, 2015, Beth Egbert and Laura Lee presented the PDT analysis of management triggers along with the PDT recommendation to proceed with a revision to the Division Management Review Team (MRT.) The MRT agreed with the PDT recommendation to proceed with a revision, but recommended that the language be changed regarding the criteria for management action from "management action 'would' be considered" to "management action 'may' be considered." The MRT consensus was to proceed with the news release soliciting issues from the public for the Kingfish FMP review.

To alert the public that the Kingfish FMP was under review and to solicit public input on potential issues, a news release was issued Jan. 26, 2015. The deadline for comment by the public was Feb. 17, 2015. The PDT received five comments. Each comment was reviewed by the PDT and a response to each comment was drafted (see enclosed.) Only one of the five comments requested any changes to regulations for kingfishes.

On Feb. 25, 2015, the Kingfish PDT met via conference call to discuss the public comments and whether or not any of the comments warranted an issue paper or an amendment instead of a revision to the plan. The PDT was notified by the FMP Process Workgroup that the term “revision” is now called an “information update” and refers to only changes in factual and background information, not management measures.

After careful consideration of the FMP and the public comments, the Kingfish PDT recommends to the MRT that the Kingfish FMP review should proceed as an information update and that the public comments, and Division responses to the comments, will be included as an appendix to the FMP.

cc: Plan Development Team for Kingfish Fishery Management Plan

/be
Enclosure

Goals and Objectives

The goal of the 2007 Kingfish Fishery Management Plan is to determine the status of the stock and ensure the long-term sustainability for the kingfishes stock in North Carolina.

Objectives:

1. Develop an objective management program that provides conservation of the resource and sustainable harvest in the fishery.

2. Ensure that the spawning stock is of sufficient capacity to prevent recruitment overfishing.

3. Address socio-economic concerns of all user groups.

4. Restore, improve, and protect critical habitats that affect growth, survival, and reproduction of the North Carolina stock of kingfishes.

5. Evaluate, enhance, and initiate studies to increase our understanding of kingfishes' biology and population dynamics in North Carolina.

6. Promote public awareness regarding the status and management of the North Carolina kingfishes stock.

Evaluation of Management Triggers for Kingfish

November 2014
Updated January 2015

Laura Lee
Ray Mroch
Will Smith

BACKGROUND

Current management triggers for kingfish are organized into three groups: biological monitoring, fisheries-dependent catch per unit effort (CPUE), and fisheries-independent surveys. The triggers within each group are listed below:

<u>Biological Monitoring</u>
Mean fish length by fishery compared to last five years
Proportion of age one kingfishes greater than 50% of fish 11.0 to 11.8" TL

<u>Fisheries-Dependent CPUE</u>
Commercial < 2/3 of the mean harvest from 1999 to 2004
Recreational < 2/3 of the mean harvest from 1999 to 2004

<u>Fisheries-Independent Surveys—Juvenile and Adult</u>
Pamlico Sound fall 2/3 below mean CPUE
Southeast Area Monitoring and Assessment Program (SEAMAP) fall 2/3 below mean CPUE

If one of the management triggers is "tripped" then the NCDMF will consider management action.

EVALUATION

The first issue that needs clarification is whether the triggers apply to southern kingfish only or all kingfish species separately or combined (see Follow Up section).

It is not clear how the indicator related to mean length by fishery will be judged. It simply states that it will be compared to the average length from the previous five years, but it does not specify what constitutes a good or bad result. It will be assumed that the intention was that a decrease in average length relative to the previous five years will trip the trigger.

It is expected that the average age of a fish population decreases with increasing fishing pressure because fewer fish survive to old age (Francis and Smith 1995; Francis and Jellyman 1999). Since age is often highly correlated with length it is not unreasonable to assume that average length would decrease with decreasing biomass; however, this is not always the case (Francis and Smith 1995). Additionally, natural variations in recruitment can cause substantial variation in annual average length, even when fishing pressure is constant (Francis and Jellyman 1999). For these reasons, evaluation of average length alone may not be appropriate.

Since tracking average length is considered (incorrectly) an index of the fraction of the population that survives to relatively older ages, it might be more appropriate to identify another metric based on length frequencies that is expected to more accurately track the relative abundance of older fish. The loss of larger, presumably older fish from the population is expected to produce a signal in the tails of the length distribution rather than the center of the distribution; thus, some index that accounts for the tails of the annual length-frequency distribution is more appropriate. For example, if no fish greater than a certain size are observed for five years, that might be a management trigger. The same logic could be applied to age distributions in order to identify another trigger based on ages; however, if age samples are collected in a less random way with respect to length data collection, length data may be more accurate.

The triggers based on fisheries-dependent CPUE indices are not clear. As stated, the triggers suggest they will be tripped if the CPUE index is less than 2/3 of the average harvest from 1999 to 2004. It is assumed that the intention was that the trigger would be tripped if the CPUE index is less than 2/3 of the average CPUE index from 1999 to 2004.

Fisheries-dependent indices are associated with numerous biases. Relative indices are assumed to be proportional to stock size. In order for a fisheries-dependent index to be proportional to abundance, fishing effort must be random with respect to the distribution of the population and catchability must be constant over space and time. This is one of the benefits of fisheries-independent surveys for use as indices of abundance—they are designed to provide unbiased estimators and employ a standard methodology over time and space. Other factors affecting the proportionality of fisheries-dependent indices to stock size include changes in fishing power, gear selectivity, gear saturation and handling time, fishery regulations, gear configuration, fishermen skill, market prices, discarding, vulnerability and availability to the gear, distribution of fishing activity, seasonal and spatial patterns of stock distribution, changes in stock abundance, and environmental variables. Additionally, it is often difficult to define a standard unit of effort for fisheries-dependent data. Many agencies, including the NCDMF, don't require fishermen to report records of positive effort with zero catch; lack of these "zero catch" records in the calculation of indices can introduce further bias. Furthermore, fisheries-dependent indices are, at most, only reflective of trends in fished areas and apply only to individuals within the size range that is capable of being caught by the fishing gear. Both fisheries-dependent and fisheries-independent indices can be standardized to account for factors other than changes in abundance that affect the indices (Maunder and Punt 2004). This requires the collection of auxiliary data at the time of harvest or sampling event. Often, such data are not available for fisheries-dependent indices. Finally, fisheries-dependent indices tend to exhibit hyperstability (Harley 2001); that is, the CPUE index remains high while the population declines.

A further issue related to the recreational fishery CPUE index is the recent change in methodology that occurred in 2013 (see http://www.st.nmfs.noaa.gov/recreational-fisheries/index). Accounting for this change in the computation of the recreational fishery CPUE index will be a difficult task, if possible at all.

As mentioned above, fisheries-independent indices can be standardized to account for factors beyond abundance changes that impact the index. Other considerations for fisheries-independent survey series include length of time series, survey design, consistency in methodology, catchability and availability to the gear, sample timing and spatial coverage, and precision. The minimum length for a survey index to be considered sufficient is the average lifespan of the species. Southern kingfish live approximately nine years so the Pamlico Sound Survey index is considered of adequate length (twenty-four years). The survey is based on a sound statistical design, so survey design is not thought to be an issue. There have been some changes in methodology over time; this can be accommodated by limiting the time series to those years in which the methods have been consistent. For the Pamlico Sound Survey, this would be from 1990 forward. Sample timing is not thought to be an issue as southern kingfish have been caught in the June and September components during every year of the survey. Spatial coverage is an issue as the southern kingfish extends beyond North Carolina waters.

Catchability and availability are more difficult to assess. One way this can be evaluated is by looking at the percentage of tows in which the species does not occur (“zero” tows). Consistently high proportions of tows with zero catch can indicate that there is low catchability and/or availability. The percentage of zero tows was calculated for southern kingfish observed in the Pamlico Sound Survey for both the June and September components of the survey. In many years the percentage of zero tows exceeds 60% for June (Table 1). The average number of zero tows per year for June is 59% and the average for September is 49%. A closer look at the data shows that there are three strata (‘NR’, ‘PR’, ‘PUN’) in which southern kingfish are infrequent or rare (Tables 2, 3). The calculation of an index based on these survey data could consider eliminating data collected from these strata. Alternatively, one could consider applying a zero-inflated model when constructing the index.

Precision is easily evaluated by computing the standard error associated with the annual index. A stratified-GLM approach was used to calculate standardized indices for June and September. The standard errors and proportional standard errors (PSEs) were also calculated. Most statistical texts recommend a PSE of 20% or less. The PSEs of the June and September indices are shown in Figures 1 and 2. PSE values exceed 20% in all but three years for the June index and all but one year for the September index. Elimination of the three strata suggested above may lead to improved precision.

RECOMMENDATION (accepted by PDT 1/7/2015)
Based on the evaluation, it is recommended that consideration of management action should not be based on any one trigger alone but some combination of two or more triggers. Management triggers based on average length should not be considered; instead a trigger based on the upper tail of the length and/or age distribution should be developed. Another recommendation is to eliminate the fisheries-dependent CPUE indices as management triggers. Finally, the Pamlico Sound Survey index should be computed for June and September separately and should not include data collected in the ‘NR’, ‘PR’, or ‘PUN’ strata.

JANUARY 2015 FOLLOW UP
The Kingfish PDT met on Wednesday, January 7 to discuss several issues including the evaluation of management triggers. Upon further review of prior plan and stock assessment report text, the recommendations put forward in this document, and review of the full time series of data through 2013, the PDT during its discussion accepted this report’s initial

recommendations and made further refinements. Additionally, the PDT clarified that management triggers apply to southern kingfish. The PDT decided on the following management triggers (organized into three categories; see PDT minutes for 1/7/2015):

<u>Biological Monitoring</u>
Proportion of adults ≥ length at 50% maturity (L_{50}) for NCDMF Program 195 June
Proportion of adults ≥ L_{50} for NCDMF Program 915
Proportion of adults ≥ L_{50} for SEAMAP summer

→ If the proportion of adults ≥ L_{50} falls below 2/3 of the average proportion of adults ≥ L_{50} for the time series, then the trigger will be considered tripped.

<u>Fisheries-Independent Surveys—Juvenile and Adult</u>
NCDMF Program 195 September index of YOY relative abundance
SEAMAP summer index of adult relative abundance
SEAMAP fall index of YOY relative abundance

→ If a fisheries-independent survey falls below 2/3 of the average abundance for the time series (through 2013), then the trigger will be considered tripped.

<u>Other</u>
Relative fishing mortality rate (*F*)

→ If relative *F* rises above 66% of the average relative *F* for the time series (through 2013), the trigger will be considered tripped.

If any two triggers trip two years in a row (regardless of category), then data will be reevaluated and management action may be considered.

DETAILS
Peak spawning for southern kingfish occurs in April so data collected by the NCDMF during March and April were used to estimate the maturity schedule. The value for L_{50} was estimated using the standard logistic maturity curve (males and females pooled) and the estimate was 210 mm total length (TL; Figure 3). Adults collected during the June component of the Program 195 survey (excluding strata NR, PR, and PUN) were considered individuals > 150 mm TL. For the July through September component of Program 915 (Pamlico Sound deep strata only), adults were defined as individuals > 190 mm TL. For the summer component of the SEAMAP (Onslow, Raleigh, and Long bays, inner—shallow—strata) survey, adults were considered individuals > 150 mm TL.

Defining cut-offs for YOY and adults for the fisheries-independent surveys varied by survey and season. For the September component of the Program 195 survey (excluding strata NR, PR, and PUN), YOY were defined as individuals ≤ 190 mm TL. For the summer component of the SEAMAP (Onslow, Raleigh, and Long bays, inner—shallow—strata) survey, adults were defined as above (>150 mm TL). For the fall component of the SEAMAP (Onslow, Raleigh, and Long bays, inner—shallow—strata) survey, YOY were considered individuals ≤ 205 mm TL.

The relative index derived from the Program 195 survey was calculated using a stratified GLM approach. The indices derived from the SEAMAP survey were computed using standard (non-stratified) GLMs.

Relative *F* is a simple method for estimating trends in *F* (Sinclair 1998). It is estimated as catch divided by a fisheries-independent index of relative abundance. Here, catch (commercial landings plus recreational harvest) was divided by the SEAMAP spring index (Onslow, Raleigh, and Long bays, inner—shallow—strata) of relative abundance.

RESULTS

The management triggers based on the proportions of adults ≥ L_{50} are shown in Figures 4 through 6. The proportions of adults ≥ L_{50} derived from the NCDMF Program 915 survey were above the trigger threshold in all years throughout the respective time series (Figure 5). The management triggers based on the fisheries-independent survey indices are shown in Figures 7 through 9. The management trigger based on relative *F* is shown in Figure 10.

In 17 of the 27 years (1987–2013), at least one trigger was tripped in each of two categories (Table 4). There were eight instances when two triggers simultaneously tripped two years in a row (regardless of category). No triggers were tripped in 2013.

DISCUSSION AND PDT RECOMMENDATIONS

The management triggers adopted in the 2007 Kingfish FMP were evaluated and recommendations were put forth in this document to improve and refine those triggers. Based on the evaluation of the newly proposed management triggers, consideration of management action is not warranted at this time. The results indicated that no triggers were tripped in 2013.

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Harley, S.J., R.A. Myers, and A. Dunn. 2001. Is catch-per-unit-effort proportional to abundance? Canadian Journal of Fisheries and Aquatic Sciences 58(9):1760–1772.

Maunder, M.N., and A.E. Punt. 2004. Standardizing catch and effort data: a review of recent approaches. Fisheries Research 70(2-3):141–159.

Sinclair, A.F. 1998. Estimating trends in fishing mortality at age and length directly from research survey and commercial catch data. Canadian Journal of Fisheries and Aquatic Sciences 55(5):1248–1263.

Table 1. Percentage of zero tows for southern kingfish occurring in the June and September components of the NCDMF Pamlico Sound Survey, 1990–2013.

Year	June	September
1990	79.6	45.1
1991	90.6	43.4
1992	64.2	59.6
1993	51.9	81.1
1994	69.8	44.9
1995	73.6	28.8
1996	63.5	81.1
1997	62.3	69.8
1998	88.5	66.7
1999	70.4	55.8
2000	50.9	47.2
2001	67.9	49.1
2002	71.7	48.1
2003	75.5	54.7
2004	57.4	43.4
2005	65.4	44.2
2006	42.6	46.3
2007	45.1	29.6
2008	50.0	44.4
2009	44.4	38.9
2010	24.1	51.9
2011	63.0	31.5
2012	20.4	46.3
2013	27.8	24.1

Table 2. Percentage of tows in which southern kingfish were present in the June component of the NCDMF Pamlico Sound Survey by strata, 1990–2013.

Year	NR	PDE	PDW	PR	PSE	PSW	PUN
1990	0	18	56	0	33	0	0
1991	0	4.5	13	0	29	33	0
1992	0	42	63	0	50	40	0
1993	0	76	44	0	71	25	0
1994	0	40	50	0	38	25	0
1995	0	36	29	0	43	25	0
1996	0	48	57	0	43	50	0
1997	20	64	29	0	17	40	0
1998	0	15	13	0	33	0	0
1999	0	26	30	0	57	80	0
2000	0	74	44	0	71	60	0
2001	0	53	45	0	14	33	0
2002	20	32	33	0	43	40	0
2003	0	30	36	0	50	0	0
2004	0	50	40	20	86	50	0
2005	0	53	44	0	50	20	0
2006	40	60	67	0	100	60	33
2007	0	78	44	20	83	60	33
2008	60	50	33	40	71	60	33
2009	0	65	44	40	86	100	0
2010	60	90	89	0	100	100	0
2011	20	60	22	0	43	40	0
2012	80	95	100	0	86	80	33
2013	20	85	89	40	86	100	0

Table 3. Percentage of tows in which southern kingfish were present in the September component of the NCDMF Pamlico Sound Survey by strata, 1990–2013.

Year	NR	PDE	PDW	PR	PSE	PSW	PUN
1990	0	70	60	0	86	100	0
1991	20	68	83	0	88	50	0
1992	0	60	0	0	75	100	0
1993	20	24	11	20	14	33	0
1994	0	79	57	20	83	50	0
1995	20	95	75	0	86	100	33
1996	20	14	13	0	67	25	0
1997	20	50	33	0	29	0	0
1998	20	39	33	0	63	33	0
1999	0	58	50	20	86	0	0
2000	0	95	10	0	100	33	0
2001	0	84	44	0	71	40	0
2002	0	95	44	0	29	50	33
2003	0	68	20	0	71	75	33
2004	0	70	56	40	86	75	0
2005	20	65	33	20	100	100	33
2006	0	65	56	40	71	80	0
2007	20	95	67	40	71	100	0
2008	20	60	56	20	86	100	0
2009	0	90	67	0	57	100	0
2010	0	45	67	40	71	60	33
2011	0	95	78	0	71	100	33
2012	20	85	44	20	43	40	33
2013	0	100	88	20	100	100	0

Table 4. Summary of management trigger organized by category. Bold values indicate values that exceed (and so would trip) the trigger.

	BIOLOGICAL MONITORING			FISHERIES-INDEPENDENT SURVEYS			OTHER
	Proportion of Adults >= L50			YOY Indices		Adult Index	Relative *F*
Year	Program 195 June	Program 915	SEAMAP Summer	Program 195 September	SEAMAP Fall	SEAMAP Summer	Relative *F*
1987	0.602			**0.538**			
1988	0.450			**0.926**			
1989	**0.300**		0.585	**1.31**	10.5	**7.63**	17,627
1990	0.529		0.463	**2.35**	9.93	29.1	**92,209**
1991	0.667		0.894	**3.45**	9.92	41.7	**31,107**
1992	0.429		0.622	**1.37**	**5.20**	15.7	**25,449**
1993	0.542		0.456	**0.106**	**4.70**	14.2	**59,442**
1994	0.794		0.917	5.07	11.3	**3.10**	**137,621**
1995	0.440		0.486	8.60	**2.36**	**11.1**	**49,097**
1996	0.872		0.780	**0.208**	9.77	**5.44**	**30,411**
1997	0.576		**0.373**	**0.452**	**4.00**	**11.0**	20,276
1998	1.00		0.769	**0.207**	10.6	**5.65**	9,743
1999	0.920		0.608	**3.79**	22.6	28.0	**24,813**
2000	0.733		0.929	8.21	8.31	**11.6**	**83,334**
2001	0.660	0.983	**0.303**	4.42	**5.15**	25.6	20,962
2002	0.704	0.978	0.882	6.30	14.2	**11.9**	**31,765**
2003	0.860	0.978	0.645	5.81	**4.24**	18.5	5,706
2004	0.513	0.963	**0.284**	**2.98**	13.2	45.0	5,579
2005	0.594	0.970	0.643	**1.52**	11.0	18.1	5,530
2006	0.541	0.979	0.423	20.4	**5.55**	23.7	13,604
2007	**0.338**	1.00	0.521	8.97	**6.59**	**8.42**	**45,254**
2008	0.480	0.987	0.577	8.79	9.56	**3.99**	**41,046**
2009	0.591	1.00	0.398	24.9	**3.75**	16.2	**33,941**
2010	0.508	0.981	0.786	**1.47**	16.9	**11.9**	20,169
2011	0.447	1.00	0.507	16.8	31.3	21.1	**31,533**
2012	0.523	1.00	**0.368**	5.02	9.22	61.9	8,052
2013	0.659	0.941	0.558	16.9	10.7	39.5	4,048
Threshold	0.402	0.654	0.394	3.97	6.68	13.1	22,396
Total Years	27	13	25	27	25	25	25
n Exceed	2	0	4	14	9	11	14

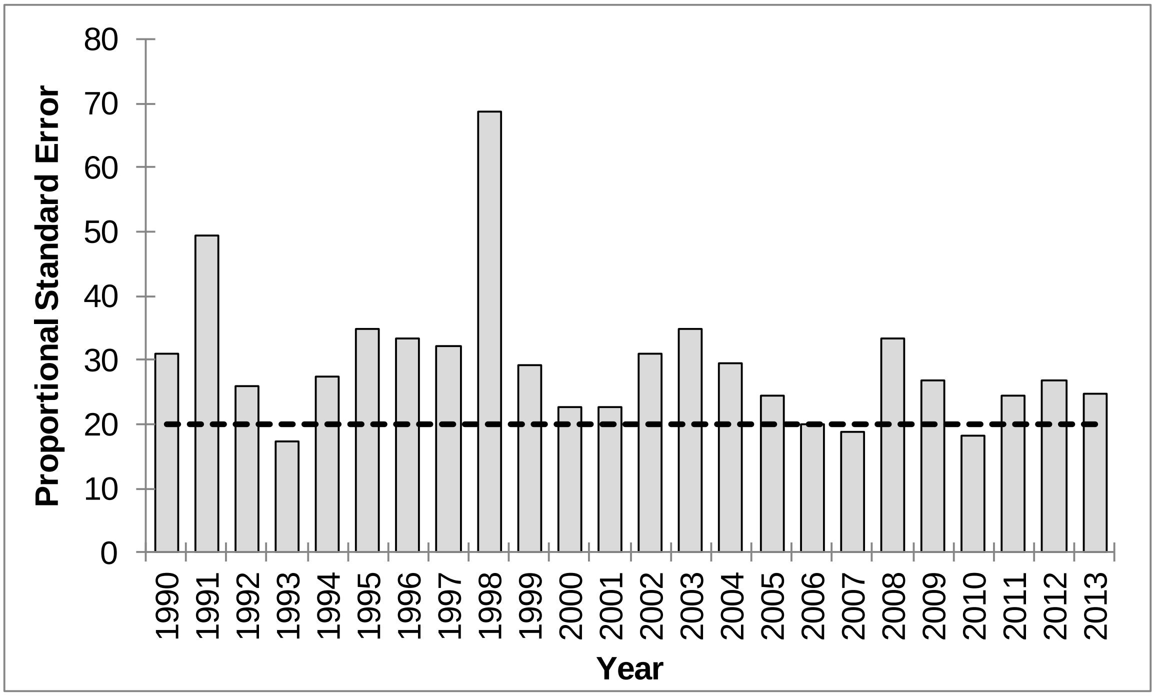

Figure 1. Annual PSE values associated with the GLM-standardized index of southern kingfish occurring in the June component of the Pamlico Sound Survey, 1990–2013. Dotted line represents 20% PSE.

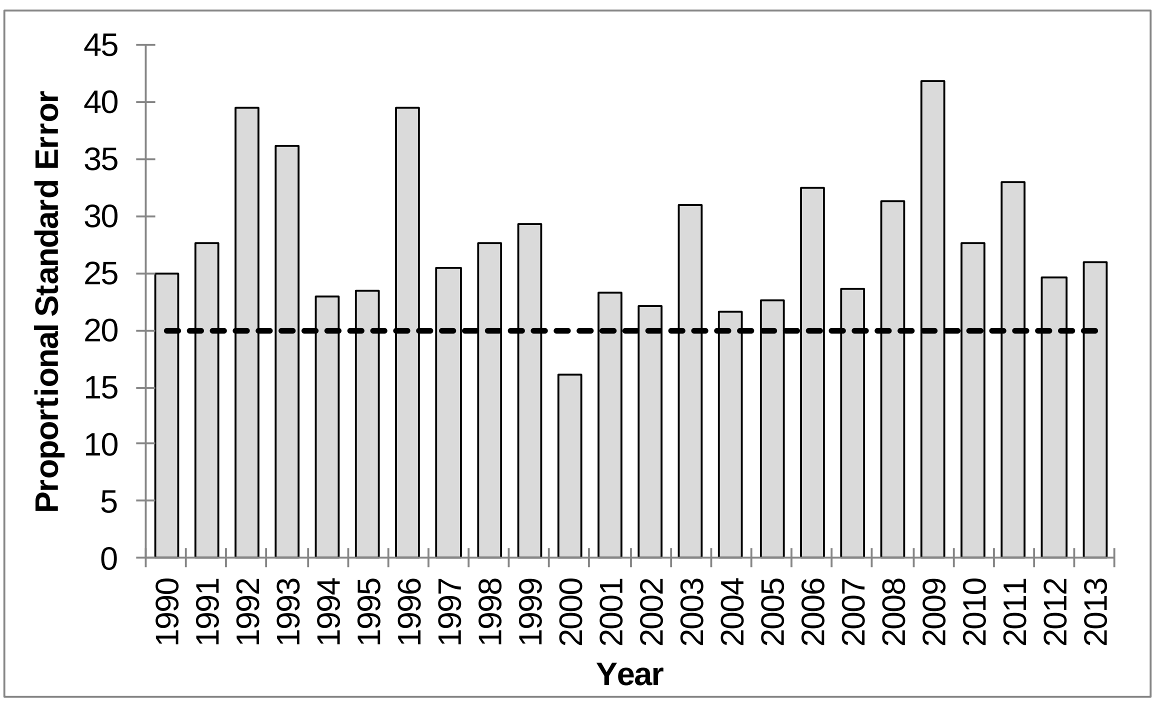

Figure 2. Annual PSE values associated with the GLM-standardized index of southern kingfish occurring in the September component of the Pamlico Sound Survey, 1990–2013. Dotted line represents 20% PSE.

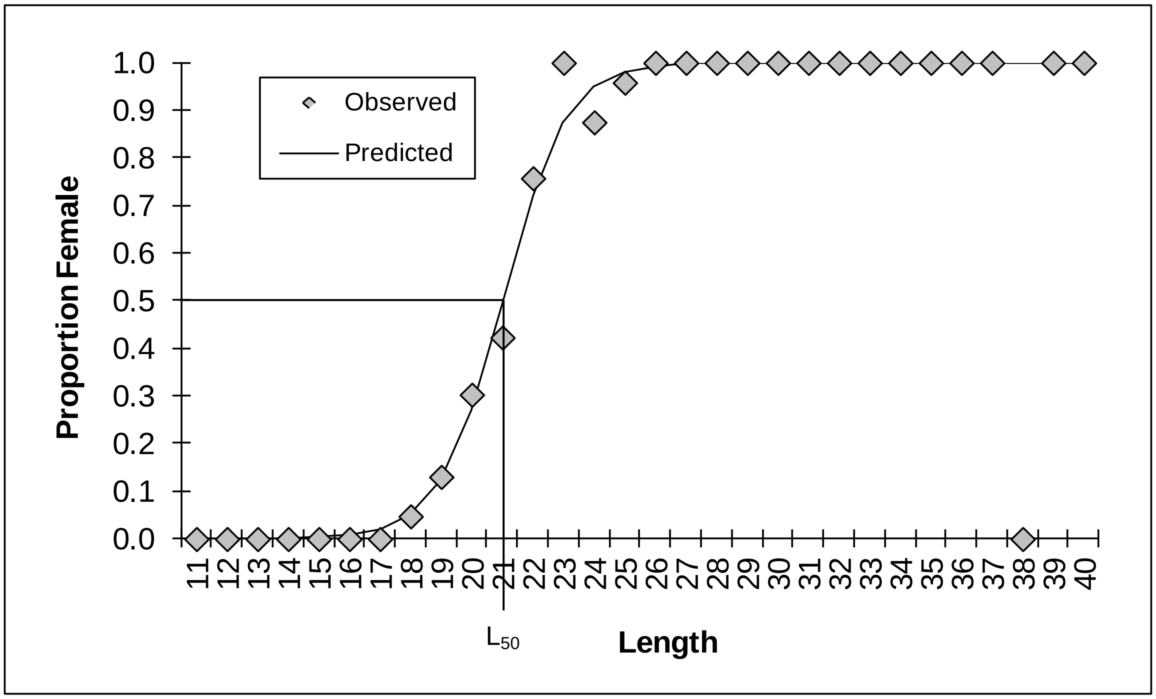

Figure 3. Predicted maturity schedule for male and female (pooled) southern kingfish.

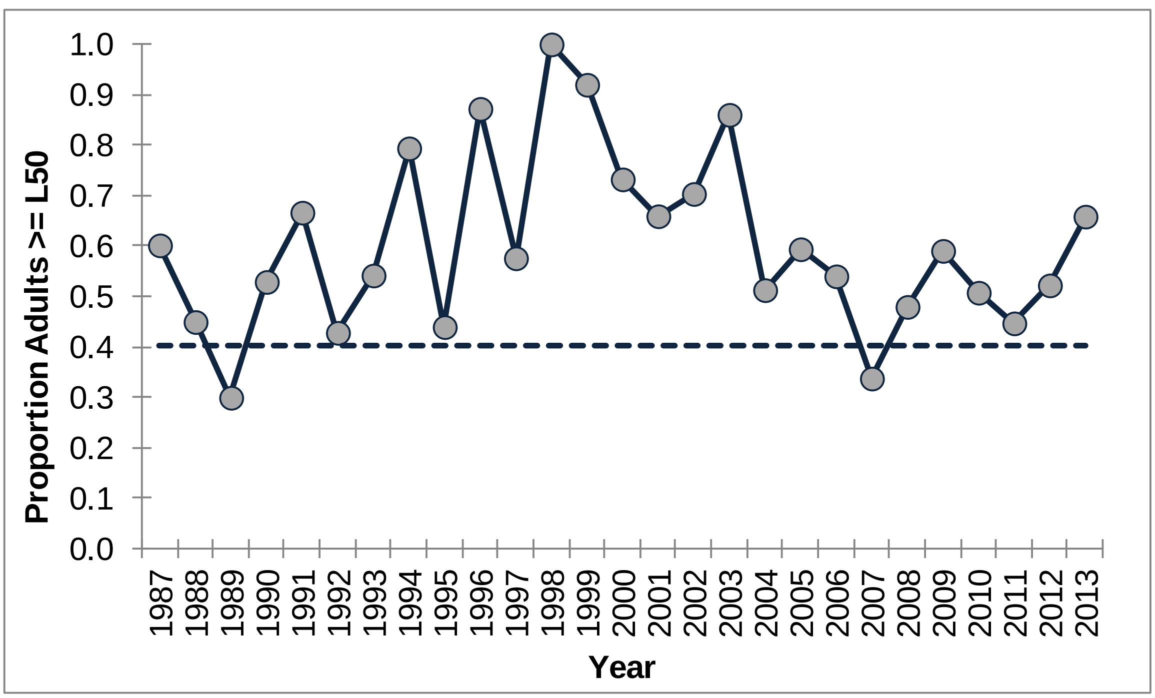

Figure 4. Annual proportions of adults greater than or equal to the length at 50% maturity occurring in the June component of the NCDMF Program 195 survey (excluding strata NR, PR, and PUN), 1987–2013. Dotted line represents 2/3 of the average of the time series.

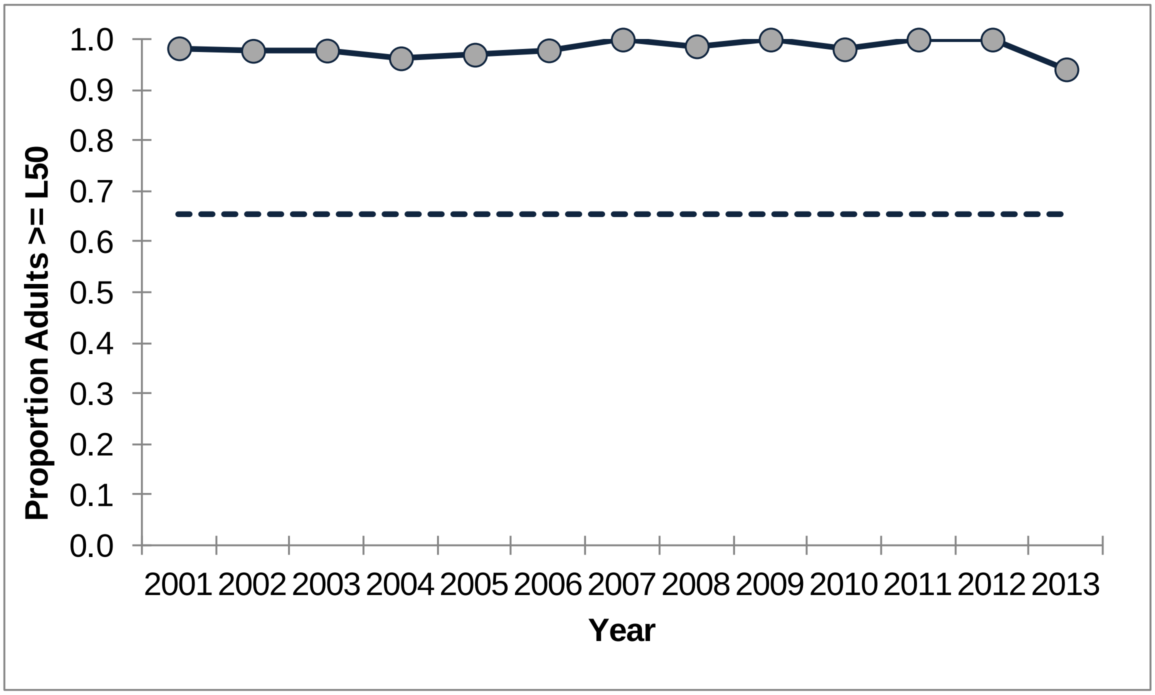

Figure 5. Annual proportions of adults greater than or equal to the length at 50% maturity occurring in the July–September component of the NCDMF Program 915 survey (Pamlico Sound deep strata only), 2001–2013. Dotted line represents 2/3 of the average of the time series.

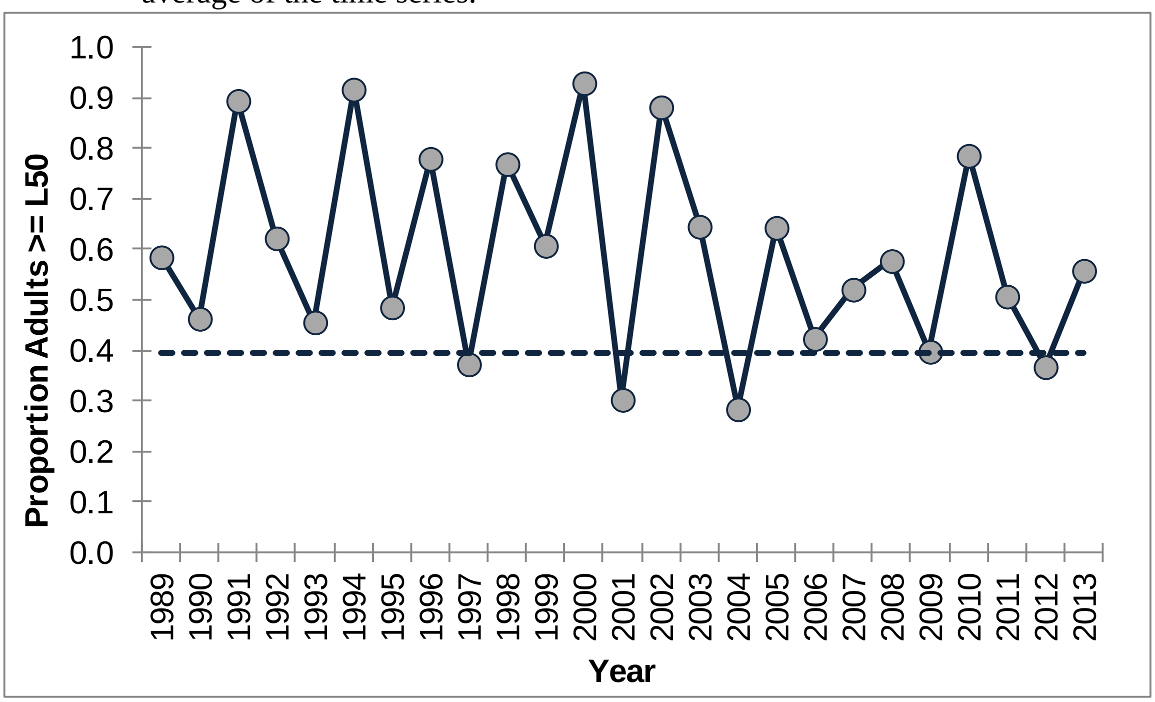

Figure 6. Annual proportions of adults greater than or equal to the length at 50% maturity occurring in the summer component of the SEAMAP survey (Onslow, Raleigh, and Long bays, inner—shallow—strata), 1989–2013. Dotted line represents 2/3 of the average of the time series.

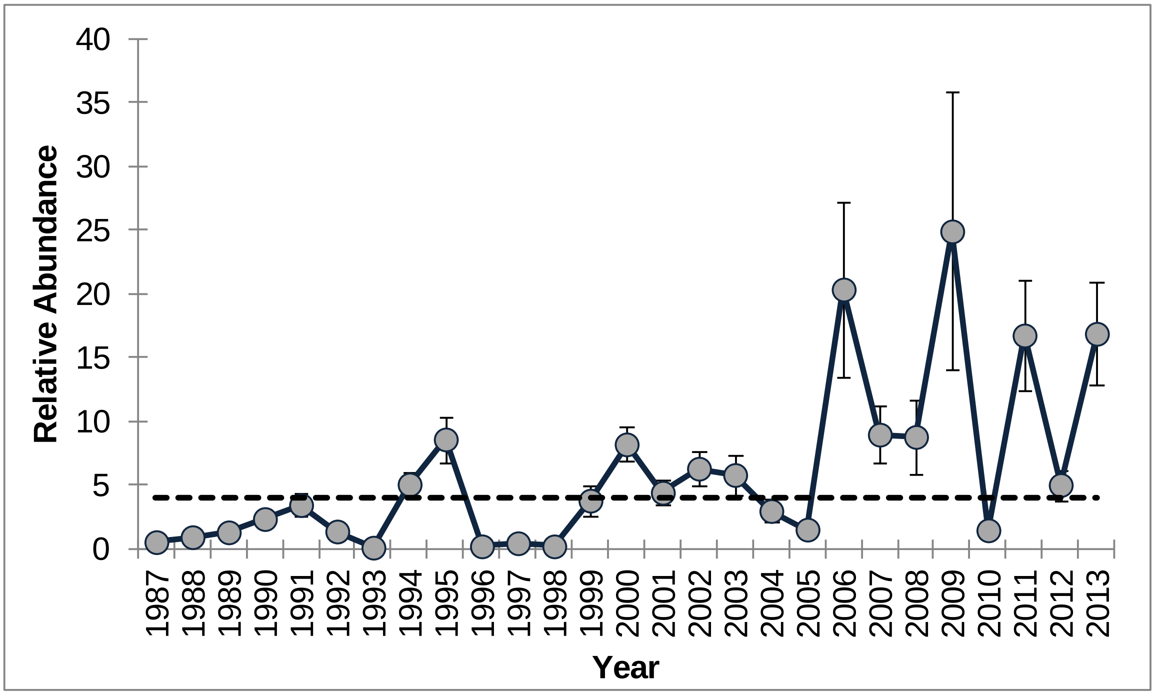

Figure 7. Annual index of relative YOY abundance derived from the September component of the NCDMF Program 195 survey (excluding strata NR, PR, and PUN), 1987–2013. Dotted line represents 2/3 of the average of the time series.

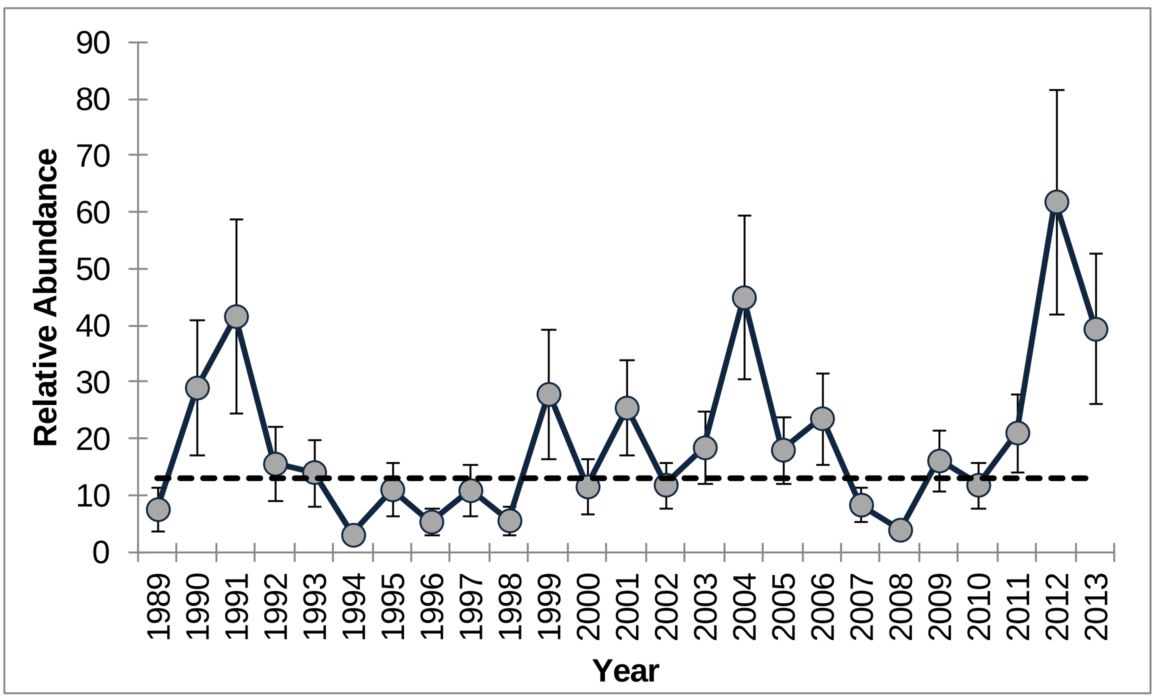

Figure 8. Annual index of relative adult abundance derived from the summer component of the SEAMAP survey (Onslow, Raleigh, and Long bays, inner—shallow—strata), 1989–2013. Dotted line represents 2/3 of the average of the time series.

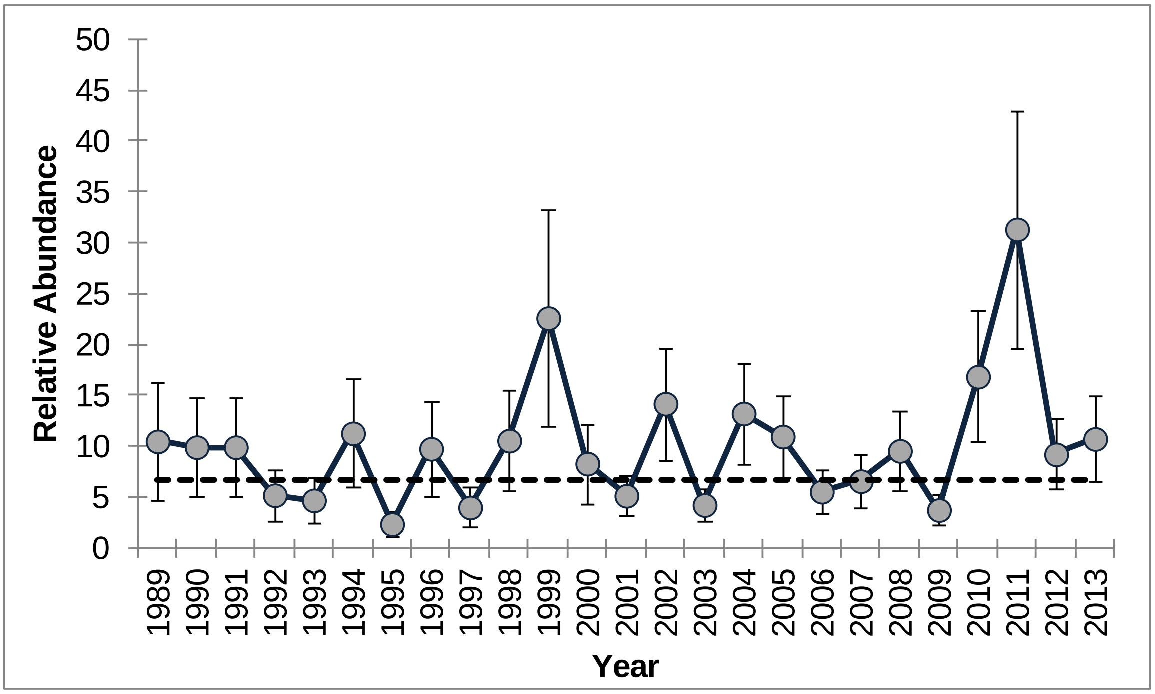

Figure 9. Annual index of relative YOY abundance derived from the fall component of the SEAMAP survey (Onslow, Raleigh, and Long bays, inner—shallow—strata), 1989–2013. Dotted line represents 2/3 of the average of the time series.

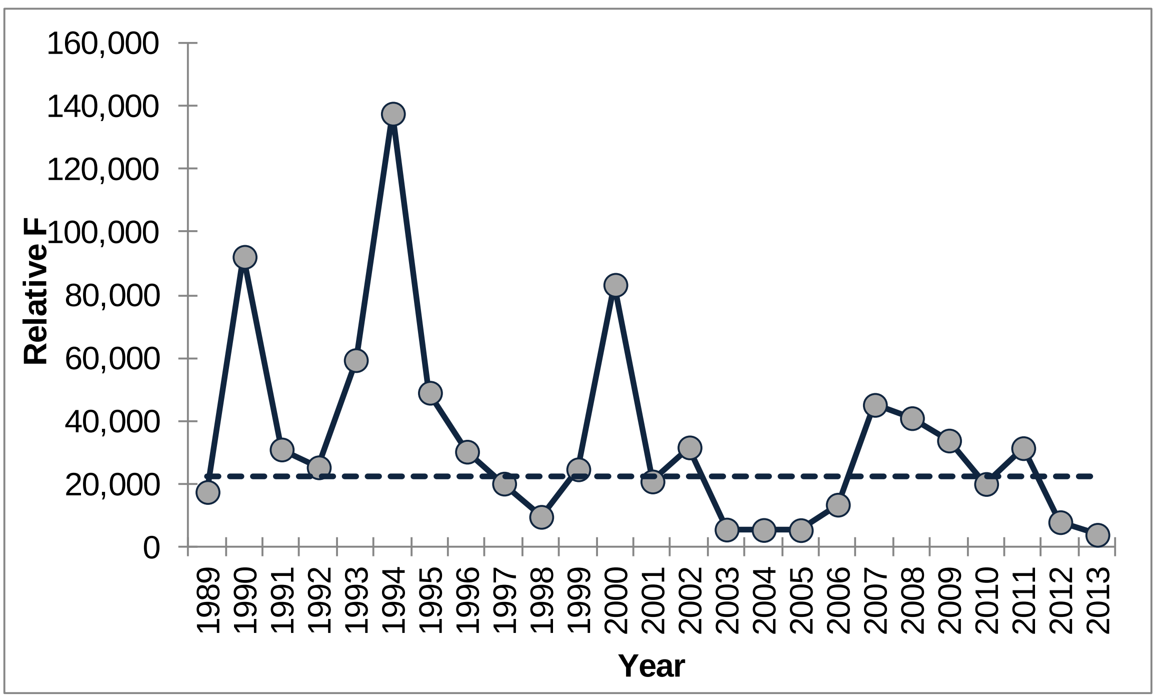

Figure 10. Annual estimates of relative fishing mortality rate, 1989–2013. Dotted line represents 66% of the average of the time series.

TIMELINE FOR KINGFISH FISHERY MANAGEMENT PLAN (FMP) REVIEW 2014
(Feb. 24, 2015)

MILESTONES	DMF GUIDELINES	TABLE 2 STEP	PROJECTED COMPLETION DATE
1. Activate plan development team, co-leads, mentor	V. D.	37 a.	August 2013
2. Review management unit, goal and objectives	II. D.	2	September 2013
3. Assess updated FMP data	V. D.	37 b.	December 2014
4. Assess whether any FMP management measures need to be changed or new issues addressed *	V. D.	37 f.	March 2015
5. Review and update all sections of FMP	V. D.	37 e.	April-June 2015
6. Present timeline and results of FMP review to Marine Fisheries Commission	III. D.	7	May 21, 2015
7. Present FMP information update to Marine Fisheries Commission	III. F.	14	Aug. 20, 2015
8. Post FMP information update on website for 30 days	III. F.	16-18	September 2015
9. Present FMP information update to MFC for final approval	IV. C.	19	Nov. 19, 2015
10. If FMP information update is approved, post on website	IV. C.	38A	December 2015
11. If information update is not approved and management changes are proposed, proceed with amendment process	V. D.	38B	December 2015
* For FMP review, a press release is issued soliciting public comment on fishery issues.			

Initial approval by director Date: 4/27/15 Signature: ______

Timeline revised by director Date: ______ Signature: ______

Reason(s): ______

Public Input for Kingfish FMP review 2015

News Release distributed Jan. 26, 2015

MOREHEAD CITY – The N.C. Division of Marine Fisheries is asking the public to submit comments on issues they would like to see addressed in an upcoming Kingfish Fishery Management Plan. State law requires the division to review each fishery management plan every five years

The division has begun a mandated review of the N.C. Kingfish Fishery Management Plan that was adopted by the N.C. Marine Fisheries Commission in 2007. The agency is soliciting public comment as part of an internal process to determine what procedural method to take in reviewing the plan.

If changes in management strategies or rules are needed, the division will pursue a plan amendment, where division staff and an advisory committee develop positions on specific issues that need to be addressed. If changes in management strategies are not required, the division will proceed with a revision, which is a more abbreviated process that involves updating data and fishery information contained in the plan.

Written comments will be accepted until February 17 and should be addressed to Beth Egbert, N.C. Division of Marine Fisheries, P.O. Box 1965, Manteo, N.C. 27954 or sent by email to Beth.Egbert@ncdenr.gov or to Kevin Brown, N.C. Division of Marine Fisheries, P.O. Box 769, Morehead City, N.C. 28557 or sent by email to Kevin.H.Brown@ncdenr.gov.

State law requires the division to prepare a fishery management plan for adoption by the Marine Fisheries Commission for all commercially and recreationally significant species or fisheries that comprise state marine and estuarine resources. These plans provide management strategies designed to ensure long-term viability of the species.

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From the Public

Email received Jan. 26, 2015 from Dan Wood

I would like to see the state put a size limit on Kingfish (whiting). Right now thousands and thousands of small whiting are killed before they have a chance to reach eating size by netters as well as by both commercial and recreational fishermen. By putting a size limit on them they would at least reach spawning size before they can legally be taken.
Thanks for your consideration,
Dan Wood
Lexington, NC
e-mail: woodjd@lexcominc.net
phone: 336-239-2315

Division Response

The management strategy set forth under the 2007 Kingfish Fishery Management Plan is the use of management triggers where management actions may be considered based on trends in several indices (biological and fishery independent). Indices have been updated through 2013 and based on these the Division has determined there is no need for additional regulations for kingfish at this time. A size limit would increase regulatory discards of kingfishes. Some culling occurs at sea and has been documented in the shrimp trawl fishery off South Carolina (DMF unpublished data). Placing a nine-inch or greater size limit on kingfishes, which are bycatch in several fisheries, would result in additional regulatory discards in the shrimp trawl, long haul seine, beach seine, sciaenid pound net, winter trawl, and recreational fisheries as well as the gill net fishery. Heads of kingfishes are also used as bait in the recreational red drum fishery. Under North Carolina law, it is unlawful to possess aboard a vessel or while engaged in fishing from the shore or a pier any species of finfish that is subject to a size or harvest restriction without having head and tail attached (Marine Fisheries Commission Rule 15A NCAC 03M .0101).

The Division is not proposing any changes in management strategies or measures for the N.C. Kingfish Fishery Management Plan. Changes in factual and background data will be documented in the upcoming Information Update to the plan. The Marine Fisheries Commission will be advised of this at its May 2015 business meeting in New Bern. The commission is scheduled to vote on final approval of the Information Update to the fishery management plan at its November 2015 business meeting in Nags Head. Thank you for your interest in the State's fisheries.

N.C. Kingfish Fishery Management Plan 2007
http://portal.ncdenr.org/c/document_library/get_file?uuid=3882c28f-da09-4978-93ab-13ba38eb0414&groupId=38337

Email received Jan. 26, 2015 from Frank Folb (Northern Regional AC)

The Sea Mullet fishery is very important to both recreational and commercial fisherfolks.

Sea Mullet was in the olden days what brought families to the Outer Banks to fish to help feed their families.
Still today it is a highly sought after fish that is of high priority to fishing piers and surf fisherman along our coast and our neighboring states above and below us.
Because these fish are NOT a highly sought after species on recreational boats I suggest that little or no limits for recreational fisheries as to size and creel be made.
If a minimum size limit is considered it should no more 9-10 inches and the creel for recreational should be no less than 50-75 fish.

Commercial Limits
In the past we have gone to historical data to see what the largest catch of a fish was and given them at least that amount for a top limit of catch for the year.
If I am correct that at present the fishery is viable and healthy I suggest we at least double any historical high for the beginning limit. This fishery is very
important to the commercial sector in recent years and fills in a void when many other fisheries are closed. Until there is a need by research that a daily limit
is needed is suggest no limit be placed on amount of catch per day or seasons open.

I would appreciate your reactions to my suggestions and also would include me on what your scientific committee minutes so I can follow and be involved throughout its implementation.
Thanks
Frank Folb
Northern Advisory Committee
Frank & Fran's Tackle
Avon, NC

Division Response

The management strategy set forth under the 2007 Kingfish Fishery Management Plan is the use of management triggers where management actions may be considered based on trends in several indices (biological and fishery independent). Indices have been updated through 2013 and based on these the Division has determined there is no need for additional regulations for kingfish at this time. Currently, the only regulation for kingfishes in North Carolina relates to shrimp and crab trawls from December 1 through March 31. During this time it is unlawful to possess finfish caught incidental to shrimp and crab trawling in the Atlantic Ocean unless the weight of the combined catch of shrimp and crabs exceeds the weight of finfish; except that an additional 300 pounds of kingfish may be taken by crab or shrimp trawlers working south of Bogue Inlet [Marine Fisheries Commission Rule 15A NCAC 03J .0202 (5)].

The Division is not proposing any changes in management strategies or measures for the N.C. Kingfish Fishery Management Plan. The upcoming Information Update will contain the most recent data to characterize the fishery and species of kingfish. The Marine Fisheries Commission will be advised of this at its May 2015 business meeting in New Bern. The commission is scheduled to vote on final approval of the Information Update to the fishery management plan at its November 2015 business meeting in Nags Head. Thank you for your interest in the State's fisheries.

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Email received Jan. 27, 2015 from Glenn Shivar

Hello! I have a few comments that I would like to express concerning sea mullet, aka kingfish.

--Are regulations really necessary? In my small part of the coast they seem larger and more numerous than I have seen and I'm 66 yrs old.

-- Make the creel limit generous, at least 30 / person.

-- Have no length requirement. Often used as bait. Big drum in the surf and for large flounder.

Thank You and have a Great Day - Glenn Shivar

Division Response

The management strategy set forth under the 2007 Kingfish Fishery Management Plan is the use of management triggers where management actions may be considered based on trends in several indices (biological and fishery independent). Indices have been updated through 2013 and based on these the Division has determined there is no need for additional regulations for kingfish at this time. Currently, the only regulation for kingfishes in North Carolina relates to shrimp and crab trawls from December 1 through March 31. During this time it is unlawful to possess finfish caught incidental to shrimp and crab trawling in the Atlantic Ocean unless the weight of the combined catch of shrimp and crabs exceeds the weight of finfish; except that an additional 300 pounds of kingfish may be taken by crab or shrimp trawlers working south of Bogue Inlet [Marine Fisheries Commission Rule 15A NCAC 03J .0202 (5)].

The Division is not proposing any changes in management strategies or measures for the N.C. Kingfish Fishery Management Plan. The upcoming Information Update will contain the most recent data to characterize the fishery and species of kingfish. The Marine Fisheries Commission will be advised of this at its May 2015 business meeting in New Bern. The commission is scheduled to vote on final approval of the Information Update to the fishery management plan at its November 2015 business meeting in Nags Head. Thank you for your interest in the State's fisheries.

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Email received February 12, 2015 from Chris McCaffity

Public Comments Regarding Kingfish Management

I am Chris McCaffity. Please keep an open mind as you think about these solutions that could be applied to managing most seafood including kingfish and herring.

Start by deciding how many kingfish their existing habitat can support. Establish reasonable recreational/charter and consumer/commercial quotas. Allow stakeholders to decide how each sector's annual quotas will be managed with a 2/3 majority vote from participating permit/license holders. Stock kingfish in rotation with other species as needed to support desired harvest levels. Take practical steps to enhance habitat so our waters can support more marine life. Reward fishermen and consumers with higher quotas as stocks reach desired levels. Process scraps from cleaned seafood into aquaculture feed.

Hatcheries and habitat enhancement could be the perfect union of mariculture and wild-caught seafood that lives free and self-sufficient until harvested. Stocked species would thrive and produce at Optimum Yield even as we harvest more. These proven solutions would feed more people while creating more recreational opportunity and generating more revenue. It is time to focus more on enhancing our fisheries than restricting access to them.

Thank you for your thoughtful consideration of these positive solutions. I am happy to answer any questions. freefish7@hotmail.com

Division Response

The management strategy set forth under the 2007 Kingfish FMP is the use of management triggers where management actions may be considered based on trends in several indices (biological and fishery independent). Indices have been updated through 2013 and based on these the Division has determined there is no need for additional regulations for kingfish at this time. Currently, the only regulation for kingfishes in North Carolina relates to shrimp and crab trawls from December 1 through March 31. During this time it is unlawful to possess finfish caught incidental to shrimp and crab trawling in the Atlantic Ocean unless the weight of the combined catch of shrimp and crabs exceeds the weight of finfish; except that an additional 300 pounds of kingfish may be taken by crab or shrimp trawlers working south of Bogue Inlet [15A NCAC 3J .0202 (5)].

The Division is not proposing any changes in management strategies or measures for the N.C. Kingfish Fishery Management Plan. The upcoming Information Update will contain the most recent data to characterize the fishery and species of kingfish. The Marine Fisheries Commission will be advised of this at its May 2015 business meeting in New Bern. The commission is scheduled to vote on final approval of the Information Update to the fishery management plan at its November 2015 business meeting in Nags Head. Thank you for your interest in the State's fisheries.

NC Fishery Management Plan Kingfish 2007
http://portal.ncdenr.org/c/document_library/get_file?uuid=3882c28f-da09-4978-93ab-13ba38eb0414&groupId=38337

Email received Feb. 16, 2015 from Adam Tyler

I would like to offer these comments on the proposed Kingfish FMP review. According to the DMF website these fish are fine. As noted in the copy and paste below from the DMF website. Commercial landing did decline in 2013 but I firmly believe that was due to the arrival of spiny dogfish in the region. Dogfish tend to eat what is available and run schools of fish out of the area. When this occurs obviously these fish leave the area. However this year 2014 was a banner year for all 3 species of Kingfish. We have caught them locally up to Super Bowl Sunday. The lack of large schools of Spiny Dogfish this year allowed us to catch king fish till later than normal due to natural predators being minimal this year. So I do not feel that any changes are currently needed in this plan. [Mr. Tyler also gave additional comments by phone concerning his interest in a correlation between dogfish abundance and kingfish abundance. He stated that he gillnets for both and when one is abundant the other is not. He asked if it would be possible for the division to investigate a correlation based on landings or other data (Kevin Brown personal communication.)]

Comments

A state fishery management plan completed in 2007 indicated a healthy age structure in the stock along with increasing trends in

Kingfishes (A)						juvenile abundance, but commercial landings dropped in 2013.

Adam Tyler

Division Response

The management strategy set forth under the 2007 Kingfish Fishery Management Plan is the use of management triggers where management actions may be considered based on trends in several indices (biological and fishery independent). Indices have been updated through 2013 and based on these the Division has determined there is no need for additional regulations for kingfish at this time. Currently, the only regulation for kingfishes in North Carolina relates to shrimp and crab trawls from December 1 through March 31. During this time it is unlawful to possess finfish caught incidental to shrimp and crab trawling in the Atlantic Ocean unless the weight of the combined catch of shrimp and crabs exceeds the weight of finfish; except that an additional 300 pounds of kingfish may be taken by crab or shrimp trawlers working south of Bogue Inlet [Marine Fisheries Commission Rule 15A NCAC 03J .0202 (5)].

While it would be interesting to investigate a correlation in the abundance of dogfish and kingfish, the division does not feel it is necessary for the Informational Update to the Kingfish Fishery Management Plan at this time.

The Division is not proposing any changes in management strategies or measures for the N.C. Kingfish Fishery Management Plan. The upcoming Information Update will contain the most recent data to characterize the fishery and species of kingfish. The Marine Fisheries Commission will be advised of this at its May 2015 business meeting in New Bern. The commission is scheduled to vote on final approval of the Information Update to the fishery management plan at its November 2015 business meeting in Nags Head. Thank you for your interest in the State's fisheries.

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Draft Issue Paper
Determine Need For and Impacts of Sheepshead Size, Creel, and Trip Limits in North Carolina

Apr. 29, 2015

I. ISSUE

Determining if management measures are needed for sheepshead and how to evaluate options without traditional stock assessment reference points.

II. ORIGINATION

At its July 2014 North Carolina Division of Marine Fisheries (NCDMF) Management Review Team (MRT) meeting, the committee requested that staff update the existing issue paper on the implementation of the proclamation authority and investigate potential management measures that may or may not be implemented as safeguards for the North Carolina sheepshead population.

III. BACKGROUND

Management History:

The initial 2004 North Carolina Interjurisdictional Fishery Management Plan (IJFMP) incorporated reef fish, including sheepshead, in the plan management unit which was defined as fish stocks managed by the federal fishery management councils or the Atlantic States Marine Fisheries Commission (ASMFC). Under the IJFMP, sheepshead was incorporated as a species managed by the South Atlantic Fishery Management Council (SAFMC) within its Snapper Grouper Fishery Management Plan. Possession was restricted to the aggregate 20 fish creel limit and this measure was implemented by proclamation (via rule 15A NCAC 03M .0512), in accordance with the IJFMP policy to comply with regulations developed through federal fishery management plans. On April 16, 2012, sheepshead was formally removed from the SAFMC's Snapper-Grouper Fishery Management Unit in the Comprehensive Annual Catch Limit (Comp ACL) Amendment. Subsequently, North Carolina's proclamation authority for the management of sheepshead was invalidated because the species was no longer part of the IJFMP, nor was there a standalone state FMP for sheepshead.

At a November 2012 business meeting, the North Carolina Marine Fisheries Commission (NCMFC) requested that division staff develop an issue paper on providing proclamation authority for implementing size, bag limits, and trip limits for sheepshead. Staff prepared an issue paper for the regional and Finfish Advisory Committees that described the current trends in the fishery as well as the species life history. The regional and Finfish committees all recommended the same management option: proclamation authority allowing the full list of management tools stated in the proposed rule. Additional committee advice included more detailed analysis of existing biological data, conducting a stock assessment if possible, and soliciting public input on future management measures. The NCDMF recommended establishing proclamation authority for gear, time, season, area, size, bag, and trip to manage sheepshead and present the issue to Finfish and regional advisory committees to solicit public comment on specific management measures. At the November 13-15, 2013 Marine Fisheries Commission Business meeting, the commission approved Rule 15A NCAC 03M .0521 which specifies the Director's proclamation authority for sheepshead, including the ability to restrict time, area, means and methods, season, size, and quantity.

In May 2014 the ASMFC South Atlantic State/Federal Fisheries Management Board considered whether to manage sheepshead through the Interstate Fisheries Management Program. The board concluded it was best to let each state come up with their own management options due it being unclear whether sheepshead are a true migratory species and given the ASMFC limited resources and budget constraints. To date there is no plan for a coastwide stock assessment by the ASMFC and any formal stock assessment would have to come from each state agency, none of which appeared to have sufficient data sets to complete one. While the stock status of sheepshead is unknown, the stock appears to be healthy; however, there have been concerns that increased fishing pressure due to more restrictive regulations on other species may negatively impact the stock.

This paper serves to review the status of the sheepshead fishery in North Carolina and presents several management options for NCMFC's consideration.

Life History

Sheepshead (Archosargus probatocephalus) is a relatively large and long-lived member of the family Sparidae (Porgies). The species is greenish-gray to silvery in color, with five to seven distinct vertical black bars and an oval shaped laterally compressed, deep body. Sheepshead commonly attain a length of 20 -25 inches and a weight ranging from 5 to 15 pounds. Fish in the 20 to 25 pound range are occasionally landed in North Carolina (Manooch 1984). Sheepshead are generally found from inshore brackish waters to offshore around rock and hard substrate, like jetties, pilings, and other structure covered with barnacles, mussels, and oysters. They have medium sized mouths with strong incisors and molars for picking up and crushing shellfish and sea urchins. Sheepshead are found in coastal waters of the eastern United States year-round based on recreational catches. Their range is from Nova Scotia to Florida along the east coast of North America continuing on to the Gulf of Mexico southward to the south Atlantic waters off Rio de Janeiro. Recreational landings of sheepshead in North Carolina are typically lower during the late fall through early spring (November-April). The decrease in landings might represent a spawning migration to oceanic waters as the temperature cools in the fall (Tremain et al. 2001). While in coastal offshore waters during the winter and spring, adults spawn on reefs (McDonough et al. 2011). They are found in coastal waters, bays and estuaries, and are tolerant of low salinity brackish waters as well. The current world record is 21 pounds, 4 ounces and was caught in New Orleans, Louisiana on April 16, 1982 (IGFA 2014). The North Carolina state record is 19 pound, 6 ounces and was caught off Oregon Inlet in 1999.

Sheepshead exhibit rapid growth from ages zero to six and have been reported to reach up to 29 inches TL in North Carolina (~28 FL; Schwartz 1990). However, less than 50 percent of the individuals are sexually mature at age one (10 inches FL). At age two (12 inches FL) most females are mature, with all sheepshead being mature at age four (14-25 inches FL). A recent study in the Chesapeake Bay found that the age at which half of the individuals could spawn (L50) was 1.51 for males (~11 inches FL), and 1.62 for females (~10 inches FL; Ballenger 2011). Both males and females were 100 percent mature at approximately 13 and 14 inches FL, respectively. Ballenger (2011) also noted that on average sheepshead in the Chesapeake Bay region attained a larger maximum size and age as compared to their more southern counterparts; reaching a maximum age of 35, living 12 to 21 years longer than previously reported. Ballenger (2011) concluded that differences in the age and growth of sheepshead found in the Chesapeake Bay region and that of sheepshead south of Cape Hatteras suggest two distinct populations in Mid-Atlantic Bight.

In South Carolina there is evidence of earlier maturation as compared to sheepshead found in North Carolina and those in the Chesapeake Bay region, with 50 percent of males and females being mature by age one (~9 inches FL) and greater than 80 percent by age three (~12 inches FL; McDonough et al. 2011). All males were mature by age four (~15 inches FL) and all females by age five (~16 inches FL). In Louisiana sheepshead also appear to mature earlier with the majority of both sexes being mature by age two; with all males and females being mature by ages three and four, respectively (Render and Wilson 1992).

In addition to differences in regional growth and maturity, migration is thought to be limited. Migration patterns based on mark recapture studies have not documented large scale movements. One study in Florida documented movement towards inlets during the fall and winter showing a more east-west offshore flow pattern than a north-south migration (Tremain et al. 2001). A Georgia study documented a maximum distance travelled of 70 miles (Woodward et al. 2000).

<u>Description of the Fishery (Coastwide)</u>
Sheepshead are a highly sought after in both the recreational and commercial fishery along the Atlantic Coast (Figure 1). From 1981 to 2013, the average landings of sheepshead from the East Coast of the United States were 1.89 million pounds per year. The majority of the landings occurred in the recreational fishery, which averaged 84 percent of the total harvest or 1.34 million pounds. Since 2002, the commercial harvest has ranged from 182,894 pounds in 2013 to a high of 318,061 pounds in 2009.

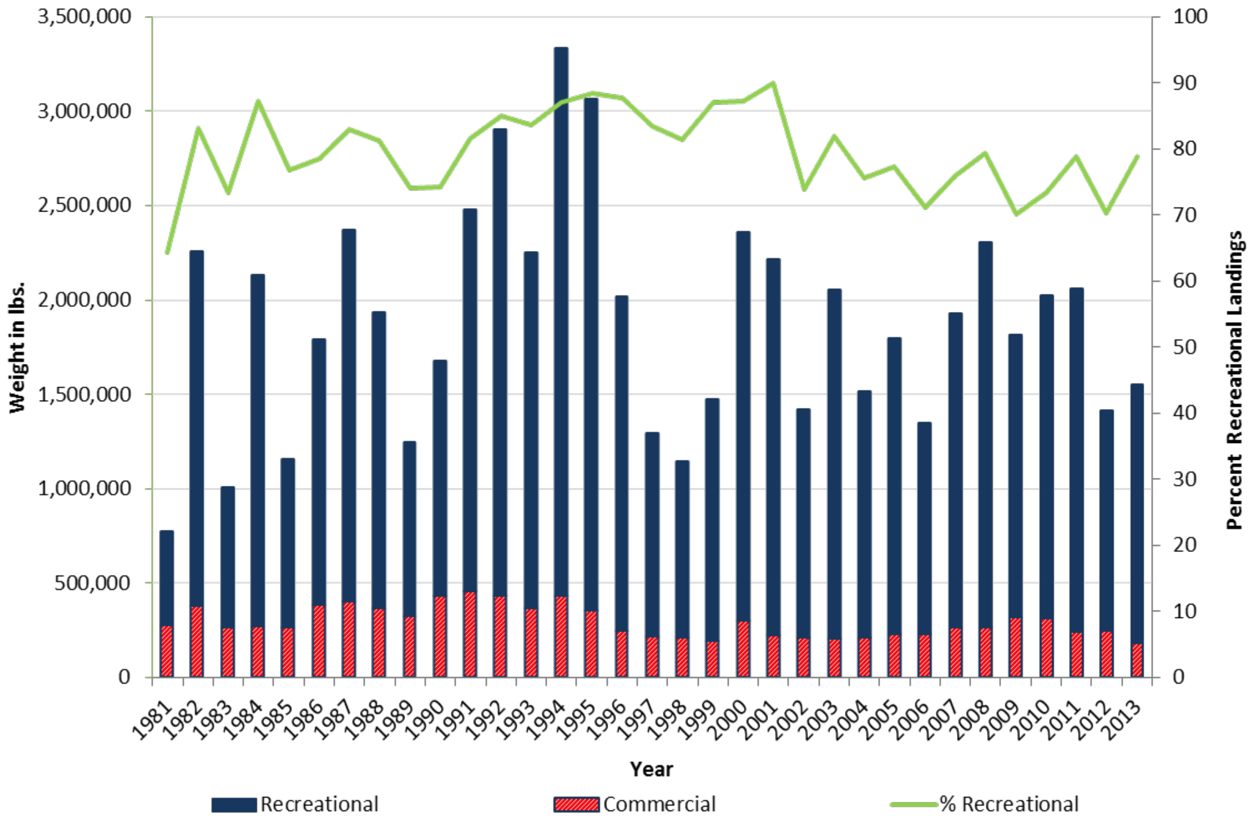

Figure 1. Recreational and commercial landings of sheepshead from the Atlantic Coast from 1980 to 2013.

Florida, South Carolina and North Carolina fisheries comprise the majority of sheepshead harvested recreationally along the Atlantic Coast. From 2002 to 2013, over 97 percent of the recreational harvest occurred in the South Atlantic (North Carolina, South Carolina, Georgia, and Florida). The recreational catch in Florida was highest on the East Coast every year except from 2007 to 2009 (Figure 2). On average, Florida harvests just below 50 percent of the recreational landings, accounting for 27 percent to as much 68 percent of the coastwide harvest annually. South Carolina ranked second in the highest total recreational landings from the South Atlantic from 2002 to 2013. Recreational landings in North Carolina have been highly variable, ranging from a low of 148, 454 pounds in 2006 to a high of 725,623 pounds in 2007. North Carolina is the only state that saw an increase in the recreational landings in 2012 and 2013. This could be due in part to the fact that it was in 2012 that the bag limits were dropped by the ASMFC for both recreational bag limits and any commercial trip limits. Proportional standard errors (PSEs) for all years were below 15.5 except for in 2008 when the PSE was 21.1. The PSE expresses the standard error of an estimate as a percentage of the estimate and is a measure of precision. Catch estimates for commonly caught species, like sheepshead, often are more precise than for rare event or pulse fisheries. PSE values greater than 50 indicate a very imprecise estimate.

The commercial harvest of sheepshead along the Atlantic Coast is primarily from two states overall: Florida (54 percent) and North Carolina (31 percent) (Figure 3). Virginia, Georgia and South Carolina accounted for 3.5 percent of the total Atlantic Coast commercial harvest. The northern states provide less than 0.1 percent of the sheepshead catch for the 12 year average. Florida has consistently harvested over 100,000 pounds for that same time period, averaging 152,349 pounds a year. Their four primary gears are cast nets, hook and line, diving spears and haul seines. From 2002 through 2008, North Carolina's landings varied averaging only 67,223 pounds a year, but since 2009, that average has increased to 140,239 pounds a year, a 73,000 pound or greater than 100 percent increase (Figure 3), again possibly due to the fact of no restrictions were in place. The popularity of sheepshead has grown in North Carolina in the last five years, especially looking at specific gears used commercially to land sheepshead.

North Carolina's leading commercial harvest gears have been gill nets, pound nets and haul seines. Use of gigs and spear fishing gear are also increasing.

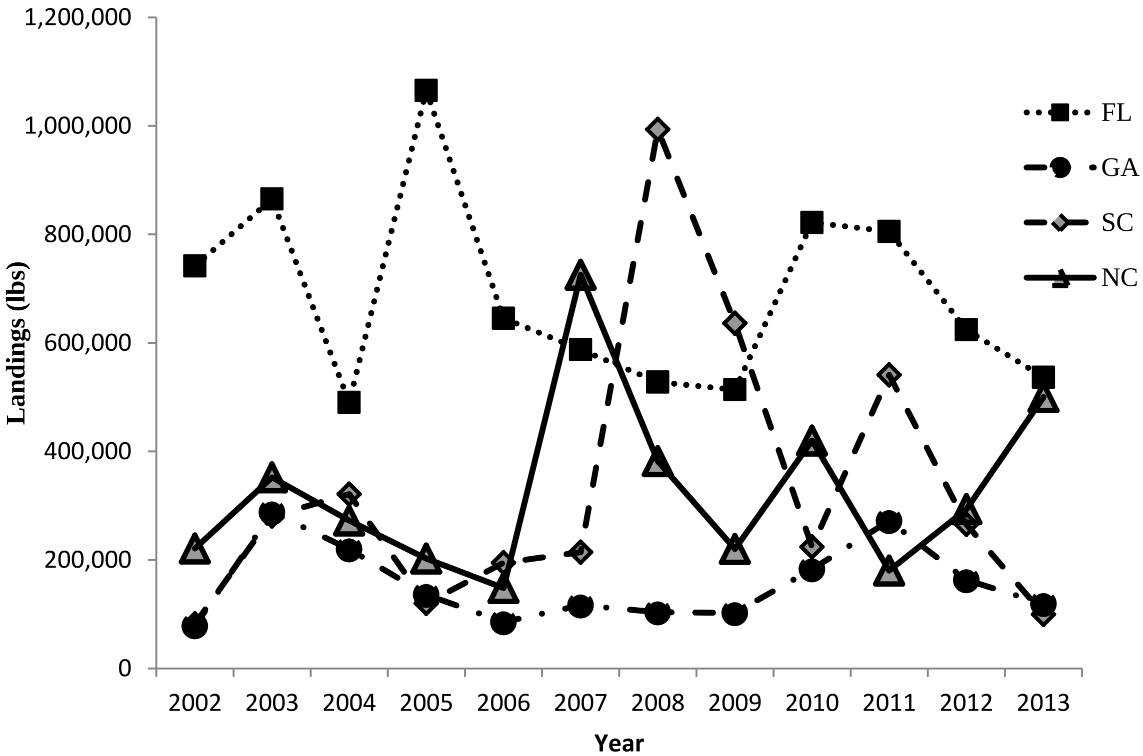

Figure 2. Recreational landings by state in the South Atlantic from 2002 to 2013.

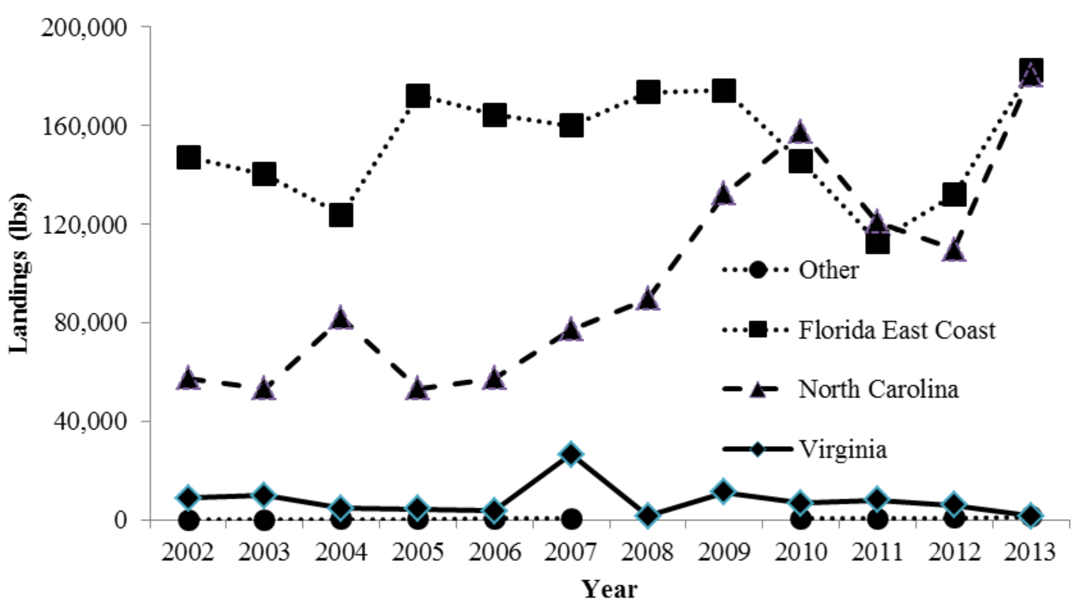

Figure 3. Commercial landings of sheepshead by state along the Atlantic Coast from 2002 to 2013

Description of the Fishery (North Carolina)

Sheepshead is a very popular recreational and commercial species in North Carolina. Seemingly, their popularity has increased in the last few years as have their landings. Sheepshead have become a favorite food fish due to their mild taste and are becoming more targeted in the recreational fishery. They are excellent baked, fried or broiled, their meat is white and dry and large bones are easily avoided (Manooch 1984). They are caught recreationally and commercially statewide, mostly from April through November. While fish are present in the fishery every month of the year, there is a peak in landings in the fall months. The highest harvest in the commercial fishery occurs in (Figure 4a). Recreational harvest peaks fluctuate among waves 3-5 (May through October), and in 2013, most sheepshead were caught in the wave 4 (July/August; Figure 4b). Harvest from recreational fishermen using hook-and-line peaked in 2007 at 725,623 pounds. In 2013, over 500,096 pounds of sheepshead were landed by recreational hook-and-line, almost tripling what was harvested in 2011 (180,319 lbs.) but again, the fact that NC has no size limits or bag limits could certainly account for these increases. Even while the recreational hook and line landings appear to have increased over the last two years, preliminary data for 2014 indicates that approximately 129,000 pounds have been harvested since October 2014. It seems that landings continue to fluctuate between the years without trend.

Sheepshead are primarily caught as bycatch in several of North Carolina's commercial fisheries, with the majority of the landings coming from gill nets, pound nets, and haul seines (Table 1). As with the recreational fishery, landings fluctuate from year to year. Gill net landings show that in 2011, 42,374 pounds of sheepshead were harvested, with 36,924 pounds in 2012, increasing to 63,667 pounds in 2013. Haul seines landed 12,539, 7,494, and 12,389 pounds in 2011-2013, respectively. Pound nets were the most variable with 55,600, 43,847, and 82,360 pounds harvested in those same three years. Commercial sheepshead landings for the last 12 years have ranged from 53,232 pounds in 2005 to the 180,225 pounds harvested in 2013, generally increasing since 2009.

Table 1. NC commercial landings of sheepshead by gear from 2002 through 2013.

Gear	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Other	199	189	78	48	92	152	168	523	190	94	940	1,840
Dive	558	442	408	2,369	812	2,442	2,912	3,180	3,003	361	9,987	10,975
Gill Nets	16,923	24,187	23,287	16,482	18,819	21,209	28,813	58,797	60,601	42,391	36,924	63,667
Haul Seines	6,081	8,091	4,924	4,567	11,988	7,868	10,728	16,060	38,597	13,143	9,473	12,350
Hook and Line	485	214		394	103	175	143	378	476	1,689	642	810
Trawls	5,185	8,450	43,885	17,235	11,886	29,416	5,564	4,237	5,478	1,992	2,140	3,940
Pound Nets	27,961	11,766	9,055	12,137	13,793	15,912	41,107	49,164	49,207	55,601	43,847	82,360
Gigs										5,585	5,929	4,285
Total	57,392	53,339	81,637	53,232	57,493	77,174	89,435	132,339	157,552	120,856	109,881	180,225

In 2013, pound nets comprised 45.7 percent, gill nets comprised 35.3 percent and spear fishing landings comprised 6.1 percent of the total commercial landings. Those three gears alone comprised 87.1 percent of all the commercial landings for 2013 (Figure 5). Sheepshead popularity among divers has increased greatly in recent years with spear-fishermen landing over 10,975 pounds of sheepshead in 2013. While only 6 percent of the total commercial landings were harvested by divers in 2013, harvest increased dramatically from the 361 pounds landed in 2011 to the almost 11,000 pounds, two years later. The majority of the dive trips harvesting sheepshead occurred in the Masonboro Sound area in New Hanover County; they averaged approximately 107 pounds per trip, within the last three years as compared to the 10 year average of only 40 pounds per trip (of landing between 1 and 100 pounds).

In North Carolina, both the recreational and commercial landings have fluctuated in the last 12 years, although the commercial landings have stayed more consistent than the recreational landings (Figure 6). One difference between the commercial and recreational landings is most of the commercial landings are incidental to targeting other species while recreational landings tend to be more of a targeted fishery. Other variables play into these landings such as weather, effort, and availability.

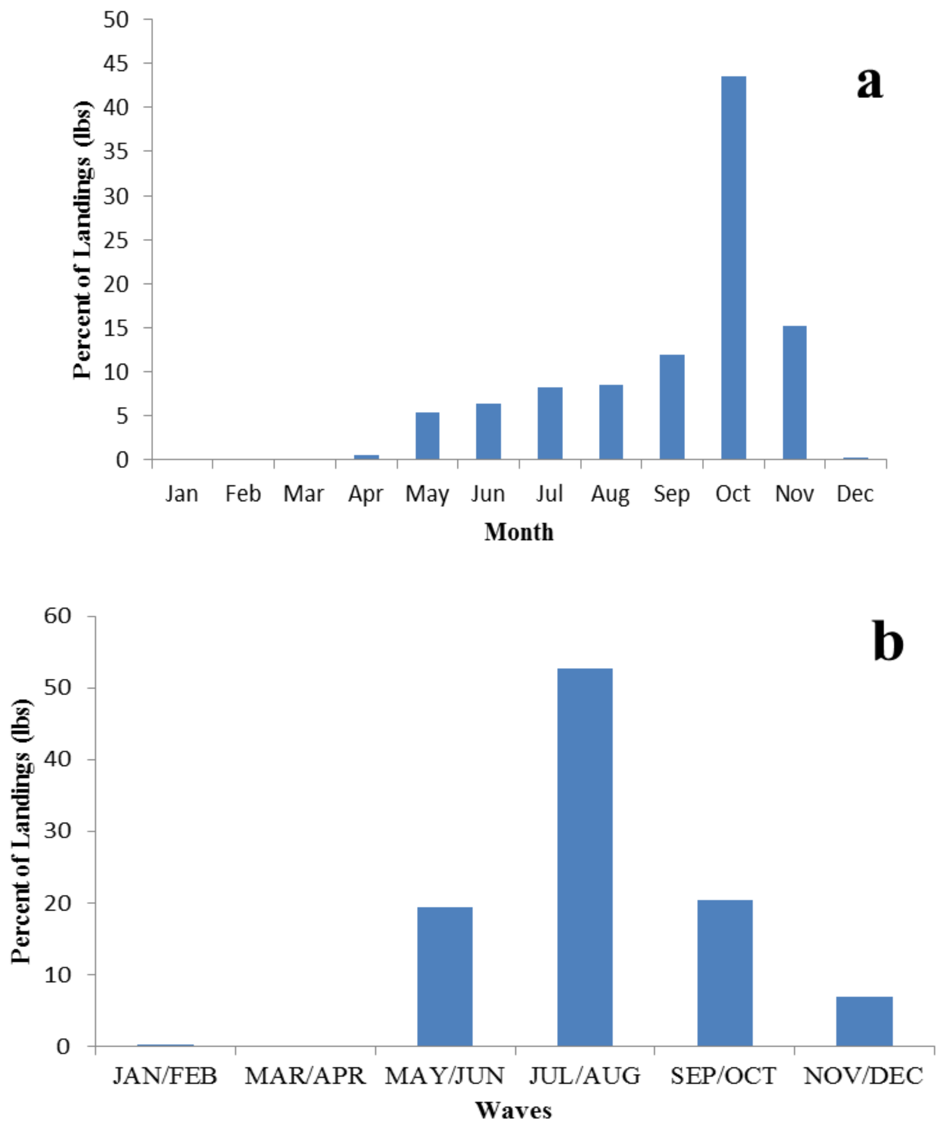

Figure 4. Percent of total landings (pounds) harvested by month for NC sheepshead, a.) commercially, 2011 – 2013 and b.) recreationally by wave from the Marine Recreational Information (MRIP) for 2013.

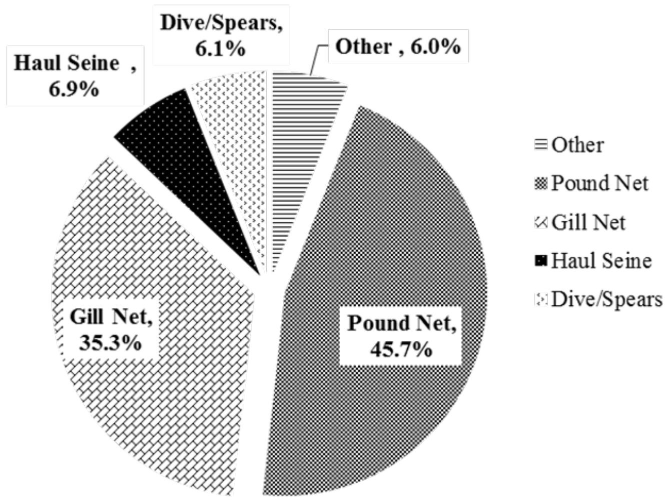

Figure 5. Percentages of North Carolina commercial landings by gear for 2013

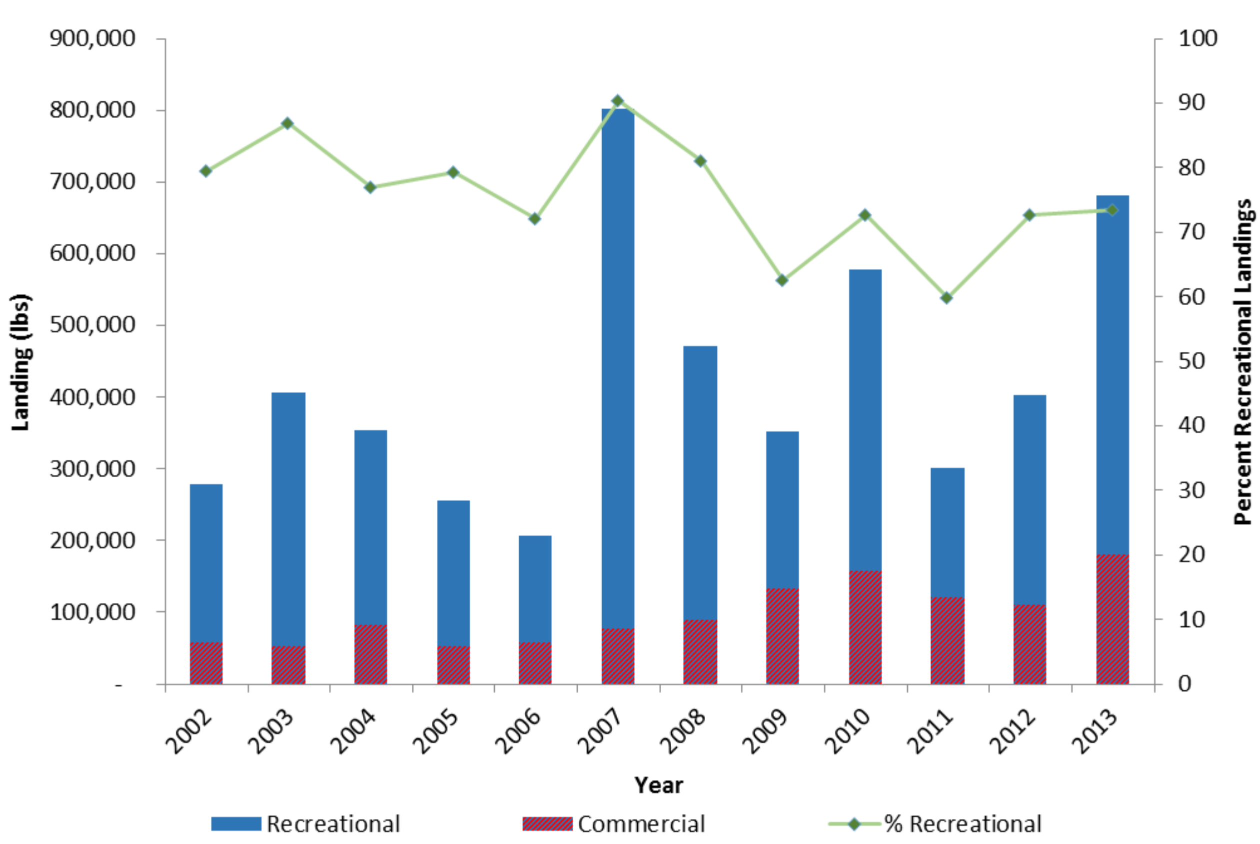

Figure 6. North Carolina sheepshead recreational and commercial landings from 2002-13 (recreational landings courtesy of Program MRIP, commercial landings courtesy of North Carolina Division of Marine Fisheries Trip Ticket Program).

IV. AUTHORITY

G.S. 113-134, 113-182, 113-221.1, 143B-289.52
15A NCAC 03M .0521

V. SUMMARY FINDINGS

Until a stock assessment can be done, there are several management measures that could be used to limit the harvest of sheepshead and address any concerns of overfishing or exploitation of juvenile sheepshead. The focus of this information paper is to provide potential management options for sheepshead. This paper provides information to determine how effective minimum size limits, slot limits and/or creel and trip limits would be as management measures for reducing the overall harvest of sheepshead. The harvest reductions provided are estimates calculated based on several assumptions about the data, gear selectivity, gear efficiency, and size class strength. Violations of any or all of these assumptions can affect the precision and accuracy of these numbers. Harvest reductions based on length frequency distributions also have the potential to be biased when the sample size is low and may not be a true indicator of relative fish abundance, thus overestimating harvest reductions. All data presented in this paper is only informational and does not suggest any comprehensive analyses was performed that would be produced with a formal stock assessment.

Recreational Options

To determine what effect a minimum size limit and/or a slot size limit as well as creel limit would have on the recreational landings of sheepshead, length frequency and catch per angler trip data was obtained from the Marine Recreational Information Program (MRIP). MRIP is the primary survey used to collect data on angler harvest from ocean and inside waters along the entire North Carolina coast. MRIP consists of two components, the Access-Point Angler Intercept Survey (APAIS) and the Coastal Household Telephone Survey (CHTS). The CHTS utilizes a random digit dialing (RDD) telephone survey approach to collect marine recreational fishing effort information from residential households located in coastal counties. APAIS, an onsite intercept survey conducted at fishing access-sites, is used for collection of individual catch and discard data for calculation of catch rate at the species level. Creel clerks collect intercept data from January through December (in two-month waves) by interviewing anglers completing fishing trips in one of the four fishing modes (man-made structures, beaches, private boats, and for-hire vessels). Individual lengths (mm-FL) and weights (kilograms) are recorded for each individual species sampled. To calculate length frequencies, millimeters (mm) were converted to inches for this paper and most lengths are in fork length and not total length. Results from both component surveys are combined at the state, area, fishing mode and wave level to provide estimates of the total number of fish caught, released, and harvested; the weight of the harvest; the total number of trips; and total participation in marine recreational fishing.

A modal length frequency distribution was observed for sheepshead caught recreationally from 2002-2013 (Figure 7). These lengths ranged from 6 inches to 25 inches FL, with no particular size dominating the catch. The length frequency for sheepshead varied from year to year, which could be due to variability in the availability of various size sheepshead from year to year or could possibly due to low sample sizes in the recreational fisheries. On average, 22.6 percent of the sheepshead measured from the recreational fishery were 10 inches FL or less (~ size of 50 percent maturity), 40.4 percent were 12 inches FL or less, and 57.5 percent were 14 inches or less. Below are the options of size limits alone with their related reductions and then reductions occurring from a combination of both, size and bag limits.

Size Limits

Listed below are the recreational options of various minimum size limits. Table 2 provides the annual percent harvest reductions based on a 10, 12 and 14 inch minimum fork length size limit and a 12 – 20 inch fork length slot limit for each year from 2002 through 2013, as well as an overall 12-year average. The reduction from a 10 inch minimum size limit ranged from a low of 4.1 percent in 2002 to a high of 40.2 percent in 2013. The overall average reduction across years was 18.3 percent. For a 14 inch minimum size limit, where the majority of fish are mature, higher reduction percentages occur (Average reduction was 51.6 percent across all years). Recreational landings increased considerably in both 2012 and 2013, resulting in higher percent reductions for those two years in all calculations of minimum size limits. It is important to note that the harvest increased as a result of smaller fish being caught as opposed to a proportional increase in harvest across all size classes. With the large amount of fish

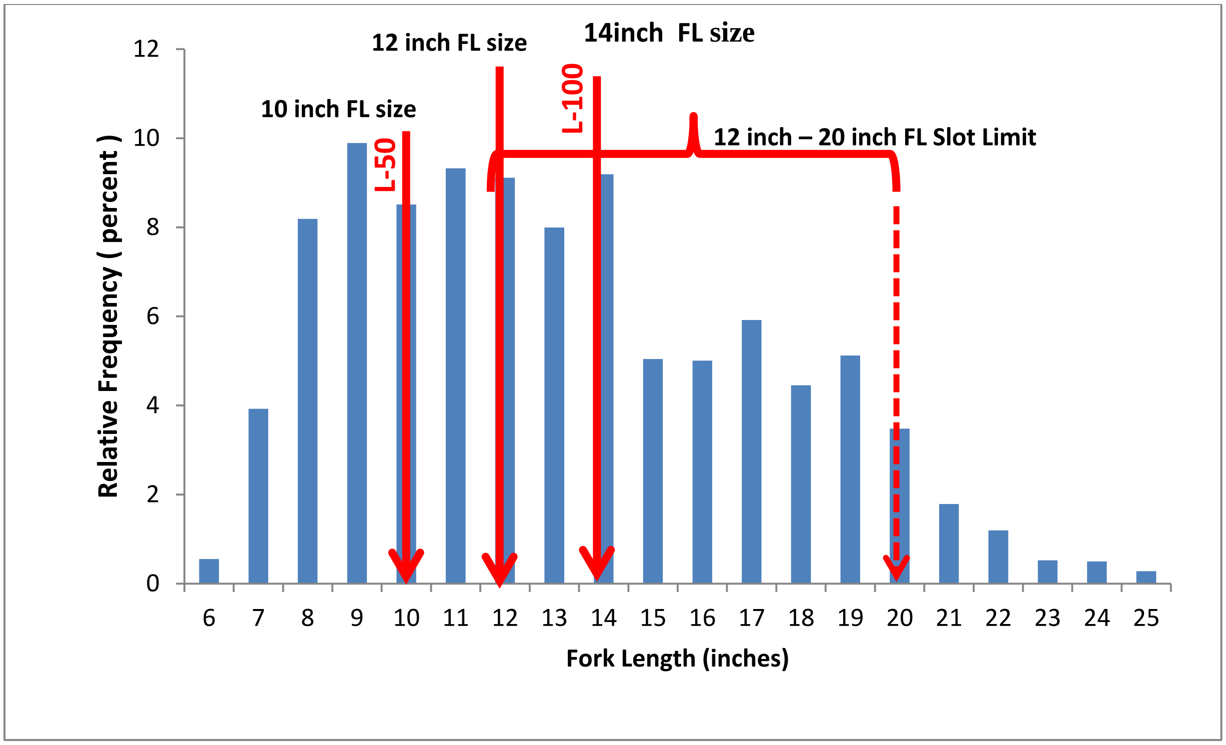

Figure 7. A length frequency distribution of sheepshead landed recreationally, 2002- 2013. Arrows indicate potential size and slot limits considered for management. L-50 and L-100 represent the lengths at 50% and 100% maturity.

harvested in 2013, a 76 percent reduction would have occurred in that year, but only be a 52 percent reduction over all 12 years. Again, the fact that there were no size, bag or trip limits during that time needs to be mentioned. Even with a 14 inch limit, there are still 42.5 percent of fish greater than 14 inches (up to 25 inches) left to catch (Figure 7). None of the size bins from this range (6 to 25 inches) contain more than 9.8 percent of fish by number for any one inch size group, demonstrating that anglers are catching sheepshead from all size and age classes.

A slot limit of 12 inches to 20 inches would incorporate allowable fish within these sizes where 80 to 100 percent are mature and all other fish smaller or larger would have to be released. Again, these reductions are greater than those of the 10 inch and 12 inch minimum size limits, but that would be expected. However, the 12 year overall reduction would be less (44.4 percent) than the overall 14 inch minimum size limit reduction of 51.6 percent (Table 2).

Table 2. Percent recreational reductions in numbers based on a 10,12, 14 inch (Fork Length) minimum size limit and a 12 inch to 20 inch (FL) slot limit for sheepshead in NC.

Minimum Size Limit (FL)	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average Reduction
10" min	4.1	25.1	8.8	6.8	16.6	9.6	29.1	35.7	5.9	4.3	33.4	40.2	18.3
12" min	21.2	42.5	17.2	8.3	30.0	15.6	45.0	67.2	31.1	17.9	38.5	70.5	33.7
14" min	49.0	52.0	25.8	16.1	46.2	37.5	75.6	79.1	47.1	59.8	54.7	76.4	51.6
12"-20" slot	33.2	52.4	48.0	41.3	37.2	30.5	46.5	69.5	36.7	22.4	41.7	73.4	44.4

Size Limits with Bag Limits

Bag limit analysis indicated most recreational trips caught five fish or less (87 percent of trips) from 2006 to 2013 (Table 3). Greater than 95 percent of the trips had 10 fish or less from 2006 to 2013. No trips have been observed to exceed the past bag limit of 20 fish (included in the SAFMC 20 fish aggregate limit).

Table 3. The cumulative percent of recreational trips with five fish or less, 10 fish or less, 15 fish or less, and 20 fish or less for NC sheepshead.

Number of fish	2006	2007	2008	2009	2010	2011	2012	2013	Combined
5 fish	96	79	86	86	87	97	89	81	87
10 fish	100	91	94	95	97	99	98	95	96
15 fish	100	98	99	100	100	100	100	98	99
20 fish	100	100	100	100	100	100	100	100	100

<u>10 inch FL Minimum Size Limit with bag limit</u>

A 10-inch fork length sheepshead is the approximate size where 50 percent of females are mature while males are around 11 inches at 50 percent maturity, based on a Virginia study. In South Carolina, males are 100 percent mature at age 4 or 14.8 inches FL and females at age 5 or 15.75 inches FL, respectively. If a 10-inch FL size limit and a one-fish bag limit were implemented, there would be a reduction in catch of approximately 74 percent of the sheepshead landed based on the average from 2004 to 2013 (Table 4). A bag limit of five fish would result in a reduction of 39.7 percent, whereas a 10-fish bag limit would yield an overall 28 percent reduction, based on the last 10 years of landings (Table 4). A bag limit going from 5 fish to 1 fish has a much greater harvest reduction than does a reduction going from 10 fish to 5 fish because angler success at maxing out the bag limit is much greater at the lower values. However, if the stock status is sustainable, a 10-fish bag limit would not seem unreasonable and could always be reduced in the future.

Table 4. Annual estimated recreational harvest reductions in numbers of fish based on 10inch FL size limit and up to a ten fish bag limit, 2004 – 2013 for NC sheepshead.

Size	Bag	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average Reductions
10	1	51.6	52.2	50.4	75.5	78.1	80.9	67.9	56.7	74.5	83.9	74.3
	2	30.3	30.8	30.1	61.0	67.4	69.0	47.8	31.2	62.0	72.9	59.8
	3	17.8	16.9	22.4	51.0	60.3	60.1	35.3	16.8	54.3	65.5	50.5
	4	12.6	12.5	20.5	43.9	54.6	54.2	26.5	11.3	48.9	59.9	44.2
	5	10.6	10.2	19.5	38.1	50.8	50.5	20.3	9.6	44.9	55.2	39.7
	6	9.4	7.9	18.6	32.3	47.4	47.0	16.0	8.2	41.9	52.1	36.1
	7	8.8	6.8	17.6	28.1	44.3	43.8	13.0	7.3	39.8	49.5	33.3
	8	8.8	6.8	16.6	34.3	41.2	41.7	10.4	6.9	38.2	47.8	31.1
	9	8.8	6.8	16.6	21.9	38.5	39.7	8.8	6.5	37.3	46.7	29.5
	10	8.8	6.8	16.6	19.4	36.4	38.2	8.0	6.0	36.5	45.7	28.2

<u>12inch FL Minimum Size Limit with bag limit</u>

Most 12 inch FL sheepshead in North Carolina are mature by this length and are about two years of age. A 12-inch FL minimum size limit with a one fish bag limit would yield an 80.3 percent overall reduction. A bag limit of five fish would result in a 53.8 percent reduction. In 2005, that yearly reduction would have been 11.7 percent and in 2013, that reduction would have jumped to 77.9 percent. Going from 10 to one fish provided a range of 45 percent to 80 percent reductions.

Table 5. Annual estimated recreational harvest reductions in numbers of fish based on 12 inch FL size limit and up to a ten fish bag limit, 2004 – 2013 for sheepshead in NC.

Size	Bag	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average Reductions
12	1	56.0	53.0	58.4	77.2	83.0	90.2	76.5	62.9	76.5	92.0	80.3
	2	36.6	31.9	41.3	63.6	74.7	84.2	61.8	40.9	64.9	86.6	69.2
	3	25.3	18.3	34.9	54.3	69.2	79.6	52.7	28.6	57.8	82.9	62.0
	4	20.6	14.0	33.3	47.6	64.8	76.6	46.2	23.9	52.8	80.2	57.2
	5	18.8	11.7	32.4	42.2	61.8	74.7	41.7	22.4	49.0	77.9	53.8
	6	17.7	9.5	31.6	36.8	59.2	72.9	38.5	21.2	46.3	76.3	51.0
	7	17.2	8.3	30.8	32.9	56.8	71.3	36.3	20.5	44.3	75.1	48.8
	8	17.2	8.3	30.0	38.7	54.4	70.2	34.4	20.1	42.9	74.2	47.2
	9	17.2	8.3	30.0	27.1	52.3	69.2	33.3	19.7	42.0	73.7	45.9
	10	17.2	8.3	30.0	24.8	50.7	68.4	32.6	19.4	41.3	73.2	44.9

<u>14inch FL Minimum Size Limit with bag limit</u>

At fourteen inches (FL) in length, both sexes of sheepshead have reached 100 percent maturity and are either three or four years of age. Below, Table 6 shows the annual estimated recreational harvest reductions based on a 14-inch FL minimum size for each year since 2004 through 2013. Calculations with various bag limits are shown. A five-fish bag limit would have a 67.4 percent reduction. A 10-fish bag limit would have a 61.1 percent reduction.

Table 6. Annual estimated recreational harvest reductions in numbers of fish based on 14 inch FL size limit and up to a ten fish bag limit, 2004 – 2013 for NC sheepshead.

Size	Bag	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average Reductions
14	1	60.6	56.9	68.0	83.1	92.5	93.8	81.9	81.8	82.7	93.6	86.1
	2	43.3	37.7	55.0	73.0	88.8	89.9	70.6	71.1	74.1	89.3	78.2
	3	33.1	25.2	50.0	66.1	86.3	87.0	63.6	65.0	68.9	86.4	73.2
	4	28.9	21.2	48.8	61.2	84.4	85.1	58.7	62.7	65.2	84.2	69.8
	5	27.3	19.2	48.2	57.2	83.1	83.9	55.2	62.0	62.5	82.3	67.4
	6	26.3	17.1	47.5	53.2	81.9	82.8	52.8	61.4	60.4	81.1	65.4
	7	25.8	16.1	46.9	50.3	80.8	81.8	51.1	61.0	59.0	80.1	63.9
	8	25.8	16.1	46.2	54.5	79.8	81.0	49.6	60.8	57.9	79.4	62.7
	9	25.8	16.1	46.2	46.0	78.8	80.4	48.7	60.7	57.3	79.0	61.8
	10	25.8	16.1	46.2	44.2	78.1	79.9	48.2	60.5	56.8	78.6	61.1

<u>Recreational Slot Limit</u>

Based on the length frequency distribution, 51.8 percent of the sheepshead landed were between 12 inches and 20 inches FL. Annual estimated harvest reductions based on a 12 to 20 inch (FL) slot limit with any bag limit range from 51 percent up to 83 percent (Table 7). A slot limit with a five fish bag limit would reduce catch of sheepshead by 59.6 percent overall, while a 10 fish bag limit would provide a 51.8 percent reduction.

Table 7. Annual estimated recreational harvest reductions in numbers of fish based on a 12 inch to 20 inch FL slot limit size limit and up to a ten fish bag limit, 2004 – 2013 for NC sheepshead.

Size	Bag	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average Reductions
12" through 20"	1	72.4	69.9	62.6	81.2	83.5	90.9	78.4	64.9	77.7	92.8	82.8
	2	60.3	56.4	47.4	70.0	75.4	85.3	64.9	44.2	66.7	87.9	73.0
	3	53.1	47.7	41.6	62.3	70.1	81.1	56.5	32.5	60.0	84.6	66.8
	4	50.2	44.9	40.1	56.9	65.8	78.3	50.5	28.1	55.3	82.2	62.6
	5	49.1	43.5	39.4	52.4	62.9	76.5	46.4	26.6	51.7	80.1	59.6
	6	48.4	42.0	38.7	48.0	60.3	74.9	43.5	25.5	49.1	78.7	57.2
	7	48.0	41.3	37.9	44.7	58.0	73.3	41.5	24.8	47.3	77.6	55.3
	8	48.0	41.3	37.2	49.5	55.7	72.3	39.7	24.5	45.9	76.8	53.8
	9	48.0	41.3	37.2	39.9	53.6	71.4	38.7	24.1	45.1	76.3	52.7
	10	48.0	41.3	37.2	38.0	52.0	70.7	38.1	23.8	44.4	75.8	51.8

Commercial Options

Length frequencies and the number of trips landing sheepshead obtained from the NCDMF commercial fisheries dependent sampling programs (Program 400s) were used to determine the impacts of a minimum size limit and/or a slot size limit and commercial trip limits on commercial landings of sheepshead. Length frequencies of sheepshead caught and the number of trips landing sheepshead were examined for the estuarine gill net, ocean gill net, gig, pound net, long haul seine, and ocean trawl fisheries. Sheepshead lengths were collected at local fish houses or on the water at the net when possible. At the fish house random samples of the graded catch (cartons from each market category) were taken. Individual fish were measured (mm, fork length-FL) and total weight (0.1 kg) of all fish measured in aggregate was obtained. Fork lengths are the standard lengths by protocol of the Division's sampling methods for this species. All lengths unless otherwise stated are in FL and any size limit proposed would be in fork length. Currently there is no conversion from FL to total length (TL) for North Carolina; however, Georgia converted its 10-inch FL minimum size limit to a 10.7-inch TL. For this information paper, millimeters (mm) were converted to inches. Subsequent to sampling a portion of the catch, the total weight of the catch by species and market grade was obtained for each trip, either by using the trip ticket weights or some other reliable estimate (i.e., fish house receipts). The number of individuals, aggregate weight, and length frequencies of each species in a sample were expanded to represent the species quantities in the sampled catch (trip ticket). Expansion was accomplished by matching at the market grade level biological fish house sample data (mean weight or length data) to the corresponding North Carolina Trip Ticket Program market grade harvest. For example, the total length frequency of a species within a catch was derived by expanding the length frequency of the individuals measured in the subsample of a market grade (culled samples) to the total market category weight of that species in the sampled trip.

From 2002 to 2013, the major commercial gears used were estuarine gill nets, gigs, spearfishing while diving, long haul, ocean gill nets, ocean trawl, and pound nets (both flounder and sciaenid combined). The percentages of landings harvested by these various gears have already been mentioned (Figure 5). Below are the length frequency graphs of sheepshead harvested from specific gears (Figures 8 and 9). Commercial reductions based on size limits and trip limits are presented in two separate sections. The first section describes harvest reductions from implementation of size limits of 10, 12, and 14-inches (FL) and a slot of 12 to 20 inch FL (Table 8). The other section discusses harvest reductions calculated from trip limits of 100 to 500 pounds. These are all associated with the different gears used in N. C. coastal waters. The reductions are for all years combined from 2002 through 2013.

Reductions using size limits by gear

Overall estimated harvest reductions based on size limit options vary by fishery and range from 4.2 percent to 73.6 percent (Table 8). The largest overall reductions (73.6 percent) would occur in the gig fishery. All gears with the exception of the ocean trawl fishery would experience harvest reductions of 64.2 percent to 73.6 percent if a 14-inch FL minimum size limit were imposed. The overall estuarine gill net harvest would be reduced by as little as 6 percent with a 10-inch FL size limit and as much as 65 percent with a 14-inch FL size limit. Annual reductions in the pound net fishery would range from 21.2 percent to 69 percent.

Estuarine Gill Nets

A uni-modal length frequency distribution was observed for sheepshead caught in this gear from 2002-2013 (Figure 8a). The percentage of sheepshead landed in gill nets between 11 and 14 inches FL was 64.6 percent. The overall harvest reduction with a 10 inch minimum size limit is 6.0 percent, for a 12 inch size limit the reduction would be 28.3 percent, a 14 inch size limit would reduce catch by 64.9 percent and a 12-inch to 20-inch slot limit would reduce harvest by 28.9 percent (Table 8).

Pound Nets

Sixty-seven point two percent of the fish harvested in this gear were from 8 to 13inches FL (Figure 9g). This demonstrates the wider size selection of sheepshead caught in this gear. The estimated harvest reduction with a 10 inch minimum size limit is 21.2 percent. The overall harvest reduction with a 12-inch minimum size limit is 47.5 percent. A 14 inch size limit would result in a 69 percent reduction and a slot limit between 12 and 20 inches would reduce catch by an overall 49.5 percent (Table 8).

Gig

A modal length frequency distribution was observed for the sheepshead caught in the gig fishery from 2002 -2013 (Figure 8b). Forty-five percent of the gig fishery is comprised of 11-inch to 14-inch FL sheepshead. The overall harvest reduction for years 2002 through 2013 in the gig fishery is 20.1 percent for a 10-inch size limit, 39.8 percent for a 12-inch size limit, 73.6 percent for a 14-inch size limit and 41.7 percent with the 12 to 20 inch slot limit (all FL, Table 8).

Long Haul

Approximately 61.2 percent of the sheepshead landed in the long haul fishery from 2002 to 2013 were between 10 and 13 inches FL, with one large fish being caught at 37 inches FL. Long haul gear was the third largest harvester of sheepshead with 12.1 percent or ~ 59,660 fish caught in this gear (Figure 9d). With just minimum size limits imposed, weighted average reduction percentages range from 9.7 percent (10-inch FL), 39.7 percent (12-inch FL), and 70.9 percent (14-inch FL). Adding a 12 to 20 inch FL slot limit would yield a 41 percent overall combined reduction (Table 8).

Ocean Gill Net

The length frequency distribution of the ocean gill net fishery demonstrates high abundance of nine-inch sheepshead (32.2 percent). Additionally, 84.5 percent of the landing are comprised of 8-inch to 15-inch FL sheepshead, representing a wide range of sizes (Figure 9e). Table 8 depicts the overall harvest reductions from size limits of 10, 12, and 14 inch sizes of 40.9, 55.5, and 70.5 percent, respectively. The slot limit of 12 to 20 inches FL would reduce harvest from the ocean gill net fishery by 59.4 percent.

Ocean Trawl

The ocean trawl fishery captured 92,094 (7.9 percent) fish from 192 trips. There is no data for this fishery for 2012 and 2013 (i.e., all data are from the years 2002 through 2011). Of these fish, 14,426 (64.1 percent) were comprised of 18 to 21-inch FL size classes (Figure 7f). Smaller sheepshead from six to 16-inches FL comprised 21.7 percent of the length-frequency distribution, whereas the majority was larger sized sheepshead within the 19 to 21 inch FL size group or 54.4 percent (Figure 9f). A 10-inch FL size limit would yield overall a 4.2 percent reduction, a 12-inch FL size limit would yield an 8.3 percent reduction, a 14-inch FL size limit would yield a 15.8 percent reduction and the 12 to 20 inch FL slot limit would yield a 48.4 percent reduction in harvest.

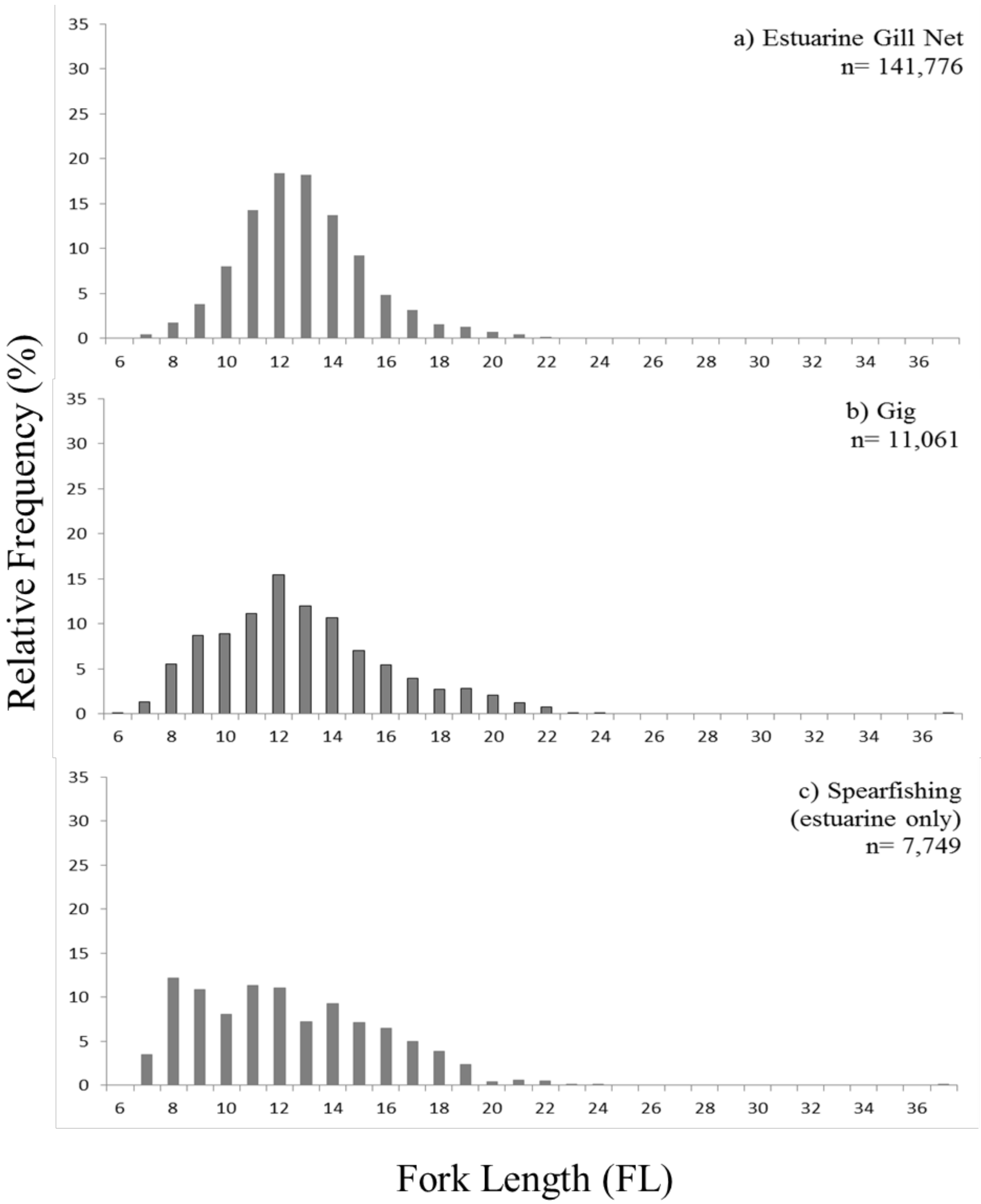

Figure 8. Weighted length-frequencies for estuarine gill nets, gigs, and spearfishing commercial gears from 2002-2013 in North Carolina.

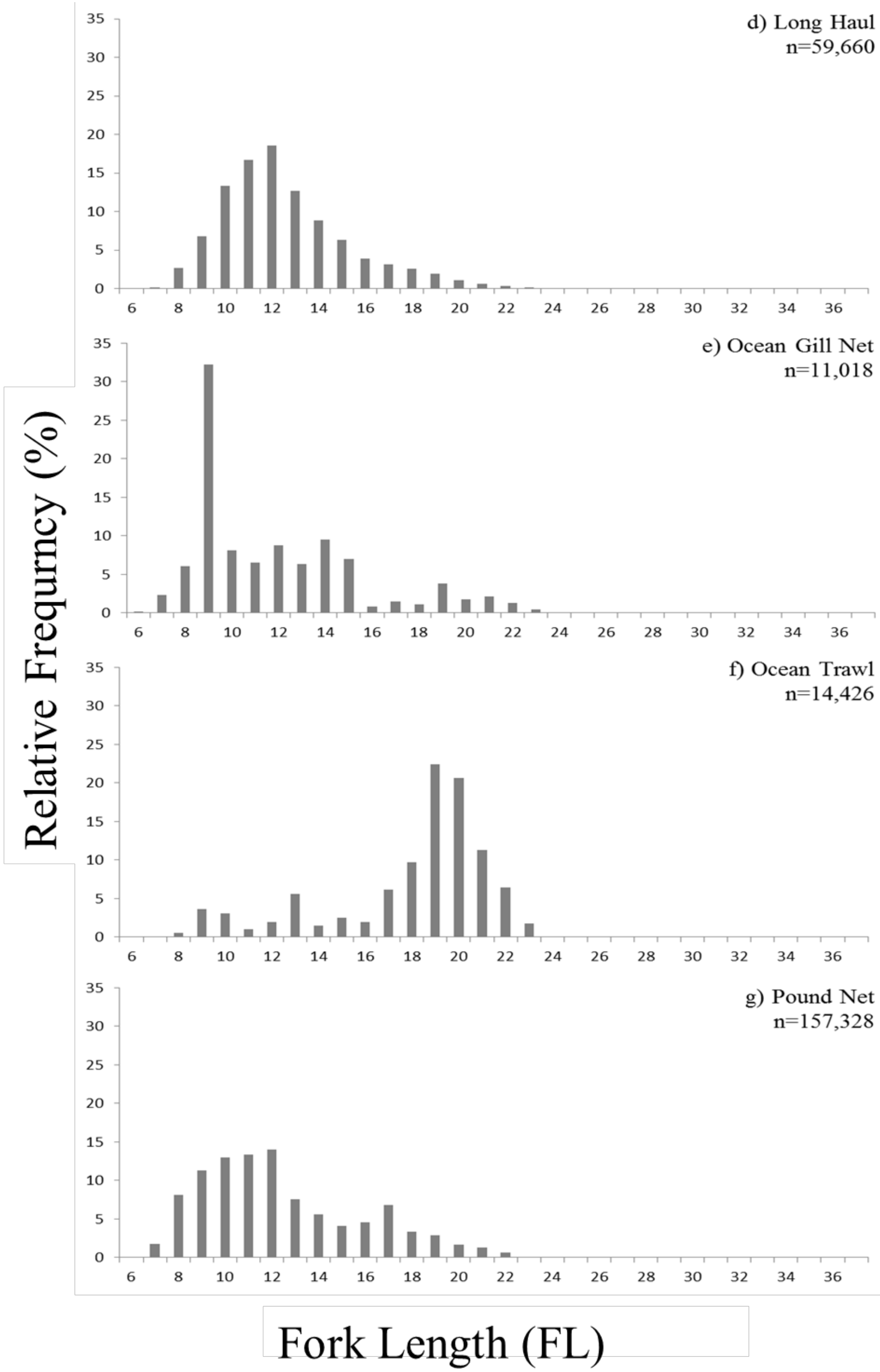

Figure 9. Weighted length frequencies of fish harvested from commercial gear of the long haul, ocean gill net, ocean trawl, and pound net fisheries from 2002-2013 in North Carolina.

Table 8. Percent reductions in harvest numbers for commercial gears based on various options of size limits of 10-inch, 12-inch, 14-inch FL and a slot limit of 12 inches to 20 inches FL for NC sheepshead. Reductions are based on number of pounds landed per year with the last column showing all years combined.

Option	Fishery	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	All years combined (2002-2013)
10" Size Limit	Estuarine Gill Net	5.2	1.0	1.1	0.0	1.4	6.1	8.2	7.2	2.0	0.4	24.2	7.6	6.0
	Pound Net	27.7	5.9	0.0	1.3	11.3	40.6	27.3	18.0	2.0	1.7	79.6	10.1	21.2
	Gig	13.5	15.4	0.3	14.0	5.8	14.9	15.4	15.1	4.5	0.7	47.4	12.4	20.1
	Long Haul	5.9	15.4	0.0	9.8	1.9	11.9	15.9	12.4	2.4	0.0	34.2	25.5	9.7
	Ocean Gill Net	12.1	0.0	0.0	9.6	3.4	8.1	10.0	86.5	67.2	0.0	44.8	72.7	40.9
	Ocean Trawl	59.7	4.7	0.2	11.4	0.0	0.0	50.0	13.4	0.1	0.3			4.2
	Spear/Diving			0.3		7.1	13.1	17.4	14.0	4.7	0.9	48.1	12.8	26.5
12" Size Limit	Estuarine Gill Net	17.1	37.0	4.2	7.2	9.7	32.1	39.0	45.6	18.3	7.4	26.9	40.9	28.3
	Pound Net	78.8	35.1	1.8	3.4	21.3	54.4	63.6	48.0	21.2	2.7	85.2	49.5	47.5
	Gig	39.8	42.5	1.6	23.5	20.5	33.1	47.0	48.9	27.7	7.3	53.1	41.4	39.8
	Long Haul	7.4	51.4	4.8	12.8	19.0	37.8	45.4	65.9	29.9	9.6	34.6	69.3	39.7
	Ocean Gill Net	33.3	0.0	0.0	16.0	6.7	22.0	32.5	92.1	97.1	0.0	49.0	85.3	55.5
	Ocean Trawl	59.7	9.7	0.4	22.8	0.0	0.1	50.0	46.0	0.6	5.2			8.3
	Spear/Diving			2.0		14.0	30.3	54.1	47.0	27.7	8.2	53.4	42.3	45.8
14" Size Limit	Estuarine Gill Net	33.7	73.2	45.3	38.1	33.9	68.1	73.8	85.4	69.7	51.1	51.5	67.3	64.9
	Pound Net	81.2	63.0	16.1	11.3	34.0	69.5	77.0	79.2	58.2	16.4	86.0	83.8	69.0
	Gig	47.0	57.9	6.4	37.4	34.0	55.3	77.7	83.1	71.8	41.9	62.5	67.0	73.6
	Long Haul	13.7	65.3	37.8	15.8	31.8	49.9	76.6	98.2	78.3	58.3	36.4	69.8	70.9
	Ocean Gill Net	34.9	41.9	1.0	25.0	29.8	54.0	85.5	92.1	97.1	40.1	53.6	88.8	70.5
	Ocean Trawl	59.7	20.7	1.6	22.8	0.0	15.4	50.0	82.1	28.5	33.1			15.8
	Spear/Diving			7.6		26.0	54.8	72.6	82.4	71.3	45.9	60.6	67.4	64.2
12"-20" Slot Limit	Estuarine Gill Net	17.1	38.0	5.2	8.8	11.8	33.1	39.8	46.2	18.5	8.0	27.5	41.3	28.9
	Pound Net	79.9	37.9	11.7	13.2	28.3	59.5	66.1	48.8	23.2	6.0	85.5	50.8	49.5
	Gig	44.6	48.1	25.7	28.5	25.4	38.9	48.7	49.7	28.4	9.4	53.6	43.3	41.7
	Long Haul	8.4	53.4	4.8	27.2	28.3	44.8	46.5	65.9	30.1	10.1	35.3	69.3	40.9
	Ocean Gill Net	33.7	0.0	13.1	16.0	26.8	30.8	33.0	97.0	100.1	0.0	75.6	85.3	59.4
	Ocean Trawl	62.6	25.0	27.8	38.7	0.8	15.3	50.0	46.7	71.8	7.8			27.8
	Spear/Diving			51.7		33.1	43.6	58.7	48.7	29.5	11.2	53.9	44.7	47.5

Spears/Diving

The length frequency distribution of the spear/dive fishery was made up of 7,749 sheepshead, of which 4,189 or 53.4 percent were all between 8 and 12 inches FL. Percentages of overall harvest reductions by size limits (10, 12 and14 inches FL) would be 26.5, 45.8, and 64.2 percent and the slot limit size limit of 12 to 20 inches FL would yield a 47.5 percent reduction (Table 8).

Previously mentioned was the increase in landings from the spears/diving fishery. When looking at the landings from 2011 through 2013, spearing for sheepshead took place from Bogue Sound south to Brunswick County. In 2011, a total of only 361 pounds was harvested from Masonboro Sound and the ocean, both in state and federal waters. In 2012, that number jumped to 9,987 total pounds harvested, with less than 500 pounds coming from Bogue Sound, and approximately 35 pounds, from the Cape Fear River. The remaining 9,483 pounds came from Masonboro Sound and the ocean, south of Cape Hatteras. The number of pounds speared from Masonboro Sound was 9,099 pounds or 94 percent of the years catch. In 2013, the total landings were 10,975 pounds, of which approximately 500 pounds came from the Cape Fear and Brunswick County Intracoastal Waterway (ICWW); the remaining 95 percent or 10,433 pounds were harvested from the same three locations of Masonboro Sound, and the ocean both inshore and outside three miles. The effort in this fishery has increased substantially in the last three years and preliminary landings from 2014 (through September) are approximately 15,000 pounds. While this may not be significant when looking at overall commercial landings, it should at least be mentioned. Gigs harvested 4,285 pounds or 2.4 percent in 2013, and 5,929 pounds (5.4 percent) of 2012 landings.

Commercial Trip Limits by Gear

Estuarine Gill Nets

A total of 99.3 percent of the estuarine gill net trips sampled landed from one to 100 pounds of sheepshead from 2002-2013 (Table 9). An average of nine pounds of sheepshead was landed per trip (Table 10). Less than one percent of the trips (n=11) landed more than 500 pounds of sheepshead, of these trips an average of 1,023 pounds was landed per trip (Table 10). The overall estimated harvest reduction with a 500 pound trip limit is 1.48 percent, whereas a 200 pound trip limit would yield a four percent reduction (Table 11). This is due to the small amount of sheepshead harvested from 300 to 500 pound trips and emphasizes the large amount of sheepshead commercially harvested in the 1 to 100 pound trip range, where 38,838 trips were taken from a total of 39,101 trips (Table 9).

Except for the 181 trips or 0.5 percent catching fish in the 101 to 200 pound range, there were very few other trips catching sheepshead.

Pound Nets

Approximately 87 percent of the pound net trips landed 100 pounds or less of sheepshead with an average of 19 pounds per trip (Tables 9 and 10). Trips landing 101 to 200 pounds (6 percent) harvested an average of 144 pounds of sheepshead per trip (Table 10). Trips landing more than 500 pounds per trip (2.5 percent) landed an average of 1,048 pounds of sheepshead. The overall estimated harvest reduction with a 500 pound trip limit is 20.89 percent, the smallest reduction compared to a 55.3 percent reduction with a 100 pound trip limit (Table 11).

Gig

Over 1,855 or 98 percent of gig trips harvesting sheepshead landed 100 pounds or less. Each trip caught on average, 14 pounds of sheepshead. Tables 9 and 10 show the majority of trips taken harvested between one to 200 pounds. Other than the 29 trips catching 101 to 200 pounds (average pounds; 137), only 6 trips caught between 200 and 300 pounds and only one trip each captured the 300 to >500 pound trips. Table 11 shows the largest reduction of 8.2 percent would be seen in the gig fishery when a 100 pound trip limit was implemented.

Table 9. Percent of commercial trips landing sheepshead by gear over a range of weight categories for pounds landed per trip, 2002 – 2013 in NC.

	1-100 lbs.		101-200 lbs.		201-300 lbs.		301-400 lbs.		401-500 lbs.		> 500 lbs.		Total trips
Fishery	#	%	#	%	#	%	#	%	#	%	#	%	#
Estuarine Gill Net	38,838	99.3	181	0.5	48	0.1	14	0.0	9	0.0	11	0.0	39,101
Pound Net	5,289	87.2	359	5.9	133	2.2	73	1.2	63	1.0	151	2.5	6,068
Gig	1,855	98.0	29	1.5	6	0.3	1	0.1	-	0.0	1	0.1	1,892
Long Haul	1,521	80.9	190	10.1	62	3.3	44	2.3	23	1.2	41	2.2	1,881
Ocean Gill Net	1,711	99.2	9	0.5	2	0.1	2	0.1	-	0.0	1	0.1	1,725
Ocean Trawl	122	63.5	17	8.9	13	6.8	5	2.6	3	1.6	32	16.7	192
Spear/Diving	138	61.9	57	25.6	19	8.5	6	2.7	3	1.3	-	-	223

Long Haul

The majority of reductions in the long haul fishery would occur under a 100 or 200 pound trip limit with a 47.0 and 29.4 percent reduction, respectively (Table 11). Out of a total of 1,881 trips, 1,521 trips landed on average 26 pounds of sheepshead per trip and 190 trips made up the 101 to 200 pound range where the average trip harvested 139 pounds (Tables 9 and 10). The remaining 9 percent of the trips comprised the 200 to over 500 pounds per trip level (Table 9).

Ocean Gill Net

One thousand seven hundred and eleven trips or 99.2 percent of fishermen caught 100 pounds or less of sheepshead per trip, with an average of 11 pounds per trip. Any trip limit higher than 100 pounds would result in very few reductions, because the majority of fish were landed from trips in the 1- 100 pound range. That percentage of reduction would only be 8.1 percent in the 100 pound range and a 1.3 to 4.3 percent range with a 500 to 200 pound trip limit range (Table 11).

Ocean Trawl

The ocean trawl fishery had 122 trips (63.5 percent) with 100 pounds or less of sheepshead caught per trip. Of those trips, the average amount landed per trip was 25 pounds. This fishery had 16.7 percent or 32 trips taken where over 500 pounds were caught. Surprisingly, the average catch per trip was 2,509 pounds (Tables 9 and 10). No data was provided for 2012 and 2013, but the 10 years of annual reductions show that this fishery would have the largest reductions of all gears with a range of 89.1 percent with a 100 pound trip limit decreasing to a 69.79 percent reduction with a 500 pound trip limit (Table 11).

Spears/Diving

The majority (62 percent) of the spear/diving trips landed one to 100 pounds of sheepshead (Table 9), with an average of 40 pounds per trip (Table 10). The average pounds landed for trips between 201-300 pounds was 235

Table 10. Average sheepshead landings (pounds) per commercial trip by specified weight categories, 2002 – 2013 in NC.

Fishery	1-100 lbs.	101-200 lbs.	201-300 lbs.	301-400 lbs.	401-500 lbs.	>500 lbs.
Estuarine Gill Net	9	137	244	351	455	1,023
Pound Net	19	144	248	352	449	1,048
Gig	14	137	232	322	-	>500
Long Haul	26	142	245	346	457	849
Ocean Gill Net	11	139	228	354	-	796
Ocean Trawl	25	146	254	341	438	2,509
Spear/Diving	40	145	235	350	420	-

pounds. Spear/dive trips landing between 301 and 500 pounds of sheepshead averaged 350 and 420 pounds per trip, respectively. There were no spear/dive trips landing more than 500 pounds. The largest overall estimated harvest reduction is 35 percent and would occur with a 100 pound trip limit. Only a three percent reduction with a 300 pound trip limit, less than one percent with a 400 pound trip limit and no reductions would be seen with a 500 pound trip limit (Table 11).

Table11. Percent reductions in harvest numbers for commercial gears based on a 100 through 500 pound trip limit, 2002 - 2013.

Options	Fishery	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	All years combined (2002-2013)
100 lb. Trip Limit	Estuarine Gill Net	0.4	0.7	0.3	0.9	2.1	2.4	6.7	9.6	13.8	3.9	6.7	16.1	7.8
	Pound Net	40.2	18.3	15.7	42.0	47.3	35.2	49.2	67.2	55.5	62.3	57.6	67.3	55.3
	Gig	0.0	0.0	0.0	12.2	18.7	22.9	8.0	1.5	1.1	15.1	4.9	4.3	8.2
	Long Haul	42.1	24.4	5.7	17.9	39.7	29.5	38.4	48.8	69.1	52.4	39.8	45.1	47.0
	Ocen Gill Net	6.5	1.5	26.4	0.0	2.3	0.0	8.6	0.0	0.0	0.0	0.0	26.7	8.1
	Ocean Trawl	7.0	74.8	97.2	88.9	87.3	84.6	0.0	59.8	84.7	64.8			89.1
	Spears/Diving			0.0		0.0	0.0	0.0	0.0	0.0	0.0	39.8	33.3	35.1
200 lb. Trip Limit	Estuarine Gill Net	0.0	0.0	0.0	0.0	0.3	0.2	3.0	4.6	5.6	1.4	4.1	11.1	4.0
	Pound Net	23.2	8.9	4.4	24.7	30.0	20.7	30.2	54.3	41.0	48.5	41.4	54.9	40.7
	Gig	0.0	0.0	0.0	0.0	6.2	17.5	0.3	0.0	0.0	3.7	0.1	0.9	2.3
	Long Haul	19.4	14.4	0.1	9.4	23.6	14.7	22.7	29.0	51.6	34.7	15.9	19.9	29.4
	Ocen Gill Net	0.0	0.0	14.3	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	20.0	4.3
	Ocean Trawl	0.0	57.0	95.1	81.6	79.1	75.1	0.0	32.6	79.0	37.1			82.5
	Spears/Diving			0.0		0.0	0.0	0.0	0.0	0.0	0.0	13.5	8.0	10.3
300 lb. Trip Limit	Estuarine Gill Net	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.0	2.7	0.3	3.4	8.3	2.6
	Pound Net	13.7	5.8	0.0	13.9	19.4	13.3	20.1	46.4	31.7	40.7	29.4	46.6	31.8
	Gig	0.0	0.0	0.0	0.0	0.0	13.2	0.0	0.0	0.0	0.4	0.0	0.0	1.0
	Long Haul	4.7	9.5	0.0	5.0	16.9	5.9	15.0	16.5	39.6	27.5	5.9	8.2	19.8
	Ocen Gill Net	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.2	2.7
	Ocean Trawl	0.0	45.9	93.5	75.2	72.6	67.0	0.0	17.1	74.1	14.0			77.4
	Spears/Diving			0.0		0.0	0.0	0.0	0.0	0.0	0.0	4.6	1.8	3.0
400 lb. Trip Limit	Estuarine Gill Net	0.0	0.0	0.0	0.0	0.0	0.0	0.2	2.3	1.5	0.1	2.9	6.7	1.9
	Pound Net	9.0	4.0	0.0	5.6	12.8	6.9	13.4	40.0	24.5	34.5	21.0	40.3	25.5
	Gig	0.0	0.0	0.0	0.0	0.0	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.7
	Long Haul	1.3	5.2	0.0	1.9	11.9	1.9	10.0	8.9	31.1	22.7	1.6	1.5	13.9
	Ocen Gill Net	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.9	1.8
	Ocean Trawl	0.0	37.3	92.0	69.4	67.8	61.1	0.0	10.8	69.2	1.3			73.4
	Spears/Diving			0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.1	0.3
500 lb. Trip Limit	Estuarine Gill Net	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.7	0.0	2.5	5.6	1.5
	Pound Net	6.8	2.2	0.0	1.7	8.1	3.3	8.6	34.9	19.7	29.4	15.4	35.2	20.9
	Gig	0.0	0.0	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.3
	Long Haul	0.0	2.7	0.0	0.0	8.2	0.0	6.6	4.8	24.3	18.4	0.0	0.0	10.1
	Ocen Gill Net	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.7	1.3
	Ocean Trawl	0.0	28.7	90.6	64.6	63.0	55.6	0.0	4.4	64.3	0.0			69.8
	Spears/Diving			0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Summary
Table 12 depicts the overall estimated commercial harvest reduction percentages by gear type based on a 100 to 500 pound trip limit range. The greatest reductions occur in ocean trawl gear. Smaller reductions are seen throughout the commercial gears in general with exceptions in the pound net and ocean trawl gears. For all fisheries, the largest reduction (36.6 percent) would occur with a 100 pound commercial trip limit implemented.

Table 12. Summary of percent reductions with associated 100 to 500 pound trip limits by gear for 2002 through 2013.

	Commercial Trip Limit (LBS)				
Fishery	100	200	300	400	500
Estuarine Gill Net	7.8	4.0	2.6	1.9	1.5
Pound Nets	55.3	40.7	31.8	25.5	20.9
Gigs	8.2	2.3	1.0	0.7	0.3
Long Haul	47.0	29.4	19.8	13.9	10.1
Ocean Gill Net	8.1	4.3	2.7	1.8	1.3
Ocean Trawl	89.1	82.5	77.4	73.4	69.8
Spears/Diving	35.1	10.3	3.0	0.3	0.0
All Fisheries	36.6	26.5	21.0	17.3	14.7

VI. DISCUSSION

Management options include: status quo until a stock assessment can be done, establish a minimum size limit, establish a recreational creel limit, and a commercial trip limit:

- The least restrictive of these options would be Status quo, as North Carolina does not currently have any recreational or commercial regulations for this species.
- Establishing a minimum size limit is a common management measure used to allow a greater portion of fish the 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 decrease the overall catch. Protecting fish so that they can reach spawning size is a common practice in fisheries management. Currently, there are no regulations to prevent overfishing from occurring in the sheepshead fisheries; however, little is known about their population biomass.
- Establishing a maximum size limit is a management measure used to expand the age structure of a stock. Maximum size limits have successfully been used to manage red drum, which are a long lived species. Sheepshead are also long lived, but mature relatively early, unlike the red drum. When over-exploitation occurs, there is a decline in the number of age classes represented in the fishery. The absence of a diverse age structure compromises the ability of any fish stock to recover. Because adult sheepshead are large and highly fecund they are extremely valuable to the stock's reproductive potential and excessive harvest could increase the chance of recruitment failure.
- By establishing a slot limit, limited harvest of juvenile sheepshead would be permitted to continue and a reasonable level of survival and escapement is provided. Slot limits also provide for the maximum possible protection of the adult spawning stock.
- Another management measure used to reduce the current harvest rate of a stock is to establish a recreational creel or bag limit that limits the number of fish allowed to be kept during a trip by an individual or boat. Commercial trip limits can also be established to reduce harvest rates. Both bag limits and trip limits reduce fishing mortality, further allowing a stock to recover. However, restricting trip limits could result in increased discards in both the gill net and pound net fisheries on days when large catches occur. Creel limits tend to work better in the recreational fishery because catches are often less variable than the commercial fishery.

A combination of recreational and commercial size limits, a slot limit, creel limits, and trips limits can be used to reduce the harvest of sheepshead in North Carolina if needed.

Determining the need to constrain harvest and devise an effective management strategy is never a simple task, but is confounded when the status of the stock is unknown. According to the N.C. Fisheries Reform Act, stock status is determined by the stock's ability to achieve sustainable harvest. Such an approach reflects stock biomass, and is typically used to determine whether a stock is overfished. A stock is also evaluated based on the rate of removals, e.g. the F rate, which determines whether overfishing is occurring. These parameters (benchmarks) for the N.C. sheepshead stock have not been determined and for this reason sheepshead are listed as unknown in the NCDMF's 2014 stock status report. While the rule granting the Fisheries Director proclamation authority has been adopted, it is still uncertain what foundation the NCDMF has to base the need/level for management actions. As noted in the comments from the regional advisory committees during the 2013 rule development, they did not support more regulations without additional data to support such restrictions.

While critical data are lacking and the NCDMF is not able to provide quantitative evaluations of reductions in F or increases to spawning stock biomass from possible management options, this does not eliminate the need to evaluate if there is a management approach that provides for a reasonable level of protection, guarding against expansion of fisheries that may negatively impact the stock. When managed under the SAFMC, possession limited to the aggregate 20-fish creel limit was the sole management action. Discussion on future actions will need to balance uncertainty about the need for further protection with the magnitude of the socioeconomic consequences.

Another consideration is operating within the intent of N.C. General Statute 113-182.1 that requires adoption of fishery management plans for all commercially or recreationally significant species or fisheries that comprise state marine or estuarine resources. The NCDMF is developing a policy to address what constitutes a significant species or fishery, necessitating development and approval of a fishery management plan for management. Guidance is also needed about when management measures are appropriate to implement if a species or fishery falls outside of the determination of "significant." There is overwhelming agreement that there is a need for consistency in how the NCDMF and NCMFC manage all species, not just sheepshead. With that said, further discussion of management options is presented.

The implementation of a recreational 10-inch FL minimum size limit and a 10-fish creel limit would reduce harvest by 28.2 percent in the recreational sector. A 12-inch minimum size limit would reduce the commercial sheepshead fisheries by as much as 8 to 56 percent throughout various gears. A variety of combinations of options are possible. An out-of-the-box option of mixing a smaller size limit with a specific creel limit and a larger size limit with a smaller creel limit may be a possibility.

Establishing a minimum size limit or a slot limit in conjunction with a recreational creel limit and commercial trip limit should allow limited recreational and commercial harvest of juvenile sheepshead to continue and provide protection to the adult spawning stock. However, these management measures have the potential to increase discards. To minimize potential discards, larger creel and trip limits could be implemented. The magnitude of discards as a result of the management measures presented in this paper should be further examined prior to establishing minimum size, slot, creel, and trip limits.

One option from the 2013 sheepshead issue paper was to manage harvest of sheepshead with a 10-inch (FL) size limit, 10-fish bag limit, and 500-pound trip limit. The size limit is based on the length at which 50 percent of sheepshead reach sexual maturity. This size would reduce the recreational harvest by approximately 18 percent based on landings from 2002 to 2013, but could be as high as 40 percent. The 10-fish bag limit for recreational fishermen would, on average, result in a 5 percent reduction. The 500-pound commercial trip limit would, on average, result in a 25 percent reduction in harvest. There would be some reduction in the impact of the bag limit and trip limit due to the size limit. These management measures will have a negative economic impact in the short term. If the stock is overfished and management measures are sufficient to enable the stock to rebuild, then the future harvest levels will increase and economic losses could be recouped.

Other State Regulations for Sheepshead

Sheepshead are currently managed on a state-by-state basis. The minimum size requirements in effect range from 10 inches FL (or 11 inches TL) in Georgia to 14 inches TL in South Carolina with some states currently not having any size limits (Table 13). Creel limits range from 10 to 20 per person/day. In South Carolina anglers additionally are limited to 30 fish per boat. Commercial trip limits range from 50 pounds as bycatch in a shrimp trawl in Florida to 500 pounds per trip in Virginia. Currently, in North Carolina there are no regulations specific to sheepshead. North Carolina is the only state from New Jersey through Florida with no commercial or recreational regulations for this species.

Table 13. Current state regulations for sheepshead.

State	Size Limit	Recreational Limit	Commercial Limit
New Jersey	None	15 fish Aggregate *	None
Delaware	None	None	None
Maryland	None	20 fish Aggregate*	None
Virginia	None	4/person	500 lb.
North Carolina	None	None	None
South Carolina	13inch FL	10/person; 30/boat	10/person; 30/boat
Georgia	10inch FL	15/person	15/person
Florida	11inch FL	15/person	None / 50 lb.**

* SAFMC 20 fish aggregate bag limit for snapper grouper complex

** FL has no commercial trip limits but does limit bycatch from shrimp trawls only to 50 lbs.

VII. PROPOSED RULE(S)

None

VIII. PROPOSED MANAGEMENT OPTIONS

A. Status Quo – have no management measures in place at present time – Director was given proclamation authority via Marine Fisheries Commission Rule 15A NCAC 03M .0521. Continue to sample and monitor the species and landings
   - \+ No rule changes for management of sheepshead
   - \- Potential for overfishing stock since no regulations are protecting sheepshead

B. Establish a 10 inch FL minimum size limit with a 20 fish/day bag limit (recreational) and a 500 pound/day/commercial trip limit (28 percent reduction; recreational, 0-70 percent reduction; commercial)
   - \+ Can protect ~50 percent of juvenile fish from harvest
   - \+ Establishes management measures for partial protection of spawning stock
   - \+ Process in place to change regulations for management of sheepshead; Director now has proclamation authority
   - \- Economic impact on recreational and commercial fisheries

C. Establish a 12 inch FL minimum size limit with a 10 fish/day bag limit (44.9 percent reduction)
   - \+ Can protect ~80 percent of juvenile fish from harvest
   - \+ Establishes management measures for protection of the majority of spawning stock
   - \+ Process in place to change regulations for management of sheepshead
   - \- Economic impact on recreational and commercial fisheries

D. Establish a 14 inch FL minimum size limit with a 10 fish/day bag recreational limit (61.1 percent reduction –largest reduction)
   + Can protect ~100 percent of juvenile fish from harvest
   + Establishes management measures for protection of the spawning stock
   + Process in place to change regulations for management of sheepshead
   - Economic impact on recreational and commercial fisheries

E. Establish a 12 inch to 20 inch FL recreational slot limit with a 500 pound commercial trip limit (~40 to 60 percent reduction)
   + Can protect ~80 percent of juvenile fish from harvest
   + Protects larger and older sheepshead outside of slot limit for spawning
   + Establishes management measures for protection of the spawning stock
   + Process in place to change regulations for management of sheepshead
   - Economic impact on recreational and commercial fisheries
   - State could implement regulations that may not be optimal for fishermen
   - Discards of fish over the maximum size limit

F. Recommend Division develop a fishery management plan for sheepshead.
   + Stock assessment could be completed
   + More time to collect and review data on NC sheepshead
   + Migration study could be done to see if stock is localized
   - Data would not be collected from all states where harvest occurs
   – Localized depletions could still occur
   – State could implement regulations that may not be optimal for fishermen

Any of the above options can add a trip limit for the commercial sector.
Any other suggested management options may follow.

IX. RECOMMENDATION

Southern Regional Advisory Committee – Recommend a recreational 12-inch FL size limit, 10 fish bag limit, 500 pound commercial trip limit, with a 100 pound/vessel trip limit for spearfishing sheepshead, develop a Fishery Management Plan and do a stock assessment for more information and to ask the Marine Fishery Commission to immediately look at the spotlight/spearfishing issue.

Northern Regional Advisory Committee – Recommend to endorse proposed management Option A, status quo with no rule changes for management of sheepshead, but charge the division with collecting data necessary to determine trends in the population and to develop a stock assessment, if one is necessary.

Finfish Advisory Committee – Status Quo and request the Division gather data on catch per unit effort and size structure through time for both the commercial and recreational fishery and other pertinent data that could identify the status of the NC sheepshead fishery and that this information be presented to the MFC at their May meeting.

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April 29, 2015

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N.C. Marine Fisheries Commission
2014-2015 Annual Rulemaking Cycle

May 2015

Time of Year	Action
January 2014	Last opportunity for a new issue to be presented to DMF Rules Advisory Team
February 2014	Second review by DMF Rules Advisory Team
January-July 2014	Fiscal analysis of rules prepared by DMF staff and approved by Office of State Budget and Management
August 2014	MFC considers approval of Notice of Text for Rulemaking
October 2014	Publication of proposed rules in the North Carolina Register
October 2014	Public hearing(s) held
(January)	(Last opportunity for a new issue to be presented to DMF Rules Advisory Team)
(February)	(Second review by DMF Rules Advisory Team)
February 2015	MFC considers approval of permanent rules
March/April 2015	New rulebook formatted
April 15, 2015	Commercial license sales begin
April 16, 2015	Rules reviewed by Office of Administrative Hearings Rules Review Commission
Late April	New rulebook published
May 1, 2015	New rulebook available online and for distribution
May 1, 2015	Effective date of new rules

N.C. Marine Fisheries Commission
2015-2016 Annual Rulemaking Cycle

May 2015

Time of Year	Action
January 2015	Last opportunity for a new issue to be presented to DMF Rules Advisory Team
February 2015	Second review by DMF Rules Advisory Team
February-April 2015	Fiscal analysis of rules prepared by DMF staff and approved by Office of State Budget and Management
May 2015	MFC considers approval of Notice of Text for Rulemaking
August 2015	Publication of proposed rules in the North Carolina Register
September 2015	Public hearing(s) held
November 2015	MFC considers approval of permanent rules
January 2016	Rules reviewed by Office of Administrative Hearings Rules Review Commission
(January)	(Last opportunity for a new issue to be presented to DMF Rules Advisory Team)
(February)	(Second review by DMF Rules Advisory Team)
February 1, 2016	Earliest possible effective date of rules
February/March 2016	Rulebook supplement prepared
April 1, 2016	Actual effective date of new rules
April 1, 2016	Rulebook supplement available online and for distribution
April 15, 2016	Commercial license sales begin

Regulatory Impact Analysis of the N.C. Striped Mullet Fishery Management Plan Amendment 1:

Name of Commission: N.C. Marine Fisheries Commission

Agency Contact: John Hadley, Fisheries Economics Program Manager
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Impact Summary:

State government:	No
Local government:	No
Federal government:	No
Substantial impact:	No

Authority: N.C. General Statues 113-134 (Rules); 113-182 (Regulation of Fishing and Fisheries); 113-221.1 (Proclamations; Emergency Review); 143B-289.52 (Marine Fisheries Commission – Powers and Duties); 15A NCAC 03J .0103 (Gill Nets, Seines, Identification, Restrictions); 03R .0112 (Attended Gill Net Areas)

Necessity: In accordance with G.S. 113-182.1 (b) and (d), the proposed rule changes (see proposed rule text in the appendix) are necessary to amend and update the N.C. Striped Mullet Fishery Management Plan (FMP) to ensure adequate management of the striped mullet resource and striped mullet fisheries occurring in state waters. Specifically, the rule changes address two separate issues and propose to:

1) Modify 15A NCAC 03J .0103 to establish restrictions for using runaround or non-stationary gill nets to address user conflicts occurring in confined creeks and in the vicinity of docks and marinas between commercial fishermen using runaround gill nets, recreational anglers, and shoreline residents. Additional changes are proposed to update gill net restrictions that have historically been put in place by the Fisheries Director's proclamation authority. These restrictions are aimed at protecting fish stocks and are also in place to protect endangered species to satisfy provisions for federal Incidental Take Permits.

2) Modify 15A NCAC 03R .0112 to remove the Newport River Trawl Net Prohibited Area as a small mesh gill net attendance area in the fall months (September through November), thereby making attendance requirements consistent with other similar areas of the state.

1. <u>Management Measures to Address User Conflicts in the Striped Mullet Runaround Gill Net Fishery and to Put Yardage Restrictions Aimed at Protecting Fish Stocks and Measures as Specified in Incidental Take Permits Into Rule (15A NCAC 03J .0103)</u>

I. Summary

For several years, conflict has at times existed between commercial runaround gill net fishermen, recreational anglers, and shoreline residents. The conflict primarily involves the blocking of navigation in waterways, competition for limited space in creeks, and a real or perceived reduction in the number of fish available to recreational fishermen during and after runaround gill net operations have taken place. Proposed rule changes seek to implement management measures similar to those already in place for set gill nets to establish restrictions for using runaround or non-stationary gill nets to address user conflicts occurring in confined creeks and in the vicinity of docks and marinas. These measures will make it unlawful to block more than two-thirds of any natural or manmade waterway, sound, bay, creek, inlet or any other body of water; or in a location where it will interfere with navigation or with existing, traditional uses of the area. Additionally, proposed rule changes seek to update the maximum gill net yardage and mesh length restrictions that have historically been put in place via the Fisheries Director's proclamation authority. These restrictions are aimed at protecting fish stocks and are also in place to protect endangered species to satisfy the terms of federal Incidental Take Permits (ITPs.)

II. Introduction and Purpose of Rule Changes

The change in inshore striped mullet fishing practices from traditional passive soak set gill nets to active tower boats with runaround gill nets has created conflicts with marinas, shoreline residents, and recreational anglers. Setting of gill nets around private piers and in restricted navigation areas as well as disruptive fishing practices associated with night fishing have resulted in charges against some striped mullet fishermen of impeding navigation and disturbing the peace. The situation has resulted in petitions for rulemaking asking the N.C. Marine Fisheries Commission (NCMFC) for varying degrees of gill net exclusion from specific areas. In regards to these issues, the recommendation in the 2006 N.C. Striped Mullet FMP was to move forward with the mediation process to resolve conflicts between commercial striped mullet fishermen, recreational anglers, and shoreline residents. In many cases, mediation has not brought satisfactory long-term results for all parties involved.

Competition and conflict in the striped mullet fishery typically occurs in the fall and winter in years when the abundance of striped mullet is high. The N.C. Division of Marine Fisheries (NCDMF) has received an increased number of complaints of conflicts between commercial gill net fishermen, recreational anglers and shoreline residents mainly from creeks where runaround gill nets have encircled schools of striped mullet or spotted sea trout and displaced or blocked access to boaters, anglers, and residents' docks. Several requests have been made since the completion of the 2006 N.C. Striped Mullet FMP to close certain creeks to commercial gill netting in response to user conflicts.

Recognizing the need to resolve this particular conflict in a manner that does not violate the public trust rights of the fishermen and addresses the residents' complaints, the N.C. Striped Mullet FMP Amendment 1 proposes the amendment of 15A NCAC 03J .0103 to add regulations for runaround or non-stationary gill nets similar to those that are already in place under 15A NCAC 03J .0101 for fixed or stationary nets. This would make it unlawful to block more than two-thirds of any natural or manmade waterway, sound, bay, creek, inlet or any other body of water, in a location where it will interfere with navigation, or with existing traditional uses of the area. This is intended to reduce the primary conflict of competition for limited space in creeks. Other conflicts such as lights, noise, and trespassing on private property by netters will continue to be handled on a case-by-case basis.

Additional changes are proposed to 15A NCAC 03J .0103, specifically to the section providing the Fisheries Director's proclamation authority. Amendments include establishing a specified maximum gill net mesh length of six and one-half inches and a specified maximum gill net yardage of 2,000 yards for gill nets with a mesh length of 4 inches or greater for Internal Coastal Waters that can be put in place via proclamation.

Since 2007, a maximum gill net mesh length of six and one-half inches has been implemented for Internal Coastal Waters by proclamation, beginning with Proclamation FF-15-2007. The proclamations have been issued under the existing authority of the Fisheries Director in 15A NCAC 03J .0103. This mesh length was initially implemented for enforcement and to prevent "cheating" across area quota boundaries in the striped bass fishery; the maximum mesh length has never been greater than six and one-half inches since 2007 and is not expected to ever increase. The most current proclamation (M-1-2014) makes it unlawful to use or possess gill nets with a mesh length of more than six and one-half inches. The stated intent of this proclamation is to allow harvest of flounder and shad while reducing the taking of red drum and striped bass in Internal Coastal Waters. Proposed rule changes constrain the Fisheries Director's proclamation authority by adding the maximum allowed mesh length that can be implemented, instead of providing the authority to specify any gill net mesh length.

Additionally, part of the proposed rule change regarding proclamation authority to "specify time" has been put forth as part of an ongoing attempt to standardize rule language granting proclamation authority across NCMFC rules. NCDMF staff has identified that proclamation authority across several rules is often similar in nature; however, the specific rule language stating the proclamation authority often differs greatly from rule to rule. In an attempt to improve consistency across rules and public clarity of proclamation authority, NCDMF seeks to standardize rule language describing proclamation authority when possible. The wording for this standard language is based on management measures found in Paragraph (a) of N.C. General Statute 113-182 (Regulation of fishing and fisheries) which states:

> "The Marine Fisheries Commission is authorized to authorize, license, regulate, prohibit, prescribe, or restrict all forms of marine and estuarine resources in coastal fishing waters with respect to:
>
> (1) Time, place, character, or dimensions of any methods or equipment that may be employed in taking fish;
> (2) Seasons for taking fish;
> (3) Size limits on and maximum quantities of fish that may be taken, possessed, bailed to another, transported, bought, sold, or given away."

The rule change specifying time is not intended to alter the scope of the proclamation authority, nor is it being proposed with the intention of changing current management.

In 2010, the NCDMF began issuing proclamations (M-8-2010) to suspend paragraph (i) (1) of the current iteration of 15A NCAC 03J .0103 and implement a reduced maximum gill net yardage that can be used per vessel in Internal Coastal Waters. The intent of this proclamation was to implement gill net restrictions while the NCDMF applied for a statewide ITP for the anchored gill net fishery from the National Marine Fisheries Service under Section 10(a)(1)(B) of the Endangered Species Act. The NCMFC has approved the Fisheries Director re-suspending this portion of the rule and re-implementing the reduced maximum gill net yardage of 2,000 yards (instead of 3,000 yards) following each NCMFC meeting since 2010. This has continued as part of the ITP and the N.C. Southern Flounder FMP. The current proclamation (M-49-2014) makes it "unlawful to use or possess more than 2,000 yards of gill net with a stretched mesh length of four inches to six and one-half inches per operation." Proposed rule changes constrain the Fisheries Director's proclamation authority by adding the maximum allowed net length that can be implemented at 2,000 yards, instead of providing the authority to specify any net length. In relation to this, additional proposed changes remove the current maximum net length of 3,000 yards from the rule.

These changes will help clarify the location of the current regulations. To reduce confusion for the public, the proposed changes clearly identify these regulations that would be contained in a proclamation, not in a rule that may or may not have been suspended. Additional minor changes are proposed for consistent capitalization, to spell out numbers and for consistent use of terms.

III. Costs

In 2013, there were 422 participants in the commercial runaround gill net fishery that took 3,787 trips and recorded $1,385,311 in landings. It is unclear how many of these trips would be affected by the new requirements provided in the proposed rule changes, but the overall effect is expected to be minor. Costs may be imposed to some participants in the runaround gill net fishery through requirements that may decrease the efficiency of the gear in some specific and limited cases. While not quantifiable, these costs are expected to be minimal, as the gear will still be allowed in areas previously open to such gear and the gear is still allowed to be set to block up to two-thirds of a waterway.

Yardage and mesh length restrictions will not impact fishermen using runaround gill nets, as this gear is currently limited to a mesh length of less than 5 inches and no more than 800 yards of gill net per commercial operation via proclamation M-39-2014. In the past, some commercial participants using set gill nets have been documented using mesh lengths greater than six and one half inches and more than 2,000 yards of gill net by the NCDMF. The total number of commercial participants that utilized mesh lengths greater than six and one half inches and more than 2,000 yards of set gill net per vessel before these restrictions were put in place by proclamation is unknown. The maximum mesh length and yardage restrictions have been in place for several years and it is unknown if or how many participants would revert to using gear above the current limits should the proposed rule change not be implemented and these restrictions be eliminated.

Without the proposed rule change, participants would still be capped at using no more than 3,000 yards of set gill net per vessel and the Director would still retain proclamation authority to limit both mesh length and net length. As such, existing restrictions would most likely remain in place to avoid non-compliance with both the sea turtle and sturgeon ITPs. Maintaining the restrictions agreed upon in the ITPs helps avoid suspension or revocation of these permits which could lead to the partial or full closure of gill net fishing in internal coastal waters in North Carolina. Therefore, it is expected that the proposed rule language to limit mesh size and maximum yardage of gill nets per vessel will not change current management and will likely impose minimal to no costs. Additional changes made for clarification of the rule are not expected to incur any costs.

IV. Benefits

Dock owners, recreational anglers, and other boaters attempting to use coastal creeks will benefit from the preserved ability to safely navigate these creeks without running into runaround gill net gear. Commercial fishermen may experience some benefit as well through fewer occurrences of vessels hitting and damaging their gear. Also, this rule may cut down on the need for the mediation process, which at times can be lengthy and take a great deal of time for the parties involved to complete. Overall, these changes are expected to reduce user conflicts in public waters. As such, there may be some time savings to NCDMF staff by not having to field as many complaints stemming from such conflicts, but the benefit to the division is expected to be negligible.

Additionally, rule changes to amend the Fisheries Director's proclamation authority will clarify for the public the content and location of regulations on maximum set gill net mesh length and total yardage that can be fished per vessel. Maximum yardage and mesh length restrictions help preserve spawning stocks for certain species of fish, overall fish populations, and related fisheries. Also, these limits help decrease the chances of interactions with sea turtles and sturgeon protected under the Endangered Species Act, benefitting the populations of these animals and also helping to prevent early regional gill net closures due to allowable takes in the ITPs being reached.

2. Newport River Gill Net Attendance Measures (15A NCAC 03R .0112)

I. Summary

An inconsistency in the area of the upper Newport River that is designated as both a trawl nets prohibited area (TNPA) and special secondary nursery area and the likely unintended implications to small mesh gill net attendance in the affected area has been brought forth as part of the proposed N.C. Striped Mullet FMP Amendment 1. Amendments are proposed to 15A NCAC 03R .0112 to correct the inconsistency between the current rule and what is believed to be the intended gill net attendance requirement for this area brought about by the designation of the Newport River TNPA as a small mesh gill net attendance area. Specifically, rule changes are proposed that would remove the attendance requirement for gill nets with a mesh length of less than five inches that are set within 50 yards of shore in the upper Newport River during the months of October and November.

II. Introduction and Purpose of Rule Changes

As a result of the 2006 N.C. Shrimp FMP, a portion of the Newport River upstream of the line from Hardesty Farm subdivision to Penn Point (Hardesty Farm line) was designated a TNPA in 15A NCAC 03R .0106 (7). Whereas this designation served the desired purpose of prohibiting shrimp trawling upstream of that line, it was implemented without consideration of the existing special secondary nursery area designation which allows for seasonal opening of an area now inside a TNPA. In 2011, the Newport River TNPA was also added to the small mesh gill net attendance areas in 15A NCAC 03R .0112 (b) (1) and it is believed that the implication to the small mesh set gill net fishery that often targets striped mullet was not considered (Figure 1.)

While examining a request to remove the TNPA designation to address the inconsistency with the special secondary nursery area designation as part of the 2011 review of the N.C. Shrimp FMP, NCDMF staff discussed the perceived unintended consequences to small mesh gill net attendance caused by the TNPA designation in 15A NCAC 03R .0112. Rule 15A NCAC 03J .0103 (h) requires gill nets with a mesh length of less than five inches ("small mesh") to be attended from May 1 through November 30 in areas designated in 15A NCAC 03R .0112 (b). In 15A NCAC 03R .0112 (b), there are two provisions applicable to Newport River: sub-paragraph (1) which requires attendance from May 1 through November 30 in primary and permanent secondary nursery areas and several TNPAs including the Newport River TNPA; and sub-paragraph (5) which describes the areas where attendance is required within 50 yards of any shoreline east of a line in Pamlico Sound except in the area from Core Sound to the South Carolina line from October 1 through November 30. Small mesh gill net attendance is required from May 1 through November 30 in Newport River upstream of the Hardesty Farm line according to 15A NCAC 03R .0112 (b) (1). However, this rule eliminates a striped mullet set gill net fishery that has been occurring there in the fall for many years. NCDMF staff and Marine Patrol officers did not feel small mesh gill net attendance was intended in this area and have not enforced the Newport River TNPA portion of 15A NCAC 03R .0112 (b) (1). Rather, 15A NCAC 03R .0112 (b) (5) has been interpreted to allow small mesh gill nets to be left unattended from October 1 to November 30, and thus, allows the traditional striped mullet set gill net fishery to occur. A recommendation from the 2011 review of the N.C. Shrimp FMP was for the shrimp trawl line to remain as shown by the Newport River TNPA, but to attempt to resolve the rule language in 15A NCAC 03R .0112 (b) in the N.C. Striped Mullet FMP amendment process so the small mesh set gill net striped mullet fishery can continue in the fall of each year.

Measures are being proposed within 15A NCAC 03R .0112 to correct the inconsistency between the current rule and what is believed to be the intended small mesh set gill net attendance requirements for this area brought about by the designation of the Newport River TNPA as a small mesh gill net attendance area. Specifically, rule changes are proposed that would allow a section of the upper Newport River to fall under the provisions of 15A NCAC 03R .0112 (b)(5), thereby removing the attendance requirement for set gill nets with a mesh length of less than five inches that are set within 50 yards of shore during the months of October and November.

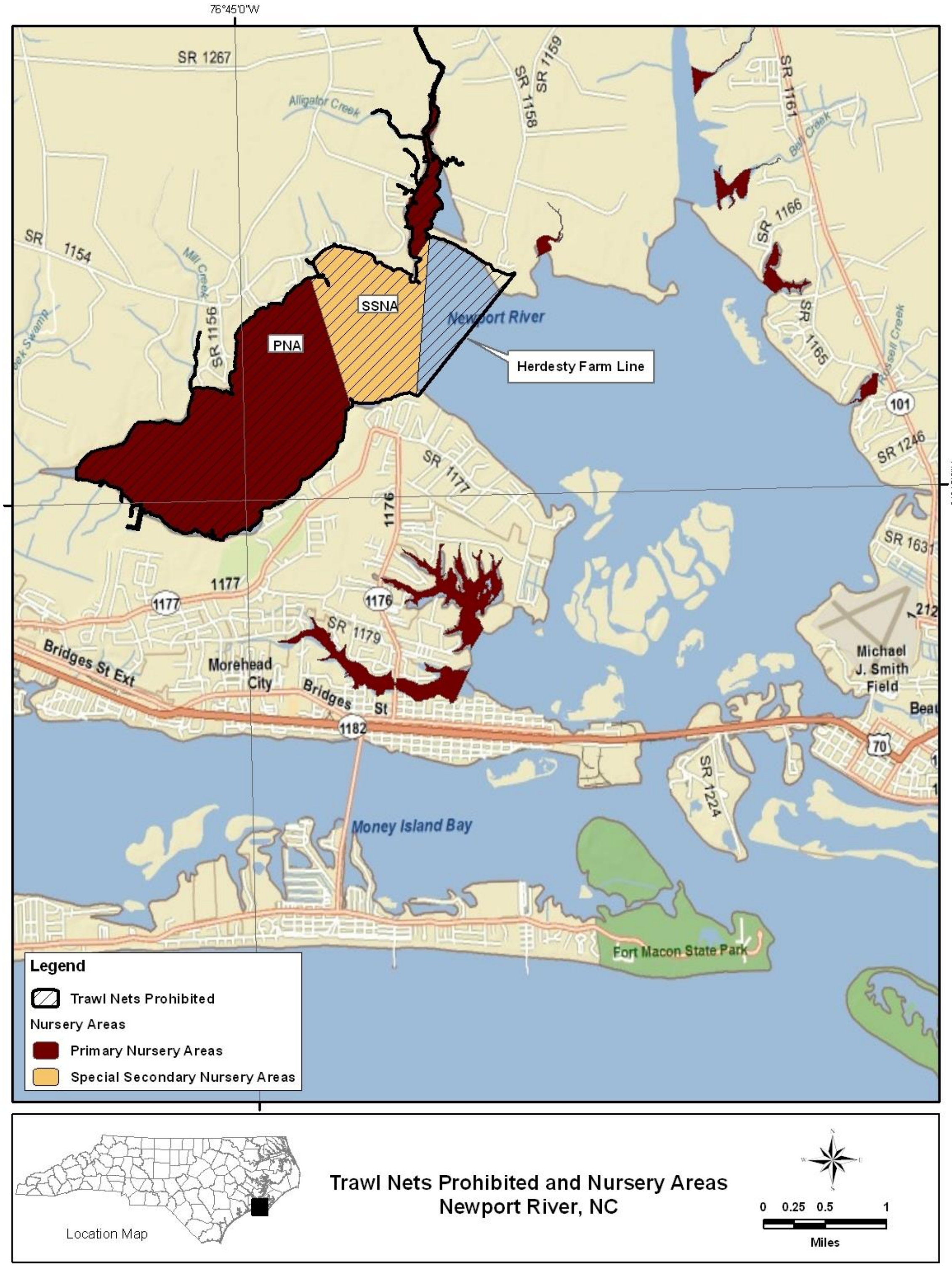

Figure 1. Existing nursery areas and trawl nets prohibited areas in the Newport River.

III. Costs

The proposed rule change may incur some costs by allowing the small mesh gill net fishery in a section of the upper Newport River to continue without attendance requirements. This facilitates the use of this gear and increases the chance for some level of user conflict over the fishery resources present in the area. Overall costs are expected to be negligible.

IV. Benefits

Implementing the proposed rule change in 15A NCAC 03R .0112 would allow the small mesh set gill net fishery occurring in the upper section of the Newport River during the fall months to continue without attendance requirements. Requiring attendance of this gear would implement an unquantified opportunity cost to participants choosing to use this gear, as they would need to remain present with the nets while they are in the water. This additional opportunity cost may cause participants to reduce fishing effort or quit fishing in the specified area. While data are not available specific to the area that would be affected, small mesh set gill net landings in the entire Newport River system in October and November combined from 2009 to 2013 have ranged from approximately $700 to $6,150 and averaged approximately $3,000 annually. This serves as a conservatively high estimate of possible benefits and represents the upper limit of benefits to commercial participants from removing attendance requirements for small mesh set gill nets in the specified portion of the upper Newport River. Additionally, the rule change will improve public clarity of 15A NCAC 03R .0112.

3. Comprehensive Statement of Costs and Benefits

Rule changes associated with the N.C. Striped Mullet Fishery Management Plan Amendment 1 are expected to be well below the substantial economic impact threshold of $1 million in aggregate costs and benefits in a 12-month period. Specifically:

1) Modifying 15A NCAC 03J .0103 may incur some costs by decreasing the efficiency of runaround gill net operations under specific and limited conditions. Additionally, some costs could theoretically be incurred by the 2,000-yard cap on total set gill net yardage for gill nets with a mesh length of four inches and greater that can be fished by a vessel at any one time, should the provision implemented as part of the ITPs for the set gill net fishery occurring in internal coastal waters be removed. Realized costs are expected to be minimal to nonexistent, as current gill net restrictions will likely remain in place to maintain compliance with the ITPs should the proposed rule change not be implemented. Benefits will be incurred through possible decreased incidences of conflict among users of public waters and the need to undergo conflict mediation, a decreased likelihood of damaged commercial gear, and improved clarity on the content and location of regulations on maximum gill net mesh length and total yardage that can be fished per vessel. While unquantified, all anticipated costs and benefits are expected to be minimal in monetary terms.

2) Modifying 15A NCAC 03R .0112 may incur some minimal costs by increasing the possibility of conflict among user groups in a section of the upper Newport River. While the exact benefit is unknown, the proposed rule change will allow the small mesh set gill net fishery in the upper Newport River to continue without attendance requirements during the months of October and November. This will help minimize opportunity costs for participants in this fishery. The small mesh set gill net fishery in the entire Newport River has recorded landings ranging from $700 to $6,150 in the months of October and November combined from 2009-2013.

Table 1. Summary of estimated annual costs and benefits from proposed rule changes.

Rule	Annual Estimated Cost	Annual Estimated Benefit
15A NCAC 03J .0103	Unquantified	Unquantified
15A NCAC 03R .0112	None	$0 to $6,150

Appendix: Proposed Rule Changes

15A NCAC 03J .0103 GILL NETS, SEINES, IDENTIFICATION, RESTRICTIONS

(a) It is unlawful to use gill nets:

(1) ~~With~~ with a mesh length less than ~~2 ½~~ two and one-half inches.

(2) ~~In internal waters~~ in Internal Coastal Waters from April 15 through December 15, with a mesh length ~~5~~ five inches or greater and less than ~~5 ½~~ five and one-half inches.

(b) The Fisheries Director may, by proclamation, limit or prohibit the use of gill nets or seines in ~~coastal waters,~~ Coastal Fishing Waters, or any portion thereof, or impose any or all of the following restrictions on gill net or seine fishing operations:

~~(1) Specify area.~~

~~(2) Specify season.~~

~~(3) Specify gill net mesh length.~~

~~(4) Specify means/methods.~~

~~(5) Specify net number and length.~~

(1) specify time;

(2) specify area;

(3) specify means and methods, including:

(A) gill net mesh length, but the maximum length specified shall not exceed six and one-half inches in Internal Coastal Waters; and

(B) net number and length, but for gill nets with a mesh length four inches or greater, the maximum length specified shall not exceed 2,000 yards per vessel in Internal Coastal Waters regardless of the number of individuals involved; and

(4) specify season.

(c) It is unlawful to use fixed or stationary gill nets in the Atlantic Ocean, drift gill nets in the Atlantic Ocean for recreational purposes, or any gill nets in ~~internal waters~~ Internal Coastal Waters unless nets are marked by attaching to them at each end two separate yellow buoys which shall be of solid foam or other solid buoyant material no less than five inches in diameter and no less than five inches in length. Gill nets, which are not connected together at the top line, are considered as individual nets, requiring two buoys at each end of each individual net. Gill nets connected together at the top line are considered as a continuous net requiring two buoys at each end of the continuous net. Any other marking buoys on gill nets used for recreational purposes shall be yellow except one additional buoy, any shade of hot pink in color, constructed as specified in this Paragraph, shall be added at each end of each individual net. Any other marking buoys on gill nets used in commercial fishing operations shall be yellow except that one additional identification buoy of any color or any combination of colors, except any shade of hot pink, may be used at either or both ends. The owner shall be identified on a buoy on each end either by using engraved buoys or by attaching engraved metal or plastic tags to the buoys. Such identification shall include owner's last name and initials and if a vessel is used, one of the following:

(1) ~~Owner's~~ owner's N.C. motor boat registration ~~number,~~ number; or

(2) ~~Owner's~~ owner's U.S. vessel documentation name.

(d) It is unlawful to use gill nets:

(1) ~~Within~~ within 200 yards of any flounder or other finfish pound net set with lead and either pound or heart in use, except from August 15 through December 31 in all ~~coastal fishing waters~~ Coastal Fishing Waters of the Albemarle Sound, including its tributaries to the boundaries between ~~coastal and joint fishing waters,~~ Coastal and Joint Fishing Waters, west of a line beginning at a point 36° 04.5184' N - 75° 47.9095' W on Powell Point; running southerly to a point 35° 57.2681' N - 75° 48.3999' W on Caroon Point, it is unlawful to use gill nets within 500 yards of any pound net set with lead and either pound or heart in use; and

(2) ~~From~~ from March 1 through October 31 in the Intracoastal Waterway within 150 yards of any railroad or highway bridge.

(e) It is unlawful to use gill nets within 100 feet either side of the center line of the Intracoastal Waterway Channel south of the entrance to the Alligator-Pungo River Canal near Beacon "54" in Alligator River to the South Carolina line, unless such net is used in accordance with the following conditions:

(1) ~~No~~ no more than two gill nets per vessel may be used at any one time;

(2) ~~Any~~ any net used must be attended by the fisherman from a vessel who shall at no time be more than 100 yards from either net; and

(3) ~~Any~~ any individual setting such nets shall remove them, when necessary, in sufficient time to permit unrestricted ~~boat~~ vessel navigation.

(f) It is unlawful to use ~~drift gill nets in violation of 15A NCAC 03J .0101(2) and Paragraph (e) of this Rule.~~ runaround, drift, or other non-stationary gill nets, except as provided in subparagraph (e) of this rule;

(1) to block more than two-thirds of any natural or manmade waterway, sound, bay, creek, inlet or any other body of water; or

(2) in a location where it will interfere with navigation or with existing, traditional uses of the area other than navigation.

(g) It is unlawful to use unattended gill nets with a mesh length less than five inches in a commercial fishing operation in the gill net attended areas designated in 15A NCAC 03R .0112(a).

(h) It is unlawful to use unattended gill nets with a mesh length less than five inches in a commercial fishing operation from May 1 through November 30 in the ~~internal coastal and joint waters~~ Internal Coastal Waters and Joint Fishing Waters of the state designated in 15A NCAC 03R .0112(b).

~~(i) For gill nets with a mesh length five inches or greater, it is unlawful:~~

~~(1) To use more than 3,000 yards of gill net per vessel in internal waters regardless of the number of individuals involved.~~

~~(2) From June through October, for any portion of the net to be within 10 feet of any point on the shoreline while set or deployed, unless the net is attended.~~

(i) It is unlawful for any portion of a gill net with a mesh length five inches or greater to be within 10 feet of any point on the shoreline while set or deployed, unless the net is attended from June through October in Internal Coastal Waters.

(j) For the purpose of this Rule and 15A NCAC 03R .0112, shoreline is defined as the mean high water line or marsh line, whichever is more seaward.

Authority G.S. 113-134; 113-173; 113-182; 113-221; 143B-289.52

15A NCAC 03R .0112 ATTENDED GILL NET AREAS

(a) The attended gill net areas referenced in 15A NCAC 03J .0103(g) are delineated in the following areas:

(1) Pamlico River, west of a line beginning at a point 35° 27.5768' N - 76° 54.3612' W on Ragged Point; running southwesterly to a point 35° 26.9176' N - 76° 55.5253' W on Mauls Point;

(2) Within 200 yards of any shoreline in Pamlico River and its tributaries east of a line beginning at a point 35° 27.5768' N - 76° 54.3612' W on Ragged Point; running southwesterly to a point 35° 26.9176' N - 76° 55.5253' W on Mauls Point; and west of a line beginning at a point 35° 22.3622' N - 76° 28.2032' W on Roos Point; running southerly to a point at 35° 18.5906' N - 76° 28.9530' W on Pamlico Point;

(3) Pungo River, east of the northern portion of the Pantego Creek breakwater and a line beginning at a point 35° 31.7198' N - 76° 36.9195' W on the northern side of the breakwater near Tooleys Point; running southeasterly to a point 35° 30.5312' N - 76° 35.1594' W on Durants Point;

(4) Within 200 yards of any shoreline in Pungo River and its tributaries west of the northern portion of the Pantego Creek breakwater and a line beginning at a point 35° 31.7198' N - 76° 36.9195' W on the northern side of the breakwater near Tooleys Point; running southeasterly to a point 35° 30.5312' N - 76° 35.1594' W on Durants Point; and west of a line beginning at a point 35° 22.3622' N - 76° 28.2032' W on Roos Point; running southerly to a point at 35° 18.5906' N - 76° 28.9530' W on Pamlico Point;

(5) Neuse River and its tributaries northwest of the Highway 17 highrise bridge;

(6) Trent River and its tributaries; and

(7) Within 200 yards of any shoreline in Neuse River and its tributaries east of the Highway 17 highrise bridge and south and west of a line beginning on Maw Point at a point 35° 09.0407' N - 76° 32.2348' W; running southeasterly near the Maw Point Shoal Marker "2" to a point 35° 08.1250' N - 76° 30.8532' W; running southeasterly near the Neuse River Entrance Marker "NR" to a point 35° 06.6212' N - 76° 28.5383' W; running southerly to a point 35° 04.4833' N - 76° 28.0000' W near Point of Marsh in Neuse River. In Core and Clubfoot creeks, the Highway 101 Bridge constitutes the attendance boundary.

(b) The attended gill net areas referenced in 15A NCAC 03J .0103(h) are delineated in the following ~~coastal and joint waters~~ Coastal and Joint Fishing Waters of the state south of a line beginning on Roanoke Marshes Point at a point 35° 48.3693' N - 75° 43.7232' W; running southeasterly to a point 35° 44.1710' N - 75° 31.0520' W on Eagles Nest Bay to the South Carolina State line:

(1) All primary nursery areas described in 15A NCAC 03R .0103, all permanent secondary nursery areas described in 15A NCAC 03R .0104, and no-trawl areas described in 15A NCAC 03R .0106(2), (4), (5), ~~(7),~~ (8), (10), (11), and (12);

(2) In the area along the Outer Banks, beginning at a point 35° 44.1710' N - 75° 31.0520' W on Eagles Nest Bay; running northwesterly to a point 35° 45.1833' N - 75° 34.1000' W west of Pea Island; running southerly to a point 35° 40.0000' N - 75° 32.8666' W west of Beach Slough; running southeasterly and passing near Beacon "2" in Chicamicomico Channel to a point 35° 35.0000' N - 75° 29.8833' W west of the Rodanthe Pier; running southwesterly to a point 35° 28.4500' N - 75° 31.3500' W on Gull Island; running southerly to a point 35° 22.3000' N - 75° 33.2000' W near Beacon "2" in Avon Channel ; running southwesterly to a point 35° 19.0333' N - 75° 36.3166' W near Beacon "2" in Cape Channel; running southwesterly to a point 35° 15.5000' N - 75° 43.4000' W near Beacon "36" in Rollinson Channel; running southeasterly to a point 35° 14.9386' N - 75° 42.9968' W near Beacon "35" in Rollinson Channel; running southwesterly to a point 35° 14.0377' N - 75° 45.9644' W near a "Danger" Beacon northwest of Austin Reef; running southwesterly to a point 35° 11.4833' N - 75° 51.0833' W on Legged Lump; running southeasterly to a point 35° 10.9666' N - 75° 49.7166' W south of Legged Lump; running southwesterly to a point 35° 09.3000' N - 75° 54.8166' W near the west end of Clarks Reef; running westerly to a point 35° 08.4333' N - 76° 02.5000' W near Nine Foot Shoal Channel; running southerly to a point 35° 06.4000' N - 76° 04.3333' W near North Rock; running southwesterly to a point 35° 01.5833' N - 76° 11.4500' W near Beacon "HL"; running southerly to a point 35° 00.2666' N - 76° 12.2000' W; running southerly to a point 34° 59.4664' N - 76° 12.4859' W on Wainwright Island; running easterly to a point 34° 58.7853' N - 76° 09.8922' W on Core Banks; running northerly along the shoreline and across the inlets following the Colregs Demarcation line to the point of beginning;

(3) In Core and Back sounds, beginning at a point 34° 58.7853' N - 76° 09.8922' W on Core Banks; running northwesterly to a point 34° 59.4664' N - 76° 12.4859' W on Wainwright Island; running southerly to a point 34° 58.8000' N - 76° 12.5166' W; running southeasterly to a point 34° 58.1833' N - 76° 12.3000' W; running southwesterly to a point 34° 56.4833' N - 76° 13.2833' W; running westerly to a point 34° 56.5500' N - 76° 13.6166' W; running southwesterly to a point 34° 53.5500' N - 76° 16.4166' W; running northwesterly to a point 34° 53.9166' N - 76° 17.1166' W; running southerly to a point 34° 53.4166' N - 76° 17.3500' W; running southwesterly to a point 34° 51.0617' N - 76° 21.0449' W; running southwesterly to a point 34° 48.3137' N - 76° 24.3717' W; running southwesterly to a point 34° 46.3739' N - 76° 26.1526' W; running southwesterly to a point 34° 44.5795' N - 76° 27.5136' W; running southwesterly to a point 34° 43.4895' N - 76° 28.9411' W near Beacon "37A"; running southwesterly to a point 34° 40.4500' N - 76° 30.6833' W; running westerly to a point 34° 40.7061' N - 76° 31.5893' W near Beacon "35" in Back Sound; running westerly to a point 34° 41.3178' N -76° 33.8092' W near Buoy "3"; running southwesterly to a point 34° 39.6601' N - 76° 34.4078' W on Shackleford Banks; running easterly and northeasterly along the shoreline and across the inlets following the COLREGS Demarcation lines to the point of beginning;

(4) Within 200 yards of any shoreline in the area upstream of the 76° 28.0000' W longitude line beginning at a point 35° 22.3752' N - 76° 28.0000' W near Roos Point in Pamlico River; running southeasterly to a point 35° 04.4833' N - 76° 28.0000' W near Point of Marsh in Neuse River; and

(5) Within 50 yards of any shoreline east of the 76° 28.0000' W longitude line beginning at a point 35° 22.3752' N - 76° 28.0000' W near Roos Point in Pamlico River; running southeasterly to a point 35° 04.4833' N - 76° 28.0000' W near Point of Marsh in Neuse River, except from October 1 through November 30, south and east of Highway 12 in Carteret County and south of a line from a point 34° 59.7942' N - 76° 14.6514' W on Camp Point; running easterly to a point at 34° 58.7853' N - 76° 09.8922' W on Core Banks; to the South Carolina State Line.

Authority G.S. 113-134; 113-173; 113-182; 113-221.1; 143B-289.52

Regulatory Impact Analysis of Proposed Amendments to Rule 15A NCAC 03R .0108

Clarify Dredges and Mechanical Methods Prohibited Areas for Harvesting Shellfish in Internal Coastal Waters

Name of Commission: N.C. Marine Fisheries Commission

Agency Contact: John Hadley, Fisheries Economics Program Manager
N.C. Division of Marine Fisheries
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Impact Summary: *De minimus* rule change

State government:	No
Local government:	No
Federal government:	No
Substantial impact:	No

Authority: N.C. General Statues 113-134 (Rules); 113-182 (Regulation of Fishing and Fisheries); 15A NCAC 03K .0108 (Dredges/Mechanical Methods Prohibited); 03K .0204 (Dredges/Mechanical Methods Prohibited); 03R .0108 (Mechanical Methods Prohibited)

Necessity: Proposed rule changes to 15A NCAC 03R .0108 align regulations regarding mechanical methods for harvesting shellfish to specify only internal coastal waters as currently managed. This rule change abides by the requirements of G.S. 150B, Administrative Procedure Act, to ensure rules are up to date with the current management practice to aid in the clarity of regulations. These rule changes will more clearly and accurately reflect North Carolina Division of Marine Fisheries operations and management.

I. Summary

To abide by the requirements of G.S. 150B, The Administrative Procedure Act, which seeks to ensure rules are up to date with current management practices to aid in the clarity of regulations, changes are being proposed to 15A NCAC 03R .0108 that specify the rule applies only to internal coastal waters. With ocean waters in North Carolina being closed to harvest of shellfish via federal regulation, the proposed rule changes align regulation of mechanical methods to harvest shellfish with current management practices as well as remove redundant and undefined language in the rule. Rule changes are anticipated to become effective April 1, 2016.

II. Introduction and Purpose of Rule Changes

The prohibition of mechanical methods to take shellfish has a long history of restrictions to areas in internal coastal waters going back to 1887. Currently, all internal coastal waters from Cedar Island to the South Carolina State line and behind the Outer Banks are closed to the mechanical harvest of oysters. Also in July 2004, the North Carolina Marine Fisheries

Commission approved amendments to 15A NCAC 03R .0108 that closed 31,000 acres of the waters around Pamlico Sound and in Roanoke Sound to mechanical oyster harvesting. All descriptive boundaries of this rule are either specific to waterbodies with latitude/longitude coordinates, or name the specific waterbodies and their tributaries, except for the final section referencing counties in the southern area of coastal North Carolina.

Under federal shellfish regulations contained in Chapter IV of the National Shellfish Sanitation Program Guide for the Control of Molluscan Shellfish (Model Ordinance), if waterbodies are not surveyed for pathogens, they must be closed to shellfishing due to the potentially serious health risks associated with eating shellfish. NCDMF does not survey areas in ocean waters for such pathogens due to limited staff and monetary resources as well as lack of public interest in harvesting shellfish in these waters. As a result, these areas are closed to the harvest of shellfish such as clams or oysters, making rule language "any of the coastal waters of" as referenced in 15A NCAC 03R .0108 (4) redundant when referring to ocean waters.

Additionally, it is in the interest of both law enforcement and the public to use terms that are legally defined when specifying areas. The term "coastal water areas" that appears in 15A NCAC 03R .0108 as it is currently written is not a term that is defined by rule or statue. The terms "Internal Coastal Waters" and "Coastal Fishing Waters" are defined by rule and statue respectively. "Internal Coastal Waters" is defined in 15A NCAC 03I .0101 (1) (c) as "All coastal fishing waters except the Atlantic Ocean". "Coastal Fishing Waters" is defined in G.S. 113-129 (4) as "The Atlantic Ocean; the various coastal sounds; and estuarine waters up to the dividing line between coastal fishing waters and inland fishing waters agreed upon by the Marine Fisheries Commission and the Wildlife Resources Commission…". The proposed rule changes seek to replace the undefined term of "coastal water areas" with the defined term of "Internal Coastal Waters", as the specified areas in rule 15A NCAC 03I .0101 reference waters not in the Atlantic Ocean and the ocean waters are already closed via Chapter IV of the Model Ordinance.

The NCDMF abides by the requirements of G.S. 150B, Administrative Procedure Act, to ensure rules are up to date with the current management practice and to aid in the clarity of regulations. Since management of mechanical methods to take shellfish is allowed only in specific areas and ocean waters are closed to the harvest of shellfish, proposed rule changes seek to specify the rule is for internal coastal waters only and to use terms that are defined in rule. For this reason, the proposed rule changes are being put forth to clarify the rule and do not change current management of mechanical harvest of shellfish.

III. Costs

There are no costs associated with the proposed rule changes, as rule changes reflect current management practices.

IV. Benefits

While there are no quantifiable economic benefits to the proposed rule change, the public and law enforcement will benefit from changing rule 15A NCAC 03R .0108 to align with current management practices and to use terms defined in rule.

Appendix: Proposed Rule Changes

15A NCAC 03R .0108 MECHANICAL METHODS PROHIBITED

The dredges and mechanical methods prohibited areas referenced in 15A NCAC 03K .0204 are delineated in the following ~~coastal water areas~~Internal Coastal Waters:

(1) In Roanoke Sound and tributaries, south of a line beginning at a point 35° 55.1461' N – 75° 39.5618' W on Baum Point, running easterly to a point 35° 55.9795' N - 75° 37.2072' W and north and east of a line beginning at a point 35° 50.8315' N- -75° 37.1909' W on the west side of the mouth of Broad Creek, running easterly to a point 35° 51.0097' N - 75° 36.6910' W near Beacon "17", running southerly to a point 35° 48.6145" N - 75° 35.3760' W near Beacon "7", running easterly to a point 35° 49.0348' N - 75° 34.3161' W on Cedar Point.

(2) In Pamlico Sound and tributaries:

(a) Outer Banks area,within the area described by a line beginning at a point 35°46.0638' N – 75°31.4385' W on the shore of Pea Island; running southwesterly to a point 35°42.9500' N – 75°34.1500' W; running southerly to a point 35°39.3500' N – 75°34.4000' W; running southeasterly to a point 35°35.8931' N – 75°31.1514' W in Chicamacomico Channel near Beacon "ICC"; running southerly to a point 35° 28.5610' N – 75°31.5825' W on Gull Island; running southerly to a point 35° 22.8671' N – 75° 33.5851' W in Avon Channel near Beacon "1"; running southwesterly to a point 35°18.9603' N – 75°36.0817' W in Cape Channel near Beacon "2"; running westerly to a point 35°16.7588' N – 75°44.2554' W in Rollinson Channel near Beacon "42RC"; running southwesterly to a point 35°14.0337' N – 75°45.9643' W southwest of Oliver Reef near the quick-flashing beacon; running westerly to a point 35°09.3650' N – 76°00.6377' W in Big Foot Slough Channel near Beacon "14BF"; running southwesterly to a point 35°08.4523' N – 76°02.6651' W in Nine Foot Shoal Channel near Beacon "9"; running westerly to a point 35°07.1000' N – 76°06.9000; running southwesterly to a point 35°01.4985' N – 76°11.4353' W near Beacon "HL"; running southwesterly to a point 35°00.2728' N – 76°12.1903' W near Beacon "2CS"; running southerly to a point 34°59.4383' N – 76°12.3541' W in Wainwright Channel immediately east of the northern tip of Wainwright Island; running easterly to a point 34°58.7853' N – 76°09.8922' W on Core Banks; running northerly along the shoreline and across the inlets following the COLREGS Demarcation lines to the point of beginning;

(b) Stumpy Point Bay, north of a line beginning at a point 35° 40.9719' N - 75° 44.4213' W on Drain Point; running westerly to a point 35° 40.6550' N - 75° 45.6869' W on Kazer Point;

(c) Pains Bay, east of a line beginning at a point 35° 35.0666' N - 75° 51.2000' W on Pains Point, running southerly to a point 35° 34.4666' N – 75° 50.9666' W on Rawls Island; running easterly to a point 35° 34.2309' N - 75° 50.2695' W on the east shore;

(d) Long Shoal River, north of a line beginning at a point 35° 35.2120' N - 75° 53.2232' W at the 5th Avenue Canal, running easterly to a point 35° 35.0666' N - 75° 51.2000' W on the east shore on Pains Point;

(e) Wysocking Bay:

(i) Wysocking Bay, north of a line beginning at a point 35° 25.2741' N - 76° 03.1169' W on Mackey Point, running easterly to a point 35° 25.1189' N - 76°02.0499' W at the mouth of Lone Tree Creek;

(ii) Mount Pleasant Bay, west of a line beginning at a point 35° 23.8652' N - 76° 04.1270' W on Browns Island, running southerly to a point 35° 22.9684' N - 76° 03.7129' W on Bensons Point;

(f) Juniper Bay, north of a line beginning at a point 35° 22.1384' N - 76° 15.5991' W near the Caffee Bay ditch, running easterly to a point 35° 22.0598' N - 76° 15.0095' W on the east shore;

(g) Swan Quarter Bay:
  (i) Cafee Bay, east of a line beginning at a point 35° 22.1944' N - 76° 19.1722' W on the north shore, running southerly to a point 35° 21.5959' N - 76° 18.3580' W on Drum Point;
  (ii) Oyster Creek, east of a line beginning at a point 35° 23.3278' N - 76° 19.9476' W on the north shore, running southerly to a point 35° 22.7018' N - 76° 19.3773' W on the south shore;
(h) Rose Bay:
  (i) Rose Bay, north of a line beginning at a point 35° 25.7729' N - 76° 24.5336' W on Island Point, running southeasterly and passing near Beacon "5" to a point 35° 25.1854' N - 76° 23.2333' W on the east shore;
  (ii) Tooleys Creek, west of a line beginning at a point 35° 25.7729' N - 76° 24.5336' W on Island Point, running southwesterly to a point 35° 25.1435' N - 76° 25.1646' W on Ranger Point;
(i) Spencer Bay:
  (i) Striking Bay, north of a line beginning at a point 35° 23.4106' N - 76° 26.9629' W on Short Point, running easterly to a point 35° 23.3404' N - 76° 26.2491' W on Long Point;
  (ii) Germantown Bay, north of a line beginning at a point 35° 24.0937' N - 76° 27.9348' W; on the west shore, running easterly to a point 35° 23.8598' N - 76° 27.4037' W on the east shore;
(j) Abel Bay, northeast of a line beginning at a point 35° 23.6463' N - 76° 31.0003' W on the west shore, running southeasterly to a point 35° 22.9353' N - 76° 29.7215' W on the east shore;
(k) Pungo River, Fortescue Creek, east of a line beginning at a point 35° 25.9213' N - 76° 31.9135' W on Pasture Point; running southerly to a point 35° 25.6012' N - 76° 31.9641' W on Lupton Point ;
(l) Pamlico River:
  (i) North Creek, north of a line beginning at a point 35° 25.3988' N - 76° 40.0455' W on the west shore, running southeasterly to a point 35° 25.1384' N - 76° 39.6712' W on the east shore;
  (ii) Campbell Creek (off of Goose Creek), west of a line beginning at a point 35° 17.3600' N - 76° 37.1096' W on the north shore; running southerly to a point 35° 16.9876' N - 76° 37.0965' W on the south shore;
  (iii) Eastham Creek (off of Goose Creek), east of a line beginning at a point 35° 17.7423' N - 76° 36.5164' W on the north shore; running southeasterly to a point 35° 17.5444' N - 76° 36.3963' W on the south shore;
  (iv) Oyster Creek-Middle Prong, southwest of a line beginning at a point 35° 19.4921' N - 76° 32.2590' W on Cedar Island; running southeasterly to a point 35° 19.1265' N - 76° 31.7226' W on Beard Island Point; and southwest of a line beginning at a point 35° 19.5586' N – 76° 32.8830' W on the west shore, running easterly to a point 35° 19.5490' N – 76° 32.7365' W on the east shore;
(m) Mouse Harbor, west of a line beginning at a point 35° 18.3915'N - 76° 29.0454' W on Persimmon Tree Point, running southerly to a point 35° 17.1825N - 76° 28.8713' W on Yaupon Hammock Point;
(n) Big Porpoise Bay, northwest of a line beginning at a point 35° 15.6993' N – 76° 28.2041' W on Big Porpoise Point, running southwesterly to a point 35° 14.9276'N - 76° 28.8658' W on Middle Bay Point;
(o) Middle Bay, west of a line beginning at a point 35° 14.8003' N - 76° 29.1923' W on Deep Point, running southerly to a point 35° 13.5419' N - 76° 29.6123' W on Little Fishing Point;
(p) Jones Bay, west of a line beginning at a point 35° 14.0406' N - 76° 33.3312' W on Drum Creek Point, running southerly to a point 35°13.3609' N – 76° 33.6539' W on Ditch Creek Point;

(q) Bay River:

(i) Gales Creek-Bear Creek, north and west of a line beginning at a point 35° 11.2833' N - 76° 35.9000' W on Sanders Point, running northeasterly to a point 35° 11.9000' N - 76° 34.2833' W on the east shore;

(ii) Bonner Bay, southeast of a line beginning at a point 35° 09.6281' N - 76° 36.2185' W on the west shore; running northeasterly to a point 35° 10.0888' N - 76° 35.2587' W on Davis Island Point;

(r) Neuse River:

(i) Lower Broad Creek, west of a line beginning at a point 35° 05.8314' N - 76° 35.3845' W on the north shore; running southwesterly to a point 35° 05.5505' N - 76° 35.7249' W on the south shore;

(ii) Greens Creek - north of a line beginning at a point 35° 01.3476' N - 76° 42.1740' W on the west shore of Greens Creek; running northeasterly to a point 35° 01.4899' N - 76° 41.9961' W on the east shore;

(iii) Dawson Creek, north of a line beginning at a point 34° 59.5920' N - 76° 45.4620' W on the west shore; running southeasterly to a point 34° 59.5800' N – 76° 45.4140' W on the east shore;

(iv) Clubfoot Creek, south of a line beginning at a point 34° 54.5424' N - 76° 45.7252' W on the west shore, running easterly to a point 34° 54.4853' N - 76° 45.4022' W on the east shore;

(v) Turnagain Bay, south of a line beginning at a point 34° 59.4065' N - 76° 30.1906' W on the west shore; running easterly to a point 34° 59.5668' N - 76° 29.3557' W on the east shore;

(s) West Bay:

(i) Long Bay-Ditch Bay, west of a line beginning at a point 34° 57.9388' N - 76° 27.0781' W on the north shore of Ditch Bay; running southwesterly to a point 34° 57.2120' N – 76° 27.2185' W on the south shore of Ditch Bay; then south of a line running southeasterly to a point 34° 56.7633' N – 76° 26.3927' W on the east shore of Long Bay;

(ii) West Thorofare Bay, south of a line beginning at a point 34° 57.2199' N - 76° 24.0947' W on the west shore; running easterly to a point 34° 57.4871' N - 76° 23.0737' W on the east shore;

(iii) Merkle Bay, east of a line beginning at a point 34° 58.2286' N - 76° 22.8374' W on the north shore, running southerly to a point 34° 57.5920' N - 76° 23.0704' W on Merkle Bay Point;

(iv) North Bay, east of a line beginning at a point 35° 01.8982' N - 76° 21.7135' W on Point of Grass, running southeasterly to a point 35° 01.3320' N - 76° 21.3353' W on Western Point.

(3) In Core Sound and its tributaries, southwest of a line beginning at a point 35°00.1000' N – 76°14.8667' W near Hog Island Reef; running easterly to a point 34°58.7853' N – 76°09.8922' W on Core Banks; and in the following waterbodies and their tributaries:Back Bay, the Straits, Back Sound, North River, Newport River, Bogue Sound and White Oak River.

(4) In ~~any of the coastal waters of~~ Onslow, Pender, New Hanover, and Brunswick counties.

Authority G.S. 113-134; 113-182; 143B 289.52;

North Carolina Department of Environment and Natural Resources

Pat McCrory
Governor

Donald R. van der Vaart
Secretary

MEMORANDUM

TO: N.C. Marine Fisheries Commission

FROM: Patti Fowler
N.C. Division of Marine Fisheries

DATE: May 4, 2014

SUBJECT: Brad Scott Timeline

At its February 2015 business meeting, the Marine Fisheries Commission requested the Division of Marine Fisheries prepare information regarding the chronology of interactions the division and the commission have had related to the denial of an Aquaculture Operations Permit requested by Mr. Brad Scott.

Please find attached an abridged timeline that goes back to 2007, when the division denied Mr. Scott's application for an Aquaculture Operations Permit. Mr. Scott seeks a permit to culture or grow shellfish seed at the Masonboro Boat Yard, which is a prohibited area polluted with heavy metal contaminants, which are considered poisonous or deleterious substances. The National Shellfish Sanitation Program does allow the nursery of seed in prohibited waters unless those waters contain poisonous or deleterious substances.

There have been numerous exchanges and inquiries regarding Mr. Scott's permit denial from legislators, the Governor's Office, the Department of Environment and Natural Resources, Division of Water Quality, Environmental Health/Pubic Health, the state health director, the state toxicologist, the FDA, the Marine Fisheries Commission and the Shellfish/Crustacean Advisory Committee. Important points in the timeline include:

- A declaratory ruling from the commission in 2008 determining that the rules were properly interpreted and Mr. Scott's permit was properly denied.
- In 2011, Dr. Ken Rudo, the state toxicologist, found elevated levels of arsenic and zinc from oyster samples collected from Masonboro Boat Yard and states he believes consumption over time would pose an increased health risk.
- A 2011 consensus statement from the Marine Fisheries Commission that the nursery of shellfish in prohibited waters to be transferred to leases is an unacceptable practice.
- Review in 2012 by the commission's Shellfish/Crustacean Advisory Committee that resulted in recommendations from several members that Mr. Scott seek another location for his facility.
- Review in 2013 by the ombudsman at the Department of Environment and Natural Resources that said his permit denial was investigated and fully vetted through the department, asks Mr. Scott if there are other more suitable locations for his operation and advises that if Mr. Scott wants to pursue his request further he would have to seek statutory and rule changes.

Abridged Brad Scott Timeline

2007	***Aquaculture Operations Permit denied***	DMF Director denies Mr. Brad Scott an Aquaculture Operations Permit for nursery of shellfish in a prohibited area.
Jan. 24, 2008	***MFC Declaratory Ruling***	Mr. Scott sought a declaratory ruling as to the applicability of 15A NCAC 3O .0501(h), which allows the division director to evaluate potential threats to public health or marine and estuarine resources regulated by the Marine Fisheries Commission in determining whether to issue a permit, to an application for an aquaculture permit for the use of prohibit (polluted) waters for the nursery/hatchery of cultured shellfish. The commission determined the rules were properly interpreted in regards to Mr. Scott's request for a declatory ruling and that Mr. Scott's application for an Aquaculture Operation Permit for the raising of shellfish in an aquaculture operation utilizing water from a prohibited and closed area due to pollution presents a potential threat to the public health from the risk of consuming contaminated shellfish and was properly denied by the DMF Director.
Jan. 24, 2008	***MFC to revisit issue***	Motion passes to revisit an issue paper on shellfish leases in polluted areas, to determine how to handle future situations of leases in polluted areas.
April 1, 2009	***DMF Director offers guidelines***	DMF Director sends email with guidelines on obtaining an Aquaculture Operations Permit in restricted or prohibited areas.
Feb. 12, 2010	***FDA advice***	FDA sends Mr. Scott an email advising that under the National Shellfish Sanitation Program, seed from waters that cause them to be contaminated with unacceptable levels of poisonous or deleterious substances is not permitted.
March - April 2011	***Mr. Scott contacts Division of Environmental Health and Director's Response***	**3/17/11:** Mr. Scott contacts Terry Pierce, Division of Environmenal Health Director, concerning shellfish nursery in marinas. **4/7/11:** Terry Pierce, DEH Director, responds to Mr. Scott that public health is the primary focus of state and national shellfish programs and that marinas have the potential to have elevated levels of contaminants other than bacteria and that N.C. General Statutes do not allow the type of shellfish lease he is requesting in waters closed to shellfish harvest by reason of pollution.
Sept.-Oct. 2011	***Oyster meat samples analyzed by State Toxicologist***	**10/11/11:** Division of Water Quality forwards heavy metals results from oysters collected from Masonboro Boat Yard to state toxicologist for analysis. **10/27/11:** Dr. Ken Rudo, state toxicologist, finds elevated levels of arsenic and zinc and believes consumption over time would pose an increased health risk.
Nov. 4, 2011	***MFC consensus statement***	DMF Director updated the Marine Fisheires Commission on the status of an application to raise seed clams in prohibited waters from Mr. Scott. He said that testing in the area where the clams would be cultured had shown elevated levels of zinc and arsenic and that it was his intent not to issue an Aquaculture Operations Permit due to health concerns. The commission agreed by consensus that the nursery of shellfish in prohibited waters to be transferred to leases is an unacceptable practice.
Nov. 7, 2011	***DMF Director maintains his decision to deny***	Email is sent from DMF Director, maintaining his original decision denying Mr. Scott's Aquaculture Operations Permit regarding nursery of shellfish in prohibited waters.
Nov. 2011- Jan. 2012	***Mr. Scott questions health risk of arsenic and response from DMF Director***	**1/18/12:** Mr. Scott sends emails, including a forwarded email from Dr. Joshua Hamilton that questions risk based on using total arsenic vs. inorganic arsenic. **1/24/12:** DMF Director email provides links that questions safety of arsenobetaine. Without conclusive evidence that there is no public health risk, he maintains his decision to deny the permit. He also reiterates that arsenic is not the only issue concerning his proposed activity.
Aug. - Oct, 2012	***Shellfish/Crustacean Advisory Committee meetings***	**8/6/12:** Mr. Scott addresses the MFC Shellfish/Crustacean Advisory Committee during public comment. Two members asked for Shellfish Sanitation staff present information concerning this issue at its next meeting. **10/2/12:** Staff met with Mr. Scott in advance of the meeting to review his concerns. The division and Mr. Scott provide presentations on the permit request. While the committee took no formal action, several members advised Mr. Scott to seek another location for his facility that did not contain unacceptable levels of poisonous or deleterious substances.
2013 - 2014	***DENR responses to Mr. Scott***	**5/2/13:** Letter from DENR Ombudsman Joseph Harwood says the issue has been investigated and fully vetted within DENR, inquires if another more suitable location has been considered and advises if Mr. Scott if he wants to pursue his request further he will need to seek statutory and rule changes. **7/21/14:** Email from DENR Ombudsman Joseph Harwood that says Sec. Skavarla believes that cultured and/or wild harvested seafood marketing can be adversely affected by incidences of health issues associated with shellfish from prohibited shellfish harvest waters and while N.C. rules may be more restrictive than other states, the secreatry believes that the current rules are protective and prudent for our state's shellfish industry and adds an extra margin of safety for its citizens.
Dec. 2, 2014	***Oyster/Clam FisheryManagement Plans***	Patti Fowler clarifies with Mr. Scott that information regarding shellfish hatcheries and nurseries in prohibited waters will be incorporated into the private culture sections of the plans.

NORTH CAROLINA DIVISION OF MARINE FISHERIES

Fish Dealer Report

License & Statistics Section, PO Box 769, Morehead City, NC 28557

MAY 2015

2014 ANNUAL COMMERCIAL LANDINGS REVIEW

Based on data collected through the N. C. Division of Marine Fisheries Trip Ticket Program, 61.7 million pounds of finfish and shellfish were landed in 2014 with an estimated dockside value of $93.8 million. This reflects a 23 percent increase in landings when compared with the 2013 harvest and a 19 percent increase in value. The five year harvest levels averaged 61.6 million pounds with an average value of $79.3 million.

2014 Percent Landings by County

The percent landings are represented by a color gradient, which increases from white to black as the percentage increases.

Dare County had the greatest percent of the 2014 landings, with 36 percent of the total landings, followed by Carteret (12 percent), Hyde (8 percent), Tyrrell (8 percent) and Camden (7 percent). The remaining counties each had landed less than 5 percent of the total.

The top five species by pounds landed were hard blue crabs with 25.2 million pounds, followed by, spiny dogfish (5.7 million pounds), shrimp (4.7 million pounds), summer flounder (2.9 million pounds) and Atlantic croaker (2.6 million pounds). Except for shrimp, landings for the top five species were up in 2014 compared with 2013.

Summer flounder landings increased dramatically, with landings in 2014 over five times higher than in 2013. This is largely due to fish being landed in N.C. instead of other states as was the case in 2013. During the 2013 season over 2.7 million pounds of the N.C. flounder quota were transferred to other states in response to the limited navigability of Oregon Inlet. The increase in landings was mirrored by an increase in the number of flounder trawl trips, the gear catching the majority of the summer flounder, which were three and a half times higher in 2014 compared with 2013.

Hard crab landings increased 18 percent from 2013, while peelers and soft blue crabs increased 39 percent and 16 percent, respectively. Values followed the increasing trend rising by 13 percent for hard crabs, 34 percent for peelers, and 2 percent for soft crabs. The number of crab dredge trips remained low this year, however crab trawl trips more than doubled in 2014 after large decreases were observed in both 2012 and 2013.

Shrimp landings decreased by 4 percent in 2014 from the four year high seen in 2012. The landings in 2012 were driven by large increases in pink and white shrimp harvest. Despite an increase of more than million pounds in brown shrimp landings the white and pink shrimp landings continued to decline leading to an overall decrease in shrimp landings. The value of the shrimp landings increased by 9 percent this year value, but increased by 19 percent when compared to the previous four-year average. The 2014 landings decrease coincided with a 19 percent decrease in the number of shrimp trawl trips and a 40 percent decrease in the number of skimmer trawl trips compared to 2013.

For a full listing of pounds and ex-vessel value by species and further information on 2013 landings data see the *2014 Annual Fisheries Bulletin*. The bulletin also contains landings for 2010 to 2013 as well as a summary of the number of trips by major gears used in North Carolina.

ESTUARINE GILL NET PERMIT

On Sept. 1, 2014 the Estuarine Gill Net Permit became effective. It is required for any anchored small or large mesh fishing operation in internal coastal waters. The permit is a requirement of the federal incidental take permits for sea turtles and Atlantic sturgeon. A condition of the incidental take permits is to maintain certain levels of observer coverage statewide. The Estuarine Gill Net Permit requires fishermen to provide an active phone number where they can be reached to schedule observer trips so that DMF can maintain the observer coverage needed to stay in compliance with the incidental take permits. To date, there have been 2,523 permits issued. Fishermen can obtain or renew their annual permit when they renew their license at any DMF office or via mail.

FISHERY MANAGEMENT PLAN UPDATES

State law requires the division to prepare a fishery management plan for adoption by the Marine Fisheries Commission for all commercially and recreationally significant species or fisheries in North Carolina. These plans provide management strategies designed to ensure long-term viability of each fishery. State law also requires the N. C. Division of Marine Fisheries to review each plan every five years.

Following are highlights from fishery management plans recently or currently under review:

- At its February 2015 meeting, the commission gave final approval of amendments to the Bay Scallop, River Herring and Shrimp fishery management plans. The implementing rules became effective May 1, 2015.
- An amendment to the Striped Mullet Fishery Management Plan is underway. Implementing rules are not expected to become effective until 2016.
- Amendments to the Oyster and Hard Clam fishery management plans are also underway. Implementing rules are not expected to become effective until 2017.

For more information regarding upcoming fishery management plan reviews, please see the News Releases page at (http://portal.ncdenr.org/web/mf/news-releases).

2015 - 2016 LICENSE YEAR FEE INCREASES

With the beginning of 2015-2016 license sales, which occurred on April 15, the price of six commercial fishing licenses increased 60 percent. The fee increases are shown in the following table, and affects all commercial fishing licenses with the exception of the Commercial Vessel Registration fee. The fee increases were proposed by the commercial fishing industry and will fund the Commercial Fishing Resource Fund. The fund will be used to cover the cost of the N.C. Division of Marine Fisheries Observer Program, a requirement of the incidental take permits for the commercial fishing industry under the federal Endangered Species Act, and for other projects to develop and support sustainable commercial fishing in the state. For more information, contact Don Hesselman at 252-808-8099 or Don.Hesselman@ncdenr.gov.

N.C. Resident Fee Changes		
License	**Old Fee**	**New Fee**
Recreational Commercial Gear	$43.75	$70.00
Standard Commercial Fishing	$250.00	$400.00
Retired Standard Commercial Fishing	$125.00	$200.00
Shellfish	$31.25	$50.00
Application Fee for New Dealers	$62.50	$100.00
Fish Dealer (Individual categories)	$62.50	$100.00
Consolidated Fish Dealer	$375.00	$600.00
Non-Resident Fee Changes		
License	**Old Fee**	**New Fee**
Recreational Commercial Gear	$312.50	$500.00
Land and Sell	$250.00 minimum	$400.00 minimum
Standard Commercial Fishing	$250.00 minimum	$400.00 minimum
Retired Standard Commercial Fishing	$162.50	$260.00

NC MARINE FISHERIES COMMISSION MEETING SCHEDULE FOR 2015

May 20-22: Hilton Riverfront, New Bern

August 19-21: Hilton Brownstone, Raleigh

November 18-20: Jennette's Pier, Nags Head

***Listen to MFC Meetings live via online streaming. See division website for details.**

NORTH CAROLINA BIENNIAL FISH DEALER SURVEY

The NC Division of Marine Fisheries Trip Ticket Program conducts a survey of fish dealers every two years to obtain input on various aspects of the program. In October 2014, the survey was mailed out to the 722 licensed fish dealers in the state. The survey responses are anonymous and dealers identify themselves only if they choose. One hundred sixty-three surveys were returned, for a 22 percent response rate. The majority of respondents reported being fish dealers for less than 10 years and were located in Dare County. Following are highlights from this biennial survey.

The survey results indicate overall satisfaction with the Trip Ticket Program among dealers. Most respondents agreed or strongly agreed that the Trip Ticket program allows for easy and accurate data reporting, the program requirements are well explained, supplies are readily available and accessible, and that customer service is satisfactory. There was also a consensus among dealers that they do not support the addition of any mandatory reporting, including price data, however, they are split evenly when it comes to voluntary price reporting.

In addition to assessing dealer opinion of the current Trip Ticket Program, the survey also assessed interest and satisfaction with electronic reporting. A total of 40 electronic reporting dealers responded to the survey. Overall opinion of electronic reporting was good to excellent. A high percentage of electronic dealers, 90 percent, found the software to be easy to use and 87 percent found the instruction they received to be good to excellent.

For more information and complete results please contact Alan Bianchi at alan.bianchi@ncdenr.gov or (252)808-8092.

COMMERCIAL FISHING LICENSE HOLDER PERSONAL CONSUMPTION AND DONATION SURVEY

The N. C. Division of Marine Fisheries carried out a mail-based pilot survey of commercial fishing license holders in early 2015 as part of an effort to gather information on fish and shellfish that are landed with commercial fishing gear but kept for personal consumption or donation. Being a pilot survey to gauge if more effort is needed to examine the extent of unsold catch, the survey was designed to be brief. Respondents were asked to answer a series of five general questions regarding their main reason for owning a commercial fishing license, whether they fished with commercial gears or harvested commercial quantities of shellfish or finfish in 2014, what kind of gears were used, typical use of catch, and estimated harvest of seafood caught by commercial gears but kept for personal consumption or donation.

Out of the 2,000 commercial fishing license holders that were mailed the survey, the division received 657 responses, making for an overall response rate of approximately 33 percent. These license holders held 477 standard commercial fishing licenses, 164 retired standard commercial fishing licenses, and 75 commercial shellfish licenses. A final report detailing the results of this survey will be available by mid-May. A full copy of the report will be made accessible on the division's website at http://portal.ncdenr.org/web/mf/social-economic-data-reports or by contacting John Hadley at john.hadley@ncdenr.gov or 252-808-8107.

LICENSE SALES
JULY 1, 2013 to APRIL 27, 2014

Below are sales as of April 27 by license type for the 2015 (July 1,2014-June 30,2015) license year. The values below include active licenses only. Totals do not include transfers, replacements or voids.

Standard Commercial Fishing License	4,886
Retired Standard Commercial Fishing License	1,171
Commercial Fishing Vessel Registration	7,947
Land or Sell License	112
NC Resident Shellfish License Without SCFL	1,285
Fish Dealer License	722
Ocean Pier License	20
Recreational Fishing Tournament License	15
Recreational Commercial Gear License	2,793
Total Licenses For All License Types	19,708

Licenses for license year 2016 (July 1, 2015 – June 30, 2016) went on sale April 15 and renewal by mail is available. If you want to avoid the lines at the license office, please use the mail-in process.

NORTH CAROLINA DIVISION OF MARINE FISHERIES

Annual Fisheries Bulletin

2014 Commercial & Recreational Statistics

License and Statistics Section
PO Box 769
Morehead City, NC 28557
May 2015

The Annual Fisheries Bulletin contains the North Carolina commercial and recreational fisheries harvest statistics for 2014. Included in this bulletin are the 2014 landings from the commercial and recreational fisheries programs, along with the 2010 to 2013 landings for comparison purposes. The bulletin also contains a summary of commercial fishing trips by major gears.

The North Carolina Trip Ticket Program collects commercial fishery landings and effort statistics. This program mandates trip level fish dealer reporting of all finfish and shellfish landed in the state. Recreational fishery harvest and effort statistics are derived from the Marine Recreational Information Program (MRIP) that conducts recreational angler interviews at public access points and telephone surveys.

Total Pounds Harvested in 2014

Commercial
61,742,966 pounds

Recreational
8,999,639 pounds

Top Five Species Caught In Each Fishery

Commercial	
Species	**Pounds**
Hard Blue Crabs	25,243,005
Spiny Dogfish	5,650,285
Shrimp (Heads On)	4,683,652
Summer Flounder	2,906,789
Atlantic Croaker	2,629,793

Recreational	
Species	**Pounds**
Dolphin	1,338,209
Bluefish	961,222
Yellowfin tuna	913,785
Spot	704,445
Red drum	598,166

Issued by the North Carolina Division of Marine Fisheries, Department of Environment and Natural Resources.

For additional information regarding Commercial and Recreational Statistics, please contact:

Alan Bianchi, Commercial Statistics
(252) 726-7021 or (800) 682-2632
alan.bianchi@ncdenr,gov

Doug Mumford, Recreational Statistics
(252) 948-3876 or (800) 338-7804
doug.mumford@ncdenr.gov

2014 North Carolina Commercial Landings 2014

Issued: May 2015

FINFISH	POUNDS (Whole/Round Weight)	VALUE
Amberjacks[1]	193,001	$198,899
Anglerfish (Monkfish including Monklivers)	75,962	$84,931
Bluefish	2,019,154	$889,681
Bonito	9,081	$14,386
Butterfish	53,607	$27,287
Carp	16,435	$1,555
Catfishes	521,241	$158,430
Cobia	41,798	$87,931
Croaker, Atlantic	2,629,793	$1,865,543
Cutlassfish, Atlantic	165,375	$221,870
Dolphinfish	423,676	$1,242,648
Drum, Black	51,023	$32,178
Drum, Red	90,594	$208,166
Eel, American	58,886	$159,727
Flounder, Southern	1,673,261	$4,838,892
Flounder, Summer	2,906,789	$8,211,281
Flounders, Other	4,413	$8,926
Garfish	10,621	$3,611
Grouper, Gag	167,572	$737,755
Grouper, Red	53,096	$202,112
Grouper, Scamp	42,207	$187,776
Grouper, Snowy	27,553	$102,830
Groupers, Other	9,125	$33,799
Grunts	39,043	$39,843
Hakes	652	$293
Harvestfish (Starbutters)	155,334	$187,874
Herring, River (Alewife and Blueback Herring)	989	$1,319
Hogfish (Hog Snapper)	9,767	$37,920
Jacks	9,151	$6,220
Mackerel, Atlantic (Boston)	1,761	$658
Mackerel, King	549,727	$1,202,899
Mackerel, Spanish	673,897	$1,230,312
Menhaden, Atlantic	917,375	$145,587
Mullet, Sea (Kingfishes)	952,263	$1,004,523
Mullet, Striped	1,825,091	$1,110,664
Perch, White	172,236	$148,530
Perch, Yellow	67,452	$82,334
Pigfish	38,570	$15,333
Pinfish	1,431	$561
Pompano	12,921	$31,171
Porgies	82,685	$144,985
Pufferfish	1,611	$886
Scup	160,508	$110,203
Sea Basses	523,234	$1,400,012
Seatrout, Spotted	241,995	$578,934
Shad, American	193,130	$160,977
Shad, Gizzard	113,841	$5,692
Shad, Hickory	109,407	$27,394

2014 North Carolina Commercial Landings

(continued)

FINFISH	POUNDS (Whole/Round Weight)	VALUE
Sharks[2]	1,005,858	$473,375
Sharks, Dogfish, Smooth	498,904	$213,763
Sharks, Dogfish, Spiny	5,650,285	$566,615
Sheepshead	173,367	$159,266
Skates	18,907	$6,137
Skippers	19,884	$5,207
Snapper, Red[3]	4,826	$23,007
Snapper, Vermilion (Beeliner)	242,259	$829,916
Snappers, Other	4,002	$11,695
Spadefish, Atlantic	22,761	$10,652
Spot	764,689	$618,398
Striped Bass	96,233	$283,241
Swordfish	694,911	$2,109,549
Tilefish	91,074	$238,808
Triggerfish	116,782	$262,199
Tuna, Bigeye	337,269	$1,222,610
Tuna, Bluefin	114,037	$375,975
Tuna, Yellowfin	816,077	$1,798,031
Tunas, Other	155,033	$115,186
Tunny, Little (False Albacore)	225,797	$107,605
Wahoo	22,715	$71,612
Weakfish (Gray Trout)	105,115	$140,430
Unclassified Fish for Food	122,116	$132,944
Unclassified Fish for Industrial Use or Bait	24,611	$4,192
TOTAL FINFISH	29,425,842	$36,975,752
SHELLFISH		
Shrimp (Heads On)[4]	4,683,652	$14,131,151
Clams, Hard (Meats)	430,777	$2,865,960
	(22,438,758 numbers)	--
Blue Crabs, Hard	25,243,005	$29,954,893
Blue Crabs, Peeler	621,040	$1,935,462
Blue Crabs, Soft	367,277	$2,137,335
Octopus	213	$271
Oysters (Meats)	727,043	$4,539,334
	(139,548 bushels)	
Scallop, Bay (Meats)	0	$0
Scallop, Sea (Meats)	92,976	$1,011,221
Squid	16,072	$13,421
Stone Crabs	7,451	$19,882
Unclassified Shellfish	74,073	$146,470
Whelks/Conchs (Meats)	53,546	$112,102
TOTAL SHELLFISH	32,317,124	$56,867,502
GRAND TOTAL	61,742,966	$93,843,254

[1] Includes species from the genus *Seriola* (amberjacks, almaco jacks, and banded rudderfish.)
[2] Includes shark fins and the following sharks: blacknose, blacktip, bonnethead, bull, finetooth, hammerhead, shortfin mako, spinner, thresher, tiger, and Atlantic sharpnose.
[3] The red snapper fishery closed on January 4, 2010 with restricted openings occurring in some years.
[4] Includes brown, pink, and white shrimp.
* Units and value not shown to avoid disclosure of private enterprise.

2013 North Carolina Commercial Landings 2013

Updated: May 2015

FINFISH	POUNDS (Whole/Round Weight)	VALUE
Amberjacks[1]	90,180	$90,035
Anglerfish (Monkfish including Monklivers)	10,566	$9,053
Bluefish	1,159,580	$564,377
Bonito	10,506	$15,460
Butterfish	93,146	$53,369
Carp	14,133	$1,360
Catfishes	548,913	$92,497
Cobia	35,456	$73,142
Croaker, Atlantic	1,927,938	$1,723,578
Cutlassfish, Atlantic	145,362	$204,869
Dolphinfish	178,922	$534,228
Drum, Black	127,170	$79,480
Drum, Red	371,949	$715,685
Eel, American	33,980	$88,649
Flounder, Southern	2,186,273	$5,672,904
Flounder, Summer	541,661	$1,386,627
Flounders, Other	*	*
Garfish	5,893	$1,208
Grouper, Gag	167,334	$704,382
Grouper, Red	72,259	$259,861
Grouper, Scamp	42,711	$180,679
Grouper, Snowy	20,274	$72,067
Groupers, Other	8,856	$31,637
Grunts	44,702	$47,062
Hakes	614	$231
Harvestfish (Starbutters)	221,168	$253,604
Herring, River (Alewife and Blueback Herring)	743	$743
Hogfish (Hog Snapper)	7,847	$30,640
Jacks	14,492	$10,639
Mackerel, Atlantic (Boston)	154	$61
Mackerel, King	345,177	$877,497
Mackerel, Spanish	620,752	$1,015,965
Menhaden, Atlantic	454,172	$73,490
Mullet, Sea (Kingfishes)	603,186	$668,480
Mullet, Striped	1,549,157	$1,402,914
Perch, White	275,652	$255,633
Perch, Yellow	31,481	$40,546
Pigfish	62,099	$28,093
Pinfish	1,536	$463
Pompano	15,423	$41,351
Porgies	72,671	$116,780
Pufferfish	5,846	$2,858
Scup	28,691	$13,323
Sea Basses	329,731	$868,920
Seatrout, Spotted	367,610	$818,078
Shad, American	257,869	$307,475
Shad, Gizzard	112,295	$4,492
Shad, Hickory	71,326	$29,144

2013 North Carolina Commercial Landings

(continued)

FINFISH	POUNDS (Whole/Round Weight)	VALUE
Sharks[2]	553,665	$282,318
Sharks, Dogfish, Smooth	783,053	$344,182
Sharks, Dogfish, Spiny	3,010,958	$302,248
Sheepshead	180,225	$145,794
Skates	2,286	$429
Skippers	15,780	$4,652
Snapper, Red[3]	2,686	$11,942
Snapper, Vermilion (Beeliner)	267,260	$886,596
Snappers, Other	6,587	$19,449
Spadefish, Atlantic	20,369	$9,246
Spot	768,592	$690,035
Striped Bass	96,935	$303,486
Swordfish	1,058,089	$2,935,940
Tilefish	217,079	$522,652
Triggerfish	160,861	$342,228
Tuna, Bigeye	243,637	$939,909
Tuna, Bluefin	106,197	$608,952
Tuna, Yellowfin	648,039	$1,434,318
Tunas, Other	96,937	$113,429
Tunny, Little (False Albacore)	189,746	$114,416
Wahoo	23,380	$75,577
Weakfish (Gray Trout)	120,188	$150,725
Unclassified Fish for Food	118,974	$116,156
Unclassified Fish for Industrial Use or Bait	24,389	$2,565
TOTAL FINFISH	22,003,366	$29,820,875

SHELLFISH		
Shrimp (Heads On)[4]	4,859,833	$12,947,004
Clams, Hard (Meats)	347,048	$2,295,096
	(17,855,759 numbers)	-
Blue Crabs, Hard	21,438,400	$26,465,890
Blue Crabs, Peeler	447,120	$1,449,542
Blue Crabs, Soft	317,426	$2,091,382
Octopus	1,205	$2,069
Oysters (Meats)	586,619	$3,353,095
	(112,595 bushels)	-
Scallop, Bay (Meats)	1,337	$9,506
Scallop, Sea (Meats)	36,445	$402,717
Squid	12,090	$10,703
Stone Crabs	6,839	$18,479
Unclassified Shellfish	89,930	$115,183
Whelks/Conchs (Meats)	50,079	$123,236
TOTAL SHELLFISH	28,194,369	$49,283,901
GRAND TOTAL	50,197,736	$79,104,776

[1] Includes species from the genus *Seriola* (amberjacks, almaco jacks, and banded rudderfish.)
[2] Includes shark fins and the following sharks: blacktip, bonnethead, bull, finetooth, hammerhead, shortfin mako, spinner, thresher, tiger, and Atlantic sharpnose.
[3] The red snapper fishery closed on January 4, 2010 with restricted openings occurring in some years.
[4] Includes brown, pink, and white shrimp.
* Units and value not shown to avoid disclosure of private enterprise.

2012 North Carolina Commercial Landings 2012

Updated: May 1, 2015

FINFISH	POUNDS (Whole/Round Weight)	VALUE
Amberjacks[1]	124,325	$104,212
Anglerfish (Monkfish including Monklivers)	21,649	$25,286
Bluefish	758,858	$349,288
Bonito	11,343	$15,833
Butterfish	127,536	$65,553
Carp	6,199	$586
Catfishes	489,492	$116,379
Cobia	31,972	$61,603
Croaker, Atlantic	3,106,616	$2,135,458
Cutlassfish, Atlantic	50,867	$61,601
Dolphinfish	249,020	$756,346
Drum, Black	94,352	$54,133
Drum, Red	66,519	$138,833
Eel, American	64,110	$160,275
Flounder, Southern	1,646,137	$4,451,482
Flounder, Summer	1,090,218	$2,969,370
Flounders, Other	0	$0
Garfish	18,490	$2,339
Grouper, Gag	187,483	$758,371
Grouper, Red	111,781	$363,767
Grouper, Scamp	49,556	$195,370
Grouper, Snowy	25,740	$78,235
Groupers, Other	7,542	$26,152
Grunts	49,734	$50,044
Hakes	280	$100
Harvestfish (Starbutters)	161,751	$202,146
Herring, River (Alewife and Blueback Herring)	678	$678
Hogfish (Hog Snapper)	8,256	$28,738
Jacks	16,200	$13,414
Mackerel, Atlantic (Boston)	1,374	$567
Mackerel, King	297,423	$831,297
Mackerel, Spanish	916,439	$1,374,648
Menhaden, Atlantic	538,783	$82,974
Mullet, Sea (Kingfishes)	596,249	$645,607
Mullet, Striped	1,859,587	$1,041,659
Perch, White	189,448	$150,940
Perch, Yellow	20,511	$23,446
Pigfish	37,555	$19,834
Pinfish	1,017	$257
Pompano	22,525	$43,376
Porgies	83,918	$132,025
Pufferfish	5,531	$2,799
Scup	3,954	$2,768
Sea Basses	256,007	$687,905
Seatrout, Spotted	265,016	$522,130
Shad, American	235,861	$257,748
Shad, Gizzard	123,813	$4,333
Shad, Hickory	65,645	$22,389

2012 North Carolina Commercial Landings

(continued)

FINFISH	POUNDS (Whole/Round Weight)	VALUE
Sharks[2]	701,924	$376,171
Sharks, Dogfish, Smooth	980,275	$379,946
Sharks, Dogfish, Spiny	2,728,882	$640,820
Sheepshead	109,881	$92,837
Skates	5,738	$1,433
Skippers	21,998	$5,804
Snapper, Red[3]	445	$1,898
Snapper, Vermilion (Beeliner)	276,172	$889,691
Snappers, Other	2,751	$8,036
Spadefish, Atlantic	24,238	$9,043
Spot	489,676	$465,750
Striped Bass	144,555	$368,516
Swordfish	903,178	$3,009,107
Tilefish	361,094	$753,966
Triggerfish	143,114	$278,968
Tuna, Bigeye	232,943	$1,036,747
Tuna, Bluefin	130,496	$1,017,958
Tuna, Yellowfin	855,006	$2,130,454
Tunas, Other	105,893	$123,039
Tunny, Little (False Albacore)	157,849	$89,798
Wahoo	23,521	$73,998
Weakfish (Gray Trout)	91,383	$111,461
Unclassified Fish for Food	111,190	$111,452
Unclassified Fish for Industrial Use or Bait	34,775	$7,615
TOTAL FINFISH	22,734,334	$31,016,802
SHELLFISH		
Shrimp (Heads On)[4]	6,141,480	$13,333,150
Clams, Hard (Meats)	396,429	$2,091,067
	(20,074,457 clams)	--
Blue Crabs, Hard	25,991,387	$20,198,891
Blue Crabs, Peeler	469,761	$1,114,177
Blue Crabs, Soft	325,426	$1,496,021
Octopus	248	$382
Oysters (Meats)	440,063	$2,572,073
	(84,465 bushels)	--
Scallop, Bay (Meats)	0	$0
Scallop, Sea (Meats)	58,882	$567,230
Squid	11,921	$10,885
Stone Crabs	5,221	$17,125
Unclassified Shellfish	77,602	$79,721
Whelks/Conchs (Meats)	39,078	$75,705
TOTAL SHELLFISH	33,957,498	$41,556,427
GRAND TOTAL	56,691,832	$72,573,230

[1] Includes species from the genus *Seriola* (amberjacks, almaco jacks, and banded rudderfish.)
[2] Includes shark fins and the following sharks: blacktip, bonnethead, bull, finetooth, hammerhead, shortfin mako, spinner, thresher, tiger, and Atlantic sharpnose.
[3] The red snapper fishery closed on January 4, 2010 with restricted openings occurring in some years.
[4] Includes brown, pink, and white shrimp.
* Units and value not shown to avoid disclosure of private enterprise.

2011 North Carolina Commercial Landings 2011

Updated: May 1, 2015

FINFISH	POUNDS (Whole/Round Weight)	VALUE
Amberjacks[1]	72,797	$62,815
Anglerfish (Monkfish including Monklivers)	38,892	$48,702
Bluefish	1,897,408	$848,327
Bonito	11,039	$20,041
Butterfish	59,951	$31,176
Carp	24,367	$2,485
Catfishes	444,445	$85,039
Cobia	19,924	$34,908
Croaker, Atlantic	5,054,186	$3,164,034
Cutlassfish, Atlantic	8,439	$9,397
Dolphinfish	94,210	$244,752
Drum, Black	56,083	$26,432
Drum, Red	91,980	$166,966
Eel, American	61,960	$123,920
Flounder, Southern	1,247,450	$2,753,128
Flounder, Summer	2,854,122	$6,136,614
Flounders, Other	*	*
Garfish	25,933	$2,334
Grouper, Gag	201,467	$790,710
Grouper, Red	154,277	$481,431
Grouper, Scamp	37,321	$143,336
Grouper, Snowy	8,999	$24,680
Groupers, Other	6,454	$22,869
Grunts	33,443	$34,344
Hakes	873	$591
Harvestfish (Starbutters)	106,660	$102,927
Herring, River (Alewife and Blueback Herring)	1,611	$1,611
Hogfish (Hog Snapper)	10,793	$37,688
Jacks	1,068	$706
Mackerel, Atlantic (Boston)	6,512	$3,286
Mackerel, King	408,162	$1,062,081
Mackerel, Spanish	871,217	$1,188,154
Menhaden, Atlantic	3,529,967	$336,528
Mullet, Sea (Kingfishes)	486,853	$520,413
Mullet, Striped	1,627,894	$1,015,852
Perch, White	245,636	$223,248
Perch, Yellow	27,838	$38,554
Pigfish	39,838	$12,838
Pinfish	905	$252
Pompano	17,016	$42,724
Porgies	90,792	$133,648
Pufferfish	1,490	$916
Scup	308,907	$126,875
Sea Basses	272,280	$627,825
Seatrout, Spotted	75,239	$144,596
Shad, American	204,085	$182,894
Shad, Gizzard	101,025	$5,051
Shad, Hickory	85,096	$23,607

2011 North Carolina Commercial Landings

(continued)

FINFISH	POUNDS (Whole/Round Weight)	VALUE
Sharks[2]	584,238	$327,802
Sharks, Dogfish, Smooth	1,241,252	$401,178
Sharks, Dogfish, Spiny	2,557,923	$383,748
Sheepshead	120,976	$90,068
Skates	19,204	$7,730
Skippers	24,510	$6,594
Snapper, Red	0	$0
Snapper, Vermilion (Beeliner)	323,389	$997,623
Snappers, Other	2,982	$7,077
Spadefish, Atlantic	21,535	$6,839
Spot	936,970	$728,475
Striped Bass	410,685	$1,164,426
Swordfish	803,725	$2,617,201
Tilefish	133,824	$314,600
Triggerfish	220,204	$411,373
Tuna, Bigeye	277,659	$1,094,276
Tuna, Bluefin	48,358	$270,637
Tuna, Yellowfin	526,238	$944,099
Tunas, Other	76,661	$68,578
Tunny, Little (False Albacore)	131,549	$66,986
Wahoo	15,870	$44,685
Weakfish (Gray Trout)	65,897	$78,522
Unclassified Fish for Food	113,326	$145,153
Unclassified Fish for Industrial Use or Bait	54,904	$9,304
TOTAL FINFISH	29,738,779	$31,278,276
SHELLFISH		
Shrimp (Heads On)[3]	5,140,360	$10,885,795
Clams, Hard (Meats)	295,466	$1,896,627
	(15,088,757 clams)	--
Blue Crabs, Hard	28,964,633	$18,016,736
Blue Crabs, Peeler	624,362	$1,186,286
Blue Crabs, Soft	446,397	$2,079,242
Octopus	327	$501
Oysters (Meats)	800,543	$4,486,741
	(153,655 bushels)	--
Scallop, Bay (Meats)	0	$0
Scallop, Sea (Meats)	91,077	$883,772
Squid	1,267,192	$291,060
Stone Crabs	7,630	$21,926
Unclassified Shellfish	90,932	$83,407
Whelks/Conchs (Meats)	34,002	$73,456
TOTAL SHELLFISH	37,762,921	$39,905,550
GRAND TOTAL	67,501,700	$71,183,826

[1] Includes species from the genus *Seriola* (amberjacks, almaco jacks, and banded rudderfish.)
[2] Includes shark fins and the following sharks: blacktip, hammerhead, lemon, shortfin mako, thresher, and Atlantic sharpnose.
[3]The red snapper fishery closed on January 4, 2010 with restricted openings occurring in some years.
[4] Includes brown, pink, white and rock shrimp.
* Units and value not shown to avoid disclosure of private enterprise.

2010 North Carolina Commercial Landings 2010

Updated: May 1, 2015

FINFISH	POUNDS (Whole/Round Weight)	VALUE
Amberjacks[1]	128,762	$95,599
Anglerfish (Monkfish including Monklivers)	47,305	$60,322
Bluefish	3,216,019	$1,129,688
Bonito	15,686	$20,152
Butterfish	55,087	$32,656
Carp	23,807	$2,200
Catfishes	354,892	$64,316
Cobia	43,715	$64,829
Croaker, Atlantic	7,312,159	$3,409,671
Cutlassfish, Atlantic	19,753	$14,353
Dolphinfish	239,551	$492,270
Drum, Black	69,194	$32,805
Drum, Red	231,828	$421,781
Eel, American	122,104	$351,048
Flounder, Southern	1,689,557	$3,695,889
Flounder, Summer	3,310,992	$7,212,191
Flounders, Other	358	$363
Garfish	12,182	$812
Grouper, Gag	222,749	$766,577
Grouper, Red	231,780	$625,224
Grouper, Scamp	60,163	$200,970
Grouper, Snowy	35,472	$106,298
Groupers, Other	11,761	$31,473
Grunts	47,219	$42,279
Hakes	5,001	$1,429
Harvestfish (Starbutters)	80,459	$106,592
Herring, River (Alewife and Blueback Herring)	1,765	$1,765
Hogfish (Hog Snapper)	13,046	$37,897
Jacks	2,288	$1,586
Mackerel, Atlantic (Boston)	45,276	$17,595
Mackerel, King	328,806	$643,861
Mackerel, Spanish	911,866	$1,026,562
Menhaden, Atlantic	1,299,130	$111,552
Mullet, Sea (Kingfishes)	886,841	$958,377
Mullet, Striped	2,082,832	$1,002,468
Perch, White	200,501	$162,388
Perch, Yellow	57,027	$68,576
Pigfish	32,867	$16,433
Pinfish	14,579	$3,635
Pompano	14,840	$39,124
Porgies	84,781	$107,864
Pufferfish	2,472	$1,629
Scup	102,853	$51,424
Sea Basses	401,489	$947,900
Seatrout, Spotted	200,822	$350,925
Shad, American	234,520	$191,453
Shad, Gizzard	87,340	$43,670
Shad, Hickory	108,032	$20,951

2010 North Carolina Commercial Landings

(continued)

FINFISH	POUNDS (Whole/Round Weight)	VALUE
Sharks[2]	629,421	$325,080
Sharks, Dogfish, Smooth	1,614,844	$503,749
Sharks, Dogfish, Spiny	1,708,437	$256,512
Sheepshead	157,631	$99,666
Skates	7,503	$1,454
Skippers	13,937	$3,991
Snapper, Red	*	*
Snapper, Vermilion (Beeliner)	316,782	$946,157
Snappers, Other	3,435	$9,346
Spadefish, Atlantic	18,827	$6,116
Spot	572,315	$384,386
Striped Bass	500,152	$1,221,524
Swordfish	629,933	$1,897,151
Tilefish	430,394	$817,388
Triggerfish	225,682	$349,179
Tuna, Bigeye	96,464	$338,881
Tuna, Bluefin	48,562	$416,044
Tuna, Yellowfin	368,027	$616,442
Tunas, Other	43,626	$41,778
Tunny, Little (False Albacore)	147,337	$76,491
Wahoo	12,626	$30,329
Weakfish (Gray Trout)	106,328	$105,293
Unclassified Fish for Food	76,320	$118,846
Unclassified Fish for Industrial Use or Bait	67,663	$14,190
TOTAL FINFISH	32,497,778	$33,369,413
SHELLFISH		
Shrimp (Heads On)[3]	5,955,335	$10,691,399
Clams, Hard (Meats)	354,961	$2,581,033
	(18,233,183 clams)	--
Blue Crabs, Hard	29,794,329	$23,801,594
Blue Crabs, Peeler	568,210	$1,197,855
Blue Crabs, Soft	320,472	$1,544,342
Octopus	941	$1,111
Oysters (Meats)	1,040,407	$5,045,127
	(199,694 bushels)	--
Scallop, Bay (Meats)	*	*
Scallop, Sea (Meats)	171,898	$1,222,893
Squid	1,228,715	$284,426
Stone Crabs	5,593	$19,104
Unclassified Shellfish	47,308	$74,953
Whelks/Conchs (Meats)	15,672	$30,623
TOTAL SHELLFISH	39,503,840	$46,494,460
GRAND TOTAL	72,001,618	$79,863,873

[1] Includes species from the genus *Seriola* (amberjacks, almaco jacks, and banded rudderfish.)
[2] Includes shark fins and the following sharks: blacktip, bull, hammerhead, shortfin mako, sandbar, thresher, tiger, and Atlantic sharpnose.
[3] Includes brown, pink, and white shrimp.

North Carolina Commercial Fishing Trips By Major Gears

(2010 - 2014)

	Trips				
Gear	2010	2011	2012	2013	2014[1]
Beach Seine	183	102	68	57	21
By Hand	18,275	15,931	15,188	16,446	17,975
Cast Net	905	612	804	703	627
Channel Net	1,069	538	1,508	1,626	1,059
Clam Dredges	603	400	492	344	388
Clam Trawl Kicking	518	286	188	180	155
Crab Dredge	147	69	5	1	5
Crab Pot	50,428	48,144	48,052	48,121	50,522
Crab Trawl	274	228	20	85	180
Eel Pot	121	93	177	70	140
Fish Pot	649	538	613	623	672
Flounder Trawl	384	344	108	71	256
Flynet	286	190	14	4	40
Fyke Net	277	266	329	424	404
Gigs	2,424	2,183	3,148	2,585	2,801
Gill Net – Anchored	33,219	30,079	31,277	36,985	27,912
Gill Net – Drift	269	182	392	236	296
Gill Net – Runaround	3,677	2,606	3,590	3,785	3,379
Haul Seines[2]	372	369	177	273	204
Longlines	568	529	578	719	634
Oyster Dredge	10,658	7,400	2,264	3,763	5,705
Peeler Pot	3,347	2,908	3,516	3,334	4,006
Peeler Trawl[3]	31	41	24	29	26
Pound Nets	2,298	2,260	2,679	2,589	2,346
Rakes	10,389	9,437	9,403	9,988	11,778
Rod-n-Reel	2,486	1,986	2,151	2,066	2,263
Shrimp Trawl	5,592	4,372	6,195	5,650	4,577
Skimmer Trawl	1,096	330	1,088	1,194	712
Spears (Diving)	84	57	134	159	195
Tongs	4,797	6,020	5,527	4,092	3,895
Trolling	2,193	1,866	1,888	2,184	2,245
Trotline	6	20	50	38	49
Other Gears[4]	130	89	92	204	166
Total trips [5]	157,755	140,475	141,739	148,628	145,633

A **trip** is defined as the time period beginning when a vessel or fisherman leaves port to conduct fishing activities and ends when that vessel or fisherman returns to land the catch. The duration of a trip can vary from a few hours, as in hand clamming, to several days, as in ocean flounder trawling. An assessment of the number of trips gives an indication of the amount of effort conducted by commercial fishermen within that fishery.

1 Trips are preliminary.

2 Includes long hauls, common seines, and swipe nets.

3 A new code to distinguish peeler trawl gear was put into effect in 2010.

4 Includes greenstick trolling, butterfly nets, conch pots, dip nets, purse seines, bay scallop dredges, scallop scoops and trawls, shrimp pots and turtle pots; includes 701 scallop scoop trips in 2009.

5 Total trips are not equal to the sum of trips by gear due to multi-gear trips.

Source: North Carolina Division of Marine Fisheries Trip Ticket Program (April 2015).

North Carolina Marine Recreational Finfish Harvest

2013 and 2014

SPECIES	NUMBER 2013	NUMBER 2014	POUNDS 2013	POUNDS 2014
Amberjacks	10,078	3,371	172,647	65,723
Barracudas	224	891	1,276	11,043
Bluefish	1,183,627	1,080,853	988,664	961,222
Bonito	9,219	6,533	133,163	30,628
Cobia	19,224	9,714	506,067	244,831
Croaker, Atlantic	411,882	541,474	141,880	227,826
Dolphin	212,388	189,413	1,562,755	1,338,209
Drum, Red	164,218	116,921	676,050	598,166
Drum, Black	363,466	24,118	713,047	60,552
Flounder, Southern	178,178	69,828	409,086	149,244
Flounder, Summer	44,941	45,699	70,874	67,783
Groupers	5,390	1,852	54,418	20,363
Grunts	16,374	27,552	26,769	41,392
Jacks	25,164	9,013	24,835	29,193
Kingfishes	1,377,835	1,141,810	343,454	451,226
Mackerel, King	22,613	25,892	235,436	403,508
Mackerel, Spanish	497,329	389,167	625,035	441,511
Perch, Silver	13,345	11,519	2,366	2,519
Pigfish	299,065	293,196	101,014	83,634
Pinfish	355,871	332,156	61,148	74,072
Pompano	471,156	166,887	171,860	83,190
Porgies	8,460	8,673	16,720	17,453
Puffers	209,770	49,269	126,039	25,416
Sea Bass, Black	49,258	76,417	68,225	134,662
Seatrout, Spotted	369,265	234,658	649,158	435,176
Sharks	13,426	3,390	20,386	23,772
Sharks, Dogfish	4,986	1,044	10,143	4,947
Sheepshead	273,211	61,379	500,096	143,782
Snappers	9,852	9,641	14,013	15,739
Spot	1,464,592	2,111,899	460,928	704,445
Striped Bass[1]	0	0	0	0
Tuna, Bluefin[2]	201	69	40,979	69
Tuna, Yellowfin	44,688	28,954	1,441,122	913,785
Wahoo	9,370	13,354	255,306	368,394
Weakfish	33,851	26,288	34,731	25,961

[1] Striped Bass landings reflect Atlantic Ocean catches only.
[2] Landings for Atlantic Bluefin Tuna (ABT) reflect the Highly Migratory Species fishing year (January 1 through December 31).

NOTE: The number and pounds of finfish listed represent estimated harvest; finfish released alive are not included. Headboat landings are not included but are available upon request from NOAA Beaufort Lab's Southeast Region Headboat Survey.

North Carolina Marine Recreational Finfish Harvest

2010, 2011 and 2012

SPECIES	NUMBER 2010	NUMBER 2011	NUMBER 2012	POUNDS 2010	POUNDS 2011	POUNDS 2012
Amberjacks	16,536	5,752	8,976	369,224	112,991	154,734
Barracudas	1,410	916	683	11,011	10,882	8,535
Bluefish	1,104,077	1,152,105	888,888	953,113	999,240	1,010,575
Bonito	551	11,144	4,281	9,967	147,403	38,551
Cobia	15,125	4,478	2,050	498,581	145,796	104,106
Croaker, Atlantic	478,156	246,676	288,813	241,993	99,298	105,530
Dolphin	498,626	472,174	327,116	3,291,521	3,538,922	2,559,382
Drum, Red	64,024	45,143	52,948	283,286	212,245	238,312
Drum, Black	122,709	211,396	139,363	305,517	151,407	243,965
Flounder, Southern	250,790	152,557	118,614	539,941	380,158	298,043
Flounder, Summer	77,157	60,422	63,135	111,539	100,543	101,642
Groupers	21,067	9,676	10,198	275,085	107,853	126,567
Grunts	44,877	27,490	62,734	56,802	44,214	95,724
Jacks	14,103	15,548	19,239	71,622	25,712	20,463
Kingfishes	953,327	587,151	1,050,826	389,905	246,886	383,427
Mackerel, King	36,541	14,220	27,353	336,327	180,014	333,614
Mackerel, Spanish	483,956	367,086	491,238	565,830	470,541	665,201
Perch, Silver	6,460	33,909	22,053	1,736	6,261	3,988
Pigfish	175,430	225,472	334,052	57,759	73,538	117,021
Pinfish	218,975	143,300	259,674	35,308	27,601	40,471
Pompano	100,541	122,819	107,260	46,660	47,406	57,882
Porgies	21,391	6,683	15,857	40,812	11,117	26,249
Puffers	149,704	156,916	268,515	72,952	91,384	134,113
Sea Bass, Black	138,961	95,004	75,638	186,803	143,234	127,621
Seatrout, Spotted	195,065	215,922	500,522	407,534	403,517	817,551
Sharks	7,145	5,831	2,350	50,787	21,241	44,170
Sharks, Dogfish	2,610	4,334	316	8,434	12,086	1,454
Sheepshead	145,873	66,689	119,899	420,108	180,145	293,570
Snappers	23,713	13,376	27,822	35,041	25,167	60,163
Spot	834,560	1,207,335	784,272	260,341	410,317	230,250
Striped bass[1]	23,778	94,182	0	435,756	2,042,981	0
Tuna, Bluefin[2]	579	329	189	88,463	53,941	31,861
Tuna, Yellowfin	23,251	25,039	57,100	828,571	811,673	1,579,260
Wahoo	12,610	14,798	30,885	365,697	396,775	854,568
Weakfish	41,598	13,464	40,299	38,721	17,621	46,081

[1] Striped bass landings reflect Atlantic Ocean catches only.
[2] Landings for Atlantic Bluefin Tuna represent Highly Migratory Species fishing year January 1 through December 31.

NOTE: The number and pounds of finfish listed represent estimated harvest; finfish released alive are not included. Headboat landings are not included but are available upon request from NOAA Beaufort Lab's Southeast Region Headboat Survey.

North Carolina Coastal Angling Program

North Carolina Marine Recreational Finfish Harvest and Release Catch Estimates

Year	Number Harvested	Pounds Harvested	Number Released
2010	10,062,809	13,636,398	20,006,836
2011	8,564,946	13,240,808	15,865,229
2012	8,472,954	12,059,556	18,536,492
2013	11,479,525	11,968,710	20,963,650
2014	9,583,082	8,999,639	19,778,828

North Carolina Marine Recreational Fishing Trip Estimates (number)

Year	Beach/Bank	Charter Boat	Manmade	Private Boat	Total
2010	1,930,919	165,304	1,382,296	2,199,055	5,677,574
2011	1,404,886	151,681	1,284,670	1,898,507	4,739,744
2012	1,599,759	160,097	1,482,635	2,060,989	5,303,480
2013	1,212,558	111,366	1,543,314	2,100,515	4,967,753
2014	1,665,273	102,419	1,484,850	1,707,330	4,959,872

Coastal Recreational Fishing License (CRFL) Sales by Residency, 2010 - 2014.

Year	In State	Out-of-State	Total
2010	296,173	157,346	453,519
2011	289,925	149,321	439,246
2012	304,840	155,457	460,297
2013	317,650	162,351	480,001
2014	320,664	165,623	486,287
Grandfathered[1]	250,239	6,460	256,699

[1] All lifetime inland state fishing licenses sold prior to 2007 were grandfathered into the new CRFL requirement on January 01, 2007.

Survey Methods

The survey consists of telephone and on-site angler interviews. Telephone interviews are used to collect data on number of trips, fishing location, and when these trips were made. Information on actual catch (species, number, weight, and length) is collected through on-site angler interviews. Information from both types of interviews is combined to produce estimates of total number and pounds of finfish caught.

Precision of Estimates

Numbers and pounds presented are estimates, not actual counts, therefore having varying levels of precision.

Coastal recreational fishery statistics are provided through participation in the Marine Recreational Information Program. In North Carolina, this project is supported in part by the U.S. Fish and Wildlife Service through the Sport Fish Restoration Program, Grant F-31.

North Carolina Department of Environment and Natural Resources

Pat McCrory
Governor

Donald R. van der Vaart
Secretary

MEMORANDUM

TO: N.C. Marine Fisheries Commission

FROM: Louis Daniel III, Director
Division of Marine Fisheries, NCDENR

DATE: Feb. 4, 2015

SUBJECT: Fiscal Year 2015-2016 Initiative Development

As discussed at your Nov. 2014 business meeting, attached are overviews providing information on all of the proposed ideas that commissioners put forward for consideration for initiatives for the upcoming fiscal year.

Just to recap, at its October meeting, the commission decided to develop initiatives on a fiscal year basis (July 1 – June 30) to complement the division's Strategic and Annual Operations Plan and the development of the annual fishery management plan schedule. Below is the timeline for development:

- By Dec. 31, 2014, commissioners put forward two proposals each for consideration as initiatives;
- For the Feb. 18-20, 2015 business meeting, division staff will prepare a paper on each proposal outlining the background, previous actions, summarizing pertinent points and what it would take to implement that proposal (see attached);
- For the May 20-22, 2015 business meeting, the commission selects three or four of the proposals as its Fiscal Year 2015/2016 initiatives; and
- Beginning July 1, 2015, division staff begins implementation of the agreed upon initiatives.

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Marine Fisheries Commission
Fiscal Year 2015-2016 Preliminary Initiatives List

Proposed Initiative: Reduce regulatory discards in both the recreational and commercial fisheries

Background

- Regulatory discards are those fish harvested in a fishery that fishermen are required by regulation (i.e. size limit, bag limit, trip limit) to discard.
- Reauthorization of Magnuson-Stevens Fishery Conservation and Management Act contains a National Standard (#9) requiring bycatch minimization. National Standard 9 states: "Conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch."
- Discards are addressed in all state fishery management plans.

Previous Actions or Considerations

- In 1998, the division required the use of escape panels in flounder pound nets, effectively reducing regulatory discards of undersized flounder.
- In 2011, the division implemented regulatory changes to address discards of striped bass in the commercial trawl fishery. A 2,000 pound per day trip limit replaced a 50 fish per day limit.
- In 2011, the division formed a Recreational Discards Workgroup that produced a guide to ethical angling.
    - Ethical angling information was printed in four publications for public distribution:
        - Ethical Angling: A Guide to Responsible Fishing
        - North Carolina Guide to Recreational Saltwater Fishing
        - North Carolina Coastal Recreational Fishing Digest
        - North Carolina Coastal Recreational Angler's Guide
    - Ethical angling information also found on the division's website (http://portal.ncdenr.org/web/mf/edu/ethical-angling)
- Culling panels are required in long haul seines and swipe nets in the Pamlico Sound west of Bluff Shoal.
- **Southern Flounder FMP (2005)**
    - Minimum large mesh gill net mesh size increased to 5.5 inches and prohibited the use of gill nets from 5 inches to less than 5.5 inches in internal waters from April 15 through Dec. 15 to reduce undersized southern flounder discards.
    - Minimum mesh sizes implemented for crab trawls in the Pamlico Sound to reduce undersized southern flounder discards.
- **Shrimp FMP (2006)**
    - Shrimp trawling was prohibited in most of the Neuse, Pamlico, and Pungo rivers to reduce shrimp trawl bycatch of undersized southern flounder.
- **Red Drum FMP (2001) and Amendment 1(2008)**
    - Steps were taken to reduce the mortality associated with regulatory discards including requiring circle hooks (i.e. Owen Lupton Rig) in some of the adult red drum recreational fisheries.
    - Small mesh gill net attendance rules established from the Pamlico Sound to the S.C. border from late spring to fall to reduce undersized red drum discards (attendance requirements for small mesh gill nets expanded in 2008 through Amendment 1).
    - Required large mesh gill nets be set greater than 10 feet from shore from June to October to reduce red drum discards.
- **Estuarine Striped Bass FMP (2004) and Amendment (2013)**
    - Maintained gill net restrictions in the Albemarle Sound Management Area (ex. allowable mesh sizes, yardage limits attendance requirements, season/area closures) to reduce discards of undersized striped bass and striped bass during closed seasons.

- Required the use of a 3-foot tie down in large mesh (5-inch stretch mesh and greater) gill nets and the maintenance of a minimum distance from shore of 50 yards for these nets, except Recreational Commercial Gear License large mesh nets may be set within 50 yards of shore if attended at all times for internal fishing waters west of the 76° 28.0000’W longitude line.
- Open harvest seasons for commercial and recreational fisheries during cooler months (fall, winter, and spring) to reduce discard mortality of striped bass.

Summary

- The division and the commission have implemented management measures to reduce regulatory discards in several commercial and recreational fisheries and continue to address discards in other fisheries.
- Regulatory discards can be minimized by converting discarded bycatch to landed catch through the development of new markets, processing techniques, and changing regulatory limits and requirements to land all catch.
- Regulations designed to reduce vessel efficiency including gear restrictions and trip limits may encourage bycatch (i.e. regulatory discards).
- Selective fishing gear is an essential element to bycatch reduction. The development of more selective gear can be a long process. The use of more selective gear is less effective when implemented through regulations only. Incentives to continually improve selectivity and disincentives for high levels of bycatch are more effective.
- Management programs designed to reduce regulatory discards need to be adaptive, making continuous improvements rather than fixed regulations.
- When gear modifications are made, efforts should be taken to ensure that they are effective.

Proposed Initiative: Eliminate Sponge Crab Harvest

Background

- There was a N.C. law prohibiting sponge crab harvest from the early 1920s through 1964.
- The underlying hypothesis of a sponge crab law is that protection of the spawning stock will lead to more recruits, which assumes a direct relationship between the size of the spawning stock and number of recruits.
- In 1964, the sponge crab prohibition law was repealed and Crab Spawning Sanctuaries were established.
- Landings of hard crabs showed some fluctuations before and after the sponge crab law was repealed.
- The blue crab spawning stock is composed of all mature females, not just sponge crabs.
- The sponge only present for approximately14 days.

Previous Actions or Considerations

1989 Position Paper:

- Several questions would have to be answered if the sale or possession of sponge crabs is prohibited
  - Will there be a tolerance?
  - At what point will culling have to take place?
  - What are the effects of stress on the viability of the eggs?
  - Should the ban include all mature females?
- Studies in South Carolina showed over 98 percent of all mature females are fertile, which means they are carrying sperm plug.
- Two viable options to protect the spawning stock of blue crabs were discussed:
  - Prohibit the sale or possession of all mature females, or
  - Keep the current sanctuary system in place.
- It was felt removing the spawning sanctuaries and replacing them with a prohibition on sponge crabs would result in less protection to the spawning stock.

1993 Briefing Paper:

- The reproductive potential of fertile mature female blue crabs is the same whether or not there is a visible egg mass (sponge).
- To provide complete protection it was recommended there should be no harvest of mature females.

1998 Blue Crab Fishery Management Plan:

- An issue paper examined spawning stock protections.
- The use of spawning sanctuaries and prohibiting harvest of sponge crabs was discussed.
- The commission decided to keep current rules in place, conduct a survey to examine other potential sanctuary areas, and prohibited all commercial gear (except attended gill nets) from March 1 – August 31 in existing spawning sanctuaries.

2004 Blue Crab Fishery Management Plan Amendment 1:

- The sanctuary rule was modified to include commercial gear prohibitions from 1998 fishery management plan.
- No additional sanctuaries were identified, as recommended in 1998 fishery management plan.
- An issue paper reexamined spawning stock protections.
- Research showed sponge crabs will destroy the egg mass once captured in pots (Rittschof 2004).
- Trawl-caught sponge crabs were observed with damaged egg masses.
- Eggleston (2003) found no significant difference in mature female catch rates within the sanctuaries and an area 5 km outside the sanctuaries.

- The commission decided to use the division’s Program 195 (Pamlico Sound Survey) as an indicator of spawning stock health, implement a seasonal maximum size of 6.75 inches for mature females and 5.25 inches for female peeler blue crabs (implemented when trigger from Program 195 is reached), and to modify the current sanctuary boundaries.

2013 Blue Crab Fishery Management Plan Amendment 2:
- Seasonal size limit for mature females and female peeler blue crabs were implemented in January 2006 and remained in effect through April 2014.
- Sanctuary boundaries were not modified as recommended in Amendment 1.
- The commission decided to repeal management triggers established in Amendment 1 and adopt adaptive management framework using the Traffic Light method as an indicator of the stock condition.
- Under the moderate management level (production characteristic 50 percent red for three consecutive years) the following measures go into effect: sponge crab harvest may be restricted, minimum and/or maximum size for mature females would be implemented, and spawning sanctuaries may be closed and further restrictions imposed.
- Under elevated management level (production characteristic 75 percent red for three consecutive years) a prohibition on sponge crab harvest and/or require use of sponge crab excluders would be implemented and may expand or designate new crab spawning sanctuaries.

Summary
- The current fishery management plan will implement limits on sponge crab and mature female harvest and allow additional management of the spawning sanctuaries if management triggers are activated under the adaptive management framework.
- North Carolina replaced the sponge law with spawning sanctuaries in 1964.
- The egg mass, or sponge, is only present for approximately 14 days.
- Over 98 percent of all mature females are fertile, which means they are carrying a sperm plug.
- Since the sponge is only present for a short period, any prohibition on sale or possession should include all mature females, not just sponge crabs.
- Studies indicate that after capture the sponge is damaged and/or shed.
- The current sanctuary system protects all spawners in the area, not just sponge crabs.
- There are some questions about boundaries of Crab Spawning Sanctuaries and their effectiveness in protecting the female spawning stock.
- Limiting sponge crab harvest would protect the crabs outside of the sanctuaries.

Proposed Initiative: Continue to investigate whether trawling in waterbodies where sedimentation has occurred could have a positive impact on reducing the sedimentation and improving water quality

Background

- In August 2013, the Marine Fisheries Commission passed motion for the Division of Marine Fisheries to design a study comparing closed trawling areas, specifically Newport River, to open trawling areas to determine the effect of trawling on sedimentation in primary and secondary nursery areas.
- Since the 1980s fishermen have stated that waterbodies closed to trawling are silting in and declining in productivity.
- The intent of the motion was to test if trawling could be a tool to flush out sediment and improve fishery productivity.
- Other waterbodies that have been mentioned by other entities as having sedimentation problems include Futch Creek, White Oak River, Bradley Creek and Lockwood Folly River.
- Upper portions of many tidal creeks were closed to trawling and dredging by Marine Fisheries Commission nursery area rules in 1977 to protect shallow nursery habitat.
- Division staff decided to compile an information paper on the subject to provide direction regarding future studies on sedimentation and trawling.

Previous Actions or Considerations

1999 Trawling Report:

- At the request of the Marine Fisheries Commission, division staff compiled a report, Shrimp and Crab Trawling in North Carolina's Estuarine Waters (N.C. Division of Marine Fisheries 1999) to determine the effects of trawling on habitat and bycatch.
- The report concluded that research in North Carolina was needed to determine this, and due to the high variability of N.C.'s estuaries, would cost $1million to $2 million a year to fund. No funding was allocated.
- Several short term research projects developed out of this effort specific to the effect of trawling on turbidity, sedimentation, and some aspect of productivity and are summarized in the 2014 information paper.

2005/2010 Coastal Habitat Protection Plan:

- Summarized the effects of trawling on bottom habitat.
- Summarized the effects of sedimentation and turbidity on fish habitat and known sources of sedimentation.
- Sources were reported to be from land disturbance, particularly non-point runoff from agriculture, forestry, and development, as well as wastewater discharges, navigational dredging, and bottom disturbing fishing activities.
- Includes several recommendations to reduce point and non-point source pollution, including sediment, as well as recommendations to protect fish habitat functions from damage associated with dredging and to restore shallow nursery habitat.

2014 Information Paper:

- Summarized research done in North Carolina and elsewhere on effect of sedimentation on productivity and effectiveness of trawling as a tool to flush out excessive sediment.
- Studies have documented the rate and source of sedimentation in Newport River, Slocum Creek, and Hancock Creek. Rates were considered relatively high and related to land disturbance from development and forestry.
- Studies on the effect of trawling on sediment dynamics were done in South Creek, Texas, and Florida. Results found that turbidity increased one to three times greater than background. Under conditions of sandy sediments or low currents, resuspended sediment settled fairly quickly and

close to the point of disturbance; conversely, sediments were resuspended longer and transported further when currents were strong and sediment was muddy. Fate of resuspended sediment (whether it is flushed out of a creek, carried further upstream, or redeposited nearby) will depend on many factors, such as tide range, currents, orientation of waterbody to prevailing wind direction, fetch, and sediment type.

- Studies on the effects of trawling on primary productivity in North Carolina found no clear trend. In terms of secondary productivity, trawling had no significant effect on secondary productivity (benthic infauna) in North Carolina, Texas, and South Carolina. None of the studies found a negative effect on larger macroinvertebrates and one study in North Carolina found a positive effect.
- Limited information is available on whether juvenile fish productivity has declined over time in North Carolina.
- The information paper concluded that a conservative approach was needed since 1) the literature review did not reveal strong indication that trawling would effectively flush out sediment or improve productivity and 2) there could be implications to other habitat protection rules if trawling was allowed in Primary Nursery Areas.
- The paper recommended that prior to conducting trawling experiments, further research is needed to:
  - Determine magnitude and change in sedimentation rates and sources over time at sufficiently representative waterbodies and regions.
  - Determine the effect of sedimentation in the upper estuaries on primary and secondary productivity and juvenile nursery function.
- The paper recommended that any resulting trawling study:
  - Design the study with academia and have process to include peer development/review.
  - Develop a clear testable hypothesis.
  - Develop a statistically valid sampling design that represents North Carolina's variable waterbody characteristics and accounts for temporal and spatial variability.
  - Assess effects of trawling at effort levels similar to typical fishery conditions.
  - Track the transport of sediment over multiple tide cycles.
  - Monitor transport of bacteria and toxins due to sediment resuspension.
  - Locate study areas in Secondary Nursery Areas or Special Secondary Nursery Areas that have not been open for multiple years.

Summary

- Division staff agrees that sedimentation is an issue to assess and address and will take steps this year to address information gaps.
- The division plans to work with university researchers to develop a phased Coastal Recreational Fishing License grant proposal that will address information gaps, and pending those results, a trawling experiment study.
- Division staff plans to further analyze juvenile fish data to assess trends in juvenile fish abundance.
- The Coastal Habitat Protection Plan Steering Committee selected sedimentation as a priority issue to address in the 2015 Coastal Habitat Protection Plan.
- This issue will be added to the division's Biological Review Team's Research Priority List.

Proposed Initiative: Reduce the culling tolerance for oysters from 10 percent to 5 percent

Background

- 15 A NCAC 03K. 202 requires a 10 percent tolerance by volume.
- The culling tolerance has been incorporated in rule at least since 1927.
- During the early years it was set at 5 percent. Between 1931 and 1934 the culling tolerance changed to 10 percent around the same time as the change in size limit from 2 ½ inches to 3 inches.
- Between 1971 and 1975, the culling tolerance for the 2 1/2 inch coon oysters was 15 percent. Prior to 1971 there was no size limit on coon oysters and therefore no culling tolerance on coon oysters.
- Law enforcement officers inspect fishermen for exceeding the tolerance limit by using a certified metric bushel tub and a keeler which is 10 percent of the tub by volume. A bushel of oysters is dumped into the metric bushel tub. The officer culls sub-legal oysters from the bushel and places them into the 10 percent keeler. If the keeler becomes full before the metric bushel is empty the catch is over the 10 percent tolerance. The officers will dump the keeler into another container and continue grading the rest of the oyster to find the total percent of undersized product.
- If the product exceeds 10 percent the officers will judge the level of oysters in the second keeler to figure the overage.

Previous Actions or Considerations

- Was not an issue in previous Oyster Fishery Management Plans, amendments, or supplements.
- Changing from 10 percent tolerance to 5 percent tolerance will require a change in keeler size to reflect 5 percent tolerance.
- Keelers are made of galvanized steel and cost approximately $25.
- Difficult in the south to change from 10 percent to 5 percent because of the intertidal nature of the southern coastal oysters.
- Intertidal oysters are in the form of clusters. Changing from the 10 percent tolerance to the 5 percent tolerance will result in finer separation of sub-legal from legal more difficult and would result in higher mortality of sub-legal oysters because of increased damage to the shell.
- May be possible to lower culling tolerance to 5 percent north of the Highway 58 Bridge. Oysters occur more subtidal as single oysters. Therefore less difficult to separate sublegal from legal oysters

Summary

- Concerns over increased effort in the south causing damage to cultch plantings and oyster rocks.
- Bushel limit changes are also an issue under consideration under Amendment 4 of the Oyster Fishery Management Plan.
- In the southern area bushel limits are currently five bushels per person/10 bushel per vessel.
- This has lead to concerns of the implications of a $31.25 shellfish license and the availability of this license to any N.C. resident.
- Culling tolerance will be addressed in an issue paper discussing harvest and effort issues in the southern coastal area.

Proposed Initiative: Develop hook-and-line, recreational-only, artificial reefs that can be used to promote local communities and tourism (or other positive recreationally oriented initiatives)

Background

- In late winter of 2007 an interaction between a recreational fisherman and gill nets occurred on AR-425 (Yaupon Beach Reef) and AR-420 (Tom McGlammery Reef). This resulted in the introduction of House Bill 2153 entitled: An Act to Prohibit Commercial Fishing Near Artificial Reefs within Three Nautical Miles of the Shoreline of Brunswick County. In response, the Fisheries Director issued proclamation M-23-2008 prohibiting the use of gill nets or trawls in the area of AR-425. This proclamation has been issued annually since.
- In 2013, Ron Zielinski submitted a Petition for Rulemaking to the N.C. Marine Fisheries Commission. This petition entailed restricting the use of commercial fishing gear and additional gear (i.e. minnow traps, collapsible crab traps, cast nets, gigs or pointed implements, hand operated rakes, seines less than 30 feet in length, manual or mechanically propelled spears and trotlines) on and around AR-396.
- On Aug. 29, 2013, at a commission meeting, a motion to approve the Ron Zielinksi petition for rulemaking was made because of the following reasons: 1) to support beneficial economic impact to the surrounding community; 2) to improve angler access to dedicated accessible and quality fishing opportunities; and 3) to be proactive in avoidance of future conflicts. The motion carried 6-2, with 1 abstention.
- On May 22, 2014, at a commission meeting, a motion was made to accept Ron Zielinksi's request to withdraw his petition for rulemaking regarding the Oriental artificial reef and to stop further rulemaking on the issue. The motion carried 9-0.

Authority

- Sufficient authority for the commission to develop recreational, hook-and-line-only artificial reefs does not currently exist in rule, but there is sufficient statutory authority for the commission to adopt rules "to regulate the location and utilization of artificial reefs in coastal waters." [G.S. 143B-289.52(b)(10)]
- The rule making process, as set forth in G.S. 150B (Administrative Procedure Act) includes completing an economic analysis of the proposed rule change, publishing the proposed rule in the *N.C. Register*, providing a public comment period, and ensuring compliance with the rulemaking principles in G.S. 150B-19.1(a).

Considerations

- In addition to considering the requirements of the rulemaking process, other factors such as funding sources, traditional fishing areas, impacts to local economies, impacts to commercial fishermen and access should be considered.
- Artificial reefs have been funded using a variety of funds including but not limited to, state appropriated money, sport fish restoration funds and grants from both state and federal agencies.
- Declaring an artificial reef hook-and-line, recreational-only, will exclude user groups, both recreational and commercial, from access to a public trust resource.
- Recreational fishermen will not be able to use gears such as gill nets, crab pots, spears and gigs to harvest their recreational limit.
- Funding sources should be considered when planning and developing hook-and-line, recreational-only, artificial reefs since use by user groups will be limited.
- Interest could be sparked from other user groups to construct reefs for sole usage by their respective user groups.
- Partnering with the N.C. Division of Marine Fisheries is a requirement since Coastal Area Management Act, United States Army Corps of Engineers and Coast Guard (Private Aids to Navigation) permits for artificial reefs are issued to the N.C. Division of Marine Fisheries.

- The process to site, permit, obtain materials, construct and monitor an artificial reef site is costly and time consuming.
- From previous experience, total inshore artificial reef construction cost ranges from $31,000 and $50,000 per acre depending on complexity, reef structures and location.

Summary

- Developing hook-and-line, recreational only, artificial reefs will require the commission to develop rules through the rulemaking process.
- There is the possibility of other user groups requesting to build artificial reefs for their exclusive use, which would exclude other user groups from a public trust resource.

Proposed Initiative: Develop a dedicated recreational position within the Division of Marine Fisheries

Develop a dedicated recreational position within the Division of Marine Fisheries (funded through Coastal Recreational Fishing License grant program) to serve as a recreational liaison that would:

- Be the contact person for recreational fishermen;
- Liaison for the for hire industry;
- Work with tourism boards;
- Promote recreational fishing; and
- Help council/Atlantic States Marine Fisheries Commission/Highly Migratory Species folks acquire recreational input on amendments and other actions.

<u>Background</u>

- Coastal Recreational Fishing License Grant submitted in FY2011 (not selected for funding); internal pre-proposal submitted in FY2012 (not selected for full proposal).
- Previous proposals focused on several areas: providing technical/policy guidance regarding recreational fisheries; development and coordination of data collection programs for recreational fisheries; promote conservation-based fishing practices; and development of positive relationships with the recreational fishing community.
- National Oceanic and Atmospheric Administration (NOAA) Fisheries has a similar national policy position that is responsible for coordination of regional recreational fisheries policy staff and oversight of NOAA Fisheries Recreational Initiative (launched 2009).

<u>Previous Considerations/Actions</u>

- Division currently has a five-year federal aid grant (Marine Fisheries Education and Outreach) that provides support for classroom education programs, development and printing of educational brochures/materials (e.g., ethical angling, Angler's Guide, etc.), exhibits at festivals, expanding/improving educational web pages.
- Governor's Cup Billfishing Series and N.C. Saltwater Fishing Tournament (Citation Program) provide informal outreach to private anglers and for-hire sector.
- Coastal Angling Program (recreational harvest data collection program) staff provide informal (dockside sampling) and formal (for-hire constituent outreach and logbook public meetings) outreach to private anglers and for-hire sector , as well as weekly regional fishing reports throughout the season.

<u>Potential Activities</u>

<u>Policy</u>

- Coordinate development of a comprehensive strategic plan for N.C. recreational fisheries across all division sections with the goal of proactively identifying recreational fishery issues of importance and initiating guidance/policy to address these issues (outreach, communication, education, technology).
- Provide guidance/input on recreational fishery characterization for all state fishery management plans in conjunction with fishery management plans and species leads.
- Serve as the division point-of-contact for:
    - Recreational fishing information for anglers, recreational fishing organizations, for-hire industry, tournaments, tourism, etc.
    - Federal efforts related to NOAA Fisheries National Recreational Fishing Policy (http://www.nmfs.noaa.gov/sfa/management/recreational/documents/recfish_policy_public_comment_draft.pdf), and provide NC perspective regarding implementation of the Southeast Regional Recreational Fisheries Action Agenda (http://www.nmfs.noaa.gov/sfa/management/recreational/documents/noaa_rfaa_ser.pdf).

- Provide policy level guidance on interstate and federal fishery management issues in coordination with federal council and interstate commission liaisons.

Communication

- Coordinate public input from recreational constituents (anglers, organizations, for-hire) on state, interstate and federal fishery management decisions.
- Improve communication with all recreational constituencies through organized workshops, seminars, and invited speaking engagements on management issues, conservation-based fishing practices, habitat enhancement/protection, etc.
- Develop a regular "on the docks" schedule of informal interaction with private anglers, for-hire captains, tackle shop owners, tourism operators, etc.
- Coordinate with other agencies, local governments and recreational fishermen to identify, enhance, conserve and develop recreational fishing access.

Outreach

- Assess the use and effectiveness of the current recreational compliance guides and recreational outreach materials in conjunction with public affairs staff.
- Develop a distribution system of recreational compliance guides and recreational outreach materials with input from anglers, the for-hire industry, and tourism.
- Coordinate with other state partners (N.C. Sea Grant, academic researchers, and other state agencies) to disseminate results of the Coastal Recreational Fishing License grant program and provide a conduit for input into the program's strategic plan.

Education

- Enhance education of fishermen and the public concerning fish habitats, how they function, and what people can do to protect them.
- Assist in cross-section initiatives to develop and disseminate gear and methodology for reducing release mortality and to reduce protected species interactions.
- Work with stock assessment scientists to develop outreach materials (similar to Marine Resource Education Program in southeast) to ensure a clear understanding of the stock assessment process for state-managed fisheries.
- Enhance education of fishermen and advise them of the public health and safety concerns surrounding naturally occurring bacteria with consumption of raw shellfish and swimming or water contact activities.

Summary

- Ultimate goal is that recreational constituents who understand the fishery management process, data collection, habitat function, conservation techniques and practices will be more informed and feel a sense of inclusion in the management process.
- Previous attempts to fund such a position have not met with success (ultimate approval of new positions typically occurs at department level)
- Division currently has a variety of recreationally-oriented education/outreach initiatives and should evaluate effectiveness of funded activities; re-program existing staff and resources towards more effective efforts based on review and constituent input.
- Potential benefits: Coordination with federal initiatives, other agencies, local governments and recreational fishermen to identify, enhance, conserve and develop recreational fishing opportunities; comprehensive plan for all division efforts related to recreational fisheries; increased understanding and improved communication between commission, division and recreational sectors.
- Potential challenges: Representing the diverse opinions of the recreational fishery; commercial sector opposition to creating a recreational liaison without creating a commercial liaison; stock management goals may differ between recreational sectors; communication with the widely dispersed and diverse recreational fishery.

Proposed Initiative: Reduce bycatch in the shrimp fishery by 30-40 percent and revisit annually to ensure compliance with these reduction levels and continuously look for ways to further reduce bycatch.

Background

- Reauthorization of Magnuson-Stevens Fishery Conservation and Management Act contains a National Standard (#9) requiring bycatch minimization (USDOC 1996). National Standard 9 states: "Conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch." The act was amended in 1990 to include bycatch research.
- In 1990, Congress mandated that the U.S. Secretary of Commerce conduct a three year research program to assess the impact of the incidental harvest by the shrimp trawl fishery on fishery resources in the South Atlantic and the Gulf of Mexico areas.
- The National Marine Fisheries Service, along with the Gulf and South Atlantic Fisheries Development Foundation, began a cooperative bycatch research program to: (1) update and expand bycatch estimates temporally and spatially; (2) identify, develop and evaluate gear options for reducing bycatch; (3) develop an information transfer and education program on bycatch; and (4) develop and operate a standardized data management system for centralized dissemination and access.
- Starting in 1992, observers were placed aboard cooperating vessels to characterize bycatch and to test bycatch reduction devices during normal commercial shrimp trawling through a NOAA program.

Previous Actions or Considerations

- During the 1960s and early 1970s, there was a primary bycatch concern was from directed ocean finfish trawling for bait and pet food.
- During the 1970s through the 1990s, rules were established to prohibit directed scrap fishing. Nursery area designation also began during this time.
- During the late 1980s, the division initiated gear testing to reduce bycatch in the shrimp trawl fishery.
- In cooperation with personnel from the North Carolina Sea Grant, an industry advisory committee was established in 1989 to act as consultants throughout the design and testing phase of a gear development project to reduce bycatch in N.C. trawl fisheries. The committee suggested two finfish excluding techniques: skylight panels and large mesh tailbags.
- Since 1972, the commission regulates the minimum mesh size for a shrimp trawl, including the tailbag at 1.5 inches (15A NCAC 03L.0103(1)).
- The division conducted preliminary tests on diamond tailbag mesh sizes in 1991, square mesh tailbags in 2000, and conducted follow up work in 2010.
- The commission required all shrimp trawlers working in state waters to equip their nets with functional fish excluders in October 1992, becoming the first state to do so.
- From 1992-1996 the division worked with fishermen to develop and test several bycatch reduction devices to reduce finfish bycatch. These tests led to the commission approving four bycatch reduction devices for use in state waters in 1996 (Proclamation SH-9-97).
- Currently the division allows five bycatch reduction devices for use in state waters (Proclamation SH-3-2012).
- Several gear evaluation studies have also been conducted in N.C. waters to document bycatch in shrimp trawls (McKenna and Monaghan 1993; Coale et al. 1994; Murray et al. 1995; McKenna et al. 1996, Brown 2010).
- In 2009, the division tested various bycatch reduction devices aboard the R/V Carolina Coast (Brown 2010).

- In 2012, the commission directed the division to amend the Shrimp Fishery Management Plan, but to limit the scope of the amendment to bycatch issues. Twenty-nine different management options were brought forward to the Shrimp Fishery Management Plan Advisory Committee to address eight different issues. The commission's preferred management strategies to reduce bycatch included:
    - Allowing any federally certified bycatch reduction devices in all N.C. internal and offshore waters;
    - Update the scientific testing protocol for the state Bycatch Reduction Device Certification Program;
    - Convene a stakeholder group to initiate industry testing of various bycatch reduction devices to reduce bycatch to the extent practicable with a 40 percent target reduction;
    - Require either a T-90/square mesh tailbag or other applications of square mesh panels, reduced bar spacing in a turtle excluder device, or another federal or state certified bycatch reduction device in addition to existing turtle excluder device and bycatch reduction device requirements; and
    - Cap fleet capacity by establishing a maximum combined headrope of 220 feet in all internal coastal waters where there are no existing maximum combined headrope requirements with a two-year phase in period.

Summary

- Policies at both the state and federal level have been adopted as conservation and management measures to minimize bycatch and bycatch mortality and incorporate that goal into management considerations.
- The control of net selectivity is a preferred management tool in lieu of other more stringent regulations such as temporal or spatial closures, quotas, or limited entry.
- The division has tested various bycatch reduction device designs since the 1980s. Testing has been sporadic based on funding.
- Development of bycatch reduction devices must be tested in many areas and over several seasons, since there is considerable variation in conditions both spatially and temporally.
- It is important to understand that the development of bycatch reduction devices is a long process, and is dependent on a number of factors.
- There is no one gear design or modification that will work in every situation. What works during the summer brown shrimp fishery may not be effective in the fall white shrimp fishery. The goal of gear researchers is to give the industry additional tools and techniques to use under various real life field situations.
- Funding is often a limiting factor for gear development programs. The division has very limited resources to conduct bycatch reduction device development testing.
- The division has and will continue to seek outside funding to conduct this type of research.
- The division has and will continue to seek outside funding to conduct characterization studies which can be used to ensure compliance with reduction levels.

Proposed Initiative: Increase Habitat

Background

There are six categories of coastal fish habitat in North Carolina – wetlands, shell bottom (oyster reef), submerged aquatic vegetation, ocean hard bottom, soft bottom, and the water column. Much of the work the division does deals with restoring and enhancing shell bottom habitat. The type, magnitude and location of created shell bottom habitat varies annually based on available funding. The division's restoration and enhancement work helps to fulfill recommendations of the Coastal Habitat Protection Plan, which was mandated by the 1997 Fisheries Reform Act. The Act contains the directive to protect and enhance habitats supporting coastal fisheries through the development and implementation of the Coastal Habitat Protection Plan. The law requires cooperation among three rule-making commissions: Environmental Management Commission, Coastal Resources Commission, and Marine Fisheries Commission. The commissions work together to develop, adopt, and implement the plan to protect and restore fish habitats through efforts of an interagency staff team and a steering committee consisting of a subset of the associated commissioners. While restoration of shell bottom habitat is addressed primarily by the Division of Marine Fisheries, restoration of other habitats is addressed by others or through mitigation or projects by conservation groups or universities. For example, the Division of Water Resources and the Ecosystem Enhancement Program are the primary groups that address wetland restoration. Through the Coastal Habitat Protection Plan process, encouragement of greater restoration of certain habitats can be discussed and recommended.

Previous Actions or Considerations

Specific Coastal Habitat Protection Plan recommendations that address increasing habitat and reducing sediment from entering coastal waters (sediment can enter through point and non-point sources), include:

- Expand habitat restoration in accordance with ecosystem restoration plans, including:
    a. Creation of subtidal oyster reef no-take sanctuaries.
    b. Re-establishment of riparian wetlands and stream hydrology.
    c. Restoration of submerged aquatic vegetation habitat and shallow soft bottom nurseries.
    d. Developing compensatory mitigation process to restore lost fish habitat functions.
- Prevent additional shellfish and swimming closures through targeted water quality restoration and prohibit new or expanded stormwater outfalls to coastal beaches and to coastal shellfishing waters (Environmental Management Commission's surface water classifications SA and SB) except during times of emergency (as defined by the Division of Water Quality's Stormwater Flooding Relief Discharge Policy) when public safety and health are threatened, and continue to phase-out existing outfalls by implementing alternative stormwater management strategies.
- Enhance coordination with, and financial/technical support for, local government actions to better manage stormwater and wastewater.
- Improve strategies throughout the river basins to reduce non-point pollution and minimize cumulative losses of fish habitats through voluntary actions, assistance, and incentives, including:
    a. Improved methods to reduce pollution from construction sites, agriculture, and forestry.
    b. Increased on-site infiltration of stormwater.
    c. Documentation and monitoring of small but cumulative impacts to fish habitats from approved, un-mitigated activities.
    d. Encouraging and providing incentives for low impact development.
    e. Increased inspections of onsite wastewater treatment facilities.
    f. Increased water re-use and recycling.
- Improve strategies throughout the river basins to reduce non-point pollution and minimize cumulative losses of fish habitats through rule making, including:
    a. Increased use of effective vegetated buffers,
    b. Implementing and assessing coastal stormwater rules and modify if justified.
    c. Modified water quality standards that are adequate to support submerged aquatic vegetation habitat.

Summary

- The initial Coastal Habitat Protection Plan was completed and approved in 2005 and updated in 2010. As the next five-year update is scheduled for completion in 2015, there is an opportunity to modify plan recommendations and implementation actions related to creating additional coastal fish habitat.

Proposed Initiative: Defining Full-Time and Part-Time Commercial Fishermen and the Purpose of the Standard Commercial Fishing License (SCFL)

Background

- In 2010 and 2012, two ad hoc Marine Fisheries Commission committee meetings were held to discuss the issue of defining a professional commercial fishermen and make changes to the Standard Commercial Fishing License (SCFL)
- The general consensus among attendees was that there are no significant problems with the current definition that requires fixing. The current definition and license system as devised by the Moratorium Steering Committee in 1999 is adequate. [see G.S. 113-168.2 (h) Identification as a Commercial Fisherman - The receipt of a current and valid SCFL or shellfish license issued by the division shall serve as proper identification of the licensee as a commercial fisherman].
- Although neither committee made any significant changes to the current system, there were some recommendations to investigate license transfers, license assignments, how to handle latent licenses (use it or lose it), establishing some form of apprenticeship program, and to consider eliminating the Shellfish License for N.C. residents.

Previous Actions

- **July/August 2010 Taskforce Meetings** – chaired by Joe Smith
    - Making changes to the definition of a commercial fisherman is always a contentious issue.
    - The industry feels that:
        - The definition is fine as is.
        - There is no reason to establish landing limits or frequency of use to exclude part-timers as there are many reasons why people hold commercial licenses: investment for retirement, for later use, to pass down to future generations, or as a side-line business to their land-based employment.
        - Further limiting available licenses and limited entry fisheries are not popular concepts.
        - License transfers should be limited to family only.
        - License assignments are necessary.
        - The revenue from latent licenses is necessary to the division.

- **January 2012 Taskforce Meeting** – chaired by Rob Bizzell
    - Industry members in attendance reiterated that the problem has not been defined and if it isn't broken, then don't try to fix it.
    - Much discussion ensued about impact of less knowledgeable commercial fishermen on the industry using the striped bass trawler episode as an example.
    - Three [non-binding] motions were made and passed by the committee:
        - Require all individuals who held a SCFL during the 2010 license year that had no recorded sales transactions be required to have at least 12 days of documented fishing activity within a three-year time period in order to renew their licenses.
        - The commission shall explore the concept of developing an apprentice program/license for persons who have no history in commercial fishing, and allowing an individual with an apprentice license to qualify for a SCFL issued through the eligibility pool once the apprenticeship is completed.
        - The commission should consider eliminating the Shellfish License for N.C. residents.

Constraints and Considerations

- The current commercial license system has been in place since 1999 and is based on recommendations by the Moratorium Steering Committee and resultant actions by the General Assembly.
- The system as implemented has many good points and is in general favor by the commercial fishing industry.

- The following is a list of the main points of discussion and constraints upon any actions:
  - The current definition of a commercial fisherman simply says one who holds a license. Most people feel this is adequate but also see problems with adolescents holding licenses, recreational fishermen holding licenses, and the large number of unused licenses. The discussion should be focused on what constitutes a "professional" commercial fishermen and could include such criteria as: relying on proceeds from commercial fishing for the bulk of their annual salary, reporting income to the IRS from commercial fishing, an individual fully licensed and permitted to operate in one or more fisheries, and an individual with the knowledge, education or experience to profit from commercial fishing. How each of these criteria is determined is currently unknown. In addition, any definition must include criteria for professional crew members who may or may not have any licenses or recorded landings.
    - Can the commission eliminate or reduce the number of available licenses? Yes, the commission has the authority to adjust the number of SCFL's in the pool based on the amount of effort it considers appropriate in the fishery. The difference between the number of SCFLs in the pool and the number of active licenses is around 1,500. The commission cannot refuse to renew a license.
    - Can license transfers be restricted to family and transfers to non-qualified individuals prevented? This is addressed in GS 113-168.2 (g) which describes the allowable reasons for license transfers (family, upon death, or sale of vessel upon retirement). Seventy-two percent of license transfers are categorized as "Other." This allowance was a legal interpretation due to discrepancies in the interpretation of "retirement" and because not all license holders had an accompanying vessel to sell with the license. This could be revisited.
    - Part time commercial fishermen play an important role and should not be discouraged. Traditionally, commercial fishermen in North Carolina have always held other money making jobs in order to support their families. Part time fishermen provide valuable product to dealers and to the market when conditions allow.
    - There should be no "use-it or lose-it" clause as fishermen hold licenses for a variety of reasons - investment, holding for retirement years, to assign to others, etc. Unused licenses have no impact on the resource yet contribute to the division's operating revenue. Forcing license holders to use their license will put more pressure on the resource and more gear in the water. SCFL holders have made the decision to spend the money to renew the license each year and therefore have an investment in that license. The revenue derived from commercial licenses is critical to the division to fund the license, trip ticket and marine patrol activities. Commercial license revenue has been on the decline in recent years and there is concern that recent increases in license fees will create further reduced revenue for the division. [follow-up: the division conducted a survey of license holders in January 2015 asking about product retained for personal use and not reported on trip tickets]
    - Establishing income levels for license qualification is unpopular and unfeasible. This is similar to establishing "days used" or a "use-it or lose-it" policy. Using income levels requires holders to substantiate their claims with tax records which in turn require someone to determine the validity of the tax records. The division does not wish to get involved in personal tax filing issues. Establishing a minimal threshold of days the license is required to be used could not only increase pressure on the resources but lead to falsified recording of catch on trip tickets in order to meet the minimal criteria.
    - Establishing an Apprenticeship Program in order to get new entrants into the fishery received general support. However, the division feels as though the current Shellfish License and proper use of assignments provides most of the benefits of an apprentice program. Neither of these licenses requires any

previous qualifications. A true apprenticeship program will require someone to function as the mentor, a role best fulfilled by commercial fishermen, not the division. The industry could still support this concept by hiring individuals as crew or by assigning licenses and eliminate the division from the program. The experience gained by working as crew or working under an assignment would qualify the individual for a SCFL through the Eligibility Board.

- The issue of recreational fishermen obtaining SCFL's on the open market and using them to sell fish to cover their fuel costs and save on taxes on tackle and equipment was also discussed extensively. This issue probably is of less importance today as the South Atlantic Fisheries Management Council has almost entirely eliminated bag limit sales of most federally managed species. Purchasing a commercial license in order to save on fuel and tackle costs is a federal and state taxing authority issue, not a division management issue.
- Should the Shellfish License be eliminated? This low cost license available only to N.C. residents was meant by the General Assembly to appease the older, traditional, clammers and oystermen who may not have qualified for a SCFL but still wanted a low cost license to gather some shellfish. It was also intended to be a license available to high school and college students to use to make some money during the summer months clamming. Eliminating this license will negatively impact applicants to the Eligibility Board and the apprenticeship program concept of entering into commercial fishing by obtaining a Shellfish License. It will have the positive benefits of reducing harvest pressure on diminishing oyster resources in the southern part of the state and reducing illegal oyster sales.

Summary

- There have been previous attempts at defining a commercial fisherman and making changes to the current license system. It is a heated topic and any changes should not be considered lightly.
- Given the commission's authorities, the most logical and achievable options to look at to address certain issues are:
  - Reduce the number of available SCFLs in the Eligibility Pool
  - Limit license transfers
  - Limit license assignments
  - Address inequities in licensing costs between residents and nonresidents (especially with Land or Sell license privileges)
- Changes to the following authorities will require legislative changes to existing statutes:
  - Limiting renewals of existing SCFLs
  - Further increases in license fees
  - Adjustments to nonresident fees
- Fee increases beginning in fiscal year 2016 will impact the number of licenses issued, especially those SCFLs that are not used. Any reductions in commercial license sales will further negatively impact division revenue and its ability to adequately implement and enforce fisheries regulations.

Proposed Initiative: Remove Spotted Seatrout from the Fishery Management Plan

Clarify intent of initiative

Intent of the initiative is to change management strategy for spotted seatrout outlined in the 2012 N.C. Spotted Seatrout Fishery Management Plan, which is based on the threshold biological reference point of a spawning potential ratio of 20 percent to managing spotted seatrout based on environmental factors.

Background

- The Atlantic States Marine Fisheries Commission Fishery Management Plan for Spotted Seatrout was adopted in 1984 and was updated with Amendment 1in 1991 and Amendment 2 in 2011.
- Amendment 1 developed a list of goals for spotted seatrout management, but allowed interested states to manage their stocks independently.
- Amendment 2 required states to comply with the Atlantic Coastal Fisheries Cooperative Management Act and the Atlantic States Marine Fisheries Commission Interstate Fishery Management Program Charter, adopt a 12-inch total length minimum size limit for both recreational and commercial sectors and recommended states establish management measures to reach a 20 percent spawning potential ratio.
- Spotted seatrout was included in both the 2002 and 2008 N.C. Interjurisdictional Fishery Management Plan.
- The N.C. Marine Fisheries Commission adopted the fishery management plan schedule that provided for the development of a state spotted seatrout plan as a means to evaluate if regulations were sufficient to provide a sustainable harvest. Initial plan development began in 2007.
- The N.C. Spotted Seatrout Stock Assessment was completed in January 2009. The stock was considered overfished and overfishing had been occurring all but one year during the entire time series of the assessment (1991 – 2008) using a threshold biological reference point of 20 percent spawning potential ratio.
- The N.C. Marine Fisheries Commission adopted the N.C. Spotted Seatrout Fishery Management Plan in February 2012.
- The N.C. Marine Fisheries Commission adopted Supplement A to the 2012 Spotted Seatrout Fishery Management Plan in March 2014.

Previous Actions or Considerations

- Supplement A to the 2012 N.C. Spotted Seatrout Fishery Management Plan implemented the following measures:
    - Maintain short-term management measures in the spotted seatrout fishery (Proclamation FF-13-2012: 14-inch minimum size, 75-fish commercial trip limit with weekend closures in joint waters except in Albemarle and Currituck sounds; Proclamation FF-12-2012: 14-inch minimum size, four-fish recreational bag limit).
    - If cold stun occurs: close spotted seatrout harvest through June 15 and retain four fish recreational bag limit and 75 fish commercial trip limit. Also more extensive research on cold stun events by the division, universities, etc…
    - Revisit the Spotted Seatrout Fishery Management Plan in three years to determine if sustainable harvest measures are working.
    - Development of a mutual aid agreement between Marine Patrol and Wildlife Enforcement Officers for Inland Fishing Waters.
- December 2014 an updated 2014 N.C. Spotted Seatrout Stock Assessment was sent for external peer review.
- The commission’s fishery management plan review schedule, adopted in August 2014, has the next spotted seatrout review scheduled to begin in July 2015.
- The N.C. Fisheries Reform Act states “The Department shall prepare proposed Fishery Management Plans for adoption by the Marine Fisheries Commission for all commercially or recreationally significant species….” [G.S. 113-182.1].

- The N.C. Fisheries Reform Act states that if overfishing is occurring the fishery management plan must "specify a time period, not to exceed two years from the date of adoption of the plan, to end overfishing." and if a fishery is considered overfished, the fishery management plan must "specify a time period, not to exceed 10 years from the date of the adoption of the plan, for achieving sustainable harvest." The statute provides that these requirements shall not apply "if the Fisheries Director determines that the biology of the fish, environmental conditions, or lack of sufficient data make implementing the requirements of this subdivision incompatible with professional standards for fisheries management." [G.S. 113-182.1].
- These provisions exempt a species from the two year period to end overfishing and the 10-year rebuilding period, not from the requirement to have a fishery management plan.
- Any adaptive management strategy designed to manage spotted seatrout based on environmental factors would likely need to be reviewed periodically. The best vehicle for this process is the species-specific state fishery management plan.

Summary

- North Carolina is currently in compliance with the minimum size limit for both recreational and commercial sectors and has adopted the 20 percent spawning potential ratio threshold recommended by the Atlantic States Marine Fisheries Commission.
- A new stock assessment covering the 1991-2013 time period will be presented to the N.C. Marine Fisheries Commission at its May 2015 business meeting.
- This initiative would require an amendment to the N.C. Spotted Seatrout Fishery Management Plan.
- Spotted seatrout would still be part of the N.C. Interjurisdictional Fishery Management Plan if the species specific state plan was retired.
- Any adaptive management strategy designed to manage spotted seatrout based on environmental factors should be part of a state fishery management plan subject to periodic review.

Proposed Initiative: Establish a two season fishing period for large mesh gill nets; one in the spring and the other in late fall to help with cost of the observer program, as well as other obvious savings to the division

Background

- Session Law 2013-360 (Senate Bill 402) provided a one-time appropriation of $1.1 million to the Observer Program in fiscal year 2014 and increased the commercial license fees by 25 percent to fund the Observer Program moving forward.
- This law also required public hearings for input on additional sources of funding for the Observer Program. The division submitted its plan for additional funding to the Marine Fisheries Commission, and the commission submitted its funding recommendations to the General Assembly.
- Session Law 2014-100 (Senate Bill 744) increased the commercial license fees by an additional 75 percent for a Commercial Fishing Resource Fund (G.S. 113-173.1). The purpose of the fund is to fund the Observer Program and to designate any surplus funds to projects that develop sustainable commercial fishing.
- The Sea Turtle and Atlantic Sturgeon Incidental Take permits require year-round monitoring of the small mesh and large mesh gill net fisheries.
- The Sea Turtle and Atlantic Sturgeon Incidental Take permits require adequate funding to ensure the permit's obligations are met, and the license fee increases for the Commercial Fishing Resource Fund are expected to meet these obligations.

Previous Actions or Considerations

Observer Program

- The Observer Program Funding report submitted to the General Assembly by the Marine Fisheries Commission suggested management options for the estuarine gill net fishery if adequate funding was not available and if no improvements were made to program efficiencies.
  - Only allow the use of unattended large and small mesh anchored gill nets in estuarine waters from Oct. 1 through April 30
    - The open season for anchored gill net fishing would occur when landings and fishing effort are high, and when sea turtle abundance is lower in estuarine waters.
    - The open season would also coincide with existing small mesh gill net attendance rules (attendance not required from late fall to spring in most estuarine waters).
  - Operate the Observer Program without any set open and closed seasons, but close the estuarine gill net fishery when annual funding runs out.
- The financial audit of the Observer Program by the State Auditor's Office conducted in 2014 identified areas where the Observer Program could be enhanced such as improved documentation of missed trips and other activities associated with observer trips, and the division has already taken these steps.
- In addition, the division's Observer Program regularly reviews its procedures to improve efficiency and save money.
  - Recent examples include improvements to the call logs, establishing target numbers of observer trips needed for each management unit (by season) for meeting the required observer coverage, and an increased proportion of positive alternative platform trips.
  - The Estuarine Gill Net Permit established in September 2014 enhanced Observer Program efficiency through improved identification of active participants and improved contact information, which has reduced the time the observers spend acquiring trips.
- The Observer Program would still be required to monitor the small mesh gill net fishery year-round as required in the Sea Turtle and Atlantic Sturgeon Incidental Take permits.

Commercial Large Mesh Gill Net Fishery (gill nets 5 inches stretched mesh and greater)

- Seasonality of large mesh gill net fishery (all data for 2007-2011)

- Seasonal commercial landings:
  - Dec.-Feb.: 7 percent of landings
  - March-May: 27 percent of landings
  - June-Aug.: 21 percent of landings
  - Sept.-Nov.: 45 percent of landings
- Cumulative landings for all months with 10 percent or more of total landings:
  - Albemarle Sound: 73 percent of landings occur March-April and Sept.-Nov.
  - Pamlico Sound: 74 percent of landings occur July-Oct.
  - Pamlico, Pungo, Bay, and Neuse rivers: 52 percent of landings occur March and Sept.-Oct.
  - Core and Bogue Sound, and the North, Newport, and White Oak rivers: 81 percent of landings occur May-June and Aug.-Oct.
  - South of White Oak River to the S.C. line: 62 percent of landings occur March-April and Aug.-Oct.

- Seasonality of species in large mesh gill net landings:
  - Spring: striped bass, American shad, hickory shad, bluefish, red drum
  - Summer: southern flounder
  - Fall: striped bass, red drum, southern flounder, black drum
  - Winter: striped bass

Summary

- Efforts to improve Observer Program efficiency and to save money are already underway and are a continuous process.
- Adaptive management through the incidental take permits provides management flexibility for monitoring the estuarine gill net under budgetary constraints and to avoid exceeding allowable takes of sea turtles and Atlantic sturgeon.
- Observer Program funding established by Session Law 2014-100 (Senate Bill 744) is expected to be sufficient.
- Fisheries vary seasonally and by area making one size fits all seasons difficult to implement.
- Tailoring open seasons for reasons other than stock health is precedent setting.

Proposed Initiative: Investigate implementing an automated, user friendly & mutually beneficial observer "call-in" system for the gill-net fishery. Fishermen should be required to "call-in" if they are going to "fish" each week. The automated system should issue "confirmation numbers" to commercial fishermen who "call-in." Fishermen who fail to "call in" and report intended fishing activities should lose their permit indefinitely. Violators should be punished on a more severe, graduating scale. Furthermore, fishermen who hold a gill-net permit should be required to sign an agreement with their annual license renewal paperwork, which clearly explains the call-in process including the appropriate phone numbers.

Background

- The Estuarine Gill Net Permit was established on Sept. 1, 2014 to meet the incidental take permits' requirement to identify the participants in the estuarine gill net fishery using anchored gill nets.
  - o The Estuarine Gill Net Permit was also designed to improve the efficiency of the Observer Program (ex. accurate contact information for the fishermen), to improve fishermen compliance with the incidental take permits, and create a clear definition and outcome for refusing observer trips.
- During the development of the Estuarine Gill Net Permit, some industry members requested the division implement a call-in system similar to what is used in other federal observer programs.
  - o Fishermen would be required to contact the division when they intended to fish estuarine anchored gill nets.
  - o Some industry members believe a call-in system would be more effective than the system the division currently employs for the Estuarine Gill Net Permit.
  - o Some industry members also believe the division already has the resources to implement a call-in system using various resources such as Marine Patrol Communications staff.
- Division was not prepared to implement a call-in system on such short notice but advised industry members that staff would research other call-in systems to understand the cost and infrastructure required.
- In response to industry's request, staff has begun researching other observer program call-in systems.
  - o Staff can provide more information once research on this topic is complete.

Previous Actions or Considerations

Systems used by other observer programs:

- The Atlantic sea scallop fishery has an industry-funded observer program with a pre-trip notification (automated call-in) system.
  - o Scallop vessel operators must call in to an automated call-in system no later than three days and no sooner than 10 days prior to sailing.
  - o A confirmation number is received after calling in.
  - o National Marine Fisheries Service sends an email within 24 hours to either issue a waiver (if no observers are available) or assign an observer to that trip.
  - o The vessel operator must provide 48 hours notice to the observer provider prior to leaving the dock.
- The Northeast Federal Observer Program uses a web based pre-trip notification system with an optional call in system.
  - o Fishermen login to the system with their permit number and personal identification number.

    - Information entered includes departure time and date, trip duration, port of departure, gear type and fishing type.
- A pre-trip notification system for the estuarine gill net fishery would require fishermen to anticipate when and where they will be fishing in order to stay in compliance.
    - This system would decrease the flexibility gill net fishermen currently have for making fishing decisions.

Considerations for a call-in system

- Number of participants
    - Atlantic sea scallop fishery has less than 400 participants (Limited Entry and Limited Entry General Category permit vessels combined).
    - Fisheries observed by the Northeast Fisheries Observer Program that are subject to the web based pre-trip notification system (ex. squid, Atlantic mackerel, butterfish fishery, Atlantic herring fishery, Northeast groundfish fishery) are also limited entry fisheries with relatively small numbers of participants.
    - Over 50 percent of the fishermen used the web based pre-trip notification making the number of phone calls even less for this fishery.
    - In contrast, over 2,300 Estuarine Gill Net Permits were issued for the estuarine anchored gill net fishery with over 80 percent of these issued to commercial fishermen.
    - Previous analysis by License and Statistics staff determined there are approximately 800 to 1,000 active commercial participants in the estuarine anchored gill net fishery.
- Fishing Effort (numbers of trips)
    - Atlantic sea scallop fishery is limited by day at-sea allocations to permitted vessels.
    - Fishing trips for Atlantic sea scallops and the fisheries subject to the web based pre-trip notification system tend to be multiple days in duration and therefore, fewer trips are made than in fisheries where “day trips” are more common (ex. N.C.’s estuarine gill net fishery).
    - In 2013, over 14,000 commercial anchored large mesh gill net trips and nearly 9,000 small mesh anchored gill net trips occurred in N.C. estuarine waters.
    - Based on 2013 N.C. gill net trips, nearly 1,600 observer trips for large and small mesh gill nets combined would be necessary to meet the target observer coverage for these gears (2 percent for small mesh and 10 percent for large mesh).
- Infrastructure
    - Marine Patrol Communications is unable to handle the volume of phone calls for a call-in system for the N.C. estuarine anchored gill net fishery, even if only a small fraction of Estuarine Gill Net Permit holders are actively fishing.
    - The Protected Resources section would need to hire staff to handle phone calls, which would draw resources (money) away from conducting at-sea observer trips.
    - A web based or automated call-in system would likely require dedicated staff to administer but would not rely on staff to answer the phone (or receive a message left by the fisherman) to collect the information.
    - However, an automated call-in system or a web-based system might be more than the division can afford and more than industry is willing to fund through license fees.
    - In addition, staff would need to consult with Information Technology support staff to ensure any system used is compatible with the existing network, computer infrastructures, and databases.
- Compliance
    - After fishermen call in to notify staff that they plan to fish, observers still need to contact the fisherman to arrange a trip, which they already do.
    - Under this system, a fisherman who fishes without notifying the division would be in violation.
    - The proposed initiative states “Fishermen who fail to "call in" and report intended fishing activities should lose their permit indefinitely,” but the rule authority for permits (15A

    - 03O .0506) does not allow the division to revoke a permit indefinitely, rather it has graduated suspension structure of 10 days, 30 days and six months.
    - In contrast Rule15A 03O .0114 bases license suspensions and revocations on the number of convictions and the severity of the conviction with a graduated suspension structure of 30 days, 60 days, and one year.
    - Marine Patrol and Protected Resources sections would need to monitor fishing activity (ex. on-the-water checks, checking trip tickets at the fish house, etc.) for compliance, which draws staff away from other responsibilities such as ensuring proper observer coverage for the gill net fisheries to stay in compliance with the incidental take permits.

<u>Summary</u>

- The division is agreeable to continue investigating this option.
- System currently in place for the Estuarine Gill Net Permit since Sept. 1, 2014, so it is still relatively new and future modifications are likely.
- Pre-trip notification systems for other observer programs are for fisheries with fewer participants taking fewer trips.
- More research by staff is needed to determine if these systems are affordable and if they are compatible with existing network and computer infrastructures.
- Compliance issues would still exist and more compliance monitoring by the division would be necessary.
- A call in system will require more forethought on the part of permit holders if they have to call in a week ahead of time.
- Permit holders will lose some flexibility.