MARINE FISHERIES COMMISSION BUSINESS MEETING
Senator Bob Martin Eastern Agricultural Center, Williamston N.C.
Feb. 20-21, 2019

N.C.G.S. 138A-15(e) mandates at the beginning of any meeting of a board, the chair shall remind all members of their duty to avoid conflicts of interest under Chapter 138. The chair also shall inquire as to whether there is any known conflict of interest with respect to any matters coming before the board at that time.

N.C.G.S. 143B-289.54.(g)(2) states a member of the Marine Fisheries Commission shall not vote on any issue before the Commission that would have a "significant and predictable effect" on the member's financial interest. For purposes of this subdivision, "significant and predictable effect" means there is or may be a close causal link between the decision of the Commission and an expected disproportionate financial benefit to the member that is shared only by a minority of persons within the same industry sector or gear group. A member of the Commission shall also abstain from voting on any petition submitted by an advocacy group of which the member is an officer or sits as a member of the advocacy group's board of directors. A member of the Commission shall not use the member's official position as a member of the Commission to secure any special privilege or exemption of substantial value for any person. No member of the Commission shall, by the member's conduct, create an appearance that any person could improperly influence the member in the performance of the member's official duties.

Commissioners having questions about a conflict of interest or appearance of conflict should consult with counsel to the Marine Fisheries Commission or the secretary's ethics liaison. Upon discovering a conflict, the commissioner should inform the chair of the commission in accordance with N.C.G.S. 138A-15(e).

Feb. 20

6 p.m. Public Comment Period

Feb. 21

9 a.m. Call to Order*
Moment of Silence and Pledge of Allegiance
Conflict of Interest Reminder
Roll Call
Approval of Agenda**
Approval of Meeting Minutes**

9:15 a.m. Public Comment Period

10:15 a.m. Chairman's Report

- Letters
- Ethics Training and Statement of Economic Interest Reminder
- 2019 Meeting Schedule
- Commission Committee Assignments
- Wildlife Resources and Marine Fisheries Commission's Joint Committee on Delineation of Fishing Waters
- **Discussion and Endorsement of Proposed Legislative Changes****
- Illustration of Definition of Overfished and Overfishing
- Fiscal Analysis of Rules Associated with N.C. Wildlife Federation's Petition for Rulemaking
- Shrimp Fishery Management Plan Amendment 2
  Continued discussion from November meeting on goals and objectives for the next plan amendment
- Open Meetings Law Overview – Shawn Maier

Noon Lunch Break

1:30 p.m. Committee Reports

- N.C. Commercial Fishing Resource Fund Committee – William Brantley
- Southern Flounder Fishery Management Plan Advisory Committee
- Blue Crab Fishery Management Plan Advisory Committee
- Coastal Recreational Fishing License Advisory Committee

1:45 p.m. Director's Report – Director Steve Murphey
Reports and updates on recent Division of Marine Fisheries activities

- Division of Marine Fisheries Quarterly Update
- Ongoing Status of Rule Development to Clarify Standard Commercial Fishing License Transfers and Assignments – Stephanie McInerny
- Atlantic States Marine Fisheries Commission – Chris Batsavage
- Mid-Atlantic Fishery Management Council Update – Chris Batsavage
- South Atlantic Fishery Management Council Update - Steve Poland
- Highly Migratory Species – Randy Gregory
  - Update on bluefin tuna season/quotas
- Informational Materials
  - Landings Update for Red Drum and Southern Flounder
  - Protected Resources Update
    - Observer Program
    - Incidental Take Permit Updates
  - Rules Suspension Update
  - Report on January 2018 Cold Stun Impact on Spotted Seatrout

4 p.m. Rulemaking Update – Catherine Blum

- Periodic Review and Expiration of Existing Rules per G.S. 150B-21.3A
  - 15A NCAC 18A report update
  - 15A NCAC 03 rule readoption update
    - 2018-2019 annual rulemaking cycle
    - 2019-2020 annual rulemaking cycle – tarpon rule issue paper

Feb. 22

9 a.m. Fishery Management Plans

- Status of ongoing plans– Catherine Blum
- Blue Crab Fishery Management Plan Amendment 3 Update – Jason Rock and Corrin Flora
- Supplement A to the Estuarine Striped Bass Fishery Management Plan Amendment 1 - Charlton Godwin
  Review temporary management measure for a no possession limit for striped bass in the Central Southern Management Area to protect important year classes while the next plan amendment is being developed
  - **Vote on supplement****

11 a.m. Coastal Habitat Protection Plan Overview and Implementation – Jimmy Johnson

11:30 a.m. Issues from Commissioners

11:45 a.m. Meeting Assignments and Preview of Agenda Items for May Meeting – Nancy Fish

Noon Adjourn

**** Times indicated are merely for guidance. The commission will proceed through the agenda until completed.***
*****Potential Action Items***

Minutes

Marine Fisheries Commission Business Meeting Minutes
Hilton Garden Inn
Kitty Hawk, North Carolina
Nov. 14-16, 2018

The commission held a business meeting Nov. 14-16 at the Hilton Garden Inn in Raleigh, North Carolina.

The briefing book, presentations and audio from this meeting can be found at http://portal.ncdenr.org/web/mf/11-2018-briefing-book.

Actions and motions from the meeting are listed in **bolded** type.

BUSINESS MEETING - MOTIONS AND ACTIONS

On Nov. 14, a public comment session was held beginning at 6 p.m. Chairman Rob Bizzell called the meeting to order. The following individuals spoke:

Glenn Skinner, Executive Director of the N.C. Fisheries Association, asked the commission chair to reconsider his decision to not having meetings in the northern and southern areas of the coast. He said it was difficult for some fishermen to travel to the central area. Skinner also felt that the policy on scientific uncertainty put forward at the August commission meeting was arbitrary and would lead to more lawsuits, saying there must be a basis for regulations adopted and the Fisheries Reform Act sets out a clear process to follow.

Jerry Schill, Legislative Affairs Director for the N.C. Fisheries Association, said it serves stakeholders better to rotate commission meetings between coastal regions, rather than just having them in the central part of the coast. Schill also reported his board unanimously endorsed the reappointment of Tim Griner to North Carolina's Obligatory Seat on the South Atlantic Fishery Management Council, saying Griner is the incumbent and has done a good job representing North Carolina on that council.

Bill Gorham, with Bowed Up Lures and speaking for the recreational industry interests in Dare County, said he talked to a lot of stakeholders, tackle shops, piers, etc. and that fair and equitable access to the commission is need and achieved by moving meetings around the state. It is hard for business owners to travel, he said and asked the commission to keep at least one meeting in Dare County. Gorham supported Tim Griner to be reappointed to the South Atlantic Fishery Management Council. He also cautioned that the proposed policy on scientific uncertainty was dangerous and fearful.

Robert Alderman, said he was speaking for the recreational fishing industry in Dare County and it breaks his heart that the commission would propose removing the voice of Dare County by not having any meetings there. He said he wants a voice and wants to come to meetings, but as a small business owner he cannot travel to meetings that are all over the state. He asked the commission chair to please reconsider his decision on meeting locations. He also opposed the

proposed policy on scientific uncertainty, saying it was like preparing for a baby before you are sure your wife is pregnant.

Mike Payment, a Currituck County commissioner, said he supported local fishermen and shared their concerns about not having future meetings in Dare County or the northern coastal region of the state.

Perry Wood Beasley, said Dare County is the top county for commercial landings in the state and that commission meetings should continue to be rotated along the coast. He does not like the way the meetings are conducted, and that public comment should come after the commission's discussion. He also does not like the 3-minute time limit on public comment. He supported Tim Griner for reappointment to the South Atlantic Fishery Management Council. Additionally, he said for striped bass in the Central Southern Management Area, that the plan should be allowed to work through the process. He closed by saying that if water quality improves, so will the stocks and more areas need to be opened to trawling to regenerate growth on the bottom.

Andrew Berry, Vice President of N.C. Watermen United, said Dare County was #1 in the state for commercial landings and had a lot of charter and head boats and that meetings should be held in areas where there are a lot of fishermen to enhance participation. He asked the commission chairman to reconsider his decision not to have meetings in the northern region. For striped bass in the Central Southern Management Area, that if the quota is being caught, shows that there are fish in there and that's a good thing. If the quota is not being caught, that would be the problem. Berry said that the proposal to close striped bass harvest is not supported by facts.

The meeting recessed at 6:20 p.m.

Chairman Rob Bizzell convened the Marine Fisheries Commission business meeting at 9 a.m. on Nov. 15 and reminded commissioners of their conflict of interest and ethics requirements.

Doug Cross and Sam Romano were sworn into the commission. Cross serves in the Commercial Industry Seat and Romano serves in a Commercial Seat.

Commission Liaison Nancy Fish reviewed evaluations from the State Board of Elections and Ethics Enforcement for actual and potential conflicts of interest for the new commissioners, as follows:

> **<u>For Douglas Cross</u>**:
> "We did not find an actual conflict of interest, but found the potential for a conflict of interest. The potential conflict identified does not prohibit service on this entity."
>
> "Mr. Cross fills the role of a member who is actively engaged in, or recently retired from, commercial fishing as demonstrated by currently or recently deriving at least fifty percent (50%) of annual earned income from taking and selling fishery resources in coastal fishing waters of the State. He is the owner and vice-president of Pamlico Packing Co., Inc., a seafood processing company. Because he would serve on the licensing authority for members of his own profession he has the potential for a conflict of interest. Accordingly, Mr. Cross should exercise appropriate caution in the performance of his public duties

should issues involving his business or issues involving any of his colleagues or competitors come before the Commission for official action."

For Samuel Romano:
"We did not find an actual conflict of interest, but found the potential for a conflict of interest. The potential conflict identified does not prohibit service on this entity."

"Mr. Romano fills the role of a member who is actively engaged in, or recently retired from, commercial fishing as demonstrated by currently or recently deriving at least fifty percent (50%) of annual earned income from taking and selling fishery resources in coastal fishing waters of the State. Mr. Romano owns financial interests in YPS LLC, a seafood retail company and Seaview Crab Co., which he co-owns with his brother. Because he would serve on the licensing authority for members of his own profession he has the potential for a conflict of interest. Accordingly, he should exercise appropriate caution in the performance of his public duties should issues involving his businesses or issues involving any of his family members, colleagues or competitors come before the Commission for official action."

The following commission members were in attendance: Rob Bizzell-Chairman, Mike Blanton, Cameron Boltes, Doug Cross, Tom Hendrickson, Pete Kornegay, Brad Koury, Chuck Laughridge and Sam Romano.

Motion by Chuck Laughridge to approve agenda. Second by Brad Koury.
Motion carries with no opposition.

Motion by Chuck Laughridge to approve minutes from the August 2018 meeting. Second by Pete Kornegay.
Motion carries with no opposition.

Public Comment Period
Chris Elkins, a former Marine Fisheries Commissioner, expressed concern about dead discards in the striped bass fishery in the Central Southern Management Area. To help more fish reach spawning age, he recommended the recreational fishery mirror the Wildlife Resources Commission's regulations of a 26-inch minimum size limit/2 fish per day bag limit and for the commercial fishery, he suggested removing gill nets and prohibiting harvest. Elkins said the stocking of striped bass in this area was to enhance recreational harvest, not commercial.

David Sneed, Executive Director of the Coastal Conservation Association – N.C., said his organization is not for the extinction of the commercial industry, but they did support the long-term future of the fishery. He said not all problems are from overfishing, that climate change has caused fish to move farther north. He said fisheries managers need to acknowledge this and not keep supporting status quo. Sneed also expressed support for Commissioner Kornegay's proposed policy on scientific uncertainty, saying conservation had to be given the highest priority. He closed his comments by asking that Tim Griner be reappointed to North Carolina's Obligatory Seat on the South Atlantic Fishery Management Council.

Chairman's Report

Chairman Bizzell reviewed correspondence that had been sent and received by the commission since the last business meeting.

Commissioners were reminded of the meeting schedule for 2019:

Feb. 20-22 in Morehead City/New Bern area
May 15-17 in Morehead City/New Bern area
Aug. 21-23 in Raleigh area
Nov. 13-15 in Morehead City/New Bern area

Several commissioners expressed concern about not rotating business meetings among the three coastal regions of the state and that this could disenfranchise fishermen. Chairman Bizzell explained the commission is required to hold three of the four quarterly business meetings in the coastal region of the state. He reiterated his decision to hold these meetings in the Morehead City/New Bern area, as these towns are more centrally located, and he felt it was a fairer option.

Proposed Policy on Scientific Uncertainty

At its August meeting, the commission tabled a motion that proposed the commission adopt a policy on scientific uncertainty; the motion was made by Commission Kornegay and seconded by Commissioner Laughridge. Chairman Bizzell made a motion to readdress the tabled motion, and asked the commission's counsel, Shawn Maier, to share concerns he had with the proposed policy. Maier said having a stand-alone policy could have the potential to create an additional standard by which the commission's actions would be judged. There are currently statutes and rules in place and adding a policy like this will generate an additional criteria against which the commission's actions can be judged to the extent that there may be an inconsistency between policy and rule and statue. Then you have an area where there is no way to win, either the commission is consistent with the policy and inconsistent with the rules and statutes, or vice versa, he explained.

The motion was withdrawn and there was discussion about examining scientific uncertainty in with fishery management plans, on a case-by-case basis.

Motion by Rob Bizzell to readdress tabled motion on Marine Fisheries Commission policy that was tabled at the August 2018 meeting.

Pete Kornegay withdrew his original motion and Chuck Laughridge withdrew his second.

Fishery Management Council Nominations

Division staff reported that the commission's Nominating Committee voted to forward the names of Robert (Tim) Griner, Brian (Scott) Buff, Samuel (Sammy) Corbett and Jack Cox to the commission for consideration as nominees to North Carolina's obligatory seat on the South Atlantic Fishery Management Council. The commission is required to submit to the governor a minimum of three candidates for consideration for each seat. Bios were reviewed for each of the potential nominees.

The commission voted to forward the names recommended by the Nominating Committee to the Governor's Office for consideration as nominees for North Carolina's South Atlantic Fishery Management Council obligatory seat.

Motion by Chuck Laughridge to approve the following nominees for the North Carolina Obligatory Seat on the South Atlantic Fishery Management Council:

- **Robert (Tim) Griner**
- **Brian (Scott) Buff**
- **Samuel (Sammy) Corbett**
- **Jack Cox**

Second by Doug Cross.
Motion carries with no opposition.

Director's Report

Division of Marine Fisheries Director Steve Murphey welcomed the new commissioners and then updated the commission on division activities occurring since the August 2018 business meeting, including:

- An update on the impacts of Hurricane Florence, and state and federal responses to the disaster. To view a slideshow of hurricane recovery images, go to: http://portal.ncdenr.org/c/document_library/get_file?p_l_id=1169848&folderId=32426618&name=DLFE-139473.pdf
- The appointment of Jerry Mannen of Wilmington to the Atlantic States Marine Fisheries Commission by Gov. Roy Cooper.
- The submission of the draft fiscal note to the Office of State Management and Budget for the rules associated with the N.C. Wildlife Federation's petition for rulemaking by July 1. OSBM reviewed the document and had about 80-90 edits, comments, questions that the division addressed. The final draft fiscal note was then resubmitted.
- Continuing work on the Shrimp Bycatch Reduction study combining the Year 1, Year 2 and Year 3 studies into one manuscript for peer review. Edits and reviews are occurring internally between the division, Sea Grant and NOAA co-authors.

Central Southern Striped Bass

The division recommended the commission ask the Secretary of the Department of Environmental Quality for approval to develop temporary management measures to supplement the Estuarine Striped Bass Fishery Management Plan with a no possession limit in the Central Southern Management Area to protect important year classes while the next plan amendment is being developed.

Division biologist Charlton Godwin gave the commission a presentation on temporary management measures to reduce striped bass mortality.

To view this presentation, go to:
http://portal.ncdenr.org/c/document_library/get_file?uuid=e2d46f4f-a24b-405a-8f5b-9d1635acf20c&groupId=38337

The commission approved the recommendation. The division noted if the necessary approvals are received, it intended to hold one public meeting on the issue in the Washington area. The supplement would be brought back to the commission for adoption in February, and the regulations would be implemented by the division director through his proclamation authority.

Motion by Cameron Boltes to authorize staff to develop temporary management measures to supplement the N.C. Estuarine Striped Bass Fishery Management Plan with a no

possession limit in the Central Southern Management Area to protect important year classes while the next plan amendment is being developed. Second by Pete Kornegay. Motion carries 6-3.

Status of Rule Development to Clarify Standard Commercial Fishing License Transfers

The commission had expressed interest in clarifying the circumstances under which standard or Retired Standard Commercial Fishing License transfers are allowed. Concern had been raised about third-party transfers allowing individuals to get a license without going through the eligibility board. Stephanie McInerny, the chief of the division's License and Statistics Section, updated the commission on the status of the rule development to clarify Standard Commercial Fishing License transfers. The commission requested further refinements be brought back at the February 2019 meeting.

N.C. Saltwater Fishing Tournament

Carole Willis, the division's Citation Program coordinator, gave the commission a presentation on the North Carolina Saltwater Fishing Tournament. The program recognizes anglers for outstanding catches for fish common to North Carolina waters.

To view this presentation, go to:
http://portal.ncdenr.org/c/document_library/get_file?p_l_id=1169848&folderId=32426618&name=DLFE-139472.pdf

Shellfish Sanitation and Recreational Water Quality Program Overview

Shannon Jenkins, the chief of the division's Shellfish Sanitation and Recreational Water Quality Section and J.D. Potts, the head of the Recreational Water Quality Program, gave an overview on shellfish sanitation and recreational water quality.

To view this presentation, go to:
http://portal.ncdenr.org/c/document_library/get_file?p_l_id=1169848&folderId=32426618&name=DLFE-139476.pdf

The division then provided an overview of recent actions from the Atlantic States Marine Fisheries Commission, an update on the Sustainable Fishery Management Plan for American Shad, the Mid- and South Atlantic Fishery Management Councils, and Highly Migratory Species, along with updates on the division's Protected Resources Program.

Summer Flounder Commercial Issues Amendment

At its August meeting, Chris Batsavage, the division's special assistant for councils and commissions, has updated the commission on the Summer Flounder Commercial Issues Amendment being considered by the Mid-Atlantic Fisheries Management Council and the Atlantic States Marine Fisheries Commission. The amendment addresses state commercial quota allocations, permit requalifying criteria and framework provisions for commercial landing flexibility. Public hearings and a comment period on this amendment were held during the fall, with final consideration slated for early December.

The commission voted to recommend that the Mid-Atlantic Fishery Management Council and Atlantic States Marine Fisheries Commission remain at status quo regarding the coastwide commercial allocation of summer flounder.

Motion by Doug Cross to recommend that the Mid-Atlantic Fishery Management Council and Atlantic States Marine Fisheries Commission remain at status quo pertaining to the coastwide commercial allocation of summer flounder. Second by Sam Romano.
Motion carries unanimously.

Update on Spotted Seatrout Cold Stun Impacts

Tracey Bauer, the division's staff lead on spotted seatrout, updated the commission on a cold stun event that occurred in January 2018 that impacted spotted seatrout. The final report on the impacts of this event was not complete as more time was needed to allow for additional tag returns to be reported to the division to reduce uncertainty and increase the accuracy of the natural mortality estimate. The final report will be provided to the commission when it is available.

The meeting recessed at 4:30 p.m.

The meeting reconvened at 9 a.m. on Nov. 16.

Rulemaking

Catherine Blum, the division's rulemaking coordinator, recommended the commission give final approval for readoption of 41 rules per G.S. 150B-21.3A, Periodic Review and Expiration of Existing Rules, that includes:

- Conforming changes to For-Hire License Requirements, 15A NCAC 03O .0112; and
- Readoption of a Portion of Rules in 15A NCAC 03I, 03J, 03K, 03L, 03M, 03O and 03R.

The commission voted to readopt 41 existing rules under the state-mandated periodic review schedule.

Motion by Tom Hendrickson to give final approval of readoption of the following rules per G.S. 150B-21.3A, Periodic Review and Expiration of Existing Rules:

- **Conforming changes to For-hire License Requirements, 15A NCAC 03O .0112**
- **Readoption of a Portion of Rules in 15A NCAC 03I, 03J, 03K, 03L, 03M, 03O and 03R including changes since publication in the North Carolina Register to 15A NCAC 03I .0120; 03J .0102, .0203, .0204, .0304, .0306; 03K .0504, as presented**

Second by Doug Cross
Motion carries unanimously.

2017 Landings Overview

Stephanie McInerny, the chief of the division's License and Statistics Section, gave an overview of the 2017 landings and harvest trends for both commercial and recreational sectors.

To view this presentation, go to:
http://portal.ncdenr.org/c/document_library/get_file?p_l_id=1169848&folderId=32426618&name=DLFE-139471.pdf

Fishery Management Plan Update

Catherine Blum, the division's Fishery Management Plan Coordinator, gave the commission an update on the status of North Carolina's ongoing fishery management plans.

During this discussion, a motion was brought forward regarding the goals and objectives of the next amendment to the Shrimp Fishery Management Plan. Several commissioners expressed concern with the motion and requested time to review the issue. The commission ultimately voted to delay discussion of the goals and objectives for the next amendment to the Shrimp Fishery Management Plan until the following meeting.

Shrimp Fishery Management Plan/Goals and Objectives

Motion by Chuck Laughridge that the Marine Fisheries Commission goals and objectives for the Shrimp Fishery Management Plan include the following:

- **Reduce takes and interactions of non-targeted species and threatened species by curtailing actual effort**
- **Limit trawling in the Pamlico Sound to 3 days per week**
- **Reduce tow times to be consistent with improving survival of non-target and endangered species**
- **Continue to minimize bycatch and enhance the economic value of shrimp**
- **Change the requirement for a second BRD to a rule instead of proclamation**
- **Reduce maximum headrope to 110 feet and delay the season until a count of 60 or greater**
- **Promote habitat enhancement and provide environmental quality necessary to improve the shrimp resource to revisions to NC nursery areas and expansion of existing nursery areas**
- **Revision of nursery areas with an updated look at secondary nursery areas with expansion of secondary nursery areas based on revised environmental and biological data**
- **Implement research and education programs to allow a better understanding of the public, industry and consumers of the shrimp bycatch impact on fish population dynamics**
- **Require shrimp trawl bycatch reduction at the tow level, which is labor saving to industry, but also to address mortality at the population levels of finfish. We must address shrimp trawl bycatch at the population level prior to any additional reliance on mechanical means**
  Second by Pete Kornegay.

Motion by Tom Hendrickson to table the previous motion to the next meeting.
Second by Doug Cross.
Motion carries 5-4.

Motion by Chuck Laughridge to discuss his prior motion no later than the February meeting, and if there is a special called meeting, that it be discussed then. Second by Pete Kornegay.
Motion carries 5-4.

Blue Crab Fishery Management Plan Amendment 3 Update

Jason Rock, one of the co-leads for the species lead for the Blue Crab Fishery Management Plan, updated the commission on the status of the plan development and the progress of the advisory committee.

Southern Flounder Stock Assessment Update

Laura Lee, the division's senior stock assessment scientist, provided the commission with an update to the January 2018 Southern Flounder Stock Assessment that incorporated data through 2017 and revised recreational numbers (harvest and discard) from the Marine Recreational Information Program (MRIP) estimates, based on the latest effort estimates. The assessment shows the stock is overfished and overfishing is occurring. There was discussion about the reductions needed to end overfishing within two years and achieve a sustainable harvest within 10 years. The commission was advised those projections would be provided at its February 2019 meeting.

To view this presentation, go to:
http://portal.ncdenr.org/c/document_library/get_file?p_l_id=1169848&folderId=32426618&name=DLFE-139475.pdf

Southern Flounder Fishery Management Plan Amendment 2 Update

Mike Loffler, one of the co-leads for the species lead for the Southern Flounder Fishery Management Plan, updated the commission on the status of the plan development and the progress of the advisory committee.

Rule Suspension Annual Update

Kathy Rawls, the division's Fisheries Management Section Chief, reviewed previously approved rule suspensions and reported that no new rules suspension had occurred since the August 2018 commission meeting.

Under ***Issues from Commissioners,*** Commissioner Boltes requested that at the next meeting the commission's counsel provide guidance about distributing motion materials among commissioners in advance of meetings and how that would relate to the Open Meetings Law.

The meeting adjourned at approximately 1 p.m.

Chairman's Report

NORTH CAROLINA MARINE FISHERIES COMMISSION
DEPARTMENT OF ENVIRONMENTAL QUALITY

Nov. 19, 2018

Dr. Christopher M. Moore, Executive Director
Mid-Atlantic Fishery Management Council
800 North State St., Suite 201
Dover, DE 19901

Dear Dr. Moore:

I am writing on behalf of the N.C. Marine Fisheries Commission regarding the amendment to the Summer Flounder, Scup, and Black Sea Bass Fishery Management Plan that primarily addresses the commercial summer flounder fishery.

The commission reviewed the amendment's management options at its business meeting last week and supported the no action option for the commercial allocations issue. We understand that the public who attended the public hearing on the amendment in Washington, NC also supported this option due to the importance of the commercial summer flounder fishery to North Carolina fishermen. The summer flounder fishery is the state's most valuable commercial finfish fishery, so any reduction to the state's allocation would have a negative impact to the commercial fishery, as well as the businesses supporting the fishery.

Thank you for the opportunity to comment on the amendment to this plan and please know how much we appreciate the work you do on behalf of our Atlantic Coast fisheries.

Sincerely,

W. Robert Bizzell, Chairman
N.C Marine Fisheries Commission

cc: Steve Murphey, Director, N.C. Division of Marine Fisheries
N.C. Marine Fisheries Commission

NORTH CAROLINA MARINE FISHERIES COMMISSION
DEPARTMENT OF ENVIRONMENTAL QUALITY

Nov. 19, 2018

Mr. Robert E. Beal, Executive Director
Atlantic States Marine Fisheries Commission
1050 N. Highland Street, Suite 200 A-N
Arlington, VA 22201

Dear Mr. Beal:

I am writing on behalf of the N.C. Marine Fisheries Commission regarding the amendment to the Summer Flounder, Scup, and Black Sea Bass Fishery Management Plan that primarily addresses the commercial summer flounder fishery.

The commission reviewed the amendment's management options at its business meeting last week and supported the no action option for the commercial allocations issue. We understand that the public who attended the public hearing on the amendment in Washington, NC also supported this option due to the importance of the commercial summer flounder fishery to North Carolina fishermen. The summer flounder fishery is the state's most valuable commercial finfish fishery, so any reduction to the state's allocation would have a negative impact to the commercial fishery, as well as the businesses supporting the fishery.

Thank you for the opportunity to comment on the amendment to this plan and please know how much we appreciate the work you do on behalf of our Atlantic Coast fisheries.

Sincerely,

W. Robert Bizzell, Chairman
N.C Marine Fisheries Commission

cc: Steve Murphey, Director, N.C. Division of Marine Fisheries
N.C. Marine Fisheries Commission

NORTH CAROLINA MARINE FISHERIES COMMISSION
DEPARTMENT OF ENVIRONMENTAL QUALITY

Jan. 9, 2019

Mr. Robert (Timothy) Griner
4446 Woodlark Lane
Charlotte, NC 28211

Dear Mr. Griner,

The U.S. Secretary of Commerce will request that Governor Cooper submit the names of qualified candidates to be considered for an obligatory appointment to the South Atlantic Fishery Management Council (Council) in August 2019. This request will occur when the federal government shutdown ends. The N.C. Marine Fisheries Commission is responsible for compiling a list of nominees for the governor's consideration. At its Nov. 14-16, 2018 business meeting, the commission reviewed information from candidates interested in an appointment to the council. Your name was among those selected by the commission for submission to Governor Cooper as a nominee for an appointment to the council.

Each council nominee is required to complete nomination materials provided by the National Marine Fisheries Service. Your nomination materials are attached and are also available in fillable, .pdf format at: http://www.nmfs.noaa.gov/sfa/reg_svcs/Councils/Nominations/applicationkit.htm when the federal government shutdown ends (the link is currently disabled). All forms must be completed in detail in order for you to be considered for an appointment. Please complete the forms and return no later than Feb. 8, 2019 to: Chris Batsavage, N.C. Division of Marine Fisheries, P.O. Box 769, Morehead City, NC 28557. The division will review your forms for completeness and forward them to the governor's office for submission to the National Marine Fisheries Service by March 15, 2019.

I wish to congratulate you on your selection by the commission as a nominee for an obligatory appointment to the South Atlantic Fishery Management Council. Please feel free to contact Mr. Batsavage by phone at 252-808-8009 or by email at chris.batsavage@ncdenr.gov if you need additional information concerning the nomination process.

Sincerely,

W. Robert Bizzell, Chairman
N.C Marine Fisheries Commission

WRB:cb:nf

Cc: John Nicholson Steve Murphey John Lucey
Nancy Fish Chris Batsavage

NORTH CAROLINA MARINE FISHERIES COMMISSION
DEPARTMENT OF ENVIRONMENTAL QUALITY

Jan. 9, 2019

Mr. Jack Cox
141 Bayview Blvd.
Atlantic Beach, NC 28512

Dear Mr. Cox,

The U.S. Secretary of Commerce will request that Governor Cooper submit the names of qualified candidates to be considered for an obligatory appointment to the South Atlantic Fishery Management Council (Council) in August 2019. This request will occur when the federal government shutdown ends. The N.C. Marine Fisheries Commission is responsible for compiling a list of nominees for the governor's consideration. At its Nov. 14-16, 2018 business meeting, the commission reviewed information from candidates interested in an appointment to the council. Your name was among those selected by the commission for submission to Governor Cooper as a nominee for an appointment to the council.

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Sincerely,

W. Robert Bizzell, Chairman
N.C Marine Fisheries Commission

WRB:cb:nf

Cc: John Nicholson Steve Murphey John Lucey
Nancy Fish Chris Batsavage

NORTH CAROLINA MARINE FISHERIES COMMISSION
DEPARTMENT OF ENVIRONMENTAL QUALITY

Jan. 9, 2019

Mr. Sammy Corbett
691 Washington Acres Road
Hampstead, NC 28443

Dear Sammy,

The U.S. Secretary of Commerce will request that Governor Cooper submit the names of qualified candidates to be considered for an obligatory appointment to the South Atlantic Fishery Management Council (Council) in August 2019. This request will occur when the federal government shutdown ends. The N.C. Marine Fisheries Commission is responsible for compiling a list of nominees for the governor's consideration. At its Nov. 14-16, 2018 business meeting, the commission reviewed information from candidates interested in an appointment to the council. Your name was among those selected by the commission for submission to Governor Cooper as a nominee for an appointment to the council.

Each council nominee is required to complete nomination materials provided by the National Marine Fisheries Service. Your nomination materials are attached and are also available in fillable, .pdf format at: http://www.nmfs.noaa.gov/sfa/reg_svcs/Councils/Nominations/applicationkit.htm when the federal government shutdown ends (the link is currently disabled). All forms must be completed in detail in order for you to be considered for an appointment. Please complete the forms and return no later than Feb. 8, 2019 to: Chris Batsavage, N.C. Division of Marine Fisheries, P.O. Box 769, Morehead City, NC 28557. The division will review your forms for completeness and forward them to the governor's office for submission to the National Marine Fisheries Service by March 15, 2019.

I wish to congratulate you on your selection by the commission as a nominee for an obligatory appointment to the South Atlantic Fishery Management Council. Please feel free to contact Mr. Batsavage by phone at 252-808-8009 or by email at chris.batsavage@ncdenr.gov if you need additional information concerning the nomination process.

Sincerely,

W. Robert Bizzell, Chairman
N.C Marine Fisheries Commission

WRB:cb:nf

Cc: John Nicholson Steve Murphey John Lucey
Nancy Fish Chris Batsavage

NORTH CAROLINA MARINE FISHERIES COMMISSION
DEPARTMENT OF ENVIRONMENTAL QUALITY

Jan. 9, 2019

Mr. Brian (Scott) Buff
4888 Coastal Dr., SE
Southport NC 28461

Dear Mr. Buff,

The U.S. Secretary of Commerce will request that Governor Cooper submit the names of qualified candidates to be considered for an obligatory appointment to the South Atlantic Fishery Management Council (Council) in August 2019. This request will occur when the federal government shutdown ends. The N.C. Marine Fisheries Commission is responsible for compiling a list of nominees for the governor's consideration. At its Nov. 14-16, 2018 business meeting, the commission reviewed information from candidates interested in an appointment to the council. Your name was among those selected by the commission for submission to Governor Cooper as a nominee for an appointment to the council.

Each council nominee is required to complete nomination materials provided by the National Marine Fisheries Service. Your nomination materials are attached and are also available in fillable, .pdf format at: http://www.nmfs.noaa.gov/sfa/reg_svcs/Councils/Nominations/applicationkit.htm when the federal government shutdown ends (the link is currently disabled). All forms must be completed in detail in order for you to be considered for an appointment. Please complete the forms and return no later than Feb. 8, 2019 to: Chris Batsavage, N.C. Division of Marine Fisheries, P.O. Box 769, Morehead City, NC 28557. The division will review your forms for completeness and forward them to the governor's office for submission to the National Marine Fisheries Service by March 15, 2019.

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Sincerely,

W. Robert Bizzell, Chairman
N.C Marine Fisheries Commission

WRB:cb:nf

Cc: John Nicholson Steve Murphey John Lucey
Nancy Fish Chris Batsavage

January 2, 2019

Rob Bizzell, Chairman
NC Marine Fisheries Commission
3441 Arendell Street
Morehead City, NC 28557

Dear Mr. Bizzell:

Please find enclosed three pictures of an unattended gillnet that I found in the Neuse River between New Bern and Bridgeton. The net was full of rotting strippers and dead turtles along with numerous other species of fish. I phoned Marine Fisheries; when the officer arrived, he stated he knew the owner of the net from previous violations.

This is just one example of the devastating destruction gillnets have on our fisheries.

- They do not target a specific species of fish
- They do not limit their catch
- They kill unknown numbers of turtles

All of North Carolina's fisheries numbers have been declining over the past twenty years while we continue to tolerate the use of destructive gillnets.

WHY?

I respectfully look forward to your reply.

Sincerely,

John Canup 1409 St James Pl., Kinston, NC 28504 Phone 252-559-6637

CC: Chuck Laughridge, NC MFC

David Snead, NCCCA

Bert Owens, NCCCA

Dr. Louis Daniel, NC Wildlife Federation

Rep. Chris Humphrey, NC Legislature

Rep. John Bell, NC Legislature

NORTH CAROLINA
State Board of Elections & Ethics Enforcement

Mailing Address:
P.O. Box 27255
Raleigh, NC 27611-7255

Phone: (919) 814-0700
Fax: (919) 715-0135

Ethics & Lobbying Education

The following information applies to public servants, legislators, legislative employees, and ethics liaisons. For information on lobbying education and awareness presentations for lobbyists and lobbyist principals.

Mandatory Education. The N.C. State Board of Elections and Ethics Enforcement provides mandatory ethics and lobbying education for *public servants*, *legislators*, *legislative employees* and *ethics liaisons*. Topics covered include:

- Filing a Statement of Economic Interest ("SEI")
- Monitoring and avoiding conflicts of interest
- The gift ban and its exceptions
- Prohibition on use of public position for private gain
- Lobbying and how it affects individuals covered by the State Government Ethics Act

Ethics education is the primary way individuals subject to the State Government Ethics Act are made aware of their public duties and responsibilities as well as the consequences for violating the ethics laws.

Who Must Participate

- **Public Servants & Ethics Liaisons.** All public servants and ethics liaisons are required to attend a Commission-approved basic ethics and lobbying education presentation within six (6) months of the person's election appointment, or employment and attend a refresher presentation at least every two (2) years thereafter.

- **Legislators & Legislative Employees.** The Commission, jointly with the Legislative Ethics Committee, makes mandatory ethics education and lobbying presentations to all legislators within two (2) months of the legislator assuming his or her office. Legislative employees must also participate in ethics education within three (3) months of employment and attend a refresher at least every two (2) years.

- **Education Presentations & Schedule.** Ethics and lobbying education presentations for public servants and ethics liaisons are offered online and live at Raleigh-only and distance education sites. Completing an online presentation or attending a live session meets either the basic or refresher mandatory education requirements. Visit https://www.ncsbe.gov/Ethics/Education to access online and live training options.

  Ethics education for **legislators** is conducted in live sessions. Legislative employees may participate in ethics education online through the General Assembly.

- **Consequences for Failure to Attend.** Failure to attend an ethics and lobbying education presentation is a violation of the State Government Ethics Act and may result in the individual being recommended for removal from his or her public position or disciplined in his or her State job.

Contact Information

For education related questions, contact:
NC State Board of Elections and Ethics Enforcement
Phone: (919) 814-3600
E-mail: Education.Ethics@doa.nc.gov

2019 STATEMENT OF ECONOMIC INTEREST REMINDERS:

Completed SEIs must be filed on or before April 15, 2019. If you have already filed a 2019 SEI, do not refile. The forms and instructions can be found at https://ethics.ncsbe.gov/sei/blankForm.aspx.

If you filed a 2018 SEI ***and*** you have had ***no changes*** since your 2018 filing, you may file a 2019 SEI No Change Form, located on the website.

You must file a 2019 Long Form if any of the following apply to you:

a. You filed a 2018 SEI **but** you have had changes since your 2018 filing;
b. You did not file a 2018 SEI; or
c. You are a first-time filer or have been appointed to a new or additional position/board.

This year, the State Board of Elections and Ethics Enforcement will roll out a new electronic process for filing SEIs. That electronic filing option will be available in **early February**.

You are encouraged to file your SEI electronically. However, if you want to file your SEIs before the updated electronic version is available, hard copies are available for filing now at the link above.

New commissioners will need to file a 2019 SEI; however, if you have not had any changes since you last filed, you can use the No Change Form, which is fairly easy to complete.

Please file by April 15th to avoid fines and other penalties.

SEI HELPFUL TIPS

1. PUBLIC RECORDS. The State Board of Elections and Ethics Enforcement (State Board) is required to collect and maintain disclosures from certain persons covered by the State Elections and Ethics Enforcement Act Government Ethics Act (Elections and Ethics Act). By law, the information requested is public record and available to the public upon request. As public records, Statements of Economic Interest (SEI) are available on the Commission's website. Personal contact information, however, is not.

2. CONTACT INFORMATION PAGE. The Contact Information page, which includes your personal contact information, will not be available on the Commission's website, but is a public **record.**

3. CHILDREN'S INITIALS. Only list minor children's INITIALS on the SEI. List each child's full legal name on the Confidential Unemancipated Children's Form. If you are filing electronically, the form will be generated at the end of the SEI from the information that you provided on your electronic SEI. The Confidential Form is not a public record, and the State Board will not make it available to the public.

4. READ EACH QUESTION CAREFULLY. Read each question carefully and pay close attention to the time periods in each question as they do vary.

5. ANSWER EACH QUESTION. It is important to answer each question, including all applicable subparts. Even if your answer is "no" or "not applicable," make certain you answer each question. Many of the questions have "yes" and "no" boxes to check for your convenience. Incomplete SEIs may cause delays and negatively impact your public service on a covered board or as an employee.

6. WHY ARE YOU FILING. You must list the complete name of the state board or state agency employer for which you are filing the SEI. Without this information, your SEI may be delayed and negatively impact your public service on a covered board or as an employee.

7. HOW TO FILE. The State Board strongly recommends electronical on-line filing as it is secure, allows easy information updates, and gives you access to your electronic SEIs previously filed. Filing your SEI on-line is easy, quick, convenient, and reduces the chance of reporting errors. Getting started is easy. Follow the simple steps to create your own account and get access today: https://EFILE.ncsbe.gov/ To file a paper version of the SEI, you must provide the State Board with a signed, original SEI form. Each SEI includes an "affirmation" and is a legally binding document. Faxed or emailed copies of your SEI CANNOT be accepted.

SEI Helpful Tips, continued

8. INCOME. List each source of income as requested on the SEI. The actual dollar amount is not required. Be sure to list your employer as a source of income in Question # 6 of the SEI.

9. READ CAREFULLY. Read each question carefully, as the Elections and Ethics Act requires that you disclose your financial holdings and obligations, personal property, and real property and may also include your knowledge of the holdings of both your immediate family and your extended family. “Immediate family” and “extended family” are defined terms in the Elections and Ethics Act, and those definitions are included with this document.

10. REFLECT. Think carefully about WHY you are filing, and whether it has any relationship to your position. Does your board or commission license or regulate you? For many of the boards, a subject matter expert like a licensee is needed. Answering “yes” does not prohibit your service on the board, and your perspective is valued.

11. MAKE A COPY. Make a copy of the SEI for your own records, and make a note in your calendar when you submit it, whether on-line or by mail or hand delivery. When you successfully submit your SEI electronically on-line, the final screen will provide a confirmation number and will be proof that you have satisfied your filing obligation. Please print the **confirmation screen for your records.**

12. ETHICS LIAISON. Contact your Ethics Liaison to assist you in your obligations under the Elections and Ethics Act. Your Ethics Liaison is good source of information about how to fill out your SEI.

13. ON-LINE HELP. The State Board has on-line resources to answer questions you may have about your SEI. For more information, please visit the State Board website which has education offerings.

14. DEFINITIONS. As noted above, certain terms are defined in the Elections and Ethics Act ("immediate family"). These definitions may be helpful to you in completing your SEI. A complete list of all definitions used in the Elections and Ethics Act is available on the State Board's website, under "Ethics". Some of the more common ones are attached to this document.

15. YOUR INTERNET BROWSER. Consider using Internet Explorer or Chrome to submit your SEI. Some users have had trouble using other browsers. 16. WE ARE HERE TO HELP YOU. In addition to on-line resources and written materials, the State Board has expert staff ready to answer any questions you might have and assist you in completing and filing your SEI. Do not hesitate to contact us at sei@ncsbee.gov (919) 814-3600.

2019 Meeting Planning Calendar

January

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

February

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28		

March

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
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17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

April

Su	Mo	Tu	We	Th	Fr	Sa
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28	29	30				

May

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12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

June

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16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

July

Su	Mo	Tu	We	Th	Fr	Sa
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21	22	23	24	25	26	27
28	29	30	31			

August

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

September

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
26	30					

October

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

November

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
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17	18	19	20	21	22	23
24	25	26	27	28	29	30

December

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

- MFC
- ASMFC
- SAFMC
- MAFMC
- State Holiday
- Southern Regional AC
- Northern Regional AC
- Finfish AC
- Habitat and Water Quality AC
- Shellfish/Crustacean AC

2019 Committee Assignments for Maine Fisheries Commissioners

1/22/19

FINFISH ADVISORY COMMITTEE

Statutorily required standing committee comprised of commissioners and advisers that considers matters related to finfish.
Commissioners: Cameron Boltes – chair, Sam Romano – vice chair
DMF Staff Lead: Lee Paramore - lee.paramore@ncdenr.gov
Meeting Frequency: Can meet quarterly, depending on assignments from MFC

HABITAT AND WATER QUALITY ADVISORY COMMITTEE & COASTAL HABITAT PROTECTION PLAN STEERING COMMITTEE

Statutorily required standing committee comprised of commissioners and advisers that considers matters concerning habitat and water quality that may affect coastal fisheries resources.
Commissioners: Pete Kornegay – chair, Doug Cross– vice chair
DMF Staff Lead: Anne Deaton - anne.deaton@ncdenr.gov
Meeting Frequency: Committee can meet quarterly, depending on assignments from MFC. CHPP Steering Committee can meet a couple of times a year.

SHELLFISH/CRUSTACEAN ADVISORY COMMITTEE

Statutorily required standing committee comprised of commissioners and advisers that considers matters concerning oysters, clams, scallops and other molluscan shellfish, shrimp and crabs.
Commissioners: Sam Romano – chair, Pete Kornegay – vice chair
DMF Staff Lead: Tina Moore - tina.moore@ncdenr.gov
Meeting Frequency: Can meet quarterly, depending on assignments from MFC

CONSERVATION FUND COMMITTEE

Committee comprised of commissioners that makes recommendations to the MFC for administering funds to be used for marine and estuarine resources management, including education about the importance of conservation.
Commissioners: Brad Koury - chair, Chuck Laughridge and Tom Hendrickson
DMF Staff Lead: Randy Gregory - randy.gregory@ncdenr.gov
Meeting Frequency: Meets as needed

LAW ENFORCEMENT AND CIVIL PENALTY COMMITTEE

Statutorily required committee comprised of commissioners that makes final agency decisions on civil penalty remission requests.
Commissioners: Rob Bizzell - chair, Tom Hendrickson and Brad Koury
DMF Staff Lead: Marine Patrol Colonel, currently vacant
Meeting Frequency: Meets as needed

COASTAL RECREATIONAL FISHING LICENSE ADVISORY COMMITTEE

Committee consisting of the three recreational seats and the science seat to provide the DMF advice on the projects and grants issued using Coastal Recreational Fishing License trust funds.
Commissioners: Chuck Laughridge - chair, Rob Bizzell, Cameron Boltes and Pete Kornegay
DMF Staff Lead: William Brantley – william.brantley@ncdenr.gov
Meeting Frequency: Meets as needed

NOMINATING COMMITTEE

Committee comprised of commissioners that makes recommendations to the MFC on at-large and obligatory nominees for the Mid- and South Atlantic Fishery Management Councils.
Commissioners: Chuck Laughridge – chair, Pete Kornegay, Cameron Boltes and Mike Blanton
DMF Staff Lead: Chris Batsavage - chris.batsavage@ncdenr.gov
Meeting Frequency: Typically meets once a year

STANDARD COMMERCIAL FISHING LICENSE ELIGIBILITY BOARD

Statutorily required three-person board consisting of DEQ, DMF and MFC designees who apply eligibility criteria to determine whether an applicant is eligible for a SCFL.
Commission Designee: Mike Blanton
DMF Staff Lead: Marine Patrol Capt. Carter Whitten - Carter.Witten@ncdenr.gov
Meeting Frequency: Meets two to three times a year, could need to meet more often depending on volume of applications

N.C. COMMERCIAL FISHING RESOURCE FUND COMMITTEE

Committee comprised of commissioners that the commission has given authority to make funding decisions on projects to develop and support sustainable commercial fishing in the state.
Commissioners: Doug Cross – chair, Mike Blanton and Sam Romano
DMF Staff Lead: William Brantley – william.brantley@ncdenr.gov
Meeting Frequency: Meets two to three times a year

WRC/MFC JOINT COMMITTEE ON DELINEATION OF FISHING WATERS

Committee formed to help integrate the work of the two commissions as they fulfill their statutory responsibilities to jointly determine the boundaries that define North Carolina's Inland, Coastal and Joint Fishing Waters as the agencies go through a statutorily defined periodic review of existing rules.
MFC Commissioners: Rob Bizzell, Doug Cross and Pete Kornegay
DMF Staff Lead: Temporarily Nancy Fish – nancy.fish@ncdenr.gov
Meeting Frequency: Meets as needed

113-168.2. Standard Commercial Fishing License.

(a) Requirement. - Except as otherwise provided in this Article, it is unlawful for any person to engage in a commercial fishing operation in the coastal fishing waters without holding a SCFL issued by the Division. A person who works as a member of the crew of a vessel engaged in a commercial fishing operation under the direction of a person who holds a valid SCFL is not required to hold a SCFL. A person who holds a SCFL is not authorized to take shellfish unless the SCFL is endorsed as provided in G.S. 113-168.5.

(al) Use of Vessels. - The holder of a SCFL is authorized to use only one vessel in a commercial fishing operation at any given time. The Commission may adopt a rule to exempt from this requirement a person in command of a vessel that is auxiliary to a vessel engaged in a pound net operation, long-haul operation, or beach seine operation. A person who works as a member of the …

(3) An administrator or executor to whom a SCFL was transferred pursuant to subdivision (2) of this subsection, to a surviving member of the deceased licensee's immediate family who is eligible to hold a SCFL under this Article.

(4) The surviving member of the deceased licensee's immediate family to whom a SCFL was transferred pursuant to subdivision (3) of this subsection, to a third-party purchaser of the deceased licensee's fishing vessel.

(5) A licensee who is retiring from commercial fishing, to a third-party purchaser of the licensee's fishing vessel.

(h) Identification as 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.

(i) Record-Keeping Requirements. - The fish dealer shall record each transaction at the time and place of landing on a form provided by the Division. The transaction form shall include the information on the SCFL or shellfish license, the quantity of the fish, the identity of the fish dealer, and other information as the Division deems necessary to accomplish the purposes of this Subchapter. The person who records the transaction shall provide a completed copy of the transaction form to the Division and to the other party of the transaction. In the event the resource that is caught, by someone not following the RCGL requirements, using commercial gear and is not sold to a licensed dealer, that individual must file a trip ticket with the DMF. Also, a non Governor's Cup Series tournament, must file an appropriate document to quantify the harvest from such a tournament. For the purpose of this section, a tournament is defined as any organized fishing event where an entry fee is paid and/or a prize is given out to the participants. The Division's copy of each transaction form shall be transmitted to the Division by the fish dealer on or before the tenth day of the month following the transaction. (1997-400, s. 5.1; 1998-225, s. 4.11; 2001-213, s. 2; 2013-360, s. 14.80); 2013-384, s. 2(c);2014-100, s. 14.9(b).)

§ 113-169.3. Licenses for fish dealers.

(a) Eligibility. - A fish dealer license shall be issued to a North Carolina resident upon receipt of a proper application at any office of the Division together with all license fees including the total number of dealer categories set forth in this section. The license shall be issued in the name of the applicant and shall include all dealer categories on the license.

(b) Application for License. - Applications shall not be accepted from persons ineligible to hold a license issued by the Division, including any applicant whose license is suspended or revoked on the date of the application. The applicant shall be provided with a copy of the application marked received. The copy shall serve as the fish dealer's license until the license issued by the Division is received, or the Division determines that the applicant is ineligible to hold a license. Where an applicant does not have an established location for transacting the fisheries business within the State, the license application shall be denied unless the applicant satisfies the Secretary that his residence, or some other office or address within the State, is a suitable substitute for an established location and that records kept in connection with licensing, sale, and purchase requirements will be available for inspection when necessary. Fish dealers' licenses are issued on a fiscal year basis upon payment of a fee as set forth herein upon proof, satisfactory to the Secretary, that the license applicant is a North Carolina resident.

(c) License Requirement. - Any person subject to the licensing requirements of this section is a fish dealer. Any person subject to the licensing requirements of this section shall obtain a separate license for each physical location conducting activities required to be licensed under this section. Except as otherwise provided in this section, it is unlawful for any person not licensed pursuant to this Article:

(1) To buy fish for resale from any person involved in a commercial fishing operation that takes any species of fish from coastal fishing waters. For purposes of this subdivision, a retailer who purchases fish from a fish dealer shall not be liable if the fish dealer has not complied with the licensing requirements of this section;

(2) To sell fish to the public; or

(3) To sell to the public any species of fish under the authority of the Commission taken from coastal fishing waters.

(d) Exceptions to License Requirements. - The Commission may adopt rules to implement this subsection including rules to clarify the status of the listed classes of exempted persons, require submission of statistical data, and require that records be kept in order to establish compliance with this section. Any person not licensed pursuant to this section is exempt from the licensing requirements of this section if all fish handled within any particular licensing category meet one or more of the following requirements:

(1) The fish are sold by persons whose dealings in fish are primarily educational, scientific, or official, and who have been issued a permit by the Division that authorizes the educational, scientific, or official agency to sell fish taken or processed in connection with research or demonstration projects;

(2) The fish are sold by individual employees of fish dealers when transacting the business of their duly licensed employer;

(3) The fish are shipped to a person by a dealer from without the State and are not resold;

(4) The fish are of a kind the sale of which is regulated exclusively by the Wildlife Resources Commission; or

(5) The fish are purchased from a licensed dealer and are not resold.

An Illustration of the meanings of overfished/overfishing is occurring

Let's say you had about $100,000 in the bank. This represents a healthy fish stock. Let's also say you have $10,000 a year in expenses, which represents the harvest and natural mortality on this fish stock, and you have $10,000+ a year of income, which represents recruitment of the stock. The stock is not overfished and overfishing is not occurring.

But let say either your income goes down or your expenses go up, and your money in the bank, the fish stock, starts to decrease. You are spending more than you are making, i.e. harvest is exceeding recruitment. The stock is not overfished but overfishing is occurring.

Then let's say that you are approaching bankruptcy when you only have $50,000 in the bank, which equates to overfished. Bankruptcy occurs when you have $25,000 in the bank, which equates to the collapse of the stock. If the above trend continues, harvesting more than recruiting, without adequate changes being made, then the stock is overfished and overfishing will be occurring. But you still have time to make personal adjustments, i. e. spend less, harvest less, to avoid bankruptcy, and the collapse of the fish stock.

From: Hollis, Carrie
Sent: Friday, January 4, 2019 3:38 PM
To: Murphey, Steve <steve.murphey@ncdenr.gov>; Nicholson, John A. <John.Nicholson@ncdenr.gov>; Batherson, John G <John.Batherson@ncdenr.gov>; Everett, Jennifer <jennifer.everett@ncdenr.gov>; Blum, Catherine <catherine.blum@ncdenr.gov>; Mcinerny, Stephanie <stephanie.mcinerny@ncdenr.gov>; Stemle, Adam T <Adam.Stemle@ncdenr.gov>
Cc: Masich, Molly <molly.masich@oah.nc.gov>; McGhee, Dana <dana.McGhee@oah.nc.gov>; Grozav, Anca <Anca.Grozav@osbm.nc.gov>; Walker, Kristin L <kristin.walker@osbm.nc.gov>; McRee, Lanier T <lanier.mcree@osbm.nc.gov>
Subject: NCWF Petition for Rulemaking, 15A NCAC 03I .0101; 15A NCAC 03L .0101 and .0103; 15A NCAC 03M .0523; 15A NCAC 03M .0524; 15A NCAC 03N .0105; and 15A NCAC 03R .0105

Good afternoon,

OSBM has reviewed the fiscal note of the proposed changes to rules 15A NCAC 03I .0101; 15A NCAC 03L .0101 and .0103; 15A NCAC 03M .0523; 15A NCAC 03M .0524; 15A NCAC 03N .0105; and 15A NCAC 03R .0105, which were submitted via public petition for rulemaking to the Marine Fisheries Commission. OSBM reviewed the fiscal note in accordance with G.S. 150B-21.4 and with E.O 70 from 10/21/2010 as amended by E.O. 48 from 4/9/2014. In accordance with 150B-21.4(a), OSBM has determined that sufficient state funds are not available to implement the proposed rule changes without undue detriment to the agency's existing activities.

OSBM did not review the rules for certification against the regulatory principles set forth in G.S. 150B 91.1(a)(2), (5), and (6). These are petitioned rules and they are not considered the agency's rules. Therefore G.S. 150B 19.1 does not apply.

The .pdf file of the rule impact analysis (attached) will be posted on our website at the following URL (please allow for some time):
https://files.nc.gov/ncosbm/documents/files/DEQ_2019-01-04.pdf

Regards,
-Carrie

Carrie Hollis
Economic Analyst
NC Office of State Budget and Management
919 807 4757 office
carrie.hollis@osbm.nc.gov

FISCAL IMPACTS OF PROPOSED RULES FROM PETITION FOR RULEMAKING SUBMITTED BY NORTH CAROLINA WILDLIFE FEDERATION

Rule Changes: 15A NCAC 03I .0101 DEFINITIONS
15A NCAC 03L .0101 SHRIMP HARVEST RESTRICTIONS
15A NCAC 03L .0103 PROHIBITED NETS, MESH LENGTHS AND AREAS
15A NCAC 03M .0523 SPOT
15A NCAC 03M .0524 ATLANTIC CROAKER
15A NCAC 03N .0105 PROHIBITED GEAR, SECONDARY NURSERY AREAS
15A NCAC 03R .0105 SPECIAL SECONDARY NURSERY AREAS

Name of Commission: North Carolina Marine Fisheries Commission

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Impact Summary:

State government:	Yes
Local government:	Yes
Private industry:	Yes
Substantial impact:	Yes
Federal government:	No

Authority: G.S. 143B-289.52. Marine Fisheries Commission - powers and duties and G.S. 113-134. Rules provide the North Carolina Marine Fisheries Commission authority to adopt rules for the management, protection, preservation, and enhancement of the marine and estuarine resources within its jurisdiction, as described in G.S. 113-132. Any person wishing to adopt, amend, or repeal a rule of the Marine Fisheries Commission can submit a rulemaking petition to the Chairman of the Commission in accordance with G.S. 150B-20 of the North Carolina Administrative Procedure Act and 15A NCAC 03P .0300.

Necessity: The North Carolina Marine Fisheries Commission passed a motion Feb. 16, 2017 to grant in full the North Carolina Wildlife Federation's Petition for rulemaking originally submitted on Nov. 2, 2016 and as amended by its Jan. 12, 2017 modification. In accordance with G.S. 150B-20, if an agency grants a rulemaking petition, it must initiate rulemaking proceedings. Per G.S. 150B-21.4, before an agency publishes in the *North Carolina Register* the proposed text of a permanent rule change that would require the expenditure of state funds, it must submit a fiscal note on the proposed rule change.

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ACRONYMS

AC	Advisory Committee
APAIS	Access Point Angler Intercept Survey
ASMFC	Atlantic States Marine Fisheries Commission
BACI	Before-After Control-Impact
BRD	Bycatch Reduction Device
CFVR	Commercial Fishing Vessel Registration
CHPP	Coastal Habitat Protection Plan
CPUE	Catch Per Unit Effort
CRFL	Coastal Recreational Fishing License
CSMA	Central Southern Management Area
EBFM	Ecosystem-Based Fisheries Management
ESA	Endangered Species Act
F	fishing mortality rate
FDA	United States Food and Drug Administration
FEUS	Fisheries Economics of the United States
FMP	Fishery Management Plan
FRA	North Carolina Fisheries Reform Act
FY	Fiscal Year
ITP	Incidental Take Permit
M	natural mortality rate
MAFMC	Mid-Atlantic Fishery Management Council
MFC	Marine Fisheries Commission
MRFSS	Marine Recreational Fisheries Statistics Survey
MRIP	Marine Recreational Information Program
NCDEQ	North Carolina Department of Environmental Quality
NCDMF	North Carolina Division of Marine Fisheries
NCREDC	North Carolina Rural Economic Development Center
NCTTP	North Carolina Trip Ticket Program

NCWF	North Carolina Wildlife Federation
NCWRC	North Carolina Wildlife Resources Commission
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
PDT	Plan Development Team
PNA	Primary Nursery Area
PSE	Percent Standard Error
RCGL	Recreational Commercial Gear License
RSCFL	Retired Standard Commercial Fishing License
SAFMC	South Atlantic Fishery Management Council
SAV	Submerged Aquatic Vegetation
SCFL	Standard Commercial Fishing License
SCMRD	South Carolina Marine Resources Division
SEAMAP	Southeast Area Monitoring and Assessment Program
SELC	Southern Environmental Law Center
SNA	Secondary Nursery Area
SPR	Spawning Potential Ratio
SSB	Spawning Stock Biomass
SSNA	Special Secondary Nursery Area
TAC	Total Allowable Catch
TC	Technical Committee
TED	Turtle Excluder Device
TLA	Traffic Light Analysis
UNC-G	University of North Carolina - Greensboro
Z	total morality rate

EXECUTIVE SUMMARY

The North Carolina Wildlife Federation submitted a petition for rulemaking on Nov. 2, 2016 to the Chairman of the North Carolina Marine Fisheries Commission (MFC), pursuant to and in accordance with the North Carolina Administrative Procedure Act, G.S. 150B-20, and 15A NCAC 03P .0301. The Petitioner filed clerical edits to the Petition on Nov. 16 and filed a modification to the original Petition on Jan. 12, 2017. The Petitioned rules were granted in full for rulemaking by the MFC Feb. 16, 2017. Per G.S. 150B-21.4, before an agency publishes in the *North Carolina Register* the proposed text of a permanent rule change that would require the expenditure of state funds, it must submit a fiscal note on the proposed rule change. The Division concludes this document represents an objective fiscal analysis to inform the public to the greatest extent possible, recognizing uncertainties and unknowns in assessing the economic impact of the proposed rules, that meets the requirements of the North Carolina Administrative Procedure Act.

Both state and federal fishery management bodies develop and adopt fishery management plans (FMPs) to manage fish stocks in their jurisdiction. The FMP process is a comprehensive way to consider the cumulative effect of management of a significant species or fishery that is based on sound, reasonably available scientific, technical, economic, and other relevant information. The goal of these plans is to ensure long-term viability of these fisheries. The use of FMPs provides basic direction for managers, provides long-range certainty for the regulated fishing community, and builds accountability into the fisheries management system. In North Carolina, the contents of the plans are specified, advisory committees are required, and reviews by the hierarchy of government are mandated. These requirements are set forth in state statutes and begin with conducting stock assessments.

In its Petition, the North Carolina Wildlife Federation states concerns about bycatch of juvenile fish, including Atlantic Croaker, Spot, and Weakfish, in the shrimp trawl fishery in the estuarine and near shore waters of North Carolina under the MFC's jurisdiction (NCWF 2016a). In addition, the Petitioner states the "MFC's efforts to minimize bycatch of juvenile finfish have proven unsuccessful" and that the recently adopted 2015 North Carolina Shrimp Fishery Management Plan Amendment 1 fell short of necessary actions to protect habitat and reduce bycatch of juvenile finfish (NCWF 2016a). The Petitioner put forth seven rules aimed at habitat protection, reduction of bycatch, and limiting possession of Spot and Atlantic Croaker through minimum size limits to allow these species to mature and spawn at least once before recruiting to the fishery.

While trying to assess the impact of the Petitioned rules, which includes costs and benefits, numerous unknowns were discovered and there was a lack of data to quantify the impacts for some sections of the analysis. Without information to quantify all costs and benefits of the proposed rules, the total impact cannot be determined. Positive changes to habitat and water quality and reduced fishing mortality over time could result in stock improvements, holding all other factors equal and assuming high compliance, but the time it would take to have an effect is unmeasurable. How effective the proposed rules would be at improving stock abundance for species important to North Carolina and how a change in stock abundance would affect commercial and recreational fisheries is unknown because of the many unpredictable human and natural factors that affect fish stock abundance. Habitat quality and fish stock abundance is influenced by directed fishing, but is also influenced by factors that cannot be controlled through fishery management strategies, such as environmental fluctuations (e.g., pH, temperature, dissolved oxygen, storms), habitat loss due to land development, water quality, and natural morality rates specific to each species (see section 2). Furthermore, it is not possible to predict with confidence the behavioral responses of fishermen to the Petitioned rules. Due to the scope of the proposed rule changes and lack of sufficient market and business operation data, it is difficult to estimate the participants' net change in fishing effort, temporal and geographic shifts in fishing patterns, and changes in gear and targeted species that could

affect fishing mortality and bycatch both positively and negatively. As a result, changes in stock abundance and habitat quality attributable to the proposed rules and associated economic impacts are difficult to predict and quantify.

A species' response to changes in directed fishing activity is not always predictable due to the many factors that affect stock status, and a regulatory intervention may not have the same effect across species. For example, in 1994, the MFC prohibited the use of flynets south of Cape Hatteras because large quantities of juvenile Weakfish were being caught as bycatch. This did not result in increased Weakfish abundance due to high levels of natural mortality for this species, which is ultimately out of a manager's control (see section 5.1.4.3). Even though overfishing is not occurring, this species is still in a depleted status despite years of management. Other species have responded positively to management measures that focus on reducing fishing mortality, including Atlantic Ocean Striped Bass (see section 5.1.4.1) and Summer Flounder (see section 5.1.4.2). There is uncertainty that Atlantic Croaker, Spot, and Weakfish would respond in a similar way under the proposed rules.

Estimating how fish stocks may respond in the future to different management strategies through stock assessment models (projections) is a common practice and is discussed in section 5 of this document. Projections program the varying magnitudes of changes in fishing or natural mortality being assessed directly into the model and do not reflect a response to a particular management action. It is important to note that the magnitude of the change in fishing and natural mortality attributable to the Petitioned rules is unknown, so it is not possible to model how these rules would change the stock status. There is no association between the Petitioned rules and the stock projections produced by Nesslage and Dumas (2017) described in section 5; the models represent various "what-if" scenarios to help answer questions such as, "If bycatch was reduced by a certain amount, how much would the fish stock change?" Although not reflective of the proposed rules, these stock projections can be used to understand the direction, timing, and relative magnitude of the effect of reducing fishing or natural mortality, as well as how much change would be needed to achieve a desired stock status. Projections were only available for two of the main species identified in the Petition as needing additional protection (i.e., Atlantic Croaker and Weakfish).

The economic impact of increased stock abundance due to improvements in the recreational fishing industry is discussed in section 6.4.1. If additional management successfully reduces both fishing and natural mortality rates, there is potential for an increase in economic benefits across the 30-year period that was examined by Nesslage and Dumas (2017). The economic analyses performed for Atlantic Croaker and Weakfish were based on the stock projections mentioned above, but used assumptions that may have inflated the impact; therefore, the actual increases to the economy from improved recreational fishing resulting from the Petitioned rules is unknown.

Studies are needed to determine the status of current habitats in the areas that are proposed to be new special secondary nursery areas (SSNAs) under the Petition to detect any improvements and if those improvements were the result of the proposed rules. Table 2.1 describes 2.8 million additional acres of coastal and joint fishing waters (including the ocean 0–3 miles) that are not already designated as nursery areas of any type but would become SSNAs under the Petitioned rules. This helps to demonstrate the magnitude of the affected area and thus, the subsequent regulations and enforcement. Documenting the current condition of the habitat in the areas affected by the proposed rules could take 18 years (see Appendix 4). Another unknown is any shift in effort that might impact areas currently less utilized. Without more information, it is difficult to determine the effect the Petitioned rules would have on the environment and to what extent.

The biggest cost from the Petitioned rules would be on the commercial fishing industry, specifically those participating in the shrimp trawl fishery. There are uncertainties in how the proposed rules would be

implemented with regards to existing management actions, especially concerning closing days of the week (see section 6.1.1). The Petitioner commented that the days to be closed to satisfy the Petition would be picked by the Fisheries Director, but the Petitioner did not comment on how the current weekend closure fits into their proposed rules. The current weekend closure is for estuarine waters only and occurs from 9 p.m. Friday to 5 p.m. Sunday. State ocean waters are currently not restricted. To estimate potential losses to the commercial fishing industry from closing four days in estuarine waters and three days in the ocean, the landings by weekday were used, but these represent the day of landing or unloading at the seafood dealer, not the fishing day. Landings could not be evaluated by fishing day because the North Carolina Trip Ticket Program does not collect those data. In other words, multiday fishing trips (a common occurrence) confound the determination of when fishing actually occurred. Estimates presented below are based on the best available data and may not reflect the actual amounts that would result from the Petitioned rules. Based on date of landing, limiting trawling to three days in estuarine waters could have an annual impact of $2.4 million to $10.7 million in the shrimp fishery and an additional impact from $48,589 to $73,405 per year for non-shrimp species caught in shrimp trawls, depending on which four days are selected to be closed. Limiting trawling to four days in state ocean waters could have an annual impact from $1.0 million to $1.4 million in the shrimp fishery and an additional impact of $28,876 to $37,399 per year for non-shrimp species caught in shrimp trawls, depending on which three days are selected to be closed.

Other trawl gears used in the commercial fishing industry in estuarine and state ocean waters would also be impacted by the weekday closure restrictions proposed in the Petition as written (see section 6.2.1). In estuarine waters, fisheries that would be impacted include hard crab trawl, peeler crab trawl, skimmer trawl, and clam trawl (or clam kicking). Hard crab trawling would have an estimated impact of $458,897 to $885,837 per year. Peeler crab trawling would have an estimated impact of $923 to $1,597 per year. Skimmer trawl fisheries for non-shrimp species would have an estimated impact of $1,277 to $2,636 per year. Finally, clam trawling would have an estimated impact of $3,313 to $3,529 per year. Trawl fisheries in state ocean waters that would be impacted include flynets, with an estimated impact of $120,264 to $194,062 per year, and flounder trawls, with an estimated impact of $28,139 to $48,531 per year.

The proposed rules for nighttime trawling restrictions, opening the shrimp season based on shrimp count size, reducing headrope length, and limiting tow times would have impacts to both the shrimp trawl fishery and non-shrimp fisheries, but because of a variety of uncertainties surrounding implementation of these rules and a lack of data to evaluate the impacts for these specific management strategies, the total impact cannot be calculated or monetized (see sections 6.1.2–6.1.5).

Minimum size limits are proposed for Spot (8 inches) and Atlantic Croaker (10 inches), which currently do not have size limits. These minimum size limits would impact the commercial shrimp fishery (see section 6.1.6) and both directed commercial and recreational fisheries for Spot and Atlantic Croaker (see section 6.2.2).

Spot and Atlantic Croaker both have targeted commercial fisheries as well as landings that are attributed to bycatch from other gears, such as shrimp trawls. Based on an 8-inch minimum size limit for Spot, an estimated 99–100% of these fish would be discarded from a shrimp trawl trip. The value of Spot caught in estuarine waters as bycatch from shrimp trawls ranges from $734 to $14,276 per year (see section 6.1.6). The value of Spot caught in state ocean waters as bycatch from shrimp trawls ranges from $1,384 to $10,382 per year. The reductions to the directed Spot commercial fishery due to an 8-inch minimum size limit is estimated to be $135,767 per year (see section 6.2.2). Approximately 100% of Atlantic Croaker caught and previously sold in the shrimp trawl fishery would be discarded (not sold) based on a 10-inch minimum size limit. The value of Atlantic Croaker in estuarine waters caught as bycatch from the shrimp trawl fishery is estimated to be from $61 to $3,983 per year (see section 6.1.6). The value of Atlantic Croaker in state ocean waters caught as bycatch from the shrimp trawl fishery ranges from $19 to $1,780

per year. The reductions to the directed Atlantic Croaker commercial fishery due to a 10-inch minimum size limit is estimated to be $311,247 per year (see section 6.2.2).

Recreational harvest reductions are estimated to be from 34–67% for Spot and from 72–84% for Atlantic Croaker. A dollar value related to the impact of these reductions in the recreational fishery could not be calculated due to the lack of data on the non-market values of this fish to recreational fishermen. Due to the disproportionate sizes on average between males and females for both species, the proposed size limits would potentially shift harvest to primarily females, resulting in unknown consequences on the stocks.

Additional impacts on the commercial industry from the proposed rules include disproportionate impacts based on vessel size, changing operational expenses, potential changes in fishing behavior to conform with the Petitioned rules to recoup lost effort, displacement of existing effort into other areas or fisheries, and lastly, the potential for fishermen to exit commercial fishing completely. Due to the broad scope of the Petitioned rules, displacement of effort could cause harvest to potentially shift from the new SSNAs to current SSNAs, increased user conflicts, and increased fishing pressure on other species. Currently, defined SSNAs are less restrictive than the rules proposed for the newly defined SSNAs. More detail on the types of displacement anticipated are discussed in sections 4.1, 5.4, and 6.3.4. The amount of displacement cannot be estimated, so the net impact these rules would have on the habitats and fisheries in North Carolina cannot be determined.

The impact the Petitioned rules would have on consumers is also unknown, as well as their impact on local governments and communities (see sections 7 and 8). Many communities in eastern North Carolina are strongly rooted in commercial fishing and this way of life supports their local government. There is a substantial lack of data with regards to costs throughout the supply chain from the fisherman to the consumer, as well as a lack of data to estimate how many small communities rely on commercial fishing and to what extent. These data are necessary to estimate the total impact of the proposed rules.

It is unknown if additional enforcement officers would be needed due to the uncertainty around the behavioral choices of fishermen responding to the new rules. There is the potential for increased workload for North Carolina Division of Marine Fisheries (NCDMF) Marine Patrol to enforce the proposed rules that could be more than what current staff can do with all other job duties continuing, but to an unknown extent. There may be a significant change in the amount of time an officer spends patrolling closure days and times for the shrimp trawl fishery. Instead of patrolling for a lack of fishing during the single closure period currently in estuarine waters (Friday night to Sunday night), enforcement officers would have to patrol daily closure times in both estuarine and state ocean waters to ensure a lack of fishing activity during closures. Fishermen could potentially shift to other gears, shift to other fisheries, continue fishing regardless of changes in requirements and potential consequences of failing to comply with them, or exit fishing completely. Initially, as both officers and fishermen become accustomed to the requirements of the Petitioned rules, there would likely be a learning curve that would take more effort by all parties until there is familiarity with the new requirements. This learning curve would likely be more pronounced than for previous regulation changes due to the magnitude of the Petitioned rules. Due to this high variability, the number of potential new officers cannot be quantified.

Existing NCDMF Marine Patrol would have to balance any new responsibilities from the Petitioned rules with existing responsibilities. The opportunity costs presented quantify the value of the hours used by Marine Patrol to perform typical job duties that would now be needed to enforce the proposed rules. They do not represent new costs to NCDMF. The estimated total number of hours that would be spent by existing NCDMF Marine Patrol each year (12 months) to properly enforce the Petitioned rules could amount to approximately 52,000 hours, which equates to all 50 field officers each working 20 hours per week during each week of the year. This is based on additional time needed to check gear requirements

and net sizes, proper licensure, size and creel limits, monitor tow time limits, closure lines, closure days, user conflicts, and the transit time to patrol a vast geographical area, especially in larger water bodies like Pamlico Sound. Additionally, it is important to understand the temporal nature of any patrol. For example, in the course of patrolling for fishing activities related to the Petitioned rules, if an officer encounters a fisherman harvesting shellfish in a polluted area, the officer would address the immediate violation and cease the former effort. This adds to the difficulty in quantifying the impacts to enforcement from the Petitioned rules. Additionally, when an officer encounters a potential violation (regardless of the type of offense), there is significant time spent to process it, displacing effort on additional patrols. Processing a violation can include identifying who is on board the vessel, plotting the location on a chart for court, escorting the vessel to the dock, offloading the catch, securing three bids to sell the catch to the highest bidder, and processing criminal charges brought against the captain and/or crew to include potential arrest. Based on the estimated total number of hours that would be spent by existing officers as a result of the Petitioned rules, at an average salary plus benefits of $32.26 per hour, the opportunity costs on NCDMF Marine Patrol could be as high as $1,677,520 per year. Diverting resources away from existing programs and activities to implement and enforce the proposed rules would be detrimental to the effectiveness of those programs and activities. The foregone societal benefits associated with the reallocation of resources is not addressed in this analysis.

Additional sampling in Pamlico Sound would be needed to determine the opening of the shrimp season based on shrimp count size (see section 9.2). It is unclear if sampling would need to occur in the bays of the sound, open waters of the sound, or both. At a minimum, new sampling costs could be as low as $4,359 or as high as $21,814 per year, including sampling costs and opportunity costs for existing staff.

Lastly, revenue from the sale of commercial licenses would be affected if the impacts to the commercial shrimp fishery are great enough that fishermen choose to exit commercial fishing completely (see section 9.4). Because the Petitioned rules reach a variety of fisheries in addition to shrimp, there is no way to estimate the potential decline in license revenue due to fewer commercial licenses being sold. A decline in recreational license sales due to the Petitioned rules is unlikely.

1 PROBLEM STATEMENT

Fisheries and aquaculture are essential to people around the world as a source of food, recreation, and trade, but also influence the livelihoods of millions. Stewardship of aquatic resources is needed to ensure these valuable resources are available in the future. Achieving and maintaining sustainable fisheries and aquaculture industries are a global concern and a coordinated effort is required (FAO 2018).

"Sustainable fisheries management is an adaptive process that relies on sound science, innovative management approaches, effective enforcement, meaningful partnerships, and robust public participation. Sustainable fisheries play an important role in the nation's economy by providing opportunities for commercial, recreational, and subsistence fishing, marine aquaculture, and sustainable seafood for the nation. Combined, U.S. commercial and recreational saltwater fishing generated more than $208 billion in sales and supported 1.6 million jobs in 2015. By ending overfishing and rebuilding stocks, the value of U.S. fisheries to the economy, our communities, and marine ecosystems is strengthened" (NOAA 2017a).

Fishery managers have a range of goals. They strive to maintain healthy fish populations and a healthy fishing industry, both recreational and commercial, by preventing fish stocks from becoming overfished and to ensure overfishing is not occurring. Overfished is defined as "a stock exploited to a level of abundance considered too low to ensure safe reproduction" and overfishing is defined as "harvesting from a stock at a rate greater than the stock's reproductive capacity to replace fish removed through harvest" (ASMFC 2009a). Managers rely on a variety of tools to achieve their goals, including quotas, size limits, gear restrictions, fishing seasons, and area closures. Additionally, managers provide outreach about their activities so those in the fishing industries and the general public can better understand what goes into management decisions. For North Carolina's managers to determine which combinations of tools will best accomplish their goals and to choose the best approach to managing a fish stock, managers must equip themselves with as much information as possible. The collection and analysis of such data is a large part of the day-to-day operations of the North Carolina Division of Marine Fisheries (NCDMF).

A study of North Carolina's entire coastal fisheries management process was conducted from 1994–1996 due to a wide range of concerns expressed by the commercial and recreational fishing communities. The central concept in the proposed new coastal fisheries management system designed to resolve the concerns was the development of fishery management plans (FMPs) by the NCDMF. The use of FMPs was intended to re-orient North Carolina's coastal fisheries management efforts by: (1) providing basic direction for the NCDMF and the North Carolina Marine Fisheries Commission (MFC), (2) providing long-range certainty for the regulated fishing community, and (3) building accountability into North Carolina's coastal fisheries management system. The Moratorium Steering Committee that conducted the study recommended the MFC implement FMPs through rulemaking changes.

The North Carolina Fisheries Reform Act of 1997 (FRA) and its subsequent amendments requires the NCDMF to prepare FMPs for adoption by the MFC for all North Carolina's commercially and recreationally significant species or fisheries that comprise state marine or estuarine resources (G.S. 113-182.1). The goal of these plans is to ensure long-term viability of these fisheries. The contents of the plans are specified, advisory committees (ACs) are required, and reviews by the North Carolina Department of Environmental Quality (NCDEQ) secretary and the Joint Legislative Oversight Committee on Agriculture and Natural and Economic Resources are mandated. The original 1997 legislation mandated the Blue Crab FMP be completed first and the MFC used the NCDMF annual stock status review to prioritize the order of species that would be addressed in subsequent plans. All initial FMPs identified on the priority list have been developed. FMPs normally take about two years to complete and are required to be reviewed at least once every five years. Upon review, amendment of a plan is required when changes to management strategies are necessary. North Carolina has 13 state FMPs.

The FMP process is a comprehensive way to consider the cumulative effect of management of a significant species or fishery that is based on sound, reasonably available scientific, technical, economic, and other relevant information. It is a sequential, deliberative process where each issue is thoroughly examined and all options for addressing the issue are carefully examined. An FMP is the product that ultimately brings all the information and management considerations into one document and is intended to provide long-range certainty for the regulated fishing community and get away from "hot topic" management. Management measures are designed to be in place for several years, which helps assess if they had the desired effect or if something else was in play.

The NCDMF and MFC are the only authorities in North Carolina coastal fishing waters that can implement plans and regulations to manage North Carolina marine and estuarine fisheries. The MFC adopted the North Carolina Fishery Management Plan for Interjurisdictional Fisheries, which selectively adopts management measures contained in approved federal council or Atlantic States Marine Fisheries Commission (ASMFC) FMPs by reference as minimum standards. The goal of the state interjurisdictional FMP is to adopt these other plans, consistent with state law, approved by the federal Councils or the ASMFC by reference, and implement corresponding fishery regulations in North Carolina to comply with or complement them.

North Carolina is an active, voting member on the ASMFC, the Mid-Atlantic Fishery Management Council (MAFMC), and the South Atlantic Fishery Management Council (SAFMC). North Carolina's participation in these organizations is critical to ensure that North Carolina's fishermen and fisheries resources are considered and adequately protected. To that end, North Carolina, through its Division staff, ASMFC, or federal council members, and citizen advisors, participates fully in the development of these federal and regional FMPs that have an impact on commercial and recreational fisheries in North Carolina.

In a perfect world, all measures needed to conserve the marine and estuarine resources of North Carolina would be developed and implemented solely under the FMP adoption and amendment process. In the real world, there are numerous initiatives ongoing at the same time. The Coastal Habitat Protection Plan (CHPP) is a parallel initiative under the FRA and the FMP sections addressing habitat and water quality recognize the CHPP as the lead. This type of overlap with the Federal Council and ASMFC FMPs was recognized with the creation of the North Carolina FMP for Interjurisdictional Fisheries, described above, that established which process took precedence and under what circumstances those priorities could be changed. Actions concerning compliance with the Endangered Species Act of 1973 (ESA) demonstrates there are other over-riding situations that cause the NCDMF to use different mechanisms to institute management measures. Not all management issues are revealed during development of each plan or amendment; it can be understood that other factors can come to light that appear valid to consider via adaptive management measures built into an FMP. In doing so, it must be determined and clearly stated in each FMP the amount of flexibility allowed for each management strategy. The ASMFC has addressed this same issue by providing for adaptive management in a number of its FMPs. Also, several North Carolina FMPs set the stage and bounds for subsequent action after the FMP has been approved, conditioned on new data or legislative action, or other limitations existing at the time the FMP is adopted. Examples of this include management triggers for the Kingfishes and Striped Mullet FMPs, as well as the Traffic Light assessment in the Blue Crab FMP. Each of the aforementioned items speaks to the complexity of fisheries management as a whole.

The North Carolina Wildlife Federation (NCWF) submitted a petition for rulemaking on Nov. 2, 2016 to the Chairman of the MFC, pursuant to and in accordance with the North Carolina Administrative Procedure Act, G.S. 150B-20, and 15A NCAC 03P .0301. The Petitioner filed clerical edits to the Petition on Nov. 16 and filed a modification to the original Petition on Jan. 12, 2017. This Petition and

modifications seek amendments to the following sections of Title 15A of the North Carolina Administrative Code: 03I .0101 (definitions), 03L .0101 and .0103 (shrimp), 03N .0105 (fish habitat areas), and 03R .0105 (descriptive boundaries). In addition, the Petitioner urges the adoption of two new rules: 03M .0522 and 03M .0523 (finfish). It should be noted that at the time the Petition was submitted, rulemaking not related to the Petition was already underway proposing adoption of 03M .0522 Spotted Seatrout. Consequently, the adoption of the Petitioned rules would be adjusted to result in new rules 03M .0523 and 03M .0524. The Petitioned rules were granted in full for rulemaking by the MFC Feb. 16, 2017.

A review of the Petition by the NCDEQ Office of General Counsel is needed to evaluate the MFC's authority to implement rules independent of the adopted management strategies in the 2015 Shrimp FMP Amendment 1 and the North Carolina FMP for Interjurisdictional Fisheries, which includes Spot, Atlantic Croaker, Weakfish, Summer Flounder, and Atlantic Ocean Striped Bass. The Petition may also interact with other FMPs, such as those for blue crabs and hard clams.

Reasons provided by the Petitioner for the proposed rule amendments include concerns about "adequate habitat protections and declining and depleted status of many of our coastal fish stocks" (NCWF 2016a, p. 5). The Petitioner is concerned about bycatch of juvenile fish, including Atlantic Croaker, Spot, and Weakfish, in the shrimp trawl fishery in the estuarine and near shore waters of North Carolina under the MFC's jurisdiction. In addition, the Petitioner states the MFC's effort to minimize bycatch of juvenile finfish has been unsuccessful and that the recently adopted 2015 North Carolina Shrimp FMP fell short of necessary actions to protect habitat and reduce bycatch of juvenile finfish (NCWF 2016a, p. 7). The intent of the proposed new rules for possession of Spot and Atlantic Croaker is to allow these species to mature and spawn at least once (NCWF 2016a, p. 6).

The Petitioner supports these reasons as follows:
"It is estimated that for every pound of shrimp harvested in North Carolina waters, over four pounds of non-target catch, including juvenile finfish, are discarded. These juvenile finfish and other organisms constitute, bycatch, which is defined as "the portion of a catch taken incidentally to the target catch because of non-selectivity of the fishing gear to either species or size differences." In 2014, an estimated 15 million pounds of juvenile Atlantic Croaker, Spot, and Weakfish were caught by trawl nets and thrown overboard. Nearly all of the fish caught in trawl nets die in the net or shortly after culling on board" (NCWF 2016a, p. 2).

The Petitioner further supports these reasons as follows:
"Despite efforts to reduce the documented bycatch that occurs in this fishery through the use of bycatch reduction devices (BRDs), closed seasons, and restricted areas, hundreds of millions of juvenile fish continue to die each year from shrimp trawls, which contributes to declining stocks. The critical importance of all these species to the recreational and commercial fisheries of North Carolina, as well as their ecosystem function as forage and energy transfer, cannot be overstated" (NCWF 2016a, p. 34).

1.1 Summary of Proposed Rules

The following rules were identified in the Petition. A summary of each proposed rule change is provided below. More detailed information on the estimated impact of these rules is provided in sections 4–9. Actual rule text changes are provided in Appendix 1.

15A NCAC 03I .0101 Definitions

The effect of proposed changes would be to change the definition of secondary nursery areas (SNA) to include the Atlantic Ocean from 0 to 3 miles offshore.

15A NCAC 03L .0101 Shrimp Harvest Restrictions

The effect of proposed changes would be to limit the use of the Fisheries Director's proclamation authority in opening the shrimping season until the shrimp count size reaches 60 shrimp per pound, heads-on, in the Pamlico Sound.

15A NCAC 03L .0103 Prohibited Nets, Mesh Lengths and Areas

The effect of proposed changes from the original Nov. 2 Petition would be to restrict the maximum headrope length to 90 feet in the Atlantic Ocean (from 0 to 3 miles) and in estuarine waters under the MFC's jurisdiction, to become effective Jan. 1, 2018. This change includes areas where existing maximum headrope length is 220 feet. The Jan. 12, 2017 modification to the Petition would change the maximum headrope length in the Atlantic Ocean (from 0 to 3 miles) to 110 feet.

Other proposed changes would be to create a rule requiring the use of two BRDs in shrimp trawls correctly installed and operational. Two BRDs in shrimp trawls are already required in North Carolina by proclamation authority (SH-2-2015).

15A NCAC 03M .0523: Spot (new rule)
15A NCAC 03M .0524: Atlantic Croaker (new rule)

The Petitioner proposed the adoption of two new rules: 03M .0522 and 03M .0523 (finfish). It should be noted that at the time the Petition was submitted, rulemaking not related to the Petition was already underway proposing adoption of 03M .0522 Spotted Seatrout. Consequently, the adoption of the Petitioned rules would be adjusted to result in new rules 03M .0523 Spot and 03M .0524 Atlantic Croaker.

The effect of the proposed changes would be to implement a minimum size limit of 8-inches for Spot and 10-inches for Atlantic Croaker. There is currently no size limit on either species.

15A NCAC 03N .0105 Prohibited Gear, Secondary Nursery Areas

The effect of proposed changes would be to allow the Fisheries Director to open all or part of the Atlantic Ocean (0 to 3 miles) and estuarine waters under the jurisdiction of the MFC, excluding waters already designated as primary, secondary and all other special secondary nursery areas (SSNAs), with the following restrictions: Only shrimp and crab trawling may occur during the open shrimp season and are restricted to a total of three days a week. No shrimp or crab trawling may occur at night and tow times are restricted to a maximum of 45 minutes. The Jan. 12 modification to the Petition would change the number of days allowed to fish in the Atlantic Ocean (0 to 3 miles) to a total of four days a week.

15A NCAC 03R .0105 Special Secondary Nursery Areas

The MFC has jurisdiction in waters out to three miles offshore in the Atlantic Ocean under G.S. 113-134.1 and 146-64. The effect of proposed changes would be to designate all undesignated areas in all coastal fishing waters under the MFC's jurisdiction (i.e., estuarine and ocean out to 3 miles offshore) as a SSNA. This does not include waters under the jurisdiction of the North Carolina Wildlife Resources Commission (NCWRC; i.e., inland fishing waters).

2 DEMONSTRATE PROBLEM

The lack of adequate habitat protection as well as the declining and depleted status of many coastal fish stocks in North Carolina is cited in the Petition as the main reasons for the need to change existing rules put into place by the MFC (NCWF 2016a). The Petitioner provides two technical reviews to demonstrate the problem with current habitat protections and depleted coastal fish stocks (Exhibits B and E; NCWF 2016a). These reviews discuss the need for a rigorous and scientifically-informed process for habitat protection for fish in early life stages, as well as for juvenile, sub-adult, and first time spawning fish. They conclude that N.C. nursery area definitions do not include habitats that protect sub-adults or young adult fish that may have only spawned once and not met their reproductive potential. The bycatch and discard mortality of juvenile marine and estuarine fish from the shrimp trawl fishery is also discussed in these reviews, which state that the shrimp trawl fishery is the largest source of bycatch mortality and proper management of this fishery would have a measurable impact for restoring these stocks.

Overfishing and declining fish stocks are not unique to North Carolina. An analysis by Britten et al. (2016) concluded that the ability of fish stocks to reproduce and replenish themselves is declining throughout the world due to both environmental changes and biological changes brought about by overfishing. The authors do note that the trends they found represent broad-scale patterns and more in-depth analysis of factors related to habitat quantity and quality is needed to understand changes in productivity of individual stocks. In contrast, Dr. Ray Hilborn recently testified to the U.S. Congress that fish stocks are increasing in abundance throughout the U.S. and the proportion of stocks at low abundance is consistently decreasing (Hilborn 2017). He stated that ocean acidification, warming temperatures, degraded coastal habitats, exotic species, land-based run off, and pollution are the current major threats to U.S. fish stocks and marine ecosystem biodiversity. He does note that overfishing is a concern for some stocks in the U.S.

North Carolina is not alone in facing challenges to address adequate habitat protection, declining fish stocks, and bycatch issues that are the focus of the Petition. The variation in success and approaches embraced across various management bodies is related to several factors. Agencies have differing jurisdictional abilities to address environmental conditions and habitats. The degree to which anthropomorphic habitat changes impact the stock is more likely in nearshore and estuarine systems that abut concentrated human populations and their land-based activities. Warming water temperatures, associated with climate change, play a significant role in the productivity, distribution, and management of many managed species. Conversely, accounting for cold stun kill events, as was done in the management of Spotted Seatrout, may help mitigate impacts to the remaining spawning stock. The amount of funding and resources available to provide the necessary science is an ongoing and expanding need. For data-poor stocks, fisheries managers struggle to accurately account for catch and determine effective mechanisms to address overfishing. There have been notable success stories for species such as Atlantic Ocean Striped Bass and Summer Flounder (see section 5.1.4), at both the state and federal level, when the paramount cause(s) of a decline has been identified and successfully addressed. As discussed in section 5, stock assessment models may assist in evaluating the relative impact of potential causative mortality factors.

Regardless of their differing jurisdictional boundaries, state and federal fishery management bodies approach their mission in a very similar manner through the development and adoption of FMPs. The goal of these plans, established under the Magnuson-Stevens Fishery Conservation and Management Act or the Atlantic Coastal Fisheries Cooperative Management Act, are similar to the goals of the North Carolina FRA of 1997 to “ensure long-term viability” of their jurisdictional species or fisheries (S.L. 1997-400; G.S. 113-182.1). Each starts with a science based framework of the best available data and assessment techniques to inform the management and conservation decisions by a policy body (i.e.,

federal council, ASMFC board, MFC). The process requires assessing the recent status of the fish stock, extensive public participation, along with the review, adoption, implementation, and enforcement of chosen management measures.

The status of progress on each plan is made available in annual stock reports found on the respective agency's website. Each exhibits varying degrees of success as shown in their criteria for evaluation (generally overfished and overfishing reference points). Grouping the 2016 evaluations into three broad categories of "unknown", "met" reference point, and "did not meet" reference points for comparative purposes by percent of each category, North Carolina, with 14 stocks has 14% unknown, 29% met, and 57% did not meet (http://portal.ncdenr.org/web/mf/stock-overview). The ASMFC report covers 26 stocks, with 4% unknown, 36% met, and 45% did not meet (http://www.asmfc.org/files/pub/ASMFC_StockStatus_March2017.pdf). Of note, both Spot and Atlantic Croaker are in the ASMFC unknown category and Weakfish is listed as depleted due to causes other than overfishing. Landing trends for these species in other states with major landings mirror those seen in North Carolina and those states do not have the large inshore shrimp trawl fishery that occurs in North Carolina. The federal councils report only on stocks with a known status, and from those stocks, 84–91% have met their reference point targets (https://www.fisheries.noaa.gov/national/2017-report-congress-status-us-fisheries ; NOAA 2017a).

2.1 Identify Causes of Problems

The condition of fish stocks is the result of a combination of factors, including fishing mortality, natural mortality of larval, juvenile, and adult life stages, environmental conditions, and habitat conditions. An upset in the balance of any of these factors could lead to stock decline.

Fishing pressure on any recreationally and commercially important fish species can lead to potential declines in fish stocks. Overfishing a stock occurs when the rate of fishing mortality (harvesting from a stock) exceeds the natural rate of replacement (stock's reproductive capacity; ASMFC 2009a). The size of a fish population is determined primarily by the positive effects of growth and recruitment, and the negative effect of mortality, both natural and due to fishing. Highly efficient technology can increase the ability for fishermen (recreational or commercial) to catch more fish using less effort. Improvements in sonar and navigation technology has greatly increased the capacity to fish. Vessel size and horsepower has also increased along with new, bigger, and better fishing gears, further increasing the efficiency of fish harvest (Cudmore 2009).

Fishing mortality can also occur in the form of bycatch. Bycatch is defined by the ASMFC as "the portion of catch taken in addition to the catch of targeted species because of non-selectivity of gear to either species or size differences" (ASMFC 2009a). Bycatch can be divided into two components: incidental catch and discarded catch. Incidental catch refers to retained catch of non-targeted species. Discarded catch is the portion of catch returned to the sea because of economic, legal, or personal considerations (NCDMF 2015a).

Loss of habitat and water quality can significantly affect the health of fish stocks by introducing mortality not related to fishing. Rapidly increasing human populations, especially along the coast of North Carolina has resulted in habitat loss and degradation, along with water quality degradation. Changes in land-use patterns have increased pollutants and added stressors to the habitat from a diversity of sources and remains a threat to fish habitats; and therefore, impact fish (NCDEQ 2016). Climate change can impact temperatures, salinity, pH, as well as circulation patterns and sea-level rise. These changes can influence abundances and distributions of recreationally and commercially important fish species.

Certain types of bottom disturbing activities (e.g., channel maintenance) and fishing gear (e.g., trawls, dredges) may impact habitats of recreationally and commercially important fish species, as well as alter community composition by disturbing benthic sediments, and crush or bury benthic organisms. Food source trophic level cascades may occur when changes in the biomass of one trophic level results in a series of changes in other trophic levels, resulting in a breakdown of food web interconnections (Myers et. al 2007; Cudmore 2009). Disease, and proliferation of less abundant species, can also impact entire ecosystems.

2.1.1 Natural Mortality

Natural mortality (*M*) is the rate at which an organism dies of natural causes. In fisheries, natural mortality can be defined as the removal of fishes from the stock due to causes other than fishing. Those causes can include predation, disease, competition, cannibalism, senescence, parasitism, starvation, and any other natural causes. The rate of natural mortality is strongly related to the life span of the fish, tending to decrease with increasing age, body mass, and length. Natural mortality rates vary among species, and within species these rates vary by sex, density, food availability, time, space, and other factors. Natural mortality occurs regardless of whether fishing is or is not also occurring.

Natural mortality rates are crucial in describing and understanding population dynamics and is one of the most important parameters in fisheries stock assessment models. It accounts for the "removal" of fish from a stock from one time step to the next in subsequent age classes due to causes not related to fishing. Estimates of stock size are often sensitive to the assumed value for natural mortality. Natural mortality affects the numbers of fish that survive to the size/age that is vulnerable to the fisheries and relates directly to stock productivity, attainable yield, and optimal harvest rates. Without an estimate of natural mortality, fishing mortality cannot be estimated from the size or age composition of fisheries-independent surveys or fisheries catches, and so the expected yield under different management scenarios cannot be predicted.

Despite the importance of knowing the natural mortality rate, its value is often poorly estimated or unknown. This can have considerable implications for management, as the results of stock assessment models serve as the basis for management decisions. That is why it is necessary to propagate the uncertainty associated with the natural mortality rate into assessment results, so as not to underestimate the uncertainty of those results. This is often accomplished through a series of sensitivity analyses, which make different assumptions about the rate of natural mortality and examine the impact on assessment results. It is essential for managers to take this uncertainty into account to make effective management decisions.

Information on the natural mortality of the major species affected by the Petitioned rules (i.e., shrimp, Spot, Atlantic Croaker, and Weakfish) are discussed in sections 2.1.1.1–2.1.1.4 to show the variety of factors that cause mortality to each species that are not related to directed fishing or bycatch.

2.1.1.1 Shrimp

The life span of shrimp varies by species and can range from 16 to 24 months (NCDMF 2015a). Shrimp are preyed upon by numerous finfish, invertebrates, and a wide variety of coastal and wading birds (NCDMF 2015a). Predation is cited as a major source of natural mortality for juvenile penaeid shrimp and decreases as shrimp grow (Zimmerman et al. 2000; Ramirez-Rodriguez and Sanchez 2003; Baker and Minello 2010; Leo et al. 2016). Trends in natural mortality are thought to be the result of age specific predation rates and physiological requirements, as well as the result of the physical environment acting on the different life history stages of penaeid shrimp (Ramirez-Rodriguez and Sanchez 2003).

Shrimp can tolerate a wide range of salinity and temperature gradients, as well as avoid extremes in temperature by moving to deeper water or by burrowing in substrate (NCDMF 2015a; Leo et al. 2016; Minello 2017). However, adverse environmental conditions can limit recruitment and negatively impact adult abundance. Hurricanes and large frontal systems can disrupt the transport of eggs and larvae into the estuary, as well as destroy habitat and food supplies. Excessive rain from these systems can also lead to premature flushing of vegetated marsh habitats, forcing shrimp to move into more open waters, making them more susceptible to predation (Baker and Minello 2010; Mace and Rozas 2017).

Diseases and parasites can also play a significant role in reducing shrimp in natural populations and come in the form of viruses, bacteria, fungi, protozoa, flatworms, and nematodes. Johnson (1978) noted that penaeid shrimp are more vulnerable to disease and parasites when stressed by other physical and chemical factors such as low dissolved oxygen (hypoxia), poisons (pollutants), low temperatures, and salinity extremes. Disease and parasites can inhibit respiration, slow growth, and damage tissue; thus, making shrimp more prone to predation.

2.1.1.2 Spot

Juvenile Spot have higher survival rates in waters with salinities less than 19 parts per thousand, potentially due to lower physiological stress (Ross 2003). While there has been very little research, predation, density dependence, and competition are not thought to be very important, but could play a role in juvenile survival. The predation on Spot occurs at every life stage (Odell et al. 2017).

The impacts of climate change and water quality (e.g., salinity, pH, dissolved oxygen) on Spot are not fully understood; however, hypoxia has been thought to be one of the greatest threats to juvenile Spot. Spot seem to adjust well to warm waters, making increased temperatures due to climate change of less concern (Odell et al. 2017).

The causes of natural mortality in Spot are not well understood, but most of the environmental impacts for Atlantic Croaker are likely to impact Spot as well, as they have similar life history characteristics.

2.1.1.3 Atlantic Croaker

Atlantic Croaker can tolerate a diversity of habitat types encompassing a wide range of salinity, water temperature, dissolved oxygen, and water depth. However, changes to habitat may lead to direct mortality, or hinder the ability of Atlantic Croaker to find prey, avoid predation, or reproduce. Juvenile Atlantic Croaker have higher survival in oligohaline (very low salinity) and mesohaline (moderately salty) waters, potentially due to lower physiological stress (Ross 2003). Hypoxia events can cause habitat shifts (Craig and Crowder 2005; Eby et al. 2005; Tuckey and Fabrizio 2016; Odell et al. 2017) and long-term exposure to hypoxic conditions can affect reproduction, gonadal growth, gametogenesis, endocrine function, hatching success, and larval survival (Odell et al. 2017). Atlantic Croaker can tolerate a wide range of temperatures, but are vulnerable to mortality when exposed to prolonged periods of low temperature, particularly as juveniles (Odell et al. 2017). Higher winter temperatures in estuarine nursery areas has been linked to increased juvenile survival and subsequent increased adult Atlantic Croaker abundance (Hare and Able 2007; Hare et al. 2010).

Due to size and general abundance, Atlantic Croaker are preyed upon at every life stage. Larval Atlantic Croaker and Atlantic Croaker eggs are preyed upon by gelatinous zooplankton and larvae may become infected with ectoparasites (Odell et al. 2017). In addition, at nearly every life stage Atlantic Croaker are in competition with other fish species for food and habitat, though the effects of competition are poorly understood.

Anthropogenic shoreline and habitat alterations, and pollution have negative impacts on juvenile Atlantic Croaker, including reduced abundance in nursery areas with man-made drainage or altered shorelines (bulkhead or rubble) and reduced growth and physical condition of juvenile Atlantic Croaker in areas with high pollution (Odell et al. 2017). The magnitude of the impacts of climate change on Atlantic Croaker are not fully understood, though climate change is associated with changes in water temperature, dissolved oxygen, pH, salinity, and turbidity (Odell et al. 2017). Changes in habitat parameters may lead to direct mortality of Atlantic Croaker or may impact growth, reproduction, and the ability of Atlantic Croaker to locate prey. In addition, warmer winter temperatures in estuaries have been linked with a northward shift of Atlantic Croaker (Hare and Able 2007; Hare et al. 2010).

2.1.1.4 Weakfish

Like many sciaenids, Weakfish can tolerate a wide range of habitat and environmental conditions common to North Carolina's estuarine waters. Juveniles of the species often inhabit deeper waters of the lower estuary, sounds, and nearshore areas, so lethal and sub-lethal effects of low dissolved oxygen (hypoxia), temperature, and salinity are probably minimal (Odell et al. 2017). Mortality of juvenile Weakfish has been correlated with rapid changes in water temperature usually associated with cooler spring time weather patterns (Paperno et al. 2000), but is not observed any other time of the year. Predation of juvenile and adult Weakfish is often cited as a major contributing factor to the observed high natural mortality in recent years (NEFSC 2009; ASMFC 2016a). Gannon and Waples (2004) observed that Weakfish was the most abundant prey item recovered from the stomachs of bottlenose dolphin that had stranded on coastal beaches.

Sources of adult natural mortality were investigated during the 2016 stock assessment by ASMFC and incorporated into the final assessment model (ASMFC 2016a). The assessment committee estimated natural mortality from several sources including food habit data from trawl surveys and climatic patterns. Results from the food habit analysis indicated that the percentage of empty stomachs observed from trawl-collected specimens positively correlate with observed increases in natural mortality in the 1990s. This suggests that competition for food resources may affect survival of Weakfish. Patterns in sea surface temperatures produced by the Atlantic Multidecadal Oscillation appeared to be negatively correlated with commercial and, to a lesser extent, recreational Weakfish harvest dating back to 1929. This suggests that there is a strong link between environmental variability and Weakfish abundance at a coastwide level.

2.1.2 Fishing Mortality

Fishing mortality (*F*) is a term used in fisheries population dynamics defined as the removal of fishes from the stock due to fishing activities. Fishing mortality is strongly related to fishing gear and varies by sex, age, time, space, and other factors. Different gears are designed to optimize harvest efficiency for different species and for a particularly desirable sex or age within the same species, and thus, can cause different fishing mortality rates. Fishing mortality tends to be high in the peak harvest season and on popular fishing hotspots.

Fishing mortality is crucial in describing and understanding the population dynamics of species subject to harvest. Together with natural mortality (the loss of fishes due to natural causes not associated with fishing), fishing mortality determines population trajectory through time. It is one of the most important parameters in fisheries stock assessment models and in fisheries management, as well as one of the parameters in which stakeholders are most interested. In fisheries management, determination of stock status and development of harvest regulations rely on the understanding and estimation of fishing mortality. Biological reference points that determine whether overfishing is occurring are developed using

fishing mortality. Closed fishing seasons/areas and size/bag limits could be enacted when fishing mortality goes higher than a pre-specified threshold. Spawning stock biomass (SSB) that one cohort can produce decreases as fishing mortality increases. Yield that one cohort can produce maximizes at a reasonable fishing mortality rate. Estimation of fishing mortality relies heavily on the quality and quantity of catch data, and is influenced by the estimation of natural mortality. Given natural mortality is often poorly estimated or unknown, estimation of fishing mortality is associated with great uncertainties and these uncertainties need to be considered in making management decisions.

Fishing mortality of both directed and indirect fishing should be considered to estimate the total fish being removed from the population. Species experiencing indirect fishing mortality are considered bycatch, as they were caught while targeting a different species. Bycatch in shrimp trawls is a known issue; therefore, one of the management strategies selected by the MFC in its final approval of the 2015 Shrimp FMP Amendment 1 was to convene an industry workgroup to test different gear configurations (e.g., BRDs, turtle excluder devices [TEDs], tailbag mesh sizes, composite/square panels, fisheyes) to reduce bycatch to the extent practicable with a target of a 40% reduction in bycatch (NCDMF 2015a). The Shrimp Bycatch Reduction Industry Workgroup was formed and convened in 2015 and consisted of fishermen, net manufacturers, gear specialists, and scientists from NCDMF, NOAA Fisheries, and N.C. Sea Grant. A series of workshops was held to develop and test different gear configurations in internal waters, ocean waters, and on large and small vessels over a three-year period.

The NCDMF has worked with the commercial fishing industry to reduce the amount of shrimp trawl bycatch. In 2015, five experimental gear combinations were tested during the summer on large vessels in the Pamlico Sound. After reviewing the results of the first year of testing, the work group recommended that new BRD/gear combinations should have an acceptable shrimp loss between 3% to 5%, depending on the reduction in finfish bycatch achieved (Brown 2015). During the summer and fall of 2016, four additional gear combinations were tested on large vessels in the Pamlico Sound (Brown 2017; Brown et al. 2017). In the final year of the study, 2017, three gear combinations were tested on both small and large vessels in the Atlantic Ocean and the Pamlico Sound (Brown et al. 2018). Gear combinations with larger tailbag mesh sizes (>1 ½-inches), reduced TED grid size (3-inch), and larger fisheyes were found to significantly reduce finfish bycatch. Four of the 12 gear combinations tested met or exceeded the 40% target reduction in finfish bycatch, while also minimizing shrimp loss. Overall, finfish bycatch reductions ranged from 4.5% to 57.2%. Differences in shrimp catch between the control and experimental nets ranged from a 16.2% loss to a 9.9% gain.

At its May 2018 business meeting, the MFC voted to require fishermen to use one of four gear combinations tested by the workgroup that achieved at least 40% finfish bycatch. The use of the selected gear configurations tested by the industry work group should help further reduce finfish bycatch in the shrimp trawl fishery and its associated fishing mortality (see section 3.5). For a detailed description of the sampling methodology, gear parameters, and full data analysis, see Brown et al. (2017, 2018).

2.1.2.1 Bycatch

Prior to the ASMFC's 2017 stock assessments for Spot and Atlantic Croaker, there were no estimates of the magnitude of shrimp trawl bycatch occurring in North Carolina for these species in the peer-reviewed literature. The estimates of shrimp trawl bycatch presented by the Petitioner in Exhibit B have not been validated by the NCDMF and are based on ratio extrapolation that was found to be inaccurate in the peer-reviewed literature (Diamond 2003; see also NCDMF 2015a which provides a full literature review on quantifying bycatch). Ratios have been shown to overestimate bycatch by as much as two to seven times higher than those based on catch-per-unit-effort (CPUE) mean per unit estimates (Diamond 2003). The use of a ratio defined as the finfish catch divided by the shrimp catch to estimate bycatch implies the quantities are correlated, which is typically not the case (Nance 1998). Ratios to estimate bycatch also

cannot be applied statewide because they are spatially and temporally variable. It is also not reasonable to assume that bycatch rates in neighboring areas can give an accurate approximation of an un-sampled area (Alverson et al. 1994; Alverson and Hughes 1996; Diamond-Tissue 1999; Diamond 2003).

While the ASMFC's 2017 stock assessments were ultimately not endorsed for management, the peer review panel supported the estimates of bycatch of Spot and Atlantic Croaker in the Southern shrimp trawl fishery (ASMFC 2017a, 2017d). See Figures 3.12 and 3.13 for estimates of bycatch in the Southern shrimp trawl fishery by state.

Conducting sensitivity analyses is a routine part of performing fisheries stock assessments to facilitate the understanding of the various aspects of uncertainty associated with natural variability, the data, and the model. The ASMFC's 2017 coastwide stock assessments for Spot and Atlantic Croaker examined the sensitivity of model results to the magnitude of bycatch occurring in the Southern shrimp trawl fishery (J. Kipp, ASMFC, personal communication; L. Lee, NCDMF, personal communication). The magnitude of the shrimp trawl bycatch in the base run was reduced by 10% to 50%. The results for both Spot and Atlantic Croaker suggest that assuming a smaller magnitude of shrimp trawl bycatch relative to the base run would lead to smaller estimates of recruitment and SSB, as the model assumes that less bycatch equates to less fish in the population (J. Kipp, ASMFC, personal communication; L. Lee, NCDMF, personal communication). If the Petitioned rules were implemented, the effect of reduced trawling on stock abundance would not be immediately evident in future stock assessments due to the standard model assumptions about the lower estimates of shrimp trawl bycatch. With regards to fishing mortality, the smaller assumed values of shrimp trawl bycatch evaluated in the sensitivity analyses had minimal impact on the estimated values of fishing mortality for Spot; however, estimated fishing mortality for Atlantic Croaker was lower when the assumed values of shrimp trawl bycatch were reduced.

See sections 3.2, 3.3, and 3.5 for more information on the 2017 stock assessments and bycatch estimates mentioned above. See section 3.5.1 for more information on studies conducted by NCDMF to reduce bycatch in the shrimp trawl fishery.

2.1.3 Insufficient Habitat Protection

The Petitioner put forth several management recommendations. One of these is to designate all inshore and ocean (0–3 miles) waters as nursery habitat. The Petitioner states the "preponderance of data regarding juvenile life stages of fishes in these programs illustrate that all inside waters serve as important locations where juvenile fishes feed and grow to maturity. Juvenile fish are defined here as fishes that have yet to spawn at least once. While some fishes may be harvested, and possess mature gonads, if they are harvested prior to spawning, their contribution to the population is zero, threatening population stability and population growth. In fact, there is no evidence that any areas within the estuarine system of North Carolina do not function as a nursery area. These data, along with the Pamlico Sound survey and the decline of Atlantic Croaker and Spot in the South Atlantic, provide unequivocal support to the argument that the area functions as critical nursery habitat (NCWF 2016a, Exhibit B, p. 17)."

There is numerous scientific literature regarding methodology to identify nursery habitat. Using the best available information, NCDMF has identified several factors that should be considered when defining nursery habitat. Designations should take into account species' spatial-temporal distributions in the estuarine complex, and associated habitat characteristics. Following the most recent advances in ecosystem science, nursery designations should consider the relative value of the area for juvenile growth, predator protection, and movement into adult habitat, in addition to the occurrence and density of juveniles. This includes information not only about abiotic factors, structured habitat conditions, and

landscape setting, but where suitable parameters overlap to create an optimal nursery environment. Finally, other factors such as water quality and changing weather patterns play an important role.

Fishery independent data should be used to inform the need for additional critical habitat designations. The NCDMF currently does not conduct ocean-based fishery independent sampling that could then be evaluated for new nursery classifications in the ocean. However, fishery-independent data from the Southeast Area Monitoring and Assessment Program (SEAMAP), a cooperative state/federal program coordinated by ASMFC, combined with the Pamlico Sound Trawl Survey (Program 195), could be evaluated for habitat purposes.

2.1.3.1 Critical Habitat Area Concept[1] and Current Habitat Protection Measures

There are approximately 2.2 million acres of coastal waters (excluding the ocean) in North Carolina, of which 242,000 acres are joint waters (salt/brackish marsh). The MFC has designated 161,830 acres as either primary nursery areas (PNAs), SNAs, or SSNAs, which represent 7% of the total estuarine waters (see Table 2.1; Figure 2.1 and 2.2). Additionally, the NCWRC has designated 30,384 acres of inland waters under their jurisdiction as inland nursery areas. Primary and secondary nursery areas are permanently closed to certain fishing gears, while SSNAs are conditionally opened to certain fishing gears.

NCDMF's habitat designations and selective gear restrictions have been guided by the concept of a critical habitat area, which takes into account multiple species groupings and their spatial-temporal distributions in the estuarine complex, and associated habitat characteristics.

In the 1980s, the NCDMF formed an internal Critical Habitat Committee to work with the MFC Habitat AC to discuss the concept of expanding habitat protections. While not used for any rule designations, analysis of the SNA data was included in the NCDMF's 1991 Classification of Pamlico Sound Nursery Areas; Recommendations for Critical Habitat Criteria report (Noble and Monroe 1991). This study identified other species groupings that were not considered in the nursery designation process. It recommended a better understanding of the spatial-temporal distributions in the estuarine complex and associated habitat characteristics. Staff recommended expanding fish sampling to identify anadromous spawning and nursery areas, estuarine areas important to reef fish like Gag Grouper, Black Sea Bass, and Sheepshead, and mapping of shellfish and submerged aquatic vegetation (SAV) resources due to their importance for numerous economically important species. Critical habitat definitions were put into rule in 1994. Sampling was conducted for anadromous fish spawning and nursery areas, and the division implemented a Bottom Mapping Program (1990). Anadromous fish spawning areas were designated in rule in 2007.

Selective gear restrictions in certain areas (without formal habitat area designations) were also used to provide protection for critical habitats. The MFC prohibited trawling and dredging over SAV beds in Pamlico Sound through a "No Trawl Area" designation (15A NCAC 03R .0106). SAV beds are nursery areas for summer/fall spawners like Spotted Sea Trout, Red Drum, Black Sea Bass, and many others. Trawling was prohibited in Albemarle and Currituck sounds due to user conflicts, but this also provides ancillary protections for habitat and bycatch of juvenile anadromous fish (15A NCAC 03J .0104). Trawl net, long haul seine, and swipe nets are prohibited in any designated Shellfish or Seed Management Area (15A NCAC 03K .0103). Crab Spawning Sanctuaries (15A NCAC 03L .0205) and inlet trawling restrictions (15A NCAC 03J .0401) may provide a "no trawl corridor" around inlets that not only protect crabs, but allow migration of sub-adult fish to the ocean. In the ocean (0–3 miles), there are

[1] The following sections do not address the designation of "Critical Habitats" under the ESA, which is applicable only to species listed as endangered or threatened and has specific meaning as defined in the ESA.

approximately 726,000 acres of water, of which about 8% (59,225 acres) are currently closed to trawling off of Onslow County, Carteret County, and from Oregon Inlet to the Virginia line (Table 2.1; Figure 2.2).

Table 2.1. Designated areas protected from shrimp trawling in coastal and joint waters. Acres of nursery area designations are included in the totals for shrimp trawl net prohibited and managed acres. (Source: NCDMF)

Designation	Acreage	Percent[1]
Nursery Areas (in estuarine waters)		
Primary Nursery Areas	76,927	3.5
Permanent Secondary Nursery Areas	47,462	2.1
Special Secondary Nursery Areas	37,441	1.7
Total	161,830	7.3
Shrimp Trawl Net Prohibited Areas (permanent closure)[2]		
Estuarine Waters	997,470	45.0
Ocean Waters	59,225	8.2
Total	1,056,695	35.9
Shrimp Trawl Net Managed Areas (seasonal openings determined by management)[3]		
Estuarine Waters	65,128	2.9
Ocean Waters	86,174	11.9
Total	151,302	5.1

[1] Percent listed is the percentage from total estuarine waters (coastal and joint) or total ocean waters (0-3 miles). Total estuarine waters: 2,220,168 acres; total ocean waters: 726,007 acres.
[2] Includes Primary and Secondary Nursery Areas, Oyster Sanctuaries, Trawl Net Prohibited Areas, and Military Danger and Prohibited Zones
[3] Includes Special Secondary Nursery Areas, Crab Spawning Sanctuaries, Designated Pot Areas, No Trawl Net Areas, and areas managed by proclamation

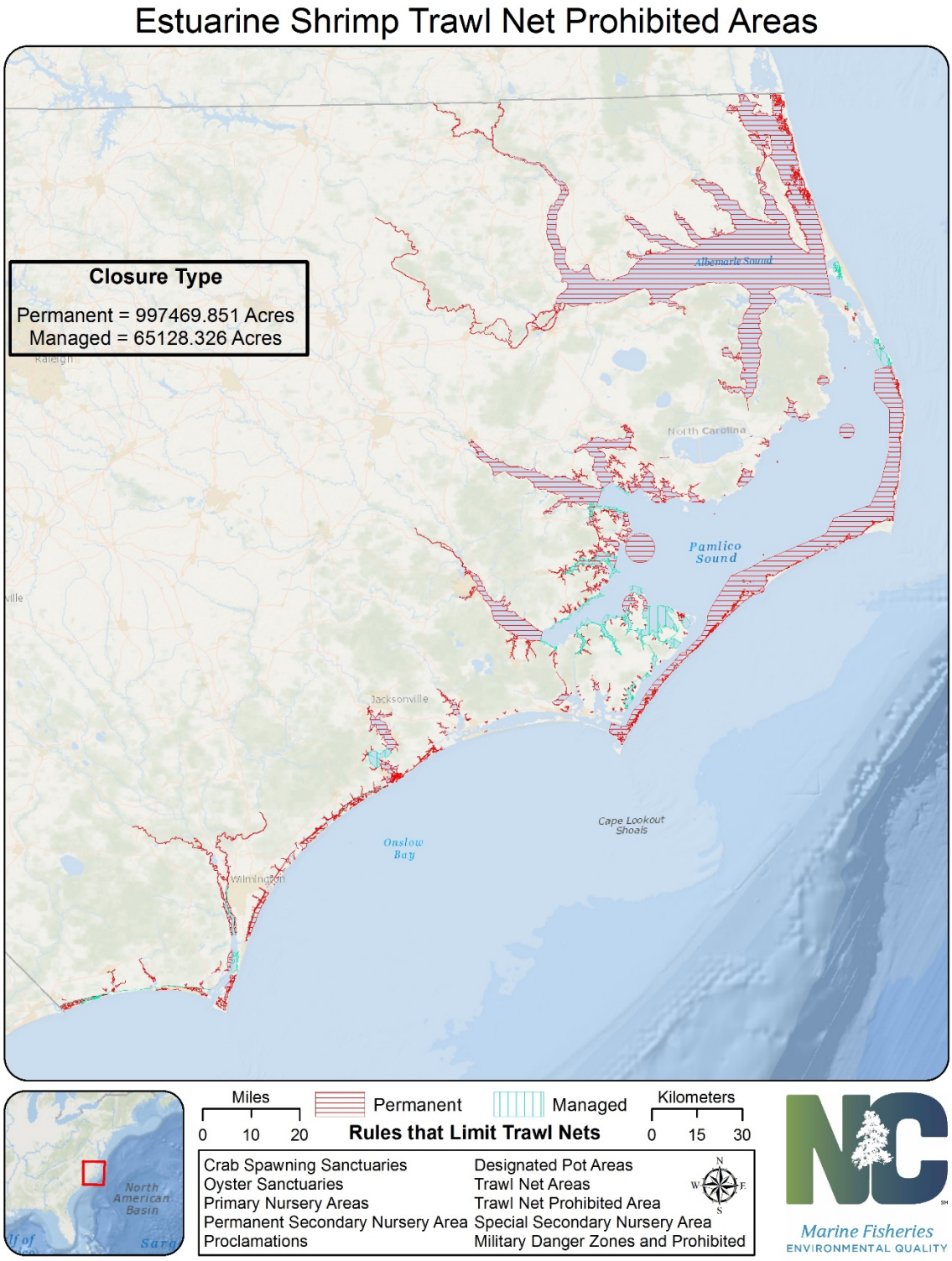

Figure 2.1. Estuarine Shrimp Trawl Net Prohibited Areas. (Source: NCDMF)

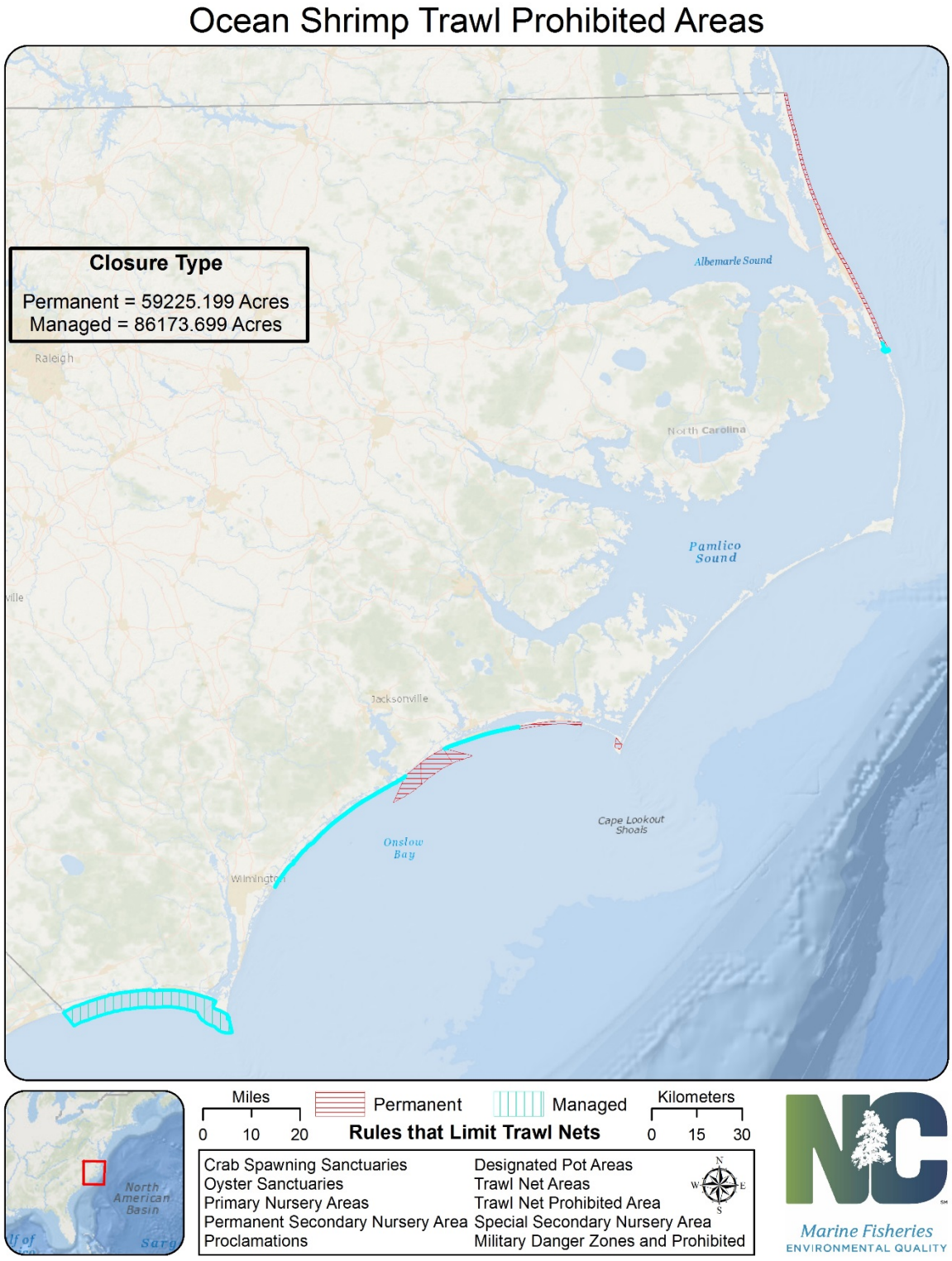

Figure 2.2. Ocean Shrimp Trawl Net Prohibited Areas. (Source: NCDMF)

2.1.3.2 Evolving Scientific Concept of Nursery Area

In recent years, the scientific literature has refined the concept of nursery areas. In earlier days, an entire estuary was initially considered a nursery area because of the occurrence of juveniles. But as ecosystem sciences advance, it has been found that in addition to density, other factors such as growth, predator protection, and movement out of the nursery into the adult habitat influence determination of nursery areas. Based on Beck et al. (2001), Dahlgren et al. (2006), and Peterson (2003), nursery areas are a subset of juvenile habitat that contributes disproportionally more to the production of juveniles that recruit into a population than another area of similar size. Shallow habitats with structure, such as wetlands, SAV, and oyster reefs, provide more predator protection and food than soft bottom habitat, enhancing growth and survival (Lehnert and Allen 2002; Ross 2003; Grabowski et al. 2005). However, juvenile species require specific optimal abiotic conditions, such as salinity and temperature to maximize growth. Productive or optimal nursery areas occur where ideal abiotic factors, structured habitat, and landscape position overlap (Figure 2.3). While all waterbodies may have juvenile fish present at any given time, the combination of the above noted factors may not align, resulting in low nursery value (Beck et al. 2001; Peterson 2003). Shrimp trawling is restricted in the majority of these optimal nursery areas through habitat designations and area and gear restrictions.

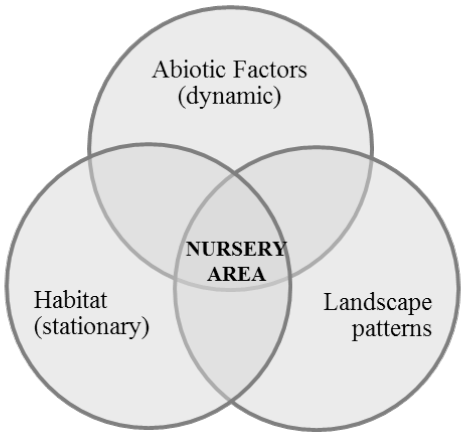

Figure 2.3. Depiction of the nursery area concept – the location where abiotic and habitat conditions, as well as the landscape setting are optimal for productivity. Abiotic factors – salinity, temperature, depth, currents; Habitat factors – wetlands, shell bottom, SAV, substrate; Landscape setting – geomorphology of the waterbody, proximity to inlets or adult habitat, habitat connectivity (adapted from Peterson 2003 and Beck et al. 2001).

There are many other non-fishing activities that have resulted in habitat loss and degradation over time (NCDEQ 2016). In the past, channel dredging has resulted in loss of wetlands, SAV, and oyster reefs. Filling of wetlands to create buildable land also contributes to wetland loss. While rules have been put in place to reduce large scale impacts, small losses continue, resulting in a net loss of habitat. Similarly, bulkheads and marinas can result in cumulatively significant habitat losses over time, particularly wetlands. Wetland loss and degradation in coastal watersheds can be directly traced to population pressures and conversion of wetlands to developed or agricultural uses, with resulting changes in water flow, increased pollution, and habitat fragmentation. Other habitat loss has occurred due to water quality degradation. Channel dredging in the lower estuary has altered flows and increased salinity in some waters. Ditching and draining of uplands and wetlands to accommodate development, agriculture, and forestry in the coastal plain has increased the volume and flashiness (i.e., frequency and rapidity of short

term changes in streamflow) of runoff into the upper estuary, resulting in more variable salinity conditions. Dewatering from mining activities to small upper tributaries can alter flow and salinity. These alterations result in less suitable nursery conditions.

Multiple studies have documented that abundance of penaeid shrimp, sciaenids, and other estuarine dependent species is significantly greater in wetlands, SAV, and oyster reef habitat than in soft bottom habitat (Ross and Stevens 1992; Murphey and Fonseca 1995; Stunz et al. 2010; Grabowski et al. 2012; Humphries and La Peyre 2015). Thus, habitat loss contributes to declines in fish populations.

2.1.3.3 Sampling Data Needed for Habitat Designations

In order to protect fish habitat, it is important to be able to designate additional critical habitats based on acceptable data, criteria, and analysis. The NCDMF currently does not conduct ocean-based fishery independent sampling that could then be evaluated for new nursery classifications in the ocean. The NCDMF shrimp trawl characterization study (Program 570), conducted from 2012 to 2015 in the ocean, does evaluate finfish length frequency, biomass, and other metrics, as indicated by the Petitioner. However, it may be inappropriate to designate nursery areas from this study, or any fishery-dependent characterization study, due to sampling bias. Lack of standardization in the gears observed (e.g., mesh size, BRDs, TEDs, net type), tow times, tow speed, and geographic locations in the characterization study do not produce comparable catch rates across tows (Brown 2015). Fishery-independent surveys address sources of bias through standardized techniques.

Under the SEAMAP, South Carolina conducts a fishery-independent Coastal Shallow Water Trawl Survey. The survey has sampled two depth-zones (4 m and 10 m) off the North Carolina coast south of Cape Hatteras beginning in 1989. The “outer deep” zone was dropped in 2001 due to budget cuts and a decision was made to increase samples in the inner strata (ASMFC 2011). There are approximately 40 stations off North Carolina in the inner strata, with an average depth of 8 meters (4 m min and 14 m max). Nearly 4,000 tows have been made, averaging 148 per year. This is an extensive dataset that has primarily been used for shrimp and finfish indices in coastwide stock assessments and could be evaluated for habitat purposes.

With the implementation of the Pamlico Sound Trawl Survey (Program 195) in 1987, there is species abundance and habitat preference data for Pamlico Sound and the lower reaches of Neuse, Pungo, and Pamlico rivers. This data has been provided to the National Oceanic and Atmospheric Administration (NOAA) Fisheries Essential Fish Habitat database, which assembled trawl surveys from state and academic organizations, covering the Gulf of Maine to South Carolina, as well as NOAA groundfish surveys. NCDMF sampling under the Estuarine Trawl Program (Program 120) in SNA and SSNA has decreased in the past 25 years with changes in shrimp management strategies (intended to avoid “grand openings”), as well as with budget reductions to state-funded programs (over 44% reduction since 2008).

2.1.4 Insufficient Water Quality Protection

Water quality degradation is a significant stressor to fish and the habitats they might utilize. Sources include point sources such as industrial or wastewater discharges and nonpoint sources originating from a variety of land use changes. Changes in land use associated with development, agriculture, or forestry increase runoff into surface waters by reducing natural vegetation that would absorb the water (NCDEQ 2016). Ditching to reduce flooding on land or lower the water table accelerates and channels runoff to surface waters. Primary pollutants in runoff are oxygen-consuming wastes, nutrients, suspended sediment, and toxins, which can impact habitats and affect fish survival.

Increased sediment loading can increase turbidity in the water column. Excessive suspended sediments directly impact aquatic animals by clogging gills and pores of juvenile fish and invertebrates, resulting in mortality or reduced feeding (Ross and Lancaster 2002) and can smother oyster reefs and SAV. Sedimentation associated with runoff and shoreline erosion generally occurs close to shore and in the upper portions of the estuary, often in nursery areas. In contrast, sedimentation associated with bottom disturbing fishing gear occurs in deeper and more open areas of the estuary, further away from structured habitat and nursery areas.

Increased nutrient loading can lead to algal blooms and hypoxia (low dissolved oxygen). Hypoxic conditions can be associated with weather conditions causing stratified waters, eutrophication, or hurricanes. These conditions occur more often and for longer in deeper portions of the water column, such as in Pamlico Sound, causing lethal and sublethal stress of benthic infauna (Luettich et al. 2000; Buzzelli et al. 2002). A study using data from the Neuse River, found that benthic invertebrate mortality from intensified hypoxia events reduced total biomass of demersal predatory fish and crabs during the summer by 51% in 1997 and 17% in 1998 (Baird et al. 2004). The decrease in available energy (fewer benthic invertebrates) greatly reduced the ecosystem's ability to transfer energy to higher trophic levels at the time of year most needed by juvenile fish (Baird et al. 2004).

2.1.5 Other Factors

Physical and chemical properties of water are key to the distribution of plant and animal life and influence growth and survival of all habitats. Thus, changes in weather conditions, such as precipitation and water temperatures, influence distribution and abundance of aquatic organisms. Predominant winds, currents, and salinity fluctuations at certain times of year highly affect annual recruitment success of larval fish into nursery habitat (Epperly and Ross 1986; Noble and Monroe 1991; Greene et al. 2009). High sustained air temperatures increase water temperature, which in combination with low winds, can lead to stratification of the water column and hypoxic waters. The latter causes mortality of benthic invertebrates, which is the food base for many juvenile fish species, including Spot and Atlantic Croaker.

Extreme weather events such as droughts, floods, Nor'easters, and hurricanes affect water quality and habitat conditions in positive and negative ways. Reduced runoff during droughts decreases pollutant inputs, increases salinity and improves water clarity within estuarine waters, enhancing conditions favorable for growth of SAV and can potentially lead to shifting fish distribution. In contrast, floods and hurricanes can flush pollutants from the upper estuarine bottom, cause sedimentation over oyster reefs, and erode wetland shorelines. From 1851 to 2014, North Carolina had more direct hurricane landfalls (48 hurricanes) than any other state on the East Coast, except for Florida (141 hurricanes; N.C. Climate Office 2015).

While extreme weather events have always occurred, there is evidence that the frequency and severity of minor (non-storm event) nuisance flooding and hurricanes on the East and Gulf coasts are increasing (IPPC 2014; Melillo et al. 2014; Sweet et al. 2014). Tropical storms, fueled by warm water temperatures and favorable atmospheric conditions, may increase in frequency and intensity with a warming climate (Melillo et al. 2014). A warming trend in air temperature is the primary driver of changing weather patterns that can alter the distribution and health of fish and their habitat. The 2014 National Climate Assessment summarizes observed and expected climate change and impacts regionally and overall in the U.S. (Melillo et al. 2014).

3 ESTABLISH BASELINE

To begin to determine what effects the Petitioned rules would have on the state of North Carolina, the current management and trends in harvest (commercial and recreational) for species affected by the Petitioned rules must be evaluated.

In North Carolina, public resources are managed for the good of the people through the Public Trust Doctrine and fish in state waters are a public trust resource (G.S. 1-45.1; G.S. 113-131). Fishery management includes all activities concerned with maintenance or improvement of estuarine and marine stocks and use of those resources (fisheries), including protection of the habitat. The NCDMF and MFC are the only authorities in North Carolina coastal fishing waters that can implement plans and regulations to manage North Carolina marine and estuarine fisheries.

The MFC's jurisdiction encompasses all coastal waters and extends to three miles offshore. The nine-member MFC and the NCDEQ Secretary establish the NCDMF's conservation policies. As mentioned previously, North Carolina is also a member of regional and federal fishery management commissions and councils including the ASMFC, MAFMC, and SAFMC.

The NCDMF can trace its roots back as early as 1822, when the North Carolina General Assembly enacted legislation to impose gear restrictions on oyster harvest. That was later followed by separate fish and shellfish commissions, which were combined in 1915 to form a commercial regulatory body. In 1965, the scope of the commission was expanded to include regulatory authority over recreational fishing activities in coastal waters.

As mentioned in section 1, the 1997 FRA and its subsequent amendments established the requirement to prepare FMPs for all North Carolina's commercially and recreationally significant species or fisheries that comprise state marine or estuarine resources (G.S. 113-182.1). The Act "recognizes the need to protect our coastal fishery resources and to balance the commercial and recreational interests through better management of these resources" and requires the MFC "to provide fair regulation of commercial and recreational fishing groups in the interest of the public." FMPs normally take about two years to complete and are required to be reviewed at least once every five years. Upon review, amendment of a plan is required when changes to management strategies are necessary. Through this process, the commission also has authority to implement federal fishery regulations (as minimum North Carolina standards) through the N.C. FMP for Interjurisdictional Fisheries, which selectively adopts management measures contained in approved federal Council or ASMFC FMPs by reference. The goal of FMPs is to provide direction for the management of fisheries and to ensure long-term viability of North Carolina fisheries.

Under G.S. 113-182.1, each FMP shall contain necessary information pertaining to the fishery or fisheries, as well as include conservation and management measures that will provide the greatest overall benefit to the State, particularly with respect to food production, recreational opportunities, and the protection of marine ecosystems, and that will produce a sustainable harvest. For these purposes, data are gathered, analyzed, interpreted, and management measures implemented. The NCDMF is empowered to collect such scientific and statistical information as may be needed to determine conservation policy (G.S. 113-181). FMPs are the ultimate product that brings all the information and considerations into one document for a species.

There are two main sources of data necessary for fisheries management and evaluated for each FMP: fishery dependent and fishery independent data. Fishery dependent data are derived from the fishing process itself and are collected through such avenues as self-reporting, fish house surveys, onboard

observers, telephone surveys, or vessel-monitoring systems. Fishery dependent sampling allows managers to account for sources of removals and the size and age structure of those removals. Fishery-independent data comes from research and monitoring surveys conducted by state agencies. Scientists take samples throughout the potential range of the target fish(es) based on statistically valid sample designs that are not influenced by changes in fishing activity. Fishery independent sampling allows managers to monitor trends in the relative abundance of a species. Fishery dependent and independent sampling complement one another to provide a more complete picture of the condition of a fish stock. Dependent sampling intended to monitor trends in relative abundance can be biased by changes in: gear specifications, fishing effort, areas fished, level of expertise of fishermen, technology, etc.

The longest running fishery dependent data source in North Carolina is commercial landings that are available back to the late 1880s. Currently, data are collected by the NCDMF Trip Ticket Program (NCTTP), which was legislatively mandated to start in 1994 and required submission of trip level data from seafood dealers. Prior to 1978, commercial landings data were collected voluntarily by the National Marine Fisheries Service (NMFS, now known as NOAA Fisheries) from seafood dealers and completeness and accuracy of the data provided varied. In 1978, the NCDMF began its own statistics program and entered a cooperative program with the NMFS to collect monthly surveys of North Carolina's major commercial seafood dealers. These surveys were still voluntary, so the 1994 NCTTP was legislatively mandated to answer an increased demand for complete and accurate trip-level commercial harvest statistics. The detailed data obtained through the NCTTP allows for the calculation of effort (i.e., trips, licenses, participants, vessels) in each fishery that was not available prior to 1994 and provides a more comprehensive and detailed record of North Carolina's seafood harvest that is sold. A trip ticket is the form used by fish dealers to report commercial landings information for every fishing trip that resulted in seafood being sold to the dealer. Trip tickets collect information about the fisherman, the dealer purchasing the product, the transaction date, the number of crew, area fished, gear used, and the quantity of each species landed for each trip. Ex-vessel value of commercial fisheries in North Carolina can be calculated by looking at the average price paid to the fishermen by the dealer for each species and market grade multiplied by the landings. Prices are collected monthly on a volunteer basis and are not available for every trip captured by the NCTTP.

A complementary NCDMF fishery dependent data source is the collection of biological data at fish houses from predominantly finfish fisheries in North Carolina and has been ongoing since 1982. Predominant fisheries sampled throughout the year include the ocean sink net fishery, estuarine gill net fishery, long haul seine/swipe net fishery, winter trawl fishery, and flounder pound net fishery. The blue crab fishery is the only invertebrate species included in fish house sampling, as it is the largest fishery in North Carolina. Also, through other observer-type programs, NCDMF staff have collected data from shrimp trawl, fish trawl, gill net, long haul seine, trawl net, channel net, and recreational hook and line fisheries. The observer data are collected either on the water from fishermen's vessels or from a NCDMF vessel operated near ongoing fisheries. These types of fishery dependent data provide monitoring of effort, gear specifications, and removals (i.e., landings and discards), and characterize the catch (e.g., species composition, size, age).

The NCDMF License Program is another source of fishery dependent information. The number of licenses issued to various types of fishermen such as the Standard Commercial Fishing License (SCFL), Retired Standard Commercial Fishing License (RSCFL), Commercial Fishing Vessel Registration (CFVR), Recreational Commercial Gear License (RCGL), and Coastal Recreational Fishing License (CRFL) may be used to determine the number of fishermen and vessels involved in various fisheries.

The Marine Recreational Information Program (MRIP) and its predecessor, the Marine Recreational Fishery Statistics Survey (MRFSS), have been providing estimates of recreational catch and fishing effort since 1981. From 1981–1986, NCDMF's role was simply to review estimates and answer questions from

the private contractor that NMFS used to conduct MRIP. In 1987, NCDMF assumed the responsibility of conducting the MRIP sampling in North Carolina and conducts angler interviews as part of the Access Point Angler Intercept Survey (APAIS). Additional NCDMF staff were also added to increase APAIS sampling to produce reliable recreational harvest estimates at the state level. MRIP sampling is only conducted in saltwater and brackish water areas, along with tidal portions of sounds, bays, and rivers. Freshwater areas are not included in the survey; therefore, in 2004, NCDMF started a comprehensive intercept survey in the Central Southern Management Area (CSMA) to estimate harvest of anadromous species such as Striped Bass and American Shad. Recreational data collected by NCDMF include the number and type of species kept and discarded, lengths and weight of kept fish, number of anglers, location, as well as socioeconomic information. These data are used to estimate total harvest and total fish discarded. These two estimates added together equal the total catch. Estimates of effort (i.e., trip counts) are also produced. In 2010, NCDMF initiated a series of mail surveys targeting CRFL holders to supplement the MRIP and CSMA intercept surveys. These surveys target fisheries such as shellfish, cast net, and flounder gigging. Surveys were also used to characterize catch from the RCGL.

The NCDMF conducts several fishery independent surveys in state estuarine waters. Fishery-independent monitoring of adult and juvenile populations enhances resource managers' ability to monitor population changes and assess the status of target species. These surveys also may provide a direct measure of habitat utilization by the various species captured. An index of relative abundance can be developed to categorize the sampling areas and establish a pattern of habitat utilization for target species. The survey data has been used to characterize nursery area habitat and to help designate new critical habitat areas. Examples of fishery-independent data include relative abundance indices (CPUE) for select species/life stages from the Estuarine Trawl Survey (Program 120), Pamlico Sound Trawl Survey (Program 195), and Fishery Independent Assessment Gill Net Survey (Program 915).

The main fishery managed by NCDMF that is affected by the Petitioned rules is the shrimp trawl fishery. Other fisheries not solely managed by NCDMF, but also affected include Spot and Atlantic Croaker. Weakfish was also identified by the Petitioner as a species that would benefit from the proposed rule changes (NCWF 2016a). Current landings and management for each of these species is discussed below in sections 3.1–3.4. The value of these fisheries is discussed in section 3.6 and 3.7. Commercial landings in North Carolina are available dating back to the 1800s for some species, but recreational data did not become available until 1981. Therefore, to show how landings have changed over time, trends in commercial landings back to 1972 are provided as well as trends in recreational harvest back to 1981.

3.1 Shrimp

The management unit for shrimp in North Carolina includes the three major species of penaeid shrimp: brown (*Farfantepenaeus aztecus)*, pink (*Farfantepenaeus duorarum*), and white (*Litopenaeus setiferus*). Its fisheries occur in all coastal fishing waters of North Carolina, which include the Atlantic Ocean offshore to three miles. Estimates of population size are not available since the fishery is considered an annual crop due to their short life spans. Annual variations in catch are presumed to be due to environmental conditions that, in turn, affect fishing effort and the economics of the fishery.

Commercial landings in the North Carolina shrimp fishery vary from year to year and are dependent primarily on environmental conditions. Environmental factors, especially severity of winter temperatures and salinity, can have a major influence on the yearly harvest. North Carolina's shrimp fishery is unusual in the southeast because all three species are taken here and most of the effort occurs in internal waters. While South Carolina, Georgia, and Florida allow limited shrimping in inside waters, much of their fisheries is conducted in the Atlantic Ocean and white shrimp comprise most of their harvest (NCDMF 2015a).

Commercial landings provided by the NCTTP are combined for the three shrimp species (Table 3.1). Annual landings of shrimp vary from year to year based on environmental conditions, but have generally remained fairly stable since 1972 (Figure 3.1). Total landings from 2007 to 2016 have averaged 7,086,786 pounds per year. In 2016, 13,190,728 pounds of shrimp were landed; the highest annual landings in North Carolina since 1953. Total landings increased 45% from 2015 to 2016. Annual shrimping effort has fluctuated with shrimp abundance, but it appears to have gradually declined since 1994 (Figure 3.2). This decline in effort can be attributed to several things including cheaper imported shrimp prices, increasing fuel prices, and fishermen retiring out of the industry. Landings in 2005 were the lowest on record. This was likely due to several reasons, one being that many large trawlers remained scalloping instead of shrimping because prices were high and the days at sea were extended (NCDMF 2015a). Hurricanes Katrina (Aug. 29, 2005) and Rita (Sep. 4, 2005) hit the Gulf Coast, also negatively affecting the fishing industry. Shrimp breading operations in the Gulf shut down with only one operational in September 2005 and some North Carolina shrimpers could not sell their product (NCDMF 2015a). While the overall effort has declined since the 1990s, the number of trips increased over the last couple of years (Figure 3.2). The majority of commercial landings come from the estuarine waters of North Carolina and on average make up approximately 80% of total landings from the state. Of the ocean landings, more than 90% are from 0 to 3 miles (Table 3.1).

Shrimp are harvested recreationally throughout the state by otter trawls, skimmer trawls, seines, cast nets, shrimp pots, and shrimp pounds with specific gear limitations. Since July 1, 1999, anyone wishing to harvest shrimp recreationally with commercial gear is required to purchase a RCGL. The RCGL is an annual license that allows recreational fishermen to use limited amounts of commercial gear to harvest seafood for their personal consumption. Seafood harvested under this license cannot be sold. Fishermen using this license are held to recreational size and possession limits, and gear marking, limits, and configuration requirements. Many of the species taken by recreational users of commercial gear are included in fishery management plans. Until 2002, the influence that RCGL holders may have on these species was unknown. Two survey strategies were used to collect information from RCGL holders: a socioeconomic survey, conducted in 2001, 2004, and 2007, and catch and effort surveys conducted monthly from 2002 through 2008. RCGL holders harvested an average of 52,352 pounds of shrimp a year from 2002 to 2008 (NCDMF 2015a). Landings from RCGLs are currently unknown since these surveys were discontinued in 2008 due to budget constraints.

In 2011, NCDMF initiated mail surveys of CRFL holders for participation in cast net fisheries. Annual cast net harvest estimates for shrimp are available from 2012 to 2016 and average about 90,000 individual shrimp per year (Table 3.2). In 2016, 120,572 shrimp (numbers) were harvested recreationally with cast nets.

Table 3.1. Shrimp commercial landings (pounds, heads-on, all three species combined) in North Carolina by region, 2007–2016. (Source: NCTTP)

Year	Estuarine Landings	Ocean Landings Less Than 3 Miles	Ocean Landings Greater Than 3 Miles	Total Landings	Total Trips
2007	7,879,879	1,483,522	50,950	9,414,351	9,287
2008	7,385,623	1,431,741	160,356	8,977,720	8,079
2009	4,417,229	716,756	94,295	5,228,280	7,770
2010	4,701,523	856,480	12,745	5,570,748	7,861
2011	4,048,526	629,866	3,042	4,681,434	5,359
2012	5,007,607	650,197	7,737	5,665,540	8,922
2013	4,119,572	704,586	7,007	4,831,165	8,682
2014	3,967,480	548,703	3,284	4,519,467	6,477
2015	7,654,742	1,251,946	23,945	8,930,632	8,170
2016	8,518,324	4,480,499	49,700	13,048,523	9,703

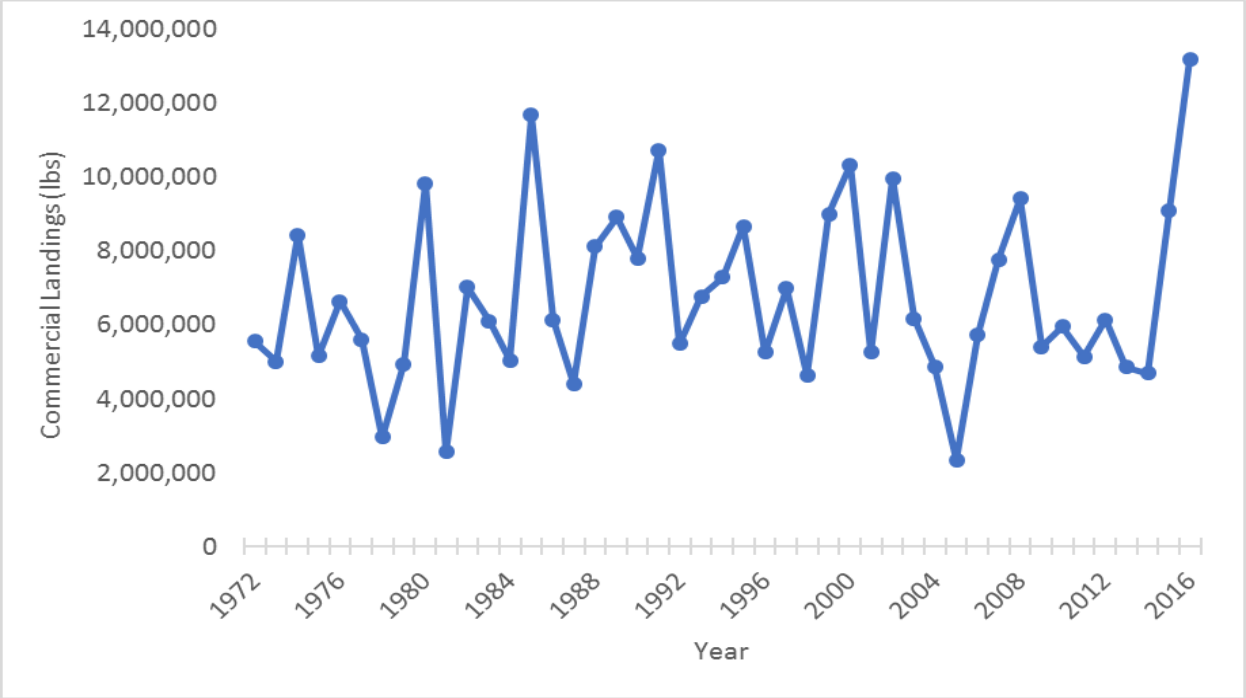

Figure 3.1. Annual commercial landings of shrimp (all three species combined) for North Carolina, 1972–2016. (Source: NCTTP)

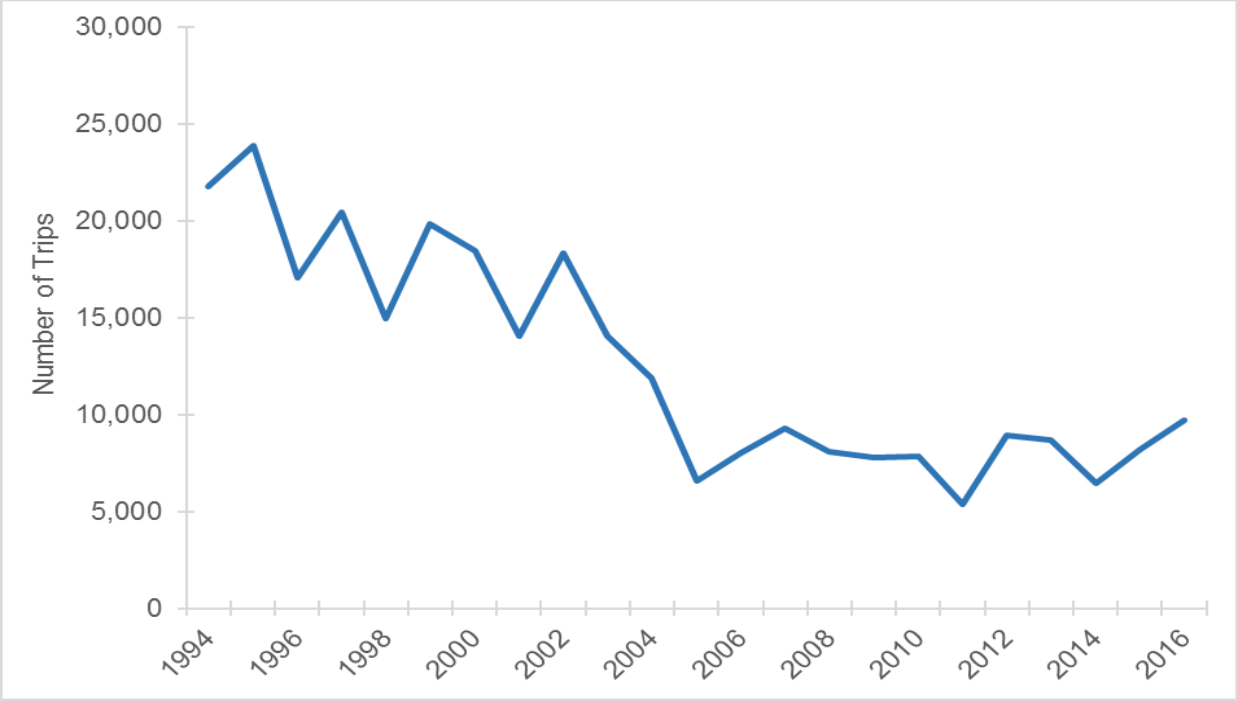

Figure 3.2. Annual number of trips reporting commercial landings of shrimp (all three species combined) in North Carolina, 1994–2016. (Source: NCTTP)

Table 3.2. Recreational cast net effort and catch (in numbers) for shrimp (all three species combined), 2012–2016 (estimates based on CRFL mail survey). (Source: NCDMF)

Year	Total Effort	PSE Effort	Total Shrimp Harvest	PSE Harvest	Total Shrimp Released	PSE Release	Total Shrimp Catch	PSE Total Catch
2012	126,891	6.1	84,335	29.7	19,584	34.8	103,919	26.9
2013	142,037	6.2	30,512	32.5	29,055	27.7	59,568	22.7
2014	202,293	6.5	38,144	37.1	38,044	40	76,187	29.7
2015	220,011	5.9	53,339	34.9	32,981	26.1	86,321	24.8
2016	199,509	6.4	81,177	45.7	39,395	34.9	120,572	37.6

The NCDMF began review of the 2006 Shrimp FMP in 2011 and initially concluded that current management strategies in the plan continued to meet the goals and objectives of the Shrimp FMP and recommended to the Fisheries Director that review of the 2011 Shrimp FMP proceed as a revision to simply update data contained in the plan. However, based on concerns about bycatch in the shrimp trawl fishery voiced at various MFC AC meetings, the NCDMF later recommended amending the 2006 Shrimp FMP. The MFC, at its November 2012 meeting, directed the NCDMF to amend the plan, but limit the scope of the amendment to bycatch issues in the commercial and recreational shrimp fisheries.

Twenty-nine different management options were brought forward to the Shrimp FMP AC to address different bycatch management strategies during monthly meetings held from January through September 2013. Management strategies discussed included:

- alternative fishing gears;
- TEDs in skimmer trawls;
- gear modifications;
- effort management;
- head rope lengths, number of nets, and vessel lengths;
- area restrictions;
- New River trawl fishery; and
- consideration of a live bait shrimp fishery.

Specific management options considered in Amendment 1 to the Shrimp FMP related to this Petition included:

- adding an additional day to the weekend closure in internal coastal waters;
- closing shrimp trawling at night in internal coastal waters;
- reducing maximum headrope length in all internal coastal waters for commercial and recreational fisheries;
- implementing tow time limits; and
- implementing a season.

Tow time limits in internal coastal waters was discussed, but the Shrimp FMP AC voted to eliminate this option in July 2013. Implementing a seasonal closure (December or January through May) was also discussed, but not selected during the development of the amendment and is related to the Petition's proposed rule change to open the shrimp season when the shrimp size is 60-count heads-on in Pamlico Sound.

The MFC approved the Shrimp FMP Amendment 1 at its February 2015 meeting. Management strategies approved by the MFC through the Shrimp FMP Amendment 1 have either been completed or are in progress of completion. Approved management strategies were as follows:

- Continue to prohibit otter trawls in the New River SSNA
- Allow hand cast netting of shrimp in all closed areas and increase the limit to four quarts (heads-on) per person
- Upon federal adoption of TEDs in skimmer trawls, the NCDMF will support the federal requirement.
- Establish a permitted live shrimp bait fishery and for NCDMF to craft the guidelines and permit fees after reviewing permitted operations in other states, and to allow live bait fishermen with a permit to fish until 12 p.m. (noon) on Saturday
- Allow any federally certified BRD in all internal and offshore waters of North Carolina.
- Update the scientific testing protocol for the state's BRD certification program
- Convene a stakeholder group to initiate industry testing of a minimum tail bag mesh size, T-90 panels, skylight panels, and reduced bar spacing in TEDs to reduce bycatch to the extent practicable with 40% target reduction
    - Upon securing funding, testing in the ocean and internal waters will consist of three years of data using test nets compared to a control net with a Florida fisheye, a federally approved TED, and a 1.5-inch mesh tailbag.

    - Results should minimize shrimp loss and maximize reduction of bycatch of finfish. Promising configurations will be brought back to the MFC for consideration for mandatory use
    - This stakeholder group may be partnered with NCDMF and Sea Grant.
    - Members should consist of fishermen, net/gear manufacturers, and scientist/gear specialists.
- Require either a T-90 panel/square mesh tailbag or other applications of square mesh panels (e.g., skylight panel), reduced bar spacing in a TED, or another federal or state certified BRD in addition to existing TED and BRD requirements in all skimmer and otter trawls
- In order to put a cap on fleet capacity as a management tool, establish a maximum combined headrope length of 220 feet in all internal coastal waters where there are no existing headrope length requirements (e.g., current 90-foot requirement in Core Sound and Cape Fear River)
- Prohibit shrimp trawling in the IWW channel from the Sunset Beach Bridge to the S.C. state line, including Eastern Channel, lower Calabash River and Shallotte River
- Recommend the MFC Habitat and Water Quality AC consider changing the designation of SSNAs that have not been opened to trawling since 1991 to permanent SNAs

3.2 Spot

Spot is a short-lived species, maturing at age two, with males maturing at 7.9 inches total length and females maturing at 8.4 inches total length in the South Atlantic (ASMFC 2010a). A coastwide stock assessment for Spot was completed by the ASMFC in 2017, but it was not accepted for management use (ASMFC 2017a). Without a valid, peer-reviewed stock assessment, it cannot be determined if the stock is currently "overfished" or experiencing "overfishing." The ASMFC lists the status of Spot as unknown due to the lack of an approved stock assessment, but management action has not been triggered based on the TLA analysis through 2016 (ASMFC 2017b).

Coastwide commercial landings of Spot have declined considerably since 1950 (ASMFC 2017b). Commercial landings of Spot in North Carolina have been steadily declining since 1979 (Figure 3.3). Since 2007, landings have been averaging about 978,000 pounds per year (Table 3.3). In 2016, commercial landings dropped well below the average to 235,670 pounds. Currently, no single commercial gear accounts for a significant majority of Spot landings in North Carolina; however, long haul seines have traditionally been a high-volume fishery for Spot. Effort in this fishery has declined dramatically, with just 31 long haul trips landing Spot in 2015. Coastwide recreational landings of Spot have declined since 1981, but have been generally consistent since the late 1980s (ASMFC 2017b). Recreational harvest (pounds) of Spot in North Carolina has fluctuated annually since 1981 with a large peak in harvest occurring in 1985 (Figure 3.3). The largest declines in harvest have occurred in the last 10 years (Table 3.3). Recreational harvest increased from 2012 through 2014 (704,445 pounds) before declining sharply in 2015 (395,268 pounds). Over this same period, recreational discards have fluctuated, but not changed drastically. From 1994–2009, commercial and recreational trips for Spot showed different trends over time with commercial trips being fairly stable through 2002 before declining, where recreational trips saw a steep decline from 1994–1999 and then peaked in 2004 before declining (Figure 3.4). Since 2010, commercial and recreational trips have followed almost identical trends.

The average size (total length) of Spot caught in the recreational fishery has remained fairly constant ranging from 200 mm (7.9 inches) to 230 mm (9.1 inches) while the average size of fish landed in the commercial fishery has been declining (Table 3.4). From 2007–2016, the average size of Spot in the commercial fishery ranged from 267 mm (10.5 inches) to 301 mm (11.9 inches).

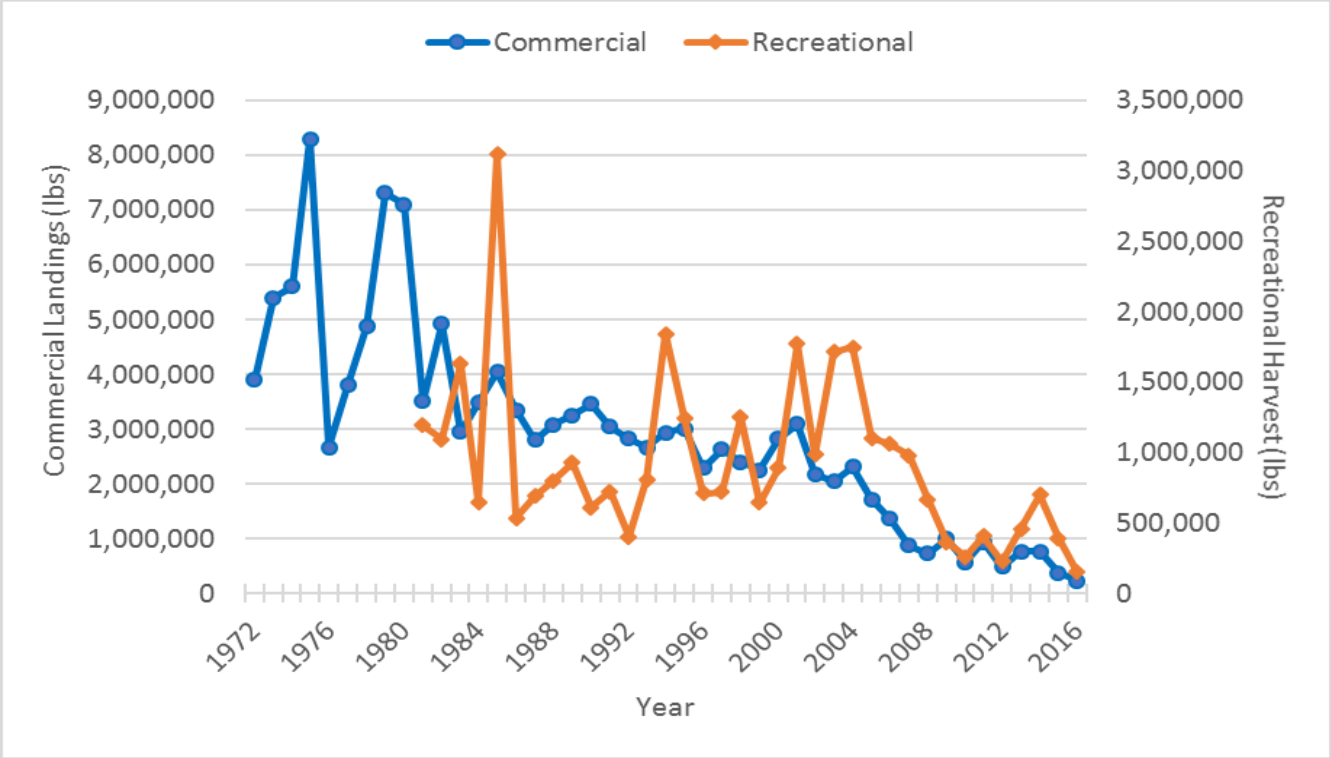

Figure 3.3. Annual commercial and recreational landings (pounds) of Spot in North Carolina, 1972–2016. (Source: NCTTP; MRIP)

Table 3.3. Commercial landings (weight in pounds), recreational harvest (number of fish and weight), and recreational releases (number of fish) of Spot from North Carolina, 2007–2016. (Source: NCTTP; MRIP)

	Commercial	Recreational					
		Number of fish				Weight (pounds)	
Year	Landings (pounds)	Released	PSE	Harvested	PSE	Harvested	PSE
2007	879,082	1,197,005	17.8	3,078,346	17.2	982,463	16.9
2008	736,484	1,322,408	14.4	1,843,343	18.0	670,511	19.4
2009	1,006,500	1,222,053	13.5	1,056,346	18.0	363,998	17.9
2010	572,315	871,054	13.8	834,560	14.2	260,341	13.8
2011	936,970	1,000,566	11.6	1,207,335	15.8	410,317	16.8
2012	489,676	759,081	11.9	784,272	22.1	230,250	24.0
2013	768,592	1,314,199	12.1	1,464,592	15.3	460,928	16.8
2014	766,224	890,831	12.1	2,111,880	20.5	704,445	21.8
2015	377,358	708,122	14.5	1,081,083	28.0	395,268	29.1
2016	235,670	498,424	19.2	513,320	23.1	151,352	23.2

The percent standard error (PSE) represents the standard error of the harvest estimate as a percentage.

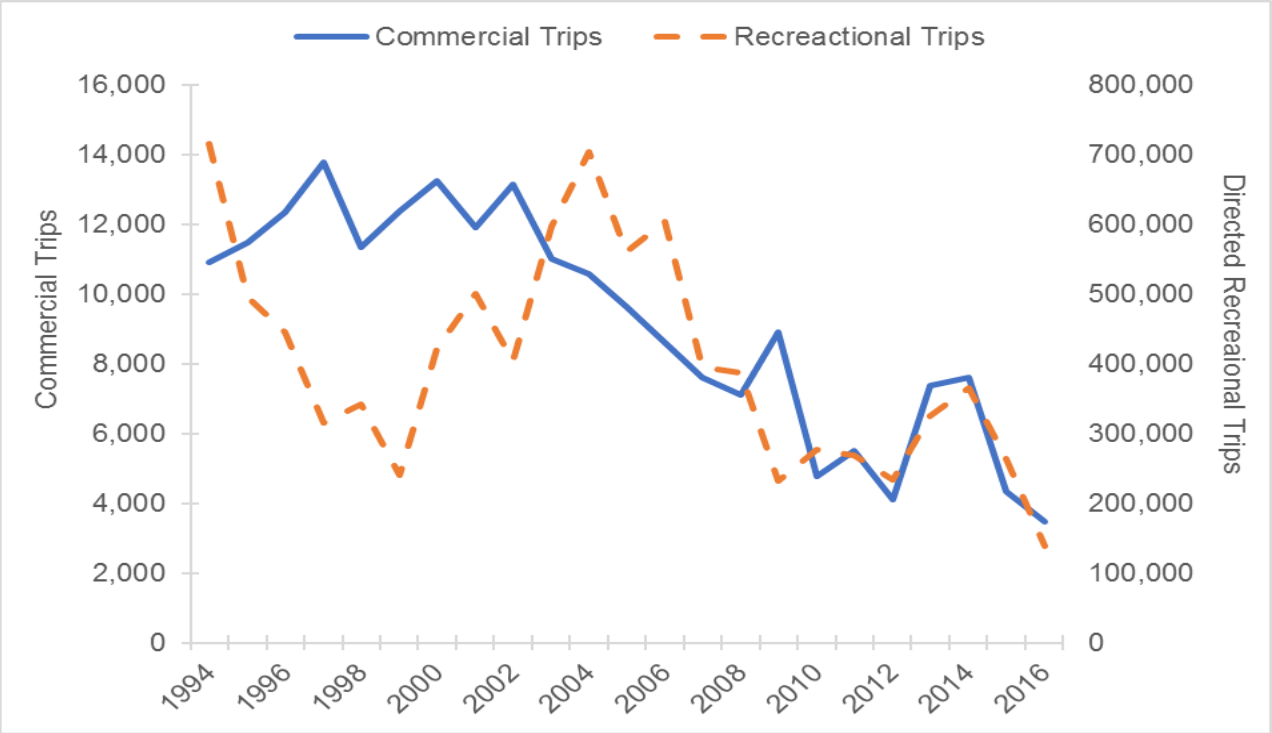

Figure 3.4. Number of trips reporting commercial landings of Spot and the number of directed recreational Spot trips, 1994–2016. (Source: MRIP) NOTE: Directed recreational trips are defined as trips where the angler specified Spot as the target of the trip or where Spot was harvested.

Table 3.4. Mean, minimum, and maximum lengths (total length, millimeters) of Spot sampled from the commercial and recreational fisheries of North Carolina, 2007–2016. (Source: NCDMF)

	Commercial				Recreational			
Year	Mean Length	Minimum Length	Maximum Length	Total Number Measured	Mean Length	Minimum Length	Maximum Length	Total Number Measured
2007	301	147	494	13,261	230	144	299	1,243
2008	294	174	495	13,274	213	128	311	1,344
2009	289	192	486	19,217	216	126	274	682
2010	288	151	452	20,239	209	147	306	1,096
2011	297	162	422	15,033	209	149	283	1,534
2012	287	188	454	10,508	200	141	298	611
2013	284	172	437	8,538	207	115	293	484
2014	267	113	423	10,946	210	121	258	344
2015	277	137	394	9,168	207	154	302	214
2016	275	187	385	6,492	200	160	263	107

Addendum I to the Omnibus Amendment for Spot established the TLA to evaluate trends in the Spot fishery in years between stock assessments (ASMFC 2014a). Annually, harvest and abundance indices are analyzed; if established thresholds for both indices are exceeded for two consecutive years, management actions are triggered. The extent of management action is determined based on whether a 30% or 60% threshold has been exceeded.

As mentioned previously, the 2017 Spot stock assessment was not endorsed for management use by a panel of independent fisheries scientists, though they did agree that immediate management actions were not necessary and that the TLA should continue to be used to monitor the stock (ASMFC 2017a). The panel noted that the models generally suggested spawning stock biomass was increasing and if new information suggests the stock could be declining, a new assessment should be expedited. The conclusions of the panel were ultimately supported by the South Atlantic Board at its August 2017 meeting (ASMFC 2017e). The main cause of uncertainty in both the Spot and Atlantic Croaker assessments was the disagreement in harvest trends and abundance trends. Spot abundance, as indicated by fisheries independent surveys, indicates increasing abundance; whereas, harvest from directed commercial and recreational fisheries has generally been declining. This trend has also been observed in the annual TLA (ASMFC 2017b).

Though the assessment did not pass peer review and will not be used for management, there are elements of the data, particularly commercial and recreational removals and dead discards from shrimp trawls, that can still be informative. The following is a description of trends in removals and independent indices from the 2017 assessment review. From 1989–2014, total annual coastwide removals (landings and discards) ranged from 4,637 to 57,287 metric tons (41 to 1,324 million fish) and have been relatively stable since 1997 (ASMFC 2017a). The stability in removals coincides with initial BRD requirements for North Carolina shrimp trawl fisheries initiated in 1992. North Carolina's BRD requirement was adopted before the device became federally required in 1997 and 1998 (50 CFR 622). After the peak year in 1991, coastwide removals were 12,785 metric tons (254 million fish). Shrimp trawl discards accounted for most of the removals.

3.3 Atlantic Croaker

Atlantic Croaker generally mature by age two, with males maturing at 7.25 inches and females maturing at 7.5 inches total length (ASMFC 2010b). Results of a stock assessment completed in 2010 indicated that Atlantic Croaker was not experiencing overfishing. Overfished status could not be determined in the 2010 ASMFC stock assessment due to uncertainty in the biomass estimates as a result of uncertainty in the shrimp trawl bycatch estimates at that time. The ASMFC lists the status of Atlantic Croaker as unknown due to the lack of an approved stock assessment, but management action has not been triggered based on the TLA through 2016 (ASMFC 2017c).

A coastwide stock assessment for Atlantic Croaker was completed and presented to the ASMFC South Atlantic State/Federal Fisheries Management Board in May 2017 (ASMFC 2017f). This 2017 assessment was not endorsed for management use by a panel of independent fisheries scientists (ASMFC 2017d). The current stock status of Atlantic Croaker could not be determined because the assessment results were sensitive to certain modeling assumptions, particularly those regarding fishery and survey gear selectivity. The panel did agree that immediate management actions were not necessary because base model and all sensitivity runs evaluated suggested the spawning stock biomass was increasing; therefore, recent removals are likely sustainable (i.e., unlikely to result in further depletion of Atlantic Croaker).

Coastwide commercial landings of Atlantic Croaker have fluctuated since 1971, but have been generally declining since the early 2000s (ASMFC 2017c). Commercial landings of Atlantic Croaker in North Carolina have followed a similar trend (Table 3.5; Figure 3.5). The decline in landings can, in part, be linked to declining effort, mostly from the traditionally high-volume flynet fishery (Figure 3.6). In 1997, 304 flynet trips landed Atlantic Croaker in North Carolina accounting for 6.9 million pounds. From 2011 through 2016, only 84 flynet trips have landed Atlantic Croaker in North Carolina accounting for a total of 2.1 million pounds over the six-year period. The decrease in effort in recent years has been attributed to shoaling at Oregon Inlet, making it difficult for flynet boats to transit. Overall, commercial landings have been declining. Coastwide recreational landings of Atlantic Croaker have fluctuated since 1981, but have generally declined since the mid-2000s (ASMFC 2017c). While recreational harvest of Atlantic Croaker in North Carolina has been declining over time, harvest since 2007 has been relatively steady, fluctuating between 99,298 pounds and 241,993 pounds (Table 3.5; Figure 3.5). Since 1995, the number of Atlantic Croaker harvested has remained relatively steady, while the number of recreational discards has been increasing since the mid-2000s. From 1994–2016, commercial and recreational trips for Atlantic Croaker have followed similar declining trends (Figure 3.6).

Unlike Spot, where the commercial fishery typically lands larger fish than the recreational fishery, the average size of Atlantic Croaker in the recreational fishery are larger than those caught commercially (Table 3.6). From 2007–2016, the average size of Atlantic Croaker caught in the recreational fishery ranged from 201 mm (7.9 inches) to 244 mm (9.6 inches) while the average size of fish landed in the commercial fishery ranged from 202 mm (8.0 inches) to 213 mm (8.4 inches).

Table 3.5. Recreational harvest (number of fish and weight) and releases (number of fish) and commercial harvest (weight in pounds) of Atlantic Croaker from North Carolina, 2007–2016. (Source: NCTTP; MRIP)

	Commercial	Recreational					
		Number of fish				Weight (pounds)	
Year	Landings (pounds)	Released	PSE	Harvested	PSE	Harvested	PSE
2007	7,271,162	1,608,120	12.7	461,162	17.6	131,185	18.8
2008	5,791,766	1,419,019	12.1	317,940	15.7	132,731	17.1
2009	6,135,437	1,912,670	11.0	368,990	16.7	131,742	16.5
2010	7,312,159	1,598,139	8.9	478,156	12.4	241,993	12.4
2011	5,054,186	1,798,230	10.7	246,676	12.9	99,298	13.2
2012	3,106,616	1,255,216	8.7	288,813	11.5	105,530	11.9
2013	1,927,938	1,984,701	9.8	411,882	14.6	141,880	13.6
2014	2,629,908	2,713,787	11.7	541,657	13.3	227,949	14.6
2015	1,819,070	2,477,625	10.4	471,869	12.3	190,808	13
2016	2,092,135	2,147,160	14.6	368,203	19.7	141,571	21.7

The percent standard error (PSE) represents the standard error of the harvest estimate as a percentage.

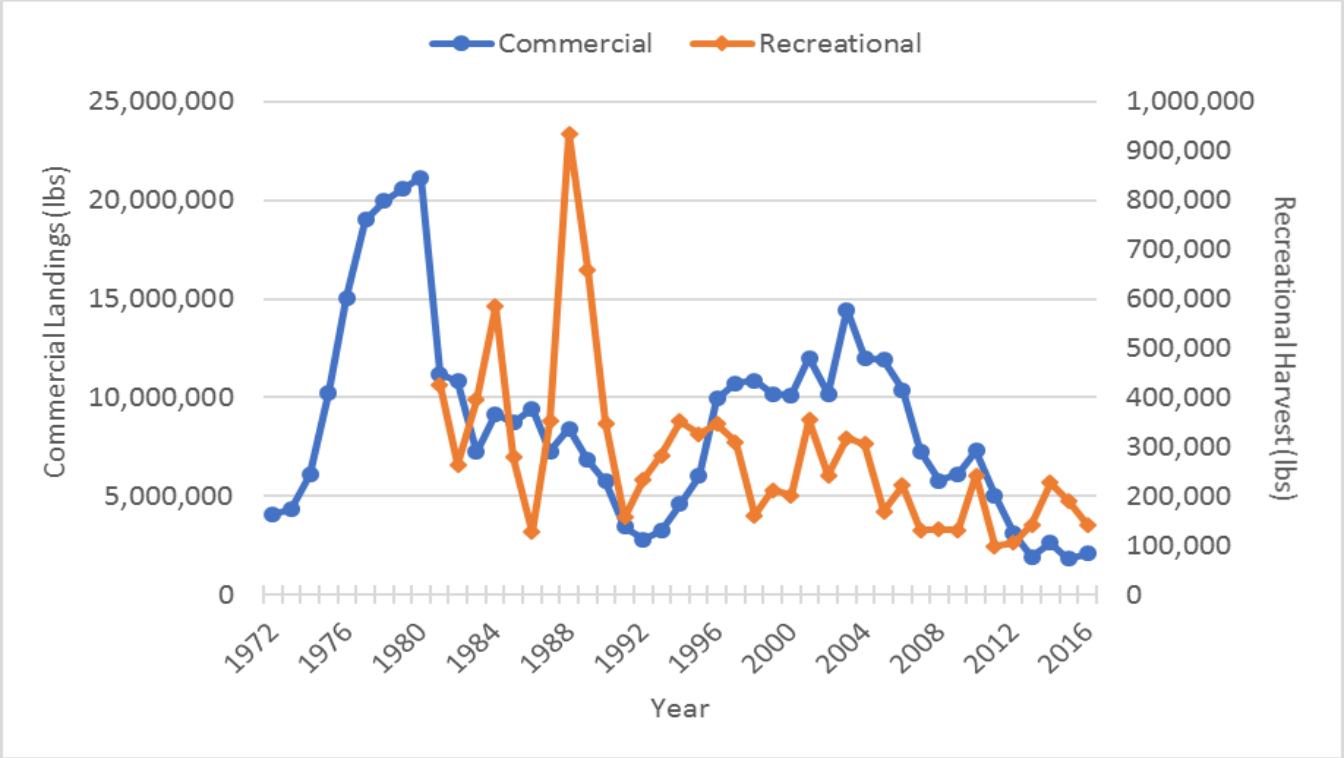

Figure 3.5. Annual commercial and recreational landings (pounds) of Atlantic Croaker in North Carolina, 1972–2016. (Source: NCTTP; MRIP)

Table 3.6. Mean, minimum, and maximum lengths (total length, millimeters) of Atlantic Croaker sampled from the commercial and recreational fisheries of North Carolina, 2007–2016. (Source: NCDMF)

Year	Commercial				Recreational			
	Mean Length	Minimum Length	Maximum Length	Total Number Measured	Mean Length	Minimum Length	Maximum Length	Total Number Measured
2007	207	152	306	12,445	201	103	348	113
2008	209	105	337	9,384	244	141	392	188
2009	208	111	298	8,546	224	145	402	210
2010	209	155	294	7,047	248	157	427	330
2011	211	116	334	8,432	239	148	363	255
2012	206	165	300	4,278	233	124	358	230
2013	213	119	339	4,626	229	151	392	267
2014	208	161	334	6,412	236	105	357	215
2015	208	162	324	4,476	237	147	352	142
2016	202	125	325	1,541	235	135	319	219

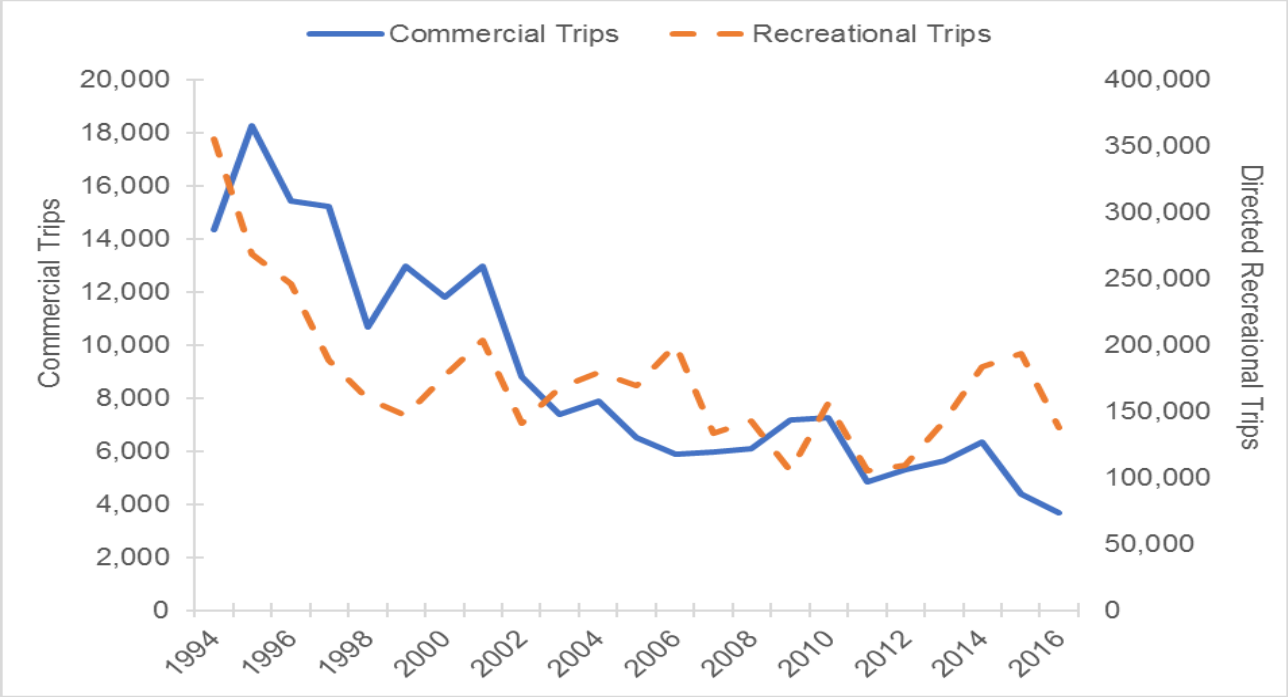

Figure 3.6. Number of trips reporting commercial landings of Atlantic Croaker and the number of directed recreational Atlantic Croaker trips, 1994–2016. (Source: MRIP) NOTE: Directed recreational trips are defined as trips where the angler specified Atlantic Croaker as the target of the trip or where Atlantic Croaker was harvested.

Exhibit B to the Petition raises concern over the decline of the commercial and recreational fisheries for Atlantic Croaker in the South Atlantic (NCWF 2016a). A northward shift of the Atlantic Croaker population that has been occurring since at least the 1970s may help partially explain the decline in landings from the Southeast (Hare and Able 2007; Nye et al. 2009), with some models predicting the center of the Atlantic Croaker population to shift northward by 50–100 km (Hare et al. 2010).

Addendum II to Amendment I to the Interstate FMP for Atlantic Croaker established the TLA to monitor trends in the Atlantic Croaker fishery in years between stock assessments (ASMFC 2014b). Annually, harvest and adult abundance indices are analyzed. If both indices exceed established thresholds for three consecutive years, management actions are triggered. The extent of management action is determined based on whether a 30% or 60% threshold has been exceeded.

The TLA for Atlantic Croaker has recently been updated with data through 2016 (ASMFC 2017c). The harvest index was above the 30% threshold in 2013–2016. While the negative trend in the harvest index is due in part to declining recreational landings, the decline is largely the result of significant declines in commercial landings. From 1997 through 2010, the harvest index indicated a largely positive trend, and the harvest index did not begin to approach the 30% threshold until 2011. The adult abundance index (age-1+) was not above the 30% threshold from 2011–2016, and there was no portion red in 2015 and 2016. Since 2004, the proportion red in the index has been low, only exceeding the 30% threshold in 2008 indicating high abundance of adult Atlantic Croaker. The juvenile abundance index (age-0) was not above the 30% threshold in 2015 or 2016. High variability in the juvenile index in comparison to the adult index is likely the result of variability in recruitment rather than population trends. Management triggers have

not been tripped because the indices in both population characteristics (harvest and abundance) were not above the 30% threshold for the 2014–2016 time period.

As mentioned previously, the 2017 Atlantic Croaker stock assessment was not endorsed for management use by a panel of independent fisheries scientists, though they did agree that immediate management actions were not necessary and that the TLA should continue to be used to monitor the stock (ASMFC 2017d). The panel also stated, "despite uncertainty in the assessment model results and an inability to confidently determine stock status, trends in landings and indices do not indicate immediate cause for concern, and therefore do not call for a subsequent new stock assessment in the short-term."

The conclusions of the panel were ultimately supported by the South Atlantic Board at its May 2017 meeting (ASMFC 2017f). The main cause of uncertainty in both the Spot and Atlantic Croaker assessments was the disagreement in harvest trends and abundance trends. Atlantic Croaker abundance, as indicated by fisheries independent surveys, indicates increasing abundance; whereas, harvest from directed commercial and recreational fisheries has generally been declining. This trend has also been observed in the annual TLA. Though the assessment did not pass peer review and will not be used for management, elements of the data, particularly commercial and recreational removals and dead discards from shrimp trawls, can still be informative. The following is a description of coastwide trends in removals from the 2017 assessment. From 1989–2014, total annual coastwide removals (landings and discards) ranged from 101,132 to 519,449 metric tons and have been relatively stable ranging from 125,00 to 225,000 metric tons since the peak in 1991 (ASMFC 2017d). The stability in removals coincides with initial BRD requirements for North Carolina shrimp trawl fisheries initiated in 1992. North Carolina's BRD requirement was adopted before the device became federally required in 1997 and 1998 (50 CFR 622). Coastwide discards in the shrimp trawl fishery ranged from 82,040 to 513,801 metric tons. Shrimp trawl discards account for most of the removals (ranging from 81–99%).

3.4 Weakfish

Weakfish are currently managed under Addendum IV to Amendment 4 of the ASMFC Weakfish FMP and requires all the Atlantic states to implement a one fish per person bag limit, a 100-pound commercial bycatch trip limit, and a 100-fish undersized trip limit allowance for the trawl fishery (ASMFC 2009b). The Weakfish Technical Committee (TC) noted that there is no long-term stable equilibrium population of Weakfish due to time varying natural mortality, so they recommended managing the stock based off *Z*-based (total mortality) targets and thresholds of 20% and 30% (ASMFC 2016a). Because the total mortality of the stock in the terminal year of the assessment (2014) was below the *Z* threshold, the TC recommended and the board approved no new management measures at this time.

Commercial landings of Weakfish peaked in 1980 at 20,343,952 pounds (Figure 3.7). Landings have since steadily dropped and reached their lowest point in 2011 (65,897 pounds; Table 3.7). Recent years have shown little increase, due to low abundance and commercial harvest restrictions. Total commercial landings for 2016 were 79,640 pounds. The ocean sink net fishery and estuarine gill net fishery dominate the catches of Weakfish, accounting for 93% of the overall commercial catch. The pound net fishery and the historically dominant long-haul seine fishery account for about 5% of the remaining commercial harvest with various gears including trawls, crab pots, and rod-n-reels making up the rest. Addendum IV to Amendment 4 to the Weakfish FMP reduced commercial harvest to 100 pounds per trip, achieving an estimated reduction of 61% from the 2005–2008 harvest levels (ASMFC 2009b).

Recreational harvest has been variable since 1989 with a peak in 1987 at 710,009 pounds (Figure 3.7). Harvest since 2009 has been considerably low due to the implementation of a one-fish bag limit in

November 2009 as part of the harvest reductions from Addendum IV, which was estimated to reduce recreational harvest by 53% for North Carolina (ASMFC 2009b). Average harvest since 2010 is 34,375 pounds and has varied from a high of 46,081 pounds in 2012 to a low of 17,621 pounds in 2011 (Table 3.7). Recreational harvest in 2016 was 34,860 pounds, near the time series average for the period of 2010–2016 (Table 3.7). A total of seven recreational citations were issued for Weakfish in 2016, 3.5 times higher than in 2015. Commercial and recreational trips for Weakfish have been declining over time even though recreational trips were high from 2004–2006 (Figure 3.8).

Minimum and average lengths of fish harvested in the commercial fishery have remained consistent over the last 10 years (Table 3.8). As with Atlantic Croaker, mean lengths of Weakfish sampled from the recreational fishery are larger than the average lengths from the commercial fishery (Table 3.8). Minimum and maximum lengths of Weakfish have varied over time with no trend.

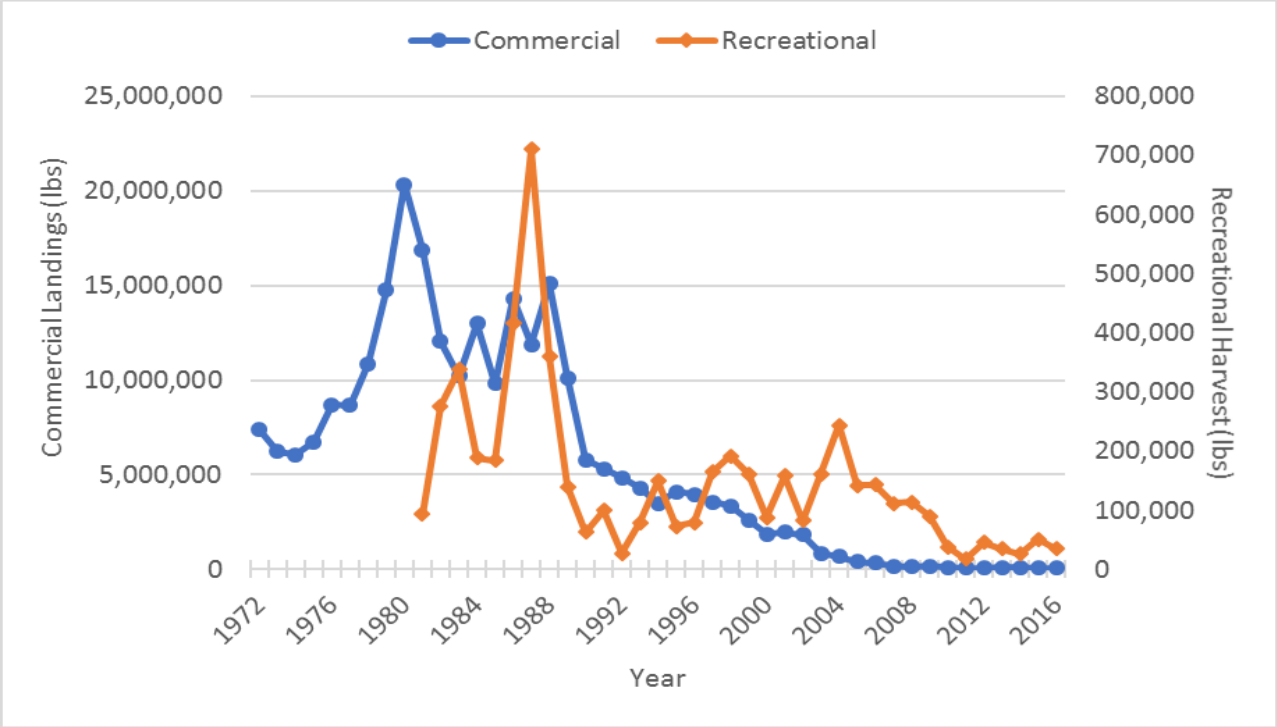

Figure 3.7. Annual commercial and recreational landings (pounds) of Atlantic Croaker in North Carolina, 1972–2016. (Source: NCTTP; MRIP)

Table 3.7. Recreational harvest (number of fish released and weight) and releases (number of fish) and commercial harvest (weight in pounds) of Weakfish from North Carolina, 2007–2016. (Source: NCTTP; MRIP)

	Commercial	Recreational					
		Number of fish				Weight (pounds)	
Year	Landings (pounds)	Released	PSE	Harvested	PSE	Harvested	PSE
2007	175,589	226,601	25.4	94,398	19.8	111,754	22.3
2008	162,516	195,776	28.4	108,389	24.5	114,192	27.4
2009	163,146	220,121	37.3	68,553	24.9	89,652	34.6
2010	106,328	225,246	27.3	41,598	15.0	38,721	15.4
2011	65,897	111,574	27.7	13,464	24.8	17,621	25.0
2012	91,383	173,843	18.5	40,299	17.4	46,081	22.6
2013	120,188	111,524	20.1	33,851	28.1	34,731	26.6
2014	105,115	281,335	21.4	26,308	17.6	25,957	17.7
2015	80,235	520,782	29.8	39,842	24.6	50,903	26.2
2016	79,640	423,482	33.7	33,585	21.9	34,860	21.0

The percent standard error (PSE) represents the standard error of the harvest estimate as a percentage.

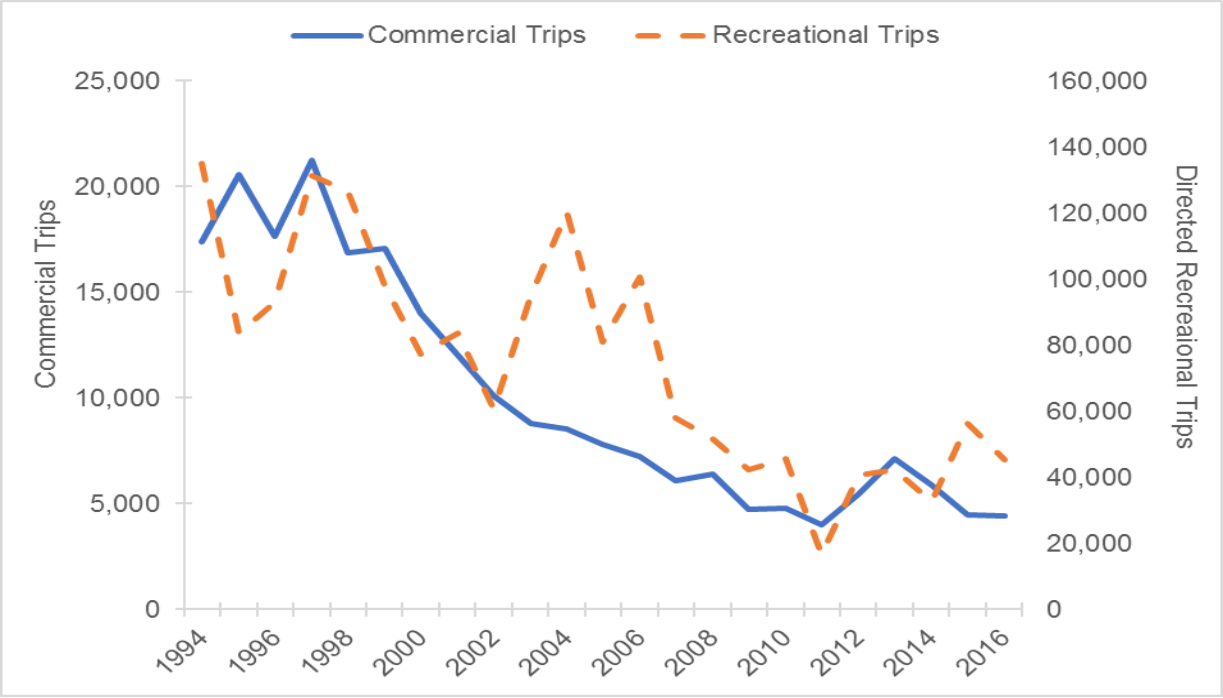

Figure 3.8. Number of trips reporting commercial landings of Weakfish and the number of directed recreational Weakfish trips, 1994–2016. (Source: NCTTP; MRIP) NOTE: Directed recreational trips are defined as trips where the angler specified Weakfish as the target of the trip or where Weakfish was harvested.

Table 3.8. Mean, minimum, and maximum lengths (total length, millimeters) of Weakfish sampled from the commercial and recreational fisheries of North Carolina, 2007–2016. (Source: NCDMF)

	Commercial				Recreational			
Year	Mean Length	Minimum Length	Maximum Length	Total Number Measured	Mean Length	Minimum Length	Maximum Length	Total Number Measured
2007	324	121	662	4,569	369	267	525	76
2008	322	127	668	3,185	355	297	519	145
2009	333	160	857	2,631	383	247	555	132
2010	322	130	880	2,074	345	235	440	96
2011	333	97	637	1,701	375	294	780	41
2012	350	127	591	2,623	367	259	529	81
2013	360	202	718	3,323	356	192	580	74
2014	358	127	620	3,322	352	277	515	71
2015	356	137	704	2,371	373	311	482	34
2016	359	220	600	2,588	353	261	457	76

Exhibit E of the Petition uses Weakfish as an example of a collapsed fishery due to overfishing and loss of spawning potential, but also states the scientific evidence to validate this point is lacking (NCWF 2016a). There is no doubt that fishing mortality contributed to the decline of Weakfish stocks in the Mid-Atlantic, but it remains unclear if the relative contribution of dead discards from the shrimp trawl fishery are affecting the recovery of the stock. The most recent ASMFC stock assessment reviewed numerous juvenile and adult abundance indices and noted that the stock-recruit relationship for Weakfish was weak because young-of-year indices did not show the same decline in abundance as the adult indices (ASMFC 2016a).

Exhibit B makes the argument for growth overfishing of Weakfish based on the truncated age structure seen in the recreational harvest of the species and implies that this is due to high mortality of age-0 and age-1 fish from bycatch in the shrimp trawl fishery (NCWF 2016a). The observed decline in harvest of fish age-1 and older in the recreational fishery is more likely due to increased natural mortality on these fish rather than failed recruitment to the fishery (ASMFC 2016b; Figure 3.9). The stock assessment noted that Weakfish recruitment trends throughout the Atlantic Coast did not show the same declining trend as adult abundance (ASMFC 2016a; Figures 3.10 and 3.11), suggesting that the observed decline in adults is not impacting, at least not substantially, recruitment of Weakfish; that is, the mortality on the age-0 fish (recruits) at current levels is independent of the adult stock size. The recent (2016) peer reviewed ASMFC assessment of the Weakfish stock concluded that the stock is depleted, but overfishing is not occurring (ASMFC 2016a). The stock has experienced some dramatic declines over the previous decades, largely attributed to overfishing and increasing natural mortality. The recent emergence of a Weakfish bottleneck at age 0 is thought to be largely due to enhanced predation by Striped Bass and Spiny Dogfish, rather than a surge in unreported landings and discards. However, empirical evidence for the increase in natural mortality due to predation is inconclusive and further work on this topic is needed.

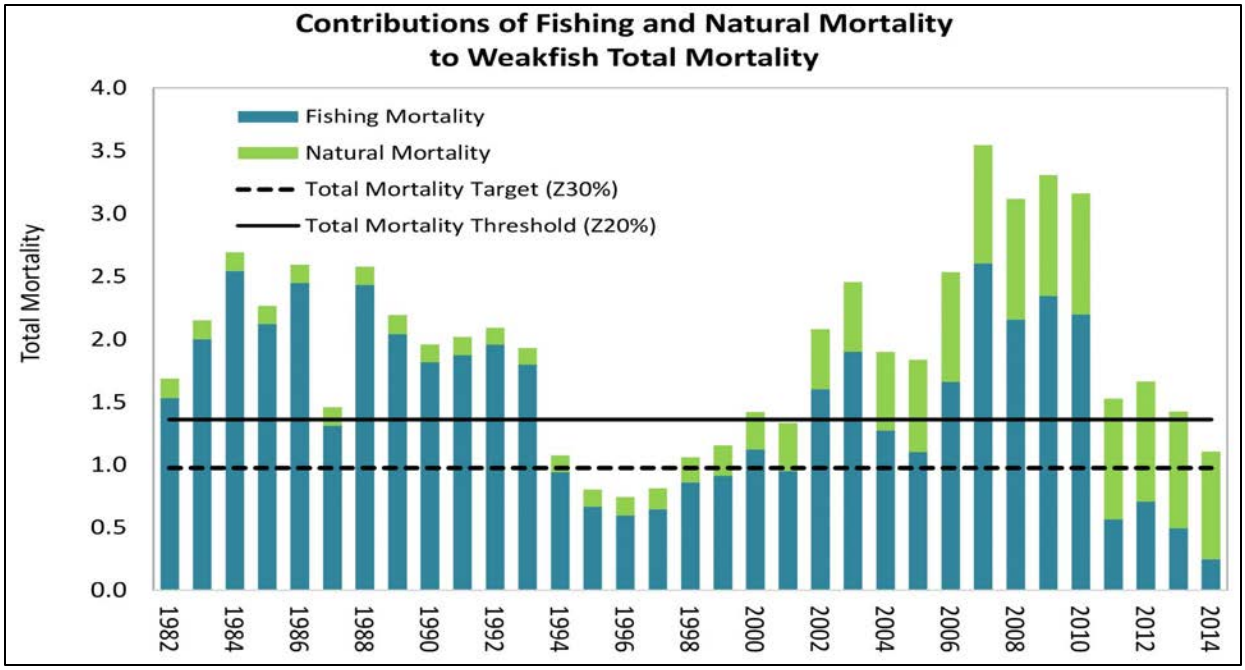

Figure 3.9. Fishing (F) and natural (M) mortality estimated from the 2016 Weakfish stock assessment, by year, 1982 – 2014. Total mortality (*Z*) overfishing target of 30% (dashed line) and threshold of 20% (solid line). (Source: ASMFC 2016b)

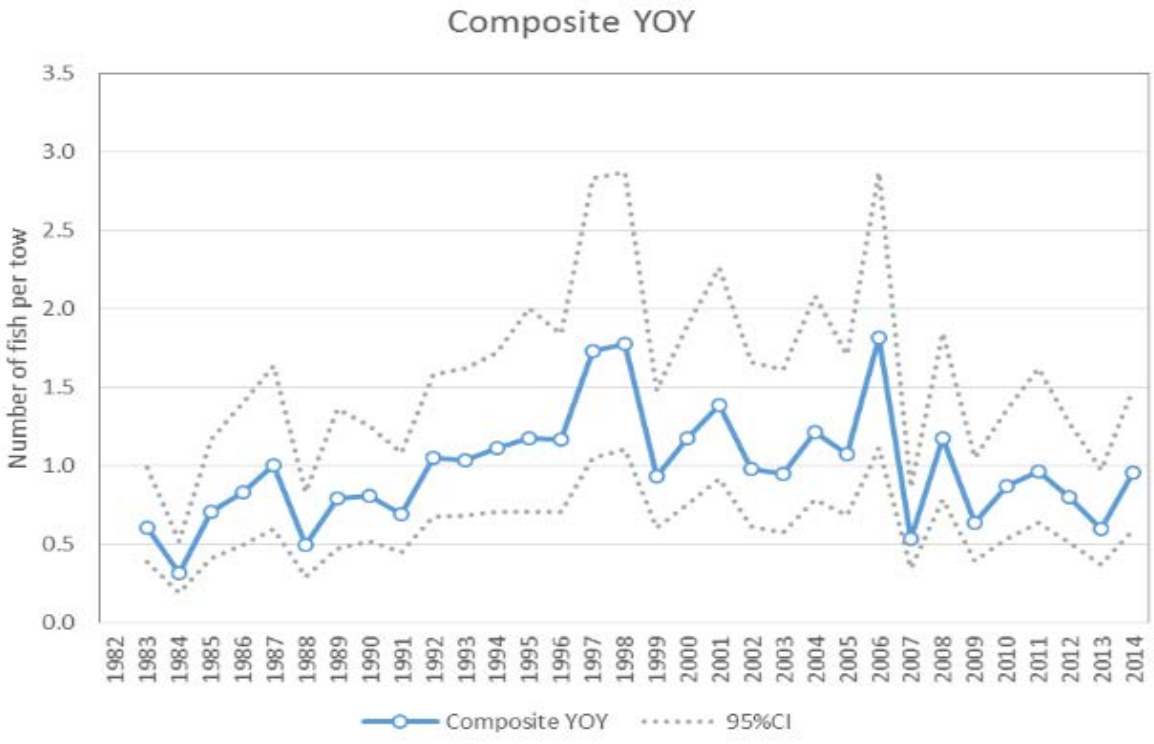

Figure 3.10. Composite of Atlantic States young-of-year index with 95% confidence intervals, 1993–2014. (Source: ASMFC 2016a)

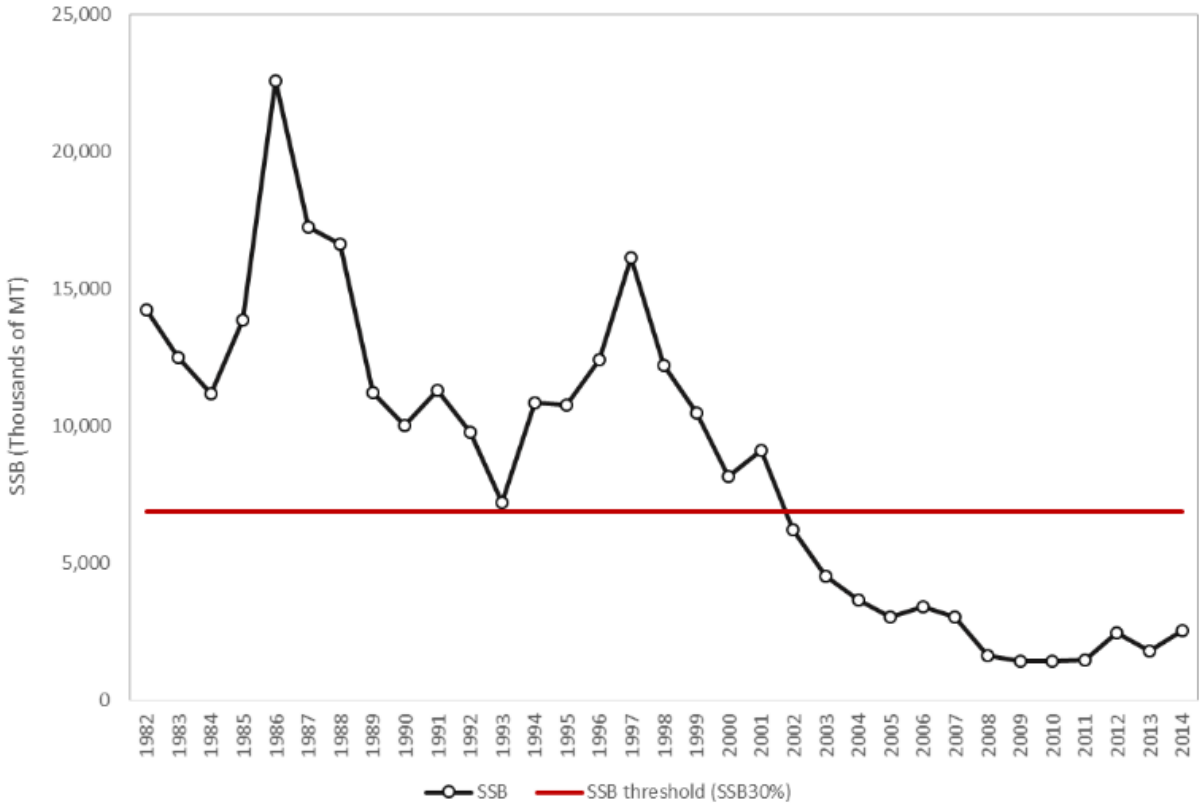

Figure 3.11. Spawning stock biomass (SSB) and the SSB threshold of 30% un-fished stock estimated from the 2016 Weakfish stock assessment. (Source: ASMFC 2016a)

3.5 Bycatch Management

NCDMF and NOAA Fisheries (formerly known as NMFS) have conducted bycatch reduction studies to develop methods and management options to reduce bycatch since the early 1980s. These studies have investigated the use of minimum tailbag mesh sizes, BRDs, and TEDs as a means of reducing finfish bycatch. See section 6.3.7 of the 2015 Shrimp FMP Amendment 1 for a full description of these studies as well as the various management strategies used to reduce bycatch in North Carolina (NCDMF 2015a). The below sections describe bycatch data available for shrimp, Spot, and Atlantic Croaker. The recent stock assessment for Weakfish did not evaluate the impact of bycatch on the resource (ASMFC 2016a).

3.5.1 Shrimp

In 1992, North Carolina became the first state to require a BRD in shrimp trawls and did so prior to implementation of federal BRD regulations. The 2015 N.C. Shrimp FMP Amendment 1 adopted the requirement of either a T-90 panel/square mesh tailbag or other applications of square mesh panels (e.g., skylight panel), reduced bar spacing in a TED, or another federal or state certified BRD, in addition to existing TED and BRD requirements in all skimmer and otter trawls. This was accomplished by

proclamation in 2015 (SH-2-2015) and implemented the requirement of a second BRD, but allows flexibility for fishermen to select from a wide variety of state and federally-certified BRDs appropriate for the fishing situation. This also made North Carolina the first state to require two BRDs in shrimp trawls. Based on characterization data and anecdotal reports from fishermen, most have selected the reduced bar spaced TED or a second fisheye. Based on anecdotal information from fishermen and NCDMF observations, this second BRD appears to be having noticeable positive effects on bycatch reduction (K. Brown, NCDMF, personal communication). However, other factors may be contributing to this reduction in bycatch, including higher concentrations of shrimp.

In 2011, the North Carolina General Assembly made several changes to the Administrative Procedure Act (G.S. 150B) via Session Law 2011-398, the Regulatory Reform Act of 2011. One of these changes was to add a new section entitled "Limitation on Certain Environmental Rules" (G.S. 150B-19.3). This statute prohibits an agency from adopting "a rule for the protection of the environment or natural resources that imposes a more restrictive standard, limitation, or requirement than those imposed by federal law or rule, if a federal law or rule pertaining to the same subject matter has been adopted" with only narrow exceptions provided. The MFC is specifically named in the statute as such an agency. In the Federal Code of Regulations, 50 CFR 622.207 specifically requires the use of a single BRD on a shrimp trawler in the South Atlantic Exclusive Economic Zone (3–200 miles from shore) for each net that is rigged for fishing, with only narrow exceptions provided. Currently, the requirement in North Carolina for fishermen to use a second BRD is implemented by existing proclamation authority via MFC rule 15A NCAC 03J .0104, Trawl Nets. The MFC was not required to adopt a rule to implement this management strategy from the Shrimp FMP Amendment 1. The addition of a second BRD in rule as a result of the Petitioned rules would not impact the current level of bycatch since this requirement has already been implemented by proclamation.

In 2015, in accordance with Amendment 1 to the Shrimp FMP, a Shrimp Bycatch Reduction Industry Work Group was convened, comprised of fishermen, net manufacturers, gear specialists, and scientists from NCDMF, NOAA Fisheries, and N.C. Sea Grant. The group was tasked to develop different gear configurations to reduce bycatch to the extent practicable, with a 40% target reduction. During 2015–2017, a series of gear comparisons were made using modified shrimp trawls in Pamlico Sound and the Atlantic Ocean to determine methods of reducing bycatch, while maintaining acceptable shrimp harvest (Brown et al. 2017, 2018). Twelve experimental otter trawl configurations were tested against a control net consisting of a federally-certified TED with 4-inch bar spacing, one state fisheye BRD, and a 1 ½-inch stretch mesh tail bag (current industry standard). Paired t-tests and a randomization test were used to determine whether the catches between the control and experimental nets were significantly different for each catch category (shrimp and bycatch species). The randomization test does not require the data to be normally distributed and does not require tows to be dropped from the analysis.

Four of the 12 gears tested met or exceeded the 40% target reduction in finfish bycatch while minimizing shrimp loss (Tables 3.9 and 3.10). Tows made with a 4-inch TED, double federal fisheyes, and 1 3/4-inch tailbag significantly reduced finfish bycatch from 54.0% (randomization test) to 57.2% (t-test) and had the greatest reduction in finfish bycatch of all the gear combinations tested by the work group. Tows made with a 3-inch TED, double federal fisheyes, and 1 3/4-inch tailbag gears yielded the second highest reduction of the gear combinations tested, reducing finfish bycatch by 44.9% (t-test and randomization test). Finfish bycatch reductions were slightly lower in the fall for the gear combination of one state fisheye, the Virgil Potter BRD, and 1 3/4-inch tailbag. Finfish bycatch reductions ranged from 43.2% (t-test) to 44.3% (randomization test). T-test results indicated the mean weight of shrimp was significantly reduced by 5.5% for this gear combination. The double federal fisheye, 4-inch TED and 1 7/8-inch tailbag gear combination was found to significantly reduce finfish bycatch by 40.8% based on the t-test results. Randomization test results also found that finfish bycatch was reduced by 40.6% for this gear. It is important to note the reductions in bycatch achieved by the industry work group testing are in addition to

the 30% reduction in finfish mandated by the federal BRD certification process; therefore, gear combinations that met the MFC's 40% finfish bycatch reduction target achieved nearly twice the federal requirement for reducing bycatch. For a detailed description of the sampling methodology, gear parameters, and full data analysis, see Brown et al. (2017, 2018).

At its May 2018 business meeting, the MFC voted to require fishermen to use one of four gear combinations tested by the workgroup that achieved at least 40% finfish bycatch. The new gear configurations will be required in all shrimp trawls, except skimmer trawls, used in inside waters where greater than 90-foot headrope length is allowed (Pamlico Sound and portions of Core Sound, Pamlico River and Neuse River) and will be effective July 1, 2019. The commission also voted to continue the shrimp industry workgroup and explore funding options for more studies, to survey fishermen to determine what bycatch reduction devices the shrimp trawl industry currently uses, and to begin development of Amendment 2 to the Shrimp Fishery Management Plan. The information paper titled "Shrimp Fishery Management Plan (FMP) Amendment 1: Consideration of Gear Modifications to Reduce Bycatch in the North Carolina Shrimp Trawl Fishery" will serve as a Revision to Amendment 1 to the North Carolina Shrimp Fishery Management Plan and will document the management strategy changes and rationale. All other management strategies contained in Amendment 1 will remain in place until another Revision, Supplement, or Amendment to the N.C. Shrimp FMP is adopted.

The amount of finfish bycatch reduced from these new required gear configurations represents all finfish species and may not have equal effects on the species addressed by the Petition. The regulations to be implemented in July 2019 will reduce bycatch independently from the proposed rules and may affect the baseline landings and harvest numbers of shrimp as well as those species that are typically caught as bycatch such as Atlantic Croaker, Spot, and Weakfish. The extent of the effect will be dependent upon compliance to the new regulations and the difference between an individual fisherman's current gear and the new gear requirements.

Table 3.9. Results from the paired t-test of the four experimental gears tested that met or exceeded the MFC 40% target reduction in finfish bycatch. Mean weight of catch data reported in kg. Values in bold indicate significant p-values (alpha = 0.05). (Source: Brown et al. 2017, 2018)

Season / Waterbody	Vessel size (ft)	Gear	Tailbag (in)	TED (in)	Species group	N	Control Mean	Exp. Mean	T-test % Change	T-test p-value
Summer / Pamlico Sd.	88	Double federal fisheye	1 7/8	4	Finfish	25	90.0	53.3	-40.8	< **0.001**
					Shrimp	25	61.3	61.9	1.0	0.778
Summer / Pamlico Sd.	75	Double federal fisheye	1 3/4	4	Finfish	6	201.5	86.3	-57.2	**0.001**
					Shrimp	6	23.0	20.2	-12.1	0.215
					Invert.	6	7.2	6.1	-15.7	0.081
					Shark	6	1.8	2.6	45.8	0.509
Summer / Pamlico Sd.	75	Double federal fisheye	1 3/4	3	Finfish	30	115.4	63.6	-44.9	< **0.001**
					Shrimp	30	27.0	25.7	-4.9	0.435
					Invert.	30	2.1	1.8	-13.3	0.418
					Shark	27	1.8	1.4	-18.6	0.404
Fall / Pamlico Sd.	68	Single state fisheye, Virgil Potter BRD	1 3/4	4	Finfish	20	189.0	107	-43.2	< **0.001**
					Shrimp	20	33.1	31.3	-5.5	0.055
					Invert.	25	0.0	0.0	n/a	n/a
					Shark	25	0.0	0.1	n/a	n/a

*See Brown et al. (2017, 2018) for the results of gear combinations that did not meet the target reduction.

Table 3.10. Results from the randomization test of the four experimental gears tested that met or exceeded the MFC 40% target reduction in finfish bycatch. Mean weight of catch data reported in kg. Values in bold indicate significant p-values (alpha = 0.05). (Source: Brown et al. 2017, 2018)

Season / Waterbody	Vessel size (ft)	Gear	Tailbag (in)	TED (in)	Species group	N	Control Mean	Exp. Mean	T-test % Change	T-test p-value
Summer / Pamlico Sd.	88	Double federal fisheye	1 7/8	4	Finfish	32	88.3	52.9	-40.1	< **0.001**
					Shrimp	32	60.6	61.9	2.2	0.862
Summer / Pamlico Sd.	75	Double federal fisheye	1 3/4	4	Finfish	23	164.5	75.6	-54	< **0.001**
					Shrimp	23	28.1	23.6	-16.2	0.28
					Invert.	23	5.4	5.1	-4.9	0.833
					Shark	23	2.1	2.5	18.8	0.573
Summer / Pamlico Sd.	75	Double federal fisheye	1 3/4	3	Finfish	30	115.4	63.6	-44.9	**0.007**
					Shrimp	30	27.0	25.7	-4.9	0.706
					Invert.	30	2.1	1.8	-13.3	0.601
					Shark	30	1.6	1.3	-18.6	0.568
Fall / Pamlico Sd.	68	Single state fisheye, Virgil Potter BRD	1 3/4	4	Finfish	25	172.3	96.1	-44.3	**0.001**
					Shrimp	25	31.3	29.5	-5.8	0.691
					Invert.	25	0.0	0.0	n/a	n/a
					Shark	25	0.0	0.0	n/a	n/a

*See Brown et al. (2017, 2018) for the results of gear combinations that did not meet the target reduction.

3.5.2 Spot

In North Carolina, Spot discards from shrimp trawls ranged from 945 million fish in 1991 to 6.1 million fish in 1997 (Figure 3.12; J. Kipp, ASMFC, personal communication). Discards have declined significantly since 1991 (both inshore and offshore), with a few small peaks throughout the time period and a slight increasing trend since 2012 (Figure 3.12). Generally, shrimp trawl effort in North Carolina has been declining since at least the mid-1990s (ASMFC 2017a). Methods to estimate discards of Spot from the South Atlantic shrimp trawl fishery were similar to those used by Walter and Isley (2014) in a peer approved SEDAR for estimating King Mackerel bycatch in the shrimp trawl fishery (J. Kipp, ASMFC, personal communication).

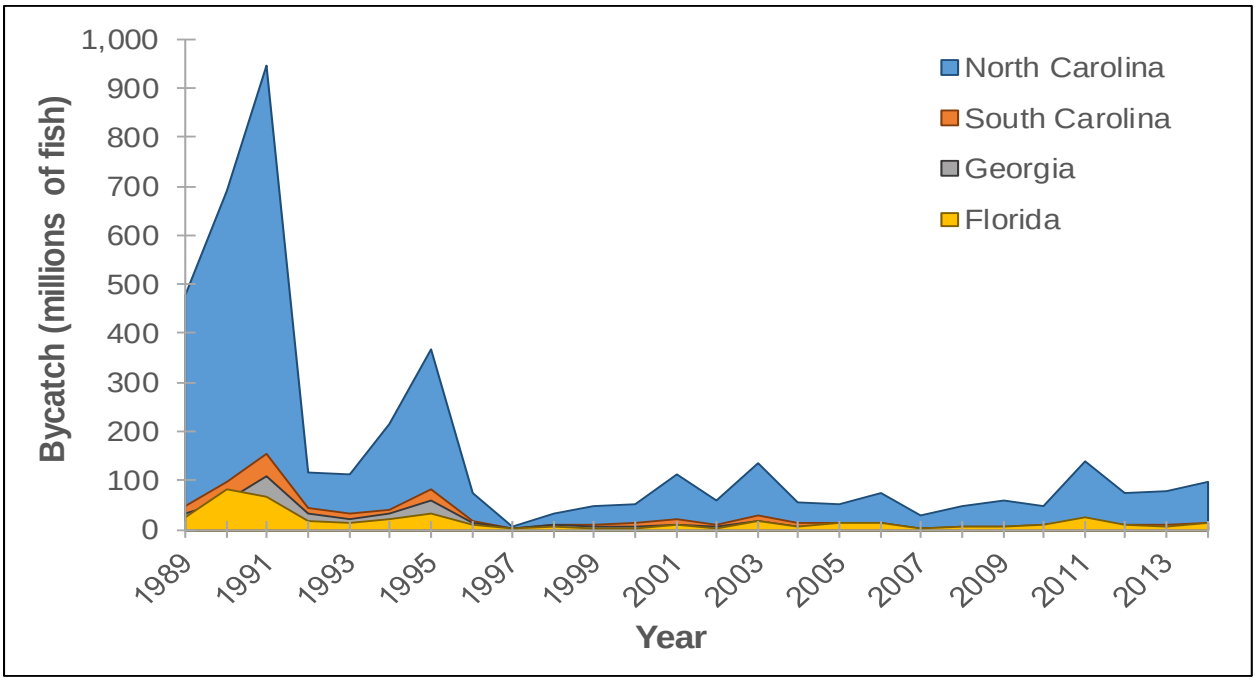

Figure 3.12. Annual estimates of Spot bycatch in the south Atlantic shrimp trawl fishery by state, 1989–2014. (Source: J. Kipp, ASMFC, personal communication)

3.5.3 Atlantic Croaker

In North Carolina, Atlantic Croaker discards from shrimp trawls ranged from 2.8 billion fish in 1991 to 195 million fish in 2005 (Figure 3.13; J. Kipp, ASMFC, personal communication). Discards have declined significantly since 1991 (both inshore and offshore), but have increased slightly since 2009 (Figure 3.13; ASMFC 2017d). Generally, shrimp trawl effort in North Carolina has been declining since at least the mid-1990s (NCDMF 2015a). Methods to estimate discards of Atlantic Croaker from the South Atlantic shrimp trawl fishery were similar to those used by Walter and Isley (2014) in a peer approved SEDAR for estimating King Mackerel bycatch in the shrimp trawl fishery (J. Kipp, ASMFC, personal communication).

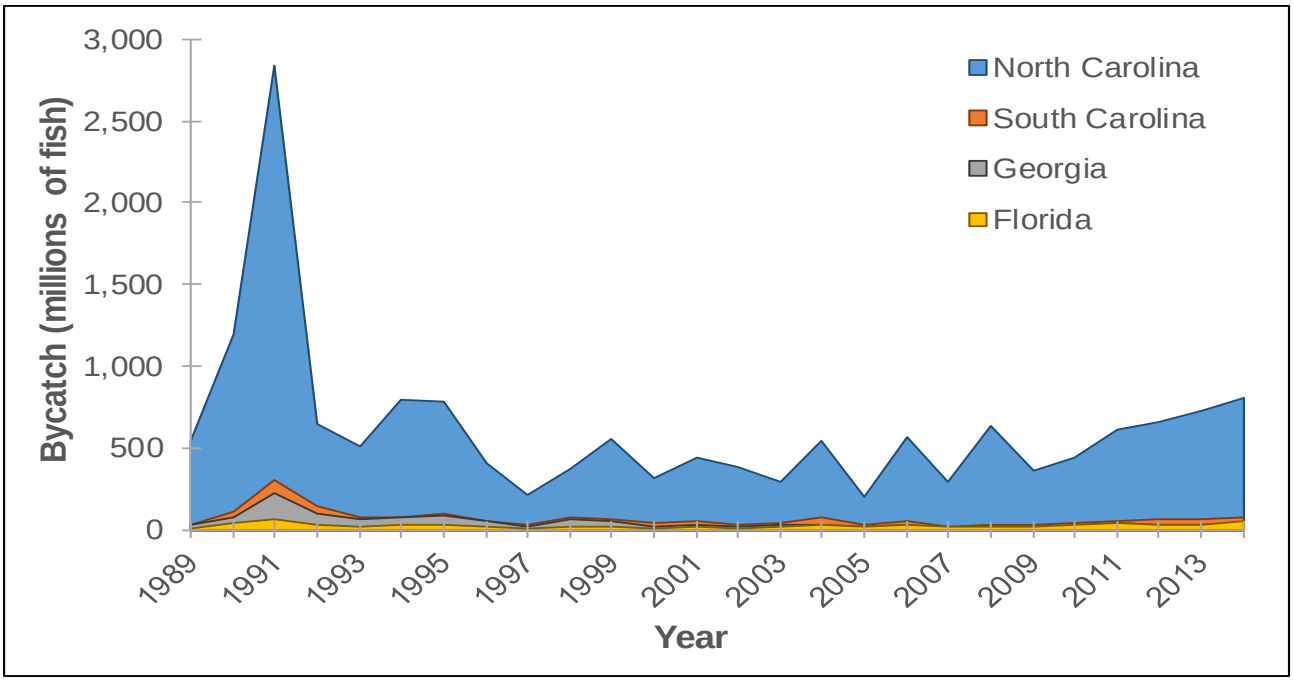

Figure 3.13. Annual estimates of Atlantic Croaker bycatch in the south Atlantic shrimp trawl fishery by state, 1989–2014. (Source: J. Kipp, ASMFC, personal communication)

3.6 Commercial Value

The U.S. exports the majority of its domestic catch, and then imports seafood to satisfy domestic demand. Stronger demand and more restricted supply make prices from exporting more profitable for U.S. fishing operators than selling domestic products (Newsome 2014). U.S. exports of edible fishery products of domestic origin in 2015 were 1,378,364 tons valued at $5.2 billion, a decrease of 113,114 tons (7.6%) and $134.9 million (2.5%) from 2014 (NOAA 2015). The volume of shrimp imported in 2015 was 585,826 tons, an increase of 18,153 tons (3.2%), from the quantity imported in 2014. Shrimp imports were valued at $5.4 billion, a decrease of $1.2 billion (18.6%) from 2014. Shrimp imports accounted for 29% of the value of total edible imports.

In 2013, the North Carolina Rural Economic Development Center conducted interview surveys of North Carolina fishermen and fish house operators (NCREDC 2013). They found that one of the main underlying issues in the supply chain is that many independent fish houses only have ice and refrigeration units for freshly caught seafood. They note that the shelf life of unfrozen seafood is generally less than a week, based on certain post-harvest handling practices. Product must be moved quickly into distribution before it spoils, and this results in fishermen and fish house owners carrying exclusively North Carolina seafood to sell even when demand is low and supplies are high.

One way to look at the effect a business, industry, or event has on a specified area is through economic impact modeling. Typically, an economic impact model examines the effect of an event on the economy through measuring changes in business revenue, business profits, personal wages, and jobs. The total industry output is the compilation of direct impacts, indirect impacts, and induced impacts generated in the economy as a result of the industry. Direct impacts include all direct effects the organization has on the region due to the organization’s production operations. These include direct employment, business

spending, and employee spending. Indirect impacts include the impact of local industries buying goods and services from other local industries. This spending from indirect impacts works its way backward through the supply chain until all the money is spent outside of the local economy. The induced impact is the response by an economy to an initial change (direct and indirect) that occurs through re-spending of income received by a component of the value-added impacts. In other words, higher incomes from direct and indirect effects induce further spending back into the local economy. "Sales refer to the gross value of all sales by regional businesses affected by an activity, such as commercial fishing. It includes both the direct sales of fish landed and sales made between businesses and households resulting from the original sale. Income includes personal income (wages and salaries) and proprietors' income (income from self-employment). Value-added is the contribution made to the gross domestic product in a region. Employment is specified on the basis of full-time and part-time jobs supported directly or indirectly by the sales of seafood or purchases of other goods and services related to commercial fishing. The first three types of measures are calculated in terms of dollars, whereas employment impacts are measured in terms of numbers of jobs. The United States seafood industry is defined here as the commercial fishing sector, seafood processors and dealers, importers, and seafood retailers" (NOAA 2017b).

The economic impact estimates presented below represent those of commercial seafood harvesters, dealers, wholesalers, and retailers in North Carolina and are calculated via the NCDMF commercial fishing economic impact model as updated in July 2017. These estimates are a product of IMPLAN economic impact modeling software customized with data from NCDMF and economic multipliers originating from the NOAA Fisheries Commercial Fishing and Seafood Industry Input/Output Model (NOAA 2015; IMPLAN 2013). Commercial landings data from the NCTTP are used as the primary input, as well as data from North Carolina commercial fishermen and seafood dealers collected through surveys that have been carried out by the NCDMF Fisheries Economics Program (Crosson 2007a, 2007b, 2009, 2010a; Hadley and Crosson 2010; Hadley and Wiegand 2014, Stemle and Wiegand 2017). Economic impact estimates for the commercial harvesting and seafood dealer sectors are derived from NCDMF data, while estimates for seafood wholesalers and retailers originate from multipliers found within the NOAA Fisheries model.

Total economic impact from commercial fishing has been on the rise in the past few years, although appears to be leveling off (Table 3.11; Figure 3.14). Income impacts have also been increasing in a similar trend to total economic impacts. While commercial participants have been declining as overall ex-vessel values rise, the number of job impacts has been increasing since a decline in 2011 (Table 3.11). Overall, North Carolina's percent contribution to the total economic impact of commercial fishing in the U.S. is relatively small. The economic impacts from commercial harvesters, seafood processors and dealers, importers, wholesalers and distributers, and retail contribute to less than 2% to the total jobs, sales, income, and value added to the entire U.S. (Table 3.12; NOAA 2015). The U.S. relies heavily on imported seafood to meet consumption demands. When imports are removed from the economic impacts, total jobs decrease by 70%, sales decrease by 178%, income is reduced by 109%, and total value added is reduced by 125%. North Carolina shows similar dependence on imported seafood when imports are removed from the economic impacts. Jobs are decreased by 71%, sales by 210%, income by 109%, and value added by 135% (Table 3.12).

Table 3.11. Economic Impacts of commercial fishing in North Carolina, all species. (Source: NCDMF Economics Program)

				Economic Impacts		
Year	Commercial Participants[1]	Pounds[1]	Ex-Vessel Value[1]	Jobs[2,3]	Income Impacts (thousands of dollars)[3]	Total Economic Impacts (thousands of dollars)[3,4]
2007	3,742	68,847,979	$82,284,625	7,508	$133,211	$320,728
2008	3,665	71,200,227	$86,809,853	7,597	$140,417	$338,662
2009	3,757	68,963,523	$77,196,361	7,022	$122,757	$297,558
2010	3,598	72,001,861	$79,865,263	7,094	$127,316	$307,322
2011	3,244	67,502,014	$71,184,083	6,373	$114,216	$275,867
2012	3,170	56,690,935	$72,571,121	6,405	$116,154	$281,369
2013	3,152	50,197,517	$79,105,058	6,795	$127,136	$303,982
2014	3,173	61,965,232	$94,105,047	7,360	$147,190	$351,513
2015	3,134	65,954,924	$94,284,106	7,728	$163,153	$389,173
2016	2,973	59,939,039	$94,049,856	7,410	$166,066	$388,325

[1]As reported by the NCDMF Trip Ticket Program
[2]Represents both full-time and part-time jobs
[3]Economic impacts calculated using the NCDMF commercial fishing economic impact model and IMPLAN economic impact modeling software. Economic impact estimates are for the state economy of North Carolina
[4]Represents sales impacts

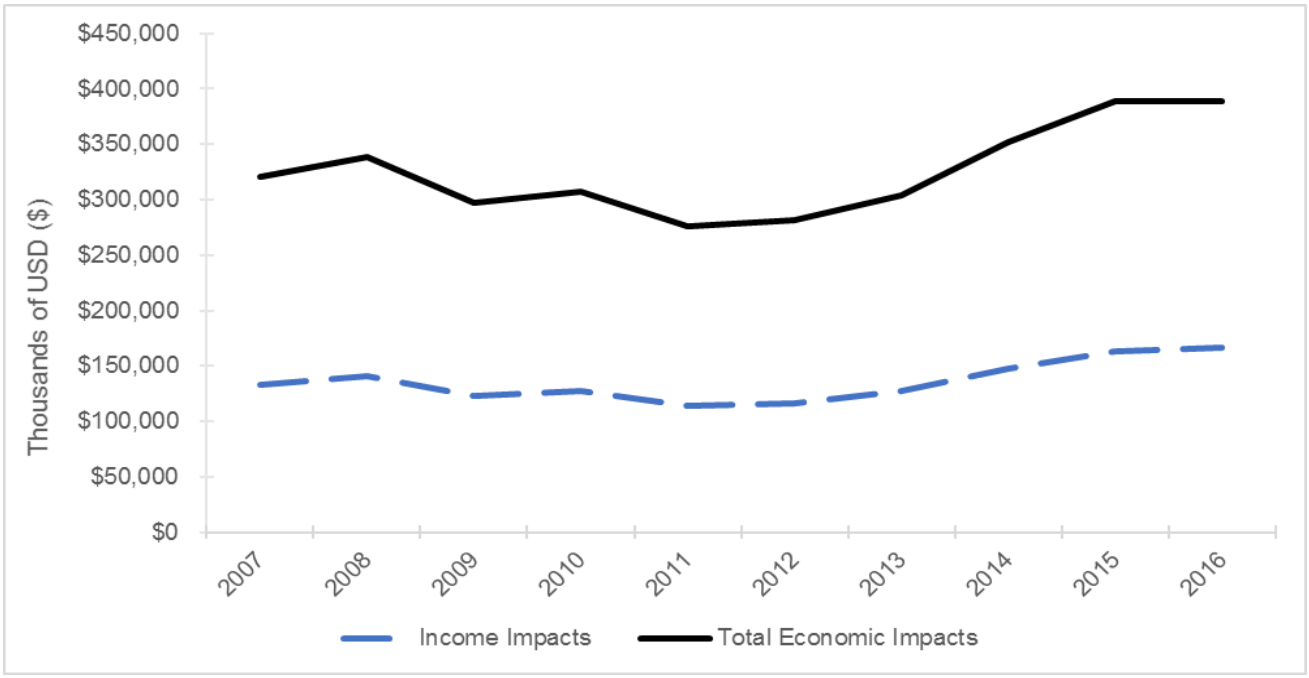

Figure 3.14. Total economic impact and income impacts of commercial fishing in North Carolina, 2007–2016. (Source: NCDMF Economics Program)

Table 3.12. Economic impacts of the commercial seafood industry (thousands of dollars) for the United States and North Carolina, 2015. (Source: NOAA 2017b).

	With Imports				No Imports			
All of U.S.	# Jobs	Sales	Income	Value Added	# Jobs	Sales	Income	Value Added
Total Impacts	1,179,848	144,194,119	39,743,521	60,565,501	695,794	51,905,330	18,997,595	26,958,135
Commercial Harvesters	164,047	13,894,494	4,617,433	7,190,601	164,047	13,894,494	4,617,433	7,190,601
Seafood Processors & Dealers	200,919	30,922,511	9,758,943	13,566,022	52,972	8,152,699	2,572,939	3,576,672
Importers	188,385	58,271,127	9,339,060	17,763,591	0	0	0	0
Seafood Wholesalers and Dist.	53,548	8,166,237	2,683,482	3,839,697	24,666	3,761,719	1,236,127	1,768,729
Retail	572,949	32,939,750	13,344,602	18,205,590	454,109	26,096,417	10,571,096	14,422,133

	With Imports				No Imports			
North Carolina	# Jobs	Sales	Income	Value Added	# Jobs	Sales	Income	Value Added
Total Impacts	10,439	1,026,699	286,269	427,301	6,120	331,175	137,194	181,715
Commercial Harvesters	2,586	160,383	65,212	88,618	2,586	160,383	65,212	88,618
Seafood Processors & Dealers	1,214	90,790	35,300	45,615	484	36,215	14,081	18,195
Importers	1,739	537,913	86,211	163,979	0	0	0	0
Seafood Wholesalers and Dist.	499	60,283	21,142	27,906	145	17,522	6,145	8,111
Retail	4,401	177,330	78,405	101,184	2,905	117,055	51,756	66,791

Note that these categories are not additive. Numbers are presented in thousands of dollars.

Shrimp are the second most valuable commercial fishery in North Carolina, typically making up 16% to 22% of the overall commercial landings value (Table 3.13). On average, the contribution of the shrimp fishery (i.e., shrimp landed in shrimp trawls or skimmer trawls) to the total commercial landings in North Carolina increases by 1% every five years, even though total shrimp landings have remained fairly constant over the last 36 years (Table 3.13; Figure 3.15–3.16). Currently, shrimp is the second most landed species by volume in North Carolina. Landings of shrimp from shrimp trawls and skimmer trawls in estuarine and state ocean waters (areas affected by the Petitioned rules) make up about 98% of the total shrimp landings for North Carolina. Landings of shrimp fluctuate from year to year due to a variety of environmental factors (Figure 3.17). Shrimp ex-vessel values have decreased since the 1990s, but shrimp price does not follow a typical supply-price relationship. There are years when shrimp landings are high and price remains high, as well as years of low landings while price remains steady from year to year (Figure 3.17). This could be due to the fact that domestic shrimp face market competition with foreign shrimp that are imported in high volumes at low prices. The U.S. does have anti-dumping measures in place on foreign shrimp, but imported shrimp continue to be regarded as one of the largest challenges to the U.S. shrimping industry (Crosson 2010b; Newsome 2014).

Compared to shrimp, the commercial fishery for Spot in North Carolina accounts for only 1.5% of the total commercial pounds landed and 1% of the total value of the commercial industry (Table 3.13). In recent years, the value of Spot as a percentage of the entire commercial sector has dropped to less than 1%. Spot landings have been dropping on average around 700,000 pounds every five years and the

fishery's overall value is declining on average by $75,000 every five years (Table 3.13; Figures 3.15 and 3.16). Spot landings have been declining dramatically since 2006, but ex-vessel price have been rising during the same period (Figure 3.18). When supply is restricted, there is typically an increase in overall price.

Atlantic Croaker is one of the most landed commercial species in North Carolina. On average, it has been the fourth largest fishery in terms of total landings from 1978–2015 and eighth in total value to the industry. Croaker landings have been near or even greater than shrimp landings in some years; however, since 2007, there has been a sharp decline in overall landings. Atlantic Croaker made up a large proportion of the landings between 2003 and 2012, but in recent years has dropped to levels typical of the 1980s and 1990s (Table 3.13; Figure 3.15). ASMFC has reported that landings of Atlantic Croaker typically exhibit a cyclical pattern in abundance that could explain the flux in North Carolina landings (ASMFC 2017c). In recent years, 2013–2015, Atlantic Croaker has been fifth in total pounds landed and 13th in total ex-vessel value. On average, the Atlantic Croaker industry's contribution to the total landings declines by less than 1% every five years, while the value of the fishery has been declining on average about 1% every five years (Table 3.13; Figures 3.15 and 3.16). Like Spot, ex-vessel price for Atlantic Croaker has been increasing as a result of reduced supply (Figure 3.19).

In the late 1970s and 1980s, Weakfish were landed in quantities similar to Atlantic Croaker and shrimp (Table 3.13; Figure 3.15). However, in recent years, landings of Weakfish have declined drastically, now only representing less than half a percent of the total commercial landings and value of North Carolina. As such, ex-vessel price has sharply increased from less than $1.00 a pound to an all-time recent high of $1.52 per pound (Figure 3.20).

The current decline in landings of Spot, Atlantic Croaker, and Weakfish since 2012 and the rising ex-vessel price indicates that the demand for these species has not diminished despite the recent supply constraints (Figures 3.18–3.20).

Table 3.13. Average landings and nominal ex-vessel value of Atlantic Croaker, shrimp, Spot, and Weakfish compared to total North Carolina landings by five-year period, 1978–2016. (Source: NCTTP)

	Species	Avg. Landings	Avg. Value	% of Total Commercial Landings	% of Total Commercial Value	Avg. $/Lb.
2013–2016	Croaker, Atlantic	2,117,262	$1,849,858	3.56%	2.07%	$0.87
	Shrimp	7,958,314	$17,604,567	13.37%	19.68%	$2.21
	Spot	536,961	$498,717	0.90%	0.56%	$0.93
	Weakfish	76,417	$99,583	0.13%	0.11%	$1.30
2008–2012	Croaker, Atlantic	5,480,033	$2,970,980	8.15%	3.83%	$0.54
	Shrimp	6,411,860	$12,533,156	9.53%	16.17%	$1.95
	Spot	748,389	$526,914	1.11%	0.68%	$0.70
	Weakfish	117,854	$120,206	0.18%	0.16%	$1.02
2003–2007	Croaker, Atlantic	11,198,641	$3,227,401	11.55%	4.20%	$0.29
	Shrimp	5,735,916	$10,371,565	5.92%	13.50%	$1.81
	Spot	1,663,773	$898,813	1.72%	1.17%	$0.54
	Weakfish	498,946	$367,752	0.51%	0.48%	$0.74
1998–2002	Croaker, Atlantic	10,676,122	$3,174,007	6.80%	3.23%	$0.30
	Shrimp	7,839,513	$17,726,260	4.99%	18.02%	$2.26
	Spot	2,553,375	$1,077,145	1.63%	1.09%	$0.42
	Weakfish	2,325,821	$1,253,518	1.48%	1.27%	$0.54
1993–1997	Croaker, Atlantic	6,915,638	$2,440,672	3.61%	2.54%	$0.35
	Shrimp	6,996,290	$16,893,732	3.65%	17.61%	$2.41
	Spot	2,706,849	$936,678	1.41%	0.98%	$0.35
	Weakfish	3,890,226	$2,099,681	2.03%	2.19%	$0.54
1988–1992	Croaker, Atlantic	5,452,317	$2,482,277	3.03%	3.57%	$0.46
	Shrimp	8,212,408	$15,476,592	4.56%	22.29%	$1.88
	Spot	3,132,727	$724,288	1.74%	1.04%	$0.23
	Weakfish	8,236,196	$3,516,865	4.58%	5.06%	$0.43
1983–1987	Croaker, Atlantic	8,369,781	$2,972,103	3.78%	4.82%	$0.36
	Shrimp	6,675,076	$13,444,848	3.02%	21.81%	$2.01
	Spot	3,327,658	$758,937	1.50%	1.23%	$0.23
	Weakfish	11,848,339	$4,183,519	5.36%	6.79%	$0.35
1978–1982	Croaker, Atlantic	16,736,151	$4,054,060	4.68%	7.01%	$0.24
	Shrimp	5,462,016	$10,500,886	1.53%	18.16%	$1.92
	Spot	5,542,446	$1,090,899	1.55%	1.89%	$0.20
	Weakfish	14,979,648	$3,863,241	4.19%	6.68%	$0.26

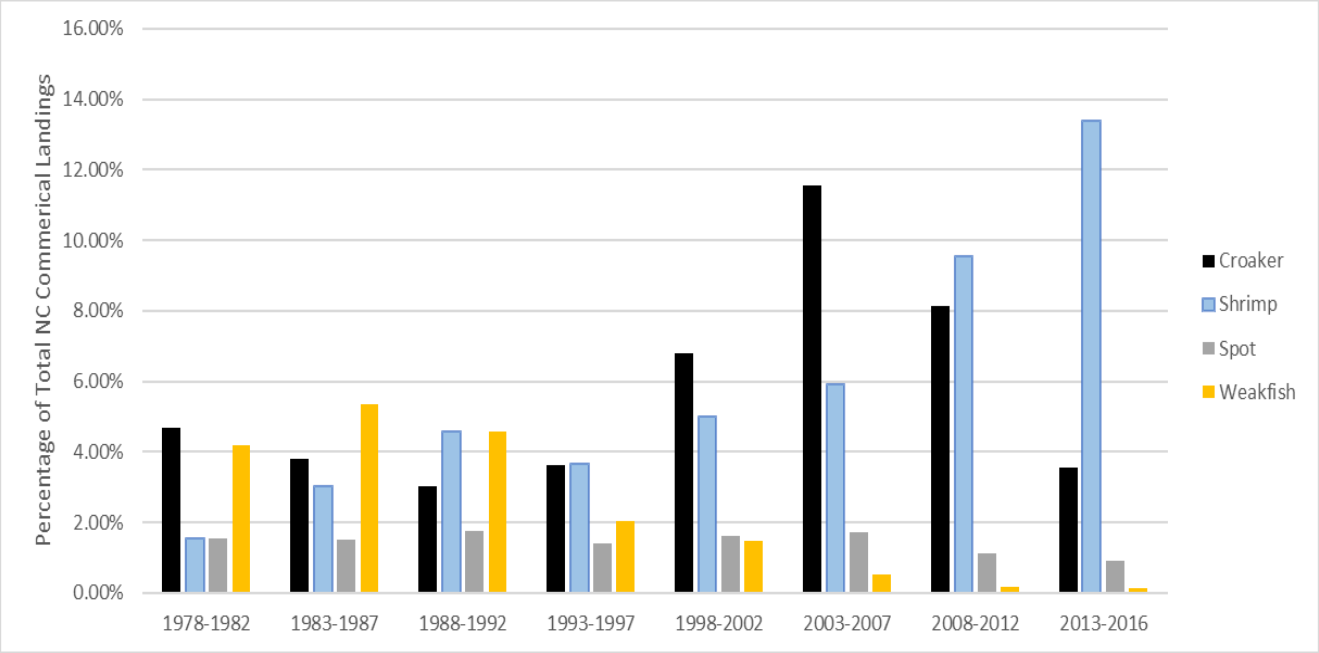

Figure 3.15. Percentage of North Carolina's total commercial landings by species and five-year period for Atlantic Croaker, shrimp, Spot, and Weakfish, 1978–2016. (Source: NCTTP)

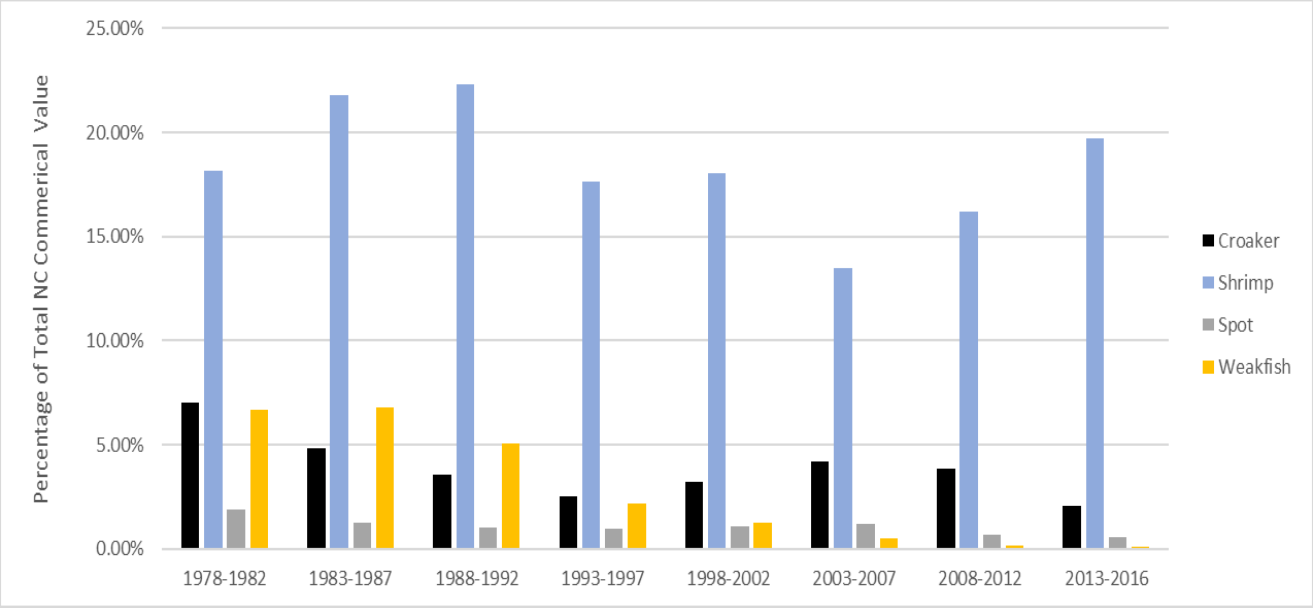

Figure 3.16. Percentage of North Carolina's total commercial ex-vessel value by species and five-year period for Atlantic Croaker, shrimp, Spot, and Weakfish, 1978–2016. (Source: NCTTP)

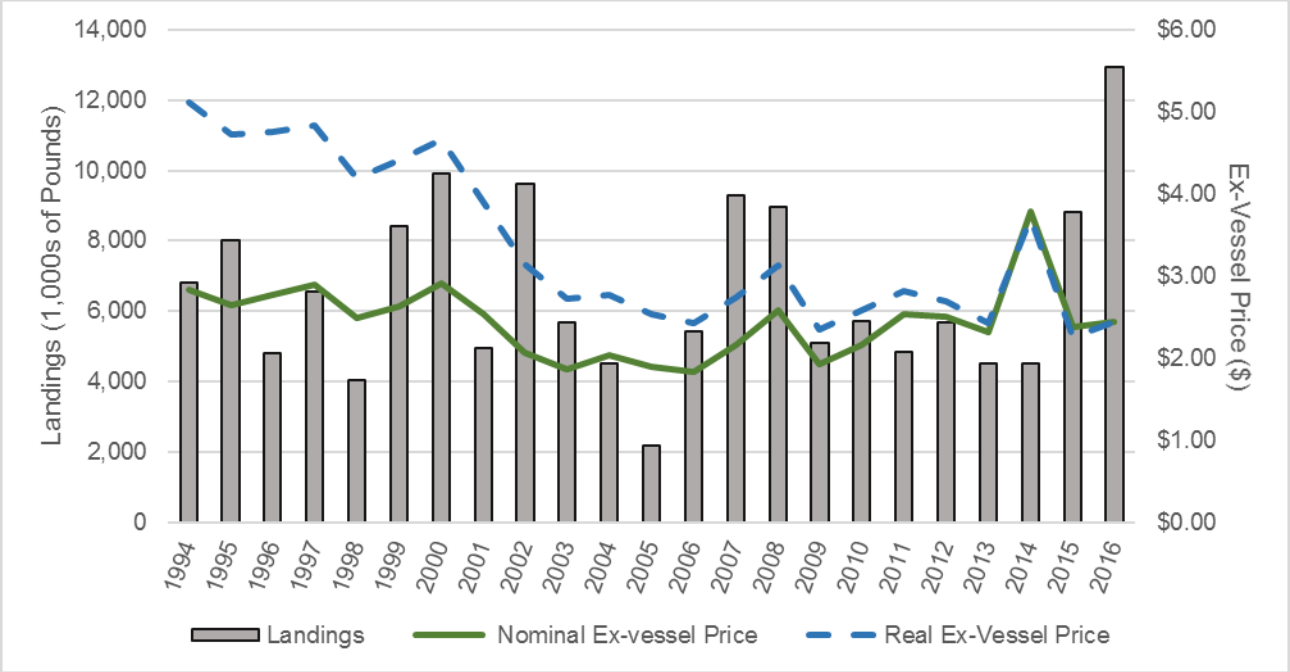

Figure 3.17. Commercial landings and ex-vessel prices (real and nominal) of shrimp in estuarine and state ocean waters for North Carolina from shrimp and skimmer trawls, 1994–2016. (Source: NCTTP; Bureau of Labor Statistics 2017) NOTE: Nominal prices represent the original price in its current year and real price refers to those which have been adjusted for inflation and are represented in 2016 dollar values.

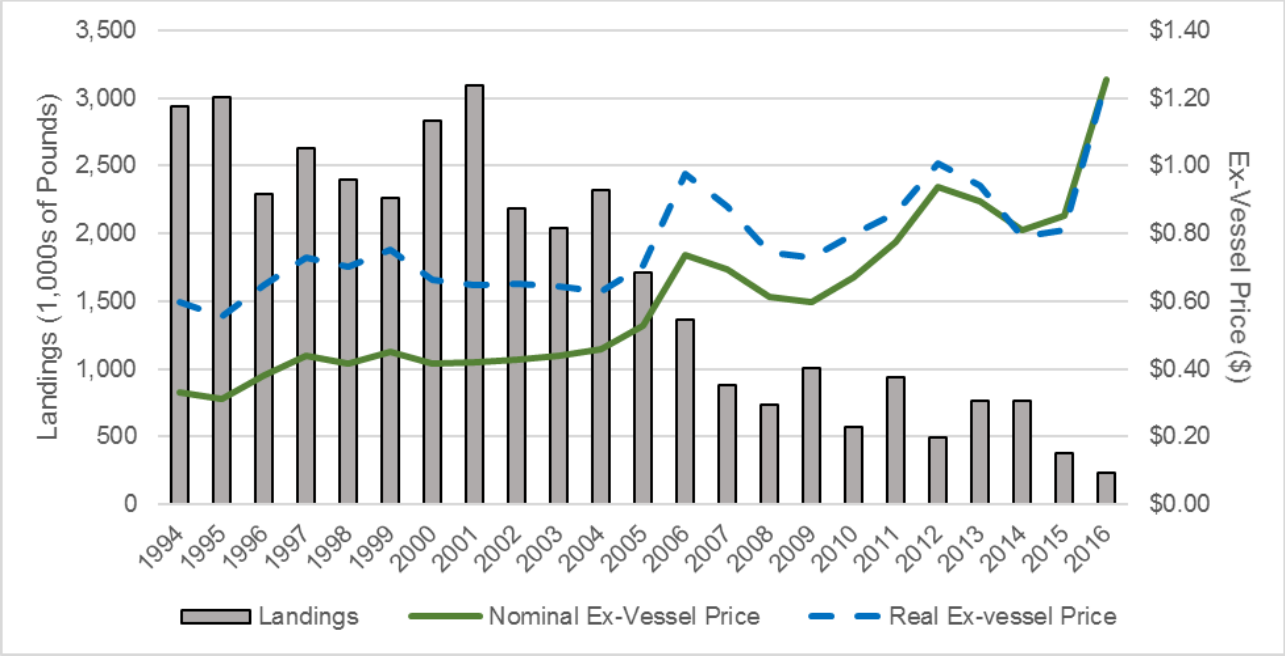

Figure 3.18. Spot landings and ex-vessel prices (real and nominal) for North Carolina, 1994–2016. (Source: NCTTP; Bureau of Labor Statistics 2017) NOTE: Nominal prices represent the original price in its current year and real price refers to those which have been adjusted for inflation and are represented in 2016 dollar values.

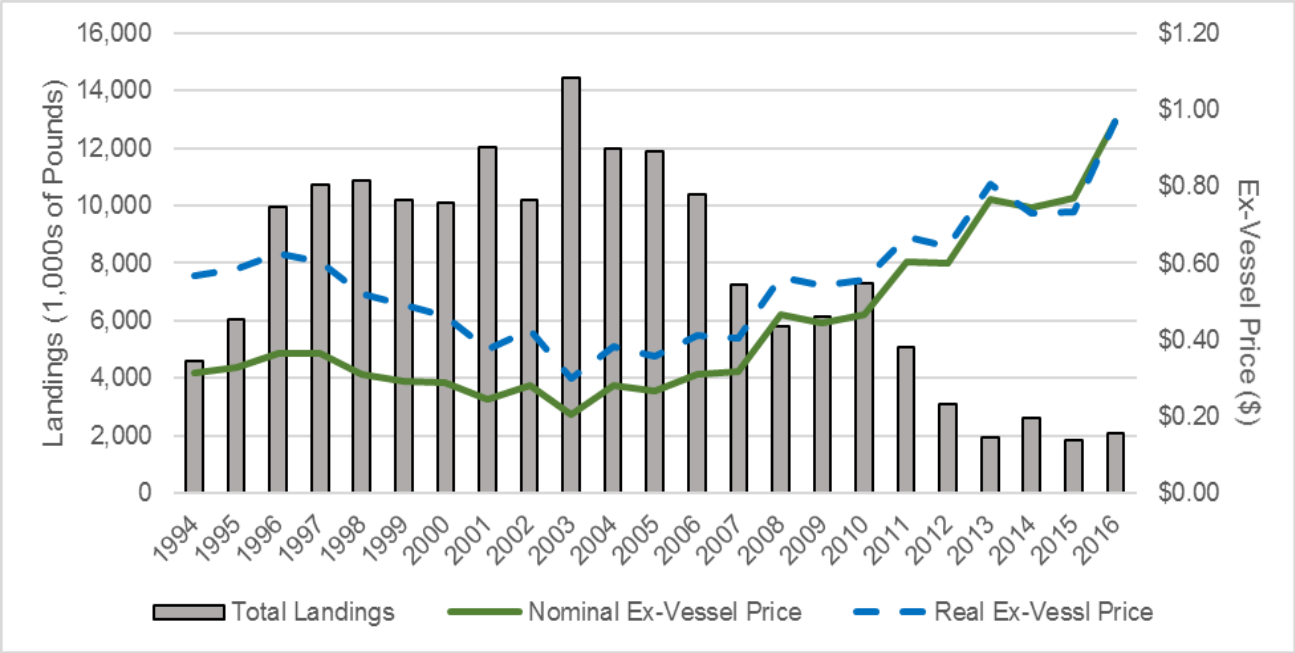

Figure 3.19. Atlantic Croaker commercial landings and ex-vessel prices (real and nominal) for North Carolina, 1994–2016. (Source: NCTTP; Bureau of Labor Statistics 2017) NOTE: Nominal prices represent the original value in its current year and real price refers to those which have been adjusted for inflation and are represented in 2016 dollar values.

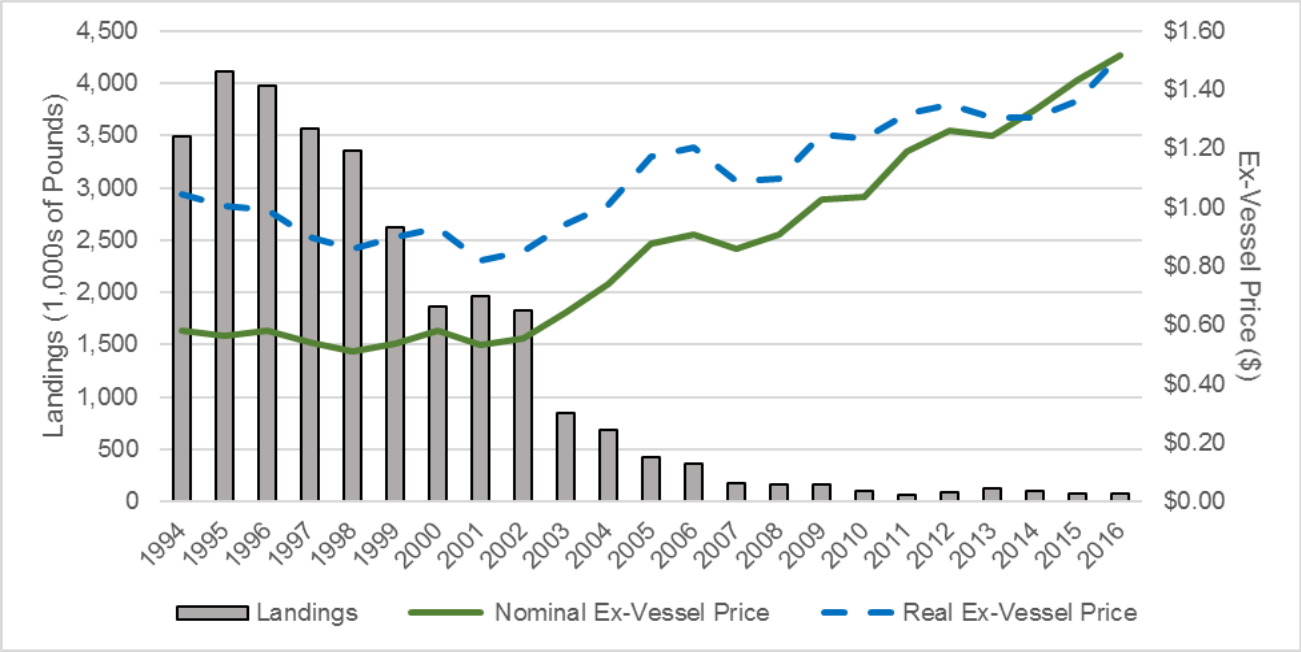

Figure 3.20. Weakfish commercial landings and ex-vessel prices (real and nominal) for North Carolina, 1994–2016. (Source: NCTTP; Bureau of Labor Statistics 2017) NOTE: Nominal prices represent the original price in its current year and real price refers to those which have been adjusted for inflation and are represented in 2016 dollar values.

3.7 Recreational Value

Generally, federal and state agencies have mandatory reporting requirements in commercial fishing for catch and sale of seafood products. This provides managers with data to make informed decisions regarding catch limits, seasonal restrictions, and other harvest rules to ensure the sustainability of a fishery. However, there are very few (if any) mandatory reporting requirements for recreational fishermen. Furthermore, even fewer voluntary data collection programs exist for economic information on recreational angling. Therefore, far less information is available to measure the economic impact of recreational fishing on the national economy. Most impacts for recreational fishing come from the production, sales, and consumption of durable goods related to recreational fishing. These goods typically include things such as tackle, ice, bait, fishing equipment, and other purchases required to go recreational fishing. The value of many of these items that are also necessary for commercial fishing are not commonly estimated. Other factors that add value to the recreational fishery that cannot be monetized include the non-market value of the fishing itself, as a form of recreation, and the worth of the fish to the fisherman for consumption or as a trophy ("bragging rights").

Since 1994, NOAA Fisheries (formerly known as NMFS) has collected annual economic and human dimension data from recreational anglers using the MRFSS sampling frame, until 2006, when the program was redesigned and became the MRIP. This program is the primary entity collecting recreational catch, effort, and socioeconomic data for marine species in the U.S. MRIP also conducts nationwide expenditure add-on surveys of anglers every three to five years. Survey results are used to assess how marine recreational fishing contributes to the economies of coastal communities and to the nation's economy.

The economic activity associated with the North Carolina coastal recreational fishing industry is calculated via the NCDMF coastal recreational fishing economic impact model as updated in July 2017. The economic impact estimates presented for coastal recreational fishing represent the economic activity generated by both trip expenditures and durable goods expenditures. These estimates are a product of economic data originating from the NOAA Fisheries coastal recreational fishing economic impact estimates for durable goods expenditures and IMPLAN economic impact modeling software input with data from NCDMF for trip expenditures (Gentner and Steinback 2008; Lovell et al. 2013). To calculate recreational fishing trip expenditures, the NCDMF coastal recreational fishing economic impact model uses effort data by area and by mode (i.e., shore, for-hire, private/rental vessel, and man-made) that are derived from the MRIP. These data are combined with angler trip expenditure data collected from North Carolina recreational anglers during surveys that have been carried out by the NCDMF Fisheries Economics Program and N.C. Sea Grant to provide estimated total coastal recreational fishing trip expenditures (Dumas et al. 2009; Crosson 2010b; Hadley 2012).

As with the commercial economic impacts, "[s]ales refer to the gross value of all sales by regional businesses affected by an activity, such as recreational fishing. It includes both the direct sales of durable recreational fishing goods and sales made between businesses and households resulting from the original sale. Income includes personal income (wages and salaries) and proprietors' income (income from self-employment). Value-added is the contribution made to the gross domestic product in a region" (NOAA 2017b). "Employment is specified on the basis of full-time and part-time jobs supported directly or indirectly" by the sales of durable goods related to recreational fishing (NOAA 2017b).

Below is a table of the estimated impacts of recreational fishing on the North Carolina economy from the NCDMF recreational impact model (Table 3.14). It contains total estimated participants, durable good expenditures, sales and income impacts, and estimated job impacts. The number of recreational participants for 2016 rose above the 10-year average (1.7 million anglers) to 1.88 million anglers (Table

3.14). Total durable goods expenditures in 2016 was also above the 10-year average ($1.55 billion) at $1.74 billion. In 2016, job impacts were at a recent low of 15,069 estimated jobs supported by the industry, falling by 1,300 jobs from the 10-year average. Income impacts have remained fairly constant over the last 10 years, averaging approximately $603 million (Table 3.14; Figure 3.21). Total economic impacts are on a slight downturn with recent years falling below the 10-year average of $1.75 billion. Recreational fishing is a vital part of the coastal economy in North Carolina and affects many facets of the state economy as a whole.

Table 3.14. Economic impacts of coastal recreational fishing in North Carolina. (Source: NCDMF Economics Program)

			Economic Impacts		
Year	Recreational Participants[1]	Estimated Expenditures (thousands of dollars)[2]	Jobs[3,4]	Income Impacts (thousands of dollars)[4]	Total Economic Impacts (thousands of dollars)[4]
2007	1,908,162	$1,575,233	18,248	$640,208	$1,798,433
2008	1,969,675	$1,556,843	18,029	$631,103	$2,016,206
2009	1,680,781	$1,195,326	13,699	$487,256	$1,543,353
2010	1,914,029	$1,343,080	14,948	$540,245	$1,711,079
2011	1,499,041	$1,505,438	16,398	$602,563	$1,911,811
2012	1,661,474	$1,810,385	18,304	$692,901	$1,870,460
2013	1,404,600	$1,531,847	16,356	$600,664	$1,741,763
2014	1,655,544	$1,525,307	16,050	$592,779	$1,732,482
2015	1,547,964	$1,754,483	16,624	$664,672	$1,658,302
2016	1,888,821	$1,747,730	15,069	$621,019	$1,575,947

[1]Participant estimates as reported by the NOAA Fisheries MRIP
[2]Estimated expenditures includes both durable good expenditures and fishing trip expenditures.
[3]Includes full time and part time jobs
[4]Economic impacts calculated using the NCDMF coastal recreational fishing economic impact model and IMPLAN economic impact modeling software. Economic impact estimates are for the state economy of North Carolina.

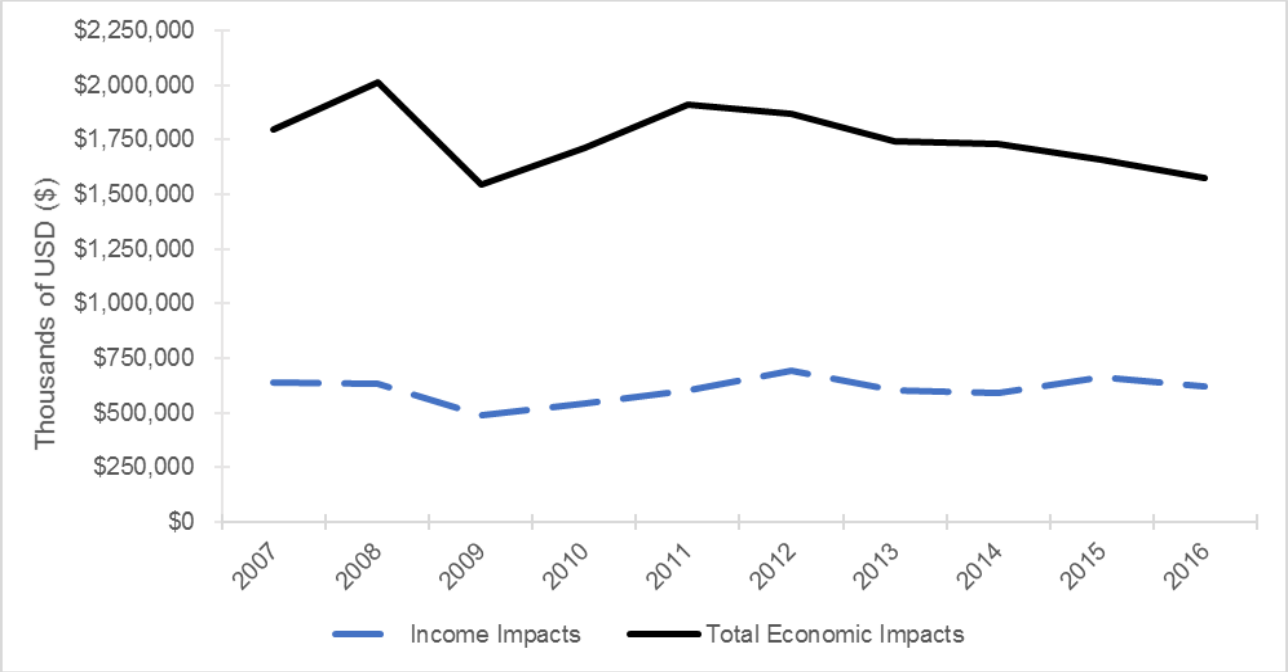

Figure 3.21. Total economic impact and income impacts of coastal recreational fishing in North Carolina, 2007–2016. (Source: NCDMF Economics Program)

Below are two tables from the most recent edition of Fisheries Economics of the United States (FEUS) published by the NOAA Fisheries Office of Science and Technology office, also showing economic impact estimates from recreational fishing for North Carolina in 2015 (NOAA 2017b). Similar impacts were presented above from the NCDMF impact model, but the NCDMF model shows the total across all modes (Table 3.14). The FEUS tables break these impacts down by fishing mode: for-hire, private boats, and shore trips (Tables 3.15 and 3.16). Table 3.15 shows both the durable good expenditures and trip related expenditures made by anglers in the state of North Carolina for 2015. These data are used to estimate the economic impact of marine recreational fishing to the state's economy via a regional input-output model. The input-output model used in these reports generates four different metrics, referred to as "impacts", for assessing the overall economic impacts of expenditures on marine recreational fishing. Table. 3.16 shows the results of that input-output model for North Carolina in 2015. While the estimate of total sales and income impacts produced by FEUS is less than the NCDMF model, the NOAA Fisheries impacts are presented in this document to show the range of impact estimates that are generated from different survey data and model methodologies.

Table 3.15. Angler trip and durable goods expenditures (thousands of dollars) in North Carolina, 2015. (Source: NOAA 2017b).

Fishing Mode	Trip Expenditures	Equipment	Durable Goods Expenditures
		Fishing Tackle	$226,458
For-Hire	$43,624	Other Equipment	$91,681
Private Boat	$136,986	Boat Expenses	$607,243
Shore	$208,215	Vehicle Expenses	$55,538
Total Trip Expenditures	$388,825	Second Home Expenses	$21,973
		Total Durable Expenditures	$1,002,893
Total State Trip and Durable Goods Expenditures			**$1,391,718**

Table 3.16. Economic impact of the recreational fishery (thousands of dollars) in North Carolina, 2015. (Source: NOAA 2017b)

		#Jobs	Sales	Income	Value Added
Trip Impacts by Fishing Mode	For-Hire	623	$72,896	$26,480	$38,956
	Private Boat	1,369	$131,781	$46,301	$74,109
	Shore	2,973	$268,806	$94,946	$154,912
Total Durable Expenditures		9,198	$976,818	$392,131	$602,739
Total State Economic Impacts		**14,163**	**$1,450,301**	**$559,858**	**$870,716**

4 IMPACT ON ENVIRONMENT

The Petition proposes designating all coastal fishing waters (estuarine and state ocean) that are currently not designated as primary, secondary, or special secondary nursery areas as a new classification of SSNA (special secondary nursery area). New gear and effort limits would be applied to the new nursery areas to reduce the overall amount of trawling and afford these areas additional habitat and water quality protection and bycatch reduction of juvenile species. The Petitioner states that reducing bycatch levels of lower trophic level prey species (e.g., Spot, Atlantic Croaker) will benefit higher trophic level species that are "more" economically valuable (e.g., Spotted Seatrout, Red Drum, flounder), and enhance the overall ecosystem services provided by a balanced trophic structure (NCWF 2016a).

These new nursery area designations would require a large enforcement effort (see section 9.1) to ensure rules are being adhered to and would likely result in a displacement of effort to less restrictive waters (i.e., previously designated SSNAs). Indirect impacts to surrounding environments due to displaced effort from the designation of new SSNAs are discussed below in section 4.1. Benefits to the ecosystem, including potential improvements in habitat and water quality conditions are discussed in section 4.2.

4.1 Displacement of Effort

Proposed changes to 15A NCAC 03N .0105 by the Petition provide an exception for existing SSNAs, which have less restrictive harvest regulations than areas that would be newly designated as SSNAs by the Petitioned rules (i.e., Pamlico Sound, Core Sound, and the ocean 0–3 miles). The Petitioned rules divide SSNAs into two subparagraphs (Table 4.1; NCWF 2016a). The first (subparagraph (b)) is the current list of SSNAs, which are nursery area habitat where later juvenile development takes place and are designated to protect larger juvenile species that have moved down from the primary nursery areas. These areas are required to be closed to shrimp and crab trawling between May and August and are opened to trawling once migration of these juvenile and sub-adult fish has occurred. Once these areas are opened, based on sampling by NCDMF after Aug. 15, fishermen are able to trawl day and night, five days a week with unlimited tow times. Proposed subparagraph (c), additional areas designated by the Petition, describes new SSNAs, which are not subject to this May–August closure. These proposed SSNAs encompass a much larger area with a broader range of habitat types that include the ocean waters out to three miles and whose ecological functions are different compared to the SSNAs already in existence. The existing SSNAs have less restrictions and are typically located in upstream, small, shallow, and brackish water areas. The designation of the new SSNAs may result in increased bottom disturbance in the existing shallow nursery areas from increased trawl fishing effort by fishermen avoiding the additional restrictions in the proposed SSNAs.

Table 4.1. Comparison of restrictions of trawling between existing designated SSNAs and the proposed SSNAs per 15A NCAC 03N .0105.

Existing SSNAs (closed May–Aug)	**Proposed SSNA**
1.3% of Coastal Waters	94.5% of Coastal Waters
Daytime and night trawling	Daytime trawling only
Five days a week	Three/Four days a week (estuarine/ocean)
Unlimited tow times	45-minute tow times

4.2 Benefits

Potential benefits from the Petitioned rules include habitat improvements in estuarine and state ocean waters to a variety of habitat types, including soft bottom, water column, oyster reefs, and SAV. Improvement in these habitats as a result of the Petitioned rules would be extremely difficult to quantify without a baseline measurement of how "good" the habitat in the areas affected by the proposed rules is now. That baseline is currently unavailable, as data do not exist for the whole area defined by the Petition to be designated as SSNAs. Any overall improvement to the habitats in those areas and in North Carolina as a whole is contingent on compliance with the proposed rules and how the fishermen respond. There is a large amount of uncertainty about whether fishermen would intensify effort during the times they are allowed to fish to recoup potential losses or move to other areas that are less restrictive, causing potential increased effort in those waterbodies. This section discusses the types of improvements that may occur due to better habitat and water quality over time, but with so many uncertainties, the magnitude of change from the proposed rules is unknown and the impact on habitat is unquantifiable at this time.

4.2.1 Habitat Improvements

If an area of soft bottom habitat that had been heavily trawled on a consistent basis, was no longer subject to trawling, it is possible that habitat conditions would improve relative to the baseline trend, holding all other factors constant. Improvements could include:

- More diverse, abundant, and productive benthic community, that in turn benefits small and demersal finfish;
- Lower predation on invertebrates and small fish due to increased microstructure that could lead to greater abundance of fishery species due to increased prey availability; and
- Increased water clarity and productivity in the water.

If oyster reefs and SAV had been impacted indirectly by trawling-related turbidity and sedimentation, an increase in SAV acreage and/or density, and an increase in growth rates, recruitment, and reef structure might occur relative to the baseline trend, holding all other factors constant. Positive changes to SAV and oysters could take many years. A study to look at before and after the Petitioned rules would go into effect would be needed to evaluate, if and when, any changes occur (see section 10 and Appendix 4).

The severity of impact to soft bottom habitat from trawling depends on the frequency a specific area is trawled and the size of the trawl doors. This information has not been quantified on a site-specific level in North Carolina. The management changes in the Petition would not eliminate trawling, but would reduce days and times available. Without knowing how much or where trawling would be reduced, there is a large degree of uncertainty regarding expected benefits. A potential way to evaluate improvements to habitat is through ecosystem services enhancement discussed in section 4.2.2.

Implementation of the Petition would designate 65,128 acres of estuarine waters and 86,174 acres of ocean waters that are currently managed for shrimping as a new type of SSNA (Table 2.1). Under the Petitioned rules, shrimp trawling activity would not be prohibited, but is estimated to potentially be limited to approximately 22% of the year for estuarine trawling and 29% of the year for ocean trawling, compared to the current level of about 75% (NCDMF 2017). Three NCDMF documents summarized the effects of trawling on habitat and water quality in estuarine and ocean waters (NCDMF 1999; NCDMF 2014; NCDEQ 2016). Based on references in those documents, habitat impacts to soft bottom and the water column from trawling potentially include:

- Reduced abundance, diversity, and productivity of the benthic community;

- A shift in benthic invertebrate species composition to those that are more resilient to frequent disturbance;
- Reduced structural complexity on the bottom (e.g., sand ripples, troughs, biotic structure like worm tubes, sponges, algae, shell);
- Change in sediment composition to finer and more easily suspended material;
- Temporary resuspension of sediment and nutrients into the water column;
- Reduced productivity of benthic microalgae on the sediment surface, since light availability would be more limited where bottom sediments were resuspended;
- Clogged gills of filter feeding fish and invertebrates due to increased turbidity in the water column; and
- Siltation onto nearby oyster reefs and SAV from redeposited sediment, which would negatively impact oyster filtration, oyster recruitment, and SAV growth.

Because shrimp trawling activity is estimated to be greatly reduced under the Petitioned rules, the corresponding habitat impacts from trawling would likely be mitigated.

However, studies conducted in North Carolina estuaries have shown no or minimal negative impacts to soft bottom or water column habitat or benthic productivity (NCDMF 2014). For example, Cahoon et al. (2002) and Corbett et al. (2004) studied the effects of trawling in the Pamlico River and some tributaries on productivity in the sediment and water column, respectively. In comparing trawled and un-trawled areas, both found a short-term increase in suspended sediment, and no significant difference in benthic microalgae. Change to nematodes, an important food source for shrimp and juvenile fish, was inconsistent and no significant difference in the macrofauna was evident. Trawling increased nutrient concentrations in the water column, but they were not statistically significant and persisted less than one day. Deehr et al. (2014) examined differences in productivity between Core Sound (trawled) and adjacent bays (Nelson, Jarrett, and Thoroughfare bays). The bays are designated SSNAs, but can be opened after Aug. 15, and usually have been. This scenario is similar to the Petitioned scenario, since the Petition would designate all undesignated waters as SSNAs, which are not closed to trawling, but opened conditionally by proclamation. Results of the Deehr et al. (2014) study found the open areas of Core Sound had significantly lower abundance of nematodes, but significantly higher abundance of total macroinvertebrates (e.g., deposit feeding polychaetes) and crabs compared to that found in the bays that were open less frequently. One likely reason for lack of significant negative impacts in North Carolina estuaries from trawling is because they are relatively shallow, dynamic, and frequently subject to disturbance from currents and wind. Consequently, effects of trawling are similar to the natural conditions.

4.2.2 Ecosystem Services Enhancement

Ecosystem services are defined as benefits people obtain from ecosystem functions, often expressed in monetary terms. These may include water quality cleansing (reduces cost that would otherwise be needed for wastewater treatment – e.g., oyster reefs), food production (habitats that improve survival of juvenile fish, and thus produce more food at no cost to people – e.g., SAV), and erosion control (habitats that buffer wave energy and protect shoreline development naturally instead of having to construct a costly bulkhead – e.g., wetlands; Costanza et al. 2008).

1. Effect of reduced trawling to ecosystem services of soft bottom:
   Ecosystem services of soft bottom include 1) subtidal bottom acts as a storage reservoir of nutrients, bacteria, and chemicals where they can become inactive, and thus enhance water quality conditions; 2) subtidal and intertidal soft bottom provide food (benthic microalgae) for small invertebrates, thereby increasing productivity of benthic fishery species such as

shrimp and red drum; 3) intertidal shorelines, shoals, and beaches provide erosion control for shoreline properties; and 4) shorelines and beaches enhance the coastal economy by providing areas for beach goers to recreate. The latter two services are not affected by trawling activity. Studies are lacking regarding the economic value of soft bottom habitat for ecosystem services and fishery production.

2. Effect of reduced trawling to ecosystem services of water column:
   Potential negative effects from trawling to the water column include temporarily elevated nutrients and toxins that are biologically available, and elevated turbidity, which can impact phytoplankton production and possibly redeposit it on SAV or oyster reefs. A healthy water column is necessary to support swimming, aquatic life, fishery production, and recreational and commercial fishing. In 2013, the estimated economic impact of commercial fisheries was $305 million and recreational fisheries was $1.7 billion (NCDMF unpublished data). Coastal tourism is highly dependent on having waters open to swimming. In 2017, coastal tourism expenditures (within the 20 coastal counties) were estimated at $11 billion (Harrison et al. 2017). While it has not been quantified how much of these values decline with somewhat lower water quality, some portion of the total amount could potentially decline, depending on the magnitude of reduced water quality.

3. Effect of reduced trawling to ecosystem services of subtidal oyster reefs:
   Ecosystem services provided by subtidal oyster reefs include 1) enhancing water quality through filtration or trapping of nutrients, sediment and toxins; 2) enhancing survival of many species by providing predator protection, increasing fishery production; and 3) providing erosion control for shoreline properties. This last function is not affected by trawling activity. Ecosystem services of oyster reefs were estimated at $2,200–$40,200/acre/year, excluding fishery values (Grabowski et al. 2012). The increased value to recreational fishing due to reef restoration was estimated at $640,000/year. These values are for increases in oyster acreage. It is uncertain if reductions in trawling would improve conditions for oyster reefs to the extent that growth and survival would substantially increase.

4. Effect of reduced trawling to ecosystem services of SAV:
   Ecosystem services provided by SAV include 1) erosion control due to trapping and binding sediment; 2) water quality improvements and climate regulation by absorbing nutrients and carbon dioxide and releasing oxygen into the water column; and 3) food production by enhancing survival of many species by providing predator protection and increasing fishery production. Ecosystem services of SAV were estimated at $7,700/acre/year (Costanza et al. 1997). These values are for increases in SAV acreage that may result from reduced trawling. It is uncertain if reductions in trawling would improve conditions for SAV to the extent that growth and survival would substantially increase.

5 IMPACT ON FISH STOCKS

The Petitioner states that mortality due to bycatch from shrimp trawls is contributing to the decline of fish stocks in North Carolina, especially for species such as Spot, Atlantic Croaker, and Weakfish (NCWF 2016a). The idea behind this statement is that these species are being caught before they are able to spawn and contribute to the population. The Petition proposes to implement new gear and effort limits to the new special secondary nursery areas to reduce the overall amount of trawling and afford these areas additional habitat protection and reduced bycatch of juvenile species. The Petition also proposes to establish minimum size limits for Spot and Atlantic Croaker to increase biomass (weight of the stock) and abundance (numbers of fish) by reducing mortality.

Increasing juvenile recruitment into the adult population is a goal of most FMPs in hopes of increasing stock abundance, but there are more threats to juvenile fish than just fishing mortality, whether caused by directed or indirect methods (bycatch). Natural mortality was discussed in section 2.1.1 and the other causes of mortality outside of fishing, such as environmental factors were discussed in sections 2.1.3–2.1.5. This section focuses on the effect of the proposed rules on biomass and abundance of finfish species, including impacts and benefits to fish stocks utilizing estuarine and state waters. Impacts and benefits of the proposed rules on the industry are discussed in section 6.

Fishing mortality can be reduced through management strategies such as area and season closures, trip limits, and size limits, as well as by reducing indirect fishing mortality such as bycatch (see section 5.1). Reducing fishing mortality can typically have positive effects on fish stock abundance (see section 5.1.4.1 and 5.1.4.2), but in cases where the natural mortality of the stock is larger than the fishing mortality, a reduction in fishing may not result in increased abundance (see section 5.1.4.3). Potential benefits to the stock from habitat improvements is summarized in section 5.2. Minimum size limits as a management tool can have positive benefits on stock abundance if appropriate size limits based on the species life history and fishery characteristics are taken into account (see section 5.3). If regulations implemented are stringent enough to negatively affect the profitability of a fishery, fishermen may shift effort to other species. This displacement of effort may have positive impacts to the species under restriction, but could have an adverse effect on the abundance of any new target species if this new effort is high enough (see section 5.4).

Fishing mortality will likely be reduced from an overall reduction in total fishing effort due to the Petitioned rules; however, the magnitude of the expected effect is unknown. This is due in part to several factors that make quantifying impacts or benefits difficult. Among these are factors that can be both positive and potentially negative for fish stock abundance. Positive factors include additional non-fishing days due to weather impacts and reduced effort in regulated fisheries due to displacement of effort to other fisheries. Potentially negative factors include recoupment of effort by fishermen on allowed fishing days, noncompliance with proposed rules, and increased effort in fisheries not directly affected by the Petitioned rules. For example, a shrimp trawl fisherman may shift effort to a more profitable species if the proposed rules make trawling less desirable, which in turn could result in a decline in biomass of the other species.

Management scenarios may also include methods to reduce indirect fishing mortality resulting from bycatch in gears not targeting the species caught and the mortality of fish that are discarded. The mortality level of species harvested as bycatch is dependent on several factors including gear, marketability, handling practices of fishermen, culling time, and heartiness of the species caught. For these reasons, in addition to the unknown magnitude of the effect on fishing mortality, the magnitude of the reduction on bycatch in the shrimp trawl fishery from of the proposed rules is also unknown.

5.1 Stock Responses to Changes in Mortality

In order to determine the status of fish stocks, various types of models are used. Scientific modeling is the generation of a physical, conceptual, or mathematical representation of a real phenomenon that is difficult to observe directly (Rogers 2011). Models may explain and predict the behavior of real systems; however, models are at best only approximations of the systems that they represent. Striving to fully understand the system in question requires multiple models with each representing a part of the system. When necessary, incomplete information from the best available models (grounded in the best available data) is employed to make decisions that balance competing conservation goals.

Fisheries management modeling is evolving from a single species approach to the entire ecosystem addressing a broader perspective of ecosystem considerations. An ecosystem is defined as "an ecological community together with its environment, considered as a unit" (adapted from Tansley 1935; Link 2002). Ecosystems are complex and cover many processes at many levels of the biological hierarchy. Single species approaches generally do not consider species interactions, allocation of biomass, changes in ecosystem structure or function, biodiversity, non-fishing ecosystem services, protected or rare species, non-target species, ecosystem effects of discarding unwanted bycatch, or gear impacts on habitat. Ecosystem approaches generally do not consider demographic parameters, density-dependent effects, stock recruitment relationships, genetic diversity, economic tradeoffs, or standards, reference points, and performance statistics (Link 2002). In theory, ecosystem-based fisheries management (EBFM) is a holistic strategy for dealing with the complexities of diverse ecosystems; its strength lies in the ability to simultaneously explore the trade-offs among social, cultural, economic, and environmental factors that may influence an ecosystem, and to find optimal solutions for all stakeholders (Link et al. 2002). The ability to quantify the relative strength of "the complex interconnections that exist among many species, habitat types, and human activities" in an ecosystem threatened by various pressures, both natural and anthropogenic, is the theory, but has not yet been realized in the management arena. There is the inherent difficulty of ever fully determining, especially to the point of predictability, the complex dynamics of ecosystems.

This shortcoming in the reliable predictability of model outcomes confounds simple projections of what may happen with fish stocks, such as the extent of any improvements in biomass and abundance of Spot and Atlantic Croaker that may be caused by a combination of management strategies like those noted in the Petition. Weakfish (see section 5.1.4.3) is a good example of where unaccounted changes in mortality factors (see section 2.1) nullified the expected recovery from a significant mandated reduction in harvest based on a stock assessment model. Without advances in EBFM and a corresponding improvement in the best available data for model inputs, the model predictions of a system's response to management action are debatable (Schwart 2002). The accuracy needed from model outputs may depend on the way in which the model output will be used, as well as who is impacted. Decision making often is adapted to the perceived complexity of the model. For example, the TLA referenced in sections 3.2 and 3.3 for Spot and Atlantic Croaker has not triggered management action despite declining trends in a number of the traffic light metrics and given where the management trigger levels were set (30% and 60%). The external peer review panel for both species also indicated while the TLA generally suggested spawning stock biomass was increasing, if new information suggests the stock could be declining, a new stock assessment to produce estimates of population size and fishing mortality should be expedited (ASMFC 2017b, 2017c).

Stock assessment models are necessarily a simplification of reality. This simplification does not mean the models cannot be complex and many are, in fact, highly complex, requiring considerable data and knowledge of biological parameters. It is important to evaluate the sensitivity of model results to our assumptions regarding the model parameters, as changing assumptions may impact stock status and

recommended management strategies. Sensitivity analysis is an important tool for evaluating the robustness of results and is a routine part of conducting a stock assessment.

Stock assessment models may assist in evaluating the relative impact of natural and fishing mortality on stock status, taking into account the population dynamics of the species. Nesslage and Dumas (2017) provided model projections for Atlantic Croaker and Weakfish. Projection models were tailored to each species to explore the potential biological response of the population from alternative fishing mortality scenarios and the resulting economic impacts, based on completed stock assessments available at the time of the report.

This section focuses on how the stock size of Atlantic Croaker and Weakfish could respond to varying fishing and natural mortality. These models help answer questions like, "If bycatch was reduced by a certain amount, how much will the fish stock change?" The various changes in fishing or natural mortality being assessed are programmed directly into the model and do not reflect a response to a particular management action. It is important to note that the size of the change in fishing and natural mortality attributable to the proposed rules is unknown. Therefore, it is not possible to model the associated change in the stock. There is no association between any regulatory intervention and the stock projections described below; they represent various "what-if" scenarios. Although not reflective of the proposed rules, these stock projections can be used to understand the direction, timing, and relative magnitude of the effect of reducing fishing or natural mortality, as well as how much change would be needed to achieve a desired stock status. Such "what if" models can inform professional judgements about the probability of a specific management intervention delivering the required effect size. Economic impact projection data is discussed in section 6.4.4.

5.1.1 Spot

The coastwide stock assessment of Spot was not yet completed at the time Nesslage and Dumas (2017) completed their report; therefore, their report did not perform projections of the Spot stock. Due to the similarities in life histories between Spot and Atlantic Croaker, Spot may respond to natural and fishing mortality changes in a similar way to Atlantic Croaker.

5.1.2 Atlantic Croaker

At the time of the Nesslage and Dumas (2017) report, the 2010 ASMFC stock assessment of Atlantic Croaker was the most recent coastwide stock assessment available (ASMFC 2010b). Nesslage and Dumas (2017) considered stock projections based on the assessment model used in the 2010 assessment. They projected the stock forward 40 years under eight different combinations (scenarios) of fishing mortality and shrimp trawl bycatch. In Scenario 1, the stock was projected forward assuming stock conditions equivalent to those in 2008. In Scenarios 2 through 5, the stock was projected assuming reductions in fishing mortality equally across all fleets and that removals of age-0 fish in the shrimp trawl bycatch were the same as the levels estimated for 2008. Projected SSB increased with decreasing fishing mortality in those scenarios. In Scenario 6, fishing mortality for all fleets was assumed equal to the 2008 value and the magnitude of the age-0 removals in the shrimp trawl bycatch was assumed to double. In that scenario, predicted SSB increased in the first three years of the stock projection and then decreased to the estimated SSB target (SSB at maximum sustainable yield), where it stabilized throughout the rest of the projected time series. This result comes from assumptions made in the model about the population dynamics of the species that predict a rebound followed by a stabilization in stock size. Scenarios 7 and 8 also assumed fishing mortality for all fleets was equal to the 2008 value; however, it was assumed that no removals in the shrimp trawl bycatch occurred starting in 2017. In those scenarios, SSB was projected to stabilize at a value higher than that projected for Scenario 6. All scenarios projected the stock would equal or exceed

the SSB target in the long term and so would suggest sustainable stock levels for each of the proposed scenarios.

It is important to note that the 2010 ASMFC stock assessment model on which stock projections by Nesslage and Dumas (2017) were based was considered acceptable for management by the external peer review panel, but the estimates of biomass were not approved due to the high uncertainty associated with the shrimp trawl bycatch estimates (ASMFC 2010b). For this reason, any projections of biomass based on that model would likely also be deemed unacceptable. The reviewers of the 2017 ASMFC Atlantic Croaker stock assessment endorsed the new shrimp trawl bycatch estimates, but did not consider the assessment model acceptable for management due to the model's sensitivity to certain assumptions, particularly those regarding fishery and survey gear selectivity (ASMFC 2017). Despite the inability to estimate stock status in the 2017 ASMFC stock assessment, the peer review panel agreed that recent removals were likely sustainable and no immediate management action was needed. The reviewers of the 2010 ASMFC stock assessment did not comment on management, but did believe that it was unlikely that the stock was in trouble (ASMFC 2010b).

In their report, Nesslage and Dumas (2017) noted the high degree of uncertainty regarding how the stock might respond to reductions in fishing and bycatch mortality. Their results indicate that a reduction in either fishing or bycatch mortality could have a benefit on the stock, suggesting a possible benefit to the Atlantic Croaker stock due to the Petitioned rules. They also noted that if age-0 removals in the shrimp trawl bycatch are two or more times higher than the 2008 estimate, the stock risks dropping below sustainable levels. The estimates of shrimp trawl bycatch from the 2017 stock assessment were, on average, 7.5 times higher (in terms of weight) than those referenced by Nesslage and Dumas (2017) from the 2010 stock assessment. The completion of a stock assessment seven years later (ASMFC 2017d) using estimates of shrimp trawl bycatch much higher than those estimated in the 2010 stock assessment showed the stock did not respond as projected by Nesslage and Dumas (2017); however, shrimp trawl bycatch was calculated differently in the more recent assessment and the type of model used was different, so results are not directly comparable.

5.1.3 Weakfish

Nesslage and Dumas (2017) applied stock projections for Weakfish to the model used in the 2016 coastwide stock assessment conducted by the ASMFC (ASMFC 2016a). The analysis projected the stock forward 30 years under nine different scenarios of commercial and recreational fishing mortality, natural mortality, and the stock-recruitment relationship. Scenarios that considered reductions in fishing mortality assumed that fishing mortality for the commercial and recreational fisheries were reduced by equal amounts. The results of the stock projections suggest that natural mortality rates need to reduce substantially for SSB to increase, assuming current fishing mortality rates do not increase. Weakfish SSB has been seriously compromised by high natural mortality rates in recent years (ASMFC 2016a). Reductions in fishing mortality alone (Scenarios 1 and 2) are not predicted to result in sustainable levels of SSB within at least the next 30 years. Reductions in natural mortality (Scenarios 3–9) do show positive impacts to the stock over time, but the low levels of natural mortality used in the stock projections do not accurately represent the current level for the stock. It is unclear why the natural mortality of weakfish is currently at a high level (e.g., water quality, predation, environmental impacts), so it is not possible at this time to determine if the proposed rules would result in a reduction in natural mortality for this species.

Scenarios used by Nesslage and Dumas (2017) are not comparable to the reductions in fishing proposed by the Petition due to use of natural mortality estimates that do not currently exist in nature. The size of the reductions in fishing and natural mortality created by the proposed rules is unknown.

5.1.4 Existing Species Examples

All fish, of every species, will experience a mortality event that removes them from the population. There are two types of mortality that act on any fish stock. The first type is fishing mortality where death is caused by removal of fish through use of fishing gears. The second type is natural mortality where death is caused by things other than fishing such as predation, cannibalism, competition, disease, and pollution. Natural mortality is difficult to quantify due to unmeasurable environmental factors, while identification of fishing mortality events can be identified through fisheries monitoring (Pauly 1980). As mentioned previously, reducing fishing mortality is the most common approach used by managers in an attempt to improve fish stocks that are experiencing a decline in abundance or are heading toward that result in the near future. If fishing mortality is very high and a fish stock is in poor condition then regulations are developed to reduce fishing mortality by adjusting things such as quotas, size limits, bag limits, seasons, and fishing gear. Striped Bass (*Morone saxatilis*) and Summer Flounder (*Paralichthys dentatus*) are examples that exhibit how reducing fishing mortality can both serve to rebuild and sustain a fish stock that has been experiencing overfishing. On the other hand, Weakfish serves as an example of how a reduction in fishing mortality did not benefit the stock as expected. For more information about natural mortality and fishing mortality, see section 2.

5.1.4.1 Atlantic Ocean Striped Bass

Atlantic Ocean Striped Bass is a good example of a stock for which strict harvest regulations along with improvements in habitat and water quality restored the stock to sustainable levels. Striped Bass have long been the focus of fisheries from North Carolina to New England and were integral in the development of numerous coastal communities since the 1600s. Attempts at regulations were made by states during the 1940s when size limits were imposed. Minimum size limits ranged from 16 inches for many coastal states to 10 inches in some southern states. By the 1970s, it became increasingly evident that stronger regulations would be needed to maintain stocks at a sustainable level. Recruitment in the Chesapeake Bay stock had reached an all-time low, as determined by a juvenile survey conducted by the Maryland Department of Natural Resources since 1954. In response to the decline, the ASMFC developed a FMP in 1981 to increase restrictions in commercial and recreational fisheries. Two amendments were passed in 1984 recommending management measures to reduce fishing mortality. To strengthen the regulations, a federal law was passed in late 1984, which mandated that coastwide regulations already implemented would be adhered to by the Atlantic states between North Carolina and Maine.

Amendment 3 to the FMP called for size regulations to protect the 1982-year class, which was the first modest size cohort since the previous decade. The objective was to increase size limits to allow at least 95% of the females in the 1982 cohort to spawn at least once. This required an increase in the size limit as the cohort grew, which equaled a 36-inch minimum size limit by 1990. However, estuaries have traditionally been considered producer areas and smaller size limits were permitted in these producer areas than elsewhere along the coast. This was allowed because the migration of fish out of the producer areas after spawning reduces the availability of the larger females in these areas. However, several states, beginning with Maryland in 1985, opted for a more conservative approach and imposed a complete moratorium on Striped Bass landings.

Consequently, the management plan was amended for the fourth time to allow state fisheries to reopen their fisheries in 1990 under a target fishing mortality of 0.25, which was half the 1990 F_{MSY}.[2] estimate of 0.5. Amendment 4 to the FMP allowed an increase in the target F once the SSB was restored to levels estimated during the late 1960s and early 1970s. The dual size limit concept was maintained with a 28-

[2] F_{MSY} is defined as [t]he fishing mortality rate that will result in the stock biomass producing the maximum greatest yield over time, or weight of harvest within a year" (ASMFC 2009a).

inch minimum size limit in coastal jurisdictions and 18 inches in producer areas. A recreational trip limit and commercial season was implemented to reduce the harvest to 20% of that in the historic period of 1972-1979. Amendment 4 and its four addenda aimed to rebuild the resource, rather than maximize yield. Based on the results of a model simulation of the increase in SSB, Striped Bass was declared restored by the ASMFC in 1995. The model, known as the SSB model, was a life history model resulting in a relative index of SSB (Rugolo et al. 1994). When the time series of SSB crossed the level comparable to the 1960-1972 average, the stock reached the criteria for a restored stock.

Under Amendment 5 (adopted in 1995), target *F* was increased to 0.31, midway between the initial *F* (0.25) and F_{MSY}, which was revised to equal 0.40. Regulations were developed to allow 70% of the historic harvest (based on the historic period of 1972-1979) and achieve the target *F*, although states could submit proposals for alternative regulations that were conservation equivalent. Amendment 5 retained the limit of two fish per day at 28 inches minimum size limit in coastal waters, but allowed two fish per day at 20 inches in producer areas. States could adjust the minimum size, if the size change was compensated with a change in season length, bag limits, commercial quota, or a combination of changes. However, no size limit could be less than 18 inches (NEFSC 2013).

Currently Atlantic Striped Bass are managed under Amendment 6 and its addenda. In response to the results of the various stock assessments conducted on Striped Bass over the last three decades, there have been several instances when regulations were put in place to reduce fishing mortality, which in most cases had the intended effect of reducing *F* to below the desired target. The reductions in *F* allowed the SSB to increase to an adequate level to produce successful year classes, and from 1993 through 2004, the stock experienced nearly a decade of above average recruitment (i.e., the number of age-1 fish entering the stock each year; a measure of spawning success). However, this period of above average recruitment was immediately followed by a nine-year period (from 2005 through 2013) in which the stock experienced below average recruitment, including one of the lowest years of recruitment on record with the 2013 cohort. This period of low recruitment occurred when the total SSB of the stock was estimated to be at its highest levels during the entire stock assessment time series (1982–2015) (ASMFC 2015). It is therefore important to recognize that for estuarine dependent species that rely on the rivers and/or estuaries for spawning and/or subsequent larval development, environmental conditions during the critical periods of egg development and larval settlement can be the most important factor in determining annual spawning success. There absolutely must be a minimum level of SSB at which managers do not want a stock's biomass to fall below, but even at high levels of SSB other factors can influence spawning success. This example shows that a variety of factors over several decades resulted in successful improvement in the stock, but cannot be used as an indication that the Petitioned rules would have the same effect for Atlantic Croaker, Spot, and Weakfish.

5.1.4.2 Summer Flounder

Summer Flounder are one of the most important commercial and recreational fisheries along the Atlantic Coast. They range from Massachusetts to North Carolina. Commercially, the primary gear used to harvest Summer Flounder is the ocean trawl fishery. Trawling for Summer Flounder has been ongoing since 1880. Commercial and recreational landings peaked in 1979 and 1983, respectively. By 1990, commercial and recreational landings declined far below peak periods. The 1991 stock assessment determined that the Summer Flounder stock was overfished and overfishing was occurring. According to the stock assessment, the fishing mortality rate for Summer Flounder on the spawning stock (fish at least age-2 or greater) was F=1.1, which was nearly five times the fishing mortality threshold (F_{max}=0.23). The stock assessment recommended reducing fishing mortality rates to rebuild the SSB and age structure of Summer Flounder (Terceiro 2002).

In 1992, Amendment 2 to the Summer Flounder Fishery Management Plan was drafted and implemented by the ASMFC and MAFMC. Amendment 2 enacted stringent harvest controls to curtail fishing mortality. These included annual commercial quotas, minimum mesh sizes and other gear specifications, seasons, recreational harvest limits, and recreational size and bag limits. Although in 1999, Summer Flounder were still considered overfished and overfishing was occurring, the stock had improved dramatically with fishing mortality reduced to the lowest levels since the 1960s and SSB being the highest since the 1970s. Also, the age structure for mature fish in the population that had been truncated was now expanding far beyond what was observed in the early 1990s (Terceiro 2002).

Continued restrictions and rebuilding resulted in the Summer Flounder population being considered not overfished and not overfishing when a new stock assessment was conducted in 2011. Fishing mortality was F=0.216 with a threshold of F_{max} =0.31 in 2010 (Terceiro 2011). Not long after, the Summer Flounder stock was declared rebuilt (Terceiro 2018). A few years later, the 2016 stock assessment update found that the Summer Flounder population was not overfished, but overfishing was once again occurring with an F=0.390 and a fishing mortality threshold (F_{max} =0.309; Terceiro 2018). Managers continue to evaluate and adjust target and threshold biological reference points to sustain the Summer Flounder stock and fishery (Terceiro 2011).

5.1.4.3 Weakfish

Reducing fishing mortality through stringent harvest restrictions does not guarantee that the stock will respond in a positive way. There are a variety of factors that can cause stock decline other than mortality due to fishing and Weakfish provides a good example of this. Under Amendment 3 to the ASMFC Interstate FMP for Weakfish, measures were adopted to reach and maintain a target fishing mortality rate of F=0.5 (34% annual harvest rate and spawning potential ratio (SPR) of 20%) and to restore the age structure to the average of 1979–1994 (ASMFC 1996). In 1994, the exploitation rate was estimated at 76% with a rate of F=1.88, and the maximum spawning potential was only 3%. States could use conservation equivalency to accomplish the reductions necessary to meet Amendment 3 goals. North Carolina opted to maintain a 12-inch commercial minimum size limit for all fisheries, except for the estuarine pound net and long haul seine fisheries (seasonal 10-inch size limit). For the recreational fishery, a 12-inch total length minimum recreational size limit with a 4-fish per day creel limit was implemented. For all measures combined (including trawl and gill net mesh restrictions), a 32% reduction in Weakfish exploitation was needed during the April through March ASMFC-designated fishing season. Evaluation guidelines for states were included as Appendix 2 in Amendment 3 (O'Reilly 1996). For the 1994/1995 timeframe and using the methods in the evaluation guidelines, the closure to flynets south of Cape Hatteras, based on the 1990–1992 fishing years, was computed as a 42% reduction in F, exceeding the reduction required to achieve the required reduction in exploitation. The 2015 Information Update to the N.C. FMP for Interjurisdictional Fisheries, Appendix B, contains a summary of subsequent management actions for North Carolina Weakfish up to 2015 (NCDMF 2015b).

The main Weakfish fishing grounds for the flynet fishery were south of Cape Hatteras. These fishing grounds were documented in the early 1930s by Pearson (1932). The flynet closure was premised on the quantity of small Weakfish caught by the fishery in that area. Fish less than 12 inches comprised 95% of the catch south of the Cape, compared to 74% north of the Cape for the years 1990–1992. Also 82% of the harvest on average were caught south of the Cape during the same time span (NCDMF 1994).

While management measures implemented (initiated 1994) through Amendments 3 and 4 resulted in an initial (1994–1998) positive response to rebuilding the overfished stocks of Weakfish along the Atlantic Coast, the 2006 stock assessment indicated that SSB declined rapidly after 1999 and was at the lowest level in the time series (ASMFC 1996, 2002, 2006). The decline in biomass was reflected in landings along the Atlantic Coast, which were at historic lows. While the 2006 stock assessment was not upheld by

a peer review panel, the Weakfish Management Board accepted five conclusions (supported by significant evidence) for management use: 1) the stock is declining; 2) total mortality is increasing; 3) there is not much evidence of overfishing; 4) something other than fishing mortality is causing the decline in the stock; and 5) there is a strong chance that regulating the fishery will not reverse stock decline (ASMFC 2006).

The latest assessment completed in 2016 employed a new spatially-structured forward projecting statistical catch-at-age model with time-varying natural mortality (ASMFC 2016a). This model accounts for varying population spatial distribution and changing natural mortality through time. After review of the assessment results, the Weakfish TC recommended an SSB threshold (*Z* based) of 15.2 million pounds that is equivalent to 30% of the projected SSB under average natural mortality and no fishing ($SSB_{30\%}$). The model indicated natural mortality has been increasing since the mid-1990s, from approximately 0.16 at the beginning of the time-series to an average of 0.93 from 2007–2014. The assessment proposed a total mortality target of 0.93 and threshold of 1.36. Total mortality in 2014 was 1.11, which is above the target but below the threshold, indicating that total mortality is still high but within acceptable limits. Results of the assessment show that the Weakfish stock is depleted and has been for the past 13 years, but overfishing is not occurring. Declining trends are seen along the Atlantic Coast. Even though fishing mortality has been at low levels in recent years, the Weakfish population has been experiencing very high levels of total mortality, which has prevented the stock from recovering. Because the total mortality of the stock in the terminal year of the assessment (2014) was below the *Z* threshold, the board did not take any new management measures. Other states along the Atlantic coast (that do not have an inshore shrimp fishery) are also experiencing declines in landings. Due to the coastwide nature of the stock and current compliance with conservative management measures, the Petitioned rules would not likely have an effect on the Weakfish population.

5.2 Stock Responses to Changes in Habitat Quality

As mentioned in section 4.2, habitat protections and reduced natural mortality on a fish stock can lead to increases in abundance. Improving habitats such as soft bottom could result in increased diversity in the benthic community that may benefit small demersal fish as well as invertebrates by providing increased microstructure that provides more protection from predators. Increased water quality can have impacts all the way up the food chain from benthic microalgae (food for small invertebrates) to benthic fishery species such as shrimp and red drum. However, the extent of the proposed rules' effect on water quality is unknown.

Improvements to oyster reefs and SAV can enhance water quality and increase the survival of species that use these habitats to protect themselves from predators. As mentioned previously, it is uncertain if reductions in trawling from the Petitioned rules would improve conditions to the extent that growth and survival of these habitats would substantially increase.

Another unknown is estimating the decrease in natural mortality due to increases in the quality of these habitats. Natural mortality is tied to the life history of a species. If better habitat led to a longer life span, then the natural mortality of the species could decrease. If habitats associated to a particular life stage (e.g., nursery areas) improved, then it is possible that natural mortality associated with that life stage (e.g., juveniles) could decrease. It is unclear what effect the Petitioned rules would ultimately have on a stock's abundance or its life history.

5.3 Minimum Size Limits

Minimum size limits as a management tool to improve stock abundance can be beneficial if size limits based on the life history of the target species are appropriately evaluated. Appropriate size limits can allow fish to spawn at least once, contributing to the overall population, before being removed from the population due to mortality. This section focuses on how minimum size limits could impact fish stock abundance. Impacts to commercial and recreational fisheries from minimum size limits on direct and indirect landings of Spot and Atlantic Croaker are discussed in more detail in sections 6.1.6 and 6.2.2, respectively.

Length at maturity is used in fisheries management to set minimum size limits and to estimate what portion of the population may be able to reproduce before recruiting to the fishery. Minimum length at maturity, length at 50% maturity, and length at 100% maturity are metrics commonly used in stock assessments. Minimum size at maturity for male Spot ranges from 10.9–17.5 centimeters (4.3–6.9 inches), average length at maturity ranges from 18–27 centimeters (7.0–10.6 inches), and minimum length at 100% maturity ranges from 22–27 centimeters (8.7–10.6 inches; ASMFC 2010a). Minimum size at maturity for female Spot ranges from 12–17 centimeters (4.7–6.7 inches), average size at maturity ranges from 18–29 centimeters (7.0–11.4 inches), and minimum length at 100% maturity ranges from 26-33 centimeters (10.2–13.0 inches; ASMFC 2010a). Based on the ranges discussed above for female Spot, instituting an 8-inch minimum size limit would likely have little effect on allowing a majority of female Spot to reach spawning size. Based on biological data collected by NCDMF from 2004–2017, Spot greater than or equal to 8 inches are 77% female and 23% male (Table 5.1); therefore, instituting the size limit proposed in the Petition would shift harvest to primarily females, which would have unknown consequences on the stock.

Utilizing data collected from North Carolina commercial fisheries for Atlantic Croaker, minimum length at maturity for males was 18 centimeters (7.0 inches), length at 50% maturity was 22.4 centimeters (8.8 inches), and minimum length at 100% maturity was 25 centimeters (9.8 inches). Minimum length at maturity for females was 11 centimeters (4.3 inches), length at 50% maturity was 19.3 centimeters (7.6 inches), and minimum length at 100% maturity was 29 centimeters (11.4 inches). Utilizing the North Carolina commercial fisheries dataset, the 2010 ASMFC assessment found 66.7% of male Atlantic Croaker and 90.4% of female Atlantic Croaker were mature by age two (22–27 centimeters) (ASMFC 2010b). Based on length at maturity estimates, instituting a 10-inch minimum size limit for Atlantic Croaker in North Carolina would be adequate to allow 50% of females to reach spawning size (7.6 inches), but would not be adequate to allow 100% of females to reach minimum spawning size (11.4 inches). Based on biological data collected by NCDMF from 2004-2017, Atlantic Croaker greater than or equal to 10 inches are 73% female and 27% male (Table 5.1); therefore, as mentioned above for Spot, instituting the size limit proposed in the Petition would shift harvest to primarily females, which would have unknown consequences on the stock.

Table 5.1. Percentage of Spot and Atlantic Croaker by sex based on size (inches), 2004–2017. (Source: NCDMF)

Spot			Atlantic Croaker		
Size (inches)	% Male	% Female	Size (inches)	% Male	% Female
<8	31.57	68.43	<10	28.66	71.34
≥8	23.36	76.64	≥10	26.66	73.34

The minimum size limits that would be implemented by the Petitioned rules, although not a complete moratorium, would have a drastic impact on commercial landings and recreational harvest. Data has shown that a large percentage of the marketable commercial catch of Spot and Atlantic Croaker from shrimp trawls is below the Petition-requested size limits for these species (see section 6.1.6). Under the proposed rules, these fish would have to be discarded. For commercial gears targeting these species, portions of the current landings would also be under the proposed minimum size limits, resulting in a 46% (Spot) and 14% (Atlantic Croaker) loss in value to those fisheries, in which, ultimately, fishermen may choose to not continue to target these species, given the already low ex-vessel prices they command (section 6.2.2.1). Again, this portion of the catch would have to be discarded. Recreational harvest (i.e., kept fish) that would be below the proposed minimum size limits may be between 34% and 67% for Spot and between 72% and 84% for Atlantic Croaker (see section 6.2.2.2). Fishermen who target these species would be required to discard any catch below the size limit. Catch and release fishermen would not be directly affected by the rule change; however, fishermen that keep their catch may choose to target other species since they would have to discard a large portion of their catch.

Discarded fish experience varying levels of mortality after being discarded (e.g., potential injuries from gear, handling of the fish while out of the water). It is estimated that up to 67% of species discarded from shrimp trawls will likely die after being discarded (NCDMF 2015a). Spot had the greatest mortality rates of the commonly discarded species caught as bycatch in shrimp trawls. Atlantic Croaker showed increased mortality after release when subjected to more time out of the water. The extent of the discard mortality from recreational hook and line fishing is currently unknown for Spot and Atlantic Croaker. Discard mortality adds to the total mortality on a species. The magnitude of increase on total mortality due to additional discards that would come from the Petitioned rules is unknown; however, increased mortality would have negative effects on stock abundance.

5.4 Displacement of Effort

The Petitioned rules present a probability that fishermen who normally participate in either the shrimp trawl, Spot, or Atlantic Croaker fisheries will exit the fishery completely, or shift their efforts into another commercial fishery. This often happens when increased regulations make a fishery unprofitable for fishermen (Conrad 2010; Tidd et al. 2011). As discussed in the previous section, this may be largely true for the commercial Spot fishery, which could potentially see a 46% loss in value, and recreational Atlantic Croaker, which could see as much as an 84% reduction due to the minimum size limits proposed in the Petition. Reduction in effort due to displacement may benefit the originally targeted species by reducing fishing mortality on those stocks, but an increase in effort on other potentially more profitable species would cause increased levels of fishing mortality on these species in both the commercial and recreational fisheries. Over time, this increased fishing mortality could lead to lower biomass and abundance for these stocks. Currently, the magnitude of any effort shift due to the Petitioned rules is unknown and without proper economic performance indicators for the fisheries affected by these rules, it is not possible to model probabilities of how many fishermen would exit or shift to other fisheries. Shifts in effort, if any, would not be able to be determined until several years after the Petitioned rules would be in place.

6 IMPACT ON INDUSTRY

The Petitioned rules would greatly affect the shrimp trawl fishery, as well as other trawl fisheries throughout the state. Both commercial and recreational fishing industries would be affected, but the Petitioned rules would impact the commercial fishing industry more severely. For a complete picture of the impacts of the Petition on the fishing industry, each management measure proposed is discussed in detail for two fishery categories: shrimp (section 6.1) and other (section 6.2), which includes the recreational fishery. Benefits to the industry due to the Petitioned rules is also discussed. Additionally, there would likely be impacts throughout the supply chain, but data are not available to evaluate the scope or magnitude of these impacts. Estimates presented in the section below are based on the best available data and may not reflect the actual amounts that would result from the Petitioned rules.

6.1 Shrimp Fishery

The shrimp fishery is the second largest and second most valuable fishery in North Carolina. The combination of management strategies proposed by the Petitioner, including setting the season based on a count size, decreasing headrope length in both the ocean (where there is no headrope length maximum) and the internal coastal waters, and limiting the number of days in combination with limits on time of day and length of tow, has the potential to significantly reduce the commercial shrimping industry effort, resulting in losses to the industry. Shrimp are considered an annual crop and are highly influenced by the environment; therefore, shrimp abundance and recruitment to the fishery can be highly variable and differ by species (i.e., brown, pink, and white) and location, making it difficult to estimate total reductions in landings and bycatch from reduced effort.

Currently, fishermen can shrimp trawl approximately 74% of the year in internal coastal waters with the existing weekend trawl closures in place (9 p.m. Friday through 5 p.m. Sunday). If restricted to fishing three days in internal coastal waters (example: Wednesday–Friday), trawling would be limited to approximately 45% of the year (see section 6.1.1). Since weekend fishing is allowed in the ocean, a four-day reduction would limit fishing to approximately 57% of the year. By incorporating nighttime restrictions along with limited tow times, the amount of allowable trawling time in both the ocean and internal coastal waters is further reduced (see sections 6.1.2 and 6.1.5). Unfavorable weather, tides, and moon phases can lead to additional losses in days fished. While this is true now, potential losses due to these conditions could be magnified under the Petitioned rules when the conditions occur during the shorter windows of allowed fishing.

Given the high variability in the timing and abundance of the three species that make up North Carolina's shrimp fishery, it is difficult to accurately predict when the count size would open the season. The Petitioner suggests that based on count sizes in the Pamlico Sound, the fishery would open sometime after mid-May. Recognizing that effort is low from January to May, this still potentially reduces the shrimping season by approximately 42% (see section 6.1.3).

Restricting total headrope length from 220 feet to 110 feet in the ocean would cut the maximum allowable headrope length by 50% (see section 6.1.4). Restricting maximum total headrope length from 220 feet to 90 feet in internal coastal waters would reduce maximum allowable headrope length by 59%. It should be noted that not all vessels fish the maximum headrope sizes. While it is not possible to estimate what the magnitude of the reduction in fishing effort would be if the proposed rules are implemented, overall effort would be reduced due to a loss of fishing power.

The Petitioned rules center around reducing harvest time in the shrimp fishery, which may affect the amount of shrimp available to consumers and limits the catch of other marketable species on those fishing trips through minimum size limits (see section 6.1.6).

Shortening the harvest period could lead to surplus quantities of shrimp getting to the dealers and processors at the same time, depressing the price fishermen can earn on their catch. The North Carolina Rural Economic Development Center found that North Carolina fish houses often have their shrimpers bringing catch to the market simultaneously, causing ex-vessel prices to be suppressed (NCREDC 2013). Ex-vessel value is based on the estimated average price paid to the fishermen by the dealer for each species and market grade. Typically, these fish houses then need to move the supply of shrimp to wholesalers as soon as possible, resulting in sale to economy food processors at low or near break-even prices, devaluing the front end of the supply chain. Current seafood market trends show a growing demand for seafood in countries like the U.S. due to ease of overseas aquaculture production and importation. Capture fisheries, on the other hand, peaked in the 1980s and are predicted to shrink as demand grows for aquaculture products (Kite-Powell et al. 2013).

When harvest is heavily restricted in an open access fishery (not limited entry), derby fishing can occur. Derby fishing is defined as racing to harvest as much as possible before the fishery closes (NOAA 2006). This activity has been seen in many open access fisheries around the U.S., with an upper bound on total harvest (i.e., total allowable catch or TAC) such as the Alaskan Salmon fishery, Gulf of Alaska Halibut and Sable fishery, and the New England groundfish fishery. Homans and Wilen (1997) found that if a fishery was under an open access TAC, fishermen were incentivized to participate in derby-style fishing. This caused seasons to inadvertently become shorter because the TAC was met soon after the season opened. From the early 1970s to 1990, Halibut seasons in Alaska fell from 150 days to just two or three days as a result of derby fishing (NRC 1999). In addition to shortened seasons, fishermen often overcapitalize their vessels when in these situations, meaning they increase gear and fishing power to catch as much as possible; thereby, increasing the cost of each trip hoping for high returns from increased harvest. Derby fishing also creates user conflicts as many fishermen are competing for fishing grounds before the harvest is gone, thus increasing the propensity for vessel accidents or disputes between fishermen and fishing sectors (i.e., commercial vs. recreational). It has been often observed that the pulse of fishing from derbies results in landings reaching dealers and processers in large quantities at the same time. Dealers are then required to freeze the catch to be sold throughout the year, or sell their large supply for sub-optimal prices to off-load excesses. This decreases the ex-vessel value paid to fishermen and the overall value of the fishery itself. Although the proposed rules would not implement an upper bound on total catch, if fishermen perceive the proposed reductions in available fishing time and limitations on total effort as significantly limiting their total catch potential, it is possible that the rules could create an incentive for a similar behavioral response.

It is impossible to predict the number of shrimping vessels that would exit the fishery due to the Petitioned rules. Economic literature tells us that fishermen will generally exit the fishery when the marginal cost of effort exceeds marginal revenue (Conrad 2010; Tidd et al. 2011). Very little is known about the costs and structure of shrimping enterprises in North Carolina. In order to determine the exit point most shrimpers would face, the equilibrium point of where cost and revenue functions intersect would need to be known. Determining an equilibrium, or break-even point, is further confounded by the diversity of shrimping vessel configurations. Shrimping vessels vary greatly in net length, mesh size, number of rigs towed, overall vessel size, and engine displacement. This results in significant variability in yield-effort estimates and cost structures for operation. However, some generalizations can be made. Smaller vessels typically land smaller quantities of shrimp, have smaller gear configurations, and employ less crew members (see section 6.3.1, Table 6.18). The Petitioned rules are less likely to affect smaller shrimping vessels because average headrope length is already under the proposed limit of 90 feet. Large

vessels, on the other hand, are at a greater risk for exiting the fishery. Owners of large vessels typically have more capital invested in their shrimping vessels, a higher debt to equity ratio, and typically exceed the total proposed headrope length of the Petitioned rules. Larger trawlers are also highly specialized vessels, whose only purpose is typically shrimping. If shrimping is no longer a viable option because of the regulatory changes proposed, it is doubtful these larger vessels could be repurposed for other fisheries. Whether individual shrimping vessels would be able to sustain profitability under the proposed management measures is unknown.

There are potential benefits to the shrimp industry. While the industry may experience a loss of overall fishermen employed, industry consolidation and reduced effort may yield greater positive net revenues for the remaining shrimpers. Harvest restrictions may prove fruitful if the total biomass of shrimp increases over time and effort is simultaneously reduced.

There are a multitude of data needs and analyses needed to determine the factors other than fish stock abundance affecting industry trends. Trends in overall operational costs over the last few decades, ex-vessel prices, and employment costs would need to be examined, along with import and export data, supply chain factors, and consumer purchases. This is an extremely broad topic that would require a large amount of time, research, and analysis. NCDMF does not currently have the resources to perform such analyses. Each proposed rule is discussed in more detail below and the value of each impact is calculated using the data available.

6.1.1 Limiting Days per Week

The proposed rules designate millions of acres of coastal and joint waters as new SSNAs that would restrict harvest. Currently, shrimpers can freely choose when to go fishing in these waters except in areas already restricted (i.e., those designated as PNAs, SNAs, existing SSNAs, and shrimp trawl net prohibited areas; see Table 2.1). Holding all other factors constant, reducing the number of days in a week to fish would reduce shrimp trawling effort (i.e., fewer trips); however, it may be difficult to quantify associated reductions in bycatch. It is possible that recoupment may occur (e.g., increased number of tows during open periods resulting in a minimal reduction of bycatch). It is unknown if fishermen are currently maximizing effort during periods when the shrimp are available. Therefore, the extent of the effort reduction and the associated costs and benefits are uncertain. Commercial landings are reported on trip tickets, which only collect self-reported dates of when the trip started (vessel left the dock) and when they returned to offload. Specific fishing days and times are not currently collected, so an estimate of when effort is maximized is not possible with the data available. More specific data on fishing times would be needed.

The Petitioner correctly points out that it has been observed that the best catches of shrimp are usually immediately after the existing weekend closure. The literature cited by both the Petitioner and the Shrimp FMP Amendment 1 state there is as much as twice as many pounds of shrimp caught early in the five-day trawling week than later in the week (Johnson 2006). This suggests that time restrictions could improve the efficiency of the shrimp fishery. However, reducing allowable days to three per week does not take into account days lost to weather, unfavorable tides, and moon phases, when less options could remain in a week for fishermen to decide when to go fishing. Johnson (2006) further notes that the efficiency of the fishery may be improved by increasing the number of breaks in the week, either by having two one-day closures during the week rather than one two-day closure, or by reducing the number of total days during the week for which trawling is allowed. These potential benefits may be offset, to an unknown extent, by concentrated recoupment of effort and the potential for depressed ex-vessel prices mentioned previously.

It is also unclear how the proposed rules limiting days of the week would affect vessels that are out for multiple days at a time, which is a common practice for large trawlers. If the allowed fishing days are not consecutive, these trawlers may not be allowed to conduct multi-day trips, which would cut into overall profitability of the trip and would complicate enforcement.

The Petition document does not address which days of the week to close and the Petitioner stated in their comments they did not intend to recommend specific days for closure and that decision is best left to the Fisheries Director. The Petitioned rules as written limit trawling effort in estuarine waters to no more than three days per week. If days of the week are eliminated based on average participation (Thursday, Friday, Wednesday, Tuesday; weekdays with the most fishermen ranked from highest to lowest number of fishermen participating) then, with other conditions remaining the same, the maximum potential loss would be an average of 7,612 trips and a total of $10,757,771 in revenue from the shrimp fishery annually (253 participants; Table 6.1). At a minimum (Tuesday, Monday, Saturday, Sunday; weekdays with least fishermen ranked from highest to lowest number of fishermen participating), it would result in a potential average loss of 3,107 trips and $2,466,074 in revenue annually (146 participants). This is only an approximation based on the average daily value of shrimping trips from the NCTTP. Dates used to derive landings by weekday represent the unload/off load date at the dealer and may not reflect actual fishing days. The NCTTP does not record fishing date or time spent fishing. Actual losses may be greater or less depending on how effort is redirected into the new available fishing days, and/or exits from the fishery.

The Petitioned rules as written limit trawling efforts in state ocean waters to no more than four days per week. If days of the week are eliminated based on average participation (Monday, Thursday, Friday; weekdays with the most fishermen ranked from highest to lowest number of fishermen participating) then, with other conditions remaining the same, the maximum potential loss would be an average of 1,463 total trips and a total of $1,419,681 in revenue annually (77 participants; Table 6.1). At a minimum (Tuesday, Saturday, Sunday; weekdays with the least fishermen ranked from highest to lowest number of fishermen participating), it would result in a potential average loss of 1,086 total trips and $1,007,044 in revenue annually (63 participants). This is only an approximation based on the average daily value of shrimping trips from the NCTTP. Dates used to derive landings by weekday represent the unload/off load date at the dealer and may not reflect actual fishing days. The NCTTP does not record fishing date or time spent fishing. Actual losses may be greater or less depending on how effort is redirected into the new available fishing days, and/or exits from the fishery.

Shrimp trawlers also land other species of finfish and shellfish as non-targeted catch that can be legally sold rather than discarded. Table 6.2 shows an average weekday catch by shrimp otter trawlers of non-shrimp species and the value of those non-shrimp catches. Applying the same logic as before in restricting the days of the week based on average participation (number of fishermen), and using shrimping effort as the determinate since shrimp are the target species of those trips, the loss in revenue for non-target species can be estimated.

For estuarine waters, with other conditions remaining the same, eliminating Thursday, Friday, Wednesday, and Tuesday would result in a potential additional loss of an average of $48,589 in revenue annually from non-shrimp species in the shrimp trawl fishery (25 participants; 1,323 trips; Table 6.2). Eliminating Tuesday, Monday, Saturday, Sunday would result in a potential additional loss of an average of $73,405 in revenue annually (32 participants; 2,094 trips). This is only an approximation based on the average daily value of shrimping trips from the NCTTP. Dates used to derive landings by weekday represent the unload/off load date at the dealer and may not reflect actual fishing days. The NCTTP does not record fishing date or time spent fishing. Actual losses may be greater or less depending on how effort is redirected into the new available fishing days, and/or exits from the fishery.

For state ocean waters, with other conditions remaining the same, eliminating Monday, Thursday, Friday would result in a potential additional loss of an average of $37,399 in revenue annually from non-shrimp species in the shrimp trawl fishery (19 participants; 975 trips; Table 6.2). Eliminating Tuesday, Saturday, Sunday would result in a potential additional loss of an average of $28,876 in revenue annually (17 participants; 881 trips). This is only an approximation based on the average daily value of shrimping trips from the NCTTP. Dates used to derive landings by weekday represent the unload/off load date at the dealer and may not reflect actual fishing days. The NCTTP does not record fishing date or time spent fishing. Actual losses may be greater or less depending on how effort is redirected into the new available fishing days, and/or exits from the fishery.

There is a current weekend closure for shrimp trawling in internal coastal waters (non-ocean waters) that has been in place since 1991 (15A NCAC 03L .0102). The Petitioner did not address how the proposed rules limiting the number of allowable trawling days would interact with this current restriction.

A Weekend Trawling for Live Shrimp Permit was established as part of the 2015 Shrimp FMP Amendment 1, allowing permit holders to shrimp for live bait in areas open to the harvest of shrimp with trawls from Friday at 9 p.m. until Saturday at 12 p.m. (noon). Permit holders must report the location of all activities prior to each weekend use of the permit and are only allowed one gallon of dead shrimp per trip. Additional gear restrictions require the use of trawls with no more than a 40-foot combined headrope length and require the use of live tanks with aerators and/or circulating water (50-gallon minimum). While bycatch does occur in this fishery, overall bycatch and at-net mortality is generally low due to short tow times and culling times associated with smaller trawls operating in this fishery. The Petition does not address how reducing the number of days of the week would interact with rules that were established to implement this permit.

Reducing the number of days in the week that trawling is allowed would not only directly impact the live bait shrimp fishery, but would also impact bait users such as recreational fishermen and dealers. The Weekend Trawling for Live Shrimp Permit was established at the request of the MFC Southern Regional AC and was developed to meet the needs of the state's growing live bait market. Live shrimp are a popular bait for many recreational hook and line fishermen, especially anglers targeting Spotted Seatrout in the fall. Prior to the development of the permit, many live bait dealers would sell out of shrimp before the weekend due to limited tank capacity to hold large volumes of live shrimp. Restricting the number of days in the week that trawling is allowed would further limit the supply of live bait shrimp and hinder the growth of the live bait market. The overall value of the fishery has increased over time and its value is higher than food shrimp (NCDMF 2015a). The value of live shrimp sold by the dozen can be as high as $27 per pound. Reducing the number of days that trawling is allowed could further drive up the price per pound of live shrimp for recreational fishermen; however, this could result in higher profits for bait fishery participants. The average value of the bait shrimping fishery for 2007-2016 was $47,897 per year with an average price per pound of $26.11. Regardless of which days of the week would be closed, the availability of live shrimp and the revenue generated from its sale would be negatively and positively impacted by additional closure days, the magnitude of which is unknown as this time.

Table 6.1. Average weekday landings of shrimp from shrimp trawls and skimmer trawls, 2007–2016. (Source: NCTTP)

	Avg. Landings per Trip (lb)	Avg. Ex-Vessel Price ($)	Avg. Number of Trips	Avg. Number of Participants	Avg. Daily Value
Estuarine					
Sunday	169	$1.61	235	59	$63,809
Monday	268	$1.52	1,058	200	$429,952
Tuesday	318	$1.83	1,377	231	$802,358
Wednesday	480	$2.23	1,728	252	$1,847,068
Thursday	667	$2.26	2,043	265	$3,076,013
Friday	860	$2.37	2,464	263	$5,032,333
Saturday	1,136	$2.36	436	94	$1,169,955
State Ocean					
Sunday	376	$1.81	254	50	$173,310
Monday	489	$1.99	478	78	$465,580
Tuesday	539	$1.96	464	75	$490,286
Wednesday	442	$1.95	467	76	$402,270
Thursday	480	$1.94	490	76	$457,471
Friday	529	$2.01	519	78	$551,831
Saturday	473	$1.97	368	64	$343,448

Table 6.2. Average weekday landings and value of non-shrimp species caught with otter trawls, 2007–2016. (Source: NCTTP)

	Avg. Landings per Trip (lb)	Avg. Ex-Vessel Price ($)	Avg. Number of Trips	Avg. Number of Participants	Avg. Daily Value
Estuarine					
Sunday	27	$1.01	1,080	42	$29,609.70
Monday	36	$0.88	263	28	$8,338.25
Tuesday	24	$0.84	196	17	$3,999.51
Wednesday	27	$0.88	33	7	$790.07
Thursday	33	$1.14	692	43	$26,023.03
Friday	44	$1.00	402	34	$17,776.29
Saturday	59	$0.95	555	39	$31,458.19
State Ocean					
Sunday	30	$0.88	333	19	$8,613.01
Monday	43	$0.97	335	20	$13,884.18
Tuesday	41	$0.97	232	15	$9,243.87
Wednesday	37	$1.00	187	12	$6,861.18
Thursday	33	$0.96	319	18	$9,914.18
Friday	44	$0.97	321	20	$13,600.91
Saturday	34	$1.01	317	18	$11,018.83

6.1.2 Nighttime Restrictions

Life histories of the three primary shrimp species harvested in North Carolina determine nighttime or daytime shrimping. Brown and pink shrimp stay burrowed during the day and are more active at night while white shrimp tend to be found more in the water column and can be caught during both day and night (NCDMF 2015a). Ingraham (2003), which is cited by the Petitioner, looked at nighttime versus daytime trawling only off the coast of Brunswick County. They found that the catch of shrimp (*Penaeus spp*.) did not vary significantly between day and night, but catch rates of shrimp were generally higher during the day. They also observed that catch rates of Southern Flounder, Spot, Atlantic Croaker, and Southern Kingfish were significantly higher during night trawling. It should also be noted that this is one study in one geographic area, and may not be representative of the fishery across the state. Currently, there are other areas in the state where nighttime trawling is not allowed. In New River, nighttime trawl restrictions from 9 p.m. through 5 a.m. from Aug. 16 through Nov. 30 were put in place due to user conflicts and are also in place in the ocean off Brunswick County (15A NCAC 03J .0208(b); 15A NCAC 03J .0202(8)).

According to data retrieved from the Astronomical Applications Department of the U.S. Naval Observatory, there are 8,760 hours in a year, and approximately 4,446 hours of daylight in 2017 (AAD 2017). Currently, shrimp trawlers have 6,455 hours available to harvest under current regulations, or about 75% of the time in a year. As mentioned in section 6.1.1, the Petitioned rules seek to limit shrimp trawling efforts to only three days a week for estuarine waters, and four days for state ocean waters. In addition to these weekdays restrictions, the Petitioned rules seek to limit trawling to daylight hours only. A reduction to three days a week reduces the available time for estuarine harvest to 59% of the year, and 45% for state ocean harvest. The available harvest time is further reduced by constraining harvest to daylight hours only. Estuarine trawling would then be limited to 22% of the year, and ocean-going vessels would be limited to 29%. It should be noted that calculating an increased impact to the industry in addition to the reductions from weekday closures presented in section 6.1.1 would be inaccurate, as those estimates likely include reductions from nighttime restrictions as well. When determining weekday reductions, estimates were calculated using unload dates from the Trip Ticket Program since time of fishing was not available. For example, a trip that fished for two days and landed (unloaded) on Wednesday likely included both day and night harvest from that 48-hour trip, so including additional impacts from nighttime trawling on top of weekday restrictions may inadvertently multiply the reduction. The reductions using only weekday closures do not include additional nighttime restrictions on open fishing days, but also do not account for recoupment of effort.

Estimating accurate economic losses to the shrimp fishery from nighttime restrictions is extremely difficult to project. Trip tickets only record total trip duration, defined as the date from when the vessel left the dock to the date when the vessel landed their catch at the seafood dealer. Data elements such as fishing time, tow times, or time of the day when fishing began and ended are not required to be recorded on trip tickets. As a result, the NCDMF does not know what percentage of trips occur exclusively at night, nor how long each trip takes on average. Without this information, it is very difficult to project the loss in shrimp harvest, as the NCDMF does not have a measure for landings per hour. Even though the available time for shrimp trawling would be reduced, economic literature would suggest that a large increase in effort and pressure during available times for trawling would be expected, as fishermen often respond to season and time restrictions by overcapitalizing vessels to increase fishing pressure and recoup lost effort (Conrad 2010; Pfeiffer and Gratz 2016).

The extent that effort is maximized during specific times of the day is unknown. Commercial landings are reported on trip tickets, which only collect self-reported dates of when the trip started (vessel left the dock) and when they returned to offload. Specific fishing times are not currently collected. There are

mixed reports from dialogue between commercial fishermen and NCDMF staff about their preferences for night or daytime trawling, but without a survey of the fleet, it would be difficult to extrapolate to the entire population with any confidence.

6.1.3 Opening Shrimp Season based on Shrimp Count Size

The Petitioner states that opening the fishery when the shrimp count size reaches 60 shrimp per pound (heads-on) would reduce concerns that "shrimp are too small or that bycatch is too high" when the fishery becomes more active in the Pamlico Sound in mid-May (NCWF 2016a). Shrimping effort in Pamlico Sound does not increase until larger quantities of marketable shrimp are available in the sound. Under existing regulations, shrimpers can freely choose when to go fishing in coastal and joint fishing waters except in areas already restricted (i.e., those designated as PNAs, SNAs, existing SSNAs, and shrimp trawl net prohibited areas; see Table 2.1).

Analysis of NCTTP landings data indicates that a 60-count opening target size for Pamlico Sound may not provide a predictable outcome in delaying the opening of shrimp season. Landings (by count size) in Pamlico Sound indicate that the shrimping season may not be greatly affected in the sound if a proposed 60-count opening target size is established and no consideration of shrimp species is accounted for. Brown shrimp would most likely drive the opening date based on shrimp count size because that species is the first shrimp to enter North Carolina estuaries each year.

While setting species-specific target sizes may or may not delay the opening of the shrimping season, the brown shrimp fishery in the southern portion of the state would likely be delayed, as well as the spring shrimp fishery in the Atlantic Ocean. Roughly 90% or greater of all shrimp (i.e., brown, white, pink) harvested in Pamlico Sound are 60-count size or larger (e.g., 56/60 count, 51/55 count, 46/50 count; Table 6.3). Furthermore, only a minimal delay in the opening date would occur if the proposed measures were to include species-specific openings. By May, 52% of all brown shrimp landed in Pamlico Sound from 1994–2015 were 56/60 count or larger, and by June, 95% were 56/60 count or larger (Table 6.4; NCDMF 2017). The same count size of white shrimp landed ranged from a low of 87% in June to a high of 100% in January (Table 6.5). By April, 95% of the pink shrimp landed from Pamlico Sound were 56/60 count or larger (Table 6.6).

NCTTP data only show what was landed and not what may have been discarded due to size. Different culling practices between fishing operations may result in different sizes of discarded shrimp, whereas some vessels typically discard smaller shrimp while others prefer to sell it for bait or keep for consumers who prefer smaller, cheaper shrimp. Independent sampling would be the best way to determine opening based on shrimp count size. The NCDMF conducts a fisheries-independent survey in the waters of Pamlico Sound, and the lower Neuse and Pamlico rivers during the middle two weeks of June and September each year. One objective of the survey is to monitor the distribution, relative size abundance, and size composition of fish, shrimp, and crabs. Sampling is of a stratified random design where 54 stations are randomly selected from strata based on depth and location. Double rigged 30-ft demersal mongoose trawls (9.1-m headrope, 1.0-m by 0.6 m doors, 2.2-cm bar mesh body, 1.9-cm bar mesh cod end, and a 100-mesh tailbag extension) are deployed from the 44-ft fiberglass hulled R/V *Carolina Coast* and towed during daylight hours for a duration of 20 minutes at 2.5 knots. This survey or the use of the R/V *Carolina Coast* may be a means to sample for opening on a 60-count shrimp size. See section 9.2 for a discussion of impacts to the state from monitoring for opening the season based on shrimp count size.

Shrimp count size estimates are based on a combination of conversions used by the NCTTP and length frequencies from marked and released shrimp from the 1960s (McCoy 1968; Appendix 2). Analysis of sizes of brown shrimp from the June Pamlico Sound Survey for the last five years (2012 through 2016),

show approximately 57% of brown shrimp caught were 95 mm or more (61/65 count heads-on and larger; Figure 6.1). Additionally, historical data from the Juvenile Shrimp Sampling (Program 510) taken from 1972 through 2010 (when sampling ended in the Pamlico Sound) during May, June, and July in Pamlico Sound bays and tributaries show that in May 3% of brown shrimp were 95 mm or more (Figure 6.2). This increases through June and July to approximately 64% and 85% of brown shrimp being 95 mm or more, respectively. If brown shrimp count sizes are used to determine an opening, it is possible that the shrimping season could open in June, dependent on environmental conditions. This would potentially have an effect on shrimp fisheries in the southern part of the state where shrimping effort increases in May. Brown shrimp would most likely drive the opening date based on shrimp count size because that species is the first shrimp to enter North Carolina estuaries each year.

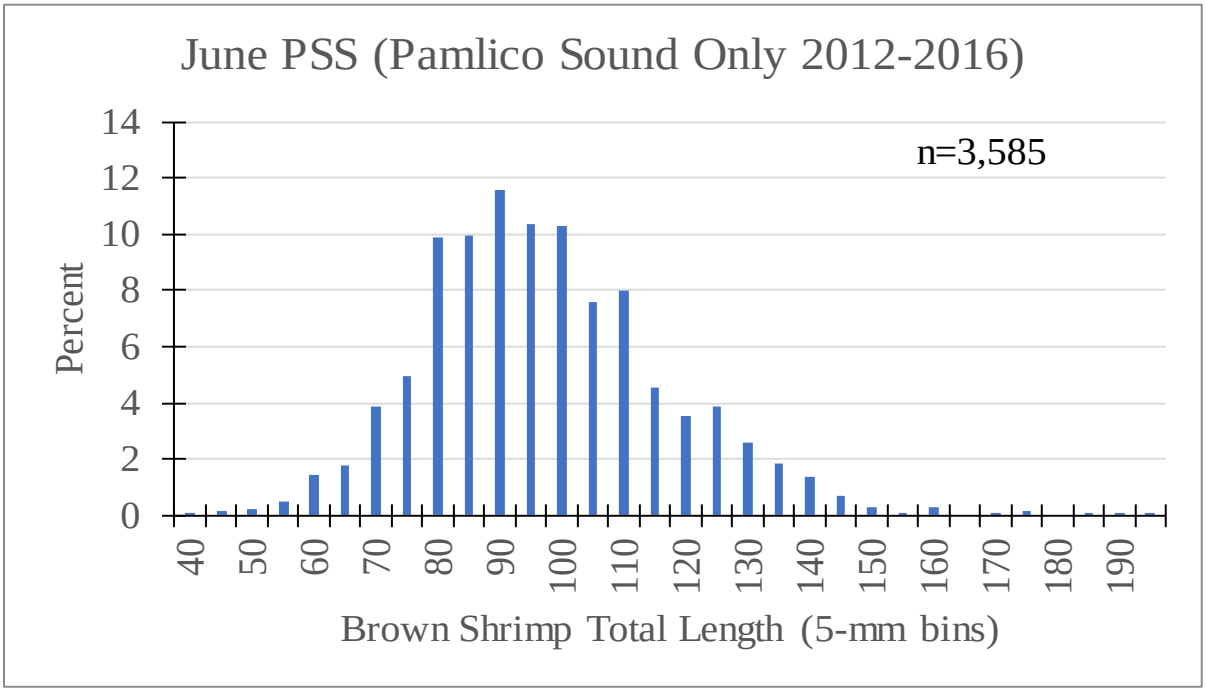

Figure 6.1. Percent brown shrimp lengths from the June Pamlico Sound Survey (Program 195) from 2012–2016. (Source: NCDMF)

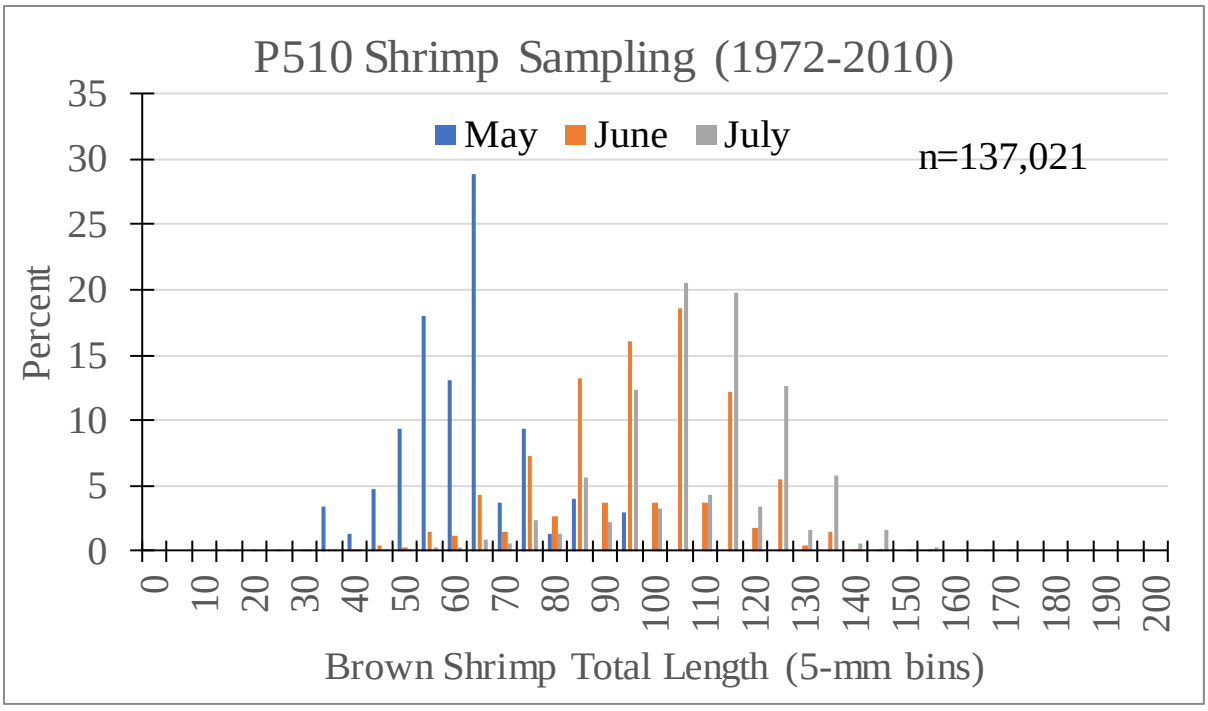

Figure 6.2. Percent brown shrimp lengths from Juvenile Shrimp Sampling (Program 510) of Pamlico Sound bays and tributaries from 1972–2010. (Source: NCDMF)

Table 6.3. Monthly shrimp* (all three species combined) landings and trips by size for Pamlico Sound, 1994–2015 (Source: NCDMF 2017). *Does not include live/bait shrimp (number/dozen).

All Species	Month																									
	1		2		3		4		5		6		7		8		9		10		11		12		Total	
Size	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%
0/15	16,988	35.2	854	8.5	89	4.4	648	1.9	13,321	3.2	77,458	3.3	3,061,672	11.1	7,158,976	30.5	3,245,806	28.4	4,750,376	40.8	2,369,011	49.2	212,549	48.2	20,907,749	25.4
16/20	5,175	10.7	2,307	23.1	774	38.5	1,064	3.2	58,519	14.2	262,518	11.2	7,461,671	27.1	8,260,325	35.1	2,599,565	22.8	2,310,767	19.8	690,220	14.3	63,389	14.4	21,716,294	26.4
21/25	17,099	35.4	6,311	63.1	295	14.7	2,717	8.1	79,202	19.2	484,069	20.6	8,217,683	29.8	3,944,475	16.8	2,145,877	18.8	1,777,708	15.3	638,042	13.2	95,751	21.7	17,409,230	21.2
26/30	1,395	2.9	78	0.8	1	<0.1	5,113	15.2	93,225	22.6	545,250	23.2	4,973,122	18.1	1,688,741	7.2	912,582	8.0	437,025	3.8	128,741	2.7	8,920	2.0	8,794,194	10.7
31/35	4,416	9.1	275	2.8	162	8.1	6,492	19.3	64,546	15.7	278,068	11.8	1,258,997	4.6	491,852	2.1	742,568	6.5	924,798	7.9	436,873	9.1	28,081	6.4	4,237,127	5.2
36/40	1,756	3.6	51	0.5			6,469	19.3	41,528	10.1	340,845	14.5	1,275,412	4.6	591,198	2.5	761,373	6.7	705,102	6.1	292,851	6.1	15,925	3.6	4,032,509	4.9
41/45	816	1.7			438	21.8	3,237	9.6	7,540	1.8	93,762	4.0	119,993	0.4	176,394	0.8	345,036	3.0	287,006	2.5	140,381	2.9	6,258	1.4	1,180,860	1.4
46/50	5	<0.1			33	1.6	3,666	10.9	9,599	2.3	88,529	3.8	170,885	0.6	86,795	0.4	132,489	1.2	106,013	0.9	18,425	0.4	1,380	0.3	617,820	0.8
51/55							797	2.4	339	0.1	12,358	0.5	13,076	<0.1	15,993	0.1	20,287	0.2	9,503	0.1	1,638	<0.1	134	<0.1	74,124	0.1
56/60							232	0.7	2,488	0.6	21,076	0.9	20,519	0.1	23,663	0.1	30,238	0.3	11,221	0.1	2,516	0.1	263	0.1	112,216	0.1
60/70									1,959	0.5	14,156	0.6	7,371	<0.1	10,507	<0.1	20,571	0.2	4,783	<0.1	1,813	<0.1	339	0.1	61,498	0.1
70/80											1,950	0.1	2,845	<0.1	3,697	<0.1	6,433	0.1	881	<0.1	596	<0.1	94	<0.1	16,496	<0.1
80+									11	0.0	1,463	0.1	9,045	<0.1	6,562	<0.1	7,214	0.1	7,199	0.1	93	<0.1	16	<0.1	31,603	<0.1
MIXED	672	1.4	126	1.3	220	10.9	3,135	9.3	39,402	9.6	125,804	5.4	958,718	3.5	1,044,876	4.4	453,753	4.0	315,390	2.7	95,468	2.0	7,762	1.8	3,045,327	3.7
Total	48,321	0.1	10,002	<0.1	2,013	<0.1	33,570	<0.1	411,679	0.5	2,347,306	2.9	27,551,008	33.5	23,504,052	28.6	11,423,791	13.9	11,647,772	14.2	4,816,669	5.9	440,861	0.5	82,237,044	
Size ≥ 56/60	47,649	98.6	9,877	98.7	1,792	89.0	30,435	90.7	370,307	90.0	2,203,933	93.9	26,573,030	96.5	22,438,411	95.5	10,935,820	95.7	11,319,519	97.2	4,718,699	98.0	432,651	98.1	79,082,121	96.2
Size ≥ 60/70	47,649	98.6	9,877	98.7	1,792	89.0	30,435	90.7	372,266	90.4	2,218,089	94.5	26,580,400	96.5	22,448,917	95.5	10,956,391	95.9	11,324,301	97.2	4,720,512	98.0	432,990	98.2	79,143,619	70.8

Table 6.4. Monthly brown shrimp* landings and trips by size for Pamlico Sound, 1994–2015 (Source: NCDMF 2017). *Does not include live/bait shrimp (number/dozen).

Brown Shrimp	Month																							
	1		2		3		4		5		6		7		8		9		10		11		12		Total	
Size	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%
0/15										0.0	23,275	2.3	2,739,682	11.8	5,890,906	31.9	1,645,421	34.9	562,875	44.0	79,625	49.4	6,263	53.7	10,948,047	22.4
16/20									3,123	16.3	72,436	7.1	6,682,595	28.8	6,875,050	37.2	1,275,097	27.0	304,779	23.8	27,125	16.8	1,633	14.0	15,241,837	31.2
21/25					273	100.0					181,267	17.9	6,688,592	28.9	2,750,898	14.9	643,822	13.7	114,587	9.0	19,264	11.9	1,230	10.6	10,399,932	21.3
26/30									1,884	9.9	249,333	24.6	4,417,103	19.1	1,490,067	8.1	458,996	9.7	115,842	9.1	14,251	8.8	1,079	9.3	6,748,554	13.8
31/35									981	5.1	120,196	11.9	739,386	3.2	154,944	0.8	68,404	1.5	21,526	1.7	11,136	6.9			1,116,573	2.3
36/40									1,143	6.0	207,876	20.5	943,251	4.1	377,932	2.0	305,316	6.5	68,554	5.4	7,498	4.7	804	6.9	1,912,374	3.9
41/45									66	0.3	37,928	3.7	64,304	0.3	82,750	0.4	50,056	1.1	10,907	0.9	251	0.2			246,262	0.5
46/50									1,510	7.9	43,399	4.3	127,043	0.5	45,143	0.2	28,397	0.6	10,518	0.8	904	0.6			256,914	0.5
51/55											5,454	0.5	8,650	<0.1	5,384	<0.1	3,104	0.1	1,296	0.1	40	<0.1			23,928	<0.1
56/60									1,136	5.9	9,949	1.0	14,531	0.1	7,591	<0.1	4,281	0.1	845	0.1	48	<0.1			38,381	0.1
60/70											6,418	0.6	4,050	<0.1	2,173	<0.1	6,339	0.1	148	<0.1					19,127	<0.1
70/80											4	<0.1	1,058	<0.1	283	<0.1	528	<0.1	41	<0.1	14	<0.1			1,928	<0.1
80+											4	<0.1	7,934	<0.1	5,329	<0.1	1,019	<0.1	544	<0.1					14,830	<0.1
MIXED									9,271	48.5	56,438	5.6	730,718	3.2	800,570	4.3	225,791	4.8	66,349	5.2	1,067	0.7	650	5.6	1,890,854	3.9
Total					273	<0.1			19,114	<0.1	1,013,976	2.1	23,168,896	47.4	18,489,018	37.8	4,716,571	9.7	1,278,811	2.6	161,224	0.3	11,658	<0.1	48,859,542	
Size ≥ 56/60					273	100.0			9,843	51.5	951,112	93.8	22,425,137	96.8	17,680,664	95.6	4,482,894	95.0	1,211,728	94.8	160,143	99.3	11,008	94.4	46,932,803	96.1
Size ≥ 60/70					273	100.0			9,843	51.5	957,530	94.4	22,429,187	96.8	17,682,836	95.6	4,489,233	95.2	1,211,876	94.8	160,143	99.3	11,008	94.4	46,951,930	96.1

Table 6.5. Monthly white shrimp* landings and trips by size for Pamlico Sound, 1994–2015 (Source: NCDMF 2017). *Does not include live/bait shrimp (number/dozen).

White Shrimp	Month																									
	1		2		3		4		5		6		7		8		9		10		11		12		Total	
Size	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%
0/15	15,493	43.4	131	98.7			103	20.1	209	100.0	10,208	65.9	7,062	22.4	36,455	16.1	669,981	21.3	3,136,115	44.5	1,826,022	55.7	170,825	53.8	5,872,604	41.7
16/20	4,615	12.9									777	5.0	507	1.6	40,555	17.9	727,041	23.1	1,550,635	22.0	537,116	16.4	45,635	14.4	2,906,881	20.6
21/25	9,096	25.5					390	76.0			1,510	9.8	6,001	19.0	40,614	18.0	834,828	26.6	1,115,585	15.8	411,283	12.5	56,168	17.7	2,475,474	17.6
26/30	1,303	3.6			1	5.3	20	3.9			858	5.5	1,727	5.5	14,079	6.2	198,856	6.3	188,949	2.7	63,109	1.9	3,801	1.2	472,703	3.4
31/35	3,006	8.4									70	0.5	7,607	24.1	45,024	19.9	366,092	11.6	541,674	7.7	241,024	7.3	22,772	7.2	1,227,269	8.7
36/40	1,325	3.7									89	0.6	4,347	13.8	14,438	6.4	98,561	3.1	197,914	2.8	59,825	1.8	8,583	2.7	385,081	2.7
41/45	816	2.3											1,657	5.2	8,434	3.7	111,561	3.5	116,931	1.7	70,053	2.1	4,566	1.4	314,018	2.2
46/50													112	0.4	4,952	2.2	17,300	0.6	23,771	0.3	7,567	0.2	667	0.2	54,369	0.4
51/55															294	0.1	3,326	0.1	1,612	<0.1	572	<0.1	114	<0.1	5,918	<0.1
56/60													845	2.7	2,886	1.3	5,618	0.2	3,430	<0.1	1,355	<0.1	80	<0.1	14,214	0.1
60/70															62	<0.1	1,859	0.1	800	<0.1	1,208	<0.1	224	0.1	4,152	<0.1
70/80															786	0.3		<0.1	121	<0.1	459	<0.1	52	<0.1	1,418	<0.1
80+															29	<0.1	1,568	0.0	2,489	<0.1	37	<0.1	10	<0.1	4,133	<0.1
MIXED	78	0.2	2	1.3	18	94.7					1,971	12.7	1,725	5.5	17,384	7.7	105,983	3.4	165,732	2.4	60,187	1.8	4,315	1.4	357,395	2.5
Total	35,734	0.3	133	0.0	19	0.0	513	0.0	209	0.0	15,483	0.1	31,590	0.2	225,992	1.6	3,142,573	22.3	7,045,758	50.0	3,279,817	23.3	317,812	2.3	14,095,631	
Size ≥ 56/60	35,656	99.8	131	98.7	1	5.3	513	100.0	209	100.0	13,512	87.3	29,865	94.5	207,731	91.9	3,033,163	96.5	6,876,617	97.6	3,217,925	98.1	313,211	98.6	13,728,533	97.4
Size ≥ 60/70	35,656	99.8	131	98.7	1	5.3	513	100.0	209	100.0	13,512	87.3	29,865	94.5	207,793	91.9	3,035,021	96.6	6,877,417	97.6	3,219,133	98.1	313,435	98.6	13,732,685	97.4

Table 6.6. Monthly pink shrimp landings and trips by size for Pamlico Sound, 1994–2015 (Source: NCDMF 2017).

Pink Shrimp	Month																									
	1		2		3		4		5		6		7		8		9		10		11		12		Total	
Size	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%
0/15									5,892	2.5	40,620	5.2	218	0.1	534	3.8	776	9.4	11,498	20.8	645	4.7			60,182	4.2
16/20							1,053	6.2	51,243	21.4	174,945	22.2	46,985	14.9	3,846	27.3	491	6.0	9,990	18.0	100	0.7			288,654	19.9
21/25							2,327	13.8	65,151	27.2	212,865	27.1	69,881	22.2	5,201	37.0	197	2.4	11,115	20.1	200	1.5			366,936	25.3
26/30	22	10.8					3,375	20.0	56,525	23.6	189,408	24.1	120,233	38.2	818	5.8	985	12.0	8,483	15.3	2,404	17.4			382,253	26.4
31/35			36	87.8			4,387	26.0	22,803	9.5	44,564	5.7	33,184	10.6	2,415	17.2	3,285	39.9	3,717	6.7	9,520	69.1			123,911	8.5
36/40							2,486	14.7	18,578	7.7	62,810	8.0	24,823	7.9	496	3.5	1,000	12.1	7,877	14.2	300	2.2	414	100.0	118,784	8.2
41/45					123	67.6	1,290	7.6	3,296	1.4	11,436	1.5	887	0.3	436	3.1	970	11.8	1,723	3.1	583	4.2			20,745	1.4
46/50					33	18.1	1,038	6.2	3,390	1.4	22,282	2.8	3,152	1.0	22	0.2	52	0.6	261	0.5					30,230	2.1
51/55							488	2.9	274	0.1	1,597	0.2	339	0.1		0.0	400	4.9	615	1.1					3,713	0.3
56/60							232	1.4	384	0.2	5,476	0.7	169	0.1	295	2.1	80	1.0	60	0.1					6,696	0.5
60/70											697	0.1	224	0.1					65	0.1	14	0.1			1,000	0.1
70/80													6	0.0											6	<0.1
80+																										<0.1
MIXED	181	89.2	5	12.2	26	14.3	202	1.2	12,373	5.2	19,934	2.5	14,267	4.5							18	0.1			47,006	3.2
Total	203	<0.1	41	<0.1	182	<0.1	16,878	1.2	239,909	16.5	786,634	54.2	314,368	21.7	14,064	1.0	8,236	0.6	55,405	3.8	13,784	1.0	414	<0.1	1,450,117	
Size ≥ 56/60	22	10.8	36	87.8	156	85.7	16,676	98.8	227,536	94.8	766,003	97.4	299,871	95.4	14,064	100.0	8,236	100.0	55,340	99.9	13,752	99.8	414	100.0	1,402,105	96.7
Size ≥ 60/70	22	10.8	36	87.8	156	85.7	16,676	98.8	227,536	94.8	766,700	97.5	300,095	95.5	14,064	100.0	8,236	100.0	55,405	100.0	13,766	99.9	414	100.0	1,403,105	96.8

Environmental conditions also play a role in size and number of shrimp, affecting each species differently. Once post-larval shrimp enter the estuaries, growth is highly dependent on salinities and temperature (NCDMF 2015a). For example, a warm winter, along with a dry year may have a positive impact on shrimp count size and growth while a cold winter during a wet year may result in fewer and smaller shrimp. Extreme weather conditions that result from hurricanes can also have an impact.

Current rules do not restrict shrimping effort in any waters except in PNAs, SNAs, existing SSNAs, and shrimp trawl net prohibited areas, leaving a large amount of water open to shrimping (See Table 2.1). Restricting shrimping effort in these remaining waters and enacting a closure until shrimp count size reaches 60 shrimp per pound in Pamlico Sound could also result in "grand openings," where a large number of vessels operate in an area following a closure. Reductions in bycatch may then be offset by recoupment from the increased effort once an area is opened. Previous fishing seasons observed by NCDMF have shown that delayed openings in the existing SSNAs in waterbodies such as New River and Stump Sound have resulted in a large number of vessels in a small area trying to recoup harvest and effort once the areas are opened.

As proposed, the Petitioner recommends that all areas open once Pamlico Sound shrimp are 60-count size heads-on (NCWF 2016a). They proposed the use of Pamlico Sound as a "proxy" for other areas to determine coastwide opening of the shrimp season because the majority of effort occurs in Pamlico Sound. Under the Petition, NCDMF would be required to develop new sampling protocols that would likely involve significant effort by the NCDMF to sample shrimp in Pamlico Sound (see section 9.2). The Shrimp FMP Amendment 1 provides guidance on count sizes for opening shrimping in different areas, especially in the southern and central coast.

6.1.4 Reduction in Headrope Length

The Petitioner interprets Brown (2015) to say that otter trawl headrope length has increased over time and states that in 2012, the average maximum headrope length was 94 feet and in 2015, this length increased to 134 feet (NCWF 2016a). Therefore, the Petitioned rules propose a 90-foot maximum headrope length in estuarine waters and a 110-foot maximum in ocean waters. However, it should be noted that observer coverage during this time was less than 2% of the commercial shrimp otter trawl fishery (fishing days) for 2015 and may not provide a true representation of the fishery.

The Shrimp FMP Amendment 1 examined headrope lengths for the years 2010 and 2011 by area, using data from the CFVR gear survey, and found that average total headrope length in Pamlico Sound was 128 feet and 117 feet, respectively (Table 6.7). In the mouths of the Neuse, Pamlico, and Bay rivers, the average total headrope length was 55 feet in 2010 and 52 feet in 2011. Total headrope lengths in Carteret County waterbodies averaged 47 and 46 feet during those same years. South of Carteret County, vessels with average total headrope lengths measuring 40 feet or less made up the majority of the fleet in both years, in the ocean, vessels using total headrope lengths less than 120 feet accounted for 44% of the fleet in 2010 and 46% in 2011. Average total headrope length for skimmer trawlers was less than 50 feet in the Pamlico Sound, as well as other parts of the state. Based on these data, the larger double-barrel and four-barrel shrimp trawlers would be the most affected by the proposed 90-foot headrope length. These vessels typically fish in Pamlico Sound (164–189 vessels over 90 feet of headrope) and the Atlantic Ocean (70–93 vessels over 90 feet of headrope; Table 6.7). Data from the CFVR gear survey has its limitations and should be used with the understanding that it was the best data available at the time. Limitations from this survey include the fact that answers to the survey reflect the fisherman's predominant gear and does not capture variations in the use of different sizes and number of nets or rigs. In addition, only one predominant waterbody can be captured on some trip ticket forms, limiting the geographic scope of the survey results as compared to trip ticket landings and does not capture the variety of waterbodies in which

these fishermen operate. A more comprehensive gear survey is needed to better characterize the fishery, specifically in regards to headrope length.

North Carolina's headrope regulations were put in place following the 2006 Shrimp FMP as a means to allocate the resource fairly among vessels of all sizes, reduce bycatch, and to limit the effects of trawling in the prescribed areas. Greater headrope length and the use of multiple smaller nets ("double-barrel" and "four-barrel" rigs) allow trawlers to sweep a larger total area per gallon of fuel, resulting in increased CPUE and efficiency (Watson 1984). Currently, there are no data that show that larger headrope lengths yield more bycatch per unit effort. The type and amount of bycatch from a single tow is hard to predict as some tows result in very low bycatch and others have greater levels of bycatch. Reducing headrope length would reduce the total area fished, but since there is not a one to one relationship between harvest and bycatch, neither the magnitude of the bycatch reduction nor the impact on the harvest of target species can be determined. Restricting the total headrope length of otter trawls would essentially restrict the total number of rigs, as well as vessel size in most parts of the state (Table 6.7). It is also important to note that the fishing power, efficiency, and selectivity of the gear rely on more than just the length of the headrope. Currently, it is unlawful to use shrimp trawls that have a combined headrope greater than 90 feet in internal coastal waters (non-ocean) except Pamlico Sound and in the mouths of the Pamlico and Neuse rivers. Through the Shrimp FMP Amendment 1, the areas of Pamlico Sound and the mouths of the Pamlico and Neuse rivers have a maximum headrope length of 220 feet. This became effective on Jan. 1, 2017 and was implemented to cap the fishing capacity of the fleet. In both South Carolina and Georgia, maximum headrope length is also 220 feet. The Atlantic Ocean of North Carolina has no headrope limits.

Decreasing the overall headrope would decrease the overall landings per tow. This would increase the number of haul backs needed to capture the same volume of shrimp with longer headrope lengths. This may result in decreased efficiency and higher operating cost for the fishery. If the efficiency of the gear is reduced due to smaller headropes, some shrimpers may pull more tows and/or longer than normal tows, so total area fished could potentially increase as well as effort. Some may exit the fishery completely, causing effort and intensity to be reduced. Because the Petitioned rules affect multiple aspects of the shrimp fishery in addition to headrope length, it is impossible to predict how fishermen would respond to the proposed rules in order to recoup potential losses or if operating costs started to exceed their profits. Operating costs may also be on the rise with increasing fuel costs and gear costs due to inflation. Additionally, the NCDMF does not have complete or representative data on operational costs per trip in the shrimp fishery, so it would be extremely difficult, if not impossible, to monetize the effect of the proposed rules on gear efficiency and operational costs. To determine the average expenditures for each trip and vessel, additional data would need to be collected. See section 6.3.2 for more on operational expenses.

A benefit of reduced headrope length could be shorter culling times due to the drop in overall landings per tow, which may potentially decrease the discard mortality of species not kept for sale. Reduced landings per tow also reduces the weight or volume of catch in the tailbag of the trawl, which also has an effect on discard mortality, along with species composition of the catch and the size of discarded fish. It is difficult to estimate what percent of discarded fish die once they return to the water due to delayed mortality (mortality happening after the fisherman has lost sight of the released fish) and predation.

Table 6.7. North Carolina vessel and shrimp trawl configuration by area and year, 2010–2011. (Source: NCDMF 2017)

Year	Trawl Type	Area Fished	Total Shrimp	Trips	Average Shrimp	Vessels	Vessel Length		Total Headrope Length		Single Rig		Double-Barrel Rig		Four-Barrel Rig	
							Average	Mode	Average	Mode						
			lb	#	(lb/trip)	#	ft	ft	ft	ft	#	%	#	%	#	%
2010	Otter	Pamlico Sound	3,837,201	1,656	2,317	220	53	36	128	180	31	14%	71	32%	118	54%
2011	Otter	Pamlico Sound	3,633,502	1,502	2,419	201	49	36	117	70	37	18%	71	35%	93	46%
2010	Otter	Neuse, Pamlico, Bay Rivers	114,871	377	305	58	31	20	55	80	22	38%	33	57%	3	5%
2011	Otter	Neuse, Pamlico, Bay Rivers	104,743	446	235	49	30	19	52	30	21	43%	25	51%	3	6%
2010	Otter	Bogue/Core/ Newport/North River	110,046	553	199	67	29	22	47	15	30	45%	35	52%	2	3%
2011	Otter	Bogue/Core/ Newport/North River	34,584	166	208	43	28	21	46	15	21	49%	22	51%	0	0%
2010	Otter	Southern	216,110	1,394	155	103	22	17	38	35	92	89%	7	7%	4	4%
2011	Otter	Southern	114,799	945	121	65	23	19	39	30	55	85%	9	14%	1	2%
2010	Otter	Ocean	1,253,754	1,623	772	116	51	55	120	160	23	20%	38	33%	55	47%
2011	Otter	Ocean	1,091,810	1,333	819	92	51	55	120	200	22	24%	26	28%	44	48%
2010	Skimmer	Pamlico Sound	*	*	*	2	24		20		0	0%	2	100%	0	0%
2011	Skimmer	Pamlico Sound	699	4	175	4	34	34	46		0	0%	4	100%	0	0%
2010	Skimmer	Neuse, Pamlico, Bay Rivers	14,771	73	202	7	28	25	27	28	0	0%	7	100%	0	0%
2011	Skimmer	Neuse, Pamlico, Bay Rivers	17,191	73	235	4	22		21		0	0%	4	100%	0	0%
2010	Skimmer	Bogue/Core/ Newport/North River	132,458	607	218	37	28	25	29	20	0	0%	37	100%	0	0%
2011	Skimmer	Bogue/Core/ Newport/North River	14,470	94	154	12	29	28	32	24	0	0%	12	100%	0	0%
2010	Skimmer	Southern	137,408	439	313	26	30	17	40	48	0	0%	26	100%	0	0%
2011	Skimmer	Southern	23,215	156	149	17	33	38	42	48	0	0%	17	100%	0	0%

***** Confidential, 3 or less participants, vessels, or dealers

† It is unlawful to take shrimp with trawls which have a combined headrope of greater than 90 feet in internal coastal waters except:

(1) Pamlico Sound;

(2) Pamlico River downstream of a line from a point 35° 18.5882'N – 76° 28.9625'W at Pamlico Point; running northerly to a point 35° 22.3741'N - 6°28.6905'W at Willow Point;

(3) Neuse River northeast of a line from a point 34° 58.2000'N – 76° 40.5167'W at Winthrop Point on the eastern shore of the entrance to Adam's Creek running northerly to a point 35° 01.0744' N – 76°42.1550' W at Windmill Point at the entrance of Greens Creek at Oriental.

6.1.5 Limiting Tow Times

The Petitioned rules establish 45-minute tow times for all trawl nets in estuarine and state ocean waters. This would greatly impact the shrimp trawl fishery as well as the other trawl fisheries operating in the state, as no tow time limits are currently required. Other trawl fisheries operating in estuarine waters that would be affected by the proposed tow time limits include clam trawling, crab trawling, peeler trawling, and the skimmer trawl fishery that targets both shrimp and non-shrimp species. Other trawl fisheries operating in state ocean waters include flounder trawling and flynets. The potential impact to the shrimp trawl fishery is discussed below. Due to a lack of data on the tow times used by fishermen in other trawl fisheries, the impacts from the Petitioned rules to these fisheries are unknown.

Similar to statements regarding headrope length, the Petitioner interprets Brown (2015) to say that tow times have increased over time. The Petition states that in 2012, average tow times were 100 minutes in Pamlico Sound and in 2015, tow times increased to an average of 181 minutes (NCWF 2016a). It must again be considered that these times are from observer data collected from less than 2% of the fishery and may not indicate trends in the fishery overall.

Reduced tow times were also considered as a potential management measure in the Shrimp FMP Amendment 1 in 2015. Reduced tow times would likely reduce bycatch mortality by reducing contact time with the fishing gear, culling time, and exposure on the deck, since total catch per tow would be reduced. However, fish aggregations as well as shrimp aggregations are not uniformly distributed, thus the magnitude of reductions in catch per unit of effort is unknown. Johnson (2006) found that tow duration patterns were inconsistent. Short tow times sometimes produced less bycatch and sometimes they produced more bycatch. Decreasing tow times means increasing the time gear is out of the water (increased number of haul backs), which may decrease effort, but some recoupment with additional tows would likely occur. Finally, increased frequency of gear deployment and haul back may result in a greater chance of fouling the gear, as well as increased risks of crew injury from doors and winches. This management option was removed by the Shrimp FMP AC from the overall option list during the development of Amendment 1.

As mentioned in section 6.1.4 with regards to a reduction in headrope length, a decrease in tow time may decrease the overall landings per tow. This would likely increase the number of haul backs needed to capture the same volume of shrimp during a tow where the time was not restricted to 45 minutes as put forth in the Petitioned rules. This could result in decreased efficiency and higher operating cost. However, there are not specific data available on operational cost per trip in the shrimp fishery. It is hard to determine what the losses would be in terms of efficiency or how operational cost would rise. To determine the average expenditures for each trip and vessel, additional data would need to be collected.

Enforcement of a tow time is extremely difficult without either constant Marine Patrol oversight for the entire duration of a tow or implementation of a costly vessel monitoring system. A NCDMF Marine Patrol officer must be able to observe when the trawl doors go into the water and observe when the doors are out of the water, as well as determine how long the tow lasts. It is challenging for one officer to observe more than one vessel at a time, so it is a labor-intensive process and one where the vessels outnumber the officers. See section 9.1 for enforcement concerns regarding tow time restrictions.

As written, the Petition's proposal to implement shrimp trawl tow time limits would be very difficult to enforce. Even if a marine patrol officer is in close proximity to a shrimp trawl while it is in the middle of a tow, it is difficult for the officer to see if the trawl doors come completely out of the water, which determines the stopping point of the time limit. The proposed rule may also need a requirement to empty the contents of the net at the end of the tow in order to clearly distinguish a single tow event.

Tow times in the ocean were enforced from 1996 through 2005 under a now-expired Incidental Take Permit (ITP) from NMFS issued to the NCDMF to allow trawlers from Browns Inlet to Rich's Inlet to operate without turtle excluder devices due to the presence of grass (brown algae). This involved constant monitoring and numerous observers and was difficult to enforce. Proclamations issued to regulate that permit (such as SH-15-2001) established a tow time definition and required the nets to be emptied in-between tows, which were critically important details to the feasibility of the restrictions. The requirement to empty nets between tows allowed officers to determine the length of the tow and, in this case, gave any endangered turtles that had interacted with the trawl a better chance of survival.

Another component of the enforcement concern about shrimp trawl tow times is the lack of a definition of a start and stop for skimmer trawls. This would be needed to enable monitoring by NCDMF Marine Patrol officers. Unlike otter trawls, skimmer trawls do not have doors and the trawl frames remain in the water at all times. These issues, as well as responding to the anticipated bystander complaints regarding operation of legal tow times, would likely impact the ability of officers to enforce other fishery regulations.

6.1.6 Minimum Size Limits

Minimum size limits implemented as part of the Petitioned rules would result in increased discards as well as a loss of revenue from the sale of Spot and Atlantic Croaker incidentally caught in the shrimp trawl fishery. Using length data from commercial shrimp trawl characterization studies conducted in the estuarine and ocean waters of North Carolina, approximately 99% to 100% of Spot caught would be discarded as the result of an 8-inch minimum size limit (total length; TL). The majority of Spot measured in the estuarine otter trawl fishery ranged from 2 to 7 inches TL and 3 to 5 inches TL in the skimmer trawl fishery (Brown 2010, 2015, 2017). The majority of Spot measured in the ocean otter trawl fishery ranged from 3 to 8 inches TL; however, 8-inch Spot were only recorded from ocean otter trawls by Brown (2017) in the fall of one study period and this size made about 10% of the total Spot sampled during that study (Brown 2009, 2015, 2017).

In the estuarine and ocean shrimp trawl fisheries, it is estimated that approximately 100% of Atlantic Croaker caught and previously sold would be discarded as the result of a 10-inch minimum size limit (TL). The majority of Atlantic Croaker measured in the estuarine otter trawl fishery ranged from 3 to 7 inches TL and 4 to 6 inches TL in the skimmer trawl fishery (Brown 2010, 2015, 2017). In the ocean otter trawl fishery, the majority of Atlantic Croaker measured ranged from 5 to 8 inches TL (Brown 2009, 2015, 2017). See Brown (2009, 2010, 2015, 2017) for a full description of the species composition and length frequencies of key species.

NCDMF Trip Ticket data indicate the annual ex-vessel value of Spot caught as bycatch in the estuarine shrimp trawl fishery over the last 10 years has ranged from $734 to $14,276 (Table 6.8). The average landings of Spot caught in the estuarine shrimp trawl fishery was 9,476 pounds annually from 2007 to 2016. In state ocean waters (0–3 miles), ex-vessel value of Spot caught as bycatch in the shrimp trawl fishery ranged from $1,384 to $10,382 per year with average landings of 6,353 pounds annually from 2007 to 2016. The annual ex-vessel value of Atlantic Croaker caught as bycatch in the estuarine shrimp trawl fishery, for the same time period, has ranged from $61 to $3,983 (Table 6.9). The average landings of Atlantic Croaker caught in the estuarine shrimp trawl fishery was 910 pounds annually from 2007 to 2016. In state ocean waters (0–3 miles) from 2007 to 2016, Atlantic Croaker landed annually are valued from $19 to $1,780. The average landings of Atlantic Croaker caught in the ocean fishery was 363 pounds annually from 2007 to 2016.

Currently, no data are available to establish the opportunity costs of culling undersized fish. While tow time is recorded for characterization studies conducted in North Carolina waters (Brown 2009, 2010, 2015, 2017), culling time is not. Longer tow times are not always indicative of longer culling times. The amount

of bycatch in a trip can be skewed, with many tows having some bycatch and fewer tows with high bycatch (Johnson 2006; NCDMF 2015a). Thus, culling times can be highly variable due to spatial and temporal differences in fishing effort and the distribution of finfish. Additionally, the species makeup and volume of the catch often dictate culling times as well as the size and efficiency of the crew.

Table 6.8. Annual landings and total value of Spot from shrimp trawls in estuarine and state ocean waters (0–3 miles) in North Carolina, 2007–2016. (Source: NCTTP)

Year	Waterbody	Pounds Landed	Nominal Value	Waterbody	Pounds Landed	Nominal Value
2007	Estuarine	13,609	$9,475	State Ocean	8,004	$5,596
2008	Estuarine	15,452	$9,333	State Ocean	5,797	$3,588
2009	Estuarine	24,341	$14,276	State Ocean	12,170	$7,301
2010	Estuarine	1,089	$734	State Ocean	3,320	$2,225
2011	Estuarine	1,081	$798	State Ocean	1,807	$1,384
2012	Estuarine	3,203	$2,970	State Ocean	3,727	$3,521
2013	Estuarine	15,213	$13,599	State Ocean	9,711	$8,718
2014	Estuarine	16,094	$12,749	State Ocean	8,470	$6,857
2015	Estuarine	1,822	$1,530	State Ocean	2,309	$1,990
2016	Estuarine	2,852	$3,578	State Ocean	8,214	$10,382

Table 6.9. Annual landings and total value of Atlantic Croaker from shrimp trawls in estuarine and state ocean waters (0–3 miles) in North Carolina, 2007–2016. (Source: NCTTP)

Year	Waterbody	Pounds Landed	Nominal Value	Waterbody	Pounds Landed	Nominal Value
2007	Estuarine	161	$61	State Ocean	47	$19
2008	Estuarine	265	$113	State Ocean	241	$124
2009	Estuarine	485	$220	State Ocean	119	$56
2010	Estuarine	341	$139	State Ocean	184	$70
2011	Estuarine	91	$57	State Ocean	77	$57
2012	Estuarine	164	$92	State Ocean	249	$150
2013	Estuarine	368	$281	State Ocean	749	$692
2014	Estuarine	6,787	$3,983	State Ocean	296	$231
2015	Estuarine	179	$141	State Ocean	76	$45
2016	Estuarine	263	$303	State Ocean	1,596	$1,780

6.2 Other Fisheries Including Recreational (excluding Shrimp)

The North Carolina shrimp fishery would be the most affected by the Petitioned rules, but as proposed, those rules impact all trawling in estuarine and state ocean waters and are not specific to just shrimp trawling. Other trawl fisheries that would be impacted include blue crabs, hard clams, and finfish such as flounder. The proposed minimum size limits on Spot and Atlantic Croaker would increase culling time in the trawl fisheries as discussed above, but most notably, would reduce the commercial and recreational harvest in the directed Spot and Atlantic Croaker fisheries.

6.2.1 Limiting Days Per Week

As written, the Petitioned rules would not allow trawling for anything other than crabs or shrimp, effectively eliminating clam trawling (kicking) in the mechanical clam harvest areas in estuarine waters over public bottom and flounder trawling in state ocean waters. Clam harvest can occur over private leased bottom with the proper permit and would not be affected by the Petitioned rules. From 2007–2016, data from the NCTTP show that clam trawling over public bottom accounted for an estimated annual average of 220 directed trips with 15 vessels participating in this fishery. These participants harvested an average of 8,773 pounds of clams with an estimated value of $59,328 annually. The peeler crab trawl fishery is exclusively a nighttime fishery, and under the Petitioned rules, the fishery would also be eliminated. This would result in an average loss of 1,806 pounds of peeler crabs and 23 directed fishing trips whose landings are valued at $5,136 annually. Flounder trawling in state ocean waters had five participants total from 2012–2016 that took an average of five trips each year, accounting for an average of 11,418 pounds of seafood valued at $21,173 annually.

For other trawl fisheries subject to the same weekday closures as shrimp trawling, projected losses to those fisheries can be estimated by mirroring closures in the same fashion as those done for shrimp trawling in section 6.1.1. Other trawl fisheries operating in estuarine waters include clam trawling, crab trawling, peeler trawling, and the skimmer trawl fishery that targets non-shrimp species. Other trawl fisheries operating in state ocean waters include flounder trawling and flynets.

For estuarine waters, with other conditions remaining the same, the restriction of the most active days for shrimp trawling based on participant counts (Thursday, Friday, Wednesday, and Tuesday; weekdays with most fishermen ranked from highest to lowest number of fishermen participating) would result in a potential average annual loss for the clam trawl fishery of 238 total trips and $3,529 dollars in revenue (12 participants; Table 6.10). Potential loss in the crab trawl fishery would be an average of 565 total trips and $885,837 in total revenue (13 participants). Potential loss in the peeler trawl fishery would be an average of 16 trips and $1,597 in total revenue each year (3 participants). Skimmer trawls targeting non-shrimp species would expect a potential annual loss on average of 59 trips and $2,636 in total revenue (3 participants). Restricting the days of the week to the least active days for shrimp trawling based on participant counts (Tuesday, Monday, Saturday, Sunday; weekdays with least fishermen ranked from highest to lowest number of fishermen) would result in a potential loss for the clam trawl fishery of an average of 226 total trips and $3,313 dollars in revenue annually (17 participants). Potential loss in the crab trawling fishery would be on average 306 total trips and $458,897 in total revenue each year (8 participants). Peeler trawling could potentially lose on average 17 trips and $923 in total revenue annually (2 participants) and skimmer trawls landing non-shrimp species would expect a potential average loss of 44 trips and $1,277 in total revenue per year (3 participants). This is only an approximation based on the average daily value of shrimping trips from the NCTTP. Dates used to derive landings by weekday represent the unload/off load date at the dealer and may not reflect actual fishing days. The NCTTP does not record the fishing date or time spent fishing. Actual losses may be greater or less depending on how effort is redirected into the new available fishing days, and/or exits from the fishery.

For state ocean waters, with other conditions remaining the same, eliminating Monday, Thursday, and Friday (most active shrimp trawling weekdays ranked from highest to lowest number of fishermen participating), the potential loss for flounder trawling would be an average of 22 trips and a total of $48,531 in revenue each year (2 participants; Table 6.11). The flynet fishery would have losses of an average of 28 trips and a total of $194,062 in revenue annually (3 participants). Eliminating Tuesday, Saturday, and Sunday (least active weekdays for shrimp trawling ranked from highest to lowest number of fishermen participating), the potential loss to the flounder trawl fishery would be an average of 14 trips and $28,139 in total revenue each year (2 participants). The flynet fishery would lose an average of 17 trips and $120,264 in total revenue annually (2 participants). Dates used to derive landings by weekday represent the unload/off load date at the dealer and may not reflect actual fishing days. The NCTTP does not record the

fishing date or time spent fishing. Again, actual losses may be greater or less depending on how effort is redirected into the new available fishing days, and/or exits from the fishery.

Table 6.10. Average landings per trip, ex-vessel value, and number of participants and number of trips using clam, crab, peeler, and skimmer trawls in estuarine waters by weekday, 2007–2016. (Source: NCTTP)

	Avg. lb per Trip	Avg. Ex-Vessel Price	Avg. Number of Participants	Avg. Number of Trips	Average Value
Clam Trawl Kicking[1]					
Sunday	-	-	-	-	-
Monday	55	$0.26	18	119	$1,707.63
Tuesday	54	$0.28	16	107	$1,606.12
Wednesday	52	$0.23	16	99	$1,171.84
Thursday	61	$0.54	8	17	$558.33
Friday	58	$0.22	7	15	$193.33
Saturday	-	-	-	-	-
Crab Trawl					
Sunday	503	$2.10	1	5	$5,060
Monday	404	$2.27	12	129	$118,324
Tuesday	672	$2.52	14	159	$270,048
Wednesday	524	$2.70	12	136	$192,372
Thursday	424	$2.82	13	140	$168,176
Friday	674	$2.92	12	130	$255,242
Saturday	449	$11.38	3	13	$65,464
Peeler Trawl[2]					
Sunday	78	$0.73	2	6	$367
Monday	67	$0.79	2	5	$257
Tuesday	81	$0.71	2	5	$278
Wednesday	77	$2.06	2	6	$970
Thursday	81	$0.76	2	4	$228
Friday	41	$1.87	1	2	$121
Saturday	26	$0.92	< 1	1	$21
Skimmer Trawl					
Sunday	26	$0.95	1	3	$70
Monday	28	$0.90	5	21	$531
Tuesday	39	$0.97	4	14	$535
Wednesday	69	$1.14	3	11	$882
Thursday	37	$0.95	3	16	$575
Friday	36	$1.02	4	17	$644
Saturday	33	$0.72	2	6	$142

[1] Clam Trawling is prohibited over public bottom on the weekend.
[2] Peeler trawls were separated from traditional crab trawls in 2010.

Table 6.11. Average landings per trip, ex-vessel value, and number of participants and number of trips using flounder trawls and flynets in state ocean waters by weekday, 2007–2016. (Source: NCTTP)

	Avg. lb per Trip	Avg. Ex-Vessel Price	Avg. Number of Participants	Avg. Number of Trips	Average Value
Flounder Trawl					
Sunday	1,002	$2.64	1	2	$4,759
Monday	1,221	$1.57	3	10	$18,195
Tuesday	1,380	$1.86	2	6	$15,921
Wednesday	954	$1.78	2	11	$18,648
Thursday	1,409	$1.96	3	8	$20,726
Friday	952	$1.91	2	5	$9,610
Saturday	779	$1.54	2	6	$7,458
Flynet					
Sunday	5,477	$2.09	1	2	$26,373
Monday	3,112	$1.79	3	9	$47,435
Tuesday	2,681	$1.73	3	9	$42,141
Wednesday	3,774	$1.47	3	9	$49,371
Thursday	4,786	$1.82	4	12	$100,781
Friday	4,998	$1.22	2	8	$45,847
Saturday	7,165	$1.36	2	5	$51,749

6.2.2 Minimum Size Limits

6.2.2.1 Commercial Reductions

Percent reductions in commercial harvest value of Spot based on an 8-inch minimum size limit and Atlantic Croaker based on a 10-inch minimum size limit in North Carolina waters were estimated using data from the NCTTP for years 2007–2016, combined with expanded length frequencies for Spot and Atlantic Croaker by market grade from the NCDMF fish house sampling. Fish house sampling data were available by year and gear and once combined with the trip ticket data, reductions could be evaluated by area (i.e., estuarine, state ocean, and federal ocean waters). The estimated reductions for Spot vary by market grade ranging from 0.19% in the large market grade to 67% in the small market grade (Table 6.12). Most Spot landed commercially in North Carolina are in the Mixed market grade, which saw a 35.6% reduction. Across all market grades, Spot is estimated to have an average loss of $135,767 per year (Table 6.13). In 2016, the Spot fishery was valued at approximately $295,019 resulting in an overall 46% loss of value to the fishery.

As with Spot, reductions for Atlantic Croaker varied widely by market grade. Jumbo croaker had no estimated reductions, but x-small croaker would all be under the proposed size limit; therefore, a 100% loss would occur in that market grade (Table 6.14). Atlantic Croaker is estimated to have an average loss of $311,247 per year across all market grades and areas (Table 6.15). In 2016, the Atlantic Croaker fishery was valued at approximately $2,216,106; therefore, the imposed 10-inch size limit would roughly result in an overall 14% loss of value to the fishery.

6.2.2.2 Recreational Reductions

Percent reductions in recreational harvest of Spot based on an 8-inch minimum size limit and Atlantic Croaker based on a 10-inch minimum size limit in North Carolina waters were estimated using data collected by MRIP. Harvest and the percentage of fish at length were examined from 2011-2016 to estimate percent reduction. In 2012, 2013, and 2016, the modal length of Spot in the recreational harvest was 7

inches (Figure 6.3). In 2011, 2014, and 2015, the modal length of Spot in the recreational harvest was 8 inches. Recreational harvest of Spot in North Carolina would have been reduced by 34–67% from 2011–2016 if an 8-inch total length size limit were applied to those harvest numbers, holding all else equal (Table 6.16).

In 2012–2014 and 2016, the modal length of Atlantic Croaker in the recreational harvest was 8 inches (Figure 6.4). In 2011 and 2015, the modal length of Atlantic Croaker in the recreational harvest was 9 inches. Recreational harvest of Atlantic Croaker in North Carolina would have been reduced by 72–84% from 2011–2016 if a 10-inch total length size limit were applied to those harvest numbers, holding all else equal (Table 6.17).

Table 6.12. Estimated reductions in total commercial landings of Spot due to 8-inch minimum size limit by market grade and gear. (Source: NCDMF)

	Market Grade			
Fishery	Large	Medium	Mixed	Small
Estuarine Gill Net	0.19%	25.28%	16.98%	57.00%
Long Haul	0.19%	3.65%	45.41%	67.34%
Ocean Gill Net	0.19%	45.44%	12.40%	77.68%
Ocean Trawl	0.19%	24.79%	35.48%	67.34%
Pound Net	0.19%	24.79%	67.94%	67.34%
Overall Average	**0.19%**	**24.79%**	**35.64%**	**67.34%**

Table 6.13. Estimated average ex-vessel value loss from reductions in Spot landings due to 8-inch minimum size limit by market grade and area. (Source: NCTTP)

	Market Grade			
Area	Large	Medium	Mixed	Small
Estuarine	-$2.91	-$503.98	-$107,996.15	-$641.63
State Ocean	-$2.64	-$1,003.48	-$23,959.61	-$895.91
Federal Ocean	-$0.11	-$56.47	-$591.59	-$112.63
Total	**-$5.66**	**-$1,563.94**	**-$132,547.35**	**-$1,650.17**

Table 6.14. Estimated reduction in total commercial landings of Atlantic Croaker due to 10-inch minimum size limit by market grade and gear. (Source: NCDMF)

	Market Grade					
Fishery	Jumbo	Large	Medium	Mixed	Small	X-small
Estuarine Gill Net	0%	0.12%	20.10%	46.39%	66.59%	100%
Long Haul	0%	0.03%	19.77%	59.07%	83.91%	100%
Ocean Gill Net	0%	0.02%	2.46%	52.59%	87.83%	100%
Ocean Trawl	0%	8.37%	5.53%	8.14%	56.88%	100%
Pound Net	0%	11.54%	13.77%	99.20%	66.44%	100%
Overall Average	**0%**	**4.02%**	**12.33%**	**53.08%**	**72.33%**	**100%**

Table 6.15. Estimated average ex-vessel value loss from reductions in Atlantic Croaker landings due to 10-inch minimum size limit by market grade and area. (Source: NCTTP)

	Market Grade					
Area	Jumbo	Large	Medium	Mixed	Small	X-Small
Estuarine	$0.00	-$32.99	-$4,072.40	-$3,249.88	-$8,126.49	-$29.57
State Ocean	$0.00	-$413.48	-$7,498.87	$39,690.07	-$14,039.42	-$923.54
Federal Ocean	$0.00	-$10,425.69	-$55,719.52	-$41,748.73	-$112,128.76	-$13,147.78
Total	**$0.00**	**-$10,872.16**	**-$67,290.78**	**-$84,688.68**	**-$134,294.67**	**-$14,100.88**

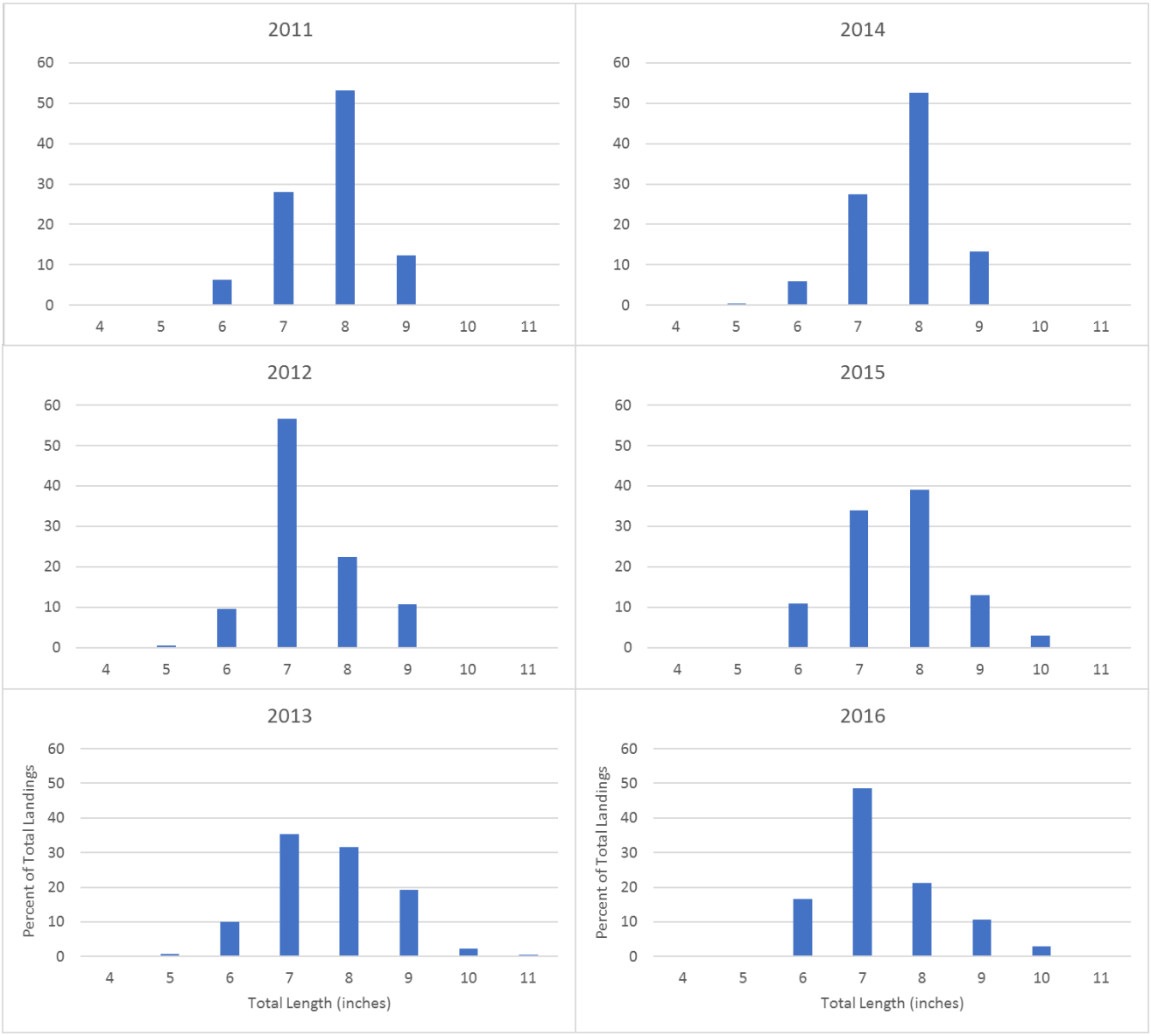

Figure 6.3. Percentage of total Spot landings by length bin (TL) in inches. (Source: NCDMF)

Table 6.16. Estimated reduction in the number of Spot caught recreationally based on an 8-inch minimum size limit. (Source: NCDMF)

	Spot			
Year	Total # of Fish	# of Fish < 8 in.	# of fish ≥ 8 in.	% Reduction
2011	1,206,744	416,002	790,742	34
2012	784,272	523,599	260,672	67
2013	1,464,592	679,067	785,525	46
2014	2,109,790	718,097	1,391,693	34
2015	1,081,083	484,973	596,110	45
2016	513,320	335,094	178,226	65

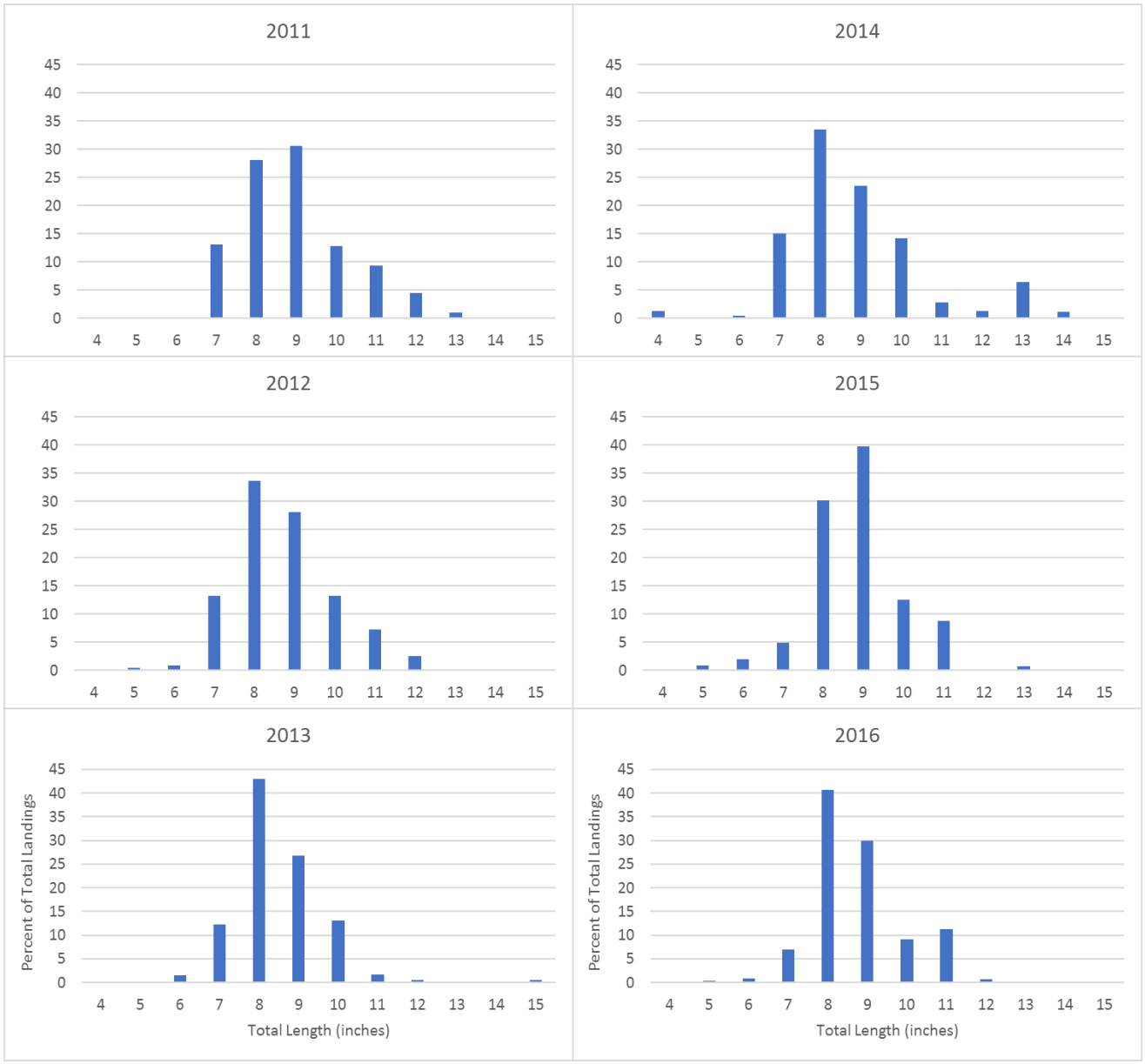

Figure 6.4. Percentage of total Atlantic Croaker landings by length bin (TL) in inches. (Source: NCDMF)

Table 6.17. Estimated reduction in the number of Atlantic Croaker caught recreationally based on a 10-inch minimum size limit. (Source: NCDMF)

	Atlantic Croaker			
Year	Total # of Fish	# of Fish < 10 in.	# of Fish ≥ 10 in.	% Reduction
2011	246,415	177,990	68,425	72
2012	286,309	219,454	66,855	77
2013	411,633	345,656	65,977	84
2014	538,879	398,554	140,325	74
2015	458,338	356,050	102,289	78
2016	363,315	286,719	76,596	79

6.3 Additional Impacts

6.3.1 Disproportionate Impacts by Vessel Size

As mentioned in section 6.1.4, the Petitioned rules have a potential to impact vessels of different size classes disproportionately. Larger vessels on average command greater ex-vessel prices and have overall larger total trip values and landings. Estuarine vessels have more dramatic increases in trip values than their ocean-going counterparts. Average values per trip rise, on average, 48% per size class for estuarine vessels, while only 7% for ocean going vessels (Table 6.18). Landings exhibit a similar distinction between estuarine and ocean vessels. Estuarine vessels land on average 45% more, moving up size classes; however, ocean vessels only increase by 9% per size class. This suggests that ocean vessels are more tightly grouped together in fishing power regardless of vessel length. Both estuarine and ocean vessels take less trips as vessel size increases, due to the ability to land more shrimp per trip. Larger vessels also have more total headrope lengths and an increase in number of rigs; however, the largest ocean-going vessels (80'+) have one less rig on average than the next smallest size class (60–79'). Both estuarine and ocean vessels typically land larger grades of shrimp as their vessel size increases. While most of these observations would be considered easily inferable, it is important to demonstrate that larger vessels are likely to be affected more by the Petitioned rules than smaller vessels, and would most likely bear the majority of losses.

6.3.2 Operational Expenses

North Carolina does not mandate the collection of operational business expenditure data for any specific commercial fishery. NOAA Fisheries requires mandatory reporting of operational expenses for federal shrimpers in the Gulf of Mexico, but the program is voluntary in the South Atlantic, the region under which North Carolina is managed. Federal ocean going shrimping vessels are typically larger and generally different than the smaller estuarine shrimp vessels operating in North Carolina, so their operating costs would be different. Without adequate information about vessels participating in the shrimp fishery in North Carolina waters, it is not possible to determine average operational expenses such as accounting costs, docking fees, insurance payments, and other forms of overhead for the entire fleet. Whether the Petitioned rules would affect overhead could only be determined from observing operational expenses before and after the proposed rules would be in effect.

Evaluating "economic returns" and "returns on equity" of the shrimp fleet should provide some insight on the economic performance of commercial fishermen operating in this fishery. An average economic return

is calculated by dividing net operating revenue by the value of vessel assets. Economic return quantifies the vessel's productivity from a societal perspective. In contrast, the return on equity is the primary concern of the individual vessel owner. The return on equity is calculated by dividing the profit by the equity currently invested by the owner in the vessel.

After reviewing the available survey data from past economic studies conducted by NCDMF characterizing commercial fishing in North Carolina, there were a total of 150 surveys that captured information from shrimp trawlers over the 11 years when these studies took place. Many of these surveys have blank or missing costs fields, making it difficult to get an accurate assessment of average operational expenditures of shrimp trawlers. These data need to be updated to include the most recent surveys conducted 2017; however, there would likely not be enough data to make a statistically valid extrapolation to the whole shrimping fleet. In addition, returns on equity is not possible to calculate given the NCDMF does not collect total loan balances, only estimated monthly payments, in surveys. This is something to consider for future survey/data collection work.

Table 6.18. Average trip characteristics for vessels using shrimp trawls by vessel length and area. (Source: NCTTP)

	Vessel Length (ft)				
Otter Trawl Averages	0–19	20–39	40–59	60–79	80+
Estuarine					
Ex-Vessel Price	$1.44	$1.65	$2.12	$3.06	$3.26
Trip Value	$206	$408	$1,045	$2,428	$3,243
Pounds Landed	132	231	526	1,171	1,565
Trips	678	2,166	1,471	2,158	610
Number of Vessels	33	52	13	15	4
Total Headrope Length	33	58	99	152	173
Rig Count	1	2	3	4	4
Days at Sea	0	3	2	4	5
Shrimp Grade	36/40	31/35	21/25	21/25	21/25
Crew Size	1	2	2	3	4
Vessel Horsepower	69	231	349	447	579
State Ocean					
Ex-Vessel Price	$1.64	$2.04	$1.76	$2.04	$2.65
Trip Value	$836	$361	$676	$2,103	$3,919
Pounds Landed	375	168	315	909	1,680
Trips	41	834	1,143	735	148
Number of Vessels	4	13	8	11	3
Total Headrope Length	40	56	92	132	148
Rig Count	1	1	3	4	3
Days at Sea	0	0	0	2	6
Shrimp Grade	26/30	26/30	26/30	21/25	21/25
Crew Size	2	2	2	3	3
Vessel Horsepower	88	192	344	493	444

6.3.3 Fishing Behavior

Commercial fishing is one of the most dangerous professions in the country, with an annual average fatality rate of more than 30 times the U.S. average (Pfeiffer and Gratz 2016). Despite voluntary and regulatory fishing safety initiatives, the fatality rate has decreased only marginally and substantially less so when compared to other forms of employment in the U.S.

The competitive nature of commercial fishing often results in fishermen being assumed to have risk-prone preferences and engaging in behavior such as fishing in poor weather, capital stuffing (i.e., overcapitalizing by investing more to increase fishing power), and neglecting maintenance of their gear and vessels (Pfeiffer and Gratz 2016). Bockstael and Opaluch (1983) was one of the first widely cited works to have used a random utility model to model uncertainty and risk preferences into the behavioral choices of fishermen. They examined species, location, and gear choice of New England ground fishermen and found that fishermen are responsive to trip alternatives that would land a higher catch and result in more revenue and would forgo some trips with a higher payout for trips that would yield a more constant catch and a steadier stream of revenue, even if it meant less profit. They determined fishermen would rather have constant returns, than a boom or bust with potentially larger revenue yields.

The study by Pfeiffer and Gratz (2016) shows an example that seasonal limitations and open access quotas often lead to derby fishing and fishermen needing to take higher risk in order to land the same volume of catch to make ends meet. Their example of a catch share program being implemented in a large U.S. fishery shows that giving fishermen the opportunity to fish year-round, without restriction reduces the overall risk fishermen take, for example, making the decision to take a trip in adverse weather conditions. After catch shares were implemented in an economically important U.S. West Coast fishery, a fisherman's probability of taking a fishing trip in high wind conditions decreased by 82% compared with only 31% in the former open access fishery with seasonal restrictions.

Historically, many fisheries have been managed as open access, and fishery management has often restricted the length of fishing seasons to mitigate the depletion of a fishery resource (Pfeiffer and Gratz 2016). Seasonal closures of fisheries often "tends to create a perverse incentive to increase fishing power to catch the maximum amount of fish in the shortest amount of time" (Pfeiffer and Gratz 2016). Seasonal restrictions incentivize derby fishing, capital stuffing of vessel gear, and furthermore, fishermen have the incentive to participate in around-the-clock fishing in all weather conditions, overload their vessels, and ignore maintenance problems to maximize catch.

Policy changes affecting health and safety risk are often captured in economic studies as the value of mortality risk reduction, which is defined as how much people are willing to pay for small reductions in their probability of dying from adverse conditions. Calculating a direct cost as a result of increased risk taken by fishermen if the Petitioned rules become effective is not possible to quantify at this time due to the inability to estimate the change in mortality risk.

Another risky behavior resulting from increased regulations not discussed above is fishing outside of the regulations. The amount of fishing occurring outside of the regulations cannot be quantified without collecting information from Marine Patrol for several years after the rules would go into effect, to assess if there has been an increase in violations and a quantifiable impact on the industry. An analysis of violations may not provide a true estimate of increased risky behavior because it is only an estimate of individuals that were caught fishing outside of the regulations. It is impossible to predict how many fishermen would not comply with the proposed rules or how many of those would be found in violation; therefore, the impact of the proposed rules on the profitability of the industry cannot be fully assessed.

Some of the proposed rules (i.e., limiting headrope and tow times) could also cause increased wear and tear on fishing gear and vessel engines. Trying to determine if the proposed rules caused an additional cost to

affected fishermen via gear and engine repair or replacement would not be possible until years after the rules were implemented. North Carolina does not currently survey fishermen for information on gear dexterity; however, it is anecdotal knowledge that trawl nets typically last about three years (K. Brown, NCDMF, personal communication). How tow times and trawling speed would affect the gear and engines remain in question. A survey of gear manufacturers and fishermen would be needed to gather information on refitting costs.

Regulations imposed by fishery managers such as harvest quotas and moratoriums, among others, have resulted in harvest practices where fishermen harvest as much of one species as possible while the season is open, commonly referred to as derby fishing (NCREDC 2013). This harvest practice leads to an oversupply of product, resulting in lower profit margins for fishermen and seafood dealers. Smaller independently owned seafood dealerships typically have only ice and refrigeration to store their own products, which provide a shelf life of less than a week. Consequently, seafood must be moved quickly to avoid spoiling, which can cause low prices and revenues for both fishermen and dealers when supply exceeds demand.

6.3.4 Displacement of Effort

As mentioned in section 4.1, proposed changes to 15A NCAC 03N .0105 provide an exception for existing SSNAs, which have less restrictive harvest regulations than areas that would be newly designated as SSNAs by the Petitioned rules, possibly resulting in a displacement of effort from the newly proposed SSNAs to the currently designated SSNAs.

The Petitioned rules divide SSNAs into two subparagraphs (Table 4.1). Subparagraph (b) is the current list of SSNAs and makes up approximately 37,000 acres. These areas are required to be closed to shrimp and crab trawling between May and August and make up 1.3% of all coastal and joint waters (including the ocean 0 to 3 miles; Table 2.1). Once these areas are opened based on sampling, fishermen are able to trawl day and night, five days a week with unlimited tow times after Aug. 15. The proposed subparagraph (c) describes new SSNAs that include 2.8 million acres of coastal and joint waters not already designated as a nursery area (94.5%; Table 2.1) and would not be subject to the May–August closure. The proposed SSNAs place more restrictions on trawling in a much larger area compared to those SSNAs already in rule.

The existing SSNA rule, 15A NCAC 03N .0105, places less restrictions in a smaller defined area, which may create an increase in trawl fishing effort by fishermen who want to avoid the additional restrictions in the proposed SSNAs. This displacement of fishermen from a large area to smaller areas may result in more user conflicts by concentrating more vessels in the currently defined SSNAs. This may also add to small vessel/large vessel conflict by enabling small vessels to catch shrimp in these smaller, less restricted areas, while larger vessels may only be able to fish in the larger proposed SSNAs.

6.3.5 Exits from Commercial Fishing

It is impossible to predict the number of participants that would exit commercial fishing due to losses in trawl fisheries affected by the Petitioned rules, as many fishermen in North Carolina participate in multiple fisheries throughout the year. Fishermen rarely specialize in any one species or gear, instead switching among gears, areas, and target species throughout the course of a year. This practice in known as “annual round” (Griffith 1996; Johnson and Orbach 1996). This flexible coping strategy accommodates changes or variations in species abundance, environmental conditions, and management regulations (Griffith 1996). Johnson and Orbach (1996) defined the network of relationships among fisheries in the different areas within North Carolina. Even though fishermen participate in multiple fisheries, shrimp trawling was identified as a top five gear in several areas of the state. The shrimp trawl was the central nodal gear in the Carteret and Southern area networks and ranked third in the Pamlico area behind crab pots and flounder gill

nets. In discussing the current Friday night shrimp closure, fishermen revealed it required them to be more regimented in their fishing behavior, negating aspects of their flexibility strategy (Griffith 1996). As mentioned in section 6.1, large trawlers are highly specialized and it is doubtful that these vessels could be repurposed for other fisheries.

Studies in the 1970s and 1980s revealed that shrimp fishermen engage in a variety of both land and water based activities. Fishing activities required moving from one target species to another as opportunities prevailed, even though shrimping involved most of the effort throughout the year (Maiolo 2004). Shrimp fishermen continue to engage in a variety of capture activities throughout the year and, like most of North Carolina's commercial fishermen, they tend to diversify the species they target, gears they use, and waterbodies they fish (NCDMF 2015a). Shrimp constituted an average of 59% of their fishing income.

6.4 Benefits

The Petitioner expects "to see increases in the availability of fishes for harvest under the proposed rules" and says "[a]ll recreational fisheries will benefit if fish stocks currently in depleted or declining status rebound as a result of the proposed rule[s] (NCWF 2016a, p. 14–15)." There is a lack of literature that specifically discusses the benefits expected from implementing rules similar to those proposed in a similar ecological and economic context. Benefits to the fishing industries in the form of increased stock abundance is difficult to evaluate without data both before and after the proposed rules would be implemented. In addition, without an estimate of the effect size of the proposed rules, it is not possible to directly quantify the potential benefits.

Benefits to the industry are dependent on how fish stocks respond to reduced fishing mortality from the Petitioned rules, compliance with new regulations, and displacement of effort in other fisheries. If effort in the primary fisheries affected by the Petitioned rules is displaced into other fisheries, the long-term effects of increased fishing mortality on those fisheries could eventually result in decreased stock abundance, which would result in additional regulations and losses to the industry. There are additional factors that confound how successful the proposed rules would be at increasing stock abundance over time and make quantifying benefits to the industry difficult. These include lost fishing days due to weather in addition to the proposed weekday restrictions defined in the Petitioned rules, as well as any recoupment of effort by fishermen on allowed fishing days and other factors that could offset the intended benefits.

To evaluate the benefits of the proposed rules on the fishing industry, increased CPUE in the shrimp fishery and potential economic impacts due to increased abundance were evaluated for the commercial fishing industry. For the recreational fishing industry, improvements to recreational fishing and associated economic benefits were assessed. Stock projections and their associated economic impact projections were developed by Nesslage and Dumas (2017) for Atlantic Croaker and Weakfish. The stock projections were discussed previously in section 5.1. The economic impact projections are discussed in section 6.4.4. Projections for shrimp and Spot were not available. These projections were not modeling the effect of the proposed rules, but present examples of how the economic impact of commercial and recreational fisheries could potentially respond to changes in stock status.

6.4.1 Recreational Fishing Improvements

Of the 5.4 million recreational fishing trips taken in 2016, 792,883 of those were directed trips for Spot, Atlantic Croaker, or Weakfish (Source: MRIP). This constitutes about 15% of the total recreational fishing trips in North Carolina. These trips were either inshore private vessel trips (57%), inshore trips on man-made structures (piers) (18%), or beach fishing trips (25%). Generally, these three species are not fished for

recreationally in waters greater than three miles offshore, nor are they the directed target of any charter/headboat paid fishing trip.

To assess if any improvements would occur in recreational fishing due to the Petitioned rules, data on the number of recreational trips, licenses sold, and surveyed expenditure information before and after the rules were implemented would be needed, and the change in the quality of recreational opportunities would need to be evaluated. It is unclear, and likely impossible to predict, how many years would need to pass after the Petitioned rules would be implemented before improvements could be detected or the magnitude of any impact could be determined on expenditures, sales, income, jobs, or participant satisfaction. Even with such data, it may not be possible to determine whether any improvements would be caused by the proposed rules or other factors.

6.4.2 Increases in Catch per Unit Effort

The Petitioner states that "the amount of effort in the shrimp trawl fishery may *increase* catch per unit effort, making the shrimp trawl fishery more efficient" (SELC 2017a). For CPUE to increase, one of two conditions must be met. The first condition is that the catch (numerator) must increase and this assumes that effort stays the same or decreases. Alternatively, the effort (denominator) must decrease and this assumes that catch stays the same or increases. For catch to increase, there must be an increase in the fishable shrimp biomass, assuming catchability (the proportion of the stock caught by one unit of effort) remains constant. A decrease in effort (assuming constant or increasing catch) would also increase CPUE for shrimp, but would require a reliable measure of effort to detect. The NCDMF does not currently require fishermen to report detailed effort information. Instead, effort is measured using generic "trips". The problem with using these trips to measure effort is that all trips are not equivalent. That is, one trip may consist of a single two-hour tow while another trip may consist of multiple tows of varying haul times. This lack of consistency makes it impossible to reliably quantify effort or to provide a reliable measure of CPUE. Additionally, the NCDMF does not require reporting of trips where no catch was made. These no-catch trips are important to the calculation of CPUE and the lack of this information adds further difficulty in measuring CPUE for the shrimp trawl fishery.

Decreasing the number of shrimping vessels may not increase the efficiency of the fleet at harvesting shrimp as suggested by the Petitioner (SELC 2017a). The implementation of a limited entry fishery for shrimp in the Gulf of Mexico in December 2002, as part of Amendment 13 to the Gulf of Mexico Shrimp FMP, showed that increased profitability did not occur due to less competition for the resource. Amendment 13 established a 10-year moratorium on the issuance of commercial shrimp vessel permits, capping the number of vessels in the federal fishery. The number of vessels and the fishing power of the vessels was increasing, but the level of landings had been stable, resulting in each participant becoming less efficient and therefore less profitable (GMFMC 2015a). This moratorium was implemented due to the excess capacity in the fishery and the expected result was fewer vessels harvesting the available shrimp resources at a more profitable level. Following the implementation of the moratorium, increased CPUE values were observed for a temporary time-period stemming from an overall reduction in effort and fleet size. However, substantial increases in CPUE were not seen after 2007. Overall, after implementation of the moratorium, acute increases to prices and gross revenue were observed because of decreased landings, such as in 2013 and 2014; however, long-term increases in profitability for permit holders have not been realized (GMFMC 2015b).

Improved efficiency alone does not ensure higher profits. Nearly 10 years later, vessels, on average, were still operating at a loss due to extreme economic conditions at the time, showing negative returns on equity and economic returns (Liese and Stemle 2014, 2017). Several factors may have led to the overall struggle of the financial performance of the Gulf of Mexico shrimping fleet. The year 2007 brought about an overall financial recession for the United States as well as record high fuel prices. In 2010, the Deepwater Horizon oil spill took place and had a profound effect on the economics of the Gulf shrimp fishery. Many vessels

relied on damage claims and oil clean up jobs as a primary source of income after the spill (GMFMC 2015a). However, the main issue continues to be that variable non-labor costs, such as fuel costs that can account for 50% of all related operating costs, continue to dictate profitability of the industry. Overall net revenue cannot seem to overcome the expense of operating a shrimping vessel in the Gulf of Mexico.

6.4.3 Fishery Impacts from Harvest Restrictions and Closures

The question of whether certain types of commercial fishing practices and gears are detrimental to the abundance of species that interact with those gears is a common issue facing fisheries managers. Two situations in South Carolina and Florida are referenced as examples of management actions of a large magnitude. Reviewing other states' responses to these issues is informative to managers, helping them to identify the potential intended and unintended consequences of management interventions. But due to differences in the ecology, fishery economics, and regulatory implementation between locales, it is important to be cautious about generalizing outcomes to North Carolina.

In 1986 and 1987, South Carolina had an experimental closure and subsequent study of shrimp trawling in its sounds and bays. South Carolina's allowance of shrimp trawlers in sounds had been the subject of much debate for the better part of 30 years prior to the study. Some commercial fishermen wanted the sounds closed to allow shrimp to grow to a larger size, while fishermen on smaller vessels wanted the sounds open. Recreational finfish fishermen and environmentalists became involved in the conflict and asked for permanent closure of the sounds and bays to protect important sportfish and forage species. It was argued that the sounds were important spawning areas for sportfish and that many of these sportfish, particularly Spotted Seatrout and Red Drum, were caught in large numbers by commercial trawlers. The initial response of South Carolina's Marine Resources Center was that "the past policy of opening the sounds and bays had probably not increased or decreased the overall physical or economic yield of shrimp" (Whitaker et al. 1989). However, at the urging of several stakeholder groups, including environmentalists as well as commercial and recreational fishermen, three sounds and one bay were closed to commercial trawling in 1986 and 1987. The South Carolina Marine Resources Division (SCMRD) stressed that "a two-year closure would probably be much too short to properly assess the impact of the closing..." and it "may not be possible to definitely determine the usefulness of the closure".

The SCMRD assessed the closure through a fall trawl survey and a shrimp tagging program. After the evaluation was completed, no evidence was found to link trawling in these areas with long term decreases in the populations of finfish species collected during the evaluation (Whitaker et al. 1989). At the time of this evaluation, Spot and Atlantic Croaker stocks were believed to be of sufficient biomass for a viable population. The authors state that "had trawling in the sounds been significantly detrimental to whiting, Spot and croaker stocks, we would have expected a dramatic increase in our catch rates in 1987 after an absence of trawling for over 21 months" (Whitaker et al. 1989). It was concluded by the authors that commercial shrimp trawling did not have a negative effect on shrimp and fish stocks in South Carolina sounds and estuaries and they recommended that economic and social factors be the primary guidance used in future management plans for species within South Carolina's sounds.

A second example of a state's implementation of a largely impactful harvest restriction was Amendment Three to the Florida Constitution. This colloquially became known as the "net ban". In November of 1994, approximately 2.8 million residents of Florida voted to enact Amendment 3, Article X, Section 16 to the Florida Constitution, which made it unlawful to use entanglement nets such as gill nets and trammel nets in Florida state territorial waters (Adams et al. 2000). Other nets such as seines, cast nets, and trawls were still permitted, provided they did not exceed 500 square feet.

The origin of the net ban has its roots in the early 1990s. In 1991, the Florida Marine Research Institute delivered a preliminary stock assessment to the Florida Wildlife Commission, indicating that the Striped Mullet stock was in bad condition (Anderson 2002). It was proposed that the fishery be closed for several

days during the annual roe harvest. This proposal was met with significant opposition by commercial fishermen and effectively stalled in the state legislature. Because of the perceived ineffectiveness of Florida's Marine Fisheries Commission, a petition was started by the recreational industry to gather signatures to allow a statewide vote to limit commercial netting within state waters. The Florida Conservation Association and several other groups launched a large media campaign to raise awareness and successfully gathered enough signatures to put the measure on the legislative ballot in November of 1994. The amendment passed with 71% of the total vote and went into effect in July 1995.

The impacts of banning entanglement nets in Florida state waters was researched in subsequent years following the implementation of the amendment (Shivlani et al. 1998; Adams et al. 2000; Anderson 2002). The net ban had an impact on several user groups, including commercial fishermen, wholesalers, retailers, anglers, marine supply dealers, and consumers. Typical expectations were that commercial landings would decline, but the price of the species most affected by the ban would increase (Adams et al. 2000). Twenty-two species were identified to be most impacted by the net ban. For those species, the average annual ex-vessel value declined by 38% from $21 million to $13 million in the three years following the ban (1996–1998). Trips declined by 56% and commercial license sales declined by 15%. Numbers of wholesalers and dealers statewide were affected very little, but impacts may have been greater on a more local basis. Striped Mullet, the initial driving factor of the ban, experienced a 60% decline in landings, an increase of 26% in price, but had an overall value decline of 49%. As expected, trips targeting species commonly caught with inshore nets decreased trips as did overall value due to lower total landings while ex-vessel prices increased. Recreational landings of the same species evaluated for commercial trends discussed above declined by 27% between 1996 and 1998, even though recreational license sales increased by 3%. The decrease in recreational catch may have been due to other more stringent regulations that were placed on some of these species during that same period.

Adams et al. (2000) found that the stock health of fish historically targeted with entangling nets was variable after the net ban, with some stocks showing improvement (e.g., Spanish Mackerel), some remaining at stable levels (e.g., Spotted Seatrout), and others are exhibiting trends that make it unclear if the net ban affected these species or not (e.g., Bluefish, Pompano). It was also reported that for some species, improvements in stock condition were already being noticed before the net ban went into place (e.g., Striped Mullet). "Overfishing still occurs for some of these species, reportedly due to increases in recreational and commercial harvests since the net ban" (Adams et al. 2000).

Changes to fishermen's family income structure were also observed. The number that identified themselves as a full-time commercial fisherman declined by 20% three years following the net ban, and working time on the water dropped from 62 hours per week to 38 (Adams et al. 2000). Total income from commercial fishing was reduced from 80% to 55%. Approximately 1,500 fishermen were identified as having to modify their gear use, or exit the industry completely because of the net ban. To help mitigate the burden, the state of Florida developed several assistance programs including a net buyback program, unemployment compensation, job retraining, and assistance through the Florida Cooperative Extension Service. In total, 82% of fishermen participated in the net buyback program, 26% collected unemployment benefits, 16% collected food stamps, and 16% of fishermen also participated in job re-training efforts such as aquaculture training.

Recreational angling was observed to improve following the net ban. Spanish Mackerel and Spotted Seatrout were stocks that benefitted from banning entanglement nets and anglers surveyed in the years following expressed satisfaction with increased catches following the net ban (Adams et al. 2000; Anderson 2002).

There are differing perspectives on whether the net ban was successful overall. Commercial fishermen experienced economic hardships in the first years following the ban and several redirected their fishing effort into other already fully-exploited fisheries, thus potentially resulting in overfishing of other fisheries

(Shivlani et al. 1998). However, overall the ban was seen by many recreational anglers and conservationists as a victory for recreational use of the resource (Anderson 2002). Again, due to differences in the ecology, fishery economics, and regulatory implementation between locales, it is important to be cautious about generalizing outcomes to North Carolina. North Carolina's management of its fisheries is governed under the 1997 FRA, which addresses the need for balanced management between commercial and recreational interests (S.L. 1997-400; G.S. 113-181; 113-182.1, 143B-289.52).

6.4.4 Economic Impact Projections

Nesslage and Dumas (2017) estimated stock abundance and the economic impacts for commercial and recreational fishing by species over a 30-year projection period (i.e., 2017 to 2046). Several scenarios analyzed varying levels of commercial and recreational fishing mortality to see how abundance and economic impacts changed over time. Species analyzed that are affected by the Petitioned rules include Atlantic Croaker and Weakfish. See section 5.1 for information on how stock abundance responded to each model scenario. It is important to note that the size of the change in fishing and natural mortality attributable to the proposed rules is unknown. Therefore, it is not possible to model the associated change in the fish stocks and the economic impacts to fishing industries. There is no association between any regulatory intervention and the projections described below; they represent various "what-if" scenarios.

Currently, it is not possible to recreate the producer and consumer surplus numbers or the economic impact results presented by Nesslage and Dumas (2017) because the stock projection-harvest relationship from year to year was not provided in the report. However, the overall trend in the results presented by the authors show how economic impacts in each fishing sector could potentially change if mortality (both fishing and natural mortality) on the species was to change. While evaluating these economic projections, it was determined that the data and assumptions used to predict the value of the commercial fishery were too general and could have artificially inflated the input into the projection models. The economic estimates generated by Nesslage and Dumas (2017) for Atlantic Croaker and Weakfish will not be presented due to uncertainty in the data, but the overall trend in the projections showed that as fishing mortality decreased, economic impacts for both commercial and recreational fisheries also decreased, which translates to economic losses for these fishing sectors. This result was expected since a reduction in fishing mortality equated to a decrease in the total amount of fishing in each sector. The effects of shrimp trawl bycatch were examined for Atlantic Croaker and projections with no bycatch resulted in positive effects on commercial and recreational fishing values, but would take about 30 years for any noticeable improvement.

Projections using lower levels of natural mortality than is currently estimated for Weakfish resulted in economic gains for both commercial and recreational fisheries. As mentioned in section 3.4 for Weakfish, high levels of natural mortality are currently the driving factor limiting stock improvement, so projections using biologically unrealistic levels of natural mortality do not appropriately characterize current stock conditions. Economic gains resulting from scenarios removing bycatch from the fishery or decreasing natural mortality are attributed to increased stock abundance. Results from Nesslage and Dumas (2017) are not comparable to the Petitioned rules. The various changes in fishing or natural mortality being assessed are programmed directly into the model and do not reflect a response to a particular management action and in the case of Weakfish, use estimates of natural mortality that do not currently exist in nature. From these results, an economic estimate of cost or benefit cannot be determined because the magnitude of change that would result from implementation of the Petitioned rules is unknown. It is unclear if potential benefits would outweigh the impacts and based on the projections evaluated by Nesslage and Dumas (2017), a drastic change would be needed to see a substantial benefit. See Appendix 3 for a detailed review of the economic projections evaluated for Atlantic Croaker and Weakfish.

7 IMPACT ON CONSUMERS

The Petitioned rules that would affect shrimp harvest, as well as Spot and Atlantic Croaker size limits may have a negative impact on the availability of local seafood to consumers in the state of North Carolina if the proposed rules result in a substantive decrease in the total effort, and total harvest, of the commercial industry. While the overall availability of seafood may not be impacted due to the overwhelming availability of cheaper imported seafood, consumers may be more deterred to purchase seafood if they prefer local-caught seafood. Unfortunately, data on retail sales of local versus imported seafood are not readily available for this fiscal analysis to determine any price premium for local seafood or estimate the lost value to consumers if the supply of local seafood declines. Studies on consumer preferences for local or fresh seafood mentioned below, while not representative of the North Carolina population as a whole, do indicate that consumers prefer seafood that is wild caught, and more so from a sustainable source.

Carteret Catch, a program whose mission is to sustain the livelihood and heritage of the Carteret County fishing industry through public marketing and education, surveyed the public at the North Carolina Seafood Festival in 2005. They found that over 90% of respondents would choose local seafood over imports (Nash and Andreatta 2011). The results from this survey also showed that 90% of the people who completed the survey expected the seafood served in local restaurants to be harvested locally. Another survey completed in 2006 by the University of North Carolina at Greensboro (UNC-G) found similar results and also reported that 83% of respondents were willing to pay more for locally caught seafood at restaurants versus imports. A survey in 2007 by the University of North Carolina at Chapel Hill determined that the vast majority (95%) of respondents would buy local seafood if available. In addition to the superior quality and freshness of local seafood, a 2010 survey by UNC-G found that 84% of buyers want to buy local seafood due to perceived health superiority and to support local fishermen.

A study conducted in Oregon by Fonner and Sylvia (2015) analyzed preferences for four classes of seafood information labels including safety, quality, local, and ecolabels with regards to crab and salmon. A portion of their study sample strongly preferred products with the local labels. Results showed 19% (crab) and 16% (salmon) of their survey respondents preferred the local label over other labels, and consumers were willing to pay an average of $1.91 (crab) and $3.15 (salmon) more for products that bore a local label. Adding additional labels to a product did not affect the preference for the local label, suggesting that local labels have the potential to add value to seafood, even in the presence of other classes of information labels.

While the overall literature on price premiums for local seafood, labeled or otherwise, is limited, research suggests consumers have a preference towards seafood harvested from local waterbodies. Therefore, a decrease in the overall supply of local seafood to North Carolina suppliers and retailers might negatively affect business revenues. Consumer demand may decrease for seafood products overall, if the supply of local seafood is decreased. Likewise, imported seafood may not command as high a market price as locally sourced seafood.

After further investigation, the NCDMF is not aware of additional market and product-specific quantitative data to evaluate the impact of the Petitioned rules on consumers.

8 IMPACT ON LOCAL GOVERNMENT AND LOCAL COMMUNITIES

The Petitioned rules would certainly impact the fishing industry, but would also stand to impact the local government and municipalities where these industries operate. Several of North Carolina's coastal counties have historically been home to various fishing communities. These counties traditionally have a workforce that has a large prevalence of employment based around commercial fishing, whether from harvesting, manufacturing, or through supply chain industries and as a result, these "fishing communities" stand to be disproportionally affected by the Petitioned rules. In *North Carolina Fisheries Association, Inc. v. Daley*, 27 F. Supp. 2d 650 (E.D. Va. 1998), a summary judgment was awarded to the North Carolina Fisheries Association on the issue of a summer flounder fishing quota for 1997. It was ruled that the decision to issue the quota by the U.S. Secretary of Commerce accompanied by an economic impact analysis that did not include an in-depth explanation of the possible ramifications to small fishing communities was arbitrary and capricious and the quota was dismissed that year. The Court ruled that the failure to consider the effect on small fishing communities in the economic analysis was inconsistent with regulatory requirements of the Small Business Reform Act of 1996 and National Standard 8 of the Magnuson-Stevens Fishery Conservation and Management Act.

North Carolina has 20 coastal counties that all support commercial fishing enterprises. Combined, these counties make up 10% of the total population in the state. However, each one of these counties represents 2% or less of the entire North Carolina population and has an average unemployment rate of 5.83%. Several communities dependent on commercial fishing can exist within each county, especially with regards to shrimping. Ten of these 20 counties have substantial shrimp landings over the past five years. Carteret County employs, on average, 132 commercial shrimp fishermen each year and five other counties (Pamlico, Hyde, Onslow, Dare, and Brunswick) employ, on average, between 44 and 61 commercial shrimpers per year (Table 8.1). In addition to fishermen that harvest shrimp, Carteret and Brunswick counties have over 30 seafood dealers that sell shrimp, annually. Examples of two coastal counties that support commercial fishing enterprises follow.

Hyde County is a primary example of an area that is dependent on its small fishing communities such as Engelhard for labor and economic production. It also serves to highlight that small fishing communities are still economically important to the state's economy and must be given consideration when adopting new rules or rule changes. Hyde County is the second smallest county in North Carolina in terms of total population (5,621; Table 8.1; NCDOC 2018). Of the coastal counties, it has the highest rate of unemployment at 10.38% for 2016. This small county is responsible for the largest amount of shrimp landings and value in North Carolina. Over the last five years, Hyde County averaged 1.9 million pounds of shrimp, worth approximately $4.2 million each year. Engelhard, a town in Hyde County with a population of 445 (based on 2010 census; NCDOC 2018) makes up only 8% of the county's total population, but lands 77% of the total pounds of shrimp within the county; revenue from shrimping accounts for 78% of the total county revenue as well. There are on average 61 fishermen with landings of shrimp in Hyde County each year, which represents only 1% of the county's total population, but contributes a significant amount to the county's economy.

It was reported in the 1997 court ruling mentioned above that manufacturing jobs related to commercial fishing made up 82% of the total manufacturing jobs in Pamlico County. In 2016, Pamlico County had 169 total manufacturing jobs (NCDOC 2018). Pamlico County averages 1.4 million pounds of shrimp each year worth $3.1 million (Table 8.1). The town of Oriental (Pamlico County) is one of the top five cities with respect to total commercial shrimp landings and value for North Carolina and makes up 68% of the total shrimp landings in the county. On average, over the past five years (2012–2016), Oriental had 967,603 pounds of shrimp per year worth approximately $2.1 million annually.

The Petitioned rules have the potential to drastically alter the labor force, municipal tax revenue, unemployment rates, and social service costs in small fishing communities such as those mentioned above. Some counties would be able to mitigate losses to the commercial shrimping industry better than others, but the potential impacts to those that are heavily dependent on shrimping are evident. Losses to the commercial shrimping industry would disproportionally affect smaller counties with smaller labor forces that have traditionally relied on commercial shrimping. This may lead to increased reliance on social service programs.

Tourism and durable good purchases related to recreational fishing is also a large source of seasonal income for many coastal counties in North Carolina. This tourism supports charter and guide fishing operations, as well as tackle shops, and local stores and hotels. A potential benefit of the proposed rules might be increased angler tourism to these counties if recreational fishing is perceived to improve after reduction in trawling effort in subsequent years following implementation of the Petitioned rules. Whether the benefits would off-set the losses to these coastal communities from decreased commercial fishing operations can only be observed in hindsight.

Table 8.1. Employment for 2016 and average commercial landings and value of shrimp by coastal county, 2012–2016. (Source: NCTTP; NCDOC 2018) NOTE: Only coastal counties that reported shrimp over the last five years to the NCTTP were included.

County	2016 Population	2016 Employment	2016 Unemployment	2016 Unemployment Rate	Avg. Value	Avg. Pounds Landed	Avg. # of Dealers	Avg. # of Fishermen
Hyde	5,621	1,936	201	10.38%	$4,201,338	1,904,880	6	61
Carteret	69,881	30,100	1,637	5.44%	$3,162,682	1,569,274	39	132
Pamlico	13,336	5,118	286	5.59%	$3,147,354	1,417,391	11	60
Dare	36,387	18,716	1,353	7.23%	$2,086,453	916,767	15	44
Onslow	193,914	60,231	3498	5.81%	$1,495,925	689,632	16	52
Brunswick	127,750	46,600	3,158	6.78%	$889,886	406,270	30	48
New Hanover	223,608	111,212	5,464	4.91%	$138,061	77,545	16	16
Pender	59,459	25,278	1,409	5.57%	$126,294	74,986	11	19
Beaufort	47,610	19,267	1,162	6.03%	$116,030	57,241	3	10
Craven	103,737	39,659	2,198	5.54%	$21,699	11,907	6	10

***Currituck, Tyrrell, and Washington had shrimp landings each year, but were minimal.

9 IMPACT ON STATE AGENCY

The NCDMF's mission is to ensure sustainable marine and estuarine fisheries and habitats for the benefit and health of the people of North Carolina. The agency enforces statutes and rules governing fishing in coastal waters; monitors the supply of fish and their health; protects public health of shellfish consumers and recreational bathers; monitors and protects fisheries habitats, including rehabilitation of shellfish habitat; and encourages public responsibility through information, technical assistance, and education.

The Petitioned rules would impact the NCDMF in a number of ways. Current staff would have to shift from normal job duties to ensure rules are enforced and sampling efforts would need to increase to determine when the shrimp fishery would be allowed to open. It is unknown if additional enforcement officers would be needed due to the uncertainty around the behavioral choices of fishermen responding to the Petitioned rules. There is the potential for increased workload for NCDMF Marine Patrol to enforce the proposed rules that could be more than what current staff could do with all other job duties continuing. Trawl restrictions in other fisheries as a result of the Petitioned rules would also cause staff to amend all FMPs of affected fisheries. The amendment of a FMP takes about two years and there is already a process in place to implement management measures for fisheries. The FMP process is prescribed under the FRA and set forth in G.S. 113-182.1. The majority of the rules proposed in the Petition were suggested as potential management options in Amendment 1 to the Shrimp FMP (adopted in 2015), but were not selected as the MFC's preferred management strategies adopted via Amendment 1. There is also a large impact on other existing rules and fisheries.

Diverting resources away from existing programs and activities to implement and enforce the proposed rules would be detrimental to the effectiveness of those programs and activities. The foregone societal benefits associated with the reallocation of resources is not addressed in this analysis.

9.1 Enforcement

There are three main enforcement concerns related to the Petitioned rules. The first pertains to having two different sets of restrictions for the category of "special secondary nursery areas." The second pertains to enforcing shrimp trawl tow times. The third concern is about patrolling multiple openings and closings across the state each week, resulting from reducing the number of days in a week for trawling and limiting trawling to daylight hours only. Additional concerns include the need for increased NCDMF Marine Patrol enforcement due to the potential elimination of certain fisheries, displacing other enforcement efforts.

The first enforcement concern is due to the 12 existing SSNAs (that would be exempted from the new requirements) adjoining a proposed new SSNA that would be subject to the more restrictive harvest practices. This could cause an increase in user conflicts. Patrolling these transition zones across the state could be time-consuming and displace other enforcement efforts, but to an unknown extent.

As mentioned in section 6.1.5, enforcement of tow times is extremely difficult without constant oversight by NCDMF Marine Patrol for the duration of the tow. Other concerns about the implementation of the proposed tow restrictions stem from how the Petitioned rules are currently written. The Petitioned rules would not require the net and trawl doors to be removed from the water between tows. Without that, it is not possible to determine the actual tow time, resulting in a regulation that is not enforceable. Skimmer trawls and other trawls without doors operate with their trawl frame in the water at all times, so enforcement of tow times in these gears would be problematic even with a requirement to remove the trawl doors from the water between tows.

Sections 6.1.1 and 6.2.1 describe the impacts from limiting the fishing days per week available for trawl fishermen. The Petition document does not address which days of the week to close and the Petitioner stated in their comments they did not intend to recommend specific days for closure and that decision is

best left to the Fisheries Director. The Petitioned rules as written limit trawling effort in estuarine waters to no more than three days per week; there are currently five days per week available for fishing. The Petitioned rules as written limit trawling efforts in state ocean waters to no more than four days per week; there are currently seven days per week available for fishing. Additionally, section 6.1.2 describes the impacts from nighttime restrictions. The Petitioned rules seek to limit trawling to daylight hours only. The combination of these restrictions on fishing days and time of day for fishing would result in multiple openings and closings across the state each week. Whether consecutive days are selected to allow trawling or alternate days, when coupled with nighttime restrictions, the continuous openings and closings cannot be avoided. As a result, there may be a significant increase in the amount of time an officer spends patrolling closure days and times for the shrimp trawl and other trawl fisheries. Instead of patrolling for a lack of fishing during the single closure period for shrimp trawls currently in estuarine waters (Friday night to Sunday night), enforcement officers would have to patrol daily closure times in both estuarine and state ocean waters for multiple trawl fisheries to ensure a lack of fishing activity (compliance) during closures.

Currently, the NCDMF Marine Patrol has officers working in three distinct law enforcement districts along the coast. In addition to checking commercial and recreational fishermen, officers patrol waterways, piers, and beaches in coastal areas. They also inspect seafood houses, vehicles transporting seafood, and restaurants across the state to ensure compliance with fisheries rules. In addition to the inspections listed above, the NCDMF Marine Patrol have mandatory patrol responsibilities that must be fulfilled before trying to enforce the additional widespread restrictions proposed in the Petition. The U.S. Food and Drug Administration (FDA) requires North Carolina to patrol a certain number of hours in polluted waters each year. This is a primary function for the NCDMF Marine Patrol to ensure the health and welfare of consumers of North Carolina shellfish. In 2016, each NCDMF Marine Patrol officer spent, on average, 171 hours per year patrolling polluted areas to ensure fishermen are not harvesting shellfish from polluted waters, which would be dangerous and, in some cases, deadly to consumers who could ingest polluted shellfish. The Marine Patrol also assists the observer program with gill net observations to ensure that the NCDMF meets the observer coverage as required by its current federal ITPs. Failure to follow the requirements of the ITPs through lack of sufficient observer coverage could cause the estuarine gill net fishery to close completely.

The estimated total number of hours that would be spent by existing NCDMF Marine Patrol each year (12 months) to enforce the Petitioned rules is approximately 52,000 hours (Table 9.1). This is a total of 50 officers each working 20 hours per week during each week of the year. This is based on time needed to check gear requirements and net sizes, proper licensure, size and creel limits, monitor tow time limits, closure lines, closure days, user conflicts, and the transit time to patrol a vast geographical area, especially in larger water bodies like Pamlico Sound. Additionally, when an officer encounters a potential violation (regardless of the type of offense), there is significant time spent to process the violation, displacing effort on additional patrols. Processing a violation can include identifying who is on board the vessel, plotting the location on a chart for court, escorting the vessel to the dock, offloading the catch, securing three bids to sell the catch to the highest bidder, and processing criminal charges brought against the captain and/or crew, to include potential arrest. At an average salary plus benefits of $32.26 per hour, the opportunity costs for NCDMF Marine Patrol as a result of the Petitioned rules would be $1,677,520 per year.

Table 9.1. Number of hours estimated to be spent by existing NCDMF Marine Patrol officers to enforce Petitioned rules by district. (Source: NCDMF)

District	Number of Officers	Hours per Week	Total Hours per Week
1	19	20	380
2	15	20	300
3	16	20	320
All	50	20	1,000

Existing NCDMF Marine Patrol would have to balance any new responsibilities from the Petitioned rules with existing responsibilities. The opportunity costs presented quantify the value of the hours used by Marine Patrol to perform typical job duties that would now be needed to enforce the proposed rules. They do not represent new costs to NCDMF. Additionally, it is important to understand the temporal nature of any patrol. For example, in the course of patrolling for fishing activities related to the Petitioned rules, if an officer encounters a fisherman harvesting shellfish in a polluted area, they would address the immediate violation and cease the former effort. This adds to the uncertainty in quantifying the impacts to enforcement from the Petitioned rules.

It is unknown if additional enforcement officers would be needed due to the uncertainty around the behavioral choices of fishermen responding to the Petitioned rules. There is the potential for increased workload for existing NCDMF Marine Patrol to enforce the proposed rules that could be more than what current staff could do with all other job duties continuing, but to an unknown extent. The Petitioned rules may require a significant amount of additional monitoring and enforcement on the part of the NCDMF Marine Patrol. Actual work hours would likely be more than 20 hours per week during more active fishing months, but on average, is estimated to be about 20 hours per week per officer year-round.

Additional officers could enable the Marine Patrol to continue ensuring that other fisheries have the necessary coverage to maintain compliance with fisheries rules and regulations. To maintain the aforementioned monitoring required by the FDA and patrol additional areas more frequently due to the Petitioned rules, more officers could be required. This could also hold true with the assistance Marine Patrol provides to the observer program to meet required ITP observer coverage. It is highly uncertain what the behavioral choices of fishermen responding to the Petitioned rules would be. Fishermen could potentially shift to other gears, shift to other fisheries, continue fishing regardless of changes in requirements and/or potential consequences of failing to comply with them, or exit fishing completely. Initially, as both officers and fishermen become accustomed to the requirements of the Petitioned rules, there would likely be a learning curve that would take more effort by all parties until there is familiarity with the new requirements. This learning curve would likely be more pronounced than for previous regulation changes due to the nature of the combination of management strategies that would be implemented by the Petitioned rules, as well as the size of the area that would be affected. Due to this high variability, the number of potential new officers cannot be quantified. Existing NCDMF Marine Patrol would have to continue to balance any new responsibilities from the Petitioned rules with existing responsibilities. This would change over time as fishermen would make choices about their level of continued participation.

Currently, NCDMF Marine Patrol has 50 officers in the field to enforce regulations. There is also one aviation pilot to conduct aerial monitoring and enforcement. In addition to more officers, the additional restrictions to shrimp harvesting could require additional pilots to supplement coverage by officers on the water. The estimated costs of hiring and equipping one new officer and one new pilot for enforcement are shown in Table 9.2. After the initial cost of $118,625 for vessels, the estimated annual costs for one additional officer total $83,234. After the initial cost of $488,500 for a plane, the estimated annual costs for one additional pilot total $109,444. These are average costs and supplies when NCDMF Marine Patrol needs to add an additional officer to the personnel. Base salary is included for an average NCDMF Marine Patrol officer, as well as fringe benefits. Operational costs are also included for outfitting officers with standard equipment including vessels, supplies, uniforms, and other essential items needed for a NCDMF Marine Patrol officer to carry out enforcement duties. Due to the diverse habitats in North Carolina, two different types of vessels (i.e., 23-foot Parker, 21-foot flat bottom vessel) per officer are needed to safely access small and large bodies of water. Smaller water bodies have shallow areas that can only be accessed by a flat bottom boat; whereas, large areas like Pamlico Sound and the ocean require a v-hulled vessel to navigate safely. Again, the number of potential new officers or pilots cannot by quantified.

Table 9.2. Estimated initial costs per additional NCDMF Marine Patrol officer and pilot. (Source: NCDMF)

Cost for additional officers	1 officer	1 pilot
Law enforcement officer salary	$ 39,611	$ 50,000
Fringe benefits (Social security, retirement, health insurance)	18,183	21,414
Supplies/equipment/uniforms, etc.	8,500	8,500
Vehicle rental/miles (2,000 miles/ month x $.46/mile + $35/month)	11,460	11,460
Vessel gas ($2.20 per gallon x 1900 gallons)	4,180	0
Plane fuel	0	7,770
Travel for training	1,300	1,300
Cessna Skylane 182 S/T plane[1]	0	488,500
Plane hangar rental	0	4,000
Plane insurance	0	5,000
23' Parker SE model (includes: GPS, radar, radios, etc.)[1]	76,000	0
21' flat bottom vessel (includes: GPS, radios, etc.)[1]	42,625	0
Total Initial Cost	**$ 201,859**	**$ 597,944**
Subsequent Annual Cost	**$83,234**	**$109,444**

[1] Not a recurring annual cost

9.2 Monitoring for Opening Season based on Shrimp Count Size

The NCDMF has many fishery independent sampling programs that use a variety of gears to monitor trends in the relative abundance of species, their habitat use, and to collect environmental information. These programs are conducted by division staff and do not involve the commercial or recreational harvest of fish. They are designed to sample species present in an area as well as species at different sizes and ages, are not dependent on the skill of the sampler, and can be repeated following a set protocol. The value of a sampling program increases with time because it allows biologists and stock assessment scientists to look at a species' abundance over time. Fishery independent data allow managers to have a more complete picture to understand stock condition and to evaluate management measures and the likely causes of stock changes.

Fishery independent sampling by NCDMF through Program 510 (Juvenile Shrimp Sampling) is performed with small outboard boats to determine area openings or the need to close an area based on shrimp count size per the N.C. Shrimp FMP. The majority of this sampling occurs in SSNAs in the southern district. This sampling uses a 25-foot trawl with ¾-inch bar body and ¼-inch bar cod end. Trawls may be two-seamed, four-seamed, or tongue trawl based on the target species of shrimp. Tows are typically 10 minutes long, but

can vary based on abundance of shrimp and fish and can be less than five minutes or up to 20 minutes. This sampling gear is different from commercial shrimp gear in that no BRDs or TEDs are used and although the body of the gear is legal size, the cod end is a smaller mesh than what is allowed by the public. This allows the NCDMF to retain smaller shrimp and fish, which provides a better "snapshot" of what is present in the area being sampled. Shrimp count size as well as the amount of bycatch are determinants for opening these areas. Unfortunately, this sampling program could not be used "as is" to determine shrimp count size in Pamlico Sound, as this program only operates in the southern district of the state. Even though there are existing sampling programs in the Pamlico Sound area, such as Program 120 (Estuarine Trawl Survey) and Program 195 (Pamlico Sound Survey), these programs are insufficient to determine when to open shrimp season based on shrimp count size due to their limited temporal and spatial coverage.

To adequately monitor Pamlico Sound for a 60-count shrimp size as proposed by the Petition, a new survey would need to be designed. Sampling in the Pamlico Sound may entail a similar monitoring strategy to Program 510, as described above, in the bays within Pamlico Sound using similar gear. Sampling trips would likely be one-day trips made on multiple days to ensure adequate coverage of bays selected to be sampled. These days may take up to 12 hours or more due to further distances to travel to each of the selected bays, as compared to the southern district. Costs of this sampling include salary of three new temporary technicians, equipment, and fuel. The estimated new cost of this sampling could range from $4,359.40 to $9,318.80 per year depending on gear replacement needs, the number of sampling trips, and estimated fuel costs and salaries from 2017 (Table 9.3). It is unknown if sampling in the bays of the sound would be sufficient due to the timing of growth and movement of shrimp into the open waters as they emigrate to the ocean or if sampling in the open waters of Pamlico Sound would be required. For example, by the time shrimp reach the 60-count size threshold, they may have already left the bays and moved into the sound.

Table 9.3. Estimated new annual sampling costs of Pamlico Sound 60-count size sampling in the bays of Pamlico Sound (based on costs for Program 510).

Item	Cost	Trip Length	Number of Trips	Total Cost
Technician II	$21.58/hour	12 hours	5–10	$1,294.80 – $2,589.60
Technician II	$21.58/hour	12 hours	5–10	$1,294.80 – $2,589.60
Technician II	$21.58/hour	12 hours	5–10	$1,294.80 – $2,589.60
Boat fuel	$45.00/day	1 day	5–10	$225.00 – $450.00
Truck fuel	$50.00/day	1 day	5–10	$250.00 – $500.00
25-ft 4-seam trawl net	$600.00			$600.00
Total				**$4,359.40 – $9,318.80**

If sampling in the open waters of Pamlico Sound is required, then sampling could be completed using the R/V *Carolina Coast*, a 44-foot fiberglass hulled research vessel. Trawl nets on the R/V *Carolina Coast* are double rigged 30-foot mongoose trawls with a 7/8-inch bar mesh body and a ¾-inch bar mesh cod ends. The type of data collected from this survey would need to be determined, including time of year, time of day, station locations, tow times, as well as environmental and species data. Consideration of shrimp species targets for the 60-count size criteria would also determine net needs for sampling aboard the R/V *Carolina Coast*. The need for this additional sampling is dependent on environmental conditions and the prevalence of shrimp, both of which cannot be predicted.

Sampling trips on the R/V *Carolina Coast* would be completed in three days with eight hours of sampling done each day. An estimated two to three trips would be needed for determining the opening of shrimp season based on 60-count size shrimp. Costs of sampling include salary of three new temporary technicians, as well as the existing vessel captain and deck hand, plus equipment and fuel. The estimated total cost of

this sampling ranges from $8,792.52 to $12,495.50 depending on the number of sampling trips (Table 9.4). The estimated new sampling costs range from $6,302.28 to $8,760.14 per year (i.e., total cost minus existing staff costs for captain and deck hand). The estimated opportunity costs range from $2,490.24 to $3,735.36 (i.e., cost for existing captain and deck hand). These costs may be in addition to the costs described in Table 9.3 if both the bays and open waters of Pamlico Sound would need to be sampled.

Table 9.4. Estimated sampling costs (new and opportunity) using R/V *Carolina Coast* to determine the opening of shrimp season in Pamlico Sound based on 60-count size shrimp in the open waters of the sound. (Source: NCDMF)

Item	Cost	Trip Length	Number of Trips	Total Cost
Technician III	$27.83/hour	24 hours (3 x 8-hour)	2–3	$1,335.84 – $2,003.76
Technician II	$21.58/hour	24 hours (3 x 8-hour)	2–3	$1,035.84 – $1,553.76
Technician II	$21.58/hour	24 hours (3 x 8-hour)	2–3	$1,035.84 – $1,553.76
Boat Captain[1]	$31.18/hour	24 hours (3 x 8-hour)	2–3	$1,496.64 – $2,244.96
Deck Hand[1]	$20.70/hour	24 hours (3 x 8-hour)	2–3	$993.60 – $1,490.40
Truck fuel	$25.00/day	3 days	2–3	$150.00 – $225.00
Boat use	$200.00/day	3 days	2–3	$180.00 – $270.00
Food cost for crew	$189.50/day	3 days	2–3	$1,137.00 – $1,705.50
Galley supplies	$20.00/trip		2–3	$40.00 – $60.00
(2) 30-ft trawl net	$1,388.36			$1,388.36
Total new costs				$6,302.28 – $8,760.14
Total opportunity costs[1]				$2,490.24 – $3,735.36
Grand Total				**$8,792.52 – $12,495.50**

[1]Opportunity costs only

The total amount of sampling required to determine the opening of shrimp season based on shrimp count size in Pamlico Sound is unknown. It is unclear if both the bays of Pamlico Sound and the open waters would need to be sampled to adequately determine the opening of shrimp season based on shrimp count size. At a minimum, new sampling costs could be as low as $4,359.42. This cost reflects the low end of the range of annual sampling costs presented in Table 9.3. New sampling costs could be as high as $18,078.94 per year. This cost reflects the highest sampling costs from both Table 9.3 and 9.4 minus the opportunity costs from Table 9.4. Estimates presented are based on the best available data and may not reflect the actual amounts that would result from the Petitioned rules.

9.3 Impacts to Other Rules

One consideration about impacts to other rules is the unintended consequences of proposed changes to 15A NCAC 03N .0105(c), making it unlawful “to use trawl nets” instead of “to take shrimp with trawl nets” in the new SSNAs proposed by the Petition. Without this important distinction, numerous fisheries that use trawl nets would be impacted, resulting in amendments to the concomitant FMPs, rules, and proclamations. As written, the Petitioned rule would not allow trawling for anything other than crabs or shrimp, effectively eliminating clam trawling (kicking) in the mechanical clam harvest areas in estuarine waters and finfish trawling in state ocean waters. In its Jan. 26, 2017 letter to MFC Chairman Sammy Corbett, the Petitioner states it “did not intend to impact activity in other fisheries, including but not limited to the peeler trawling, clam kicking, finfish trawling, and live bait harvest fisheries” (NCWF 2017b, p. 3). This is evident by the proposed amendments in the Petition that would change 15A NCAC 03L .0103 to restrict headrope length and require the use of two BRDs only for taking shrimp with trawls, and not for other types of trawling activities.

Clam trawl harvest (kicking) currently occurs during the winter in specific areas that are open by proclamation, but this would be eliminated in areas where it is currently allowed under the proposed nursery area designations. The proposed rules would only allow shrimp or crab trawling. This would also be the case for finfish trawl fisheries. Finfish trawls such as flynets are allowed in state ocean waters north of Cape Hatteras, while flounder trawls are allowed in state ocean waters. Species targeted with trawls north of Cape Hatteras include Atlantic Croaker, Bluefish, Atlantic Menhaden, Summer Flounder, and Striped Bass. In addition, trawls targeting Striped Bass can only fish in state ocean waters since it is unlawful to fish for Striped Bass in federal waters. The Petitioned rules only allow shrimp or crab trawling in all areas not already designated as nursery areas today, so each of these fisheries would be eliminated.

The peeler trawl and crab trawl fisheries operate primarily at night, but this activity would be prohibited in areas where it is currently allowed under the proposed nursery area designations. As written, the proposed amendments to 15A NCAC 03N .0105 would subject any remaining effort in these two fisheries to the new requirements of no trawling at night, tow time limits, and trawling only three days per week in estuarine waters and four days per week in the state ocean waters. The harvest of crabs with trawls would also be contingent on opening the shrimp season, which (under the Petition) would require a shrimp count size of 60 shrimp per pound, heads-on, in the Pamlico Sound.

A second consideration about impacts to other rules is the potential effect on rules recently amended by the MFC to implement the Permit for Weekend Trawling for Live Shrimp, as authorized by the 2015 North Carolina Shrimp FMP Amendment 1. These rules became effective May 1, 2017 and included the following changes: amendments to 15A NCAC 03J .0104 (Trawl Nets) and 03L .0102 (Weekend Shrimping Prohibited) made exceptions to the weekend closure for trawling for live shrimp; and amendments to 15A NCAC 03O .0503 (Permit Conditions; Specific) constrained this exception to 12 p.m. (noon) on Saturday. The Petition does not address how the proposed rules would impact the rules that implemented the Permit for Weekend Trawling for Live Shrimp, other than stating the Petitioner did not intend to impact them. The Petitioned rules would require further amendments to be made to 15A NCAC 03J .0104, 03L .0102, and 03O .0503 to address the differences in the proposed requirements under the Petition and make conforming changes.

The impacts to other rules would result in the need to make conforming changes to affected FMPs, rules, and proclamations. It is highly unlikely that new staff would be funded to do this work. It is more probable that existing staff would be tasked with undertaking these changes. Some tasks, like amending proclamations, can be completed quickly as part of regular duties and would take minimal resources. Other tasks, like amending rules and FMPs to reflect the changes to management strategies resulting from the Petitioned rules, are more involved, require the participation of other entities (e.g., ACs, the NCDEQ, the Joint Legislative Oversight Committee on Agriculture and Natural and Economic Resources) and would take more resources to complete. There are potentially many FMPs that would need amending or development resulting from the Petitioned rules. This would displace other rulemaking and FMP activities underway per the MFC's annual FMP review schedule and annual rulemaking cycle. The extent to which this is true depends on the number of plans under review or development at the time the Petitioned rules would be adopted, and therefore, cannot be quantified at this time.

9.4 Revenue Loss Associated with License Sales

9.4.1 Commercial Fishery

The Petitioned rules have the potential to cause some commercial fishermen to exit the fishery due to regulations becoming too stringent to remain profitable in their respective fisheries. Fishermen exiting

commercial fishing completely would result in the decrease of commercial fishing license sales, and therefore, operating revenue for the NCDMF. Sales transaction data were used from the NCDMF to determine a five-year average of revenue from the sale of commercial fishing licenses, the number of licenses sold, and revenue per license sold for fiscal years 2012–2016. Fiscal years (FY) run from July to June, so FY2016 includes July 1, 2015 to June 30, 2016. FY2017 was not included because the 2017 Trip Ticket data were not finalized at the time of this analysis. The commercial fishing licenses included in the analysis were Standard Commercial Fishing License (SCFL), Retired Standard Commercial Fishing License (RSCFL), Commercial Fishing Vessel Registration (CFVR), Fish Dealer Licenses, and Land or Sell Licenses. Transaction types included in the analysis were Add, Approve, Renew, and Transfer. Counting transfer transactions is important with regards to determining total revenue when a resident license is transferred to a non-resident. In this instance, during the transfer, the transferee pays the difference between the resident and non-resident fees for their state of residence. Counting these transferred licenses may have inflated the total number of licenses issued when compared to previous reports. From FY2012–2016, the commercial license sales for those five licenses had an average value of $2 million (Table 9.5). Sales of SCFLs and RSCFLs make up the majority of transactions per year and generate the most revenue. The NCDMF sells on average 16,239 of these commercial fishing licenses annually. SCFLs and RSCFLs comprise 44% of average annual license sales, while 51% of license sales are CFVRs, indicating that some commercial fishermen have more than one vessel they use for commercial fishing. The overall average price of any commercial fishing license transaction is $126. The prices of commercial fishing licenses have seen several changes during this period, which affect the averages shown in the tables below. In FY2015, the price of these licenses increased by 25% from FY2014. In FY2016, prices doubled from the price in FY2014.

Table 9.5. Average revenue, average number of licenses sold, and average revenue per license for the top 5 commercial fishing licenses issued by NCDMF by fiscal year, 2012–2016. (Source: NCDMF License Program; NCTTP)

License Type	Avg. License Revenue	Avg. Number of Licenses	Avg. Revenue per License
Commercial Fishing Vessel Registration	$363,681	8,273	$43.96
Fish Dealer License	$103,361	755	$136.87
Land or Sell License	$31,122	92	$339.02
Retired Standard Commercial Fishing License	$161,313	1,291	$124.99
Standard Commercial Fishing License	$1,388,787	5,829	$238.26
Grand Total	**$2,048,263**	**16,239**	**$126.13**

The Petitioned rules have the largest impact on commercial shrimpers. Therefore, commercial fishermen who would most likely exit commercial fishing due to the proposed rules would be commercial shrimpers, as their industry would be subject to multiple regulatory changes. To quantify potential losses in license revenue to NCDMF, license sales data were matched to trip ticket data for commercial shrimp landings to estimate average license sales and revenue for commercial shrimpers for a five-year period by fiscal year (2012-2016). On average, commercial shrimpers accounted for 8% of the total revenue from the five licenses mentioned above and 7% of the total licenses sold per year (Tables 9.5 and 9.6). It is important to note that fishermen can operate as their own dealer by purchasing a Fish Dealer License from NCDMF. It is not uncommon for a commercial shrimp fisherman to also have a dealer license to remove the middle man and sell their catch directly to the public. Anyone holding a Fish Dealer License must fill out trip tickets and report their landings to the NCDMF monthly.

Because it is unknown how large the effect of the Petitioned rules would be on the commercial fishing industry, the extent of potential losses in license revenue from commercial shrimp fishermen exiting commercial fishing completely cannot be determined. It is also impossible to predict how the General Assembly could change the cost of licenses in the future (increases or decreases).

Table 9.6. Average revenue, average number of licenses used, and average revenue per license for the top 5 commercial fishing licenses issued by NCDMF for fishermen with commercial landings of shrimp by fiscal year, 2012–2016. (Source: NCDMF License Program; NCTTP)

License Type	Avg. License Revenue	Avg. Number of Licenses	Avg. Revenue per License
Commercial Fishing Vessel Registration	$63,926.10	628	$101.83
Fish Dealer License	$8,362.10	71	$117.78
Land or Sell License	$80.00	0	$400.00
Retired Standard Commercial Fishing License	$6,097.00	47	$129.72
Standard Commercial Fishing License	$108,576.10	440	$246.99
Grand Total	**$187,041.30**	**1,186**	**$157.76**

9.4.2 Recreational Fishery

It is unclear if recreational license sales would be affected by the Petitioned rules. If stock abundance noticeably increases for species such as Spot and Atlantic Croaker, there is the potential for an increase in the number of recreational licenses. These species are not the highest priority to recreational fishermen visiting North Carolina; however, they are commonly caught. In 2016, Spot was ranked 10th in the number of recreational trips that caught this species. Atlantic Croaker was ranked 6th. For 2016, about 1.5% of recreational fishing trips in North Carolina targeted Spot. Only 0.46% of recreational trips in 2016 reported targeting Atlantic Croaker. Weakfish is considered a more prestigious species in North Carolina; however, only 0.23% of recreational trips in North Carolina targeted this species. It should be noted that about 50% of trips do not indicate a target species. For those fishermen that do target Spot and Atlantic Croaker, minimum size limits on these species could cause some fishermen to shift harvest effort to other species, but it would be unlikely that they exit recreational fishing completely.

10 ALTERNATIVES

In the North Carolina Administrative Procedure Act, G.S. 150B-19.1(f) requires if "the agency determines that a proposed rule will have a substantial economic impact as defined in G.S. 150B-21.4(b1), the agency shall consider at least two alternatives to the proposed rule. The alternatives may have been identified by the agency or by members of the public." G.S. 150B-21.4(b1) defines the term "substantial economic impact" to mean "an aggregate financial impact on all persons affected of at least one million dollars ($1,000,000) in a 12-month period."

As analyzed throughout this document and described in the Executive Summary, the proposed rules are expected to have a substantial economic impact. As such, alternatives to the proposed rules are included here.

The agency previously considered multiple management options for shrimp with a focus on bycatch reduction of non-target species in the 2015 Amendment 1 to the North Carolina Shrimp FMP. Within that effort, several options were developed and subsequently vetted by the public, ACs of the MFC, the NCDEQ secretary, the Joint Legislative Commission on Governmental Operations, and the MFC. Ultimately, the MFC selected its preferred management options for the FMP. The MFC gave its final approval of Amendment 1 and associated rules Feb. 19, 2015; implementing rules became effective May 1, 2015. The preferred management options did not include every option that was developed, vetted, and presented to the MFC. These options are alternatives to the Petition for reconsideration.

The North Carolina Shrimp FMP Amendment 1 was developed by the NCDMF with the assistance of the Shrimp FMP AC, as is required by G.S. 113-182.1(c). The committee was formed in January 2013 and met over a period of eight months to become familiar with the content of the FMP in general and the bycatch issue specifically and to review different bycatch management options. The NCDMF proposed a holistic approach to review the numerous options under consideration and directed the ACs to assess the different management options through a series of evaluation matrices. Each evaluation matrix listed management options along with an initial list of potential impacts discussed by the NCDMF Plan Development Team (PDT). Quantifying the potential biological gain to affected bycatch species populations was not possible with existing data; therefore, it was important for the committee to consider reasonable and practicable management strategies to reduce bycatch while balancing the economic and social value of the shrimp fishery. The AC was directed to the following two FMP objectives during its deliberations:

- Minimize waste and enhance economic value of the shrimp resource by promoting more effective harvesting practices.
- Minimize harvest of non-target species of finfish and crustaceans, and protected, threatened, and endangered species.

The committee assessed bycatch reduction, economic impacts, social impacts, and inter-fishery impacts for each management option for the shrimp fishery. The additional categories of enforcement and authority/administration were only assessed by the PDT. These evaluation matrices provided focused deliberations and provided a starting point for thorough and meaningful discussions in determining the best approaches for reducing bycatch in the shrimp trawl fishery. The committee was able to add options and remove options as well as change or rephrase the initial impacts as contemplated for each management option.

Twenty-nine different management options were brought forward to address eight different issues during monthly meetings from May through August 2013. Each of these issue papers is found in Section 12 of Amendment 1[3], including both sets (AC and PDT) of evaluation matrices. The committee voted to remove

[3] http://portal.ncdenr.org/c/document_library/get_file?p_l_id=1169848&folderId=24626903&name=DLFE-134540.pdf

four of those options from the evaluation process. After all options were evaluated, the members of the committee were sent an option selection package and asked to select what he or she considered to be the five best options to reduce bycatch. This enabled discussion to be focused on the best options and combinations of those options, and to discuss the details needed to develop management recommendations. The AC deliberated and recommended actions for the MFC to consider addressing bycatch in the shrimp fisheries. The NCDMF also assessed management options in a similar manner. Bycatch management recommendations for each issue from the Shrimp FMP AC and the NCDMF, and the preferred management strategy of the MFC are found in Section 12.10 of the FMP and are also found in Appendix 5 of this document. Recommendations contained in Amendment 1 of the Shrimp FMP that were not already implemented under the authority of Amendment 1 of the Shrimp FMP are alternatives to the proposed rules for reconsideration. Some of these alternatives would be more restrictive than measures already implemented by the amendment, while other alternatives would primarily address a different way of achieving what is already in place.

G.S. 150B-19.1(f) also allows "members of the public" to identify alternatives to proposed rules. Within the context of the statute, the Petitioner is a member of the public. Jan. 12, 2017, the Petitioner submitted a letter to the MFC to make two substantive modifications to the Petition (NCWF 2017a). The modifications were reflected in the Petitioned rules that were granted in full for rulemaking by the MFC Feb. 16, 2017.

The first modification was to the Petitioner's original proposal to reduce headrope length on all shrimp trawls in North Carolina coastal fishing waters. The Petition initially proposed limiting maximum headrope length on all shrimp trawls operating in all coastal fishing waters to 90 feet under 15A NCAC 03L .0103 (NCWF 2016a). The requested modification was to establish a 110-foot headrope limit in the Atlantic Ocean (from 0 to 3 miles; NCWF 2017a). The Petitioner stated this change will allow commercial fishermen operating in coastal fishing waters in the Atlantic Ocean to continue to use gear that was recently modified to meet the current 220-foot limit on headrope length for all trawls in internal coastal fishing waters that went into effect on Jan. 1, 2017. An alternative would be proposed changes to the rule as originally submitted by the Petitioner, which would be more restrictive than the Petitioned rules granted in full by the MFC for rulemaking.

The second modification the Petitioner submitted was to its proposal regarding trawling activities in SSNAs under 15A NCAC 03N .0105 to allow for an additional day of shrimp trawling in coastal fishing waters in the Atlantic Ocean. The Petition initially proposed restricting trawling to a total of three days per week in all SSNAs (NCWF 2016a). The requested modification was to limit trawling in SSNAs in the Atlantic Ocean (from 0 to 3 miles) to four days per week (NCWF 2017a). This modification would change the number of days allowed to fish in the Atlantic Ocean to a total of four days per week. These restrictions on trawling exclude waters already designated as PNAs, SNAs, and all other SSNAs and would only apply to waters newly designated as SSNAs resulting from the Petition. An alternative would be proposed changes to the rule as originally submitted by the Petitioner, which would be more restrictive than the Petitioned rules granted in full by the MFC for rulemaking.

In addition to the above modifications, the Petitioner made a recommendation to the MFC in its Jan. 12, 2017 letter (NCWF 2017a). The original Petition proposed a size limit for Spot and Atlantic Croaker for all commercial and recreational fisheries in order to limit the harvest of juvenile fish of these species. Limits on mesh size in commercial fishing gear are often used to achieve the same result. Mesh selectivity studies evaluating the most appropriate mesh size to limit harvest of juvenile Spot and Atlantic Croaker are not available, so the Petition did not include a mesh size limit to complement the size limit contained in the proposed rules. The Petitioner recommended in its Jan. 12, 2017 letter that the MFC undertake a mesh selectivity study to evaluate the mesh size most effective at limiting the harvest of juvenile Spot and Atlantic Croaker. Upon completion, rules could be further amended in accordance with the results of the study to reflect the best available data. Depending on the availability of funding, a mesh selectivity study could be an alternative to the proposed rules for minimum size limits for Spot and Atlantic Croaker. This

could help inform the determination if mesh size and/or minimum size limits are appropriate management measures for these species.

At the Aug. 16, 2017 MFC meeting in Raleigh, North Carolina, a member of the Southern Environmental Law Center (SELC) spoke on behalf of the NCWF and provided two alternatives to the Petitioned rules during the public comment period of the meeting (SELC 2017b). The two alternatives put forth were (1) *Status quo* and (2) a complete net ban in estuarine waters. It was also stated "the Petitioned rules should not be evaluated as the most restrictive option" and "would provide the public with reasonable alternatives against which to weigh the impact of the proposed rules". In a letter from the SELC on Sep. 18, 2017 inquiring about the status of the NCWF Petition for Rulemaking, the two alternatives mentioned at the August 2017 MFC meeting were restated (SELC 2017a). Although a complete net ban in estuarine waters illustrates the spectrum of management actions to address bycatch and habitat protection concerns, a complete net ban in estuarine waters is not recognized as an alternative to the Petitioned rules because it includes gears outside the scope of the Petition including gill nets, trammel nets, pound nets, seine nets, hoop nets, and any other kind of net used in a fishing operation. Under the status quo alternative, there are already mechanisms in place to manage state and interjurisdictional species through the FMP process (see section 1) per the requirements of the FRA (G.S. 113-182.1). The issue of bycatch in the shrimp trawl fishery was discussed in the 2015 North Carolina Shrimp FMP Amendment 1.

Additional information about an alternative to the proposed rules is found in Appendix 4, which explains the potential benefits of conducting a Before-After Control-Impact study. The information is appended to this document because it provides an alternative to the rulemaking process underway at this time that would be in lieu of the Petitioned rules. This study would include monitoring of sediment and water quality, as well as mapping the soft bottom habitat and looking for changes in oyster reef and SAV abundance, to determine what effects the Petitioned rules had on the environment in the newly proposed SSNAs. Because of the size of the area that would be affected by the proposed rules, the total time needed to document the current habitat under existing levels of trawling would occur over a period of 18 years and cost approximately $2.9 million dollars.

11 LITERATURE CITED

AAD (Astronomical Applications Department). 2017. Duration of Daylight/Darkness Table for One Year. The United States Naval Observatory. Retrieved August 1, 2017. http://aa.usno.navy.mil/data/docs/Dur_OneYear.php

Adams, C., S. Jacob, and S. Smith. 2000. What happened after the net ban? Publication # FE123. Food and Resource Economics Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. 7 p.

Alverson, D.L., and S.E. Hughes. 1996. Bycatch: from emotion to effective natural resource management. Reviews in Fish Biology and Fisheries 6: 443–462.

Alverson, D.L., M.H. Freeberg, S.A. Murawski and J.G. Pope. 1994. A global assessment of fisheries bycatch and discards. FAO Fisheries Technical Paper. No. 339, Rome, FAO. 233 p.

Anderson, D.K. 2002. Understanding the Impacts of the Florida Net Ban (Article X, Section 16 of the State Constitution). Texas A&M University, Department of Wildlife and Fisheries Science. 15 p.

ASMFC (Atlantic States Marine Fisheries Commission). 1996. Amendment 3 to the Interstate Fishery Management Plan for Weakfish. ASMFC Report Number 27, Washington, District of Columbia. 54 p.

ASMFC. 2002. Amendment 4 to the Interstate Fishery Management Plan for Weakfish. Report Number 39. ASMFC, Washington, District of Columbia. 101 p.

ASMFC. 2006. 2006 Weakfish Stock Assessment Report. ASMFC, Washington, District of Columbia. 315 p.

ASMFC. 2009a. Guide to fisheries science and stock assessments. Atlantic States Marine Fisheries Commission. National Oceanic and Atmospheric Administration Grant No. NA05NMF4741025. 66 p.

ASMFC. 2009b. Addendum IV to Amendment 4 to the Weakfish Fishery Management Plan. ASMFC, Washington, District of Columbia. 18 p.

ASMFC. 2010a. Spot Life History Report: Report to the ASMFC South Atlantic State/Federal Fisheries Management Board. Washington (DC): ASMFC. 46 pp.

ASMFC. 2010b. Atlantic Croaker 2010 Benchmark Stock Assessment. ASMFC, Washington, District of Columbia. 366 p.

ASMFC. 2011. SEAMAP 2011–2015 Management Plan. US Department of Commerce, National Oceanic and Atmospheric Administration. Award No. NA11NMF4350029. 101 p.

ASMFC. 2014a. Addendum I to the Omnibus Amendment to the Interstate Fishery Management Plans for Spanish mackerel, Spot, and Spotted seatrout. ASMFC, Arlington, VA. 7 p.

ASMFC. 2014b. Addendum II to Amendment I to the Interstate Fishery Management Plan for Atlantic Croaker. ASMFC, Arlington, VA. 7 p.

ASMFC. 2015. Atlantic Striped Bass Stock Assessment Update 2015. ASMFC, Arlington, Virginia. 100 p.

ASMFC. 2016a. Weakfish benchmark stock assessment and peer review report. ASMFC, Arlington, VA. 270 p.

ASMFC. 2016b. ASMFC Stock Assessment Overview: Weakfish. ASMFC, May 2016, Arlington, VA. 5 p.

ASMFC. 2017a. 2017 Spot stock assessment peer review. ASMFC, Arlington, Virginia. 9 p.

ASMFC. 2017b. 2017 Review of the Atlantic States Marine Fisheries Commission Fishery Management Plan for Spot (*Leiostomus zanthurus*) – 2016 fishing year. ASMFC, Arlington, Virginia. 20 p.

ASMFC. 2017c. 2017 Review of the Atlantic States Marine Fisheries Commission Fishery Management Plan for Atlantic Croaker (*Micropogonias undulatus*) – 2016 fishing year. ASMFC, Arlington, Virginia. 24 p.

ASMFC. 2017d. 2017 Atlantic Croaker stock assessment peer review. ASMFC, Arlington, Virginia. 10 p.

ASMFC. 2017e. Proceedings of the Atlantic States Marine Fisheries Commission South Atlantic State/Federal Fisheries Management Board. ASMFC, August 1, 2017, Alexandria, Virginia. 41 p.

ASMFC. 2017f. Proceedings of the Atlantic States Marine Fisheries Commission South Atlantic State/Federal Fisheries Management Board. ASMFC, May 11, 2017, Alexandria, Virginia. 40 p.

Baker, R., and T.J. Minello. 2010. Growth and mortality of juvenile white shrimp *Litopenaeus setiferus* in a marsh pond. Marine Ecology Progress Series. 413: 95–104.

Baird, D., R. R. Christian, C.H. Peterson, and G.A. Johnson. 2004. Application of mass-balance food web modeling to assess impacts of hypoxia on trophic transfers to vertebrate consumers and ecosystem functions in a eutrophied estuary. Ecological Applications 14: 805–822.

Beck, M.W., K.L. Heck, K.W. Able, D.L. Childers, D.B. Eggleston, B.M. Gillanders, B. Halpern, C.G. Hays, K. Hoshino, T.J. Minello, R.J. Orth, P.F. Sheridan, and M.P. Weinstein. 2001. The identification, conservation and management of estuarine and marine nurseries for fish and invertebrates. Bioscience 51(8): 633–641.

Bockstael N.E., and J.J. Opaluch. 1983. Discrete Modelling of Supply Response under Uncertainty: The Case of the Fishery. J Environ Econ Manage. 10: 125–137.

Britten, G.L., M. Dowd, and B. Worm. 2016. Changing recruitment capacity in global fish stocks. Proceedings of the National Academy of Sciences of the United States of America 113(1):134–139.

Brown, K.B. 2009. Characterization of the near-shore commercial shrimp trawl fishery from Carteret County to Brunswick County, North Carolina Completion report for NOAA award no. NA05NMF4741003 North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries, 29 p.

Brown, K.B. 2010. Characterization of the inshore commercial shrimp trawl fishery in Pamlico Sound and its tributaries, North Carolina Completion report for NOAA award no. NA05NMF4741003 North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries, 28 p.

Brown, K.B. 2015. Characterization of the commercial shrimp otter trawl fishery in the estuarine and ocean (0–3 miles) water of North Carolina Completion report for NOAA award no.

NA08NMF4740476 and NA13NMF4740243. North Carolina Department of Environment Quality, Division of Marine Fisheries. 177 p.

Brown, K.B. 2017. Characterization of the commercial shrimp fishery in the estuarine and ocean (0–3 miles) waters of North Carolina. Completion report for NOAA award no. NA13NMF4740243. North Carolina Department of Environmental Quality, Division of Marine Fisheries, 86p.

Brown, K., B. Price, L. Lee, S. Baker, and S. Mirabilio. 2017. Technical Solutions to Reduce Bycatch in the North Carolina Shrimp Trawl Fishery. Completion report for NOAA Award NA15NMF4720376. North Carolina Department of Environment Quality, Division of Marine Fisheries. 50 p.

Brown, K.B., B. Price, L. Lee, S. Baker, and S. Mirabilio. 2018. An evaluation of bycatch reduction technologies in the North Carolina shrimp trawl fishery. North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, NC. 40 p.

Bureau of Labor Statistics. 2017. U.S. Department of Labor, Consumer Price Index dataset CUSR0000SAF112, [06/01/2017] Available at: https://www.bls.gov/cpi/data.htm

Buzzelli, C.P., R.A. Luettich, S.P. Powers, C.H. Peterson, J.E. McNinch, J.L. Pinckney, and H.W. Paerl. 2002. Estimating the spatial extent of bottom water hypoxia and habitat degradation in a shallow estuary. Marine Ecology Progress Series 230:103–112.

Cahoon, L.B., M.H. Posey, T.D. Alphin, D. Wells, S. Kissling, W.H. Daniels, and J. Hales. 2002. Shrimp and crab trawling impacts on estuarine soft-bottom organisms. UNC-Wilmington, Wilmington, N.C. 18 p.

Conrad, J.M. Resource Economics. 2nd ed., Cambridge University Press, 2010.

Costanza, R., R. d'Arge, R. deGroot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. V. Oneill, J. Paruelo, R. G. Raskin, P. Sutton, and M. Vandenbelt. 1997. The value of the world's ecosystem services and natural capital. Nature 387 (6630):253–260.

Costanza, R., Perez-Maqueo, O., Martinez, M.L., Sutton, P., Anderson, S.J., Mulder, K. 2008. The value of coastal wetlands for hurricane protection. AMBIO: J. Hum. Environ. 37: 241–248.

Corbett, D.R., T. West, L. Clough, and H. Daniels. 2004. Potential impacts of bottom trawling on water column productivity and sediment transport processes. N.C. Sea Grant, Raleigh, N.C. NCSG 01-EP-04. 60 p.

Craig, J.K., and L.B. Crowder. 2005. Hypoxia-induced habitat shifts and energetic consequences in Atlantic croaker and brown shrimp on the Gulf of Mexico shelf. Marine Ecology Progress Series 294:79–94.

Crosson, S. 2007a. A Social and Economic Analysis of Commercial Fisheries in North Carolina: Albemarle and Pamlico Sounds. N.C. Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, N.C. Conducted under the Fisheries Disaster Assistance Program, Section 312 of the Magnuson-Stevens Fisheries Conservation and Management Act, National Oceanic and Atmospheric Administration Award No. NA16FW1543.

Crosson, S. 2007b. A Social and Economic Analysis of Commercial Fisheries in North Carolina: Core Sound. N.C. Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, N.C. Conducted under the Fisheries Disaster Assistance Program, Section 312 of

the Magnuson-Stevens Fisheries Conservation and Management Act, National Oceanic and Atmospheric Administration Award No. NA16FW1543. 32 p.

Crosson, S. 2009. A Social and Economic Analysis of Commercial Fisheries in North Carolina: Atlantic Ocean. N.C. Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, N.C. N.C. Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, N.C. Atlantic Coastal Fisheries Cooperative Management Act, National Oceanic and Atmospheric Administration Award No. NA05NMF4741003. 26 p.

Crosson, S. 2010a. A Social and Economic Analysis of Commercial Fisheries in North Carolina: Beaufort Inlet to South Carolina State Line. N.C. Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, N.C. Atlantic Coastal Fisheries Cooperative Management Act, National Oceanic and Atmospheric Administration Award No. NA05NMF4741003. 25 p.

Crosson, S. 2010b. A Social and Economic Survey of Recreational Saltwater Anglers in North Carolina. N.C. Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, N.C. 26 p.

Cudmore, W.W. 2009. Marine Fisheries-causes of decline and impacts. Northwest Center for Sustainable Resources, Chemeketa Community College. DUE #0757239. 83 p.

Dahlgren, C.P., G.T. Kellison, A.J. Adams, B.M. Gillanders, M.S. Kendall, C.A. Layman, J.A. Ley, I. Nagelkerken, and J.E. Serafy. 2006. Marine nurseries and effective juvenile habitats: Concepts and applications. Marine Ecology Progress Series 312: 291–295.

Deehr, R.A., J.J. Luczhovich, K.J. Hart, L.M. Clough, B.J. Johnson, and J.C. Johnson. 2014. Using stable isotope analysis to validate effective trophic levels from Ecopath models of areas closed and open to shrimp trawling in Core Sound, N.C., USA. Ecological Modeling 282:1–17.

Diamond, S.L. 2003. Estimation of bycatch in shrimp trawl fisheries: a comparison of estimation methods using field data and simulated data. Fishery Bulletin 101(Supplement 3): 484–500.

Diamond-Tissue, S.L. 1999. Characterization and estimation of shrimp trawl bycatch in North Carolina waters. Doctorate dissertation, North Carolina State University, Department of Zoology, Raleigh, N.C. 27695. 54 p.

Dumas, C. F., J. C. Whitehead, C. E. Landry, J. H. Herstine. 2009. Economic Impacts and Recreation Value of the North Carolina For-Hire Fishing Fleet. Final Report, North Carolina Sea Grant, Fishery Resource Grant (FRG) Report 07-FEG-05, April 29.

Eby, L.A., L.B. Crowder, C.M. McClellan, C.H. Peterson, and M.J. Powers. 2005. Habitat degradation from intermittent hypoxia: impacts on demersal fishes. Marine Ecology Progress Series 291:249–261.

Epperly, S., and S. Ross. 1986. Characterization of the North Carolina Pamlico-Albemarle estuarine complex. NOAA Technical Memo. NMFS-SEFC-175.

FAO (Food and Agriculture Organization of the United Nations). 2018. The FAO Fisheries and Aquaculture Department and the UN agenda. In: *FAO Fisheries and Aquaculture Department* [online]. Rome. Updated 23 September 2014. [Cited 4 June 2018]. http://www.fao.org/fishery/.

Fonner, R., and G. Sylvia. 2015. Willingness to Pay for Multiple Seafood Labels in a Niche Market. Marine Resource Economics 30(1): 51-70.

Gannon, D.P., and D.M. Waples. 2004. Diets of coastal bottlenose dolphins from the US Mid-Atlantic coast differ by habitat. Marine Mammal Science 20.3:527–545.

Gentner, B., and S. Steinback. 2008. The economic contribution of marine angler expenditures in the United States, 2006. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. NOAA Technical Memorandum NMFS-F/SPO-94.

GMFMC (Gulf of Mexico Fishery Management Council). 2015a. Public Hearing Draft for Amendment 17A to the Fishery Management Plan for the Shrimp Fishery in the Gulf of Mexico, U.S. Waters. Gulf of Mexico Fishery Management Council. 83 p.

GMFMC. 2015b. Yield, Threshold Number of Permits, and Transit Provisions- Draft Options for Amendment 17B to the Fishery Management Plan for the Shrimp Fishery of the Gulf of Mexico, U.S. Waters. National Oceanic and Atmospheric Administration Award No. NA10NMF4410011.

Grabowski, J.H., A.R. Hughes, D.L. Kimbro, and M.A. Dolan. 2005. How habitat setting influences restored oyster reef communities. Ecology 86(7):1926–1935.

Grabowski, J.H., R.D. Brumbaugh, R.F. Conrad, A.G. Keeler, J.J. Opaluch, C.H. Peterson, M.F. Piehler, S.P. Powers, and A.R. Smyth. 2012. Economic valuation of ecosystem services provided by oyster reefs. Bioscience 62(10):900–909.

Greene, K.E., J.L. Zimmerman, R.W. Laney, and J.C. Thomas-Blate. 2009. Atlantic coast diadromous fish habitat: A review of utilization, threats, recommendations for conservation, and research needs. Atlantic States Marine Fisheries Commission Habitat Management Series No. 9, Washington, D.C.

Griffith, David. 1996. Impacts of new regulations on North Carolina fishermen: a classification analysis. Fisheries Research Report to the NC Moratorium Steering Committee. North Carolina Sea Grant UNC-SG-96-07. 110 p.

Hadley, J. and S. Crosson. 2010. A Business and Economic Profile of Seafood Dealers in North Carolina. N.C. Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, N.C. Atlantic Coastal Fisheries Cooperative Management Act, National Oceanic and Atmospheric Administration Award No. NA05NMF4741003. 23 p.

Hadley, J. 2012. A Social and Economic Profile of Ocean Fishing Piers in North Carolina. N.C. Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, N.C. CRFL Grant Award 2010-F-001. 27 p.

Hadley, J. and C. Wiegand. 2014. An Economic and Social Analysis of Commercial Fisheries in North Carolina: Albemarle Sound and Pamlico Sound. N.C. Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, N.C. Atlantic Coastal Fisheries Cooperative Management Act, National Oceanic and Atmospheric Administration Award No. NA08NMF4740476. 46 p.

Hare, J.A., and K.W. Able. 2007. Mechanistic links between climate and fisheries along the east coast of the United States: explaining population outbursts of Atlantic croaker (*Micropogonias undulatus*). Fisheries Oceanography 16(1):31–45.

Hare, J.A., M.A. Alexander, M.J. Fogarty, E.H. Williams, and J.D. Scott. 2010. Forecasting the dynamics of a coastal fishery species using a coupled climate-population model. Ecological Applications 20(2):452–464.

Harrison, J., A. Pickle, T. Vegh, J. Virdin, and N. Decker. 2017. North Carolina's ocean economy: A first assessment and transitioning to a Blue Ecomony. Jointly prepared by N.C. Sea Grant, N.C. State University and Nicholas Institute for Environmental Policy Solutions, Duke University. UNC-SG-17-02. 26 p.

Hilborn, R. 2017. Testimony of Ray Hilborn to U.S. Senate subcommittee. 24 October 2017.

Homans, F.R., and J.E. Wilen. 1997. A model of regulated open access resource use. Journal of Environmental Economics and Management 32:1–21.

Humphries, A.T., and M.K. La Peyre. 2015. Oyster reef restoration supports increased nekton biomass and potential commercial fishery value. PeerJ 3, e1111. DOI 10.7717/peerj.1111.

IMPLAN Group, LLC. 2013. IMPLAN System, Version 3.1.1001.2. Huntersville, NC. www.implan.com

Ingraham, B. 2003. Night Vs. Day Bycatch Comparison for Shrimp Trawling in the Southern District of North Carolina. North Carolina Fisheries Resource Grant. FRG-98-FEG-46.

IPPC (Intergovernmental Panel on Climate Change). 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II, III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. IPPC, Geneva, Switzerland.

Johnson, S.K. 1978. Handbook of Shrimp Diseases. Sea Grant College Program. TAMU-SG-75-603. Texas A&M University, College Station. 23p.

Johnson, G.A. 2006. Multispecies interactions in a fishery ecosystem and implications for fisheries management: the impacts of the estuarine shrimp trawl fishery in North Carolina. Dissertation. University of North Carolina at Chapel Hill, Department of Marine Science. 159 p.

Johnson, J.C., and M.K. Orbach. 1996. Effort management in North Carolina fisheries: A total systems approach. Fisheries Research Report to the NC Moratorium Steering Committee. North Carolina Sea Grant UNC-SG-96-08. 155 p.

Kite-Powell, H.L., M. Rubino, and B. Morehead. 2013. The future of US seafood supply. Aquaculture Economics and Management 17(3):228–250.

Lehnert, R.L., and D.M. Allen. 2002. Nekton use of subtidal oyster shell habitat in a southeastern U.S. estuary. Estuaries 25(5):1015–1024.

Leo, J.P., R.J. Minello, W.E. Grant, Wang H.H. 2016. Simulating environmental effects on brown shrimp production in the northern Gulf of Mexico. Ecological Modelling. 300: 24–40.

Liese, C., and A. Stemle. 2014. Economics of the Federal Gulf of Mexico Shrimp Fisheries - 2011. NOAA Technical Memorandum NMFS-SEFSC-601, 26p.

Liese, C., and A. Stemle. 2017. Economics of the Federal Gulf of Mexico Shrimp Fisheries - 2012. NOAA Technical Memorandum NMFS-SEFSC-668, 26p.

Link, J.S. 2002. What does ecosystem-based fisheries management mean? Fisheries 27(4): 18–21.

Link, J.S., J.K.T. Brodziak, S.F. Edwards, W.J. Overholtz, D. Mountain, J.W. Jossi, T.D. Smith, and M.J. Fogerty. 2002. Marine ecosystem assessment in a fisheries management context. Canadian Journal of Fisheries and Aquatic Sciences 59(9): 1429–40.

Lovell, S., S. Steinback, and J. Hilger. 2013. The economic contribution of marine angler expenditures in the United States, 2011. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. NOAA Technical Memorandum NMFS-F/SPO-134.

Luettich, R.A., J.E. McNinch, J.L. Pinckney, M.J. Alperin, C.S. Martens, H.W. Paerl, C.H. Peterson, and J.T. Wells. 2000. Neuse River estuary modeling and monitoring project, final report: Monitoring phase. Water Resources Research Institute, Raleigh, N.C.

Mace, M.M., and L.P. Rozas. 2017. Population dynamics and secondary production of juvenile white shrimp (*Litopenaeus setiferus*) along an estuarine salinity gradient. Fisheries Bulletin. 115: 74–88.

Maiolo, J.R. 2004. Hard times and a nickel a bucket: Struggle and survival in North Carolina's shrimp industry. Chapel Hill, NC: Chapel Hill Press. 191 p.

Melillo, J.M., T.C. Richmond, and G.W. Yohe. 2014. Climate change impacts in the United States: The Third National Climate Assessment. US Global Change Research Program. doi:10.7930/J0Z31WJ2., Washington, D.C.

McCoy, E.G. 1968. Movement, growth, and mortality of brown shrimp (*Penaeus aztecus*) marked and released in San Quarter Bay, Pamlico Sound, North Carolina. Presentation, American Fisheries Society, Baltimore, Maryland. 15 p.

Minello, T.J. 2017. Environmental factors affecting burrowing by brown shrimp *Farfantepenaeus aztecus* and white shrimp *Litopenaeus setiferus* and their susceptibility to capture in towed nets. Journal of Experimental Marine Biology and Ecology. 486: 265–273.

Murphey, P.L., and M.S. Fonseca. 1995. Role of high and low energy seagrass beds as nursery areas for *Penaeus duorarum* in North Carolina. Marine Ecology Progress Series 121:91–98.

Myers, R.A., J.K. Baum, T.D. Shepherd, S.P. Powers, and C.H. Peterson. 2007. Cascading effects of the loss of Apex predatory sharks from a coastal ocean. Science 315(March): 1846–1850.

Nance, J.M. (editor). 1998. Report to Congress. Southeastern United States shrimp trawl bycatch program. National Marine Fisheries Service, Silver Spring, Maryland.

Nash, B., and S. Andreatta. 2011. New business models for small-scale fishermen and seafood processors. North Carolina Sea Grant. UNC-SG-11-05. Available at https://ncseagrant.ncsu.edu/ncseagrant_docs/products/2010s/new_biz_model_fishermen_11-05.pdf

N.C. Climate Office. 2015. Hurricane Statistics. Available at: https://climate.ncsu.edu/climate/hurricanes/statistics

NCDEQ (North Carolina Department of Environmental Quality). 2016. North Carolina Coastal Habitat Protection Plan Source Document. Morehead City, N.C. Division of Marine Fisheries. 475 p.

NCDMF (North Carolina Division of Marine Fisheries). 1994. North Carolina Weakfish Reduction Plan, 1994–1995. North Carolina Department of Environment, Quality, and Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, North Carolina. 18 p.

NCDMF. 1999. Shrimp and crab trawling in North Carolina's estuarine waters. Report to N.C. Marine Fisheries Commission. DENR, Morehead City, N.C. 163 p.

NCDMF. 2014. Sedimentation in tidal creeks, Information Paper. Prepared by BRT Habitat Subcommittee for the Marine Fisheries Commission. 31 p.

NCDMF. 2015a. North Carolina Shrimp Fishery Management Plan Amendment 1. North Carolina Department of Environmental Quality. North Carolina Division of Marine Fisheries. Morehead City, North Carolina. 519 p.

NCDMF. 2015b. Fishery Management Plan for Interjurisdictional Fisheries: Information Update. North Carolina Department of Environmental Quality. North Carolina Division of Marine Fisheries. Morehead City, North Carolina. 85 p.

NCDMF. 2017. Division of Marine Fisheries Review of the Petition for Rulemaking to Amend 15A Admin. Code 3I .0101, 3L .0101, 3L .0103, 3N .0105, and 3R .0105 and Adopt 3M .0522 and 3M .0523 to Designate Special Secondary Nursery Areas and Reduce Bycatch Mortality in North Carolina Coastal Fishing Waters. North Carolina Department of Environmental Quality. North Carolina Division of Marine Fisheries. Morehead City, North Carolina. 55 p.

NCDOC (North Carolina Department of Commerce). 2018. County Profile Data. Available at: https://accessnc.nccommerce.com/DemographicsReports/.

NCREDC (North Carolina Rural Economic Development Center). 2013. A supply chain analysis of North Carolina's commercial fishing industry: a briefing paper by the North Carolina Rural Economic Development Center (NPO), September 2013 -- UNC-SG-13-01(Sea Grant), 50 p.

NCWF (North Carolina Wildlife Federation). 2016a. Petition for Rulemaking to Amend 15A Admin. Code 3L .010, 3L .0103, 3M .0522, 3M .0523, 3N .0151, and 3R .0105 to Designate Special Secondary Nursery Areas and Reduce Bycatch Mortality in North Carolina Coastal Fishing Waters (Nov. 2, 2016). 99 p. http://portal.ncdenr.org/c/document_library/get_file?uuid=c2b70a32-34a8-45f3-b96a-0b2c275af883&groupId=38337.

NCWF. 2016b. Clerical edits to Petition for Rulemaking Submitted to N.C. Marine Fisheries Commission on November 2, 2016 (Nov. 16, 2016). 2 p. http://portal.ncdenr.org/c/document_library/get_file?uuid=37dceee8-6177-464b-b742-79ed31e9bad2&groupId=38337.

NCWF. 2017a. Modification to Petition for Rulemaking Submitted to N.C. Marine Fisheries Commission on November 2, 2016 (Jan. 12, 2017). 6 p. http://portal.ncdenr.org/c/document_library/get_file?uuid=6dfafd58-f3ef-4334-8039-f00488f23da8&groupId=38337.

NCWF. 2017b. Public Comments in Support of N.C. Wildlife Federation's Petition for Rulemaking (Jan. 26, 2017). 7 p. http://portal.ncdenr.org/c/document_library/get_file?uuid=84bd85d0-dc58-400e-befb-550463aeff29&groupId=38337 (pp. 111–117).

NEFSC (Northeast Fisheries Science Center). 2009. 48th Northeast Regional Stock Assessment Workshop (48th SAW) Assessment Report. U.S. Department of Commerce, Northeast Fisheries Science Center. Reference Document 09-15. 834 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026 or online at http://www.nefsc.noaa.gov/nefsc/saw/

NEFSC. 2013. 57th Northeast Regional Stock Assessment Workshop (57th SAW) Assessment Report: Part B. Striped Bass Stock Assessment for 2013, Updated through 2011. Northeast Fisheries Science Center Reference Document 13-16 (https://www.nefsc.noaa.gov/publications/crd/crd1316/)

Nesslage, G.M., and C.F. Dumas. 2017. A biological and economic evaluation of imperiled marine fish stocks and the stock assessment process in North Carolina. Final Report submitted to N.C. Sound Economy, UMCES Technical Report Series #TS-703-17. 188 p.

Newsome, J. 2014. An Analysis of North Carolina's Seafood Industry: National and State Perspective. North Carolina State University, Poole College of Management.

NOAA (National Oceanic and Atmospheric Administration). 2006. NOAA Fisheries Glossary. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-F/SPO-69. 61 p.

NOAA. 2015. Fisheries imports and exports of fishery products annual summary, 2015. Current Fishery Statistics NO. 2015-2.

NOAA. 2017a. Status of Stocks 2017: Annual Report to Congress on the Status of U.S. Fisheries. 7 p. Available at: https://www.fisheries.noaa.gov/national/2017-report-congress-status-us-fisheries

NOAA. 2017b. Fisheries Economics of the United States, 2015. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-F/SPO-170. 247 p.

Noble, E.B., and R.J. Monroe. 1991. Classification of Pamlico Sound nursery areas: recommendations for critical habitat criteria. North Carolina Department of Environment, Health, and Natural Resources, A/P Project No. 89-09, Morehead City, North Carolina.

NRC (National Research Council) 1999. Sharing the fish: toward a national policy on individual fishing quotas. Committee to Review Individual Fishing Quotas, Ocean Studies Board, Commission on Geosciences, Environment, and Resources, National Research Council. National Academy Press, Washington, D.C. 402 p.

Nye, J., J. Link, J. Hare, and W. Overholtz. 2009. Changing spatial distribution of northwest Atlantic fish stocks in relation to temperature and stock size. Marine Ecology Progress Series 393:111–129.

Odell, J., D.H. Adams, B. Boutin, W. Collier II, A. Deary, L.N. Havel, J.A. Johnson Jr., S.R. Midway, J. Murray, K. Smith, K.M. Wilke, and M.W. Yuen. 2017. Atlantic sciaenid habitats: A review of utilization, threats, and recommendations for conservation, management, and research. Atlantic States Marine Fisheries Commission Habitat Management Series No. 14, Arlington, VA. 144 p.

O'Reilly, R. 1996. Appendix 1 Evaluation Manual Assessing States' Compliance to the ASMFC FMP for Weakfish, In Amendment 3 to the Interstate Fishery Management Plan for Weakfish. ASMFC Report Number 27, Washington, District of Columbia. 54 p.

Paperno, R., T.E. Targett, and P.A. Grecay. 2000. Spatial and temporal variation in recent growth, overall growth, and mortality of juvenile Weakfish (*Cynoscion regalis*) in Delaware Bay. Estuaries 23(1):10–20.

Pauly D. 1980. On the interrelationships between natural mortality, growth parameters and mean environmental temperature in 175 fish stocks. *Journal du Conseil International pour l'Exploration de la Mer* 39(2): 175-192.

Pearson, J.C. 1932. Winter trawl fishery off the Virginia and North Carolina coasts. U.S. Bureau of Fish. Investigative Report 10. 31 p.

Peterson, M.S. 2003. A conceptual view of environment-habitat-production linkages in tidal river estuaries. Reviews in Fisheries Science 11(4):291–313.

Pfeiffer, L., and T. Gratz. 2016. The effect of rights-based fisheries management on risk taking and fishing safety. Proceedings of the National Academy of Sciences of the United States of Americas 113(10):2615–2620.

Ramirez-Rodriguez, M. and F. Arreguin-Sanchez. 2003. Life history stage duration and natural mortality for the pink shrimp *Farfantepenaeus duorarum* (Burkenroad, 1939) in the southern Gulf of Mexico, using the gnomonic model for time division. Fisheries Research. 60: 45–51.

Rogers, K. 2011. Scientific Modeling. Encyclopedia Britannica. Available at: https://www.britannica.com/science/scientific-modeling

Ross, J.L., and T.M. Stevens. 1992. Life history and population dynamics of red drum (*Sciaenops ocellatus*) in North Carolina waters. NCDMF Completion Report Project F-29. North Carolina Division of Marine Fisheries.

Ross, S.W. 2003. The relative value of different estuarine nursery areas in North Carolina for transient juvenile marine fishes. Fishery Bulletin 101:384–404.

Ross, S.W., and J.E. Lancaster. 2002. Movements and site fidelity of two juvenile fish species using surf zone nursery habitats along the southeastern North Carolina coast. Environmental Biology of Fishes 63(2):161–172.

Rugolo, L.J., V.A. Crecco, and M.R. Gibson. 1994. Modeling stock status and effectiveness of alternative management strategies for Atlantic coast striped bass. Summary Report to the Striped Bass Management Board, ASMFC. May,1994. p. 1-30.

Schwart, S. 2002. All models are wrong. Water Resources Research Institute News, April Issue. 2 p.

Shivlani, M., D. Letson, and C. Sawcyzn. 1998. Socioeconomic Effects of the Florida Net Ban in Monroe County. Florida Geographer 29:12–29.

Southern Environmental Law Center (SELC). 2017a. Letter to Dr. Braxton Davis, North Carolina Division of Marine Fisheries. Re: Status of North Carolina Wildlife Federation Petition for Rulemaking on Sep. 18, 2017. 3 p.

Southern Environmental Law Center (SELC). 2017b. Public comment by Blakely Hildebrand on behalf of the North Carolina Wildlife Federation on Aug. 16, 2017. http://ncdmf.net/audio/08-2017_mfc_audio/08-Public-Comment.mp3

Stemle, A., and C. Wiegand. 2017. A Social And Economic Analysis Of Commerical Fisheries In North Carolina: Core Sound to the South Carolina State Line. Division of Marine Fisheries, Morehead

City, N.C. Atlantic Coastal Fisheries Cooperative Management Act, National Oceanic and Atmospheric Administration, under Grant Award NA15NMF4270334.

Stunz, G.W., T.J. Minello, and L.P. Rozas. 2010. Relative value of oyster reef as habitat for estuarine nekton in Galveston Bay, Texas. Marine Ecology Progress Series 406: 147–159.

Sweet, W.J., J. Park, J. Marra, C. Zervas, and S. Gill. 2014. Sea level rise and nuisance flood frequency changes around the United States. NOAA, Silver Springs, MD.

Tansley, A.G. 1935. The use and abuse of vegetational concepts and terms. Ecology 16:284–307.

Terceiro, M. 2002. The summer flounder chronicles: science, politics, and litigation. 1975-2000. Reviews in Fish Biology and Fisheries 11:125-168.

Terceiro, M. 2011. The summer flounder chronicles II: new science, new controversy. 2001-2010. Reviews in Fish Biology and Fisheries 21:681-712.

Terceiro, M. 2018. The summer flounder chronicles III: struggling with success. 2011-2016. Reviews in Fish Biology and Fisheries 28:381-404.

Tidd, A.N., T. Hutton, L.T. Kell, and G. Padda. 2011. Exit and entry of fishing vessels: an evaluation of factors affecting investment decisions in the North Sea English bean trawl fleet. Journal of Marine Science 68(5): 961–971.

Tuckey, T.D., and M.C. Fabrizio. 2016. Variability in fish tissue proximate composition is consistent with indirect effects of hypoxia in Chesapeake Bay tributaries. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science 8:1–15.

Walter, J.F., and J. Isley. 2014. South Atlantic shrimp fishery bycatch of king mackerel. SEDAR38-RW-01. SEDAR, North Charleston, SC. 18 p.

Watson, J.W. 1984. Configurations and relative efficiencies of shrimp trawls employed in southeastern United States waters. US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

Whitaker, J.D., L.B. DeLancey, and J.E. Jenkins. 1989. A Study of the Experimental Closure of South Carolina's Sounds and Bays to Commercial Trawling. Technical Report No. 72. Commercial Crustacean Management Section, Office of Fishery Management, Division of Marine Resources, South Carolina Wildlife and Marine Resources Department. 60 p.

Zimmerman, R.J., T.J. Minello, and L.P. Rozas. 2000. Salt marsh linkages to productivity of penaeid shrimps and blue crabs in the northern Gulf of Mexico. In: Weinstein, M.P., Kreger, D.A. (Eds.), Concepts and Controversies in Tidal Marsh Ecology. New Jersey Marine Sciences Consortium, Fort Hancock, New Jersey, pp. 293–314.

APPENDIX 1 Proposed Rule Text (Source: NCWF 2016a)

TEXT OF PROPOSED RULES

The added text is denoted by underline and deleted text is denoted ~~by strike-through~~ below.

15A N.C. Admin. Code 3R .0105: Special Secondary Nursery Areas

The special secondary nursery areas referenced in 15A NCAC 3N .0105(b) are designated in the following coastal water areas:

(1) Roanoke Sound:

(a) Outer Shallowbag Bay--west of a line beginning on Baum Point at a point 35° 55.1461' N--75° 39.5618' W; running southeasterly to Ballast Point to a point 35° 54.6250' N--75° 38.8656' W; including the canal on the southeast shore of Shallowbag Bay; and

(b) Kitty Hawk Bay/Buzzard Bay--within the area designated by a line beginning at a point on the east shore of Collington Creek at a point 36° 2.4360' N--75° 42.3189' W; running westerly to a point 36° 2.6630' N--75° 41.4102' W; running along the shoreline to a point 36° 2.3264' N--75° 42.3889' W; running southwesterly to a point 36° 2.1483' N--75° 42.4329' W; running along the shoreline to a point 36° 1.6736' N--75° 42.5313' W; running southwesterly to a point 36° 1.5704' N--75° 42.5899' W; running along the shoreline to a point 36° 0.9162' N--75° 42.2035' W; running southeasterly to a point 36° 0.8253' N--75° 42.0886' W; running along the shoreline to a point 35° 59.9886' N--75° 41.7284' W; running southwesterly to a point 35° 59.9597' N--75° 41.7682' W; running along the shoreline to the mouth of Buzzard Bay to a point 35° 59.6480' N--75° 32.9906' W; running easterly to Mann Point to a point 35° 59.4171' N--75° 32.7361' W; running northerly along the shoreline to the point of beginning;

(2) In the Pamlico and Pungo rivers Area:

(a) Pungo Creek--west of a line beginning on Persimmon Tree Point at a point 35° 30.7633' N--76° 38.2831' W; running southwesterly to Windmill Point to a point 35° 31.1546' N--76° 37.7590' W;

(b) Scranton Creek--south and east of a line beginning on the west shore at a point 35° 30.6810' N--76° 28.3435' W; running easterly to the east shore to a point 35° 30.7075' N--76° 28.6766' W;

(c) Slade Creek--east of a line beginning on the west shore at a point 35° 27.8879' N--76° 32.9906' W; running southeasterly to the east shore to a point 35° 27.6510' N--76° 32.7361' W;

(d) South Creek--west of a line beginning on Hickory Point at a point 35° 21.7385' N-- 76° 41.5907' W; running southerly to Fork Point to a point 35° 20.7534' N--76° 41.7870' W; and

(e) Bond Creek/Muddy Creek--south of a line beginning on Fork Point 35° 20.7534' N-- 76° 41.7870' W; running southeasterly to Gum Point to a point 35° 20.5632' N--76° 41.4645' W;

(3) In the West Bay Area:

(a) West Thorofare Bay--south of a line beginning on the west shore at a point 34° 57.2199' N--76° 24.0947' W; running easterly to the east shore to a point 34° 57.4871' N--76° 23.0737' W;

(b) Long Bay-Ditch Bay--west of a line beginning on the north shore of Ditch Bay at a point 34° 57.9388' N--76° 27.0781' W; running southwesterly to the south shore of Ditch Bay to a point 34° 57.2120' N--76° 27.2185' W; then south of a line running southeasterly to the east shore of Long Bay to a point 34° 56.7633' N--76° 26.3927' W; and

(c) Turnagain Bay--south of a line beginning on the west shore at a point 34° 59.4065' N--76° 30.1906' W; running easterly to the east shore to a point 34° 59.5668' N--76° 29.3557' W;

(4) In the Core Sound Area:

(a) Cedar Island Bay--northwest of a line beginning near the gun club dock at a point 34° 58.7203' N--76° 15.9645' W; running northeasterly to the south shore to a point 34° 57.7690' N--76° 16.8781' W;

(b) Thorofare Bay-Barry Bay--northwest of a line beginning on Rumley Hammock at a point 34° 55.4853' N--76° 18.2487' W; running northeasterly to Hall Point to a point 34° 54.4227' N--76° 19.1908' W;

(c) Nelson Bay--northwest of a line beginning on the west shore of Nelson Bay at a point 34° 51.1353' N--76° 24.5866' W; running northeasterly to Drum Point to a point 34° 51.6417' N--76° 23.7620' W;

(d) Brett Bay--north of a line beginning on the west shore at a point 34° 49.4019' N--76° 26.0227' W; running easterly to Piney Point to a point 34° 49.5799' N--76° 25.0534' W; and

(e) Jarrett Bay--north of a line beginning on the west shore near Old Chimney at a point 34° 45.5743' N--76° 30.0076' W; running easterly to a point east of Davis Island 34° 45.8325' N--76° 28.7955' W;

(5) In the North River Area:

(a) North River--north of a line beginning on the west shore at a point 34° 46.0383' N-- 76° 37.0633' W; running easterly to a point on the east shore 34° 46.2667' N--76° 35.4933' W; and

(b) Ward Creek--east of a line beginning on the north shore at a point 34° 46.2667' N-- 76° 35.4933' W; running southerly to the south shore to a point 34° 45.4517' N--76° 35.1767' W;

(6) Newport River--west of a line beginning near Penn Point on the south shore at a point 34° 45.6960' N--76° 43.5180' W; running northeasterly to the north shore to a point 34° 46.8490' N--76° 43.3296' W;

(7) New River--all waters upstream of a line beginning on the north side of the N.C. Highway 172 Bridge at a point 34° 34.7680' N--77° 23.9940' W; running southerly to the south side of the bridge at a point 34° 34.6000' N--77° 23.9710' W;

(8) Chadwick Bay--all waters west of a line beginning on the northeast side of Chadwick Bay at a point 34° 32.5630' N--77° 21.6280' W; running southeasterly to a point near Marker "6" at 34° 32.4180' N--77° 21.6080' W; running westerly to Roses Point at a point 34° 32.2240' N--77° 22.2880' W; following the shoreline in Fullard Creek to a point 34° 32.0340' N--77° 22.7160' W; running northwesterly to a point 34° 32.2210' N--77° 22.8080' W; following the shoreline to the west point of Bump's Creek at a point 34° 32.3430' N--77° 22.4570' W; running northeasterly to the east shore to a point 34° 32.4400' N--77° 22.3830' W; following the shoreline of Chadwick Bay back to the point of origin;

(9) Intracoastal Waterway--all waters in the IWW maintained channel from a point near Marker "17" north of Alligator Bay 34° 30.7930' N--77° 23.1290' W; to a point near Marker "49" at Morris Landing at a point 34° 28.0820' N--77° 30.4710' W; and all waters in the IWW maintained channel and 100 feet on either side from Marker "49" to the N.C. Highway 50-210 Bridge at Surf City;

(10) Cape Fear River--all waters bounded by a line beginning on the south side of the Spoil Island at the intersection of the IWW and the Cape Fear River ship channel at a point 34° 1.5780' N--77° 56.0010' W; running easterly to the east shore of the Cape Fear River to a point 34° 1.7230' N--77° 55.1010' W; running southerly and bounded by the shoreline to the Ferry Slip at Federal Point at a point 33° 57.8080' N--77° 56.4120' W; running northerly to Bird Island to a point 33° 58.3870' N--77° 56.5780' W; running northerly along the west shoreline of Bird Island and the Cape Fear River spoil islands back to point of origin;

(11) Lockwood Folly River--all waters north of a line beginning on Howells Point at a point 33° 55.3680' N--78° 12.7930' W and running in a westerly direction along the IWW near IWW Marker "46" to a point 33° 55.3650' N--78° 13.8500' W; and

(12) Saucepan Creek--all waters north of a line beginning on the west shore at a point 33° 54.6290' N--78° 22.9170' W; running northeasterly to the east shore to a point 33° 54.6550' N--78° 22.8670' W.

(13) All Coastal Fishing Waters under the jurisdiction of the Marine Fisheries Commission, pursuant to N.C. Gen. Stat. § 113-132(a), not otherwise designated as primary, secondary, or special secondary nursery areas under .0103, .0104, or above, respectively.

15A N.C. Admin. Code 3L .0101: Shrimp Harvest Restrictions

(a) It is unlawful to take shrimp until the Fisheries Director, by proclamation, opens the season.

(b) The Fisheries Director may not open the season until the shrimp count reaches 60 shrimp per pound, heads on, in the Pamlico Sound.

~~(b)~~ (c) The Fisheries Director may, by proclamation, impose any or all of the following restrictions on the taking of shrimp:

(1) specify time;
(2) specify area;
(3) specify means and methods;

(4) specify season;
(5) specify size; and
(6) specify quantity.

15A N.C. Admin. Code 3L .0103: Prohibited Nets, Mesh Lengths and Areas

(a) It is unlawful to take shrimp with nets with mesh lengths less than the following:

(1) Trawl net--one and one-half inches;
(2) Fixed nets, channel nets, float nets, butterfly nets, and hand seines--one and one-fourth inches; and
(3) Cast net--no restriction.

(b) It is unlawful to take shrimp with a net constructed in such a manner as to contain an inner or outer liner of any mesh length. Net material used as chafing gear shall be no less than four inches mesh length, except that chafing gear with smaller mesh may be used only on the bottom one-half of the tailbag. Such chafing gear shall not be tied in a manner that forms an additional tailbag.

(c) ~~It is unlawful to take shrimp with trawls that have a combined headrope of greater than 90 feet in Internal Coastal Waters in the following areas:~~

~~(1) North of the 35| 46.3000' N latitude line;~~
~~(2) Core Sound south of a line beginning at a point 34| 59.7942' N- 76| 14.6514' W on Camp Point; running easterly to a point 34| 58.7853' N- 76| 9.8922' W on Core Banks; to the South Carolina State Line;~~
~~(3) Pamlico River upstream of a line from a point 35| 18.5882' N- 76| 28.9625' W at Pamlico Point; running northerly to a point 35| 22.3741' N- 76| 28.6905' W at Willow Point; and~~
~~(4) Neuse River southwest of a line from a point 34| 58.2000' N- 76| 40.5167' W at Winthrop Point on the eastern shore of the entrance to Adams Creek; running northerly to a point 35| 1.0744' N- 76| 42.1550' W at Windmill Point at the entrance of Greens Creek at Oriental.~~

~~(d)~~ (c) Effective January 1, 201~~7~~8 it is unlawful to take shrimp with trawls that have a combined headrope of greater than 90 feet in Coastal Fishing Waters. ~~220 feet in Internal Coastal Waters in the following areas:~~

~~(1) Pamlico Sound south of the 35| 46.3000' N latitude line and north of a line beginning at a point 34| 59.7942' N- 76| 14.6514' W on Camp Point; running easterly to a point 34| 58.7853' N- 76| 9.8922' W on Core Banks;~~
~~(2) Pamlico River downstream of a line from a point 35| 18.5882' N- 76| 28.9625' W at Pamlico Point; running northerly to a point 35| 22.3741' N- 76| 28.6905' W at Willow Point; and~~
~~(3) Neuse River northeast of a line from a point 34| 58.2000' N- 76| 40.5167' W at Winthrop Point on the eastern shore of the entrance to Adams Creek; running northerly to a point 35| 1.0744' N- 76| 42.1550' W at Windmill Point at the entrance of Greens Creek at Oriental.~~

~~(e)~~ (d) It is unlawful to use a shrimp trawl in the areas described in 15A NCAC 3R .0114.

~~(f)~~ (e) It is unlawful to use channel nets except as provided in 15A NCAC 3J .0106.

~~(g)~~ (f) It is unlawful to use shrimp pots except as provided in 15A NCAC 3J .0301.

~~(h)~~ (g) It is unlawful to use a shrimp trawl that does not conform with the federal rule requirements for Turtle Excluder Devices (TED) as specified in 50 CFR Part 222.102 Definitions, 50 CFR Part 223.205 (a) and Part 223.206 (d) Gear Requirements for Trawlers, and 50 CFR Part 223.207 Approved TEDs. These federal rules are incorporated by reference including subsequent amendments and editions. Copies of these rules are available via the Code of Federal Regulations posted on the Internet at http://www.gpoaccess.gov/cfr/index.html and at the Division of Marine Fisheries, P.O. Box 769, Morehead City, North Carolina 28557 at no cost.

~~(i)~~ (h) It is unlawful to use a shrimp trawl without two (2) authorized North Carolina Division of Marine Fisheries bycatch reduction devices properly installed and operational in the cod end of each net in Coastal Fishing Waters.

15A N.C. Admin. Code 3N .0105: Prohibited Gear, Secondary Nursery Areas

(a) It is unlawful to use trawl nets for any purpose in any of the permanent secondary nursery areas designated in 15A NCAC 3R .0104.

(b) It is unlawful to use trawl nets for any purpose in any of the special secondary nursery areas designated in 15A NCAC 3R .0105(1)-(12), except that the Fisheries Director, may, by proclamation, open any or all of the special secondary nursery areas listed in 15A NCAC 3R .0105(1)-(12), or any portion thereof, ~~listed in 15A NCAC 3R .0105~~ to shrimp or crab trawling from August 16 through May 14 subject to the provisions of 15A NCAC 3L .0100 and .0200.

(c) It is unlawful to use trawl nets for any purpose in any of the special secondary nursery areas designated in 15A NCAC 3R .0105(13), except that the Fisheries Director, may, by proclamation, open any special secondary nursery areas listed in 15A NCAC 3R .0105(13), or any portion thereof, to shrimp or crab trawling, subject to the provisions of 15A NCAC 3L. 0100 and .0200 and the restrictions described below:

(1) Trawling may only occur during shrimp season;
(2) Trawling is restricted to a total of three days per week;
(3) Trawling is prohibited between sunset and sunrise; and
(4) Tow time may not exceed 45 minutes. Tow time begins when the doors of the trawl enter the water and ends when the doors exit the water.

15A N.C. Admin. Code 3I .0101: Definitions

All definitions set out in G.S. 113, Subchapter IV and the following additional terms apply to this Chapter:

(1) Enforcement and management terms:

(a) Commercial Quota. Total quantity of fish allocated for harvest by commercial fishing operations.

(b) Educational Institution. A college, university, or community college accredited by an accrediting agency recognized by the U.S. Department of Education; an Environmental Education Center certified by the N.C. Department of Environment and Natural Resources Office of Environmental Education and Public Affairs; or a zoo or aquarium certified by the Association of Zoos and Aquariums.

(c) Internal Coastal Waters or Internal Waters. All Coastal Fishing Waters except the Atlantic Ocean.

(d) Length of finfish.

i. Curved fork length. A length determined by measuring along a line tracing the contour of the body from the tip of the upper jaw to the middle of the fork in the caudal (tail) fin.
ii. Fork length. A length determined by measuring along a straight line the distance from the tip of the snout with the mouth closed to the middle of the fork in the caudal (tail) fin, except that fork length for billfish is measured from the tip of the lower jaw to the middle of the fork of the caudal (tail) fin.
iii. Pectoral fin curved fork length. A length of a beheaded fish from the dorsal insertion of the pectoral fin to the fork of the tail measured along the contour of the body in a line that runs along the top of the pectoral fin and the top of the caudal keel.
iv. Total length. A length determined by measuring along a straight line the distance from the tip of the snout with the mouth closed to the tip of the compressed caudal (tail) fin.

(e) Recreational Possession Limit. Restrictions on size, quantity, season, time period, area, means, and methods where take or possession is for a recreational purpose.

(f) Recreational Quota. Total quantity of fish allocated for harvest for a recreational purpose.

(g) Regular Closed Oyster Season. March 31 through October 15, unless amended by the Fisheries Director through proclamation authority.

(h) Scientific Institution. One of the following entities:

(i) An educational institution as defined in this Item;

i. A state or federal agency charged with the management of marine or estuarine resources; or
ii. A professional organization or secondary school working under the direction of, or in compliance with mandates from, the entities listed in Subitems (h)(i) and (ii) of this Item.
iii. Seed Oyster Management Area. An open harvest area that, by reason of poor growth characteristics, predation rates, overcrowding or other factors, experiences poor utilization of oyster populations for direct harvest and sale to licensed dealers and is designated by the Marine Fisheries Commission as a source of seed for public and private oyster culture.

(2) Fishing Activities:

(a) Aquaculture operation. An operation that produces artificially propagated stocks of marine or estuarine resources or obtains such stocks from permitted sources for the purpose of rearing in a controlled environment. A controlled environment provides and maintains throughout the rearing process one or more of the following:

i. food;
ii. predator protection;
iii. salinity
iv. temperature controls; or
v. water circulating, utilizing technology not found in the natural environment.

(b) Attended. Being in a vessel, in the water or on the shore, and immediately available to work the gear and be within 100 yards of any gear in use by that person at all times. Attended does not include being in a building or structure.

(c) Blue Crab Shedding. The process whereby a blue crab emerges soft from its former hard exoskeleton. A shedding operation is any operation that holds peeler crabs in a controlled environment. A controlled environment provides and maintains throughout the shedding process one or more of the following:

i. food;
ii. predator protection;
iii. salinity;
iv. temperature controls; or
v. water circulation, utilizing technology not found in the natural environment. A shedding operation does not include transporting pink or red-line peeler crabs to a permitted shedding operation.

(d) Depuration. Purification or the removal of adulteration from live oysters, clams, or mussels by any natural or artificially controlled means.

(e) Long Haul Operations. Fishing a seine towed between two vessels.

(f) Peeler Crab. A blue crab that has a soft shell developing under a hard shell and having a white, pink, or red-line or rim on the outer edge of the back fin or flipper.

(g) Possess. Any actual or constructive holding whether under claim of ownership or not.

(h) Recreational Purpose. A fishing activity that is not a commercial fishing operation as defined in G.S. 113-168.

(i) Shellfish marketing from leases and franchises. The harvest of oysters, clams, scallops, or mussels from privately held shellfish bottoms and lawful sale of those shellfish to the public at large or to a licensed shellfish dealer.

(j) Shellfish planting effort on leases and franchises. The process of obtaining authorized cultch materials, seed shellfish, and polluted shellfish stocks and the placement of those materials on privately held shellfish bottoms for increased shellfish production.

(k) Shellfish production on leases and franchises:

i. The culture of oysters, clams, scallops, or mussels on shellfish leases and franchises from a sublegal harvest size to a marketable size.
ii. The transplanting (relay) of oysters, clams, scallops, or mussels from areas closed due to pollution to shellfish leases and franchises in open waters and the natural cleansing of those shellfish.

(l) Swipe Net Operations. Fishing a seine towed by one vessel.

(m) Transport. Ship, carry, or cause to be carried or moved by public or private carrier by land, sea, or air.

(n) Use. Employ, set, operate, or permit to be operated or employed.

(3) Gear:

(a) Bunt Net. The last encircling net of a long haul or swipe net operation constructed of small mesh webbing. The bunt net is used to form a pen or pound from which the catch is dipped or bailed.

(b) Channel Net. A net used to take shrimp that is anchored or attached to the bottom at both ends or with one end anchored or attached to the bottom and the other end attached to a vessel.

(c) Commercial Fishing Equipment or Gear. All fishing equipment used in Coastal Fishing Waters except:

i. Cast nets;
ii. Collapsible crab traps, a trap used for taking crabs with the largest open dimension no larger than 18 inches and that by design is collapsed at all times when in the water, except when it is being retrieved from or lowered to the bottom;
iii. Dip nets or scoops having a handle not more than eight feet in length and a hoop or frame to which the net is attached not exceeding 60 inches along the perimeter;
iv. Gigs or other pointed implements that are propelled by hand, whether or not the implement remains in the hand;
v. Hand operated rakes no more than 12 inches wide and weighing no more than six pounds and hand operated tongs;
vi. Hook-and-line and bait-and-line equipment other than multiple-hook or multiple-bait trotline;
vii. Landing nets used to assist in taking fish when the initial and primary method of taking is by the use of hook and line;
viii. Minnow traps when no more than two are in use;
ix. Seines less than 30 feet in length;

x. Spears, Hawaiian slings, or similar devices that propel pointed implements by mechanical means, including elastic tubing or bands, pressurized gas, or similar means.

(d) Corkline. The support structure a net is attached to that is nearest to the water surface when in use. Corkline length is measured from the outer most mesh knot at one end of the corkline following along the line to the outer most mesh knot at the opposite end of the corkline.

(e) Dredge. A device towed by engine power consisting of a frame, tooth bar or smooth bar, and catchbag used in the harvest of oysters, clams, crabs, scallops, or conchs.

(f) Fixed or stationary net. A net anchored or staked to the bottom, or some structure attached to the bottom, at both ends of the net.

(g) Fyke Net. An entrapment net supported by a series of internal or external hoops or frames, with one or more lead or leaders that guide fish to the net mouth. The net has one or more internal funnel-shaped openings with tapered ends directed inward from the mouth, through which fish enter the enclosure. The portion of the net designed to hold or trap fish is completely enclosed in mesh or webbing, except for the openings for fish passage into or out of the net (funnel area).

(h) Gill Net. A net set vertically in the water to capture fish by entanglement of the gills in its mesh as a result of net design, construction, mesh length, webbing diameter, or method in which it is used.

(i) Headrope. The support structure for the mesh or webbing of a trawl that is nearest to the water surface when in use. Headrope length is measured from the outer most mesh knot at one end of the headrope following along the line to the outer most mesh knot at the opposite end of the headrope.

(j) Hoop Net. An entrapment net supported by a series of internal or external hoops or frames. The net has one or more internal funnel-shaped openings with tapered ends directed inward from the mouth, through which fish enter the enclosure. The portion of the net designed to hold or trap the fish is completely enclosed in mesh or webbing, except for the openings for fish passage into or out of the net (funnel area).

(k) Lead. A mesh or webbing structure consisting of nylon, monofilament, plastic, wire, or similar material set vertically in the water and held in place by stakes or anchors to guide fish into an enclosure. Lead length is measured from the outer most end of the lead along the top or bottom line, whichever is longer, to the opposite end of the lead.

(l) Mechanical methods for clamming. Dredges, hydraulic clam dredges, stick rakes, and other rakes when towed by engine power, patent tongs, kicking with propellers or deflector plates with or without trawls, and any other method that utilizes mechanical means to harvest clams.

(m) Mechanical methods for oystering. Dredges, patent tongs, stick rakes, and other rakes when towed by engine power, and any other method that utilizes mechanical means to harvest oysters.

(n) Mesh Length. The distance from the inside of one knot to the outside of the opposite knot, when the net is stretched hand-tight in a manner that closes the mesh opening.

(o) Pound Net Set. A fish trap consisting of a holding pen, one or more enclosures, lead or leaders, and stakes or anchors used to support the trap. The holding pen, enclosures, and lead(s) are not conical, nor are they supported by hoops or frames.

(p) Purse Gill Nets. Any gill net used to encircle fish when the net is closed by the use of a purse line through rings located along the top or bottom line or elsewhere on such net.

(q) Seine. A net set vertically in the water and pulled by hand or power to capture fish by encirclement and confining fish within itself or against another net, the shore or bank as a result of net design, construction, mesh length, webbing diameter, or method in which it is used.

(4) Fish habitat areas. The estuarine and marine areas that support juvenile and adult populations of fish species, as well as forage species utilized in the food chain. Fish habitats as used in this definition, are vital for portions of the entire life cycle, including the early growth and development of fish species. Fish habitats in all Coastal Fishing Waters, as determined through marine and estuarine survey sampling, include:

(a) Anadromous fish nursery areas. Those areas in the riverine and estuarine systems utilized by post-larval and later juvenile anadromous fish.

(b) Anadromous fish spawning areas. Those areas where evidence of spawning of anadromous fish has been documented in Division sampling records through direct observation of spawning, capture of running ripe females, or capture of eggs or early larvae.

(c) Coral:

i. Fire corals and hydrocorals (Class Hydrozoa);
ii. Stony corals and black corals (Class Anthozoa, Subclass Scleractinia); or
iii. Octocorals; Gorgonian corals (Class Anthozoa, Subclass Octocorallia), which include sea fans (Gorgonia sp.), sea whips (Leptogorgia sp. and Lophogorgia sp.), and sea pansies (Renilla sp.).

(d) Intertidal Oyster Bed. A formation, regardless of size or shape, formed of shell and live oysters of varying density.

(e) Live rock. Living marine organisms or an assemblage thereof attached to a hard substrate, excluding mollusk shells, but including dead coral or rock. Living marine organisms associated with hard bottoms, banks, reefs, and live rock include:

i. Coralline algae (Division Rhodophyta);
ii. Acetabularia sp., mermaid's fan and cups (Udotea sp.), watercress (Halimeda sp.), green feather, green grape algae (Caulerpa sp.) (Division Chlorophyta);
iii. Sargassum sp., Dictyopteris sp., Zonaria sp. (Division Phaeophyta);
iv. Sponges (Phylum Porifera);

v. Hard and soft corals, sea anemones (Phylum Cnidaria), including fire corals (Class Hydrozoa), and Gorgonians, whip corals, sea pansies, anemones, Solengastrea (Class Anthozoa);
vi. Bryozoans (Phylum Bryozoa);
vii. Tube worms (Phylum Annelida), fan worms (Sabellidae), feather duster and Christmas treeworms (Serpulidae), and sand castle worms (Sabellaridae);
viii. Mussel banks (Phylum Mollusca: Gastropoda); and
ix. Acorn barnacles (Arthropoda: Crustacea: Semibalanus sp.).

(f) Nursery areas. Areas that for reasons such as food, cover, bottom type, salinity, temperature, and other factors, young finfish and crustaceans spend the major portion of their initial growing season. Primary nursery areas are those areas in the estuarine system where initial post-larval development takes place. These are areas where populations are uniformly early juveniles. Secondary nursery areas are those areas in the ocean and estuarine system where later juvenile development takes place. Populations are composed of developing sub-adults of similar size that have migrated from an upstream primary nursery area to the secondary nursery area located in the middle portion of the estuarine system.

(g) Shellfish producing habitats. Historic or existing areas that shellfish, such as clams, oysters, scallops, mussels, and whelks use to reproduce and survive because of such favorable conditions as bottom type, salinity, currents, cover, and cultch. Included are those shellfish producing areas closed to shellfish harvest due to pollution.

(h) Strategic Habitat Areas. Locations of individual fish habitats or systems of habitats that provide exceptional habitat functions or that are particularly at risk due to imminent threats, vulnerability, or rarity.

(i) Submerged aquatic vegetation (SAV) habitat. Submerged lands that:

i. are vegetated with one or more species of submerged aquatic vegetation including bushy pondweed or southern naiad (Najas guadalupensis), coontail (Ceratophyllum demersum), eelgrass (Zostera marina), horned pondweed (Zannichellia palustris), naiads (Najas spp.), redhead grass (Potamogeton perfoliatus), sago pondweed (Stuckenia pectinata, formerly Potamogeton pectinatus), shoalgrass (Halodule wrightii), slender pondweed (Potamogeton pusillus), water stargrass (Heteranthera dubia), water starwort (Callitriche heterophylla), waterweeds (Elodea spp.), widgeongrass (Ruppia maritima), and wild celery (Vallisneria americana). These areas may be identified by the presence of above-ground leaves, below-ground rhizomes, or reproductive structures associated with one or more SAV species and include the sediment within these areas; or
ii. have been vegetated by one or more of the species identified in Sub-item (4)(i)(i) of this Rule within the past 10 annual growing seasons and that meet the average physical requirements of water depth (six feet or less), average light availability (secchi depth of one foot or more), and limited wave exposure that characterize the environment suitable for growth of SAV. The past presence of SAV may be demonstrated by aerial photography, SAV survey, map, or other documentation. An extension of the past 10 annual growing seasons criteria may be considered when average environmental conditions are altered by drought, rainfall, or storm force winds.

This habitat occurs in both subtidal and intertidal zones and may occur in isolated patches or cover extensive areas. In defining SAV habitat, the Marine Fisheries Commission recognizes the Aquatic Weed Control Act of 1991 (G.S. 113A-220 et. seq.) and does not intend the submerged aquatic vegetation definition, or this Rule or Rules 3K .0304 and .0404, to apply to or conflict with the non-development control activities authorized by that Act.

(5) Licenses, permits, leases and franchises, and record keeping:

(a) Assignment. Temporary transferal to another person of privileges under a license for which assignment is permitted. The person assigning the license delegates the privileges permitted under the license to be exercised by the assignee, but retains the power to revoke the assignment at any time, and is still the responsible party for the license.

(b) Designee. Any person who is under the direct control of the permittee or who is employed by or under contract to the permittee for the purposes authorized by the permit.

(c) For Hire Vessel. As defined by G.S. 113-174, when the vessel is fishing in state waters or when the vessel originates from or returns to a North Carolina port.

(d) Holder. A person who has been lawfully issued in his or her name a license, permit, franchise, lease, or assignment.

(e) Land:

i. For commercial fishing operations, when fish reach the shore or a structure connected to the shore.
ii. For purposes of trip tickets, when fish reach a licensed seafood dealer, or where the fisherman is the dealer, when fish reach the shore or a structure connected to the shore.
iii. For recreational fishing operations, when fish are retained in possession by the fisherman.

(f) Licensee. Any person holding a valid license from the Department to take or deal in marine fisheries resources.

(g) Logbook. Paper forms provided by the Division and electronic data files generated from software provided by the Division for the reporting of fisheries statistics by persons engaged in commercial or recreational fishing or for-hire operators.

(h) Master. Captain of a vessel or one who commands and has control, authority, or power over a vessel.

(i) New fish dealer. Any fish dealer making application for a fish dealer license who did not possess a valid dealer license for the previous license year in that name. For purposes of license issuance, adding new categories to an existing fish dealers license does not constitute a new dealer.

(j) Office of the Division. Physical locations of the Division conducting license and permit transactions in Wilmington, Washington, Morehead City, Roanoke Island, and Elizabeth City, North Carolina. Other businesses or entities designated by the Secretary to issue Recreational Commercial Gear Licenses or Coastal Recreational Fishing Licenses are not considered Offices of the Division.

(k) Responsible party. Person who coordinates, supervises, or otherwise directs operations of a business entity, such as a corporate officer or executive level supervisor of business operations, and the person responsible for use of the issued license in compliance with applicable statutes and rules.

(l) Tournament Organizer. The person who coordinates, supervises, or otherwise directs a recreational fishing tournament and is the holder of the Recreational Fishing Tournament License.

(m) Transaction. Act of doing business such that fish are sold, offered for sale, exchanged, bartered, distributed, or landed.

(n) Transfer. Permanent transferal to another person of privileges under a license for which transfer is permitted. The person transferring the license retains no rights or interest under the license transferred.

(o) Trip Ticket. Paper forms provided by the Division and electronic data files generated from software provided by the Division for the reporting of fisheries statistics by licensed fish dealers.

15A N.C. Administrative Code 3M .0522: Spot (new section)

It is unlawful to possess spot less than 8 inches in total length.

15A N.C. Administrative Code 3M .0523: Atlantic croaker (new section)

It is unlawful to possess Atlantic croaker less than 10 inches in total length.

APPENDIX 2 Shrimp Count Conversions based on Species and Lengths

Length (inches)	Length (modal, mm)	Length (mm)	Count (heads-off)	Count (heads-on) Brown and Pink[1]	Count (heads-on) White[2]
3	75	70–79	160+	99+	100+
3.38	85	80–89	136–140	85–90	90–95
3.75	95	90–99	96–100	61–65	61–65
4.13	105	100–109	66–70	41–45	41–45
4.5	115	110–119	51–55	31–35	31–35
5	125	120–129	41–45	26–30	26–30
5.25	135	130–139	31–35	16–20	21–25
5.75	145	140–149	26–30	16–20	16–20
6.13	155	150–159	21–25	0–15	0–15
6.5	165	160–169	16–20	0–15	0–15

[1]Heads-off conversion to heads-on conversion for brown shrimp is 1.61 and pink shrimp is 1.60 heads-off. Using the same count for both.
[2]Heads-off conversion to heads-on conversion for white shrimp is 1.54.

APPENDIX 3 Economic Impact Projections

Nesslage and Dumas (2017) estimated stock abundance and the economic impacts for commercial and recreational fishing by species over a 30-year projection period (i.e., 2017 to 2046). Several scenarios analyzed varying levels of commercial and recreational fishing mortality to see how abundance and economic impacts changed over time. Species analyzed that are affected by the Petitioned rules include Atlantic Croaker and Weakfish. See section 5.1 for information on how stock abundance responded to each model scenario.

Currently, it is not possible to recreate the producer and consumer surplus numbers or the economic impact results presented by Nesslage and Dumas (2017) because the stock projection-harvest relationship from year to year was not provided in the report. However, the overall trend in the results presented by the authors show how economic impacts in each fishing sector could potentially change if mortality (both fishing and natural mortality) on the species was to change.

A3.1 Atlantic Croaker

Producer surplus (i.e., revenue minus cost from landings) and economic impacts (i.e., sales, income, jobs) were estimated by Nesslage and Dumas (2017) using seven different scenarios presented alongside a status quo scenario that vary commercial fishing mortality, recreational fishing mortality, scrap/baitfish mortality, recreational discard mortality, shrimp trawl bycatch, natural mortality, and recruitment (Nesslage and Dumas 2017). It should be noted that the model used by the authors to produce stock projections for each scenario was the same stock assessment model used by ASMFC for the 2010 Atlantic Croaker stock assessment (ASMFC 2010b), where estimates of SSB were considered too uncertain to be used to determine stock status. This overall uncertainty largely stemmed from the high degree of uncertainty associated with the estimates of shrimp trawl bycatch.

Scenario 1 was status quo, assuming stock conditions were equivalent to those in 2008 (Nesslage and Dumas 2017). Scenarios 2–5 reduced commercial fishing mortality, recreational fishing mortality, scrap/baitfish mortality, and recreational discard mortality by 10%, 25%, 50%, and 100%, respectively while holding shrimp trawling bycatch at 2008 levels. Scenario 6 was status quo with all mortality parameters, but doubled the current amount of bycatch estimated. Scenario 7 and 8 kept commercial fishing mortality, recreational fishing mortality, scrap/baitfish mortality, and recreational discard mortality at current estimates, but Scenario 7 had no bycatch beyond 2017, with 2016 exhibiting normal bycatch estimates, and Scenario 8 has no bycatch beyond 2017, with 2016 having double the estimated bycatch estimates.

Data used in the economic impact models of Nesslage and Dumas (2017) for the 30-year projections are annual landings and value for Atlantic Croaker and appear to be from the NCDMF License and Statistics Section Annual Statistics Report. There are two issues with using this resolution of data. The economic projections were made from source data by species across all gear types combined. As noted in a more detailed review of the authors' analysis below, this can lead to issues when calculating true total value of the fishery and the model that generates the ex-vessel price relationship. Secondly, the source data also includes all waterbodies, while the analysis seems to be intended for estuarine waters only.

A3.1.1 Commercial Impacts

In Nesslage and Dumas (2017), the authors calculated average nominal dockside (ex-vessel) prices for Atlantic Croaker in North Carolina for each year 1994-2014 by dividing nominal dollar value of landings in North Carolina by pounds landed in North Carolina for each year. This may be an overly simplified way of specifying the average ex-vessel price for annual data coming from the NCTTP. Value data within

the NCTTP are calculated by multiplying landings by an average ex-vessel price per market grade for each species. Therefore, if a market grade sold at a specific price (whether high or low) was the majority of the catch then the simple division of total value by total landings could primarily represent that market grade and not represent the actual average price across all market grades. In 2016, average prices for Atlantic Croaker by market grade ranged from $0.68/pound to $1.47/pound. A closer estimation of average price can be calculated by using data received from electronic trip tickets, when available, and then filling in missing prices per trip with the average annual price per market grade. Electronic data are available since 2004 and provide prices at the species and market grade level for each trip for some species such as Atlantic Croaker. This provides a value for the whole trip and facilitates a regression analysis at the trip level. Prices are missing on a large percentage of trip tickets because price is not a mandatory reporting requirement; therefore, average prices calculated using this method should still be considered an estimate, but are of a finer resolution than that used by Nesslage and Dumas.

In 2016, 99% of Atlantic Croaker landings came from ocean waters. If the economic impact analysis conducted by Nesslage and Dumas (2017) was intended to be limited to estuarine waters (sound and estuaries) then the data used might result in the analysis suffering from misspecification. This issue is raised due to the following statement describing operating behavior of fishermen only in sounds: “It is assumed that the operating costs of vessels landing croaker in North Carolina sounds are similar to the operating costs of average-length gill net / crab pot vessels operating in Albemarle and Pamlico sounds” (Nesslage and Dumas 2017).

Another assumption in the Nesslage and Dumas (2017) analysis with regards to Atlantic Croaker is that the number of vessels using gill net gear operating in 2014 was 1,340 vessels that took 26,228 trips; this may not be correct. These numbers represent statewide aggregations and include all ocean vessels and trips that recorded landings from anchored gill nets, regardless of species. In 2016, the number of gill net vessels landing Atlantic Croaker from estuarine waters was only 313 and the number of trips was only 1,845. Nesslage and Dumas (2017) assumed that captain and crew is equal to the number of participants, which is an incorrect assumption because the data used for participant count is equal to the number of licensed fishermen who recorded commercial landings. It is not an accurate reflection of the count for captain and crew. In 2016, only 309 participants recorded landings of Atlantic Croaker from gill nets in estuarine waters. The average crew size from these same estuarine trips was 1.3. Because the size of the vessel will determine the amount of crew, a closer measure of the total captain and crew count would be to multiply the average crew size by the number of vessels (1.3*313). This is equal to 407 people, but still less than half of the number used by Nesslage and Dumas (2017) in their analysis, which was 1,214 participants.

Nesslage and Dumas (2017) assumed the average size of a vessel used in the estuarine gill net fishery to be approximately 25 feet and the maximum carrying capacity of a vessel of that size is 2,500 pounds. This information is reported to originate from a personal communication with O’Neal’s Seafood Harvest, a large North Carolina dealer. In 2016, there were 305 vessels 25 feet or less and 12 vessels from 26 to 49 feet in length that reported landings of Atlantic Croaker from estuarine waters using gill nets. These vessels (from both size ranges) averaged about 10 pounds of Atlantic Croaker per trip. The maximum amount of Atlantic Croaker caught per trip from gill nets in estuarine waters was 358 pounds in vessels of 25 feet or less, and 265 pounds in vessels between 26 and 49 feet. This shows that Atlantic Croaker is not a commonly targeted fish for these gill net vessels and that no estuarine vessel would approach landing 2,500 pounds. Average annual Atlantic Croaker landings in 2016 of vessels that were 25 feet or less was 50 pounds and the maximum was 1,430 pounds. For vessels from 26 to 49 feet, the annual average landings of Atlantic Croaker was 114 pounds with the maximum amount of landings at 918 pounds.

Another major assumption by the authors is that if Atlantic Croakers landings increase, the economic model determines whether the existing number of vessels and trips can accommodate the increased

landings. If landings exceed the capacity of the existing trips, then each existing vessel is assumed to increase its number of trips to 24.5 trips per vessel per year, the maximum annual average number of observed trips per vessel for 25'–35' gill net vessels over the period 1994–2014 (Nesslage and Dumas 2017). If increased landings do not exceed the capacity of the existing vessels and trips, then an increase in landings also increases ex-vessel value, producer surplus, and downstream economic impacts, but it does not increase upstream impacts, which depend on the number of vessels, trips, and crew, which do not change in this case. Again, it is doubtful that landings can reach the capacity stated previously by each vessel per trip.

The authors also assume, through Hadley and Crosson (2010), that 25.75% of finfish sold by North Carolina seafood dealers was sold to out-of-state buyers; therefore, they assumed 74.25% of Atlantic Croaker from North Carolina dealers is sold to in-state buyers (Nesslage and Dumas 2017). When calculating producer surplus and the economic impacts that commercial Atlantic Croaker harvest has on the North Carolina economy, Nesslage and Dumas (2017) excluded exports of Atlantic Croaker from their analysis. This assumption reduces the total value of economic impacts for Atlantic Croaker by a quarter for the 30-year projection period. Exported seafood still creates value for in-state dealers; however, the effects of seafood harvested in North Carolina and then exported are not traceable through the supply chain beyond the state's dealers.

The authors assume that in multispecies fisheries, such as the Atlantic Croaker gill net fishery, a fishing trip is made and operating costs are incurred, even if no croaker are caught, because the (expected) revenues from landings of other species cover the variable costs of the trip (Nesslage and Dumas 2017). As a result, if Atlantic Croaker are caught, the authors assume trip revenues increase without an increase in trip operating costs. If croaker landings can be accommodated with no change in the number of vessels or vessel trips, then the ex-vessel revenue from Atlantic Croaker landings flows directly to producer surplus. If Atlantic Croaker landings decrease, they assume vessels remain in the fishery and the number of trips does not change because gill nets catch species other than Atlantic Croaker and other gear can be used on these same vessels to catch other target species (Nesslage and Dumas 2017). These assumptions may not reflect the actual behavior of gill net vessels depending on how much they rely on Atlantic Croaker to pay for their fishing trips. Directed Atlantic Croaker gill net trips usually land a majority of Atlantic Croaker with minimal marketable bycatch, which is inconsistent with the assumption above (NCDMF unpublished data, Program 434 Ocean Gill Net Fishery). Therefore, it may be incorrect to assume that on an Atlantic Croaker gill net trip, if no Atlantic Croaker are landed, that fishermen would be able to cover the variable cost of a trip. In fact, fishermen may incur costs they cannot recoup if no fish are caught during the trip.

As expected, reductions in fishing-related mortality (Scenarios 2–5) reduced the overall producer surplus and economic impacts associated with the commercial Atlantic Croaker fishery. Scenario 6 (shrimp trawl bycatch mortality was doubled, but all other fishing mortalities remained the same) also resulted in reductions to the overall producer surplus and economic impacts. Removing shrimp trawl bycatch completely (Scenario 7 and 8) resulted in increasing producer surplus and economic impacts over the 30-year period. These increases are related to expected increases in stock abundance. Scenario 1 was status quo. The scenarios examined by Nesslage and Dumas (2017) cannot be directly compared to the Petitioned rules, as many of these scenarios reduce commercial and recreational fishing (therefore, reducing fishing mortality) in equal amounts. Most of the Petitioned rules would greatly impact directed fishing mortality from commercial fishing, while directed recreational fishing mortality would remain unchanged except for the addition of size limits proposed for Spot and Atlantic Croaker; however, the proposed size limits would affect both commercial and recreational fisheries. The scenarios that removed shrimp trawl bycatch kept all other fishing mortality levels at status quo, which again is not comparable to the Petitioned rules. It is unclear whether potential benefits from the Petitioned rules would outweigh the costs over time to result in net positive results for North Carolina commercial fishing as a whole.

A3.1.2 Recreational Impacts

The economic analysis by Nesslage and Dumas (2017) estimates the consumer surplus (i.e., recreational value of catching a fish) of recreational anglers participating in the Atlantic Croaker recreational fishery and the economic impacts (i.e., sales, income, jobs) supported by the recreational fishing activity. Estimates of consumer surplus per Atlantic Croaker caught by recreational anglers along the U.S. Atlantic Coast were presented as an average across two data sources. Estimates for the value per fish were calculated through two methods in these sources, including travel cost estimation and a random utility model valuation. The economic impacts of the recreational Atlantic Croaker fishery were calculated for four fishing modes: 1) beach or bank, 2) man-made locations (e.g., pier, dock), 3) charter or headboats, and 4) privately-owned or rented vessels (Nesslage and Dumas 2017). This analysis assumed that bag limits remain fixed, so increased catch translates to an increase in the number of recreational trips. More information on how expenditures and impacts for the recreational fishery were calculated by the authors can be found in their report.

Except for Scenario 1 (Status quo), the scenarios varied commercial fishing mortality, recreational fishing mortality, natural mortality, scrap/bait mortality, and shrimp trawl bycatch. Similar to the commercial fishery for Atlantic Croaker, scenarios that reduced fishing mortality (Scenarios 2–5) resulted in losses to consumer surplus and economic impacts from recreational fishing, as did Scenario 6 (doubling shrimp trawl bycatch; Nesslage and Dumas 2017). Scenarios 7 and 8 that removed shrimp trawl bycatch completely resulted in increases in consumer surplus and economic impacts related to the recreational fishing industry. These increases are related to expected increases in stock abundance.

The projections showed that reducing shrimp trawl bycatch may have a greater effect on consumer surplus, economic impacts, and angler expenditures than if only fishing mortality is reduced. These results cannot be directly compared to the Petitioned rules as these scenarios reduce commercial and recreational fishing in equal amounts. As mentioned in the previous section, most of the Petitioned rules would greatly impact directed fishing mortality from commercial fishing, while directed recreational fishing mortality would remain unchanged except for the addition of size limits proposed for Spot and Atlantic Croaker; however, the proposed size limits would affect both commercial and recreational fisheries.

A3.2 Weakfish

Producer surplus (i.e., revenue minus cost from landings) and economic impacts (i.e., sales, income, jobs) were estimated by Nesslage and Dumas (2017) using eight different scenarios presented alongside a status quo scenario that vary commercial fishing mortality, recreational fishing mortality, natural mortality, and recruitment. Scenario 1 was status quo based on the 2014 Weakfish stock assessment completed by the ASMFC. Scenario 2 assumed a complete moratorium on Weakfish starting in 2017; therefore, fishing mortality, both commercial and recreational, would be zero. Scenario 3 assumed status quo for commercial and recreational fishing levels, but used a reduced estimate for natural morality. Scenarios 4–7 reduced commercial fishing mortality and recreational fishing mortality by 10%, 25%, 50%, and 100%, respectively while using the reduced estimate for natural mortality. Scenarios 8 and 9 used a low estimate of natural mortality equal to the natural mortality estimated prior to 1995; however, Scenario 8 used status quo for commercial and recreational fishing, while Scenario 9 used a 50% reduction in both fishing sectors.

Data used in the economic impact models of Nesslage and Dumas (2017) for the 30-year projections are annual landings and value for Weakfish and appear to be from the NCDMF License and Statistics Section Annual Statistics Report. There are two issues with using this resolution of data. The economic projections were made from source data by species across all gear types combined. As noted in a more detailed review of the authors' analysis below, this can lead to issues when calculating true total value of the fishery and the model that generates the ex-vessel price relationship. Secondly, the source data also includes all waterbodies, while the analysis seems to be intended for estuarine waters only.

A3.2.1 Commercial Impacts

As with Atlantic Croaker, the authors calculated average nominal dockside (ex-vessel) prices for Weakfish in North Carolina for each year 1994–2014 by dividing nominal dollar value landed by pounds landed for each year (Nesslage and Dumas 2017). As stated previously, this may be an overly simplified way of specifying the average ex-vessel price for annual data coming from the NCTTP. Value data within the NCTTP are calculated by multiplying landings by an average ex-vessel price per market grade for each species. Therefore, if a market grade sold at a specific price (whether high or low) was the majority of the catch then the simple division of total value by total landings could primarily represent that market grade and not represent the actual average price across all market grades. In 2016, average prices for Weakfish by market grade ranged from $1.17/pound to $1.96/pound. A closer estimation of average price can be calculated by using data received from electronic trip tickets, when available, and then filling in missing prices per trip with the average annual price per market grade. Electronic data are available since 2004 and provide prices at the species and market grade level for each trip for some species such as Atlantic Croaker. This provides a value for the whole trip and facilitates a regression analysis at the trip level. Prices are missing on a large percentage of trip tickets because price is not a mandatory reporting requirement; therefore, average prices calculated using this method should still be considered an estimate.

Although a larger proportion of the landings of Weakfish come from estuarine waters, Weakfish are commonly landed in ocean waters. In 2016, 54% of the landings were from estuarine waters. If the intention of the analysis performed by Nesslage and Dumas (2017) for economic impacts was intended to be limited to estuarine (sound and estuaries) waters, then the data used might result in the analysis suffering from misspecification, as the landings data used in the projections were statewide (which include ocean landings). This issue is raised due to the following statement describing operating behavior of fishermen only in sounds: "It is assumed that the operating costs of vessels landing Weakfish in North Carolina sounds are similar to the operating costs of average-length gill net / crab pot vessels operating in Albemarle and Pamlico sounds" (Nesslage and Dumas 2017).

The authors' assumption of the number of vessels using gill net gear operating in 2014 is not accurate with regards to Weakfish and is a large over-estimate of the fleet. In Nesslage and Dumas (2017), it is reported that 1,340 vessels took 26,228 trips using gill nets; however, these numbers represent statewide aggregations and include all ocean vessels and trips that recorded landings from anchored gill nets, regardless of species. In 2016, the number of gill net vessels landing Weakfish from estuarine waters was only 305 and the number of trips was only 2,458. The authors' analysis also assumes that the number of participants is equal to the captain and crew; however, the number of participants from the data source is the number of licensed fishermen who recorded commercial landings using gill nets. It is not an accurate reflection of the count for captain and crew. The authors assume that the number of participants would be constant through 2017 at 1,214. In 2016, only 291 participants had landings of Weakfish from gill nets in estuarine waters. The average crew size from those same trips was 1.4. Because the size of the vessel will determine the amount of crew, a closer measure of the total captain and crew count would be to multiply the average crew size by the number of vessels (1.4*305). This is equal to 427 people, but still less than half of the 1,214 participants used by Nesslage and Dumas (2017).

Another assumption made by the authors is that the size of the vessel used in the estuarine fishery is approximately 25 feet and that the maximum carrying capacity of a vessel of that size is 2,500 pounds. This information is reported to originate from a personal communication with O'Neal's Seafood Harvest, a large North Carolina dealer. In 2016, 291 vessels 25 feet or less and 27 vessels from 26 to 49 feet reported landings of Weakfish from estuarine waters using gill nets. Both vessel size ranges averaged about 14–16 pounds of Weakfish per trip. The maximum amount of Weakfish caught per trip from gill nets in estuarine waters was 152 pounds in vessels of 25 feet or less, and 100 pounds in vessels from 26 to 49 feet. This shows that Weakfish is not a commonly targeted fish for these gill net vessels, and that no estuarine vessel would approach landing 2,500 pounds. There are also trip limits currently set at 100 pounds, so for this analysis, the maximum carrying capacity should have been 100 pounds.

Another major assumption by the authors is that if Weakfish landings increase, the economic model determines whether the existing number of vessels and trips can accommodate the increased landings. If landings exceed the capacity of the existing trips, then each existing vessel is assumed to increase its number of trips to 24.5 trips per vessel per year, the maximum annual average number of observed trips per vessel for 25'–35' gill net vessels over the period 1994–2014 (Nesslage and Dumas 2017). If increased landings do not exceed the capacity of the existing vessels and trips, then an increase in landings also increases ex-vessel value, producer surplus, and downstream economic impacts, but it does not increase upstream impacts, which depend on the number of vessels, trips, and crew, which do not change in this case. Again, it is doubtful that landings can reach the capacity stated previously by each vessel per trip, especially given current harvest restrictions.

The authors also assume, through Hadley and Crosson (2010), that 25.75% of finfish sold by North Carolina seafood dealers was sold to out-of-state buyers; therefore, they assumed 74.25% of Weakfish from North Carolina dealers is sold to in-state buyers (Nesslage and Dumas 2017). When calculating producer surplus and the economic impacts that commercial Weakfish harvest has on the North Carolina economy, Nesslage and Dumas (2017) excluded exports of Weakfish from their analysis. This assumption reduces the total value of economic impacts for Weakfish by a quarter for the 30-year projection period. Exported seafood still creates value for in-state dealers; however, the effects of seafood harvested in North Carolina and then exported are not traceable through the supply chain beyond the state's dealers.

The authors also assume that in multispecies fisheries, such as the Weakfish gill net fishery, a fishing trip is made and operating costs are incurred, even if no Weakfish are caught, because the (expected) revenues from landings of other species cover the variable costs of the trip (Nesslage and Dumas 2017). As a result, if Weakfish are caught, trip revenues increase without an increase in trip operating costs. If Weakfish landings can be accommodated with no change in the number of vessels or vessel trips, then the ex-vessel revenue from Weakfish landings flows directly to producer surplus. This assumption makes sense because Weakfish is managed commercially as a bycatch fishery. If Weakfish landings decrease, it is assumed that vessels remain in the fishery and the number of trips does not change because gill nets catch species other than Weakfish and other gear can be used on the same vessels to catch other target species (Nesslage and Dumas 2017). These assumptions may not reflect the actual behavior of gill net vessels depending on how much they rely on Weakfish to pay for their fishing trips. In 2016, the ex-vessel price of Weakfish was between $1.16 and $1.96 per pound depending on market grade size, so even a small amount of catch can add a lot of value to a single fishing trip where Weakfish were harvested.

When looking at the data across the different model scenarios, Scenarios 2 and 7 removed all fishing mortality and thus, resulted in losses to producer surplus and economic impacts in the commercial fishing industry. Scenarios 3–6 progressively resulted in increases to producer surplus and economic impacts related to increases in stock abundance as fishing mortality decreased. Finally, Scenarios 8 and 9 assumed a 0.15 natural mortality rate (i.e., historically low rate occurring prior to 1995) and Scenario 9 also had a

50% reduction in all fishing mortality. Again, as a result of increased Weakfish stock abundance, these models resulted in a large positive impact to commercial fishing. Lowering the mortality rates means that more fish are surviving and available to the fishery. The natural mortality rate used in Scenarios 3–9 do not currently exist in nature; therefore, any positive impacts from these Scenarios cannot be expected under existing stock conditions. Scenario 1 was status quo.

The results from Nesslage and Dumas (2017) cannot be directly compared to the Petitioned rules as these scenarios reduce commercial and recreational fishing in equal amounts. The Petitioned rules affecting Weakfish focus on shrimp trawl bycatch reduction, which was not analyzed by Nesslage and Dumas (2017) specific to Weakfish and would only reduce commercial fishing levels. Recreational fishing effort would remain the same for Weakfish under the Petitioned rules. It is unclear whether potential benefits from the Petitioned rules would outweigh the costs over time to result in net positive results for the North Carolina commercial fishing industry.

A2.2.2 Recreational Impacts

The economic analysis performed by Nesslage and Dumas (2017) estimates the consumer surplus (i.e., recreational value of catching a fish) of recreational anglers participating in the Weakfish recreational fishery and the economic impacts (i.e., sales, income, jobs) supported by the recreational fishing activity. Estimates of consumer surplus per Weakfish caught by recreational anglers along the U.S. Atlantic Coast were presented as an average across two data sources through two methods in these sources, including travel cost estimation and a random utility model valuation. The economic impacts of the recreational Weakfish fishery were calculated for four fishing modes: 1) beach or bank, 2) man-made locations (e.g., pier, dock), 3) charter or headboats, and 4) privately-owned or rented vessels (Nesslage and Dumas 2017). This analysis assumed that bag limits remain fixed, so increased catch translates to an increase in the number of recreational trips. More information on how expenditures and impacts for the recreational fishery were calculated by the authors can be found in their report.

For the consumer surplus, angler expenditures, and economic impacts results, eight different scenarios were presented alongside a status quo scenario (Scenario 1) that varied commercial fishing mortality, recreational fishing mortality, natural mortality, and recruitment. Scenarios 2 and 7 removed all fishing mortality, consequently resulting in losses to consumer surplus and economic impacts in the recreational fishing industry. Scenarios 3–6 assumed average natural mortality conditions (but lower than current levels) and varied fishing mortality at levels from status quo to 50% for both commercial and recreational fisheries. Scenarios 3–6 had progressive increases in consumer surplus, angler expenditures, and economic impact values from an expected increase in stock abundance as fishing mortality decreased. The reduction in natural mortality assumed by the model likely played a bigger role than fishing mortality in the increase in stock abundance since scenarios without a reduction in natural mortality had little effect on stock size. Scenarios 8 and 9 assumed a 0.15 natural mortality rate (i.e., historically low rate occurring prior to 1995) and Scenario 9 also had a 50% reduction in all fishing mortality. These models resulted in large positive economic impacts to the recreational fishing industry. As mentioned with the commercial industry, the natural mortality rate used in Scenarios 3–9 do not currently exist in nature; therefore, any positive impacts from these scenarios cannot be expected under existing stock conditions.

These results cannot be directly compared to the Petitioned rules as the scenarios reduce commercial and recreational fishing in equal amounts. The Petitioned rules affecting Weakfish focus on shrimp trawl bycatch reduction, which was not analyzed by Nesslage and Dumas (2017) specific to Weakfish and would only reduce commercial fishing levels. Recreational fishing effort would remain the same for Weakfish under the Petitioned rules.

APPENDIX 4 Monitoring for Habitat Improvements

One goal of the Petitioned rules is an improvement of the habitat in the proposed SSNAs once trawling is reduced, which would be more utilized by fish species than current habitat existing in the estuaries and ocean off North Carolina. A BACI (Before-After; Control-Impact) monitoring design is the preferred method to evaluate human disturbances (e.g., reduced trawling effort) on ecological conditions. Without data in the same area before and after a treatment and at a control site, it would be difficult to determine if the observed water quality and soft bottom characteristics are due to less or no trawling, or due to other environmental or anthropogenic factors. Unfortunately, the NCDMF does not have before data on the relevant water quality and habitat conditions in Pamlico Sound. Also, all areas not previously designated as nursery areas would be affected, so there would be no control area. Sampling would have to be completed prior to implementation of the Petitioned rules and repeated after management changes were in place for at least one year.

Study Objectives

A study to determine habitat changes due to the Petitioned rules would have the following objectives.

1. Compare soft bottom topography before and after Petition implementation to determine if soft bottom microstructure changes.
2. Compare changes in soft bottom community (e.g., infauna, epifauna, benthic primary productivity) before and after Petition implementation to determine change in abundance or diversity of benthic fauna and flora.
3. Assess turbidity and nutrient conditions in the water column before and after Petition implementation to assess changes in water clarity and nutrient concentrations in the water column.
4. Compare changes in oyster reef and SAV habitat before and after Petition implementation.

Monitoring

Because the greatest impact from trawling would be in deeper waters less influenced by wind and where trawling is most concentrated, monitoring should focus in Pamlico Sound, the lower Pamlico and Neuse rivers, and Core Sound. Pamlico Sound is approximately 5,200 km^2. To make monitoring more logistically feasible, several sentinel sites should be selected within different Pamlico Sound Survey (Program 195) strata as well as Core Sound (Table A4.1; Figure A4.1). Trawling areas further south are smaller in area and would not be monitored. The weighting of sites per strata follows the area-based weighting ratio used in the Pamlico Sound Survey. The exact location of sites would be determined later. Size and number of sentinel sites may need to be adjusted for logistical reasons.

Table A4.1. Proposed sampling grids for monitoring in the Pamlico Sound system.

Strata	Dimensions of Sentinel Sites (km)	Area of Sentinel Sites (km^2)	Number of Sites
Pamlico Deep East	10x10	100	8
Pamlico Deep West	10x10	100	4
Pamlico Shallow East	10x10	100	2
Pamlico Shallow West	10x10	100	2
Pamlico River	10x10	100	2
Neuse River	10x10	100	2
Core Sound	10x10	100	2
Total Sampled			22

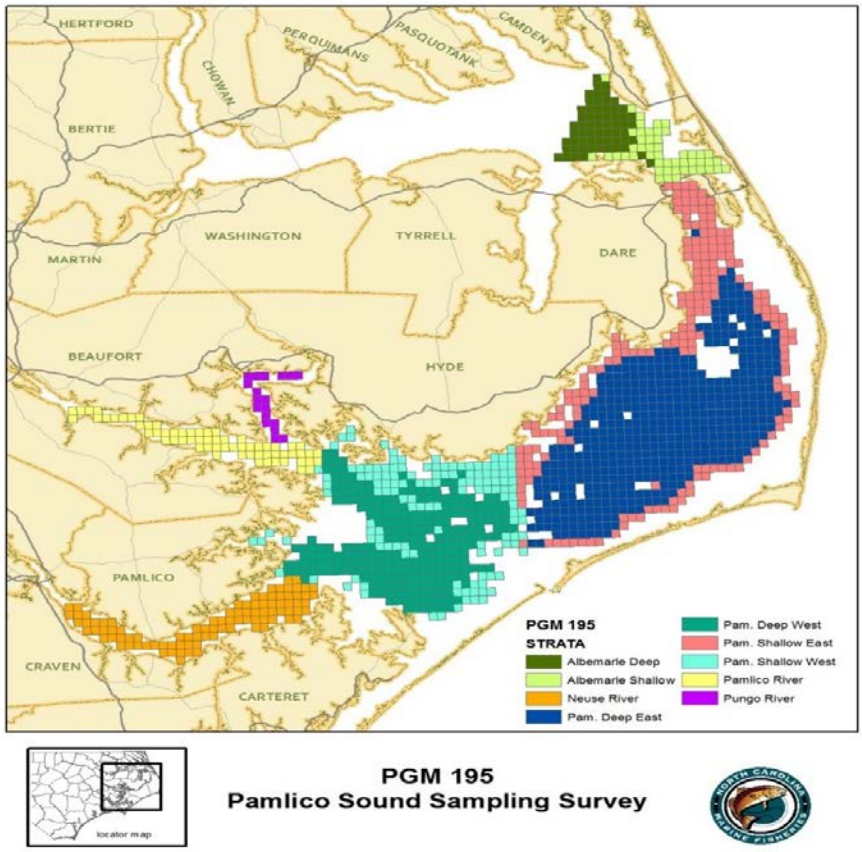

Figure A4.1. Location of strata used in the Pamlico Sound Survey.

Sediment and Water Quality Data

Within each of the 22 sampling grids (Table A4.1), approximately three random sediment cores would be collected quarterly. Sample collection could be done by temporary staff and an existing NCDMF vessel. Analysis would need to be completed by a contractor. Sediment and water quality sampling could be conducted during the same time periods as the mapping work described below. Cores would be used to

quantify benthic microalgae, meiofauna, macrofauna, grain size, and possibly sedimentation rates. Random water samples would be analyzed for nutrient levels, chlorophyll a, turbidity, and total suspended sediments. Resources needed to collect and analyze water and sediment samples for two years include:

Option A

2 temporary Technician IIs - 2 year	$129,150
Funds to hire contractor for analysis	$190,000
Total	$319,150

Option B

Collection and analysis completed by contractor: $320,000–$380,000

Mapping Topography of Soft Bottom Habitat

The NCDMF Habitat and Enhancement Section can use existing side scan equipment (Edge Tech 6205 Dual Side Scan Sonar and Swath Bathymetry – 550 and 1600 kHz) and software (Sonar Wiz) to map bottom topography within each sampling grid two times (one time before the Petitioned rule changes would go into effect, and one after). The accuracy of the side scan is +/- 10 cm. Initial costs for a side scan sonar (including the hardware, vessel, computer, and insurance) add up to over $205,000, so purchase of a second unit is prohibitive. A pilot test should be conducted to determine if this accuracy will be satisfactory for detecting sediment profile changes. Mapping is estimated to take 5.5 hr/km^2. One grid in each of the six strata in Pamlico Sound and the Pamlico and Neuse rivers, as well as Core Sound should be selected to map before and after the management change would go in effect. Grids with relatively intense trawling activity should be selected. Seven grids that are 100 km^2 each (700 km^2) would take approximately 642 days, or 2.5 years, to map (estimating six hours/day of mapping). Since side scan would be done before and after the management change, this would need to be repeated after the management change would occur. Total mapping time needed for soft bottom habitat would be five years. In addition, side scan and bathymetry data would need to be post-processed, which is estimated to take 1–2 days for every day of field mapping. The biologist would be responsible for field planning and post-processing. Resources needed to map the seven sampling grids two times include:

2 temporary Technician IIs – 5 years	$322,876
1 temporary Biologist I – 5 years	$214,750
Total	$537,626

Changes to Oyster Reef and SAV Abundance

Effects of reduced trawling activity on oyster reefs and SAV could be assessed by mapping around the perimeter of the sounds before and after the management change occurs. Mapping of subtidal oyster reefs in Pamlico Sound could be done with the same side scan system described above, but not concurrently with the soft bottom mapping. The aerial limit of the mapping would need to be determined through GIS assessment, but could be restricted to the area where oyster reef habitat is generally distributed (Figure A4.2). Potential oyster habitat within the Pamlico Sound system that should be mapped is roughly 1,600 km^2. An area of that size would take approximately six years to complete. Total mapping time needed for oyster reefs and SAV would be 12 years. In addition to mapping, it would be valuable to monitor oyster size and density on a subset of sites, as well as sedimentation. This could possibly be integrated into existing oyster sanctuary monitoring. Resources needed include:

2 temporary Technician IIs – 6 years	$774,900
1 temporary Biologist I – 6 years	$515,400
Total	$1,290,300

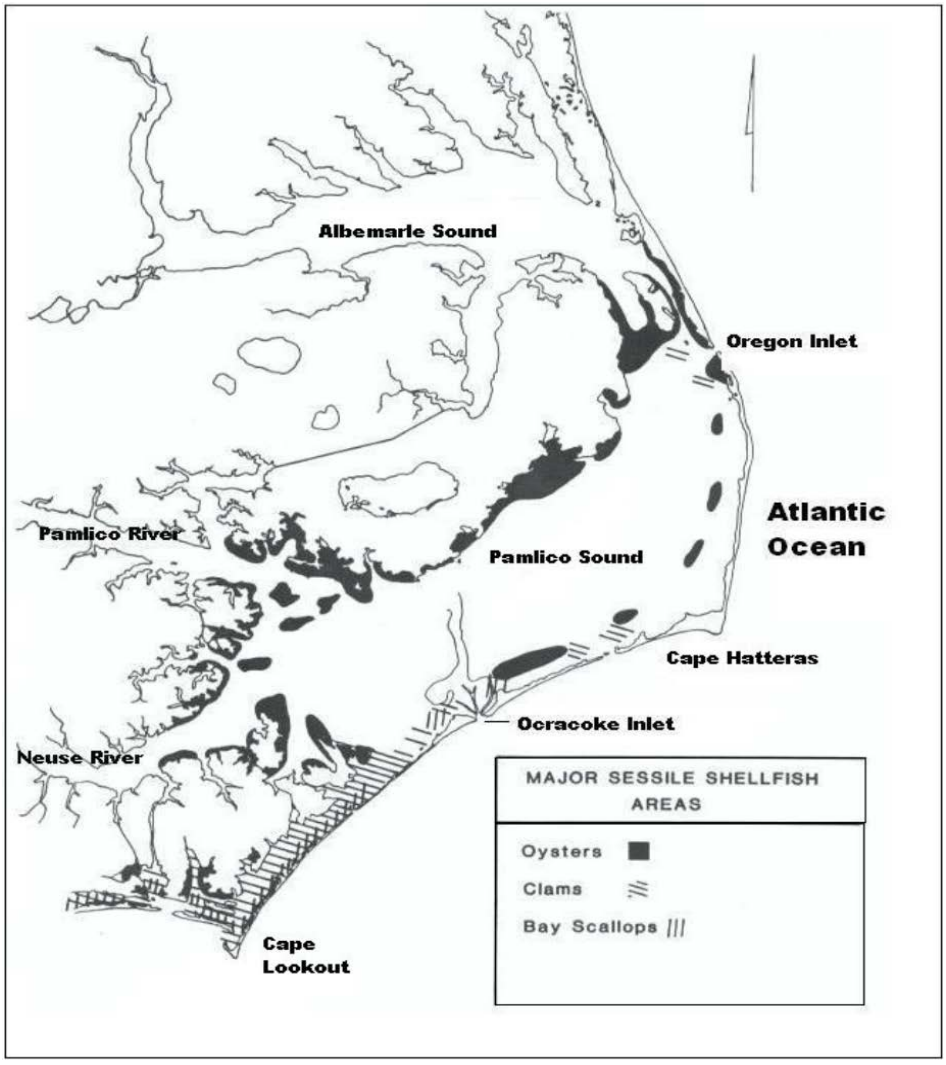

Figure A4.2. Location of area to map for SAV and oyster reefs based on the general distribution of eastern oysters, hard clams, and bay scallops in the Albemarle-Pamlico estuarine system (Epperly and Ross 1986).

Maps of SAV from aerial imagery in the Pamlico and Core sounds is available from 2013 (Figure A4.3). SAV maps in Pamlico and Neuse rivers from sonar data is available from 2016 and 2017 (Figure A4.3). New mapping data could be limited to post-Petition change and compared to these existing datasets. Aerial imagery and sonar data and delineation could be completed by a contractor. Based on previous work, a rough estimate for doing this one time would include the following costs:

Aerial imagery and digitized maps	$ 200,000
Sonar data and digitized maps	$ 130,000
Subtotal (one time)	$ 330,000
Total (two times; before and after)	$ 660,000

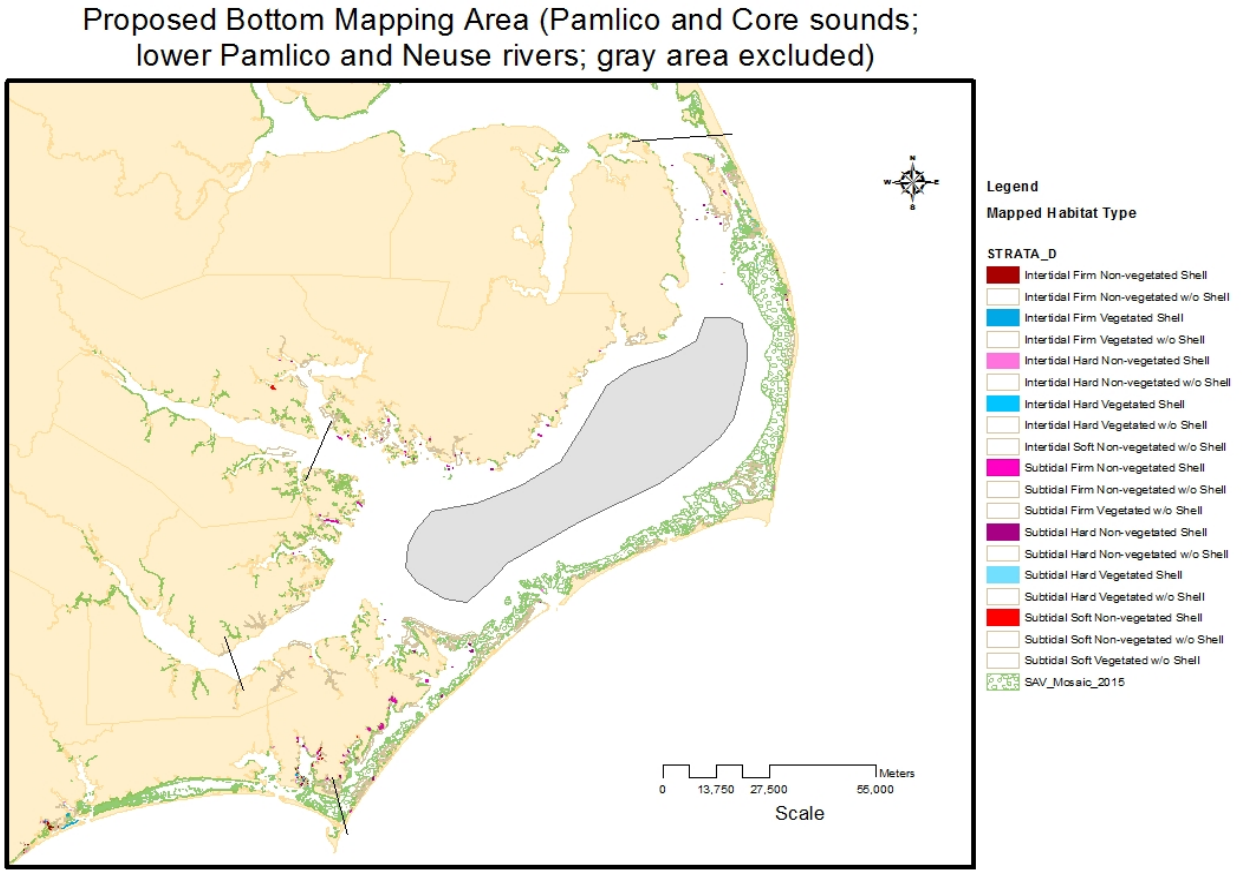

Figure A4.3. Proposed bottom mapping area for SAV mapping.

Equipment Costs

Initial costs for a side scan sonar including the hardware, vessel, computer, and insurance add up to over $205,000. The NCDMF already owns this equipment, so costs for the use of this equipment for the BACI habitat monitoring studies discussed above will include only the recurring annual costs for the eight-year time span estimated to complete these studies. Annual recurring costs that include insurance on both the vessel and the side scan equipment is estimated at $3,097 (Table A4.2). The SonarWiz software extended maintenance agreement (EMA) costs $1,195 each year. The computer equipment is estimated to be replaced every three years, but will only be replaced as needed and costs $1,529 per replacement (Table A4.3). Total recurring equipment costs over the 18-year study period is estimated to be $86,430 (Table A4.4). This would include annual costs for the side scan equipment and the vessel, as well as computer costs every three years throughout the study period. The 18-year period includes 2.5 years to map soft bottom before changes, six years to map oyster reef/SAV abundance before rule implementation, one year for the Petitioned rules to be in place, and 2.5 years and six years of mapping after implementation. These costs do not include any additional staff time needed to operate the sonar, vessel fuel, or routine maintenance on the vessel or equipment. The NCDMF would incur the annual recurring equipment costs to conduct other division sampling that depends on side scan sonar, regardless of the BACI; however, they are included here to provide an overall high estimate of the total equipment costs.

Table A4.2. Estimated recurring annual costs for side scan sonar equipment and vessel.

Vessel Insurance	$ 900
Survey Equipment Insurance	$ 2,197
SonarWiz EMA	$ 1,195
Total	$ 4,292

Table A4.3. Estimated cost of computer equipment needed to accompany side scan sonar.

Item	**Quantity**	**Cost per Item**	**Total Cost**
Laptop	1	$ 1,208	$ 1,208
Monitor	1	$ 132	$ 132
1TB external HDD	3	$ 54	$ 162
Wireless keyboard	1	$ 18	$ 18
Wireless mouse	1	$ 9	$ 9
Total			$ 1,529

Table A4.4. Annual breakdown for 3-year cycle of recurring costs for use of side scan sonar.

Item	**Year1**	**Year2**	**Year3**	**3-Year Total**
Insurance (vessel, survey equipment)	$ 3,097	$ 3,097	$ 3,097	$9,291
SonarWiz EMA	$ 1,195	$ 1,195	$ 1,195	$3,585
Computer Equipment	$ -	$ -	$ 1,529	$1,529
Subtotal	$ 4,292	$ 4,292	$ 5,821	$14,405
Grand Total (six cycles)				**$86,430**

Cost Summary

Grand total cost to complete sampling as described in this Appendix over an 18-year time span, at a maximum, would be $2,954,356 (Table A4.5).

Table A4.5. Summary of total costs for 18-year BACI study period.

Item	Total Cost
Sediment and Water Quality	$319,150–$380,000
Mapping Topography of Soft Bottom Habitat	$537,626
Changes to Oyster Reef and SAV Abundance – Oyster	$1,290,300
Changes to Oyster Reef and SAV Abundance – SAV	$660,000
Equipment Costs	$86,430
Grand Total	**$2,893,506–$2,954,356**

*Cost estimates are not adjusted for inflation or other variables.

APPENDIX 5 Excerpt from 2015 North Carolina Shrimp Fishery Management Plan Amendment 1

12.10 BYCATCH MANAGMENT RECOMMENDATIONS

12.10.1 Trawling in the New River above the Highway 172 Bridge

Marine Fisheries Commission Preferred Management Strategy

Status quo (Continue to prohibit otter trawls in the New River special secondary nursery area above the Highway 172 Bridge)

Advisory Committee Recommendation

Allow skimmer and otter shrimp trawling in the New River special secondary nursery area (above the Highway 172 Bridge).

Division Recommendation

Status quo (Continue to prohibit otter trawls in the New River special secondary nursery area above the Highway 172 Bridge)

12.10.2 Evaluation of the skimmer trawl and other gears used for shrimping in North Carolina

Marine Fisheries Commission Preferred Management Strategies

Allow hand cast netting of shrimp in all closed areas and increase the limit to four quarts, with heads on per person.

Status quo on a license requirement to fish a cast net for shrimp

Advisory Committee and Division Recommendation

Allow hand cast netting of shrimp in all closed areas and increase the limit to four quarts, with heads on per person. **Division added "heads on".**

Advisory Committee Recommendation

Require a fishing license from DMF to fish a cast net.

Division Recommendation

Status quo on a license requirement to fish a cast net for shrimp

12.10.3 The use of TEDs in commercial skimmer trawl operations

Marine Fisheries Commission Preferred Management Strategy

Upon federal adoption of TEDs in skimmer trawls, the division will support the federal requirement.

Advisory Committee Recommendation

Status quo

Division Recommendation

Upon federal adoption of TEDs in skimmer trawls, the division will support the federal requirement (Rule 15A NCAC 03L .0103 (g) allows for state enforcement).

12.10.4 Consideration of a commercial live bait shrimp fishery in North Carolina

Marine Fisheries Commission Preferred Management Strategy

Establish a permitted live shrimp bait fishery and for DMF to craft the guidelines and permit fees after reviewing permitted operations in other states, and to allow live bait fishermen with a permit to fish until 12 p.m. (noon) on Saturday.

Advisory Committee Recommendation

Establish a permitted live shrimp bait fishery and for DMF to craft the guidelines and permit fees after reviewing permitted operations in other states.

Division Recommendation

Status quo (continue to manage the live shrimp bait fishery the same as food shrimp fishery).

12.10.5 Gear Modifications in North Carolina shrimp trawls to reduce finfish bycatch

Marine Fisheries Commission Preferred Management Strategies

Allow any federally certified BRD in all internal and offshore waters of North Carolina.

Update the scientific testing protocol for the state's BRD certification program.

Convene a stakeholder group to initiate industry testing of minimum tail bag mesh size, T-90 panels, skylight panels, and reduced bar spacing in TEDs to reduce bycatch to the extent practicable with 40% target reduction.

- Upon securing funding, testing in the ocean and internal waters will consist of three years of data using test nets compared to a control net with a Florida fish eye, a federally approved TED, and a 1.5-inch mesh tailbag.

- Results should minimize shrimp loss and maximize reduction of bycatch of finfish. Promising configurations will be brought back to the MFC for consideration for mandatory use.
- This stakeholder group may be partnered with DMF and Sea Grant.
- Members should consist of fishermen, net/gear manufacturers and scientist/gear specialists.

Require either a T-90 panel/ square mesh tailbag or other applications of square mesh panels (e.g., skylight panel), reduced bar spacing in a TED, or another federal or state certified BRD in addition to existing TED and BRD requirements in all skimmer and otter trawls.

Advisory Committee Recommendations

Allow any federally certified BRD in all NC internal and offshore waters.

Update and certify bycatch reduction devices through the state bycatch reduction program.

Convene an ongoing stakeholder workgroup charged with suggesting new trawl gear or trawl gear modification.

Initiate industry testing of new or modified bycatch reduction devices and gear modifications under the supervision of the DMF. After testing and collection of scientific data, regulations should be implemented to require or allow such devices or modifications to be used in NC internal and offshore waters.

Test a three-inch bar-spaced turtle excluder device to see if it can be certified as a bycatch reduction device.

Allow the shrimp industry a two-year period to test bycatch reduction devices.

Division Recommendations

Allow any federally certified BRD in all NC internal and offshore waters.

Update the scientific testing protocol for the state BRD certification program.

Convene a stakeholder group to initiate industry testing of minimum tail bag mesh size, T-90 panels, skylight panels, and reduced bar spacing in TEDs to reduce bycatch to the extent practicable.

- Upon securing funding, testing in the ocean and internal waters will consist of three years of data using test nets compared to a control net with a Florida Fish Eye, a federally approved TED, and a one and a half inch tailbag.
- Results should minimize shrimp loss and maximize reduction of bycatch of finfish. Promising configurations will be brought back to the MFC for consideration for mandatory use.
- This stakeholder group may be partnered with DMF and Sea Grant.

- Members could consist of fishermen, net/gear manufacturers and scientist/gear specialists.

Require either a T-90 panel/ square mesh tailbag or other applications of square mesh panel (e.g., skylight panel), reduced bar spacing in a TED, or another federal or state certified BRD in addition to existing TED and BRD requirements in all skimmer and otter trawls.

Marine Fisheries Commission Recommendation **At November 2013 MFC meeting, requested this recommendation be reviewed by public, regional and standing committees.*

*Convene a stakeholder group to initiate a three-year study to test minimum tail bag mesh size, T-90 (square mesh) panels, skylight panels, reduced bar spacing in TEDs and any other new methods of reducing unwanted finfish bycatch to achieve a minimum of a 40 percent reduction of finfish by weight.

- Compare these to a control net with a Florida fish eye, a federally approved TED, and a one and half inch mesh tail bag.
- The stakeholder group should partner with DMF and Sea Grant to help secure funding for the study.
- If the 40 percent target reduction by weight in finfish is not achieved, further restrictions will be placed on the shrimp trawl industry to achieve the 40 percent reduction.
- Additional restrictions on the shrimp trawl industry will be reviewed and discussed at that time.

12.10.6 Effort Management for bycatch reduction in the North Carolina shrimp trawl fishery

Marine Fisheries Commission Preferred Management Strategy

Status quo on effort management (no changes in season, weekend or nighttime fishing)

Advisory Committee Recommendation

Status quo (no changes in season, weekend or nighttime fishing)

Division Recommendation

Status quo (no changes in season, weekend or nighttime fishing)

12.10.7 Characterization of the North Carolina commercial shrimp trawl fleet

Marine Fisheries Commission Preferred Management Strategy

In order to put a cap on fleet capacity as a management tool, establish a maximum combined headrope length of 220 feet in all internal coastal waters where there are no existing maximum combined headrope requirements (i.e., 90-foot requirement) with a two-year phase out period.

Advisory Committee Recommendation

Status quo (no additional maximum combined headrope requirements)

Division Recommendation

In order to put a cap on fleet capacity as a management tool, establish a maximum combined headrope length of 220 feet in all internal coastal waters where there are no existing maximum combined headrope requirements (i.e., 90-foot requirement).

12.10.8 Area restrictions to reduce shrimp trawl bycatch in North Carolina's internal coastal waters

Marine Fisheries Commission Preferred Management Strategies

Prohibit shrimp trawling in the IWW channel from the Sunset Beach Bridge to the SC state line, including Eastern Channel, lower Calabash River and Shallotte River.

Recommend the MFC Habitat and Water Quality Advisory Committee to consider changing the designation of special secondary nursery areas that have not been opened to trawling since 1991 to permanent secondary nursery areas.

Advisory Committee and Division Recommendation

Prohibit shrimp trawling in the IWW channel from the Sunset Beach Bridge to the SC line, including Eastern Channel, lower Calabash River and Shallotte River.

Division Recommendation

Recommend the MFC Habitat and Water Quality Advisory Committee to consider changing the designation of special secondary nursery areas that have not been opened to trawling since 1991 to permanent secondary nursery areas. Based on the outcome of AC input, rule changes may follow under the authority of the Shrimp FMP.

Motion on Shrimp Fishery Management Plan/Goals and Objectives from November 2018 Meeting

Motion by Chuck Laughridge that the Marine Fisheries Commission goals and objectives for the Shrimp Fishery Management Plan include the following:

- Reduce takes and interactions of non-targeted species and threatened species by curtailing actual effort
- Limit trawling in the Pamlico Sound to 3 days per week
- Reduce tow times to be consistent with improving survival of non-target and endangered species
- Continue to minimize bycatch and enhance the economic value of shrimp
- Change the requirement for a second BRD to a rule instead of proclamation
- Reduce maximum headrope to 110 feet and delay the season until a count of 60 or greater
- Promote habitat enhancement and provide environmental quality necessary to improve the shrimp resource to revisions to NC nursery areas and expansion of existing nursery areas
- Revision of nursery areas with an updated look at secondary nursery areas with expansion of secondary nursery areas based on revised environmental and biological data
- Implement research and education programs to allow a better understanding of the public, industry and consumers of the shrimp bycatch impact on fish population dynamics
- Require shrimp trawl bycatch reduction at the tow level, which is labor saving to industry, but also to address mortality at the population levels of finfish. We must address shrimp trawl bycatch at the population level prior to any additional reliance on mechanical means

  Second by Pete Kornegay.

Motion by Tom Hendrickson to table the previous motion to the next meeting.
Second by Doug Cross.
Motion carries 5-4.

Motion by Chuck Laughridge to discuss his prior motion no later than the February meeting, and if there is a special called meeting, that it be discussed then. Second by Pete Kornegay.
Motion carries 5-4.

Goal and Objectives
of
Amendment 1 to the Shrimp Fishery Management Plan

The goal of the North Carolina Shrimp FMP is to utilize a management strategy that provides adequate resource protection, optimizes the long-term commercial harvest, maximizes social and economic value, provides sufficient opportunity for recreational shrimpers, and considers the needs of all user groups. To achieve this goal, it is recommended that the following objectives be met:

1. Minimize waste and enhance economic value of the shrimp resource by promoting more effective harvesting practices.

2. Minimize harvest of non-target species of finfish and crustaceans and protected, threatened, and endangered species.

3. Promote the protection, restoration, and enhancement of habitats and environmental quality necessary for enhancing the shrimp resource.

4. Maintain a clear distinction between conservation goals and allocation issues.

5. Reduce conflicts among and within user groups, including non-shrimping user groups and activities.

6. Encourage research and education to improve the understanding and management of the shrimp resource.

Committee Reports

ROY COOPER
Governor

MICHAEL S. REGAN
Secretary

STEPHEN W. MURPHEY
Director

MEMORANDUM

TO: N.C. Marine Fisheries Commission Commercial Resource Fund Committee

FROM: Beth Govoni, Administrative Services Office Section Chief
Division of Marine Fisheries, NCDEQ

DATE: December 19, 2018

SUBJECT: MFC Commercial Resource Fund Committee Meeting Minutes

The MFC Commercial Resource Fund Committee met at 7 p.m. on Wednesday, December 19, 2018 at the N.C. Department of Environmental Quality Washington Regional Office. The following attended:

MFC Commercial Resource Fund Committee: Doug Cross, Sam Romano, Mike Blanton

Absent: None

Commercial Fishing Resource Funding Committee Members: Steve Weeks

DMF Staff: Dee Lupton, Beth Govoni, William Brantley

Public: None

APPROVAL OF AGENDA AND MINUTES

Chairman Doug Cross called the meeting to order, gave a reminder of the duty to avoid conflicts of interest, and inquired of any known conflicts of interest (N.C.G.S. 138A-15e).

Sam Romano made a motion to approve the meeting agenda. Mike Blanton seconded the motion. The motion carried unanimously.

Minutes from the July 26, 2018 MFC Commercial Resource Fund (CRF) Committee meeting were reviewed.

PUBLIC COMMENT

None offered

William Brantley read for the record public comment received by Mr. Chris McCaffity via email.

Marine Fisheries Commission's Commercial Fishing Resource Fund Committee Meeting Public Comment

Please use any extra revenue from our license fees to stock local seafood. Please apply for matching Saltonstal/Kennedy grants that are intended to enhance domestic seafood production. A 1% restocking fee on all seafood sales in NC would provide enough additional revenue to fund a world-class stocking program that could make our fisheries better than ever. This approach would benefit everyone and the resource by sustainably increasing seafood production and recreational opportunity.

I am always happy to answer any questions and/or go into greater detail.

Thank you,
Chris McCaffity

MFC COMMERICAL FISHING RESOURCE FUND PROGRAM OVERVIEW

Beth Govoni briefed the incoming CRF Committee on three supporting documents that guide the Commercial Fishing Resource Fund's administration. These included the Fund's Memorandum of Understanding between the MFC and the Funding Committee for the N.C. Commercial Fishing Resource Fund, Strategic Plan for the N.C. Commercial Fishing Resource Fund, and Administrative Procedures for Funding from the N.C. Commercial Fishing Resource Fund.

FUNDING OPTIONS FOR THE COMMERCIAL FISHING RESOURCE FUND

Chairman Cross opened discussion regarding five funding options from the North Carolina Commercial Fishing Resource Fund.

Beth Govoni discussed prepared drafts that the Division of Marine Fisheries (DMF) had developed for the Commercial Fishing Resource Funding Committee. These proposals and RFP's had been approved by the Funding Committee at the October 18 meeting.

1. NC Commercial Resource Fund Proposal for Commercial Gear Development Projects

   Chairman Cross asked Beth Govoni to summarize this project. The proposal would be for Year 1 funding, then reassessed for Year 2 funding at a date. William Brantley clarified the budget narrative and chart listed within the proposal.

2. NC Commercial Resource Fund Proposal for Disease and Pathology: Research and Monitoring

   This project would set aside a $25,000 retainer in preparation for funding pathology work for species within North Carolina's commercial fisheries. Chairman Cross asked if funds could be directed with a caveat to water quality issues. DMF Deputy Director Lupton stated that this was not within the existing scope of this project, however, it would be a topic to bring up at a future meeting of the committees. Mike Blanton asked

where the $25,000 figure came from, and what would happen in the instance of multiple pathologic needs during a fiscal year. Deputy Director Lupton stated the fund amount was an estimate, and in the case of multiple pathology issues, additional funding could be secured at the approval of both the committees.

3. NC Commercial Resource Fund Proposal for Commercial Fishery Statistics

   Govoni explained this funding would sustain and enhance the trip-ticket program for Year 1 of funding. Lupton explained the background of the trip-ticket program, and the need for sustained funding. Chairman Cross stated that the statistics to support North Carolina's commercial fishing industry were needed. Blanton asked if this funding supported federal and state quota monitoring, and if additional funds were being sought to support the trip-ticket program. Lupton stated the Quota Monitoring Biologist and Port Agent that this proposal supports would cover both federal and state monitoring, and no additional funding source was available.

4. NC Commercial Resource Fund Request for Proposals – Economic Impact Study

   Beth Govoni gave a brief description of the Request for Proposals (RFP) process, as well as a summary of the economic impact study. Chairman Cross asked for specifics to what economic variables would be covered in the study. Funding Committee member Steve Weeks explained that this study would differ from previous studies and would be extrapolated out to include variables such as durable good expenditures and infrastructure. Mike Blanton questioned if the study would cover what the commercial industry was worth, or what it could be worth; with discretion to industry-wide regulatory issues currently in place. The RFP's methodology would depend on the applicant's proposal and could be reviewed during the process and at Vendor presentations. Blanton stated this in his opinion, there were more significant research priorities and fishery management issues, such as the statistical data-gap in Southern Flounder juveniles and adults, that should also be considered for funding.

   Romano inquired as to whom would receive the RFP. This would go out in a DMF press release, as well as into the NC State contracting system.

5. NC Commercial Resource Fund Request for Proposals – Public Relations Campaign

   Govini read an excerpt from the description of the Public Relations (PR) RFP. Blanton expressed concern on funding RFP's, with respect to management and research issues that needed to be addressed. Chairman Cross stated that funding to support NC's Commercial Fishing industry was vital to the future of the industry. Blanton asked about state appropriations that were already in place for similar projects. Blanton also asked who would validate the message that the PR campaign portrays? Chairman Cross stated that the committees would review the progress and results. Romano stated that the proposal was broad, and the product that comes out of the RFP would show the public what the industry entails. Blanton stated that the science behind NC's commercial fishing industry was vital for the industry's future, and there were gaps in science that needed review. Deputy Director Lupton stated if the Committees wanted to address

additional fishery management issues, the Committee Chairs could call a meeting at any point. Lupton stated she could talk with DMF staff on future project proposals.

Sam Romano asked how additional issues could be addressed through funding of the NC Commercial Fishing Resource Fund. Mike Blanton followed up by asking how often the CRF Committee would be meeting. Lupton stated the Committees could meet as often as they wanted, as long as they met the requirements of the Memorandum of Understanding minimum requirements of two meeting per year.

Chairman Cross called for the committee to vote on the DMF projects for funding.

Mike Blanton made a motion to approve DMF projects for Year 1 funding.

1) **NC Commercial Resource Fund Proposal for Commercial Gear Development Projects**
1) **NC Commercial Resource Fund Proposal for Disease and Pathology: Research and Monitoring**
2) **NC Commercial Resource Fund Proposal for Commercial Fishery Statistics**

Sam Romano seconded. The motion carried unanimously.

Chairman Cross called for the Committee to vote on the RFP's.

Sam Romano made a motion to approve the following RFP's:

1) **NC Commercial Resource Fund Request for Proposals – Economic Impact Study**
2) **NC Commercial Resource Fund Request for Proposals – Public Relations Campaign**

Mike Blanton seconded. The motion carried unanimously.

ADDITIONAL ITEMS

Chairman Cross asked DMF to bring forward future projects for funding to support NC's commercial fishing industry at the next called meeting of the CRF Committee. Deputy Director Lupton suggested a joint meeting, and she would get with DMF Fishery Management staff to develop additional projects on sustainable fishery management, potentially during a Spring meeting.

Chairman Cross moved to make a motion to adjourn. Sam Romano seconded the motion. Motion carried unanimously.

Meeting adjourned at 7:45 p.m.

BG/wb

ROY COOPER
Governor
MICHAEL S. REGAN
Secretary
STEPHEN W. MURPHEY
Director

DRAFT

MEMORANDUM

TO: Marine Fisheries Commission
Southern Flounder FMP Advisory Committee

FROM: Michael Loeffler, Co-lead Southern Flounder Plan Development Team
Anne Markwith, Co-lead Southern Flounder Plan Development Team

DATE: November 29, 2018

SUBJECT: Southern Flounder FMP Advisory Committee Meeting

The Southern Flounder FMP Advisory Committee met on Wednesday, November 28, 2018 at 6 p.m. at the NCDEQ Washington Regional Office located at 943 Washington Square Mall in Washington, NC. The following attended:

Advisers: Fred Scharf (chairman), Michael Oppegaard, Tom Roller, Kurt Tressler, Mary Ellon Ballance, Keneth Johnson, Joe Romano, Bradley Styron.

Absent: Robert Cox, James Williams

Staff: Michael Loeffler, Anne Markwith, Charlton Godwin, Lee Paramore, Kathy Rawls, Trevor Scheffel, Lisa Hollensead, Laura Lee, Catherine Blum, Carter Witten

Public: David Sneed, Billy Byrd, Greg Judy, Joe Luczkovich, Brent Fulcher, Cathy Fulcher, Tylor Peacock

MFC: Mike Blanton

Fred Scharf informed the committee he would be late, so the agenda was shifted to go over agenda items, such as presentations, that did not require votes. Mike Loeffler called the meeting to order at 6:09 p.m. As there was a new committee member, Bradley Styron, the committee and lead staff made quick introductions before presentations started.

REVIEW DRAFT FMP SECTIONS

Division staff gave a presentation on the draft biological species profile section of the FMP. The committee asked questions about the age and growth of southern flounder, including differences between the states. The committee also had discussion on the lack of information on the ocean portion of the stock. It was mentioned that money from the Commercial Fishing Resource Fund could potentially be used for buying additional satellite tags to help with the ongoing work to identify the ocean portion of the stock and potential spawning areas.

The commercial presentation was postponed until the recreational section is completed. The committee felt that seeing the two sections together would give them a better understanding of the total fishery. Both the commercial and recreational fisheries sections will be presented at the January meeting.

Chairman Scharf arrived during the biological profile section presentation. At the completion of the presentation, after questions were addressed from advisers, the committee went back to the postponed action items and then the meeting continued as written on the agenda.

APPROVAL OF AGENDA

Motion by Mike Oppegaard to approve agenda, seconded by Mary Ellon Ballance – motion was approved unanimously.

APPROVAL OF MINUTES

Motion by Mike Oppegaard to approve meeting minutes from July 18, 2018, seconded by Joe Romano with the request to check spelling of names of Kurt Tressler and Mary Ellon Ballance – motion was approved unanimously.

PUBLIC COMMENT

Chairman Scharf let the committee know that there was one written comment submitted prior to the meeting and pointed the committee members to the copy of the full email in their briefing materials. Only one member of the public, Mr. Brent Fulcher, wished to make public comment. Mr. Fulcher inquired if the division had looked at NEAMAP data when doing the assessment, as he thought it might be helpful for information on portions of the stock. He also requested, from an industry standpoint, that the division keep in mind the latitudinal changes relative to seasons. He felt that TACs, ACLs, or any other type of quotas may be detrimental to the southern flounder fishery because it will cause people to fish on bigger fish to make up the economic loss; while the industry has been able to compensate for economic reductions in the summer flounder fishery due to an increasing price per pound, this will not be possible with the southern flounder fishery as the price per pound is already high. In closing, he offered help to the division from the commercial fishing industry with survey or tagging work.

UPDATE TO THE JANUARY 2018 SOUTHERN FLOUNDER STOCK ASSESSMENT

Division staff presented the results of the updated southern flounder stock assessment with data through 2017. Most of the discussion by the committee was on the model and the data. The committee asked questions about correlations between adverse weather, general weather patterns, and the landings. Division staff mentioned that the model indirectly takes this type of information into account, however regardless of weather conditions, recruitment is still not going up. There was also discussion on what causes the SSB target and threshold lines to go up and down. An explanation was given about how the line moves, and that decisions on the percentage at which it is set are made prior to getting the biomass results. From a model standpoint, to come up with the targets and thresholds, it is the biological factors that are driving that line. As mortality increases, SSB will decrease. A question was raised as to how we define the shrimp trawl estimates. This is done through observer coverage. The shrimp trawl is an incidental catch, they are not intended to catch flounder.

The committee also discussed the coastwide premise of the stock assessment. It was mentioned that what North Carolina does impacts other states and what other states do impacts North Carolina. From state to state, North Carolina makes the biggest commercial contribution, but Florida is the biggest in recreational landings. There was a question about the robustness of data from other states compared to data from North Carolina. The other states data are top notch; it is just too early to know how cooperative management is going to work.

REVIEW THE DRAFT GOAL AND OBJECTIVES FOR THE FMP

Division staff reviewed the draft goal and objectives for the fishery management plan with the committee. The goal and objectives have been revised to provide general guidelines that are more consistent across the state's FMPs with specifics for individual plans as needed (i.e., the coastwide nature of the southern flounder stock and other states' management). There was discussion on how hatcheries and stocking might play into the management plan. The division would not recommend this route at this time for several reasons: flounder take a lot of room to grow out, there is too little information on flounder hatcheries, and more research needs to be done, including studies on success rates of stocking. Additionally, the southern flounder stock is not at the point that it could not recover on its own and stocking could interrupt the natural reproduction of the fish. It was discussed that the focus of management should be regulation changes and habitat improvements, and hatchery work should be added as a research recommendation to help address some of the unknowns associated with it.

There was discussion by the committee on when they would get guidance on what reductions are needed and how this relates to the coastwide nature of the assessment and these objectives. Similar to ASMFC managed species, North Carolina will take its proportion of the reductions needed. The division will provide information to the committee as it is available to help with the discussions on reductions and potential management actions. It is the division director's intention to meet with the directors of the other states at the beginning of 2019 to discuss what management actions they may take. There was also discussion by the committee on when the draft amendment would go to the Marine Fisheries Commission for action. At the February 2019commission meeting, the division will present the goal and objectives for approval.

Motion by Mike Oppegaard to approve the draft goal and objectives for the FMP, seconded by Tom Roller – motion approved unanimously.

DISCUSS AND SET THE 2019 JANUARY-JUNE MEETING SCHEDULE

Division staff reviewed the proposed 2019 meeting schedule. The AC members will review the dates and let staff know if they anticipate schedule conflicts. The January meeting date was acceptable to everyone in attendance.

ADJOURN

Motion by Mary Ellon Ballance to adjourn, seconded by Mike Oppegaard – motion approved unanimously.

The meeting adjourned at 8:20 p.m.

cc:

John Batherson	Laura Lee	Patricia Smith
Chris Batsavage	Dee Lupton	Jason Walker
Catherine Blum	Shawn Maier	Biological Supervisors
Ellie Davis	Stephen Murphey	Committee Staff Members
Anne Deaton	Hardy Plyler	District Managers
Nancy Fish	Steve Poland	Marine Fisheries Commission
Jess Hawkins	Jerry Schill	Marine Patrol Captains
David Hilton	Isaiah Smith	Section Chiefs

ROY COOPER
Governor
MICHAEL S. REGAN
Secretary
STEPHEN W. MURPHEY
Director

DRAFT

MEMORANDUM

TO: Marine Fisheries Commission
Southern Flounder FMP Advisory Committee

FROM: Michael Loeffler, Co-lead Southern Flounder Plan Development Team
Anne Markwith, Co-lead Southern Flounder Plan Development Team

DATE: January 15, 2019

SUBJECT: Southern Flounder FMP Advisory Committee Meeting

The Southern Flounder FMP Advisory Committee met on Wednesday, January 9, 2019 at 6 p.m. at the NCDEQ Washington Regional Office located at 943 Washington Square Mall in Washington, NC. The following attended:

Advisers: Fred Scharf (chairman), Michael Oppegaard, Tom Roller, Kurt Tressler, Mary Ellon Ballance, Joe Romano, Bradley Styron, James Williams

Absent: Keneth Johnson, Robert Cox

Staff: Michael Loeffler, Anne Markwith, Lee Paramore, Kathy Rawls, Lisa Hollensead, Laura Lee, Catherine Blum, Carter Witten, Jesse Bissette, Brandi Salmon, Debbie Manley, Katy West, Daniel Ipock, William Boyd, Steve Anthony

Public: Glenn Skinner, Greg Judy, David Sneed, Bert Hill, David Jones, Francis J. Welch, Jeremy Swanner, Steve Midgett

MFC: Pete Kornegay

The start of the meeting was delayed slightly due to staff from Temporary Solutions working with the advisors to complete necessary paperwork. Fred Scharf called the meeting to order at 6:13 p.m.

APPROVAL OF AGENDA

Motion by Tom Roller to approve agenda, seconded by Mike Oppegaard – motion was approved unanimously.

APPROVAL OF MINUTES

Motion by Joe Romano to approve meeting minutes from November 28, 2018, seconded by Mary Ellon Ballance – motion was approved unanimously.

PUBLIC COMMENT

Fred reviewed one email that was received prior to the meeting; all advisors were provided a hard copy at the meeting. There was only one person who wished to provide public comment at the meeting. Steve Midgett stated that the commercial guys are always getting blamed and overfishing is always their fault. He felt that water quality, including sedimentation, is an issue with many of the species, but no one is bringing it up as a cause for decline in populations.

REVIEW FMP SECTION: DESCRIPTION OF THE FISHERIES

Division staff presented the draft Description of the Fisheries section of the FMP, which included information on both the commercial and recreational fisheries.

Commercial Fishery

There was discussion about the different commercial gears and landings by areas. The one data point that caused confusion was the Albemarle Sound landings from 2011, which were abnormally low as a hurricane had moved the fish out of the sound. Advisors brought up several reasons that they thought might have caused the increase in the southern flounder fishery, particularly the gill nets. The large peak in landings in the 1990s was most likely due to summer flounder regulations. There was also an uptick in the gill net fishery starting in 1988. Several advisors commented that as more fisheries became regulated, more people seem to switch to the unregulated fisheries (i.e., offshore permit costs caused some to switch to inshore fisheries; gigging increased with the introduction of the ITP). Cost prohibition, and ease, may have caused some fishermen to switch from pound nets to gill nets. Gill nets are important in certain areas and not in others, as are pound nets.

- **A request was made for information on how the gig fishery grew as the gill net fishery declined as well as landings by area.**
- **A request was made for detailed data to show the geographical differences in gear.**

Recreational Fishery

There was discussion as to why flounder are separated out by species for the recreational fishery but not commercial. The importance of species identification education was brought up during this discussion. Most of the discussion, however, focused on the Marine Recreational Information Program (MRIP), and questions concerning how sampling is conducted. During the

discussion the committee, and public, were pointed to various presentations and sources for supplemental information; staff will follow up with an email detailing this information. It is important to note that the recreational estimates are based on the best available scientific information, however better species identification will improve these estimates.

- **A request for how many MRIP surveys are sent out each year and to who, as well as how many CRFL licenses there are each year.**
- **Request that the FES and DMF presentations be sent to the southern flounder advisory committee.**
- **A request for the night gig creel survey data was made**.

REVIEW PROJECTIONS

Division staff presented projection scenarios from the updated stock assessment. These scenarios were used to determine the fishing mortality (*F*) needed to end the overfished status. Three of the five projections shown (i.e., fishing at current *F*, two moratorium scenarios) were for information purposes only to help the committee understand what the projections were doing. The two scenarios for informing management indicated that a 52% reduction in total catch was needed to reach the spawning stock biomass (SSB) threshold by 2028, and a 72% reduction would be needed to reach the SSB target by 2028. The committee will need to help the division figure out how to reduce total catch relative to 2017 (the terminal year of the assessment) by at least 52%.

There was discussion on any uncertainty around the projections. All scenarios, as required by statute, have a 50% probability of success. Other questions about the projections were also raised, including why the shrimp trawl bycatch fleet had been excluded and southern flounder recruitment estimates in relation to abiotic factors. The difficulty with the shrimp trawl bycatch fleet is that the values used are coast wide, not state specific, and it's impossible to parse out North Carolina's contribution to be used in the projections. However, the catch from this fleet is relatively small, accounting for only two percent of the coast-wide catch. The recruitment estimates are calculated assuming average environmental conditions. There was a short discussion on why previous management measures from the last 20 years had not worked and how the public could be assured (with such a large reduction in catch) that anything coming from this Amendment would work better. It was acknowledged that environmental conditions, outside of NCDMF control, can play a role in stock rebuilding. It is also possible that the previously enacted regulation changes, like season closures due to protected species, aren't as quantifiable as other measures (i.e., quota), and as a result more fishing is occurring than was assumed would happen when the regulations were enacted. Finally, there is not the variation in recruitment like in other species. The committee is going to have to come up with recommendations for management that haven't been tried before.

DISCUSS SUSTAINABLE HARVEST

The discussion on sustainable harvest started with staff explaining that the division would be taking an amendment (Amendment 2) to the N.C. Marine Fisheries Commission at its February meeting. Amendment 2 will focus on season and area closures as a way to end overfishing and

start rebuilding the stock. The committee will receive a presentation on Amendment 2 at their February meeting, and will be able to provide recommendations to the division at this time concerning the amendment. This amendment does not negate the purpose of the committee, as discussions will be held concerning other management strategies (i.e., quotas, seasons, gear restrictions) that allow for sustainable harvest. These management strategies will be addressed in Amendment 3 to the FMP. It was decided to wait on further discussion of potential management options until the committee had seen the presentation on Amendment 2 in February.

ADJOURN

Motion by Mary Ellon Ballance to adjourn, seconded by Mike Oppegaard – motion approved unanimously.

The meeting adjourned at 8:55 p.m.

cc:

John Batherson	Laura Lee	Patricia Smith
Chris Batsavage	Dee Lupton	Jason Walker
Catherine Blum	Shawn Maier	Biological Supervisors
Ellie Davis	Stephen Murphey	Committee Staff Members
Anne Deaton	Hardy Plyler	District Managers
Nancy Fish	Steve Poland	Marine Fisheries Commission
Jess Hawkins	Jerry Schill	Marine Patrol Captains
David Hilton	Isaiah Smith	Section Chiefs

ROY COOPER
Governor
MICHAEL S. REGAN
Secretary
STEPHEN W. MURPHEY
Director

DRAFT

December 13, 2018

MEMORANDUM

TO: Marine Fisheries Commission

FROM: Jason Rock, Co-lead Blue Crab Plan Development Team
Corrin Flora, Co-lead Blue Crab Plan Development Team

SUBJECT: Blue Crab Fishery Management Plan Advisory Committee Meeting

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The Blue Crab Fishery Management Plan Advisory Committee met on December 6, 2018 at 6 p.m., at the NCDEQ Washington Regional Office located at 943 Washington Square Mall in Washington, NC. The following attended:

Advisers: **Joseph Romano, Mike Marshall, Kenneth Seigler, Robert Bruggeworth, Thomas Roller**

Staff: Jason Rock, Corrin Flora, Robert Corbett, Kathy Rawls, Debbie Manly, Daniel Ipock, Katy West

Public: Glenn Skinner, Wayne Dunbar

Chairman Romano called the meeting to order at 6:17 p.m.

APPROVAL OF THE AGENDA AND MINUTES/PUBLIC COMMENT

Chairman Romano entertained a motion to approve the agenda with the removal of the 8pm agenda item. Seigler moved to approve the agenda with edits and Marshall seconded the motion. The motion passed unanimously. Chairman Romano entertained a motion to approve the draft minutes from the August 8 meeting. Roller moved to approve the minutes as presented and Bruggeworth seconded the motion. The motion passed unanimously. No members of the public provided comment during the formal public comment period.

FISHERY MANAGEMENT PLAN PRESENTATION: ECOSYSTEM IMPACT ON THE FISHERY

Division staff (Flora) gave a presentation to the committee on the fishery management plan section entitled “Ecosystem Impact on the Fishery.” Discussion covered water quality and

degradation, habitat quality and degradation, significant weather events, disease and parasites, bycatch in other fisheries, and invasive species. There was additional discussion about toxins, including mosquito and agricultural pesticides and their persistence in the environment. The committee asked about mortality estimates, including environmental parameters and bycatch gear studies, livestock farm impacts, and water quality monitoring stations. Staff recognized that there is a data need in blue crab bycatch mortality. The staff also explained livestock farms and water quality will be addressed in an issue paper, however, the division does not regulate or study these aspects directly.

FISHERY MANAGEMENT PLAN ISSUE PAPER: ACHIEVING SUSTAINABLE HARVEST IN THE NORTH CAROLINA BLUE CRAB FISHERY

Division staff (Rock) gave a presentation to the committee on the fishery management plan issue paper to achieve sustainable harvest in the blue crab fishery. The presentation included several options and combinations of options. Options included maximum harvest size of mature female crabs, limited harvest on immature females, late season closure, and cull tolerance. Additionally, the presentation included adaptive management framework for the blue crab fishery. Staff explained that these options are those able to be quantified and additional options which cannot be quantified will be presented at the next meeting. Discussion covered the difference between a minimum rather than a maximum size limit on mature female crabs, environmental aspects, market value, and peak season closures as opposed to late season. The committee requested additional analysis be included on a minimum size limit of mature female crabs. The committee discussed the positives and negatives of adaptive management. They voiced concerns about consistency in the fishery across long term affects.

Kenneth Seigler made a motion to look to placing a minimum size limit on all mature female crabs, maintain the 5% cull tolerance, maintain the prohibition on immature female harvest. Robert Bruggeworth seconded the motion. Discussion of the motion included the addition of adaptive management. The committee wanted more time to research the topic. Motion passed 4 to 1.

DISCUSS AND SET THE 2019 MEETING SCHEDULE

Staff presented proposed dates to the committee and no objections or concerns were made. Dates will be set and any additional meetings will be scheduled as needed.

The meeting adjourned at 9:27 p.m.

cc:

John Batherson	Laura Lee	Jason Walker
Chris Batsavage	Dee Lupton	Biological Supervisors
Catherine Blum	Shawn Maier	Committee Staff Members
Ellie Davis	Stephen Murphey	District Managers
Anne Deaton	Steve Poland	Marine Fisheries Commission
Nancy Fish	Jerry Schill	Marine Patrol Captains
Jess Hawkins	Patricia Smith	Section Chiefs

ROY COOPER
Governor
MICHAEL S. REGAN
Secretary
STEPHEN W. MURPHEY
Director

February 1, 2019

MEMORANDUM

TO: Marine Fisheries Commission

FROM: Jason Rock, Co-lead Blue Crab Plan Development Team
Corrin Flora, Co-lead Blue Crab Plan Development Team

SUBJECT: Blue Crab Fishery Management Plan Advisory Committee Meeting

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The Blue Crab Fishery Management Plan Advisory Committee met on January 24, 2019 at 6 p.m., at the NCDEQ Washington Regional Office located at 943 Washington Square Mall in Washington, NC. The following attended:

Advisers: Joseph Romano, Mike Marshall, Kenneth Seigler, Robert Bruggeworth, Perry Beasley, Sammy Corbett

Staff: Jason Rock, Debbie Manly, Katy West, Anne Deaton, Jeff Dobbs, Odell Williams

Public: Wesley Potter, Vic White, Alton Parker, Wayne Dunbar, Dallas Ormond, Joe Geer, John Midget, Larry Paul, Jan Corbett, David Quip

MFC: Mike Blanton

Chairman Romano called the meeting to order at 6:00 p.m.

APPROVAL OF THE AGENDA AND MINUTES/PUBLIC COMMENT

Chairman Romano entertained a motion to approve the agenda. Marshall moved to approve the agenda and Seigler seconded the motion. The motion passed unanimously. Chairman Romano entertained a motion to approve the draft minutes from the December 6 meeting. Marshall moved to approve the minutes as presented and Seigler seconded the motion. The motion passed unanimously.

Members of the public provided comment during the formal public comment period. Wesley Potter shared concern with habitat and water quality. John Midgett and Joe Geer both commented on opening crab dredging to continue supporting their small community and the importance of the fishery. Dallas Ormond spoke on the importance of protecting the nursery and end overfishing of blue crabs. Mr. Ormond supports 2 cull rings in pots larger than the current minimum size.

FISHERY MANAGEMENT PLAN ISSUE PAPER: MANAGEMENT OPTIONS BEYOND QUANTIFIABLE HARVEST REDUCTIONS

Division staff (Rock) gave a presentation to the committee on the fishery management plan issue paper management options beyond quantifiable harvest reductions. The presentation included several options and combinations of options. Options included gear modifications including size, number, and placement of cull rings; removing cull ring exemptions; degradable panels; crab trawl tailbag mesh size; sponge crab and early season closures; peeler size limits; and effort control. There was additional discussion from the committee about water quality, expanding crab sanctuaries, and day of the week closures. Staff explained crab sanctuaries and water quality will be addressed in future issue papers. The committee requested more information from division staff on regional early season closures, peeler size limits, returning cull ring exemptions to proclamation only, and an increased cull ring size with defined placement.

FISHERY MANAGEMENT PLAN ISSUE PAPER: ACHIEVING SUSTAINABLE HARVEST IN THE NORTH CAROLINA BLUE CRAB FISHERY

Division staff (Deaton and Dobbs) gave a presentation to the committee on the fishery management plan issue paper bottom disturbing gear in the blue crab fishery. The presentation included several options in regard to crab dredge and crab trawl. Options included elimination of the crab dredge fishery, no blue crab bycatch in the oyster dredge fishery, increasing crab trawl tailbag mesh size, and moving the crab trawl line. Discussion covered areas in which crab dredge and crab trawl are allowed, small number of participants in the fisheries, impact on the bottom, and financial impacts.

Kenneth Seigler made a motion to not adopt any of the recommended management options on crab dredge. Perry Beasley seconded the motion.
Motion passed 4 to 1 with 1 abstention.

Kenneth Seigler made a motion to leave crab trawl lines as is. Sammy Corbett seconded the motion.
Motion passed 4 to 1 with 1 abstention.

The meeting adjourned at 9:27 p.m.

cc:

John Batherson	Laura Lee	Jason Walker
Chris Batsavage	Dee Lupton	Biological Supervisors
Catherine Blum	Shawn Maier	Committee Staff Members
Ellie Davis	Stephen Murphey	District Managers

Anne Deaton	Steve Poland	Marine Fisheries Commission
Nancy Fish	Jerry Schill	Marine Patrol Captains
Jess Hawkins	Patricia Smith	Section Chiefs

ROY COOPER
Governor

MICHAEL S. REGAN
Secretary

STEPHEN W. MURPHEY
Director

MEMORANDUM

TO: Marine Fisheries Commission Coastal Recreational Fishing License Advisory Committee

FROM: William Brantley, Coastal Recreational Fishing License Project Coordinator
Division of Marine Fisheries, NCDEQ

DATE: December 18, 2018

SUBJECT: Coastal Recreational Fishing License Advisory Committee Meeting Minutes

The Coastal Recreational Fishing License Advisory Committee met at 10:00 a.m. on Tuesday, December 18, 2018 at the N.C. Division of Marine Fisheries Headquarters Office. The following attended:

Funding Committee: Cameron Boltes, Pete Kornegay, Chuck Laughridge

Absent: Rob Bizzell

DMF Staff: Beth Govoni, William Brantley

Public: Matt Kenworthy

APPROVAL OF AGENDA AND MINUTES

Chairman Cameron Boltes called the meeting to order, gave a reminder of the duty to avoid conflicts of interest, and inquired of any known conflicts of interest (N.C.G.S. 138A-15e).

Chuck Laughridge made a motion to approve the meeting agenda. Pete Kornegay seconded the motion. The motion carried unanimously.

PUBLIC COMMENT

None offered

ADVICE ON THE CRFL REQUEST FOR PROPOSALS (RFP)

Chairman Boltes opened discussion regarding the 2018 CRFL Request for Proposals.

A brief summary on the draft RFP that the Division of Marine Fisheries (DMF) had developed for the MFC Coastal Recreational Fishing License Advisory Committee (Committee) was given

by William Brantley. Brantley noted that the RFP presented during this meeting was a draft, and advice forthcoming by the Committee would be compiled and briefed to DMF management for consideration prior to release.

The DMF Artificial Reef Program was discussed, specifically how the RFP would affect reef projects. Brantley mentioned that future reef construction and maintenance would be handled by DMF, through partnership opportunities with regional organizations, on a rotational basis spanning the North Carolina coast. Beth Govoni stated that these projects were organized within a 5 year-plan. Kornegay stated that he had heard concern over the frequency of reefs in the northern district. Govoni stated that some CRFL funded artificial reef development was previously a competitive process within the RFP.

Chairman Boltes directed the meeting to Goal 1 of the RFP draft: *Marine Resources and Habitat Management*. It would be beneficial to know what strategy in the RFP current funds were being directed to, which would possibly identify gaps or overlap for future funding opportunities. DMF would provide a summary of the current projects and what goals/strategies they currently aligned with.

Boltes asked how DMF decided if the projects were recreationally significant and was there a requirement that they be recreationally significant for funding through the Marine Resources Fund. Govoni stated that for CRFL projects, the focus was N.C.G.S 113-175.1. Govoni stated the statue does not specify recreational specific projects, however, the focus had traditionally been on recreational fishery projects that could not be achieved through appropriated funds.

Discussion on the return-on-investment for CRFL projects was initiated by Laughridge. Metrics, trends and data needed to not be simply collected, but the potential use of results from projects needs to be taken into account with consideration to how they will affect various management methods. Part of this could include a public relations effort, which includes social media, to display return on investment to license holders and allows the public to see benefits of the CRFL grant program. Laughridge also mentioned that it can be difficult to see tangible results from CRFL funding of DMF's Marine Patrol, however, he thought additional enforcement officers would provide a considerable return-on-investment to recreational license holders.

Order of precedence in expending CRFL funds was a topic, with Laughridge leading the discussion. Laughridge mentioned that CRFL funds should first be used to obtain DMF's mission before funding outside RFP projects. Laughridge stated he admired the format of the RFP; and followed up by stating that though the MFC no longer controls the Marine Resources Fund, DMF will likely see the MFC object/support projects for record.

Project Suggestions by the MFC CRFL AC

- A project proposal to study data amassed by DMF. Fisheries data should be able to be implemented as quickly as possible.

- A project proposal to study catch and release mortality using single barbless hooks. This would be an example of research that held practicable applicability. Results could impact angler catch-and-release practices.

- A project proposal to study siting of artificial reefs, as there was research from East Carolina University depicting less-than-preferred locations of reefs north of Hatteras. This would provide useable data to the Dare County region in their reef planning.

- Continued focus on Submerged Aquatic Vegetation areas, with collaboration of the Coastal Habitat Protection Plan.

- Require applicants to state how each RFP proposal would benefit the recreational angler.

Considerations for the CRFL Program Going-Forward

Future grant completions, Chairman Boltes stated, should involve "action" plans or results, such as credible recommendations or implementation of research. At the request of Chairman Boltes, DMF will provide an on-going effort to advise the Committee of completed CRFL projects with a short, one-page summary of the final results and impacts.

William Brantley discussed the budget report, and explained that after all FY19 obligations were considered, there was $1,315,795 available for RFP funding.

To summarize, Chairman Boltes stated that the focus of CRFL funding should be to take care of the needs of the Division.

A future meeting request with senior DMF management was mentioned by Laughridge, focusing on the potential utilization of CRFL funds and Marine Patrol's staffing.

ADDITIONAL ITEMS

None

Chairman Boltes adjourned the meeting.

Meeting adjourned at 11:04 a.m.

Director's Report

ROY COOPER
Governor

MICHAEL S. REGAN
Secretary

STEPHEN W. MURPHEY
Director

Feb. 6, 2019

MEMORANDUM

TO: N.C. Marine Fisheries Commission

FROM: Stephanie McInerny, License and Statistics Section Chief

SUBJECT: Status of Rule Development to Clarify Standard Commercial Fishing License Transfers

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Issue

Concern has been raised about third-party transfers (e.g., Craigslist) of Standard Commercial Fishing Licenses (SCFLs) allowing individuals to get a license without going through the eligibility board. At the November 2018 Marine Fisheries Commission meeting, proposed amendments to the SCFL rule (15A NCAC 03O .0108) were presented that added language to allow transfers of SCFLs or Retired SCFLs under specific circumstances in addition to those defined in statute (G.S. 113-168.2). Concern was raised about several of the proposed amendments to the rule due to potential loopholes in enforcement. Division staff further reviewed the draft language in more depth and are presenting a second version of the rule.

Findings

- The authorizing statute only recognizes five circumstances as a legal basis for completion of a transfer of these licenses. Additionally, the statute delegates to the commission the authority to establish in rule additional circumstances under which a transfer is allowed.
- There were two proposed amendments to the draft rule presented in November to further facilitate transfers that could move forward, as previously presented, to public comment within the rulemaking process. Those were:
    1. Adding additional family members to the immediate family definition to allow grandparents, grandchildren, and legal guardians to be eligible for a SCFL or Retired SCFL transfer since they are recognized in the SCFL eligibility criteria rule (15A NCAC 03O .0404); and
    2. Confirming the presence of a certification statement from the transferee that affirms the information provided to the division is true and accurate, which is already required for any transfer, but not explicitly stated in rule.
- The remaining proposed amendments were potentially ambiguous and may create loopholes with regards to processing license transfers; therefore, those amendments were removed from the draft rule. Potentially ambiguous amendments included:
    1. Adding business to business transfers between businesses owned by the same person;
    2. Adding owner to business and business to owner transfers; and

3. Adding transfer of a SCFL or Retired SCFL from an entity without a vessel **only** if retiring and the licensee provides required documentation for retirement.

Action Needed
No action by the commission is needed at this time. Staff appreciates the commission's feedback on the status of proposed amendments to the rule (see attached).

Overview
The draft rule presented today (attached) only includes the two proposed amendments that are ready to move forward. This version of the rule will be included in the commission's 2019-2020 package of rules for readoption under the Periodic Review and Expiration of Existing Rules that will be voted on by the commission at its May 2019 meeting to begin the rulemaking process.

Further details on the needs of stakeholders would need to be collected before additional amendments to the transfer rule could be undertaken.

15A NCAC 03O .0108 is proposed for readoption with substantive changes as follows:

15A NCAC 03O .0108 LICENSE AND COMMERCIAL FISHING VESSEL REGISTRATION TRANSFERS

(a) Upon transfer of a license or Commercial Fishing Vessel Registration, the transferee becomes the licensee and assumes the privileges of holding the license or Commercial Fishing Vessel Registration.

(b) A transfer application including a certification statement form shall be provided by the Division of Marine Fisheries. A transfer application shall be completed for each transfer including, but not limited to:

(1) the information required as set forth in Paragraph (a) of Rule .0101 of this Section;

(2) a certified statement from the transferee listing any violations involving marine and estuarine resources in the State of North Carolina during the previous three years; and

(3) a certified statement from the transferee that the information and supporting documentation submitted with the transfer application is true and correct, and that the transferee acknowledges that it is unlawful for a person to accept transfer of a license for which they are ineligible.

(c) A properly completed transfer application shall be returned to an office of the Division by mail or in person, except as set forth in Paragraph (e) of this Rule.

(d) A transfer application submitted to the Division without complete and required information shall be deemed incomplete and shall not be considered further until resubmitted with all required information. Incomplete applications shall be returned to the applicant with deficiency in the application so noted.

~~(a)~~(e) ~~Licenses~~ A License to Land Flounder from the Atlantic Ocean ~~may~~ shall only be transferred:

(1) with the transfer of the ownership of a vessel that the licensee owns that individually met the eligibility requirements of ~~15A NCAC 3O .0101 (b) (1) (A) and (b) (1) (B)~~ Sub-Part (b)(1)(A) and (b)(1)(B) of Rule .0101 of this Section to the new owner of ~~that vessel. Transfer of the License to Land Flounder from the Atlantic Ocean transfers all flounder landings from the Atlantic Ocean associated with~~ that vessel; or

(2) by the owner of a vessel to another vessel under the same ownership.

Transfer of a License to Land Flounder from the Atlantic Ocean transfers with it all flounder landings from the Atlantic Ocean associated with that vessel. Any transfer of license under this Paragraph ~~may~~ shall only be processed through the Division of Marine Fisheries Morehead City Headquarters Office and no transfer is effective until approved and processed by the Division.

~~(b)~~(f) Commercial Fishing Vessel Registration ~~Transfer.~~ transfers: When transferring ownership of a vessel bearing a current ~~commercial fishing vessel registration,~~ Commercial Fishing Vessel Registration, the new ~~owner~~ owner;

(1) shall follow the requirements in ~~15A NCAC 03O .0101~~Rule .0101 of this Section and pay a replacement fee ~~of ten dollars ($10.00)~~ as set forth in Rule .0107 of this Section for a replacement ~~commercial fishing vessel registration.~~ Commercial Fishing Vessel Registration; and

(2) ~~The new owner must~~ shall submit a transfer ~~form~~ application ~~provided by the Division~~ with the signatures of the former ~~licensee~~ owner and ~~the signature of~~ the new ~~licensee~~ owner notarized.

~~(c)~~(g) Standard or Retired Standard Commercial Fishing License transfers:

(1) It is unlawful for a person to accept transfer of a Standard or Retired Standard Commercial Fishing License for which they are ineligible.

~~(1)~~(2) A Standard or Retired Standard Commercial Fishing License ~~may~~ shall only be transferred if both the transferor and the transferee have no current suspensions or revocations of any Marine Fisheries license ~~privileges.~~ privileges except, in the event of the death of the transferor.

~~(2)~~(3) At the time of the transfer of a Standard or Retired Standard Commercial Fishing License, the transferor ~~must~~ shall indicate the retainment or transfer of the landings history associated with that Standard or Retired Standard Commercial Fishing License. The transferor may retain a landings history only if the transferor holds an additional Standard or Retired Standard Commercial Fishing License. Transfer of a landings history is all or none.

~~(3)~~(4) To transfer a Standard or Retired Standard Commercial Fishing License, the following information is required:

(A) information on the transferee as set ~~out~~ forth in ~~15A NCAC 03O .0101;~~Rule .0101 of this Section;

(B) notarization of the ~~current license holder's~~ transferor's and the transferee's signatures on ~~a~~ the transfer ~~form provided by the Division;~~application; and

~~(C) when the transferee is a non-resident, a written certified statement from the applicant listing any violations involving marine and estuarine resources during the previous three years;~~

~~(D)~~(C) when the transferor is retiring from commercial fishing, ~~the transferor must submit~~ evidence showing that such retirement has in fact occurred, ~~for example,~~ which may include, but is not limited to, evidence of the transfer of all ~~licensee's~~ the transferor's Standard Commercial Fishing Licenses, sale of all the ~~licensee's~~ transferor's registered vessels, or discontinuation of any active involvement in commercial fishing.

~~Properly completed transfer forms must be returned to Division Offices by mail or in person.~~

~~(4)~~(5) The Standard or Retired Standard Commercial Fishing License ~~which~~ that is being transferred ~~must~~ shall be surrendered to the Division at the time of the transfer application.

~~(5)~~(6) Fees:

(A) ~~Transferee~~ The transferee ~~must~~ shall pay a replacement fee ~~of ten dollars ($10.00).~~as set forth in Rule .0107 of this Section.

(B) ~~Transferee~~ The transferee ~~must~~ shall pay the differences in fees as specified in G.S. ~~113-168.2 (e)~~ 113-168.2(e) or G.S. ~~113-168.3 (b)~~ 113-168.3(b) when the transferee who is a non-resident is being transferred a resident Standard or Retired Standard Commercial Fishing License.

(C) ~~Transferee~~ The transferee ~~must~~ shall pay the differences in fees as specified in G.S. ~~113-168.2 (e)~~ 113-168.2(e) when the license to be transferred is a Retired Standard Commercial Fishing License and the transferee is less than 65 years old.

~~(6)~~(7) Transfer of Standard or Retired Standard Commercial Fishing License for Deceased Licensees:

(A) When the deceased licensee's immediate surviving family member(s) is eligible to hold the ~~deceased=s~~ deceased's Standard Commercial Fishing ~~Licenses~~ License or Retired Standard Commercial Fishing License, the Administrator/Executor must give written notification within six months after the Administrator/Executor qualifies under ~~G. S.~~G.S. 28A to the ~~Morehead City Office of the~~ Division ~~of Marine Fisheries~~ of the request to transfer the ~~deceased=s~~ deceased's license to the estate Administrator/Executor.

(B) A transfer to the Administrator/Executor shall be made according to the provisions of ~~Subparagraphs (c (2) (c) (4)~~Sub-Paragraphs (g)(2) - (g)(4) of this Rule. The Administrator/Executor must provide a copy of the deceased licensee's death certificate, a copy of the certificate of ~~administration~~ administration, and a list of eligible immediate family members to the ~~Morehead City Office of the Division of Marine Fisheries.~~Division.

(C) The Administrator/Executor ~~may~~ shall only transfer a license in the Administrator/Executor name on behalf of the estate to ~~a~~ an eligible surviving family member. The surviving family member transferee ~~may~~ shall only transfer the license to a third party purchaser of the deceased licensee's fishing vessel. Transfers shall be made according to the provisions of ~~Subparagraphs (c) 2 (c) (4)~~ Sub-Paragraphs (g)(2) - (g)(4) of this Rule.

(8) For purposes of effecting transfers under this Paragraph, "immediate family" shall include grandparents, grandchildren, and legal guardians of a person, in addition to those family members defined in 113-168(3a).

~~(d) Transfer forms submitted without complete and required information shall be deemed incomplete and will not be considered further until resubmitted with all required information.~~

~~(e) It is unlawful for a person to accept transfer of a Standard or Retired Standard Commercial Fishing License for which they are ineligible.~~

History Note: *Authority G.S. 113-134; 113-168.1; 113-168.2; 113-168.3; 113-168.6; 113-182; 143B-289.52;*
Eff. January 1, 1991;
Amended Eff. March 1, 1994;
Temporary Amendment Eff. August 1, 1999; July 1, 1999;
Amended Eff. April 1, 2020; August 1, 2000.

Volume 27, Issue 5
October/November 2018

ASMFC

FISHERIES focus

Vision: Sustainably Managing Atlantic Coastal Fisheries

INSIDE THIS ISSUE

ASMFC Presents Roy W. Miller Prestigious Captain David H. Hart Award

The Atlantic States Marine Fisheries Commission presented Roy W. Miller, Delaware's Governor Appointee to the ASMFC and former Director of Delaware's Division of Fish and Wildlife (DE DFW), the Captain David H. Hart Award, its highest annual award, at the Commission's 77th Annual Meeting in New York City. For the past 40 years, Mr. Miller has admirably served the State of Delaware and the Commission.

Captain David H. Hart Award recipient Roy W. Miller with an Atlantic striped bass.

From the outset of his career in 1978 through passage of the Atlantic Striped Bass Conservation Act in 1984, Mr. Miller served on the Striped Bass Science and Statistical Committee (now known as the Striped Bass Technical Committee), working with the Committee to address the precipitous decline of the striped bass population. As part of those discussions, he was instrumental in getting Delaware to join Maryland in implementing a moratorium on the Delaware striped bass fishery. To this day, he considers the recovery of the striped bass population and the return of the Delaware Bay as a productive and important spawning area as two of his proudest Commission moments.

Beginning in 2003, as Section Administrator for DE DFW, Mr. Miller became the state's Administrative Commissioner Proxy. In that position, he served on and chaired numerous management boards, including Shad and River Herring, Weakfish, and the Horseshoe Crab Board. His chairmanship of the Horseshoe Crab Board was during the highly contentious development and implementation of the FMP, which sought to balance the needs of watermen, who wanted to continue to harvest crabs to use as bait, with the desires of environmentalists, who wanted to preserve the crabs so their eggs could feed migrating shorebirds. Mr. Miller skillfully guided the Board through some intense Board meetings, including significant public comment provided at the meetings. In addition to a management program that accommodated the needs of all the stakeholders and the resource, those meetings also resulted in revised comment protocols for public speaking at ASMFC meetings.

Immediately after his retirement in 2009, Mr. Miller was chosen by Governor Jack Markell (D-DE) to serve as his Appointee to the Commission. Notably, Mr. Miller didn't miss a meeting between his retirement and

continued, see ROY MILLER on page 12

Upcoming Meetings

November 27 (9:30 - 11:30 AM)
Atlantic Herring Plan Development Team Webinar, visit http://www.asmfc.org/calendar/11/2018 for more information

November 27 - 30
Atlantic Striped Bass Benchmark Stock Assessment Peer Review, Northeast Fisheries Science Center's 66th Stock Assessment Workshop (SAW/SARC), Woods Hole, MA

December 3 - 7
South Atlantic Fishery Management Council, Hilton Garden Inn/Outer Banks, 5353 N. Virginia Dare Trail, Kitty Hawk, NC

December 4 - 6
New England Fishery Management Council, Hotel Viking, Newport, RI

December 6 (9:30 - 11:30 AM)
American Lobster Technical Committee Webinar, visit http://www.asmfc.org/calendar/12/2018 for more information

December 11 - 13
Mid-Atlantic Fishery Management Council, Westin Annapolis, 100 Westgate Circle, Annapolis, MD

December 13 (9:30 AM - 12:30 PM)
Atlantic Menhaden Stock Assessment Subcommittee Webinar, visit http://www.asmfc.org/calendar/12/2018 for more information

January 9 (9:30 - 11:30 AM)
American Lobster Technical Committee Webinar, visit http://www.asmfc.org/calendar/1/2019 for more information

January 28-31
American Lobster Benchmark Stock Assessment Workshop, Massachusetts Division of Marine Fisheries, 836 South Rodney French Boulevard, New Bedford, MA

January 29 - 31
New England Fishery Management Council, Portsmouth Harbor Events Center, Portsmouth, NH

February 5 - 7
ASMFC Winter Meeting, Westin, 1800 South Eads Street, Arlington, VA

February 12 - 14
Mid-Atlantic Fishery Management Council, Hilton Virginia Beach Oceanfront, 3001 Atlantic Avenue, Virginia Beach, VA

March 4 - 8
South Atlantic Fishery Management Council, Westin Jekyll Island, 110 Ocean Way, Jekyll Island, GA

April 9 - 11
Mid-Atlantic Fishery Management Council, Icona Golden Inn, 7849 Dune Drive, Avalon, NJ

April 16 - 18
New England Fishery Management Council, Hilton Hotel, Mystic, CT

April 29 - May 2
ASMFC Spring Meeting, Westin, 1800 South Eads Street, Arlington, VA

The Atlantic States Marine Fisheries Commission was formed by the 15 Atlantic coastal states in 1942 for the promotion and protection of coastal fishery resources. The Commission serves as the deliberative body of the Atlantic coastal states, coordinating the conservation and management of nearshore fishery resources, including marine, shell and diadromous species. The fifteen member states of the Commission are: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida.

Report From the Chair: Reflections on Our Past & Future

For this issue, we are dedicating this space to Commission Chair James Gilmore and the speech he presented to Commissioners at our 77th Annual Meeting in New York City in October 2018.

"This meeting holds special meaning for me. As a New Yorker, born and raised, and someone who has worked in the city (and in the South Tower of the Twin Towers), I am profoundly proud of this city and its people, who have had to come together to deal with one of the nation's worst tragedies. As horrible as 9/11 was, the ability of New Yorkers to set aside their differences and personal losses to come to each other's aid was inspiring and uplifting. It renewed my faith in the goodness of people and their ability to unite and accomplish great feats for a common cause. My fellow New York Commissioners and I felt so strongly about this notion of strength through unity – the ability of people with diverse interests and backgrounds to unify for a greater good – that we chose to use the image of the One World Trade Center as our Annual Meeting logo.

New York also has immense historical significance to the Commission. It was one of a handful of states that came together through the Eastern States Conservation Conference in 1937 to discuss the concept of forming an interstate commission for the purposes of coordinating state marine fisheries activities along the Eastern Seaboard. Upon the Commission's establishment in 1940, New York served as its headquarters with Wayne Heydecker, New York State Regional Representative for the Council of State Governments, serving as the Commission's Secretary-Treasurer, a position he would hold for the next two decades. The Roosevelt Hotel itself played an important part in the Commission's history, serving as the meeting place for 11 out of the first 17 Annual Meetings. It's at the Roosevelt Hotel where Commissioners solidified their commitment to seek solutions that were in the best interests of their shared fishery resources.

> Our greatest strength is in our ability to work cooperatively for the benefit of the fisheries under our care and those that depend on these resources…

So now we find ourselves back at the Roosevelt Hotel 60 years later, dealing with many of the same issues: declining fish stocks, changing environmental conditions, and growing stakeholder demands. And, I'm here to tell you, as it was so many years ago and throughout the evolution of the Commission, we are all in this together. We are all inextricably connected and it's reflected in our shared interests and the challenges we face. Just look at the resources we manage. They show no loyalty to one region or state. They move up and down the coast, inshore and offshore. Filling the role of predators and prey, seeking optimal environmental conditions to maximize their survival, and striving to produce more offspring than are removed – all part of one big interconnected ecosystem. No one piece of it belongs to New York, or Maine, or North Carolina. And yet we divvy up the resources, each of us seeking the biggest piece of pie we can get. I don't blame us, I'm in there with the next guy trying to do what I think is right for our fishermen. But, in doing so, in our struggle to ensure that we get our fair piece, I think we can easily lose sight of the larger picture, of all the reasons why we all choose to be in fisheries management: our love of the ocean and its marine resources, and the deep desire to be effective stewards and ensure that these resources are available to those who want to use them now and over the long-run.

As your Chair, I see it as my responsibility to remind you why we are all here and why now, more than ever, we need to re-energize ourselves and recommit to our shared vision of sustainable Atlantic coastal fisheries. Our greatest strength is in our ability to work cooperatively for the benefit of the fishery resources under our care and those that depend on these resources – recreational anglers and the industries they support, commercial fishermen and processors, who enable consumers to purchase and eat fresh fish, as well as those who place value in the non-consumptive aspects of our coastal resources.

The issues before us are great. They include changing ocean conditions and their effect on species distribution and survival; reallocation of resources between recreational and commercial sectors, as well as between the states; increased fisheries/protected species interactions; responding to recent changes in recreational catch estimates; competing ocean uses; and the challenge of maintaining an engaged membership given the ebb and flow of veteran and new Commissioners, in addition to always present fiscal limitations. While the issues may seem daunting, they are not insurmountable. What is required is a renewed commitment by all of us to work through our challenges with respect for each other and the integrity of our process. When we stray from our intended goal, we need to remind ourselves to take a step back and refocus our energies for the common good. We also must remember to not get caught up in us versus them when we do not get what we want. Let's not lose sight of the fact that we are the Commission. What happens to one state ultimately impacts us all.

Fortunately, we have the continued support of Congress and our federal partners, and an outstanding staff to arm us with the needed resources and information to make informed, balanced decisions. And, we have each other – intelligent, dedicated, passionate, innovative stewards of our Atlantic coastal fisheries. Together, there is nothing we cannot accomplish.

It has been a great honor to serve as your Chair this past year. I am excited about the opportunities and challenges ahead and look forward to working with you all in the coming year."

New Stock Assessment Could Lead to Management Changes

Introduction

Until recently, the Atlantic herring stock had been considered healthy and fully rebuilt from a collapsed stock in the 1980s. However, the results of the 2018 benchmark stock assessment have raised new concerns about the Atlantic herring resource. While the stock remains not overfished and was not experiencing overfishing in the terminal year (2017) of the assessment, the assessment did show very low levels of recruitment over the past five years. These results will likely have management implications for the species as regulators work to prevent overfishing from occurring in the coming years. Diminished stock size and, in turn, lowered catch limits will also impact fisheries that rely on Atlantic herring as an important source of bait, such as American lobster, blue crab, tuna, and striped bass fisheries.

Life History

Atlantic sea herring is one of 200 species in the clupeid family, which includes menhaden, shad, and river herring. It inhabits coastal waters of the U.S. from Cape Hatteras, North Carolina through Labrador, Canada, and off the coast of Europe. Herring form the base of the food web as a forage species for many animals, from starfish and whelk to economically important fish such as haddock, cod, and flounder. Even the vast amount of eggs produced during spawning events serve as an important protein source for marine mammals, seabirds, and many fishes throughout the Mid-Atlantic and Northeast.

The species' entire life cycle occurs in the ocean and is closely associated with plankton. After hatching, the larvae drift passively along coastal currents, consuming eggs and larvae of copepods, barnacles, and other invertebrates. After the larvae herring metamorphose into juveniles (called sardines), they begin to gather in schools inhabiting shallow, inshore waters during the warmer months of the year. As they grow into adults, herring continue to feed on plankton. Feeding behavior consists of nightly vertical migrations following the zooplankton that inhabit deep waters by day and surface waters by night. Adults (age three and older) migrate south from summer/fall spawning grounds in the Gulf of Maine and Georges Bank to spend the winter in Southern New England and the Mid-Atlantic.

Herring spawn as early as August in Nova Scotia and eastern Maine, and during October and November in the southern Gulf of Maine, Georges Bank, and Nantucket Shoals. When temperatures are ideal, the ripe adult herring aggregate in massive shoals over habitats consisting of rock, gravel, or sand bottoms ranging from 50-150 feet deep. A single mature female can produce between 30,000 and 200,000 eggs in one spawning event. Schools can produce so many eggs the ocean bottom is covered in a dense carpet of eggs several centimeters thick. Eggs hatch in 10-12 days depending on water temperature.

Commercial Fisheries

The earliest herring fisheries in North America date back 450 years. Today, Atlantic herring is predominantly a commercially caught species with markets in the U.S. and Canada. Since 2000, the domestic ex-vessel value of commercial herring landings has averaged $30 million/year. The most common gears used to catch Atlantic herring are trawls (midwater and bottom) and purse seines. A small fixed-gear fishery continues in Maine.

Atlantic herring catch increased in the 1960s, peaking in 1968 at 477,767 mt (1.05 billion pounds), largely due to a foreign fishery that developed on Georges Bank. Catch declined in the 1980s, averaging 78,164 mt (172 million pounds). Landings in the 2000s were fairly stable around 113,358

Species Snapshot

Atlantic Herring
Clupea harengus

Management Unit: Maine through New Jersey

Common Names: Sea herring, sardine, sild, common herring, Labrador herring, sperling

Interesting Facts:

- Atlantic herring and other clupeid fish have exceptional hearing. They can detect sound frequencies up to 40 kilohertz, beyond the range of most fish. This allows schooling fish to communicate while avoiding detection by predatory fish.
- While most members of the clupeid family are typically 5.9-9.8 inches in length, the tarpon can grow up to 8 feet long and weigh up to 280 pounds.
- Fresh herring bait is considered premium product and demands the highest prices.
- You can find fresh herring in some high-end restaurants and fish shops. Herring is often canned, pickled, or smoked. The meat is off-white and soft. Small fish have a more delicate flavor than larger fish, which tend to taste oilier and pungent.

Age/Length at Maturity: 3 years/9.1 inches

Stock Status: Not overfished and not experiencing overfishing

THE SARDINE INDUSTRY: Washing, draining, and flaking herring at the sardine cannery, Eastport Maine. From a photograph by T.W. Smilie. Image (c) NOAA.

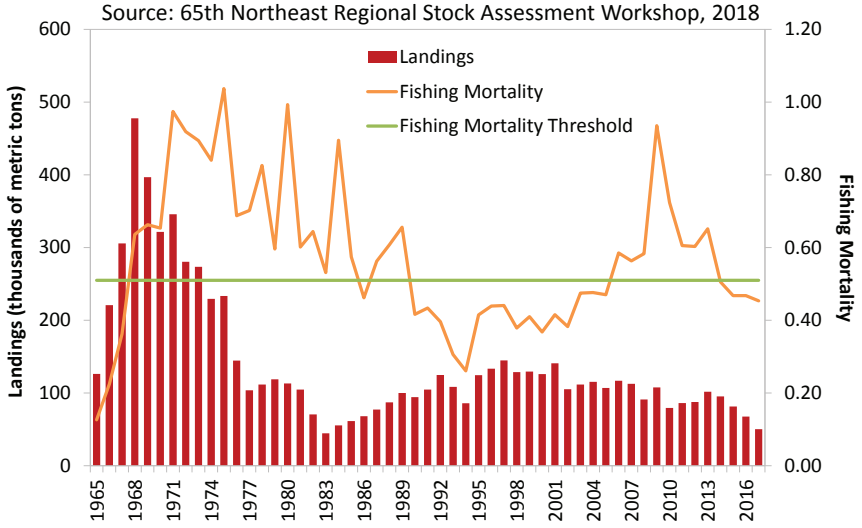
mt (250 million pounds), but have decreased over the past four years to 50,250 mt (111 million pounds) in 2017.

The herring resource was once primarily used for the canning industry, but now provides bait for important fisheries such as lobster, blue crab, tuna, and striped bass. The fish are also a valued commodity overseas where they are frozen and salted.

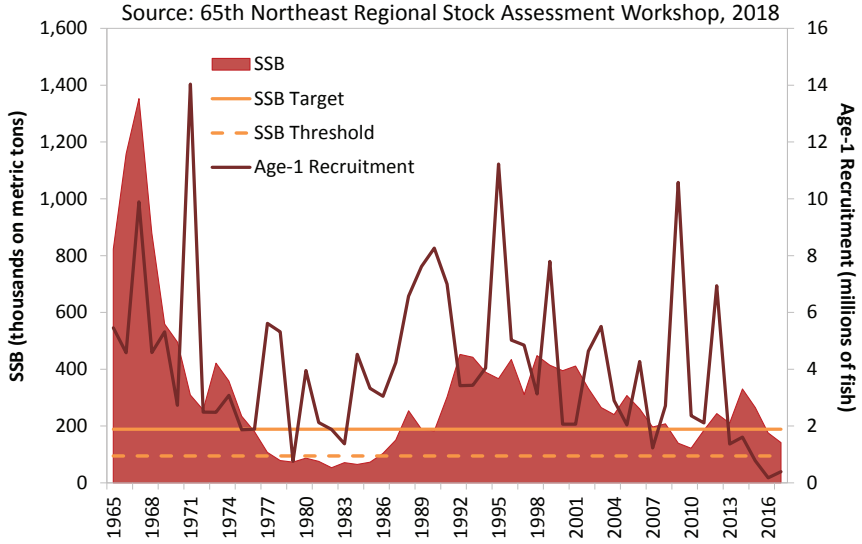
Stock Status

The 2018 benchmark stock assessment, conducted by the Northeast Fisheries Science Center, provided an updated picture of stock health. While Atlantic herring were not overfished and overfishing was not occurring in the terminal year (2017) of the assessment, the report highlighted concerns about trends in recruitment and spawning stock biomass (SSB). Recruitment, a measure of how many herring are born into the population, has been well below the time series average for the past five years. In particular, 2016 recruitment was the lowest on record at 1.7 million fish. While recruitment has been variable throughout time, recent and continuing low levels of recruitment indicate there will be fewer fish available to harvest in future years. SSB, the portion of the population that is capable of reproducing, has also declined in recent years. In 2017, SSB was estimated at 141,473 mt (312 million pounds). Fishing mortality has also decreased in recent years, with a 2017 level of 0.45, below the fishing mortality threshold of 0.51.

Atlantic Herring Commercial Landings
Source: 65th Northeast Regional Stock Assessment Workshop, 2018



Atlantic Herring Spawning Stock Biomass & Recruitment
Source: 65th Northeast Regional Stock Assessment Workshop, 2018



Atlantic Coastal Management

Atlantic herring is cooperatively managed by the Commission and the New England Fishery Management Council (Council). The Commission's fishery management program seeks to prevent overfishing, provide protection to spawning herring, and promote full utilization of herring catch. Both the Commission and Council use annual quotas, called a total allowable catch (TAC), to manage catch in four areas. Management of Atlantic herring includes conservation of its relatives, alewife and blueback herring, collectively known as river herring. River herring populations have declined and remained low in recent years. As a result, river herring and shad catch caps were implemented in order to minimize bycatch in the directed Atlantic herring fishery.

A key component of the Commission's Amendment 3 is the implementation of seasonal closures in the Gulf of Maine (GOM) to protect spawning herring. These closures use a modified GSI-based spawning monitoring system to track reproductive maturity and better align the timing of closures with the onset of spawning. To address the fact that spawning generally occurs earlier in the eastern GOM, as opposed to western GOM, the closures are implemented in three distinct areas at different times. At its most recent meeting, the Atlantic Herring Management Board initiated two addenda to strengthen the spawning protections in the GOM and consider establishing a spawning protection program in Area 3 (off of Cape Cod and Georges Bank). This was prompted by the results of the 2018 benchmark stock assessment.

In 2017, the Commission implemented Addendum I to Amendment 3 to establish management measures to stabilize the rate of catch in the Area 1A (inshore GOM) fishery and distribute the seasonal quota throughout Trimester 2 (June through September). The Addendum modifies the 'Days Out' program by adding management tools to the FMP, including a weekly harvester landing limit and potential restrictions on transfers-at-sea and carrier vessels. In addition, the Addendum allows state staff to access daily catch report data to better monitor landings in the fishery.

For more information, please contact Megan Ware, Fishery Management Plan Coordinator, at mware@asmfc.org or 703.842.0740.

Coastal Sharks

The Coastal Sharks Management Board approved Addendum V to the Interstate Fishery Management Plan (FMP) for Atlantic Coastal Sharks. The Addendum allows the Board to respond to changes in the stock status of coastal shark populations and adjust regulations through Board action rather than an addendum, ensuring greater consistency between state and federal shark regulations.

	Delaware Bay Origin Horseshoe Crab Quota (no. of crabs)	Total Quota**
State	**Male Only**	**Male Only**
Delaware	162,136	162,136
New Jersey	162,136	162,136
Maryland	141,112	255,980
Virginia*	34,615	81,331

*Virginia harvest refers to harvest east of the COLREGS line only
** Total male harvest includes crabs which are not of Delaware Bay origin.

Previously, the FMP only allowed for commercial quotas, possession limits, and season dates to be set annually through specifications. All other changes to commercial or recreational management could only be accomplished through an addendum or emergency action. In instances when addenda were initiated, the timing of when the addenda were completed and state implementation resulted in inconsistencies between state and federal shark regulations, particularly when NOAA Fisheries adopted changes through interim emergency rules.

Addendum V allows the Board to change a suite of commercial and recreational measures, such as recreational size and possession limits, season length, and area closures (recreational and commercial) in addition to the current specifications for just the commercial fishery, throughout the year when needed. Under this provision, if the Board chooses to adjust measures through Board action, the public will be able to provide comment prior to Board meetings, as well as at Board meetings at the discretion of the Board Chair. Additionally, the Board can still implement changes in shark regulations through an addendum.

In addition, the Board considered proposed federal 2019 Atlantic shark specifications. Similar to recent years, NOAA Fisheries is proposing a January 1 open date for all shark management groups, with an initial 25 shark possession limit for large coastal and hammerhead management groups, with the possibility of in-season adjustments. The Board will set the 2019 coastal shark specifications via an email vote after the final rule is published later this fall.

Addendum V is available at http://www.asmfc.org/uploads/file/5be5af89CoastalSharksDraftAddendumV_Oct2018.pdf and on the Commission's website (www.asmfc.org) on the Coastal Sharks webpage. For more information, please contact Kirby Rootes-Murdy, Senior Fishery Management Plan Coordinator, at krootesmurdy@asmfc.org or 703.842.0740.

Horseshoe Crab

The Horseshoe Crab Management Board approved the harvest specifications for horseshoe crabs of Delaware Bay origin. Under the Adaptive Resource Management (ARM) Framework, the Board set a harvest limit of 500,000 Delaware Bay male horseshoe crabs and zero female horseshoe crabs for the 2019 season. Based on the allocation mechanism established in Addendum VII, the above quotas were set for the States of New Jersey, Delaware, and Maryland and the Commonwealth of Virginia, which harvest horseshoe crabs of Delaware Bay origin.

The Board chose a harvest package based on the Delaware Bay Ecosystem Technical Committee's and ARM Subcommittee's recommendation. The ARM Framework, established through Addendum VII, incorporates both shorebird and horseshoe crab abundance levels to set optimized harvest levels for horseshoe crabs of Delaware Bay origin. The horseshoe crab abundance estimate was based on data from the Benthic Trawl Survey conducted by Virginia Polytechnic Institute (Virginia Tech).

This survey, which is the primary data source for assessing Delaware Bay horseshoe crab abundance for the past two years, as well as the ongoing benchmark stock assessment, has not been funded consistently in recent years. However, due to the efforts of three Senators and six Representatives – namely, Senators Chris Coons (D-DE), Tom Carper (D-DE), Cory Booker (D-NJ); and Representatives Frank Pallone (D-NJ), Frank LoBiondo (R-NJ), Lisa Blunt-Rochester (D-DE), Donald Norcross (D-NJ), Chris Smith (R-NJ), and Bill Pascrell (D-NJ) – and the support of NOAA Fisheries, funding for the survey was restored beginning in 2016. They have also requested that NOAA Fisheries incorporate the survey into the agency's annual budget.

Work is well underway on the 2019 Benchmark Stock Assessment and Peer Review, which will be presented to the Board in May 2019. For more information, please contact Dr. Michael Schmidtke, Fishery Management Plan Coordinator, at mschmidtke@asmfc.org or 703.842.0740.

Northern Shrimp

In response to the continued depleted condition of the northern shrimp resource, the Atlantic States Marine Fisheries Commission's Northern Shrimp Section extended the moratorium on commercial fishing through 2021. This three-year moratorium was set in response to the low levels of biomass and recruitment and the fact that, should recruitment improve, it would take several years for those shrimp to be commercially harvestable.

The 2018 Stock Assessment Update indicates the Gulf of Maine northern shrimp population remains depleted, with spawning stock biomass (SSB) at extremely low levels since 2013. SSB in

2018 was estimated at 1.3 million pounds, lower than SSB in 2017 (1.5 million pounds). Recruitment has also been low in recent years, with 2018 recruitment estimated at two billion shrimp. This is below the time series median of 2.6 billion shrimp. Fishing mortality has remained low in recent years due to the moratorium.

High levels of natural mortality and low levels of recruitment continue to hinder recovery of the stock. Predation contributes significantly to the natural mortality of northern shrimp and has been at high levels over the past decade. In addition, long-term trends in environmental conditions have not been favorable for the recruitment of northern shrimp. Ocean temperatures in the western Gulf of Maine have increased over the past decade, with warmer water temperature generally associated with lower recruitment indices and poorer survival during the first year of life. With ocean temperatures predicted to continue to rise, this suggests an increasingly inhospitable environment for northern shrimp in the Gulf of Maine.

Given this change in the environment and the lack of change in stock status despite the fishery being under a moratorium for the past five years, the Section debated current management approaches and if they are appropriate in the face of changing ocean conditions. Ultimately, the Section unanimously agreed to establish a working group to evaluate management strategies for northern shrimp given changes in species abundance, particularly as a result of changing ocean conditions. In February 2018, the Commission approved guidance that species management boards and sections could use to address shifts in species abundance and distribution. The Section will have the opportunity to use this guidance to determine if or what management changes should be made if the stock has no ability to recover.

While industry members advocated for re-opening the commercial fishery in order to evaluate the stock status and provide economic benefits to local fishermen, Technical Committee analysis showed there is little-to-no possibility of 2019 SSB being greater than it was in 2017, even in the absence of fishing. Given the low biomass of the stock, the Section did not establish a Research Set Aside; however, annual surveys including the summer shrimp survey and the Northeast Fisheries Science Center trawl survey will continue to collect important data on the stock.

The Section also approved Addendum I to the Interstate Fishery Management Plan for Northern Shrimp. The Addendum provides states the authority to allocate their state-specific quota between gear types in the event the fishery reopens.

Finally, the Section established a second working group to review the existing Gulf of Maine Summer Northern Shrimp Survey. This working group will evaluate ways to improve the reliability and efficiency of the survey, including shifting to greater commercial industry involvement in the collection of data. Transitioning the shrimp survey to a commercial platform would be one of the options considered by the working group.

For more information, please contact Megan Ware, Fishery Management Plan Coordinator, at mware@asmfc.org or 703.842.0740.

Spiny Dogfish

The Spiny Dogfish Management Board approved the following coastwide commercial quotas for the 2019-2021 fishing seasons (May 1-April 30): 20,522,832 pounds for 2019/2020; 23,194,835 pounds for 2020/2021; and 27,421,096 pounds for 2021/2022 (see below for state-specific allocations).

Spiny Dogfish State Allocations (in pounds) for the 2019-2021 Fishing Seasons

	Northern Region (ME-CT)	NY	NJ	DE	MD	VA	NC
Possession Limit	6,000	To be specified by the individual southern region states					
Allocation	58%	2.707%	7.644%	0.896%	5.92%	10.795%	14.036%
2019/20	11,903,243	555,716	1,568,900	183,893	1,214,957	2,215,484	2,880,640
2020/21	13,453,004	628,069	1,773,165	207,835	1,373,141	2,503,932	3,255,689
2021/22	15,904,236	742,507	2,096,248	245,704	1,623,336	2,960,166	3,848,898

* Any overages in the above quotas will be deducted from that region's or state's quota allocation in the subsequent year. Similarly, any eligible rollovers from one season can be applied to that region's or state's quota allocation the following year.

The quotas are consistent with the measures recommended to NOAA Fisheries by the Mid-Atlantic Fishery Management Council. The Board also established a 6,000 pound commercial trip limit for the northern region states of Maine through Connecticut, while New York through North Carolina have the ability to set state-specific trip limits based on the needs of their fisheries. The Commission's actions are final and apply to state waters (0-3 miles from shore). The Mid-Atlantic and New England Fishery Management Councils will forward their recommendations for federal waters (3 –200 miles from shore) to the NOAA Fisheries Greater Atlantic Regional Fisheries Administrator for final approval.

The quotas are based on the 2018 Stock Assessment Update, which indicates that while the population is not overfished and overfishing is not occurring, biomass has declined, requiring an approximate 46% reduction in the 2019-2020 quota to ensure that overfishing does not occur. The next benchmark stock assessment is currently scheduled for completion in 2021. For more information, please contact Kirby Rootes-Murdy, Senior Fishery Management Plan Coordinator, at krootes-murdy@asmfc.org or 703.842.0740.

ASMFC Seeks Input on Options for Summer Flounder, Scup and Black Sea Bass Management

The Commission's Summer Flounder, Scup and Black Sea Bass Management Board is seeking public comment on Draft Addenda XXXI and XXXII to the Summer Flounder, Scup and Black Sea Bass Fishery Management Plan (FMP). Draft Addendum XXXI and the Mid-Atlantic Fishery Management Council's complementary framework consider adding the following management options to the Summer Flounder, Scup, and Black Sea Bass FMP.

1. Conservation equivalency for the recreational black sea bass fishery
2. Conservation equivalency rollover for summer flounder
3. Transit provisions for Block Island Sound for recreational and/or commercial fisheries for all three species
4. Slot limits (not currently a management option in the Council's FMP)

The Draft Addendum aims to increase the suite of tools available for managing summer flounder, scup and black sea bass, as well as reduce inconsistencies between state and federal regulations. This action does not consider implementing black sea bass conservation equivalency or slot limits for any of the three species in 2019. Rather, the options would update the FMPs to allow these management tools to be used in future years.

Draft Addendum XXXII was initiated to establish new recreational management programs for summer flounder and black sea bass, as the current addenda under which the two fisheries are currently managed (Addenda XXVIII and XXX, respectively) expire at the end of 2018. The Draft Addendum proposes two options for each recreational fishery: (1) coastwide management (the default program for both species under the FMP), or conservation equivalency for summer flounder; and (2) setting measures through a specifications process.

The Draft Addendum seeks to address several challenges with the recreational management of summer flounder and black sea bass. Since the adoption of the FMP, shifts in abundance, distribution, and behavior of these two species have created challenges in constraining harvest to the coastwide recreational harvest limit (RHL) while providing fair and equitable access to fishermen throughout the species' ranges. In addition, the use of highly variable and inherently delayed annual harvest estimates to establish management measures for the subsequent year has led to regulatory instability, regulatory disparities, and frustration on the part of stakeholders.

Setting measures through specifications would be a procedural change, allowing regional management to reflect the current condition and distribution of the stocks and fisheries, and enabling measures to be established based on more complete harvest data rather than preliminary projections. This process would eliminate the need for measures to be established through addenda; instead, the Board would approve measures in the late winter or early spring each year, based on technical committee analysis of harvest estimates and other information on resource availability. Public input on specifications would be gathered by states through their individual public comment processes. For each species, the Draft Addendum also includes proposed standards and guiding principles to structure how measures are set in order to provide fair and equitable access to the resource, and increase regulatory stability.

States from Massachusetts through Delaware are conducting public hearings on the Draft Addenda throughout November; the details of those hearings can be found at http://www.asmfc.org/calendar/. Interested groups are encouraged to provide input on Draft Addenda XXXI and XXXII either by attending state public hearings or providing written comment. Draft Addenda are available at http://www.asmfc.org/files/PublicInput/SF_Scup_BSB_DraftAddendumXXXI_PublicComment_Oct2018.pdf and http://www.asmfc.org/files/PublicInput/SF_BSB_DraftAddendumXXXII_PublicComment_Oct2018.pdf. They can also be accessed on the Commission website (www.asmfc.org) under Public Input. Public comment will be accepted until 5:00 PM (EST) on November 29, 2018 and should be forwarded to Caitlin Starks, Fishery Management Plan Coordinator, 1050 N. Highland St., Suite 200 A-N, Arlington, Virginia 22201; 703.842.0741 (fax) or at comments@asmfc.org (Subject line: Draft Addendum XXXI and XXXII).

Boy with scup by Mark Terciero

Photo courtesy of open boat Laura Lee

Living shorelines, or soft shorelines, are an approach to shoreline stabilization that preserves natural sand edge or vegetated shoreline. An increasingly popular management strategy along the Atlantic coast, living shorelines not only control erosion but create environmentally desirable features, including habitat and vegetated buffers that improve water quality and reduce the effects of upland runoff. This type of shoreline protection is mostly used along shorelines fronting bays, sounds, and in other estuarine settings, as beach and inlet systems experience energy levels that are higher than those for which natural materials can successfully be employed. Unlike traditional bulkhead or revetment approaches to shoreline protection, living shorelines also tend to dissipate rather than reflect wave energy.

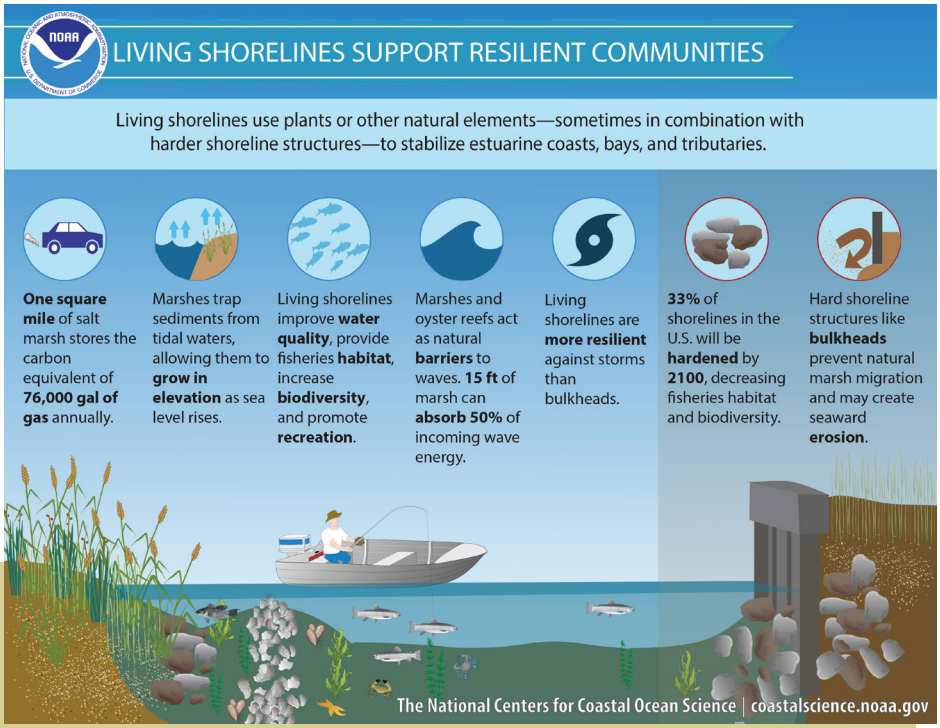
NOAA defines living shorelines as: "A shoreline management practice that provides erosion control benefits; protects, restores, or enhances natural shoreline habitat; and maintains coastal processes through the strategic placement of plants, stone, sand fill, and other structural organic materials." These "green" erosion control installations are often compared to "gray" infrastructure like seawalls and revetments. Unlike their gray alternatives, living shorelines integrate habitats across the shoreline landscape, by promoting the land-water continuum, provide enhanced habitat for fish and wildlife, naturally adapt to changing sea levels in the face of climate change, and enhance the natural beauty of their adjacent properties.

As sea level rise continues, armoring shorelines against wave energy and erosion will continue to be important to those living along coastal waters. Using living shorelines to accomplish this will ensure connections remain established between the uplands and estuaries to maintain or even improve the health of the important fish habitats they sustain.

In 2010, the Commission published *Living Shorelines: Impacts of Erosion Control Strategies on Coastal Habitats*, with the purpose of providing resource managers and the general public with a concise comparative discussion of the benefits of living shorelines, and a case study of successful projects to use for reference within their own programs.

Since then, there has been a growing body of literature and lessons learned. This new information has been incorporated into a factsheet that features selected case studies, websites, and references in support of the application of best practices moving forward. The factsheet will be available on the Commission's website at http://www.asmfc.org/habitat/program-overview (under Sedimentation Management) by the end of the year. A copy of the full Report can be found at - http://www.asmfc.org/uploads/file/hms10LivingShorelines.pdf.

For more information, please contact Lisa Havel, Habitat Committee Coordinator, at lhavel@asmfc.org or 703.842.0840.



The Living Shorelines Act

The importance of living shorelines has also gained the attention of federal legislators, with Representative Frank Pallone (D-NJ-6) and Senator Chris Murphy (D-CT) having introduced the Living Shorelines Act (H.R. 4525 and S. 3087). While the bills are unlikely to advance during this year's lame duck session, both Members of Congress intend to reintroduce the Living Shorelines Act in 2019. The Living Shorelines Act would authorize $25 million per year to establish a new NOAA grant program for states, local governments, and NGOs to create living shorelines. As drafted, the Living Shorelines Act would award a 1:1 federal funding match to implement large- and small-scale, climate-resilient living shoreline projects based on a project's potential to protect communities, the environmental conditions of the site, the ecological benefits of the project, and a project's ability mitigate erosion and flooding, absorb coastal storms, and sustain coastal ecosystems. Innovation in the use of natural materials to protect coastal communities, habitats, and natural system functions is encouraged and the Living Shorelines Act seeks to prioritize projects in areas with a history of storms and coastal inundation or erosion.

For more information, please contact Deke Tompkins, Legislative Executive Assistant, at dtompkins@asmfc.org.

ACCSP: What Do You Do?

Fisheries Management and Data Collection Applications

Meet our Software Team: Team Lead Karen Holmes and Senior Developer Nico Mwai. Together, they manage the Standard Atlantic Fisheries Information System, a fisheries data collection system used by thousands of dealers and harvesters all along the Atlantic coast.

We asked them a few questions to learn more about what they do at ACCSP…

1. How would you describe the Software Team's role at ACCSP? What does your day-to-day look like?

The Software Team is responsible for the fisheries management and data collection applications in use by ASMFC state members and ACCSP partners. Applications include all Standard Atlantic Fisheries Information Systems (SAFIS) applications such as Electronic Dealer Reporting (eDR) and Electronic Trip Reporting (eTRIPs), as well as specialized applications for lobster management, highly migratory species reports, and state eLogbooks.

Requirements for applications are generally provided by partners based on state/federal regulations and it is the responsibility of the Software Team to address each of these requirements within the framework of an application. An example might include a state requirement to report on shellfish to its Department of Public Health. This would require the team to develop an understanding of the new fields required, how those fields might impact an application and database, and the how they can be incorporated in a way that makes sense to the end user. The Software Team works closely with partners and end users to identify solutions and see them through to completion.

A master plan of development is identified and reviewed each year during the Information Systems Committee's annual meeting. Short-term goals might include an enhancement to an existing application, such as the ability to report target species in eTRIPS. Long-term goals are multi-year projects like the SAFIS redesign.
On a good day, a Software Team member may spend hours coding and/or analyzing and reviewing new requests. The overall goal and vision of the Software Team is to render the challenging business practices spread over multiple partners and systems into a responsible and complete fisheries management tool that will help dealers, fishermen, and state/federal staff.

2. How has fisheries data collection evolved since you started with ACCSP?

The Software Team has witnessed a growing awareness - both among ACCSP partners and the public at large - of the importance of detailed, timely fisheries management data. Consequently, the goal of ACCSP software applications is to support more robust data collection. Data collected today have a higher degree of specificity than they did ten or fifteen years ago. For example, software is currently being coded to include exacting information on gears and attributes and latitude/longitude are being used to determine areas fished.

3. What are the big projects you're currently working on?

A multi-year project to redesign the SAFIS applications and database is currently underway. This project, which will touch each of the existing SAFIS applications as well as the underlying database structures, aims to produce a more robust fisheries data collection system able to transition data to and from external systems and partners in a cohesive, one-stop repository. It will incorporate business rules and regulations from all ACCSP partners and will impact all current applications. It is the role of the Software Team to understand the requirements and business rules needed to guide development. It is an ambitious goal, and we are on our way.

4. Are there any new technologies you hope to incorporate into ACCSP's systems in future?

The Software Team is looking to standardize its data transfer processes using REST Application Program Interfaces (APIs). APIs are code that enable two software programs to talk to one another, sort of like how telephones allow people to talk to one another. A Representational State Transfer, or REST, API is a type of API that allows the exchange of information between computer systems by way of the Internet.

When one API initiates a communication, the REST API is able to respond automatically and a transfer of information can occur. This would be like needing to enter a 10-digit code from your phone to reach another—when the format is followed, the receiving phone activates (rings) automatically, and the two users can now communicate. That is, provided the users are speaking the same language. In the same way, two APIs must communicate using the same language so that information can be exchanged between the two. ACCSP's REST APIs will provide data in a data "language" called JSON, or JavaScript Object Notation.

By facilitating the automated transfer of data between systems, these REST APIs in JSON will allow for the creation of more useful 3rd party tools like mobile applications and remote servers.

ACCSP is also undergoing a security audit that will likely lead to an increased use of two-factor authentication via Authenticator apps and USB security keys.

2018 Midterm Elections Update

The 2018 midterm elections on the Atlantic coast featured contests for eleven governors, eleven U.S. Senators, and every Member of the U.S. House on November 6, 2018. All nine of ASMFC's Legislative Commissioners on ballots won their election contests.

Governor

Eleven Atlantic coast states held elections for governor. Seven incumbents sought reelection and won. In the remaining four states of Maine, Connecticut, Florida and Georgia, new governors will be sworn-in. However, Georgia's contest between Stacey Abrams (D) and Brian Kemp (R) to replace term-limited Governor Nathan Deal (R) remains contested.

ASMFC Legislative Commissioners/ State Legislatures

Four Atlantic state legislative chambers flipped from Republican to Democratic majorities: Maine's Senate, New Hampshire's House and Senate, and New York's Senate. In the Connecticut Senate, Democrats won control and broke last session's 18-18 split majority.

U.S. Senate

U.S. Senate election contests were held in eleven Atlantic coast states, with the incumbent seeking reelection and winning in ten. The Florida contest between incumbent Bill Nelson (D) and Sen Rick Scott (R) is still being contested. Senate Republicans picked up at least one seat and hold a 51-47 majority, which includes Senators Bernie Sanders (I-VT) and Angus King (I-ME) who caucus with Democrats.

U.S. House of Representatives

In the U.S. House, nearly a quarter (104) of the chamber's membership from the 115th Congress won't return next year (the most since 1992). Democrats control a 232-198 advantage with four races still undecided. Member and staff changes on the House Natural Resources and Appropriations Committees will have an immediate impact on federal fisheries policy and appropriations.

For more information, please contact Deke Tompkins, Legislative Executive Assistant, at dtompkins@asmfc.org.

*published 11/16/2018

2018 Elections for Governor				
State	**Winner**	**Party**	**Result**	**Flip**
Maine	Janet Mills	D	First term	Y
New Hampshire	Chris Sununu	R	Reelected	N
Massachusetts	Charlie Baker	R	Reelected	N
Rhode Island	Gina Raimondo	D	Reelected	N
Connecticut	Ned Lamont	D	First term	N
New York	Andrew Cuomo	D	Reelected	N
Pennsylvania	Tom Wolf	D	Reelected	N
Maryland	Larry Hogan	R	Reelected	N
South Carolina	Henry McMaster	R	Reelected	N
Georgia	Stacey Abrams (D) OR Brian Kemp (R)		First term	
Florida	Ron DeSantis	R	First term	N
ASMFC Legislative Commissioners				
State	**Winner**	**Party**	**Result**	
New Hampshire	Sen David H. Watters	D	Reelected	
Massachusetts	Rep Sarah Peake	D	Reelected	
Rhode Island	Sen Susan Sosnowski	D	Reelected	
Connecticut	Sen Craig A. Miner	R	Reelected	
New York	Sen Philip M. Boyle	R	Reelected	
Delaware	Rep William J. Carson	D	Reelected	
Maryland	Del Dana Stein	D	Reelected	
North Carolina	Rep Bob Steinburg	R	Elected to Senate	
Florida	Rep Thad Altman	R	Reelected	
2018 for U.S. Senate Races				
State	**Winner**	**Party**	**Result**	**Flip**
Maine	Angus King	I	Reelected	N
Massachusetts	Elizabeth Warren	D	Reelected	N
Rhode Island	Sheldon Whitehouse	D	Reelected	N
Connecticut	Chris Murphy	D	Reelected	N
New York	Kirsten Gillibrand	D	Reelected	N
New Jersey	Bob Menendez	D	Reelected	N
Pennsylvania	Bob Casey Jr.	D	Reelected	N
Delaware	Tom Carper	D	Reelected	N
Maryland	Ben Cardin	D	Reelected	N
Virginia	Tim Kaine	D	Reelected	N
Florida	Rick Scott (R) OR incumbent Bill Nelson (D)			
2018 Elections for U.S. House of Representatives				
State	**Winner**	**Party**	**Result**	**Flip**
ME-02	Jared Golden	D	First Term	Y
NH-01	Chris Pappas	D	First term	N
MA-03	Lori Trahan	D	First term	N
MA-07	Ayanna Pressley	D	First term	N
CT-5	Jahana Hayes	D	First term	N
NJ-02	Jeff Van Drew	D	First term	Y
NJ-03	Andy Kim	D	First term	Y
NJ-07	Tom Malinowski	D	First term	Y
NJ-11	Mikie Sherrill	D	First term	Y
VA-02	Elaine Luria	D	First term	Y
VA-10	Jennifer Wexton	D	First term	Y
SC-01	Joe Cunningham	D	First term	Y
FL-26	Debbie Mucarsel-Powell	D	First term	Y
FL-27	Donna Shalala	D	First term	Y

ROY W. MILLER continued from page 1

Roy (center) with past Award recipients (from left): Pat Augustine, Ritchie White, David Borden and Jack Travelstead

the Governor's appointment and continues to serve to this day without fail. As Governor Appointee, Mr. Miller continues to chair management boards and has been a regular visitor to Capitol Hill, keeping staffers apprised of important developments in Delaware and at the Commission. At one such meeting with former Congressman Carney's staff, Mr. Miller expressed his concern about funding shortfalls that resulted in the discontinuance of the Mid-Atlantic Horseshoe Crab Trawl Survey. That meeting and others that followed ultimately led to the restoration of the survey's funding in 2016. The survey is now supported by Senators and Representatives throughout the Mid-Atlantic; the survey's third consecutive year was completed this October.

Throughout his four decades of service, Mr. Miller has distinguished himself by his dedication to the Commission's management process. An insightful and respectful debater, and one of the most collegial Commissioners, Mr. Miller has consistently sought compromise instead of contention. These traits, combined with his long and meritorious record of accomplishments and dedication to sustainable fisheries management, make him a most worthy award recipient.

The Commission instituted the Hart Award in 1991 to recognize individuals who have made outstanding efforts to improve Atlantic coast marine fisheries. The Hart Award is named for one of the Commission's longest serving members, Captain David H. Hart, from the State of New Jersey, who dedicated himself to the advancement and protection of marine fishery resources.

ROY COOPER
Governor
MICHAEL S. REGAN
Secretary
STEPHEN W. MURPHEY
Director

Feb.6, 2019

MEMORANDUM

TO: Marine Fisheries Commission

FROM: Chris Batsavage, Special Assistant for Councils

SUBJECT: Mid-Atlantic Fishery Management Council Meeting Summary-Dec. 10-13, 2018

Issue
This memo informs the Marine Fisheries Commission of the issues discussed and actions taken by the Mid-Atlantic Fishery Management Council.

Findings
- The memo highlights management actions of particular interest to the Marine Fisheries Commission.
- Additional information about the meeting can be found in the Mid-Atlantic Fishery Management Council meeting report and news release in the briefing book.

Action Needed
For informational purposes only, **no action is needed at this time.**

Overview
The Mid-Atlantic Fishery Management Council met on Dec. 10-13, 2018 in Annapolis, MD. The council met jointly with the Atlantic States Marine Fisheries Commission's Summer Flounder, Scup, and Black Sea Bass Management Board to discuss several topics related to management of summer flounder, scup, and black sea bass. Highlights of the management actions taken by the council are discussed below.

Summer Flounder Commercial Issues Amendment
The council and board moved to postpone final action on the Summer Flounder Commercial Issues Amendment until their joint February 2019 meeting, but that meeting was recently cancelled due to the ongoing federal government shutdown. The public comments received on commercial allocations were divided, so there was not an option in the amendment that would satisfy everyone. A motion was made to allow states to submit additional allocation options for consideration at the next meeting, but it narrowly failed. However, this motion could be made again at a subsequent meeting. As such, it is uncertain when final action will occur and if so, what preferred options will be selected by the council and board.

2019 Recreational Summer Flounder Management Measures
The council and board delayed setting 2019 recreational summer flounder management measures until their February 2019 meeting due to the timing of the benchmark stock assessment for this species. However, the council's February meeting was cancelled, and the stock assessment results will not be ready next month due to the ongoing federal government shutdown. The council and board need the stock assessment results to determine the most appropriate management measures.

2019 Recreational Black Sea Bass Management Measures
The council and board recommended maintaining the 2018 federal waters recreational management measures in 2019 north of Cape Hatteras (May 15-Dec. 31 open season, 12.5-inch minimum size limit and a 15-fish possession limit). The council and board also recommended that if state waters regulations do not constrain harvest to the recreational harvest limit, then the federal waters regulations north of Cape Hatteras will be a May 15 – Sept. 15 open season, 14-inch minimum size limit and a 5-fish possession limit. States also have the option to open their recreational black sea bass fishery in February with a 12.5-inch minimum size limit and 15-fish bag limit as long as they modify their regulations later in the year to account for the harvest in February. North Carolina elected to open the recreational black sea bass season north of Cape Hatteras in February and will delay reopening the season in May to account for the harvest.

Summer Flounder, Scup, and Black Sea Bass Framework on Conservation Equivalency, Block Island Sound Transit, and Slot Limits
The council and board took final action on a framework and addendum that allows conservation equivalency (state or region-specific management) for black sea bass starting in 2020, slot limits for the recreational summer flounder and black sea bass fisheries, and federal waters transit in Block Island Sound (Rhode Island) when state and federal regulations for summer flounder, scup and black sea bass differ. Conservation equivalency means that federal regulations are waived for the state regulations once NOAA Fisheries determines that the state regulations are equivalent to coast wide regulations—this has been in place for summer flounder since 2001. Allowing slot limits for the recreational summer flounder and black sea bass fisheries include the use of regular slot limits, split slot limits, and trophy fish. However, these are additional management tools that may not be implemented any given year.

Upcoming Meeting
The next regularly scheduled meeting of the Mid-Atlantic Fishery Management Council on Feb. 11-14 at the Hilton Virginia Beach Oceanfront in Virginia Beach, VA was cancelled due to the ongoing federal government shutdown. The meeting was tentatively rescheduled for March 6-7 at the same location.

December 2018 Council Meeting Summary

December 10-13, 2018

Annapolis, Maryland

The following summary highlights actions taken and issues considered at the Mid-Atlantic Fishery Management Council's December 2018 meeting in Annapolis, MD. Presentations, briefing materials, and webinar recordings are available on the Council website at www.mafmc.org/briefing/december-2018.

Summer Flounder, Scup, and Black Sea Bass 2019 Recreational Specifications

The Council met jointly with the Atlantic States Marine Fisheries Commission's Summer Flounder, Scup, and Black Sea Bass Board (Board) to develop recreational specifications for summer flounder, scup, and black sea bass for 2019.

Black Sea Bass

The Council and Board reviewed recent recreational fishery performance and recommendations from the Monitoring Committee, Advisory Panel, and staff for 2019 recreational black sea bass management measures. To achieve the 2019 **recreational harvest limit of 3.66 million pounds**, the Council and Board agreed to maintain status quo recreational management measures in federal waters. These include a **12.5-inch total length minimum fish size**, a **15 fish possession limit**, and a **May 15 - December 31 open season**. The Council and Board also agreed that if the states do not take appropriate action to ensure harvest does not exceed the 2019 recreational harvest limit, a set of backstop measures including a 14 inch minimum fish size, a 5 fish possession limit, and a May 15 - September 15 open season should be implemented in federal waters and in all state waters from Maine through North Carolina, north of Cape Hatteras. The Board will approve proposals for state measures during their February 2019 meeting. States have the option of opening their recreational black sea bass fisheries in state and federal waters from February 1-28, 2019 with a 12.5 inch minimum fish size and 15 fish bag limit.

Scup

The Council and Board reviewed recent recreational fishery performance and recommendations from the Monitoring Committee, Advisory Panel, and staff for 2019 recreational scup management measures. To achieve the 2019 **recreational harvest limit of 7.37 million pounds**, the Council and Board agreed to maintain status quo recreational management measures in federal waters. These include a **9-inch total length minimum fish size**, a **50 fish possession limit**, and a **year-round open season**. The Board voted to continue their regional approach to recreational scup management in state waters. The Board will approve proposals for state measures during their February 2019 meeting.

Summer Flounder

The Council and Board reviewed recent recreational fishery performance for summer flounder, and a planned schedule for reviewing and responding to the recent benchmark stock assessment. This assessment was peer reviewed in November 2018, and the assessment report will be finalized in early 2019. Due to this timing, the Council and Board will delay adopting 2019 recreational management measures until their joint February 2019 meeting in Virginia Beach, VA, where they will also consider revisions to the 2019 summer flounder recreational harvest limit.

Summer Flounder, Scup, and Black Sea Bass Framework on Conservation Equivalency, Block Island Sound Transit, and Slot Limits

After reviewing public comments and a draft impacts analysis, the Council and Board took final action on a joint framework and addendum for summer flounder, scup, and black sea bass. They agreed to allow use of conservation equivalency in the recreational black sea bass fishery in future years, starting in 2020. The Board and Council will annually decide whether to use conservation equivalency for black sea bass, which would allow federal waters recreational management measures to be waived and instead require anglers to abide by the measures of the state where they land their catch. They also recommended that non-federally permitted recreational and commercial vessels be allowed to transit federal waters in Block Island Sound while in possession of summer flounder, scup, and black sea bass legally harvested from state waters. They recommended that such transit be allowed in the same area as the existing striped bass transit zone. Lastly, the Council agreed to modify their Summer Flounder, Scup, and Black Sea Bass Fishery Management Plan to allow for a maximum size limit to be used in the recreational fisheries for summer flounder and black sea bass. This will allow for the use of regular slot limits, split slot limits, and trophy fish. It is important to emphasize that decisions regarding black sea bass conservation equivalency and slot limits provide additional "tools in the toolbox" and do not implement these measures for any particular fishing year.

Summer Flounder Commercial Issues Amendment

The Council and Board moved to postpone final action on the Summer Flounder Commercial Issues Amendment until their joint February 2019 meeting. The groups considered a motion that would have established a deadline for states to submit proposals for additional commercial allocation options, to be considered at the February meeting; however, this motion did not pass. The Council and Board then voted to postpone selecting preferred alternatives for all amendment issues (revisions to FMP objectives, federal permit requalification, commercial allocation, and landings flexibility framework provisions) until February. Additional information about this decision is available here.

2019 Stock Assessment and Catch Limit Specification Timing

The Council and Board discussed potential timelines for the scheduled stock assessments and the catch limit specification setting process in 2019 for summer flounder, scup, black sea bass, and bluefish. At their joint meeting in February 2019, the Council and Board will receive the results of the 2018 peer review of the summer flounder benchmark stock assessment and will recommend revised 2019 commercial and recreational catch limits and set new specifications for 2020-2021. Operational stock assessment updates are scheduled in 2019 for scup, black sea bass, and bluefish. These operational assessment updates will incorporate recent survey information, commercial catch (harvest and discards) data and the revised time series of recreational catch data from the Marine Recreational Information Program (MRIP). The Council and Board agreed to delay the completion of these operational assessment updates to ensure the most recent information available (i.e. through 2018) will be incorporated to help inform stock status and set specifications. Under the agreed-to schedule, the operational assessment updates and peer review will take place in July 2019, and the Council and Board will set new 2020-2021 commercial and recreational catch limits for all three species in October 2019.

Revised Stock Assessment Process

The Northeast Fisheries Science Center (NEFSC) updated the Council and Board on recently approved changes to the stock assessment process and long-term scheduling for Mid-Atlantic and New England stocks. After two years of development, these changes were approved by the Northeast Regional Coordinating Council (NRCC), whose primary responsibility is to set stock assessment priorities and schedules and consists of leadership from the Mid-Atlantic and New England Councils, the Atlantic States Marine Fisheries Commission (ASMFC), the Greater Atlantic Regional Fisheries Office (GARFO), and the NEFSC. This new process will improve the quality of stock assessments in the region, will allow for greater flexibility and improvements to stock assessments within

a defined process, and will provide for a more strategic and longer-term planning process for research and staffing demands.

Summer Flounder Management Strategy Evaluation (MSE) Presentation

Dr. Gavin Fay (University of Massachusetts Dartmouth) and Dr. Jason McNamee (RI DEM Division of Marine Fisheries) presented an interim report on their Council-funded Management Strategy Evaluation (MSE) to test potential outcomes of different management approaches for the recreational summer flounder fishery. A simulation model is being developed to demonstrate the relative value of an F-based management approach to developing recreational fishing measures compared to the typical approach of evaluating prior year performance and modifying measures annually to constrain recreational harvest to the annual limit. The MSE will also evaluate the effects of accounting for uncertainty in the recreational estimates when adjusting recreational measures. A final report from this project is expected in late winter 2019.

Black Sea Bass Amendment and Review of Progress on ASMFC Strategic Plan for Black Sea Bass

The Council and Board reviewed past discussions related to an amendment to the black sea bass FMP, as well as a strategic plan developed by Board members for reforming black sea bass recreational management. The Board's strategic plan addresses broad issues for black sea bass recreational management, including annual variability in management measures and equity in regional harvest opportunities. The Council and Board agreed that initiation of a joint black sea bass amendment is not needed at this time. They instead agreed to form a working group of Monitoring and Technical Committee, Council, and Board members to further develop and analyze potential approaches for improving stability in recreational management measures from year to year.

Risk Policy Framework: Next Steps

Dr. Doug Lipton (NOAA Fisheries) and Dr. Cyrus Teng (University of Maryland) provided the Council with the final results of a management strategy evaluation (MSE) that analyzed the economic impacts of different risk policy harvest control rules in the summer flounder fishery. The results indicate statistically significant differences in the total net economic benefits between the different control rule alternatives that were evaluated. These differences are highly influenced by the starting condition of the summer flounder biomass with lower catch and, therefore, lower net economic benefit for some harvest control rules when stock biomass is below the biomass at maximum sustainable yield (B_{MSY}). The Council then discussed potential next steps to complete the risk policy framework action that was initiated in 2017. The Council decided to re-evaluate and reconsider the control rule alternatives, both existing and potentially new alternatives, with the results from all available analyses that consider both biological and economic factors. It is anticipated that the Council will take final action on the risk policy framework in 2019. Also scheduled for 2019, as part of the risk assessment review, the Council will review and provide feedback on a decision document the Council's Scientific and Statistical Committee (SSC) would use when defining the appropriate level of uncertainty to be applied to the Overfishing Limit (OFL).

Collaborative Research Update

The Council and Board received a report and meeting summary as a result of the Research Steering Committee webinar held on November 27, 2018. The report detailed the Committee requests for staff and recommendations to the Council. Through consensus, the Council recommended that staff formalize the "program approach," which will detail how the program will follow steps from setting priorities to utilizing project results in a transparent document that defines the role of the Research Steering Committee and that RSA Program Review/Development be added to possible additions in the 2019 Implementation Plan.

Law Enforcement Workshop Report

The Council received a report on the Law Enforcement/For-Hire Workshop held November 13-14, 2018. This workshop addressed several topics, including: (1) Operator versus angler (client) responsibility for fisheries

violations that occur on for-hire vessels, (2) issues related to the sale of fish by private recreational anglers (particularly golden tilefish and tunas); (3) complexity of fishing regulations impacting enforceability. The Council reviewed a summary of recommendations organized under the categories of HMS Permitting, Data Reporting, and Law Enforcement. After some discussion, the Council tasked the Law Enforcement Committee with reviewing the workshop findings and developing formal recommendations for Council consideration at the February 2019 meeting.

Atlantic Large Whale Take Reduction Team Presentation

Dr. Michael Asaro (NOAA Fisheries Greater Atlantic Regional Office) presented an update on efforts to reduce incidental entanglement of North Atlantic right whales. The population of North Atlantic right whales has been in decline since 2010. Recent evidence indicates that the population is experiencing a low rate of reproduction, longer calving intervals, continued mortality from vessel and fishing gear interactions, changes in prey availability, and increased transboundary movement and risk. A number of measures are already in place to reduce the level of serious injury and mortality of large whales in commercial gillnet and trap/pot fisheries. Dr. Asaro provided an overview of proposals recently developed by the Atlantic Large Whale Take Reduction Team (ALWTRT) to further reduce incidental entanglement of North Atlantic right whales. The ALWTRT will meet in March 2019 to develop recommendations for NOAA Fisheries to modify the Atlantic Large Whale Take Reduction Plan.

2019 Implementation Plan

The Council reviewed and approved an implementation plan for 2019. The implementation plan lists activities and priorities for the coming year and is linked to the Council's strategic plan. The final approved plan will be posted at www.mafmc.org/strategic-plan.

Next Council Meeting

Monday, February 11, 2019 – Thursday, February 14, 2019

Hilton Virginia Beach Oceanfront
3001 Atlantic Avenue
Virginia Beach, VA 23151
757-213-3000

MID-ATLANTIC
FISHERY MANAGEMENT COUNCIL

PRESS RELEASE

FOR IMMEDIATE RELEASE
December 18, 2018

PRESS CONTACT: Mary Clark
(302) 518-1143

Final Action on Summer Flounder Commercial Issues Amendment Postponed Until February 2019

During a joint meeting last week in Annapolis, Maryland, the Mid-Atlantic Fishery Management Council (Council) and Atlantic States Marine Fisheries Commission's Summer Flounder, Scup, and Black Sea Bass Board (Board) voted to postpone final action on the Summer Flounder Commercial Issues Amendment until their next joint meeting in February 2019.

The amendment considers several potential changes to the management of the commercial summer flounder fishery and proposes modifications to the fishery management plan goals and objectives for summer flounder.

Discussion during the meeting focused predominantly on options in the amendment that could modify allocations of the commercial summer flounder quota to the states. The current commercial allocations were last modified in 1993 and are perceived by some as outdated given their basis in 1980-1989 landings data. The amendment proposes three sets of alternatives for modifying the current state-by-state allocations. After reviewing public comments on these options, the administrative Commissioner from New York introduced a motion that would have allowed states to submit additional commercial quota allocation options for discussion in February 2019. While some Council and Board members offered support for the motion, others felt that it was too late in the process to introduce new alternatives and that the existing options adequately address the purpose of the amendment. After a lengthy discussion, the motion was defeated due to lack of majority from the Council.

Given the limited time available to discuss the remaining issues addressed in the amendment, the Council and Board voted to postpone final action until their next joint meeting, to be held February 11-14, 2019 in Virginia Beach, VA. Additional information about this action is available at: http://www.mafmc.org/actions/summer-flounder-amendment.

Questions? Contact Kiley Dancy, Fishery Management Specialist, kdancy@mafmc.org, (302) 526-5257.

ROY COOPER
Governor
MICHAEL S. REGAN
Secretary
STEPHEN W. MURPHEY
Director

Feb. 6, 2019

MEMORANDUM

TO: N.C. Marine Fisheries Commission

FROM: Steve Poland, Executive Assistant for Councils

SUBJECT: South Atlantic Fisheries Management Council Meeting Summary Dec. 3 – 7, 2018

Issue
This memo is to update the Marine Fisheries Commission on issues discussed and actions taken by the South Atlantic Fisheries Management Council with attentions to items of relevance to the state of North Carolina.

Findings
- The council partially approved Regulatory Amendment 26 (Recreational Visioning Amendment) which modifies the current 20-fish aggregate bag limit to include no more than 10-fish per species and removes the size limit of three deepwater snapper species.
- Delayed action on Regulatory Amendment 30 (Red Grouper rebuilding plan) until the Science and Statistical Committee can provide recommendations on the Allowable Biological Catch* of the species.
- The Dolphin Wahoo Committee reviewed diet information and considered a request from the Mid-Atlantic Fisheries Management Council to manage some forage species under this plan.
- The council began work on Dolphin Wahoo Amendment 10 by selecting potential items for inclusion that include bag limit sales of fish and reduction in the recreational vessel limit.
- Further information about these findings and other issues that the council discussed can be found in the council meeting report in the briefing book, proceeding this memo.

Action Needed
For informational purposes only, **no action is needed at this time.**

Overview
The South Atlantic Fisheries Management Council met on Dec. 3 – 7, 2018 in Kitty Hawk, NC. Highlights of the discussions and management actions taken by the council are detailed below.

Recreational Visioning Amendment
Regulatory Amendment 26 (Recreational Visioning Amendment) contains actions that reorganize the existing aggregate bag limits to better reflect the species composition of a recreational trip. The council reviewed selected preferred alternatives and considered public

comment received at the meeting before taking final action on the amendment. The North Carolina delegation took issue with the selected preferred alternative or Action 2 which would add a January – February component to the May – August deepwater species season. Concern was raised that the addition of the January – February season risked an early closure by allowing Florida access to the resource during a time of the year where North Carolina has little to access due to poor weather and low fishing effort. This would create the potential for Florida to land all or most of the Annual Catch Limit before the May – August season, possibly triggering an early closure to the fishery. There was considerable discussion about this issue and the seasonality differences between Florida and North Carolina in the blue line tilefish fishery. The council decided to postpone taking final action on Actions 1 – 3 (establish deep water species aggregate, adjust the deep water species season, and specify bag limits for deep water aggregate species) and consider state or regional allocations for the deep water recreational fisheries at a later meeting. Actions approved for Secretarial Review include modify the current 20-fish aggregate bag limit to include no more than 10 fish of any species and removal of the recreational size limit for queen, silk, and blackfin snapper.

Red Grouper

The red grouper assessment update in 2017 found the species was overfished* but overfishing* was not occurring. The finding of overfished status for red grouper triggered a statutory requirement to approve a rebuilding plan within two years to end overfishing. A recommendation by the Science and Statistical Committee to the Council for an Allowable Biological Catch level for red grouper has not been made because of a delay in the review of the updated assessment incorporating new recreational catch estimates. The council is expecting a recommendation be ready for the March 2019 meeting. Draft actions that the council has discussed to end overfishing include extending the spawning season closure off of North and South Carolina through May and setting the commercial trip limit to 200 pounds.

Dolphin Wahoo

In March 2018, the Mid Atlantic Fisheries Management Council sent a letter requesting that the South Atlantic Fishery Management Council consider management of bullet and frigate mackerel as forage species under the Dolphin Wahoo Fishery Management Plan. The Mid-Atlantic Fishery Management Council recently developed a comprehensive forage fish amendment with the purpose of protecting forage species for their managed fisheries by establishing a trip limit and reporting requirement for species identified as forage. During final rule review, the National Marine Fisheries Service removed bullet and frigate mackerel from the list of forage species included in the amendment citing the lack of diet studies confirming that they are consumed by council-managed species prompting the request to the South Atlantic Fishery Management Council. The council discussed the merits of this request and reviewed diet information of dolphin and wahoo from North and South Carolina and considered the importance of bullet and frigate mackerel and other prey species as forage. The council instructed staff to develop a white paper with potential options for managing bullet and frigate mackerel as forage species and investigate the need for management of other prey species. The council will review this information at the March 2019 meeting.

The council began work on Amendment 10 to the Dolphin Wahoo Fishery Management Plan that was previously postponed in 2016. The council reviewed actions that were included in the postponed amendment and discussed the addition of new items for consideration. Potential

actions include revise the Accountability Measures for dolphin, modify the commercial and recreational Annual Catch Targets for dolphin, remove the requirement of possessing a Vessel Operator Card, allow bag limit sales of dolphin, reduce the dolphin recreational vessel limit to 40-fish, modify gear, bait, and training requirements for the commercial longline fishery to compliment Highly Migratory Species longline requirements, and revise sector allocations for dolphin. The council will discuss these actions again at the March 2019 meeting and discuss timing of public scoping.

For-Hire Electronic Reporting

The council was updated on the timing and implementation of the for-hire electronic reporting program. All captains who have a federal for-hire permit will be required to submit weekly landings reports. The publishing of the final rule and implementation of the reporting requirements is expected by mid-2019. An in-person training was held during the December council meeting and additional trainings will be schedule in North Carolina throughout the first half of the year.

Upcoming meeting

The next meeting of the South Atlantic Fisheries Management Council will be March 4 – 8, 2019 in Jekyll Island, GA.

***Definitions**

Allowable Biological Catch - A term used by a management agency, which refers to the range of allowable catch for a species or species group.
Overfishing – Occurs when the rate that fish that are harvested or killed exceeds a specific threshold.
Overfished – Occurs when the spawning stock size of a population is below a specified threshold. This condition significantly reduces the stock's reproductive capacity to replace fish removed by harvest.

SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL

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DECEMBER 3-7, 2018 COUNCIL MEETING REPORT
KITTY HAWK, NORTH CAROLINA

The following summary highlights the major issues discussed and actions taken at the South Atlantic Fishery Management Council's December 2018 meeting in Kitty Hawk, North Carolina. Briefing materials, presentations, and public comments are available on the Council's website at: http://safmc.net/safmc-meetings/council-meetings/

Final Committee Reports contain more details of what was accomplished for each committee and are located on the December 2018 briefing book page. In addition, the Summary of Motions on the Council's website includes all motions from the meeting. Read further details and see images and other links at the December 2018 Council Meeting Round-up Story Map: https://www.arcgis.com/apps/MapJournal/index.html?appid=073b19ccdf1540e78247f2b03e33724f
The December 2018 Meeting Summary is also available at: http://safmc.net/download/Dec2018-SAFMC_MeetingSummaryFinal.pdf

Issue:	Action Taken:	Schedule:
Recreational Visioning Amendment	Regulatory Amendment 26: reviewed & modified document, chose preferred alternatives, selected no action on 3 actions and approved 3 actions for formal review: **Selected No Action On:** **Action 1. Establish a deep-water species aggregate** **Alternative 1 (No Action).** The following recreational Snapper Grouper aggregates are in place in the South Atlantic Region: • Snapper Aggregate: lane snapper, yellowtail snapper, gray snapper, mutton snapper, cubera snapper, queen snapper, blackfin snapper, and silk snapper. • Grouper and Tilefish Aggregate: gag, black grouper, red grouper, scamp, yellowfin grouper, yellowmouth grouper, red hind, rock hind, graysby, coney, sand tilefish, snowy grouper, misty grouper, yellowedge grouper, blueline tilefish, and golden tilefish. • 20-Fish Aggregate: whitebone porgy, jolthead porgy, knobbed porgy, saucereye porgy, scup, gray triggerfish, bar jack, almaco jack, banded rudderfish, lesser amberjack, white grunt, margate, sailor's choice, and Atlantic spadefish.	Revise document and send for formal review by the Secretary of Commerce based on guidance from the= the December 3-7, 2018 meeting. **Approved Actions:** **Action 4.** Remove the 12-inch fork length recreational minimum size limits for queen, silk, & blackfin snapper. **Action 5.** Reduce the recreational minimum size limit for gray triggerfish in the exclusive economic zone off east Florida to 12-inches fork length. **Action 6**. Modify the aggregate bag limit for the 20-fish aggregate –Specify no more than 10 fish can be of any one species within the 20-fish aggregate.

	Action 2. Specify the recreational season for the deep-water species aggregate **Alternative 1 (No Action).** Recreational fishing for blueline tilefish and snowy grouper is allowed from May 1 through August 31, annually. Recreational fishing for wreckfish is allowed from July 1 through August 31, annually. Recreational fishing for other deep-water species (misty grouper, yellowedge grouper, and golden tilefish) is allowed year-round. **Action 3. Specify the aggregate bag limit for the deep-water species aggregate** **Alternative 1 (No Action).** The following bag limits are in place for the grouper and tilefish aggregate and for wreckfish in the South Atlantic Region: • Grouper and Tilefish Aggregate Bag Limit: Three per person per day: gag1, black grouper[1], red grouper, scamp, yellowfin grouper, yellowmouth grouper, red hind, rock hind, graysby, coney, sand tilefish, snowy grouper[2], misty grouper, yellowedge grouper, blueline tilefish, and golden tilefish[3]. [1]Maximum of one gag or black grouper (but not both) per person per day [2]Maximum of one snowy grouper per vessel per day [3]Maximum of one golden tilefish per person per day • The recreational bag limit for wreckfish is one per vessel per day.	
Red Grouper	Regulatory Amendment 30: discussed the AP comments, reviewed and modified the document, and approved all actions. • Revise the rebuilding schedule to the maximum time allowed (Tmax) which is 10 years ending in 2028 with 2019 = Year 1 • Jan thru April no recreational or commercial harvest/possession/sale/purchase of any shallow-water grouper (gag, black grouper, scamp, red grouper, yellowfin grouper, yellowmouth grouper, red hind, rock hind, grasby, or coney) and extend the closure off NC & SC for red grouper in May • Establish a commercial red grouper trip limit = 200 pounds gutted weight	Due to the timing of the SSC's review of the updated stock assessment that incorporates revisions to the MRIP estimates, the Council requested that staff bring Regulator Amendment 30 back at the March 2019 meeting for further review and consideration for final approval.
Sea Turtle Release Gear & Framework Modification	Regulatory Amendment 42 – the Council reviewed and approved the amendment for public hearings.	A public hearing session will be held during the March 2019 meeting. The Council will consider public comments and the need to modify the document.
Allocation Review Trigger Plan	This action would establish a policy that determines which triggers would automatically initiate a review of allocations. The Council reviewed options and provided guidance to staff on drafting an allocation trigger review policy.	The Council will review a draft allocation trigger review policy for review at the March 2019 meeting.

Issue:	Action Taken:	Schedule:
Yellowtail Snapper	Regulatory Amendment 32: The Council reviewed comments on the proposal to modify the accountability measure as a short-term solution to the early closure of the commercial fishery. Based on public and AP input, the Council postponed consideration until after the next yellowtail snapper stock assessment.	The Council will consider this amendment after the next yellowtail snapper stock assessment currently scheduled for completion in late 2019. The SSC will review in early 2020, and the Council will consider the results at the June 2020 meeting.
Recreational Accountability Measures Amendment	The Council provided guidance to staff on items in the document, indicated this amendment would only address snapper grouper and dolphin wahoo FMPs, and approved the amendment for scoping.	Scoping meetings will be held prior to the March 2019 meeting.
Vision Blueprint Biennial Evaluation	The Council provided the following guidance: • Create a webpage/story map to update stakeholders on actions accomplished to-date and those left to be addressed and solicit their input. • Provide list of actions in the Vision Blueprint appendix that were not prioritized for development in 2016-2020 and provide to the Committee in 2019. • Also, during 2019, conduct a stakeholder survey once projects that are still under development are completed (e.g., best fishing practices amendment, recreational permit/stamp, etc.). • Provide evaluation of FMP objectives that was conducted in 2014 as part of the Visioning Project. Bring this material to the Committee at the March 2019 meeting.	The Council directed staff to develop a webpage/story map to update stakeholders on progress to date on vision blueprint activities during 2016-2018 and bring to the committee in March or June 2019 for approval.
Characterization of the Commercial Snapper Grouper Fishery	The Council requested additional details of the study be presented to inform discussions about the "2 for 1" permit reduction program. The Council requested the following: • What was the original intent/rationale of the 2 for 1 program at its inception and was there a target number of permits specified? • Include a permit application in the March 2019 briefing book • Bring back information to March 2019 meeting on total commercial ACL available to the commercial sector. • Consolidate a list of topics/questions to provide to the SERO Permits Office to include in presentation being requested for March 2019.	The requested information will be presented at the March 2019 meeting. The NMFS SERO permits office will also give a presentation at the March 2019 meetng.

Issue:	Action Taken:	Schedule:
Citizen Science Program	The Council reviewed and approved the SOPPs which detail how the program will operate. They were also updated on the Scamp app to collect discard data for the next assessment and a new project to document the historical catch and length distribution for early headboat catches.	Work will continue on the program and these two projects. The Scamp app will be available in January 2019.
Dolphin Wahoo	The Council discussed the Mid-Atlantic Council's request that the South Atlantic Council manage bullet and frigate mackerel as important prey for dolphin and wahoo and provided guidance to staff. The Council also reviewed items for inclusion in Amendment 10 and provided guidance to staff: • **Action 1.** Revise the optimum yield (OY) definition for dolphin. • **Action 2.** Modify the recreational annual catch target (ACT) for dolphin. • **Action 3.** Establish a commercial annual catch target (ACT) for dolphin. • **Action 4.** Allow adaptive management of sector annual catch limits (ACLs) for dolphin. • **Action 5.** Revise the accountability measures for dolphin. • ~~**Action 6.** Revise the acceptable biological catch (ABC) control rule for dolphin and wahoo.~~ Action 6 was removed because it is addressed in another amendment. • **Action 7.** Allow properly permitted vessels with gear onboard that are not authorized for use in the dolphin wahoo fishery to possess dolphin or wahoo. • **Action 8.** Remove the requirement of vessel operators or crew to hold an Operator Card in the Dolphin Wahoo Fishery. • **New Item:** Allow bag limit sales of dolphin for dually permitted for-hire and commercial permit holders. • **New Item:** Modify gear, bait, and training requirements in the commercial longline fishery for dolphin and wahoo to align with HMS requirements (excluding monitoring). • **New Item:** Reduce the recreational vessel limit to 40 fish for dolphin. • **New Item:** Revise the ACLs of dolphin and wahoo to accommodate new MRIP data. • **New Item:** Revise sector allocations for dolphin and wahoo.	Staff will present a white paper at the March 2019 meeting on managing important prey species for dolphin and wahoo. A draft list of options for items to be included in Amendment 10 will also be presented at the March 2019 meeting.

Issue:	Action Taken:	Schedule:
For-Hire Recreational Reporting	The Council received an update on the amendment: The Amendment was approved on June 12, 2018 and the Final Rule is expected to publish in March or April 2019. Council staff conducted a training session on Thursday evening.	A March/April 2019 effective date will allow ACCSP to complete a phone app, so charter captains will not have to purchase a tablet. Also, duel permit holders will not be required to learn two systems. The training will continue, and details will be shared. For-Hire reporting training and outreach and NMFS information meetings will continue in 2019.
Habitat and Ecosystem Based Management	The Council provided guidance on the issue of species expanding northwards and requested the following: 1. Prior to February CCC meeting staff will prepare the following support information to inform and support SAFMC input during the joint session during the March Council meeting: a. Table of recreational and commercial species in the Snapper Grouper and Coastal Migratory Pelagic Management Units for MA/NE regions in pounds caught including identification of management jurisdiction, to include non-managed species b. Table of management and coordination alternatives available to the Council to address species change in distribution and movement north c. Pros and cons on permits d. Tables of ACL for managed species The Council also received a presentation on a proposed wind project off Kitty Hawk.	The Council will have further talks with the MAFMC and NEFMC at the March 2019 meeting.
SEDAR	The Council made appointments to SEDAR 58 (Atlantic Cobia), SEDAR 66 (Golden tilefish), and SEDAR 68 (Scamp). The Council approved terms of reference for the SEDAR snowy grouper update and terms of reference and schedule for SEDAR 68 (Scamp). The Council also received updates on assessment projects and the next SEDAR Steering Committee.	The next SEDAR Steering Committee meeting will be May 16-17, 2019 in Charleston, SC to discuss project planning, long-term priorities, and other issues.

Issue:	Action Taken:	Schedule:
MyFishCount	Council staff gave an update on progress with increasing usage of the app and is exploring how to include a way for fishermen to report losing a catch to sharks.	The app is now available and Council staff will continue working with private recreational fishermen to have them report. This experience will be used by the Council as they continue to work on the permitting and reporting amendment at the June 2019 meeting.

ROY COOPER
Governor

MICHAEL S. REGAN
Secretary

STEPHEN W. MURPHEY
Director

February 6, 2019

MEMORANDUM

TO: N.C. Marine Fisheries Commission

FROM: Randy Gregory, Division of Marine Fisheries, NCDEQ

SUBJECT: Highly Migratory Species Update

Issue
This memo is to inform the Marine Fisheries Commission on issues and activities related to the management of Highly Migratory Species.

Action Needed
For informational purposes only, **no action is needed at this time.**

Overview
Due to the federal government shutdown the Spring Highly Migratory Species Advisory Panel meeting has not been scheduled. The advisory panel is due to discuss pre-draft Amendment 13 for Atlantic bluefin tuna management and pre-draft Amendment 14 for domestic shark quota management.

Tuna
The December General category Atlantic bluefin tuna fishery opened on Dec. 1, 2018 with a 50 metric ton sub-quota. As of Dec. 20, 2018, preliminary commercial landings for the December fishery were 14.1 metric tons. Due to the federal government shutdown on Dec. 22, 2018, no landings updates have been issued. Most of the bluefin caught during the December fishery were landed in Carteret County.

On Jan. 1, 2019, the January General category Atlantic bluefin tuna sub-quota opened with a daily retention limit of one large medium or giant bluefin tuna (measuring 73 inches or greater) per vessel per day/trip. Although it is called the "January" sub-quota, the regulations allow the General category fishery under this quota to continue until the sub-quota is reached or until March 31, whichever comes first, and it will remain closed until the General category fishery reopens on June 1, 2019. NOAA Fisheries transferred 19.5 metric tons of quota from the 28.9 metric ton General category December 2019 sub-quota period to the January 2019 sub-quota period, resulting in a sub-quota of 49 metric tons for the January 2019 period and a sub-quota of 9.4 metric ton for the December 2019 period.

Dealers are required to submit landing reports within 24 hours of a dealer receiving bluefin tuna. General category and Charter/Headboat category vessel owners are required to report their own catch of all bluefin tuna retained or discarded dead within 24 hours of the landing or at the end of each trip. As of Jan. 23, 2019, approximately 32 bluefin tuna have been landed in Dare County since the January sub-quota opened.

The recreational Atlantic bluefin tuna fishery opened Jan. 1, 2019. The bluefin tuna daily retention limit is the default limit of one school, large school, or small medium bluefin tuna (27 inches to less than 73 inches). This default limit applies to both Angling category-permitted vessels and Charter/Headboat category-permitted vessels. Angling and Charter/Headboat vessels may also land one bluefin tuna measuring 73 inches or greater per vessel per year. All recreational vessel owners/operators who recreationally fish for or retain regulated Atlantic tunas (bluefin, yellowfin, bigeye, albacore and skipjack), sharks, swordfish and billfish in Atlantic Federal waters, including the Gulf of Mexico and the Caribbean Sea, must obtain an Highly Migratory Species Angling category permit or a Highly Migratory Species Charter/Headboat permit by accessing the Highly Migratory Species Permit Shop.

Sharks

In December, NOAA Fisheries announced the Final Environmental Impact Statement Available for Amendment 11: Conservation of Shortfin Mako Sharks. The final rule is still in development. The preferred alternatives in the Final Environmental Impact Statement include allowing retention of shortfin mako sharks by persons with a Directed or Incidental Shark Limited Access Permit when caught with pelagic longline or gill net gear and only if the shark is dead at haul back. No landings are allowed of shortfin mako sharks by fishermen using other commercial gear types. Recreational measures include requiring the use of circle hooks in all areas and a minimum size limit of 71 inches fork length for male and 83 inches fork length for female shortfin mako sharks.

Red Drum Landings 2017-2018

Landings are complete through October 31, 2018
2017 landings are final. 2018 landings are preliminary.

Year	Month	Species	Pounds	2009-2011 Average	2013-2015 Average
2017	9	Red Drum	28,280	28,991	35,003
2017	10	Red Drum	58,824	43,644	63,662
2017	11	Red Drum	27,705	14,318	27,643
2017	12	Red Drum	4,714	3,428	2,197
2018	1	Red Drum	2,056	5,885	1,699
2018	2	Red Drum	2,176	3,448	3,996
2018	3	Red Drum	4,797	5,699	3,971
2018	4	Red Drum	17,096	7,848	6,528
2018	5	Red Drum	15,656	13,730	9,664
2018	6	Red Drum	11,673	12,681	6,985
2018	7	Red Drum	9,838	13,777	15,618
2018	8	Red Drum	14,786	21,252	15,846
Fishing Year (Sept 1, 2017 - Aug 31, 2018) Landings			**197,600**		

Year	Month	Species	Pounds	2009-2011 Average	2013-2015 Average
2018	9	Red Drum	11,149	28,991	35,003
2018	10	Red Drum	42,364	43,644	63,662
2018	11	Red Drum	9,629	14,318	27,643 *
2018	12	Red Drum	1,129	3,428	2,197 *
Fishing Year (Sept 1, 2018 - Aug 31, 2019) Landings			**64,271**		

*partial trip ticket landings only
***landings are confidential

Year	Month	Species	Pounds	Dealers	Trips	Average (2007-2009)	
2015	1	SOUTHERN FLOUNDER	1,984	30	237	7,713	
2015	2	SOUTHERN FLOUNDER	495	21	93	4,617	
2015	3	SOUTHERN FLOUNDER	10,750	62	768	23,512	
2015	4	SOUTHERN FLOUNDER	20,812	88	1,072	68,389	
2015	5	SOUTHERN FLOUNDER	42,424	117	1,279	122,514	
2015	6	SOUTHERN FLOUNDER	53,835	116	1,481	154,090	
2015	7	SOUTHERN FLOUNDER	42,806	106	1,144	170,387	
2015	8	SOUTHERN FLOUNDER	43,900	111	1,152	201,862	
2015	9	SOUTHERN FLOUNDER	255,067	122	2,335	396,301	
2015	10	SOUTHERN FLOUNDER	429,234	127	2,554	781,717	
2015	11	SOUTHERN FLOUNDER	301,489	90	1,755	392,150	
2015	12	SOUTHERN FLOUNDER	89	7	10	37,303	
2016	1	SOUTHERN FLOUNDER	2,625	33	264	7,713	
2016	2	SOUTHERN FLOUNDER	1,643	31	291	4,617	
2016	3	SOUTHERN FLOUNDER	9,183	58	914	23,512	
2016	4	SOUTHERN FLOUNDER	10,558	72	628	68,389	
2016	5	SOUTHERN FLOUNDER	24,522	90	821	122,514	
2016	6	SOUTHERN FLOUNDER	44,952	100	1,242	154,090	
2016	7	SOUTHERN FLOUNDER	43,574	102	1,132	170,387	
2016	8	SOUTHERN FLOUNDER	53,057	106	1,409	201,862	
2016	9	SOUTHERN FLOUNDER	245,870	131	3,004	396,301	
2016	10	SOUTHERN FLOUNDER	279,618	117	2,161	781,717	
2016	11	SOUTHERN FLOUNDER	182,148	102	1,465	392,150	
2016	12	SOUTHERN FLOUNDER	14	5	5	37,303	
2017	1	SOUTHERN FLOUNDER	1,677	38	122	7,713	
2017	2	SOUTHERN FLOUNDER	2,758	55	215	4,617	
2017	3	SOUTHERN FLOUNDER	8,254	67	874	23,512	
2017	4	SOUTHERN FLOUNDER	9,591	83	787	68,389	
2017	5	SOUTHERN FLOUNDER	33,105	105	1,121	122,514	
2017	6	SOUTHERN FLOUNDER	74,785	115	1,904	154,090	
2017	7	SOUTHERN FLOUNDER	74,879	108	1,755	170,387	
2017	8	SOUTHERN FLOUNDER	102,751	116	2,364	201,862	
2017	9	SOUTHERN FLOUNDER	235,915	128	2,849	396,301	
2017	10	SOUTHERN FLOUNDER	548,740	142	3,971	781,717	
2017	11	SOUTHERN FLOUNDER	301,670	123	1,993	392,150	
2017	12	SOUTHERN FLOUNDER	166	7	8	37,303	
2018	1	SOUTHERN FLOUNDER	610	14	43	7,713	
2018	2	SOUTHERN FLOUNDER	1,833	34	154	4,617	
2018	3	SOUTHERN FLOUNDER	2,771	42	384	23,512	
2018	4	SOUTHERN FLOUNDER	7,973	72	760	68,389	
2018	5	SOUTHERN FLOUNDER	18,268	89	947	122,514	
2018	6	SOUTHERN FLOUNDER	42,415	105	1,399	154,090	
2018	7	SOUTHERN FLOUNDER	55,641	113	1,461	170,387	
2018	8	SOUTHERN FLOUNDER	70,704	119	1,880	201,862	
2018	9	SOUTHERN FLOUNDER	108,791	114	1,771	396,301	
2018	10	SOUTHERN FLOUNDER	355,066	103	2,992	781,717	
2018	11	SOUTHERN FLOUNDER	217,874	71	1,259	392,150	*
2018	12	SOUTHERN FLOUNDER	39	3	3	37,303	*

*2018 data are preliminary and only complete through October.

***data are confidential

ROY COOPER
Governor
MICHAEL S. REGAN
Secretary
STEPHEN W. MURPHEY
Director

February 6, 2019

MEMORANDUM

TO: Marine Fisheries Commission

FROM: Kathy Rawls, Fisheries Management Section Chief

SUBJECT: Observer Program Update January through November 2018

Issue
This memo provides the Marine Fisheries Commission summary from the division's Observer Program from January through November 2018.

Action Needed
For informational purposes only, **no action is needed at this time.**

Observer Program Overview
Tables 1 – 4, that follow, summarize the division's Observer Program coverage and protected species interactions* from January through November 2018. These tables provide the number of trips, observed trips, observer coverage and protected species interactions for anchored large and small mesh gill nets by month and management unit. Please note that observer coverage is based on the average number of trips from previous years' finalized data, because 2018 trip data are preliminary.

A total of 12 sea turtle interactions were observed in large mesh gill nets and zero sea turtle interactions were observed in small mesh gill nets from January through November 2018. No sea turtle interactions were self-reported during this timeframe.

A total of 22 (20 alive and two dead) Atlantic sturgeon interactions were observed in large mesh gill nets and two live Atlantic sturgeon were observed in small mesh gill nets from January through November 2018, with most of the interactions occurring in March and in Management Unit A. Two Atlantic sturgeon interactions were self-reported by gill net fisherman during this timeframe.

Management Unit Gill Net Regulation Changes
Gill net regulation changes as well as openings and closings by management unit for January through November 2018 are included in Table 5.

***Definition:** **Incidental Take Permit Interaction -** when a protected species is caught or otherwise comes in contact with a gill net.

Table 1. Preliminary data collected for large mesh gill nets by month and management unit through the NCDMF Observer Program through November 2018.

		Trips		Observer Large Mesh				Observed Takes By Species								
								Kemp's		Green		Loggerhead		Unknown	A.Sturgeon	
Month	Unit	Estimated [1]	Actual [2]	AP Attempts [3]	Trips	Yards	Coverage [4]	Live	Dead	Live	Dead	Live	Dead	Live	Live	Dead
January	A	248	192	8	15	10,260	6.1									
	B	28	2	14	0	0	0.0									
	C	7	0	5	1	50	13.9									
	D1	0	0	0	0	0	0.0									
	D2	0	0	1	0	0	0.0									
	E	6	5	35	0	0	0.0									
February	A	433	254	29	25	12,490	5.8								**1**	
	B	44	7	21	0	0	0.0									
	C	77	38	21	16	12,180	20.8								**1**	
	D1	0	0	0	0	0	0.0									
	D2	2	2	6	1	100	50.0									
	E	18	15	41	0	0	0.0									
March	A	1,001	467	24	90	41,640	9.0								**9**	**1**
	B	48	48	17	1	600	2.1									
	C	680	422	11	29	18,610	4.3									
	D1	0	0	4	0	0	0.0									
	D2	6	5	2	3	1,100	50.0									
	E	52	25	52	2	180	3.8									
April	A	774	650	38	57	24,655	7.4								**2**	
	B	104	141	16	4	1,700	3.9									
	C	190	348	9	13	5,950	6.8									
	D1	1	0	1	0	0	0.0									
	D2	22	5	7	4	2,700	18.3									
	E	77	83	39	14	6,330	18.1									
May	A	250	84	56	7	1,405	2.8								**1**	
	B	193	138	24	6	3,975	3.1	**2**	**1**	**1**						
	C	107	105	27	17	11,165	15.9									
	D1	5	0	2	0	0	0.0									
	D2	43	28	11	1	500	2.3									
	E	122	206	50	28	11,020	23.0			**2**						
June	A	375	170	45	11	6,530	2.9									
	B	224	21	23	0	0	0.0									
	C	193	209	24	20	10,270	10.4									
	D1	0	1	3	0	0	0.0									
	D2	38	66	12	6	1,800	15.8									
	E	170	270	35	25	6,900	14.7									
July	A	297	147	48	10	5,090	3.4									
	B	257	9	21	1	100	0.4									
	C	203	243	22	19	14,570	9.4									
	D1	0	0	3	0	0	0.0									
	D2	29	102	7	3	1,600	10.3									
	E	135	255	36	31	11,700	23.0	**2**								
August	A	497	306	43	34	18,700	6.8									
	B	196	28	36	0	0	0.0									
	C	202	220	16	34	27,790	16.8									
	D1	0	0	6	0	0	0.0									
	D2	72	166	3	8	3,100	11.1									
	E	166	390	46	59	19,170	35.5									
September	A	1,126	623	17	32	42,020	2.8									
	B	298	212	10	9	6,580	3.0									
	C	461	155	15	9	4,220	2.0									
	D1	0	0	1	0	0	0.0									
	D2	119	75	3	4	1,900	3.4									
	E	156	204	21	12	3,825	7.7									
October	A	840	731	29	83	70,480	9.9	**1**		**3**					**3**	
	B	764	652	7	59	33,370	7.7									
	C	269	282	25	22	13,400	8.2									
	D1	18	0	1	0	0	0.0									
	D2	176	193	0	14	3,900	8.0									
	E	247	292	39	25	8,600	10.1								**1**	
November	A	670	407	46	16	12,220	2.4									
	B	189	90	13	8	4,275	4.2								**2**	**1**
	C	73	56	17	6	1,900	8.2									
	D1	8	0	7	0	0	0.0									
	D2	75	45	1	7	3,800	9.4									
	E	150	115	50	13	4,400	8.7									
Total		13,232	10,005	1,302	914	508,820	6.9	5	1	6	0	0	0	0	20	2

[1] Finalized trip ticket data averaged from 2013-2017

[2] Preliminary trip ticket data for 2018

[3] Alternative Platform trips where no fishing activity was found

[4] Based on estimated trips and observer large mesh trips

Table 2. Preliminary data collected for large mesh gill nets by month through the NCDMF Observer Program through November 2018.

							Observed Takes By Species								
	Trips		Observer Large Mesh				Kemp's		Green		Loggerhead		Unknown	A. Sturgeon	
Month	Estimated [1]	Actual [2]	AP Attempts [3]	Trips	Yards	Coverage [4]	Live	Dead	Live	Dead	Live	Dead	Live	Live	Dead
January	289	199	63	16	10,310	5.5									
February	574	316	118	42	24,770	7.3								**2**	
March	1,787	967	110	125	62,130	7.0								**9**	**1**
April	1,168	1,227	110	92	41,335	7.9								**2**	
May	720	561	170	59	28,065	8.2	**2**	**1**	**3**					**1**	
June	999	736	142	62	25,500	6.2									
July	922	756	137	64	33,060	6.9	**2**								
August	1,134	1,112	150	135	68,760	11.9									
September	2,160	1,269	67	66	58,545	3.1									
October	2,314	2,152	101	203	129,750	8.8	**1**		**3**					**4**	
November	1,165	713	134	50	26,595	4.3								**2**	**1**
Total	13,232	10,008	1,302	914	508,820	6.9	5	1	6	0	0	0	0	20	2

[1] Finalized trip ticket data averaged from 2013-2017

[2] Preliminary trip ticket data for 2018

[3] Alternative Platform trips where no fishing activity was found

[4] Based on estimated trips and observer large mesh trips

Table 3. Preliminary data collected for small mesh gill nets by month and management unit through the NCDMF Observer Program through November 2018.

		Trips		Observer Small Mesh			Observed Takes By Species								
							Kemp's		Green		Loggerhead		Unknown	A. Sturgeon	
Month	Unit	Estimated [1]	Actual [2]	Trips	Yards	Coverage [3]	Live	Dead	Live	Dead	Live	Dead	Live	Live	Dead
January	A	385	153	1	150	0.3									
	B	178	58	1	300	0.6									
	C	63	21	4	1,000	6.3									
	D1	1	0	0	0	0.0									
	D2	20	1	5	900	24.8									
	E	26	4	1	800	3.9									
February	A	479	265	12	3,700	2.5									
	B	153	235	1	700	0.7									
	C	83	152	8	3,130	9.6									
	D1	1	1	0	0	0.0									
	D2	11	2	3	400	27.8									
	E	16	4	1	300	6.4									
March	A	521	225	3	750	0.6									
	B	316	157	6	2,080	1.9									
	C	111	143	3	1,000	2.7									
	D1	7	1	0	0	0.0									
	D2	4	2	0	0	0.0									
	E	23	7	1	600	4.4									
April	A	343	301	6	2000	1.7									
	B	700	661	18	8610	2.6									
	C	61	71	1	220	1.6									
	D1	24	35	3	1200	12.6									
	D2	15	4	0	0	0.0									
	E	61	37	1	255	1.6									
May	A	172	115	2	500	1.2									
	B	360	386	5	1050	1.4									
	C	70	12	1	800	1.4									
	D1	6	10	2	825	32.3									
	D2	20	14	0	0	0.0									
	E	92	45	0	0	0.0									
June	A	105	111	0	0	0.0									
	B	303	246	0	0	0.0									
	C	103	18	0	0	0.0									
	D1	2	2	0	0	0.0									
	D2	12	10	0	0	0.0									
	E	78	83	0	0	0.0									
July	A	73	88	1	50	1.4									
	B	309	185	0	0	0.0									
	C	83	22	0	0	0.0									
	D1	4	0	0	0	0.0									
	D2	10	14	0	0	0.0									
	E	78	68	1	250	1.3									
August	A	74	167	1	700	1.4									
	B	361	246	2	300	0.6									
	C	90	23	0	0	0.0									
	D1	4	1	0	0	0.0									
	D2	30	10	1	200	3.4									
	E	87	132	0	0	0.0									
September	A	94	85	0	0	0.0									
	B	307	126	0	0	0.0									
	C	72	16	1	100	1.4									
	D1	11	4	0	0	0.0									
	D2	52	6	0	0	0.0									
	E	106	52	0	0	0.0									
October	A	128	59	1	700	0.8								**2**	
	B	439	282	0	0	0.0									
	C	60	25	1	800	1.7									
	D1	34	18	0	0	0.0									
	D2	114	30	0	0	0.0									
	E	229	96	0	0	0.0									
November	A	145	40	4	1600	2.8									
	B	241	137	11	4700	4.6									
	C	89	8	6	3000	6.7									
	D1	11	10	0	0	0.0									
	D2	76	15	7	1300	9.2									
	E	196	28	3	430	1.5									
Total		8,531	5,585	129	45,400	1.5	0	0	0	0	0	0	0	2	0

[1] Finalized trip ticket data averaged from 2013-2017

[2] Preliminary trip ticket data for 2018

[3] Based on estimated trips and observer small mesh trips

Table 4. Preliminary data collected for small mesh gill nets by month through the NCDMF Observer Program through November 2018.

						Observed Takes By Species								
	Trips		Observer Small Mesh			Kemp's		Green		Loggerhead		Unknown	A. Sturgeon	
Month	Estimated [1]	Actual [2]	Trips	Yards	Coverage [3]	Live	Dead	Live	Dead	Live	Dead	Live	Live	Dead
January	673	238	12	3,150	1.8									
February	743	659	25	8,230	3.4									
March	982	535	13	4,430	1.3									
April	1,205	1,109	29	12,285	2.4									
May	719	582	10	3,175	1.4									
June	603	470	0	0	0.0									
July	557	377	2	300	0.4									
August	646	579	4	1,200	0.6									
September	643	289	1	100	0.2									
October	1,003	512	2	1,500	0.2								**2**	
November	758	238	31	11,030	4.1									
Total	8,532	5,588	129	45,400	1.5	0	0	0	0	0	0	0	2	0

[1] Finalized trip ticket data averaged from 2013-2017

[2] Preliminary trip ticket data for 2018

[3] Based on estimated trips and observer small mesh trips

Table 5. Gill net regulation changes that occurred from January to November 2018 in accordance with the Sea Turtle and Atlantic Sturgeon Incidental Take Permits.

Date	Description of Regulation Change (Proclomation referenced)
2018 January 1	In Management Unit A, it makes it unlawful to use gill nets with a stretched mesh length *other than 3 ¼ inches, or from 5 ½ inches through 6 ½ inches*, EXCEPT IN THE AREAS DESCRIBED IN SECTION IV. It also maintains large mesh gill net closures and vertical height restrictions for all anchored gill net sets. This action was taken to minimize interactions in accordance with the Atlantic Sturgeon Incidental Take Permit. (M-24-2017)
2018 February 15	This proclamation implements gear exemptions for portions of the Internal Coastal Waters south of Management Unit A to allow fishermen to set gill nets for the shad fishery (See Section III.). It also opens the remaining portions of Management Unit B to the use of gill nets with a stretched mesh length of 4 inches through 6 ½ inches (except as described in Section III.) in accordance with the Sea Turtle Incidental Take Permit. (M-1-2018)
2018 March 3	Opens all of Management Unit A to the use of gill nets and allows gill net configurations for harvesting American shad by removing vertical height restrictions for up to 1,000 yards of gill net with stretched mesh lengths of 5 ¼ through 6 ½ inches. This proclamation also implements additional gill net restrictions for Management Subunit A-South of US-64-BYP/US-64, in accordance with the Sea Turtle and Atlantic Sturgeon ITPs. (M-2-2018)
2018 March 25	Removes the use of gill nets configured for harvesting American shad by implementing vertical height restrictions for all gill nets. This proclamation also closes a portion of the western Albemarle Sound to all gill nets with stretched mesh lengths of 5 ½ through 6 ½ inches, and maintains additional gill net restrictions in accordance with the Sea Turtle and Atlantic Sturgeon ITPs. (M-3-2018)
2018 May 3	Implements small mesh gill net attendance requirements in Management Unit A and implements additional gill net restrictions in accordance with the Sea Turtle ITP. This proclamation also maintains a closure in a portion of the western Albemarle Sound to all gill nets with stretched mesh lengths of 5 ½ through 6 ½ inches. (M-5-2018)
2018 May 18	This proclamation closes Management Unit B to gill nets with a stretched mesh length of 4 inches through 6 ½ inches in accordance with the Sea Turtle ITP and reduces the maximum stretched mesh length for run-around, strike, drift, drop and trammel gill nets to 5 inches. (M-7-2018)
2018 September 1	This proclamation opens a previously closed area in the western part of Management Unit A to gill nets with stretched mesh lengths of 5 ½ inches through 6 ½ inches in accordance with the Sea Turtle ITP. It maintains small mesh gill net attendance requirements in Management Unit A. (M-8-2018)
2018 September 3	This proclamation opens Management Unit B Subunit MGNRA to the use of gill nets with a stretched mesh length of 4 inches through 6 ½ inches for the new ITP year (September 1, 2018 through August 31, 2019) in accordance with the Sea Turtle ITP. This proclamation maintains attendance requirements for gill nets with a stretched mesh length less than 4 inches in Management Subunit B. 1. It maintains openings for Management Units C, D2 and portions of Management Unit E (except those described in Section II.) to the use of gill nets with a stretched mesh length of 4 inches through 6 ½ inches. This proclamation also maintains the closure of Management Unit D1 to the use of gill nets with a stretched mesh length of 4 inches through 6 ½ inches. (M-9-2018)
2018 October 1	This proclamation opens Management Unit B Subunits SGNRA 1-4, and CGNRA to the use of gill nets with a stretched mesh length of 4 inches through 6 ½ inches for the new ITP year (September 1, 2018 through August 31, 2019) in accordance with the Sea Turtle ITP. (M-10-2018)
2018 November 24	This proclamation closes a portion of the lower Chowan River and western Albemarle Sound to all gill nets with stretched mesh lengths of 5 ½ through 6 ½ inches due to dead sturgeon takes nearing the authorized amount for Management Unit A, and maintains additional gill net restrictions in accordance with the Sea Turtle and Atlantic Sturgeon ITPs. (M-13-2018)
2018 December 1	This proclamation closes the Albemarle Sound proper to the use of gill nets with a stretched mesh length of 5 ½ inches through 6 ½ inches, limits large mesh gill net length to 1,000 yards in open areas, and maintains nets must be set to fish the bottom of the water column and not to exceed a vertical height of 48 inches. Anchored small mesh gill nets (gill nets with a stretched mesh of 3 ¾ inches and smaller) may be unattended but must be set to fish the bottom of the water column and not to exceed a vertical height of 48 inches. This action is being taken due to low observer coverage and approaching the take limit of dead Atlantic sturgeon. (M-14-2018)

ROY COOPER
Governor

MICHAEL S. REGAN
Secretary

STEPHEN W. MURPHEY
Director

February 6, 2019

MEMORANDUM

TO: Marine Fisheries Commission

FROM: Kathy Rawls, Fisheries Management Section Chief

SUBJECT: Temporary Rule Suspension

Issue
In accordance with the North Carolina Division of Marine Fisheries Resource Management Policy Number 2014-2, Temporary Rule Suspension, the North Carolina Marine Fisheries Commission will vote on any new rule suspensions that have occurred since the last meeting of the commission.

Findings
No new rule suspensions have occurred since the November 2018 meeting.

Action Needed
For informational purposes only, **no action is needed at this time.**

Overview
In accordance with policy, the division will report current rule suspensions previously approved by the commission as non-action, items. The current rule suspensions previously approved by the commission are as follows:

- Continued suspension of North Carolina Marine Fisheries Commission Rule 15A NCAC 03M .0516 Cobia, for an indefinite period of time. This continued suspension allows the division to manage the commercial and recreational cobia fisheries in accordance with management actions taken by the commission and in accordance with Framework Amendment 4 to the federal Coastal Migratory Pelagics Fishery Management Plan. This suspension was continued in Proclamation FF-57-2018.

- Continued suspension of portions of North Carolina Marine Fisheries Commission Rule 15A NCAC 03J .0301 Pots, for an indefinite period of time. This continued suspension allows the division to implement the crab pot escape ring requirements adopted by the commission in the May 2016 Revision to Amendment 2 of the North Carolina Blue Crab

Fishery Management Plan. This suspension was effective January 15, 2017, implemented in Proclamation M-11-2016.

- Continued suspension of portions of North Carolina Marine Fisheries Commission Rule 15A NCAC 03L .0201 Crab Harvest Restrictions, and portions of 03L .203 Crab Dredging, for an indefinite period of time. This continued suspension allows the division to implement the blue crab harvest restrictions adopted by the commission in the May 2016 Revision to Amendment 2 of the North Carolina Blue Crab Fishery Management Plan. These suspensions were implemented in Proclamation M-11-2016.

- Continued suspension of portions of North Carolina Marine Fisheries Commission Rule 15A NCAC 03J .0501 Definitions and Standards for Pound Nets and Pound Net Sets, for an indefinite period of time. Continued suspension of portions of this rule allows the division to increase the minimum mesh size of escape panels for flounder pound nets in accordance with Supplement A to Amendment 1 of the North Carolina Southern Flounder Fishery Management Plan. This suspension was implemented in Proclamation M-34-2015.

- Continued suspension of portions of North Carolina Marine Fisheries Commission Rule 15A NCAC 03M .0519 Shad and 03Q .0107 Special Regulations: Joint Waters, for an indefinite period of time. Continued suspension of portions of these rules allows the division to change the season and creel limit for American shad under the management framework of the North Carolina American Shad Sustainable Fishery Plan. These suspensions were continued in Proclamation FF-56-2018 (REVISED).

ROY COOPER
Governor
MICHAEL S. REGAN
Secretary
STEPHEN W. MURPHEY
Director

Feb. 6, 2019

MEMORANDUM

TO: N.C. Marine Fisheries Commission

FROM: Tracey Bauer, Spotted Seatrout Lead

SUBJECT: January 2018 Spotted Seatrout Cold Stun Report

Issue
At its February 2018 business meeting, the Marine Fisheries Commission was provided a brief overview of the cold stun event that occurred in January 2018 and was informed that a more comprehensive report on the cold stun impacts to the spotted seatrout stock* would be provided when complete. The report is complete and available in the briefing book.

Findings
- Estimated spotted seatrout natural mortality* during the 2017/2018 winter was high, consistent with previously published cold stun natural mortality estimates.
- Analysis of water temperature data indicates that conditions were conducive to spotted seatrout cold stuns along most of coastal North Carolina; 79 percent of the division's water temperature monitoring stations met triggers based on spotted seatrout cold temperature tolerance.
- Analysis of division independent sampling data indicates spotted seatrout recruitment* in 2018 was above average.

Action Needed
For informational purposes only, **no action is needed at this time.**

Overview
A significant cold stun event occurred in January 2018 due to prolonged cold temperatures and two winter storms. Based on early confirmed reports of cold stunned spotted seatrout and data from the division's water temperature loggers, this cold stun event met the conditions established in the division's Guidelines for Adaptive Management for Cold Stun Closures, indicating a need for a closure. The director issued a proclamation on Jan. 3, 2018 closing the spotted seatrout fishery effective 3 p.m. on Jan. 5 until June 15, 2018. This action was taken in accordance with the management strategy adopted in the 2012 Spotted Seatrout Fishery Management Plan.

At its February 2018 business meeting, the commission was provided a brief overview of the cold stun event and informed that a more comprehensive report would be provided when complete. The report is now available and can be found in the commissioners' briefing book. The report contains estimates of spotted seatrout natural mortality* before, during, and after the cold stun event, an estimation of the geographical extent of the cold stun event in North Carolina using water temperature data, and an updated spotted seatrout juvenile abundance index* to provide information on post-cold stun spotted seatrout recruitment*. The report uses a quantitative approach to examine the impact the January 2018 cold stun event had on the North Carolina spotted seatrout stock. Data analyzed in this report will be considered in the development of the new model to assess the spotted seatrout stock, which is scheduled to begin in 2019.

*Definitions

Stock – A group of fish of the same species in a given area. Unlike a fish population, a stock is defined as much by management concerns (jurisdictional boundaries or harvesting locations) as by biology.
Natural Mortality – A measurement of the rate of removal of fish from a population from natural causes.
Recruitment – The number of spotted seatrout that survive to the juvenile stage.
Juvenile Abundance Index – A measure of abundance of juveniles in a fish population, which may serve as an indication of reproductive success. This does not measure the actual number of fish, but shows changes in juvenile abundance over time.

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January 2018 Spotted Seatrout Cold Stun

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February 2019

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This document may be cited as:

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ABSTRACT

Following a winter storm and extreme cold in January 2018, the division received reports of stunned spotted seatrout throughout North Carolina. In addition to reports of stunned fish, preliminary water temperature data met triggers established in Guidelines for Adaptive Management of Spotted Seatrout Closures, prompting the director issue a proclamation to the close the spotted seatrout fishery until June 15, 2018. The division has prepared a final, comprehensive assessment of the cold stun event. Natural mortality of spotted seatrout was estimated before, during, and after the January 2018 cold stun event to quantify the affects the cold stun had on the North Carolina spotted seatrout population. In addition, water temperature data was analyzed to estimate the geographical extent of the cold stun event. Lastly, a juvenile abundance index for spotted seatrout was calculated using the division's Program 120 Estuarine Trawl Survey, providing estimates of post-cold stun recruitment. Estimated spotted seatrout natural mortality during the winter of 2017/2018 was high and was consistent with previously published spotted seatrout cold stun natural mortality estimates. In addition, the severity of the January 2018 cold stun event on the spotted seatrout population was supported by water temperature data. Seventy-nine percent of stations coastwide met at least one of the water temperature triggers. Lastly, the spotted seatrout juvenile abundance index in 2018 was above average, indicating increased recruitment. With the spotted seatrout benchmark stock assessment scheduled to begin this year (2019), all data included in this report will be considered in the development of the new model to assess the spotted seatrout stock.

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1 INTRODUCTION

Cold stun events have a major impact on spotted seatrout population dynamics, contributing to periodic declines in population abundance (NCDMF 2012; Merriner 1980; Ellis et al. 2018). Cold stun events occur when prolonged cold temperatures or snow and ice melt cause water temperatures to drop below the minimum temperature spotted seatrout can withstand, causing detrimental physiological effects, such as a loss of equilibrium and immobilization. If spotted seatrout are unable to move to warmer water (i.e., a thermal refuge), then mortalities can occur. In North Carolina, spotted seatrout cold stun events have occurred recently in the winters of 2009, 2010, 2011, 2014, 2015, and 2018 (NCDMF 2012, 2016).

Mortality due to cold stuns is recognized in the 2012 Spotted Seatrout Fishery Management Plan (FMP) as a factor impacting the abundance of spotted seatrout in North Carolina (NCDMF 2012). At their February 2012 business meeting, the Marine Fisheries Commission (MFC) directed the division to remain status quo regarding spotted seatrout management, with the assumption that in the event of a "catastrophic" cold stun the director would use proclamation authority to enact a temporary closure (NCDMF 2012). The objective of a spotted seatrout fishery closure after a cold stun event is to allow surviving fish an opportunity to spawn during their spring spawning season, potentially increasing recruitment the following year.

Division staff, with input from the MFC, developed adaptive management guidelines for spotted seatrout cold stun closures which stated that if verifiable cold stunned fish were found in at least four counties, then the fishery would close until June 15 at the director's discretion. These original adaptive management guidelines were used to evaluate three cold stuns from 2011-2015. The division determined that the guidelines were met in 2011 and 2014 (Proclamation FF-7-2011; FF-30-2011; FF-9-2014), closing the fishery until June 15 in both years. In the winter of 2015, reports from the public of cold stunned spotted seatrout were investigated by the division. Many reports could not be verified or were inconsistent with what was observed by the division. Consequently, the division determined that the four-county threshold was not met, and the director chose to not close the fishery. The public disagreed with the division's determination, citing the subjectivity involved in making the decision. With a goal to develop more objective and quantifiable guidelines, the division reexamined its adaptive management strategy for spotted seatrout cold stun closures.

Beginning in 2016, the division enacted revised adaptive management guidelines which, in addition to taking into consideration the magnitude and scope of the kill, includes water temperature triggers of 5 °C (41 °F) at eight consecutive days and/or 3 °C (37.4 °F) for a consecutive 24-hour period (NCDMF 2016). If either of the triggers are met in at least two spotted seatrout management areas (Figure 1), then the director will use proclamation authority to close the spotted seatrout fishery until June 15. The triggers are based on the cold tolerance of North Carolina spotted seatrout; survival probabilities of spotted seatrout fall below 50% after eight days of prolonged exposure to 5 °C water temperatures or one day of prolonged exposure to 3 °C water temperatures (Ellis et al. 2017a). In the event of a potential cold stun event, the division determines if water temperatures have met the triggers by reviewing data from continuous water temperature logging devices located in cold stun prone areas throughout the state.

In late December 2017 and January 2018, North Carolina experienced a coastwide snow/ice and record cold event. Beginning on December 26, 2017, a strong Arctic cold front moved into North Carolina and remained in the area through January 8, 2018. From January 3-4, 2018, a major winter

storm affected an extensive area of North Carolina. Ice accumulation was up to 0.2 inch, and snowfall amounts ranged from about two inches at the coast up to eight inches inland. After the snow event, clear skies and calm winds led to very cold nights, near all-time record lows. The Newport/Morehead City National Weather Service recorded a record eight straight days of temperatures below 20 degrees. Later in the month, the combination of an Arctic cold front and low pressure developing off the Outer Banks led to snow on the evening of January 17, 2018 into the morning of January 18, 2018, making it the second major winter storm to impact North Carolina during January 2018.

Reports of cold stunned fish began shortly before the storm on January 2, 2018, with confirmed reports of cold stunned spotted seatrout in the White Oak River near Stella, North River (Carteret County), Gales Creek, and Hancock Creek, and unconfirmed reports ranging from mainland Dare County to Lockwood Folly River. Widespread observations of stunned spotted seatrout along the coast of North Carolina were reported by division staff and the public throughout January 2018. The northernmost confirmed stun occurred at Broad Creek at Wanchese Harbor. Reports of spotted seatrout mortality were confirmed in multiple locations along the Pamlico River (e.g., at Washington Park, at the Washington waterfront, along Whichards Beach, near the Highway 17 overpass and between Jack's Creek and the railroad trestle, South Creek, Bear Creek) and in the Pungo River. Spotted seatrout cold stuns were confirmed in the Neuse River and its tributaries at the mouth of Tranters Creek and Broad Creek at the mouth of the Neuse. Cold stuns were also confirmed in Bogue Sound, Spooners Creek, Queen Creek and further south to Pages and Topsail creeks and canals near Holden Beach. Reports from the public and division staff of stunned fish were noted until late January. Species other than spotted seatrout that were observed impacted by the snow/ice and record cold event included eastern oyster, red drum, southern flounder, sheepshead, black drum, and striped mullet. Counties with confirmed spotted seatrout cold stuns included Dare, Hyde, Beaufort, Pamlico, Craven, Carteret, Onslow, Pender, New Hanover, and Brunswick; cold stunned spotted seatrout were observed in all three spotted seatrout cold stun management areas.

In addition to the widespread confirmed and unconfirmed reports of cold stunned spotted seatrout, low water temperatures were recorded throughout North Carolina waters (Table 1). On January 3, water temperatures in Croatan Sound ranged from 1.3 °C to 6.9 °C. Water temperature readings taken from northern Beaufort and Hyde counties on January 3 ranged from -0.4 °C in Pungo Creek to 5.1°C in Scranton Creek. Temperature data downloaded on January 3 from North River and White Oak River near Stella showed that the 3 °C at 24-hour trigger had been met or that water temperatures had fallen below 2 °C multiple times with no observed deeper, warmer waters to act as a thermal refuge for the fish.

Based on early confirmed reports of cold stunned fish and water temperature data, the triggers were determined to be met in at least two of the spotted seatrout cold stun management areas, and the director issued a proclamation on January 3, 2018 to close the spotted seatrout fishery effective 3:00 p.m. Friday, January 5, 2018 until June 15, 2018.

The division provided a memo to the MFC at their February 2018 business meeting giving a brief overview of the cold stun event, and indicated a more comprehensive report would be provided when more data were collected on the spotted seatrout stock. At the November 2018 business meeting, the Commission was provided an additional memo giving an update on the status of the report.

Using data from the division's tagging program, natural mortality of spotted seatrout was estimated before, during, and after the January 2018 cold stun event to quantify the effects the prolonged cold had on the North Carolina spotted seatrout population. In addition, temperature data downloaded from the division's water temperature loggers was analyzed to estimate the geographical extent of the cold stun impacts on the stock. Lastly, the division's Program 120 Estuarine Trawl Survey spotted seatrout juvenile abundance index was updated, providing estimates of post-cold stun recruitment.

2 METHODS

Spotted Seatrout Natural Mortality

Data Preparation

Tag-return data were pulled from the NCDMF Biological Database (BDB) and transformed into a low reward matrix, a high reward matrix, and a double tagged matrix. All fish that were tagged within the selected time period (March 1, 2014 – December 31, 2018) were included (Table 2). Each of these matrices were used in the model (as described below) on a timestep basis, which included both the number of released and recaptured tags per timestep within each sector (commercial and recreational) and by catch type (e.g., harvest or discards). Prior to pulling data from the BDB all fishery independent recaptures, defined here as fish recaptured by NCDMF staff during routine or targeted sampling, or recaptures by other research-related sampling efforts (e.g., federal or university), were excluded from analysis. For ease of analysis commercial and recreational discards were merged into a single "discards" category within the matrices. Discards were merged because a majority of returned discards were from the recreational sector, with only 0.01% (1/94) from the commercial sector. There are currently no estimates of discards from the commercial sector.

Model Structure

An instantaneous rates tag-return model was used, that was parameterized, described, and equations the same as used in Ellis et al. (2018). The instantaneous rates model was run in a Bayesian framework in Just Another Gibbs Sampler (JAGS) software (Plummer 2003) called from R statistical software (R2Jags; R Core Team 2016). Instantaneous rates models aim to estimate fishing mortality (F), natural mortality (M), total mortality (Z), acute and chronic tag loss, and sector specific (e.g., commercial and recreational) reporting rates (λ), when previous information on discard mortality and initial tagging survival is known. The model allowed for both harvest and catch-and-release fisheries (termed here forward as "discard"), which is an added feature of this type of tag-return modeling.

The model was run on a 4-month timestep (j) (March/April/May/June, July/Aug/Sept/Oct, Nov/Dec/Jan/Feb), for a total of nine timesteps (March 2016–December 2018).

Model Priors

Uninformative uniform prior distributions were used for the following estimated parameters: λr (0, 1), λc (0, 1), and the natural logs of Frj (−10, 2), Fcj (−10, 2), Fdj (−10, 2), and Mj (−10, 2). The probability of tag retention immediately after tagging (ρ) was set at [uniform (0,1)], while chronic instantaneous tag loss (Ω) was assumed to equal a previously calculated estimate (A. Flowers, unpublished). Discard mortality rate was assumed equal to a previously calculated estimate (A. Flowers, unpublished) for the recreational fishery that was then averaged across

seasons (δ=10%). The tagging survival rate (s) were assumed equal to 100%, which was based on results of a pen study (NCDMF, unpublished). Finally, the reporting rate (λH) for high-reward tags was assumed to be 100%, which was a main assumption of this model.

Parameter Estimation

The first 15,000 of 30,000 samples from three Markov chains were excluded. The chains were then thinned by five to meet convergence criteria and to remove bias associated with initial parameter estimates. Convergence of the three Markov chains posterior distributions were assessed visually. All parameter estimates in this report are presented as posterior medians with 95% credible intervals (CrI).

Water Temperature Trigger Analysis

Onset HOBO Water Temp Pro v2 (U22-001) loggers were deployed throughout the coastal rivers and creeks of North Carolina beginning in October 2015. Logger deployment stations were chosen to be representative of the systems in each area and in areas prone to cold stuns (Table 1). In most locations, two loggers were deployed to gather surface and bottom temperature readings. However, one logger was deployed in locations where the shallow water depth made two loggers unnecessary.

HOBO loggers were either tied or attached using longline clips to a weighted line within a perforated 2-inch schedule 40 PVC pipe covered with anti-foul paint or clipped to a steel cable attached to a cement mooring with a marked float. Suspending the loggers within the PVC pipe minimized fouling and offered protection to the loggers while allowing for necessary water circulation to gather temperature readings. The PVC pipes were attached to existing Coast Guard maintained shoal/channel markers, dock pilings, trees, or bridge pilings using adjustable stainless-steel strapping and bungee cord. Loggers deployed on mooring lines were suspended one meter off the bottom or one meter below the surface using longline clips. Before deployment, loggers were programmed to gather temperature readings every 15 minutes.

Loggers were downloaded on a semi-annual basis or as time permitted at each office, and on a more frequent basis during and after a suspected cold stun. The software HOBOware version 3.7.5 (Onset Computer Corporation 2015) was used to download, view, and export the logger data to an Excel file format by each office. Anomalous temperature readings were removed by visual inspection of graphically represented data. If in anomalous data, air temperature data coincided with the recorded water temperatures and/or there were unusually large spikes in water temperature data, this data was deemed inaccurate and omitted (EPA 2014). Stations were analyzed as to whether they met the 5 °C for eight consecutive days and/or 3 °C for 24 consecutive hours triggers by visually inspecting the data. Water temperature triggers were considered met if water temperatures remained at or below 5 or 3 °C for the respective number of hours of each trigger. If there were surface and deep HOBO loggers at a station, only water temperature data from deep loggers were analyzed because 1) deeper depths were less likely to be exposed to air and/or ice and thus are more accurate; 2) as water temperatures drop spotted seatrout attempt to move to deeper and warmer water, but if deeper waters are meeting the trigger then that means there is less likely to be a thermal refuge in the body of water that the logger is located in.

Program 120 Juvenile Abundance Index

Program 120, the North Carolina Estuarine Trawl Survey, is a fisheries independent multispecies monitoring program that has provided a long-term database of annual juvenile recruitment for

economically important species since 1978. This survey samples a fixed set of 105 core stations with additional stations as needed. Spotted seatrout specific sampling started in 2004 at 27 additional stations located in Pamlico Sound, and the Pamlico, Pungo, and Bay rivers (Figure 2), which are sampled twice a year in June and July. Sampling is conducted using an otter trawl with a 3.2 m headrope, 6.4 mm mesh wings and body, and 3.2 mm mesh cod end. Tow duration is one minute, and all individuals collected are identified, sorted, and counted.

For analysis, Program 120 data were limited to the 27 spotted seatrout stations sampled in June and July from 2004-2018. Spotted seatrout less than 150 mm TL (all fish from 2004 to 2018) were assumed to be juvenile fish. A spotted seatrout juvenile abundance index (JAI) was calculated by year as an average of the number of fish collected per minute at each station. Since all tows are one minute, no reweighting was necessary.

3 RESULTS

Spotted Seatrout Natural Mortality

Triannual estimates of spotted seatrout natural mortality for the period of March 2016 through October 2018 ranged from a low of 0.002 (CrI=lower and upper bounds of the 95% credible interval) (CrI: 0.000, 0.120) in the summer of 2017 to a high of 1.595 (CrI: 0.482, 2.467) in the winter of 2017/2018 (Table 3; Figure 3). Spotted seatrout natural mortality estimates showed seasonality, with peaks in the winters of 2016/2017 and 2017/2018, and lows during summer and fall. A significantly higher rate of natural mortality was estimated in the winter of 2017/2018 compared to the winter of 2016/2017 (0.423; CrI: 0.000, 0.891).

Water Temperature Trigger Analysis

Water temperature data from the period of the cold stun (December 28, 2017 through January 28, 2018) was available from 43 stations throughout coastal North Carolina; water temperature data and triggers from stations selected to represent locations coastwide is shown in Figure 4. Thirty-four stations met at least one of the triggers (79%) (Table 1; Figures 5 and 6). Locations of stations that met at least one of the triggers spanned from North River (Currituck/Camden counties) to the New River (Onslow County). Thirty-three stations met the 5 °C trigger (Table 1; Figure 5) and 33 stations met the 3 °C trigger (Table 1; Figure 6). Slocum Creek Head met the 5 °C trigger but did not meet the 3 °C trigger. Spooners Creek met the 3 °C trigger but did not meet the 5 °C trigger. The nine stations that did not meet either trigger were located from South River south to the Cape Fear River. There appeared to be a transitional region for the cold stun event between tributaries of the Neuse River and tributaries of the New River, which included stations that did and did not meet water temperature triggers (Figures 5 and 6). No stations south of the New River met either trigger.

Program 120 Juvenile Abundance Index

The Program 120 spotted seatrout juvenile abundance index was variable, with no clear trend and peaks in 2006, 2008, 2012, 2013, and 2018 (Table 4; Figure 7). Juvenile abundance ranged from a low of 0.67 fish per tow in 2004 to a high of 4.15 fish per tow in 2008, and averaged 2.19 fish per tow from 2004-2017. The spotted seatrout juvenile abundance index in 2018 (2.89 fish per tow) was above the time-series average and above the five-year average (1.67 fish per tow).

4 DISCUSSION

Spotted Seatrout Natural Mortality

Cold stun events are relatively common in North Carolina coastal waters, occurring every several years, although the magnitude, extent, and consequent impact on spotted seatrout populations will differ (McEachron et al. 1994; NCDMF 2015; Ellis et al. 2017a; Ellis et al. 2018). While winter severity is strongly correlated to spotted seatrout natural mortality, quantifying the magnitude of mortality is difficult. A tag-return model was used to estimate an instantaneous rate of natural mortality during the period of the January 2018 cold stun event. The values of natural mortality presented in this report are not numbers of fish, but instead rates at which individual fish are lost from a population over a specific time interval, which can be used to compare to previous reported rates of natural mortality for spotted seatrout.

The high rate of spotted seatrout natural mortality in the winter of 2017/2018 (i.e., 1.59) estimated by the model was consistent with estimated natural mortality from previous cold stun events. Comparatively, Ellis et al. (2018) estimated North Carolina spotted seatrout mortality from 2008-2012, and found that their natural mortality estimates supported the occurrences of two cold stun events in the winters of 2009/2010 (i.e., 1.55) and 2010/2011 (i.e., 2.91) (Ellis et al. 2017a; Ellis et al. 2018). Therefore, while the rate of natural mortality from the winter of 2017/2018 was high and similar to the winter of 2009/2010, it was not as high as the natural mortality observed in the winter of 2010/2011. The results in this report provide additional insight into natural mortality rates during cold stun events, but the complete range of natural mortality for the North Carolina spotted seatrout stock is still unknown (Ellis et al. 2018). Continued tagging effort is needed through the division's multispecies tagging program to fully understand the effects of varying winter severity on spotted seatrout natural mortality.

Water Temperature Trigger Analysis

The implementation of the adaptive management framework for spotted seatrout cold stun closures (NCDMF 2016) has reduced uncertainty in the magnitude and geographical extent of a spotted seatrout cold stun event, allowing NCDMF to make objective management decisions. Based on this report's analysis of stations that met one or both water temperature triggers, the January 2018 cold stun event was clearly extensive, encompassing most of coastal North Carolina. Survival probabilities of spotted seatrout are estimated to fall below 50% after meeting either of the triggers (Ellis et al. 2017a); water temperatures fell below spotted seatrout's cold tolerance in many of North Carolina's creeks and bays for long enough to make spotted seatrout highly vulnerable to cold-related mortality. In nearly all creeks and bays north of New River that met the 3 °C trigger, the water remained at or below 3 °C for more than two days, which is low enough to cause 100% mortality of spotted seatrout. This water temperature analysis is largely consistent with statewide reports by the public and division of cold stunned spotted seatrout, especially the high numbers of dead spotted seatrout observed in the White Oak, Neuse, and Pamlico rivers and their tributaries.

Minor spotted seatrout cold stuns (approximately 1-5 dead spotted seatrout observed per location) were reported by the public and NCDMF in the southern region of the state where neither trigger was met, such as in Topsail Creek, Pages Creek, and canals near Holden Beach (respectively Pender, New Hanover, and Brunswick counties). Ellis et al. (2017a) reported survival rates of approximately 83% for spotted seatrout subjected to 10 days at 7 °C; thus, while not meeting the water temperature triggers, water temperatures were low enough for long enough to stun fish and cause some mortality. In addition, when water temperatures drop below 7 °C, spotted seatrout will attempt to either leave the area (i.e., emigrate) or move to deeper waters (i.e., a thermal refuge) (Ellis et al. 2017b). However, environmental conditions, such as tidal currents, may impede the fishes' ability to find thermal refuge or emigrate, making them more susceptible to becoming

stunned. Another explanation is that water temperatures may have abruptly fallen critically low for a short period of time, causing instantaneous loss of equilibrium and then mortality. During the period of the cold stun event, water temperatures at Pages Creek dropped below 2 °C four times between Jan. 4 and Jan. 8, 2018. Similarly, water temperatures at Dutchman Creek (Brunswick County), the southernmost station, fell below 2 °C once. For spotted seatrout, the minimum stressful but survivable water temperature over a very short duration is approximately 2-3 °C. Water temperatures below 2-3 °C, even for a short duration, will most likely be fatal (McDonald et al. 2010; Ellis et al. 2017a).

Only one report of cold stunned spotted seatrout was confirmed in the northern region of the state; however, all stations in this region met both triggers. The lack of observed stuns is most likely due to a difference in migration patterns and overwintering habits of spotted seatrout further north. At the northernmost extent of their range, spotted seatrout migrate out of estuaries in the fall and overwinter south along the coast (Dorval et al. 2005; Smith et al. 2008; Ellis 2014; Ellis et al. 2017b). If these spotted seatrout overwinter in the ocean as opposed to creeks and bays, they are not exposed to the rapid temperature declines associated with cold stun events, and therefore experience no related mortality. If these fish migrated to southern North Carolina estuaries (Ellis et al. 2017b), they too may have been affected by the cold stun there. However, for spotted seatrout that may have migrated south, their probability of survival was more likely greater than if they had remained in the northern regions of the state.

Program 120 Juvenile Abundance Index

After the January 2018 cold stun, harvest was closed until June 15, 2018 to allow the surviving population the opportunity to spawn in the spring. The Program 120 spotted seatrout JAI showed above average 2018 recruitment. Although we cannot definitively determine whether the closure explains the observed increase in recruitment, a harvest closure has been suggested to promote a quicker recovery of the population (McEachron et al. 1994).

5 CONCLUSIONS

The analysis of water temperature and tagging data, in addition to the reports of cold stunned fish, provides evidence of the January 2018 cold stun's extensive impacts on the spotted seatrout population. However, positive signs for the spotted seatrout stock can be seen in the above average 2018 recruitment.

Population dynamics of spotted seatrout in North Carolina are driven primarily by sources of natural mortality, such as cold stun events, which has high interannual variability (i.e., not all years have cold stun events so natural mortality will be very high some years and low others) (Ellis et al. 2018). The previous spotted seatrout stock assessment (NCDMF 2015) was unable to incorporate variable natural mortality estimates but recognized its importance to more accurately assess the spotted seatrout population. Consequently, development of a model that incorporated variable natural mortality estimates was added as a research recommendation to investigate during the next assessment. The next spotted seatrout benchmark stock assessment is scheduled to begin in 2019, and tag-return and water temperature data will be considered in the development of the model.

6 LITERATURE CITED

Anweiler, K.V., S. A. Arnott and M. R. Denson. 2014. Low-Temperature Tolerance of Juvenile Spotted Seatrout in South Carolina. Transactions of the American Fisheries Society 143:4, 999-1010.

Dorval, E., C. M. Jones, R. Hannigan, and J. van Montfrans. 2005. Can otolith chemistry be used for identifying essential seagrass habits for juvenile spotted seatrout, *Cynoscion nebulosus*, in Chesapeake Bay? Marine and Freshwater Research 56: 645-653.

Ellis, T.A. 2014. Mortality and movement of spotted seatrout at its northern latitudinal limits. (PhD dissertation). North Carolina State University, Raleigh, NC, 258 pp.

Ellis, T. A., J. A. Buckel, J. E. Hightower, and S. J. Poland. 2017a. Relating cold tolerance to winterkill for spotted seatrout at its northern latitudinal limits. Journal of Experimental Marine Biology and Ecology 490: 42-51.

Ellis, T. A., J. A. Buckel, and J. E. Hightower. 2017b. Winter severity influences spotted seatrout mortality in a southeast US estuarine system. Marine Ecology Progress Series 564: 145–161.

Ellis, T. A., J. E. Hightower, and J. A. Buckel. 2018. Relative importance of fishing and natural mortality for spotted seatrout (*Cynoscion nebulosus*) estimated from a tag-return model and corroborated with survey data. Fisheries Research 199: 81-93.

McEachron, L. W., G. C. Matlock, C. E. Bryan, P. Unger, T. J. Cody, and J. H. Martin, 1994. Winter mass mortality of animals in Texas bays. Northeast Gulf Science 13: 121–138.

McDonald, D. L., B. W. Bumguardner, and M. R. Fisher. 2010. Winterkill simulation on three size classes of spotted seatrout. Texas Parks and Wildlife Department, Austin Texas, Management Data Series No. 259.

Merriner 1980. History and management of the spotted seatrout fishery. Proc. Colloq. on the biology and management of red drum and spotted seatrout. Gulf States Mar. Fish. Comm. Spec. Rep.No. 5:55-61.

North Carolina Division of Marine Fisheries (NCDMF). 2012. North Carolina Spotted Seatrout Fishery Management Plan. NCDMF, Morehead City, North Carolina. 344 pp.

NCDMF. 2015. Stock Assessment of Spotted Seatrout, *Cynoscion nebulosus*, in Virginia and North Carolina Waters. NCDMF, Morehead City, North Carolina. 142 pp.

NCDMF. 2016. Internal guidelines for adaptive management for cold stun closures. NCDMF, Morehead City, North Carolina. 12 pp.

North Carolina Division of Marine Fisheries (NCDMF). 2012. North Carolina Spotted Seatrout Fishery Management Plan. NCDMF, Morehead City, North Carolina. 344 pp.

Plummer, M. 2003. JAGS: A program for analysis of Bayesian graphical models using Gibbs sampling. 3rd International Workshop of Distributed Statistical Computing (DSC 2003); Vienna, Austria. 124pp.

Smith, N. G., C. M. Jones, J. van Montfrans. 2008. Spatial and temporal variability of juvenile spotted seatrout *Cynoscion nebulosus* growth in Chesapeake Bay. Journal of Fish Biology 73: 597-607.

U.S. Environmental Protection Agency (EPA). 2014. Best practices for continuous monitoring of temperature and flow in wadeable streams. Global Change Research Program, National Center for Environmental Assessment, Washington, DC; EPA/600/R-13/170F. Available from the National Technical Information Service, Springfield, VA, and online at http://www.epa.gov/ncea.

7 TABLES

Table 1. A description of each HOBO temperature logger station that had data available during the time of the January 2018 cold stun event (Dec. 28, 2017 – Jan. 28, 2018), including the county the station is located in, the Division of Marine Fisheries office responsible for that station, the station water depth, and whether the station met the 5 °C and/or 3 °C triggers. Lastly, minimum, mean, and maximum water temperatures for the period of the cold stun event are given. EC=Elizabeth City Office, MAN=Manteo Office, WS=Washington Office, MC=Morehead City Office, WI=Wilmington Office.

Station Description	County	DMF Office	Depth (m)	Met 5 °C Trigger	Met 3 °C Trigger	Min Water Temp (°C)	Mean Water Temp (°C)	Max Water Temp (°C)
North River marker 135	Currituck	EC	2.6	Y	Y	-0.3	3.0	8.6
Little Alligator Old HWY 64 Bridge Alligator River	Tyrrell	EC	2.4	Y	Y	0.8	4.5	9.2
Little Alligator DOT Canal Alligator River	Tyrrell	EC	2.1	Y	Y	-0.2	4.4	9.5
Little Alligator River Rock Pt. Alligator River	Tyrrell	EC	0.9	Y	Y	0.4	4.8	11.1
Upper Second Creek Alligator River Mike Binkleys blind	Tyrrell	EC	0.9	Y	Y	-0.3	4.8	12.3
Lower Second Creek Alligator River	Tyrrell	EC	0.9	Y	Y	-0.3	4.2	11.2
Kitty Hawk Bay marker 6	Dare	MAN	2.4	Y	Y	-0.2	3.8	10.7
Peter Mashoes Creek 1	Dare	MAN	1.1	Y	Y	-0.5	3.3	9.5
Avon Basin	Dare	MAN	2.0	Y	Y	-3.0	4.1	20.3
Hatteras Slash Creek bridge	Dare	MAN	1.3	Y	Y	-1.3	4.4	17.0
Long Shoal Deep Creek bridge	Dare	MAN	3.4	Y	Y	-0.6	4.5	10.2
Long Shoal Deep Creek mouth	Dare	MAN	0.9	Y	Y	2.4	5.6	10.3
Swan Quarter Bay marker # (red light 10) - sign post	Hyde	WS	2.3	Y	Y	-0.7	4.9	10.9
Pungo River 264 Bridge Leechville - Stump	Beaufort	WS	2.2	Y	Y	0.5	4.7	10.8
Pungo Creek HWY 92 - piling	Beaufort	WS	2.1	Y	Y	0.1	4.3	9.8
Bath Creek - Old railroad piling	Beaufort	WS	2.4	Y	Y	-0.1	5.0	10.6
Blounts Creek SR1112 bridge	Beaufort	WS	2.4	Y	Y	0.2	4.5	9.9
South Creek (Pamlico) - Hwy 33 bridge	Beaufort	WS	1.8	Y	Y	-1.5	6.1	15.8
Bay River Green marker 9	Pamlico	WS	3.4	Y	Y	1.9	5.4	11.5
Oriental HWY 55/SR1308 bridge Neuse River	Pamlico	WS	3.4	Y	Y	1.7	5.5	12.2
Slocum mouth on VR2 station #NE315	Craven	MC	2.6	Y	Y	-0.6	5.4	13.1

Station Description	County	DMF Office	Depth (m)	Met 5 °C Trigger	Met 3 °C Trigger	Min Water Temp (°C)	Mean Water Temp (°C)	Max Water Temp (°C)
Tucker Creek split	Craven	MC	1.3	N	N	0.6	7.6	14.7
Slocum Creek head	Craven	MC	3.0	Y	N	1.8	6.7	16.0
Hancock Creek mid	Craven	MC	1.3	Y	Y	-3.1	6.5	20.2
Hancock Creek head	Craven	MC	4.8	N	N	4.8	8.0	12.9
North River Narrows	Carteret	MC	2.0	Y	Y	-1.4	5.5	15.1
Spooners Creek	Carteret	MC	1.6	N	Y	0.5	7.1	16.5
White Oak River Stella bridge	Onslow	MC	4.0	Y	Y	0.3	5.5	10.1
Pettiford Creek	Carteret	MC	2.3	Y	Y	-0.4	5.7	13.2
Jarrett Bay; Smyrna Creek	Carteret	MC	2.0	Y	Y	-1.2	6.1	18.7
Long Bay headwaters	Carteret	MC	1.5	Y	Y	0.1	6.0	16.6
South River mid	Carteret	MC	1.0	N	N	3.4	7.6	11.5
South River headwaters	Carteret	MC	2.5	Y	Y	0.9	6.1	16.3
Queens Creek	Carteret	MC	1.0	Y	Y	-0.5	5.8	13.4
New River 172 bridge	Onslow	WI	3.4	Y	Y	-1.0	5.6	11.2
New River Mill Creek boat ramp	Onslow	WI	1.5	N	N	0.0	5.2	16.0
New River North East Creek HWY 24 bridge	Onslow	WI	2.7	Y	Y	0.6	6.8	14.1
New River S Marine BLVD bridge	Onslow	WI	3.0	N	N	2.7	7.4	14.4
New River Southwest Creek	Onslow	WI	1.4	Y	Y	-0.1	5.0	11.1
Cape Fear River Dutchman Creek	Brunswick	WI	2.1	N	N	1.4	8.3	15.5
Pages Creek	New Hanover	WI	1.1	N	N	1.5	7.7	15.1
Sunny Point	Brunswick	WI	3.6	N	N	2.7	7.0	10.9
Mallory Creek	Brunswick	WI	2.1	N	N	2.3	6.9	11.3

Table 2. Total number of spotted seatrout used in the tag-return model that were released and recaptured each year for the period of this study (March 2016 – December 2018).

Year	Annual Time Period	Released	Recaptured
2016	Mar-Feb	1,203	96
2017	Mar-Feb	2,520	122
2018	Mar-Dec	1,095	14

Table 3. Summary of the triannual time step estimates of natural mortality (*M*) for spotted seatrout from March 2016 to October 2018. Presented estimates are the posterior medians and associated lower and upper bounds of the 95% credible interval (CrI).

Time Step	*M*	Lower CrI	Upper CrI
March 2016 - June 2016	0.061	0.000	0.868
July 2016 - October 2016	0.005	0.000	0.347
November 2016 - February 2017	0.423	0.000	0.891
March 2017 - June 2017	0.170	0.000	0.767
July 2017 - October 2017	0.002	0.000	0.120
November 2017 - February 2018	1.595	0.482	2.467
March 2018 - June 2018	0.005	0.000	0.735
July 2018 - October 2018	0.005	0.000	0.664

Table 4. Program 120 juvenile abundance index (JAI; average number of fish collected per tow) from 2004-2018, June and July combined, with number of samples (N) and standard error (SE).

Year	N	JAI	SE
2004	54	0.67	0.23
2005	54	2.80	0.69
2006	54	4.13	1.54
2007	54	2.59	0.81
2008	54	4.15	1.08
2009	54	1.09	0.29
2010	54	1.72	0.54
2011	54	1.11	0.31
2012	54	4.00	1.13
2013	54	3.54	0.91
2014	54	1.46	0.39
2015	54	1.81	0.55
2016	54	0.72	0.22
2017	54	0.80	0.25
2018	54	2.89	0.74

8 FIGURES

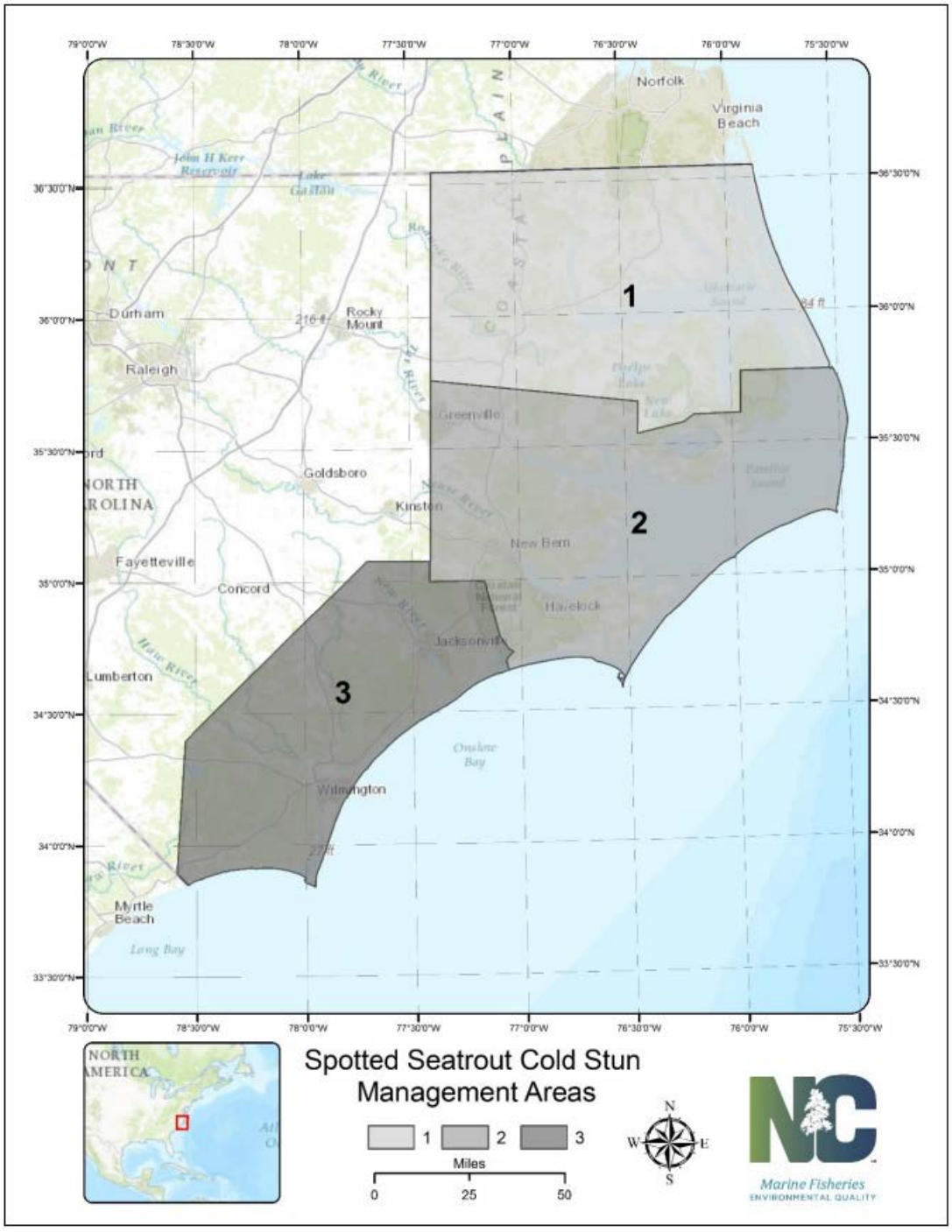

Figure 1. Spotted seatrout cold stun management areas

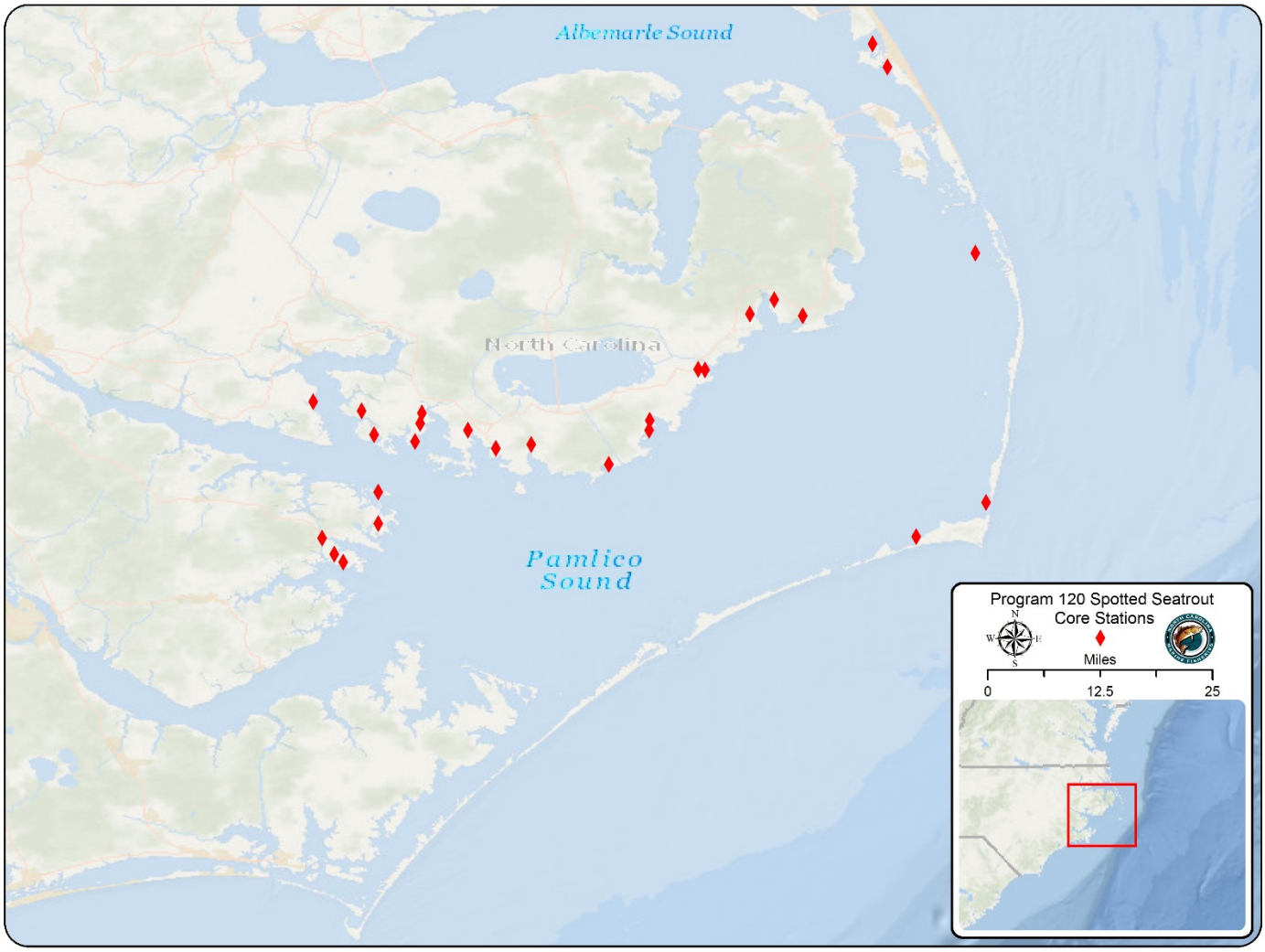

Figure 2. Program 120 Estuarine Trawl Survey spotted seatrout core stations that are sampled June and July, 2004-Present.

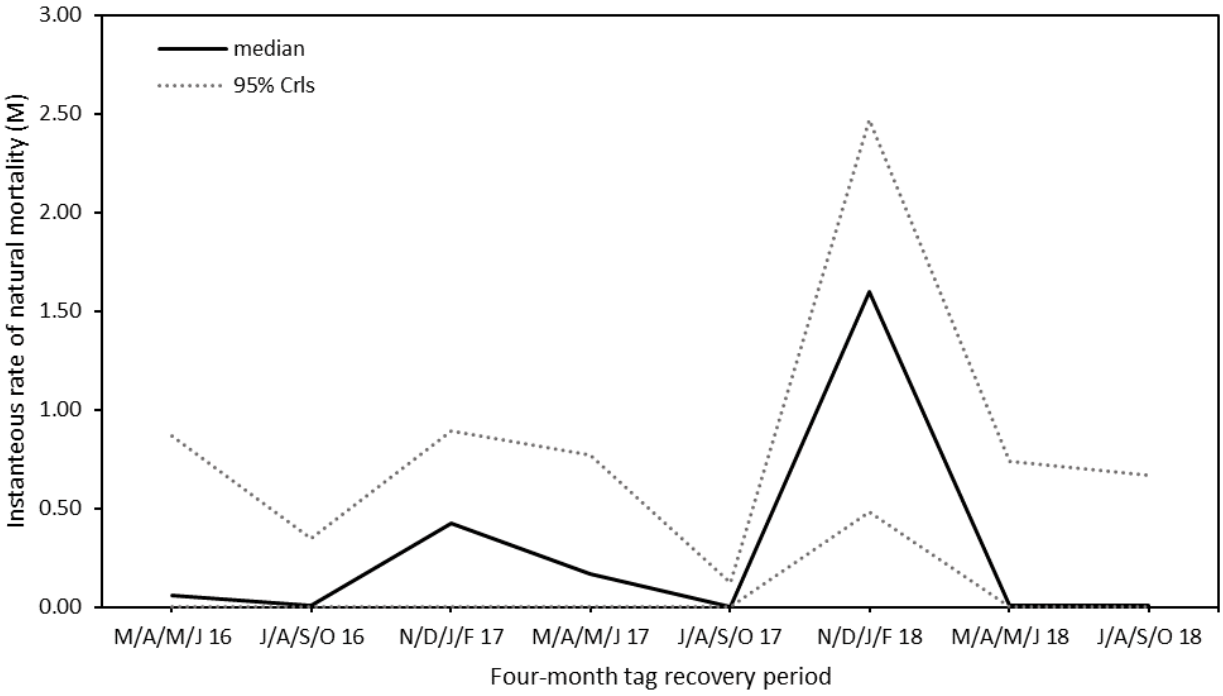

Figure 3. The instantaneous natural mortality rate estimated across eight triannual tag-recovery periods (March 2016–October 2018) from spotted seatrout tagged in North Carolina waters. Presented estimates are the posterior medians and associated lower and upper bounds of the 95% credible interval (CrI).

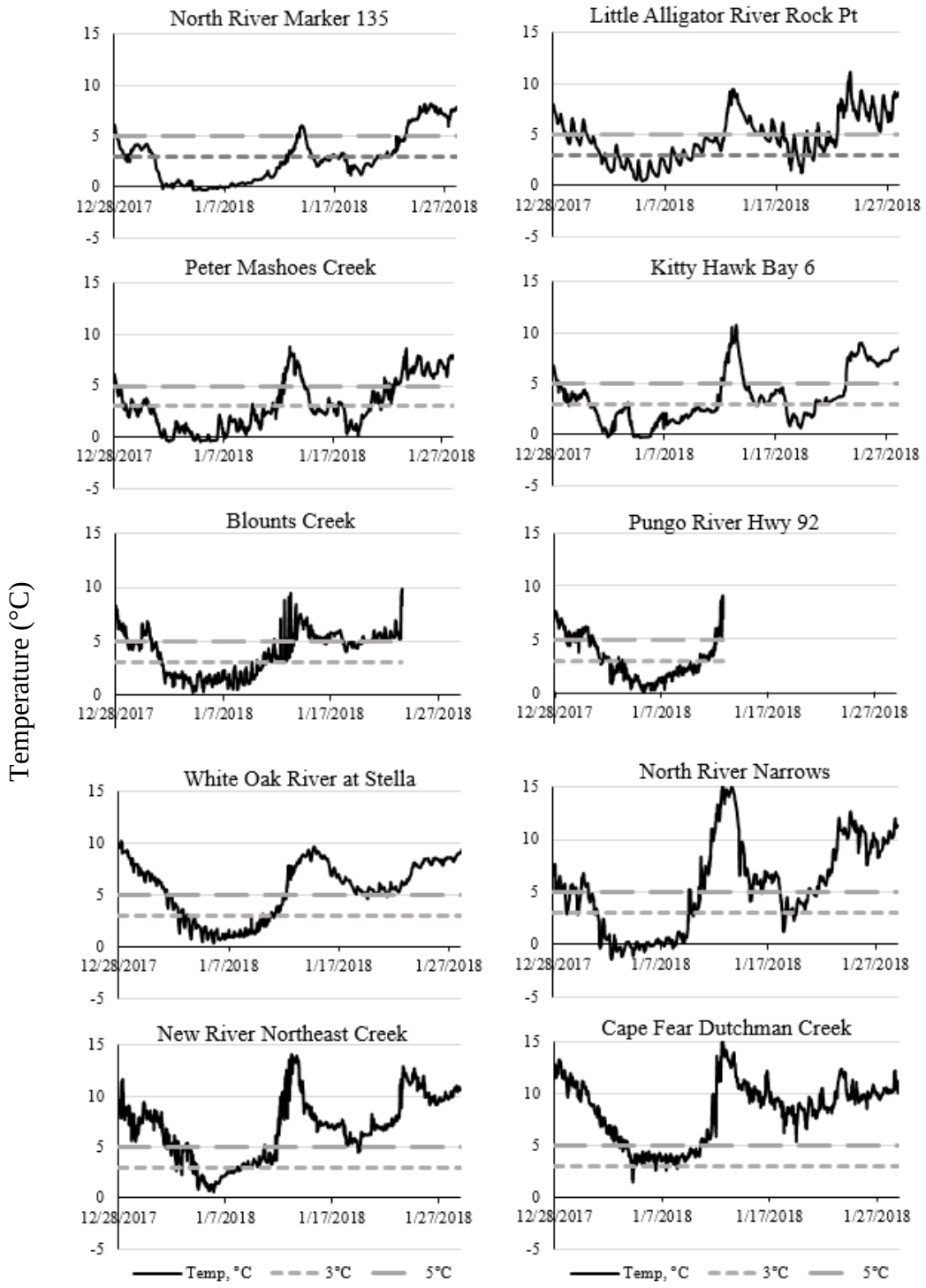

Figure 4. Water temperatures (°C) from 12/28/17 through 1/28/18 (during the period of the January 2018 cold stun) from representative stations across North Carolina, with the 3°C (short dash) and 5°C (long dash) triggers. If there were shallow and deep loggers at a station, only data from the deep logger is shown.

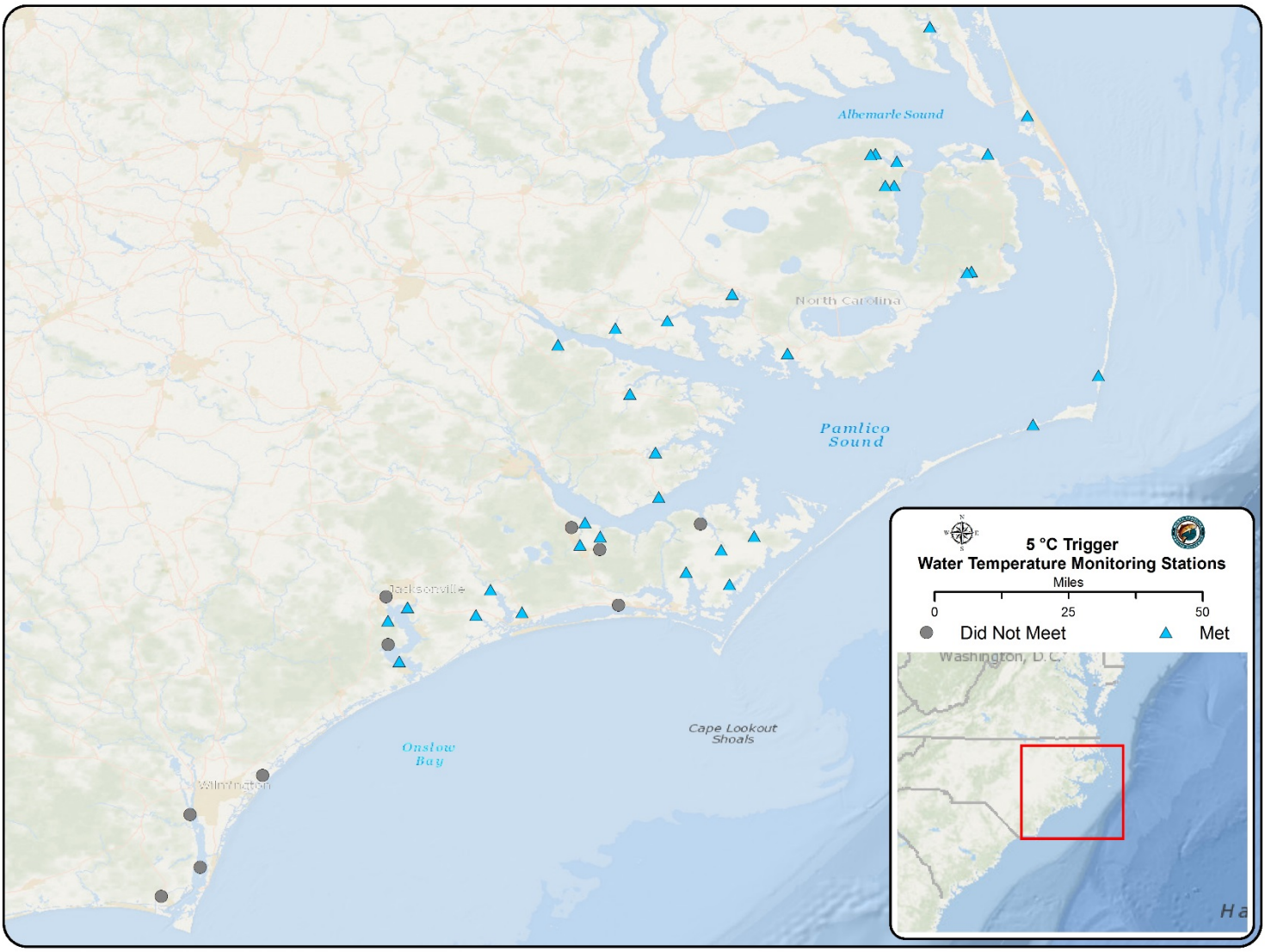

Figure 5. Water temperature monitoring stations that did (light blue triangle) and did not (gray circle) meet the 5 °C for eight consecutive days trigger for the period of December 28, 2017 to January 28, 2018.

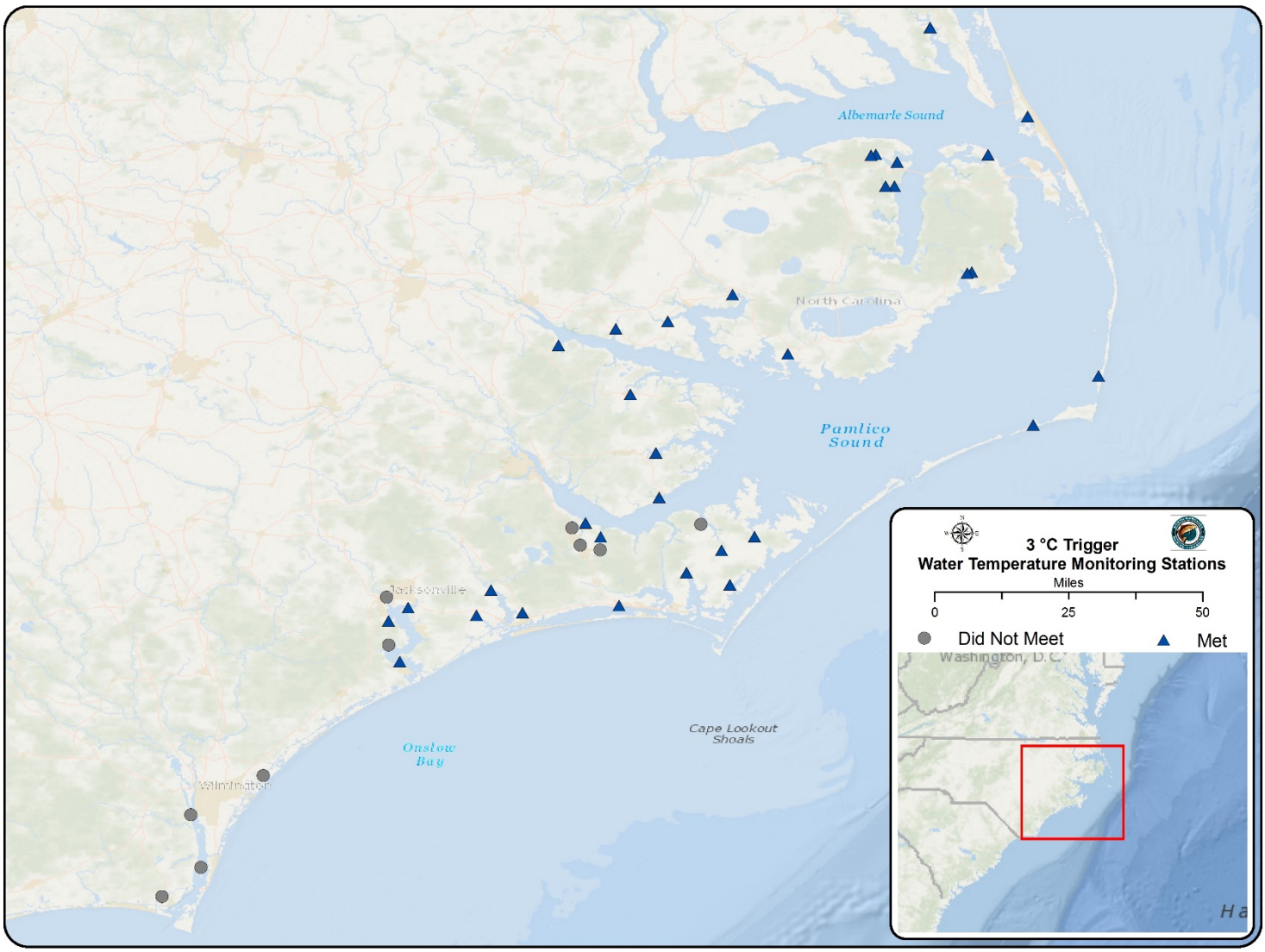

Figure 6. Water temperature monitoring stations that did (dark blue triangle) and did not (gray circle) meet the 3 °C for 24 consecutive hours trigger for the period of December 28, 2017 to January 28, 2018.

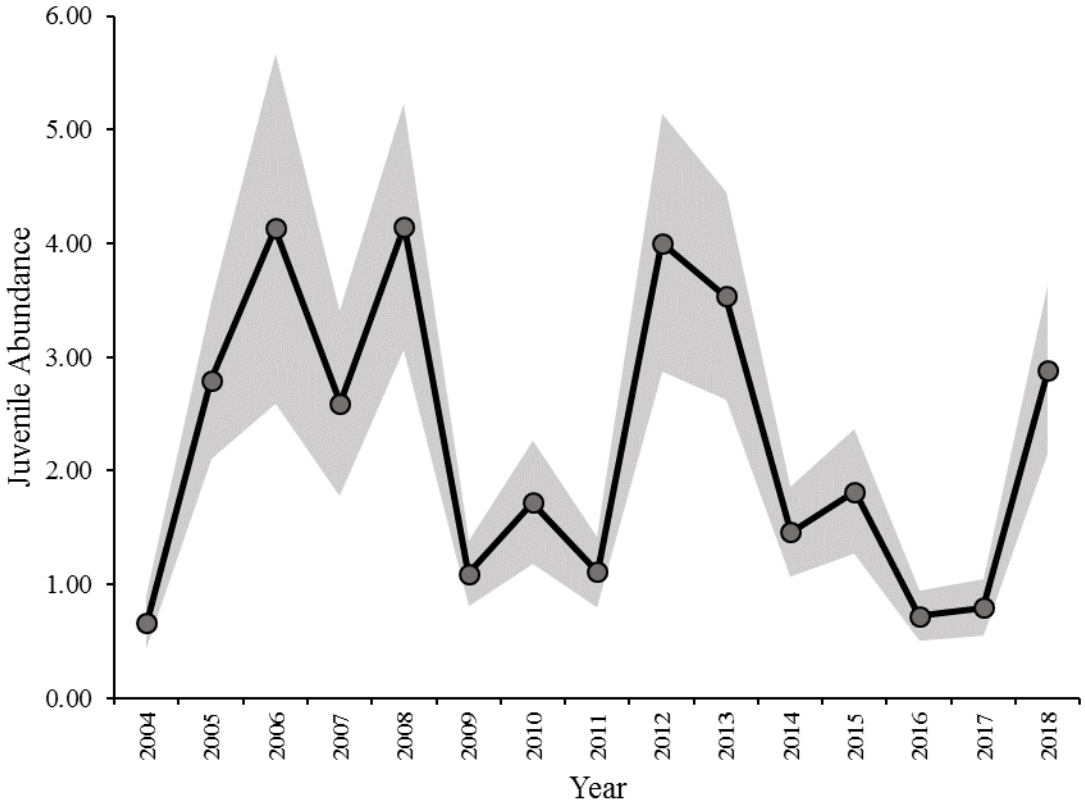

Figure 7. Spotted seatrout juvenile abundance index (average number of fish per tow) from Program 120 Estuarine Trawl Survey, June and July, 2004-2018. The shaded area represents standard error.

Issues/Reports

ROY COOPER
Governor
MICHAEL S. REGAN
Secretary
STEPHEN W. MURPHEY
Director

Feb. 6, 2019

MEMORANDUM

TO: N.C. Marine Fisheries Commission

FROM: Catherine Blum, Fishery Management Plan and Rulemaking Coordinator
Fisheries Management Section

SUBJECT: Rulemaking Update

Issue
This memo updates the Marine Fisheries Commission on the status of rulemaking in support of the Periodic Review and Expiration of Existing Rules per G.S. 150B-21.3A.

Action Needed
For informational purposes only; **while no action is needed at this time**, the division is seeking the commission's input on the proposed tarpon rule change that will be part of the 2019-2020 annual rulemaking cycle.

Summary
This memo provides an overview for the February 2019 commission meeting on the status of rulemaking.

15A NCAC 18A Report Update

At its February 2018 meeting, the Marine Fisheries Commission gave approval to begin the report process for the 164 rules in 15A NCAC 18A .0100, .0300-.0900, and .3400, regarding shellfish sanitation and recreational water quality requirements. All rules were classified as necessary with substantive public interest and will be subject to readoption. The final report was approved by the Marine Fisheries Commission at its August 2018 meeting and the Rules Review Commission at its January 2019 meeting. The report will be forwarded to the Joint Legislative Administrative Procedure Oversight Committee for final determination.

15A NCAC 03 Rule Readoption Update

2018-2019 Annual Rulemaking Cycle

At its May 2018 meeting, the Marine Fisheries Commission approved Notice of Text for Rulemaking to begin the readoption process for 41 rules per G.S. 150B-21.3A, Periodic Review and Expiration of Existing Rules. The rules received final approval by the Marine Fisheries Commission at its November 2018 meeting and the Rules Review Commission at its January 2019 meeting. The rules will be effective April 1, 2019 and the process will be complete. A handout showing the steps in the Marine Fisheries Commission's 2018-2019 annual rulemaking cycle is included in the briefing materials.

State of North Carolina | Division of Marine Fisheries
3441 Arendell Street | P.O. Box 769 | Morehead City, North Carolina 28557
252-726-7021

2019-2020 Annual Rulemaking Cycle

At its May 2019 meeting, the Marine Fisheries Commission is scheduled to consider approval of Notice of Text for Rulemaking to begin the readoption process for the second group of rules in 15A NCAC 03. In preparation for this step and as requested by the commission at its February 2018 meeting, a draft issue paper to consider amendments to the tarpon rule, 15A NCAC 03M .0509 is included in the briefing materials. The issue paper considers amending the rule to remove the daily harvest allowance and make it unlawful to spear or gaff tarpon in N. C. Coastal Fishing Waters.

The Marine Fisheries Commission received public comment at its February 2018 meeting to consider tarpon a no kill species and prohibit gaffing and spearing to improve the survival of the fish. There was also public comment supporting tarpon as a catch and release only species. The commission passed a motion for the Division of Marine Fisheries to draft rules to make tarpon a no spear, no gaff and no possession fish. The issue paper in the briefing materials provides background information on the issue, including regulations in other southeast states. The discussion section explains the management options and associated proposed rule amendments provided in the paper for the commission's consideration. The division's recommendation is also included. Based on the commission's input at its February 2019 meeting, a final proposed version of the rule will be provided to the commission at its May 2019 meeting to begin the rulemaking process. The rule is intended to become effective April 1, 2020.

Overview

This memo provides an overview for the February 2019 commission meeting on the status of rulemaking for informational purposes only; **no action is needed at this time**. Background information is provided here, including recent actions that have occurred. Two supporting handouts are provided in the briefing materials: a figure showing the steps in the commission's 2018-2019 annual rulemaking cycle and an issue paper requested by the commission for proposed amendments to the tarpon rule.

Background on the Periodic Review and Expiration of Existing Rules

Session Law 2013-413, the Regulatory Reform Act of 2013, implemented requirements known as the "Periodic Review and Expiration of Existing Rules." These requirements are codified in a new section of Article 2A of Chapter 150B of the General Statutes in G.S. 150B-21.3A. Under the requirements, each agency is responsible for conducting a review of all its rules at least once every 10 years in accordance with a prescribed process.

The review has two parts. The first is a report phase, followed by the readoption of rules. An evaluation of the rules under the authority of the Marine Fisheries Commission is being undertaken in two lots (see Figure 1.) A report on the rules in Title 15A, Environmental Quality, Chapter 03, Marine Fisheries was due to the Rules Review Commission December 2017. A report on the rules in Chapter 18, Environmental Health, for portions of Subchapter A that govern shellfish sanitation and recreational water quality was due January 2019. The Marine Fisheries Commission has 211 rules in Chapter 03 and 164 rules in Chapter 18A. The Marine Fisheries Commission is the body with the authority for the approval steps prescribed in the process for these rules.

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252-726-7021

Rules	2017	2018	2019	2020	2021	2022
Chapter 03 (211 rules)	Report	Rule Readoption				
Chapter 18A (164 rules)		Report	Rule Readoption			

Figure 1. Marine Fisheries Commission schedule to comply with G.S. 150B-21.3A, Periodic Review and Expiration of Existing Rules.

The process began for the Marine Fisheries Commission at its February 2017 meeting with approval of the draft report on the rules in Title 15A, Environmental Quality, Chapter 03, Marine Fisheries. This report contained 211 rules. Nine of these 211 rules are jointly adopted by the Marine Fisheries Commission and the Wildlife Resources Commission. The rules are subtitled "Jurisdiction of Agencies: Classification of Waters" and are found in 15A NCAC 03Q .0100. Similarly, the Wildlife Resources Commission has 11 rules that are jointly adopted and have the same subtitle; they are found in 15A NCAC 10C .0100. For the required steps in the periodic review process, both agencies must approve both sets of rules, since the rules were jointly adopted. The approvals for the draft report on these rules occurred at the Marine Fisheries Commission's February and May 2017 meetings and the Wildlife Resources Commission's April 2017 meeting.

For the reports, the first step is for each agency to make a determination as to whether each rule is necessary with substantive public interest, necessary without substantive public interest, or unnecessary. After the draft reports are approved, they are posted on the agency website for public comment for a minimum of 60 days. It is important to note, for the purposes of these requirements, "public comment" means written comments from the public objecting to the rule. The agency must review the public comments and prepare a brief response addressing the merits of each comment. This information becomes the final report.

A public comment period was held for rules in 15A NCAC 03Q .0100 from April 25-July 5, 2017. There was one comment received on Rule 15A NCAC 03Q .0105, "Posting Dividing Lines." The commenter did not agree with the agency's determination of the rule being classified as necessary with substantive public interest. The commenter determined the rule is unnecessary, but did not provide a reason. Staff recommended the rule remain classified as necessary with substantive public interest. The final report reflected one public comment without merit was received for this rule and was otherwise unchanged from the draft version. A public comment period was held for all other rules in 15A NCAC 03 from Feb. 23-May 3, 2017; no public comments were received. A public comment period was held for rules in 15A NCAC 10C .0100 from May 22-July 31, 2017; no public comments were received.

The final report for rules in 15A NCAC 03Q .0100 and the final report for rules in 15A NCAC 10C .0100 were approved by the Marine Fisheries Commission at its August 2017 meeting, the Wildlife Resources Commission at its August 2017 meeting, and the Rules Review Commission

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at its December 2017 meeting. The final report for all other rules in 15A NCAC 03 was approved by the Marine Fisheries Commission at its August 2017 meeting and the Rules Review Commission at its December 2017 meeting. The reports were forwarded to the Joint Legislative Administrative Procedure Oversight Committee for final determination. The committee met Jan. 9, 2018 and the review process was complete.

At its February 2018 meeting, the Marine Fisheries Commission gave approval to begin the report process for the 164 rules in 15A NCAC 18A .0100, .0300-.0900, and .3400, regarding shellfish sanitation and recreational water quality requirements. The process followed the same timing that occurred in 2017 for the previous rule reports. A public comment period was held for these rules from Feb. 26-May 7, 2018; no public comments were received. The final report was approved by the Marine Fisheries Commission at its August 2018 meeting and the Rules Review Commission at its January 2019 meeting. The report will be forwarded to the Joint Legislative Administrative Procedure Oversight Committee for final determination.

The second part of the periodic review process is the readoption of rules. The final report determines the process for readoption. Rules determined to be necessary and without substantive public interest and for which no public comment was received remain in effect without further action. Rules determined to be unnecessary and for which no public comment was received expire on the first day of the month following the date the report becomes effective. Rules determined to be necessary with substantive public interest must be readopted as though the rules were new rules. The Rules Review Commission works with each agency to consider the agency's rulemaking priorities in establishing a deadline for the readoption of rules.

The final determinations for the nine rules in 15A NCAC 03Q .0100 were unchanged from how they were submitted and as a result, are subject to readoption. All other rules in 15A NCAC 03 were unchanged from how they were submitted. As a result, three rules were determined to be unnecessary and expired, 36 rules were determined to be necessary without substantive public interest and remained in effect without further action, and 163 rules were determined to be necessary with substantive public interest and must be readopted as though they were new rules. The final determinations for the 11 rules in 15A NCAC 10C .0100 were unchanged from how they were submitted and as a result, are subject to readoption.

The next step in the process is to set a readoption schedule. At its February 2018 meeting, the Marine Fisheries Commission approved the schedule for readoption of these rules to be completed by June 30, 2022. Due to the nature of the jointly-adopted rules of the Marine Fisheries Commission and the Wildlife Resources Commission, the Wildlife Resources Commission also approved the readoption schedule at its April 2018 meeting. The proposed readoption schedule, as approved by the Marine Fisheries Commission and the Wildlife Resources Commission, was approved by the Rules Review Commission at its June 2018 meeting.

To achieve readoption of the 15A NCAC 03 rules within the deadline, staff will prepare approximately 40 to 45 rules for readoption in each of four years. For the 2018-2019 rule package, the Marine Fisheries Commission approved Notice of Text for Rulemaking at its May 2018 meeting for 41 rules, which began the rulemaking process. The proposed rules in this package were recently

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amended and/or needed only technical changes. The rules had no anticipated costs associated with them and they benefit stakeholders with increased clarity and consistency across rules. The rules were published in the Aug. 1, 2018 *N.C. Register*. A public comment period was held from Aug.1 through Oct. 1, 2018. A public hearing was held Aug. 22, 2018 in Morehead City, N.C.; no one from the public attended. One written public comment was submitted. The commenter proposed additional changes outside the scope of the proposed technical and conforming changes that were originally approved to move forward by the Office of State Budget and Management and the Marine Fisheries Commission. The Marine Fisheries Commission gave final approval of the rules at its November 2018 meeting. The Rules Review Commission gave final approval of the rules at its January 2019 meeting. The rules will be effective April 1, 2019 and the process will be complete. A handout showing the steps in the Marine Fisheries Commission's 2018-2019 annual rulemaking cycle is provided in the briefing materials.

Staff is already preparing the next package of 40 to 45 rules in 15A NCAC 03 for readoption, which will occur in the second of four years. For the 2019-2020 rule package, rules proposed for readoption will include 15A NCAC 03M .0509, Tarpon. At its February 2018 meeting, the Marine Fisheries Commission voted to have the division begin the process of drafting a rule to make tarpon a no spear, no gaff, and no possession fish. A draft issue paper to consider these amendments to the tarpon rule is included in the briefing materials. The rules in the 2019-2020 package will be provided to the Marine Fisheries Commission at its May 2019 meeting to begin the rulemaking process. These rules are intended to become effective April 1, 2020.

N.C. Marine Fisheries Commission
2018-2019 Annual Rulemaking Cycle

February 2019

Time of Year	Action
January 2018	Last opportunity for a new issue to be presented to DMF Rules Advisory Team
February 2018	Second review by DMF Rules Advisory Team
February-April 2018	Fiscal analysis of rules prepared by DMF staff and approved by Office of State Budget and Management
May 2018	MFC approved Notice of Text for Rulemaking
Aug. 1, 2018	Publication of proposed rules in the North Carolina Register
Aug. 1-Oct. 1, 2018	Public comment period
Aug. 22, 2018	Public hearing held: 6 p.m., Division of Marine Fisheries, 5285 Highway 70 West, Morehead City, NC 28557
November 2018	MFC considers approval of permanent rules
January 2019	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)
Feb. 1, 2019	Earliest possible effective date of rules
February/March 2019	Rulebook prepared
April 1, 2019	Actual effective date of new rules
April 1, 2019	Rulebook available online
April 15, 2019	Commercial license sales begin

PROPOSED TARPON RULE CHANGE ISSUE PAPER

Jan. 29, 2019

I. ISSUE

Consider amending N.C. Marine Fisheries Commission Rule 15A NCAC 03M .0509 to remove the daily harvest allowance and make it unlawful to spear or gaff tarpon in N.C. Coastal Fishing Waters.

II. ORIGINATION

N.C. Marine Fisheries Commission

III. BACKGROUND

Anecdotal reports from the public since 2017 expressed concern over the rule 15A NCAC 03M .0509 that allows for the recreational hook and line harvest of tarpon, and that tarpon were being used as cut bait to fish for sharks. An email and a phone conversation with two fishing guides to staff occurred since July 2017, and one public comment was received, on behalf of some recreational guides, during the Marine Fisheries Commission meeting on February 14, 2018, asking the Commission to consider tarpon a no kill species and include no gaffing and no spearing, to improve the survival of the fish. During the public comment it was indicated the recreational guides know that tarpon move into N.C. waters on their migratory run from the south to spawn and they see juveniles, but was unsure if these juveniles survive the winter. A letter was also given to the commission from the Bonefish and Tarpon Trust Foundation further supporting tarpon as a catch and release only species. A motion was introduced and passed by the commission the next day asking the Division of Marine Fisheries to draft rules to make tarpon a no spear, no gaff, and no possession fish. This paper responds to their motion and initiates the division process for considering rule changes.

Tarpon are prized by recreational anglers for their large size and strength in their fight. They are found in warmer waters on both sides of the Atlantic Ocean and in the Gulf of Mexico. Tarpon found in state waters are presumed to have migrated from points south, most likely Florida. They will enter the estuaries and have been found in the brackish or low salinity areas as well during the summer months. The population size of tarpon along the southeastern coast of the United States or in North Carolina is unknown. They are a bony fish and not desirable to eat, so most are released after they are caught. Only two tarpon were observed harvested in the 24 years of the division's recreational sampling program in 1987 and 2010, and although harvest is legal they are rarely encountered. Very little information is known about tarpon and there are no directed sampling programs for tarpon in North Carolina.

Reports on the harvest of tarpon for use as cut bait are undocumented. If used as cut bait, it is required that the angler, while engaged in fishing activities, must retain the carcass with head and tail intact per the Marine Fisheries Commission's mutilated finfish rule, NCAC 15A NCAC 03M .0101. The size of these fish would pose challenges to adhere to this rule. Recreational release mortality information on tarpon is limited to studies from Florida in the Boca Grande Pass and Tampa Bay areas. All release mortality studies are on tarpon caught from boats with fishing guides and not from shore or piers, with acoustic tagging following the fish for no more than 12 hours after release (Edwards 1992; Edwards 1998; Guindon 2011). These studies found low immediate post-release mortality of tarpon from catch and release. The most comprehensive and latest study estimated tarpon immediate post-release mortality at five percent, and factored the mortality to poor handling and irreparable physiological damage from the angling event (Guindon 2011). Use of a gaff or other puncturing tools to facilitate landing the tarpon increases damage to the fish and could decrease their chance of survival. Pier fishing, with their higher elevation from the water and distance from shore, makes it more likely that gaffs are used in order to land the fish. Therefore, the survival of tarpon from this mode may be less likely than from other modes of capture (i.e., boats, shore).

There is no interstate or federal fishery management plan in place for tarpon; management of this species rests solely with each coastal state. Rule 15A NCAC 03M .0509 for tarpon has been in effect since October 1, 1992 in North Carolina and has remained unchanged. The rule limits tarpon to be taken only with hook-and-line, and allows for the harvest of one fish per person per day, with no allowance to sell or offer to sell. South Carolina regulations for

tarpon are similar to regulations in North Carolina. Georgia also allows the taking of one tarpon per person per day at a minimum size of 68 inches fork length. Details on each state's regulations for tarpon and their website links are found below:

- Florida: http://myfwc.com/fishing/saltwater/recreational/tarpon/
  No minimum size limit, tarpon over 40 inches must remain in the water. It is a catch and release only fishery. One tarpon tag per person per year may be purchased when in pursuit of an International Game Fish Association record. Vessel, transport, and shipment limited to one fish.

- Georgia: http://www.eregulations.com/georgia/fishing/finfish-seasons-limits-sizes/
  Minimum size 68-inch fork length. Allowed one tarpon per person per day.

- South Carolina: http://dnr.sc.gov/marine/species/tarpon.html
  No minimum size limit. Allowed one tarpon per person per day, and may only be taken with rod and reel. Tarpon is designated as a State gamefish and therefore, cannot be sold.

- North Carolina: http://portal.ncdenr.org/web/mf/recreational-fishing-size-and-bag-limits
  No minimum size limit. Allowed one tarpon per person per day and may only be taken with hook and line. Cannot be sold.

- Virginia: https://webapps.mrc.virginia.gov/public/reports/vmrc_regulations_pdf.php
  Release only, with a minimum size release citation at 36 inches.

IV. AUTHORITY

N.C. General Statutes
§ 113-134 Rules
§ 113-182 Regulation of fishing and fisheries
§ 143B-289.52 Marine Fisheries Commission – power and duties

North Carolina Marine Fisheries Commission Rules (May 1, 2015)
15A NCAC 03M .0509 Tarpon

V. DISCUSSION

Rule 15A NCAC 03M .0509 limits tarpon harvest to only one fish per person per day by hook-and-line only with no allowance to sell. This rule has remained unchanged since it was adopted in 1992.

As a management option, the current rule for tarpon minimizes waste if the fish was not to survive a hook-and-line encounter by allowing the fishermen to harvest the fish instead of becoming a dead discard. On the other hand, the current rule may encourage recreational anglers to use puncturing tools to bring in a fish or to facilitate handling the fish during hook removal, which could impact its survival.

Another option as requested by the Marine Fisheries Commission is to make tarpon a no kill species, and specifically allow no gaffing, no spearing, and no puncturing, but still allow for catch-and-release with hook-and-line. The term "possess" is made unlawful in this option and equates to no harvest, but still allows the taking of fish with hook and line, but must be released. This option provides a better chance for the tarpon to survive a hook-and-line encounter when released, but there is the potential for waste if the fish was not to survive after release and would have to be discarded rather than harvested.

An intermediate option for consideration is to amend the rule to prohibit puncturing tarpon, but still allow the daily harvest limit to reduce the discarding of the fish that may not survive after release. Based on more communication available through social media, the pier fishery seems more popular than in the past for catching tarpon. Landing a fish from a pier is more challenging; sometimes the tarpon is pulled alongside the pier and landed on the beach, or the fish is lifted from the water onto the pier with the assistance of nets or puncturing tools to elevate the fish out of the

water. The fight time from a pier is more likely longer than from a vessel or shore, which will likely increase the post-release mortality on the tarpon.

VI. PROPOSED RULE(S)

Option 1: No change, just format updates.

15A NCAC 03M .0509 TARPON
It shall be unlawful to do any of the following:
~~(a) It is unlawful to~~(1) sell or offer for sale ~~tarpon.~~tarpon;
~~(b) It is unlawful to~~(2) possess more than one tarpon per person taken in any one ~~day.~~day; and
~~(c) It is unlawful to~~(3) take tarpon by any method other than hook-and-line.

History Note: *Authority G.S. 113-134; 113-182; ~~113-221;~~ 143B-289.4;*
Eff. October 1, 1992;
Readopted Eff. April 1, 2020.

Option 2: MFC recommendation: no kill, no spear, no gaff, no puncturing, no keeping any tarpon, but catch-and-release still allowed.

15A NCAC 03M .0509 TARPON
It shall be unlawful to do any of the following:
~~(a) It is unlawful to~~(1) possess, ~~sell~~ sell, or offer for sale ~~tarpon.~~tarpon;
~~(b) It is unlawful to possess more than one tarpon per person taken in any one day.~~
~~(c) It is unlawful to~~(2) take tarpon by any method other than ~~hook-and-line.~~hook and line; and
(3) spear, gaff, or puncture a tarpon.

History Note: *Authority G.S. 113-134; 113-182; ~~113-221;~~ 143B-289.4;*
Eff. October 1, 1992;
Readopted Eff. April 1, 2020.

Option 3: Intermediate recommendation, no spear, no gaff, no puncturing, but allow the daily harvest and catch-and-release still allowed.

15A NCAC 03M .0509 TARPON
It shall be unlawful to do any of the following:
~~(a) It is unlawful to~~(1) sell or offer for sale ~~tarpon.~~tarpon;
~~(b) It is unlawful to~~(2) possess more than one tarpon per person ~~taken in any one day.~~per day;
~~(c) It is unlawful to~~(3) take tarpon by any method other than ~~hook-and-line.~~hook and line; and
(4) spear, gaff, or puncture a tarpon.

History Note: *Authority G.S. 113-134; 113-182; ~~113-221;~~ 143B-289.4;*
Eff. October 1, 1992;
Readopted Eff. April 1, 2020.

VII. PROPOSED MANAGEMENT OPTIONS

1. Status Quo, maintain MFC Rule 15A NCAC 03M .0509 which continues to allow puncturing and limited harvest of tarpon.
   + Public familiar with rule that has remained unchanged since 1992.
   + Minimizes waste if the fish does not survive catch and release by it still being able to be harvested.
   − Does not comply with MFC motion
   − Higher potential for mortality.

– Allows puncturing and harvest of a species not common for human consumption.

2. Amend MFC Rule 15A NCAC 03M .0509 to make it unlawful to puncture or harvest tarpon, but catch-and-release still allowed.
   + Complies with MFC motion.
   + Increase chance for survival.
   – Public will need be educated on rule change.
   – May increase waste if the fish does not survive hook-and-line catch and release because it could no longer be harvested.

3. Amend MFC Rule 15A NCAC 03M .0509 to make it unlawful to puncture tarpon, but maintain the daily harvest limit.
   + Minimizes waste if the fish does not survive hook-and-line catch and release by it still being able to be harvested.
   + Improves survival by not allowing puncturing of the fish.
   – Does not comply with MFC motion.
   – Public will need be educated on rule change.
   – Higher potential for mortality.

VIII. RECOMMENDATION

No DMF recommendation is provided. This paper is to offer more information on tarpon and three options for further consideration to this rule.

Marine Fisheries Commission Rule 15A NCAC 03M .0509 is subject to re-adoption under the Periodic Review and Expiration of Existing Rules (G.S. 150B-21.3A) by June 30, 2022.

Prepared by: Tina Moore, Tina.Moore@ncdenr.gov, 252-808-8082
December 3, 2018

Revised: January 11, 2019
January 17, 2019
January 24, 2019
January 29, 2019

IX. LITERATURE CITED

Edwards, R. E. 1992. Tarpon release mortality assessment using acoustic tracking. Final Project Report 6634. Florida Department of Natural Resources. 45 pp. https://dspace.mote.org/bitstream/2075/1290/1/MTR%20259.pdf

Edwards, R. E. 1998. Survival and Movement Patterns of Released Tarpon (*Megalops atlanticus*). Gulf of Mexico Science 16 (1). Retrieved from https://aquila.usm.edu/goms/vol16/iss1/1

Guindon, K. Y. 2011. Evaluating lethal and sub-lethal effects of catch-and-release angling in Florida's Central Gulf Coast recreational Atlantic tarpon (*Megalops atlanticus*) fishery. Graduate Theses and Dissertations. http://scholarcommons.usf.edu/etd/313.

Notice of Text Attachment

15A NCAC 03M .0509 TARPON

Option 1: Proposed amendments make minor format corrections to the rule.

Option 2: Proposed amendments make minor format corrections, add no allowance to spear, gaff, or puncture a tarpon, no longer allows for the daily harvest of tarpon, but continues to allow catch-and-release of tarpon with hook and line.

Option 3: Proposed amendments make minor format corrections and add no allowance to spear, gaff, or puncture a tarpon to the rule.

MFC Rulebook Index Worksheet

Rule	Subject	Index Entry (**Bold** major headings)	Add/Delete/ No Change
03M .0509	tarpon	**species:** tarpon	No change

Ancillary Items:

- Update recreational guide.
- Provide further outreach on the no puncturing and no harvest of tarpon.
- Verify if complementary regulations are needed by the Wildlife Resources Commission in inland waters.
- Provide educational outreach to piers, guides, and tournaments.

ROY COOPER
Governor

MICHAEL S. REGAN
Secretary

STEPHEN W. MURPHEY
Director

Feb. 7, 2019

MEMORANDUM

TO: N.C. Marine Fisheries Commission

FROM: Catherine Blum, Fishery Management Plan and Rulemaking Coordinator
Fisheries Management Section

SUBJECT: Fishery Management Plan Update

Issue
Update the Marine Fisheries Commission on the status of ongoing North Carolina fishery management plans.

Action Needed
For informational purposes only; **no action is needed at this time**.

Overview
This memo provides an overview on the status of the North Carolina fishery management plans for the February 2019 commission meeting.

The review process for the **Blue Crab Fishery Management Plan** is underway. The Blue Crab Advisory Committee is continuing to assist the division with development of Amendment 3 to the plan. The next advisory committee meeting will be held at the end of February. Agenda items will include additional draft sections and issue papers for the plan. Lead staff will provide a summary on the progress of the amendment at the February Marine Fisheries Commission meeting.

The review process for the **Southern Flounder Fishery Management Plan** is also underway. As part of the review, a coast-wide stock assessment determined the stock is overfished and overfishing is occurring. The division is proceeding with an amendment to the plan to end overfishing. The Southern Flounder Advisory Committee is assisting the division with development of Amendment 2 to the plan.

For the review of the **Estuarine Striped Bass Fishery Management Plan**, stock assessments for the Central Southern Management Area stocks and the Albemarle Sound-Roanoke River stock that began in 2017 are continuing. The plan development team held the last stock assessment methods workshop Feb. 19, 2018. Multiple assessment techniques were chosen,

given the number of systems to assess and the variety of data sources for each system. This is a joint plan with the Wildlife Resources Commission, so all updates and reviews are joint efforts by both agencies.

At the November 2018 Marine Fisheries Commission meeting, the division provided a presentation and recommendation in support of developing temporary management measures to supplement the fishery management plan consisting of a no-possession limit for striped bass in the internal coastal and joint waters of the Central Southern Management Area while Amendment 2 to the N.C. Estuarine Striped Bass Fishery Management Plan is being developed and adopted. On Dec. 3, 2018, division director Steve Murphey sent a request to Department of Environmental Quality Secretary Michael Regan to develop a temporary management measure to supplement the N.C. Estuarine Striped Bass FMP consisting of a no-possession limit for striped bass in the Central Southern Management Area. On Dec. 19, 2018, Secretary Regan responded to Director Murphey that "after careful consideration, I concur with your recommendation." The division held a public comment period from Jan. 9-23, 2019, within which one public meeting on the issue was held Jan. 16 in Washington, N.C. The draft supplement, the public comments, and a detailed memo are provided in the briefing materials. The commission is scheduled to vote on adoption of the supplement at its Feb. 20-22, 2019 meeting. If approved, the management measure will be implemented by proclamation no later than March 1, 2019.

ROY COOPER
Governor

MICHAEL S. REGAN
Secretary

STEPHEN W. MURPHEY
Director

Feb. 6, 2019

MEMORANDUM

TO: N.C. Marine Fisheries Commission

FROM: N.C. Estuarine Striped Bass Fishery Management Plan, Plan Development Team

SUBJECT: Summary of Public Comments on draft Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass Fishery Management Plan

Issue
The Division of Marine Fisheries accepted public comment Jan. 9 – Jan. 23, 2019 on draft Supplement A to the N.C. Estuarine Striped Bass Fishery Management Plan. This supplement proposes to implement temporary management measures to prohibit possession of striped bass in the Central Southern Management Area to protect important year classes while the next fishery management plan is being developed. The public could complete an online comment form, mail in written comments, or provide comment at a public meeting to review the draft supplement held Jan. 16, 2019 at 6 p.m. at the N.C. Department of Environmental Quality's Washington Regional Office.

Findings
Written Comments: The division received three letters of public comment, two in support of the supplement (67%) and one opposed (33%) that are included as Appendix 1.

On-line Comments: The division received 149 unique responses (two people submitted comments twice) from online public comments, 31 in support (21%) and 118 opposed (79%). The online form allowed respondents to either support or oppose the supplement and to include comments. It should be noted that 97 of the 118 respondents that did not support the supplement included in their comments the need to eliminate gill nets entirely or in some areas of the state. The online comments are included as Appendix 2.

Public Meeting: Approximately 88 members of the public, one commission member, and numerous division staff attended the public meeting. There were several questions from the public and 20 members of the public provided comments that are summarized in Appendix 3.

The table below summarizes all public comments received from all sources into three categories: 1) supports the supplement, 2) does not support the supplement, and 3) did not indicate support or not.

Method Public Comment Received	Support (number and %)	Not Support (number and %)	Did not indicate (number and %)	Total
Mail	2 (67%)	1 (33%)	0	3
Online	31 (21%)	118 (79%)	N/A	149
Public Meeting	0	15 (75%)	5 (25%)	20

Recommendation
The division recommends the commission adopt Supplement A to Amendment 1 to the N. C. Estuarine Striped Bass Fishery Management Plan as presented.

APPENDIX 1

Mac Currin
801 Westwood Dr.
Raleigh, NC 27607

January 13, 2019

Comments
Central Southern Striped Bass Supplement
N.C. Division of Marine Fisheries
P.O. Box 769
Morehead City, N.C. 28557

received
1/16/2019

Dear Sir/Madam:

I am writing to ask that you do in fact eliminate the harvest of striped bass in the central southern management zones. These fish have been overharvested for years and rarely if ever allowed to grow to sizes that will permit movement into the coastal stock, then return to spawn in the Neuse and Pamlico river systems. I would encourage a meaningful closure that lasts for at least 10 years. A wise director of DMF once said at a public hearing that if you want 10 year old fish you must allow them to grow for 10 years. It was sage advice then and is still sage advice.

Thank you for allowing me to provide comments.

Regards,

Mac Currin

APPENDIX 1

January 12, 2019

To Whom It May Concern:

For several years now, the striped bass in the CSMA (Neuse, Tar, and Pamlico Rivers) of North Carolina have been in severe decline. So much so that a stocking program has been in place in hopes of helping the population become self-sustaining again. That program has not succeeded because the stripers have been experiencing cryptic mortality during the length of time while the stocking has been ongoing. Now, two year classes of native fish have been detected through genetic analysis in such numbers that demonstrate that successful spawns have occurred. In order to protect these spawning classes, the Division of Marine Fisheries is proposing a no-possession, no-harvest closure of the striped bass fishery in the short term while a new Fisheries Management Plan is being developed.

I will support the closure provided that two things happen. ALL GILL NETS MUST BE REMOVED FROM SPECIFIC AREAS IN THE CSMA AND SIGNIFICANT CONSEQUENCES MUST BE APPLIED TO THOSE THAT VIOLATE THE CLOSURE BY TAKING STRIPERS ILLEGALLY.

Recent studies by the North Carolina Wildlife Federation have shown that the main reason stripers have been experiencing the aforementioned cryptic mortality is because they are falling victim to unintended bycatch in gill nets targeting other species. While the idea of a closure to protect these spawning classes is laudible, it will ultimately fail unless you remove all gill nets from specific areas of the rivers in the management area. As an example, a line should be drawn from Dawson Creek across to Clubfoot Creek in the Neuse River and no nets of any kind should be allowed upriver of that line. That is the ONLY way to ensure that these fish are protected.

In addition, if the DMF chooses to close the fishery and heed my recommendation of removing all gill nets from the necessary areas, the penalties for violating that closure should be significantly stiffened. Recreational fishermen who are found in possession of stripers should have their licenses revoked and pay a large fine. Those funds should then be used to continue to aid the stocking program. Commercial fishermen that are found netting in those areas should have their license revoked and their gear confiscated. It should also be mentioned that sufficient law enforcement officers from both DMF and NCWF should be stationed in the region to ensure adequate coverage of the water.

If the Division of Marine Fisheries is honestly serious about restoring the striped bass population to its historic levels, then in addition to initiating a no-possession, no-harvest closure, it must also place a moratorium on all other gill nets in specific areas of the affected rivers. The division must also increase the penalties and add enforcement officers to provide sufficient deterrent to prevent violations of the closure and gear restrictions.

Sincerely, Jack Hollingsworth

APPENDIX 1

January 12, 2019

P.S.

I had responded previously through CCA. I that letter I supported the closure as something is better than no activity toward protecting what is left of our fishery, In that letter I had expressed the desire to protect nursery arrears and more financial backing to enforcement and education.

APPENDIX 1

January 23, 2019

Stephen Murphey
Central Southern Striped Bass Supplement
North Carolina Division of Marine Fisheries
P.O. Box 769
Morehead City, North Carolina 28557

Dear Mr. Murphey,

The American Sportfishing Association (ASA) appreciates the opportunity to provide comments to the North Carolina Division of Marine Fisheries regarding Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass Fishery Management Plan.

ASA is the nation's recreational fishing trade association and represents sportfishing manufacturers, retailers, wholesalers, and angler advocacy groups, as well as the interests of America's 49 million recreational anglers. ASA also safeguards and promotes the social, economic, and conservation values of sportfishing in America, which result in a $125 billion per year impact on the nation's economy.

ASA is concerned about the economic impacts of the proposed no possession limit for the recreational fishery in the Central Southern Management Area (CSMA) for estuarine striped bass. Many sportfishing manufacturers, retailers, wholesalers, and recreational anglers will be negatively impacted by the no possession limit as proposed. We ask that you weigh these serious and real economic impacts alongside the potential biological benefits of protecting a stock that, at this time, is predominately composed of hatchery fish. ASA suggests that this management action could be better informed by the upcoming stock assessment for the CSMA, and Amendment 2 to the Estuarine Striped Bass Fishery Management Plan.

Sincerely,

Michael Waine
Atlantic Fisheries Policy Director
American Sportfishing Association

AMERICAN SPORTFISHING ASSOCIATION
1001 N. Fairfax Street, Suite 501, Alexandria, VA 22314 • 703-519-9691 • Fax: 703-519-1872
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APPENDIX 2

Online Public Comments on Draft Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass Fishery Management Plan

Submission Time	First Name	Last Name	City	State	Support?	Comments
1/16/2019 8:45	Benjamin	James	Greenville	NC	Yes	Must remove nets because commercial shad netting will kill Stripe Bass during Spring run.
1/10/2019 14:45	Bobby	White	Wilmington	NC	Yes	
1/12/2019 13:14	Charles	Godwin	Fayetteville	NC	Yes	Supplement A to the Estuarine Striped Bass Fishing Plan is a good first step in returning the fishery to viable levels. It appears that the only fish available is the ones that the state tax payers are providing through the hatchery process. We need to promote the return of native fish if there are any left to populate the species. Thank you CV Godwin
1/11/2019 10:33	Christopher	Naff	Manteo	NC	Yes	You have allowed commercial takes of this hatchery supported fishery in spite of the state law against it. Now, it becomes evident that only protection of the limited biomass can allow spawning success for native fish, which may already have been wiped out by NCDMF allowing gill netting of the remaining fish. The division obviously will not allow this fishery to be conserved on its own, but this supplement gives you a chance to repair a small part of your anti-resource reputation. The alternative will see recurrent lawsuits by an awakening public that will demand an NCDMF that pursues conservation and resource protection for all user groups in the public trust. Commercial fishermen will ultimately benefit as will the public at large, IF you allow the resource to increase without continued rapacious mortality by entities interested only in profit at the expense of all other users and the public.
1/11/2019 9:58	Dale	Madren	Raleigh	NC	Yes	This proposal seems to be the best hope for rebuilding a natural stripper population in the CSMA. The situation is drastic and calls for drastic measures.
1/11/2019 12:21	david	wiggins	morehead city	NC	Yes	
1/14/2019 9:12	Dempsey	Barwick	La Grange	NC	Yes	

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Online Public Comments on Draft Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass Fishery Management Plan

Submission Time	First Name	Last Name	City	State	Support?	Comments
1/23/2019 6:54	diana	keen	Rocky Mount	NC	Yes	I support WITH ADDED NOTATION. ALL GILL NETS BE REMOVED. There is no such thing as no-possession if there are gill nets in the waterways. The management measure is being considered to protect the minimal Striped Bass population that exists. I am FOR protection, requesting your assistance with the matter. The Striped Bass are NOT PROTECTED when there are gill nets. The no-possession restriction proposed has a HUGE LOOP HOLE. Please complete the task at hand and protect the Striped Bass. NO NETS! While fishing I have caught a lure on the nets. Retrieving my lure I saw DEAD Striped Bass in the nets. Also birds trapped and dying in the nets as well as other fish. The carrying capacity of the ecosystem will be greatly enriched with legislation that will provide COMPLETE PROTECTION for the Striped Bass by NOT ALLOWING NETS! Nets x number of feet from the shore and at certain depths does NOT WORK for protecting Striped Bass. I HAVE SEEN IT FIRST HAND.
1/12/2019 11:02	Gordon	Churchill	Newport	NC	Yes	I support a no kill period but what would be better and is needed even more is eliminating the bycatch gill net fishery for striped bass and eliminating gill nets from our inside waters entirely. The fish we see are all of a size that are just the size to slip through nets and any over 25 inches will have net scars on them. It is pretty obvious they are severely depleted by the nets. The majority of the fish are stocked. Stocking is supported by recreational license fees. Why are netters then allowed to eliminate the majority of the fish that my fees have allowed for them to be stocked?
1/12/2019 10:14	Joe	Billingsly	Sneads Ferry	NC	Yes	The larger issue is the gill nets, they are eradicating many other species other than what is being targeted. It is wiping stripers out along with everything else, to include red drum, all gill nets should be banned in all state waters.
1/10/2019 11:04	John	Kaplan	Oriental	NC	Yes	I support the closure given the condition that all gill nets be removed upriver from a certain line on each of the river systems. For example, on the Neuse, I suggest drawing a line from Dawson Creek across to Clubfoot Creek and removing all nets upriver of that line.
1/11/2019 15:55	John	Bello	Ashburn	VA	Yes	I buy an annual out of state Coastal Fishing License. I support a temporary restriction to allow this stock to build.
1/14/2019 8:24	Kathryn	Coltrain	Ayden	NC	Yes	Remove all gill nets from all waters in NC.
1/11/2019 9:42	Ken	Shivar	Raleigh	NC	Yes	It is currently a put and take fishery with negative economic impact. Further the idea behind stocking fish is to help them recover and reproduce. Allowing commercial harvest is idiotic and runs counter to the goals of stocking. STOP IT NOW! Please. Ken Shivar
1/11/2019 9:25	Lee	Hiner	New Bern	NC	Yes	

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Online Public Comments on Draft Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass Fishery Management Plan

Submission Time	First Name	Last Name	City	State	Support?	Comments
1/15/2019 7:05	Lee	Stone	Washington	NC	Yes	
1/11/2019 8:57	Michael	Moody	New Bern	NC	Yes	Please consider a one fish limit at 26" to mirror the WRC rules. The rules should be simplified so that its much easier to follow. In addition, these are stocked fish bought and paid for by RECREATIONAL fishing dollars. If commercial fishing is allowed to continue on these fish, some sort of reimbursement should be applied by the commercial fishermen themselves. They are not harvesting a wild species of fish. I'm sure a fairly accurate estimate exist on what these fish cost/fish. It is only fair to all parties involved and to the recovery of the striped bass in the Tar/Pamlico and Neuse Rivers.
1/11/2019 10:28	Michael	Collins	Wilson	NC	Yes	
1/14/2019 10:24	Mickey up	Hale	Tarboro	NC	Yes	Rec fishermen are not the cause of this problem, gil nets are ducking the life from NC waters!
1/12/2019 9:27	Norman	Lewis	North topsail beach	NC	Yes	All gill nets should be banned in inland coastal waters!
1/9/2019 16:31	Ralph	Haddock	Ayden	NC	Yes	Our marine resources are important to eastern, N.C. If the no possession limit will strengthen the resource base, then I fully support the measure.
1/12/2019 5:58	Read	Samples	Beulaville	NC	Yes	Rec bag limits should be reduced. Please get the nets out of the waters. It is slowly taking a great effect over years of over commercial harvest.
1/10/2019 15:09	Rick	Sasser	Goldsboro	NC	Yes	What the MFC should do is: Match the proposed 2017 WRC rule change increasing the recreational minimum size limit to 26" with a one fish daily creel limit. -Close all commercial harvest of striped bass in the CSMA. -Prohibit all gill net fishing in the Neuse(Minnesott Beach/Cherry Branch) and Pamlico(Bayview/Aurora) rivers at the ferry lines to the inland water boundaries. -Require full-time gill net attendance in all remaining CSMA waters. If you don't stop the cryptic mortality in the gillnet fisheries, you haven't addressed the real problem.
1/11/2019 22:22	Stan	Griffith	Surf City	NC	Yes	We need to prohibit gill nets from North Carolina esturine waters. StripedBass and other fish stocks are being lost.
1/14/2019 12:37	Steven	Thompson	Greenville	NC	Yes	

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Online Public Comments on Draft Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass Fishery Management Plan

Submission Time	First Name	Last Name	City	State	Support?	Comments
1/10/2019 14:13	Thomas	Boyd	Blounts Creek	NC	Yes	It seems the NC Marine Fisheries are coming to the game very late as usual. But, I applaud the effort to protect the resource if it applies evenly to recreational and commercial alike. The NC wildlife folks have imposed restrictions before you guys which I also support but only if it is equal. Conservation should apply to ALL waters in NC. As a side note, I am convinced nothing serious will ever be done until the commercial segment has harvested the last of our fisheries and that alone may get lawmakers attention. Please wake up and see what is happening to our resource. Look at what other states have done and the success they have seen. Thank you for allowing this forum. Yes, I am a recreational fisherman and over my 60 years of fishing have seen the fishing worsen each year, mother nature can repair the damage if we allow it to, this means no trawling or nets in the sound period.
1/14/2019 8:21	THOMAS	COLTRAIN	AYDEN	NC	Yes	REMOVE ALL GILL NETS year round period. Why is nothing being done in Bay River? Stripe Bass are in this river too.
1/11/2019 12:30	Tom	Merritt	Roanoke Rapids	NC	Yes	only if you remove the gill nets.
1/11/2019 16:21	Tony	Fleck	Onancock	VA	Yes	Rather than be reactive to a crash in the future we need to be proactive to avoid such a crash. Please give the Bass populations a chance to rebound for your future generations of NC fisherman. Thank you for your time and consideration.
1/11/2019 9:07	will	lathan	new bern	NC	Yes	please protect our resources
1/12/2019 13:24	Winston	Brown	Wilmington	NC	Yes	No gill nets period. Our inter coastal fishing is suffering . Recreational fishing and guides are hurting. Our children only will hear finish story's . Sad. Make changes. North Carolina
1/12/2019 9:59	Allen	Jernigan	Holly Ridge	NC	No	This moratorium is nothing but a failure in management. Gill nets are killing all of these stocked striper before the reach sexual maturity. It is past time to ban all gill nets in all state waters. We have the same issue with southern flounder, striped mullet amongst others. It is past time to address the real problem. Nets in our waters. Dmf has done nothing but fail to manage anything properly. All you guys have done is manage for maximum commercial extraction. It is time to address the destructive gear. Even blue crab is on the edge of collapse because of our management practices.

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Online Public Comments on Draft Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass Fishery Management Plan

Submission Time	First Name	Last Name	City	State	Support?	Comments
1/12/2019 9:31	Andrew	Isenhour	Wilmington	NC	No	Gill nets used by both commercial and recreational fishermen are a great harm to both the striped bass and all other species. Before any measure is passed to protect a species, all Gill netting should be banned, then observe all species populations. In other states, where gill nets are banned, fish populations flourish more so than NC; therefore, I vote NO to further restriction until this matter is resolved and fish populations are monitored, then further restrictions should be considered.
1/11/2019 22:43	Andy	Scott	Clayton	NC	No	Gill nets are destroying the striper population and all other Species in our NC waters. Please ban commercial Gill netting in all the north Carolina waters. NO GILL NETS!!
1/12/2019 9:27	Anthony	Fuhrer	Hampstead	NC	No	I live in Hampstead NC have a second home at lale Gaston. I'm an avid fisherman that has fished the NC coast in its entirety since I was a kid and my dad stationed at Camp Lejeune. I have also fished coastal waters up and down the east coast beyond our state waters. It is clear that the use of gill nets in NC waters is an antiquated practice which has proven detrimental to fish, avian, mammal, and reptilian species alike. I have seen indiscriminate net effects on striped bass, red drum, duck species, alligator, and others. Use of gill nets is extremely counter productive to the NC fisheries efforts and NC tax dollars in hopes of replenishing the depleted striped bass stock. NC needs to modernize it's fishery practices and banish all varients of gill net fishing. Then and only then will striped bass rebound and NC could truly become a world class fishery. Anthony Fuhrer Major USMC
1/12/2019 9:49	Ben	Friberg	Winnabow	NC	No	All gill netting should be banned in NC state waters
1/11/2019 11:24	Bert	Owens	Beaufort	NC	No	I support removal of nets from the creeks and the end of the by catch mortality due to these nets. Keep the nets off of our fish paid for by recreational dollars. This is a poorly crafted, biased, and inadequate survey.
1/11/2019 21:44	Bill	Lombardo	Camp Lejeune	NC	No	Nets are wiping out the striper and drum. Gill nets should be illegal in all waters.
1/14/2019 10:24	Bill	Adkins	Minnesott Beach	NC	No	I do not catch that many during the season. I believe that the commercial fishing does more harm to the population than recreational.
1/12/2019 10:17	Billy	Wills	Jacksonville	NC	No	gill nets are wiping stripers out along with everything else, to include redfish, the very species shown on the NC fisheries logo, it's a shame all gill nets should be banned in all state waters.
1/12/2019 13:54	Billy	Thorpe	Wilmington	NC	No	Gill nets are wiping out the stripers and our fishery. Let's talk about that.

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Online Public Comments on Draft Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass Fishery Management Plan

Submission Time	First Name	Last Name	City	State	Support?	Comments
1/12/2019 10:44	Blake	Martin	Ayden	NC	No	
1/12/2019 13:34	BOBBY	NORRIS	APEX	NC	No	Prohibit all gill net fishing in the Neuse(Minnesott Beach/Cherry Branch) and Pamlico(Bayview/Aurora) rivers at the ferry lines to the inland water boundaries.
1/12/2019 0:02	Brad	Chandler	Durham	NC	No	Please Stop This!
1/12/2019 7:34	Bradley	Arthur	Raleigh	NC	No	Gill nets continue to destroy the fishery in North Carolina in my opinion as a recreational fisherman. I lived on the west coast of Florida and the inshore waters were considered breeding grounds for so many species nets weren't allowed. When I moved to Hampstead NC, I personally saw what netters did to the local waters. The New River was an awesome fishery and then netting season came in. We still did catch some fish but it sure did make a day fishing a lot more hard work to have a little fun. At that time, I thought it was only local to the New River and Cape Fear River. Now that I'm in Raleigh I've traveled to the Pungo, Neuse, Trent, Alligator Rivers, and the sounds. I don't seem to understand why NC continues to let these netters r**e the inshore waters of our state. Please understand it is time these nets are banned inshore. We need to breathe life back in our waters. Thank you for giving me a platform to be heard. Brad Arthur
1/11/2019 22:01	Brandon	Gillette	Jacksonville	NC	No	Gill nets are destroying our fishery. They should be banned completely.
1/12/2019 10:13	Brian	Cobb	Ernul	NC	No	This is a sensless plan; the root of our fisheries problems stems from inaction on the negative effects of unchecked gillnetting. This has been an issue that other states have resolved successfully but NC remains behind the times when it comes to quality fisheries management. If this measure passes it will be nothing more than a patch on a sore that will only grow worse.
1/12/2019 15:40	Carla	Bitler	Chatlotte	NC	No	Gill nets are HORRIBLE!!! They are wiping stripers out along with sea turtles, dolphins, and other marine life. Gill nets should be banned in all state waters!
1/12/2019 10:12	Casey	Rice	Hampstead	NC	No	Gill nets are wiping out stripers along with everything else including drum. Fishing in SC is so much better so stop netting!!!

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Submission Time	First Name	Last Name	City	State	Support?	Comments
1/11/2019 21:28	Charles	Wood	Washington	NC	No	Born and raised in North Carolina, I have recreationally fished the waters of the Pamlico, Pungo and Nuese rivers my whole life. Studies have shown that the majority of the striped bass in these waters are stocked fish paid for by the recreation anglers/ tax payers, yet... They are allowed to be commercially harvested by Gill nets. This has never made sense to me. We pay to sustain the fishery, just so someone can make money off them. Flounder and sea trout have suffured the wrath of Gill nets as well. Where does it all end? When all the fish are gone? A great example is lousianna and florida. Since the banning of Gill nets their fisheries are thriving. I am a firm believer that we have the potential to have a better fishery than both of them. But there must be change!!!
1/14/2019 19:07	Charles	Wilkins	Fayetteville	NC	No	We need to do away with all inshore gill netting.
1/12/2019 7:52	Chase	Overcash	Salisbury	NC	No	Gill nets are wiping stripers out along with everything else, and all gill nets should be banned in all state waters. That is the problem, not rec fishermen
1/11/2019 21:52	Christopher	Medlin	Hampstead	NC	No	gill nets are wiping stripers out along with everything else, all gill nets should be banned in all state waters.
1/12/2019 10:05	Christopher	Miller	Deep Run	NC	No	
1/12/2019 10:07	Christopher	Miller	Deep Run	NC	No	Nets are wiping out the fish population all over NV. Ban netting indefinitely. Thanks
1/12/2019 6:06	Cody	Ames		NC	No	gill nets are wiping stripers out along with everything else, and all gill nets should be banned in all state waters. They cant control what they are catching in these nets. Why is NC one of the last states to allow this?
1/14/2019 9:10	CURTIS	PELT	ROCKY MOUNT	NC	No	SEEMS LIKE YOU WANT TO STOP RECREATIONAL FISHING IN NORTH CAROLINA IN THIS AREA . COST ME 100.00 DOLLARS EACH TRIP FOR GAS , FOOD ETC. AND CAN ONLY KEEP A FEW FISH AND NOW YOU WANT A NO- POSSESSION ON STRIPED BASS !!! FISHING FOR ROCK , DRUM , SPECKLED TROUT AND FLOUNDER IN NORTH CAROLINA IS GOING THE WAY OF HERRING AND GREY TROUT , SO SAD !! IF YOU REALLY WANT TO DO SOMETHING USEFUL , GET THE NETS OUT OF COASTAL CREEKS AND MAKE TROUT A GAME FISH . THANK YOU
1/12/2019 15:44	Damien	James	Hampstead	NC	No	We need to remove all gillnets from state waters as it's killing all fish not just the ones targeted!
1/11/2019 22:27	Daniel	Brinson	Hampstead	NC	No	Please do not shut down this fishery. We police ourselves.
1/12/2019 4:54	Daniel	Olvera	Jacksonville	NC	No	

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Submission Time	First Name	Last Name	City	State	Support?	Comments
1/12/2019 11:37	Daniel	Griffee	Havelock	NC	No	The gill nets are number one NON SELECTIVE. The fish get whipped out along with all the other habitats that bring these fish in. I've caught numerous trout and stripers this year, watch a netter come and whipe the place out, put the bet out run all over scaring the fish, leaving nothing behind. There needs to be a balance between the commercial and recreational angler. 1.no nets except the Main River. 2. Hook and line only. 3. No nets anywhere No matter the rules there will always be those who disobey but something in place to allow the fish population to stay healthy is better than nothing.
1/11/2019 6:37	Darryl	Price	Seven Springs	NC	No	Get rid of the nets!
1/11/2019 10:44	David	Drach	Snow Hill	NC	No	I do not support this measure because the Gill nets will still be set in the coastal waters killing all the rock anyway. We need to get the nets out of the water to make this effective. If the nets were out of the water I would support this for everyone.
1/11/2019 21:56	David	Robinson	Durham	NC	No	I would support wholeheartedly the removal of gill nets in our inland waters. The gill nets are harming the striper population along with trout, red fish and other species. Take gill nets out of our inland waters and you will see an increase stripers, trout and redfish
1/12/2019 4:59	David	Banks	Jacksonville	NC	No	The problem we have in NC is gill nets they are wiping out every species we have in the inland waters something has to be done about how deep they are going up in our creeks.
1/12/2019 10:14	David	Skipper	Coats	NC	No	Fill nets are trapping and killing the majority of stripe bass needs to be banned inshore inlets
1/12/2019 11:12	David	Ball	Newport	NC	No	The only reason that we're not going to support this is that it does not require the commercial fisherman to take the gillnets out of the water meaning that they're going to continue to murder the species and every other species that swims into their nets I think we're the only state that hasn't put restrictions on gillnetting and the only state that suffers from a depleted fishery in the southeast. These people do not even make that much money but they killed thousands upon thousands of fish every year it's time to North Carolina join the rest of the states and start making laws that protect the species
1/11/2019 20:55	Dearl	Roughton	Chocowinity	NC	No	I would support a full closure if the refs were the same across the board for commercial and recreation
1/13/2019 6:12	Dennis	Rouse	Kinston	NC	No	All gill nets in coastal waters should be banned. Stripers as well as other fish are being wiped out.

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Submission Time	First Name	Last Name	City	State	Support?	Comments
1/13/2019 14:10	Douglas	Beckwith	Roxboro	NC	No	All gill nets should be banned in all state public waters
1/12/2019 11:06	Dr. Ben	Thigpen	Beulaville	NC	No	Start with no nets....then if problems take steps to eliminate season. You're putting cart before the horse without addressing net issue.
1/12/2019 9:10	Ed	Sentman	Hampstead	NC	No	Gill nets need to go. The are destroying inshore stocks. The inshore fishery is on the verge of collapse.
1/12/2019 10:20	Edward	Cobb	Newport	NC	No	This proposal is nothing more than a quick fix attempt rather than resolving the true problem: gill nets. NC has failed to enact meaningful reforms to ban damaging gill nets and our fisheries decline is the proof. Beyond striped bass we have lost innumerable trout and red drum to these destructive devices and our conversation leaders have been hamstrung far too long by the commercial fishing lobby. If this Amendment passes it will do nothing but cripple an already hurting fishery, and no corrective measures will come about so we will repeat the same situation once they become overfished again. It is past time to take action and ban gill bets from NC waters.
1/14/2019 12:44	Edward	Ammons	Belhaven.	NC	No	The only way that I would support it is if DMF outlaws nets in the area (to include nets intended for any other game fish ie flounder, trout, etc). Other wise the netters will be killing rock as a by catch,
1/11/2019 21:50	Eric	Bregman	Greensboro	NC	No	This will accomplish nothing if the nets are in the water killing everything. Why should rec fisherman get punished while commercial fisherman get to kill.
1/12/2019 8:11	Eric	Luke	Hampstead	NC	No	
1/12/2019 10:40	Eric	Kimes	Mount Olive	NC	No	I fish recreationally three days a week year-round. I fish from Ocean Isle to Cedar Island on a regular basis and pick fishing locations based on tides and weather. I love to fish and do so with my four children and my friends. It is a public resource that should protected by our elected officials and a heritage for my children to enjoy. As such, I employ catch and release on almost all of the fish I hook on my boat. Gill Nets are amazing tools for catching fish. Their incredible effectiveness,however leads to catching fish and other marine animals indiscriminately. I have seen non-target species, sea turtles, birds dead in these nets. Striped Bass, which our state spends considerable time and money to stock in state waters are also being caught successfully in these nets. I have often found a great spot for striped bass, only to see a gill net there the following day, full of dead Striped Bass. Please protect our public resource and heritage by eliminating gill nets.

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Online Public Comments on Draft Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass Fishery Management Plan

Submission Time	First Name	Last Name	City	State	Support?	Comments
1/12/2019 13:16	Eric	Bitler	Mint Hill	NC	No	We all know what the real problem is....gill nets. Its insulting to anyone who actually cares about proper conservation measures that this state continues to to allow such a practice. Completelt non selective abd with little to no enforcement of regulations, I sick of seeing the aftermath of gill netters. Its long overdue to make the change that will actually matter, nearly ever other state has done so ages ago.
1/14/2019 19:53	Eric	Anderson	Wilmington	NC	No	It is gill nets being allowed inshore that is the problem. I have witnessed firsthand how destructive that type of commercial gear is and it does not discriminate. There is a reason inshore fishing is so much better in our neighboring states. No gill nets, simple as that. Please consider new legislation that will protect our resource for future generations. Thank you.
1/13/2019 18:23	Frank	Holt	Snow Camp	NC	No	As an alternative to a moratorium, please use the N.C. Wildlife Resources Commission striped-bass size and creel limits for recreational anglers in open waters, close the directed commercial harvest in the CSMA, remove gill nets in the Pamlico and Neuse rivers and enforce mandatory year-round attendance of gill nets. If a striped-bass moratorium is adopted for recreational anglers in the Tar, Pamlico, Pungo, Bay and Neuse rivers and joint and coastal waters of other CSMA waters, it will increase pressure on striper populations in Albemarle Sound and Roanoke River Management Areas and other inland fishing waters with open seasons and creel limits. Over time, that could create increased angler pressure on native striped bass in those areas, promote use of hatchery stockings, further reduce native populations of stripers and create additional moratoriums. Law of Unitended Consequences.
1/11/2019 21:26	Garritt	Jernigan	Holly Ridge	NC	No	Gill nets are wiping out stripers, redfish, turtles, and many other species of fish. All gill nets need to either be banned immediately or severely restricted and have those restrictions be heavily enforced
1/12/2019 16:58	Gary	Cowan	Louusnurg	NC	No	Do not shut it down. Please stop gill nets...
1/10/2019 18:44	Glenwood	Montgomery	Beaufort	NC	No	Need to allow some take especially as an incidental fishery for netters that are targeting shad.
1/13/2019 10:45	Harold	Smith	New Bern	NC	No	I am almost exclusively catch and release by my own choice but to many times have I personally witnessed either harvest of multiple species by not with the majority being bycatch. I appreciate heritage and a person making a living but shouldn't we be looking at real world management instead of possible accurate reported numbers? Spend time on the water like others and it won't take long to see what we witness year round.

APPENDIX 2

Online Public Comments on Draft Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass Fishery Management Plan

Submission Time	First Name	Last Name	City	State	Support?	Comments
1/12/2019 9:42	Heather	Luke	Hampstead	NC	No	I am amazed that North Carolina continues to support gill netting. It only take one trip to South Carolina to see difference in fisheries. Please stop all gill netting. Thank you, Heather Luke
1/11/2019 22:07	Henry	Murray	Goldsboro	NC	No	To solve this any many other species sustainability issues, gill nets MUST be removed from all inshore waters in N.C.
1/12/2019 8:26	Jacob	Ledford	Jacksonville	NC	No	Gill nets are destroying striped bass and everything else around. It is common to find dead bye catch in every Gill. Net around the Jacksonville area. I have fished all over the east coast and why we are still allowing gill nets to devestate the fishery is beyond me.
1/12/2019 8:41	James	Wilson	Raleigh	NC	No	Gill nets are decimating all the other species and the commercial fisherman need to adapt.
1/12/2019 10:25	james	reilly	morehead city	NC	No	The sole reason the striped bass population is in jeopardy is the targeted gill net fishery and the by catch in the mullet and speckled trout net fisheries. These nets are devastating out striped bass, speckled trout, southern flounder, and red fish populations, dramatically reducing spawning recruitment and keeping all of these species in a depleted status. How can anyone in their right mind think it is acceptable to allow commercial harvest of a species that has to be stocked annually in order to maintain an even marginally viable population? This has baffled me for years and no one has been able to give me an answer. This stocking effort is supported in the main by recreational license proceeds, so how can their possibly be enough biomass to allow any kind of commercial fishery? The nets, in all our estuaries and creeks have to go.
1/13/2019 15:33	James	Buie	Eastover	NC	No	Ban nets for a noticeable and immediate controlled management of fish. I used to net and know know it impacts.
1/17/2019 8:52	James	lyndon	Wilson	NC	No	I support mirroring the WRC limits for recreational anglers, closure of the directed commercial harvest, and the removal of gill nets on the Pamlico and Neuse rivers inland from the respective ferry
1/12/2019 10:57	Jamie	Smith	Rockmart	GA	No	Gil nets are indiscriminate killers and don't get checked enough for them to be a safe way of harvesting fish They kill everything from turtles to sharks and gamefish.

APPENDIX 2

Online Public Comments on Draft Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass Fishery Management Plan

Submission Time	First Name	Last Name	City	State	Support?	Comments
1/14/2019 12:55	Jamie	Winslow	Tarboro	NC	No	I do not support a moratorium for striped bass in the CSMA region. Considering the fact that studies have indicated two strong class years without further manipulation, I believe that to be a sign that Rock, like other fish stocks, naturally experience cyclical years of growth. Further, I would like to see additional studies done on improving the quality of water in North Carolina before moratoriums/bans are considered. For instance, it has been thoroughly documented that increased secretions of Bisphenol-A and other hormone-mimicking/disrupting chemicals in waterways have caused increased feminization of fish, impacting populations of different species around the world, including NC. BPA looks enough like Estrogen (E2) that the body (in humans & fish alike) cannot tell the difference. It is causing male fish to develop eggs and ultimately is causing them not to breed with females, hence a lower population. This won't change with a ban, it can only change when we clean our water!
1/12/2019 11:55	Jason	Beaver	Zebulon	NC	No	Gill nets are killing striped bass along with everything else and should be totally banned in all state waters.
1/11/2019 22:35	JD	Lee	Hampstead	NC	No	Ban gill nets. They kill everything. They are Not needed. They wipe out all our stripers, trout, drum and flounder. Enough is enough.
1/12/2019 10:16	Jeff	Byrd	Roaring River	NC	No	No gill nets are whats killing things stop thay problem solved
1/12/2019 10:49	Jim	Morgan	Apex	NC	No	Vote no
1/10/2019 14:05	John	Steffens	Chapel Hill	NC	No	While I believe Supplement A's no-possession restriction will have some impact on striped bass populations in CSMA waters, I do not support the measure because it is an inadequate compromise unlikely to achieve the goal of restoring native striped bass populations. In addition to the no-possession restriction, the following steps should also be instituted: 1) Prohibit all gill net fishing in the Pamlico and Neuse Rivers AND their tributaries, from the ferry lines (Minnesott/Cherry branch for the Neuse, and Bayview/Aurora on the Pamlico) upstream to the Inland water boundaries 2) Close the CSMA to all commercial harvest of striped bass. 3)Require full-time attendance of gill nets in remaining CSMA waters. As with many other aspects of NC fisheries management, the situation with CSMA striped bass has gone on far too long, and restoration of these populations needs to be addressed with a far greater sense of urgency and effectiveness than this supplement provides in its current form.

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Online Public Comments on Draft Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass Fishery Management Plan

Submission Time	First Name	Last Name	City	State	Support?	Comments
1/11/2019 21:45	John	Koz	Charlotte	NC	No	I'm not sure how issues get priority to be addressed, but it seems that gillnets are the source of so many of these types of issues. Why is this method still allowed? Start there, and if that doesn't help, utilize a different method.
1/11/2019 21:51	John	Tedder	Jacksonville	NC	No	I do a lot of fishing in all of our water ways for a variety of inshore/brackish fish. The one thing that doesn't change is the amount of bycatch you see floating or sunk to the bottom do to net fishing. These fish come into these inshore waterways to feed, breed, and to habitat, we should make it a point to protect what we have in our state. It is well known that the other states that surround us have a thriving population, because they remove gill nets and other nets from their inshore water ways. It has proven to be beneficial to recreational and commercial fisherman alike for the nets to be off the coast. I would hope that we as North Carolina will jump onboard and do what's right for the fishing community.
1/12/2019 9:12	John	Stanfield	Angier	NC	No	Gill nets are wiping stripers out along with everything else, and all gill nets should be banned in all state waters. I've seen this with my own eyes as I fish nearly every weekend.
1/12/2019 9:13	John	Raynor	Hampstead	NC	No	I've seen gill net destruction first hand in nc inshore waters. The gill nets are wiping out striped bass and everything else in their paths. Gills nets need to be banned in all state waters. It's been long enough
1/12/2019 10:34	John	Schall	Hope Mills	NC	No	Commercial fishing is the problem. NOT recreational fishermen. If you truly care, focus on the real problem.
1/11/2019 21:43	Johnny	Whitley	Wilmington	NC	No	Please start taking care of our state's resources...
1/12/2019 13:40	Jordan	Nason		NC	No	Because the fishery is not sustainable with locals and others coming here to take them by net. I've already watched the netters come from all over to wrap up our best schools of speckled trout every winter. All to make a cheap buck, it's not sustainable. Not to mention the un-ethical tactics netters commonly used to. Sustainable species for a good ecosystem and recreational anglers, tourists, people moving here for our beautiful resources.
1/14/2019 9:56	Jordan	Jernigan	Goldsboro	NC	No	There should be no commercial harvest and no gill nets should be allowed to be set in these management areas. What good is not allowing harvest if there will still be bycatch issues in the gillnet fishery?
1/11/2019 21:54	Josh	Newton	Burlington	NC	No	Gill Nets catch and kill all species, all gill nets should be banned.
1/10/2019 18:44	karen	Montgomery	Beaufort	NC	No	
1/12/2019 10:39	Keith	Boughton	Spring lake	NC	No	
1/11/2019 23:00	Kevin	Sickle	Hubert	NC	No	get nets are wiping stripers out along with everything else, and all gill nets should be banned in all state waters.

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Online Public Comments on Draft Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass Fishery Management Plan

Submission Time	First Name	Last Name	City	State	Support?	Comments
1/12/2019 9:29	LARRY	MANN		NC	No	Gill nets do not need be used at all in inland waters! I have witnessed Gill nets wipe out areas in days of all species. I don't understand why the State Government keeps trying to maintain a failing commercial fishery. THERE IS A REASON THAT EVERY OTHER STATE FROM VIRGINIA TO TEXAS HAS DONE AWAY WITH INLAND GILL NETS!
1/12/2019 17:02	Lawrence	Mercer	Beaufort	NC	No	In the past 4 years while fishing in the lower Neuse River, I have seen a substantial increase in the number of striped bass that I have taken while fishing there so I can't understand the need for a no-possession restriction at this time. No-possession restriction for striped bass has done nothing to improve the Cape Fear River for the past ten years. Something to maintain river levels during the spawning season would be the most positive thing that might help increase the striped bass population in the CSMA when it is compared to the Roanoke system. Recreational anglers need striped bass for our Winter fishing. Closing the inland coastal waters to striped bass fishing isn't fair when the inland waters are still open. The DMF should not be influenced by the WRC. In my opinion,a limit of 2 18' striped bass per day will not hurt their population. Let those who don't want any have memories of not getting any, but don't include me. LD Mercer
1/12/2019 12:51	Luke	Tippett	Wilmington	NC	No	While spending generally over 200 days a year, I have seen first hand the devestation of gill nets in our inshore waters. Many times I have encountered un-attended nets during the day that have looped up large numbers of fish. Many of these nets have also been illegally placed at points and Creek mouths. Until NC starts taking the commercial industry into account for the damage it's causing, it simply isn't fair to pin all the blame on the recreational angler. I for one would like my son to be able to enjoy catching fish in our inshore waters as I did with my father growing up here. Traveling just south of us to SC, anyone can clearly see how proper fisheries management creates a sustainable fishery. Thabks, Luke
1/14/2019 8:28	Lynn	Jourden	Fayetteville	NC	No	Recreational fishermen do not harm the population like Nets do
1/14/2019 12:50	Malcolm	Carmichael II	Ayden	NC	No	you have already limited the length of stripped bass to the point hook and line fisherman can not catch one at the legal size limit. rules are made for he commercial fisherman advantage and the hook and line weekend fisherman are the ones who bear the brunt of all the changes. I do not support this change.

APPENDIX 2

Online Public Comments on Draft Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass Fishery Management Plan

Submission Time	First Name	Last Name	City	State	Support?	Comments
1/13/2019 8:20	Margarito	Leal	Richlands	NC	No	Gill nets are wiping out striped bass, red fish, and other game fish along with other marine life such as sea turtles and birds. I have witnessed the waste of resources caused by gill netting outfits and it will go on unchanged unless there is greater oversight. Gill nets should be banned in all state waters. If this ban is adopted our resources will flourish. All you have to do is look at the other states who have banned the use of commercial gill nets and see how the fishery has improved.
1/13/2019 14:07	Marilyn	Lowe	Fayetteville	NC	No	The gill nets kill everything in the water. I have been out there and seen it with my own eyes. They should be banned. I have seen them kill thousands of fish that weren't grown yet... is a shame to let this happen. If you have seen it then you would vote no.
1/12/2019 13:47	Mark	Tippett	Wilmington	NC	No	Gill nets do not produce a sustainable fishery. I'm not sure why our State has taken so long to eliminate inshore netting.
1/11/2019 21:18	Marty	Fara	Durham	NC	No	I think gill nets should be outlawed, we should have our fisheries more in line with SC and LA
1/11/2019 21:48	Marty	Fara	Durham	NC	No	Gill nets should be outlawed for the entire state, they destroy our fish numbers. Just look at how well SC fishery is since they outlawed them and compare them to us.
1/13/2019 15:29	Mary	Castleberry	Belhaven	NC	No	I support: 1. Adopting WRC limits for recreational fishermen; 2. Closure of targeted commercial harvest; 3. No gill nets west of ferry lines on the Pamlico and Neuse rivers; and, 4. Mandatory full-time attendance of all gill nets in the CSMA areas open to gill netting.
1/14/2019 9:32	Matt	Sechler	Salisbury	NC	No	All gill nets should be banned in state waters, non selective fishing that kills all species is destructive.
1/12/2019 8:19	Michael	Miller		NC	No	Gill nets are wiping stripers out along with everything else, and all gill nets should be banned in all state waters.
1/13/2019 16:23	michael	mattice	jacksonville	NC	No	The gill nets are the reason. All species are being depleted by inshore nets. Why dont we do the right thing. Our fishery is getting worse and worse. Nc is an embarresment compared to sc,fla,la. Lets make changes
1/14/2019 11:44	Michael	Perella	Sneads Ferrry	NC	No	gill nets are wiping stripers out along with everything else, and all gill nets should be banned in all state waters.

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Online Public Comments on Draft Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass Fishery Management Plan

Submission Time	First Name	Last Name	City	State	Support?	Comments
1/12/2019 9:22	Nick	Brinkley	Wilmington	NC	No	Why stock striper if the gill nets are just going to kill them all? I've spent years watching dead striper and other by catch float dead in our icw's from harkers island to Wilmington. The fact we still allow shrimping and gill nets in our estuaries proves to me (a former federal law enforcement officer) just how corrupt our fishery management is. The same guys gill netting and killing all the stock striper are the same guys in the half million dollar house on the water with a dock. Then telling us their $5k on commercial fishing income is their livelihood. Makes no sense! Close Recs so some commercial gill netting can kill all of them anyway.... come on.
1/11/2019 11:56	Patrick	Mallette	Greenville	NC	No	I support: 1. Adopting WRC limits for recreational fishermen; 2. Closure of targeted commercial harvest; 3. No gill nets west of ferry lines on the Pamlico and Neuse rivers; and, 4. Mandatory full-time attendance of all gill nets in the CSMA areas open to gill netting.
1/14/2019 12:35	Paul	Lane	Hertford	NC	No	I am opposed to a moratorium on striped bass in the CSMA region. I have participated in the Shad fishery in the Neuse River since 2014. This past season, due to a warmer than average spring, most Striped Bass were well past the Highway 70 bridge before the March Rock season opened for the CSMA. This particular year, due to the Hurricane and the copious amounts of rain we have received, the fresh water has pushed the majority of the Rock (and speckled trout and flounder) out to the mouth of the river and into the sound. The 25000 pound quota, assuming a four pound average, leaves roughly 6200 fish over this region that includes portions of five rivers. To deny complete access to this small # of fish in the CSMA will only negatively affect the general public's ability to consume these fish during an already extremely limited season. I hope that you will not approve of this moratorium-as history has shown us, it will likely never be returned, even when the populations rebound.
1/10/2019 17:16	PHILLIP	WOOD		NC	No	STOP THE NETS !!!!!!!
1/17/2019 13:02	Randy	Parker	New hill	NC	No	I think gill nets should not ne allowed they are depleting our fishery.
1/11/2019 21:41	Raymond	Brittain	Holly Ridge	NC	No	With WRC findings that most are being caught by commercial fishing, I believe we should remove the commercial element before limiting access to recreational opportunity, givin that these fish have been paid for and stocked by recreational funding.

APPENDIX 2

Online Public Comments on Draft Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass Fishery Management Plan

Submission Time	First Name	Last Name	City	State	Support?	Comments
1/17/2019 9:34	Rennie	Clark Jr	Wilmington	NC	No	Please quit masking the real problem with our Coastal fishery. We both know inshore gill nets are the real problem. How about do what's right for once and ban inshore gill nets. I fish all over the south and this state is the worst fishery of them all.
1/12/2019 14:25	Robin	Geck	Monroe	NC	No	Recreational fishing is not the problem...BAN ALL GILL NETTING!!
1/12/2019 9:39	Rodney	McKeel	Bailey	NC	No	Gill nets are horrible
1/12/2019 6:55	Roy	Dawson	Newport	NC	No	
1/12/2019 10:03	Sandy	Stephenson	Willow Spring	NC	No	I only support measures that would ban all Gill nets in inland waters
1/12/2019 13:08	Scott	Scarola	Wilmington	NC	No	Need to get rid of gill nets. They are destroying our fisheries and very harmful to our striper population as well as other important species.
1/12/2019 9:23	Sean	Bird	Fuquay Varina	NC	No	Gill nets must be banned in all State inshore waters. The evidence is clear to all. Other States have done the same with similar difficult circumstances, and have improved commercial and recreational fishing for all.
1/12/2019 15:34	Stephen	Myslinski	Jacksonville	NC	No	The simple thing to do. Remove nets from our waters. Instead of restricting the fish we can keep and size limits. Remove the problem from our waters. Fix the problem. Don't keep adjusting numbers and keep compounding our problem
1/11/2019 22:03	STEVEN	BREWSTER	Wilmington	NC	No	Gill nets are killing stripers as well as everything else that touches them and should be banned in all state waters. I fish almost every day and I see discarded dead fish with gill net marks on them regularly. There is hardly a day that I fish that I don't see the impact of this destructive gear on our waterways. After a few years without gill nets the fishery will come back strong and still be able to support a commercial fishery that doesn't involve this gear. The data makes the numbers look confusing but if you ask anyone who has been fishing the area for 40+ years you can see the decline in our fisheries. We do not see a similar decline in freshwater fisheries where there are no nets being used. I would say that is evidence enough along with places like SC that banned gill nets and saw amazing recovery as well as enjoying the economic boom associated with a recovered fishery that is stronger without nets.
1/12/2019 13:05	Stone	Tippett	Wilmington	NC	No	First off, Gill nets are ruining the striped bass fishery as long as many of species of fish in NC. I've personally experienced seeing many redfish, striped bass, trout, dolphin and other species of fish floating close to gill nets with gill net marks around them.. I love to fish and the fact that the gill nets are still around ruining our fishery sucks. Take the nets away. It's simple.

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Online Public Comments on Draft Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass Fishery Management Plan

Submission Time	First Name	Last Name	City	State	Support?	Comments
1/22/2019 16:57	Thomas	Boylan	Wilson	NC	No	I do not support it as presented. If you truly want stocks to recover, you cannot go with half measures, i.e. no possesion on the recreation side and allowing the Gill net side continue even with restrictions. I do not believe there are resources enough to police that activity. Do you really believe the reporting of catches by the netters or the buyers is always truthful?, and you cannot possibly have enough resources on the water to check all the nets that would be out there. We ALL need to make sacrifices to assure that this valued natural resource will recover and thrive and benefit all those who depend on it for sport or livelihood for years to come. Thank You, Tom Boylan
1/11/2019 22:08	Timothy	Reagan	Maple Hill	NC	No	Commercial gill nets are directly responsible for declining numbers within state waters, specifically the tar/amplico and Neuse rivers. Furthermore multiple species are in decline, due to commercial gill nets specifically, causing these fisheries to directly suffer the consequences of inadequate fisheries management. It's time our state place the future of our public resources above commercial interests and ban large mesh gill net usage.
1/12/2019 10:58	timothy	Taramelli	hubert	NC	No	gill nets are killing off WAY to many fish and animals in our waters and THEY should be banned from the water ways ,red drum are allowed to be harvested as by catch Birds are killed by kill nets gators as well and any other animal that becomes entangled in GILL NETS they are NOT selective in any way shape or form and are the BIGGEST downfall of the state of NC not one single state that used to have gill nets NOW allow it NC is the LAST state that is living WAY in the past NOT the present. it has been recorded and documented MANY MANY times of there distruction yet NC fails every year to do ANYTHING about it
1/12/2019 9:36	todd	FISCHER	hubert	NC	No	Gill nets are absolutely wiping out our recreational inshore gamefish (redfish, trout, flounder and stripers)! All gill nets should be banned in state waters.
1/12/2019 9:41	Toni	Jernigan	Holly Ridge	NC	No	It is not a recreational issue. This is a full net problem. Gill nets kill iall sea life that swims into its net. Turtle, sea birds, dolphins, even alligators which are protected species. Ban the gill nets and our fishery problems will resolve themselves within a few years. Ban the nets!
1/11/2019 21:45	Tyler	Graybeal	Raleigh	NC	No	The gill nets are the problem.

APPENDIX 2

Online Public Comments on Draft Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass Fishery Management Plan

Submission Time	First Name	Last Name	City	State	Support?	Comments
1/17/2019 9:41	Wayne	Hardee	Ayden	NC	No	Seen and caught more in the last five years,been fishing The Neuse and tar for 30 years wonder why there is no bream anymore they have eaten them all.It is a shame that Virginia and SC.can keep herrings and we can't.I commercial fish and believe in attending my nets drifting a long past time leaving along with everything else.Offsore federal Commercial fish for King,Dolphin and Wahoo Spanish also hook and line. Why in the world would the State not allow Commercial fisherman to Catch rock or shad by hook and line where there is no by catch not be aloud .I have never yet understood this.Dont strip every right we have away to making a living.And yes I do all trip tickets.
1/13/2019 15:30	WILLAM	GORHAM	SOUTHRN SHORE	NC	No	Too much alternative motive. ...
1/12/2019 9:11	William	Smith	Jacksonville, NC	NC	No	We need an outright ban on gill nets, because they are detrimental to every species of fish. Also we need to reduce shrimp trawling in the Pamlico, as their bycatch is also extremely harmful to every species of fish.
1/12/2019 10:17	Willie	McLeod	Dunn	NC	No	

APPENDIX 3

MARINE FISHERIES COMMISSION
SUMMARY OF PUBLIC MEETING FOR SUPPLEMENT A to AMENDMENT 1 to the N.C. ESTUARINE STRIPED BASS FISHERY MANAGEMENT PLAN
DIVISION OF MARINE FISHERIES
WASHINGTON REGIONAL OFFICE
WASHINGTON, NORTH CAROLINA
JAN. 16, 2019, 6 PM

Marine Fisheries Commission: Cameron Boltes

Division of Marine Fisheries Staff: Steve Murphey, Dee Lupton, Kathy Rawls, Katy West, Tina Moore, Charlton Godwin, Todd Mathes, Jennifer Lewis, Deborah Manley, Nancy Fish, Dan Zapf, Jason Rock, Lee Paramore, Chris Wilson, Chris Braddy, Ami Staples, Clay Caroon, Drew Cathey, Joel Lauritsen, Steve Anthony, Daniel Ipock, Odell Williams, and Brian Long

Public: 88 members of the public which included 20 individuals that provided public comment

Media: None

Fisheries Management Section Chief Kathy Rawls opened the public meeting for the Division of Marine Fisheries draft Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass Fishery Management Plan at 6:00 p.m. Kathy introduced Director Murphey, Commissioner Cameron Boltes, and biologist supervisor Charlton Godwin. Charlton provided a 45-minute long presentation regarding the issue contained within Supplement A and then answered questions for 20 minutes following his talk. The last part of the meeting was allocated to receive public comment. Each person who wished to speak was allotted three minutes to provide comments.

Question/Answer Summary

1. **Michael Lobos -** recreational fisherman
   Q: What is the criteria for reopening this Amendment or this situation?

   Charlton Godwin - NCDMF Striped Bass Lead
   A: Charlton explained that DMF did not develop criteria in the supplement, that any criteria would be developed through the full Amendment 2 process and all options will be evaluated. He also stated that managers would look at several indicators to determine when to reopen and the direction with management moving forward. Charlton explained that in 2017 a juvenile striped bass seine and trawl survey were reinitiated in the Tar-Pamlico and Neuse rivers which will give us the ability to detect successful natural spawning. He also suggested that if there's good recruitment from the protected year classes the DMF would potentially see increased abundance in our gill net survey and WRC would see increased abundance in their spawning ground survey.

2. **Chris Elkins** - CCA
   Q: Of the 921 dots on observer trip maps within the Tar-Pamlico and Neuse rivers (presentation slide # 27), how many were red and how many are green (green are observer trips without striped bass, red are observer trips with striped bass)?

   Charlton Godwin
   A: Charlton responded that of the 921 observed trips (red dots), 251 observed a striped bass (green dots) or 27%.

3. **David Sneed** - CCA
   Q: Do you know the dates or time period for when those observer trips occurred when they saw striped bass?

   Charlton Godwin
   A: Charlton replied that 35% occurred in the winter (Jan-Mar), 18% occurred in the spring (Apr-Jun), 34% in the summer (Jul-Sep), and 13% in the fall (Oct-Dec) overall. He stated that breakdown was for trips that saw striped bass and he could provide the breakdown for all trips in the area if needed.

4. **Richard Andrews** - recreational guide
   Q: We're trying to keep these fish alive in order to spawn, is the DMF doing anything to evaluate the conditions of the spawning grounds, yes or no answer?

   Charlton Godwin
   A: Yes

   Q: What?

   Charlton Godwin
   A: Charlton explained that flow and habitat quality were one of the DMFs main concerns in the Tar-Pamlico and Neuse rivers and that managing flows to keep striped bass eggs afloat on the Roanoke River was crucial in that stocks recovery. He replied that the WRC has looked at striped bass egg production on the Neuse and that the DMF recently funded a two-year CRFL project to researchers at NCSU to look at the egg characteristics of CSMA striped bass, including egg buoyancy. He suggested that depending on results of the egg buoyancy research, maybe we would get different broodstock fish (maybe from South Carolina) that have a different egg type that will potentially provide successful spawning and recruitment.

5. **Mitchel Blake**
   Q: In the Cape Fear there's been a moratorium for 10 years, why should we think that this moratorium won't be in place for that long?

Charlton Godwin
A: Charlton explained that the biggest difference in the Cape Fear is the issues with upriver blockage caused by lock and dam # 1 which are not present on the Tar-Pam and Neuse rivers. He remarked that there isn't the same type of habitat issues, we have flow issues on the Tar-Pamlico and Neuse and suggested that most of the flow comes from water discharge at municipalities. He stated that as we work through Amendment 2 all of those issues will be looked at, including striped bass management in the Cape Fear.

6. **Chad Bond**
Q: Why did you include wild fish larger than 23 inches that might not have been genetically tagged in the 2017 genetic results (presentation slide # 13)?

Charlton Godwin - NCDMF Striped Bass Lead
A: Charlton replied that most of the striped bass sampled were in the range of sizes that could have genetic markers, but more importantly the large number of wild fish below 22 inches are believed to represent a successful spawn of two year classes of fish that the supplement would protect.

7. **Steve Midgette**
Q: Have you looked at poor water quality (e.g., estrogen) and its effect on fish?

Charlton Godwin
A: Charlton stated that it has been an issue for many years and it is a concern, however he's not aware of any studies on the Tar-Pam and Neuse rivers that specifically looked at the effects of estrogen on fish. He explained that the Coastal Habitat Protection Plan (CHPP) had a whole section on the topic and he could look for the results of the meetings and discussion on the subject if needed. Charlton also mentioned that the research currently being conducted by NCSU looking at egg quality could be used to detect issues with striped bass eggs in relation to water quality.

Q: Is there anything being done about sedimentation?

Charlton Godwin
A: Charlton explained that there is a lot of information contained in the CHPP regarding sedimentation.

APPENDIX 3

Public Comment

1. **Chris Elkins** with the CCA stated that most of the controversy related to management of marine finfish in North Carolina is based on lax rules related to gill nets. Elkins asked which other state allows more than one mile of unattended webbing in estuaries and expressed his concern that the non-selective nature of the gill net fishery has led to depletion of target species and bycatch. Elkins said that the native striped bass stock is worse off than southern flounder and that now a very small percentage of wild fish exist because we've nearly extirpated them with nets due to mis-mismanagement. Elkins stated that a choice must be made by the division and Commission between two objectives: having a self-sustaining population of striped bass or continuing to allow gill nets to remain in the water in a small area. Elkins explained that the recreational anglers he knows would prefer to see the Commission mirror WRC's rule, to eliminate directed harvest and remove gill nets from this area. He concluded that, if the Commission does insist on a moratorium most anglers could live with it but only if gill nets are removed.
2. **Eric Braddy** of Chocowinity, N.C. explained that he grew up on the Tar and Pamlico rivers and supports both recreational and commercial sides on this issue. He stated that, although he is not a biologist, he has seen that there are striped bass out there and feels that the data is inconclusive. Braddy stated that managers are not doing their jobs and that the focus needs to be on the spawning grounds, genetics, and water quality, not shutting down the fishery. Braddy mentioned that many stakeholders could not attend a 6 pm meeting because they were working until 5:30. He expressed concern that the decision had already been made.
3. **Tim Hergenrader** is a recreational fisherman from New Bern, N.C. who would like to match the WRC 26-inch size limit, close all commercial harvest of striped bass within the CSMA, prohibit all gill net fishing from the Tar-Pamlico, and Neuse rivers from the ferry lines to the inland water boundary, and require fulltime gill net attendance in all other CSMA waters. He raised the concern that if striper fishing is shut down in the upper Neuse there will be nothing left to fish for other than largemouth bass, bluegill, crappie, and catfish. Trout haven't been around for two years, red drum are practically-nonexistent and mostly undersized, and there are no flounder because they're undersized. The increase in striped bass fishing is because there's nothing else to fish for. He stated that he lives close to a major boat ramp and he's hardly seeing any boats out there fishing and that there hasn't been fishing pressure since the hurricane. He said he would hate to see managers close the fishery and keep the gill nets in the water.
4. **Stuart Creighton** is a recreational angler from Oriental, N.C. who believes that the striped bass stocking program in place within the CSMA has not been successful and that striped bass have been experiencing cryptic mortality during the stocking period. Now, two year classes of striped bass have been detected through genetic analysis demonstrating successful spawning. To protect these year classes the DMF is proposing a no possession, no harvest closure in the short term while a new Fishery Management Plan is being developed. Creighton stated that the closure would certainly minimize all recreational removals and would minimize commercial removals and targeted gill net mortality. However, this proposed closure does not sufficiently address unintended gill net bycatch. Creighton will

only support this closure provided that all gill nets are removed from the areas in each river system that managers are trying to protect. Creighton referred to recent studies by the NCWRC suggesting that stripers have been victims of cryptic mortality related to unintended bycatch by gill nets. The DMF acknowledges that gill net effort is a significant factor in striped bass mortality. Given that the observer trip coverage is so far below the targeted ITP coverage, he could only conclude that the commercial dead discards comprising just 7% from gill nets trips is too low. How many other trips were taken where no trip tickets are registered? He feels that the proposal would undoubtedly help the striper populations, however it does nothing to reduce unintended bycatch when targeting other species.

5. **Donald Willis** owns Custom Marine Fabrication in New Bern, N.C. and is representing his family and his business. Since 1986, Willis has made his living from recreational fisheries. Willis expressed concern that gill nets are too efficient in catching fish and would like to see them removed to the ferry lines to save the striped bass; he would like to see all other WRC regulations adopted. Willis explained that if striped bass fishing is stopped his company will bear a very hard burden.
6. **David Daniel** of Chocowinity, N.C. stated that the Tar-Pamlico will never be the Roanoke River. In 2004, he served as the Co-Chair of the CSMA Striped Bass Advisory Committee and spent three years of his life on this topic. During that time, he explained that the recommendation was a two-fish limit, 18 inches in size, October through April season, and everyone was spending money and catching fish and it was going great. Daniel was given information from Marine Fisheries stating that of the fish that went up the Tar River only 2% had a successful spawn and that 100,000 pounds of striped bass were killed by commercial fishermen to sell 25,000 pounds of fish. When asked to do a 90% reduction, they did. Daniel explained that what is wrong with the Tar-Pamlico River is that it is shallow and polluted with no dam upstream; there is no way to adjust the flow during peak spawning times. He said that flow adjustment cannot be done on the Tar-Pamlico; one day they might be able to do it on the Neuse. Daniel believes that this fishery works as a put-and-take fishery. He explained that we saw two successful spawns because water flow was just right, which means we got lucky. He does not feel that there is a reason to change anything. He concluded by saying that these fish are not going to recover on their own, and that recovery would entail spending money on dredging and cleaning up the river. Daniel provided a proclamation written by the Beaufort County Commissioners in 2016 asking the Marine Fisheries Commission to continue the put-and-take fishery.
7. **Richard Andrews** stated that the moratorium is flawed because it assumes that these fish will spawn. He urged the group to start looking for the source of the problem and examine why the fish are not spawning rather than using Band-Aid approaches. Andrews suggested focusing on what could be done to improve the spawning grounds, including flow management in the spring. He felt that we may be jumping the gun with the moratorium.
8. **David Sneed** with the CCA stated that following the November 2018 MFC meeting the CCA sent a letter on Dec. 7 to DMF with questions regarding the striped bass presentation. Sneed stated that they never received an answer from DMF. Sneed remarked that tonight's presentation answered a lot of questions that were raised, however he also expressed concerns that it was impossible to adequately address the issue in the three minutes provided.

Sneed was concerned that DMF results presented at the MFC meeting in Kitty Hawk, N.C. were in stark contrast with WRC published data and findings that recreational and commercial directed harvest were more than gill net bycatch mortality of striped bass. Sneed commented on using the sea turtle observer data because it's a small subset of information that you're basing decisions on. He explained that the CCA would support a moratorium if the gill net issue is addressed as well. He stated that since that is not in the proposal, the CCA instead supports mirroring the WRC regulations to eliminate confusion between water boundaries, supports a closure on directed commercial harvest of striped bass, and supports the removal of gill nets to the ferry lines. He stated the need to address dead discards in bycatch, that they do not help with rebuilding the stock.

9. **Jerry Schill** with the N.C. Fisheries Association (written comments forthcoming) stated that bycatch mortality occurs in both user groups, and if you address one you have to address the other. Schill stated that the biggest issue was addressing the issue of the inland fisheries spawning grounds. If WRC is not willing to address it then the fishery is DOA. Schill explained that you can't do it by simply what is proposed, it has to be addressed at the spawning grounds.
10. **Roger Rulifson with** ECU has researched striped bass for 36 years in N.C. and wanted to clear up some things tonight based on his research. Rulifson stated that he uses ear bones (otoliths) to identify striped bass nursery grounds by examining the elements present in the water which are deposited within the otolith. He explained that they were able to identify every hatchery fish in the Tar and Neuse rivers because of a strong strontium signature in the water at the Edenton National Hatchery. He stated that the first year's results were 87% hatchery and a few years later it was around 90% hatchery. Rulifson explained that hatchery fish mature faster (age 3) than wild fish (age 4-6; Roanoke) and suggested that it may not be a habitat issue because we're stocking almost the entire population with hatchery fish and they are not going to reproduce as well.
11. **James Carraway** is a recreational fisherman from Greenville, N.C. who asked about a figure in the presentation regarding angler numbers, angler hours, angler trips and the recreational economic impact because he thought he might have misread the figure; clarification was given.
12. **Chad Bond** is both a recreational and commercial fisherman who grew up herring fishing on the Chowan River. He expressed concern that there's been a moratorium on herring for 20 years, and a moratorium on striped bass in the CFR for 11 years, and he didn't want to see the same thing happen here. Bond stated that he opposed it. Bond also questioned analysis in the striped bass genetic samples and the percent wild contribution of fish greater than 23 inches in 2017. He felt by including those fish the percent number of wild fish would be diluted.
13. **Joe Balazsi,** Vice President of the Carolina Fishers of Men Inshore Trail, stated that back in 1999 he started fishing in Washington. Balazsi expressed concerns that past management aimed to fix it did nothing. Why do we think if we shut it down for two years it will fix it? Balazsi explained that this proposal is not going to fix it and it's frustrating. He stated that there are plenty of fish in the Tar River but none over 26 inches. He expressed the WRC had done a good job of creating a moratorium up the river and said the record of the MFC is that

if they take it away, it's gone. Balazsi explained that in his 20 years no restoration program has improved the fishery. He stated that it's a terrible thing to shut down rock fishing and ruin an industry, because that's what's it's going to do.

14. **Mitchel Blake** explained that it's priceless being able to take a kid out to catch a fish for dinner. You can put a value on the recreational and commercial sectors, but you cannot put a value on bringing a fish home for your family. He expressed concern that putting a moratorium on this fishery would close it down to a lot of people and lead to missed outdoor experiences. He stated that there's a lot more at stake with shutting it down, then to try and figure it out. Blake explained that there needed to be flow regulations on the Tar and Neuse like on the Roanoke to have striped bass. He stated that something has to be done, everybody here knows there are issues. The moratorium would take away from these kids, give us a fish or we'll lose the kids to fishing and see that money shift to the ball parks instead of fishing.
15. **Martin Schramm** stated that the State of N.C. puts out $600,00 to stock fish. He expressed concerns that the State was taking his tax dollars to stock the fish, but he can't take these fish that he paid for. You're taxing me and not allowing me to benefit from the public resource.
16. **Bonner Latham** is a commercial fisherman from Bath, N.C. who had concerns about pollution. He also stated that a striped bass is a mean fish, he eats everything and anything (eels, flounder), so what you're doing are turning loose a battleship that is going to eat everything. He asked if it is right for those fishermen to be destroyed?
17. **Todd Willis** is the owner of Neuse River Bait and Tackle in Pamlico County, N.C. and didn't think it's right to shut down the fishery. He was concerned about the economic decline that's going to happen and stated that it was going to cut his sales of inshore fishing by 1/3. He stated that it would take that time with my son away from me and that he would have to explain why his son cannot keep a fish. He expressed concern that the DMF doesn't even know what the problem is; doesn't know if it is pollution, or if commercial or recreational are taking too much. He stated that we should match what WRC has done and don't close a thing until you figure out what the problem is.
18. **David Jones** suggested that if you close commercial and recreational harvest it's just going to increase commercial discard and recreational removals. What happens in the fall when there are commercial nets and recreational fishermen fishing for trout, aren't those striped bass going to be caught as discards? He stated that until you figure out what's happening and have a plan, don't close it. Jones explained that we're paying for these fish to be there, you're taking our money.
19. **Bobby Hinnant** said that If you close this, do both recreational and commercial. He also expressed concern that by closing it down here, it would shift the fishing pressure to Kerr and Gaston lakes. He expressed concern that the decision had already been made
20. **Steve Turner** of Martin County, N.C. wanted to know if anyone thought about the pressure closing it down here would have on the Roanoke River, Albemarle Sound, and the lakes? He stated that it was a disgrace that the people who live on the river can't go catch a fish.

DRAFT

Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass Fishery Management Plan

Implementation of a Striped Bass No-Possession Limit in the Internal Coastal and Joint Fishing Waters of the Central Southern Management Area

February 1, 2019

I. ISSUE

The issue is consideration of Supplement A to Amendment 1 to the N. C. Estuarine Striped Bass Fishery Management Plan (FMP) consisting of a no-possession limit for striped bass *(Morone saxatilis)* in the internal coastal and joint waters of the Central Southern Management Area (CSMA) while Amendment 2 to the N.C. Estuarine Striped Bass Fishery Management Plan is being developed and adopted. New information suggests there have been two recent successful striped bass spawning events in the Tar-Pamlico and Neuse rivers. The supplement objective is to protect these year classes of fish to help support specific goals of Amendment 1, which are to achieve sustainable harvest through science-based decision-making processes that conserve adequate spawning stock and provide and maintain a broad age structure.

II. ORIGINATION

General Statute 113-182.1 provides a supplement mechanism to modify a FMP between the five-year scheduled reviews when the Secretary of the Department of Environmental Quality determines it is in the interest of the long-term viability of the fishery.

At the November 2018 N. C. Marine Fisheries Commission (NCMFC) business meeting the following motion was passed: *Motion to authorize staff to develop temporary management measures to supplement the N.C. Estuarine Striped Bass Fishery Management Plan with a no-possession limit in the Central Southern Management Area to protect important year classes while the next plan amendment is being developed.*

The draft supplement contains an analysis of the proposed management change including pertinent data with projected outcomes, and proposed proclamation measure necessary to implement that provision.

On December. 3, 2018, N.C. Division of Marine Fisheries (NCDMF) Director Stephen W. Murphey sent a recommendation to N.C. Department of Environmental Quality Secretary Michael S. Regan to develop a temporary management measure to supplement the N.C. Estuarine Striped Bass FMP consisting of a no-possession limit for striped bass in the CSMA. On December 19, 2018, Secretary Regan responded to Director Murphey that “after careful consideration, I concur with your recommendation”.

III. BACKGROUND

Management History

The N. C. Estuarine Striped Bass FMP approved in May 2004 was the first FMP for striped bass developed under the criteria and standards of the 1997 Fisheries Reform Act (NCDMF 2004). The plan focused on identifying water flow, water quality, and habitat issues related to survival and reproduction throughout the state, reducing discard mortality in the commercial anchored gill-net fisheries, continued stocking of striped bass in the Tar-Pamlico, Neuse, and Cape Fear rivers of the CSMA, and developing creel surveys in the Tar-Pamlico, Neuse, and Cape Fear rivers to estimate recreational striped bass harvest in those systems.

CSMA Management Strategies Adopted in Amendment 1

Estuarine striped bass in North Carolina are managed under Amendment 1 to the N. C. Estuarine Striped Bass FMP and its subsequent revision (NCDMF 2014). It is a joint plan between the NCMFC and the N. C. Wildlife Resources Commission (NCWRC). Amendment 1, adopted in 2013, lays out separate management strategies for the Albemarle-Roanoke (A-R) stock in the Albemarle Sound Management Area (ASMA) and the Roanoke River Management Area (RRMA), and the CSMA stocks in the Tar-Pamlico, Neuse, and Cape Fear rivers (Figure 1). Management measures in Amendment 1 consist of daily possession limits, open and closed harvest seasons, seasonal gill-net attendance and other gill-net requirements, minimum size limits, and slot limits to maintain sustainable harvest and reduce regulatory discard mortality in all sectors. Amendment 1 also maintains the stocking measures in the major CSMA river systems and the harvest moratorium on striped bass in the Cape Fear River and its tributaries, including Snow's Cut (NCDMF 2013).

CSMA Regulations Adopted in Amendment 1

The following regulations are those contained in the jointly adopted Amendment 1 to the N. C. Estuarine Striped Bass FMP. Both commercial and recreational fisheries are subject to an 18-inch total length (TL) minimum size limit for striped bass within the CSMA. As an additional protective measure in joint and inland CSMA waters, it is unlawful for recreational fishermen to possess striped bass between 22 and 27 inches TL. The recreational harvest season for striped bass within the CSMA is October 1 through April 30. Recreational fishermen are constrained to a two fish per person per day possession limit.

Unlike the commercial fishery in the ASMA, the striped bass commercial fishery in the CSMA is a directed fishery, except in Pamlico Sound where bycatch restrictions are in place, and primarily uses anchored large mesh (≥5 inches stretched mesh (ISM) gill-nets. There is a commercial daily possession limit of 10 fish per person per day with a maximum of two limits per commercial operation enacted by proclamation annually. Daily reporting of the number and pounds of striped bass landed from all licensed striped bass dealers helps ensure the 25,000-pound total allowable landings (TAL) is not exceeded. The commercial harvest season opens by proclamation and may occur between January 1 and April 30 and is closed by proclamation once the annual 25,000-pound TAL is reached or on April 30, whichever occurs first. After the closure of the commercial harvest

season and continuing through December 31, commercial fishermen are required to use three-foot tie downs in gill-nets with a stretch mesh length ≥5 inches in internal coastal fishing waters west of the 76 28.0000' W longitude line. They must also maintain a minimum distance from shore (DFS) of 50 yards for these nets upstream of the existing DFS line (Figure 2).

In both fishery sectors it has been unlawful to possess striped bass taken from the internal coastal and joint waters of the Cape Fear River and its tributaries since 2008 per MFC Rules 15A NCAC 03M .0202 and 03Q .0107.

The following management change was developed and implemented solely under the purview of the NCWRC and was not developed through the joint FMP process. The NCWRC has jurisdiction in the inland waters of the CSMA, and on February 16, 2016, the NCWRC voted to modify the exception to the general statewide size regulation for striped bass in inland waters of the Tar-Pamlico, Pungo, and Neuse rivers and their tributaries by increasing the minimum size limit from 18 inches to 26 inches TL. The no-possession prohibition on fish between 22 and 27 inches TL was removed. The daily creel limit (two fish per person per day) and harvest season (October 1–April 30) were not changed. The new rule was scheduled to go into effect August 1, 2017, but 10 letters of objection requesting legislative review of the rule were received in March 2017. No action was taken during the mandatory legislative review period, and NCWRC Rule 15A NCAC 10C .0314 became effective on June 1, 2018.

Stock Concerns

The NCDMF's 2018 stock overview http://portal.ncdenr.org/web/mf/stock-overview notes it is difficult to quantitatively assess the CSMA stocks relative to overfishing and overfished stock status. As stated in the CSMA 2010 stock assessment the large confidence intervals and lack of precision in the catch curves Z (total mortality rate) estimates make them unsuitable for making a stock status determination (NCDMF 2010). The FMP review for estuarine striped bass is underway and results from a benchmark stock assessment are expected in 2019. The need for continued conservation management efforts has been supported by persistent low overall abundance, minimal natural recruitment, multiple sources of mortality, the absence of older fish on the spawning grounds, non-optimal environmental conditions on the spawning grounds in the spring, potential impacts from stocked juveniles and hybrid striped bass, and the high percentage of stocked fish in the population.

A management strategy adopted in Amendment 1 continued the annual stocking program in the CSMA rivers. Specific objectives for stocking striped bass included attempts to increase spawning stock abundance while promoting self-sustaining population levels appropriate for various habitats (see Amendment 1, Section 11.2 Striped Bass Stocking In Coastal Rivers, NCDMF 2013). The adopted management strategy from Amendment 1 increased the annual numbers stocked to a goal of 100,000 hatchery reared striped bass in each of the major river systems (Tar-Pamlico, Neuse, and Cape Fear rivers) to aid in recovery of the stocks. From 2006 to 2009 stocking occurred on a rotating basis where only two out of the three systems were stocked annually. Prior to 2006 stocking was focused on the Tar-Pamlico and Neuse rivers with sporadic stocking in the Cape Fear River (Table 1). Various levels of stocking have been going on in these two systems since the 1950s (Woodroffe 2011), with the NCDMF's formal involvement beginning in 1980 as the result

of a cooperative agreement with the United States Fish and Wildlife Service (NCDMF 2013). The prior practice of cross-stocking (stocking of striped bass from one drainage system to another, e.g. Roanoke River striped bass offspring being stocked throughout the southeastern United States), has introduced non-endemic genetic strains to many striped bass populations. The effects of this long-standing practice remain largely undocumented and unquantified (Rulifson and Laney 1999; Bergey et al. 2003). It is now known the egg buoyancy of certain strains (e.g., Roanoke River and Chesapeake Bay) are ideally suited for certain flow types. The Chesapeake strain eggs are lighter and maintain their position in the water column of calmer tidal waters through neutral buoyancy, whereas the Roanoke River strain eggs are much heavier and use the more turbulent, high energy system of the Roanoke River to maintain their position in the water column (Bergey et al. 2003).

To determine the percent contribution of hatchery fish to the wild population, the long-standing convention was to chemically mark hatchery reared striped bass prior to stocking by holding fish at the hatchery in water treated with an antibiotic, oxytetracycline. The chemical leaves a mark on the otoliths (ear bones) of the fish which can be examined by researchers in later years to determine if the fish was hatchery reared or not. Results from the chemical marking methodology suggested hatchery reared striped bass stocked in the Tar-Pamlico, Neuse, and Cape Fear rivers contributed very little to the spawning populations. However, through the years and since the adoption of Amendment 1, researchers realized the chemical mark was not being retained in 100% of fish as previously thought, which led to underestimation of the percent of hatchery reared fish in the striped bass populations in the CSMA (Barwick et al. 2008; NCDMF 2013).

Beginning in 2010 a new method of identifying hatchery reared fish based on genetics, termed parental based tagging (PBT), was implemented by the NCWRC to more accurately determine the percent hatchery contribution to the striped bass on the spawning grounds in the CSMA. In 2016 the NCDMF started collecting striped bass fin clip samples for genetics analysis from the commercial and recreational fisheries and from areas away from the spawning grounds in the lower portions of the rivers to gain additional spatial coverage of samples. The genetics-based method has been proven to be greater than 99% accurate at determining if a fish was hatchery produced (Darden et al. 2012). By 2016, the results of this new genetics-based analysis since 2011 revealed that rather than contributing minimally to the CSMA stocks of striped bass as previously thought, hatchery stocked fish were nearing 100% on the spawning grounds and in internal coastal fishing waters of the Tar-Pamlico, Neuse, and Cape Fear rivers (O'Donnell and Farrae 2017).

Results from genetic testing of sampled fish in 2017, in contrast to prior years, revealed a noticeable decrease in contribution of hatchery stocked fish (Table 2; Farrae and Darden 2018). Of the fish identified as non-hatchery, approximately 23% were >23 inches TL, of which 59% came from the Cape Fear River where PBT testing started in 2010. Only one striped bass in the 2017 genetic results was larger than the size that would allow for PBT testing, therefore almost all of the striped bass sampled were of length that could have been identified through PBT analysis (Figure 3). However, the non-hatchery fish <22 inches in TL collected in 2017 were most likely wild and indicative of successful natural spawning events (Table 2; Figures 3 and 4; Farrae and Darden 2018). Otolith ages of the non-hatchery fish <22 inches TL (n=42) indicate they are all from the 2014 and 2015 year classes (Table 3). These two year classes represent the first significant evidence of successful natural reproduction in the Tar-Pamlico and Neuse rivers since PBT genetics analysis began in 2011.

Juvenile sampling in the Tar-Pamlico and Neuse rivers by the NCDMF with beach seine and trawl gear from 1977–1982 resulted in the collection of very few juveniles in some years and no juveniles in other years. Juvenile sampling by the NCWRC with beach seines and electrofishing gear in 2007 resulted in zero juveniles collected. Results from these sampling efforts supports the hypothesis of very limited, if any, natural reproduction occurring in the Tar-Pamlico and Neuse rivers for several decades (Hawkins 1979; Judy and Hawkins 1982; NCDMF 2005; Barwick et al. 2008; NCDMF 2013).

Characterization of the Fishery

Recreational

Recreational harvest in the CSMA has fluctuated since 2004 ranging from a low in 2008 of 2,990 pounds to highs of 22,958, 25,260 and 26,973 pounds in 2004, 2016, and 2017, respectively (Table 4; Figure 5). In recent years both the number of recreational trips and the hours spent targeting striped bass within the CSMA have increased. Since 2011, recreational harvest in the Tar-Pamlico and Neuse rivers has been similar, ranging from approximately 4,000 to 9,000 pounds, however starting in 2016 there was a sharp increase in recreational harvest. The number of legal sized striped bass recreational discards began increasing over the past six years, with the 2017 estimate of 26,487 fish nearly double the previous high of 13,621 fish in 2012. The number of slot limit sized fish released has fluctuated over the past ten years ranging from a low in 2015 of 813 fish to a high of 6,779 fish in 2016. In 2017, in addition to harvesting the highest number of striped bass in over 10 years, there was a twofold increase to more than 100,000 undersized striped bass discards (Table 4). There is also a significant recreational catch-and-release fishery during the summer closed harvest season in the middle reaches of the Tar-Pamlico and Neuse rivers. Total recreational releases during the last 10 years averaged 39,913 fish annually (Table 4).

The proportional standard error (PSE) expresses the standard error of an estimate as a percentage of the estimate and is a measure of precision. In general, PSEs greater than 50% represent imprecise estimates. The PSEs for striped bass harvest in numbers and pounds in the Tar-Pamlico and Neuse rivers range from 16.0 to 69.2%, and the PSEs of estimates of discarded fish range from 1.4 to 43.5% (Table 5).

Commercial

Commercial landings in the CSMA have been regulated by an annual TAL of 25,000 pounds since 1994. Over the past 10 years, commercial landings have closely followed the annual TAL, except for 2008 when less than half of the TAL was landed (Figure 6). About twice the number of landings come from the Tar-Pamlico and Pungo rivers compared to the Neuse and Bay rivers (Table 6). Since 2004 there has only been a spring harvest season, recently opening March 1 each year and closing when the TAL is reached, usually near the end of March (Table 7). Commercial discard estimates are lower for the Neuse and Bay rivers, ranging from 194 to 629 discarded fish annually compared to 199 to 1,431 fish from the Tar-Pamlico and Pungo rivers (Table 6). The PSEs of commercial live discard estimates range from 30.2 to 65.8%, and the PSEs for dead discard estimates range from 40.8 to 118.0% (Table 5). The aforenoted gill-net tie down and DFS

regulations have helped to decrease commercial discards significantly compared to pre-2008 estimates (Rock et al. 2016). Additionally, other regulations developed to reduce regulatory discards of important estuarine finfish and protected species have also reduced regulatory discards of striped bass.

The following proclamations and rules for gill-nets are in effect in the CSMA (Figure 2).

In effect once the commercial striped bass harvest season closes through December 31 each year, for gill-nets with a stretched mesh length of five inches or greater in all internal coastal waters west (upstream) of the 76° 28.0000' W longitude line which passes near Roos Point at the mouth of Pungo River south to Point of Marsh at the mouth of the Neuse River:

- It is unlawful to fail to equip gill-nets with tie downs spaced no farther apart than 10 yards to restrict the vertical distance between the top and bottom lines to 36 inches or less. If the vertical height of the net (distance between the top and bottom line) is 36 inches or less, no tie-downs are required. Nets must be set so as to fish on the bottom and not exceed a vertical height of 36 inches.
- It is unlawful for any portion of the net to be within 50 yards of any point on shore when set or deployed in the following river areas:
    - Neuse River - Upstream of a line beginning at a point at Cooper Point 35° 02.1433' N - 76° 55.9965' W; running southwesterly to a point at Fisher Landing Point 35° 00.1550' N - 76° 58.5738' W.
    - Pamlico River - Upstream of a line beginning at a point at Gum Point 35° 25.1669' N - 76° 45.5251' W; running southwesterly to a point at Fork Point at 35° 23.4453' N - 76° 46.4346' W.
    - Pungo River - Upstream of a line beginning at a point at Sandy Point 35° 26.8680' N - 76° 33.9520' W; running southwesterly to a point on the west shore at 35° 26.2810' N - 76° 35.5530' W.

In effect in the Tar-Pamlico, Neuse, and Bay rivers:

- The Pamlico, Pungo, Bay, and Neuse rivers all waters west of the 76° 30.0000'W longitude line). Within the areas above, gill-nets must be checked at least once during a 24-hour period and no later than noon each day.
- Attendance of small mesh gill-nets (<5 ISM) is required year-round in the following areas based on NCMFC rule 15A NCAC 3R.0112 (a):
    - Upper portions of the Pamlico, Pungo, Neuse, and Trent rivers
    - Within 200 yards of shore in the lower portions of the Pamlico, Pungo, Neuse, and Trent rivers

In effect statewide:

- All unattended gill-nets ≥ 5 ISM must be at least 10 feet from shore from June through November (NCDMF 2008).
- Gill-nets with a mesh size ≥ 5 ISM and <5 ½ ISM is prohibited from April 15 through December 15 (NCDMF 2005).
- 2,000 yard/vessel limit on gill-nets ≥ 5 ISM (NCDMF 2005).

- Gill-nets with a mesh size < 5 ISM must be attended in all primary and secondary nursery areas and no-trawl areas described in NCMFC Rule 15A NCAC 3R.0106(2), (4), (5), (7), (8), (10), (11), and (12) from May 1 through November 30 (NCDMF 2001; NCDMF 2008).
- It is unlawful to set gill-nets in joint waters from midnight on Friday to midnight on Sunday each week, except in Albemarle Sound and Currituck Sound north of the Highway 158 Wright Memorial Bridge (NCDMF 2014).
- The use of gill-nets > 6 ½ ISM stretch mesh is prohibited in all waters.
- It is unlawful to use gill-nets with a mesh size < 2 ½ inches ISM stretch mesh.
- As of September 1, 2014, individuals taking marine and estuarine resources with gill-nets (with an exception for run around, strike, drop or drift gill-nets) in Internal Coastal Waters are required to obtain an Estuarine Gill Net Permit (Proclamation M-24-2014).

IV. AUTHORITY

G.S. 113-134. Rules.
G.S. 113-182. Regulation of fishing and fisheries.
G.S. 113-221.1. Proclamations; emergency review.
G.S. 143B-289.52. Marine Fisheries Commission – powers and duties.

15A NCAC 03H .0103 Proclamations, General
15A NCAC 03M .0202 Season, Size and Harvest Limit: Internal Coastal Waters
15A NCAC 03M .0512 Compliance with Fishery Management Plans
15A NCAC 03Q .0107 Special Regulations: Joint Waters
15A NCAC 03Q .0108 Management Responsibility for Estuarine Striped Bass in Joint Waters
15A NCAC 03Q .0109 Implementation of Estuarine Striped Bass Management Plans: Recreational Fishing

V. DISCUSSION

No-possession Requirement

At the request of the NCDMF director, the Estuarine Striped Bass FMP Plan Development Team, composed of both NCDMF and NCWRC members, met in fall 2018 to review the most current information regarding CSMA striped bass. The meeting resulted in the division recommending the NCMFC adopt a no-possession requirement for striped bass that would apply to the Tar-Pamlico and Neuse rivers and other joint and internal coastal waters of the CSMA. In MFC rule 15A NCAC 03R .0201 the CSMA is defined as:

The CSMA is designated as all internal, coastal, joint, and contiguous inland waters south of a line beginning at a point 35° 48.5015' N - 75° 44.1228' W on Roanoke Marshes Point, running southeasterly to a point 35° 44 .1710' N - 75° 31 .0520' W on the north point of Eagle Nest Bay, to the South Carolina line.

The proposed supplement measure differs from this definition by omitting the contiguous inland waters which are under the sole jurisdiction of the NCWRC. Additionally, NCMFC Rules 15A NCAC 03M .0202 and 15A NCAC 03Q .0107 state “It is unlawful to possess striped bass from

the coastal fishing waters of the Cape Fear River and its tributaries", and "It is unlawful to possess striped bass or striped bass hybrids taken from the joint fishing waters of the Cape Fear River", respectively. Amendment 1 of the FMP maintains the no possession measure on striped bass in the Cape Fear River and its tributaries that has been in place since 2008. The proposed supplement maintains these measures and does not modify these existing rules.

Upon adoption by the NCMFC of Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass FMP, the division director, in compliance with a FMP as authorized by NCMFC Rules 15A NCAC 03M .0512 and 03H .0103, will implement the supplement measure by proclamation. As stated in N.C. General Statute 113-182.1, the urgency of the issue makes it impossible to address it the through the FMP amendment process. Also, the lengthy rule adoption process under the Administrative Procedure Act would negate the urgent nature of the supplement measures to address the long-term viability of the striped bass fishery.

Since May 2008 and as maintained in the adopted management strategy for CSMA striped bass in Amendment 1, the commercial gill-net restrictions requiring the tie-down and DFS measures that are implemented after the commercial striped bass harvest season closes and remain in effect through December 31 of each year are also implemented via proclamation (see Amendment 1, Section 11.6 and Figure 2). These Amendment 1 measures are stated as:

- After the closure of the commercial striped bass season through December 31, require the use of a 3 foot tie down in large mesh (>=5 inch stretch mesh) gill-nets in internal coastal fishing waters upstream of the 76° 28.0000' W longitude line.
- Maintain a minimum distance from shore of 50 yards for these nets upstream of the existing DFS line.

Consistent with Amendment 1, these gill-net measures would then apply year-round with the adoption of this supplement.

Rationale

Recent genetics-based evidence suggests two successful natural spawning events likely occurred in the Tar-Pamlico and Neuse rivers in 2014 and 2015 (Tables 2 and 3; Figures 3 and 4). Based on information available for the CSMA stocks this is an unusual event, although the occurrence of sporadic successful spawning events in the past is supported by other research, such as otolith microchemistry work suggesting that 53% of fish sampled from the Neuse River in 2010 were not of hatchery origin (Rulifson 2014). With the objective to protect these year classes of fish from harvest as they mature and enter the spawning stock, further restrictive measures could increase the abundance of older females in the spawning stocks of these two river systems, promoting self-sustaining populations.

One option explored to protect these fish was to complement the NCWRC rule in inland waters of the CSMA that states the minimum size limit is 26 inches total length with a daily creel limit of two fish per person (NCWRC Rule 15 NCAC 10C .0314).

In the following discussion the years 2012–2017 were chosen for analysis of harvest reduction scenarios to match available comparable data across the recreational and commercial sectors.

Creel clerks measured 1,337 striped bass in the Tar-Pamlico and Neuse rivers and their tributaries during the years 2012–2017. A 26-inch TL minimum size limit would have eliminated 96.9% of the recreational harvest during 2012–2017 across all jurisdictions combined, (inland, joint, and coastal) and in both river systems combined (Figure 7). Reductions of 100% would have occurred in individual years and jurisdictions, mostly in joint and internal coastal jurisdictions, as the majority of the fish harvested greater than 26 inches TL occurred in inland waters. For years 2012–2017, 57% of striped bass harvest occurred in inland waters, 16% occurred in joint waters, and 27% occurred in coastal waters (Figure 8).

For the commercial sector, a similar analysis was performed. Division staff sample commercially harvested striped bass at fish houses to determine the size, sex, weight, and age composition of the commercial harvest. There were 2,825 length measurements available for analysis from the commercial harvest during 2012–2017. A 26-inch TL minimum size limit would have reduced commercial harvest by 91.9% (Figure 9). While this reduction is slightly less than the reduction for the recreational sector, it is significant and in practicality eliminates the commercial fishery. Additionally, a no-possession measure would likely cause a decrease in gill-net effort during March.

Although there is only a slight difference in the amount of harvest reductions realized under a 26-inch TL minimum size limit compared to a no-possession provision, the increase in the stock's spawning potential ratio (SPR) is significant. Rachels and Ricks 2015 indicated a 26-inch minimum size limit equates to a SPR of 0.45; however, with a no-possession limit, 100% of the stock's SPR is realized (SPR=1.0). This is an increase in SPR of 0.55. Also, as female striped bass get older and larger, they produce not only more eggs but more viable eggs (Boyd, 2011; Knight 2015). Research has shown the largest females in a stock can have the greatest reproductive potential (Cowan et al. 1993; Barneche et al. 2018). A 26-inch TL minimum size limit would shift harvest, albeit a small amount, to the older, larger fish in the stock, while a no-possession provision protects these fish. With so few older fish observed on the spawning grounds and very limited natural recruitment observed in decades prior to 2014, it is important to protect not only these two recent year classes, but also the existing older, more fecund fish. In the Tar-Pamlico and Neuse rivers, 98% of striped bass are mature by age three. The length at which 50% of females are mature is 18 inches and length at 100% maturity is 21 inches (Knight 2015).

Understanding the influences that impact the annual mortality on the population is critical to rebuilding and sustaining the stock for long-term viability. Rachels and Ricks (2018) recently used a generalized linear model (GLM) approach to evaluate environmental conditions and commercial exploitation factors (i.e., commercial harvest and gill-net trips) that potentially could influence discrete annual mortality on the Neuse River from 1994–2015. Results indicated the relative annual variation in commercial effort and in commercial harvest were significant factors contributing to the relative annual variation in total mortality of striped bass in the Neuse River. To determine the impact of all sources of removals from all sectors that influence discrete annual mortality, division stock assessment scientists re-ran the analysis to include recreational metrics. Results from the additional analysis showed, along with the relative annual variation in

commercial effort and in commercial harvest, the relative annual variation in recreational effort and in recreational discards were also significant factors contributing to the relative annual variation in total mortality of striped bass in the Neuse River.

If environmental conditions and egg viability are favorable during the spring spawning season in the coming years, any natural juvenile production occurring in the coming years should be observed in the NCDMF's striped bass juvenile seine and trawl survey conducted throughout the CSMA, which was re-initiated in 2017. The NCWRC's spring electrofishing survey on the spawning grounds in the CSMA should also observe increased numbers of striped bass in the coming years due to the no-possession provision. In addition, the NCDMF's gill-net survey should observe increased catches of the 2014 and 2015 year classes as they are protected from harvest. The NCDMF's juvenile seine and trawl and gill-net surveys, the NCWRC's electrofishing survey, as well as genetic analyses of fin clips, will all be used in determining if the no-possession limit has the intended effect of substantially increasing abundance of older fish in the stock, which should in turn lead to the potential for increased successful natural reproduction events.

Impacts

There are two sources of fishing mortality on any stock: 1) harvest and 2) dead discards. The combination of these is often referred to by fisheries scientists as "*total removals*". To be consistent with the 2012–2017 time block of years analyzed for the 26-inch minimum size limit reductions, all harvest and discard analyses utilized the same 2012–2017 time period.

Recreational striped bass harvest, discard, effort, and economics data for the Tar-Pamlico and Neuse rivers is collected through a recreational angler survey conducted by the NCDMF. Because the striped bass harvest in these systems occurs in internal coastal rivers as opposed to the ocean or sounds, this survey is conducted independent of the Marine Recreational Information Program (MRIP) administered through the National Oceanic and Atmospheric Administration (NOAA). The recent MRIP calibrations of harvest and effort statistics are not applicable to division estimates of striped bass harvest, effort, and economics in the Tar-Pamlico and Neuse rivers (NCDMF 2018).

Recreational discards of striped bass in the Tar-Pamlico and Neuse rivers come from several categories, including fish discarded because they are under the minimum size limit, within the 22–27 inch TL protective slot limit, because the angler reached the daily possession limit, because the harvest season was closed, or because the angler was simply practicing catch-and-release fishing with no intention of harvesting fish. Once total discards are determined that number is multiplied by a discard mortality rate, which is the number of fish that are expected to die within the next few days from the stress of being caught and released. In general, the discard mortality rate increases as salinity decreases and water temperature increases. Striped bass discard mortality rates vary as much as 0.0%–73.8% in freshwater (Wilde et al. 2000). While it is possible to calculate seasonal discard mortality rates, often scientists will use one rate to apply to all discards that captures the seasonal variability in discard mortality. A discard mortality rate of 6.4% is used for recreational striped bass releases in the Tar-Pamlico and Neuse rivers, though this rate comes from a study conducted in the spring and may not accurately reflect the discard mortality of catch and release fishing occurring during the summer months (Nelson 1998).

Commercial striped bass harvest data is collected through the N. C. Trip Ticket Program (TTP). Each time fish are sold to a licensed dealer, the dealer is required to fill out a trip ticket to record the species harvested and the total weight of each species harvested. Division staff go to fish houses weekly to collect biological information on harvested fish to determine the size, sex, weight, and age composition of the commercial harvest. The TTP is considered a census of commercial landings sold at fish houses, but there is potential for unreported commercial harvest if fish are used for personal consumption or donation (Hadley 2015).

Accurate discard estimates in any commercial fishery require the use of data collected through on-board observer trips in the fishery. Prior to 2012, striped bass commercial discards were estimated by using striped bass catch rates (e.g. number of fish caught per yard of gill-net set for 24 hours) from the NCDMF's independent gill-net survey as a proxy for striped bass catch rates in commercial gill-net fisheries, then multiplying that catch rate by the total number of gill-net trips that occurred in the Tar-Pamlico and Neuse rivers each year (See Amendment 1 Section 11.6 for a complete discussion of how striped bass discard estimates in the CSMA have been calculated through the years, NCDMF 2013). However, with implementation of the mandatory observer program in 2012 there are now many more on-board observer trips annually in the Tar-Pamlico and Neuse rivers to more accurately estimate striped bass discards from the commercial gill-net fisheries. The same methodology used by the NCDMF staff to develop commercial gill-net discard estimates for the sea turtle and Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) Incidental Take Permits, and used in the peer-reviewed stock assessments for red drum (*Sciaenops ocellatus*) and southern flounder (*Paralichthys lethostigma*), was used to estimate striped bass discards in the Tar-Pamlico and Neuse river commercial gill-net fisheries (Crawley 2007; Zuur et al. 2009, 2012; Lee et al. 2018). Discards from the commercial fisheries are broken into two categories, live and dead discards as recorded by the observer. Live discards are multiplied by a discard mortality rate, which for gill-net fisheries is estimated at 43% (Northeast Fisheries Science Center. 2013).

Striped bass total removals (harvest plus dead discards) from the recreational and commercial fisheries in the Tar-Pamlico and Neuse rivers during 2012–2017 were fairly even between sectors and stable between years, except for 2016 and 2017 when recreational dead discards increased in both years (Table 6; Figures 10 and 11). This increase in recreational dead discards is attributed to increased abundance of undersized striped bass from the two large, naturally spawned year classes available to the recreational fishery. From 2012 through 2015 undersized recreational discards averaged 21,840 fish annually, then increased to 57,874 fish in 2016 and 101,787 in 2017 (Table 4). Recreational dead discards of legal sized striped bass also increased in 2017 to 26,487 fish, the highest value in the time series, which would correspond to the 2014 year class reaching the 18-inch minimum size limit during 2017 (Table 3).

To explore how no possession will influence recreational discarded striped bass within the CSMA a statistical comparison between the catch rate (catch/trip) during the current open season (Oct 1 through Apr 30) and closed season (May 1 through Sep 30) from 2012-2017 was conducted. Specifically, a randomization test of catch rate (striped bass catch/trip) by Closed vs. Open season was performed. The results of this analysis demonstrate that there is no difference in catch rate as a function of seasonality ($p > 0.70$). This suggests that under a no-possession scenario all harvested fish will be transferred into regulatory discards, which will be an overall increase in discarded catch of ~9%. However, the total removals from the recreational sector will be approximately 43%

lower (based on 2012–2017 data) under a no-possession provision than under the current harvest regime. This assumes angler behavior stays the same. If angling pressure for striped bass is reduced due to the no-possession provision, then discards and total removals will be even lower, but there is no way to predict angler behavior. The CSMA creel survey in the coming years will provide actual estimates of recreational discards to evaluate.

To explore how a no-possession limit will change estimated discarded striped bass within the commercial gill-net fishery in the CSMA, a GLM framework was used to predict striped bass discards in North Carolina's estuarine gill-net fishery based on observer data collected during 2012–2017. Standard errors of the discard point estimates were calculated using a bootstrapping technique (2,000 iterations).

If the no-possession provision is implemented and gill-nets must adhere to the DFS and tie-down requirements throughout the entire year, then we can assume striped bass discards from gill-nets for the months of January, February, and March (i.e. the winter season, currently the only season in the discard model in which the gill-net requirements are not in place) will be similar to discard estimates for the spring season (which include the months April, May, and June) when the DFS and tie-down regulations are in place. Winter discard estimates for 2012–2017 averaged 657 total discards (live plus dead) per year, while spring discards estimates for the same time period averaged 261 fish per year. Assuming commercial fishermen's fishing behavior remains the same, striped bass discards should be expected to decrease by approximately 23%. Observer coverage in the coming years will provide actual estimates of discards to evaluate.

To evaluate potential economic impacts to the recreational and commercial fisheries under a no-possession provision, the striped bass recreational hook-and-line fisheries just in the Tar-Pamlico and Neuse rivers and all commercial fisheries occurring in the Tar-Pamlico and Neuse rivers were characterized in the Background Section. The following data analyses were also based on years 2012–2017.

Recreational anglers spent an average of 424,925 angler hours each year on all fishing trips for all species in the Tar-Pamlico and Neuse rivers during 2012–2017, while they spent an average of 107,029 angler hours each year specifically targeting striped bass during the same time period (Figure 12). There was a wide range of species anglers reported targeting, including catfish, sunfish, largemouth bass (*Micropterus salmoides*), spotted seatrout (*Cynoscion nebulosus*), red drum, and white perch (*Morone americana*) in addition to striped bass. The majority of anglers reported they had no particular target species in mind when going on a fishing trip (Figure 13).

The economic impact estimates presented for striped bass recreational fishing in the CSMA represent the economic activity generated from recreational trip expenditures. The NCDMF has been surveying recreational anglers in several of the major internal coastal river basins of the central and southern portions of eastern North Carolina since 2004, with a focus on gathering catch, effort, demographic, and economic information from anglers targeting anadromous species such as striped bass, American shad, and hickory shad. For a detailed explanation of the methodology used to estimate the economic impacts of recreational fishing activity occurring in the internal coastal waters of the CSMA please refer to the NCDMF's License and Statistics Section Annual Report (NCDMF 2018).

For the period 2012–2017 estimated expenditures associated with the recreational striped bass fishery in the Tar-Pamlico and Neuse rivers have ranged from $504,870 to $872,249. Income impacts ranged from $77,422 to $145,773, and output impacts ranged from $188,540 to $361,495 (Table 8).

Commercial gill-net fishermen in the Tar-Pamlico and Neuse rivers use both anchored and runaround gill-nets. Runaround gill-nets are set to encircle a school of fish and are then immediately retrieved. The primary species harvested in the runaround gill-net fishery is striped mullet (*Mugil cephalus*) in the fall. The primary species harvested from anchored gill-nets include flounder (Paralichthys spp.), Atlantic menhaden (*Brevoortia tyrannus*), spotted seatrout, and striped bass (Figure 14). For the years 2012–2017 commercial fishermen took an average of 3,303 anchored gill-net trips and 967 runaround gill-net trips per year (Figure 15). From those gill-net trips an average of 300,618 pounds of finfish was harvested from anchored gill-nets and 290,591 pounds of finfish was harvested from runaround gill-nets (Figure 16).

The economic impact estimates presented represent those of commercial seafood harvesters, dealers, wholesalers, and retailers of striped bass from the CSMA. These estimates are a product of IMPLAN regional inter-industry transactional data customized with data from NCDMF and economic multipliers originating from the NOAA Fisheries Commercial Fishing and Seafood Industry Input/Output Model (IMPLAN 2013; NOAA 2018). For a detailed explanation of the methodology used to estimate the commercial impacts of commercial fishing activity occurring in the CSMA, please refer to the NCDMF's License and Statistics Section Annual Report (NCDMF 2018).

For the period 2012–2017, the ex-vessel value for striped bass in the Tar-Pamlico and Neuse rivers has ranged from $51,119 to $83,466. Income impacts ranged from $81,819 to $134,847, and output impacts ranged from $198,196 to $321,360 (Table 9).

The potential of year-round tie-down and DFS regulations due to a striped bass no-possession measure would likely have the greatest impact on the commercial harvest of American shad, as most American shad are harvested in conjunction with the March striped bass fishery. The tie-down and DFS regulations are currently in effect each year from the time the striped bass commercial harvest season closes (typically near March 31) through December 31 of each year. During 2012–2017, commercial fishermen harvested an average of 16,805 pounds of American shad in the months of January–March in the Tar-Pamlico and Neuse rivers combined each year (Figure 17). During 2012–2017, the number of participants that landed striped bass from gill-nets in the Tar-Pamlico and Neuse rivers has ranged from 63 to 97 (Figure 18).

VI. PROPOSED RULE(S)

There are no proposed rule changes for the supplement management measures.

VII. RECOMMENDATION

The division recommends the NCMFC adopt the supplement as described herein which the director will implement by proclamation. The supplement will result in a no-possession requirement for striped bass as defined by NCMFC Rule 15A NCAC 03M .0201 that would apply to the Tar-Pamlico and Neuse rivers and other joint and internal coastal waters of the CSMA as described in NCMFC Rule 15NCAC 03R .0201, excluding the joint and internal coastal fishing waters of the Cape Fear River and tributaries (including Snow's Cut). Additionally, consistent with Amendment 1, commercial set gill-net restrictions requiring tie-downs and distance from shore (DFS) measures will apply year-round.

NCMFC Action

To be determined.

VIII. LITERATURE CITED

Barneche, D. R., D. R. Robertson, C. R. White, and D. J. Marshall. 2018. Fish reproductive-energy output increases disproportionately with body size. Science 360 (6389), 642-645.

Barwick, R. D., J. M. Homan, and C. D. Thomas. 2010. Investigating striped bass recruitment in the Neuse River, North Carolina. 2009 Proc. Annu. Conf. Southeast Assoc. Fish and Wildl. Agencies 63:161-165.

Barwick, R. D., K. R. Rundle, J. M. Homan, W. J. Collart, and C. D. Thomas. 2008. An assessment of striped bass spawning stocks and contribution by stocked juveniles in two North Carolina coastal rivers. North Carolina Wildlife Resources Commission, Federal Aid in Sport Fish Restoration, Project F-22, Final Report, Raleigh N. C.

Bergey, L. L., R. A. Rulifson, M. L. Gallagher, and A. S. Overton. 2003. Variability of Atlantic coast striped bass egg characteristics. North American Journal of Fisheries Management 23:558-572.

Boyd, J.B. 2011. Maturation, fecundity, and spawning frequency of the Albemarle/Roanoke striped bass stock. Master's thesis. East Carolina University, Greenville, North Carolina.

Crawley, M.J. 2007. The R book. John Wiley & Sons, Chischester, UK. 942 p.

Cowan, J. H., K. A. Rose, E. S. Rutherford, and E. D. Houde. 1993. Individual based model of young-of-year striped bass population dynamics. II. Factors affecting recruitment in the Potomac River, Maryland. Transactions of the American Fisheries Society 122:439–458.

Darden, T. L., F. Sessions, and M. R. Denson. 2012. Use of Genetic Microsatellite Markers to Identify Factors Affecting Stocking Success in Striped Bass. American Fisheries Society Symposium 79:000-000, 2012.

Farrae, D., and T. Darden. 2018. South Carolina Department of Natural Resources. North Carolina Division of Marine Fisheries 2017 Striped Bass Genotyping Report.

Hadley, J. 2015. Survey of commercial fishing license holders for personal consumption of seafood caught with commercial gear. North Carolina Department of Environment and Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, NC.

Hawkins, J. H. 1979. Anadromous Fisheries Research Program – Neuse River, Progress Report for Project AFCS – 13-2, NC Dept. of Nat. Resour. and Comm. Develop., Div. Mar. Fish., Morehead City, NC 101p.

IMPLAN Group, LLC. 2013. IMPLAN System, Version 3.1.1001.2. Huntersville, NC. www.implan.com.

Judy, G. W., and J. H. Hawkins. 1982. Neuse and Pamlico-Tar Rivers Anadromous Fisheries Project, Completion Report for Project AFCS -16 Project II, NC Dept. of Nat. Resour. and Comm. Develop., Div. Mar. Fish., Morehead City, NC 56p.

Knight, E. H. 2015. Maturation and Fecundity of the Neuse and Tar-Pamlico Rivers Striped Bass (Morone saxatilis) Stocks in Coastal North Carolina. Master's Thesis, East Carolina University, Greenville, NC. 59 pp.

Lee, L.M., S.D. Allen, A.M. Flowers, and Y. Li (editors). 2018. Stock assessment of southern flounder (*Paralichthys lethostigma*) in the South Atlantic, 1989–2015. Joint report of the North Carolina Division of Marine Fisheries, South Carolina Department of Natural Resources, Georgia Coastal Resources Division, Florida Fish and Wildlife Research Institute, University of North Carolina at Wilmington, and Louisiana State University. NCDMF SAP-SAR-2018-01. 425 p.

Nelson, K. T. 1998. Catch-and-Release Mortality of Striped Bass in the Roanoke River, North Carolina. North American Journals of Fisheries Management 18:25-30.

NCDMF. 2018. North Carolina Division of Marine Fisheries License and Statistics Section Annual Report. North Carolina Department of Environmental Quality, Division of Marine Fisheries, Morehead City, NC.

NCDMF. 2014. November 2014 Revision to Amendment 1 to the North Carolina Estuarine Striped Bass Fishery Management Plan. N.C. Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, N.C.

NCDMF. 2013. Amendment 1 to the North Carolina Estuarine Striped Bass Fishery Management Plan. N.C. Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, N.C.

NCDMF. 2014. Supplement A to the N.C. Spotted Seatrout Fishery Management Plan. Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, N.C.

NCDMF. 2008. North Carolina Red Drum Fishery Management Plan Amendment I. N.C. Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, N.C.

NCDMF. 2005. North Carolina Southern Flounder Fishery Management Plan. N.C. Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, N.C.

NCDMF. 2004. North Carolina Estuarine Striped Bass Fishery Management Plan. N.C. Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, N.C.

NCDMF. 2001. North Carolina Red Drum Fishery Management Plan. N.C. Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, N.C.

NOAA. 2018. Fisheries Economics of the United States 2016. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. NOAA Technical Memorandum NMFS-F/SPO-187

Northeast Fisheries Science Center. 2013. 57th Northeast Regional Stock Assessment Workshop (57th SAW) Assessment Summary Report. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 13-14; 39 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://nefsc.noaa.gov/publications/

O'Donnell T., and D. Farrae. 2017. South Carolina Department of Natural Resources. North Carolina Wildlife Resources Commission 2016 Striped Bass Genotyping and Parentage Analyses 2016 Final Report.

Rachels, K. T., and B. R. Ricks. 2015. Neuse River Striped Bass Monitoring Programs, Population Dynamics, and Recovery Strategies. Federal Aid in Sport Fish Restoration. Project F-108. Final Report. North Carolina Wildlife Resources Commission. Inland Fisheries Division. Raleigh.

Rachels, K. T., and B. R. Ricks. 2018. Exploring Causal Factors of Spawning Stock Mortality in a Riverine Striped Bass Population. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science 10:424-434, 2018.

Rock, J., D. Zapf, C. Wilson, and D. Mumford. 2016. Improving Estimates of Striped Bass Discards in the Central Southern Management Area (CSMA) Through a Recreation Access Site Survey and an Expanded Observer Program. North Carolina Department of Environmental Quality, Division of Marine Fisheries. Morehead City, NC. CRFL Grant 2011-F-001 Final Report. 76 pp.

Rulifson, R. A. 2014. Origin of Central Southern Management Area Striped Bass Using Otolith Chemistry, and Recommendations for Fishery Management. Coastal Recreational Fishing Grant 2011-F-005 Final Report 67pp.

Rulifson, R. A. and R. W. Laney. 1999. Striped bass stocking programs in the United States: ecological and resource management issues. Department of Fisheries and Oceans Canadian Stock Assessment Secretariat Resource Document 99-07 Ottawa.

Wilde, G. R., M.I. Muoneke, P. W. Bettoli, K. L. Nelson, and B. T. Hysmith. 2000. Bait and Temperature Effects on Striped Bass Hooking Mortality in Freshwater. North American Journals of Fisheries Management 20:810-815.

Woodroffe, J. R. 2011. Historical Ecology of Striped Bass Stocking in the Southeastern United States. Master's thesis. East Carolina University, Greenville, North Carolina.

Zuur, A.F., E.N. Ieno, N.J. Walker, A.A. Saveliev, and G.M. Smith. 2009. Mixed effects models and extensions in ecology with R. Springer-Verlag, New York. 574 p.

Zuur, A.F., A.A. Saveliev, and E.N. Leno. 2012. Zero inflated models and generalized linear mixed models with R. Highland Statistics Ltd. United Kingdom. 324 p

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Table 1. Stocking numbers of Phase II (5–7 inches total length) striped bass by system and year for the Albemarle Sound, Tar-Pamlico and Neuse rivers.

	Tar-Pamlico River	Neuse River	Cape Fear River
Year Class	Number stocked	Number stocked	Number stocked
1979			14,874
1980			
1981		47,648	
1982	76,674		
1983			56,437
1984	26,000		
1985		39,769	
1986			
1987	17,993		
1988		71,092	
1989			77,242
1990		61,877	
1991	30,801		
1992		116,820	
1993	118,600		
1994	183,254	79,933	
1995	140,972		
1996		100,760	
1997	24,031		
1998		83,195	30,479
1999	17,954		
2000		108,000	8,915
2001	37,000		
2002		147,654	
2003	159,996		
2004		168,011	172,055
2005	267,376		
2006		99,595	102,283
2007	69,871	69,953	
2008	91,962		92,580
2009	61,054	104,061	112,674
2010	114,012	107,142	210,105
2011	107,767	102,089	130,665
2012	45,667	90,178	127,078
2013	123,416	113,834	195,882
2014	92,727	78,899	141,752
2015	52,922	109,146	116,011
2016	121,190	134,559	63,914
2017	101,987	14203 *	154,024

2010 first year of *in situ* broodstock collection from the Cape Fear River

2011 first year of *in situ* broodstock collection from all three Central-Southern rivers

* Poor spawning of broodstock led to low stocking numbers

Table 2. Percent hatchery contribution from striped bass genetic samples collected in the Tar-Pamlico and Neuse rivers by NCDMF and NCWRC staff. Source South Carolina Department of Natural Resources.

Year	Agency	System	N Samples	Hatchery	"Wild"	% Hatchery	% "Wild"
2016	NCDMF	Tar-Pamlico	190	164	26	86%	14%
		Neuse	150	142	8	95%	5%
2016	NCWRC	Upper Tar	206	181	25	88%	12%
		Upper Neuse	113	88	25	78%	22%
2017	NCDMF	Tar-Pamlico	147	102	45	70%	30%
		Neuse	118	66	52	56%	44%
2017	NCWRC	Upper Tar	156	114	42	73%	27%
		Upper Neuse	269	231	38	86%	14%

Table 3. Length at age information for striped bass collected by NCDMF staff in 2017 that genetic results determined to be not of hatchery origin (a.k.a. “wild”). Striped bass were aged using otoliths.

Year Class	N	Age	Minimum total length (inches)	Mean total length (inches)	Maximum total length (inches)
2014	6	3	13.6	16.7	18.7
2015	36	2	12.2	14.9	19.0

Table 4. Recreational effort, harvest, and discards estimates for striped bass in the Tar-Pamlico and Neuse rivers and tributaries.

River	Year	Total Angler Fishing Trips	Total Fishing Effort (Angler hours)	Striped Bass Angler Trips	Striped Bass Effort (Angler hours)	Recreational Harvest (N)	Recreational Harvest (LB)	Striped Bass Discard (#over creel)	Striped Bass Discard (#under-sized)	Striped Bass Discard (#legal sized)	Striped Bass Discard (#slot sized)	Total Recreational Discards (N)
Neuse River	2004	26,663	162,424	7,445	39,942	3,985	14,845	29	5,721	1,221	0	6,971
	2005	64,301	249,396	9,678	42,107	1,641	6,540	13	6,473	630	77	7,193
	2006	39,181	162,559	6,260	24,053	1,244	4,079	0	7,797	1,979	0	9,776
	2007	31,052	142,093	4,965	20,966	2,616	7,115	140	4,858	1,484	0	6,482
	2008	28,134	136,575	3,174	12,954	405	1,510	2,838	4,801	2,450	51	10,140
	2009	17,519	77,634	2,474	12,995	249	868	0	443	704	138	1,285
	2010	19,540	83,108	2,340	9,177	109	361	0	699	1,440	13	2,152
	2011	24,407	97,302	5,657	21,393	1,080	3,809	0	7,426	2,434	913	10,773
	2012	70,649	210,197	8,703	34,652	1,508	5,742	334	13,660	9,741	664	24,400
	2013	62,013	201,924	10,433	45,068	2,563	9,604	312	6,709	3,286	1,191	11,498
	2014	56,805	213,867	7,840	35,829	1,230	5,603	0	5,810	3,050	1,044	9,903
	2015	56,636	250,634	6,515	27,747	1,373	4,804	0	4,904	3,184	387	8,476
	2016	49,869	210,111	7,107	30,422	1,506	5,619	0	10,788	3,599	2,189	16,575
	2017	60,899	270,485	10,450	50,648	3,188	12,337	519	27,870	16,343	1,479	46,210
	sub-total	607,668	2,468,308	93,041	407,953	22,696	82,836	4,184	107,960	51,544	8,146	171,834
Tar-Pamlico River	2004	19,412	115,557	5,337	23,849	2,156	8,113	56	6,008	522	0	6,586
	2005	25,363	102,974	6,736	27,263	2,191	8,425	139	9,136	386	0	9,661
	2006	23,482	117,074	4,351	18,013	1,237	3,273	33	4,751	335	0	5,119
	2007	34,712	167,241	6,006	25,689	981	3,679	7	16,815	223	0	17,045
	2008	24,753	130,240	3,447	15,459	438	1,480	0	6,920	866	40	7,826
	2009	28,388	136,125	3,168	13,616	646	2,193	7	4,028	1,065	580	5,680
	2010	17,978	81,535	4,219	16,177	1,648	5,176	29	4,501	961	347	5,838
	2011	20,839	88,505	6,949	30,147	1,648	5,665	9	9,233	2,963	1,210	13,415
	2012	40,041	159,824	9,635	37,312	2,414	9,498	106	12,683	3,879	2,246	18,914
	2013	52,110	207,845	9,704	40,980	2,904	9,933	134	12,592	7,070	1,166	20,963
	2014	29,954	134,207	7,404	32,323	2,071	7,765	728	13,375	4,054	597	18,755
	2015	44,280	180,038	11,435	50,949	2,561	9,465	40	17,367	4,845	426	22,678
	2016	55,506	245,998	16,176	78,567	5,191	19,641	203	47,086	6,379	4,590	58,258
	2017	63,410	264,423	15,649	68,874	4,147	14,636	31	73,916	10,144	814	84,905
	sub-total	480,228	2,131,586	110,217	479,218	30,232	108,943	1,522	238,412	43,693	12,016	295,643
All	2004	46,075	277,981	12,782	63,791	6,141	22,958	85	11,729	1,743	0	13,557
	2005	89,664	352,370	16,414	69,370	3,832	14,965	152	15,609	1,016	77	16,854
	2006	62,663	279,633	10,611	42,066	2,481	7,352	33	12,548	2,314	0	14,895
	2007	65,764	309,334	10,971	46,655	3,597	10,794	147	21,673	1,707	0	23,527
	2008	52,887	266,815	6,621	28,413	843	2,990	2,838	11,721	3,316	91	17,966
	2009	45,907	213,759	5,642	26,611	895	3,061	7	4,471	1,769	718	6,965
	2010	37,518	164,643	6,559	25,354	1,757	5,537	29	5,200	2,401	360	7,990
	2011	45,246	185,807	12,606	51,540	2,728	9,474	9	16,659	5,397	2,123	24,188
	2012	110,689	370,021	18,338	71,964	3,922	15,240	439	26,343	13,621	2,910	43,313
	2013	114,123	409,768	20,136	86,049	5,467	19,537	447	19,302	10,356	2,357	32,461
	2014	86,759	348,074	15,244	68,153	3,301	13,368	728	19,185	7,104	1,641	28,658
	2015	100,916	430,672	17,950	78,696	3,934	14,269	40	22,272	8,029	813	31,154
	2016	105,375	456,109	23,283	108,989	6,697	25,260	203	57,874	9,977	6,779	74,833
	2017	124,309	534,908	26,100	119,522	7,334	26,973	549	101,787	26,487	2,293	131,115
Total		1,087,896	4,599,895	203,258	887,171	52,929	191,778	5,707	346,372	95,237	20,162	467,477

* Source CSMA Creel survey live releases multiplied by 6.4% delayed mortality

‡ Source CSMA model results of observer data; dead discards plus live releases multiplied by 43% delayed mortality

Prior to August 2008 their was no season or creel limit in the CSMA waters. In August 2008 measures were implemented to reduce harvest.

Table 5. Proportional Standard Error (PSE) values for recreational estimates of striped bass harvest and discards and commercial estimates of striped bass discards for the Tar-Pamlico and Neuse rivers. Commercial striped bass harvest values are considered a census, not a survey, so PSEs are not available for those values.

River	Year	Recreational Harvest (N)	PSE	Recreational Harvest (LB)	PSE	Total Recreational Discards (N)	PSE	Commercial Harvest (N)	Commercial Harvest (LB)	Commercial Live Discards (N)	PSE	Commercial Dead Discards‡ (N)	PSE
Neuse and Bay Rivers	2004	3,985	26.1	14,845	26.1	6,971	20.8	1,553	7,820	161		468	
	2005	1,641	23.3	6,540	23.3	7,193	34.4	857	5,173	89		258	
	2006	1,244	39.3	4,079	39.3	9,776	24.3	984	7,090	102		297	
	2007	2,616	31.8	7,115	31.8	6,482	18.4	1,273	6,731	132		384	
	2008	405	46.6	1,510	46.6	10,140	34.6	479	4,828	50		144	
	2009	249	56.8	868	56.8	1,285	43.5	1,364	8,285	141		235	
	2010	109	69.2	361	69.2	2,152	33.8	2,070	11,226	214		357	
	2011	1,080	33.2	3,809	33.2	10,773	14.9	2,203	15,612	228		380	
	2012	1,508	26.1	5,742	24.9	24,400	25.3	412	4,291	122	53.3	203	118
	2013	2,563	21.4	9,604	21.6	11,498	19.9	1,533	11,747	230	46.3	322	52.8
	2014	1,230	43.0	5,603	43.0	9,903	24.0	1,084	6,176	123	42.0	172	46.1
	2015	1,373	42.6	4,804	39.8	8,476	29.1	1,236	8,363	66	44.6	187	56.2
	2016	1,506	57.3	5,619	36.1	16,575	18.3	1,571	9,384	147	42.5	170	40.8
	2017	3,188	24.5	12,337	23.1	46,210	2.0	2,087	13,012	118	63.3	316	54.1
	sub-total	22,696		82,836		171,834		18,706	119,735	1,922		3,893	
Tar-Pamlico and Pungo Rivers	2004	2,156	34.2	8,113	34.2	6,586	15.5	3,194	24,615	869		848	
	2005	2,191	19.8	8,425	19.8	9,661	19.5	2,866	21,960	780		761	
	2006	1,237	23.3	3,273	23.3	5,119	14.1	1,866	13,937	508		495	
	2007	981	19.1	3,679	19.1	17,045	14.1	2,333	18,264	635		619	
	2008	438	23.8	1,480	23.8	7,826	13.0	649	5,281	177		172	
	2009	646	17.4	2,193	17.4	5,680	15.1	2,776	16,222	755		421	
	2010	1,648	24.1	5,176	24.1	5,838	13.9	2,416	12,662	657		367	
	2011	1,648	18.5	5,665	18.5	13,415	13.9	1,880	12,442	512		285	
	2012	2,414	19.2	9,498	19.1	18,914	14.2	3,281	18,418	797	35.8	471	97.3
	2013	2,904	16.0	9,933	16.1	20,963	21.5	2,906	16,823	1,179	39.5	664	50.9
	2014	2,071	20.1	7,765	20.3	18,755	21.9	4,746	19,069	704	30.2	381	51.5
	2015	2,561	21.1	9,465	21.5	22,678	16.4	4,383	18,973	434	34.0	320	42.0
	2016	5,191	21.7	19,641	22.2	58,258	14.0	4,314	13,064	1,300	39.5	690	53.1
	2017	4,147	20.6	14,636	20.9	84,905	1.4	2,273	9,803	734	65.8	518	59.8
	sub-total	30,232		108,943		295,643		39,883	221,532	10,041		7,010	
All	2004	6,141	17.9	22,958	17.9	13,557	12.4	4,747	32,435	1,030		1,316	
	2005	3,832	18.0	14,965	18.0	16,854	17.9	3,723	27,132	869		1,019	
	2006	2,481	22.9	7,352	22.9	14,895	16.7	2,850	21,026	610		792	
	2007	3,597	23.7	10,794	23.7	23,527	11.4	3,606	24,996	767		1,003	
	2008	843	25.6	2,990	25.6	17,966	20.3	1,128	10,109	226		316	
	2009	895	20.2	3,061	20.2	6,965	14.7	4,140	24,507	897		656	
	2010	1,757	23.0	5,537	23.0	7,990	13.7	4,486	23,888	872		723	
	2011	2,728	17.3	9,474	17.3	24,188	10.2	4,083	28,054	740		665	
	2012	3,922	15.5	15,240	15.2	43,313	15.5	3,693	22,709	919		674	
	2013	5,467	13.1	19,537	13.3	32,461	15.5	4,439	28,569	1,409		986	
	2014	3,301	20.4	13,368	21.5	28,658	15.9	5,830	25,245	827		553	
	2015	3,934	20.3	14,269	19.6	31,154	14.2	5,619	27,336	500		507	
	2016	6,697	21.2	25,260	19.0	74,833	11.6	4,123	22,448	1,447		860	
	2017	7,334	15.8	26,973	15.5	131,115	1.1	4,386	22,815	852		833	
Total		52,929		191,778		467,477		56,853	341,268	11,963		10,903	

*PSEs cannot be calculated for commercial discard estimates prior to 2012 because a different methodology was used to calculate discards in those years.

Table 6. Recreational and commercial effort, harvest, discards, recreational striped bass angler interviews and commercial gill net observer trips for striped bass in the Tar-Pamlico and Neuse rivers and tributaries.

River	Year	Striped Bass Angler Trips	Striped Bass Effort (Angler hours)	Striped Bass Angler Interviews	Recreational Harvest (N)	Recreational Harvest (LB)	Total Recreational Discards	Recreational Dead Discards*	Total Recreational Removals (N) (Harvest + Dead Discards)	Commercial Gill Net Trips	Commercial Observer Trips	Commercial Harvest (N)	Commercial Harvest (LB)	Total Commercial Discards (N)	Commercial Dead Discards ‡	Total Commercial Removals (N) (Harvest + Dead Discards)	Percent Removals Recreational	Percent Removals Commercial
Neuse and Bay Rivers	2004	7,445	39,942	21	3,985	14,845	6,971	446	4,431	2,446	Insufficient observer coverage^	1,553	7,820	629	468	2,021	0.69	0.31
	2005	9,678	42,107	260	1,641	6,540	7,193	460	2,101	2,648		857	5,173	347	258	1,115	0.65	0.35
	2006	6,260	24,053	116	1,244	4,079	9,776	626	1,870	3,323		984	7,090	398	297	1,281	0.59	0.41
	2007	4,965	20,966	91	2,616	7,115	6,482	415	3,031	3,322		1,273	6,731	515	384	1,657	0.65	0.35
	2008	3,174	12,954	57	405	1,510	10,140	649	1,054	2,405		479	4,828	194	144	623	0.63	0.37
	2009	2,474	12,995	26	249	868	1,285	82	331	2,990		1,364	8,285	316	235	1,599	0.17	0.83
	2010	2,340	9,177	30	109	361	2,152	138	247	1,932		2,070	11,226	479	357	2,427	0.09	0.91
	2011	5,657	21,393	177	1,080	3,809	10,773	689	1,769	1,576		2,203	15,612	510	380	2,583	0.41	0.59
	2012	8,703	34,652	185	1,508	5,742	24,400	1,562	3,070	2,170	60	412	4,291	273	203	615	0.83	0.17
	2013	10,433	45,068	169	2,563	9,604	11,498	736	3,299	3,275	80	1,533	11,747	453	322	1,855	0.64	0.36
	2014	7,840	35,829	138	1,230	5,603	9,903	634	1,863	2,625	128	1,084	6,176	242	172	1,256	0.59	0.41
	2015	6,515	27,747	140	1,373	4,804	8,476	542	1,915	1,763	79	1,236	8,363	225	187	1,423	0.58	0.42
	2016	7,107	30,422	125	1,506	5,619	16,575	1,061	2,567	2,071	89	1,571	9,384	254	170	1,741	0.60	0.40
	2017	10,450	50,648	197	3,188	12,337	46,210	2,957	6,145	2,575	129	2,087	13,012	383	316	2,403	0.72	0.28
average		6,646	29,139	124	1,621	5,917	12,274	786	2,407	2,509	94	1,336	8,553	373	278	1,614	0.60	0.40
Tar-Pamlico and Pungo Rivers	2004	5,337	23,849	637	2,156	8,113	6,586	422	2,578	3,040	Insufficient observer coverage^	3,194	24,615	980	848	4,042	0.39	0.61
	2005	6,736	27,263	578	2,191	8,425	9,661	618	2,809	2,968		2,866	21,960	879	761	3,627	0.44	0.56
	2006	4,351	18,013	274	1,237	3,273	5,119	328	1,565	2,709		1,866	13,937	573	495	2,361	0.40	0.60
	2007	6,006	25,689	380	981	3,679	17,045	1,091	2,072	3,010		2,333	18,264	716	619	2,952	0.41	0.59
	2008	3,447	15,459	230	438	1,480	7,826	501	939	2,588		649	5,281	199	172	821	0.53	0.47
	2009	3,168	13,616	238	646	2,193	5,680	364	1,010	3,134		2,776	16,222	852	421	3,197	0.24	0.76
	2010	4,219	16,177	266	1,648	5,176	5,838	374	2,022	1,742		2,416	12,662	741	367	2,783	0.42	0.58
	2011	6,949	30,147	306	1,648	5,665	13,415	859	2,507	1,607		1,880	12,442	577	285	2,165	0.54	0.46
	2012	9,635	37,312	304	2,414	9,498	18,914	1,210	3,624	1,859	16	3,281	18,418	925	471	3,752	0.49	0.51
	2013	9,704	40,980	299	2,904	9,933	20,963	1,342	4,246	2,448	39	2,906	16,823	1,336	664	3,570	0.54	0.46
	2014	7,404	32,323	228	2,071	7,765	18,755	1,200	3,271	2,083	117	4,746	19,069	782	381	5,127	0.39	0.61
	2015	11,435	50,949	270	2,561	9,465	22,678	1,451	4,012	1,472	86	4,383	18,973	567	320	4,703	0.46	0.54
	2016	16,176	78,567	406	5,191	19,641	58,258	3,728	8,919	1,434	60	4,314	13,064	1,431	690	5,004	0.64	0.36
	2017	15,649	68,874	388	4,147	14,636	84,905	5,434	9,581	1,849	38	2,273	9,803	936	518	2,791	0.77	0.23
average		7,873	34,230	343	2,159	7,782	21,117	1,352	3,511	2,282	59	2,849	15,824	821	501	3,350	0.51	0.49
All	2004	12,782	63,791	658	6,141	22,958	13,557	868	7,009	5,486	Insufficient observer coverage^	4,747	32,435	1,609	1,316	6,356	0.52	0.48
	2005	13,205	44,313	838	3,832	14,965	16,854	1,079	4,911	5,616		3,723	27,132	1,226	1,019	4,949	0.50	0.50
	2006	10,609	30,889	390	2,481	7,352	14,895	953	3,434	6,032		2,850	21,026	971	792	3,821	0.47	0.53
	2007	10,974	37,088	471	3,597	10,794	23,527	1,506	5,103	6,332		3,606	24,996	1,231	1,003	4,837	0.51	0.49
	2008	6,621	21,296	287	843	2,990	17,966	1,150	1,993	4,993		1,128	10,109	393	316	1,521	0.57	0.43
	2009	5,642	20,695	264	895	3,061	6,965	446	1,341	6,124		4,140	24,507	1,167	656	5,307	0.20	0.80
	2010	6,558	16,060	296	1,757	5,537	7,990	511	2,268	3,674		4,486	23,888	1,220	723	5,706	0.28	0.72
	2011	12,608	33,353	483	2,728	9,474	24,188	1,548	4,276	3,183		4,083	28,054	1,086	665	5,169	0.45	0.55
	2012	18,338	71,964	489	3,922	15,240	43,313	2,772	6,694	4,029	76	3,693	22,709	1,198	674	4,891	0.58	0.42
	2013	20,136	86,049	468	5,467	19,537	32,461	2,077	7,544	5,723	119	4,439	28,569	1,789	986	6,228	0.55	0.45
	2014	15,244	68,153	366	3,301	13,368	28,658	1,834	5,135	4,708	245	5,830	25,245	1,024	553	6,854	0.43	0.57
	2015	17,950	78,696	410	3,934	14,269	31,154	1,994	5,928	3,235	165	5,619	27,336	792	507	6,411	0.48	0.52
	2016	23,283	108,989	531	6,697	25,260	74,833	4,789	11,486	3,505	149	4,123	22,448	1,685	860	5,808	0.66	0.34
	2017	26,100	119,522	585	7,334	26,973	131,115	8,391	15,726	4,424	167	4,386	22,815	1,319	833	5,705	0.73	0.27
Average		14,289	57,204	467	3,781	13,698	33,391	2,137	5,918	4,790	154	4,061	24,376	1,194	779	5,255	0.53	0.47

* Source CSMA Creel survey live releases multiplied by 6.4% delayed mortality

‡ Source CSMA model results of observer data; dead discards plus live releases multiplied by 43% delayed mortality

^ Insufficient observer coverage exists during these years in the rivers to use in the discard model, therefore estimates were hindcast using a ratio methodology

Table 7. Season open and close dates and commercial harvest of striped bass in the Central Southern Management Area.

Year	TAL (lbs)	Spring season	# Days	Bag limit	Total Pounds landed
2018	25,000	Mar 1 - Apr 30 (Cape Fear Closed)	60 days	10 fish	19,939
2017	25,000	Mar 1 - Apr 3 (Cape Fear Closed)	33 days	10 fish	23,018
2016	25,000	Mar 1 - Mar 21 (Cape Fear Closed)	21 days	10 fish	23,041
2015	25,000	Mar 1 - Mar 18 (Cape Fear Closed)	18 days	10 fish	27,336
2014	25,000	Mar 1 - Mar 20 (Cape Fear Closed)	20 days	10 fish	25,245
2013	25,000	Mar 1 - Apr 15 (Cape Fear Closed)	46 days	10 fish	28,597
2012	25,000	Mar 1 - Mar 30 (Cape Fear Closed)	30 days	10 fish	22,709
2011	25,000	Mar 1 - Mar 25 (Cape Fear Closed)	25 days	10 fish	28,054
2010	25,000	Mar 1 - Mar 27 (Cape Fear Closed)	26 days	10 fish	23,888
2009	25,000	Mar 16 – Apr 10 (Cape Fear Closed)	26 days	7 fish	24,407
2008	25,000	Mar 3 - Apr 30 Jan 10 - Apr 30 (Cape Fear)	137 days	5 fish	10,230
2007	25,000	Mar 1 - Apr 3 Jan 10 - Apr 30 (Cape Fear)	97 days	5 fish	24,040
2006	25,000	Mar 1 - Mar 31 Jan 2 - Mar 31 (Cape Fear)	137 days	5 fish	20,269
2005	25,000	Feb 28 - Mar 24 Jan 3 - Apr 31 (Cape Fear)	143 days	5 fish	25,620
2004	25,000	Mar 8 - Apr 5 Jan 16 - Apr 30 (Cape Fear)	142 days	5 fish	32,315

Table 8. Economic impact of recreational fishing in the Tar-Pamlico and Neuse rivers.

Year	Estimated Angler Hours[1]	Estimated Expenditures [2]	Economic Impacts		
			Jobs[3,4]	Income Impacts [4]	Output Impacts[4]
2017	119,522	$872,249	4.1	$145,773	$361,495
2016	108,989	$722,652	3.3	$118,311	$292,347
2015	78,696	$582,458	2.6	$92,718	$230,204
2014	68,152	$504,870	2.1	$77,422	$188,540
2013	86,049	$746,993	3.4	$118,234	$288,232
2012	71,964	$583,894	2.7	$88,759	$213,664

[1] Effort estimates as reported by the NCDMF Coastal Angling Program.
[2] Estimated fishing trip expenditures.
[3] Includes full time and part time jobs.
[4] Economic impacts calculated using the NCDMF coastal recreational fishing economic impact model and IMPLAN economic impact modeling software. Economic impact estimates are for the state economy of North Carolina.

Table 9. Economic impact of commercial harvesters of striped bass in the Central Southern Management Area.

Year	Commercial Participants[1]	Pounds[1]	Ex-Vessel Value[1]	Economic Impacts		
				Jobs[2,3]	Income Impact [3]	Output Impacts[3,4]
2017	100	23,018	$66,033	5	$124,211	$303,093
2016	94	23,041	$69,271	5	$125,768	$286,344
2015	104	27,336	$84,226	7	$136,075	$324,288
2014	125	25,245	$69,098	6	$113,188	$270,311
2013	97	28,597	$84,824	7	$136,327	$325,958
2012	69	22,709	$51,922	5	$83,104	$201,310

[1] As reported by the NCDMF Trip Ticket Program.
[2] Represents both full-time and part-time jobs.
[3] Economic impacts calculated using the NCDMF commercial fishing economic impact model and IMPLAN economic impact modeling software. Economic impact estimates are for the state economy of North Carolina.
[4] Represents sales impacts.

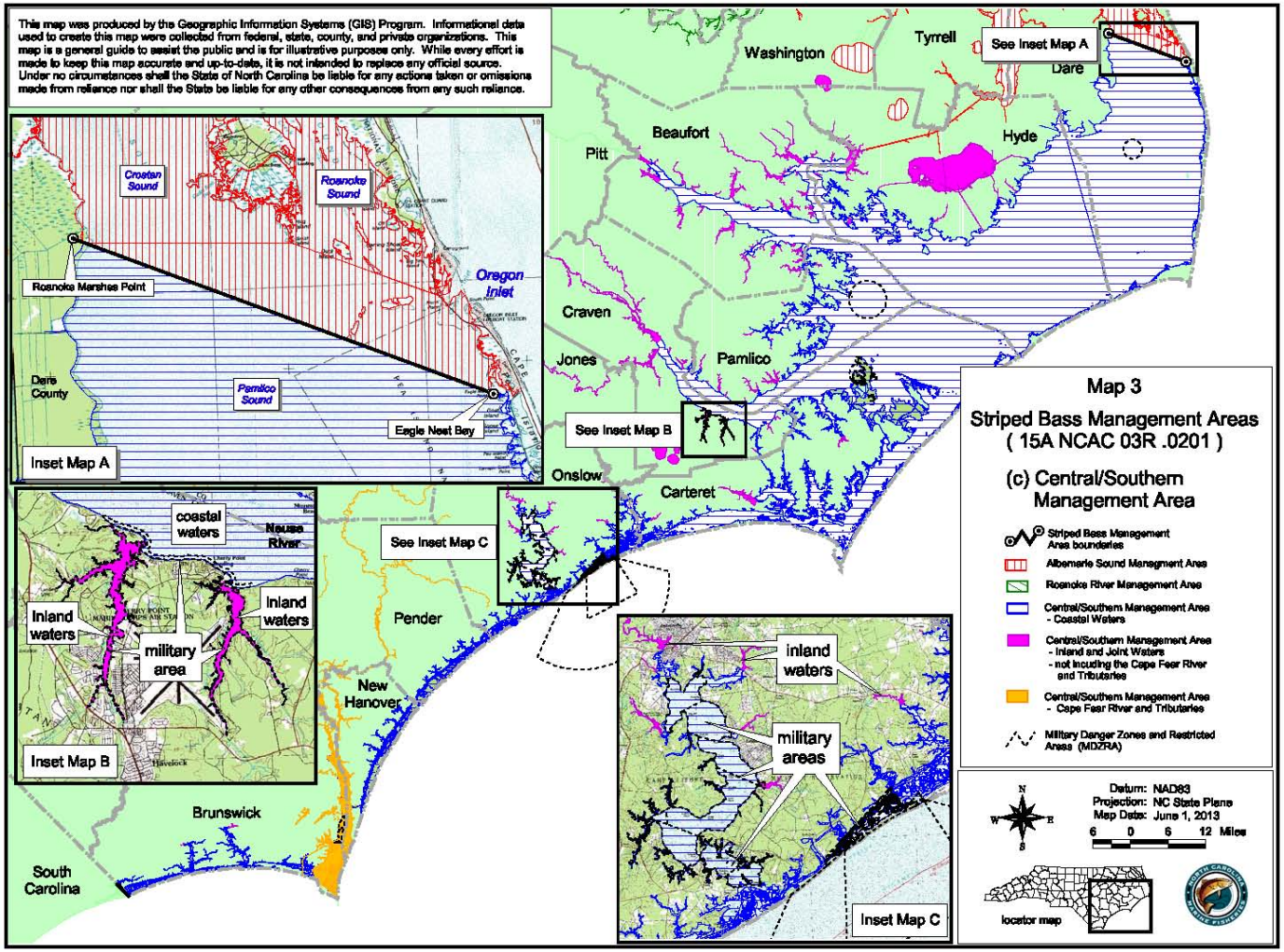

Figure 1. Boundary map for the Central Southern Striped Bass Management Area.

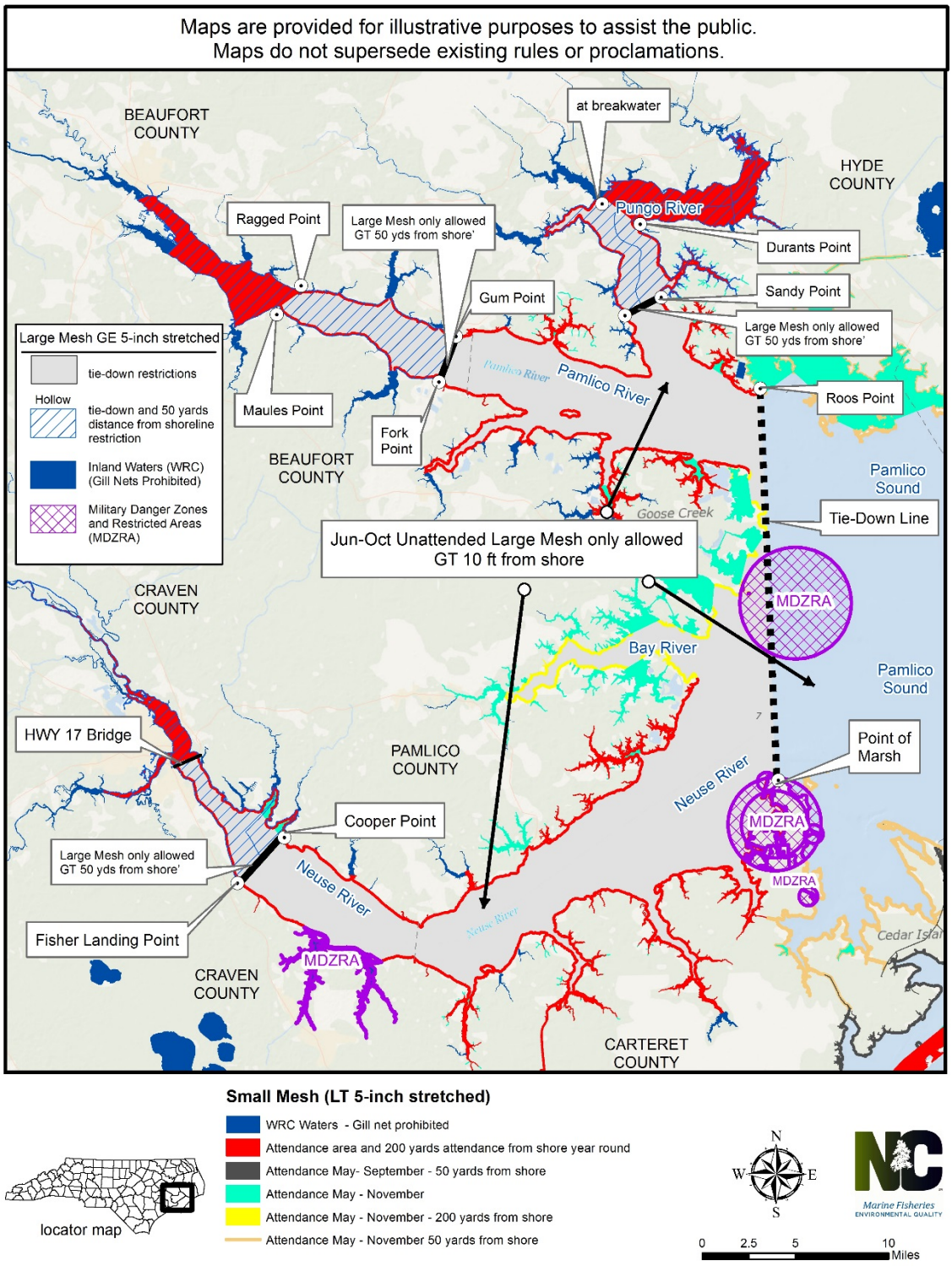

Figure 2. Gill-net regulation map for various gill-net types and seasons in the Central Southern Management Area.

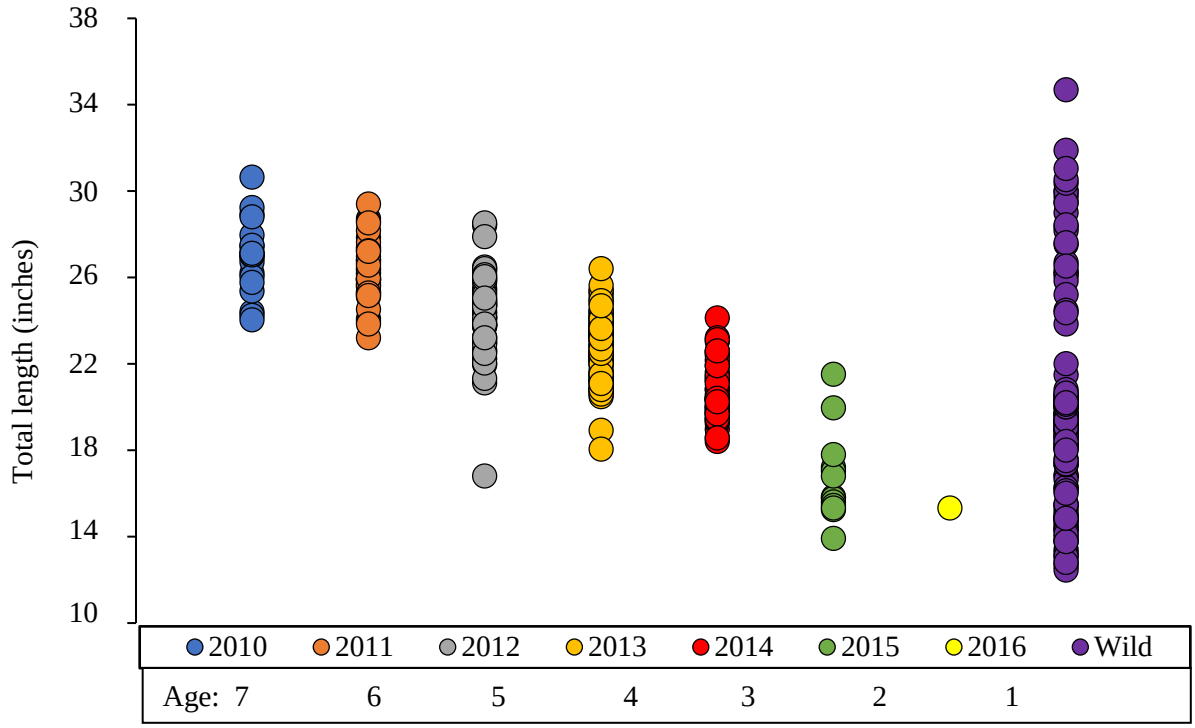

Figure 3. Length frequencies of striped bass fin clips sampled in 2017 that were sent for genetic analysis. The "wild" fish were determined to be not of hatchery origin. All other fish were determined to be of hatchery origin. Bottom axis denotes year class and age. Source: Farrae and Darden 2018.

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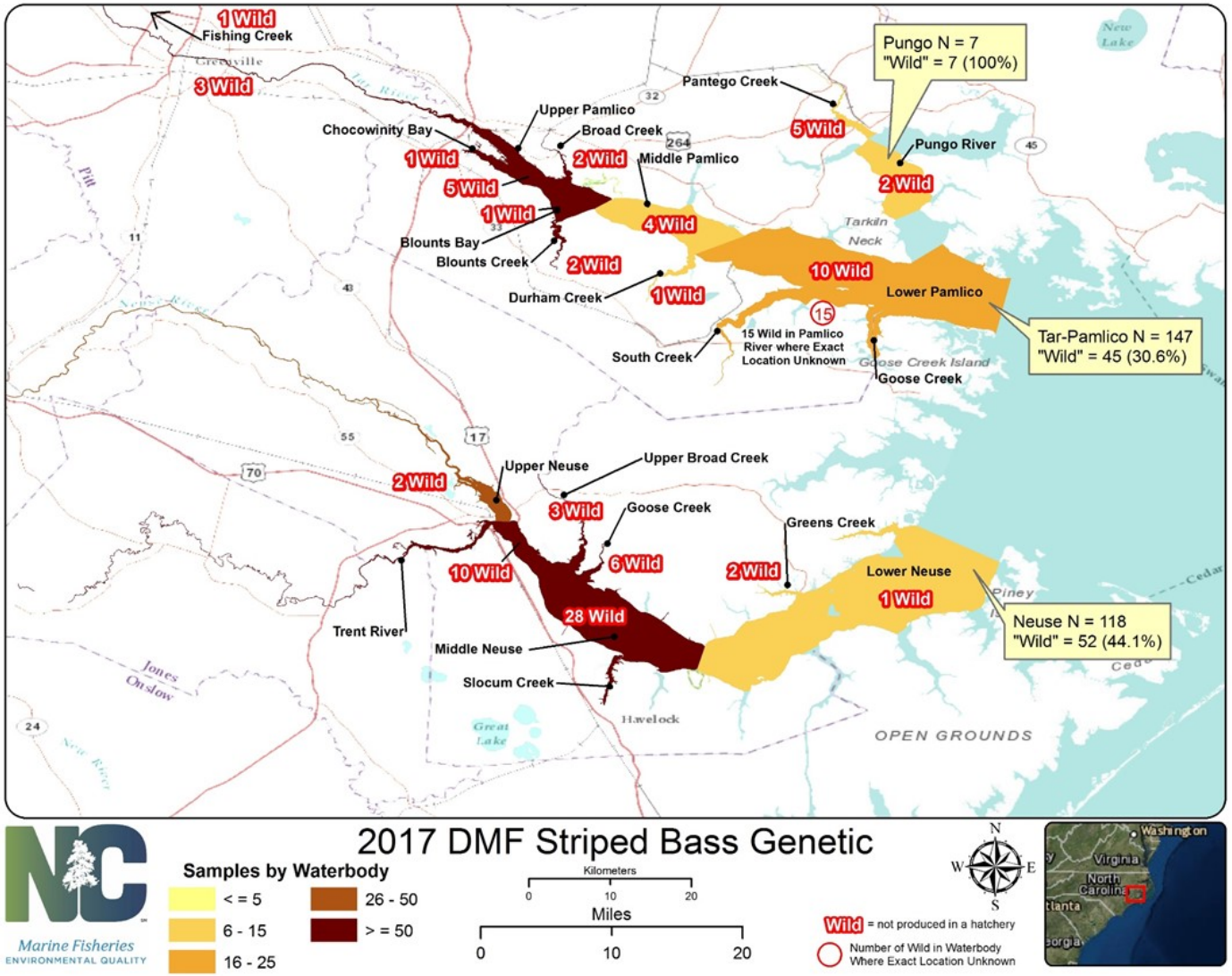

Figure 4. Map illustrating the number of genetic samples collected through NCDMF sampling sent for analysis and the results of hatchery versus non-hatchery (wild) fish.

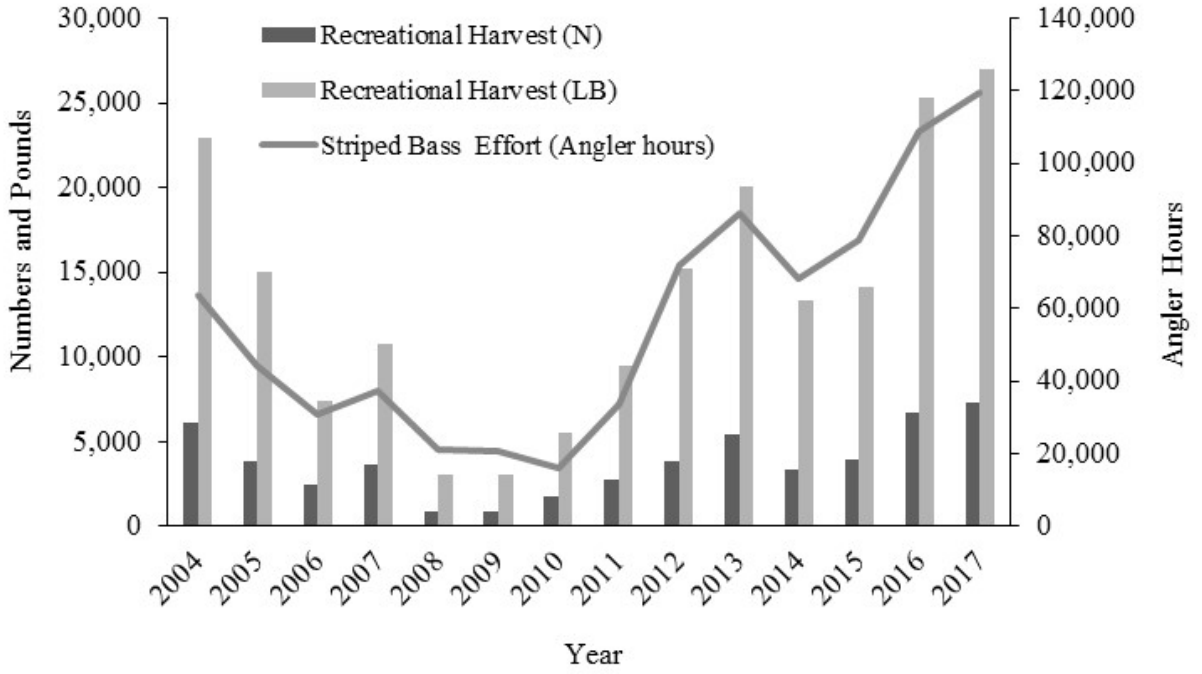

Figure 5. Recreational striped bass harvest in numbers and pounds and effort in angler hours for the Tar-Pamlico and Neuse rivers and tributaries.

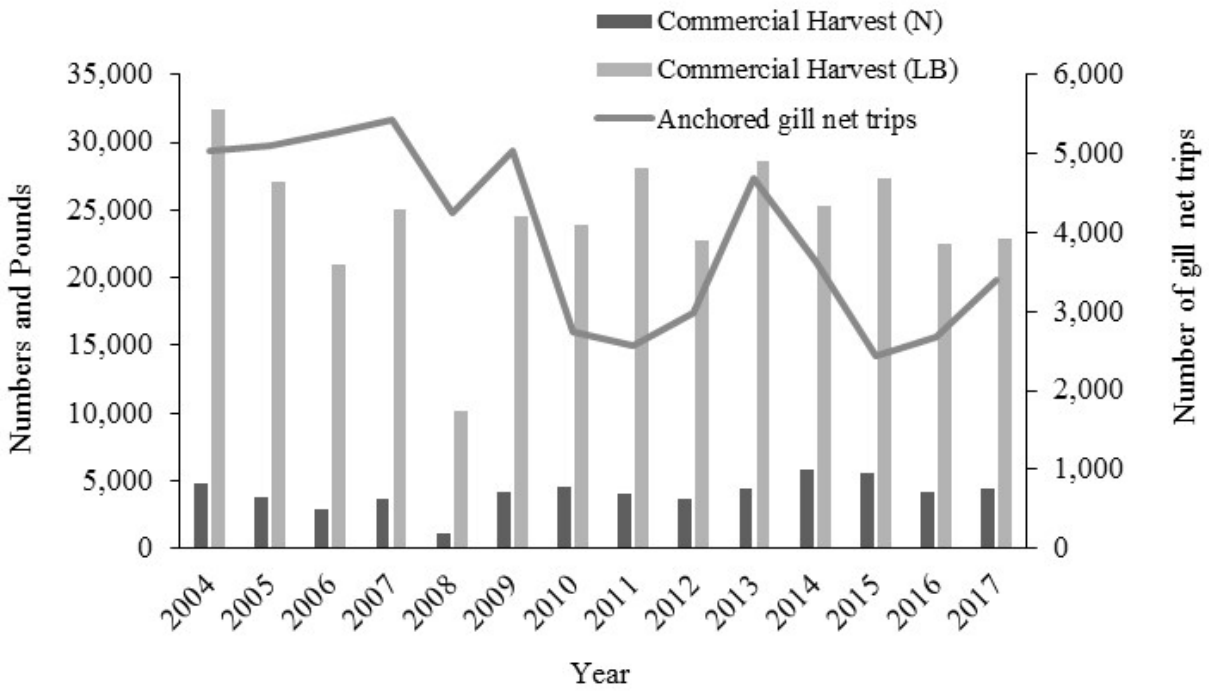

Figure 6. Commercial harvest in numbers and pounds and anchored gill-net trips for striped bass in the Tar-Pamlico and Neuse and Bay rivers.

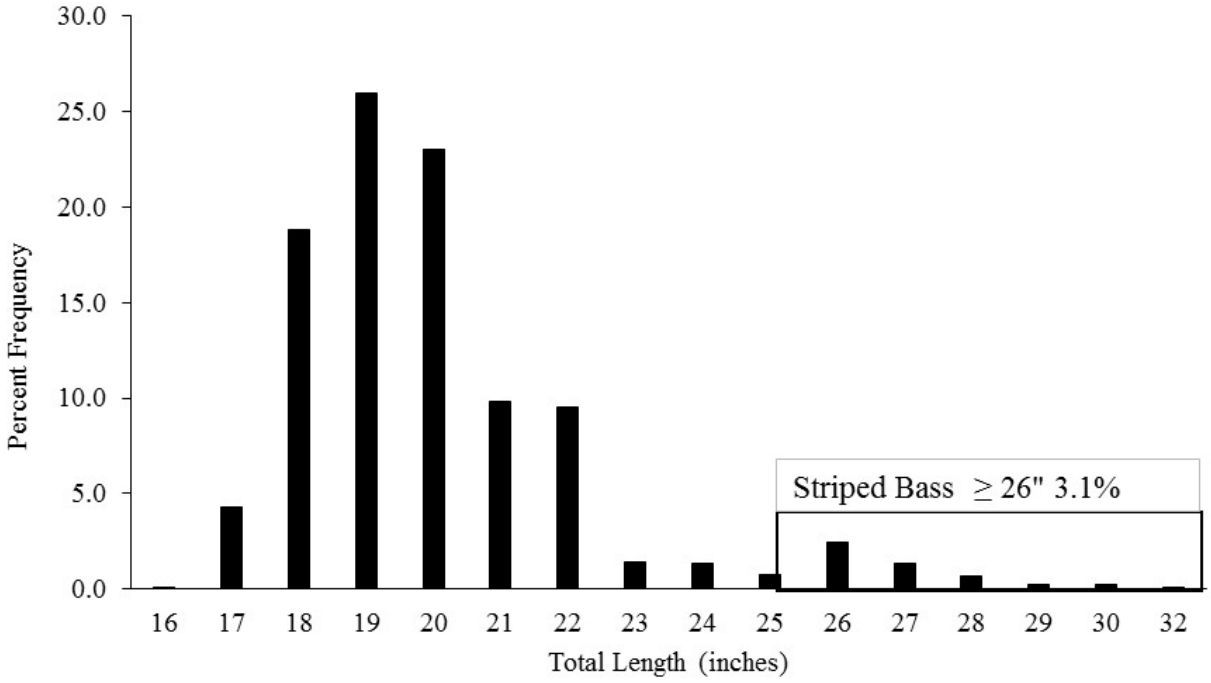

Figure 7. Recreational length distribution for striped bass sampled from the Tar-Pamlico and Neuse rivers, 2012–2017.

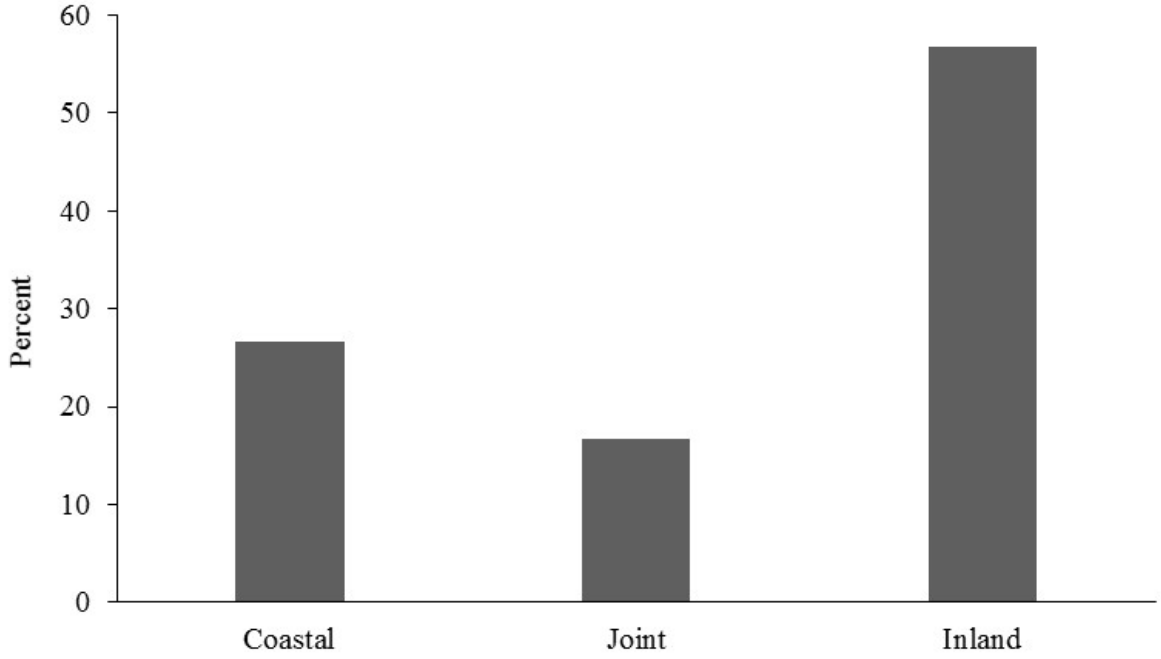

Figure 8. Percent recreational harvest of striped bass by coastal, joint, and inland jurisdictions in the Tar-Pamlico and Neuse rivers, 2012–2017.

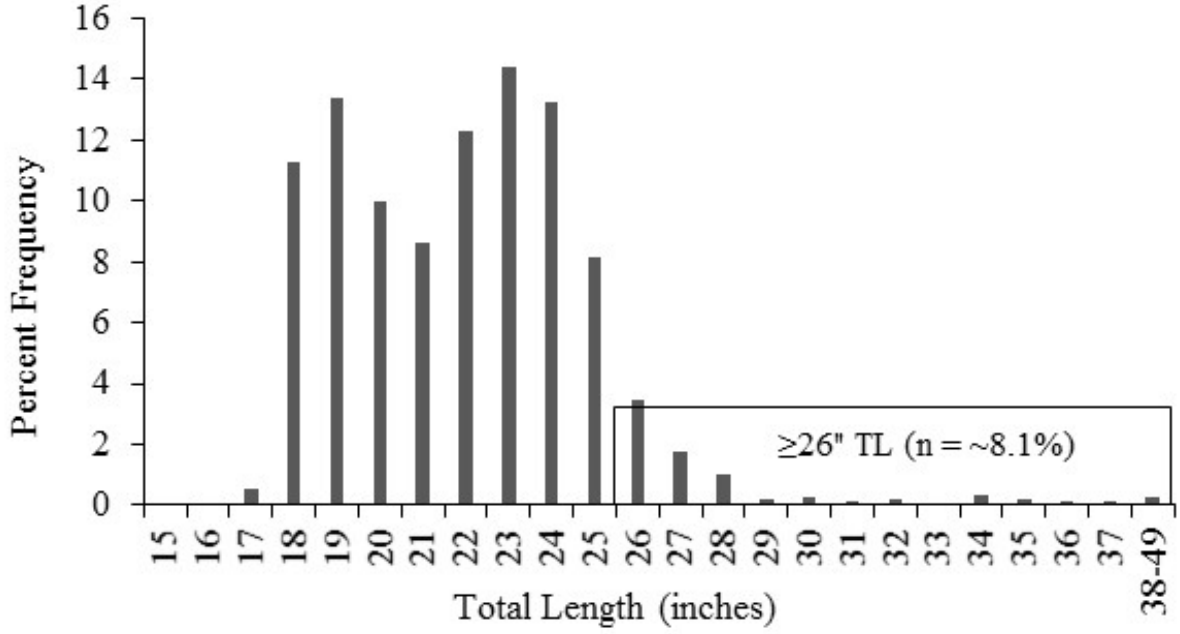

Figure 9. Commercial length distribution for striped bass sampled from the Tar-Pamlico, Neuse and Bay rivers, 2012–2017.

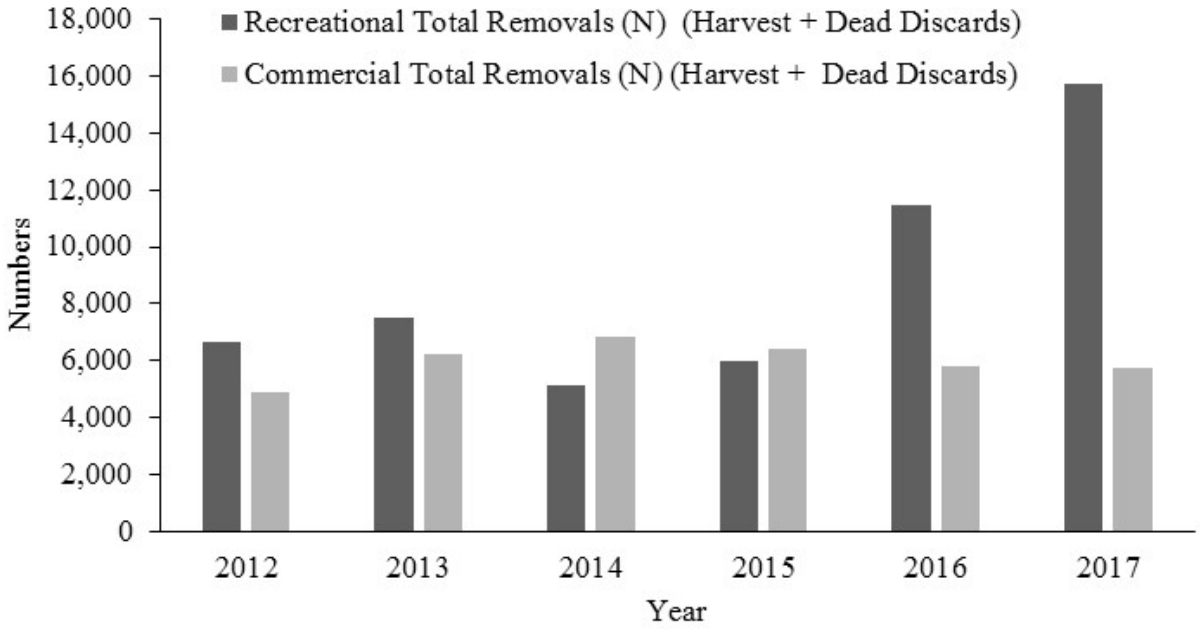

Figure 10. Commercial and recreational total removals of striped bass from the Tar-Pamlico and Neuse and Bay rivers.

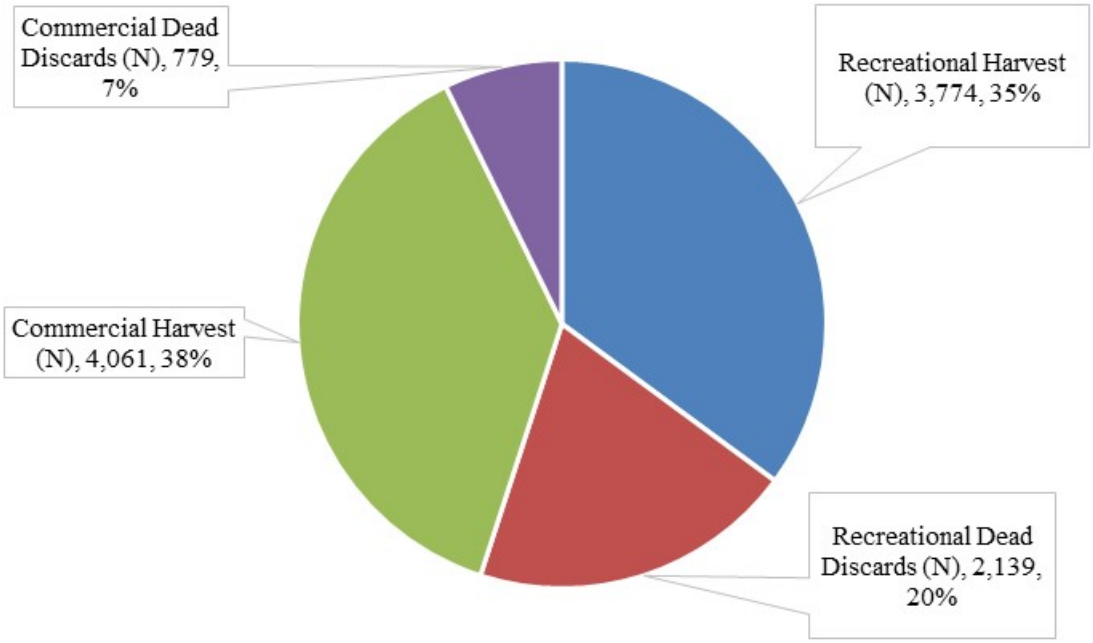

Figure 11. Average number of striped bass harvest and discards each year from the recreational and commercial sectors in the Tar-Pamlico and Neuse rivers, 2012–2017.

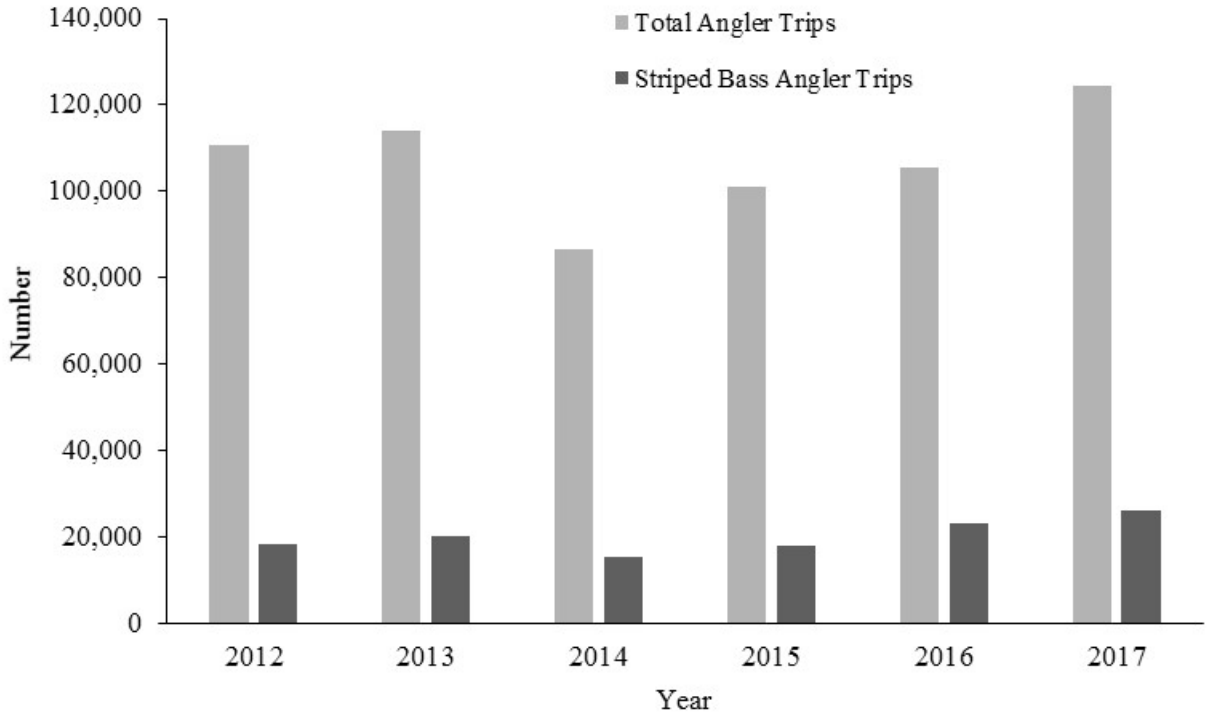

Figure 12. Total recreational angler trips and angler trips targeting striped bass the Tar-Pamlico and Neuse rivers.

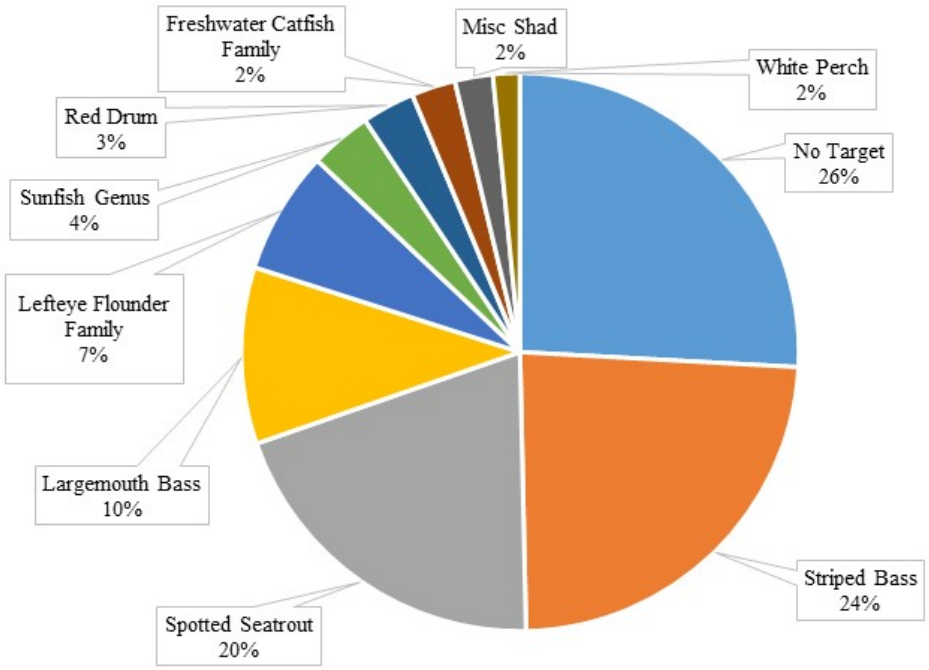

Figure 13. Top ten reported targeted species for recreational anglers fishing in the Tar-Pamlico and Neuse rivers, 2012–2017.

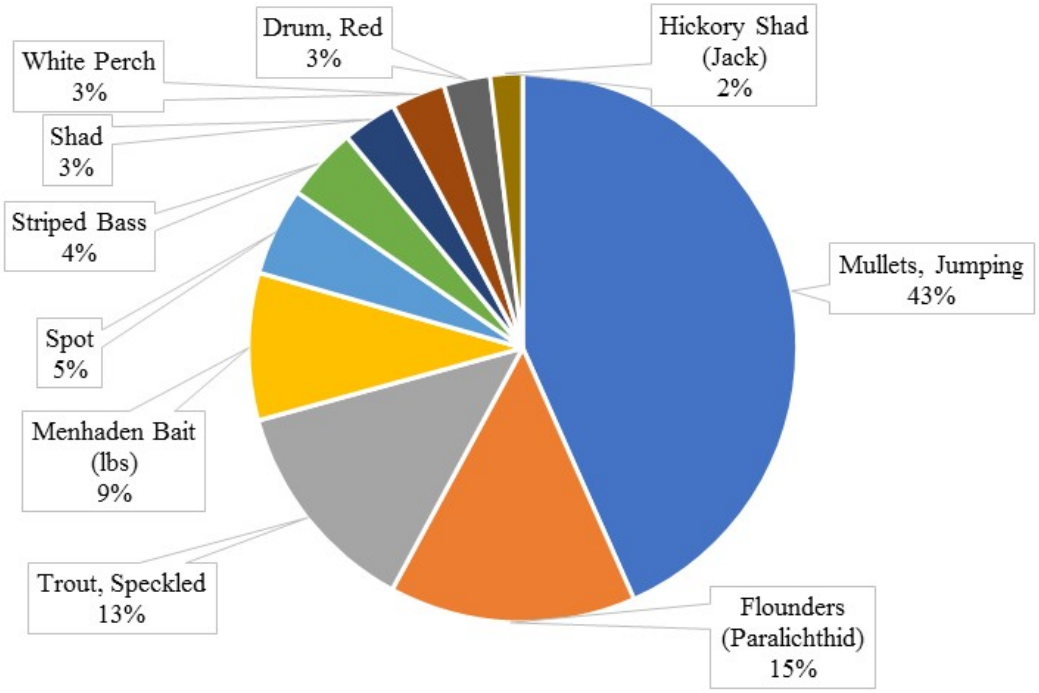

Figure 14. Top ten species harvested from all commercial gill-nets in the Tar-Pamlico and Neuse rivers, 2012–2017.

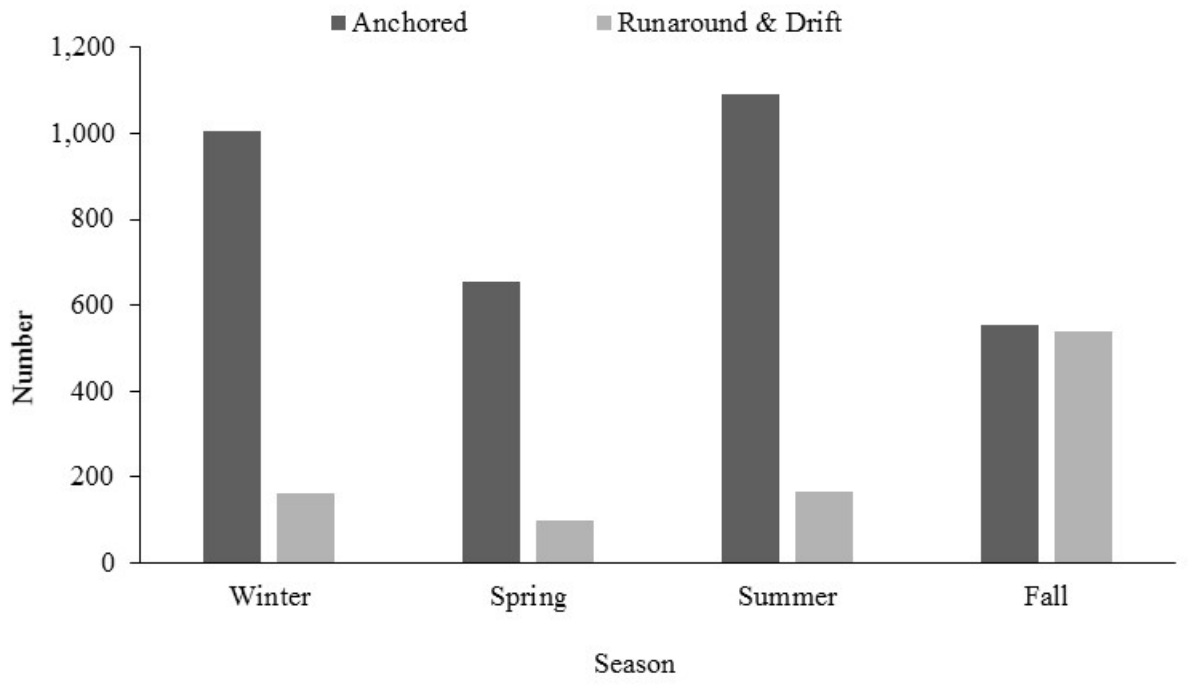

Figure 15. Average number of commercial gill-net trips per year by gill-net type in the Tar-Pamlico and Neuse and Bay rivers, 2012–2017.

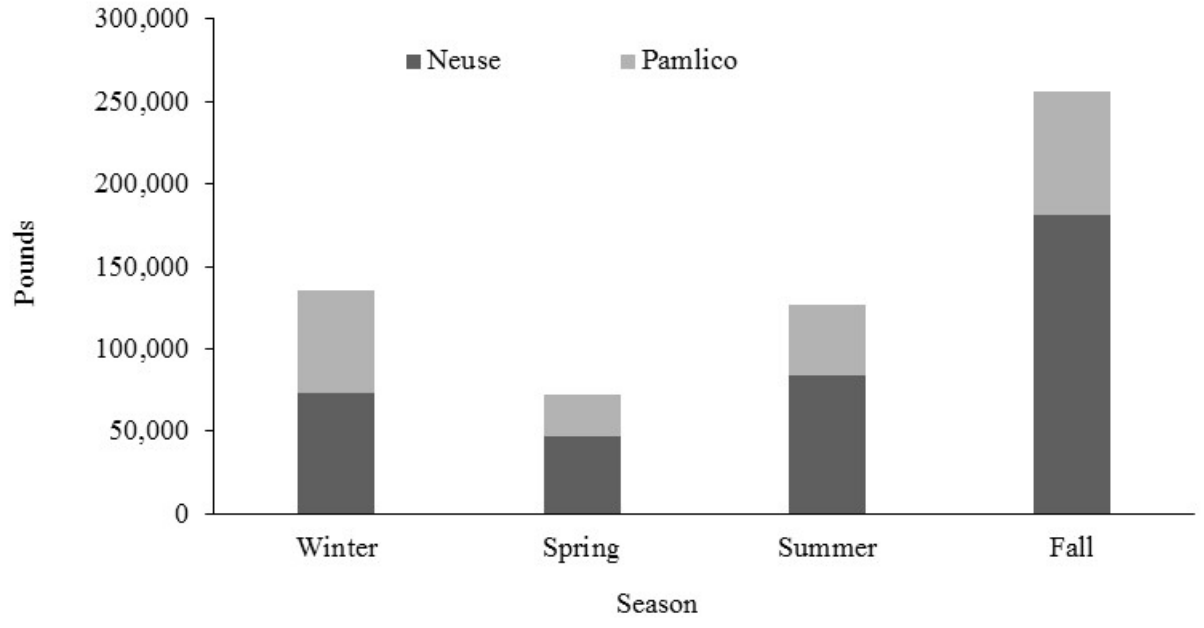

Figure 16. Average pounds of finfish harvested per year from commercial gill-nets in the Tar-Pamlico and Neuse and Bay rivers, 2012–2017.

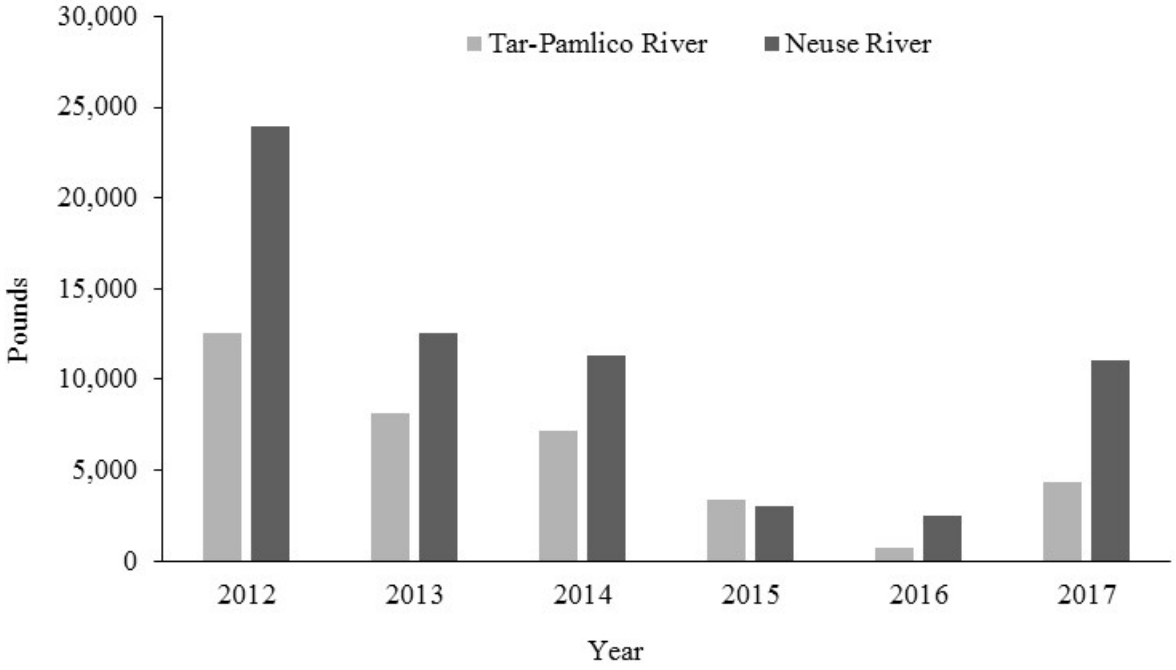

Figure 17. Total pounds of American Shad commercially harvested during the months of January–March in the Tar-Pamlico and Neuse and Bay rivers.

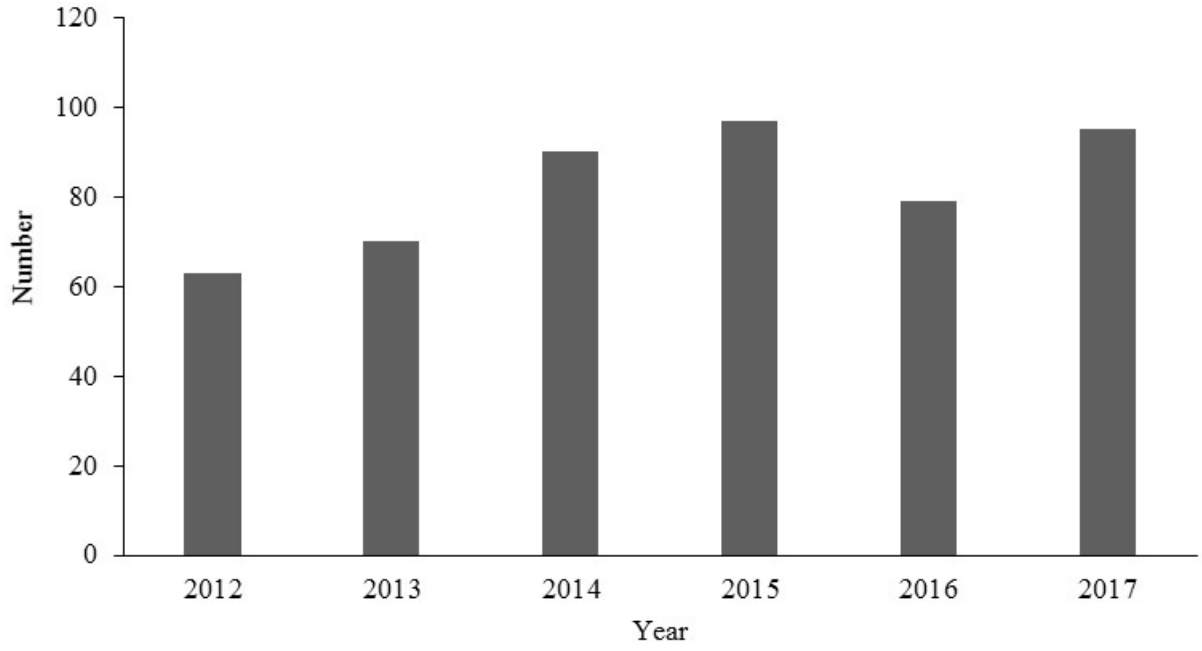

Figure 18. The number of participants that landed striped bass from the commercial gill-net fishery in the Tar-Pamlico and Neuse rivers.