

North Carolina Fishery Management Plan

Amendment 2 Hard Clam



Marine Fisheries
ENVIRONMENTAL QUALITY

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**North Carolina
Hard Clam
Fishery Management Plan**

Amendment 2

By

North Carolina Division of Marine Fisheries

North Carolina Department of Environmental Quality
Division of Marine Fisheries
3441 Arendell Street
P. O. Box 769
Morehead City, NC 28557

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1.0 ACKNOWLEDGEMENTS

Amendment 2 of the North Carolina Hard Clam Fishery Management Plan (FMP) was developed by the North Carolina Department of Environmental Quality (NCDEQ) Division of Marine Fisheries (NCDMF) under the direction of the North Carolina Marine Fisheries Commission (MFC) with advice from the Oyster and Hard Clam Advisory Committee (AC), the Plan Development Team (PDT), and the Rules Subcommittee who contributed their time and knowledge to this document.

Oyster and Hard Clam Advisory Committee

Bob Cummings – Co-chair
Joey Daniels
Nancy Edens
Niels Lindquist
Dell Newman
Howard (Lee) Setkowsky

Stephen Swanson
Jeffrey Taylor
Adam Tyler
Ami Wilbur
Ted Wilgis – Co-chair

Oyster and Hard Clam Plan Development Team

Greg Allen
Tere Barrett
Alan Bianchi
Clay Caroon
Brian Conrad
Joe Facendola – Hard Clam FMP Co-lead
John Hadley
Craig Hardy
Shannon Jenkins
Lara Klibansky

Laura Lee
Mike Marshall
Tina Moore – Hard Clam FMP Co-lead
Steve Murphey
Trish Murphey – Oyster FMP Co-lead
Dean Nelson
Jason Peters
Stephen Taylor – Oyster FMP Co-lead
Curtis Weychert
Garry Wright

Oyster and Hard Clam Rules Subcommittee

Patti Fowler
Jack Holland
Shannon Jenkins
Tina Moore

Steve Murphey
Trish Murphey
Dean Nelson
Garry Wright

2.0 TABLE OF AMENDMENTS

2.1 AMENDMENT 1

MANAGEMENT STRATEGIES	OBJECTIVES	OUTCOME
INSUFFICIENT DATA		
1. Recommend no change (status quo) to collect information on recreational harvest of shellfish	7	Accomplished
MANAGEMENT		
1. Rescind the proclamation but keep authority to open the designated area in the ocean for the mechanical harvest of clams if and when necessary	1, 4 and 8	Accomplished; Proclamation SF-3-2009 dated May 1, 2009
2. Define recreational shellfish gear	1 and 4	Accomplished; Rule change to 15A NCAC 03I .0101
3. Allow no sale of weekend shellfish harvest except from leases	1 and 8	Accomplished; Rule change to 15A NCAC 03K .0106
4. Propose repeal of G.S. 113-169.2 license exemption.	1	Accomplished; Statute G.S. 113-169.2 change and Rule 15A NCAC 03K .0105 change
5. Set recreational limits in rule and proclamation	1 and 8	Accomplished; Rule change for 15A NCAC 03K .0105 and existing proclamation authority
6. Adopt a new rule limiting mechanical harvest of other shellfish to areas where and season when mechanical harvest gear for shellfish is allowed in existing fisheries	6	Accomplished; Rule change to 15A NCAC 03K .0108
7. Recommend no change to the open shellfish harvest license	1, 3, 7, and 8	Accomplished
8. Require all shellfish to be tagged at the dealer level	1 and 3	Accomplished; Rule change to 15A NCAC 03K .0101
9. Discontinue rotation of Pamlico Sound with northern Core Sound.	1, 4, 5, 6, 7, and 8	Accomplished; Existing proclamation authority
10. Institute a resting period within the mechanical clam harvest area in the northern part of Core Sound	1, 4, 5, 6, 7, and 8	Accomplished; Existing proclamation authority
PRIVATE CULTURE		
1. Support the recommendation by the MFC that the Shellfish Hatchery Planning Advisory Team consider multiple uses of the demonstration shellfish hatchery facilities for different shellfish species	2 and 8	Accomplished
2. If clam seed grow out is initiated then the hatchery facility should work with the MFC Shellfish AC and DMF to determine management criteria for the uses of the clam seed stock	1, 2, 3, 5, and 8	Accomplished
3. Propose an exemption from G.S. 113-168.4(b)(1) when the sale is to lease, UDOC permit, or Aquaculture Operations Permit holders for further rearing	1 and 7	Accomplished; Statute change to G.S. 113-168.4(b)(1)
4. Leave regulations in place as is for depuration facilities.	7 and 8	Accomplished
5. Utilize user coordination plans for shellfish lease issuance coast wide	1, 3, 5, 7, and 8	Funding required but was not sought due to budget situation.
6. Develop an independent education package in coordination with the Oyster Hatchery Program, N. C. Sea Grant, and other state agencies, and organizations to be presented at seminars with a mandatory attendance for all new leaseholders, and a mandatory completion of an examination with a passing score to meet education requirements for both new leaseholders and leaseholder transferees	2, 6, and 8	Under development through the Resource Enhancement Section and NC Sea Grant
7. Require an examination with a passing score based on pertinent information in the training package irrespective of whether the applicant has obtained instruction voluntarily or is reviewing the information independently	1 and 4	Under development through the Resource Enhancement Section
8. Request that appropriate agencies such as the Oyster Hatcheries and N.C. Sea Grant conduct shellfish lease training as part of their educational and outreach activities	8	Under development through the Resource Enhancement Section and NC Sea Grant
9. Modify G.S. 113-201 to include a requirement of an examination with a passing score for persons acquiring shellfish leases by lawful transfers unless they have a shellfish lease that is currently meeting production requirements	3 and 8	Under development through the Resource Enhancement Section
10. Support private oyster larvae monitoring programs	1, 2, 3, 5, and 7	Accomplished

2.1 AMENDMENT 1 (Continued)

MANAGEMENT STRATEGIES	OBJECTIVES	OUTCOME
PRIVATE CULTURE		
11. Support construction of an integrated system of shellfish hatcheries and remote-setting sites	1, 2, 5, 7, and 8	Accomplished
12. Develop a subsidized, fee-for-service disease diagnosis program	2 and 5	Not under consideration at this time
13. Recommend status quo on the movement of seed shellfish from polluted waters	2 and 7	Accomplished
14. Change the current rule specifying a three year running production average to a five year production average and change the statutory provision for a ten year lease contract to a five year contract	1 and 5	Accomplished; Amended G.S. 113-202. Accomplished changes to rule 15A NCAC 03O .0201
15. Limit acreage per shellfish lease application to 5 acres	1 and 5	Accomplished; Rule change to 15A NCAC 03O .0201
16. A leaseholder holding at least 5 acres of shellfish bottom is required to meet shellfish lease production requirements before being approved for any additional lease acreage	1 and 7	Accomplished; Rule changes to 15A NCAC 03O .0201 and 15A NCAC 03O .0210
17. Require Lat./Long. coordinates on lease corner locations as part of the requirement of a registered land survey	3	Accomplished; Rule changes to 15A NCAC 03O .0203
18. Develop regional lease acreage caps based on established use of water bodies	1, 3, 5, 7, and 8	Accomplished; Amend G.S. 113-202
19. Rewrite the statutory provision limiting the amount of shellfish lease acreage that can be held by an individual to include acreage held by corporations where the individual is a member, or any combination of corporate or family holdings	1, 5, and 7	Accomplished; Amend G.S. 113-202
20. Monitor seeded oyster sanctuaries for cownose ray predation	2	Currently under investigation through a University study.
21. Provide bilingual (English and Spanish) educational materials to consumers, leaseholders, UDOC permit holders, shellfish dealers, and other DENR state regulatory agencies	7 and 8	Under development by the ISSC and will come through the Division of Environmental Health, Shellfish Sanitation
22. Encourage harvesters to take volunteer time and temperature control measures on their product.	2, 5, and 8	Accomplished through permit process.
HABITAT AND WATER QUALITY CONCERNS		
1. Identify and delineate Strategic Habitat Areas that will enhance protection of clam habitats; research physical factors influencing clam abundance predictably	6	Existing authority through the CHPP implementation plan
2. Coordinate SHAs with land-based conservation and restoration activities such as One North Carolina Naturally and DENR's green infrastructure planning	6	Existing authority through the CHPP implementation plan
3. Ensure oyster and SAV habitat definitions are consistent across regulating agencies	6	SAV definition in effect since April 2009. Existing authority through the CHPP implementation plan
4. Completely map all structured habitat (i.e., shell bottom, SAV) in North Carolina, including the deep, subtidal rocks on Pamlico Sound	2 and 6	Ongoing through Resource Enhancement Section Shellfish Mapping Program
5. Remap structured habitats to assess changes in distribution and abundance over time	2 and 6	Ongoing through Resource Enhancement Section Shellfish Mapping Program
6. Restore historical distribution and acreage of oysters and SAV where possible; coordinate with land-based protection and restoration	2 and 6	Existing authority through the CHPP implementation plan
7. Balance protection of oyster beds and SAV (as habitat) with harvest provisions and expand oyster sanctuary planting and designation	2 and 6	Existing authority through the CHPP implementation plan; Accomplished expansion of oyster sanctuaries
8. Monitor biological/ecological condition and effectiveness of oyster sanctuaries and restored SAV beds	2 and 6	Accomplished in oyster sanctuaries. Not under investigation for SAV beds.
9. Cooperate with University researchers on oyster larvae distribution and oyster recruitment studies to aid in restoration planning	2 and 6	Accomplished
10. Develop and implement a comprehensive coastal marina and dock management plan and policy to minimize impacts to oyster and SAV habitat	6	Existing authority through the CHPP implementation plan

2.1 AMENDMENT 1 (Continued)

MANAGEMENT STRATEGIES	OBJECTIVES	OUTCOME
HABITAT AND WATER QUALITY CONCERNS		
11. Develop permit application survey protocols for shellfish and SAV habitats for CAMA applicants	6	Accomplished through CHPP implementation plan
12. Evaluate and adjust as necessary dredging and trawling boundaries to protect and enhance oyster and SAV habitat	4 and 6	Existing proclamation authority and ongoing pilot study in Archer Creek to develop protocols
13. Seek additional resources to enhance enforcement of and compliance with expanded bottom disturbing fishing gear restrictions that protect oyster and SAV habitat	4 and 6	Existing authority through the CHPP implementation plan
14. Evaluate making conservation leasing available to non-government organizations for the purpose of oyster restoration and sanctuary development	6	Scheduled for consideration by CHPP Steering Committee
15. Work with NOAA and DWQ to determine appropriate levels of TSS, turbidity, chlorophyll a, and other water clarity parameters to achieve adequate water quality conditions for SAV growth and clam	6	Existing authority through the CHPP implementation plan
16. Seek additional funds and process changes to allow local communities to more rapidly address repairs and upgrades to all aspects of the municipal waste systems, including collection and	6	Existing authority through the CHPP implementation plan
17. Target productive shellfish resources in conditionally approved closed areas for land-based protection and restoration efforts. This could include designation as Strategic Habitat Area or Use-Restoration	6	Existing authority through the CHPP implementation plan
18. Modify mechanical harvest lines to exclude areas currently open to mechanical harvest where oyster habitat and SAV habitat exist based on all available information	4 and 6	Existing proclamation authority
19. Provide educational materials to harvesters in license offices and on DMF webpage, through other training opportunities, and through DMF Port Agent contact with harvesters and dealers and include other state and federal regulatory agencies to reach all coastal waters users	8	Accomplished
20. Support DWQ's efforts to improve stormwater rules through permit comments and CHPP implementation and co-ordinate with sister agencies	6	Accomplished. Rule change occurred in Oct. 2008
21. Recommend DWQ to designate Use-Restoration waters in conditionally closed waters where moderate contamination and healthy shellfish beds are present and develop strategies to restore and protect those waters	6	Accomplished; URW Coordinator hired by DWQ
22. Recommend DWQ designate Use-restoration waters in areas where moderate contamination and appropriate shellfish culture conditions are present and develop strategies to restore and protect	6	Accomplished; URW Coordinator hired by DWQ
23. Recommend to the DWQ to accept a lower threshold of 10,000 square feet to coastal stormwater rules	6	Partially accomplished. Not as restrictive through DWQ rule changes as of Oct. 2008
24. Recommend a naturally vegetative riparian buffer width of 50 feet	6	Partially accomplished. Not as restrictive through DWQ rule changes as of Oct. 2008
25. Recommend the exclusion of all wetlands (coastal and non-coastal), from the built-upon area calculations	6	Partially accomplished. Not as restrictive through DWQ rule changes as of Oct. 2008
26. Recommend repeal of G.S. 113-207 (a) and (b) to end the requirement that all oyster rocks must be posted by the Department	3	Accomplished; Repeal G.S. 113-207 (a) and (b)
27. Recommend that conservation leasing for constructed oyster rock habitat be studied by DENR counsel for development of a proper mechanism and to develop siting criteria	2 and 6	Scheduled for consideration by CHPP Steering Committee
28. Leave current management practices in place for Ward Creek	1 and 7	Accomplished; Existing proclamation authority

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3.3 ACRONYMS

AC – Advisory Committee

AEC – Areas of Environmental Concern

AFS – American Fisheries Society

AOP – Aquaculture Operation Permit

ASMFC – Atlantic States Marine Fisheries Commission

ASTP – Aquaculture Seed Transplant Permit

BMP – Best Management Practices

CA – Closed Shellfish Areas

CAMA – Coastal Area Management Act

CDC – Centers for Disease Control

CHPP – Coastal Habitat Protection Plan

COE – United States Army Corp of Engineers

CPI – Consumer Price Index

CPUE – Catch Per Unit Effort

CRC – North Carolina Coastal Resources Commission

CRFL – Coastal Recreational Fishing License

DCM – North Carolina Division of Coastal Management

DEHNR - North Carolina Department of Environment, Health and Natural Resources

DENR – North Carolina Department of Environment and Natural Resources

DEM – North Carolina Division of Environmental Management

DWQ- North Carolina Division of Water Quality

DWR – North Carolina Division of Water Resources

EBHM - Estuarine Benthic Habitat Mapping

EFH – Essential Fish Habitat

EMC – North Carolina Environmental Management Commission

EPA – United States Environmental Protection Administration

ETS – Endorsement to Sell

FA – Known Fishing Areas

FDA – United States Food and Drug Administration

FIN – Fisheries Information Network

FMP – Fishery Management Plan

FRA – Fishery Reform Act

FRG – Fishery Resource Grant

GAMLSS - Generalized Additive Models for Location Scale and Shape

GIS – Geographical Information System

GPS – Global Positioning System

GS – General Statute

HAB – Harmful Algal Bloom

HBR – Hatchery Based Restoration

HQW – High Quality Waters

ISSC – Interstate Shellfish Sanitation Conference

IWW – Intracoastal Waterway

MAFMC – Mid Atlantic Fisheries Management Council

MFC – North Carolina Marine Fisheries Commission

MHW – Mean High Water

MMPA – Mechanical Methods Prohibited Area

MPN – Most Probable Number

MRFSS- Marine Recreational Fisheries Statistical Survey

MRIP - Marine Recreational Information Program

MSC – Moratorium Steering Committee

NCAC – North Carolina Administrative Code

NCDEQ – North Carolina Department of Environmental Quality

NCDMF – North Carolina Division of Marine Fisheries

NCCF – North Carolina Coastal Federation

NCSGA – North Carolina Shellfish Growers Association

NCSPD – North Carolina Department of Administration of State Property

NCSU – North Carolina State University

NMFS – National Marine Fisheries Service

NOAA – National Oceanic and Atmospheric Administration

NPDES - National Pollution Discharge Elimination System

NSP – Neurotoxic Shellfish Poisoning

NSSP – National Shellfish Sanitation Program

NSW – Nutrient Sensitive Waters

NWP – Nationwide Permit 48

OEEB – Occupational and Environmental Epidemiology Branch

ORW – Outstanding Resource Waters

PCN – Pre-Construction Notification

PDT – Plan Development Team

PLS – Professional Land Surveyor

PNA – Primary Nursery Area

PPT – Parts Per Thousand

QPX – Quahog Parasite Unknown

RAT – Rules Advisory Team

RCGL – Recreational Commercial Gear License

RSCFL – Retired Standard Commercial Fishing License

SA (waters) – Market Shellfishing, Salt Water (DWR surface water classification)¹

SAFMC – South Atlantic Fishery Management Council

SAV – Submerged Aquatic Vegetation

SB (waters) – Primary Recreation, Salt Water (DWR surface water classification)²

SC (waters) – Aquatic Life, Secondary Recreation, Salt waters (DWR surface water classification)

SCFL – Standard Commercial Fishing License

SHA – Strategic Habitat Area

SMA – Shellfish Management Area

SNA – Secondary Nursery Area

SRH – Shellfish Research Hatchery

ST – Shellfish mapping Strata

TTP – North Carolina Division of Marine Fisheries Trip Ticket Program

UNC – University of North Carolina

UNC-CH – University of North Carolina, Chapel Hill

UNCW – University of North Carolina, Wilmington

USACE – United States Army Corps of Engineers

USFWS – United States Fish and Wildlife Service

VIMS – Virginia Institute of Marine Science

V_p – *Vibrio parahaemolyticus*

V_v – *Vibrio vulnificus*

¹ Tidal salt waters that are used for commercial shellfishing or marketing purposes and are also protected for all Class SC and Class SB uses. All SA waters are also HQW by supplemental classification.

² Tidal salt waters protected for all SC uses in addition to primary recreation. Primary recreational activities include swimming, skin diving, water skiing, and similar uses involving human body contact with water where such activities take place in an organized manner or on a frequent basis.

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4.0 EXECUTIVE SUMMARY

Hard Clam Stock Status: The status of the hard clam stock in North Carolina is currently listed as unknown. A stock assessment cannot be completed at this time due to data limitations.

Problem Areas: (A) Insufficient Data – (1) Inability to conduct a stock assessment; (B) Management of Public Bottoms – (1) Evaluate the maximum recreational daily vessel harvest limit (2) Evaluate the management of the public mechanical harvest fishery (3) Consider the use of power hauling equipment in commercial hand harvest fishery (4) Reevaluate use of, and need for an open access shellfish license; (C) Private Culture – (1) Improve the allocation of leases and requirements for the continuance of leases (2) Insufficient protection for lease owners unable to meet harvest requirements because of “Acts of God” (3) Insufficient protection of shellfish lease and franchise rights (4) Reevaluate lease moratoriums in certain waterbodies (5) Consider modifications to specific lease provisions (D) Environment and Public Health – (1) Consider requirements for shading molluscan shellstock.

Sustainable Harvest: Data limitations prevent N.C. Division of Marine Fisheries from conducting a hard clam stock assessment and calculating sustainable harvest. While landings records will reflect population abundance to some extent, the relationship is confounded by changes in effort, gear technology, regulations, and market demand. Based on the best available indicators harvest levels in most areas appeared relatively constant. It is recommended to increase hard clam sampling programs to collect information necessary for the completion of a stock assessment.

Public Fishery Aspects: Since 1991 annual hard clam landings from public bottoms have been in decline which may be attributed to less market demand, higher harvesting costs, weather events, and increasing polluted area closures.

Private Fishery Aspects: Hard clams have historically been the principal species produced on leased bottom in North Carolina, but recent trends have seen a shift in effort toward oyster culture. Today the majority of shellfish leases are held by commercial fishermen to supplement their income from public harvest areas by holding shellfish to improve the meat condition and/or sell during better market conditions. Number and acreage of private culture operations have fluctuated very little over time.

Recreational Fishery: The amount and extent of recreational harvest of hard clams is unknown at this time. Recreational harvest data has been collected since November 2010 by means of a monthly shellfish survey sent to select Coastal Recreational Fishing License holders. No license is needed to recreationally harvest shellfish in North Carolina, so many recreational harvesters may not be represented by the CRFL survey. An expansion of recreational harvest data collection to encompass the entire recreational shellfishing universe is needed to accurately estimate recreational fishing mortality of hard clams.

Economic Status: In real dollar (inflation-adjusted) terms, 2012 had the least-valued landings since the mid-1970s. Prices for some grades of clams have dropped in recent years, but this decline in total value is largely driven by a decline in catch. Clams are, however, important to the shellfishermen that harvest them, supplementing their income when other fisheries are slow.

Habitat and Water Quality: Sections 10.0 and 11.0, and issues in Section 12.0 address habitat and water quality concerns specific to hard clams. Adequate habitat and suitable water quality are imperative to support the hard clam population.

Management Options: Section 12.0 provides background and discussion of the 12 issues considered by the Marine Fisheries Commission in selecting their management and research recommendations. The Marine Fisheries Commission recommends maintaining current recreational catch limits for clams, and continue to maintain the commercial harvest of clams under the Shellfish License. It also recommends several modifications to shellfish lease provisions including; increasing protection for lease and franchise rights, providing extensions where “Acts of God” prevent production requirements, and changing re-issuing rules and maximum acreage. It further recommends shading requirements for clams.

4.1 GOAL AND OBJECTIVES

The goal of N.C. Hard Clam Fishery Management Plan (FMP) is to manage hard clam stocks in a manner that achieves sustainable harvest and protects its ecological value. To achieve this goal, it is recommended that the following objectives be met:

1. Protect the hard clam stock from overfishing, while maintaining levels of harvest at sustained production, providing sufficient opportunity for both recreational and commercial hard clamming, and aquaculture.
2. Identify, develop, and promote research to improve the understanding of hard clam biology, ecology, population dynamics, and aquaculture practices.
3. Initiate, enhance, and continue studies to collect and analyze economic, social, and fisheries data needed to effectively monitor and manage the hard clam fishery.
4. Identify, develop and promote efficient hard clam harvesting practices while protecting habitat.
5. Promote the protection, restoration, and enhancement of habitats and water quality so that the production of hard clams is optimized.
6. Consider the socioeconomic concerns of all hard clam resource user groups, including market factors.
7. Promote public awareness regarding the status and management of the North Carolina hard clam stock.

4.2 MARINE FISHERIES COMMISSION SELECTED MANAGEMENT OPTIONS

MANAGEMENT STRATEGIES	OBJECTIVES	REQUIRED ACTION
MANAGEMENT OF PUBLIC BOTTOM		
1. Status quo (Continue the daily harvest limit for recreational purposes at 100 clams per person per day not to exceed 200 per clams per vessel per day)	1 and 6	No action required
2. Status quo (Maintain management of the mechanical clam harvest in existing areas from Core Sound south to Topsail Sound, including modifications to the mechanical clam harvest lines to exclude areas where oyster habitat and SAV habitat exist based on all available information)	1, 4 and 6	No action required
3. Remove the Pamlico Sound mechanical clam harvest areas in rule no longer in use	1	Rule change to 15A NCAC 03K .0302
4. Take latitude/longitude coordinates of the poles marking the open mechanical clam harvest area boundary in the New River, still with the flexibility to move a line to avoid critical habitats	4 and 7	Completed in 2015
5. Allow mechanical clam harvesters to have access to the bottom before maintenance dredging occurs	1 and 6	No action required
6. Status quo (Maintain current definitions and enforcement of hand harvest methods)	1	No action required
7. Allow Shellfish License holders to be eligible to acquire a Standard Commercial Fishing License after they show a history of sale of shellfish. Continue to allow commercial harvest of all other shellfish (clams included) as currently allowed	1 and 6	No action required
PRIVATE CULTURE		
1. Support modification of G.S. 113-208 and G.S. 113-269 to add minimum fines for violations on shellfish leases and franchises. With minimum fines set at \$500 for the first violation and \$1,000 for the second violation	5 and 6	Amend G.S. 113-208 and G.S. 113-269
2. Support modification of G.S. 113-269 to include protection to all shellfish leases and franchises, not just those with water column amendments	5 and 6	Amend G.S. 113-269
3. Modify Rule 15A NCAC 03O .0114, regardless whether statute changes occur, so that a first conviction under G.S. 113-208 or G.S. 113-269 the Fisheries Director shall revoke all licenses issued to the licensee	5 and 6	Rule change to 15A NCAC 03O .0114
4. Status quo (Adhere to Regional Conditions of USACE NWP48 with no adverse effect to SAV from shellfish leases and following measure identified in the interim)	4 and 5	No action required
5. Continue the moratorium of shellfish leases in Brunswick County	1, 4, 5 and 6	No action required

4.2 MARINE FISHERIES COMISSION SELECTED MANAGEMENT OPTIONS CONTINUED

MANAGEMENT STRATEGIES	OBJECTIVES	REQUIRED ACTION
PRIVATE CULTURE		
6. Establish a rule to support extensions for where "Acts of God" prevent lease holder from making production, with a two year extension and only one extension allowed per term	1, 4 and 6	Rule change 15A NCAC 03O .0201
7. Allow leases returned to the state to remain delineated for a period of one year to allow the pre-existing leased bottom to be re-issued to other shellfish growers	1, 4, 5 and 6	Amend G.S. 113-202
8. Improve public notice of proposed lease applications on the physical lease, at fish houses, and/or through electronic notices	7	No action required
9. Allow a maximum of ten acres in both mechanical methods prohibited areas and mechanical methods allowed areas	1, 4 and 5	Rule change 15A NCAC 03O .0201(a)(3)
ENVIRONMENT AND PUBLIC HEALTH		
1. Implement shading requirements for clams on a vessel, during transport to a dealer, or storage on a dock during June through September. These requirements would be implemented as a public health protection measure under 15A NCAC 03K .0110 by proclamation annually	4	Existing proclamation authority

4.3 SUSTAINABLE HARVEST STRATEGY

Data limitations prevent NCDMF from conducting a hard clam stock assessment and calculating sustainable harvest. Based on the best available indicators, harvest levels showed increasing trends in eight areas (Bogue Sound, Core Sound, Inland Waterway, New River, Newport River, North River/Back Sound, Shallotte River, and White Oak River) for hand harvest. A significant decreasing trend was found in the hand harvest catch rates in Pamlico Sound. The remaining water bodies showed no trend in hand harvest catch rates over time. For mechanical harvest trends the Intracoastal Waterway, New River, Newport River, North River/Back Sound, and Stump Sound demonstrated significantly increasing trends in mechanical harvest catch rates over time. No trends were detected in Bogue Sound, Core Sound, or White Oak River catch rates for mechanical harvest.

Refer to Subsection 6.2 and 6.3, for an overview of the methods used to provide stock indicators although there are strong caveats associated with using these methods. It is recommended that the hard clam fishery maintain the current daily vessel harvest limit in the recreational fishery and continue without change in the management of the mechanical and hand clam harvest in existing areas. It is also recommended that several modifications to shellfish lease provisions be made including; increasing protection for lease and franchise rights, providing extensions where “Acts of God” prevent required harvest, and changing re-issuing rules and maximum acreage. It is further recommended that shading requirements for molluscan shellstock be implemented. It is recommended to increase hard clam sampling programs to collect information necessary for the completion of a stock assessment.

5.0 INTRODUCTION

The status for hard clams in North Carolina continues to be defined as unknown due to the continued lack of data needed to conduct a reliable assessment of the stock. While landings records will reflect population abundance to some extent, the relationship is confounded by changes in effort, gear technology, regulations, and market demand. Commercial harvest levels appeared to show an increasing trend for more areas than not for both hand and mechanical harvest methods, based on the best available indicators. Recreational harvest levels continue to be unknown. It is recommended to increase hard clam sampling programs to collect information necessary for the completion of a stock assessment.

5.1 MANAGEMENT AUTHORITY

All authority for management of North Carolina's hard clams is vested in the State of North Carolina. Management of the hard clam fishery includes all activities associated with maintenance, improvement, and utilization of the hard clam population and their habitats in the coastal area, including research, development, regulation, enhancement, and enforcement. Hard clam harvest occurs from coastal waters and is under rules of the North Carolina Marine Fisheries Commission (MFC). However, the North Carolina Department of Environmental Quality (NCDEQ) is the agency directed by North Carolina General Statute 113-182.1 (G.S. 113-182.1) to prepare FMPs for all commercially or recreationally significant species or fisheries that comprise State marine or estuarine resources. These plans must be approved and adopted by the MFC.

Many different state laws (General Statutes - G.S.) provide the necessary authority for fishery management in North Carolina. General authority for stewardship of the marine and estuarine resources by the NCDEQ is provided in G.S. 113-131. The NCDMF is the branch of the NCDEQ that carries out this responsibility. G.S. 113-136 provides enforcement authority for NCDMF Marine Patrol officers. The MFC was created to "manage, restore, develop, cultivate, conserve, protect, and regulate the marine and estuarine resources of the State of North Carolina including aquaculture facilities which cultivate or rear marine and estuarine resources" (G.S. 113-132 and 143B-289.51). The MFC can regulate harvest times, areas, gear, seasons, size limits, and quantities of shellfish harvested and possessed (G.S. 113-182 and 143B-289.52). General Statute 143B-289.52 allows the MFC to delegate authority to implement its regulations for fisheries "which may be affected by variable conditions" to the Director of NCDMF by issuing public notices called "proclamations". Thus, North Carolina has a very powerful and flexible legal basis for coastal fisheries management. The General Assembly has retained for itself the authority to establish fishing licenses and a cap on fees charged for permits. It has delegated authority to the MFC to establish permits for various commercial fishing activities.

The Fisheries Reform Act of 1997 (FRA) establishes a process for preparation of coastal fisheries management plans in North Carolina (G.S. 113-182.1). The FRA was amended in 1998 and again in 2004. In 1998 the FRA was amended for several changes, that: 1) determine limited entry authority in federal quota-based fisheries; 2) authorized that FMPs and management measures from FMPs be reviewed by the regional advisory committees; 3) authorized that MFC meetings must have a super quorum; 4) clarified definitions; and 5) clarified licensing provisions for standard commercial fishing licenses (SCFL) and recreational commercial gear licenses (RCGL). The amendment of the FRA in 2004 required FMPs to achieve sustainable harvest rather than optimal yield and to specify a time period not to exceed 10 years for ending overfishing and rebuilding a fishery. The amendment of the FRA in 2010

required FMPs to specify time periods for ending overfishing and achieving a sustainable harvest and include as standard of at least fifty percent probability of achieving a sustainable harvest. The FRA states that the goal of the plans shall be to ensure the long-term viability of the State's commercially and recreationally significant species or fisheries. Each plan shall be designed to reflect harvest practices so that one plan may apply to a specific fishery, while other plans may be based on gear or geographic areas. Each plan shall:

- a. Contain necessary information pertaining to the fishery or fisheries, including management goals and objectives, status of relevant fish stocks, stock assessments for multi-year species, fishery habitat, and water quality considerations consistent with Coastal Habitat Protection Plans adopted pursuant to G.S. 143B-279.8, social and economic impact of the fishery to the State, and user conflicts.
- b. Recommend management actions pertaining to the fishery or fisheries.
- c. 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 will produce a sustainable harvest.
- d. Specify a time period, not to exceed two years from the date of the adoption of the plan, to end overfishing. This subdivision shall not apply if the Fisheries Director determines that the biology of the fish, environmental conditions, or lack of sufficient data make implementing the requirements of this subdivision incompatible with professional standards for fisheries management.
- e. Specify a time period, not to exceed 10 years from the date of the adoption of the plan, for achieving a sustainable harvest. This subdivision shall not apply if the Fisheries Director determines that the biology of the fish, environmental conditions, or lack of sufficient data make implementing the requirements of this subdivision incompatible with professional standards for fisheries management.
- f. Include a standard of at least fifty percent (50%) probability of achieving sustainable harvest for the fishery or fisheries. This subdivision shall not apply if the Fisheries Director determines that the biology of the fish, environmental conditions, or lack of sufficient data make implementing the requirements of this subdivision incompatible with professional standards for fisheries management.

Sustainable harvest is defined in the FRA as "The amount of fish that can be taken from a fishery on a continuing basis without reducing the stock biomass of the fishery or causing the fishery to become overfished" (G.S. 113-129(14a)). Overfished is defined as "the condition of a fishery that occurs when the spawning stock biomass of the fishery is below the level that is adequate for the recruitment class of a fishery to replace the spawning class of the fishery" (G.S. 113-129(12c)). Overfishing is defined as "fishing that causes a level of mortality that prevents a fishery from producing a sustainable harvest" (G.S.113-129(12d)).

5.2 GENERAL PROBLEM STATEMENT

Clam harvest has fluctuated historically, often in response to changes in demand, improved harvesting, and increases in polluted shellfish area closures.

Issues that will be addressed in Amendment 2 of the Hard Clam FMP fall into 4 general categories. The categories include: 1) insufficient data; 2) management of public bottom; 3)

private culture; and 4) environment and public health. The only historical data available for hard clams are commercial landings and various short-term surveys. Fishery dependent and independent sampling programs were initiated in 1999 and 2007 respectively. The fishery independent program is currently small in scale and occurs only in Core Sound. Fishery dependent sampling has been expanded to all areas in the state in 2013 for hard clams.

5.2.1 INSUFFICIENT DATA

Data limitations prevent NCDMF from conducting a hard clam stock assessment and calculating sustainable harvest. Prior to 1994, hard clam data for North Carolina were limited to landings from the commercial fishery and a number of short-term surveys. **The statutory obligation to manage hard clams according to sustainable harvest cannot be met until the appropriate data are collected.** While landings records reflect population abundance to some extent, the relationship is confounded by changes in harvest effort and efficiency. The North Carolina Trip Ticket Program (TTP), initiated in 1994, provides commercial landings as well as individual trip information. Fishery-dependent and independent monitoring program were initiated in 1999 to collect biological data to complement trip ticket landings information in Core Sound. Unfortunately, very limited data is collected for the recreational harvest of hard clams. Socioeconomic surveys of recreational participants need to be performed to determine specific characteristics of the user group, which issues are important to them, attitudes toward management of the fishery, as well as general demographic information.

Specific background and research recommendations are outlined in Sections 6.5 and 9.3.

5.2.2 MANAGEMENT OF PUBLIC BOTTOM

The hard clam fishery has been managed through harvest and size limits. The minimum size limit is set at 1-inch thickness. Recreational harvesters are limited to a 100 per person per day not to exceed 200 clams per vessel daily harvest limit. Hand harvest is open year round with a maximum daily harvest limit of 6,250 clams (25 bags) per day, although most hand harvesters are limited in the daily limits they can bring in because of market conditions. Mechanical harvest also has gear, season, and area restrictions. A resting period (every other year open) in the northern Core Sound region was initiated in Amendment 1 in 2008 and since 2001 lower bag limits to 20 bags per day have been in place. White Oak River, the Intracoastal Waterway (IWW) of Onslow and Pender counties (Marker 65 to the BC Marker at Banks Channel), and New River are rotated on a yearly basis since the 1990s. Specific daily harvest limits for the open mechanical clam harvest areas are established in each area as well. The management program needs to be re-assessed and modified as data become available. Other issues of concern include: evaluating the maximum recreational daily vessel harvest limit, management of the public mechanical harvest fishery, consider the use of power hauling equipment to pull in rakes, and consider the effort from an open access shellfish license to all state residents.

Specific issues, options, and potential actions are outlined in Sections 12.0 and 13.0.

5.2.3 PRIVATE CULTURE

The current shellfish lease program in North Carolina needs to be evaluated and changes implemented in order to make the system more productive. Improvements in the allocation of leases and requirements for the continuance of leases are needed to benefit culturists. Other issues of concern include the protection of shellfish lease and franchise rights, re-visiting the

issues on lease moratoriums in certain water bodies, and consider modification to specific lease provisions.

Specific issues, options, and potential actions are outlined in Sections 12.0 and 13.0.

5.2.4 ENVIRONMENT AND PUBLIC HEALTH

Adequate habitat and suitable water quality are imperative to the hard clam population. Support of the Coastal Habitat Protection Plan (CHPP) is essential in collaborating with other agencies such as, the Coastal Resources Commission (CRC) and the Environmental Management Commission (EMC) to improve habitat and water quality coast wide. Sanitary controls are also established over all phases of the growing, harvesting, shucking, packing, and distribution of fresh and frozen shellfish, based on public health principles designed to prevent human illness associated with the consumption of hard clams. These recommendations should include ways to prevent or minimize potential negative impacts to shellfish growing waters and the prevention of human illnesses associated with the consumption of molluscan shellfish. Environment and public health issues include requirements for shading clams.

Specific issues, options, and potential actions are outlined in Sections 12.0 and 13.0.

5.3 DEFINITION OF THE MANAGEMENT UNIT

The unit stock for management is considered all hard clams (*Mercenaria mercenaria*) occurring within North Carolina coastal waters.

5.4 EXISTING PLANS, STATUTES, AND RULES OF NORTH CAROLINA

5.4.1 PLANS

There are no federal or interstate FMPs regulating hard clams in North Carolina. A state hard clam FMP was written in 1997 but was never finalized and did not address private culture issues.

The N.C. Hard Clam Fishery Management Plan (FMP) was completed August 2001 (see Appendix 14.1 for a summary of actions taken). Amendment 1 of the FMP was finalized in 2008 (NCDMF 2008). The Hard Clam FMP is reviewed and updated at least every five years and was amended 2008 under its scheduled 5-year review. Highlights of the management measures developed in Amendment 1 recommended that the hard clam fishery continue to harvest at current daily harvest limits, eliminate the mechanical clam harvest rotation in Pamlico Sound, institute a resting period in the northern Core Sound mechanical clam harvest area, and develop sampling programs to collect information necessary for the completion of a hard clam stock assessment. Any revisions to the plan resulting from this 5-year review will be designated as Amendment 2.

5.4.2 STATUTES [From selected North Carolina General Statutes (August 2015)]

North Carolina General Statutes (G.S.) 113-134, 113-182, and 143B-289.54 allow the MFC broad authority to promulgate rules for the management of marine and estuarine resources, including clams, in coastal fishing waters (MFC 2013). General Statute 113-201 also empowers the MFC to make rules and take all steps necessary to develop and improve the cultivation, harvesting, and marketing of shellfish in North Carolina from public grounds and private beds.

Propagation of shellfish by the NCDEQ both for public or private beds is authorized under G.S. 113-204.

Aquaculture, including the aquaculture of estuarine shellfish, is under the jurisdiction of the North Carolina Department of Agriculture. That department and its Aquaculture Advisory Board are charged with reviewing and making recommendations on policies, laws, and regulations to facilitate aquaculture development. The powers and duties associated with this charge are contained in North Carolina General Statutes 106-756 through 106-760.

The MFC has jurisdiction, as provided in G.S. 113-132, over all activities connected with the conservation and regulation of marine and estuarine resources, including the regulation of aquaculture facilities (as defined in G.S. 106-758) which cultivate or rear marine and estuarine resources.

Other North Carolina General Statutes that address specific items relating to the hard clam fishery as referred from the North Carolina Marine Fisheries Commission Rules of May 1, 2015 (MFC 2015) and are listed as follows:

- | | | |
|----------------|--|--|
| G.S. 113-168.2 | Standard Commercial Fishing License | This is a \$400 license to commercially harvest and sell finfish, crabs, and shrimp to licensed seafood dealers. An endorsement to this license to commercially harvest and sell shellfish is free to North Carolina residents only. |
| G.S. 113-168.5 | License endorsements for Standard Commercial Fishing License | This is a no charge shellfish endorsement for North Carolina residents holding a SCFL. The endorsement allows the holder to take and sell shellfish. |
| G.S. 113-168.6 | Commercial fishing vessel registration | This registration is a requirement for commercial fishermen who use boats to harvest seafood. Fees are based on boat length. Fees range from \$1.25 to \$7.50 per foot. |
| G.S. 113-169.2 | Shellfish license for NC residents without a SCFL | There is an annual \$50.00 license for individuals to commercially harvest shellfish. This license is available only to residents of North Carolina. |
| G.S. 113-169.3 | Licenses for fish dealers | This establishes a license requirement and a \$100.00 fee for dealing in clams. Dealer licenses are restricted to North Carolina residents. |
| G.S. 113-182.1 | Fishery Management Plans | This requires the Department to prepare and the MFC to adopt FMPs for all commercially or recreationally significant species. |

- G.S. 113-187 Penalties for violations if Subchapter and rules
- Penalties for shellfishing in an area closed because of suspected pollution or using mechanical methods for clams in a designated primary nursery area is guilty of a class A1 misdemeanor.
- G.S. 113-201.1 Definitions
- This provides definitions for: Natural Shellfish Beds, Riparian Owner, Shellfish, Single Family Unit, and Water Column.
- G.S. 113-202 New and renewal leases for shellfish cultivation; termination of leases issued prior to January 1, 1966
- This allows shellfish leases meeting certain standards to be granted in coastal fishing waters except in Brunswick County and Core Sound.
- G.S. 113-202.1 Water column leases for aquaculture
- This allows shellfish leaseholders to use the water column above their bottom lease for shellfish cultivation if certain standards are met.
- G.S. 113-202.2 Water column leases for aquaculture for perpetual franchises
- This allows shellfish franchise holders to use the water column above their franchise area for shellfish cultivation if certain standards are met.
- G.S. 113-203 Transplanting of oysters and clams
- Establishes rules for transplanting clams to private beds.
- G.S. 113-206 Chart of grants, leases and fishery rights; overlapping leases and right; contest or condemnation of claims; damages for taking of property.
- This provides for resolution of submerged lands conflicts.
- G.S. 113-207 Taking shellfish from certain areas forbidden; penalty
- It is unlawful to take any shellfish from within 150 feet of a publicly owned pier in which the NCDMF has deposited cultch material. A violation is a class 3 misdemeanor.
- G.S. 113-208 Protection of private shellfish rights
- This establishes a maximum \$5,000 fine for theft from a shellfish lease.
- G.S. 113-209 Taking polluted shellfish at night or with prior convictions forbidden; penalty
- This establishes a Class I felony with a minimum \$2,500 fine for repeat offenders taking shellfish from polluted areas or at night.

G.S. 113-269 Robbing or injuring hatcheries and other aquaculture operations

This defines fines and punishment for robbing or injuring aquaculture operations.

G.S. 143B-279.8 Coastal Habitat Protection Plans

This establishes plans that shall provide for the long-term enhancement of coastal fisheries associated with coastal habitats including shellfish beds. Also requires the Environmental Management Commission (EMC), Coastal Resources Commission (CRC), and MFC to adopt and follow the plans.

5.4.3 RULES [All references are from Title 15A Environment and Natural Resources Chapter 3 Marine Fisheries and Subchapter 18A Sanitation of the NC Administrative Code (NCAC)]

5.4.3.1 GENERAL

- Aquaculture operation is defined as an operation that produces artificially propagated stocks of marine or estuarine resources or obtains such stocks from authorized sources for the purpose of rearing in a controlled environment (15A NCAC 03I .0101(2)(a)).
- Depuration is defined as the purification or the removal of adulteration from live oysters, clams and mussels by any natural or artificially controlled means (15A NCAC 03I .0101(2)(d)).
- Shellfish marketing from leases and franchises is defined as the harvest of clams from privately held shellfish bottoms and lawful sale of those shellfish to the public at large or to a licensed shellfish dealer (15A NCAC 03I .0101(2)(i)).
- 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 (15A NCAC 03I .0101(2)(j)).
- Shellfish production on leases and franchises is defined as the culture of clams on shellfish leases and franchises from a sublegal harvest size to a marketable size. And also the transplanting (relay) of clams from designated areas closed due to pollution to shellfish leases and franchises in open waters and the natural cleansing of those shellfish. (15A NCAC 03I .0101(2)(k)).
- Dredge is defined as 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 (15A NCAC 03I .0101(3)(e)).
- Mechanical methods of clamming is defined as 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 (15A NCAC 03I .0101(3)(l)).
- Intertidal Oyster Bed is defined as a formation of shell and live oysters of varying density (15A NCAC 03I .0101(4)(d)).
- Shellfish producing habitats are those areas, historic or existing, in which shellfish, such as clams, 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 (15A NCAC 03I .0101(4)(g)).

- It is unlawful to introduce, transfer, hold, or maintain any live aquatic animals or plants not native to the state without first obtaining a permit from the Fisheries Director. Requirements to obtain the permit are included in this rule. (15A NCAC 03I .0104).

5.4.3.2 SHELLFISH GENERAL

- It is unlawful to possess, sell, or take clams from prohibited (polluted) areas in or out of North Carolina. The Fisheries Director may close areas to the taking of clams in order to protect shellfish populations for management purposes or for public health purposes (15A NCAC 03K .0101).
- It is unlawful to use a rake more than 12 inches wide or weighing more than six pounds to take clams in any live oyster bed, in any established bed of submerged aquatic vegetation, or in any established bed of saltwater cordgrass (*Spartina alterniflora*) (15A NCAC 03K. 0102(2)).
- The Fisheries Director may designate Shellfish Management Areas based on certain criteria such as bottom type, salinity, currents, cover, or cultch necessary for shellfish growth and have the ability to produce commercial quantities of shellfish, produce shellfish suitable for transplanting as seed or relaying from prohibited areas. Or serve as sanctuaries to increase spawning and disease resistance or prevent predation (15A NCAC 03K .0103(a)).
- It is unlawful to use a trawl net, long haul seine, or swipe net in a designated Shellfish/Seed Management area. It is unlawful to take clams from a closed Shellfish/Seed Management area, except the Fisheries Director may, by proclamation, open specific areas to the taking of shellfish (15A NCAC 03K .0103 (b)(c)).
- Relaying of clams from polluted public bottom to privately controlled bottom may only occur between April 1 through May 15 only with a permit and closure of the private bottom is required (15A NCAC 03K .0104 (a)(b)).
- The season for relaying does not apply from 15A NCAC 03K .0104 (b) for areas designated by the Fisheries Director as sites where shellfish would otherwise be destroyed in maintenance dredging operations (15A NCAC 03K .0104 (c)).
- The Fisheries Director shall close and reopen any private shellfish bed for which the owner has obtained a permit to relay oysters and clams from polluted public bottom upon the recommendation of Shellfish Sanitation (15A NCAC 03K .0104(d)).
- It is unlawful to take clams on Sundays from public bottoms except in recreational quantities and except from shellfish leases and franchises pursuant to G.S. 113-208 (15A NCAC 03K .0105(a)).
- The recreational harvest limit for clams is one hundred clams per person per day, not to exceed two hundred clams per vessel per day (15A NCAC 03K .0105 (b)(3)).
- Clams may be taken from prohibited areas for depuration in an approved depuration plant only when oysters would otherwise be lost due to maintenance dredging operations. Specifications for approved depuration plants can be found in 15A NCAC 18A Sections .0100 - .0900. Proclamation authority, permits, and transportation guidelines are established (15A NCAC 03K .0107(a), (b), and (c)).
- Clams harvested from polluted areas for depuration within or outside of the state of North Carolina shall be transported under the supervision of the NCDMF (15A NCAC 03K .0107(d)).
- It is unlawful to ship clams harvested for depuration to depuration facilities located in a state other than North Carolina unless the facility is in compliance with the applicable rules and laws of the shellfish control agency of that state (15A NCAC 03K .0107(e)).
- It is unlawful to possess or sell clams in a commercial fishing operation without a harvest

tag affixed to each container. Tags shall be affixed by the harvester or dealer and must meet certain criteria (15A NCAC 03K .0109).

5.4.3.3 HARD CLAMS (MERCENARIA)

- It is unlawful to take, land, or possess aboard a vessel more than 6,250 clams per fishing operation from public bottom in internal waters. It is unlawful to take, possess, sell or purchase any clams less than one-inch thick, except for hatchery/aquaculture clams (15A NCAC 03K .0301).
- It is unlawful to take buy, sell, or possess any clams taken by mechanical methods from public bottom except when the Fisheries Director may open and close the season in the ocean at any time and between December 1 through March 31 in internal waters. Areas that may be open are Core and Bogue sounds, Newport, North, White Oak and New rivers, the Intracoastal Waterway north of the "BC" Marker at Topsail Beach, and an area in Pamlico Sound (15A NCAC 03K .0302).
- It is unlawful to take clams by any method, other than by hand tongs, hand rakes or by hand. It is unlawful to take clams by hand tongs in any established bed of submerged aquatic vegetation or salt water cordgrass (15A NCAC 03K .0304 (a)).
- It is unlawful to have mechanical harvest gear aboard a vessel at any time except during mechanical harvest season, except for activities that are permitted for relaying clams from prohibited waters and permitted for harvesting from private leases or franchises (15A NCAC 03K .0304 (b)).
- Possession and sale of hatchery/aquaculture clams are exempted from bag and size limits (15A NCAC 03K .0305).

5.4.3.4 NURSERY AREAS

- It is unlawful to use mechanical methods for the harvest of clams in a primary nursery area (15A NCAC 03N .0104).

5.4.3.5 LEASES AND FRANCHISES

- This rule makes it unlawful to use mechanical methods for the harvest of clams on a lease or franchise without a permit. Procedures and requirements for obtaining permits are found in 15A NCAC 03O .0500 (15A NCAC 03K .0111).
- All areas of public bottom must meet certain criteria in order to be deemed suitable for leasing for shellfish cultivation purposes (15A NCAC 03O .0201 (a)).
- All franchises must produce 10 bushels of shellfish per acre per year or plant 25 bushels of cultch or seed shellfish per acre per year or plant 50 bushels of cultch per acre per year or a combination of cultch or seed (15A NCAC 03O .0201(b) and (c)).
- Planting, production, and marketing standards for compliance to maintain a shellfish lease or franchise (15A NCAC 03O .0201 (d)).
- Water columns superjacent to leases or franchises must meet certain criteria in order to be deemed suitable for aquaculture purposes (15A NCAC 03O .0201 (e)(f)).
- All water column leases must produce and market 40 bushels of clams per acre per year or plant 100 bushels of cultch or seed shellfish per acre per year (15A NCAC 03O .0201(g)).
- Application information, maps, management plans, and marking of the proposed lease site are specified (15A NCAC 03O .0202).
- Processing of shellfish lease applications includes: inspection for compliance with

standards, modification of sites, notification of approval, and surveying requirements (15A NCAC 03O .0203).

- Specifications established for marking poles, signs, spacing of marker, and removal of markers (15A NCAC 03O .0204).
- Management plan, survey, application of standards, and appeal-of-denial information is given for lease renewals (15A NCAC 03O .0205).
- Comments and formal protest procedures on lease applications are specified if any member of the public wishes to protest the issuance of a lease (15A NCAC 03O .0206).
- Owners of shellfish leases and franchises shall provide annual production reports to the Division. Failure to furnish production reports can constitute grounds for termination (15A NCAC 03O .0207).
- States that cancellation proceedings will begin for failure to meet production requirements and interfering with public trust rights. Corrective action and appeal information is given (15A NCAC 03O .0208).
- Requirement for the transfer of a lease include: a minimum size of the lease, 30-day notification, water columns are not transferrable unless approved by the Secretary in accordance with G.S. 113-202.1(f) and G.S. 113-202.2(f), training within 6-months after transfer, and resident status before the transfer of ownership is given (15A NCAC 03O .0209).
- Specifies survey requirements, management plans, and production requirements for recognized franchises (15A NCAC 03O .0210).
- It is unlawful to use any bottom disturbing fishing gear on any shellfish lease or franchise unless it has been duly authorized by the Fisheries Director (15A NCAC 03O .0211).
- Requires an aquaculture operation permit to conduct aquaculture operations (15A NCAC 03O .0503(f))

5.4.3.6 SANITATION OF SHELLFISH GENERAL

- Definitions that apply to Sections .0300 to .0900 (15A NCAC 18A .0301).
- Specifies facilities and practices that require permits from NCDMF (15A NCAC 18A .0302 - .0304).

5.4.3.7 SANITATION OF SHELLFISH - GENERAL OPERATION STANDARDS

- Specifies minimum requirements for shellfish facility construction (15A NCAC 18A .0402 - .0418).
- Requires minimum sanitary conditions for harvest vessels and sanitary and refrigeration requirements for transport vehicles to prevent adulteration and cross contamination (15A NCAC 18A .0419-.0420).
- Requirements for daily buy, sell and ship records for shellfish (15A NCAC 18A .0421)
- Sanitary requirements for sale of clean and wholesome shellstock (15A NCAC 18A .0422-.0423).
- Tagging requirements for shellstock including bulk shipments (15A NCAC 18A .0424-.0426).
- Temperature and bacteriological requirements for shellstock with stop sale and disposal provisions for non-compliance. (15A NCAC 18A .0427-.0430).
- All restaurants, facilities, roadside stands etc. that offer for sale raw molluscan shellfish must conspicuously display a consumer advisory to warn those with compromised immune systems of the increased risk of serious illness or death from consumption of raw or undercooked shellfish (15A NCAC 18A .0432).

- Hazard Analysis and Critical Control Plan requirements, sanitation plan requirements and monitoring records. These plans identify and address specific hazards and sanitation controls in the permitted facility and are required under 21 CFR for all seafood processing facilities (15A NCAC 18A .0433 -.0436).
- Specifies requirements for grading and reshipping shellstock (15A NCAC 18A .0501-.0504).

5.4.3.8 OPERATION OF SHELLFISH SHUCKING AND PACKING PLANTS AND REPACKING PLANTS

Lists specific requirements in addition to general requirements, for permitting and operation including: food and non-food contact surfaces, sanitation, ice, shucking and repacking requirements including heat shock methods, containers and labeling, and recall procedures.

5.4.3.9 OPERATION OF DEPURATION (MECHANICAL PURIFICATION) FACILITIES

Lists specific requirements for: design, construction, sanitation, source water, disinfection, laboratory procedures, and operation of a depuration facility.

5.4.3.10 WET STORAGE OF SHELLSTOCK

Lists specific requirements for design, sanitation, source water and equipment used in a wet storage operation.

5.4.3.11 CLASSIFICATION OF SHELLFISH GROWING WATERS

- Definitions that apply to Section .0900 (15A NCAC 18A .0901).
- Shellfish growing areas are classified as Approved, Conditionally Approved (open or closed status), Restricted, or Prohibited (15A NCAC 18A .902).
- Sanitary Surveys are required for each growing area every three years and must include a shoreline survey of pollution sources, hydrographic survey to evaluate meteorological and hydrographic factors that affect pollution distribution, a bacteriological survey which includes a minimum of 6 sets of samples per year for each sampling station in a growing area, and annual update reports (15A NCAC 18A .0903).
- Specifics regarding classification of growing areas, buffer zones and reclassifications (15A NCAC 18A .0904-.0910).
- Classification requirements specific to marinas, docking facilities and other mooring areas including minimum prohibited area closure areas (15A 18A .0911).
- Public Health Emergency is specified here with regards to immediate closure and re-opening of shellfish waters (15A NCAC 18A .0913).
- Laboratories operated by the Division for examination of shellfish and water must meet minimum criteria specified here (15A NCAC 18A .0914).

5.4.4 OTHER JURISDICTIONS

Shellfish Sanitation and Marine Patrol are the primary Sections of NCDMF responsible for North Carolina's compliance with the National Shellfish Sanitation Program (NSSP). The NSSP is the federal/state cooperative program recognized by the U.S. Food and Drug Administration (FDA) and the Interstate Shellfish Sanitation Conference (ISSC) for the sanitary control of shellfish produced and sold for human consumption. The NSSP Guide for the Control of Molluscan

Shellfish consists of a Model Ordinance, supporting documents, recommended forms and other related materials. The Model Ordinance includes minimum requirements that states who participate in the ISSC must meet to allow for the culture, harvest, processing and sale of molluscan shellfish.

The Shellfish Sanitation Section classifies shellfish growing areas and recommends closures and re-openings to the Director that are implemented by proclamation. Growing area and tagging enforcement is primarily carried out by the Marine Patrol Section. The Shellfish Sanitation Section also permits and inspects shellfish shippers, reshippers, repackers and shucker-packers and wholesale crustacean cooking facilities. The NCDMF Shellfish Sanitation Section and Marine Patrol participate in the Interstate Shellfish Sanitation Conference (ISSC) as voting delegates at biennial and annual meetings that develop and modify the minimum requirements of the NSSP Model Ordinance.

Other than the Food, Drug and Cosmetic Act, under which the NSSP operates, the Lacey Act of 1981 probably has the most authority over shellfish. The National Marine Fisheries Services (NMFS) enforces the Lacey Act, which prohibits import, export, and the interstate transport of illegally taken fish and wildlife, which includes illegally- possessed clams. The Atlantic States Marine Fisheries Commission (ASMFC) approved a plan in 1989 to control the transfer and introduction of shellfish, although it has no authority over shellfish in the states (ASMFC 1989). The plan supports state regulation. A key provision of the plan is the training of state biologists in detection and management of shellfish diseases. The intent is to reduce introductions of diseases and pests from contaminated areas into waters free of such organisms.

6.0 STATUS OF THE STOCK

6.1 GENERAL LIFE HISTORY

6.1.1 DISTRIBUTION

The hard clam, *Mercenaria mercenaria*, is distributed from the Gulf of St. Lawrence, Canada to Texas and has been transplanted successfully in California and areas in Europe (Eversole et al. 1987). Common names for *M. mercenaria* include quahog, quahaug, northern quahog, littleneck clam, and cherrystone clam. Another species, *M. campechiensis*, also known as the southern quahog, inhabits ocean waters off North Carolina and occurs mainly from North Carolina to Florida (Hadley and Coen 2006). Hard clams occur throughout the south Atlantic region in estuaries from the intertidal zone to depths exceeding 50 feet (Abbott 1974; Eversole et al. 1987). In North Carolina hard clams are most abundant in higher salinity waters inside the barrier islands from Ocracoke southward to the North Carolina/South Carolina border (NCDMF shellfish bottom mapping data unpublished). Hard clams are found near Oregon and Hatteras inlets and the western side of Pamlico Sound but in much lesser quantities than seen from Ocracoke Island southward in inside waters.

Localized adult population densities vary considerably and are dependent on many environmental factors. Population densities appear to be similar in the northeast and southeast United States and areas where they have been introduced (Fegley 2001). Experimental studies have shown that areas with multiple substrates (those with shell and seagrass present) often support more clams than homogeneous substrates because indirectly they protect smaller clams from predation (Peterson et al. 1984; Peterson 1986b).

6.1.2 HABITAT PREFERENCES AND TOLERANCES

Hard clams occupy mostly shallow estuarine environments but can be found in deeper water areas. The hard clam occurs in groups ranging from small patches to extensive beds at intertidal and subtidal water depths, from sand to muddy sediments, from bare substrates to seagrass beds, and shell bottom habitat near oyster beds (Harte 2001).

Hard clams have wide temperature and salinity tolerances, which probably contributes to the extensive range in the species. Growth rates of hard clams are most favorable at water temperatures around 20 °C and ceases at 9 °C and 31 °C (Ansell 1968; Eversole et al. 1986). Adult hard clams can survive below freezing temperatures but have a higher survival rate when covered by water or sediment than those exposed in the intertidal areas (Eversole et al. 1987). Adult hard clams have been found in waters with salinity ranges from 4 to 35 parts per thousand (ppt). Growth is optimal at salinities between 24 to 28 ppt (Chestnut 1951a). Hard clams cease pumping in water that is below 15 ppt and above 40 ppt, and will close their shells tightly during periods of stress and respire anaerobically to reduce mortality (Eversole et al. 1987).

Adequate water circulation is essential for good growth and recruitment of hard clams. Water currents move food, maintain water quality, removes wastes, and transport eggs and larvae in the water column (Eversole et al. 1986). Hard clams obtain food by filtering suspended particulate matter and absorbing dissolved organics directly from the water. Larvae and adult hard clams are able to select their food and regulate the quality and quantity of food they consume. Hard clams adapt well to a changing food supply, but they are sensitive to the presence or absence of particular algal species that can affect growth (Eversole et al. 1986;

Eversole et al. 1987). More detailed habitat and water quality information is available in Section 11.0: Environmental Factors.

6.1.3 REPRODUCTIVE BIOLOGY

The gametogenic and spawning cycle of the hard clam varies with latitude (Eversole et al. 1984; Eversole et al. 1987). Spawning occurs in North Carolina from spring through fall, when water temperatures reach 20 °C (68 °F) (Loosanoff and Davis 1950; Porter 1964). Spawning clams release eggs and sperm through the exhalent siphon into the water where fertilization occurs and rapid development begins. The first larval stage is the trochophore stage that lasts about a day, followed by several veliger/pediveliger stages that last approximately 20 days. Juvenile clams (spat) settle along edges of sandbars and channels where varying water currents occur (Carriker 1959). Hard clams will also settle in substrates with shell and subtidal vegetation. These substrates appear to have better conditions for spat survival than unstructured substrates because they offer protection from predators (Kerswill 1941; Wells 1957; MacKenzie 1977; Peterson 1982).

Precursors to both male and female sex cells are found in the gonads of juveniles (Eversole 2001). During the juvenile stage, gonad cells differentiate and clams develop predominately as males. As adults, many clams transform into females. The sex ratio of adult clams is approximately 1:1 across its geographical range (Eversole 2001).

Sexual maturity in hard clams tends to be a function of size not age, therefore maturity is dependent on growth. Sexual maturity is usually reached during the second to third year at a shell length of 1.3 inches (33 mm), but faster growing clams may mature at an earlier age (Eversole et al. 1987). The legally harvestable size of one-inch thick (25.4 mm) is typically reached by age two to five with three as a reasonable average expectation in North Carolina (C. Peterson, UNC Institute of Marine Science, personal communication).

Although estimates vary, fecundity depends on size and condition (Ansell and Loosmore 1963). Several studies have found that fecundity increased with shell length (Bricelj and Malouf 1980; Peterson 1983; Eversole et al. 1984; Peterson 1986a). Reproductive senescence is often common in long-lived species but there is no evidence that reproductive production declines with age in hard clams (Peterson 1983; Peterson 1986a). Hard clams occur in aggregations over a wide area, and close proximity of adults is important for successful reproduction to occur in organisms that spawn in the water column (Peterson 2002). Because clams have limited mobility, spawning efficiency could be reduced in areas where harvest has caused a significant decrease in number and size of clams within these aggregations. Reduced spawning efficiency could affect future recruitment in hard clam populations (Fegley 2001; Peterson 2002).

6.1.4 AGE, SIZE STRUCTURE, AND GROWTH

Hard clam populations show a wide size range of individuals (Fegley 2001). A fishery independent sampling program in North Carolina from 2007 to 2012 randomly samples for hard clams in Core Sound (Figure 6.1). Samples were taken in areas open and closed to harvest and all clams captured were measured for shell thickness and length (mm). Shell length across multiple years of sampling varied from 25 mm to 102 mm, with 51 percent of the hard clams in the 70 mm and 80 mm length bins. Growth rates of hard clams are highly variable and depend on water temperature, habitat, food availability, and genetics (Ansell 1968; Pratt and Campbell 1956; Chanley 1958; Peterson et al. 1983; Peterson et al. 1985; Arnold et al. 1991). Shell growth is greatest during the first year after which growth decreases as age increases (Eversole et al. 1986; Eversole et al. 1987). Shell growth is fastest in the spring and fall, slower in the

winter, and the slowest in the summer months when water temperatures exceed 30 °C (Eversole et al. 1987).

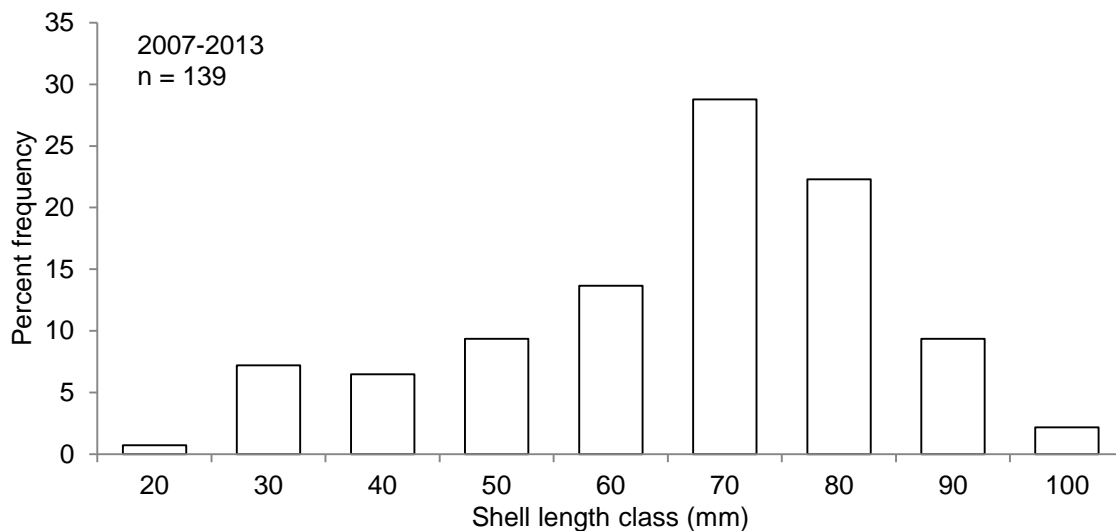


Figure 6.1. Shell length class (mm) frequency distribution of hard clams from the independent sampling program in Core Sound, 2007-2013. NCDMF biological database.

The age of clams can be determined by direct examination of annual growth lines within the shell. Age frequency distributions show a lot of difference among sites within and between regions (Fegley 2001). There is also a lot of variation in age of similar-sized clams even within the same habitat (Peterson et al. 1984; Rice et al. 1989; Fegley 2001). Maximum age was determined to be 46 years old in North Carolina (Peterson 1986a). Shell growth patterns vary by latitude. North Carolina shell growth follows a southern growth pattern where a light band forms in the middle layer of the shell during the winter months and dark band forms during the late summer to fall months resulting in annual banding patterns (Peterson et al. 1983; Arnold et al. 1991). The opposite shell pattern growth is observed in northern latitudes (i.e., Connecticut to Massachusetts and England) where a dark band forms during the colder winter months, and a light band forms during the warmer months in the middle layer. At the middle part of the geographical range (i.e., New Jersey) shell pattern banding follows the northern banding pattern during the first several years of growth and then takes on a more “southern” banding pattern as they age (Fritz 2001).

6.1.5 BIOLOGICAL STRESSORS: PREDATION AND DISEASE

Little data is available on the direct predation rates on larval hard clams (Kraeuter 2001). High natural mortality in the larval stages suggests that predation is probably high during this life stage of the hard clam. Newly set or juvenile hard clams (<1 mm shell length) are vulnerable to a large number of predators. Primary predators of juvenile hard clams are the snapping shrimp (*Alpheus heterochaelis*), mud crabs (*Neopanope sayi*), and blue crabs (*Callinectes sapidus*) (Beal 1983; Kraeuter 2001). Several types of snails (*Urosalpinx* sp., *Polinices* sp.), whelks, (*Busycon* sp.), cownose rays (*Rhinoptera bonasus*), and various birds feed on adult hard clams (Kraeuter and Castagna 1980; Kraeuter 2001). As hard clams grow the number of potential predators is reduced (Kraeuter 2001). Hard clam survival from predation can be affected by sediment characteristics such as presence of shell fragments and seagrasses, and presence of other prey species (Peterson 1982; Peterson 1986b; Kraeuter 2001).

Infectious diseases can result in devastating losses of wild populations of some mollusks. For the most part hard clams appear to be relatively disease free and a number of studies of captive populations show that non-predation losses are typically only 5 % to 10% per year (Eldridge and Eversole 1982; Eversole et al. 1987; Bower et al. 1994). QPX (Quahog Parasite X = Unknown) is a parasite that has been found in hard clams along the eastern coast of North American from Atlantic Canada to Virginia (Smolowitz et al. 1998; Dahl et al. 2011). Susceptibility to QPX is variable but with higher outbreaks in southern broodstocks compared to northern broodstocks within its range, yet QPX disease has not been identified in hard clams south of Virginia (Dahl et al. 2011). A study in 2011 confirmed that QPX disease is a cold water infection and not likely to occur in North Carolina because of warmer waters which impedes development of this disease in hard clams (Dahl et al. 2011).

Many of the large-scale hard clam mortalities along the northeastern United States and Canada are related to air exposure during extreme cold events and negative impacts from stress associated with parasites (Smolowitz et al. 1998). Diseases in larval and juvenile hard clams held in culture conditions are often caused by bacteria, fungi, and viruses that are common in the cultured bivalves and are associated with opportunistic invaders of animals under stress in high-density culture situations (Ford 2001).

6.2 PRESENT STOCK STATUS

6.2.1 UNIT STOCK

For the purposes of stock assessment, the unit stock is considered all hard clams occurring within North Carolina coastal waters.

6.2.2 ASSESSMENT DATA AND METHODS

Data are not available to perform a traditional assessment so it was not possible to estimate population size or fishing mortality rates.

6.2.2.1 FISHERY-INDEPENDENT DATA

A fisheries-independent monitoring program (Program 640) is currently underway in Core Sound to provide baseline data on hard clam abundance and gather quantitative environmental parameters. In the future it may be possible to expand this sampling into other areas to evaluate the entire population. Thirty randomly selected stations are sampled each year within three strata. The three designated strata were: Shellfish Mapping Strata (ST), Known Fishing Areas (FA), and Closed Shellfish Areas (CA; Figure 6.2). Sampling is performed at each station location within each stratum using a small patent tong on a 25-ft flat bottom boat. The patent tong has an opening of 0.51 square meters. Samples are quantified by meter square. Three replicates at each station location are taken.

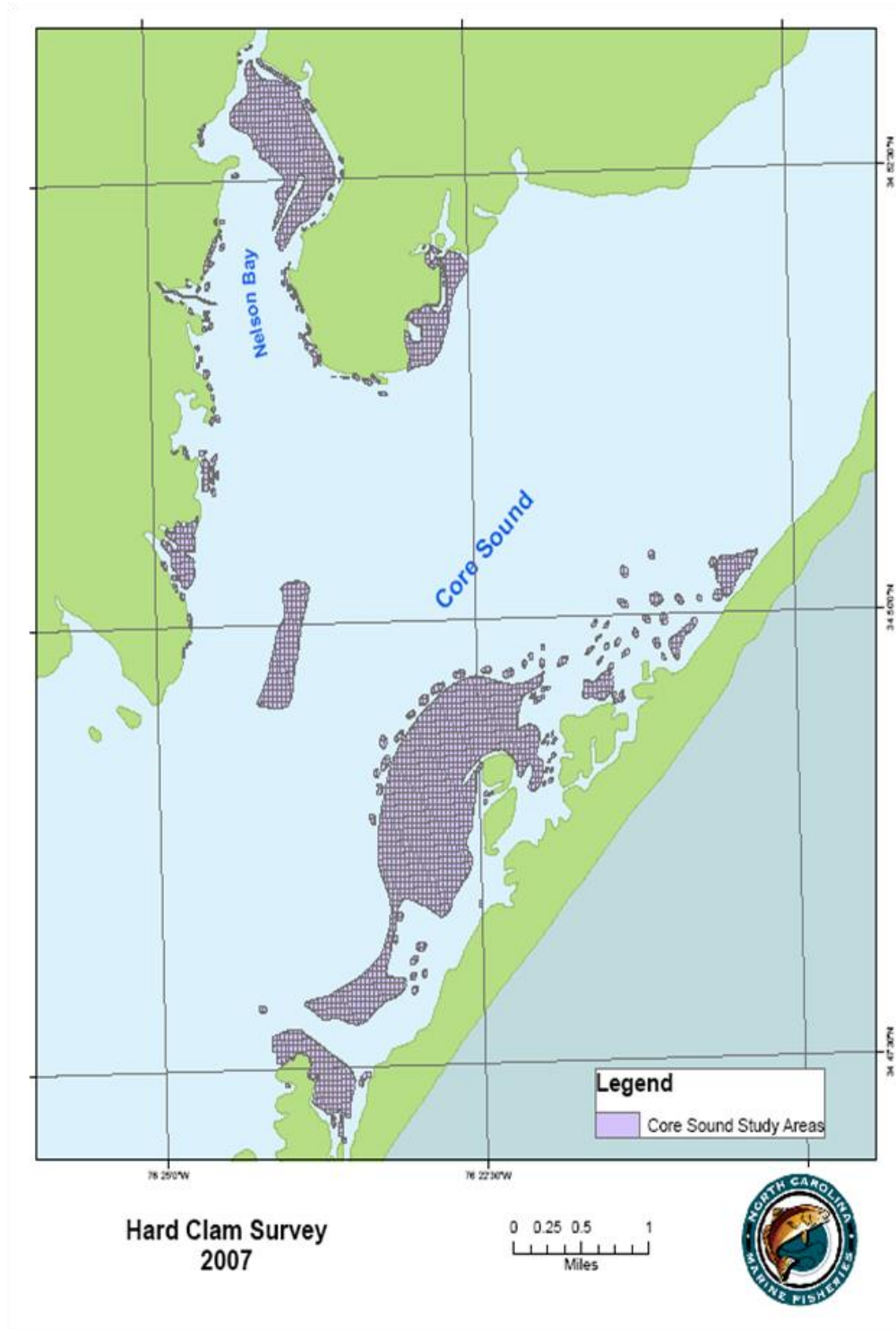


Figure 6.2. Map of grid system for NCDMF's fishery-independent hard clam survey (Program 640). NCDMF biological database.

All hard clams are measured for thickness and length to the nearest mm using calipers. Environmental data collected includes depth (m), surface and bottom salinity (ppt), surface and bottom temperature (°C), surface and bottom dissolved oxygen (mg/L), secchi depth (m), weather and wind elements, water level, distance from shore, and altered state. Sediment type is qualitatively described.

An index of relative abundance for hard clams based on the Program 640 data was calculated using the standard equation for a random stratified average—the unbiased design-based estimator for random stratified sampling designs. The associated standard errors were also calculated.

6.2.2.2 FISHERY-DEPENDENT DATA

Currently, the only data available for the stock in most areas are the commercial landings and associated effort. For this reason, the current assessment focuses on trends in catch rates in the commercial hard clam fishery. These catch rates should not be considered an unbiased representation of trends in population size; fisheries-dependent data are often not proportional to population size due to a number of caveats and should be interpreted with caution if the interest is relative changes in the population (see Section 6.3).

The North Carolina commercial hard clam fishery is subject to trip limits, which could bias catch rates (Mike Wilberg, University of Maryland Center for Environmental Science, personal communication; John Walter, National Oceanic and Atmospheric Administration (NOAA), personal communication); that is, the trip limits affect the amount of catch that is observed per unit effort—the true value of the variable cannot be observed. Here, a censored regression approach is applied to calculate an unbiased index of relative abundance using data collected from a fishery with trip limits. Preliminary analysis found that for years in which greater than or equal to 50% of transactions equaled or exceeded the trip limit in a particular water body, the censored regression produced nonsensical results. For this reason, such years were removed from those water bodies where this occurred. Note that this was only an issue for mechanical harvest data.

Data were obtained from the TTP for 1994 through 2013. The censored response variable (catch per unit effort—the number of clams per transaction) was fit within a Generalized Additive Models for Location Scale and Shape (GAMLSS) framework using the ‘gamlss.cens’ (Stasinopoulos et al. 2014) and ‘survival’ (Therneau 2014) packages in R (R Core Team 2014). Catch rates were estimated for both hand harvest and mechanical harvest in each of the major water bodies from which hard clams are harvested where sufficient data were available (see previous paragraph). Hand harvest occurs year-round and is summarized by calendar year. The majority of mechanical harvest occurs from December through March with some harvest occasionally allowed during other times of the year; therefore, mechanical harvest is summarized by fishing year (December through March). Only landings from public bottoms were examined because planting of seed clams, grow-out availability, and market demand often artificially drives landings from private leases.

The Mann-Kendall test was performed to evaluate trends in the annual percentages. The Mann-Kendall test is a non-parametric test for monotonic trend in time-ordered data and allows for missing values (Gilbert 1987). The test was applied to the percentage of trip limits for hand harvest and mechanical harvest by area. Trends were considered statistically significant at $\alpha = 0.05$.

6.2.3 TRENDS IN CATCH RATES

6.2.3.1 FISHERY-INDEPENDENT CATCH RATES

The fisheries-independent index of abundance was expressed as average numbers caught per grab. The index demonstrated a peak in 2009, but there was no apparent trend over the time series (Figure 6.3).

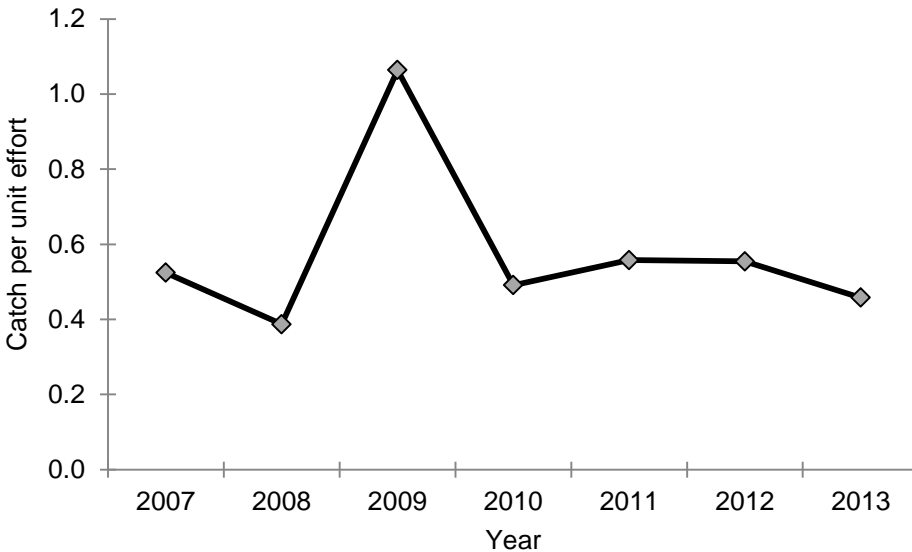


Figure 6.3. Annual fishery-independent index of relative abundance (average numbers caught per grab) for hard clams in Core Sound based on data collected from NCDMF's fishery-independent hard clam survey (Program 640).

6.2.3.2 FISHERY-DEPENDENT CATCH RATES

Fisheries-dependent catch rates were expressed as numbers harvested per transaction. Catch rates were consistently higher for mechanical harvest than for hand harvest (Figure 6.4).

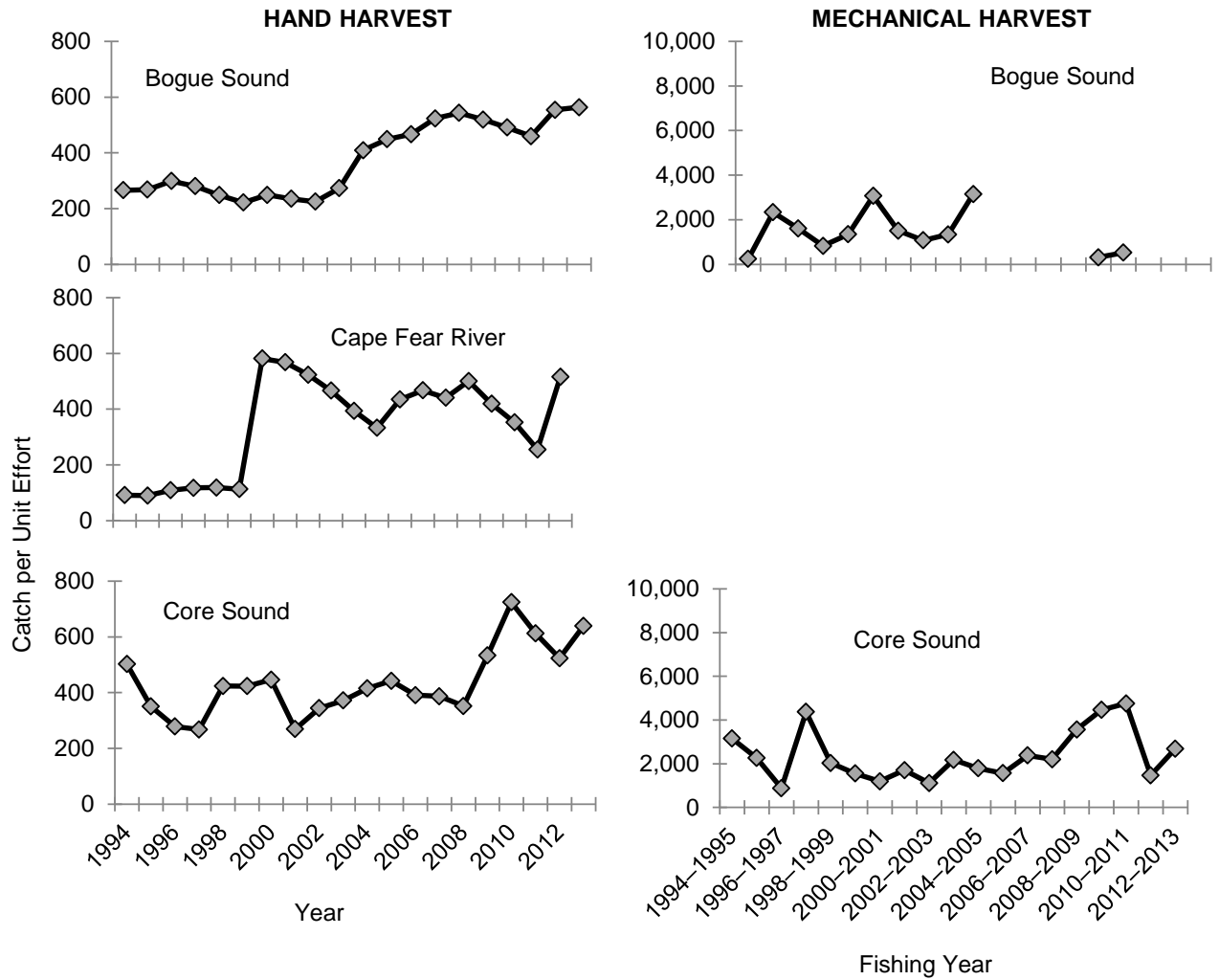


Figure 6.4. Annual fishery-dependent catch rates (number harvested per transaction) for hard clams commercially landed by hand (calendar year, Jan–Dec) and mechanical (fishing year, Dec–Mar) gears from public bottom.

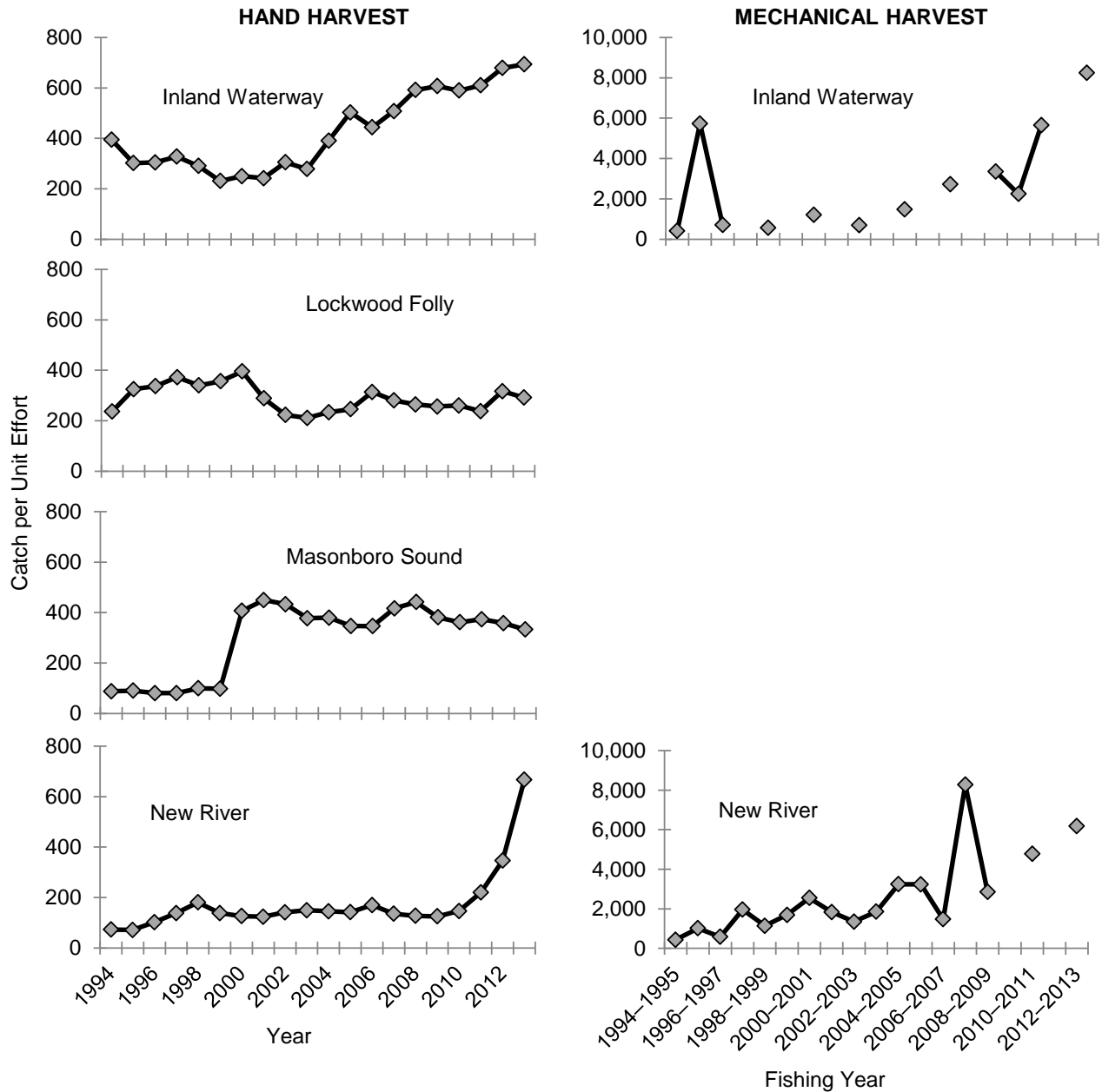


Figure 6.4. Continued.

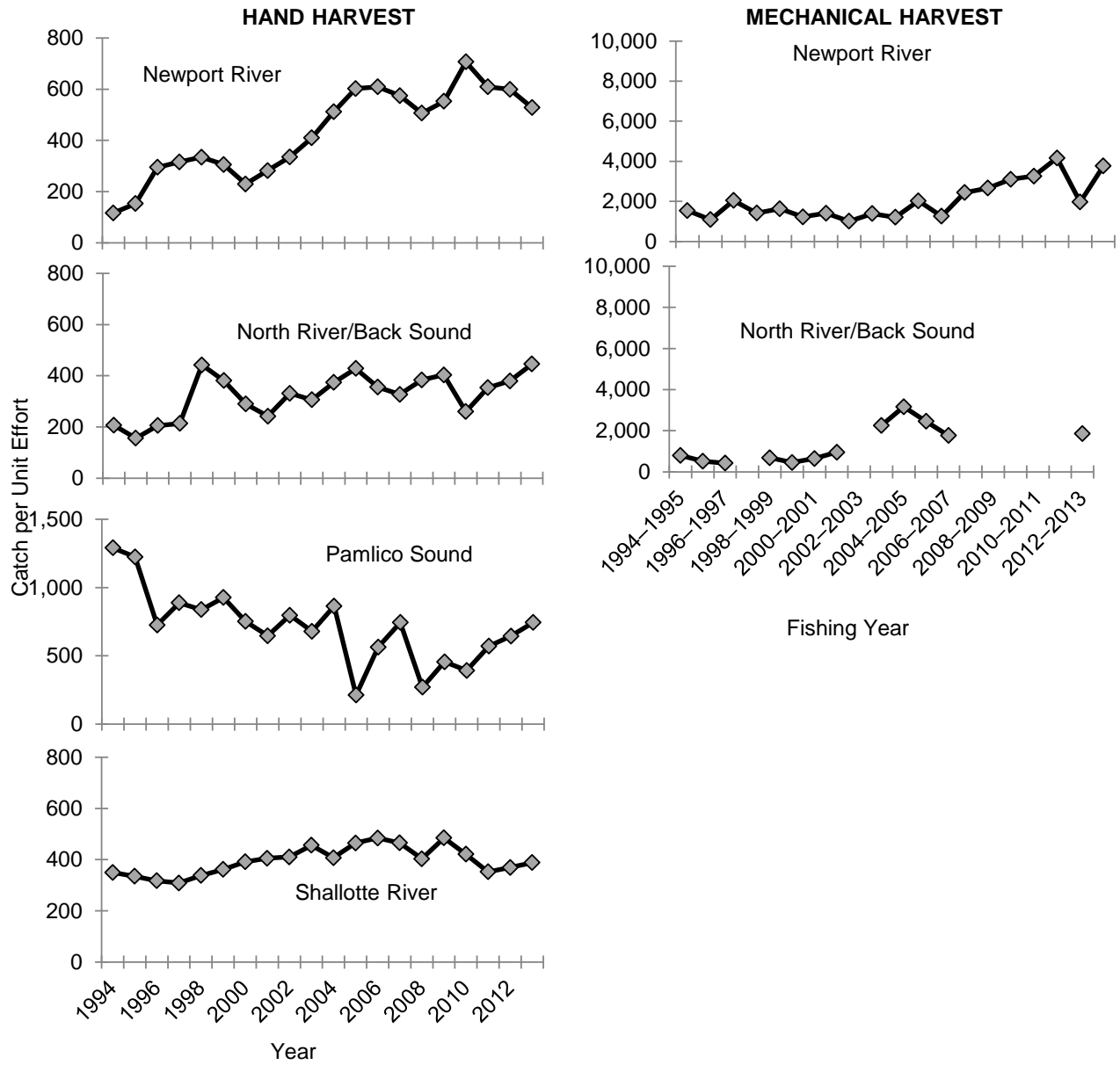


Figure 6.4. Continued.

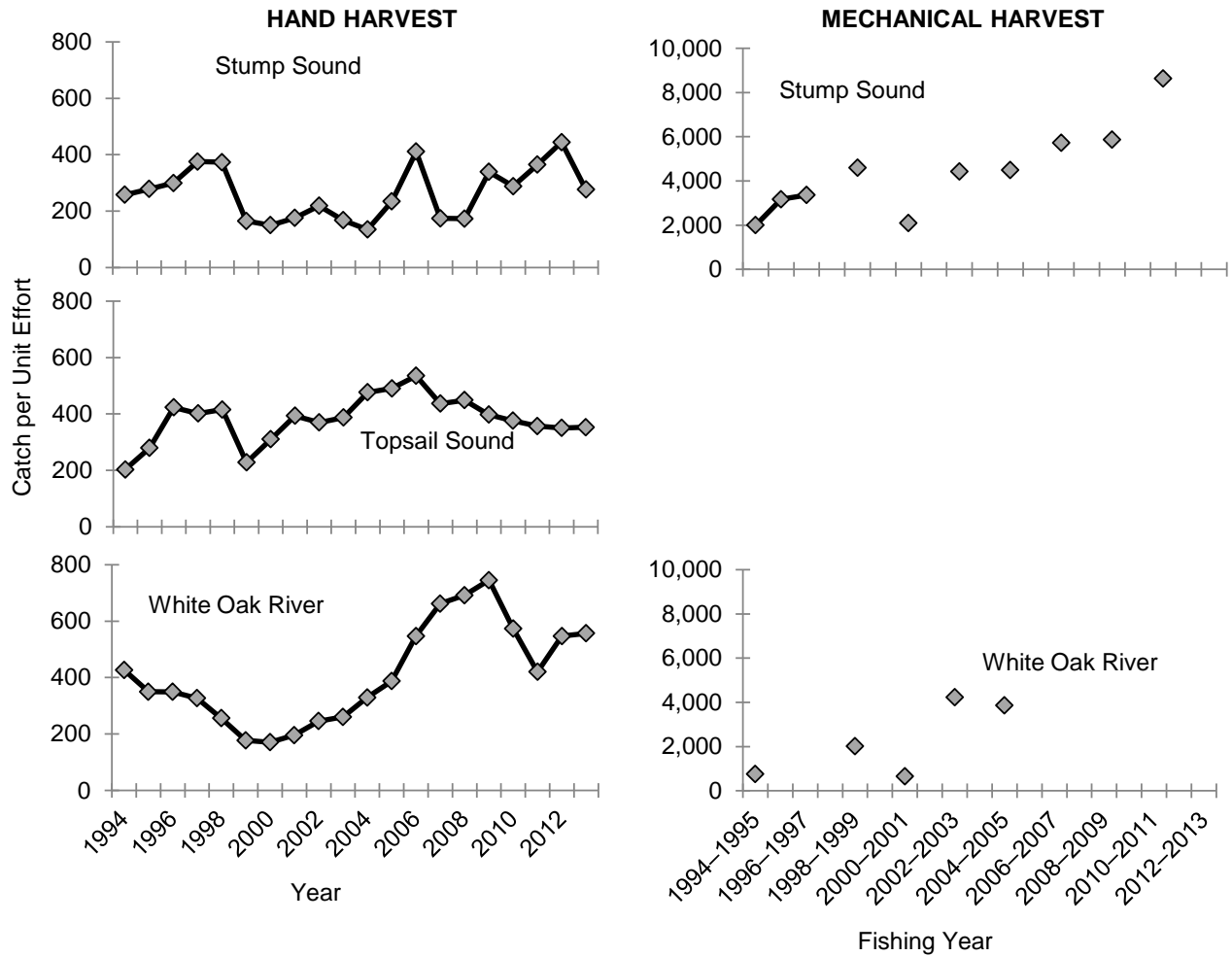


Figure 6.4. Continued.

Significant increasing trends over time were detected in eight areas for hand harvest—Bogue Sound, Core Sound, Inland Waterway, New River, Newport River, North River/Back Sound, Shallotte River, and White Oak River (Table 6.1). A significant decreasing trend was found in the hand harvest catch rates in Pamlico Sound. The remaining water bodies showed no trend in hand harvest catch rates over time.

Table 6.1. Results of Mann-Kendall trend analyses applied to the annual fishery-dependent catch rates for hand harvest of hard clams. P-value is the one-tailed probability for the trend test. Trend indicates the direction of the trend if a statistically significant temporal trend was detected (two-tailed test: P-value < $\alpha/2$; $\alpha=0.05$); NS = not significant.

Area	P-value	Trend
Bogue Sound	0.000158	↑
Cape Fear River	0.0322	NS
Core Sound	0.00893	↑
Inland Waterway	$P < 0.0001$	↑
Lockwood Folly	0.173	NS
Masonboro Sound	0.0636	NS
New River	0.00158	↑
Newport River	$P < 0.0001$	↑
North River/Back Sound	0.00354	↑
Pamlico Sound	0.00128	□
Shalotte River	0.00624	↑
Stump Sound	0.228	NS
Topsail Sound	0.291	NS
White Oak River	0.00624	↑

The Inland Waterway, New River, Newport River, North River/Back Sound, and Stump Sound demonstrated significantly increasing trends in mechanical harvest catch rates over time (Table 6.2). No trends were detected in Bogue Sound, Core Sound, or White Oak River catch rates for mechanical harvest.

Table 6.2. Results of Mann-Kendall trend analyses applied to the annual fishery-dependent catch rates for mechanical harvest of hard clams. *P*-value is the one-tailed probability for the trend test. Trend indicates the direction of the trend if a statistically significant temporal trend was detected (two-tailed test: *P*-value < $\alpha/2$; α = 0.05); NS = not significant.

Area	<i>P</i> -value	Trend
Bogue Sound	0.366	NS
Core Sound	0.104	NS
Inland Waterway	0.00559	↑
New River	0.000169	↑
Newport River	0.00392	↑
North River/Back Sound	0.0118	↑
Stump Sound	0.000470	↑
White Oak River	0.242	NS

6.2.4 FISHING MORTALITY

Available data are considered insufficient for estimating reliable fishing mortality rates.

6.3 STOCK STATUS

Since Amendment 2 to the NCDMF FMP for Hard Clams, the status of the hard clam stock in North Carolina has been considered unknown due to the paucity of data available to assess the population (NCDMF 2008a). The NCDMF Hard Clam PDT recommends the status continue to be defined as unknown due to the continued lack of data needed to conduct a reliable assessment of the stock.

6.4 SPECIAL COMMENTS

Trends observed in fishery-dependent indices must be interpreted with strong caveats. In order for a fisheries-dependent index to be proportional to abundance, fishing effort must be random with respect to the distribution of the population and catchability must be constant over space and time. Other factors affecting the proportionality of fishery-dependent indices to stock size include changes in fishing power, gear selectivity, gear saturation and handling time, fishery regulations, gear configuration, fishermen skill, market prices, discarding, vulnerability and availability to the gear, distribution of fishing activity, seasonal and spatial patterns of stock distribution, changes in stock abundance, and environmental variables. Many agencies, such as the NCDMF, don't require fishermen to report records of positive effort with zero catch; lack of these "zero catch" records in the calculation of indices can introduce further bias.

Regardless of how hard clam data are collected and analyzed, an important issue that should be settled is that of stock identification. A stock, for assessment purposes, consists of a population (of a single species) for which population processes (i.e., recruitment, survival) are independent of processes of other populations. It is quite probable that multiple unit stocks exist

in North Carolina waters and, therefore, responsible management of hard clams should include their identification (Charles Peterson, UNC Institute of Marine Science, personal communication). If multiple unit stocks are ignored and managed based on a statewide assessment, there is a risk of over- or under-harvesting clams in regions where conditions differ from the statewide trend. Identification of source and sink areas and a better understanding of the effect of hydrodynamics on the transport of clam larvae would also lead to more efficient management schemes.

6.5 RESEARCH RECOMMENDATIONS

- Improve the reliability for estimating recreational shellfish harvest.
- Survey commercial shellfish license holders without a record of landings to estimate hard clam harvest from this group.
- Determine the consequences to hard clams from impacts to habitat due to harvest practices.
- Develop regional juvenile and adult abundance indices.

7.0 STATUS OF THE FISHERIES

7.1 COMMERCIAL FISHERY

The Division of Commercial Fisheries (now known as the U.S. Fish and Wildlife Service, Department of the Interior) collected annual commercial landings information for North Carolina from 1880 to 1974 (Chestnut and Davis 1975). The National Marine Fisheries Service standardized landings statistics collection methods for U.S. South Atlantic fishery species in 1972. Landings were collected monthly from major seafood dealers, although reporting was not mandatory. The NCDMF and NMFS began a cooperative commercial fishery data collection program in 1978, maintaining the same methodology established in 1972. However, NCDMF assumed the primary role of data collection for the state and further improved data collection coverage with additional staff. Under-reported landings, however, were a growing concern due to the reliance on voluntary program cooperation from seafood dealers. The rising perception of deteriorating attitudes toward fisheries management by North Carolina fishermen in the late 1980s and early 1990s contributed to the reform of the NCDMF/NMFS cooperative statistics program (Lupton and Phalen 1996). With the support of the commercial fishing industry, NCDMF instituted a mandatory, dealer-based, trip-level, reporting system for all commercial species in 1994 that greatly improved reporting compliance. Improved collection methods that began in 1994 should be considered when comparing pre-1994 landings with post-1994 landings.

Since the inception of the TTP in 1994, data collection of hard clam information has improved through time. One thing that must be considered with hard clam landings is they can come from either public harvest or private production, which are under different regulations therefore trip numbers, landings, and effort cannot be compared between public harvest and private production. On July 1, 1999, the NCDMF changed over to a new licensing system, which was mandated by the 1997 FRA. This new system allows NCDMF to more accurately assess the impact of commercial fishing activities. In 1994, 16% of the total hard clam landings could not be identified as either public harvest or private production. Since 2003 less than 1% of the overall annual hard clam landings lack this identification. Much of the improvement has been from better recording and editing requirements, and from the new licensing system. In the following sections the different gear types in the fishery data are separated into either public harvest or private production. Since there are some trips that could not be differentiated in the database, they were excluded in the analyses.

The hard clam industry has provided a way to make a living and food for coastal communities along the entire Atlantic East Coast from the Canadian maritime region to Florida. The leading hard clam producers historically in the northeast have been New York, New Jersey, Massachusetts, and Rhode Island, and more recently Connecticut. In the southeast Virginia and North Carolina have led in commercial landings of hard clams. Fluctuations in commercial landings are common along the Atlantic East Coast with a general trend of decline through time (Figure 7.1). New York and Rhode Island have dominated the Atlantic Coast hard clam landings from 1950 to 1992. A large part of the decline in Atlantic Coast landings occurred after the 1970's as a result of overfishing in New York and closure of shellfish beds due to bacterial pollution. In the southeast, Virginia had higher landings most years except from the mid-1970s through the mid-1980s when North Carolina hard clam landings increased significantly (MacKenzie et al. 2002).

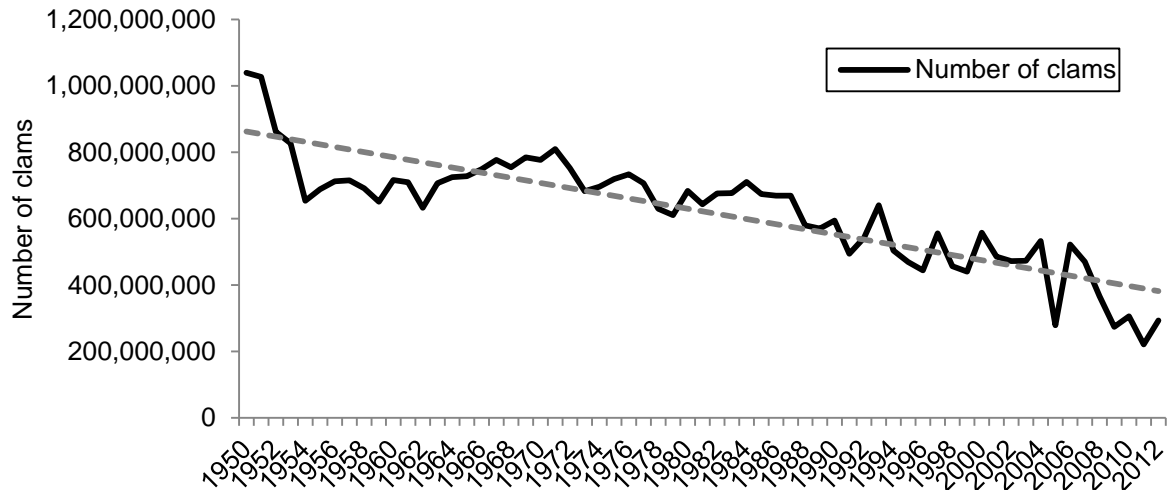


Figure 7.1. Commercial hard clam landings (Number of clams, using a conversion factor of 0.32 oz per individual; ASFMC 1992) along the Atlantic East Coast (Maine south to Florida east coast), 1950-2012. Source: NMFS commercial fisheries landings database, except for NC landings from 1994 to 2012 using TTP.

7.1.1 GEAR TYPES

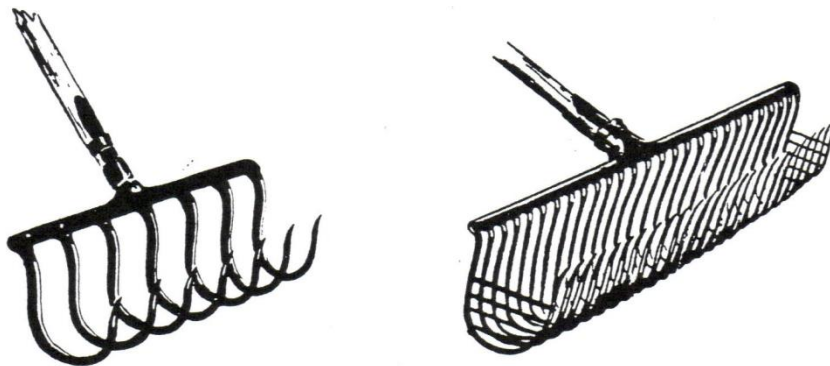
7.1.1.1 HAND HARVEST

The hand harvest fishery for hard clams is year-round in North Carolina. Hand harvesting methods include signing (spotting siphon holes), treading, hand raking, hand tonging, and bull raking. Clams are taken by hand and rake in shallow water, up to 4 feet deep, (≤ 1.2 meters) while hand tongs and bull rakes are used in deeper water up to 20 feet deep (1.2 to 12.2 meters) (Cunningham et al. 1992) (Figure 7.2a-c). Bull rakes, a gear introduced to North Carolina in the mid-1970s have been used to exploit clam populations in New River, White Oak River, Bogue Sound, and the Intracoastal Waterway channel of Brunswick, New Hanover, Pender, and Onslow counties (Figure 7.2b). A large number of subsistence fishermen use bull rakes in the southern area of the state. Clam tongs consist of two long handles joined together like scissors and a rake at each end of the handle with teeth attached to a basket-like frame to hold the clams as they are dug out of the substrate (Figure 7.2c).

A. Hand rakes, No more than 12 inches wide and weighing no more than 6 pounds;
Source: Cunningham et al. 1992



B. Bull rakes; Source: Cunningham et al. 1992



C. Hand tongs; Source: Dumont and Sundstrom 1961

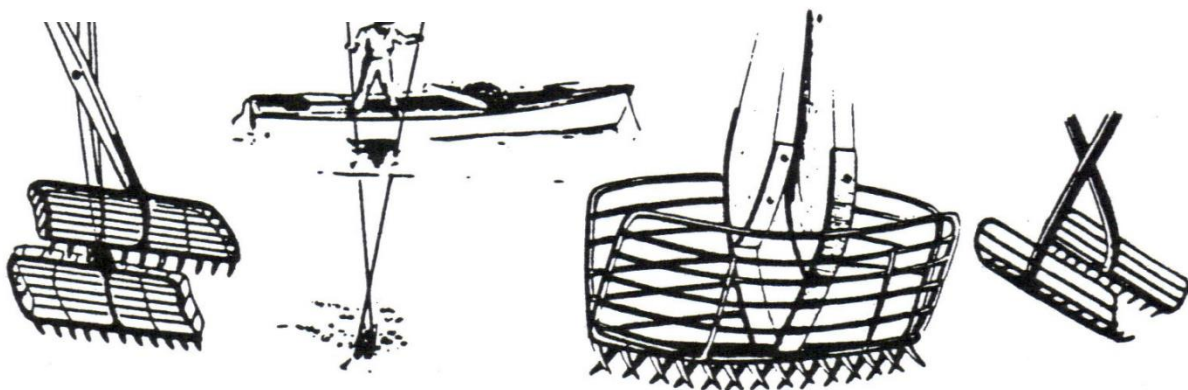
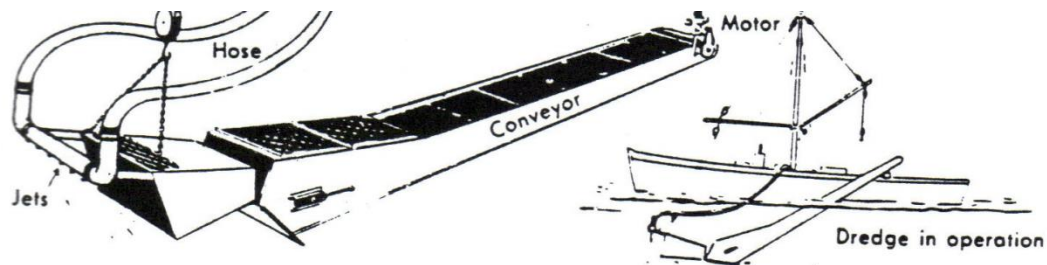


Figure 7.2. Hard clam hand harvest gears (Dumont and Sundstrom 1961; Cunningham et al. 1992).

7.1.1.2 MECHANICAL HARVEST

The two types of mechanical harvest gear currently used in North Carolina are the hydraulic escalator dredge and the clam trawl or “clam kicking” vessel. The hydraulic escalator dredge has an escalator or conveyor located on the side of the vessel (Figure 7.3a). A sled is connected to the front end of the escalator. When the front end of the escalator is lowered to the bottom, the sled glides over the bottom. A blade on the sled penetrates the bottom to a depth of about four inches (10 cm) and collects the clams as they are forced from the bottom by water pressure (Cunningham et al. 1992). In clam trawling or “kicking”, clams are dislodged from the bottom with propeller backwash and a heavily chained trawl with a cage attached at the cod end towed behind the boat gathers the clams (Figure 7.3b). Kick boats are generally 20 to 30 ft long, and can operate in depths from 3 to 10 feet (1.0m to 3.05 m). The propeller is usually positioned 12 to 15 inches above the bottom and extra weight can be added to the stern to improve the angle and height above the bottom. For better efficiency in varying water depths, boats include a winged rudder, which has two iron plates welded on either side of the rudder to deflect water downward (Cunningham et al. 1992). One person operates smaller kick boats, while larger boats may have a crew of two or three (Guthrie and Lewis 1982).

A. Hydraulic escalator dredge; Source: Sundstrom 1957



B. Clam kicking gear; Source: Guthrie and Lewis 1982

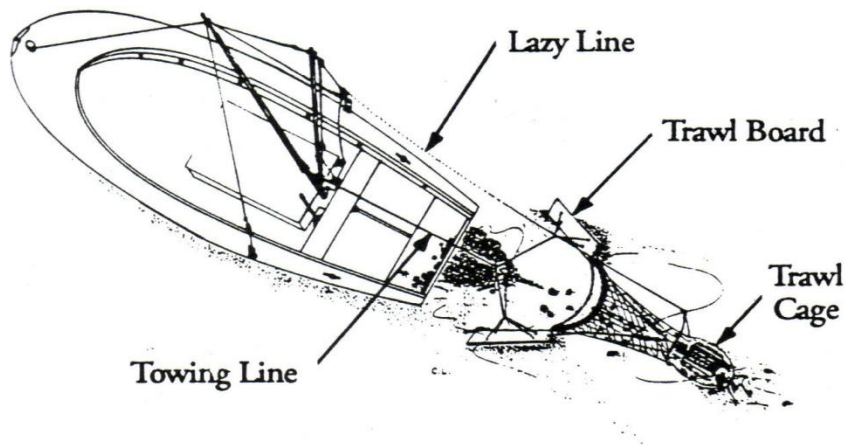


Figure 7.3. Hard clam mechanical harvest gears (Sundstrom 1957; Guthrie and Lewis 1982; Cunningham et al. 1992).

7.1.2 HISTORICAL PUBLIC HARVEST FISHERY

The clam industry has existed since the 1880s when dealers from Virginia sent boats to the sounds of North Carolina to buy clams (Chestnut 1951a). These boats came mostly to the Ocracoke area. J.H. Doxy of Long Island, NY established a clam processing plant in 1898 at the entrance of Silver Lake in Ocracoke. Clams were processed as whole clams, clam chowder, and clam juice and labeled as quahogs from Islip, Long Island, NY. Clam landings increased noticeably as a result of this processing operation and peaked at 134,286 bushels in 1902 (Figure 7.4). Three years later, the plant was moved to Atlantic, NC because of diminished clam resources in the Silver Lake area and later moved to Florida. Following the demise of the processing plant, production slowly dropped to below 45,714 bushels in 1918 and remained low until 1934 (Figure 7.4).

Increased clam abundance in upper Core Sound is attributed to a hurricane that opened up several inlets in 1933 (Chestnut 1951a). High landings of hard clams from 1935 to 1942 are attributed to the opening of a processing plant in Morehead City, NC, which processed clams and also shipped whole clams to Virginia (Figure 7.4). Landings dropped during World War II and reached a low in 1949.

Clam harvest has fluctuated historically, often in response to changes in demand, improved harvesting, and increases in polluted shellfish area closures. Hand harvest accounted for all recorded landings prior to the mid-1940s, when early forms of mechanical harvest were developed. Hand harvest is currently allowed year-round with daily harvest limits. The daily harvest limit was unlimited until 1983 when it was reduced to 40 bags (10,000 clams) per fishing operation in public waters by proclamation. The daily harvest limit was further reduced in 1986 by proclamation to 6,250 clams per fishing operation from public waters and has remained in effect since. The daily harvest limit was written into rule in 1989.

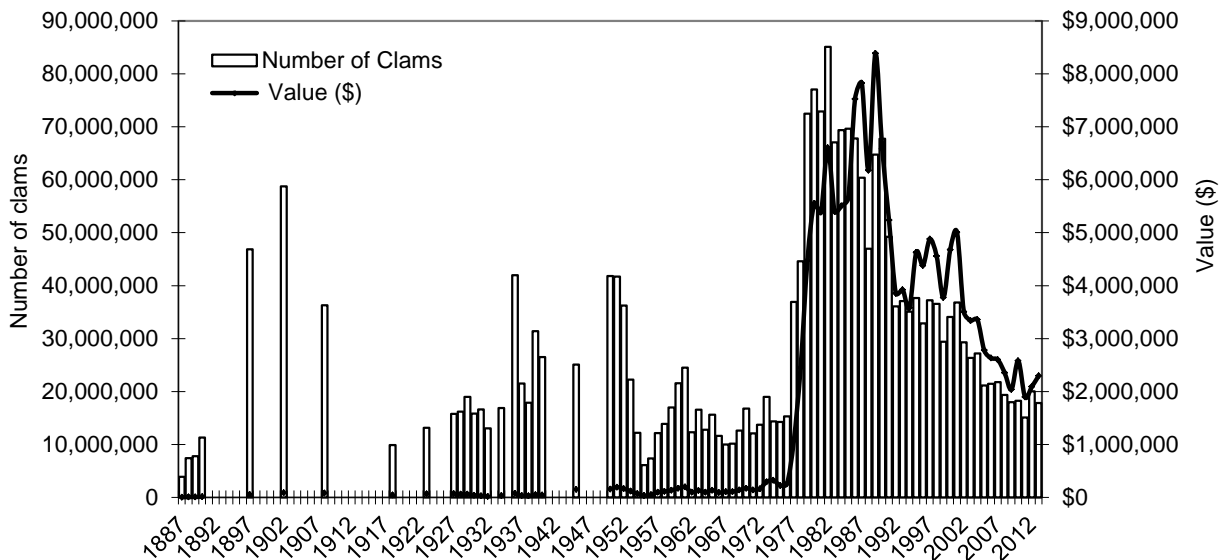


Figure 7.4. Hard clam historical annual landings (Number of clams) from both public harvest and private production combined and value (\$), 1887-2013. TTP and Chestnut and Davis (1975).

The first mechanical method for harvesting clams was known as dredging. Dredging initially evolved from the anchor method, where an anchor was put out behind a boat to stop forward motion and cause the vessel to swing in an arc (Guthrie and Lewis 1982). The boat also had a weighted stern to lower the propeller wash to expose the clams. The fishermen then picked up these exposed clams with a rake. Over time, the bedstead method was developed, in which a wide, low profile sled-like gear called a bedstead was placed behind the anchored boat (Guthrie and Lewis 1982). A bunt with a heavy lead line was attached to the bedstead and used to scoop up clams exposed by the prop wash. This gear allowed fishermen to remain on board and enabled them to work in poor weather. The cumbersome bedstead was replaced by a modified oyster drag in the mid-1940s. The oyster drag was four feet wide, weighed approximately 100 lb and had a removable bar on the bottom with three-inch teeth (Guthrie and Lewis 1982). The bag was made of metal rings connected together. A kicking stake was used to anchor the boat while allowing movement in a complete circle. Cable was released to increase the circle size with each revolution.

A southern quahog (*M. campechiensis*) fishery developed in the Atlantic Ocean between Barden's Inlet near Cape Lookout and Beaufort Inlet in 1960 (Porter and Chestnut 1960). Southern quahogs were harvested at water depths between 30-50 feet with "Fall River" dredges weighing approximately 500 pounds towed from shrimp trawlers. About a dozen vessels were involved in the fishery during the January through March period and it continued until 1962. The southern quahog stock in the ocean had declined so that it was no longer profitable to fish in the area. In 1990, local fishermen wanted the area re-opened to assess the southern quahog stock. The MFC added a provision to the mechanical harvest rule [15A NCAC 03K .0302(a)] that enabled a harvest season to open in the area in the Atlantic Ocean at any time. In the early 1990s there were requests from mechanical clam harvesters to allow them to survey areas in the Atlantic Ocean for southern quahog. On March 7, 1994 a proclamation (SF-9-93/94) was issued to open an area in the Atlantic Ocean from Beaufort Inlet east to Cape Point at Cape

Lookout to mechanical harvest after Shellfish Sanitation certified the area for harvest. A permit was required, dredge weight and harvest restrictions did not apply in this open ocean area and harvest was allowed from 7:00 a.m. to 4:00 p.m. five days a week. Only a few trips with less than 5,000 clams combined were taken in this open ocean area in 1995 and 1996. One Scientific and Educational Collecting Permit was issued in 2005 to explore shellfish resources in the ocean with no success. On occasion, fishermen have used this open ocean area to test new mechanical harvest gear, such as towed hydraulic dredges, outside of the main harvest season and in deeper water. In Amendment 1 of the Hard Clam FMP the MFC decided to rescind the proclamation but keep the authority to open the Atlantic Ocean to the mechanical harvest of clams if and when necessary (NCDMF 2008a). The proclamation has not been re-issued because no requests have been made.

Trawls were first used to harvest clams in 1968 and remain in use today in a technique known as “kicking” (Guthrie and Lewis 1982). Increase in market demand along with more efficient gear soon lead to increased landings (Figure 7.4). Another major development in the fishery also occurred in 1968 with the advent of hydraulic dredges. This gear used jets of water from a high-pressure pump to displace bottom sediments covering the clams and a conveyor carried the catch up to the vessel. Hard clam landings remained stable through the 1960s and 1970s. An increase in demand for North Carolina clams was created during the 1976-1977 season, when clam beds became inaccessible in the northeastern states due to abnormally thick ice. Since the late 1980s hard clam landings have declined. This decline may be the result of a decrease in abundance, increase closures of shellfish waters from pollution, changing market demand, and several storms in Core Sound.

Allocation conflicts did not occur in the hard clam fishery until the late 1980’s as more management measures were put in place to reduce impacts to habitat and harvesters had to compete more for the limited resource. It is accepted that mechanical harvest methods can negatively impact submerged aquatic vegetation (SAV) and oyster rocks (Peterson et al. 1987). Regulations to protect habitats from mechanical harvest methods have been in place since 1977 and mechanical harvest was largely confined to the deeper waters of the sounds and rivers. In the early 1980s, mechanical harvesters proposed a rotation scheme between White Oak River and New River including a portion of the Intracoastal Waterway. The intent was to prevent overharvesting of the clam stocks, discourage violations by mechanical harvesters who cross the lines in search of more lucrative clam quantities, and the taking of undersized clams, or “buttons”. These measures continue to be in place each year by proclamation. In 1990, the MFC wanted to prevent expansion of the mechanical harvest fishery because of habitat concerns and prohibited the opening of any new bottom that had not traditionally been opened between January 1979 through September 1988 [15A NCAC 03K .0302(b)].

The NCDMF also allows the harvest of clams by mechanical means before maintenance dredging occurs in some navigational channels. In 1994 and 1999 clams were relayed from the closed portions of navigational channels before the U.S. Army Corps of Engineers (USACE) performed dredging activity. In March of 1999, approximately 165,000 clams were mechanically harvested from closed portions of the IWW in Brunswick County and transferred to nearby Second Bay, below the Fort Fisher area north of Bald Head Island. The relay effort was funded entirely by NCDMF using a barge and staff to collect the clams over a 4-day period. The intent was to keep Second Bay marked and closed for 18 months to replenish seed clams lost due to hurricanes shoaling the area. After several months, NCDMF sampled 30 quadrants (m²) in Second Bay and found only 34 live and 2 dead clams. It was determined that relaying is not cost effective and has not been attempted since 1999 by NCDMF.

One management recommendation adopted in the 2001 Hard Clam FMP included opening a mechanical harvest area in southeastern Pamlico Sound and rotate it two years on and off with a mechanical harvest area in the northern Core Sound (Figure 7.5). The northern Core Sound area was established based on similar acreage and the amount of effort that historically occurred. The new area was opened for the first time in December of 2001. NCDMF staff monitored the fishery for the first year and observed that on days of good weather, effort was concentrated in Pamlico Sound. During days of adverse weather, the majority of the effort was in Core Sound. Running time for those boats fishing in Pamlico Sound also decreased effort from eight hours a day to five or six hours a day. Market grade also varied between the two areas with topnecks and cherries harvested from Pamlico Sound and little necks, topnecks and chowders from Core Sound.

During the first year of rotation (2001/02), larger boats fished Pamlico Sound successfully with the majority of the fishermen catching their 20 bag limit in the beginning of the season. Core Sound was fished by smaller boats and was available to the larger boats during times of poor weather conditions. The second year of the rotation plan (2002/03) had much lower trips and lower landings in Pamlico Sound. By the time of the start of the second 2-year rotation with Pamlico Sound in 2005/06, the channel by Wainwright Island had filled in making it impossible for the larger boats to get to the Pamlico Sound kicking area. There were no landings made from Pamlico Sound during the 2005/06 season. The 2006/07 season suffered from low clam prices and high fuel prices, curtailing mechanical harvest in both areas. Very few fishermen were reported mechanically harvesting in 2006/07 and the distance fishermen had to run was an added cost to fishing in the Pamlico Sound area. Deep water and weather conditions also limited the area to the larger vessels. Crab pot fishermen also complained about impacts to the blue crab fishery in that area because of mechanical harvest.

In Amendment 1 of the Hard Clam FMP, the MFC selected to discontinue rotation of Pamlico Sound with northern Core Sound, but keep the Pamlico Sound area for mechanical clam harvest in rule. In addition, a resting period was established within the mechanical clam harvest area in the northern part of Core Sound (NCDMF 2008a). Since 2008 northern Core Sound has been opened every other year opposite the open mechanical clam harvest season for the New River (Figure 7.7).

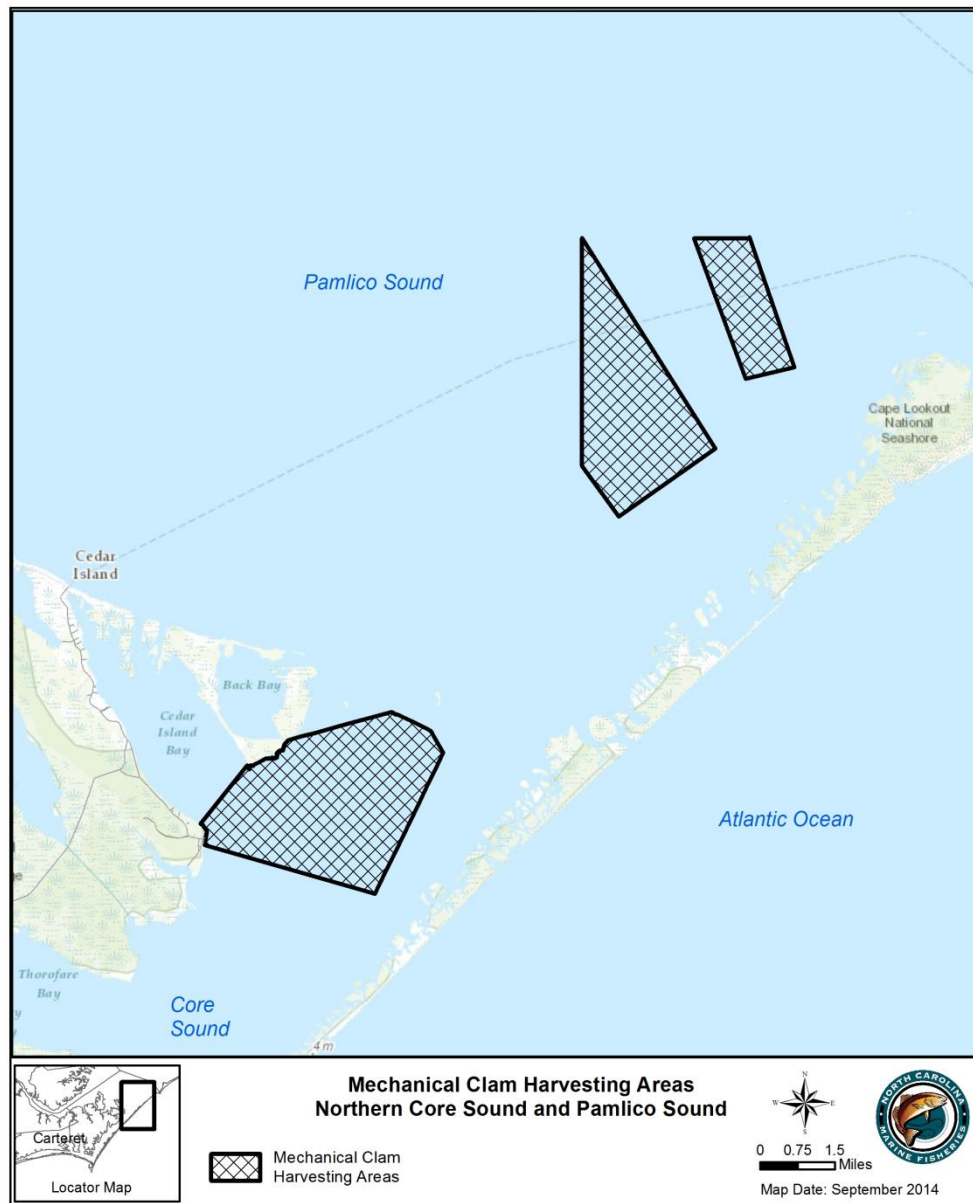


Figure 7.5. Public mechanical harvest areas in Northern Core Sound and Pamlico Sound. These areas were rotated two years on and then two years off with each other starting in the 2001/2002 harvest season and discontinued in 2008. NCDMF Geographic Information System (GIS) database.

7.1.3 PRESENT PUBLIC HARVEST FISHERIES

The current minimum size limit for clams is 1-inch thickness (width). The current daily hand harvest limit is 6,250 clams and the fishery is open year-round. Current public mechanical harvest limits vary by waterbody. In some instances, mechanical harvest areas are rotated (alternately open and close) with other areas (Table 7.1). The White Oak River (Figure 7.6), New River (Figure 7.7), and the Intracoastal Waterway (IWW) of Onslow and Pender counties (Marker 65 to the BC Marker at Banks Channel) (Figures 7.8 and 7.9) are fished mainly with escalator dredges and are rotated on a yearly basis with maximum daily limits of 6,250 clams (25 bags at 250 clams per bag) per operation (Table 7.1). The mechanical harvest area from Marker 72A to the New River Inlet is opened annually with a maximum daily harvest limit of 6,250 clams. The maximum daily harvest of 3,750 clams is allowed in North River (Figure 7.10), Newport River (Figure 7.11), and Bogue Sound (Figure 7.12) (Table 7.1). Since 2008, upon adoption of Amendment 2 to the Hard Clam FMP, Core Sound has been divided into two areas and the northern area is open every other year while the southern portion is opened annually (Figures 7.13 and 7.14). Each area in Core Sound has a daily harvest limit of 5,000 clams per operation (Table 7.1).

Table 7.1. Current daily mechanical hard clam harvest limits by waterbody.

Waterbody	Daily harvest limit (number of clams)	Additional information
Northern Core Sound	5,000	Rotates one year open and one year closed opposite the open/close rotation of the New River
Southern Core Sound	5,000	Limit reduced from 6,250 in 2001. Open annually.
North River	3,750	Open annually
Newport River	3,750	Open annually
Bogue Sound	3,750	Open annually
White Oak River	6,250	Rotates one year open and one year closed opposite the open/close rotation of the New River
New River	6,250	Rotates one year open and one year closed opposite the open/close rotation of the White Oak River and the ICW in the Onslow/Pender
New River Inlet	6,250	Open annually from Marker 72A to the New River Inlet
ICW Onslow/Pender counties area	6,250	Intracoastal Waterway (maintained marked channel only) from Marker #65, south of Sallier's Bay, to Marker #49 at Morris Landing. All public bottoms within and 100 feet on either side of the Intracoastal Waterway from Marker #49 at Morris Landing to the "BC" Marker at Banks Channel. Open every other year when the New River is closed.

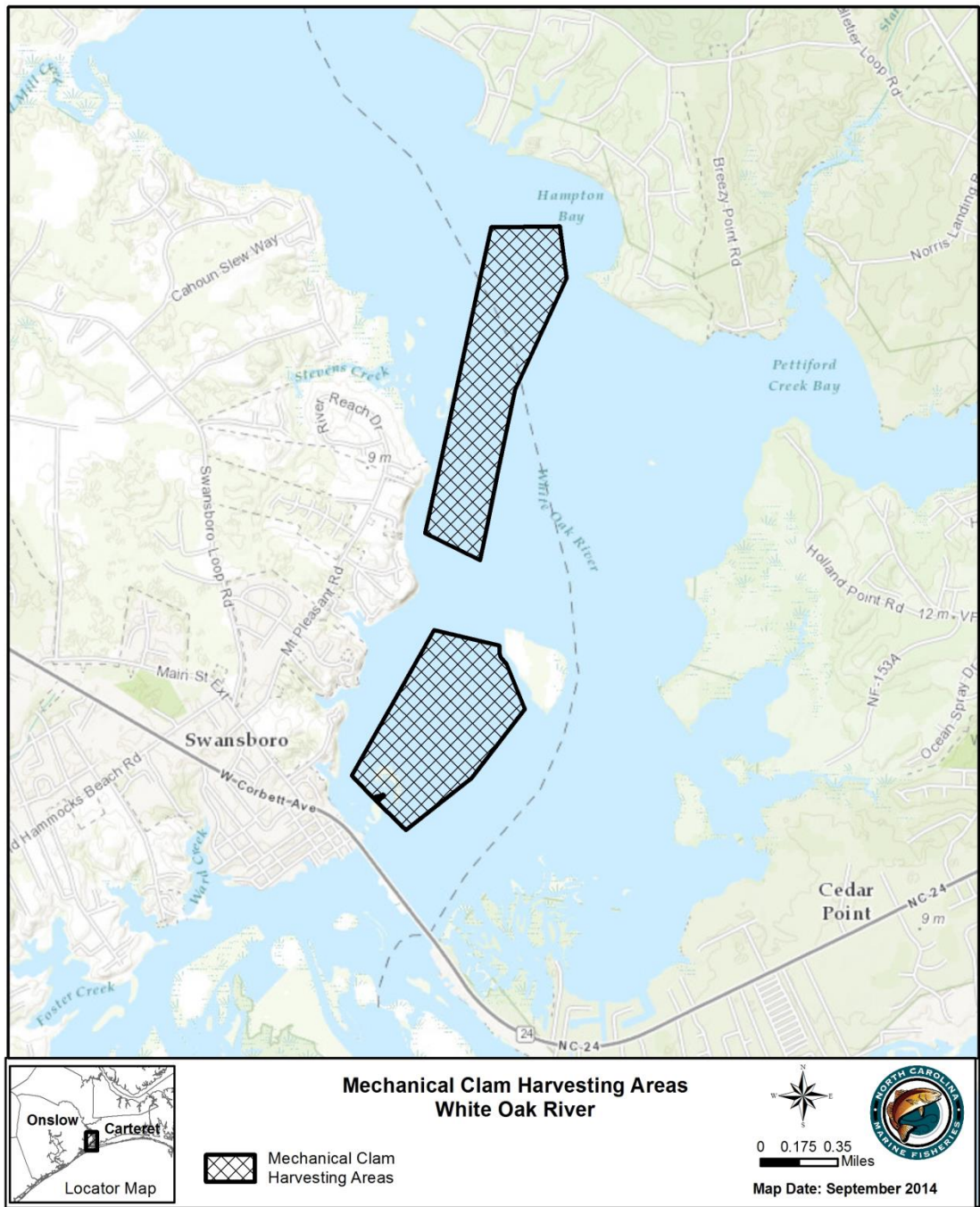


Figure 7.6. The current public mechanical harvest area in White Oak River. This area is rotated one year on and then one year off opposite the open and closed season for the mechanical harvest area in New River. NCDMF GIS database.

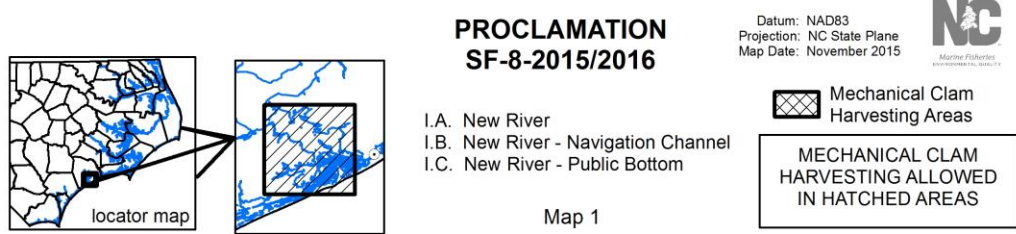
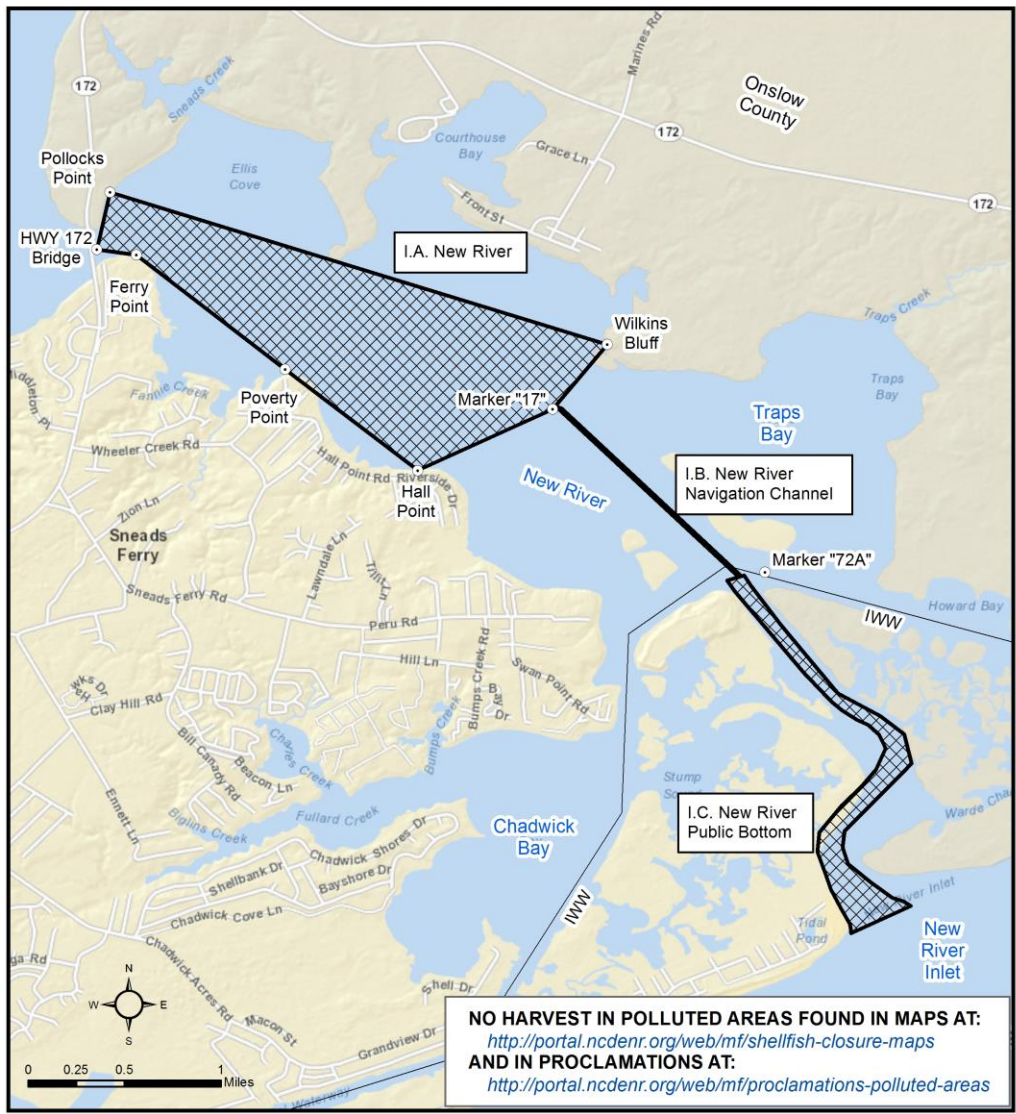


Figure 7.7. The current public mechanical harvest area in New River and the Intracoastal Waterway Marker #72A to the New River Inlet. The New River area is rotated one year on and then one year off opposite the open and close season for the mechanical harvest area in White Oak River. NCDMF GIS database.

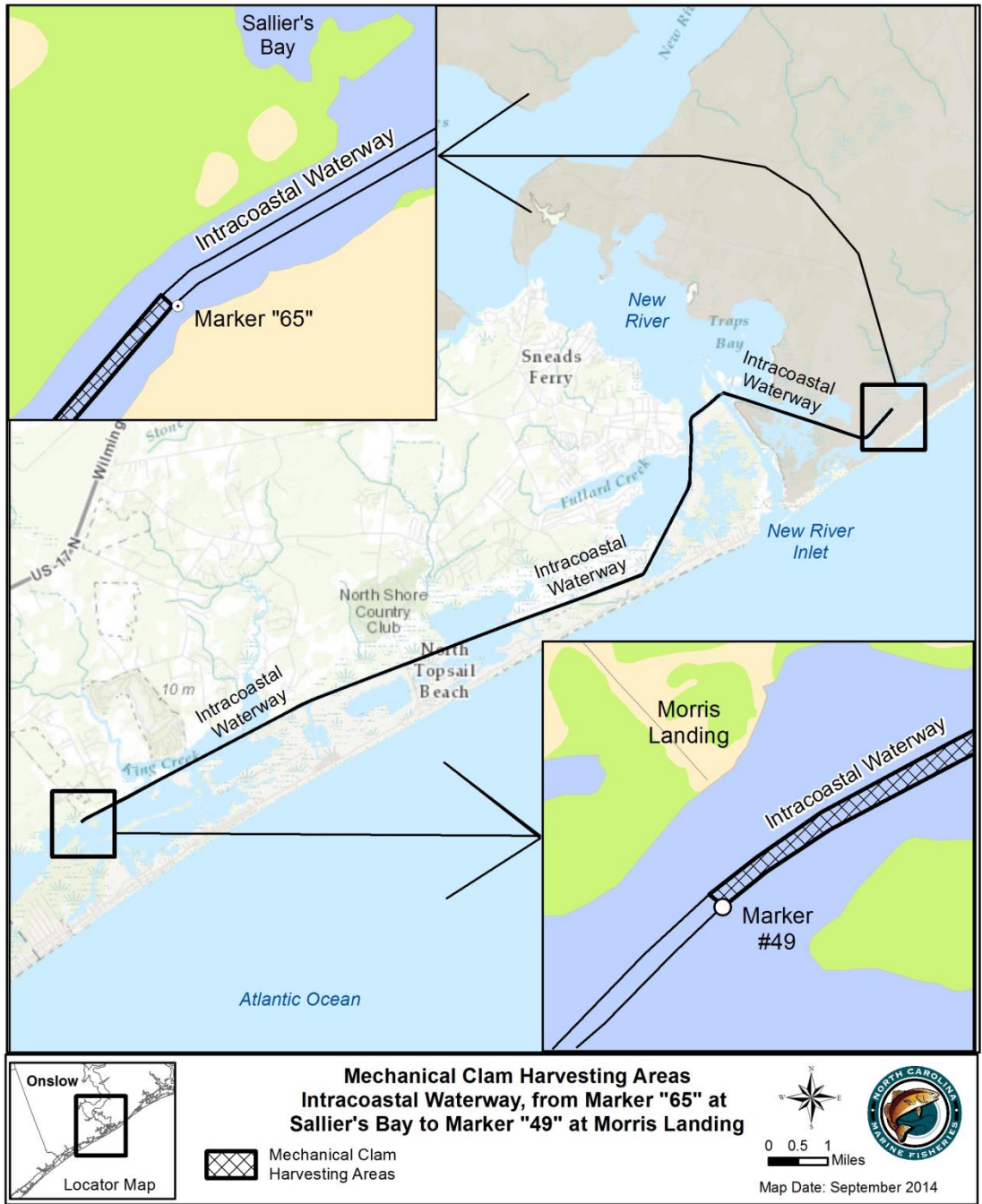


Figure 7.8. The current public mechanical harvest area in the Intracoastal Waterway (maintained marked channel only) from Marker #65, south of Sallier's Bay, to Marker #49 at Morris Landing. NCDMF GIS database.

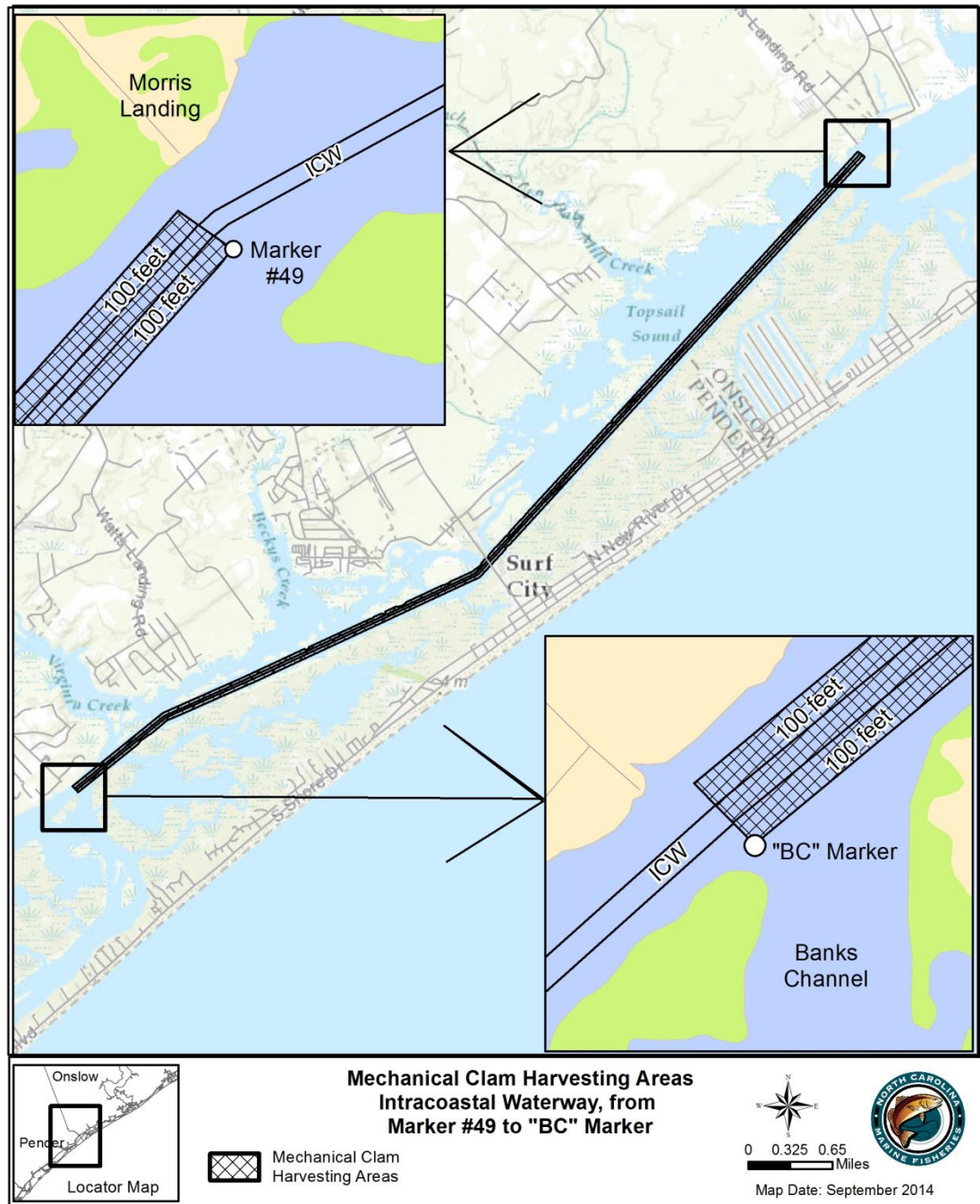


Figure 7.9. The current public mechanical harvest area within and 100 feet on either side of the Intracoastal Waterway from Marker #49 at Morris Landing to the "BC" Marker at Banks Channel. NCDMF GIS database.

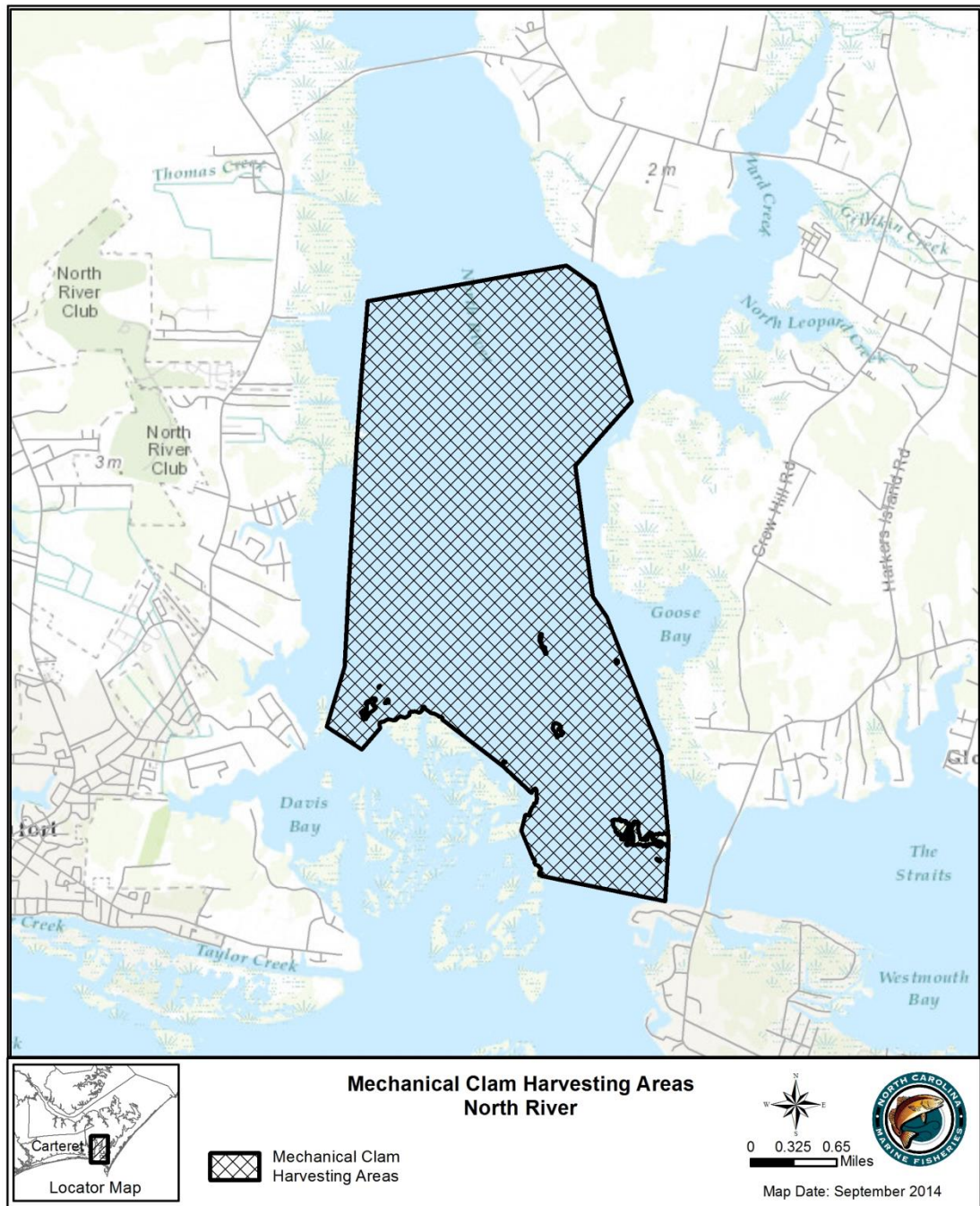


Figure 7.10. The current public mechanical harvest area in North River. NCDMF GIS database.

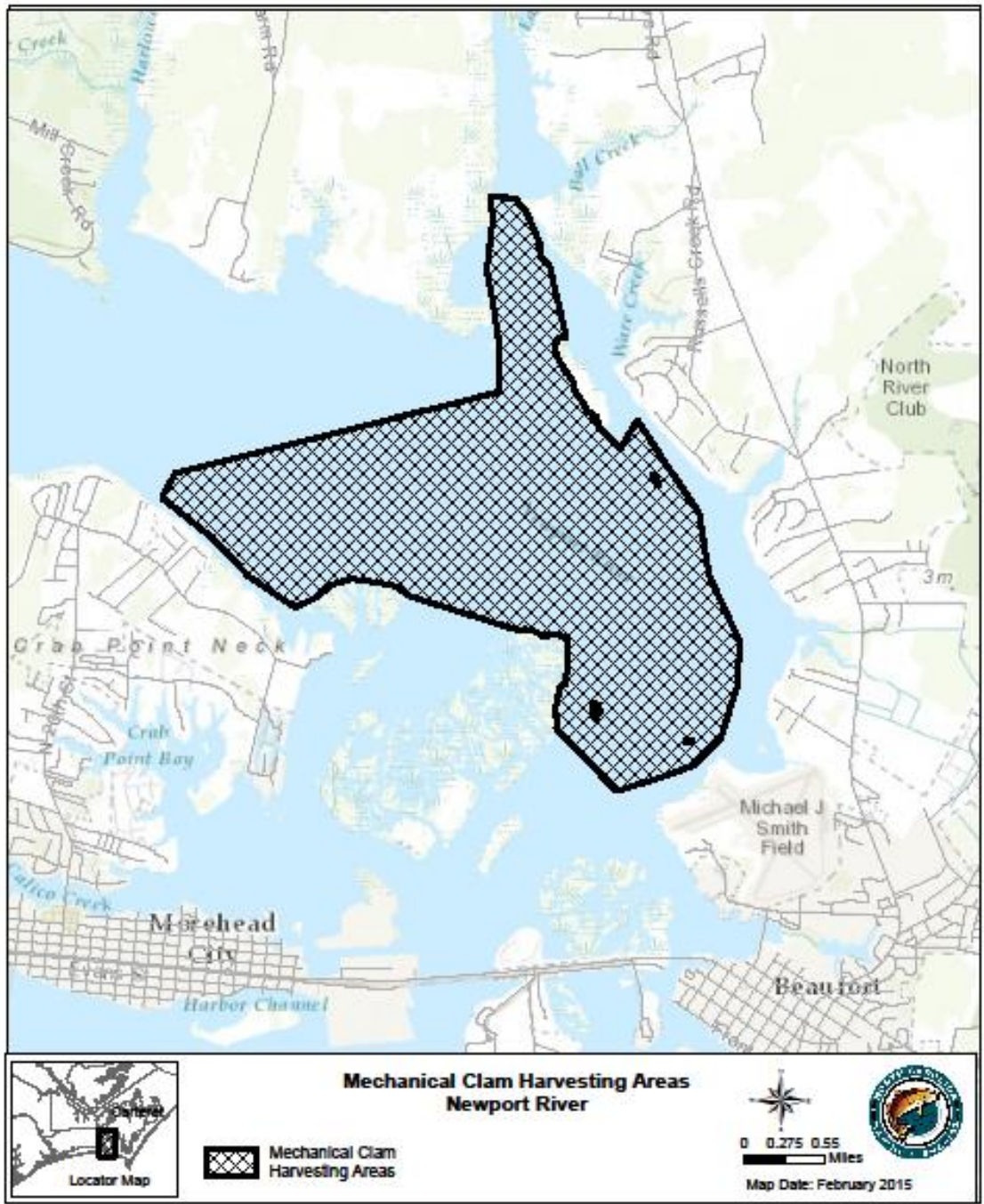


Figure 7.11. The current public mechanical harvest area in Newport River. NCDMF GIS database.

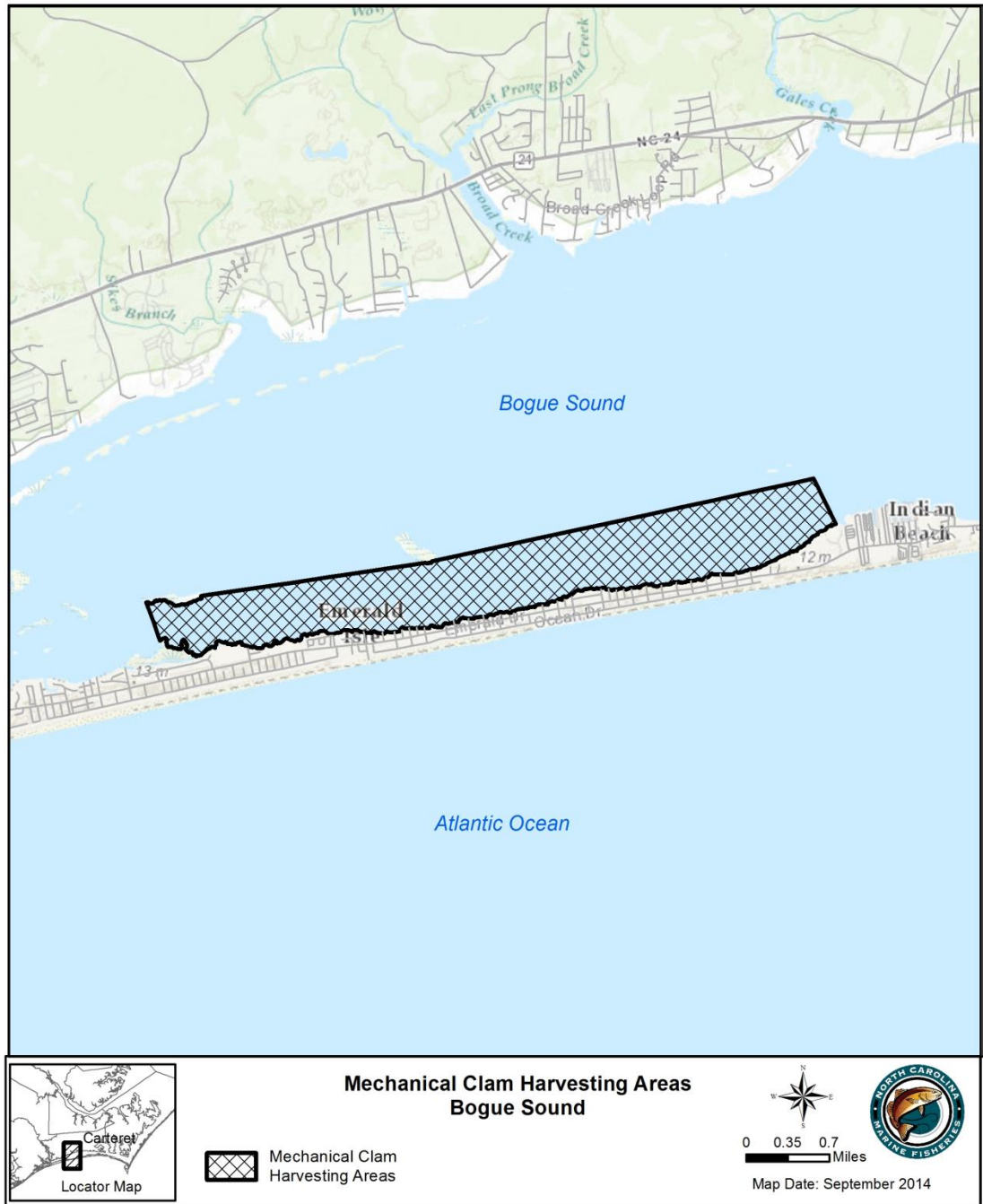


Figure 7.12. The current public mechanical harvest area in Bogue Sound. NCDMF GIS database.

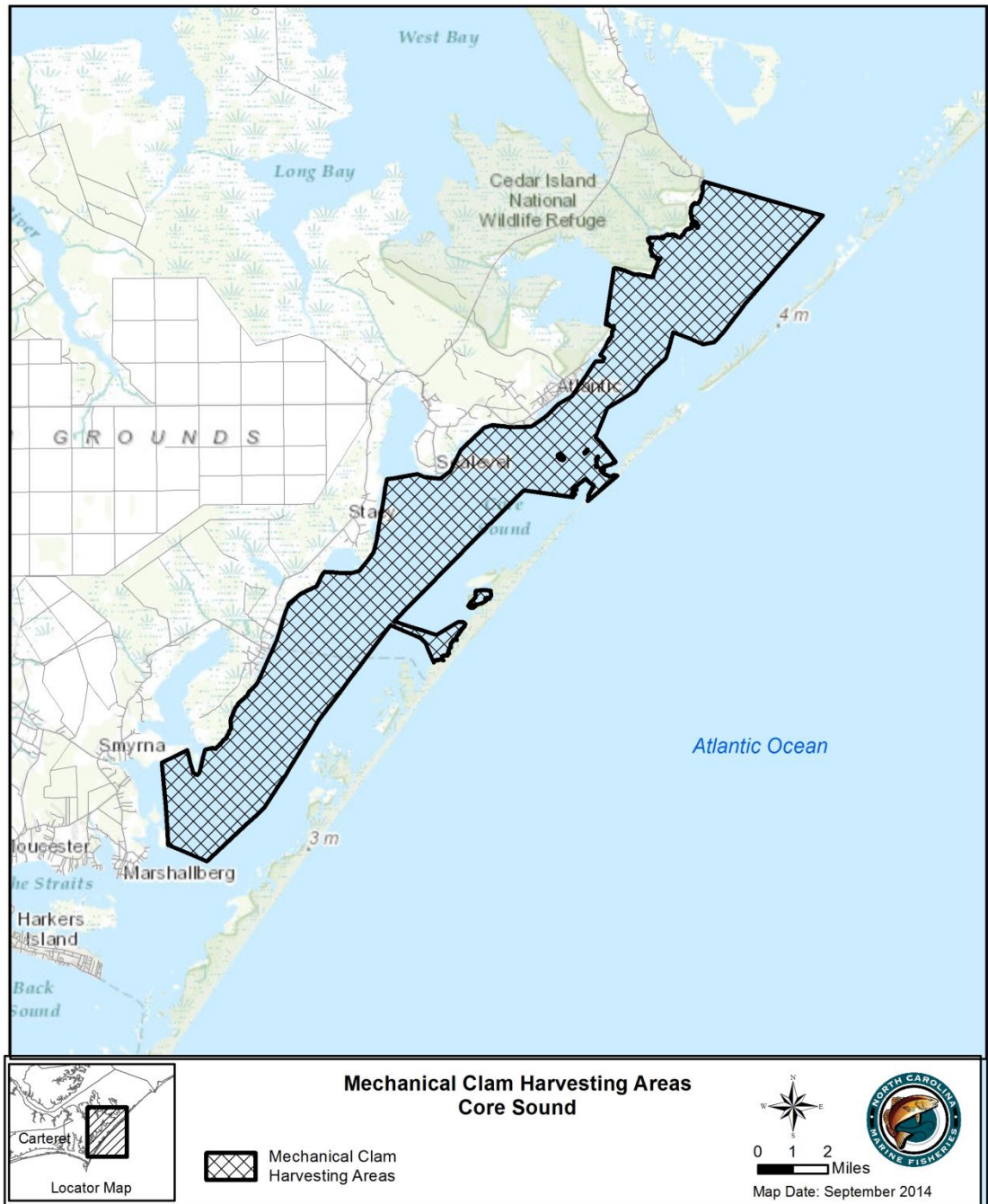


Figure 7.13. The current public mechanical harvest area in southern Core Sound. Opened every year. NCDMF GIS database.

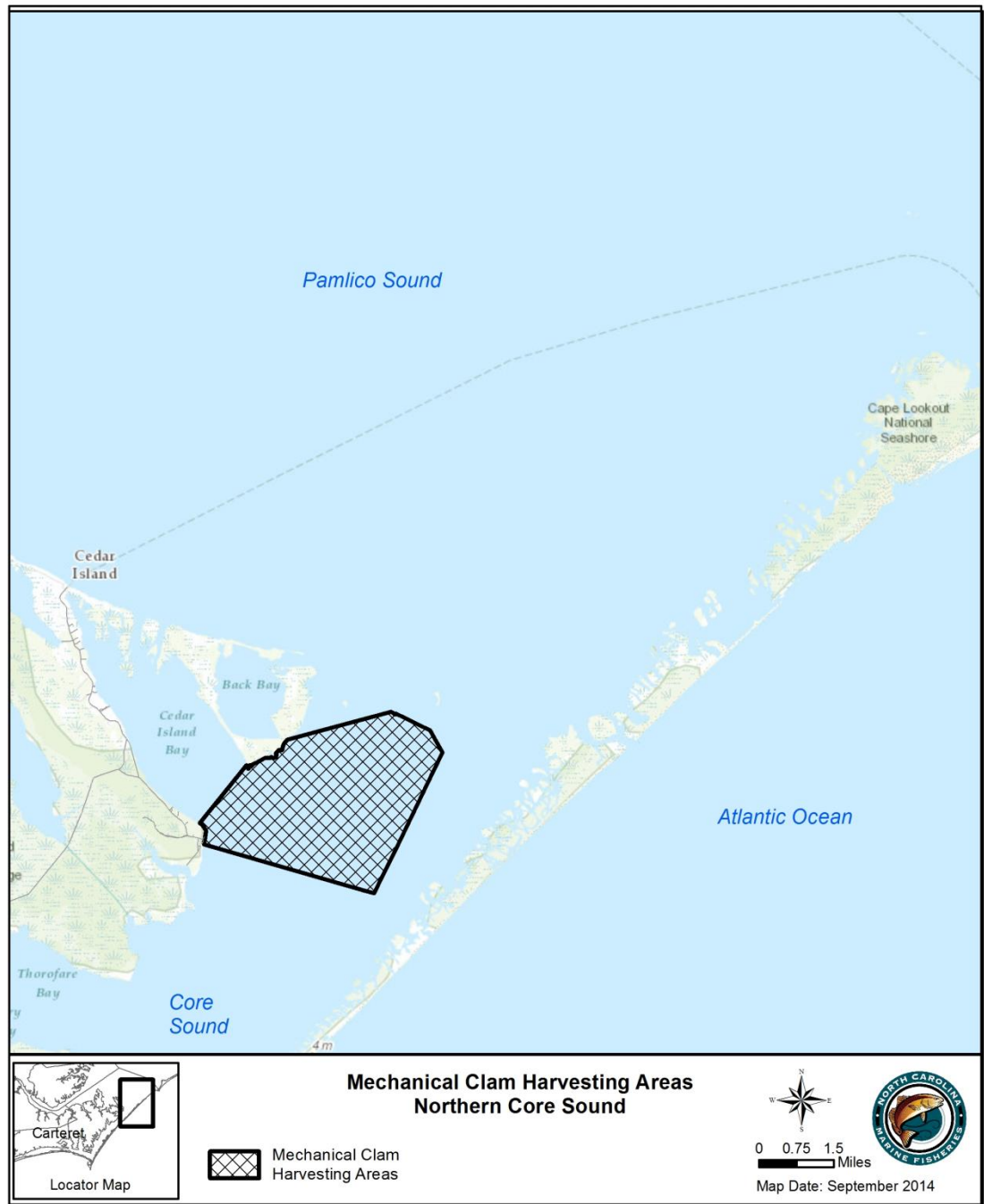


Figure 7.14. The current public mechanical harvest area in northern Core Sound open every other year, opposite the open and close season for the mechanical harvest area in the New River. NCDMF GIS database.

7.1.3.1 ANNUAL LANDINGS, TRIPS, AND MARKET GRADES

Separating the hard clam landings data into public harvest and private production is inexact prior to 1994 because landings information was collected only on a voluntary basis. Since 1994 it is known that about 88% (1994-2013 combined estimates) of the total commercial hard clam harvest come from public harvest areas in North Carolina. It is assumed that trends in hard clam landings from both sources combined can be attributed to changes in hard clam landings from public harvest areas since they make up the largest component to the overall harvest (Figure 7.15). Prior to the 1950s, the lack of a steady market attributed to the fluctuations in landings. From 1950 to 1976 the average annual commercial landings of hard clams was 17,189,943 clams (Figure 7.15). Production declines in New York and New Jersey in the 1970s plus the introduction of new harvest gears (bull rakes and clam kicking) increased landings significantly. From 1977 to 1990, average annual landings were 64,494,711 clams a year (Figure 7.15). The first and only documented red tide event caused by the dinoflagellate, *Karenia brevis*, in North Carolina inside waters occurred from October 1987 through February 1988 (Tester et al. 1991; Summerson and Peterson 1990). About 564 square miles (1,460 km²) of shellfish harvesting areas were closed from as far north as Buxton in Dare County southward to the North Carolina/South Carolina border because of shellfish contamination (NCDMF 1991; Tester and Fowler 1990). During 1988, landings dropped to 46,998,800 clams harvested. Landings over the two-year period after the red tide event increased back to pre-red tide levels but since 1991 annual hard clam landings have been in decline, which may be attributed to less market demand, higher harvesting costs, weather events, and increasing polluted area closures. Annual average hard clam landings from 2005 to 2013 were 19,223,893 clams. Annual landings in 2011 were the lowest on record since 1975 at 15,088,757 clams (Figure 7.15).

There are year-to-year fluctuations in the number of trips harvesting hard clams. The annual number of trips has declined during the time series (1994-2013) with the highest number of trips in 2001 (Figure 7.16). Adverse weather conditions (i.e., hurricanes, heavy rain events) can impact the annual landings. Ten tropical cyclones (hurricanes and tropical storms) have made landfall in North Carolina since 1996 (<http://www.nc-climate.ncsu.edu>). Freshwater runoff after storm events often increase shellfish harvest area closures and therefore reduce effort in hard clam harvest for short term periods.

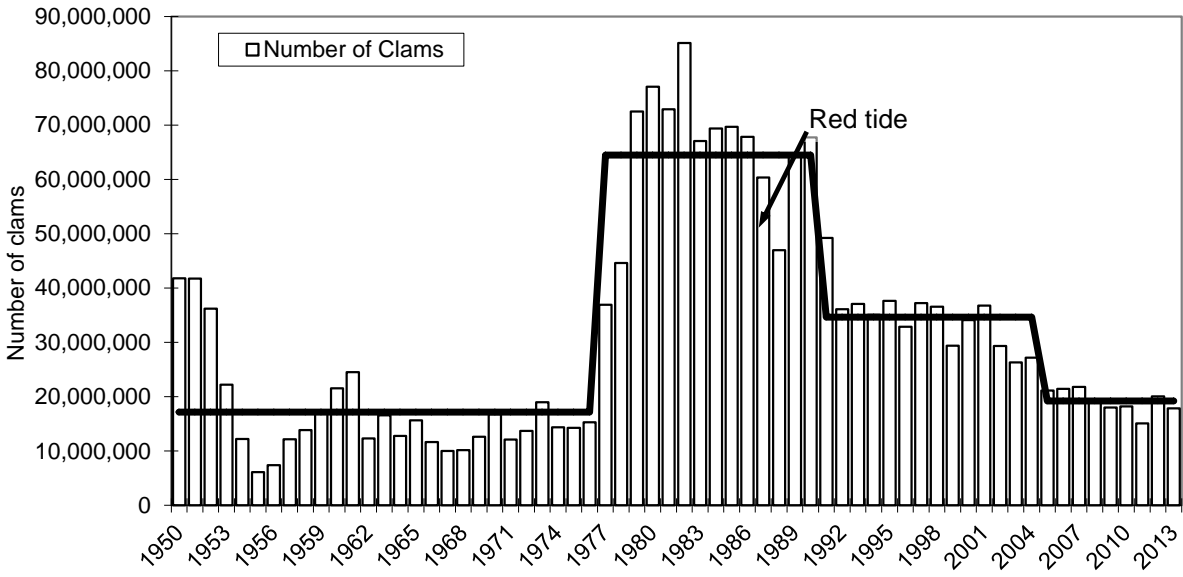


Figure 7.15. Hard clam landings (Number of clams) from public harvest and private production showing the average annual landing trends for specific time periods, 1950-2013. TTP.

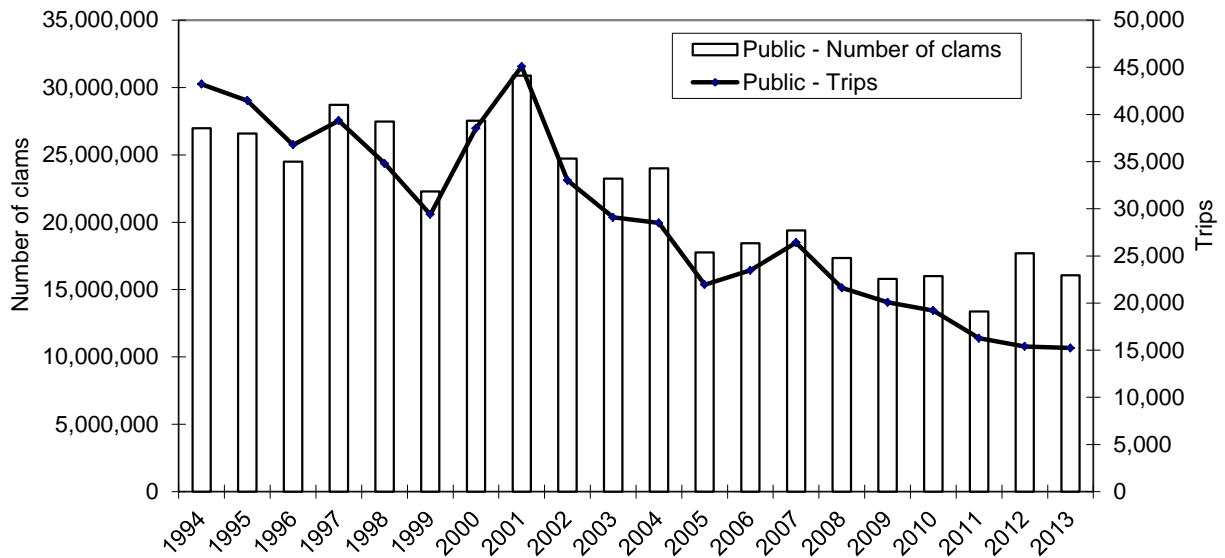


Figure 7.16. North Carolina annual commercial hard clam landings (Number of clams) and trips from public harvest, 1994-2013. TTP.

New River and Core Sound are the top two waterbodies where hard clams are harvested from public harvest areas and accounted for 48% of the landings from 1994 to 2013 (Figure 7.17). Landings in the southern part of the state, including the areas of Stump Sound, Lockwood Folly, Topsail Sound, Masonboro Sound, Cape Fear River, Shallotte River and the Inland Waterway accounted for an additional 28% of the hard clam landings from public harvest from 1994 to 2013.

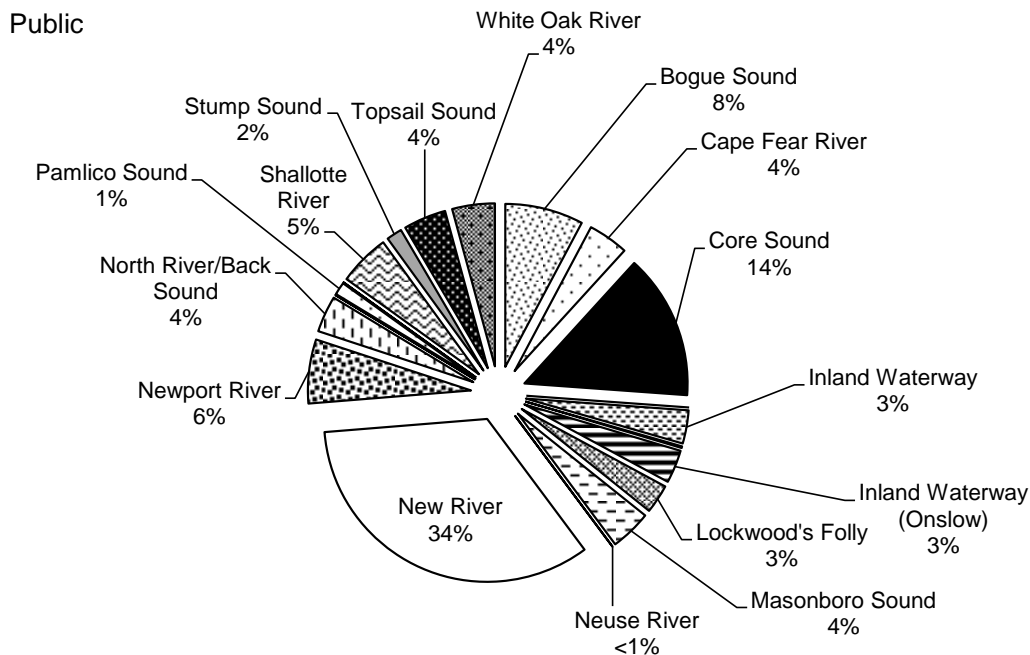


Figure 7.17. Commercial hard clam landings (Percent of total landings) by waterbody from public harvest 1994 to 2013 combined. TTP.

Hard clam harvest is sorted by shell width or thickness into various market grades when purchased by the seafood dealer from the fisherman. A mixed or unclassified market grade is the most common hard clam size category from public harvest and comprised 79% of the total landings from 1994 to 2013 (Figure 7.18a). Commercial fish house sampling shows the size ranges from the minimum allowed of 1-inch (25 mm) thickness to 3-inches (80 mm) thick (Figure 7.19). The trend in the proportion of hard clams in the mixed market category to the total landings from public harvest has increased each year since 1998. Little neck is the second dominant market category in the hard clam landings from public harvest (Figure 7.18b). This market grade consists of the smallest sized hard clams measuring between 1-inch (25 mm) to 1 ¼-inch (32 mm) in thickness. From 1994 to 1999 little neck hard clams comprised 10% to 17% of the total hard clam landings from public harvest, but since 2000 have shown a lower trend but are staying steady (3-8%). Top neck is the next market category in size and ranges from 1 ¼-inch (32 mm) to 1 5/8-inch in thickness (41 mm). The proportion of hard clams as top necks to the total hard clam landings from public harvest has remained about the same throughout the time series (Figure 7.18b). Hard clams in the cherry and top cherry market grades are selected by a shell thickness that ranges between 1 5/8-inch (41 mm) to 2 ¼-inches (57 mm). These two market categories have not shown much change in proportion to the total hard clam harvest from public harvest from 1994 to 2005 (Figure 7.18b). Chowder hard clams are the largest market category by size and are any hard clams greater than 2 ¼-inch shell width. Chowder clams only make up a small proportion to the total landings (Figure 7.18b).

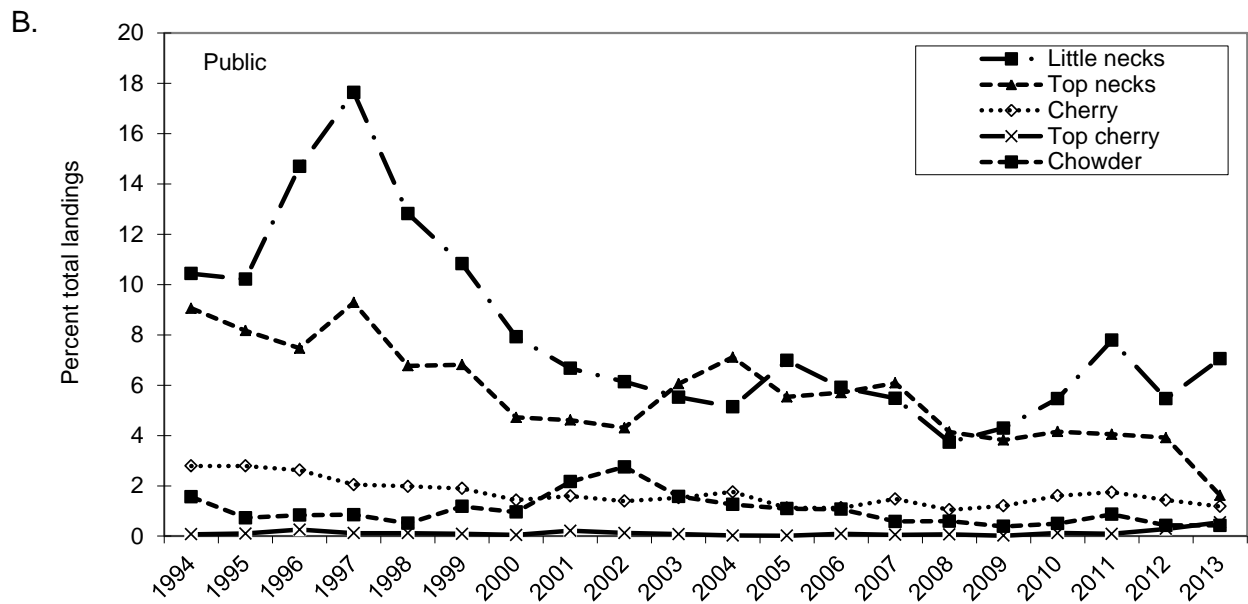
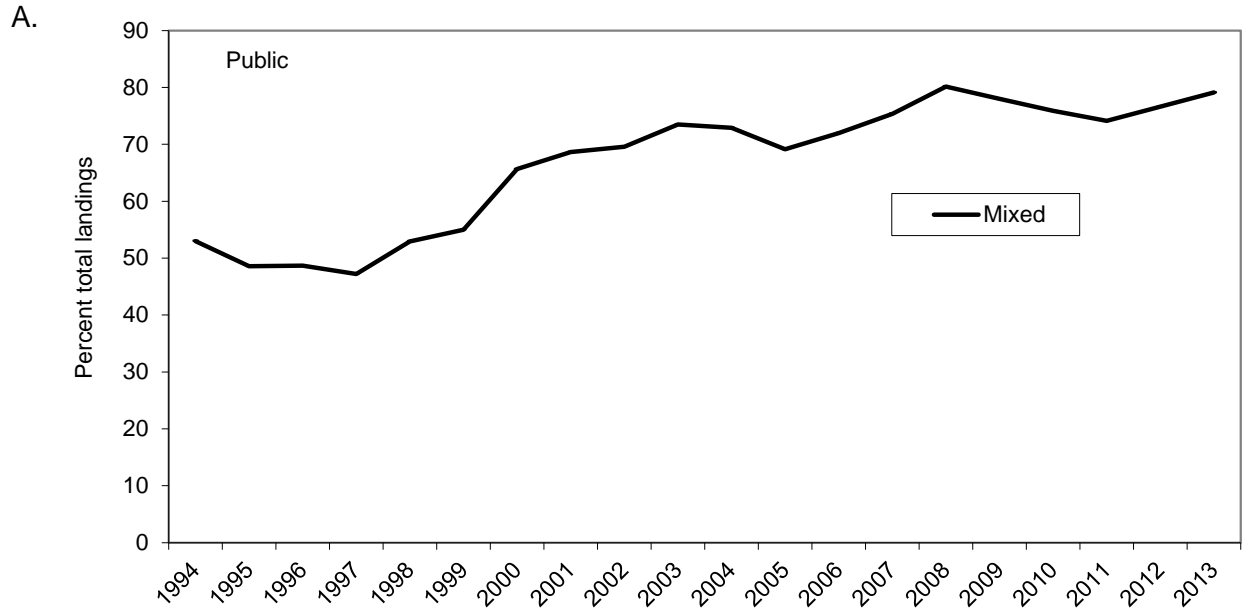


Figure 7.18. Annual landings (Percent to total annual landings) from public harvest by market grade, 1994-2013 combined. A. Mixed grade only; B. All other market grades. TTP.

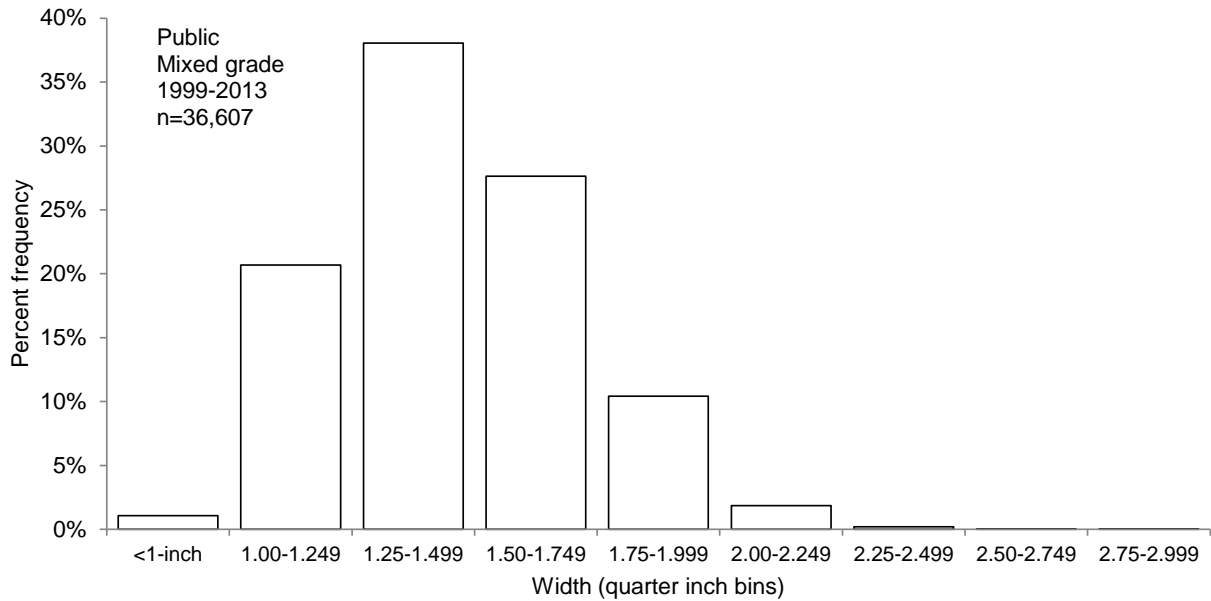


Figure 7.19. Size class (width in quarter-inch bins) distribution of hard clams in the unclassified market category from public harvest. Samples collected from commercial fish houses, 1999-2013 combined. NCDMF biological database.

7.1.3.2 HAND HARVEST

Hand harvest from public areas is a year round fishery and has average landings of 18,791,751 clams a year (1994-2013). Most hand clamming occurs in the spring and summer when warm water is conducive to wading (Figure 7.20). Annual public harvest and the number of hand harvest trips a year for hard clams has declined overall from 1994 to 2013 (Figure 7.21). The annual catch per unit effort (CPUE; number of clams per trip) of hand harvest from public areas have been unchanged from 1994 to 2011, with a slight increase in the last two years of the time series (Figure 7.22).

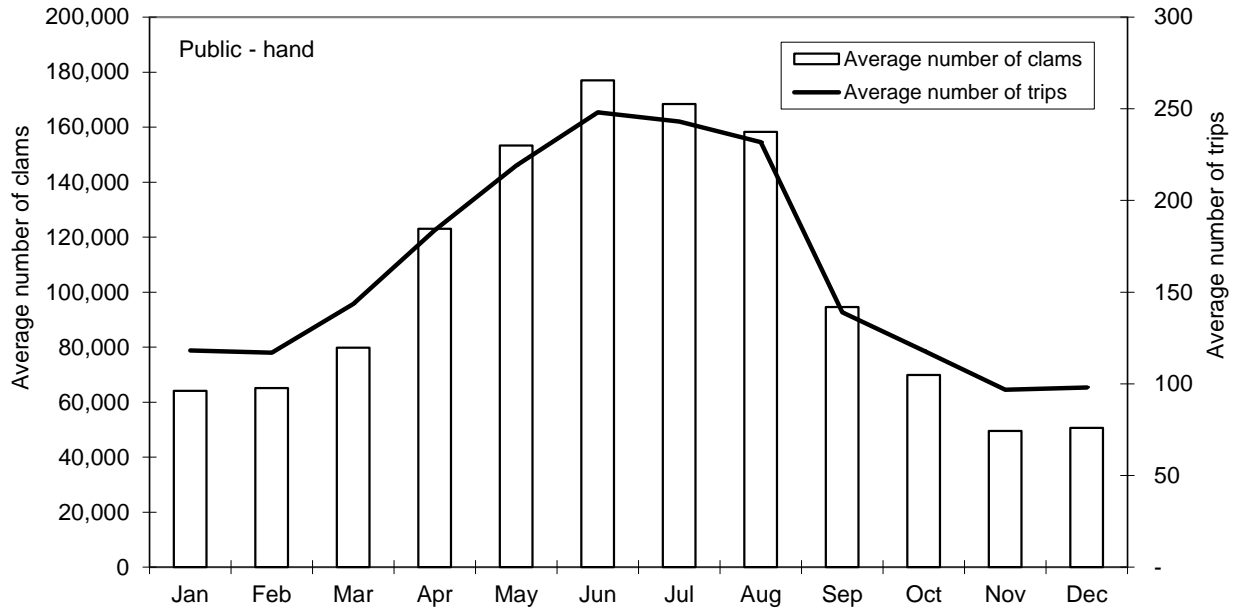


Figure 7.20. Average hard clam landings (Number of clams) and average number of trips by month from public harvest using hand gears, 1994-2013. TTP.

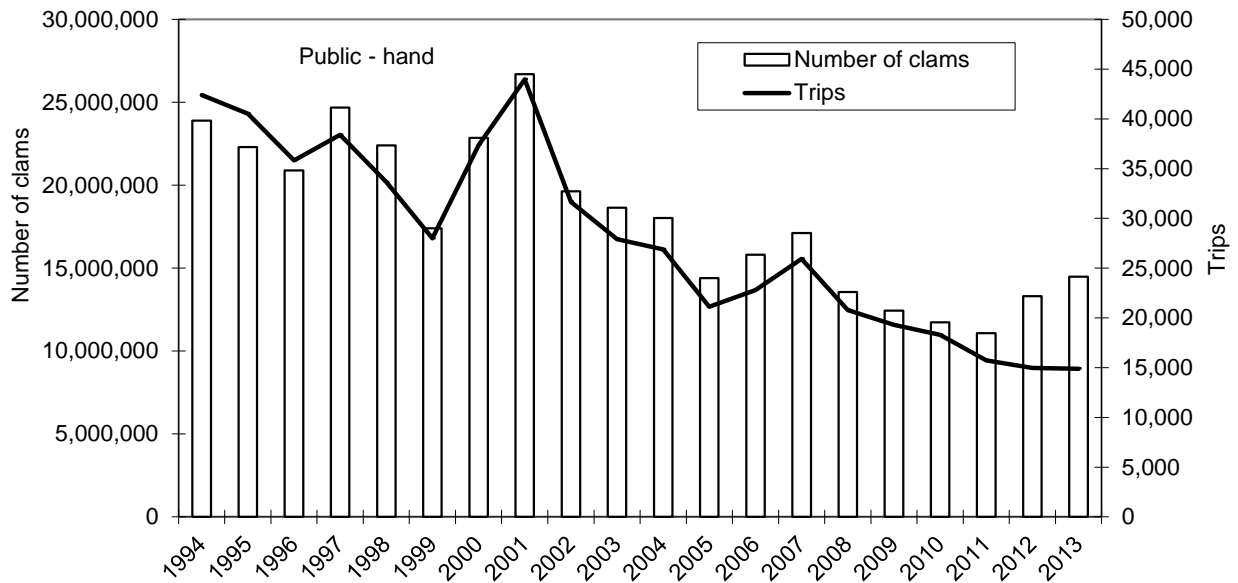


Figure 7.21. Annual hard clam landings (Number of clams) and trips from public harvest using hand gears, 1994-2013. TTP.

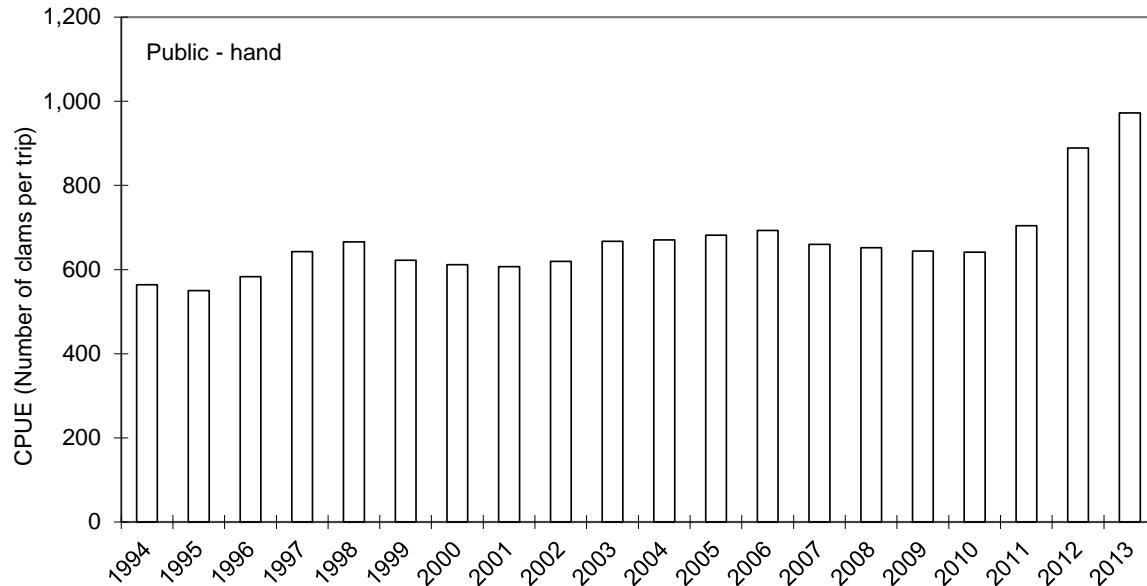


Figure 7.22. Annual catch per unit effort (CPUE; number of clams per trip) of hand harvest from public areas, 1994-2013. TTP

7.1.3.3 MECHANICAL HARVEST

Mechanical harvest season usually begins the second Monday in December and extends through the week of March 31st. Harvest is allowed only from 7:30 a.m. to 4:00 p.m. on Monday through Friday until before the Christmas holiday and then Monday through Wednesday after December 25th for the remainder of the open harvest season.

Hard clam landings from public harvest, using mechanical methods, has average landings of 3,934,082 clams each fishing year (1994/95 to 2012/13). The mechanical clam harvest season usually has the highest landings at the beginning of the fishing season in December and declines as the season progresses (Figure 7.23). Landings outside of the usual mechanical clam harvest season are from temporary openings for the maintenance of channels and temporary openings in Core Creek when bacteriological levels are at acceptable levels to harvest clams. Hard clam landings and trips fluctuate from fishing year to fishing year and appear to be greatly influenced by harvest from the New River mechanical harvest area (Figure 7.24). Since 1994, when the public mechanical harvest area of New River is open, 48 to 97 percent of the total mechanical harvest landings are from this area.

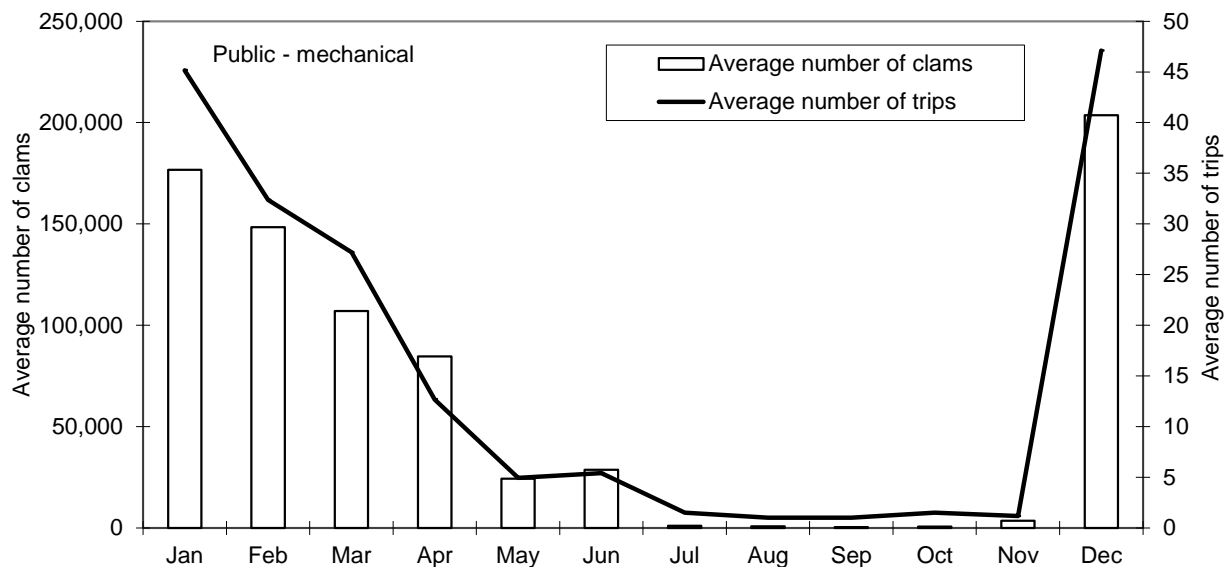


Figure 7.23. Average hard clam landings (Number of clams) and average number of trips by month from public harvest using mechanical gears, 1994/95-2012/13. TTP.

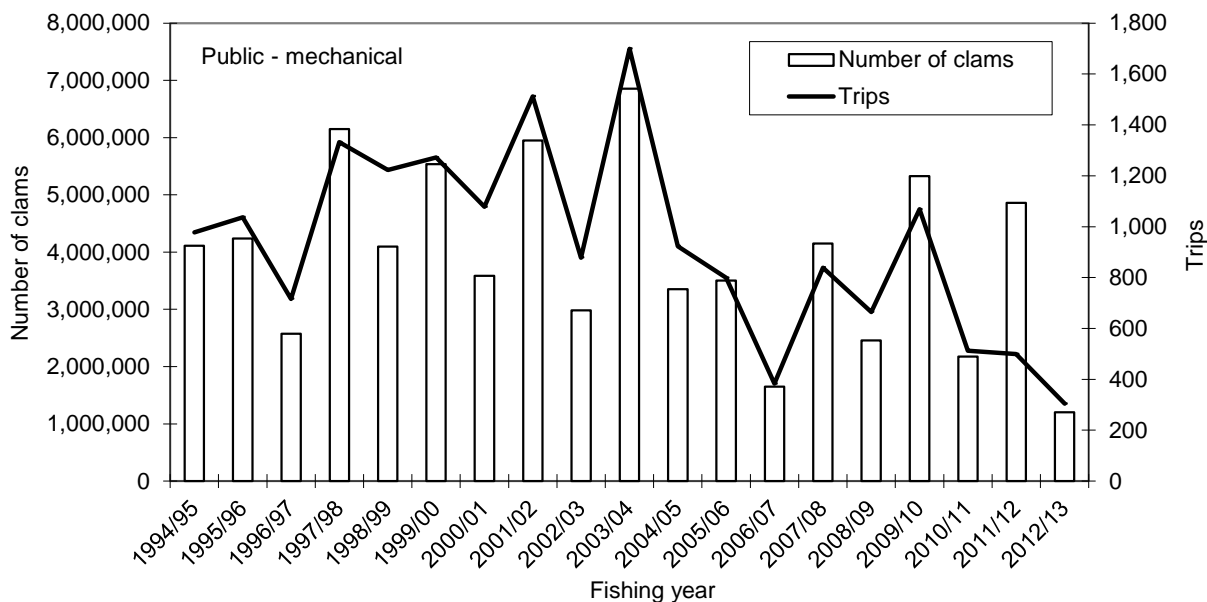


Figure 7.24. Hard clam landings (Number of clams) and trips from public harvest using mechanical gears by fishing year (Dec-Nov), 1994/95-2012/13. TTP.

7.1.4 HISTORICAL PRIVATE SHELLFISH CULTURE: SHELLFISH LEASES AND FRANCHISES

Although North Carolina law did not formally prescribe the methods for obtaining areas for private shellfish cultivation until 1858, laws existed giving private shellfish growers special privileges in harvesting and selling their shellfish as early as 1855. Early cultivation sites were based on "squatters" rights, once the site was posted.

In 1858 a law was established that a license for oyster and hard clam bottoms was to be issued by the Clerk of Superior Court of the respective county at no charge. The licensed bottom had to be marked and used on a continuing basis for the production of shellfish. Initially, grants could be no larger than two acres. In 1873 this restriction was raised to allow ten-acre sites. Only one grant could be held per person. Riparian owner's rights could not be affected, and no natural shellfish bed could be enclosed. Some clerks required surveys for these shellfish licenses (Winslow 1889).

There were 250 such licenses in the state in the 1880s (Winslow 1889). The plots were defined as "gardens," a term which is still in use today to describe shellfish leases. Production from these gardens was normally limited to amounts adequate to supply the licensee's table (Winslow 1889). Although subsequent laws for shellfish cultivation were passed, this system remained in effect in some counties until 1907 (Jernigan 1983).

On 15-16 October 1884, papers were presented at the Fishermen's Convention in Raleigh that created a great deal of interest in oyster culture. Lieutenant Francis Winslow, U.S. Navy, and Professor W. K. Brooks, John Hopkins University, both presented arguments encouraging a privately controlled oyster industry in North Carolina. They cited the depletion of the public oyster beds in Chesapeake Bay and the increasing oyster production from private beds in Connecticut and foreign countries as examples of what could be expected here (Winslow 1885; Brooks 1885).

Pursuant to the interest generated at the Fishermen's Convention, a survey began in April 1886 to determine the extent and condition of North Carolina's oyster-producing habitat. The survey determined there were 8,328 acres of oyster producing bottom in Dare, Hyde, Pamlico, Carteret and portions of Onslow counties. Additionally, 583,000 acres of bottom were identified as suitable for oyster cultivation (Winslow 1889). An entirely new system for allowing private cultivation of oysters was proposed on public bottoms. The General Assembly adopted these recommendations under the authority of the 1887 Session Laws, Chapter 90, for Onslow County and Chapter 119 for Pamlico Sound, which included hard clams (Jernigan 1983).

Under these laws, a board of three Shellfish Commissioners established natural oyster beds held in the public trust. Natural shellfish beds could not be included in grants for private cultivation. This new system of granting private shellfish cultivation rights was a franchise system. Shellfish franchises had to be approved by the Secretary of State. Application fees were \$2.05 and franchises were purchased at a cost of 25 cents per acre. A state surveyor conducted surveys of each grant for the applicant. The grounds were recorded for tax purposes (Winslow 1889).

It was required that these grants be improved within five years. Within two miles of the shore of Pamlico Sound, grants could be for no more than ten acres, and only one grant per creek was allowed. However, one person could be granted up to 640 acres in any five-year period. Non-residents were allowed to enter grants more than two miles from shore in Pamlico Sound. This

new law caused a great deal of interest and by 1889 approximately 50,000 acres had been issued in franchises.

Statutory authority to lease bottomlands for shellfish cultivation can be traced back to a statute adopted in 1909. Interest was generated from the cultivation experiments of the North Carolina Geological and Economic Survey as fishermen harvested oysters from the planted areas and probably influenced the adoption of the legislation (Pratt 1911). The early legislation contained concepts that are still in use today. All leaseholders had to be residents of North Carolina. A survey was required and qualified personnel conducted an investigation of existing shellfish stocks for each application. There were rental fees and strict marking requirements. The application fee was a \$10 deposit to be applied to survey costs if the lease was approved.

Other aspects of the law were somewhat different from today. Shellfish lease acreage was limited to ten acres in the bays and smaller sounds (Chestnut 1951b). Single leaseholders could hold up to fifty acres within two miles of the shore of Pamlico Sound and 200 acres farther from shore. Shellfish leases were issued for an initial 20-year term with the option for unlimited 10-year renewals. The performance requirement for leaseholders was strictly set at planting an average of 50 bushels of shells or oyster seed per acre after the first two years and an average of 125 bushels per acre after four years. For up to four months after the granting of the lease, the public could protest on the grounds that the area contained a natural shellfish bed. In any given year from 1901 to 1949 there were about 264 leased areas totaling 3,232 acres (Chestnut 1951b).

During the early 1960s the shellfish lease statute was changed to reduce the initial lease period to ten years. The rental fee was raised to \$5.00 per acre per year for all leases. A differential system had previously been in place, basing rent on the area and the length of existence of the lease. Due to the extended length of time necessary to legally put these changes in place, all leases did not operate under these changes until 1997.

The General Assembly in 1965, in order to clear title on submerged lands so as to preserve the rights asserted by various individuals, enacted legislation (G.S. 113-205 and G.S. 113-206) requiring registration of private claims to lands beneath navigable waters in 25 coastal counties. The claimant had to claim an interest to any part of the bed, or right of fishery, in navigable waters superior to that of the general public, and have the claim registered pursuant to N.C. General Statute 113-205 on or before January 1, 1970.

A shellfish franchise is a grant exclusive to the claimant, to harvest shellfish on a given tract of deeded bottom or submerged land as provided under 1889 laws and now under North Carolina G.S. 113-205 and G.S. 113-206 which are governed by standards in Departmental Rules 15A NCAC 01G .0200 and .0300 and 15A NCAC 03O .0203(d). There are 239 recognized submerged land claims, having an issued final claim resolution within the 25 coastal counties. As of 2014, 50 shellfish franchises existed, encompassing 516.53 acres in Onslow, Carteret, Pamlico, and Hyde counties.

In 1965 the Marine Fisheries Commission was given the authority to adopt rules defining commercial production of shellfish based upon the productive potential of areas and considering climatic or biological conditions, availability of seed oysters and clams, and availability of shells or other cultch materials. From 1966 through 1975, the MFC adopted the production requirement of "at least five bushels of oysters or clams per lease acre per year, averaged over any two consecutive years after January 1 following the second anniversary of an initial lease

and throughout the term of a renewal lease" (North Carolina Fisheries Regulations for Coastal Waters 1975. H-12 Cultivation of Oysters).

In 1976 this rule was changed to read "Failure to produce and market at least 25 bushels of oysters or clams per lease acre per year, averaged over the most recent three-year period after January 1 following the second anniversary of an initial lease and throughout the term of a renewal lease, shall constitute failure to utilize the leasehold on a continuing basis for the commercial production of shellfish" (North Carolina Regulations for Coastal Waters 1977, 15A NCAC 03C.0311). The produce and market wording was intended to emphasize the commercial purpose.

The legislation authorizing the MFC to adopt production requirements also made provisions for periods of low oyster productivity. The statute further provided that if a leaseholder made a diligent effort, his or her lease could not be terminated; "Acts of God" were also reason to excuse lack of production.

Following a legislative study in 1981, the shellfish lease application fee was raised from \$25.00 to \$100.00 and a lease renewal fee of \$50.00 was established. During the period 1982 to 1986, an average of 10 bushels of shellfish per acre of leased bottom was produced in North Carolina. This figure includes both oysters and clams and falls well below the requirement of 25 bushels per acre. The production requirement was not being met by 71% of the active shellfish leaseholders from 1982 to 1986. Furthermore, by policy, the NCDMF was accepting the planting of 25 bushels per acre of seed or shells as a diligent effort to meet production. A total of 100 of the 285 leases could not meet production requirements during that period. Action to terminate these shellfish leases was blocked by legislative action for one year. In the interim, leaseholders were given an opportunity to attend instructional seminars and receive a two-year extension to meet production.

In 1989 legislation was enacted to allow the use of the water column above the shellfish lease. The number of water column leases was low because the high rental fee of \$500 per acre per year for renewed water column amendment probably deterred many potential leaseholders from holding these areas longer than 4 years. In 2005, the General Assembly decreased the cost of the water column leases to \$100 per acre a year; the rent is prorated if a water column amendment is issued for less than a 12-month period. The rental is in addition to the fees required for the new and renewal of shellfish leases (G.S. 113-202.1(d)).

The MFC recommendations from the 2001 Hard Clam and Oyster FMP included statutory increases in application fees (\$200), renewal of application fees (\$100), rental fees (\$10 per acre per year), and changing the term of the lease contract expiration date to June 30 to coincide with the commercial licensing system (G.S. 113-202).

In 2003 the production requirements for shellfish leases were changed to accommodate the MFC management recommendation in the 2001 Oyster and Hard Clam FMP to require planting of seed or cultch material. The new production requirements are: (1) Produce and market 10 bushels of shellfish per acre per year and; (2) Plant 25 bushels of seed shellfish per acre per year or 50 bushels of cultch per acre per year, or a combination of cultch and seed shellfish where the percentage of required cultch planted and the percentage of required seed shellfish planted totals at least 100 percent (15A NCAC 03O .0201(b)(1)(2)).

The 2008 amendments to the Oyster FMP and Hard Clam FMP endorsed several changes to the shellfish lease program to increase the accountability of the leaseholders and improve public

acceptance of the program (NCDMF 2008a; NCDMF 2008b). The modifications required both rule and statute change. The NC General Assembly accepted the changes to the statutes in 2009 and the rules were modified in 2008. The changes included:

- Change the rule specifying a three year running production average to a five year running production average and change the statutory provision for a ten-year lease contract to a five-year contract.
- Limit acreage per shellfish lease applications to 5 acres.
- A leaseholder holding at least 5 acres of shellfish bottom is required to meet shellfish lease production requirements before being approved for any additional lease acreage.
- Require latitude/longitude coordinates on lease corner locations as part of the requirement of a registered land survey.
- Develop regional lease acreage caps based on established use of water bodies.
- Rewrite the statutory provision limiting the amount of shellfish lease acreage to 50 acres that can be held by an individual to include acreage held by corporations where the individual is a member, or any combination of corporate family holdings.
- Modify the statute to add a training requirement for persons acquiring leases through lawful transfer to become more familiar with shellfish cultivation techniques and requirements.
- Require applicants or transferees not currently holding a shellfish cultivation lease and leaseholders not meeting production requirements to review training and educational materials on the leaseholder program and obligations of the participants;
- Require the satisfactory completion of an examination with a passing score based on information provided in the training materials.
- Exempt the sale of oysters and clams by a hatchery or aquaculture operation from the requirement to sell to a licensed dealer if the sale is to the holder of an Aquaculture Operation Permit holder, Under Dock Oyster Culture Permit holder, or shellfish cultivation leaseholder for further grow out.

Today some shellfish leases are held by commercial fishermen to supplement their income from public harvest areas. Other shellfish leases are held by individuals and corporations looking to augment other sources of income; to be engaged in a sustainable business opportunity; or to maintain an attachment to cultural maritime heritage and way of life.

Since 2012 administrative and process changes have been made to allow for better customer service, communication and ongoing support of the N.C. Shellfish Lease and Franchise Program. Process operations and customer support were reviewed; actions were undertaken and implementation steps were completed to improve process operations and to provide a higher level of customer service (Table 7.2).

Table 7.2. Implementation of administrative and process improvements to the shellfish lease and franchise program by NCDMF.

NC Shellfish Lease and Franchise Program			
Objective/Problem	Action	Implementation	Year
Process Operations/ Customer Support	Review and streamline process operations for shellfish lease applications	Lease application process reduced to 2-3 months instead of 9-15 months	2012
Process Operations/ Customer Support	Review and streamline process operations for shellfish lease applications and permit applications	Applicants now can fax, email, mail or hand deliver applications.	2013
Process Operations/ Customer Support	Review and streamline process operations for shellfish lease applications and permit applications	Establish lease program service email address for one point of contact for public, applicants and growers.	2013
Process Operations/ Customer Support	Review and streamline process operations for shellfish lease applications and permit applications	Applicants are no longer required to have permit applications notarized, except for UDOCs.	2013
Process Operations/ Customer Support	Review and streamline process operations for shellfish lease applications and permit applications	For lease specific permits, applicants may list multiple leases on a single application for a specific permit. The work load now rests with NCDMF staff in processing individual permits and not on the applicant.	2013
Process Operations/ Customer Support	Review and streamline process operations for shellfish lease applications and permit applications	Lease and franchise specific permit fields have been standardized.	2013
Process Operations/ Customer Support/ Education	Review and streamline process operations for shellfish lease applications and permit applications	All conditions, rules and reporting forms are mailed out with permit applications	2013
Process Operations/ Customer Support	Review and streamline process operations for shellfish lease applications and permit applications	Renewal permit applications are mailed with the applicants information already listed on the application. The applicant need only review, make any applicable changes, and return the application.	2013
Process Operations/ Customer Support	Review and streamline process operations for shellfish lease applications and permit applications	Rules and conditions now printed on back of each issued permit.	2014
Customer Support/ Education	Create website with information, applications and maps	Website created with Lease Information, Applications and Permit Applications. Maps ongoing.	2014

7.1.5 HISTORICAL AQUACULTURE

There is no evidence of clam aquaculture in North Carolina before 1950 but several leases existed for holding surplus clams until market conditions improved (Chestnut 1951a). Carricker (1959) successfully spawned and raised clam larvae from Chesapeake Bay during the 1950s and minimal success was achieved with clams from North Carolina in the 1960s (Porter 1964). Bayer and Chestnut (1964) began a project to determine the potential of rearing clams in North Carolina in February 1963. Their work consisted of spawning adult clams, rearing larval clams to the juvenile stage and then broadcasting the seed over bottom. Problems included mass mortalities of larvae because of disease and predation of seed not covered with mesh screens (Bayer and Chestnut 1960). Other aquaculture operations over the next 15 to 20 years experienced varying levels of success because of predation resulting from lack of covering seed. North Carolina shellfish growers began to purchase seed clams from various out of state clam hatcheries and nursery companies in the 1990s.

The importation of shellfish seed has become an integral part of many aquaculture operations and shellfish growers in North Carolina. The few shellfish hatcheries in North Carolina are

unable to produce sufficient number of seed to meet the demands of shellfish growers. Therefore, shellfish growers must use out-of-state sources for shellfish seed. The importation of shellfish seed into North Carolina was not regulated prior to 1986. The Atlantic States Marine Fisheries Commission (ASMFC) addressed the potential danger of spreading shellfish pest, predators, and disease in their October 1986 meeting. The states of Maine, New Hampshire, Massachusetts, Rhode Island, Virginia, North Carolina, South Carolina, Georgia, and Florida endorsed a cooperative agreement. The agreement assigned the responsibility of controlling imports to the importing state. In this fashion, the importing state retains the ultimate authority to accept or reject any shipment of shellfish. The exporter retains the ultimate responsibility of proving the health status of shipments.

The ASMFC Interstate Shellfish Transport Committee drafted a plan implementing the Cooperative Agreement (ASMFC 1989). Although the agreement was endorsed by the member states, the implementation of the plan has not been consistent across the states. The NCDMF policy is to follow the guidelines set forth in the ASMFC Cooperative Agreement. NCDMF requires certification, by the seed seller, to ensure that shellfish seed shipment is free of shellfish pests, predators, pathogens, or parasites, with documentation that the exporting facility uses sterile hatchery procedures that would not contaminate the shipment (sterile closed system or treatment of incoming water). A documented history that organisms from the exporting facility have had no incidence of contamination is also required. The applicant is responsible for obtaining the certification. This policy is consistent with policies in Maine, Rhode Island, Virginia, and South Carolina, although not as restrictive.

A selected management strategy in both the Oyster and Hard Clam FMP in 2001 was to formulate and amplify policy on the importation of marine and estuarine organisms. Based on information gained from the Eastern United States Interstate Shellfish Seed Transport Workshop held in Charleston, South Carolina in February 2002, the NCDMF reviewed and updated the disease assessment protocols as part of the criteria for issuance of Permits to Introduce or Transfer Marine and Estuarine Organisms into the Coastal Waters of the State of North Carolina. The only significant modification deemed necessary was to increase the number of organisms for analysis from 30 individuals to 60 from each batch.

The shipping window, or time between sample removal from the batch and delivery, was also assessed. It was determined that a thirty-day shipping window was the shortest timeframe practical to complete an assessment, submit a report, issue a permit, and deliver a sample. The concern with the shipping window was due to the possibility of events that could cause infections or infestations of the remaining individuals in the batch during the assessment and processing timeframe. The permitting procedures require testing by a qualified laboratory but are not specific in the testing requirements. By not specifying the testing requirements, there is flexibility to use historically acceptable procedures and to develop new technologies. The flexible range in testing also allows for specified testing, including analyses prescribed for species-specific diseases. The testing criteria for the issuance of the permit provides a measure of oversight of species legally entering our waters. It is also required that shellfish lease holders provide documentation of the source of their shellfish seed in order to receive credit towards their mandatory production limits. Additional reinforcement to comply with the permit requirement for shellfish lease holders is that they are required to provide documentation of the source of their shellfish seed to receive credit towards their mandatory production limits, seed originating outside the state without an accompanying permit are illegal and are not credited toward the lease production. The importation of seed hard clams into North Carolina has been minimal. In 2012, four importation permits were issued for hard clams; in 2013 six

were issued and in 2014 three importation permits were issued. All clam seed imports to North Carolina during this period were from Virginia, South Carolina, and Florida.

7.1.6 PRESENT PRIVATE SHELLFISH CULTURE: SHELLFISH LEASES AND FRANCHISES

The NCDMF administers the shellfish lease program whereby state residents may apply to lease estuarine bottom and water columns for the commercial production of shellfish. The NCDMF does not differentiate between clam, oyster, bay scallop, and mussel leases; therefore, allowing shellfish growers to grow out multiple species simultaneously or as their efforts and individual management strategy allows. For the period of 2003-2013, roughly 35% of all private culture operations harvested only clams (Table 7.3).

Table 7.3. Private culture operations harvesting clams or oysters, 2003-2013. TTP.

Year	Total Number of Private Culture Operations	Total Number Submitting Trip Tickets	Harvested Only Oysters	Harvested Only Clams
2003	270	161	34	74
2004	265	151	33	63
2005	260	153	32	62
2006	247	149	39	55
2007	244	143	37	49
2008	246	135	34	49
2009	237	131	39	42
2010	239	144	42	43
2011	236	141	49	43
2012	237	138	42	42
2013	236	138	40	30

An application for a bottom or water column lease must be submitted along with a management plan, a map of the site, and a \$200.00 application fee for a bottom lease. A \$100.00 application fee also applies for a water column amendment, if so desired by the applicant. Once the application is received, NCDMF investigates the site and NCDMF Biologists, Marine Patrol and Shellfish Sanitation officials review the resulting report prepared by NCDMF staff. Hearings are held to solicit public input regarding the issuance of a proposed lease. The Secretary of the NCDEQ or his proxy then evaluates the proposed lease. After approval by the Secretary, the applicant must provide a survey plat before execution of the lease contract. The contract includes production and reporting requirements and yearly lease fees. Contracts prior to 2009 were renewable on a 10-year cycle for a shellfish bottom lease and a five year cycle for water columns; contracts after 2009 are on a five year contract cycle for both the shellfish bottom lease and the water column.

Applicants and transferees not currently holding a shellfish cultivation lease, and applicants and transferees holding one or more shellfish cultivation leases which are not meeting production requirements are required to complete an examination, with a minimum of 70 percent correct answers, based on an educational package provided by NCDMF. The educational package is

based on General Statutes and MFC Rules pertaining to shellfish leases. Rules and General Statutes are provided to applicants and transferees.

Once the lease contract is issued, leaseholders are authorized to begin operations. Production standards exist for both planting and harvest. Shellfish bottom leases are required to plant 25 bushels of shellfish seed or 50 bushels of cultch per acre per year or a combination of both to meet 100% of the planting requirement. Shellfish bottom leases must harvest and market 10 bushels of shellfish per acre each year. Water columns must either plant 100 bushels of seed/cultch, or harvest and market 40 bushels of shellfish per acre per year. The ability to meet production standards continues to be an issue for some leaseholders. Possible causes include localized environmental issues, weather events, market changes, lack of investment opportunity, improper management and inability to work the lease.

Hard clams were once the principal species produced on private culture operations in North Carolina up until 2003. Unique environmental conditions enable the use of various hard clam culture methods. As of August 2014 there were 50 shellfish franchises, 174 shellfish bottom leases and 13 water column leases on 1,696 acres (Table 7.4). In 2013, 95 private culture operations harvested and sold 4,256 bushels of hard clams.

The number and acreage of private culture operations has remained relatively consistent in the period of 1994-2013, while the planting of clam seed and the relaying of clams have greatly fluctuated over time (Figure 7.25).

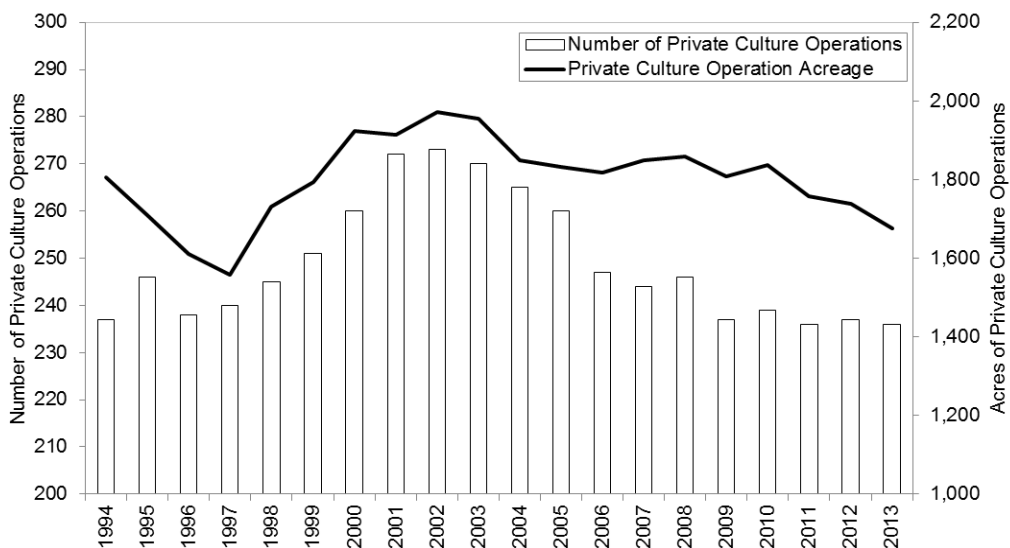


Figure 7.25. Number of private culture operations and associated acreages by year (1994-2013). NCDMF Shellfish Lease and Franchise Program Fisheries Information Network data.

Table 7.4. Reported hard clam leases, planting, and harvesting activities, 1994-2013. NCDMF Shellfish Lease and Franchise Program from FIN and the TTP. Calculations based on verified planting effort reporting (in bushels) from annual lease rent notices and trip tickets.

Year	Number of Private Culture Operations	Private Culture Operation Acreage	PLANTED (bu)											HARVESTED (bu)					
			CULTCH						SEED		Adult			Clam	% of State's Clam Landings	Oyster	% of State's Oyster Landings	Blood Clam	% of State's Blood Clam Landings
			Oyster	Marl	Rock	Shell	Surf Clam	Unknown	Clam Seed	Oyster	Clam Relay	Blood Clam	Oyster						
1994	237	1,806		1		0		50,216	4,189	539	13,726		12,961	5,889	8.0%	2,782	9.6%	12	0.7%
1995	246	1,709						21,017	25,690	418	4,327		9,731	8,185	11.0%	4,081	11.7%	10	0.6%
1996	238	1,612						22,227	46,815	2,545	4,241		11,478	7,006	10.3%	4,445	14.6%	199	14.5%
1997	240	1,559						14,968	42,388	7,415	1,589		10,826	9,837	12.0%	5,264	16.6%	45	6.2%
1998	245	1,730				0		17,667	18,592	490	5,415		14,436	12,057	14.9%	5,576	15.8%	42	3.3%
1999	251	1,795		500		311		29,695	28,842	418	5,443		15,891	12,501	18.3%	5,676	15.3%	13	2.1%
2000	260	1,923						35,933	37,774	601	6,196		17,463	12,191	15.0%	3,804	11.5%	2	0.2%
2001	272	1,914	3,482			841		12,269	36,743	184	3,240		14,211	12,454	13.9%	6,114	13.5%	6	0.4%
2002	273	1,971	6			3,573		12,361	25,118	401	25,890		15,824	10,234	14.2%	6,363	14.4%	61	5.1%
2003	270	1,954	5,240			12,521		11,541	37,323	6,585	793		13,302	7,505	11.4%	6,532	13.4%	69	3.8%
2004	265	1,849	1,515			15,533		2,228	12,904	4,875	959		18,062	7,959	11.7%	9,993	14.7%	108	8.0%
2005	260	1,832	216			13,917		4,390	8,097	4,909	1,501		26,077	8,446	16.0%	10,921	15.5%	39	4.8%
2006	247	1,819	1,622	100		8,223		6,512	7,522	2,432	505		23,217	7,492	14.0%	11,621	13.8%	27	3.3%
2007	244	1,849	3,340		2	14,495	35		7,645	3,818	846	5	27,064	5,894	10.8%	10,117	12.2%	14	0.7%
2008	246	1,858	5,000			15,927			7,967	655	410		23,730	4,843	10.0%	9,567	11.0%	33	1.1%
2009	237	1,808	4,667	1,333		7,494		1,487	9,080	3,105	449		21,470	5,311	11.9%	6,291	5.9%	26	2.2%
2010	239	1,836	30			3,250		9,124		6,981	5,882		15,986	5,183	11.5%	9,534	4.9%	39	2.3%
2011	236	1,756	385		5,289	17,698		1,058	12,845	7,388	1,124	10	24,475	4,124	11.0%	11,090	7.4%	42	4.1%
2012	237	1,739	400	191	1,778	6,373			700	1,245	223		19,398	5,791	11.6%	8,176	10.0%	67	6.4%
2013	236	1,677	93	122	105	3,647			600	1,044	811	15	13,963	4,256	9.6%	9,853	9.3%	14	1.2%

Seed supply is critical to successful clam production. Most shellfish growers in North Carolina rely on hatchery-produced seed clams for planting. A few small-scale hatcheries operate in North Carolina. However, there are currently no large-scale shellfish hatcheries in the state that can currently supply the industry's current needs, thus most clam seed are imported from other states. An importation permit is required to bring seed clams in from other states.

Shellfish growers purchase small seed clams (2-9 mm) from the hatchery for grow out in raceways and upwellers. Nursery grow out operations require an approved aquaculture operations permit and allow seed clams to grow in high densities while offering protection from predation and sedimentation. During this nursery phase seed are sorted and graded multiple times. Once seed is large enough (10-15 mm) the seed clams can be planted for grow out. A high level of mortality can occur if seed clams are not grown out to larger size prior to the grow out production phase. Larger seed clams (10-15 mm) can also be purchased from hatcheries and directly planted for grow out.

Clam grow out can be accomplished using a variety of methods or combinations of methods. The most basic approach is for shellfish growers to use their lease or franchise for the natural setting of clams. In most areas this approach often yields low production and fails to realize the full production potential of many leases and franchises.

As part of the planting requirement for a shellfish lease, leaseholders must either plant cultch or shellfish to meet production standards. Cultch plantings are used to attract natural settlement of hard clam spat. Growers can produce clams by planting shell cultch and later harvesting the crop of clams that settle underneath and within the cultch. The cultch adds some protection from predation. Growers also can plant larger size (>12mm) seed clams within cultch. Cultch planting is not used as extensively for clams as with oysters. Harvesting is allowed by hand and mechanical gear that require adherence to regulations established by MFC.

The most common version of clam grow out in North Carolina is the bedding of clams. The most basic method for the bedding of clams is planting clams on the firm bottom and covering with mesh netting which is anchored to the substrate. This mesh net covering eventually evolved to the use of a top and bottom cover, usually tied together, which led to the creation of the modern grow out bottom bags. In this method clams, usually 10-15 mm, are placed in mesh bags at densities from 40 to 60 per square foot for grow out.

Mesh size is determined by the size of the clams and availability of resources. Shellfish growers who use bagged/bedded clam grow out methods typically have higher production rates relative to those using natural set or loose seed broadcast methods. This may be a result of inherent protection from predators provided by the mesh bags. Bagged or bedded grow out methods usually produce marketable clams in one to two years, depending on environmental conditions. Often shellfish growers rotate through harvest and planting cycles on the lease or franchise to use all available space and maintain a steady supply of marketable product.

The transplanting of polluted clam stocks is another widely used method for providing clam seed to shellfish leases and franchises. Clams are relayed from areas closed to shellfishing that are classified as Restricted onto shellfish leases and franchises in open waters during a 6-week relay season opened by proclamation in April of each year. Shellfish leases and franchises participating in the polluted area relay of shellfish remain closed for harvest to allow depuration until reopened by a NCDMF Proclamation no earlier than 21 days from the end of relay season. During the 2013 Polluted Area Relay season, 87 shellfish leases and franchises applied for the permit, and 43 permittees reported the relay of oysters (Table 7.5).

Table 7.5. Polluted area relay for 2013.

2013 Polluted area relay species	Bushels reported relayed	Permittees reporting relay
Shell cultch	1,972	43
Hard clams	459	40
Blood clams	15	40
Oysters	14,543	43

The relaying of clams and clam seed has been used in the past as part of North Carolina's oyster enhancement activities as well as being used on private culture operations through the annual Polluted Area Relay permit. The Polluted Area Relay permit provides the opportunity to relay clams and oyster out of specific polluted areas to private culture operations with NCDMF coordination. Private culture operations receive the permit application in March of each year. The relay period is proclaimed and occurs in April of each year. The private culture operations permitted remain closed for harvest to allow for depuration until reopened by proclamation.

Between 2007 and 2011, NCDMF received several requests to allow the nursery and transplant of seed shellfish from prohibited waters. The issue of allowing nursery of seed shellfish in prohibited waters was first brought forward in 2007 with a request for an Aquaculture Operation Permit (AOP). NCDMF denied the permit request in 2008 based on the NSSP model ordinance, NC Shellfish Sanitation rules. From these requests, the MFC initiated a review of NCDMF rules on the nursery of seed shellfish in prohibited waters. The MFC reviewed the denial of the permit and through a Declaratory Ruling of the Commission in 2008. During this process, the MFC initiated a review of NCDMF rules on the nursery of seed shellfish in prohibited waters and found that the rules were properly interpreted in the denial of the permit. In response to additional requests for an AOP in the prohibited waters of the marina, NCDMF collected oyster samples within the prohibited waters of the marina for analysis of heavy metals. A public health risk assessment using the sample results from the oysters was conducted by the Occupational and Environmental Epidemiology Branch (OEEB) of the Division of Public Health. Results of the testing found elevated levels of arsenic (a known human carcinogen) and zinc compared to published United States Environmental Protection Agency (EPA) reference dose values and cancer slope values by OEEB. The risk assessment from OEEB determined there is an increased health risk over time upon consumption of the oysters from the marina. In 2011, the MFC revisited the issue with a request to nursery seed shellstock within a marina in Whiskey Creek in New Hanover County and agreed by consensus that the nursery of shellstock in prohibited waters to be transferred to leases is an unacceptable practice.

Additional correspondence from the Secretary of NCDEQ to the request for the AOP for nursery of seed in the prohibited waters of a marina concluded that the cultured and/or wild harvested shellfish marketing can be adversely affected by incidences of health issues associated with shellfish from prohibited shellfish harvest waters. While North Carolina rules may be more restrictive than other states, the Secretary believes that the current rules are protective and prudent for the shellfish industry in North Carolina and adds an extra margin of safety for the citizens of the state.

The practice of relaying shellstock from polluted shellfish harvesting waters to unpolluted bodies of water for a sufficient time for the shellstock to purge themselves of contaminants must be carried out with public health controls in place to not allow human consumption of harmful shellstock. Provided that the relaying process takes the proper control measures to assure that

contaminated product does not reach the consumer, it is a way to allow the use of a valuable shellstock resource that would otherwise not be available to the shellfish industry.

Legislation passed in 2014 modified G.S. 113-203 with regard to the transplanting of oysters and clams. The legislation now allows for the transplant of seed oysters or seed clams from a permitted aquaculture operation which is located in waters that are classified as “restricted” or “conditionally approved” to shellfish harvesting to private shellfish culture operations, which includes franchises, leases, Under Dock Oyster Culture permit and other AOPs that are classified “approved” (open) with an Aquaculture Seed Transplant Permit (ASTP).

With an ASTP, the shellfish from restricted waters can be harvested for human consumption after an effective treatment process. The effective treatment process for these shellfish may be executed by means of relaying or depuration. The legislation also allows for the transfer of seed oysters and seed clams to a private culture operation outside the standard relay season.

The use of prohibited waters for the taking or raising of seed shellstock, live in-shell bivalve mollusks, is permitted under the NSSP provided the seed shellstock is not contaminated with unacceptable levels of poisonous or deleterious substances, including marine biotoxins, heavy metals or chemical contaminants. Seed shellstock can come from any classified waters provided the source of the seed is sanctioned by the Authority; must have acceptable levels of poisonous or deleterious substances; and seed from growing areas in the prohibited classification are cultured for a minimum of six months. The determination of what waters can be used for the nursery of seed is up to each individual state.

Both “restricted” and “prohibited” classified waters are closed to shellfish harvesting. The differences in these classifications are the contaminants causing the closure. “Restricted” waters are contaminated with moderately high bacteria levels that through relaying to “approved” classified waters or a depuration process can be purged of those bacteria to safe levels. “Prohibited” waters can be contaminated with high bacteria levels and also other pollution sources such as point source discharges (i.e. wastewater treatment plants and marinas) that may harbor pathogenic viruses, heavy metals, pesticides, poisonous or deleterious substances, that may or may not purge after a standard relaying process.

Public opposition to shellfish leases has become an issue in some areas. In 2002-2003, public opposition to shellfish leases in Core Sound led to constituents contacting their representatives and Senate Bill 765 was passed and enacted as Session Law 2003-64. This legislated an indefinite moratorium which restricted the growth of shellfish leases in Core Sound, allowing only existing leased areas to remain. Obtaining new leases may be difficult depending on the region of the coast. The public often opposes leasing on the grounds that it is a violation of public trust that waterfront residents don’t want to view the lease from their property and due to potential conflicts between commercial fishermen and leaseholders. A moratorium on shellfish leases has existed in Brunswick County since 1967 due to public opposition by county residents with regard to an already limited area available to shellfish on public bottom.

Once leases are granted, theft often becomes difficult for many leaseholders to maintain. Leases are often located away from shorelines and difficult to observe. There is little to deter theft as the court system has seldom imposed high fines on the rare individual actually caught poaching on a lease.

7.1.6.1 ANNUAL LANDINGS, TRIPS, AND MARKET GRADES

Private enterprise has provided nearly 12% of the total commercial hard clam harvest in North Carolina between 1994 and 2013. The annual average hard clam landings from 1994 to 2013 from private production were 3,236,081 clams.

The number of trips harvesting hard clams has declined slightly since 2005 from private production (Figure 7.26). Newport River and Core Sound are the top two areas where hard clams are harvested from private production in North Carolina and accounted for 62% of the landings from 1994 to 2013 (Figure 7.27).

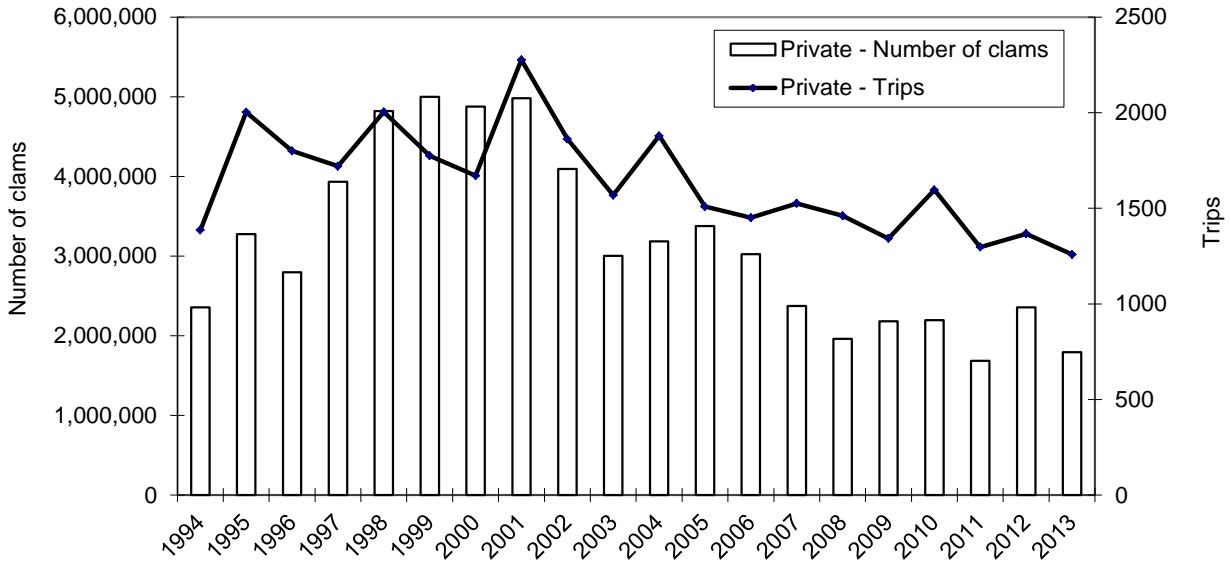


Figure 7.26. North Carolina commercial hard clam landings (Number of clams) and trips from private production, 1994-2013. TTP.

Private

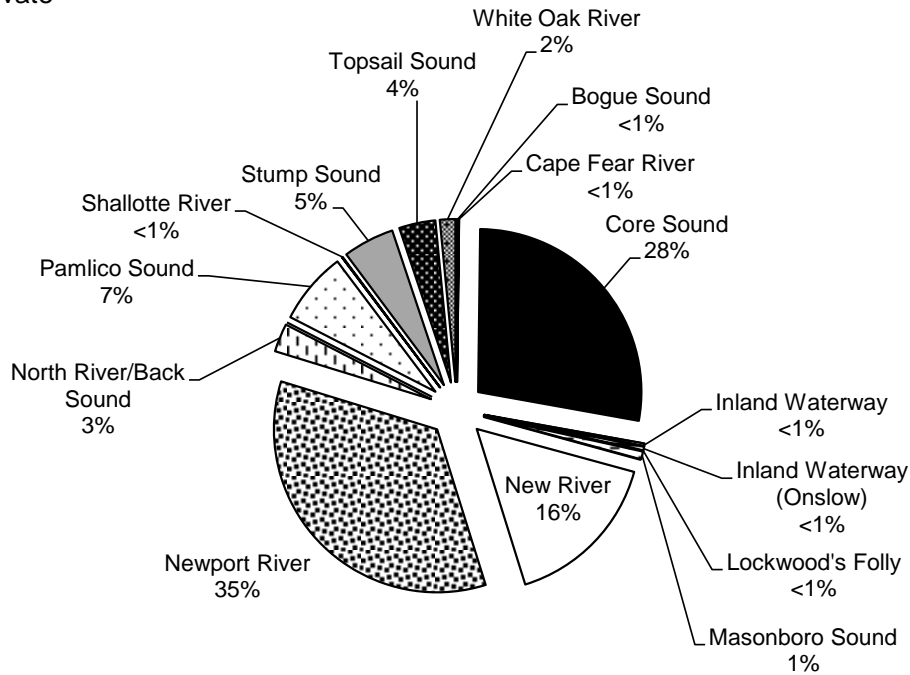


Figure 7.27. Commercial hard clam landings (percent to total) by waterbody from private culture operations, 1994-2013 combined. TTP.

A mixed or unclassified market grade is the most common hard clam size category from private production and comprised 8% of the total landings from 1994 to 2013 (Figure 7.28a). The little necks market grade is the second most dominant category in the hard clam landings from private production (Figure 7.28b). From 1994 to 2013 little neck hard clams comprised <1% to 6% of the total hard clam landings from private production. The proportion of hard clams as top necks, cherry, top cherry and chowder market grades have remained about the same from year to year (Figure 7.28b). These four market grades only make up a small proportion of the total hard clam landings (Figure 7.28b).

Clams reared on shellfish leases and franchises are exempt from size limitations for marketing purposes. Limited markets exist for clams as small as 7/8-inch (22.0 mm) thick. The minimum size for wild-harvested clams is 1-inch (25.0 mm) thick. If a grower can develop a market for smaller clams, the risk of mortality and time-to-market are reduced, increasing the economic viability of the operation. Since the amendment to the Hard Clam FMP in 2008, changes to G.S. 113-168.4(b) (3) provided exemption for a trip ticket to reduce double counting when the sale is to an AOP, Under Dock Oyster Culture permit, or shellfish lease for further grow out.

A.



B.

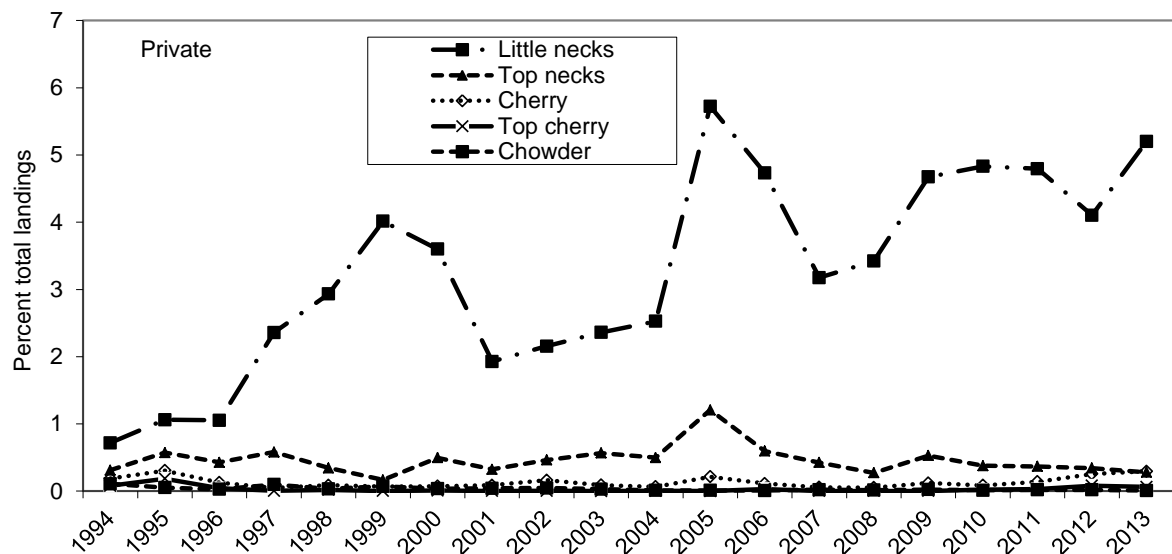


Figure 7.28. Total annual hard clam landings (Percent of annual total landings) from private production by market grade, 1994-2013. A. Mixed grade only; B. All other market grades. TTP.

7.1.6.2 HAND HARVEST

Hand harvest from shellfish leases and franchises is a year round fishery and has average landings of 2,474,697 clams a year (1994-2013). Over 57% of the hard clam landings from private production using hand gears occurs from May to August (Figure 7.29). The number of hand harvest trips from private production fluctuates from year to year with an average of 1,880 trips a year from 1994 to 2013 (Figure 7.30).

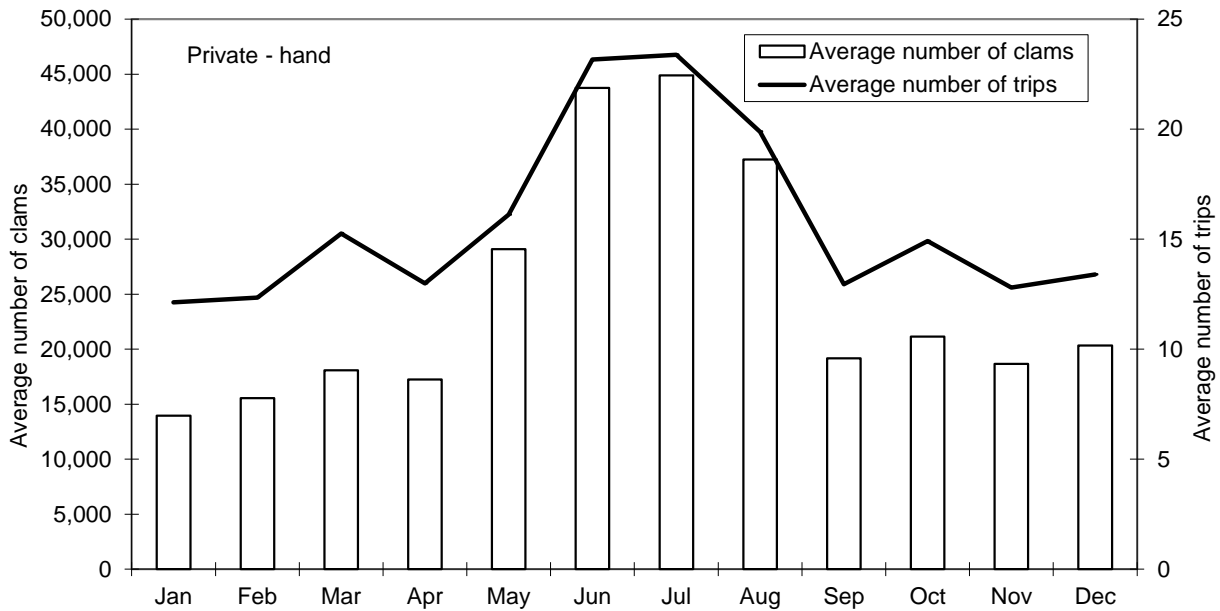


Figure 7.29. Average monthly hard clam landings (Number of clams) and average number of trips from private production using hand gears, 1994-2013. TTP.

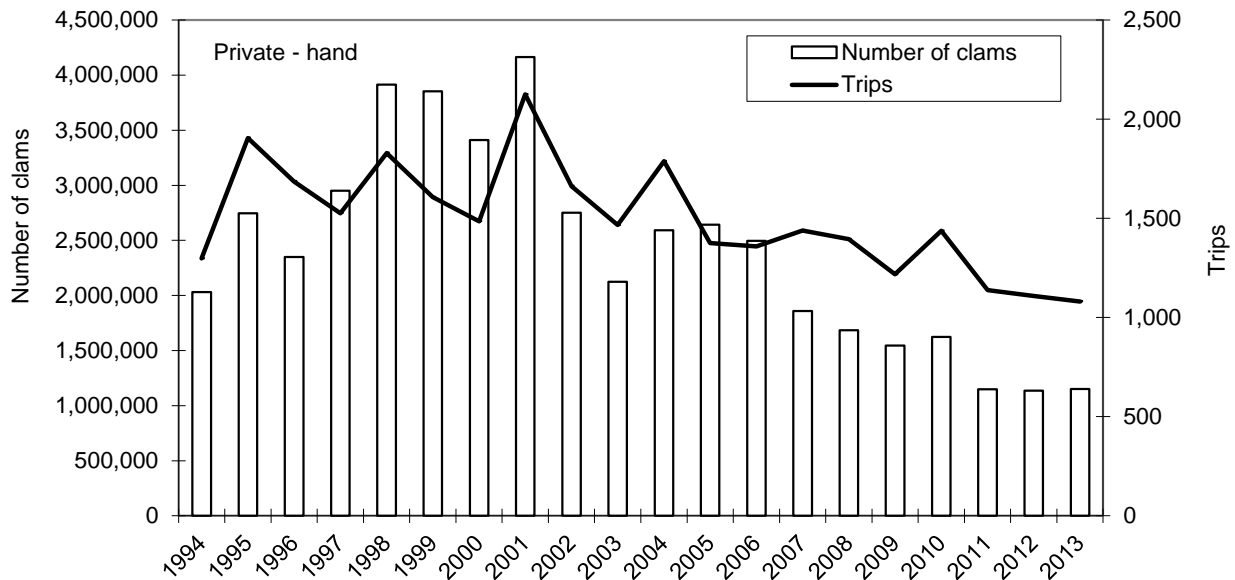


Figure 7.30. Annual hard clam landings (Number of clams) and trips from private production using hand gears, 1994-2013. TTP.

7.1.6.3 MECHANICAL HARVEST

There is no mechanical harvest season for harvesting shellfish from leases or franchises. Leaseholders can harvest shellfish using mechanical methods anytime as long as they have a permit for the gear.

Hard clam harvest from private production using mechanical methods has average landings of 761,384 clams a year (1994-2013). Hard clam harvest is highest from March to August on private bottom with mechanical methods (Figure 7.31). Landings and trips with mechanical gears from private production fluctuate from year to year from 1994 to 2012 and showed a significant increase in 2012 (Figure 7.32). Recent harvest trends, except in 2012, are lower than the average annual landings for the 19-year time series.

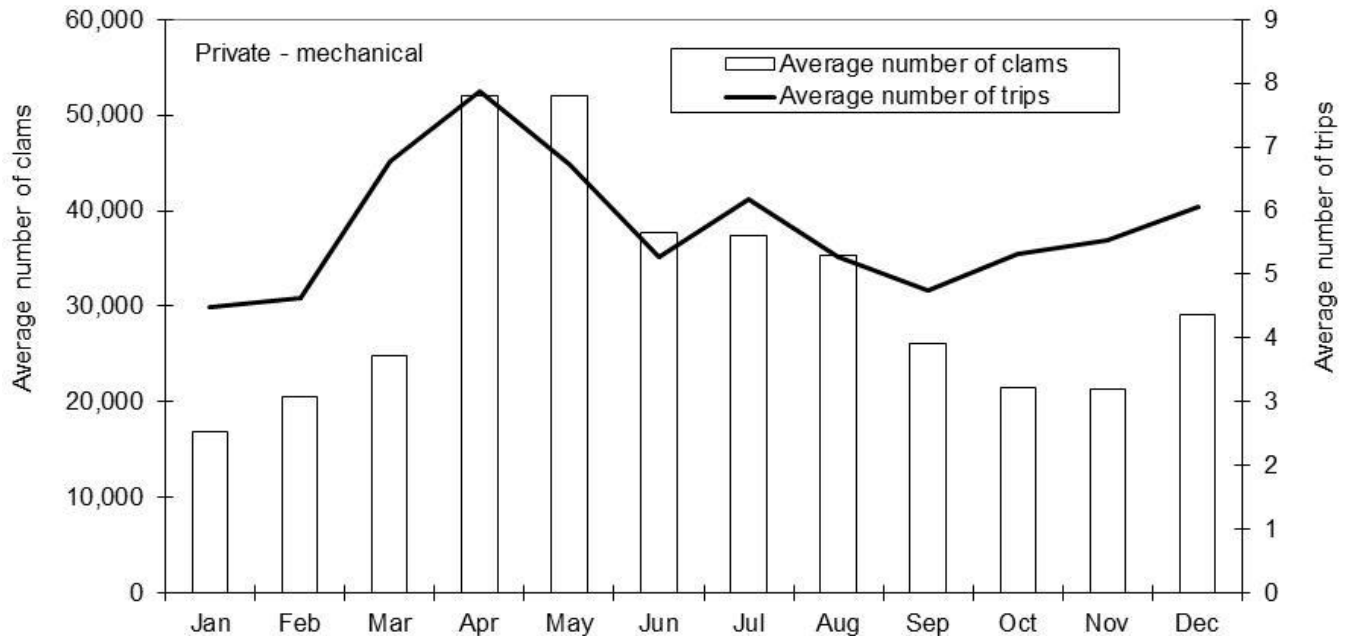


Figure 7.31. Average monthly hard clam landings (number of clams) and average number of trips from private production using mechanical gears, 1994-2013 combined. TTP.

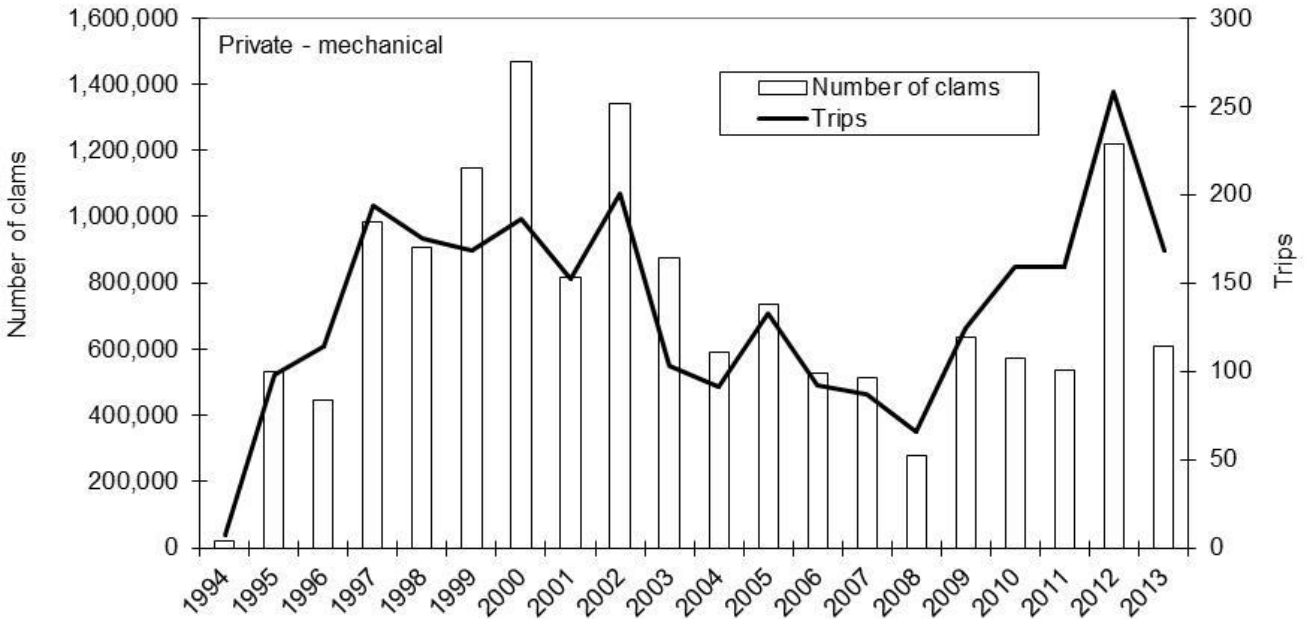


Figure 7.32. Annual hard clam landings (Number of clams) and trips from private production using mechanical gears, 1994-2013. TTP.

7.1.7 PRESENT AQUACULTURE

Aquaculture in North Carolina is currently defined under Article 63, Aquaculture Development Act as the propagation and rearing of aquatic species in controlled or selected environments, including but not limited to, ocean ranching (G.S. 106-758). Aquaculture is considered a form of agriculture and the Department of Agriculture and Consumer Services is designated as the lead state agency in matters pertaining to aquaculture (G.S. 106-759). The Department of Agriculture and Consumer Services has the authority to regulate the production and sale of commercially raised freshwater fish and freshwater crustacean species. Rules have been developed by the Board of the Department of Agriculture and Consumer Services to register facilities for the production and sale of freshwater cultured species, and set standards under which the commercially reared species may be transported, possessed, bought, and sold. The governing body of the Department of Agriculture and Consumer Services is limited to commercially reared fish and does not include authority over the wild fishery resource which is managed under the authority of the Wildlife Resource Commission (G.S. 106-761(a)). The Department of Agriculture and Consumer Services has the power and duty to provide aquaculturists, with information and assistance in obtaining permits related to aquaculture activities promote investment in aquaculture facilities to expand production and processing capabilities, and to work with the appropriate state and federal agencies to develop and implement policies and procedures to facilitate aquaculture development. The North Carolina Department of Agriculture & Consumer Services issues the aquaculture licenses. The license is for any person who owns or operates an aquaculture facility for the purpose of possession, production, transportation, sale or commercial growout. Twenty-two species are approved for propagation and production, with no shellfish species listed: <http://www.ncagr.gov/markets/aquaculture/documents/ExplanationoftheAquacultureLicense.pdf>. Possession of any species other than those on the list is not allowed except with special written permission from the Wildlife Resources Commission. Three of the 22 species have specific restrictions that also must be approved through the Wildlife Resource Commission.

The General Assembly gives the MFC the authority to make rules and take all steps necessary to improve cultivation, harvesting, marketing of shellfish in North Carolina both from public and private beds (G.S. 113-201). The General Assembly also gives the MFC jurisdiction over the conservation of marine and estuarine resources including the regulation of aquaculture facilities as defined in G.S. 106-758 which cultivate or rear marine and estuarine resources (G.S. 113-132). Through this authority, the NCDMF administers the Shellfish Lease and Franchise Program for the purposes of shellfish cultivation and aquaculture within the State of North Carolina.

An AOP is required for aquaculture operations that involve rearing of finfish or shellfish in a land based facility (tanks, ponds, raceways, etc.) or in any contained structure in submerged waters (cages, bags, racks). The NCDMF through authority of 15A NCAC 03O .0503 (f) (1) works with the North Carolina Department of Agriculture and the North Carolina Wildlife Resource Commission to provide for the issuance of an AOP. The NCDMF is the agency responsible for issuing and ensuring compliance of AOPs for marine or estuarine fish and shellfish species. The AOP provides the opportunity to conduct aquaculture operations that produce artificially propagated stocks of marine or estuarine resources or obtains such stocks from authorized 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: predator protection, food, water circulation, salinity, or temperature controls using technology not found in the natural environment. The AOP is an annual permit that requires renewal. In 2012, thirty-two AOPs were issued, with nineteen relating to clams. In 2013, thirty-two AOPs were issued, with twenty-one specified for clams.

Despite the addition of water column use on approved lease sites in 1989, increased N.C. Sea Grant outreach, and grant funding for aquaculture research through the Fisheries Resource Grant Program, early interest in using hatchery-reared seed and modern aquaculture techniques to culture shellfish remained minimal until 2012. Since 2012 the number of water column leases issued continues to grow. To be considered aquaculture by NCDMF, the product has to come from hatchery reared stock. Aquaculture operations cannot harvest from the wild stock and then grow out. Both oysters and clams are exempted from size limits and seasons on private culture operations/aquaculture operations.

In response to introduced legislation (Senate Bill 550) and budget appropriations during the 2005-2006 Legislative session, the North Carolina Aquariums Division created the North Carolina Oyster Hatchery Program and appointed an interagency committee. The committee included representatives from state agencies (the Aquariums, NCDMF, and North Carolina Sea Grant), colleges and universities (UNC-Chapel Hill, UNC Coastal Studies Institute, UNC Wilmington (UNCW), Carteret Community College) and the NC Coastal Federation (NCCF). The committee met throughout 2005-2006 to develop recommendations regarding a state-supported hatchery system and associated programs that would inform and contribute to oyster restoration and aquaculture. A system including three hatcheries and two remote setting sites was proposed to address the varied challenges facing oysters. Beyond this infrastructure, the North Carolina Oyster Hatchery Program recommendations included programs for education, training, and research that would complement and enhance production goals. While the focus was to be the culture of the eastern oyster (*Crassostrea virginica*), it was agreed that the facilities could be used to support research and development of culture strategies for other commercially important shellfish species (i.e. bay scallops and hard clams).

The mission of the Shellfish Research Hatchery (SRH) is to conduct and facilitate research that will both inform and contribute to North Carolina's efforts to restore declining populations of

ecologically and commercially important shellfish, and to build a sustainable shellfish aquaculture industry (UNCW 2009). In 2007, Senate Bill 1813 proposed \$7,682,107 for capital and operating expenses prior to the economic crisis of 2008.

Since 2008, only a portion of the recommendations made by the North Carolina Oyster Hatchery Program were moved forward, with the General Assembly authorizing and providing \$4.3 million for the construction of a research hatchery at UNCW's Center for Marine Science. Construction was initiated in late August 2009 under the supervision of NCDMF. An NCDMF advisory committee (the Hatchery Advisory Committee) was appointed in 2008 (including UNCW, NCDMF, NCCF and industry stakeholders) to make recommendations on research objectives, hatchery design and general operations. Upon completion in February 2011, the SRH was turned over to UNCW to operate. While the absence of consistent programmatic funds has constrained development of a long-term research agenda, the SRH staff has implemented programs according to a strategic plan developed and approved by the Hatchery Advisory Committee, and consistent with the overall mission to conduct and facilitate research that will both inform and contribute to North Carolina's efforts to restore declining populations of ecologically and commercially important shellfish, and to build a sustainable shellfish aquaculture industry. In 2012 a breeding program was initiated, with support from North Carolina Sea Grant and the New Hanover County Farm Bureau, and was based on oysters from five locations in North Carolina. Another four sources were spawned in 2013. Oysters resulting from the hatchery breeding program are being field tested on private farms as well as at the hatchery's test farm at UNCW Center for Marine Science. Additional research is being done on the performance advantage resulting from triploidy, and on crop diversification through the development of culture practices for bay scallops and sunray Venus clams (A. Wilbur, SRH UNCW, personal communication). In 2007, Senate Bill 1813 proposed \$7,682,107 for capital and operating expenses prior to the economic crisis of 2008. As of 2014 no funds have ever been appropriated. Current programs, staff and students are supported by funds provided by UNCW.

The SRH was not designed to produce seed at the scale needed by the industry nor was supplying the industry ever seen as a mandate for the facility, although any seed not needed by the in-house or collaborative research projects are made available to the industry. Existing policies have established a framework for hatchery operation and will be reviewed during the development of the 2016-2021 strategic plan.

Other states, such as Maryland and Virginia have active state supported hatcheries that effectively work with commercial hatcheries and state agencies. In 2003 Maryland completed the 25 million dollar construction of the Horn Point Laboratory at the University of Maryland, Cambridge. This modern facility supports finfish and shellfish aquaculture efforts. Due to the variable mesohaline conditions in the Maryland portion of the Chesapeake Bay, even the lower Maryland waters of the Chesapeake Bay sometimes do not provide adequate long term salinity for hard clam aquaculture. However hard clam aquaculture exists in Maryland within its coastal bays in Worcester County.

In 2013 the Horn Point Lab Oyster Hatchery produced 1.25 billion spat and 4 billion eyed larvae. Mandates for the Horn Point researchers include growing "cultch-less" oysters and determining if the Chesapeake Bay could sustain a fishery based on hatcheries like the west coast does. The state of Maryland also supports hatchery-based-restoration (HBR) efforts in the Chesapeake Bay. Continued long term support from the Maryland General Assembly and the State's Governor along with partnerships from watermen, private industry, conservation groups,

local and state government have led to the expedient growth of aquaculture and restoration efforts in Maryland.

Virginia has several large hatcheries, including the Virginia Institute of Marine Sciences (VIMS) at Gloucester Point. This hatchery maintains oyster broodstock lines to support local commercial hatcheries. Virginia also supports HBR efforts in the Chesapeake Bay. The current restoration plan also offers incentive money to commercial hatcheries to produce larvae and build the infrastructure to meet the increased demand for spat. The growth of hard clam aquaculture industry in Virginia is partially due to research and culture methods that initially occurred at the Virginia Institute of Marine Science (VIMS) in the 1960s through the 1970s. Clam research continues at VIMS as well as through private hatcheries in Virginia. Since the mid-1990s, Virginia's hard clam aquaculture has grown tremendously. In 2013 Virginia aquaculturist planted 516 million clams for growout, an increase of 66 million from 2012 (VIMS 2014).

In North Carolina, aquaculture education is currently available through online continuing education programs, certificate, diploma and degree programs through both Carteret Community College and Brunswick Community College; through Marine Biology degree programs with mariculture emphasis and the Aquaculture Program at UNCW. NCSU cooperative Extension office and the U.S. Department of Agriculture's Southern Regional Aquaculture Center currently provides aquaculture extension services and information for aquaculture; but the majority of this information is focused on species other than shellfish. NC Sea Grant provides research, education and outreach opportunities. Aquaculture education and outreach is important to the development, implementation, and the progression of the shellfish aquaculture industry in North Carolina. When compared to Virginia, the type and amount of education, information and outreach available from North Carolina sources pales in comparison. Proposed legislation in 2015 may provide additional funds for education and outreach opportunities for shellfish aquaculture.

The North Carolina Shellfish Growers Association (NCSGA) was founded in 1995 to represent the interests of the many people involved in the shellfish industry. The NCSGA strives to provide insight into the many issues that affect the industry including shellfish sanitation and safety, the use of public waters, and the economic and environmental value of a shellfish industry. It serves as a forum for members to compare methods and materials, discuss important issues, and pursue a united agenda that encourages the growth of a prosperous shellfish industry (NCSGA 2015). With continued interest and growth in shellfish aquaculture, the NCSGA continues to grow and to be an active partner with regard to shellfish aquaculture issues, industry development and policy change.

With the recent growth of the private culture of shellfish through aquaculture-mariculture methods within the water column; in 2015 legislation has been introduced both in the bodies of the North Carolina General Assembly which supports shellfish aquaculture in North Carolina. Through new legislation, funding, cooperative efforts and legislative support for aquaculture, the growth and further development of shellfish aquaculture in North Carolina looks promising. The NCDMF has discussed developing an aquaculture management plan to further support the growth and challenges of the present industry as well as to plan and implement for the future. Issues affecting nearshore marine aquaculture include the growing human population associated with development pressures of the coastal communities and confusing or overlapping laws. Aquaculture challenges include lack of clear regulations and questions about exclusive access to public harvest areas. Proactive policies can prevent, or at least minimize some of the following potential environmental impacts: spread of disease among populations,

genetic contamination and competition between farmed and native stocks, effects from aquaculture operations on water quality, wetlands, and other natural habitats, waste, marine mammals and birds, which can be attracted to the food source and become a nuisance or pest in higher populated areas, and the risk of introducing non-native species (intentionally or unintentionally) (U.S. Commission on Ocean Policy 2004). It is often more difficult to back-track once unclear, conflicting policies or risky facilities are in place and impacts to the environment have already occurred. Proper planning will likely stimulate and guide the evolution of the aquaculture industry by providing incentives, safeguards, attracting investment and boosting development.

7.2 RECREATIONAL FISHERY

Hard Clams are commonly harvested recreationally year-round in North Carolina by hand and rakes. The limit allowed for personal consumption is 100 clams per person per day and 200 clams per vessel at a minimum size of 1-inch thick.

In an attempt to better understand the influence of recreational fishing on shellfish stocks NOAA and the USFWS completed a survey in 1985 to quantify recreational shellfish fishing activities in the United States (NOAA 1991). Shellfish were defined as all mollusks (i.e., scallops, mussels, oysters, and clams) and crustaceans (i.e., lobsters, crabs, and shrimp). The survey reported that in 1985, 129,972 fishermen expended 1,009,000 days fishing for shellfish in North Carolina. Unfortunately, due to data limitations trends in recreational catch and effort could not be accurately assessed at that time. Subsequently, the telephone portion of the Marine Recreational Fishery Statistics Survey (MRFSS) conducted in 1991 was expanded to include a question regarding the number of recreational fishing trips targeting shellfish. Results indicated there were more than one million trips taken to recreationally harvest shellfish in North Carolina during the survey period. Similar to the initial 1985 survey, no data on actual shellfish harvest estimates were reported. At present recreational fishing data are collected by the Marine Recreational Information Program (MRIP) for finfish, but the survey excludes recreational shellfish data. These data limitations were further compounded in 1997 when the FRA implemented the RCGL. The RCGL allowed recreational fisherman to use limited amounts of commercial gear to harvest seafood for personal consumption. Shellfish gears were not authorized under the RCGL due to the ability of any North Carolina resident to purchase a commercial shellfish license (at a lower cost than a RCGL) to take shellfish in commercial quantities for recreational purposes. Thus, recreational harvest from a commercial shellfish license does not get recorded because it is not sold to a seafood dealer.

NCDMF is required by the FRA to prepare a FMP for all commercially and recreationally significant species. Given that North Carolina's shellfish fisheries are exclusively under state jurisdiction, a lack of recreational shellfish harvest data makes it extremely difficult to address potential management issues such as harvest limits, size limits, and gear restrictions for this fishery.

Based on recommendations by the Oyster and Hard Clam FMPs of 2001, House Bill 1427 was introduced before the general assembly in 2004. The purpose of this bill was to establish a recreational shellfish license on a trial basis for three years. However, House Bill 1427 was not passed. Similarly, House Bill 831 (2004) sought to create a saltwater fishing license requiring those individuals recreationally fishing for *both* finfish and shellfish to obtain a license. Ultimately, the state legislature revisited the issue in 2005 and replaced the saltwater fishing license with the Coastal Recreational Fishing License (CRFL). CRFL was implemented on January 1, 2007, and was only required when harvesting finfish, thereby eliminating the creation

of a sampling universe to be used to estimate shellfish harvest. As a result, NCDMF developed a small optional survey to obtain additional information on shellfish harvest from CRFL license holders at the point of license sale. The optional survey would ask whether the CRFL holder actively harvests crabs, oysters, clams, or scallops; and would identify a pool of individuals to survey at a later date with more specific questions regarding their recreational harvest of shellfish. However, this survey is not optimal because individuals who fish exclusively for shellfish would not need to purchase a CRFL.

NCDMF implemented a shellfish survey during November 2010 to collect monthly data on the harvest of crabs, oysters, clams, and scallops from the CRFL license pool. The survey sample is made up of approximately 650 randomly selected CRFL holders that held a valid license for at least one day during the survey period and answered “yes” to the harvest of at least one of the following species; crabs, oysters, clams, or scallops. The selected CRFL holders are sent a letter explaining the survey along with a web address and accompanying PIN to complete the survey online. Those that do not use the web-based method to respond are sent a paper version of the survey 10-14 days later. This survey obtains information on the number of trips taken during the survey period, average length of the trip, average party size, number of species kept and discarded, gear used, location information (water access), waterbody, and county of harvest. Data from this survey are limited in scope, but could potentially be used to estimate catch and effort in the recreational shellfish fishery for those people who purchased a CRFL license.

Similar to the RCGL some recreational fishermen may purchase a commercial shellfish license over a CRFL because the license is easy to obtain (available to any NC resident), is relatively inexpensive (\$31.25), and allows fishermen to harvest more shellfish than the recreational limits allow. The TTP will only capture landings of fishermen who sell their catch to certified seafood dealers. Therefore, identifying individuals who purchase a commercial shellfish license but do not have any record of landings within the TTP could potentially provide a pool of people to survey to determine if the license is indeed being used for recreational purposes only. This is also true for fishermen who buy a Standard Commercial Fishing License (SCFL) with a shellfish endorsement but do not have any reported landings of shellfish. Even though this approach limits the sampling universe to only recreational fishermen who bought a commercial license, it would still provide some information on the recreational harvest of shellfish that can occur without being constrained to recreational harvest limits. Despite our sampling limitations the new shellfish harvest survey provides the ability to characterize recreational shellfish harvest, but still has limitations for estimating the total recreational harvest of shellfish.

Recreational effort for clam harvest was reported from 60 waterbodies throughout coastal North Carolina (Table 7.6). Seventy percent of reported clamming effort originated from private residence, private boat ramp, or shore (Table 7.7). Given that only 25% of reported effort originated at public access locations, intercept oriented surveys are less than ideal. This was supported by the limited success of a supplemental shellfish questionnaire to determine the number of non-CRFL shellfish harvesters. Clamming effort remained consistent through the winter and early spring, increased during the summer months, with peak activity observed during July (Table 7.8). This trend was also reflected in the number of clams harvested during the same interval (Table 7.8). Overall survey results demonstrate a distinct seasonality for the recreational harvest of clams, with peak activity observed during the summer months. This coupled with the highest concentrations of clamming activity being observed within Pamlico, Bogue, and Masonboro Sounds and during the summer months, suggests that coastal tourism may significantly impact recreational clam harvest (Table 7.8).

Table 7.6. Distribution of North Carolina recreational clam harvest trips by waterbody fished, 2010-2013. From NCDMF recreational statistics.

Waterbody clammed	Reported clam trips	Percent of clam trips taken
Pamlico Sound	236	16.7
Bogue Sound	227	16.1
Masonboro Sound	95	6.7
Core Sound	83	5.9
Intracoastal Waterway (New Hanover County)	79	5.6
Intracoastal Waterway (Brunswick County)	70	5.0
New River	52	3.7
Intracoastal Waterway (Onslow County)	49	3.5
White Oak River	47	3.3
Intracoastal Waterway (Pender County)	46	3.3
Topsail Sound	46	3.3
Gales Creek	26	1.8
Newport River	26	1.8
North River (Carteret County)	24	1.7
Bogue Inlet	23	1.6
Bonner Bay	19	1.3
Chadwick Bay	18	1.3
Intracoastal Waterway (Carteret County)	18	1.3
Back Sound	16	1.1
Cape Fear River	15	1.1
Cedar Island Bay	15	1.1
Jarretts Bay	15	1.1
Albemarle Sound	13	0.9
Broad Creek (Neuse River)	13	0.9
Shalotte River	13	0.9
Stones Bay	12	0.9
Atlantic Ocean <3 mi (South of Hatteras)	10	0.7
Other Waterbody	10	0.7
Roanoke Sound	9	0.6
Stump Sound	9	0.6
Mason Inlet	8	0.6
Croatan Sound	7	0.5
Bald Head Creek	6	0.4
Oyster Creek	6	0.4
Back Bay	4	0.3
Lockwood Folly	4	0.3
Lockwood's Folly River	4	0.3

Table 7.6. Continued.

Waterbody clammed	Reported clam trips	Percent of clam trips taken
Ocean Isle Canals	4	0.3
Currituck Sound	3	0.2
Goose Creek	3	0.2
Intracoastal Waterway (Craven County)	3	0.2
Middle Marshes	3	0.2
Elmore Inlet	2	0.1
Pamlico River	2	0.1
Pantego Creek	2	0.1
The Straits	2	0.1
Beaufort Inlet	1	0.1
Broad Creek (Bogue Sound)	1	0.1
Broad Creek (Roanoke Sound)	1	0.1
Calabash Creek	1	0.1
Carolina Beach Basin	1	0.1
Lockwood Folly River	1	0.1
Nelson Bay	1	0.1
Old Topsail Creek	1	0.1
Perquimans River	1	0.1
Styron Bay	1	0.1
Tar Landing Bay	1	0.1
Ward Creek	1	0.1
Wysocking Bay	1	0.1
Cedar Creek	0	0.0
Total	1,410	100.0

Table 7.7. Distribution of North Carolina recreational clam harvest trips by access type, 2010-2013. From NCDMF recreational statistics.

Access type	Reported clamming trips	Percent of reported clamming trips
Marina	106	7.5
Private ramp	245	17.4
Public ramp	246	17.4
Residence	409	29.0
Shore	334	23.7
(other)	70	5.0
Total	1,410	100.0

Table 7.8. Recreational clam harvest trips reported, percent, number reported, percent, discards reported, and percent, 2010-2013. From NCDMF recreational statistics.

Month	Reported trips	Percent reported trips	Mean number of trips per respondent	Clam harvest (number reported)	Percent clam harvest (number reported)	Clam discards (number reported)	Percent clam discards (number reported)
January	92	6.5	3.1	3,073	5.0	590	4.3
February	95	6.7	5.6	3,239	5.3	1,786	13.0
March	49	3.5	3.5	854	1.4	382	2.8
April	102	7.2	3.2	1,430	2.3	436	3.2
May	106	7.5	3.0	4,177	6.9	1,335	9.7
June	131	9.3	3.0	11,325	18.6	718	5.2
July	223	15.8	2.9	11,539	19.0	2,948	21.4
August	145	10.3	2.5	5,041	8.3	1,008	7.3
September	165	11.7	3.5	6,515	10.7	1,709	12.4
October	69	4.9	2.3	2,267	3.7	495	3.6
November	61	4.3	2.5	2,276	3.7	884	6.4
December	172	12.2	3.9	9,127	15.0	1,461	10.6
Total	1,410	100.0	3.1	60,863	100.0	13,752	100.0

8.0 PROTECTED RESOURCES

The major gears used to commercially harvest hard clams in NC are hand rakes, bull rakes, by hand, clam trawls (kicking) and escalator dredges. Hand harvest methods account for approximately 80% of hard clam harvest in the state while the mechanical gears make up the other 20%. Currently, NMFS classifies the Atlantic Ocean shellfish dive, hand/mechanical collection and Atlantic shellfish bottom trawl as Category III fisheries. Category III fisheries have either a remote likelihood of interaction with protected species or no known interactions. Based on the 2014 List of Fisheries compiled by the NMFS, these fisheries has had no documented interactions with protected resources: <http://www.nmfs.noaa.gov/pr/interactions/lof> and final Federal Register Notice: <http://www.gpo.gov/fdsys/pkg/FR-2014-03-14/pdf/2014-05576.pdf> .

The current management strategy limits the use of mechanical harvest in North Carolina waters in specific areas located in Core Sound, North River, Newport River, Bogue Sound, White Oak River, New River and portions of the Intracoastal Waterway from December through March. The time period when mechanical harvest gears are in use would likely have no impact on protected species such as sea turtles. Typically, sea turtles are uncommon in the internal coastal waters of NC during the early part of the year.

9.0 SOCIOECONOMIC STATUS OF THE HARD CLAM FISHERY

9.1 ECONOMIC ASPECTS OF THE FISHERY

9.1.1 EX-VESSEL VALUE AND PRICE

The value of hard clams to the North Carolina seafood industry has fluctuated dramatically over time. Before the mid-1970s, their economic contribution was relatively small, representing no more than 1-2% of the total value of landed seafood in the state. During the 1980s, clams accounted for a larger portion of commercial seafood landings, reaching a high point of 12% of the value of North Carolina seafood in 1986 and 1987 before retreating back to the 3-5% level in the past decade. In 2013, clams were the sixth most economically important commercial seafood species in North Carolina. Landings of clams accounted for 4.7% of the total value of commercial non-finfish landings and 2.9% of the total value of all commercial seafood landings in the state.

The nominal value (the value that is not adjusted for inflation) of North Carolina hard clam landings peaked in 1989 at \$8.4 million and fell sharply thereafter, reaching less than half of that peak three years later. Total landings value of clams leveled off in the 1990s and hovered in the \$4 million to \$5 million range until it began dropping once again over the past several years, reaching \$2.3 million in the most recent year available (2013). When adjusted for the effects of inflation³, 2012 saw the lowest landings value since the mid-1970s (Figure 9.1). Prices for some grades of clams have dropped in recent years in inflation adjusted terms, but the decline in total value is largely driven by a decrease in catch (Table 9.1).

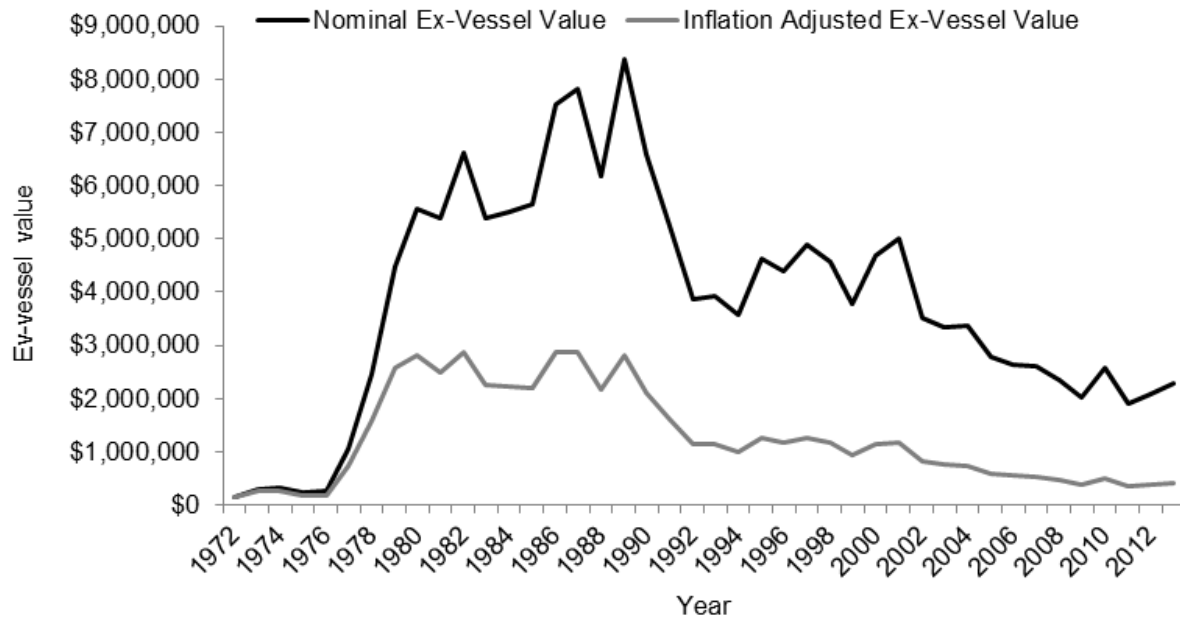


Figure 9.1. Annual ex-vessel value of clam landings in North Carolina, 1972-2013. TTP.

³ Inflation adjustments were calculated by utilizing the U.S. Consumer Price Index (CPI).

Table 9.1. Annual detail values of clams landed, nominal ex-vessel value, inflation adjusted ex-vessel value, nominal price per clam, and inflation adjusted price per clam landed in North Carolina, 1972 -2013. TTP.

Year	Clams landed	Nominal ex-vessel value	Inflation adjusted ex-vessel value	Nominal price per clam	Inflation adjusted price per clam
1972	13,707,650	\$162,655	\$162,655	\$0.01	\$0.01
1973	18,978,650	\$294,098	\$276,876	\$0.02	\$0.01
1974	14,383,750	\$321,983	\$273,000	\$0.02	\$0.02
1975	14,254,450	\$226,087	\$175,659	\$0.02	\$0.01
1976	15,308,950	\$258,163	\$189,652	\$0.02	\$0.01
1977	36,953,300	\$1,068,880	\$737,280	\$0.03	\$0.02
1978	44,611,750	\$2,449,054	\$1,570,099	\$0.05	\$0.04
1979	72,478,500	\$4,473,737	\$2,575,788	\$0.06	\$0.04
1980	77,085,950	\$5,554,047	\$2,817,466	\$0.07	\$0.04
1981	72,909,800	\$5,386,803	\$2,477,100	\$0.07	\$0.03
1982	85,089,650	\$6,606,132	\$2,861,516	\$0.08	\$0.03
1983	67,081,000	\$5,401,824	\$2,267,031	\$0.08	\$0.03
1984	69,393,200	\$5,506,233	\$2,215,212	\$0.08	\$0.03
1985	69,664,700	\$5,653,779	\$2,196,357	\$0.08	\$0.03
1986	67,815,800	\$7,522,393	\$2,868,942	\$0.11	\$0.04
1987	60,370,000	\$7,822,801	\$2,878,460	\$0.13	\$0.05
1988	46,998,800	\$6,178,117	\$2,182,969	\$0.13	\$0.05
1989	64,731,400	\$8,388,051	\$2,827,585	\$0.13	\$0.04
1990	67,742,100	\$6,584,756	\$2,105,913	\$0.10	\$0.03
1991	49,220,500	\$5,235,182	\$1,606,686	\$0.11	\$0.03
1992	36,111,750	\$3,853,005	\$1,147,937	\$0.11	\$0.03
1993	37,062,400	\$3,922,932	\$1,134,800	\$0.11	\$0.03
1994	35,067,411	\$3,582,049	\$1,010,321	\$0.10	\$0.03
1995	37,670,136	\$4,628,830	\$1,269,587	\$0.12	\$0.03
1996	32,860,713	\$4,380,620	\$1,167,049	\$0.13	\$0.04
1997	37,229,129	\$4,878,022	\$1,270,413	\$0.13	\$0.03
1998	36,573,497	\$4,559,846	\$1,169,335	\$0.12	\$0.03
1999	29,386,335	\$3,774,453	\$947,012	\$0.13	\$0.03
2000	34,098,364	\$4,680,245	\$1,136,087	\$0.14	\$0.03
2001	36,800,636	\$5,007,241	\$1,181,833	\$0.14	\$0.03
2002	29,323,338	\$3,505,642	\$814,541	\$0.12	\$0.03
2003	26,339,256	\$3,339,172	\$758,573	\$0.13	\$0.03
2004	27,199,778	\$3,357,124	\$742,868	\$0.12	\$0.03
2005	21,165,143	\$2,777,957	\$594,565	\$0.13	\$0.03
2006	21,475,443	\$2,631,373	\$545,592	\$0.12	\$0.03
2007	21,787,426	\$2,600,658	\$524,293	\$0.12	\$0.02
2008	19,332,807	\$2,355,279	\$457,160	\$0.12	\$0.02
2009	18,011,221	\$2,036,793	\$396,971	\$0.11	\$0.02
2010	18,233,183	\$2,581,033	\$494,784	\$0.14	\$0.03
2011	15,088,757	\$1,896,627	\$352,583	\$0.13	\$0.02
2012	20,066,732	\$2,090,114	\$380,527	\$0.10	\$0.02
2013	17,854,321	\$2,295,161	\$411,826	\$0.13	\$0.02

After unloading, clams are sorted into a variety of grades for market, with the smaller, more tender clams usually fetching higher prices. Fishermen are paid according to the relative value of the different grades of the catch. The average price per clam has increased over time but remained remarkably consistent over the decades when adjusted for inflation. The nominal

price per clam exhibited a marked increase in price through the 1970s and early 1980s before leveling off and remaining in the range of \$0.10 to \$0.14. The highest average price per clam on a nominal basis was observed in 2000, 2001, and 2010 at \$0.14 per clam while the lowest price occurred in 1972 at \$0.01 per clam. When adjusted for inflation, the average price per clam ranged from \$0.01 to \$0.05, with the highest inflation adjusted prices seen in 1987 and 1988. The average inflation adjusted price for per clam in 2013 (\$0.02) was the same as observed in 1974 (Figure 9.2).

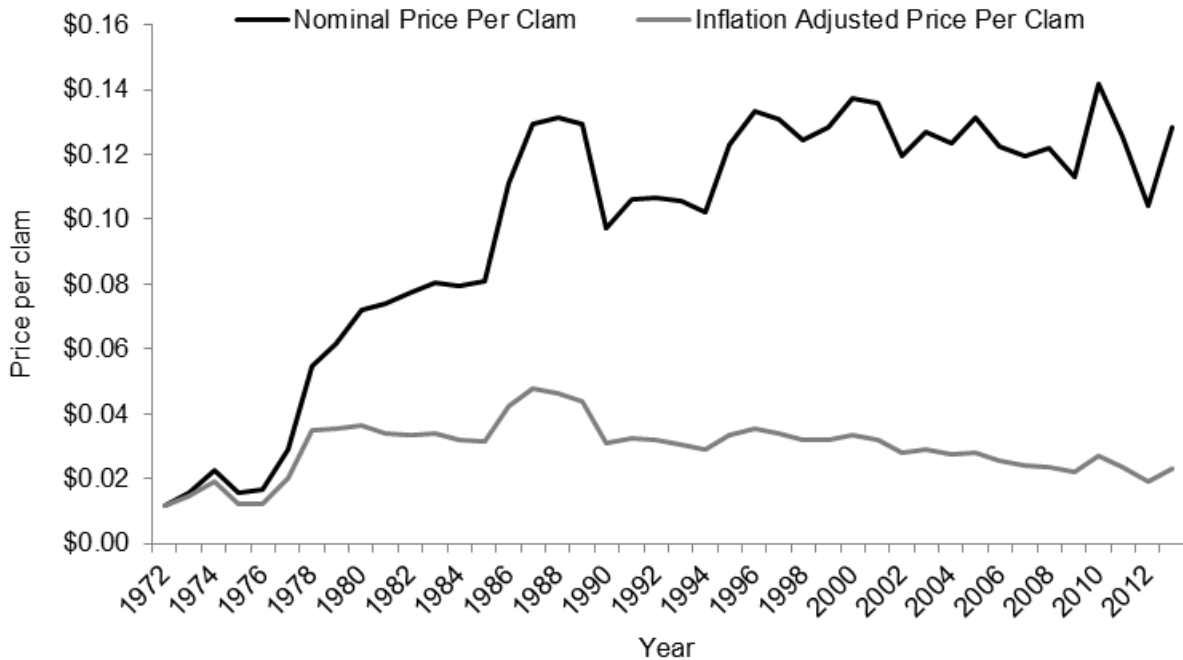


Figure 9.2. Annual average nominal and inflation adjusted price per clam in North Carolina, 1972-2013. TTP.

Over the past several years, price differences between grades have been closing, with the littleneck and topneck clams falling in price while the larger cherries and chowders seeing increases in price (Figure 9.3). In 2013, prices for the four different grades were within four cents of one another. The perception among many dealers is that this is largely due to the ability of large aquaculture facilities to flood the market with smaller-grade clams when demand is increased (see Section 9.1.3).

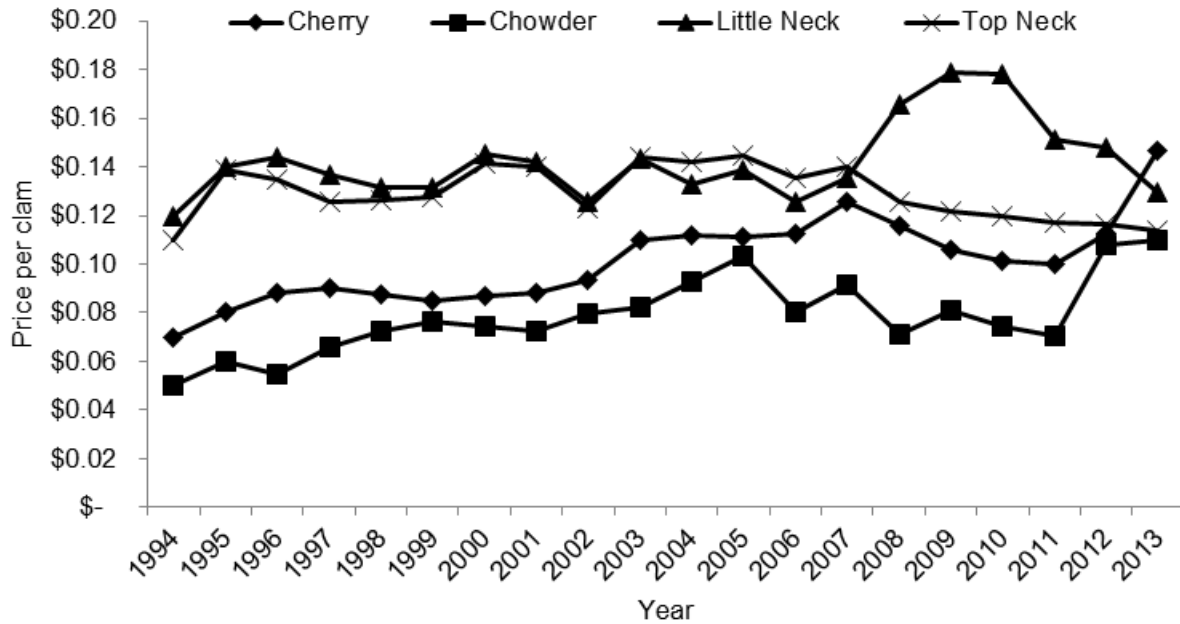


Figure 9.3. Annual average ex-vessel grade prices in North Carolina, 1994-2013. TTP.

9.1.2 HARVEST AREA

While there are several shellfish lease operations that grow and harvest clams, the majority of the clams in North Carolina are harvested from public bottom. As can be seen in Figure 9.4, since 1994, clams from public bottom have accounted for an average of 83% of the overall ex-vessel value of the commercial clam harvest. Since the early 2000s, the percent of the harvest value of clams from public bottom has remained fairly constant, however 2013 saw an uptick in public bottom landings, with 91% of the value of the clam catch coming from public bottom.

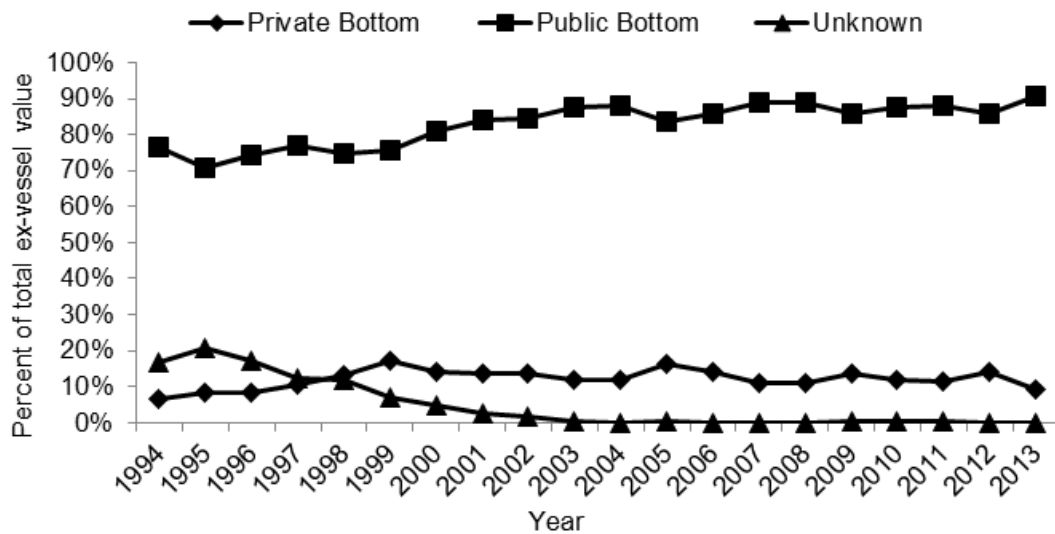


Figure 9.4. Percent of annual total commercial clam harvest value from public versus private bottom, 1994-2013. TTP.

Table 9.2 shows the percent of the total clam harvest value by water body from 1994 to 2013. While many water bodies have accounted for a steady portion of the overall harvest value, the hard clam fisheries in the Cape Fear River, Shallotte River, White Oak River, and Core Sound have seen a decreasing contribution. The contribution of catches in Core Sound exhibited the largest decline, falling from over a quarter of the overall harvest value to less than ten percent. Clam harvest in the New River made a notable gain, increasing from fifth of the overall harvest value to more 50% annually.

Table 9.2. Percent of total annual commercial clam harvest value by waterbody, 1994-2013. TTP.

Water body	Year																				Average
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	
Bogue Sound	6%	6%	4%	4%	4%	5%	5%	6%	6%	7%	7%	5%	10%	11%	10%	7%	8%	11%	8%	6%	7%
Cape Fear River	7%	6%	6%	3%	2%	1%	1%	3%	6%	9%	6%	2%	1%	1%	2%	1%	2%	1%	<1%	1%	3%
Core Sound	24%	31%	27%	26%	24%	24%	23%	21%	16%	15%	16%	14%	9%	7%	5%	10%	11%	8%	5%	7%	16%
Inland Waterway	7%	8%	5%	4%	4%	5%	6%	6%	5%	1%	-	-	-	-	-	-	-	-	-	-	5%
Inland Waterway (Brunswick)	-	-	-	-	-	-	-	-	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Inland Waterway (Onslow)	-	-	-	-	-	-	-	-	2%	5%	7%	7%	4%	5%	7%	6%	8%	9%	4%	6%	6%
Lockwood's Folly	3%	3%	4%	4%	2%	2%	4%	4%	2%	2%	2%	2%	2%	4%	3%	2%	1%	0%	0%	1%	2%
Masonboro Sound	3%	4%	4%	4%	5%	4%	3%	4%	4%	4%	5%	5%	4%	3%	3%	3%	2%	3%	2%	2%	4%
New River	18%	12%	21%	26%	28%	24%	28%	20%	32%	33%	34%	41%	41%	36%	40%	34%	38%	34%	54%	55%	33%
Newport River	7%	8%	11%	11%	12%	12%	8%	10%	7%	7%	9%	9%	7%	9%	9%	8%	11%	13%	10%	9%	9%
North River/Back Sound	5%	6%	3%	2%	4%	3%	2%	2%	2%	<1%	3%	3%	5%	6%	6%	7%	3%	5%	5%	3%	4%
Pamlico Sound	3%	1%	2%	1%	3%	5%	4%	3%	3%	1%	0%	1%	1%	1%	1%	2%	1%	1%	1%	1%	2%
Shalotte River	8%	6%	6%	7%	6%	5%	6%	6%	4%	4%	4%	4%	7%	7%	5%	4%	4%	3%	2%	1%	5%
Stump Sound	1%	2%	2%	2%	2%	2%	1%	2%	1%	1%	1%	1%	2%	2%	3%	3%	3%	3%	2%	2%	2%
Topsail Sound	2%	2%	3%	2%	3%	4%	6%	6%	5%	4%	3%	3%	4%	5%	6%	5%	5%	6%	4%	4%	4%
White Oak River	5%	5%	3%	3%	3%	4%	3%	7%	5%	4%	3%	2%	2%	3%	2%	9%	2%	5%	2%	2%	4%
Other	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%

9.1.3 GEAR

From 1994 to 2013, the majority of the clam harvest came from the use of hand harvest gears (Table 9.3). While variable from year to year, hand harvest gears accounted for approximately 80% of the clam landings in the state. In some years the make-up of the catch strayed from this long term average, however as can be seen in Figure 9.5, the allocation of the total harvest value between gears over the entire time series has remained fairly consistent.

Table 9.3. Annual nominal ex-vessel value and percent of total ex-vessel value of clam landings by gear type, 1994-2013. TTP.

Year	Gear type	Nominal value	Percent of total value	Year	Gear type	Nominal value	Percent of total value
1994	Hand harvest	\$3,147,943	88%	2004	Hand harvest	\$2,545,926	76%
	Mechanical	\$434,106	12%		Mechanical	\$811,197	24%
1995	Hand harvest	\$3,532,730	76%	2005	Hand harvest	\$2,244,761	81%
	Mechanical	\$1,096,100	24%		Mechanical	\$533,196	19%
1996	Hand harvest	\$3,423,818	78%	2006	Hand harvest	\$2,249,975	86%
	Mechanical	\$956,802	22%		Mechanical	\$381,398	14%
1997	Hand harvest	\$3,924,431	80%	2007	Hand harvest	\$2,260,300	87%
	Mechanical	\$953,591	20%		Mechanical	\$340,358	13%
1998	Hand harvest	\$3,586,301	79%	2008	Hand harvest	\$1,874,362	80%
	Mechanical	\$973,545	21%		Mechanical	\$480,917	20%
1999	Hand harvest	\$2,853,188	76%	2009	Hand harvest	\$1,601,983	79%
	Mechanical	\$921,266	24%		Mechanical	\$434,809	21%
2000	Hand harvest	\$3,756,743	80%	2010	Hand harvest	\$1,882,823	73%
	Mechanical	\$923,502	20%		Mechanical	\$698,209	27%
2001	Hand harvest	\$4,338,925	87%	2011	Hand harvest	\$1,534,783	81%
	Mechanical	\$668,316	13%		Mechanical	\$361,844	19%
2002	Hand harvest	\$2,731,246	78%	2012	Hand harvest	\$1,706,607	82%
	Mechanical	\$774,396	22%		Mechanical	\$383,423	18%
2003	Hand harvest	\$2,644,424	79%	2013	Hand harvest	\$2,007,370	87%
	Mechanical	\$694,747	21%		Mechanical	\$287,617	13%

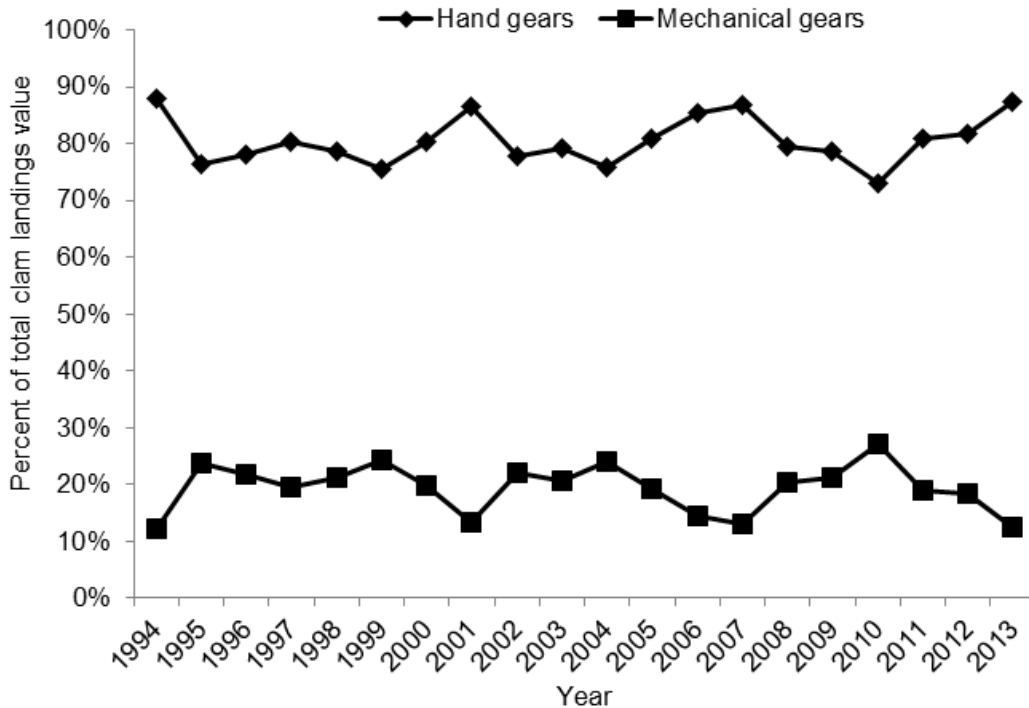


Figure 9.5 Annual percent of total landings value by gear type used to harvest hard clams, 1994-2013. TTP.

9.1.4 PARTICIPANTS AND TRIPS

The NCDMF keeps track of the commercial catches of all fishermen in the state. Information is captured for each trip when the catch is sold to a commercial seafood dealer. This information can be broken down and categorized for a closer look at the patterns of behavior of fishermen in any particular fishery.

In 2013, participants in the commercial clam fishery reported \$7.2 million in total seafood landings, with hard clams (32%) making up the majority of this catch by ex-vessel value followed by oysters (16%), shrimp (15%), blue crab (8%), and flounders (7%). On trips recording hard clam landings, hard clams (90%) made up the vast majority of the total ex-vessel value of the seafood landings on these trips, with catches of oysters (7%) and blood clams (2%) also accounting for noteworthy portions of the trip catch.

Table 9.4 shows the number of commercial clammers participating in the fishery since 1994, broken down by the number of trips that they took each year. Notice that the percentages of fishermen in each category are relatively constant, with roughly half taking ten or fewer trips in any particular year. The fishery has lost over two thirds of its participants since the high point in 2001; however, decreases in participation have been common in recent years in most commercial fisheries in the state (Figure 9.6).

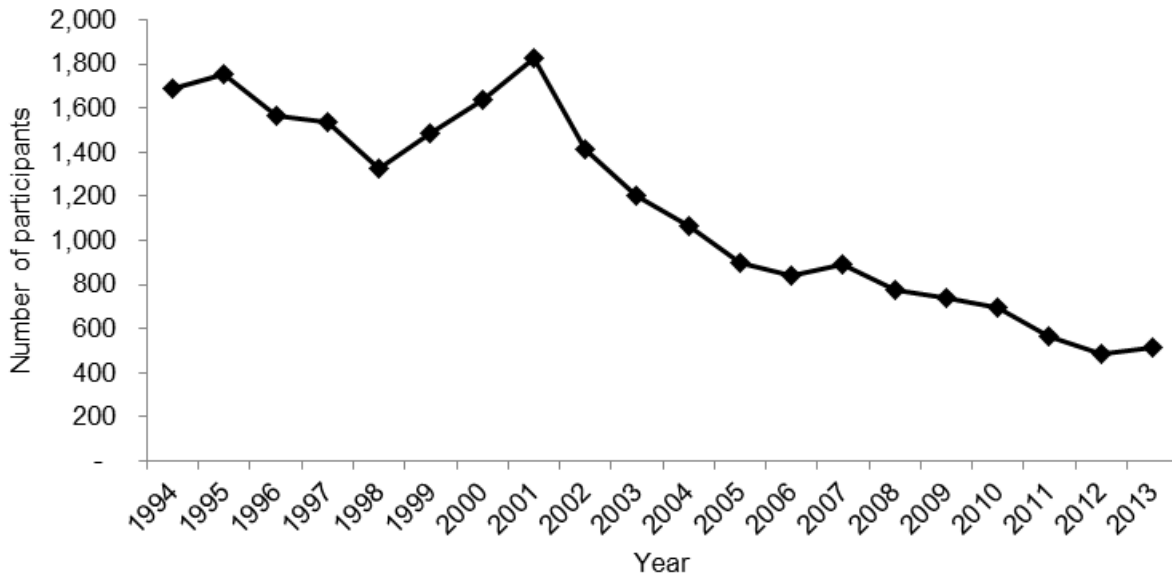


Figure 9.6. Annual number of commercial participants reporting landings of clams from 1994-2013. TTP.

Table 9.5 breaks down participants in this fishery by annual individual ex-vessel value of harvest clams. Few people make their living solely from harvesting clams, with between 40% and 50% of all commercial clammers' annual catch fetching \$500 or less in any given year. Fewer than 100 people have received over \$10,000 in a year from clams in most recent years, although this represents an increased proportion of all participants in the fishery due to a more rapid decline in the number of lower-income clam fishermen over time. In 2013, the majority of the clam harvest value (68%) could be attributed to the 68 individuals recording more than \$10,000 in ex-vessel landings of clams.

Similar to the overall clam fishery, there has been a general decrease in participants using hand harvest and mechanical gears to land hard clams from 1994 to 2013 (Figure 9.7). Hand harvest gears did see an increase in participants in the late 1990s and early 2000s, followed by a general decrease in participation since then. Both gear categories have seen at least a 70% decrease in participant count through the time series.

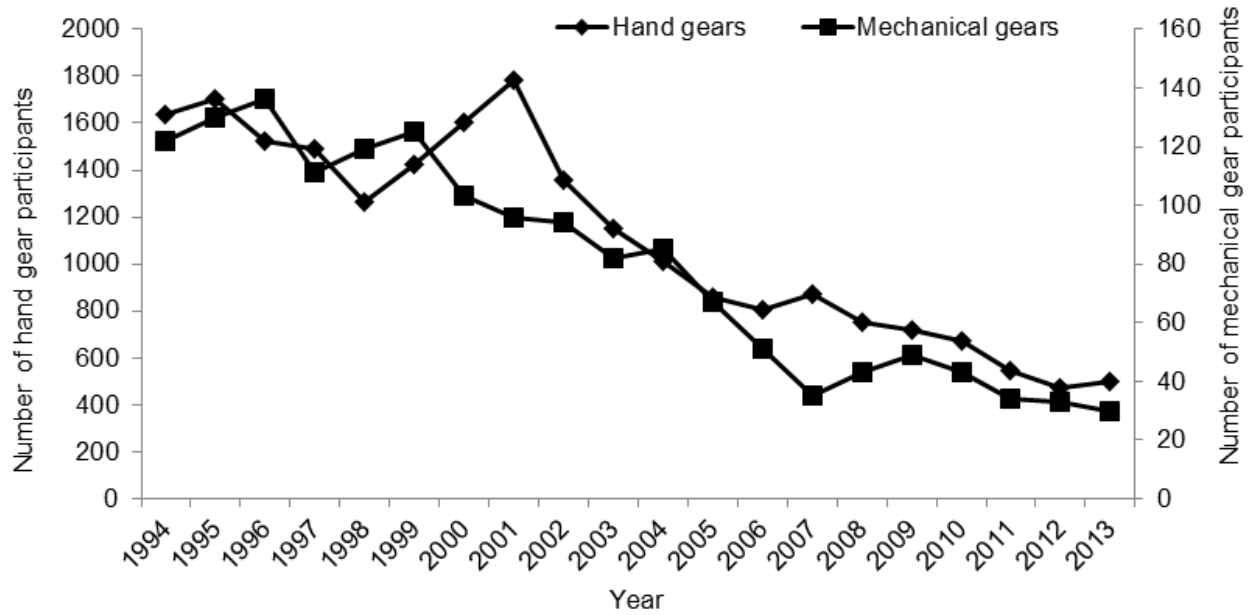


Figure 9.7. Participant count by gear category for hard clam harvest, 1994-2013. TTP.

The number of commercial hand harvest and mechanical harvest trips landing clams exhibited similar trends to participants in the fisheries respectively. Both gears have seen a considerable decrease in use for harvesting clams. Through the time series (1994-2013), trips recording landings of clams have decreased by approximately 70% for hand harvest gears and approximately 50% for mechanical gears (Figure 9.8).

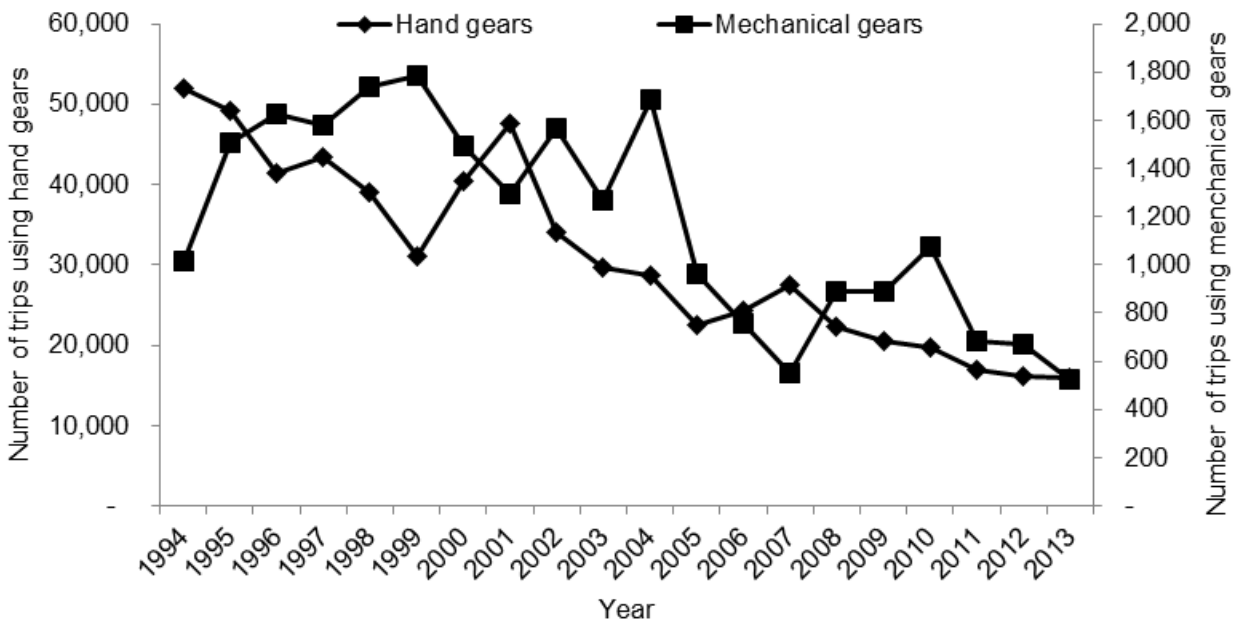


Figure 9.8. Annual total number of commercial trips landing clams by gear category, 1994-2013. TTP.

As is the case in all commercial fisheries in the state, clam fishermen may only sell their catch to licensed seafood dealers. The number of dealers who deal in clams has remained stable since 1994, with a slight increase each year since 2008 (Figure 9.9). Many of these seafood dealers are likely clam fishermen holding a seafood dealers license, which allows them to vertically integrate their commercial fishing business by both catching and selling a seafood product to a wholesaler or consumer. The majority of seafood dealers purchasing clams were located in the southern part of the coast, with 65% of the dealers located in Onslow, New Hanover, and Brunswick counties. As can be seen in Table 8.7, the number of dealers buying \$5,000 or less in clams has generally increased over the time series while the number of seafood dealers purchasing more than \$30,000 in clams has decreased. Nevertheless, in 2013 the majority of the clam harvest in North Carolina was sold through these top-tier seafood dealers (87%).

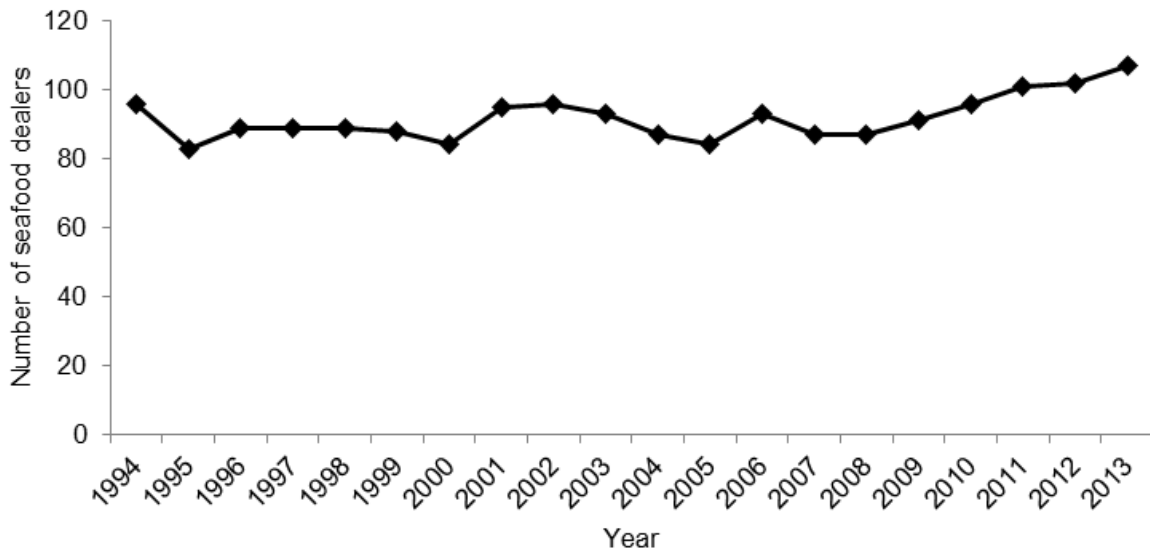


Figure 9.9. Number of seafood dealers reporting landings of clams from 1994-2013. TTP.

Table 9.4. Number of participants and the number of trips taken that landed clams in North Carolina, 1994-2013. TTP.

	Year																				Average
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	
1 Trip	355	426	369	379	282	301	233	273	211	186	181	124	133	148	132	118	124	106	81	79	212
% within year	21%	24%	24%	25%	21%	20%	14%	15%	15%	15%	17%	14%	16%	17%	17%	16%	18%	19%	17%	15%	18%
2-10 Trips	548	537	469	482	420	562	621	682	534	450	337	354	296	325	273	271	248	184	159	189	397
% within year	33%	31%	30%	31%	32%	38%	38%	37%	38%	37%	32%	39%	35%	36%	35%	37%	36%	33%	33%	37%	35%
11-20 Trips	207	222	193	171	150	226	235	253	204	170	133	121	106	98	99	99	69	65	59	69	147
% within year	12%	13%	12%	11%	11%	15%	14%	14%	14%	14%	12%	13%	13%	11%	13%	13%	10%	12%	12%	13%	13%
21-50 Trips	288	274	283	267	247	252	296	314	254	217	218	159	143	140	124	106	125	99	84	72	198
% within year	17%	16%	18%	17%	19%	17%	18%	17%	18%	18%	20%	18%	17%	16%	16%	14%	18%	18%	17%	14%	17%
51-100 Trips	183	177	164	137	136	88	161	193	131	107	126	75	95	100	80	84	67	59	49	59	114
% within year	11%	10%	10%	9%	10%	6%	10%	11%	9%	9%	12%	8%	11%	11%	10%	11%	10%	10%	10%	10%	10%
More than 100 Trips	105	117	90	99	91	58	95	113	77	76	72	66	67	84	68	61	65	52	57	49	78
% within year	6%	7%	6%	6%	7%	4%	6%	6%	5%	6%	7%	7%	8%	9%	9%	8%	9%	9%	12%	9%	7%
Total	1,686	1,753	1,568	1,535	1,326	1,487	1,641	1,828	1,411	1,206	1,067	899	840	895	776	739	698	565	489	517	1,146

Table 9.5. Number of participants in the clam fishery by value of landings and year in North Carolina, 1994-2013. TTP.

	Year																				Average
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	
\$1-\$500	842	873	725	737	597	739	687	811	681	554	453	394	366	417	362	354	300	252	211	213	528
% within year	50%	50%	46%	48%	45%	50%	42%	44%	48%	46%	42%	44%	44%	47%	47%	48%	43%	45%	43%	41%	46%
\$1,001-\$2,000	226	198	183	172	159	198	221	204	147	130	124	88	92	106	81	85	66	56	53	58	132
% within year	13%	11%	12%	11%	12%	13%	13%	11%	10%	11%	12%	10%	11%	12%	10%	12%	9%	10%	11%	11%	11%
\$2,001-\$5,000	257	242	260	216	209	209	248	283	213	153	172	133	123	120	105	100	104	81	72	53	168
% within year	15%	14%	17%	14%	16%	14%	15%	15%	15%	13%	16%	15%	15%	13%	14%	14%	15%	14%	15%	10%	14%
\$5,001-\$10,000	113	163	156	140	115	88	166	171	114	111	107	77	88	94	81	55	73	60	40	55	103
% within year	7%	9%	10%	9%	9%	6%	10%	9%	8%	9%	10%	9%	10%	11%	10%	7%	10%	11%	8%	11%	9%
\$501-\$1,000	201	200	165	161	134	178	218	226	168	164	114	123	96	87	83	81	78	59	52	70	113
% within year	12%	11%	11%	10%	10%	12%	13%	12%	12%	14%	11%	14%	11%	10%	11%	11%	11%	10%	11%	14%	12%
More than \$10,000	47	77	79	109	112	75	101	133	88	94	97	84	75	71	64	64	77	57	61	68	82
% within year	3%	4%	5%	7%	8%	5%	6%	7%	6%	8%	9%	9%	9%	8%	8%	9%	11%	10%	12%	13%	8%
Total	1,686	1,753	1,568	1,535	1,326	1,487	1,641	1,828	1,411	1,206	1,067	899	840	895	776	739	698	565	489	517	1,146

Table 9.6. Number of seafood dealers in the clam fishery by ex-vessel value of clams purchased and year in North Carolina, 1994-2013. TTP.

	Year																				
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average
\$1-\$1,000	50	31	39	37	35	32	25	36	34	36	30	26	34	31	33	36	36	42	42	49	36
% within year	52%	37%	44%	42%	39%	36%	30%	38%	35%	39%	34%	31%	37%	36%	38%	40%	38%	42%	41%	46%	39%
\$1,001-\$5,000	10	14	11	10	14	10	16	13	17	14	17	16	22	20	24	24	24	31	37	28	19
% within year	10%	17%	12%	11%	16%	11%	19%	14%	18%	15%	20%	19%	24%	23%	28%	26%	25%	31%	36%	26%	20%
\$5,001-\$30,000	10	11	13	13	10	16	16	20	19	19	17	22	20	19	18	20	20	17	11	17	16
% within year	10%	13%	15%	15%	11%	18%	19%	21%	20%	20%	20%	26%	22%	22%	21%	22%	21%	17%	11%	16%	18%
More than \$30,000	26	27	26	29	30	30	27	26	26	24	23	20	17	17	12	11	16	11	12	13	21
% within year	27%	33%	29%	33%	34%	34%	32%	27%	27%	26%	26%	24%	18%	20%	14%	12%	17%	11%	12%	12%	23%
Total	96	83	89	89	89	88	84	95	96	93	87	84	93	87	87	91	96	101	102	107	92

9.1.5 PROCESSING, MARKETING, AND DISTRIBUTION

As mentioned previously, the markets for clams have undergone significant changes in recent years, with the smaller grades falling in price, while the prices for the larger grades have risen. The NCDMF does not keep track of clam market information beyond the data that are captured on a commercial trip ticket. However, in a series of interviews in Onslow County in January 2006, the consensus among clam dealers was that the increase in clam aquaculture had “destroyed the markets for littlenecks” and that this trend was accelerating, but that the supply for the larger grades was currently unable to meet demand and had led accordingly to price increases for cherries and chowders. This scenario likely holds true today given the price movement in clam market grades. Clam dealers indicated that they ship what fishermen bring them and not what the dealers might wish for, and have to ask restaurants, wholesalers, and markets to take a number of smaller clams along with the more-desired large grade clams. This is the opposite of what was historically the case, when dealers had difficulty getting rid of the large clams without including smaller grades along with them. Many dealers indicated having limited information on what happens to the clams post-sale, but have heard that the cherries are now going to supermarkets and being processed as “prepared” or “ready to cook” meals like Clams Casino before being sold to the consumer. Small grades tend to be sold to restaurants, markets, or dumped back into the water if there is no buyer for them.

Many of the dealers ship out of state, with the most commonly mentioned destinations being the Baltimore/D.C. area, followed by Philadelphia, New York, and Florida. None of the interviewed dealers had bought out-of-state or cultured clams.

9.1.6 ECONOMIC IMPACT OF THE COMMERCIAL FISHERY

Table 9.7 shows the economic impact of the clam harvest to North Carolina’s economy. The expenditures and income within the commercial fishing industry as well as those by consumers of seafood produce ripple effects as the money is spent and re-spent in the state economy. Each dollar earned and spent generates additional economic impacts by stimulating further activity in other industries which fosters jobs, income, and business sales. These impacts are estimated using the NCDMF commercial fishing economic impact model which utilizes information from socioeconomic surveys of commercial fishermen and seafood dealers in North Carolina, economic multipliers found in *Fisheries Economics of the United States, 2012*⁴, and IMPLAN economic modeling software. In 2013, the commercial clam fishery in North Carolina supported an estimated 225 fulltime and part time jobs, \$3.8 million in income, and \$9.2 million in sales impacts.

Table 9.7. Economic impact of the commercial hard clam fishery in North Carolina, 2013. NCDMF Fisheries Economics Program.

Participants ¹	Trips ¹	Clams landed ¹	Ex-vessel value ¹	Estimated Economic Impacts		
				Jobs ^{2,3}	Income impacts (in thousands) ³	Sales impacts (in thousands) ³
517	16,496	17,854,321	\$2,295,161	225	\$3,792	\$9,192

¹As reported by the North Carolina Division of Marine Fisheries trip ticket program.

²Represents both full-time and part-time jobs.

³Economic impacts calculated using the NCDMF commercial fishing economic impact model.

9.1.5 RECREATIONAL FISHERY ECONOMICS

⁴ NOAA (National Oceanic and Atmospheric Administration). *Fisheries Economics of the United States, 2012*. 2014. National Marine Fisheries Service. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-F/SPO-137.

The NCDMF collects data about recreational fishing in conjunction with the federal government's Marine Recreational Information Program (MRIP). However, MRIP collects information on finfish only. The state requires a Coastal Recreational Fishing License (CRFL) for recreational saltwater fishing in state waters, but specifically exempts recreational shellfish gathering from this requirement. Currently, the NCDMF has limited data on recreational clamming, including the number of participants and the effect of their economic activity. For details, see the Recreational Fishery Section 7.2.

9.2 SOCIAL ASPECTS OF THE FISHERY

9.2.1 COMMERCIAL FISHERMEN

The NCDMF Fisheries Economics Program has been conducting a series of in-depth interview-style surveys with commercial fishermen along the coast since 1999. Data from these interviews are added to a growing database and used for fishery management plans, among other uses. In the most recent surveys from each region of the North Carolina coast⁵, 130 of the fishermen reported that they commercially harvest clams. That group is used to provide a snapshot of the North Carolina commercial fishermen in this section.

9.2.1.1 DEMOGRAPHIC AND FISHING CHARACTERISTICS OF COMMERCIAL FISHERMEN

Table 8.5 shows the demographic characteristics of the 130 clam harvesters surveyed by the Fisheries Economics Program. Nearly all were white males, with an average age of 51 and almost 28 years of commercial fishing experience. Two thirds had a high school diploma and 23% had at least some college education. Almost half had more than \$30,000 in household income when surveyed, with 18% indicating \$50,000 or more. A quarter of the survey respondents had less than \$15,000 in annual household income (Table 9.8).

On average, commercial fishing accounted for 65% of the personal income for these fishermen, and 43% reported that fishing was their sole source of personal income. The majority (78%) of clam fishermen fished all year long. These values are higher than presented in the previous update of this fishery management plan. The average number of vessels was two vessels, with almost every fisherman interviewed having at least one vessel. Only six commercial clambers did not have a registered commercial fishing vessel.

⁵ Interviews utilized in this analysis consisted of those conducted with fishermen who use the waters of Core Sound (last surveyed in 2007), Beaufort Inlet to the border with South Carolina (last surveyed in 2009), and the Atlantic Ocean (last surveyed in 2009).

Table 9.8. Demographic and fishing characteristics of clam harvesters. NCDMF Fisheries Economics Program.

Frequency Percent				Frequency Percent			
<u>Gender</u>				<u>Race</u>			
Male	126	97%	White	127	98%		
Female	4	3%	African American	3	2%		
<u>Marital status</u>				<u>Number of people in household</u>			
Married	90	70%	1	18	14%		
Divorced	22	17%	2	63	49%		
Widowed	4	3%	3	25	19%		
Separated	12	9%	4	18	14%		
Never married	1	0.8%	5	4	3%		
<u>Education</u>				<u>Years in community</u>			
Less than high school	41	32%	Average	32			
High school graduate	59	45%	Minimum	2			
Some college	17	13%	Maximum	84			
College graduate	13	10%	<u>Percent of individual income from commercial fishing</u>				
<u>Household income</u>				Average	65%		
Less than \$15,000	32	25%	Minimum	1%			
\$15,001-\$30,000	38	29%	Maximum	100%			
\$30,001-\$50,000	28	22%	<u>Fisherman status</u>				
\$51,001-\$75,000	14	11%	Full time	80	62%		
More than \$75,000	7	5%	Part time	49	38%		
Refuse to answer	11	8%	<u>Years fishing</u>				
<u>Age</u>				Average	28		
Average	51		Minimum	2			
Minimum	20		Maximum	70			
Maximum	84						

9.2.1.2 HISTORICAL IMPORTANCE OF THE COMMERCIAL FISHERY

A historical overview of the clam fishery can be found in Section 7.0, Status of the Fisheries. The NCDMF surveys asked commercial fishermen for their opinion as to how historically important they think commercial fishing is to their community. On a scale of one to ten in regards to particular statements, with one being “not at all” and ten being “extremely”, the average rating across all clam fishermen interviewed was 9.5 in regards to commercial fishing being historically important to their community.

9.2.1.3 COMMUNITY RELIANCE ON THE COMMERCIAL FISHERY

North Carolina coastal communities have historically been strongly dependent on the tourism and commercial fishing industries, but the latter has been decreasing in recent years, with fewer fishermen making their entire living from commercial fishing. Perceptions of current community

support for commercial fishing were rated at an average of 7.7 on the scale previously mentioned, with 18% of the respondents choosing a number on the bottom half of the scale. The statement “commercial fishing is important economically in my community” generated an average response of 7.8. These responses were similar to those presented in the previous update of this fishery management plan.

The 130 commercial clam fishermen that participated in the survey came from 39 different communities. Table 9.9 shows the communities that were most often cited by the survey participants. The largest number of commercial clammers lived in Sneads Ferry, followed by Newport, Atlantic, Beaufort, Wilmington, and Morehead City.

Table 9.9. Communities of survey respondents. NCDMF Fisheries Economic Program.

Community	Percent of respondents
Sneads Ferry	15%
Newport	10%
Atlantic	9%
Beaufort	8%
Wilmington	7%
Morehead City	5%
Hampstead	4%
Jacksonville	4%
Hubert	3%
Sea Level	3%
Swansboro	3%
Holly Ridge	2%
Harkers Island	2%
Other	25%

9.2.1.4 PERCEIVED CONFLICTS

Fishermen were asked about conflicts or negative experiences in the previous year with other commercial fishermen, recreational fishermen, state regulations, and federal regulations. Conflicts with other users of a public resource are to be expected, and part of the job of the NCDMF is to balance the needs of different user groups. The majority of commercial hard clam fishermen (83%) that were interviewed did not indicate any conflict or negative experience in these categories in the previous year. The most common conflict reported was with recreational fishermen (11%), followed by other commercial fishermen (9%), state regulations (4%), and federal regulations (1%). Several fishermen reported more than one type of conflict, therefore the percentages do not add up to 100% (Figure 9.10).

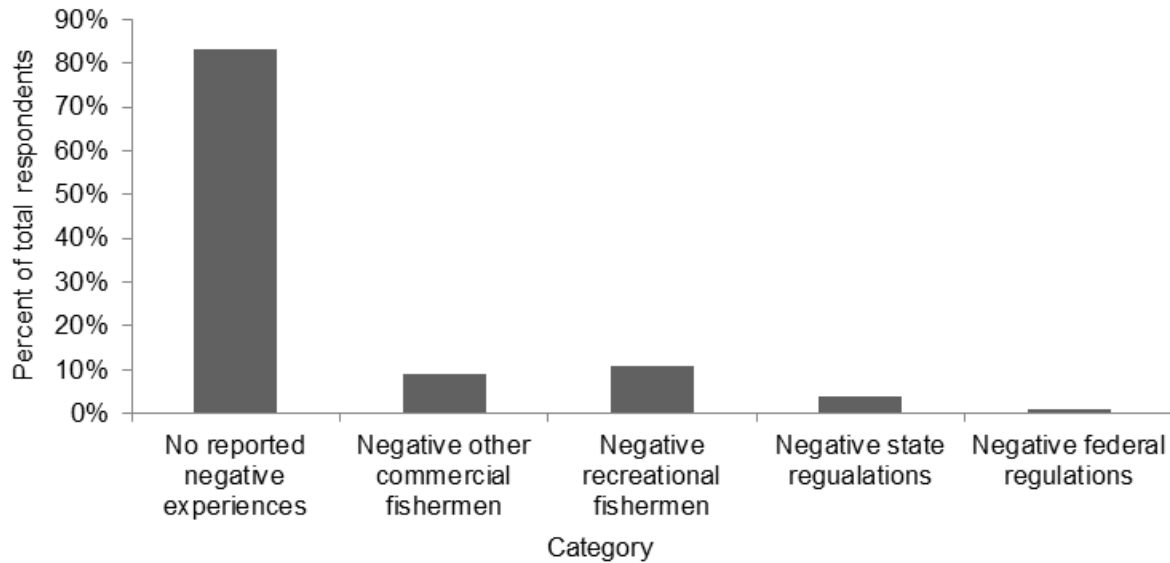


Figure 9.10. Reported conflicts of North Carolina commercial clam fishermen. NCDMF Fisheries Economics Program.

9.2.1.5 PERCEPTION OF IMPORTANT ISSUES

Clam fishermen interviewed by NCDMF were asked to rate how important certain issues were in relation to their fishing business. The most important issue to these fishermen was development of the coast (Table 9.10). As mentioned, all clam fishermen in the survey lived in the central or southern part of the coast of North Carolina, which has seen intense development in recent decades. Water quality impairments are often associated with intense development, which greatly impact if and when a shellfish area is opened. Additionally, coastal development is also associated with losing working waterfronts, which was another issue of concern for many commercial clammers. Related to one another, low prices for seafood and competition from imported seafood were also high on the list of issues that impact the businesses of clam fishermen. Keeping up with rule changes and proclamations, size limits, bag limits, and quotas were not seen as important issues effecting commercial clammers.

Table 9.10. Fishing business related issues considered most important to hard clam fishermen. NCDMF Fisheries Economics Program.

Ranking	Issue
1	Development of the coast
2	Low prices for seafood
3	Competition from imported seafood
4	Losing working waterfronts
5	Fuel price
6	Weather
7	Anticipating future business conditions
8	State regulations
9	Closed seasons
10	Federal regulations
11	Overfishing
12	Gear restrictions
13	Keeping up with rule changes and proclamations
14	Size limits
15	Bag limits
16	Quotas

9.2.2 RECREATIONAL FISHERY

As mentioned previously, the NCDMF has very limited information about recreational shellfish harvesters, or the issues that they find most important, though presumably keeping up with proclamations and area closures would be important to them as well.

9.3 RESEARCH RECOMMENDATIONS

There are currently no data on demographics, perceptions, or expenditures of recreational clam harvesters in the state. Collecting this information from recreational clam harvesters would improve knowledge of the recreational fishery as well as allow an assessment to be conducted on the economic impact of the recreational clam fishery. Additionally, socioeconomic surveys of commercial clam fishermen should be continued and updated periodically to determine the specific business characteristics, the economics of working in the fishery, fishery demographics, issues of importance for commercial participants, and attitudes towards management of the fishery.

9.4 DEFINITIONS AND ACRONYMS

Consumer Price Index (CPI) – The CPI measures the price paid by consumers for a fixed group of goods and services. Changes in the CPI over time constitute a common measure of inflation.

Commercial fishing – Fishing in which fish harvested, either in whole or in part, are intended to enter commerce through sale, barter, or trade. Since 1994, a commercial fisherman in North Carolina is required to have a license issued by the NCDMF and is allowed only to sell to a licensed dealer.

Fishing trip – A period of time over which fishing occurs. The time spent fishing includes configuring, deploying, and retrieving gear, clearing animals and debris from the gear, and storing, releasing or discarding catch. When fishing vessels are used, a fishing trip also includes the time spent traveling to and from fishing areas or locales and ends when the vessel offloads product at sea or returns to the shore. When fishing from shore or man-made structures, a fishing trip may include travel between different fishing sites within a 24-hour period.

Inflation-adjusted values – Inflation is a general upward movement in the price of goods and services in an economy. In this document, inflation is measured by changes in the U.S. Consumer Price Index (CPI). Ex-vessel prices and values can be adjusted according to the CPI to remove the effects of inflation so the value of a dollar remains consistent across years. Inflation adjusted values allow for a clearer understanding and analysis of changes in values over time.

Nominal ex-vessel price and value - The total landed dollar amount of a given species (or species landing condition and market category). Example: 100 lb of striped mullet at a PRICE of \$0.80 per pound will have a VALUE of \$80. These values represent the average amount paid to a fisherman by a seafood dealer.

Recreational fishing – A recreational fishing trip is any trip for the purpose of recreation from which none of the catch is sold or bartered. This includes trips with effort but no catch. Anglers who wish to use limited amounts of commercial fishing gear in joint and coastal waters under NCDMF jurisdiction are required to have a Recreational Commercial Gear License (RCGL).

10.0 ENHANCEMENT ACTIVITIES

10.1 PURPOSE AND NEED

NCDMF has not identified a need to target restoration efforts towards increasing hard clam populations; however, NCDMF supports enhancement programs which benefit native shellfish species through a variety of initiatives. In recognition of the eastern oyster as a keystone species in an estuarine environment, these initiatives focus on oyster restoration, while providing enhancement to hard clam habitat simultaneously.

10.2 HABITAT ENHANCEMENT PROGRAMS

10.2.1 CULTCH PLANTING

The objective of the North Carolina Division of Marine Fisheries cultch planting program is to provide shellfish habitat. While cultch planting is traditionally viewed as an oyster restoration measure, it may also serve as a restoration tool for other shellfish species, including hard clams. In the 1970's, the Virginia Institute of Marine Science planted cultch material over seed clams to protect them from predation. Through the broadcast of aggregate materials, survivorship of seed clams increased compared to controls (Castagna 1970).

While cultch planting efforts are not directly targeted towards hard clam restoration, the adjacent habitat is likely made more suitable for hard clam colonization. The emergent structure of cultch material and subsequent habitat complexity may increase food deposition, providing feeding opportunities for hard clams (Diehl 1992; Grabowski 2002; Kelaher 2003). Cultch planting areas in intertidal zones offer a variety of ecosystem services which may benefit hard clam habitat. Intertidal oyster reefs attenuate wave energy, support marsh accretion and stabilize interstitial sediments which serve as high quality habitat for hard clam recruitment. (Coen et al. 2007; Currin et al. 2010; Meyer et al. 1997).

2015 marks 100 years of cultch planting in North Carolina for restoration purposes. In that time, about 19 million bushels of oysters have been planted in North Carolina waters (Street et al. 2005). From 1981 to 2014 the state has constructed 1,961 cultch planting sites. The majority of these sites are grouped in close proximity to prior sites to create larger sites of oyster habitat over time. These sites have historically used a variety of materials for restoration, including oyster, clam, and scallop shells, as well as limestone marl. Since 2003, some portion of annually deployed cultch material has been supplemented by recycled shell. These sites range in size from 0.1-10 acres with less than 100 acres of accumulative impact per year. They are distributed throughout the state and are made available to the public as harvestable bottom. For more information on cultch planting as an oyster restoration measure, please refer to the *Oyster Fishery Management Plan Amendment 4, 10.3.1 Cultch Planting subsection*. Recently created cultch sites are monitored for oyster settlement, however protocol for assessing hard clam ecology in these areas has not been developed.

A comprehensive overview of the cultch planting program is available in the oyster FMP - amendment four.

10.2.2 OYSTER SANCTUARIES

In 1995, the Blue Ribbon Advisory Council on Oysters recommended the development of oyster sanctuaries in North Carolina waters. The objective of this initiative was to establish a self-

sustaining network of protected oyster broodstock sanctuaries. Sanctuaries in North Carolina are designed to provide interstitial soft bottom habitat between hard substrate patches (Figure 10.1). This soft bottom habitat is typically suitable for hard clam colonization and by construction can provide a refuge to preclude predation (Castagna 1970).

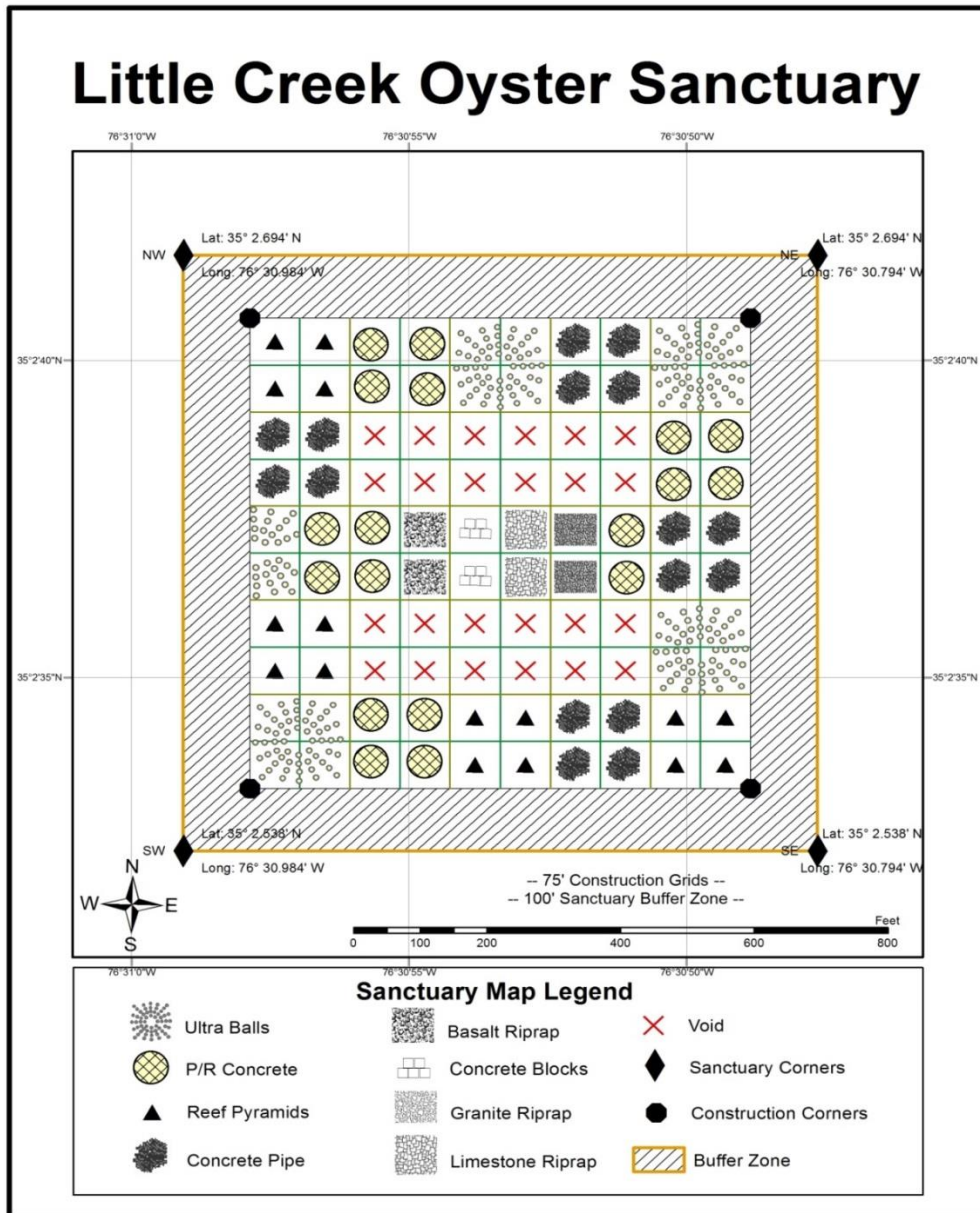


Figure 10.1. Little Creek Oyster Sanctuary conceptual map demonstrating the use of soft bottom habitat between hard substrate patches. All intentional void areas and areas between material types serve to provide unconsolidated soft bottom and hard substrate.

Within oyster sanctuary boundaries, hard clams are protected under North Carolina Marine Fisheries Rule 15A NCAC 03K .0209 and delineated in 15A NCAC 03R .0117. These rules prohibit harvest of shellfish and use of trawls, long haul seines, and swipe nets. Protecting

shellfish from harvest promotes growth and enhances survivability. Oyster sanctuaries under construction but not yet incorporated into 15A NCAC 03R.0117 can be protected under Rule 15A NCAC 03H .0103 and 03K .0103 through proclamation authority.

Protected hard clam populations would presumably boast higher survivorship compared to harvested populations, resulting from the absence of fishing mortality. Hard clams, as with oysters, in harvest-protected sanctuaries likely serve as broodstock populations, providing subsidies to harvestable areas. While monitoring protocol is in place for oyster sanctuaries, there is currently no provision for addressing hard clam ecology associated with these protected areas.

A comprehensive overview of the Oyster Sanctuary Program is available in the oyster FMP - amendment four.

10.2.3 SHELLFISH AQUACULTURE

Aquaculture of hard clams has ecosystem service value similar to wild stocks. Hard clams maintain the capacity to filter large volumes of water. Water column filtration improves water quality and clarity by reducing nutrients and suspended sediments as pseudofeces. Additionally, hard clam shell growth sequesters carbon, a service beneficial to other marine and estuarine organisms impacted by ocean acidification. Shellfish aquaculture equipment may also serve secondary functions, such as sediment stabilization and wave attenuation. Effectively, aquaculture equipment truncates high energy environments, providing suitable nursery habitat to other marine species. Larval subsidies are a valuable service of shellfish populations. Depending on the ploidy of hard clams in culture, environmental conditions, and the duration of grow out, shellfish aquaculture may provide an additional source of larvae for habitat enhancement.

11.0 ENVIRONMENTAL FACTORS

11.1 HABITAT

While the interdependency of all habitats is important to clams, some habitats are of particular importance because they are actually inhabited by clams. Those habitats include soft bottom (defined by Street et al. (2005) as “unconsolidated, unvegetated sediment that occurs in freshwater, estuarine, and marine systems” to include both deeper subtidal bottom and shallow intertidal flats), shell bottom, and submerged aquatic vegetation (SAV). The importance of each will be discussed in the following sections.

Threats to clam habitat include mobile bottom disturbing fishing gear, hand harvest methods, channel and basin excavation, dredge material disposal, and water-dependent development. Water quality threats include excess turbidity/sedimentation, nutrient enrichment, toxic chemicals and organisms, and microbial contamination. This section will focus primarily on threats within the jurisdiction of the MFC. Those threats include fishing activities, associated turbidity/sedimentation, and microbial contamination (causing shellfish harvest area closures). For information on the other threats, consult the CHPP (Deaton et al. 2010).

11.1.1 DESCRIPTION AND DISTRIBUTION

Hard clams occur extensively in estuarine systems. Habitats for juvenile and adult hard clams include intertidal sand flats, shell bottom, and SAV. Hard clams may also be found in shallow subtidal flats and deeper channels (Pattilo et al. 1997). On mudflats, suspension feeding hard clams cannot compete with deposit feeders that tend to re-suspend sediment particles and clog the feeding apparatus of the hard clam. On the other hand, deposit feeders are not found on sand flats because the larger sediment particle size has fewer bacteria to ingest (Peterson and Peterson 1979).

The filtering activity of dense aggregations of suspension feeders clears significant amounts of plankton and sediment from the water column, thus improving water clarity (Jørgensen 1990; Miller et al. 1996). Work done in the Chesapeake Bay indicates that based on abundance, filtering capacities, and water mixing parameters, bivalves could consume more than 50% of the primary production in shallow freshwater and low salinity areas. However, in deeper more saline systems, primary production was reduced to 10%. Estuary width may influence the ability of bivalves to filter primary production because of the low transport of water to the banks of an estuary where bivalves can be abundant. These results suggest that depth and width of the estuary are limiting factors when using bivalves to improve water quality, unless the bivalves are suspended in the water column (Gerritsen et al. 1994).

While hard clams commonly inhabit soft bottom habitat, they tend to be more abundant in structured habitats. Peterson et al. (1983) found higher abundances of hard clams in seagrass beds than in sand bottom, which may provide refuge from predation. He also found growth rates higher in seagrass beds. The higher growth rates are possibly due to the baffling effect of grass beds on current flow. This baffling effect slows current on the bottom of the seagrass bed creating a concentration of food particles where the hard clam feeds. Carroll et al. (2008) found that hard clams growth is often highest within dense seagrass beds due to lower predation rates by siphon nippers (Irlandi 1994; Irlandi and Mehlich 1996), or enhanced food flux caused by the slowing of water flow and sedimentation of particles (Irlandi and Peterson 1991; Irlandi 1996), allowing clams to potentially reach predation threshold size faster. Hard clams have also been

demonstrated to have higher survival in seagrass than in unvegetated sediments (Irlandi 1994) and had increasing survival with increasing seagrass cover (Irlandi 1997).

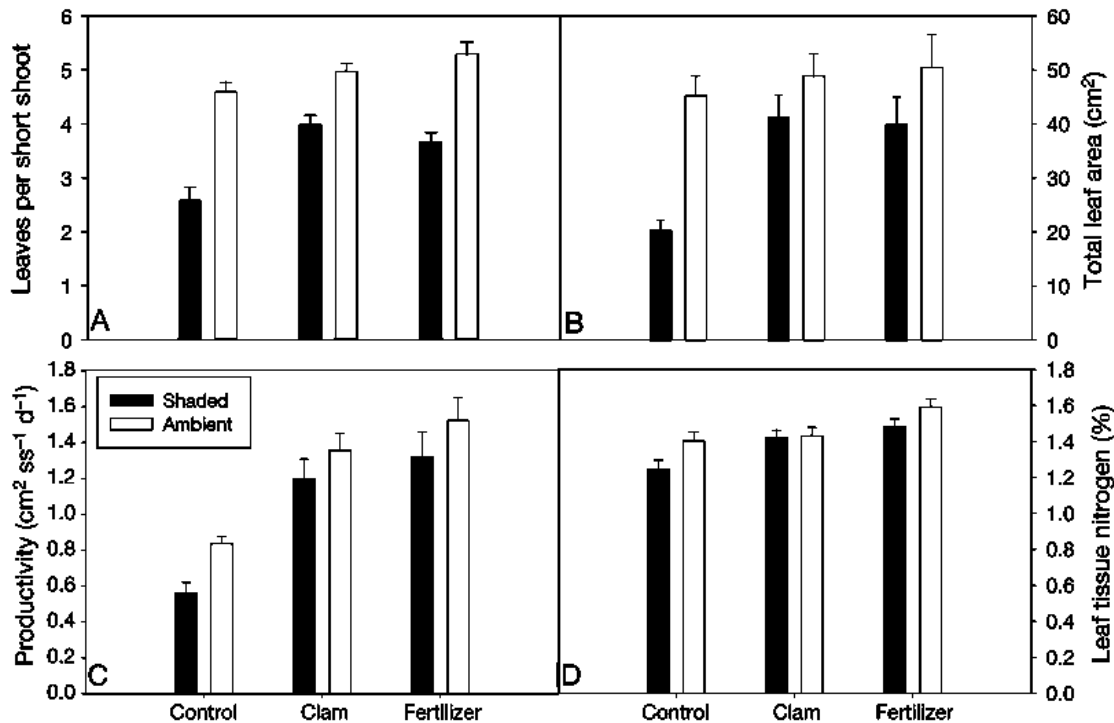


Figure 11.1 *Zostera marina*. Response variables (mean + standard error) for different nutrient treatments, ambient light conditions, and shaded light conditions. (A) total number of leaves per short shoot (ss), (B) total leaf area per short shoot (ss), (C) areal productivity per short shoot (ss), and (D) leaf tissue nitrogen (Carroll et al. 2008).

Carroll et al. (2008) focuses on the ability of hard clams to increase nutrient availability for eelgrass. Compared to control plots, eelgrass production in both ambient light and artificially shaded treatments was significantly higher in plots with hard clams (Figure 11.1C, $p < 0.05$). Eelgrass on plots with hard clams also had higher N concentrations in their tissues (Figure 11.1D, $p < 0.05$). These results were nearly identical to those obtained with fertilizer stakes (Figure 11.1C-D, $p < 0.05$). The results demonstrate the existence of positive interactions between hard clams and eelgrass, and also show that clams are capable of broadening the range of physical conditions within which eelgrass can survive by improving its habitat. Restoration efforts targeting submerged aquatic vegetation will benefit hard clams and vice versa.

Shell bottom provides significant protection for adult and juvenile hard clams. Peterson et al. (1995) reported that young clams survive better in shell bottom than open soft bottom areas. Specifically, clams are most abundant in the scattered shells forming the perimeter of oyster beds (Noble 1996). NCDMF manages some intertidal oyster cultch planting sites to take advantage of this hard clam/oyster shell relationship. After oysters are harvested from the planted site, the areas are opened for clam harvest by hand gears. Fishermen dig under the cultch to take high concentrations of hard clams that recruited under the oyster shell. Once the clam harvest is over, the areas are re-planted with cultch, and the two-year cycle begins again.

In order to identify threats to clam habitat, the current distribution of clam habitat must be documented. The NCDMF Shellfish Habitat and Abundance Mapping Program has been ongoing since 1988. Maps are compiled using standardized surveys from the North Carolina-South Carolina border north through Core Sound, along the perimeter of Pamlico, and in Croatan and Roanoke sounds. The program delineates all bottom habitats and samples the density of oysters, clams, and bay scallops in these habitats. This program has differentiated 24 different bottom types based on combinations of depth, bottom firmness, vegetation density, and density of surface shells. The program defines shell habitat (shell bottom) as significant cover (>30% of bottom) of living or dead shells. Also mapped are salt marsh, SAV, and intertidal/subtidal soft bottom. A stratified random sampling design is used to provide statistically sound shellfish density estimates by area and habitat. These data are represented on maps in Figures 11.1a, b, and c, compiled from data generated by the NCDMF Habitat and Enhancement Shellfish Habitat and Abundance Mapping Program.

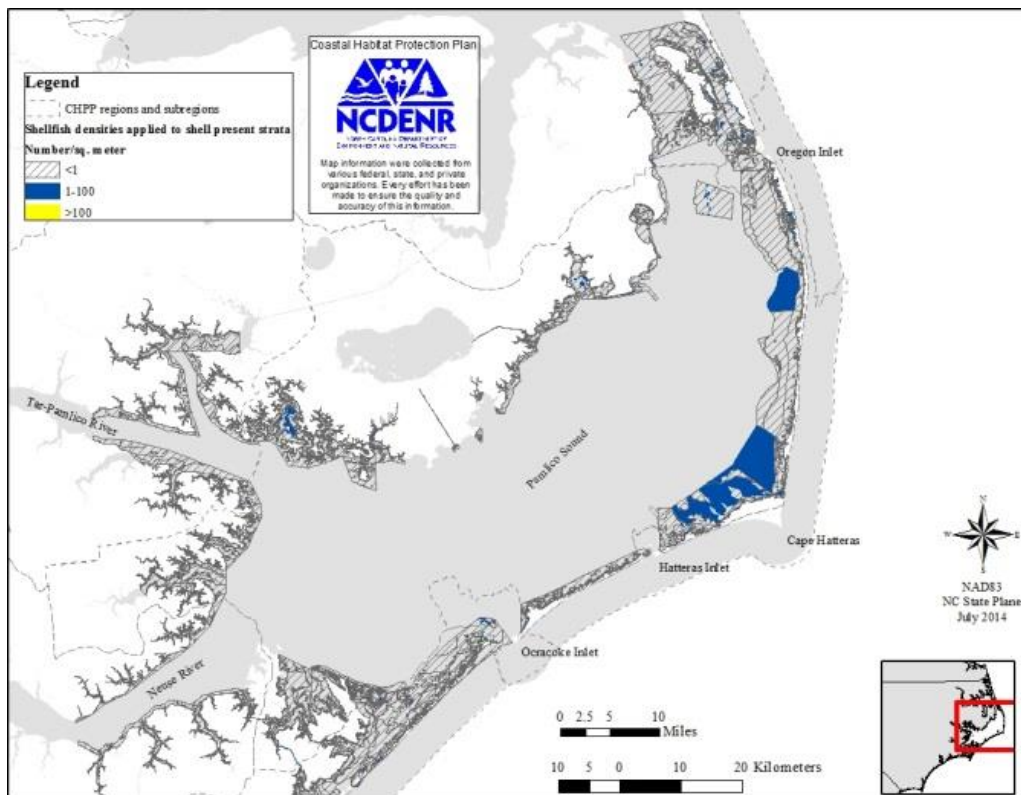
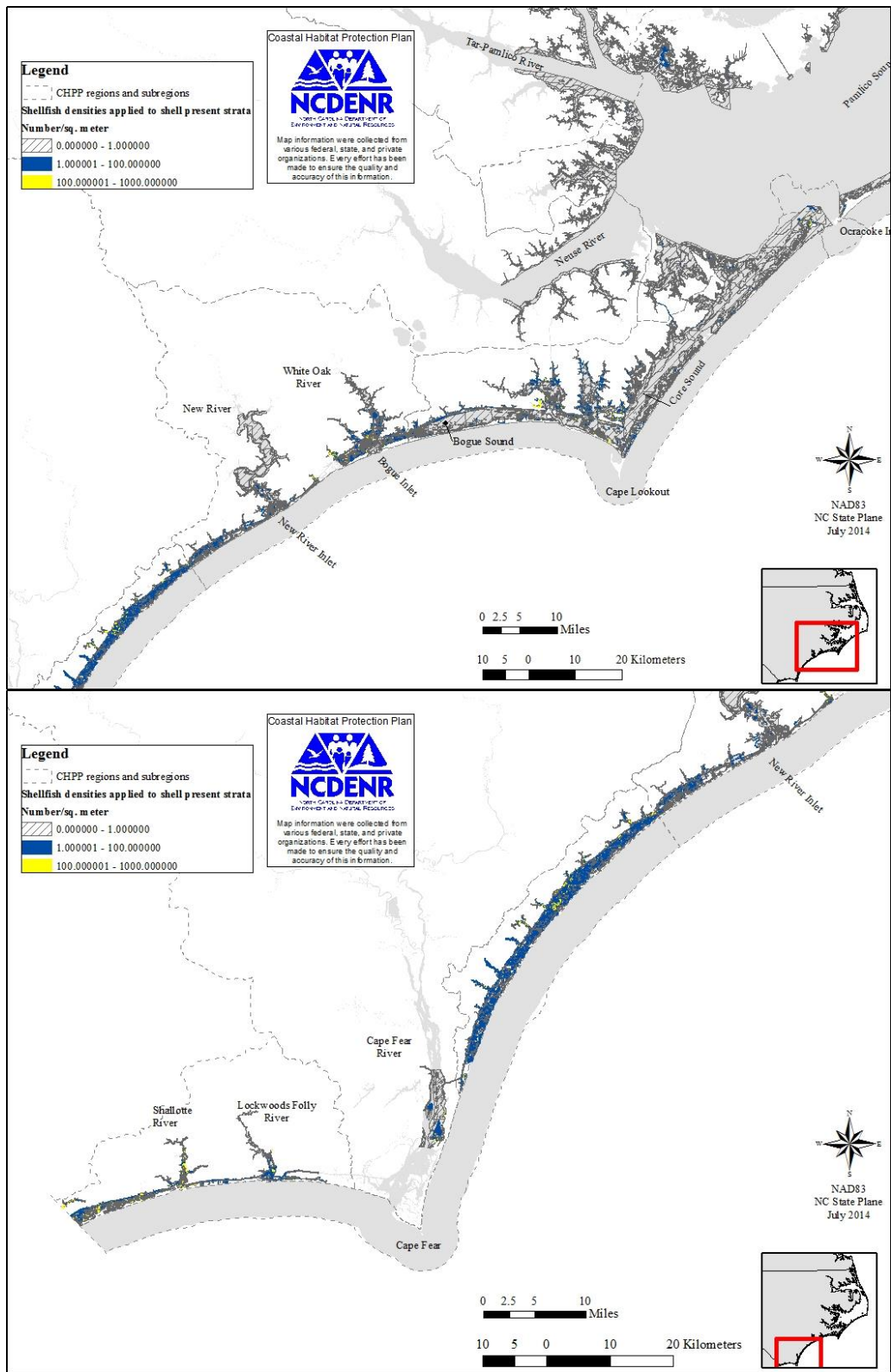


Figure 11.1a. Shellfish density, NCDMF Shellfish Habitat and Abundance Mapping Program, 2014.



Figures 11.1b and c. Shellfish density, NCDMF Shellfish Habitat and Abundance Mapping Program, 2014.

A total of 619,642 acres of commercial shellfish are scheduled to be mapped by the NCDMF Shellfish Habitat and Abundance Mapping Program. As of July 2014, 590,730 acres, or about 94%, have been mapped. A total of 8,154 acres remain to be mapped in Hyde County around West Bluff Bay and Wysocking Bay. In Brunswick County 12,680 acres remain to be mapped from Dutchman Creek into the Cape Fear and New Hanover County. It is currently estimated that approximately 1,433 acres within the Cape Fear River will not be mapped due to depth and other restrictions within the main channel. Military restricted areas, shellfish lease areas, and major navigation channels are excluded from the mapping effort. Of the entire area mapped, approximately 21,221.08 acres (3.59%) of benthic habitat was classified as shell bottom (Table 11.1 and Figure 11.2).

The Southern Estuaries have the greatest relative area of shell bottom (18% - mostly intertidal) among the CHPP sub regions mapped to date. The Cape Fear sub region had the greatest relative area of subtidal shell bottom (13%). The largest area of subtidal shell bottom was in Core/Bogue Sound (6,014 ac), followed by Pamlico Sound areas (3,436 ac), New/White Oak (3,145 ac), and Southern Estuaries (1,658 ac). The majority of intertidal shell bottom was mapped in the Southern Estuaries (3,523 ac) and Core/Bogue (939 ac) sub regions. Estimated densities of living shellfish on shell bottom are shown on Maps 3.3a-c. The shellfish densities sampled in shell-present strata/area combinations were applied to the entire strata within an area. Estimated densities suggest additional ecological benefits of living shellfish where shell bottom has been mapped.

Table 11.1 Shell bottom habitat mapped by the NCDMF Shellfish Habitat and Abundance Mapping Program by CHPP sub regions, 2014. *Does not include areas inaccessible to survey vessels such as military, shellfish leases, bridge restrictions, shallows waters, or hazards.

CHPP sub regions	Acres intended for mapping (Strata A-X, NM)	Acres mapped* (Strata A-X)	Actual % mapped	% Mapped	Mapped shell bottom (subtidal)		Mapped shell bottom (intertidal)		Total shell bottom (Acres)	% of Total shell bottom within area mapped
					Acres	% Mapped	Acres	% of Mapped		
Albemarle (1)	56,282.36	56,281.13	99.99%	100%	465.69	0.83%	40.35	0.07%	506.05	1%
Oregon Inlet (1/2)	6,828.65	6,828.65	100.00%	100%	105.36	1.54%	3.40	0.05%	108.72	2%
Pamlico Sound (2)	217,130.68	208,976.38	96.24%	96%	3436.92	1.64%	77.26	0.04%	3514.18	2%
Tar Pamlico (2)	46,425.86	46,256.72	99.64%	100%	397.47	0.86%	0	0.00%	397.47	1%
Neuse (2)	20,814.37	20,678.62	99.35%	100%	43.02	0.21%	0	0.00%	43.02	0%
Eastern Coastal Ocean (2)	6,033.53	6,033.53	100.00%	100%	0	0.00%	0	0.00%	0	0%
Ocracoke Inlet (2/3)	5,504.51	5,504.51	100.00%	100%	67.79	1.23%	9.79	0.18%	77.57	1%
Core/Bogue (3)	158,267.69	153,734.54	97.14%	100%	6,014.77	3.91%	939.34	0.61%	6954.12	5%
New/White Oak (3)	53,703.70	50,627.38	94.27%	100%	3,145.79	6.21%	505.46	1.00%	3651.24	7%
South Eastern Coastal Ocean (3)	2.13	2.13	100.00%	100%	1.75	82.17%	0.38	17.83%	2.13	100%
Southern Estuaries (4)	29,727.97	29,566.30	99.46%	100%	1,658.25	5.61%	3,522.63	11.91%	5,180.88	18%
Cape Fear (4)	18,918.61	6,238.47	32.98%	33%	768.9	12.33%	15.69	0.25%	784.59	13%
South Coastal Ocean (4)	1.79	1.79	100.00%	100%	0.35	0.00%	0.76	0.00%	1.11	62%
Total	619,641.85	590,730.15	93.77%	94.56%	16,106.02	2.73%	5,115.06	87.00%	21,221.08	3.59%

There are currently over 628 acres of Seed Oyster Management Areas south of Bogue Sound that are part of the NCDMF Shellfish Habitat and Abundance Mapping Program focus area (Table 11.2). There are also Seed Oyster Management Areas at the south end of Roanoke Island in Cedar Bush Bay, and in Bay River at Spencer Point. Oyster Research Sanctuaries and Shellfish Management Areas cover over 200 acres in coastal waters and over 100 acres in the Shellfish Habitat and Abundance Mapping Program focus area (Table 9.2).

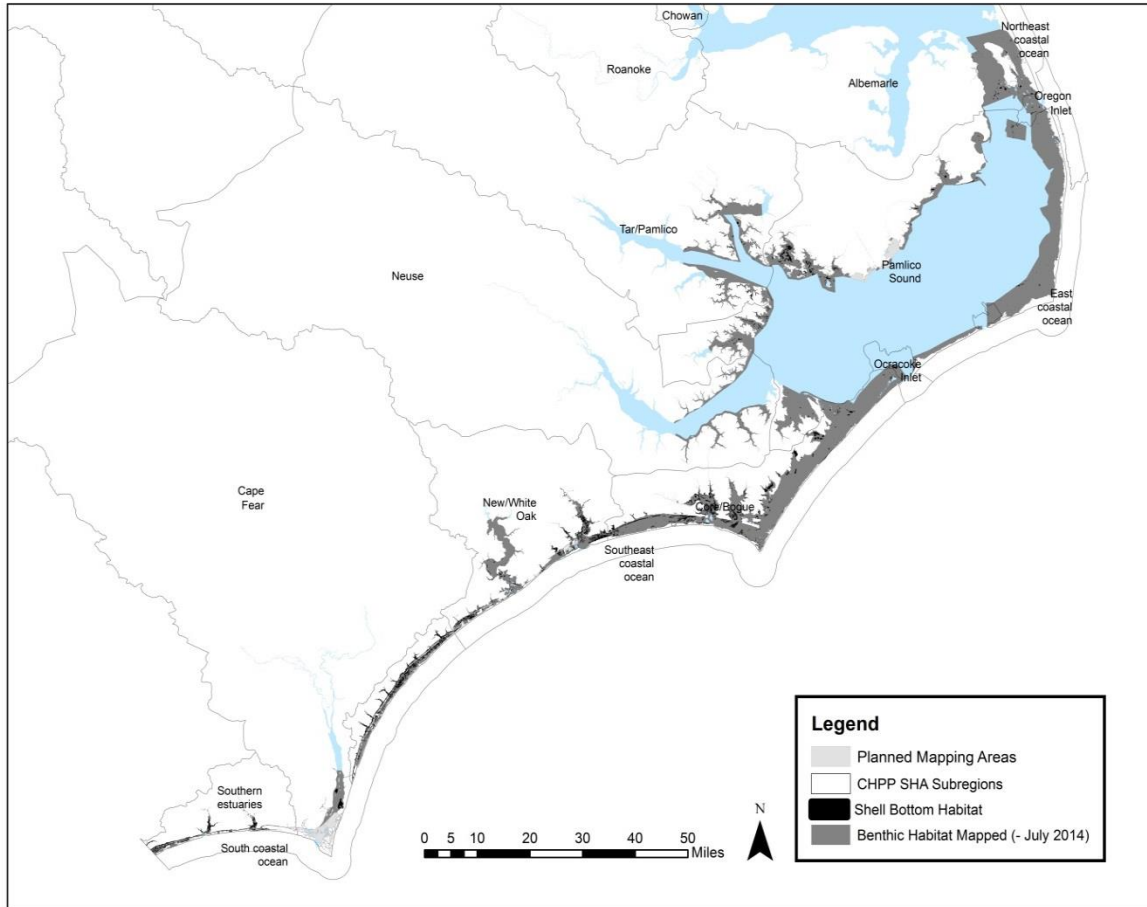


Figure 11.2. Distribution of mapped shell bottom, Habitat and Enhancement Section Bottom Mapping Program, NCDMF, 2014.

The amount of SAV in North Carolina was estimated at between 134,000 and 200,000 acres around 1990 (Ferguson and Wood 1994). Along the Atlantic coast, North Carolina supports more SAV than any state except Florida. The majority of SAV occurs in eastern Pamlico Sound and Core Sound in high salinity waters (Ferguson and Wood 1994) (Figure 11.3). Because light is the primary limiting factor affecting its distribution, SAV is restricted to relatively shallow waters, usually less than one meter in depth at low tide.

Changes in the amount or condition of high salinity seagrass beds have a direct impact on hard clam populations. Temporary loss of SAV from propeller scarring and boat groundings is a growing problem in coastal North Carolina. Grass beds are vulnerable to changes in sediment, sunlight, storms, temperature, development activity, scour, etc. As such, it is difficult to know the condition of the habitat at any point in time. Nevertheless, locating and monitoring changes in

submerged aquatic vegetation is important for protecting hard clams. Protection, enhancement, and restoration of this habitat are essential to maintaining viable hard clam populations.

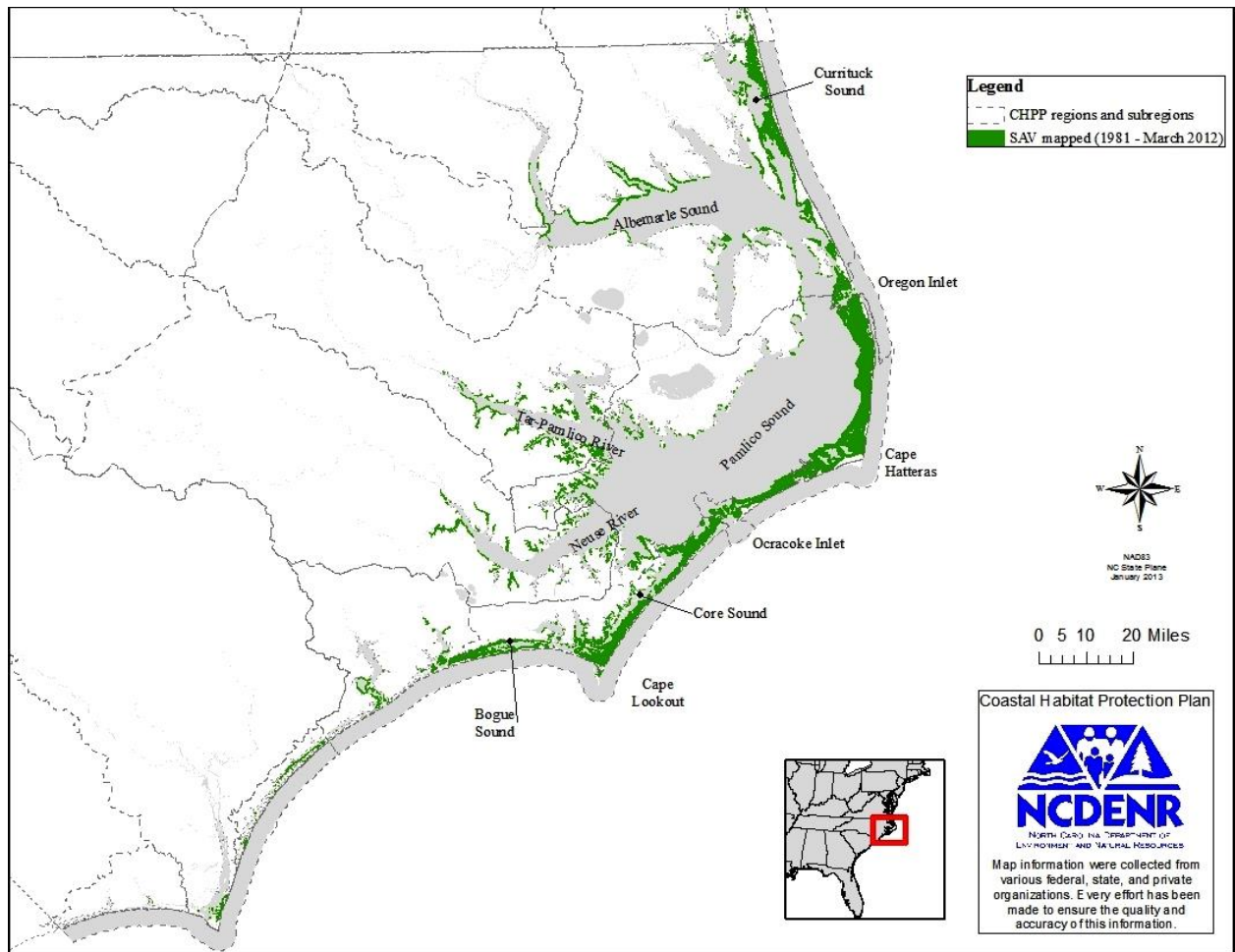


Figure 11.3. Submerged aquatic vegetation mapped from 1981 to 2012. Absence of SAV beds in a given area does not suggest actual absence of SAV as surveys have not been conducted in all areas. Presence of SAV does not reflect current presence of SAV as data shows resource dating to 1981, and beds may no longer exist in all locations. NCDMF GIS database.

11.2 PHYSICAL THREATS

11.2.1 MOBILE BOTTOM DISTURBING FISHING GEAR

Soft bottom habitat, because of its low structure and dynamic nature, has historically been considered the most appropriate location to use bottom disturbing gear. There are fishery rules that restrict bottom disturbing gears in designated soft bottom habitat. These include prohibition of trawls, dredges, long haul seines in Primary Nursery Areas (PNAs)(Marine Fisheries Commission Rule 15A NCAC 03N .0104), prohibition of trawls in Secondary Nursery Areas (SNAs)(Marine Fisheries Commission Rule 15A NCAC 03N .0105) and prohibition of trawls or mechanical shellfish gear in crab spawning sanctuaries (Marine Fisheries Commission Rule 15A

NCAC 03L .0205) in the five northern-most inlets of North Carolina during the blue crab spawning season (March-August).

Fishing related impacts to habitat have been reviewed and compiled in fishery management plans and have been summarized in documents produced by the South Atlantic Fisheries Management Council (SAFMC), Mid-Atlantic Fisheries Management Council (MAFMC), N.C. Moratorium Steering Committee (MSC 1996), Auster and Langton (1999), NCDMF (1999), and Collie et al. (2000). The gears with the greatest potential for damage to soft bottom include dredges and trawls. However, research suggests that neither activity has a significant effect on clam recruitment (Auster and Langton 1999; NCDMF 1999; Collie et al. 2000). Dredges and trawls have a greater impact on structured habitat where clams are more abundant. Oyster rocks and cultch plantings provide excellent habitat for hard clam settlement and growth in areas where salinity regimes and water flow are suitable for survival. Hard clam harvesting in oyster rocks involves overturning or sifting through shells and oysters overlying clams, possibly damaging the oysters. For this reason, oyster rocks are protected from mechanical harvest of clams and bull rakes by rule (Marine Fisheries Commission Rules 15A NCAC 03K .0304 and 03K .0102). Most harvesting of clams in relation to oysters occurs around the base of the beds where they are most abundant (Noble 1996).

Of the factors affecting the condition of structured clam habitat, mechanical shellfish harvest of clams and oyster harvest are the most obvious. Both Chestnut (1955a) and Winslow (1889) reported finding formerly productive areas in Pamlico Sound where intensive oyster harvesting made further harvest and recovery of the oyster rocks impossible. Heavily fished oyster reefs lose vertical profile and are more likely affected by sedimentation and anoxia, which can suffocate live oysters and inhibit recruitment (Kennedy and Breisch 1981; Lenihan and Peterson 1998; Lenihan et al. 1999).

The Mechanical Methods Prohibited Areas (MMPAs) are defined in Marine Fisheries Commission Rule 15A NCAC 03R .0108. In accordance with MFC Rule 15A NCAC 03K .0108, shellfish within these areas are protected from mechanical methods of harvest. In 2005, the MFC closed an additional 30,000 acres of bays to mechanical harvest. Mechanical harvest of oysters is allowed on deep water reefs in Pamlico Sound during mechanical harvest season and in certain bays during a limited six-week season. Currently, 100 lb. dredges are allowed in mechanical harvest areas. Studies performed by NCDMF staff on two occasions, comparing 100 lb. dredges and 50 lb. dredges resulted in negligible differences in habitat disturbance between the two dredge sizes (Mike Marshall, NCDMF Central District Manager, Personal Communication, July 2014). Through Amendment 2 of the Oyster FMP, hand harvest limits were increased from five bushels per operation to 10 bushels to match dredge limits and encourage more hand harvest in areas where use of the two gears coincides.

Clams are also harvested by mechanical methods using either hydraulic escalator dredge or clam trawl. Clam trawling, or kicking, began in Core Sound with a method involving the scouring of bottom sediment with a prop wash while towing a trawl. Anecdotal accounts indicate that significant negative impacts occurred to oyster rocks prior to marking and closing areas to mechanical harvest of clams. Current fisheries regulations prohibit the use of mechanical gear in SAV beds and live oyster beds because of the destructive capacity of the gear. Clam kicking is now only allowed in designated harvest areas that do not contain significant SAV or oyster resources.

Other fishing gears also impact clam habitat. Shrimp and crab trawling can remove oysters and cultch material from rocks and firm bottom, only to re-deposit on unsuitable bottom where they

will be covered by sediment (Berrigan et al. 1991; Chestnut 1955a). However, commercial fishermen generally avoid oyster beds because they damage nets; intentional disturbance of clam habitat is more likely over scattered oysters. Frequent disturbance could prevent future formation of larger oyster rocks, especially where there are historical losses. Ongoing efforts to identify suitable areas for oyster restoration may include currently trawled areas.

State posted oyster plantings are protected from any type of trawling or seining when designated as a Shellfish Management Area under Marine Fisheries Commission Rule 15A NCAC 03K .0103. This includes oyster beds planted for sanctuaries and for periodic harvest. However, the posting of all natural oyster beds has never been attempted because of the large number of areas and the lack of resources and enforcement. The NCDMF has designated Shellfish Management Areas where enhancement activities are conducted (shell is added and/or oysters transplanted) and shellfishing activities are restricted or prohibited, except by proclamation. As the oysters reach harvestable size, the areas may be opened to oyster harvest first, and then opened to clamming. The posted areas are mostly south of New River. The deep water oyster rocks in Pamlico Sound must be located and marked to be effectively managed. The location and mapping began with an expansion of the Shellfish Habitat and Abundance Mapping Program into deeper water, but was minimal due to budget cuts and subsequent loss of staff in 2011 (Brian Conrad, NCDMF, Habitat and Enhancement, personal communication, June 2014).

11.2.2 HAND HARVEST METHODS

Intensive hand harvest methods can be destructive to oyster rocks. The harvest of clams or oysters by tonging or raking on intertidal oyster beds causes damage not only to living oysters but also to the cohesive shell structure of the reef (Lenihan and Peterson 1998). This destruction has been an issue where oysters and hard clams co-exist, primarily around the inlets in the northern part of the state and on intertidal oyster beds in the south (NCDMF 2001a). Studies by Noble (1996) and Lenihan and Micheli (2000) quantified the effects of oyster and clam harvest on oyster rocks. The former study found that the density of live adult oysters was significantly reduced where clam harvesting occurred. Mortality was attributed to oysters being cracked or punctured and subsequently dying or being eaten by predators, or to being smothered beneath sediments associated with clam digging. Conversely, oyster harvesting had little effect on clam populations. The NCDMF conducted field investigations on the status of oyster rocks in Ward Creek, Carteret County, to assess the destruction of oyster rocks by individuals taking clams by legal hand harvest methods (Noble 1996). The survey determined that the oyster rocks were impacted and, subsequently, the affected portion of Ward Creek was designated a Shellfish Management Area (SMA) and was closed to clamming.

In January of 2007, the Director issued a proclamation allowing shellfishing in the Ward Creek SMA in accordance with existing harvest limits. This allowed hand rakes and tongs to be used to take the legal limits of oysters and clams. The proclamation was issued after NCDMF sampling indicated that legal sized subtidal oysters were present in sufficient quantity to open harvest. The MFC recommendation in amendment 1 of the Hard Clam FMP was to leave the current measures in place and continue to allow shellfishing in the Ward Creek SMA (NCDMF 2008b). The Southern District has a long history of managing SMAs from New River south by allowing oyster harvest on planted rocks prior to allowing clam harvest. This protects the oyster rocks from being damaged or destroyed by tongs or rakes while digging for clams. Currently, almost 90% of the bottom mapping area is open to hand harvest methods (Deaton et al. 2010).

Table 11.2. Bottom habitat mapped by the NCDMF Habitat and Abundance Mapping Program within areas receiving specific MFC designations that manage fishing activities, 2014. EBHM is Estuarine Benthic Habitat Mapping.

MFC designation	Area (acres) within NC coastal waters for GIS layer	Area (acres) within EBHM areas	% of Specific area that falls within mapping area	Area (acres) within EBHM mapped	% Mapped
Crab Spawning Sanctuaries	27,497.72	16,458.36	59.85%	14,798.33	89.91%
Military Restricted Areas	104,452.14	21,718.16	20.79%	19,049.46	87.71%
Seed Management Areas	2,178.54	2,321.79	106.58%	2,321.79	100.00%
Oyster Sanctuaries	228.42	97.22	42.56%	97.22	100.00%
Special Secondary Nursery Areas	35,794.69	31,793.33	88.82%	31,247.32	98.28%
Mechanical Clam Harvest areas	43,899.93	40,915.49	93.20%	40,089.97	97.98%
Mechanical Oyster Harvest prohibited areas	407,396.56	347,402.79	85.27%	327,801.01	94.36%
Primary nursery areas	44,973.28	48,556.80	107.97%	46,491.35	95.75%
Taking crab with dredges	86,094.68	28,031.02	32.56%	28,030.07	100.00%
Trawl net prohibited	208,591.77	158,268.09	75.87%	152,727.26	96.50%

11.2.3 WATER-DEPENDENT DEVELOPMENT

Water-dependent development is development that cannot exist over high ground without the presence of water. Such development includes but is not limited to, marinas, docks, piers, utility crossings, wharves, wind energy facilities, revetments, culverts, groins, navigational aids, mooring pilings, bridges, access channels, boat ramps, and bulkheads (Coastal Resources Commission Rule 15A NCAC 07H .0208(a)(1)). Specifically excluded are such structures as restaurants, residential development, motels, private roads, factories, parking facilities, etc. (Coastal Resources Commission Rule 15A NCAC 07H .0208(a)(1)). Although the construction of some water-dependent structures may increase substrate for oysters, activities associated with water-dependent development can harm shell bottom. Dredging of channels can remove, damage, or degrade existing shell bottom. Dredging creates turbidity that can clog clam and oyster gills or cover shellfish completely. Even low levels of siltation can affect the growth of oyster beds by reducing larval attachment.

In accordance with CRC Rule 15A NCAC 07H .0208(b)(1) navigation channels, canals, and boat basins shall be aligned or located so as to avoid primary nursery areas, shellfish beds, beds of submerged aquatic vegetation, as defined by the MFC. Maintenance excavation can be allowed within these areas subject to conditions put forth in Coastal Resources Commission Rule 15A NCAC 07H .0208(b)(1)(i)-(iv). Current (July 2014) CRC marina siting rules state: To protect

water quality in shellfishing areas, marinas shall not be located within areas where shellfish harvesting for human consumption is a significant existing use or adjacent to such areas if shellfish harvest closure is anticipated to result from the location of the marina (Coastal Resources Commission Rule 15A NCAC 07H .0208(b)(5)(E)). The rule continues to define “significant existing use” per 33 U.S. Code Section 101(a)(2) of the Federal Clean Water Act and North Carolina Water Quality Standards.

11.3 WATER QUALITY DEGRADATION

11.3.1 TURBIDITY AND SEDIMENTATION

Sediment was the largest cause of water quality degradation in the Albemarle-Pamlico estuarine area in 1989 (DEM 1989). Sediment was also listed by DWQ as a problem parameter for 964 miles of North Carolina waterways in 125 water bodies, including 25 water bodies in the Cape Fear River basin, 18 in the Neuse River basin, and 11 in the Tar-Pamlico River basin in 1998-1999 (DWQ 2000). In 2012, there were 90 North Carolina waterbodies listed as impaired due to turbidity on the NC 303(d) List (under Section 303(d) of the Clean Water Act, states are required by the EPA to list and establish rankings for impaired waters). All of these river basins contain shell bottom habitat.

Organisms in soft bottom habitat are adapted to shifting and changing sediments. However, when sedimentation is excessive, there can be negative impacts. In addition to direct physical damage to the shell mound structure, bottom disturbing fishing gear, including hydraulic clam dredges, clam trawls (kickers), and shrimp and crab trawls can impact clam beds and oyster reefs indirectly by re-suspending sediment. High levels of suspended sediment in an estuarine or marine habitat can greatly reduce successful settlement of larval clams and oysters, and can smother other benthic invertebrates (Coen et al. 1999; AFS 2003). Excessive sedimentation can also harm shellfish by clogging gills, increasing survival time of pathogenic bacteria, or increasing ingestion of non-food particles (SAFMC 1998). Sediment in excessive amounts is also a problem because it transports fecal coliform in stormwater farther downstream and allows the bacteria to persist longer in the water column than such bacteria would live in clear waters (Schueler 1999). While fecal coliform bacteria do not affect the viability of clams or oysters, pathogenic bacteria can make shellfish unfit for human consumption. The primary sources of microbial contamination in coastal waters are thought to occur within one-half mile of the shoreline (Deaton et al. 2010).

There are many other sources of human-induced turbidity and sediment pollution. Any activity that involves clearing of vegetation, grading, and ditching of land can potentially increase erosion and sediment loading in stormwater runoff. There were many thousands of wetland acres lost to agricultural drainage before the “Swampbuster” provisions of the 1985 Farm Bill (Street et al. 2005). Today, large-scale drainage projects on wetlands are prohibited without mitigation. However, existing drainage from agricultural lands, forestry operations, and construction activities continues to deliver sediment to aquatic ecosystems downstream. Increased sedimentation in headwaters from upland development has caused environmental stress and possible mortality to downstream clam and oyster stocks (Ulanowicz and Tuttle 1992; Mallin et al. 1998). In North Carolina’s estuaries, rates and sources of sedimentation have been studied in the Newport River (Mattheus et al. 2010; Gunnell et al. 2013) using radionuclide analysis of sediment cores to determine the timing and rate of sediment accumulation. These results were compared to land use changes to evaluate the relationship between the two. The Newport River is a relatively small estuary of about 63 square miles located north of Morehead City in Carteret County, North Carolina. Average depth is less than three feet with a

maximum depth in natural channels of six feet and 40 feet in the dredged channels near the State Port. The western portion of the Newport River has bottoms composed of silts, clays and oyster rocks, and the eastern part is composed of a firm sand bottom. Sedimentation rates in the upper Newport River were studied in an area visibly observed to be accreting using core analyses to date sediment deposition. Results indicated that a sharp increase in the rate of sediment accumulation (0.58 cm/yr to 0.97 cm/yr) occurred on the Newport delta (upper Newport estuary where the river widens, just upstream of Cross Rocks, MFC designated Primary Nursery Area) around 1964, and the rate remained high (Mattheus et al. 2010; Gunnell et al. 2013). The source of the increased sedimentation was correlated to extensive land clearing from a forestry operation which began in 1964, and ended around 1983. The relatively rapid transport of sediment to the estuary indicated a high connectivity between upstream and downstream sources. Although the upper Newport River has extensive forest and wetlands, ditching and large rain events likely accelerated the movement downstream (Mattheus et al. 2010). This and other studies indicate that sedimentation rates increase following land use changes that clear vegetation and increase connectivity between runoff and the estuary via ditching, navigational dredging, and loss of vegetated buffers. Improved voluntary and regulatory land use strategies must be considered to reduce non-point source pollution and subsequent habitat degradation in coastal waters. Mitigation should also be required from upstream development projects that result in habitat loss downstream.

To address land-based, non-point sources of turbidity, vegetated buffers are required along coastal waters and in selective river basins. Although definitions and characteristics of vegetated buffers vary, a buffer is generally a vegetated transitional zone situated between upland land uses and aquatic habitats that functions as a filter of surface water runoff (Crowell 1998). Vegetated buffers are very effective at trapping sediments and other pollutants from stormwater runoff (Williams and Nicks 1988; Lee et al. 1989; Gilliam et al. 1994; Lowrance 1997; DWQ 2000). Properly constructed, vegetated buffers ranging from 5 - 185 m (15 - 600 ft) have been shown to remove as much as 90% of sediment and nitrate and up to 50% of phosphorus from stormwater runoff (Desbonnet et al. 1994). Relative effectiveness is dependent on buffer width, slope, soil type, vegetative cover, quality and flow of the runoff, and size of the drainage area.

The CRC adopted a 30 ft buffer as part of the Coastal Shoreline Area of Environmental Concern (AEC) in August 2000 for all new development in the 20 coastal counties governed by Coastal Area Management Act (CAMA). This buffer begins at the normal high or normal water level, and is subject to exceptions found in Coastal Resources Commission Rule 15A NCAC 07H .0209(d)(10). Although this buffer has positive environmental benefits throughout the coast, science suggests it is inadequate to significantly reduce pollutant loading from nonpoint source runoff (Zirschky et al. 1989; Groffman et al. 1991; Desbonnet et al. 1994; Gilliam et al. 1994; Lowrance 1997; Ensign and Mallin 2001). For example, a study of Goshen Swamp, a Coastal Plain blackwater stream that was clear-cut, found that the clear-cut caused violations of ambient North Carolina water quality standards for turbidity, chlorophyll *a*, fecal coliform bacteria, and dissolved oxygen compared with a control stream (Ensign and Mallin 2001). Despite a 10 m (33 ft) buffer left along the stream bank, these violations occurred over a two-year period following the clear-cut. The buffer was less than the state best management practice recommending a 50 ft minimum.

The EMC Neuse and Tar-Pamlico riparian buffer rules were designed based on the zonation scheme in Lowrance (1997). Zone 1 must be a 30 ft wide forested area, beginning at mean high water (MHW), where the first 10 ft remain undisturbed, and the other 20 ft may have limited thinning of trees. Landward of this, Zone 2 must be 20 ft wide and have dense plant cover where no fertilizer use or development is allowed. The rule applies to all perennial and intermittent

streams, lakes, ponds, and estuaries. Man-made ditches are exempt from this rule (15A NCAC 02B .0233 (6)). The EMC considers the buffer rules to be critical to successfully reducing nitrogen. The Nutrient Reduction Strategies in the Neuse and Tar-Pamlico have resulted in the targeted 30% reductions from point source discharges and agriculture, though the overall goal of a 30% reduction in receiving waters has not been met (DWQ 2009).

11.3.2 CHEMICAL CONTAMINATION

Marine bivalves have been shown to accumulate chemical contaminants, such as hydrocarbons and heavy metals, in high concentrations. Exposure to organic contaminants has resulted in impairment of physiological mechanisms, histopathological disorders, and loss of reproductive potential (Capuzzo 1996). Reductions in growth and increased mortality have been observed in soft-shelled clams (*M. arenaria*) following oil spill pollution events (Appeldoorn 1981). Increased respiration, reduction in shell thickness, inhibition of shell growth, and general emaciation of tissues has been attributed to adult bivalve exposure to heavy metal contamination. Early developmental stages of bivalve mollusks are most sensitive to metal toxicity. Metals such as mercury, cadmium, and copper are capable of adversely affecting genetic development in bivalve embryos (Roesijadi 1996).

Hackney et al. (1998) studied North Carolina's estuaries and found widespread contamination of surface sediments by several chemical contaminants, including heavy metals, DDT, and hydrocarbons. Although attributing direct impacts to the hard clam fishery from such chemical contaminants is difficult, the presence of these contaminants in many of the state's estuaries is cause for concern for clam stocks.

11.3.3 MICROBIAL CONTAMINATION

Microbial contamination from fecal matter is important because it affects the opening and closing of shellfish harvest waters. Fecal coliform bacteria occur in the digestive tract of, and are excreted in the solid waste from warm-blooded animals. While these bacteria are not harmful to humans or other animals, their presence in water or in filter-feeding shellfish may indicate the presence of pathogens that are detrimental to human health (DWQ 2000). Moreover, elevated levels of fecal coliform bacteria suggest that pollutants, such as nutrients, sediment, or toxins, may also be entering the water. Mallin et al. (1997; 2000; 2001), studying water quality in tidal creeks, found a positive correlation between fecal coliform abundance and turbidity, nitrate, and orthophosphate. The significant correlation between bacteria and sediment was most likely because fecal coliform bacteria tend to associate with suspended particulate matter, and survive longer when in association with sediment particles (Mallin 1998; Mallin et al. 2000). The positive relationship between coliform bacteria and nutrients was attributed to both pollutants coming from the same sources in some instances. Also, some studies suggest that nutrient loading can stimulate growth and survival of fecal bacteria indicators (Evison 1988). Reduction of bacterial loading will also reduce loading of other pollutants into coastal waters and improve water quality and habitat conditions.

Because consumption of shellfish containing high levels of fecal coliform bacteria and associated pathogens can cause serious illness in humans, shellfish growing waters are closed to harvest when fecal coliform counts increase above the standard 14 MPN/100ml (15A NCAC 18A .0900), where MPN denotes "most probable number." The NCDMF closes waters where a high potential for microbial contamination exists, such as around marinas and point source discharges. Shellfish harvest closures have continued to occur over time (NCDMF 2001a and 2001b), which has led to a reduction in available harvest areas. Long-term shellfish closures due to bacterial

contamination remove available harvest areas for oysters and clams and concentrate those activities on remaining resources, compounding harvest related impacts on the resources in those areas. While closures protect shell bottom habitat from harvest, water quality degradation associated with high bacterial contamination is not advantageous for other aquatic organisms. However, because shellfish filter organisms from the water column, non-harvested shellfish may provide an important water quality enhancement function.

Fecal coliform originates from both point and non-point sources. Point sources include National Pollution Discharge Elimination System (NPDES) wastewater discharges and other sources with identifiable origins. Although wastewater discharges are treated, closures are required due to the possibility of mechanical failure allowing inadequately treated sewage to reach shellfish waters. There were five minor and three major municipal NPDES wastewater systems located within 0.5 mi of SA waters (Market Shellfishing, Saltwater waters); DWR surface water classification) in 2002. There were 39 minor and 10 major non-municipal wastewater discharges near SA waters (east of the fall line) at this same time (Street et al. 2005). This information is updated on Figures 11.5a-d, with data from 2013, indicating a trend toward the phase-out of wastewater treatment facilities near SA waters (tidal salt waters that are used for commercial shellfishing or marketing purposes and are also protected for all Class SC (Aquatic Life, Secondary Recreation, Salt waters) and Class SB (Primary Recreation, Salt Water) uses. All SA waters are also High Quality Waters (HQW) by supplemental classification by NCDEQ.

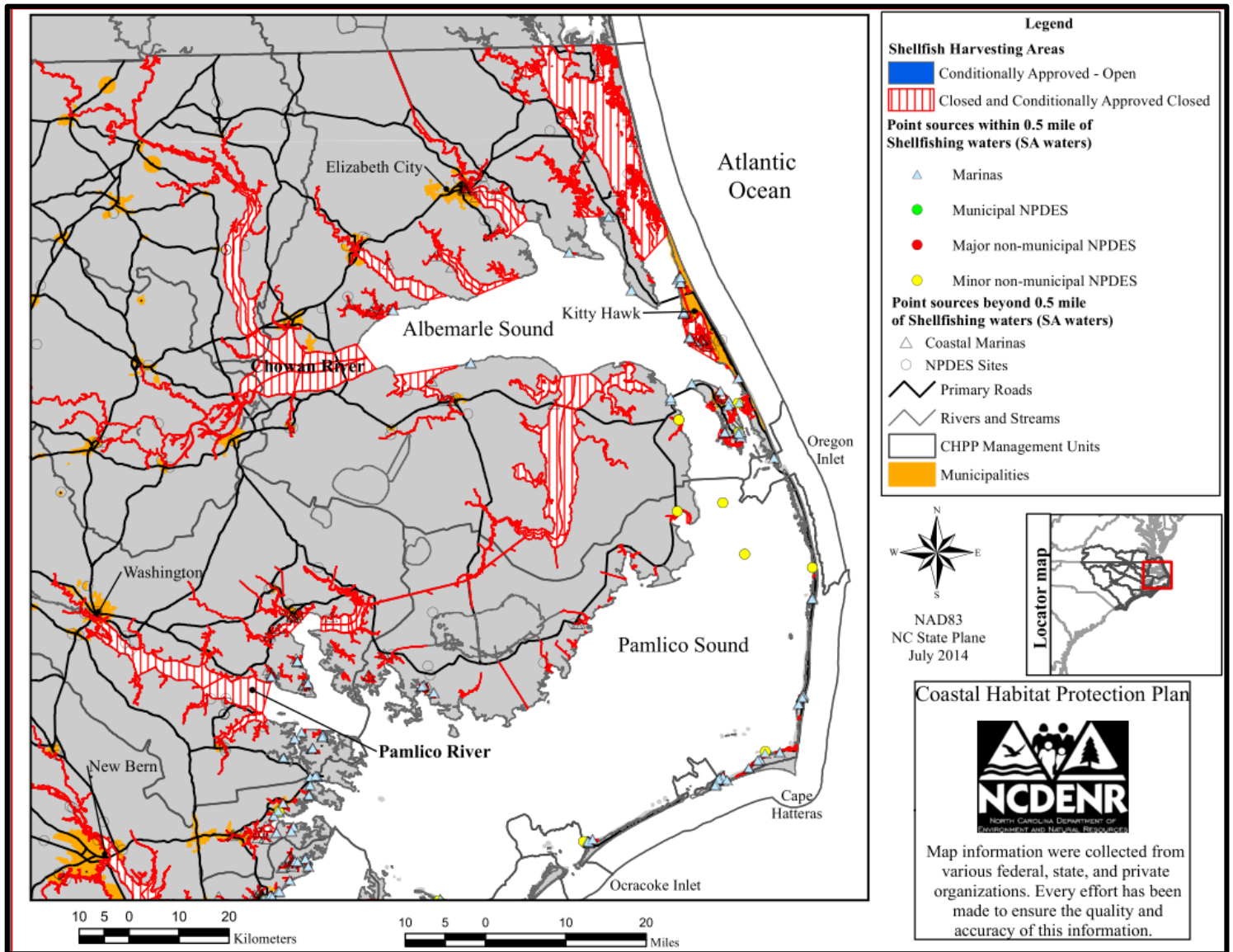


Figure 11.4a. Locations of point source discharges within 0.5 miles of Shellfishing Waters

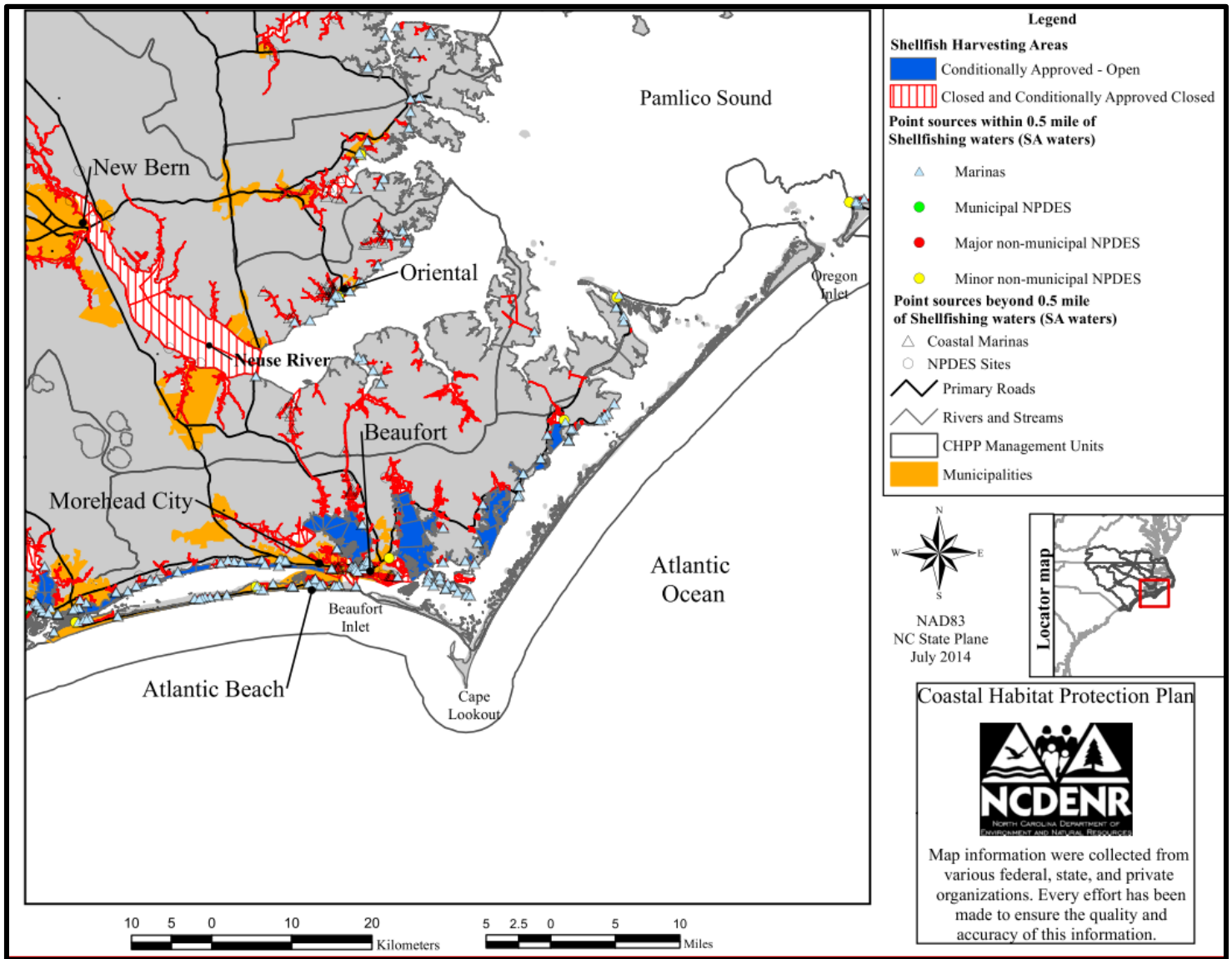


Figure 11.4b. Locations of point source discharges within 0.5 miles of Shellfishing Waters.

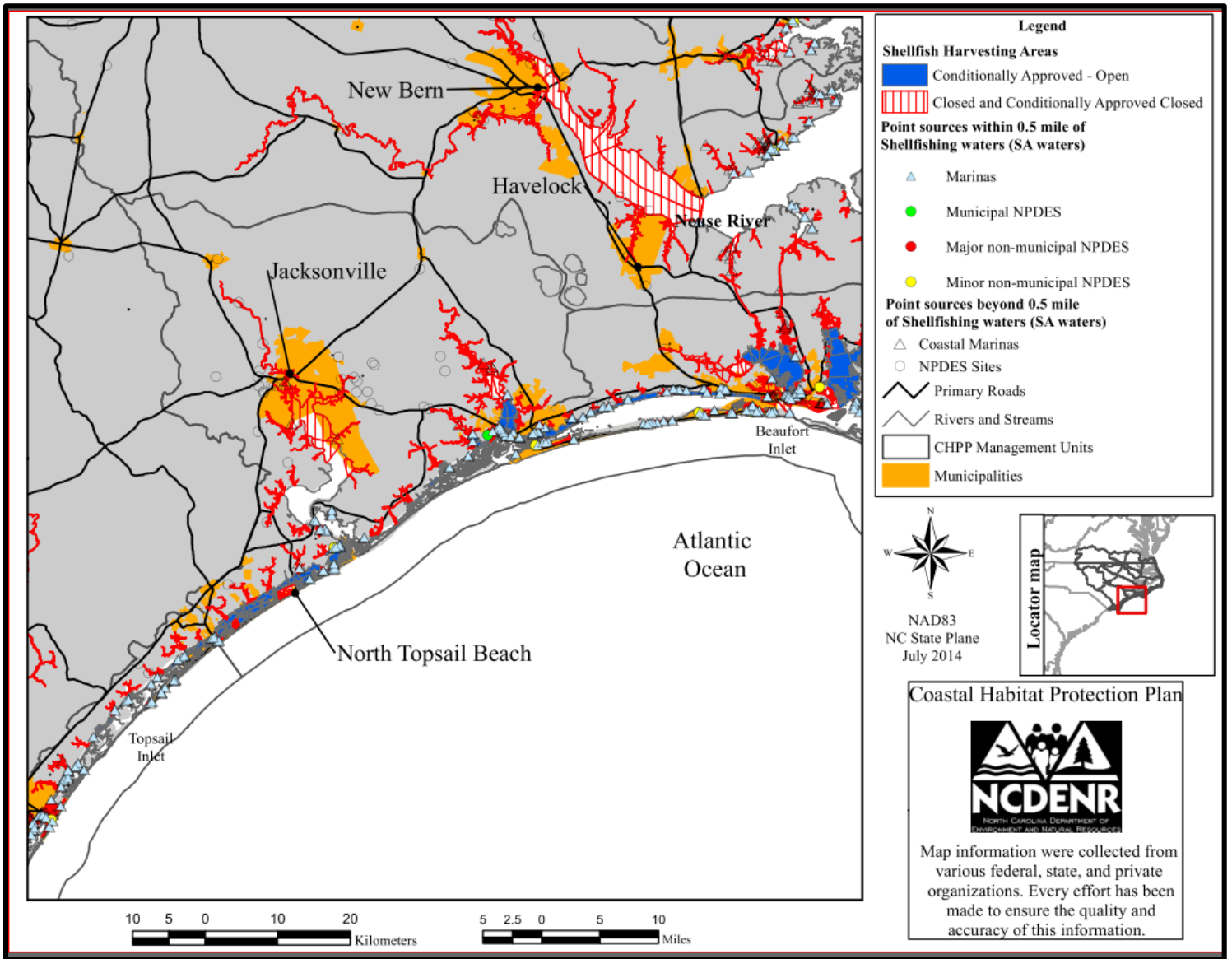


Figure 11.4c. Locations of point source discharges within 0.5 miles of Shellfishing Waters.

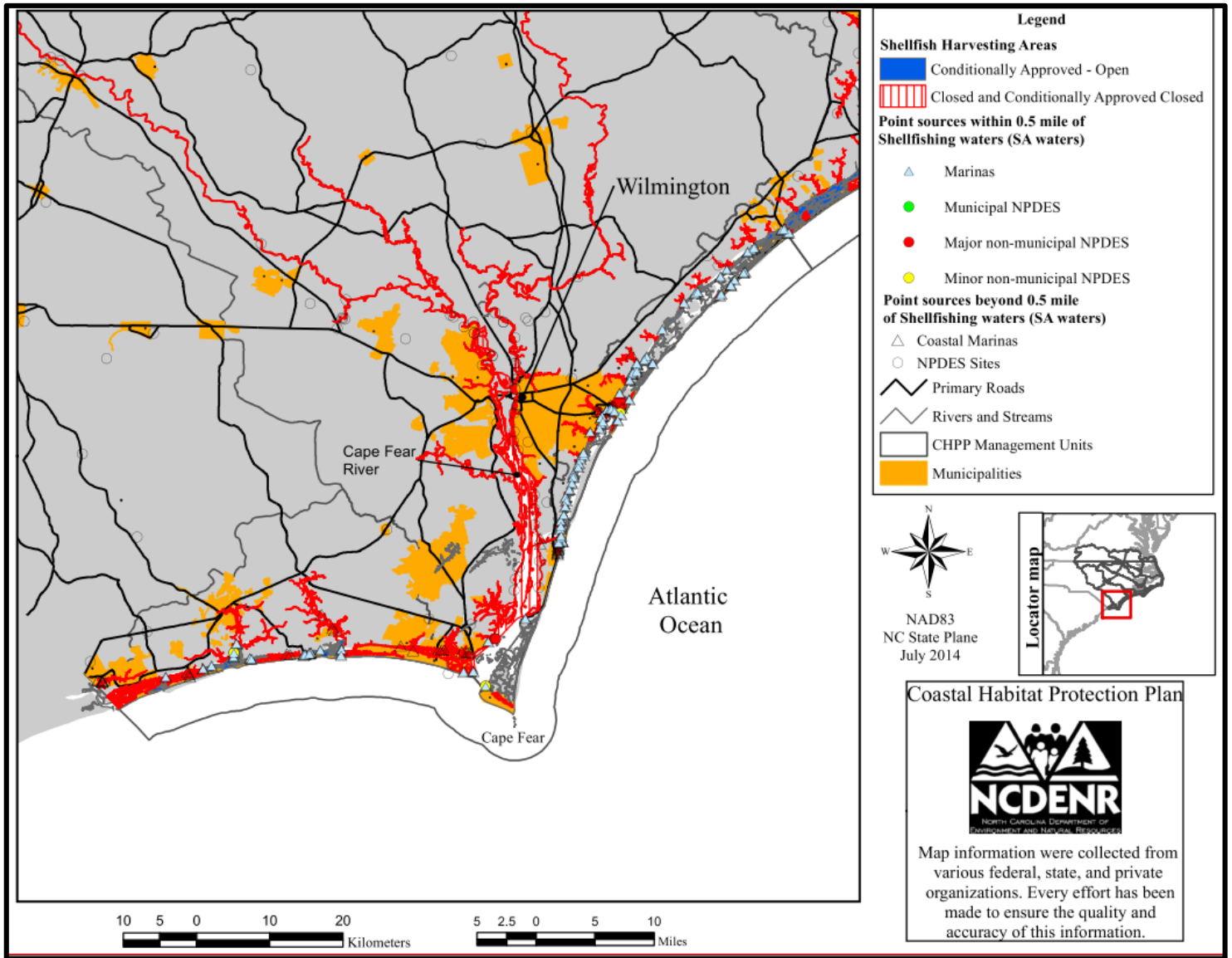


Figure 11.4d. Locations of point source discharges within 0.5 miles of Shellfishing Waters.

The number of stormwater permits issued in CAMA counties increased from approximately 500 per year from 2001 through 2004, to around 800 per year in 2005 through 2007 after which issuance of new permits began to decrease. The downward trend has continued through the 2013 (Table 11.3).

Table 11.3. Stormwater permits by CAMA county and CHPP region (Bradley Bennett, DWR November, 2014). Includes newly issued permits, renewals, modifications, 2001-2013.

CHPP region	New permits	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1	Bertie	4	2	4	7	18	8	10	5	9	5	8	7	5
1	Camden	11	6	6	10	6	7	6	4	10	5	4	1	3
1	Chowan	6	4	4	7	9	8	10	12	9	3	3	6	4
1	Currituck	25	19	25	34	34	32	34	19	18	13	15	13	24
1	Gates	1	1	2	0	1	2	2	3	2	0	3	3	1
1	Hertford	4	4	1	7	9	7	7	5	6	4	12	8	2
1	Pasquotank	17	18	24	18	38	27	25	15	22	14	15	7	5
1	Perquimans	7	7	4	11	19	9	15	3	6	5	8	5	14
1	Tyrrell	5	3	3	4	2	3	3	3	7	7	3	2	2
1	Washington	6	8	3	4	4	0	7	5	2	8	3	2	2
1.2	Dare	53	52	55	49	43	29	42	26	26	16	28	16	19
2	Beaufort	30	26	28	16	37	28	49	26	39	29	27	34	25
2	Craven	48	47	34	29	72	74	63	57	36	26	21	27	25
2	Hyde	6	9	5	3	11	9	8	6	8	5	6	6	7
2	Pamlico	10	6	14	7	19	21	31	22	12	13	10	6	9
3	Carteret	50	50	50	68	51	61	63	70	53	36	39	29	19
3	Onslow	70	75	91	83	85	131	124	126	86	100	115	97	79
4	Brunswick	78	73	91	100	116	155	166	95	60	60	48	34	45
4	New Hanover	109	107	111	123	115	153	153	110	78	53	53	53	67
4	Pender	25	35	35	35	55	44	40	28	27	21	24	23	28
Totals	New permits	565	552	590	615	744	808	858	640	516	423	445	379	385
	Renewals	0	0	3	0	2	38	48	102	203	47	66	44	49
	Modifications	81	75	93	88	112	168	209	318	229	293	294	358	320
	Total actions	646	627	686	703	858	1,014	1,115	1,060	948	763	805	781	754

With very few exceptions, all surface waters in North Carolina carry a Surface Water Classification. These classifications are designations applied to surface water bodies, such as streams, rivers and lakes, which define the best uses to be protected within these waters (e.g., swimming, fishing, drinking water supply) and carry with them an associated set of water quality standards to protect those uses. Surface water classifications are one tool that state and federal agencies use to manage and protect all streams, rivers, lakes, and other surface waters in North Carolina. Classifications and their associated protection rules may be designed to protect water quality, fish and wildlife, or other special characteristics. Each classification has associated standards that are used to determine if the designated uses are being protected (Stephanie Pettergarrett, personal communication, DWR, 2014).

The control of fecal coliform bacteria sources before they reach shellfish waters is the simplest and most cost effective measure for maintaining water quality (Reilly and Kirby-Smith 1999). However, to effectively reduce bacteria loading, the site-specific sources must be identified. There has been a steady increase in fecal coliform contamination with increasing human population along the North Carolina coast (Maiolo and Tschetter 1981; Mallin et al. 2001). In 2002, 263 SA waters were on the 303(d) list of impaired waters because of fecal coliform contamination. These waters were closed to the taking of shellfish. In 2012, there were 583 SA waters closed to the taking of shellfish in the state.

Trends in shellfish harvest closures reflect trends in fecal coliform contamination. Over 442,106 acres of coastal (salt and brackish) waters were closed to shellfish harvesting in North Carolina as of March 05, 2014 due to high levels of fecal coliform or the potential risk of microbial contamination (Table 11.4). Recent bacterial closures have primarily affected the central and southern areas of the coast. On February 4, 2015, approximately 314,710 acres were closed administratively because of the inability to sample due to budget constraints.

In addition to the areas that are permanently closed to shellfishing, other areas are temporarily closed during periods of high rainfall due to runoff. The rainfall closure threshold varies by growing area as detailed in each management plan, and can vary from 1.0" to 2.5" of rain in a 24-hr period. Closures last from several days to more than a month, and reopen when bacteriological water sample result show the area has returned to normal conditions. Large storms, such as hurricanes, results in harvest closures covering much larger areas, sometimes including all of North Carolina's estuarine waters. The conditionally approved areas are concentrated in the Core-Bogue, New-White Oak, and Southern Estuaries management units. Within these watersheds, permanent closures are most common in the upper reaches of tidal creeks and rivers, with conditionally approved areas occurring downstream of those areas or in the upper portions of less degraded creeks. As temporary closures have increased in frequency and duration, they have become an issue of great concern to the public, particularly in the southern area of the coast.

The cumulative impact of multiple docking facilities in approved waters can result in a permanent or temporary closure of shellfishing waters. Research is needed to quantify the relationship between water quality and the cumulative effect of shoreline development (e.g., docks, shoreline stabilization, channels).

Table 11.4. Status of shellfish waters in acreage from 1971 to 2014. From NCDMF Shellfish Sanitation & Recreational Water Quality. *In 2007 the NC Division of Environmental Health – Shellfish Sanitation Section started calculating acreage from GIS, whereas prior figures were hand-tallied by planimeter on NOAA Charts. 2007 data are slightly higher than previous data calculated by hand.

	Open	Closed	Approved	Conditionally Approved Open	Conditionally Approved Closed	Prohibited
1971						149,477
1972						667,989
1973						669,572
1974						666,667
1975						655,074
1976						449,844
1977						457,150
1978						449,430
1979						419,956
1980						331,025
1981						320,545
1982						322,824
1983						323,609
1984						315,547
1985						319,124
1986						319,132
1987						319,458
1988						320,090
1989						320,397
1990						370,081
1991						369,975
1992						371,671
1993						370,312
1994	1,369,099	365,162				
1995	1,370,476	363,785				
1996	1,370,528	363,733				
1997	1,370,591	363,670				
1998	1,370,044	363,503				
1999	1,369,524	364,023				
2000	1,369,526	364,021				
2001	1,122,726	364,024				
2002	1,369,229	364,318				
2003	1,369,229	364,318				
2004	1,368,633	364,673				
2005	1,368,633	364,673				
2006	1,366,933	365,885				
*2007	1,777,523	441,449	1,734,339	43,184	12,512	428,936
*2008	1,777,473	441,527	1,734,192	43,281	12,788	428,739
*2009	1,777,776	441,342	1,734,245	43,531	12,551	428,724
*2010	1,777,992	441,032	1,734,938	43,054	12,551	428,413
*2011	1,777,992	441,032	1,734,938	43,054	12,551	428,413
*2012	1,777,487	441,543	1,732,887	44,559	12,708	428,835
*2013	1,777,350	441,684	1,733,067	44,282	11,832	429,852
*2014	1,776,932	442,106	1,733,130	43,801	11,827	430,279

11.4 ENVIRONMENTAL PATHOGENS

11.4.1 NEUROTOXIC SHELLFISH POISONING

Neurotoxic Shellfish Poisoning (NSP) is a disease caused by consumption of molluscan shellfish contaminated with brevetoxins primarily produced by the dinoflagellate, *Karenia brevis*. Blooms of *K. brevis*, called Florida red tide, occur frequently along the Gulf of Mexico (Watkins et al. 2008). Brevetoxins are a group of more than ten natural neurotoxins produced by the marine dinoflagellate, *Karenia brevis* (Duagbjerg 2001).

K. brevis is naturally occurring in the Gulf of Mexico, Caribbean Sea and along the New Zealand coast; it regularly produces blooms along the coasts of Florida and Texas. This environmental phenomenon is a harmful algal bloom (HAB) known as “Florida red tide” (Steidinger 1975; Kusek 1998). Blooms of red tide can appear red, brown, or simply darkened due to the dense aggregation of cells which often includes several species of unicellular algae. Although more frequent in late summer and early fall, Florida red tide has been documented to occur in almost every month of the year (Heil and Steinger 2009). In 2006, a bloom off the coast of Sarasota (Florida) lasted over 12 months. On a global scale, HABs, including *K. brevis*, may be increasing in frequency, duration and geographic range in all aquatic environments (van Dolah 2000; Gilbert 1987).

The first recorded blooms of red tide from the Gulf of Mexico were in the 1840’s (Walker 1884; Magana 2003). The largest reported outbreak of NSP in the US occurred in North Carolina after *K. brevis* was carried into that region (Tester et al. 1988; Morris 1991; Sobel 2005). It began in October 1987 when a *K. brevis* bloom became entrained in the Gulf Stream off eastern Florida and was transported up the eastern seaboard (Fowler 1989). This was the first recorded red tide (*Karenia brevis*) in North Carolina, and caused 358,993 acres (145,280 hectares) of shellfish growing waters to be closed between 2 November 1987 and 21 January 1988. These closures affected 98% of the clam harvesting areas. The economic loss to the coast was estimated at \$25 million and had its greatest impact on the clam fishermen. Clam landings were less than half of the previous year and caused a \$2 million reduction in dockside value (Tester and Fowler 1990). There were 48 people with confirmed neurotoxic shellfish poisoning (NSP), most of the cases (35) occurring before the first shellfish closure on 2 November (Tester et al. 1988).

K. brevis cells are a motile and attracted to light, therefore they concentrate on the surface of the water during the day where their distribution can be affected by cloud cover, wind, and tide (Tester and Fowler 1990). The FDA recommends shellfish closures when cell counts are higher than 5,000 per liter (Tester and Fowler 1990). *K. brevis* produces a neurotoxin that accumulates in filter feeding shellfish such as clams, oysters, whelks, mussels, conch, coquinas, and other filter-feeding mollusks. Mild to severe nausea, vomiting, diarrhea, chills, dizziness, numbness, and tingling of the face and extremities can occur within three to four hours (mean onset time) after consumption of contaminated shellfish (Tester et al. 1991).

The NCDMF has a contingency plan in place as required by the FDA, including a monitoring program and management plan. The NCDMF contingency plan includes to conducting aerial surveillance of offshore waters, collecting samples, and closing and patrolling areas closed to harvest because of red tide (Patti Fowler, NC Division of Environmental Health, Shellfish Sanitation Section, personal communication 2007).

The following language is from the National Shellfish Sanitation Program Model Ordinance, which regulates the closure and reopening of shellfish growing waters following red tide events:

A shellfish growing area or portion thereof shall be placed in the closed status for the taking of shellstock when the number of toxin-forming organisms in the growing waters and/or the level of biotoxin present in shellfish meats is sufficient to cause a health risk. For neurotoxic shellfish poisoning (NSP), the harvesting of shellstock shall not be allowed when:

1. The concentration of NSP equals or exceeds 20 mouse units per 100 grams of edible portion of raw shellfish; or
2. The cell counts for *Karenia brevis* organisms in the water column exceed 5,000 per liter.

The closed status shall remain in effect until the Authority has data to show that the toxin content of the shellfish in the growing area is below the level established for closing the area. The determination to return a growing area to the open status shall consider whether toxin levels in the shellfish from adjacent areas are declining. The analysis upon which a decision to return a growing area to the open status is based shall be adequately documented (Patti Fowler, personal communication, September 4, 2014).

11.4.2 VIBRIOS

During the past decade the focus of the National Shellfish Sanitation Program (NSSP) has focused on the prevention of shellfish consumption illnesses from environmental *Vibrio* bacteria. *Vibrios* are salt loving bacteria that inhabit coastal waters throughout the world, and with the exception of toxigenic *Vibrio cholera* 01 are not usually associated with pollution that triggers shellfish closures, and can be ubiquitous in open shellfish growing areas. *Vibrios* are more common during the warmer summer months and are found throughout the coastal waters of North Carolina (Blackwell and Oliver, 2007; Pfeffer et al. 2003). Two species in particular, *Vibrio vulnificus* (Vv) and *Vibrio parahaemolyticus* (Vp) are responsible for most and the more severe shellfish consumption illness each year in the United States.

The most severe pathogen is *Vibrio vulnificus* which can cause septicemia (blood poisoning) and death in persons with immune-compromised conditions such as liver disease, alcoholism, diabetes, people undergoing treatments which can suppress the immune system, and hemochromatosis (an elevated iron disorder). Consumption cases have remained fairly constant for the past 10 years. Cases are sporadic (usually one illness) and shellfish consumption cases number around 25 to 30 per year in the U.S. with about half being fatalities.

Vibrio parahaemolyticus cases are less virulent and cause mild to moderate gastrointestinal symptoms that are usually self-limiting, although many cases may require hospitalization and immune-compromised individuals are at higher risk of more serious illness or death. Vp can affect normally healthy individuals and both food-borne and wound infections appear to be on the rise. Cases may be sporadic, but are usually seen in illness outbreaks of multiple individuals. The Centers for Disease Control (CDC) estimates 45,000 cases of Vp in 2011 in the United States. The CDC reports that the vast majority of these cases go unreported because the illness is usually self-limiting and those affected do not seek medical attention. Of those that do, cases may not always be confirmed as Vp.

The growing interest in shellfish aquaculture and out-of-season (summer) harvest of oysters in particular increases the probability that North Carolina will experience a *Vibrio* illness event or outbreak. Shellfish growers should be aware of this risk and closely follow NCDMF time-to-temperature requirements and keep harvested product refrigerated. Shellfish consumers should also be aware that the risk of a consumption illness from raw or undercooked shellfish, in particular oysters, is greater during these warmer months when *Vibrios* are more prolific. States

that have experienced *Vibrio* illness outbreaks have had to close areas and recall product at the expense of the shellfish industry. Thorough cooking destroys *Vibrio* bacteria.

11.5. GREEN GILL

Green gill in clams comes from the single-celled alga called *Haslea ostrearia*. This is a blue-green diatom found in the coastal waters of North Carolina. The diatom produces a blue pigment called marennine. This pigment is released into the water turning it a bluish color. Clams pick it up while filtering the blue colored water, which combines with the clam's natural yellow color, turning the gills green. The greened gilled clams, usually found in the cooler months, are harmless. The French consider the green gilled shellfish a delicacy and culture the alga to produce a somewhat nuttier tasting shellfish. However, in the U.S., shellfish markets have a hard time selling them because the typical American consumer considers them undesirable.

11.6 HABITAT AND WATER QUALITY MANAGEMENT

Federal and state laws mandate that water quality protection activities be administered through government commissions and agencies. Several divisions within NCDEQ are responsible for providing technical and financial assistance, planning, permitting, certification, monitoring, and regulatory activities that have direct or indirect impacts on coastal water quality and habitat. Various federal and state environmental and resource agencies, including NCDMF, evaluate proposed projects and provide comments and recommendations on potential water quality and resource impacts. Water quality protection relies on enforcement and, the ability of commenting agencies to evaluate impacts and incorporate recommendations into permitting decisions. Various public agencies (state and federal) and private groups have also established parks, refuges, reserves, sanctuaries, and natural areas that help to protect public trust resources and estuarine water quality.

11.6.1 MARINE FISHERIES COMMISSION AND DIVISION OF MARINE FISHERIES

Presently, the MFC has authority to manage, restore, develop, cultivate, conserve, protect, and regulate marine and estuarine resources. Marine and estuarine resources are defined as "All fish (including marine mammals, shellfish, and crustaceans), except inland game fish, found in the Atlantic Ocean and in coastal fishing waters; all fisheries based upon such fish; all uncultivated or undomesticated plant and animal life, other than wildlife resources, inhabiting or dependent upon coastal fishing waters; and the entire ecology supporting such fish, fisheries, and plant and animal life" (G.S. 113-129). Although MFC's primary responsibilities are management of fisheries (seasons, size and bag limits, licensing, etc.), the MFC also has authority to comment on state permit applications that may have an effect on marine and estuarine resources or water quality, regulate placement of fishing gear, develop and improve mariculture, and regulate location and utilization of artificial reefs. MFC authority is found in G.S. 143B-289.51 and 289.52.

As discussed previously, the MFC prohibits certain bottom disturbing gears from areas supporting SAV, shell bottom, or juvenile finfish populations in order to protect these resources. Through designation of Nursery Areas, the MFC restricts use of certain fishing gears in such areas as well as triggering protective actions by other regulatory commissions. In some cases, these areas overlap clam habitat, such as shell bottom. Other protections for shell bottom are based on protecting oysters. In addition to protection from certain fishing gears in Shellfish/Seed Management and Mechanical Methods Prohibited Areas, shell bottom is also protected from harvest in Military Restricted Areas. These areas have served as target and bombing ranges

since the World War II period. Other area designations protecting shell bottom from specific fishing gear impacts include nursery areas, mechanical oyster harvest prohibited areas, trawl net-prohibited areas, and crab spawning sanctuaries. These areas cover more than half of the shellfish bottom mapping area, leaving the largest unrestricted areas in west and northwestern Pamlico Sound, the lower Pamlico and Neuse rivers, and around Roanoke Island. A number of cultch planting sites in the Pamlico Sound and tributaries are also closed to mechanical harvest by rule (Marine Fisheries Commission Rule 15A NCAC 03R .0108(2)), although none have been designated shellfish management areas.

11.6.2 ENVIRONMENTAL MANAGEMENT COMMISSION

By EMC rule, all shellfish waters with significant resources are classified as SA waters and are, by definition, HQW. In addition, some waters that are classified SA also carry the Outstanding Resource Waters (ORW) classification, upon finding that such waters are of exceptional state or national recreational or ecological significance and that the waters have exceptional water quality. These waters are afforded additional protection from construction and runoff under EMC, CRC and Sedimentation Control Commission rules.

The NC Division of Water Resources has established the water quality classifications and standards program for "best usage." Water quality classifications and standards have been implemented to promote protection of surface water supply watersheds, high quality waters, ecosystem functions, and the protection of unique and special pristine waters with outstanding resource values. Classifications, particularly for HQW, ORW, Nutrient Sensitive Waters (NSW) and Water Supply (WS) waters, outline protective management strategies aimed at controlling point and non-point source pollution. Many water quality standards are based on potential impacts in the immediate receiving waters and do not factor in the cumulative and long-term effects to the complex functions that characterize estuarine systems. Standards should be based on the assimilative capacity of, and impacts to, the entire system.

The Comprehensive Conservation and Management Plan of the Albemarle-Pamlico Estuarine Study (EPA and NCDEHNR 1994) and other earlier plans for water quality management have recommended strategies that need to be implemented to improve water quality. Some unachieved recommendations from the plan were incorporated into the CHPP. In addition to the CHPP, achievement of basin wide water quality management objectives by DWR should improve coastal water quality.

11.6.3 COASTAL HABITAT PROTECTION PLAN

The Fisheries Reform Act of 1997 mandated the NCDEQ to prepare a CHPP (G. S. 143B-279.8). The legislative goal for the CHPP is long-term enhancement of the coastal fisheries associated with coastal habitats. The plan provides a framework for management actions to protect and restore habitats critical to North Carolina's coastal fishery resources. The first CHPP was approved in December 2004 by the CRC, EMC, and MFC, and by NCDEQ in July 2005. Implementation plans were developed for each commission and the Department. These three commissions have regulatory jurisdiction over coastal, water, and marine fishery resources. Actions taken by the commissions pertaining to the coastal area are to comply with the plan "to the maximum extent practicable." The CHPP helps ensure consistent actions among the commissions, as well as their supporting NCDEQ agencies, and is reviewed every five years. The CHPP was reviewed and updated in 2010 and is currently going through a review with the anticipation of final approval in 2015.

The CHPP describes and documents the use of habitats by species supporting coastal fisheries, status of these habitats, and the impacts of human activities and natural events on those habitats. Fish habitat is defined as “freshwater, estuarine, and marine areas that support juvenile and adult populations of economically important fish, shellfish, and crustacean species (commercial and recreational), as well as forage species important in the food chain” (Street et al. 2005). Fish habitat also includes land areas that are adjacent to, and periodically flooded by riverine, estuarine, and coastal waters. Six fish habitats are discussed in the CHPP based on distinctive physical properties, ecological functions, and habitat requirements: wetlands, SAV, soft bottom, shell bottom, ocean hard bottom, and water column.

The CHPP recommends that some areas of fish habitat be designated as Strategic Habitat Areas. Strategic Habitat Areas (SHAs) are defined as “specific locations of individual fish habitat or systems of habitat that have been identified to provide critical habitat functions or that are particularly at risk due to imminent threats, vulnerability or rarity.” While all fish habitats are necessary for sustaining viable fish populations, some areas are especially important to fish viability and productivity. Protection of these areas is a high priority (Street et al. 2005). The process of identifying and designating SHAs was initiated in 2005. To date, the Strategic Habitat Areas have been nominated for designation from the Virginia border to New River/Stump Sound.

11.6.4 RESTORATION ACTIVITIES

Restoring clam habitat involves both oysters and submerged aquatic vegetation. The Shellfish Rehabilitation Program, which began in 1947, has contributed to the restoration of depleted oyster grounds through the planting of cultch material and seed oysters (Chestnut 1955a; Munden 1975; and Munden 1981). State-sponsored cultch plantings began in 1915. Over the entire period of cultch planting from 1915-1994, about 15 million bushels of oysters were planted in North Carolina waters (Street et al. 2005). The primary purpose of the NCDMF cultch planting program has been oyster fishery enhancement, which provides temporary habitat value. Recent research showing the important ecological and economic value of oyster reefs has prompted NCDMF to broaden their primary focus to ecosystem enhancement. This broadening of focus for the protection/restoration program has occurred since the late 1990s. As of July 2014, there were 12 artificial reef sanctuaries in North Carolina, with three more proposed. Nine of these are spread through Pamlico Sound in locations near Hatteras Island, Roanoke Island, Croatan Sound, Swan Quarter, Engelhard, Pamlico Point, Ocracoke, and Point of Marsh. The other three are in Deep Bay near Swan Quarter, Neuse River near Turnagain Bay, and West Bay near Cedar Island (Michael Jordan and Jason Peters, NCDMF, Habitat and Enhancement, personal communication, July 2014). The building of these sanctuaries follows the recommendation to expand oyster habitat restoration in the CHPP (Street et al. 2005). To coordinate organizations’ interests with NCDMF restoration work, a steering committee was established by the North Carolina Coastal Federation (NCCF) to draft an oyster restoration plan for North Carolina, a synopsis of which can be found at the following: (<http://www.nccoast.org/uploads/documents/Oyster%20Summit%202014/Synopsis%20NC%20Oyster%20March%202014%20FINAL.pdf>).

Suitable and adequate habitat is a critical element in the ecology and productivity of estuarine systems. Maintenance and improvement of suitable estuarine habitat and water quality is critical to successfully recovering and sustaining oyster stocks. Below is a list of recommendations and subsequent actions involving restoration:

1. Use NCDMF bottom mapping, CHPP Strategic Habitat Areas, historical Winslow survey maps, and ground-truthing to measure gains in restored/created oyster habitat –

Fisheries Resource Grant project completed to digitize and re-evaluate the Winslow Survey maps.

2. Conduct research on regionally specific and appropriate reef design and siting for optimal water quality and habitat functions -- University (UNCW and UNC-IMS) research on restoration protocols, including on-going reef seeding by NCCF and TNC in conjunction with NCDMF cultch planting for sanctuaries.
3. Develop and apply scientifically rigorous methods to evaluate restoration success, including project monitoring, changes in oyster biomass, spatial coverage, spawning and recruitment success, survival, biological community development (e.g., expansion of SAV habitat), growth and complexity, use by other economically important species, and enhancement of water quality.
4. Appropriate staff from NCDMF should continue to participate in collaborative efforts to monitor the biological effectiveness of restoration activities and sanctuary development.

Restoration of submerged aquatic vegetation is generally conducted for compensatory mitigation, mitigation banking, or research purposes. Benefits of SAV restoration include fish habitat enhancement, sediment and shoreline stabilization, and water quality enhancement. Compensatory mitigation is the replacement of a natural resource, such as a bed of SAV destroyed or severely degraded by a permitted action or violation of rule, in a different location. Such replacement is often required by the enforcement of Section 404 of the Clean Water Act by the US Army Corps of Engineers, or by state regulations enforced by other regulatory agencies (DCM, DWR). The intent is replacement of ecological functions such as water quality, habitat, and hydrology. Mitigation is generally accomplished by replacing an area equal to or greater than that which was lost or impacted.

Seagrass restoration techniques have been developed and evaluated by NMFS. Depending on environmental variables, a similar faunal community can return, at the earliest, within two years (Fonseca et al. 1998). The success of replanting efforts is often gauged by an evaluation of "functional equivalency." As defined by Fonseca et al. (1998), an area has achieved functional equivalency when "a restored or mitigated system attains (ecological) functions the same as those of an unimpacted system in a similar setting." According to the authors, an impacted seagrass bed has the potential to become functionally equivalent, but not identical, to an undisturbed seagrass bed if a) it is at least equal in space to that of the original area prior to disturbance and b) the seagrass species composition is unchanged and persists after the disturbance. Based on review by Fonseca et al. (1998), the time needed to attain functional equivalency for seagrasses ranges dramatically, from two to more than 31 years. Seagrass shoot densities and canopy height can be used to determine when a restoration project has reached functional equivalency (Fonseca et al. 1998).

There were 12 SAV restoration projects in Carteret and two in Onslow counties between 1978 and 1991 (DCM 2002 Estuarine Biological and Physical Processes Workgroup). Of these 14 sites, 11 were considered successful, according to the document. Three projects were done as N.C. Department of Transportation mitigation, while the others were research projects conducted by NMFS. A total of 1.95 acres (0.79 ha) of bottom was restored to SAV by these projects. This area is relatively small compared to shell bottom or marsh mitigation areas. To date (September, 2014) there has been no update to this undertaking.

Seagrass restoration projects are limited due to the high water quality conditions needed for survival of the habitat. The upcoming construction of the Herbert C. Bonner Bridge and the proposed permanent bridge crossing the New Inlet on NC 12 north of Rodanthe are each anticipated to cause impacts to SAV resources. Restoration has been built into the bid process, potentially as a series of wave breaks in areas of patchy SAV, in marginally high wave energy

sites (Anne Deaton, personal communication, 2014). Anticipating the destruction of the resource before the onset of construction is a more efficient approach to habitat mitigation, and will hopefully ensure a more functionally sound restored community.

11.7 STATUS OF 2008 ENVIRONMENTAL FACTORS RECOMMENDATIONS

Since the 2008 recommendations, there have been many movements in a positive direction for hard clams and their associated habitat. Strategic Habitat Areas 1, 2, and 3 have been mapped and nominated for designation into rule from the Virginia border to New River/Stump Sound. There has been an increase in the mapping of hard bottom area and SAV habitat. The Division of Water Resources surface water rules have changed, reducing percentage coverage allowances, increasing buffers, changing and requiring infiltration systems, and reducing fecal coliform, sediment, heavy metals, and other toxins in the water column. Several municipal wastewater systems have closed since the 2008 plan was written, which was a direct management objective of the FMP and the CHPP. Unfortunately, budget concerns have reduced progress in the areas of mapping and sanctuary development, and the oyster shell recycling program was eliminated. The division has been able to salvage some sanctuary and experimental projects CRFL through grants and collaborative projects with the US Navy and The Nature Conservancy.

11.8 RESEARCH PRIORITIES

- Support all proposed implementation actions under the priority habitat issue on sedimentation in the CHPP
- Support collaborative research to more efficiently track bacterial sources for land-based protection and restoration efforts.
- Quantify the relationship between water quality parameters and the cumulative effect of shoreline development units (eg, docks, bulkhead sections).

12.0 PRINCIPAL ISSUES AND MANAGEMENT OPTIONS

12.1 CONSIDER INCREASING THE RECREATIONAL MAXIMUM DAILY HARVEST LIMIT FOR HARD CLAMS⁶

February 18, 2016

I. ISSUE

The daily harvest limit for hard clams has been 100 clams per person per day not to exceed 200 clams per vessel (15A NCAC 03K .0105) since 1984. Recreational charter operators often take more than two people per trip and favor increasing the maximum daily vessel limit to allow customers more than 200 clams for personal consumption.

II. ORIGINATION

A request from the Oyster and Hard Clam Advisory Committee on September 8, 2014

III. BACKGROUND

A request from the Oyster and Hard Clam Advisory Committee was brought forward to consider increasing the maximum daily recreational vessel harvest limit for hard clams, particularly for vessels used for recreational charter purposes, so the customers could have plenty of hard clams to eat after their paid trip. The request was specific to for-hire vessels of six or less people allowed onboard per trip.

In 2004, a free For-Hire Permit was initiated to monitor the for-hire industry. The permit provided NCDMF a known number of for-hire vessels and provided the license database necessary to conduct the For-Hire Survey which estimates effort in the industry. The For-Hire Permit was discontinued on June 30, 2014 as part of the restructuring of the for-hire license system and replaced by a non-Blanket Vessel License as well as a Captains and a Vessel blanket for-hire license. Logbook reporting requirements were also under consideration for all for-hire license holders but the for-hire industry successfully lobbied the General Assembly to remove all mandatory for-hire reporting requirements. The logbooks would have likely lead to more accurate catch, effort and release information required for finfish stock assessments. Although NCDMF cannot require for-hire operators only harvesting clams or other shellfish and crustaceans to obtain a For-Hire Blanket Coastal Recreational Fishing License, if for-hire operators hold a license for recreational angling and also harvest shellfish, NCDMF could have required them to report the shellfish catch on a logbook (Don Hesselman, NCDMF, personal communication, October 2014). Unfortunately, without some form of a for-hire logbook, clam harvest by the for-hire industry is unavailable.

The current daily recreational harvest limit for hard clams is 100 clams per person per day not to exceed 200 clams per vessel (15A NCAC 03K .0105) and has been in effect since 1984 either in statute or in rule. Prior to 1984 (15A NCAC 03B .0105(f)), the daily harvest limit was one bushel of clams or an aggregate bushel of mixed oysters and clams since 1966. A bushel converts to about 675 little neck (1-inch (25 mm) to 1 ¼-inch (32 mm) in thickness) or 450 top cherry to cherry sized hard clams (1 5/8-inch (41 mm) to 2 ¼-inches (57 mm) in thickness) (ASMFC 1992).

⁶ Presented to: PDT on 12/11/14, 8/13/15, & 1/7/16; AC on 1/5/15, 9/14/15, & 1/4/16; Rules Subcommittee on 2/4/15; RAT on 2/12/15, 3/5/15, & 10/1/15; MRT on 9/21/15 & 1/11/16; MFC on 11/20/15 & 2/18/16.

MFC Rule 15A NCAC 03O .0201 specifies that an ungraded count of 400 clams equals one bushel for commercial purposes.

In 2013, a volumetric measurement for shrimp taken in closed areas by cast nets was amended to be used in place of counts to check individuals to increase the safety of Marine Patrol Officers. A volumetric measure is a more efficient and effective way to check individuals for the harvest limit and allows officers to check more individuals in a short time if they are together in a group. But in the case of hard clams, officers will still need to count and measure the thickness of the clams to determine if the clams are at or greater than the minimum size limit. So use of a volume harvest limit is not as effective for hard clams as is it for shrimp, because shrimp do not have a minimum size limit requirement like clams.

The stock status for hard clams in North Carolina continues to be defined as unknown due to a lack of data needed to conduct a reliable assessment of the stock. The most recent update of the stock status of hard clams (Section 6.2) looked at trends in commercial hand harvest landings, which showed significant increasing trends in catch rates over time for the areas of Bogue Sound, Core Sound, Inland Waterway, New River, Newport River, North River/Back Sound, Shallotte River, and White Oak River. A significant decreasing trend was found in the commercial hand harvest catch rates in Pamlico Sound. The remaining water bodies showed no trend in commercial hand harvest catch rates over time. It appears that commercial effort on the stock may be increasing in most areas from Core Sound south.

Limited recreational clam harvest data have been collected in recent years (Section 7.2). The recreational survey results demonstrated a distinct seasonality for the recreational harvest of clams, with peak activity observed during the summer months. This coupled with the highest concentrations of clamming activity being observed in specific regions, suggests that coastal tourism may contribute to recreational clam harvest. No trends could be determined for the annual recreational harvest of clams from this survey.

IV. AUTHORITY

N.C. General Statutes

113-134 Rules
113-182 Regulation of fishing and fisheries

N.C. Marine Fisheries Commission Rules May 1, 2015 (15A NCAC)

03K .0105 Recreational harvest of shellfish

V. DISCUSSION

The license and permit sales for the for-hire industry does not show an increasing trend, however anecdotal evidence could be that the for-hire industry is offering more eco-tourism experiences to the customers and NCDMF has no means to track these changes (Table 12.1.1). Higher issuance of the for-hire permit when it was first offered may have been participants obtaining the free permit with the intention of getting involved in the business.

Table 12.1.1. The number of For-Hire Fishing Permits and For-Hire Blanket Coastal Recreational Fishing Licenses for six or fewer passenger operations by fiscal year (July-June) (NCDMF 2013).

Fiscal year (July – June)	Number of for-hire permits for all passenger capacities combined+	Number of for-hire blanket coastal recreational fishing license with six or fewer passengers	Number of for-hire permits and blanket coastal recreational fishing licenses with six or fewer passengers combined
2004	711		
2005	757		
2006	787		
2007*	750 (Jul-Dec)	577	1,327
2008	148	588	736
2009	164	554	718
2010	164	580	744
2011	186	590	776
2012	188	527	715
2013	146	515	661

* The CRFL blanket license for For-Hire vessels changed the demand for the For-Hire permit during fiscal year 2007. If an operator has the blanket CRFL license, then no permit is needed. If the operator chooses not to obtain a blanket CRFL license, then he must obtain a For-Hire permit.

+ The For-Hire Fishing Permit was discontinued on June 30, 2014 as part of the restructuring of the for-hire license system.

Safety should also be considered for officers in the field to enforce any limits. Counting 100 clams per person takes a considerable amount of time, especially when there are certain circumstances involved; i.e., weather, numerous fishermen, language barriers, time of day, location and interruptions. Officers can more quickly evaluate harvest limits based on a container volume rather than counts, but they will still need to process the hard clams if there are any in the catch that are less than the minimum 1-inch thickness. Oysters have a volume harvest limit and minimum size limit but they also have an undersized culling tolerance (Rule 15A NCAC 03K .0202) that is used consistently in enforcement across both the commercial and recreational oyster user groups. Going to a volume harvest limit in the recreational clam fishery would create a different harvest limit measure used for the commercial and recreational clam user groups.

The daily individual and vessel recreational harvest limits for hard clams have been in place for over 40 years and have been unchanged in their current state since 1984. The daily individual and maximum vessel clam daily harvest limits are for all recreational participants. Daily harvest limits for recreational purposes are in place to allow some reasonable quantity of clams for personal consumption but limit harvest to sustain the population long term. There are no license requirements to take shellfish in recreational quantities, and therefore it is open to all in-state and out-of-state residents. Because of the lack of license requirements there is no way to identify accurately how many people participate in the fishery. The stock status of hard clams is designated as unknown due to a lack of reliable population abundance estimates and unknown harvest of clams by the recreational fishery. Limited recreational hard clam harvest data makes it difficult to address potential management issues such as harvest limits on hard clams in the recreational fishery.

If the daily maximum vessel harvest limit of clams were expanded for all recreational shellfish participants some reasonable amount should be recommended that considers the unknown stock status of hard clams and the limited recreational harvest monitoring to estimate the amount

of removals in the population from this user group. Increasing the daily clam maximum vessel harvest limits for just the for-hire industry and not for other recreational clam participants could cause disparity and enforcement difficulties in the recreational hard clam fishery. There is no other species that the for-hire industry targets that allows just the for-hire participants and clients to possess more than the recreational limit.

VI. PROPOSED RULE(S)

No rule changes required based on recommendations.

VII. PROPOSED MANAGEMENT OPTIONS

(+potential positive impact of action)

(- potential negative impact of action)

1. Status quo (Continue the daily harvest limit for recreational purposes at 100 clams per person per day not to exceed 200 clams per vessel per day)
 - + Current rules have been in place for a long period of time and the public is accustomed to the interpretation and enforcement
 - + The maximum daily harvest limit for clams is similar for all recreational participants
 - Does not allow for higher daily vessel limits of clams for personal consumption if more than two people are onboard
2. Increase the daily vessel maximum recreational clam harvest limit and maintain the daily personal harvest limit of 100 clams per person per day for all recreational participants (**rule change required**)
 - + The maximum daily harvest limit for clams is similar for all recreational participants
 - Current rules have been in place for a long period of time and the public is accustomed to the interpretation and enforcement
 - May increase harvest of an unknown stock
3. Increase the daily vessel maximum recreational harvest limit for clams for just recreational participants under a for-hire license with six or fewer participants and maintain the 200 clams maximum daily vessel limit for all other recreational participants (**rule change required**)
 - + Allows for-hire charter customers to have plenty of hard clams to eat after their paid trip
 - Current rules have been in place for a long period of time and the public is accustomed to the interpretation and enforcement
 - Creates disparity in the daily harvest limits between recreational participants
 - More difficult to enforce different harvest limits between participants of the same user group
 - May increase harvest of an unknown stock
4. Eliminate the daily vessel maximum recreational harvest limit for clams but maintain the daily individual harvest limit at 100 clams per person per day for all recreational participants (**rule change required**)
 - + Allows for higher daily vessel limits of hard clams for personal consumption if more than two people are onboard
 - + The daily harvest limit for clams is similar for all recreational participants
 - Current rules have been in place for a long period and the public is accustomed to the interpretation and enforcement
 - May increase harvest of an unknown stock

5. Use a volumetric measurement for the individual and vessel recreational clam daily harvest limit **(rule change required)**
- + Could allow for quicker officer inspection if no undersized clams are present in the catch
 - Clam counts highly variable in a volume measure because of different clam sizes
 - Current rules have been in place for a long period of time and the public is accustomed to the interpretation and enforcement
 - May increase harvest of an unknown stock
 - No time savings for officers if undersized clams are present in the catch
 - Creates a different harvest limit measure for the commercial and recreational clam user groups

VIII. RECOMMENDATION

MFC Preferred Management Strategy

- Status quo (Continue the daily harvest limit for recreational purposes at 100 clams per person per day not to exceed 200 clams per vessel per day)

NCDMF and Advisory Committee

- Increase the daily vessel maximum recreational clam harvest limit to 400 clams and maintain the daily personal harvest limit of 100 clams per person per day for all recreational participants **(rule change required)**

XI. LITERATURE CITED

ASMFC. 1992. South Atlantic commercial fishery monthly landings statistics and detailed shrimp program. User documentation. South Atlantic Statistics Committee. State/Federal Statistics Program. Atlantic States Marine Fisheries Commission. Washington, D.C.

NCDMF. 2013. North Carolina license and statistics section summary of statistics of the license and permit program, commercial trip ticket program, North Carolina marine recreational information program, the striped bass creel survey for the central and southern management areas, the North Carolina recreational saltwater activity mail survey. North Carolina Department of Environment and Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, NC.

Prepared by: Tina Moore, Tina.Moore@ncdenr.gov, 252-808-8082
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12.2 MANAGEMENT OF PUBLIC MECHANICAL CLAM HARVEST⁷

February 18, 2016

I. ISSUE

Investigate aspects of the management of public mechanical clam harvest. Specifically, this issue will look at the northern Core Sound open and closed harvest season, the Pamlico Sound mechanical harvest area in rule that is no longer in use, and the boundaries for the clam mechanical harvest areas across the state.

II. ORIGINATION

The Oyster and Hard Clam Plan Development Team, Advisory Committee, and public input.

III. BACKGROUND

Mechanical methods of clamming are defined as 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 (15A NCAC 03I .0101(3)(l)). The two types of mechanical harvest gears currently used in North Carolina are hydraulic escalator dredges and a clam trawl or “clam kicking” vessels. Hydraulic escalator dredges have an escalator or conveyor located on the side of the vessel. A sled is connected to the front end of the escalator. When the front end of the escalator is lowered to the bottom, the sled glides over the bottom. A blade on the sled penetrates the bottom to a depth of about four inches (10 cm) and collects the clams as they are forced from the bottom by water pressure (Cunningham et al. 1992). In clam trawling or “kicking”, clams are dislodged from the bottom with propeller backwash and a heavily chained trawl with a cage attached at the cod end towed behind the boat gathers the clams.

Harvest by mechanical methods is both effective and efficient because it allows the harvest of clams that would otherwise not be accessible by hand gears because of water depth, weather, or bottom type. It is accepted that mechanical harvest methods can negatively impact SAV and oyster rocks (Peterson et al. 1987; Deaton et al. 2010). The public mechanical clam fishery has been heavily managed for quite some time to reduce the potential negative ecological impacts caused by disturbances to the bottom by these gears. Because of the severe disturbance to the bottom, mechanical clam harvest is restricted to open sand and mud bottoms, including areas frequently dredged as navigation channels. These areas are also posted by NCDMF staff to clearly mark the areas open to harvest and heavily enforced during the open harvest season. The use of mechanical harvest gear for clams is prohibited on oyster rock, in submerged aquatic vegetation, in marshes and in Primary Nursery Areas (Rules 15A NCAC 03K .0304, 03N .0104, and 03R .0103).

Regulations to protect habitats from mechanical harvest methods have been in place since 1977 and mechanical harvest was largely confined to the deeper waters of the sounds and rivers. In the early 1980s, mechanical harvesters proposed a rotation scheme between White Oak River and New River including a portion of the Intracoastal Waterway. The intent was to prevent

⁷ Presented to: PDT on 1/7/15, 8/13/15, & 1/4/16; AC on 2/2/15, 9/14/15 & 1/4/16; Rules Subgroup on 5/8/15; RAT on 4/30/15, 5/14/15, 7/1/15, & 10/1/15; MRT on 9/21/15 & 1/11/16; MFC on 11/20/15 and 2/18/16.

overharvesting of the clam stocks, discourage violations by mechanical harvesters who cross the lines in search of more lucrative clam quantities, and the taking of undersized clams, or “buttons”. These measures continue to be in place each year by proclamation.

Allocation conflicts did not occur in the hard clam fishery until the 1980’s as more management measures were put in place to reduce impacts to habitat and harvesters had to compete more for the limited resource (Hogarth 1989). The mechanical harvesters were directly competing with hand harvesters in the same areas. For many years, hand harvesters blamed the decline in clams on overharvest by mechanical harvesters (NCDMF 1997). NCDMF was tasked with mediating the disputes and trying to draw lines that divide the productive bottom between mechanical and hand harvesters. There were also conflicts between mechanical harvest gears. A proclamation was issued in 1986 which restricted hydraulic clam dredges to water depths of seven feet or greater in an attempt to achieve a more equitable allocation of the resource among mechanical harvesters. The hydraulic dredgers successfully brought a discrimination lawsuit (T.J. Kirk et al. vs. NCDMF, US District Court, Eastern District of NC, File # 85-65-CIV-4) against the NCDMF (NCDMF 1997). The judgement prevented the NCDMF from adopting rules and issuing proclamations which distinguish and discriminate between hydraulic dredges and clam kicking vessels. The number of mechanical harvesters in the late 1980s had increased to 299 permits in the 1988/89 harvest season, with the greatest number observed operating in one day to be 174 participants (Hogarth 1989). Mechanical harvesters were frequently requesting additional harvest area because of declining catches in traditional harvest areas during this time.

In 1990, the MFC wanted to prevent expansion of the mechanical harvest fishery because of habitat concerns and prohibited the opening of any new bottom that had not traditionally been opened between January 1979 through September 1988 [15A NCAC 03K .0302(b)]. The Fisheries Director is restricted in his proclamation authority for opening only areas to the mechanical harvest of hard clams in Rule 15A NCAC 03K .0302 (b), which include Core and Bogue sounds, Newport, North, New, and White Oak rivers, and an area in the IWW from Marker 65 to the BC marker at Bank Channel in Onslow and Pender counties.

Over time, some of the mechanical clam harvest areas have been encroached by SAV and oyster rocks and the lines have been moved. Specifically, the mechanical clam harvest line in the North River was adjusted in February 2007 because of oyster rocks in the area (proclamation SF-3-2007). The Newport River mechanical clam harvest line was adjusted in 2011 to avoid oyster rock along a portion close to an area known as the ‘Haystacks’ (proclamation SF-15-2011/12).

An area in Pamlico Sound was added to the list of areas in rule that could be opened in the 2001 Hard Clam FMP to initiate a 2-year open and closed harvest rotation with an area in northern Core Sound (NCDMF 2001). Two mechanical harvest areas were established within Pamlico Sound and opened by proclamation during the open harvest season based on aerial photography and ground truthing to avoid submerged aquatic vegetation. These areas encompassed approximately 4,500 acres in water depths from seven to 13 feet (Figure 12.2.1). The northern Core Sound area was established based on similar acreage to the two Pamlico Sound mechanical clam harvest areas. During the first year of rotation (2001/02), larger boats fished Pamlico Sound successfully with the majority of the fishermen catching their 20 bag limit in the beginning of the season. Core Sound was fished by smaller boats and was available to the larger boats during times of poor weather. The second year of the rotation plan (2002/03) had much lower trips and lower landings in Pamlico Sound. By the time of the start of the second 2-year rotation with Pamlico Sound in 2005/06, the channel by Wainwright Island had filled in making it impossible for the larger boats to get to the Pamlico Sound kicking area. There

were no landings made from Pamlico Sound during the 2005/06 season. The 2006/07 season suffered from low clam prices and high fuel prices. Very few fishermen were reported mechanically harvesting in 2006/07. Running time for those boats fishing in Pamlico Sound also decreased from eight hours a day to five or six hours a day. Market grade also varied between the two areas with topnecks and cherries harvested from Pamlico Sound and little necks, topnecks and chowders from Core Sound. Deep water and weather conditions also limited the area to the larger vessels. Crab pot fishermen also complained about impacts to the blue crab fishery in that area because of mechanical harvest. The mechanical clam harvest area in Pamlico Sound also overlaps with the no trawl area (15A NCAC 03R .0106; Figure 12.2.2).

In Amendment 1 of the Hard Clam FMP, the MFC selected to discontinue rotation of Pamlico Sound with northern Core Sound, but keep the Pamlico Sound area for mechanical clam harvest in rule (NCDMF 2008a). In addition, a resting period was established within the mechanical clam harvest area in the northern part of Core Sound. Since 2008, northern Core Sound has been opened every other year opposite the open mechanical clam harvest season for the New River, while the southern portion is opened annually (Figures 12.2.1 and 12.2.3).

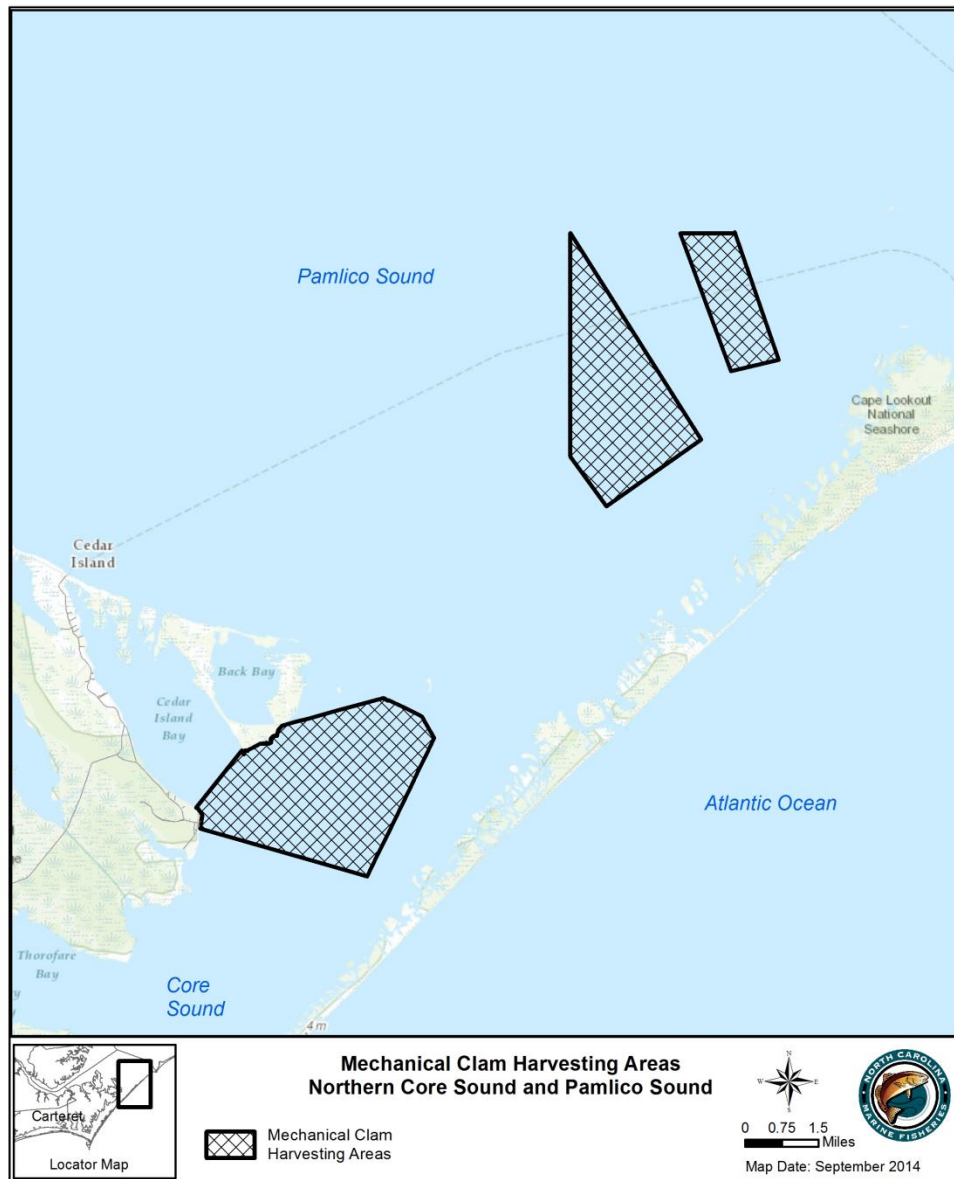


Figure 12.2.1. Public mechanical harvest areas in Northern Core Sound and Pamlico Sound. The Pamlico Sound open area to mechanical clam harvest was discontinued in 2008. NCDMF GIS database.

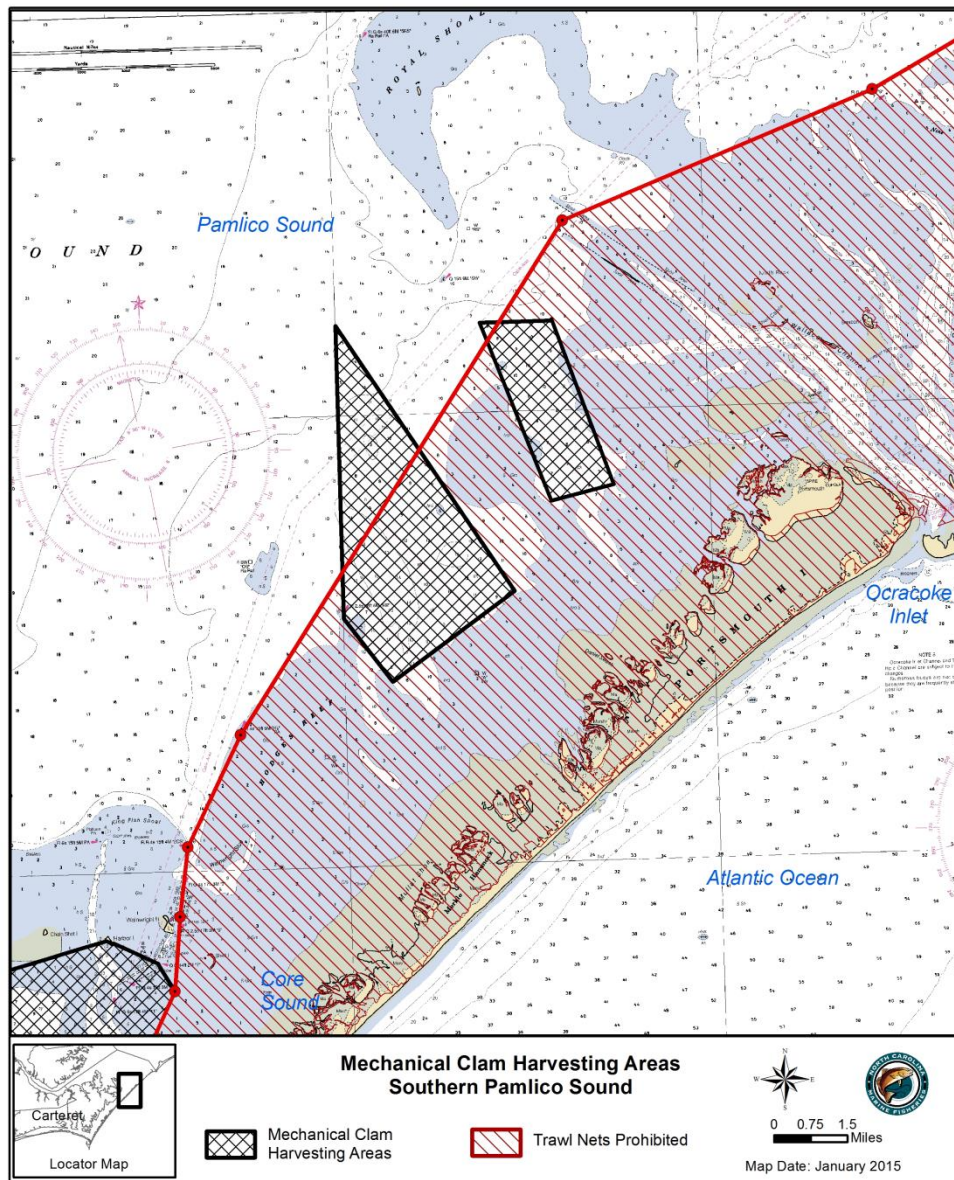


Figure 12.2.2. The no trawl area (15A NCAC 03R .0106) and the public mechanical clam harvest area in Pamlico Sound (15A NCAC 03K .0302 (b)) discontinued in 2008.

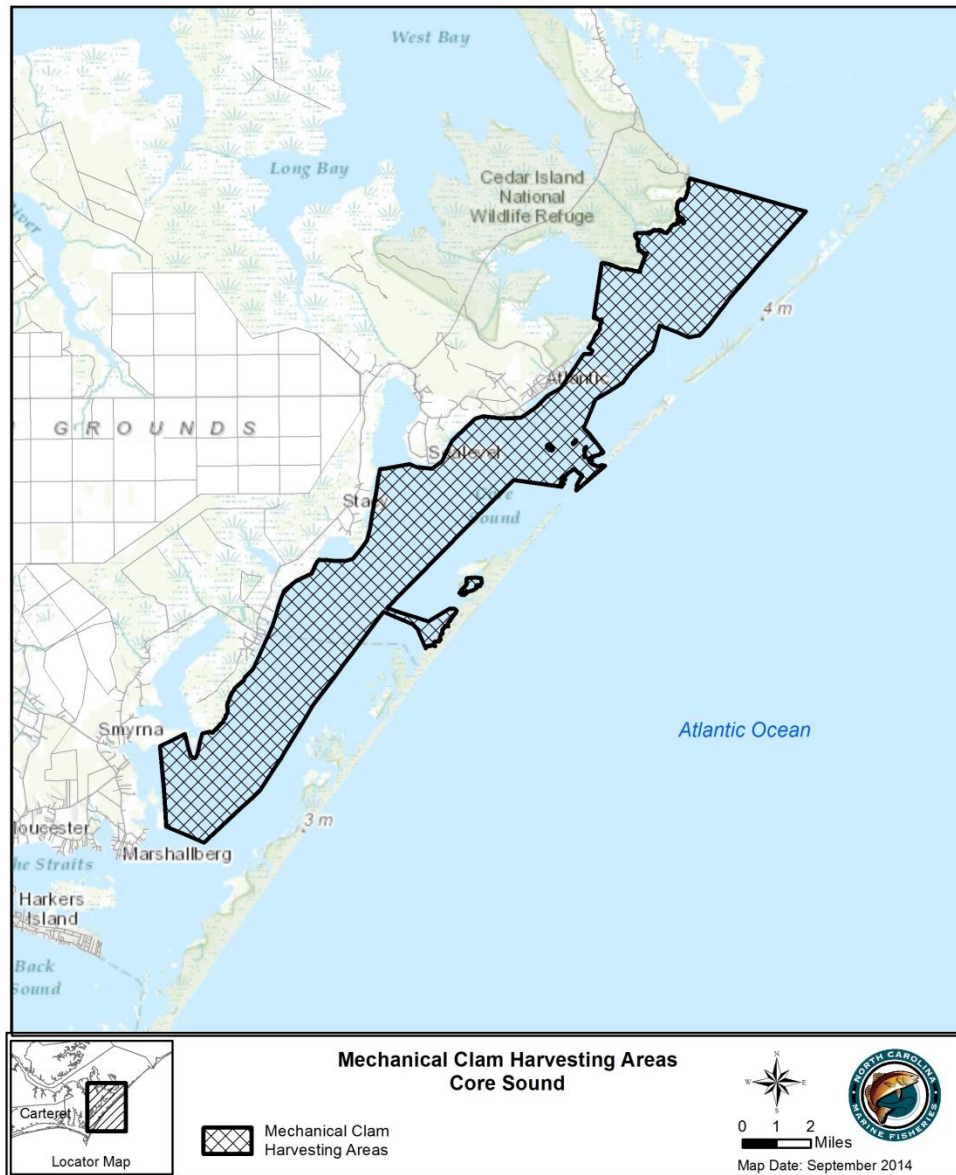


Figure 12.2.3. The current public mechanical harvest area in southern Core Sound. Opened every year. NCDMF GIS database.

Complaints from the public have come forward recently on the changing of the mechanical clam harvest boundaries in the New River. NCDMF staff place poles with green signs along the boundaries of open mechanical harvest areas and the physical delineation is considered the actual closure line during the open harvest season. In the New River and IWW, the areas are marked by Marine Patrol officers that work in the area and do not have latitude/longitude coordinates directly associated with the poles marking these areas. The mechanical harvest areas from the White Oak River and north to Core Sound are marked by staff from the Fisheries Management section and occasionally the Habitat and Enhancement section. These mechanical harvest areas have had latitude/longitude coordinates associated with each of the pole locations in the field recorded since 1999 to allow poles to be posted generally in the same locations from year to year, so long as there is no presence of SAV or oyster rock within the open area. These

coordinates are not exact locations, but help maintain the lines in about the same location from year to year.

Complaints have also been brought forward on the areas shrinking that can be used to mechanically harvest clams in the IWW due to the increasing number of docks in the vicinity. By proclamation it is unlawful to take clams by mechanical methods within 25 yards of privately marked and maintained navigation channels, docks, and piers. The areas opened to the mechanical harvest of clams in the IWW of Onslow and Pender counties include the maintained marked channel only from Marker #65, south of Sallier's Bay, to Marker #49 at Morris Landing, and all public bottoms within and 100 feet on either side of the Intracoastal Waterway from Marker #49 at Morris Landing to the "BC" Marker at Banks Channel. The IWW is open every other year when the New River is closed.

A declaratory ruling was presented in 2011 to the MFC to consider the expansion of mechanical hard clam fishery into all waters of the state greater than eight feet in depth. The proposed ruling to allow the mechanical harvest of hard clams in waters deeper than eight feet would expose most of the natural oyster rocks in Pamlico Sound to the negative impacts of mechanical harvest operations for hard clams. Nearly all of the natural oyster rocks in the open waters of Pamlico Sound lie in waters more than eight feet deep. While populations capable of sustaining a commercial fishery for hard clams are not typically found in Pamlico Sound, except in the areas around inlets and along the Outer Banks, high salinity conditions like those during drought can allow for occasional hard clam recruitment in the areas where subtidal oyster rocks exist. These occurrences would enhance the threat of mechanical harvest damage to the oyster rocks by harvesters using the additional effort required to take hard clams found under the existing oysters and shell habitat. There is also concern that using bottom mechanical harvest gears in Pamlico Sound could also impact areas where productive oyster beds once existed and possibly prevent oysters from reestablishing in parts of their historic range (Frankenberg 1995; Deaton et al. 2010). The CHPP recommended construction of oyster sanctuaries in locations of historic abundance and restriction of trawling over restored shell bottom are necessary to restore shell bottom in these northern subtidal areas (Deaton et al. 2010). After evaluating the declaratory ruling, the MFC continued to support the 2008 Hard Clam FMP Amendment 1 and only allow mechanical harvest of hard clams in designated harvest areas between Cedar Island and Topsail Beach that do not contain significant grass beds or oyster resources.

The number of trips from mechanical clam harvest gears in public areas from the fishing year (Dec-Nov) period 1994/95 to 2012/13 ranged from a high of 1,699 trips in 2003/04 to a low of 304 trips in 2012/13 (Figure 7.24 in section 7.1.3.3). Annual effort in this fishery has been declining from an average of 1,173 trips from 1994/95 to 2003/04 to an average of 666 trips from 2004/05 to 2012/13. During 1987, a total of 350 Mechanical Clam Harvest Permits were issued. Since then, the number of mechanical harvesters has declined to less than 50 participants statewide since 2006 (Figure 12.2.4). These declines are due to a combination of high fuel prices, low clam prices, and low clam abundance. Some areas within Core Sound, Newport River, Bogue Sound, and White Oak River are currently not harvested because of the lack of clam resources and lack of harvesters. All mechanical harvest areas have had a significant decline in the number of participants working in this fishery since 1994. Bogue Sound mechanical clam harvest has dropped from 13 participants in 1994 to less than four since 2000 with very limited mechanical clam harvest since 2004. White Oak River is rotated with New River with only 5 participants or less harvesting clams from that area in open years. The number of mechanical clam harvest participants has also significantly declined in Core Sound from a range of 34 to 69 participants annually from 1994 to 2005, to 15 participants or less since 2006.



Figure 12.2.4. Annual number of participants in the public hard clam mechanical harvest fishery, 1994-2013.

IV. AUTHORITY

N.C. General Statutes

- 113-134 Rules
- 113-182 Regulation of fishing and fisheries
- 143B-289.52 Marine Fisheries Commission – Powers and Duties

N.C. Marine Fisheries Commission Rules May 1, 2015 (15A NCAC)

- 03K .0302 Mechanical harvest season
- 03K .0304 Prohibited taking
- 03N .0104 Prohibited gear, Primary Nursery Areas

V. DISCUSSION

Current mechanical clam harvest areas are designated in proclamations and open the season beginning in December and close at the end of March. These areas are also posted by NCDMF staff to clearly mark those areas open to harvest. Over time, some of these areas have been encroached by SAV and oyster rocks and have become candidates for removal from mechanical harvest areas because of the presence of these sensitive habitats. White Oak and Newport rivers may need further adjustments to current lines because of oyster rocks. The Core Sound harvest area is bordered by SAV on the eastern side and a portion on the southern section, and should be adjusted to avoid physical impacts to SAV. It may be prudent to provide a wider buffer from the open harvest areas and these habitats in some areas to reduce the risk of indirect impacts to oyster rocks and SAV. Due to the long-term decline in mechanical clam harvest

effort, it has also been recommended that mechanical clam harvest areas be modified to include only actively fished areas. Some fishermen fear that once an area is closed to fishing, it will never reopen. However, these areas are delineated in proclamation allowing for the flexibility of adjusting lines as conditions warrant.

Another way to minimize the effects of mechanical clam harvest on bottom habitat includes rotation of areas. The NCDMF currently rotates White Oak River with New River every other year while the northern portion of Core Sound is opened every other year. The rotation scheme appears to work between the New River and White Oak River. The NCDMF has had several complaints from the public in years when the portion of northern Core Sound is not open to the mechanical harvest of clams and there is no evidence whether this resting period improves the clam population in the area. Shortening the season would also minimize the amount of impact to an area. Eliminating mechanical harvest would remove all harvest impacts with the exception of leases using mechanical harvest methods.

The current MFC rule 15A NCAC 03K .0302 allows the Fisheries Director to open the season from December 1 through March 31 in the areas described in Pamlico Sound, but the management strategy in Amendment 1 to the Hard Clam FMP discontinued the opening of this area. The NCDMF has a policy which recommends providing rules that are up to date with the current management practice to aid in the clarity of regulations. Since the mechanical clam harvest area in Pamlico Sound is no longer considered an area for mechanical clam harvest since 2008 it would be reasonable to eliminate the language from the rule.

It should also be noted that in Rule 15A NCAC 03K .0302 there is the requirement that any proclamation specifying means or methods must be approved by the Marine Fisheries Commission prior to issuance which has never occurred. This part of the rule was added in 1989 along with the language defining the open areas to mechanical harvest of clams during the open harvest season on public bottom that were only opened at any time from January 1979 through September 1988 by proclamation. Conflicts between the mechanical clam harvesters and other user groups were more prevalent at that time and there are significantly less participants in the fishery now than in past (Figure 12.2.4). This is an antiquated piece to the Rule 15A NCAC 03K .0302 that is no longer relevant and has never been used to manage the mechanical clam fishery and so this piece of the rule is proposed to be removed.

Consistency in marking of the open areas for mechanical clam harvest from year to year is important for fishermen to keep to the same bottom to limit impacts to habitat. Having latitude/longitude coordinates associated to each pole for an open mechanical clam harvest area may also be helpful for new NCDMF staff marking the boundary who may not be familiar with the past marking of the open area.

With more people moving to coastal communities sharing access to public resources becomes more difficult. The IWW is opened to mechanical clam harvest from Marker #65, south of Sallier's Bay, to Marker #49 at Morris Landing only within the public channel. The IWW area in Topsail Sound from Marker #49 at Morris Landing to the "BC" Marker at Banks Channel allows some public bottoms within and 100 feet on either side of the channel to be opened to mechanical clam harvest with the limitation that boats can go no closer than 25 yards of privately marked and maintained navigation channels, docks, and piers. This 25-yard boundary from private docks and channels is not in rule, but a policy in proclamation for enforcement to reduce conflicts between mechanical clam harvesters, residential landowners, and other waterway users along the coast. Removing or shrinking this boundary may increase conflicts, and has been in place for quite a long time.

Expansion of the mechanical clam harvest areas in the state has been considered in the past but has never been pursued because of limited sustainable clam resources and concerns for impact to oyster rocks in the Pamlico Sound. Since 1978 the Fisheries Director and the MFC have been consistent in their protection of oyster habitat from the negative impacts of hard clam harvest with mechanical gear. Although the eight-foot depth restriction would protect most seagrasses during the conditions encountered in typical years, care would be required to ensure that no productive habitats would be negatively impacted. Therefore, even if the rule limiting area for mechanical harvest of hard clams were changed, areas would have to be marked to protect critical habitat areas. The surveying, marking, maintenance and enforcement costs of designating and monitoring those areas in all coastal fishing waters would be huge. Also, the latest attempt to establish mechanical clam harvest areas north of Core Sound near Portsmouth showed that hard clam recruitment was not high enough to sustain mechanical harvest for hard clams in Pamlico Sound.

VI. PROPOSED RULE(S)

MFC Preferred Management Strategy:

15A NCAC 03K .0302 ~~MECHANICAL HARVEST SEASON~~ MECHANICAL HARVEST OF CLAMS FROM PUBLIC BOTTOM

(a) It is unlawful to take, buy, sell, or possess any clams taken by mechanical methods from public bottom unless the season is open.

~~(b) except that the~~ The Fisheries Director may, by proclamation, open and close the season at any time in the Atlantic Ocean and only between from December 1 through March 31 in Internal Coastal Waters. ~~internal waters for the use of mechanical clam harvesting gear. The Fisheries Director is further empowered to impose any or all of the following restrictions:~~

- ~~(1) specify number of days;~~
- ~~(2) specify areas;~~
- ~~(3) specify time period;~~
- ~~(4) specify quantity or size; and~~
- ~~(5) specify means/methods. Any proclamation specifying means or methods must be approved by the Marine Fisheries Commission prior to issuance.~~

~~(b)(c)~~ The Fisheries Director may, by proclamation, open to the taking of clams by mechanical methods from public bottom during open seasons only areas that have been opened at any time from January 1979 through September 1988 in:

- (1) Newport, North, White Oak, and New rivers;
- (2) Core and Bogue sounds;
- (3) the Intracoastal Waterway north of "BC" Marker at Topsail Beach; and
- (4) the Atlantic Ocean.

~~in Core and Bogue Sounds, Newport, North, White Oak and New Rivers and the Intracoastal Waterway north of "BC" Marker at Topsail Beach which have been opened at any time from January, 1979, through September, 1988, to the harvest of clams by mechanical methods. The Fisheries Director may, by proclamation, open the Atlantic Ocean and the area or any portion of the area in Pamlico Sound bounded by a line beginning on Portsmouth Island at a point 35° 01.5000' N 76° 06.0000' W; running northerly to a point 35° 06.0000' N 76° 06.0000' W; running westerly to a point 35° 06.0000' N 76° 10.0000' W; running southerly to a point 35° 01.5000' N 76° 10.0000' W; running easterly to the point of beginning to the harvest of clams by mechanical methods. Other areas opened for purposes as set out in 15A NCAC 03K .0301(b) shall open only for those purposes. A list of areas as described in this Paragraph is available upon request at the Division of Marine Fisheries, 3441 Arendell Street, Morehead City, NC 28557.~~

(d) The Fisheries Director may, by proclamation, impose any or all of the following additional restrictions for the taking of clams by mechanical methods from public bottom during open seasons:

- (1) specify time;
- (2) specify means and methods;
- (3) specify size; and
- (4) specify quantity.

*History Note: Authority G.S. 113-134; 113-182; ~~113-221~~; 113-221.1; 143B-289.52;
Eff. January 1, 1991;
Temporary Amendment Eff. October 1, 2001;
Amended Eff. May 1, 2017; April 1, 2003.*

VII. PROPOSED MANAGEMENT OPTIONS

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

1. Status quo (Maintain management of the mechanical clam harvest in existing areas from Core Sound south to Topsail Sound, including modifications to the mechanical clam harvest lines to exclude areas where oyster habitat and SAV habitat exist based on all available information)
 - + No additional regulation
 - + Current rules and policies have been in place for a long period and the public is accustomed to the current interpretation and enforcement
 - + Allows the fishery to operate with minimal impact to fish habitat
 - No expansion of the fishery to other areas
2. Modify mechanical clam harvest lines to exclude areas no longer fished but are currently open to mechanical clam harvest
 - + Decrease in amount of habitat that could potentially be impacted by mechanical harvest
 - + Meets Coastal Habitat Protection Plan implementation goal
 - + May reduce impacts of harvest on some of the hard clam population
 - Loss of some mechanical harvest areas
 - Increases effort in areas that are open
 - May adversely impact some fishermen more than others
3. Modify mechanical clam harvest lines currently open to mechanical clam harvest with a wider buffer between the lines and where oyster habitat and SAV habitat exist, based on all available information
 - + Decrease the amount of habitat that is impacted by mechanical harvest
 - + Meets Coastal Habitat Protection Plan implementation goal
 - + May reduce impacts of harvest on some of the hard clam population
 - Increases effort in areas that are open
 - May adversely impact some fishermen more than others
 - Requires ground truth sampling effort to determine if SAV and oyster habitat does or does not exist
4. Increase rotation of mechanical harvest in existing sites
 - + No additional resources required to implement
 - + No reporting burden on fishermen or dealers
 - + Decrease amount of habitat affected by mechanical harvest at one time
 - + May reduce impacts of harvest on some of the hard clam population
 - + May improve the ability for closed portions of area to recover from harvest impacts
 - Higher number of boats in a reduced area could increase impacts to the resource
 - Requires knowledge of consistent high and low productive areas of abundance to be effective
 - Forces commercial fishermen to search for other sources of income when an area is closed
 - Increases effort in areas that are open

- May adversely impact some fishermen more than others
5. Rotation of current mechanical harvest areas with previously unopened areas (**rule change required**)
 - + Increase in use of underutilized clam resources
 - + Ability for closed portions of area to recover from mechanical harvest impacts
 - Increase in overall amount of area impacted by mechanical clam harvest
 - May create conflicts between hand harvesters and mechanical harvesters or other fisheries
 6. Shorten the mechanical clam harvest season
 - + Shorter amount of time habitat is impacted
 - + Longer amount of time habitat can recover
 - + Reduced fishing effort on clam stocks
 - Reduced income for mechanical harvesters
 7. Eliminate all mechanical clam harvest areas
 - + No further impacts on the bottom
 - + Reduced fishing effort on clam stocks
 - Loss of income to mechanical harvesters
 8. Remove the Pamlico Sound mechanical clam harvest area in rule no longer in use (**rule change required**)
 - + No additional resources required to implement
 - + Aligns rule with management
 - Eliminates the potential to re-open this area to mechanical harvest
 9. Take latitude/longitude coordinates of the poles marking the open mechanical clam harvest area boundary in the New River, still with the flexibility to move a line to avoid critical habitats
 - + Provides more consistency in the open and closed boundary from year to year
 - Additional cost, effort and resource requirements on NCDMF staff
 10. Shorten or eliminate the minimum 25-foot distance requirement mechanical clam harvesters must maintain from privately marked and maintained navigation channels, docks, and piers
 - + Allows harvesters more access to open public mechanical clam harvest areas
 - Increases the potential for conflicts between mechanical clam harvesters, residential landowners, and other waterway users
 - Current policy has been in place for a long period and the public is accustomed to the current interpretation and enforcement
 11. Expand the mechanical clam harvest areas (**rule change required**)
 - + Increase in use of underutilized clam resources
 - Populations capable of sustaining a commercial fishery for hard clams are not typically found in other areas
 - Increase in overall amount of bottom impacted by mechanical clam harvest
 - May create conflicts between other fisheries
 - Requires ground truth sampling effort to determine if SAV and oyster habitat does or does not exist
 - Cost associated with surveying, marking, maintenance and enforcement of designating and monitoring additional areas

VIII. RECOMMENDATION

MFC Selected Management Strategy

- Status quo (Maintain management of the mechanical clam harvest in existing areas from Core Sound south to Topsail Sound, including modifications to the mechanical clam harvest lines to exclude areas where oyster habitat and SAV habitat exist based on all available information)
- Remove the Pamlico Sound mechanical clam harvest areas in rule no longer in use (**rule change required**)
- Take latitude/longitude coordinates of the poles marking the open mechanical clam harvest area boundary in the New River, still with the flexibility to move a line to avoid critical
- Allow mechanical clam harvesters to have access to the bottom before maintenance dredging occurs*

NCDMF and Advisory Committee

- Status quo (Maintain management of the mechanical clam harvest in existing areas from Core Sound south to Topsail Sound, including modifications to the mechanical clam harvest lines to exclude areas where oyster habitat and SAV habitat exist based on all available information)
- Remove the Pamlico Sound mechanical clam harvest areas in rule no longer in use (**rule change required**)
- Take latitude/longitude coordinates of the poles marking the open mechanical clam harvest area boundary in the New River, still with the flexibility to move a line to avoid critical habitats

Advisory Committee

- Allow mechanical clam harvesters to have access to the bottom before maintenance dredging occurs*

*NCDMF has allowed harvesters access to clams before maintenance dredging and can continue to do so through Rule 15A NCAC 03K .0301 (b); and increase communication with the USACE on their schedule to ensure timely notification of dredging activities.

IX. RESEARCH RECOMMENDATIONS

- Investigate impacts of clam trawls and escalator dredges on sandy bottom environments
- Investigate the effects of mechanical harvest on clam recruitment and clam mortality in the mechanical harvest areas

IX. LITERATURE CITED

Cunningham, P. A., R. J. Curry, R. W. Pratt, and S. J. Stichter. 1992. Watershed planning in the Albemarle-Pamlico estuarine system. Report 92-05 – Fishing practices mapping. North Carolina Department of Environment, Health, and Natural Resources. North Carolina Division of Marine Fisheries. Environmental Protection Agency, National Estuary Program. 227 pp.

Deaton, A.S., W.S. Chappell, K. Hart, J. O'Neal, and B. Boutin. 2010. North Carolina Coastal Habitat Protection Plan. North Carolina Department of Environment and Natural Resources. North Carolina Division of Marine Fisheries, NC. 639 pp.

Hogarth, B. 1989. Overview of the mechanical harvest of clams. North Carolina Department of Environment, Health, and Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, NC. 5 pp.

NCDMF. 1997. North Carolina Fishery Management Plan. Hard Clam. North Carolina Department of Environment, Health, and Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, NC. 58 pp.

NCDMF. 2008a. North Carolina Hard Clam Fishery Management Plan. Amendment 1. North Carolina Department of Environment and Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, NC. 158 pp.

Peterson, C. H., H. C. Summerson, and S. R. Fegley. 1987. Ecological consequences of mechanical harvesting on clams. Fishery Bulletin. 85(2): 281-298.

Prepared by: Tina Moore, Tina.Moore@ncdenr.gov
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12.3 THE USE OF POWER HAULING EQUIPMENT FOR THE HAND HARVEST OF HARD CLAMS⁸

February 18, 2016

I. ISSUE

Investigate the use of power hauling equipment to lift and retrieve hand operated rakes during the harvest of hard clams.

II. ORIGINATION

Public request made by participants in the hard clam hand harvest fishery in the New River.

⁸ Presented to: PDT on 1/7/15, 8/13/15, & 1/7/16; AC on 2/2/15, 9/14/15, & 1/4/16; MRT on 9/21/15 & 1/11/16; MFC on 11/20/15 and 2/18/16.

III. BACKGROUND

Recently, a few individuals who hand harvest hard clams in the New River have inquired about using crab pot haulers to assist with the retrieval of bull rakes from the benthic substrate onto the vessel, or “power hauling” while operating in hand harvest only areas. Hand harvest of hard clams using bull rakes from deep water is a labor intensive method and requires participants in this fishery to be physically capable of lifting heavy rakes through the water column and onto the vessel. Other states have provisions allowing the use of power equipment to haul loaded bull rakes (via a line affixed to the rake) to the surface of the water and on deck. These allowances have generated an interest among participants in the New River to employ similar techniques in the retrieval of bull rakes. Under the current North Carolina MFC rules, the use of any mechanical means during the harvest of hard clams (15A NCAC 03I .0101(3)(l)) would not be legal outside of allowed mechanical harvest locations and seasons unless in a permitted lease or franchise (15A NCAC 03K .0302). As a result of these rules, power hauling is not a legal process within any hand harvest areas. New York and Rhode Island presently allow the practice of power hauling hand rakes during the harvest of hard clams (New York Statutes and Codes 13-0309, Rhode Island Marine Fisheries Regulations 10.3.1), and are cited as examples of areas which provide the gear exemption being requested by the public for hand harvest areas in the southern region of North Carolina (Attachment 12.3.1). Neither New York nor Rhode Island currently allows any other mechanical harvest methods or gears in their hard clam fisheries.

As presently defined by MFC rules, power hauling is considered a mechanical harvest method, and would be a legal practice in discreet mechanical harvest areas during the appropriate season. The public hard clam mechanical fishery is highly regulated in North Carolina, and the Fisheries Director is restricted to only specific areas in Core and Bogue sounds, Newport, North, White Oak and New rivers as well as the Intracoastal Waterway. The use of mechanical gear to harvest clams is prohibited on oyster rock, in SAV, in marshes, and in Primary Nursery Areas (Rule 15A NCAC 03K .0304) within the state. The hand harvest of hard clams is less regulated in regards to both season and location, and may be undertaken year-round in any open public bottom approved for the harvest of shellfish. The use of hand harvest gear is allowed in nursery areas, however rakes are restricted to 12 inches or less in width and 6 pounds or less in weight when used in SAV, live oyster beds, or marsh cordgrass (15A NCAC 03K .0102). The MFC hard clam harvest rules are intended to minimize the impacts on SAV, live oyster resources, and Nursery Areas from this fishery.

The NCDMF identifies important estuarine nursery locations that consistently support and produce populations of juvenile shrimp, crab, and finfishes. Nursery Areas are defined in rule 15 NCAC 03I .0101(4)(f)0 as: “areas in which 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”. These areas are further divided by FMC rule into Primary Nursery Areas (PNAs) and Secondary Nursery Areas (SNAs). PNAs are described in MFC rules as areas usually located in the uppermost sections of the estuarine system where initial post-larval development takes place (15 NCAC 03I .0101(4)(f)). SNAs are described as areas in the middle portion of an estuarine system adjacent to PNAs where later juvenile development takes place. Fish Habitat Areas are recognized as necessary for the production of nearly all of North Carolina's economically important marine or estuarine fish species, and are accordingly established and protected by the MFC (15 NCAC 03N .0101).

The New River is one of the primary hard clam harvest areas within the state, contributing over 30% of total commercial landings of hard clam (Figure 7.17 in section 7.1.3.1). All areas within the New River north of the 172 bridge in Sneads Ferry, NC, and a portion of the shallow water

areas below the bridge are designated as hand harvest only areas. A marked mechanical harvest area is located below the bridge which is opened every other year alternating in rotation with areas in the White Oak River (Figure 7.7 in section 7.1.3). The hand harvest only area in the New River is located within both designated PNAs and SNAs, and is primarily classified as unvegetated soft bottom habitat. This habitat type has been identified in the CHPP as a particularly important nursery area for several economically important species including, Atlantic croaker, Penaeid shrimp, spot, and Southern flounder (Deaton et al. 2010). In a review of fishing gear impacts on soft bottom, the CHPP identified mechanical harvest methods (such as trawling and dredging) as the most disturbing to this habitat type and its benthic communities. Mechanical bottom disturbing gears cause damage or removal of benthic organisms, reduction in habitat complexity, and resuspension of nutrients (Mercaldo and Goldberg 2011).

The effects of hand raking on density, abundance, and recovery of SAV habitats have been well documented (Peterson et al. 1983; Stephan et al. 2000; Barnette 2001; Orth et al. 2002; Cabaço et al. 2005) however the impact on soft bottom communities from raking disturbance in the hand harvest of hard clams has been relatively unstudied. It has generally been accepted that hand harvest gears have lower negative habitat impacts than mechanized methods. When comparing hand raking to mechanized harvest gear in sandy and muddy subtidal substrates, hand raking has been demonstrated to have the least negative effects on the resident benthic macrofaunal community (Munari et al. 2006). The physical displacement of organisms, as well the alteration of density and diversity of species from fishing gears has the ability to alter the habitat function of soft bottom areas (Deaton et al. 2010). Investigating the effects of clam harvest on a mudflat in Maine, Logan (2005) not only found significantly higher numbers of amphipods recolonizing undisturbed substrates when compared to harvest areas, but also observed significant differences in abundance remaining after a five-month period. The size of raked areas can also influence the duration of alterations in populations of benthic organisms. In a European study involving cockles, the size of disturbance was shown to have an effect on the benthic community recovery time, with the larger areas raked taking the longest to recover in the Dee estuary, North Wales (Kaiser et al. 2001). In dynamic areas of sand substrate, bottom disturbance from fishing gear may be outweighed by natural processes and indistinguishable from usual variability (Coen 1995). MacKenzie and Pikanowski (2011) found no significant difference in the number of counted infaunal taxa between two levels of raking intensities and control plots in intertidal shallow sandy substrate in New Jersey. In North Carolina no significant effect from clam harvest on abundance of benthic invertebrates was observed in sandy soft bottom areas (Peterson et al. 1987).

IV. AUTHORITY

N.C. General Statutes

- 113 134 Rules
- 113 182 Regulation of fishing and fisheries
- 113-201 Legislative findings and declaration of policy; authority of Marine Fisheries Commission
- 143B-289.52 Marine Fisheries Commission – Powers and Duties

N.C. Marine Fisheries Commission Rules May 1, 2015 (15A NCAC)

- 03I .0101 Definitions
- 03K .0102 Prohibited rakes
- 03K .0302 Mechanical harvest season

03K .0304 Prohibited taking
03N .0101 Scope and purpose

V. DISCUSSION

Current North Carolina hard clam harvest regulations are designed to maintain a sustainable fishery and protect other resources from negative impacts associated with bottom disturbing harvest gear. The current approach allows for varying intensities of harvest across habitat types and within nursery areas. MFC rules restrict gear types and methods within specific areas with the intention of allowing the harvest of hard clams without significantly impairing the natural habitat functions. Mechanical bottom disturbing gear is known to change benthic communities, alter fish habitats, and locally degrade water quality (Barnette 2001; Deaton et al. 2010; Mercaldo-Allen & Goldberg 2011). Consequently, mechanical harvest is currently limited to specific areas outside of PNAs without significant amounts of oyster or SAV habitat, and in areas which produce populations of hard clams great enough to sustain this type of fishery. Hand harvest methods are generally regarded as having the least amount of associated negative habitat impacts and have limited restrictions. However, in live oyster beds, SAV, or marsh grass, MFC rules do limit rake sizes to minimize damage to these highly structured and ecologically valuable habitats. In soft bottom habitats, North Carolina rules do not have maximum size parameters for rakes and the dimensions are limited by the physical ability of the operator. The relative low efficiency of hand operated gear to extensively work large areas of bottom in a short time when compared to mechanical methods affords the habitat and clam resources in hand harvest only areas a greater level of protection from excessive bottom disturbance. PNAs are currently protected from trawling, dredging, and other gear that highly disturbs the bottom to preserve their valuable role in the production of both economically important commercial and forage species. Specific impacts to soft bottom nursery area function due to raking disturbance in the North Carolina hard clam fishery remain uncertain, and probably vary between and within water bodies. Research into the effects of raking and clam harvest on benthic communities across multiple systems suggest finer grained, more stable sediments show significant invertebrate community alterations, and larger area disturbances take longer to recover. As the use of power hauling equipment has the ability to increase the efficiency at which a hand harvester can cover larger areas, the costs to soft bottom nursery areas must be considered before making a rule change on a general allowance for the use of this method statewide.

Power hauling, if only used to retrieve a manually operated rake from the substrate, may not cause any greater impact to habitat or resources than is currently occurring in hand harvest areas. However, some individuals could interpret a power hauling gear allowance in the hand harvest fishery as an opportunity to significantly increase the weight and sizes of rakes used or deploy the gear in means not initially intended by the originators of this issue, resulting in additional unanticipated habitat and nursery area repercussions. With the current maximum size and weight of rakes being effectively limited by the ability of the harvester to manipulate and retrieve them, any addition of mechanical means to assist with lifting could allow much larger rakes to be deployed. To retrieve a bullrake with a crab pot hauler, a line is attached to the frame or handle of the rake and run back through the hydraulic line puller on the vessel at the surface. With some minor modifications, an attachment to the boat could allow a rake to be fished as a tow behind gear with the vessel under power. This would effectually turn a piece of hand harvest equipment into a substantially more damaging piece of mechanical bottom disturbing gear. To address the inadvertent possibility of persons abusing such a gear allowance, Rhode Island has included comprehensive rules on the use of bullrakes operated by mechanical power within their 2013 Marine Fisheries Statutes and Regulations (see Attachment

12.3.1) which could be utilized as a template for MFC rulemaking if power hauling were to be permitted in North Carolina.

To ensure power hauling equipment is employed for the original requested purpose and to continue to best protect natural resources in hand harvest areas, the following regulatory conditions should be considered if this practice is adopted:

1. To be used only for lifting rakes from the substrate onto the vessel
2. Not to be used while actively collecting clams into the rake
3. Not to be used while vessel is moving or under power
4. Rakes will be limited to maximum dimensions if lifted with power hauling gear
5. Not to be used in areas prohibited by NCDMF

Allowing power hauling in areas which are at present limited to only hand harvest, may cause conflicts between clam harvesters who choose to employ the new mechanical methods and those who continue to manually rake. The increase in efficiency offered by adopting powered rake retrieval could disadvantage traditional manual hand harvest participants, and cause a shift in gear use within the fishery. To reduce potential conflict and maintain a traditional hand harvest fishery, specific areas where power hauling would be legal could be established. These additional areas would need to be classified as mechanical harvest, to allow the use of power hauling under current rules. However, the mechanical methods permitted would be limited under the proclamation authority of the director (15A NCAC 03K .0302(a)(5)) to only include the power hauling of hand rakes. Under current MFC regulations any expansion of the mechanical harvest fishery is prohibited on bottom that had not traditionally been opened between January 1979 through September 1988 (15A NCAC 03K .0302(b)), requiring a rule change to add any mechanical harvest areas outside these regions. It should also be noted that recent changes to N.C. General Statutes 113-168.2 and 113-169.2 require mechanical harvesters to hold a Standard Commercial Fishing License with a shellfish endorsement. Mechanical shellfish harvesters are no longer allowed to operate under the Shellfish License and therefore if rakes are used with power hauling equipment defined as mechanical methods for clamming then the Shellfish License could no longer apply to this user group.

To maintain habitat protection measures now required by MFC rule, NCDMF staff would be required to examine any potential new mechanical harvest zones for oyster or SAV habitat prior to their establishment, and any expansion of mechanical harvest areas for the use of power hauling equipment would not be allowed in PNAs. Population surveys and monitoring of recruitment may be required to ensure any major expansions of effort due to power hauling do not have significant negative impacts on the hard clam resource. Designating specific areas where power hauling would be allowed in addition to traditional hand harvest could allow NCDMF greater control over potential user conflicts and habitat impacts associated with this practice, but would add additional complexity to current mechanical harvest boundaries and rules. Before making any large scale provisions for additional areas designated for the use of power hauling equipment in the hand harvest of hard clams, substantial consideration must be given to the possibility that associated negative habitat and fishery resource impacts as well as enforcement, management, and maintenance costs may outweigh any economic benefits to the fishery.

VI. PROPOSED RULE(S)

No recommendations require rule changes at this time.

VII. PROPOSED MANAGEMENT OPTIONS

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

1. Status quo (Maintain current definitions and enforcement of hand harvest methods)
 - + No additional regulation or enforcement
 - + The public is accustomed to the current interpretation and enforcement of rules
 - + Allows the fishery to continue to operate with the least impact to habitat
 - + No added harvest pressure on hard clam resources
 - + No added opportunity for user conflicts
 - Perceived inequality between NC and other states gear allowances

2. Amend rules to set conditions allowing for the general use of power hauling equipment in the hand harvest of hard clams (**rule change required**)
 - + Increased efficiency in hand harvest of hard clams
 - Increase in potential habitat, PNA and SNA impacts by bull rakes
 - May disadvantage hand harvest fishermen without power hauling equipment
 - Added harvest pressure on hard clam resources
 - Possible increase in user conflicts
 - Difficult to differentiate between towing and lifting the rake
 - This method would only be available to harvesters holding a valid Standard Commercial Fishing License and shellfish endorsement

3. Modify mechanical clam harvest lines to include additional waterbody areas where the use of power hauling equipment is the only mechanical harvest gear allowed through proclamation (**rule change required**)
 - + Increased efficiency in hand harvest of hard clams
 - + Allows for flexibility in harvest methods in areas determined by DMF
 - Increase in potential localized habitat and SNA impacts by bull rakes
 - May disadvantage hand harvest fishermen without power hauling equipment
 - Added harvest pressure on hard clam resources
 - Possible increase in user conflicts
 - Requires field sampling for SAV and oyster presence prior to establishment of areas
 - Creates greater complexity in mechanical harvest area boundaries and rules
 - Difficult to differentiate between towing and lifting the rake
 - This method would only be available to harvesters holding a valid Standard Commercial Fishing License and shellfish endorsement

VIII. RECOMMENDATION

MFC Selected Management Strategy

- Status quo (Maintain current definitions and enforcement of hand harvest methods).

NCDMF and Advisory Committee

- Status quo (Maintain current definitions and enforcement of hand harvest methods).

IX. LITERATURE CITED

Barnette, M. C. 2001. A review of the fishing gear utilized within the Southeast Region and their potential impacts on essential fish habitat. National Marine Fisheries Service.

- Cabaço, S., Alexandre, A., & Santos, R. 2005. Population-level effects of clam harvesting on the seagrass *Zostera noltii*. Marine Ecology Progress Series. 298: 123-129.
- Coen, L. D. 1995. A review of the potential impacts of mechanical harvesting on subtidal and intertidal shellfish resources. Charleston, SC: South Carolina Department of Natural Resources, Marine Resources Research Institute.
- Deaton, A. S., Chappell, W. S., Hart, K., O'Neal, J., & Boutin, B. 2010. North Carolina coastal habitat protection plan. North Carolina Department of Environment and Natural Resources. Division of Marine Fisheries, NC.
- Kaiser, M. J., Broad, G., & Hall, S. J. 2001. Disturbance of intertidal soft-sediment benthic communities by cockle hand raking. Journal of Sea Research. 45(2): 119-130.
- Logan, J. M. 2005. Effects of clam digging on benthic macroinvertebrate community structure in a Maine mudflat. Northeastern Naturalist. 12(3): 315-324.
- MacKenzie Jr, C. L., & Pikanowski, R. 2004. Gear effects on marine habitats: Harvesting northern quahogs in a shallow sandy bed at two levels of intensity with a short rake. North American journal of fisheries management. 24(4): 1221-1227.
- Mercaldo-Allen, R., & Goldberg, R. 2011. Review of the Ecological Effects of Dredging in the Cultivation and Harvest of Molluscan Shellfish. NOAA Tech Memo NMFS NE. 220(78): 02543-1026
- Munari, C., Balasso, E., Rossi, R., & Mistri, M. 2006. A comparison of the effect of different types of clam rakes on non-target, subtidal benthic fauna. Italian Journal of Zoology. 73(01): 75-82.
- New York State. New York Codes and Statutes. Environmental Conservation 13-0309. <http://www.nycourts.gov/lawlibraries/nycodesstatutes.shtml>
- Orth, R. J., Fishman, J. R., Wilcox, D. J., & Moore, K. A. 2002. Identification and management of fishing gear impacts in a recovering seagrass system in the coastal bays of the Delmarva Peninsula, USA. Journal of coastal Research. 111-129.
- Peterson, C. H., Summerson, H. C., & Fegley, S. R. 1983. Relative efficiency of two clam rakes and their contrasting impacts on seagrass biomass. Fishery bulletin - United States, National Marine Fisheries Service (USA).
- Peterson, C. H., H. C. Summerson, and S. R. Fegley. 1987. Ecological consequences of mechanical harvesting on clams. Fishery Bulletin. 85(2): 281-298
- State of Rhode Island and Providence Plantations Department of Environmental Management. 2013. Rhode Island Marine Fisheries Regulations. Part 10: 4-5. <http://www.dem.ri.gov/pubs/regs/regs/fishwild/rimf10.pdf>
- Stephan, C. D., Peuser, R. L., & Fonseca, M. S. 2000. Fishing Gear Impacts to Submerged Aquatic Vegetation.

Prepared By: Joe Facendola, Joe.Facendola@ncdenr.gov, (910) 796-7292

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January 14, 2015
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September 22, 2015
February 18, 2016

Attachment 12.3.1.

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS DEPARTMENT OF
ENVIRONMENTAL MANAGEMENT
BUREAU OF NATURAL RESOURCES
FISH AND WILDLIFE
&
LAW ENFORCEMENT.

RHODE ISLAND MARINE FISHERIES
STATUTES AND REGULATIONS

Part X
Equipment Restrictions

November 12, 2013

10.3.1 Use of Tongs and Bullrakes operated by Mechanical Power – Power hauling of shellfish apparatus as defined in Sections 1.3, 10.2, and 10.3 of the RIMFC regulations, and the taking of shellfish in such harvesting apparatus is permitted provided such use is consistent with the following:

- A. No person shall use any power hauling equipment.
 - 1. For any purpose other than the removal and retrieval of bullrakes and tongs from the benthic sediments;
 - 2. During such time when bay quahaugs and oysters are being gathered into the bullrakes and tongs; or
 - 3. In waters where such use has been prohibited by the RIMFC.
- B. No person shall use any power hauling equipment in the operation of bullrakes and tongs with dimensions exceeding any of the following:
 - 1. Maximum width of thirty-one and one-half inches (31-1/2") measured along a line parallel to the tooth bar;
 - 2. Maximum tooth length of four and one-half (4-1/2") inches; or
 - 3. Maximum basket depth of twelve inches (12"), measured along a line perpendicular to the tooth bar and extending from the tooth bar to any point on the basket.
- C. Possession of bullrakes and tongs in excess of the size restrictions specified in Section 10.3.1(B) shall be prohibited aboard vessels equipped with any power hauling equipment.
- D. Except as required for safety or to avoid property loss, no vessel

involved in the harvest of bay quahaugs or oysters by use of bullrakes or tongs, may be moved or propelled by any source of mechanical power at any time when any bullrakes or tongs operated from such vessel are submerged in the waters of the state.

(pp. 4-5)

12.4 CONSIDER THE ELIMINATION OF THE SHELLFISH LICENSE AND REQUIRE ALL SHELLFISH HARVESTERS TO HAVE A STANDARD COMMERCIAL FISHING LICENSE OR A RETIRED STANDARD COMMERCIAL FISHING LICENSE⁹

February 18, 2016

I. ISSUE

To reduce effort on the oyster resource, it is under consideration to eliminate the shellfish license (G.S. 113-169.2), which is open to all NC residents, and require all commercial shellfish harvesters to either have a SCFL or Retired Standard Commercial Fishing License (RSCFL) with a shellfish endorsement.

II. ORIGINATION

The public.

III. BACKGROUND

The North Carolina General Assembly passed a moratorium on the sale of commercial fishing licenses in 1994 because of concerns voiced by the commercial and recreational fishing community. The General Assembly also appointed a moratorium steering committee to oversee the study of North Carolina's fisheries management process and to make recommendations on improving the process. Five subcommittees, including a License Subcommittee, were established to examine coastal fisheries issues. The recommendations of these committees formed the basis of the FRA of 1997.

The License Subcommittee proposed the adoption of a new coastal fisheries licensing system to enable documentation of the numbers of fishermen and to establish a basis to better determine fisheries harvest and effort. The license system in place today is based on recommendations made by this subcommittee. The current commercial license system consists of the SCFL and a RSCFL for fishermen age 65 and older with a cap on the number of licenses available that was based on the number of endorsement-to-sell (ETS) licenses on June 30, 1999. The ETS license system was in place prior to the current license system. During that time, fishermen could buy one SCFL or RSCFL for every valid endorsement-to-sell license they held. A free shellfish endorsement is available to SCFL and RSCFL holders who are North Carolina residents to allow fishermen the flexibility of participating in shellfish harvest in addition to other fisheries. A commercial shellfish license is also available to persons without a SCFL and allows any North Carolina resident to harvest and sell shellfish under this license. Changes in 2013 to N.C. General Statute 113-169 now authorizes only hand harvest of shellfish for commercial purposes

⁹ Presented to: PDT on 3/17/15, 6/18/15, 8/13/15, & 1/11/16; AC on 7/13/15, 9/14/15, & 1/4/16; MRT on 9/21/15 & 1/11/16; MFC on 11/20/15 & 2/18/16.

with the shellfish license. Before 2013 commercial shellfish license holders were allowed to mechanically harvest shellfish.

The North Carolina commercial shellfish license has always been restricted to North Carolina residents because shellfish are non-motile and are found in publicly owned submerged lands. In addition, the shellfish license is available to residents at a lower cost than the SCFL so that those indigent fishermen or part-time fishermen whose commercial fishing activities are limited to shellfishing on public bottom could continue to afford a license. Lease holders also use the shellfish license as well as any crew employed by them to be able to harvest shellfish product from a bottom or water column lease.

Recreational fishermen also purchase commercial shellfish licenses without selling the shellfish because the license is easy to obtain, is relatively inexpensive, and allows them to harvest more shellfish than the recreational limits allow. Although license prices increased in 2014 and again in 2015, the shellfish license has remained low in price compared to the SCFL and the RSCFL (Table 12.4.1). Regardless of license type, the TTP only captures landings of fishermen who sell their catch to certified seafood dealers. Landings information from fishermen who do not sell their catch is unknown.

Table 12.4.1. Commercial license prices since the beginning of the FRA Derived license system in 1999.

License	1999-2013	2014/15	2015/16
Standard Commercial Fishing license	\$200	\$250	\$400
Retired Standard Commercial Fishing License	\$100	\$125	\$200
Shellfish License	\$25	\$31.25	\$50

Concerns about the shellfish license being available to all North Carolina residents were addressed in the 2001 Hard Clam FMP and 2008 Amendment 1 and also the 2001 Oyster FMP and 2008 Amendment 2. Before the new license system was in effect, ETS license data from 1995 to 2000 indicated the number of licenses to harvest shellfish was decreasing (NCDMF 2008). However, because the new license system began shortly before the implementation of the 2001 Oyster and Hard Clam FMPs, there were no data available to assess the effect of the open shellfish license on the fishery. It was recommended in both plans to revisit this issue when more license data became available. In the 2008 oyster and hard clam amendments the MFC elected to continue issuing the shellfish license to residents of North Carolina. Despite the 2008 MFC decision, there are still concerns over the number of shellfish license holders in the state and the impacts these license holders have on the shellfish resource. This is especially true for shellfish license holder harvest impacts on the oyster resource in the southern coastal region.

The numbers of license holders showing no commercial landings in the TTP are much higher than the number of shellfish license holders that commercially landed shellfish (Figure 12.4.1). This is also true for license holders from southern counties (Figure 12.4.2). It is this unknown sector of the oyster fishery and the impacts this sector may have on the resource that have

caused concerns by both the public and fisheries managers, especially since this sector can legally harvest up to five bushels instead of the recreational limit of one bushel.

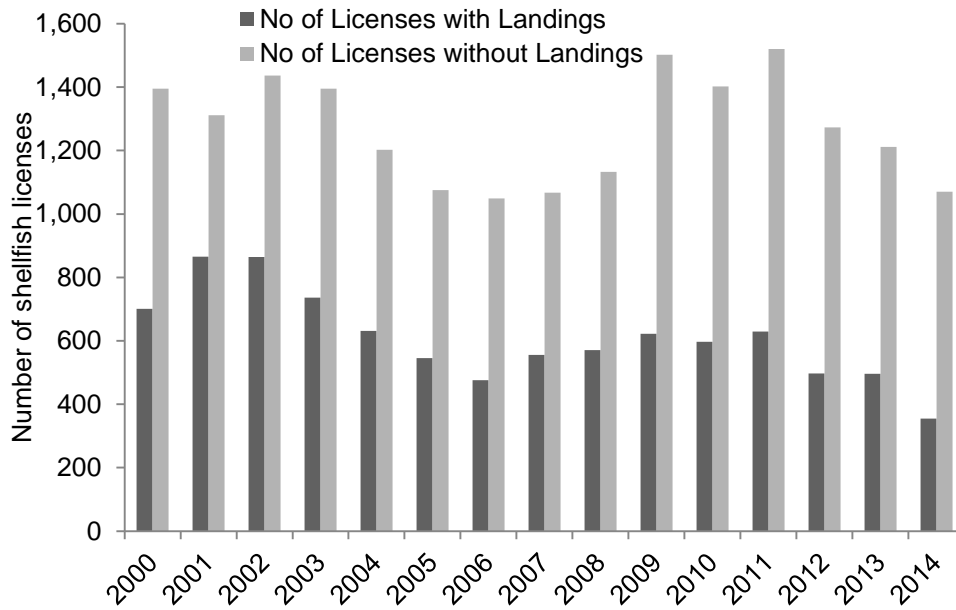


Figure 12.4.1. Comparison of shellfish licenses holders statewide with and without Trip Ticket landings, 2000-2014.

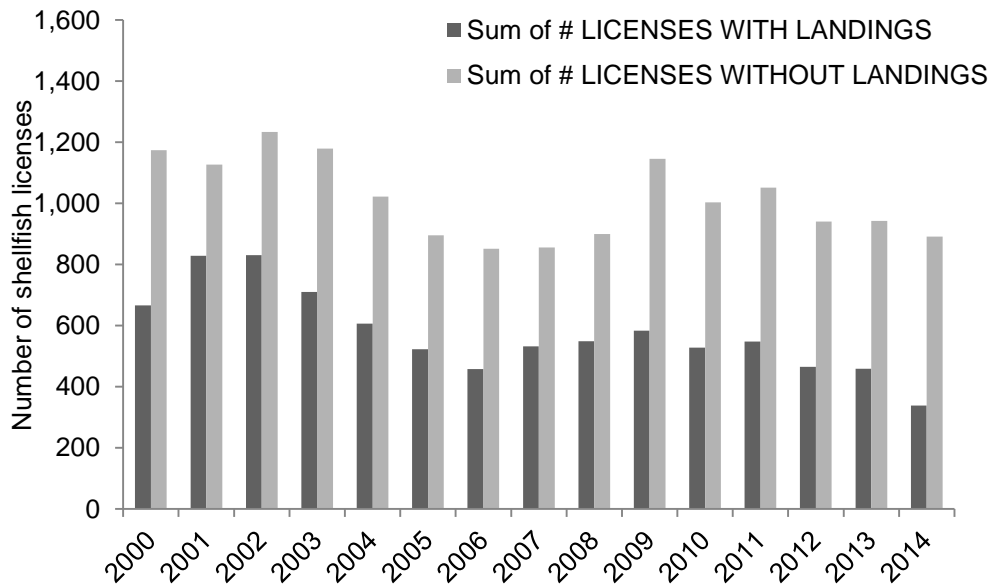


Figure 12.4. 2. Comparison of shellfish licenses holders from southern counties* with and without Trip Ticket Landings, 2000-2014 *Carteret, Jones, Onslow, Duplin, Pender, Brunswick, Bladen, Columbus, Robeson, Cumberland, Sampson, New Hanover.

IV. AUTHORITY

N.C. General Statutes

- 113-168.5 License endorsements for Standard Commercial Fishing License
 113-169.2 Shellfish license for North Carolina residents without a SCFL

V. DISCUSSION

Hand harvest is the only method allowed when harvesting shellfish with a shellfish license while a SCFL/RSCFL is required to harvest shellfish mechanically. Harvest and effort have decreased over time in the hard clam fishery (Table 12.4.3); however, there are increases in effort and participation in the oyster fishery, especially in the southern portion of the state by those who hold only a shellfish license (Table 12.4.2; Figure 12.4.3). Effort has increased in the southern water bodies since 2000, causing great concern from the public about the impacts to the oyster population. Oysters in the southern area are more intertidal in nature and tend to occur in clusters along the edge of the shore, making them easier to harvest. Harvest in these areas by shellfish license holders who do not sell their catch is unknown and therefore those impacts are unknown. Both effort and landings of shellfish license holders from the southern coastal counties decreased in 2014 (Table 12.4.2; Figure 12.4.3). Reasons for this decrease are unclear and may be due to decreases in abundance. There were reports to division staff of dead oysters in the southern area and may be a result of several things such as boring sponge, high amounts of rainfall during the summer causing increased sedimentation from runoff as well as increases in closures due to bacterial contaminants from these rainfall events.

Table 12.4.2. Effort (trips) and harvest (bushels) of oysters by license type in southern and northern counties, 2000-2014.

YEAR	NORTHERN						SOUTHERN					
	SCFL		RSCFL		Shellfish w/o SCFL		SCFL		RSCFL		Shellfish w/o SCFL	
	BUSHELS	TRIPS	BUSHELS	TRIPS	BUSHELS	TRIPS	BUSHELS	TRIPS	BUSHELS	TRIPS	BUSHELS	TRIPS
2000	1,198	121	686	86	0	0	18,004	3,822	971	241	4,093	987
2001	3,826	440	1,760	167	91	7	20,896	4,381	1,603	398	8,000	1,678
2002	5,330	562	254	40	68	8	21,641	4,316	2,076	525	8,398	1,989
2003	4,749	471	815	69	85	14	22,328	4,439	1,911	452	10,846	2,563
2004	9,574	935	867	60	0	0	24,550	5,007	2,128	533	10,107	2,367
2005	19,199	1,604	1,739	131	45	6	25,365	5,334	2,022	471	12,789	3,019
2006	23,547	2,310	2,563	244	32	9	24,030	5,075	2,488	637	14,245	3,338
2007	17,719	1,890	3,122	376	230	42	25,851	5,510	3,083	698	19,439	4,546
2008	22,770	1,951	1,660	253	157	15	21,710	4,829	3,656	923	21,703	5,213
2009	30,290	2,775	2,644	304	2,515	253	21,222	5,220	3,131	794	21,846	5,731
2010	98,605	7,641	7,819	663	10,343	1,012	18,551	4,635	3,012	772	19,836	5,195
2011	101,331	8,053	7,538	621	13,637	1,296	22,274	5,223	3,120	819	24,049	6,148
2012	30,063	2,955	1,881	215	3,426	358	25,707	6,028	4,215	1,051	27,447	7,115
2013	20,064	2,066	1,703	209	2,603	320	23,771	5,634	3,667	871	22,662	5,831
2014	31,761	2,601	1,990	195	589	73	16,094	3,612	2,042	456	13,421	3,510

Table 12.4.3. Effort (trips) and harvest (number) of hard clams by license type in southern and northern counties, 2000-2014.

YEAR	NORTHERN						SOUTHERN					
	SCFL		RSCFL		Shellfish w/o SCFL		SCFL		RSCFL		Shellfish w/o SCFL	
	NUMBERS	TRIPS	NUMBERS	TRIPS	NUMBERS	TRIPS	NUMBERS	TRIPS	NUMBERS	TRIPS	NUMBERS	TRIPS
2000	448,823	385	29,770	43	148,806	141	16,744,562	18,194	688,387	1,327	6,093,763	11,478
2001	462,951	565	24,968	49	81,767	104	17,684,547	22,078	1,186,335	2,247	8,967,686	17,604
2002	1,047,577	527	0	0	97,967	93	16,300,215	17,846	1,076,416	2,044	8,891,934	16,350
2003	232,027	107	0	0	41,058	32	14,574,103	16,423	746,217	1,447	6,944,083	12,796
2004	40,027	46	0	0	11,843	13	18,193,388	16,781	761,546	1,403	6,788,211	11,756
2005	4,024	19	16,371	17	425	1	12,027,891	12,565	740,817	1,248	5,517,753	9,801
2006	6,714	14	14,101	19	12,350	9	11,935,044	11,845	1,267,992	1,725	5,631,500	9,244
2007	21,765	33	18,191	16	0	0	9,115,805	10,911	1,032,962	1,495	7,801,768	12,094
2008	6,036	11	10,462	17	830	2	10,763,985	9,927	1,094,623	1,614	7,302,730	11,800
2009	8,822	34	5,710	13	1,847	6	8,258,592	9,022	596,927	1,237	7,142,150	11,588
2010	33,867	47	7,655	18	58,167	46	9,246,553	7,863	733,072	1,045	6,509,655	10,080
2011	5,099	12	29,699	35	350	2	6,419,859	6,683	540,057	946	6,867,015	10,102
2012	168,060	30	24,893	22	0	0	5,720,118	5,638	852,228	1,026	9,912,232	8,621
2013	20,997	28	15,856	17	2,220	2	5,836,198	5,542	1,397,117	1,395	7,485,283	8,020
2014	46,578	52	3,006	4	69,317	54	3,362,827	2,812	682,755	674	4,372,905	4,293

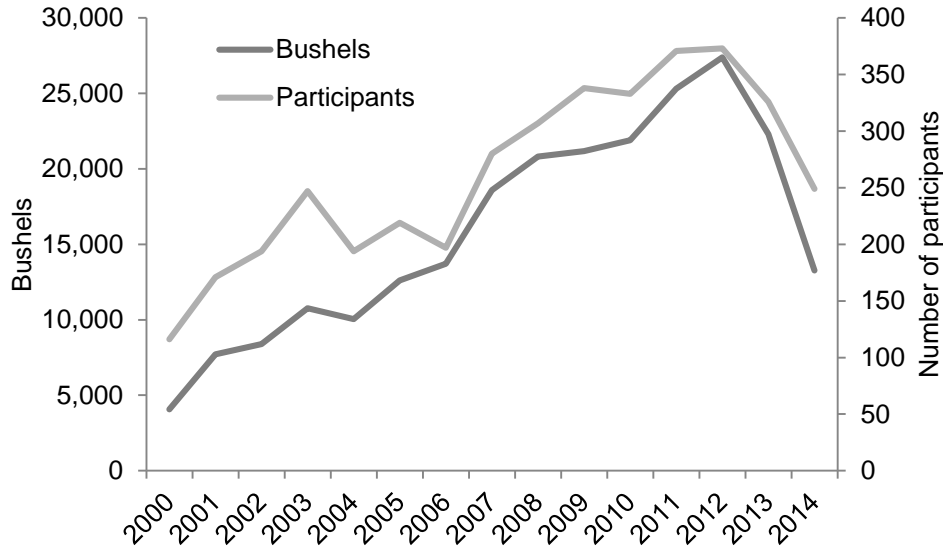


Figure 12.4.3. Number of participants and oyster bushels harvested by shellfish license holders from southern coastal counties, 2000-2014.

Shellfish such as oysters and clams are highly regulated due to three primary concerns: (1) They live in waters that can be impacted by bacterial and viral pollution; (2) molluscan shellfish filter and concentrate pathogens in their environment and; (3) consumers often eat shellfish raw or undercooked. In addition, natural occurring bacteria, such as Vibrios can become pathogenic and cause illness in those with compromised immune systems and even the general public, when temperature abused after harvest. Vibrios can be found during warmer months in areas

approved for harvest and are not associated with pollution. Shellfish are also easily cross contaminated if placed in vessel bilge water, standing water or waste in transport vehicles. The shellfish license is the most open access commercial fishing license available; however, it allows the harvest of species with the greatest potential public health threat from bacterial and viral pollution. In comparison to molluscan shellfish, only scombrotoxin fish species such as tuna, mahi, mackerels, and bluefish are associated with significant seafood illness outbreaks in the United States. This is due to temperature abuse and the formation of histamine in the flesh of these fish. The Interstate Shellfish Sanitation Program requires that all commercial shellfish harvesters and dealers receive biennial training as a pre-requisite to licensing. Dealer training will be conducted this year but training for harvesters has not occurred in North Carolina because of the logistical difficulties of implementing training for such a large group of fishermen. Work is underway to implement this training as soon as possible. Adding the requirement of additional training in order to hold a shellfish license may reduce the number of participants in the fishery thus reducing effort on the resource

The SCFL and the RSCFL are only available to an individual or business with a valid license from the previous license year or can be purchased and transferred on the open market. However, the shellfish license is available to any North Carolina resident. There are no previous license requirements to qualify for the shellfish license. If a fisherman does not possess a SCFL or RSCFL, he or she must purchase one off the open market or apply for one through an eligibility pool. The Eligibility Board then distributes licenses to persons meeting established criteria including demonstrating past involvement in commercial fishing, some degree of reliance on commercial fishing and other factors. Along with the open nature of the shellfish license availability, this license is also relatively inexpensive compared to the SCFL and RSCFL fishing licenses (Table 12.4.1).

Unlike the SCFL/RSCFL, which has a cap on the number of licenses issued, there is no cap on the number shellfish licenses. This adds to concerns about the number of fishermen participating in the shellfish fishery and impacting oyster populations. Participating in shellfish harvest with only a shellfish license is one means of gaining active participation in the commercial fishing industry and developing a history in the fishery to qualify for a SCFL/RSCFL. The shellfish license provides a way for many North Carolina fishermen to meet the criteria for obtaining a SCFL, such as building a history in the commercial fishing industry over a number of years.

There are several options to consider when addressing the ease and availability of holding a shellfish license and to lessen the impacts of users on the shellfish resource. However, it must be pointed out that any recommended changes to the license system will require statutory changes. One option to limit the number of shellfish licenses is to increase the price of the license and make it more cost prohibitive. It intentionally was priced at \$25 to allow fishermen who were unable to afford a SCFL/RSCFL to continue to fish but only in the shellfish categories. The price remained \$25 until it increased in 2014 and will increase again starting April 15, 2015 (Table 12.4.1).

When comparing license prices and requirements with Maryland, Virginia, and South Carolina, North Carolina prices are overall, considerably less (Table 12.4.4). These other states require some sort of shellfish license or use fee in addition to a commercial license unlike North Carolina who only requires a commercial license to mechanically harvest (Table 12.4.4). Maintaining the price of the shellfish license but no longer allowing harvest of oysters with only a shellfish license will also reduce effort and participation in the oyster fishery. Similar to other states, requiring a

use fee or the SCFL/RCFL with a shellfish endorsement to allow participation in the oyster fishery is another option to consider.

Table 12.4.4. Shellfish license and use fees for neighboring states (2014/15).

State	Commercial license required for shellfish	Commercial license fee	Shellfish license fee/use fee
NC	No: for hand, rakes, tongs	N/A	\$31.25 (\$50 in 2015/16)
	Yes: for mechanical	\$250 (\$400 in 2015/16)	N/A
MD	Yes	\$215	\$100: oysters \$100: clams
VA	Yes	\$190	<i>Oyster Resource Use fees:</i> \$50: hand harvest only \$50: aquaculture operation \$300: one or more gear types <i>Clam harvest licenses:</i> \$24: hand, rake, tongs \$58: single rigged patent tong boat \$84: double rigged patent tong boat \$19: hand dredge boat \$44: power dredge boat \$124: any surf clam harvest \$58: boat using a conch dredge \$51: channeled whelk with pot
SC	Yes	\$25	\$75: state shellfish grounds \$75: drag dredge \$125: other mechanical equipment

Eliminating the shellfish license and replacing it with some form of apprenticeship program and/or license as a means to enter the commercial fishing industry is another option. This system would allow an interested person to enter the industry through participation in fisheries besides the shellfish fishery, allowing that person to gain experience in multiple fisheries.

Capping the number of available shellfish licenses is another option that could be considered in the discussion of open access to shellfishing in North Carolina. The SCFL/RSCFL licenses are currently capped at 8,896 licenses with 1,257 licenses available through the eligibility pool while the shellfish license is not capped. Selection of a cap for the shellfish license could be based on the number of shellfish license that have been issued per year (Table 12.4.5). Capping the license will prevent growth in the fishery and could protect participants who have a history in the fishery.

Elimination or phasing out the shellfish license and its availability to North Carolina residents is another option to consider in the discussion of protection of shellfish populations from increase

effort and participation in the fishery due to the ease of obtaining a license. In order to fish for shellfish, the only license that would be available is the SCFL/RCFL with the shellfish endorsement. This license is more expensive and fishermen must meet requirements to obtain a license through the eligibility pool. However, because capping the license number or eliminating the shellfish license is considered a form of limited entry, these two options cannot be considered for action unless there is no other means of achieving sustainable harvest in the fishery.

Table 12.4.5. Number of shellfish licenses issued statewide per year, 2000-2014.

Year	Total of shellfish licenses Issued	Year	Total of shellfish licenses issued
2000	2,096	2008	1,704
2001	2,176	2009	2,124
2002	2,300	2010	1,999
2003	2,131	2011	2,149
2004	1,833	2012	1,770
2005	1,621	2013	1,707
2006	1,525	2014	1,425
2007	1,623		

VI. PROPOSED RULE(S)

No rule changes required based on recommendations.

VII. PROPOSED MANAGEMENT OPTIONS

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

1. Status quo
 - + Will result in no additional regulation on the fishery
 - Possible increase in number of fishermen harvesting shellfish
 - Will not result in reduced effort on the oyster resource in the southern area of the state
2. Increase the cost of the shellfish license to one-half the cost of a SCFL/RSCFL **(requires statutory change)**
 - + Will likely reduce the number of participants in the fishery
 - + Will result in no additional regulation on the fishery
 - Will increase the cost to fishermen
 - Could impact new private shellfish growers to harvest their product that are not eligible for a SCFL or RSCFL
 - Will not restrict individual increase in effort
 - Will likely reduce sales which impacts NCDMF revenue
3. Maintain the cost of the shellfish license allowing for harvest of all shellfish except oysters; require SCFL/RSCFL with a shellfish endorsement to harvest oysters **(requires statutory change)**
 - + Will likely reduce effort in the oyster fishery

- May impact new private shellfish growers who are not eligible for a SCFL or RSCFL who want to grow oysters
 - Will not restrict individual increase in effort
4. Cap the number of available shellfish licenses **(requires statutory change)**
- + Prevents growth of the fishery
 - + Protects historical participants in the fishery
 - Will not restrict individual increase in effort
 - Additional regulation
 - Could impact new private shellfish growers to harvest their product that are not eligible for a SCFL or RSCFL
 - Cannot be considered for action unless there is no other means of achieving sustainable harvest in the fishery
5. Phase out the shellfish license; allowing time for license holders to show participation to be eligible for a SCFL/RSCFL **(requires statutory change)**
- + May reduce some effort in the shellfish fishery by those interested in other fisheries
 - Will not restrict individual increase in effort
 - May increase effort in other fisheries
6. Eliminate the shellfish license and develop an apprenticeship program in place of a shellfish license **(requires statutory change)**
- + May reduce some effort in the fishery by those interested in other fisheries
 - Will not restrict individual increase in effort
 - Additional regulation
 - May eliminate participants
 - May create impacts to other fisheries
7. Eliminate the shellfish license and require a SCFL or RSCFL with a shellfish endorsement **(requires statutory change)**
- + Reduces effort in the fishery
 - Increase cost to fishermen who only have a shellfish license
 - Would require fishermen who only have a shellfish license to go through the eligibility pool application process to obtain a SCFL
 - Could impact all private shellfish growers that are not eligible for a SCFL or RSCFL
 - Cannot be considered for action unless there is no other means of achieving sustainable harvest in the fishery
 - Impacts all shellfish fisheries

VIII. RECOMMENDATION

MFC Selected Management Strategy

- Pursue elimination of the Shellfish License for oysters only and require all oyster harvesters to have a Standard or Retired Commercial Fishing License with shellfish endorsement to harvest commercially **(requires statutory change)**
- Maintain the cost of the Shellfish License, establish a daily limit of 2 bushels of oysters per person with a maximum of 4 bushels of oysters per vessel off public bottom with the Shellfish License
- Allow Shellfish License holders to be eligible to acquire a Standard Commercial Fishing License after they show a history of sale of shellfish. Continue to allow commercial harvest of all other shellfish as currently allowed

NCDMF

- Maintain the cost of the shellfish license allowing for harvest of all shellfish except oysters; require Standard/Retired Commercial Fishing License with a shellfish endorsement to harvest oysters from public bottom (**requires statutory change**)
- From Highway 58 Bridge south to NC/SC state line, maintain a daily trip limit of 2 bushels of oysters per person maximum 4 bushels of oysters per vessel off public bottom for holders of the Shellfish License. Maintain the daily trip limit at 5 bushels of oysters per person for Standard/Retired Commercial Fishing License holders in the southern region

Advisory Committee

- From Swan Point Marina south to the NC/SC state line, maintain a daily trip limit of two bushels of oyster per person maximum and four bushels of oysters per vessel off public bottom for holders of the Shellfish License. Maintain the daily trip limit at five bushels of oysters per person for SCFL and RSCFL holders in the southern area.
- Allow Shellfish License holders to be eligible to acquire a SCFL after they show a history of sale of shellfish

Prepared by: Trish Murphey, Trish.Murphey@ncdenr.gov, 252-808-8091
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12.5 PROTECTION OF SHELLFISH LEASE AND FRANCHISE RIGHTS¹⁰

February 18, 2016

I. ISSUE

Shellfish growers are concerned about the amount of money they invest in the planting and growing of clams and oysters in bottom culture and water column leases compared to the amount of money an individual would be fined if found guilty of taking shellfish from a private culture operation. They feel stricter penalties are needed to assist in reducing lease theft and helping discourage those practices.

II. ORIGINATION

NC Shellfish Growers Association brought this issue to the attention of the NCDMF staff on March 25, 2013.

III. BACKGROUND

In North Carolina the private culture of shellfish is conducted on shellfish leases and franchises. A shellfish lease or franchise provides the opportunity for citizens of North Carolina to hold an area of public estuarine bottom for the commercial production and harvest of shellfish if certain conditions are met. Grow out options for both bottom culture and water column exist. Bottom culture refers to shellfish grown on or within the estuarine bottom utilizing natural set, cultch planting, seed plantings or seed within single predator protection bags bedded in the bottom. In operations utilizing the water column, shellfish can be grown in gear which resides from the estuarine bottom to the water surface. In order to use the water column, a bottom lease with a water column amendment is required.

In recent years, the number of private culture operations using water column leases has increased. Table 12.5.1 shows the number of water column leases by year from 2003 through 2014.

¹⁰ Presented to: PDT on 11/6/14, 2/5/15, 8/13/15, & 1/7/16; AC on 12/8/14 & 1/4/16, 3/9/15 & 9/14/15; Rules Subcommittee on 1/12/15; RAT on 1/29/15, 4/1/15, & 10/1/15; MRT on 9/21/15 & 1/11/16; MFC on 11/20/15 and 2/18/16.

Table 12.5.1. Number and acreage of active water column leases by year, 2003 to 2014. Data from the Fisheries Information Network as of 9/15/2014.

Year	Number of water column leases	Acreage
2003	3	10.0
2004	3	10.0
2005	3	10.0
2006	3	10.0
2007	5	13.0
2008	4	12.5
2009	3	8.2
2010	3	8.2
2011	3	8.2
2012	7	25.2
2013	13	43.6
2014	24	70.3

Over 90 percent of all shellfish lease applications from 2012-2014 have been for shellfish culture within the water column. Growing shellfish in the water column requires a substantial amount of investment in gear, as well as the initial investment in seed shellfish. With bottom culture in North Carolina, there is no need for gear on most shellfish leases; growers utilize natural spat for the growth of their product. As of 9/15/2014, there were 24 authorized water column lease locations in North Carolina with an additional 4 water column lease applications pending approval. There is a substantial cost to the owners of these leases in the start-up and maintenance of their product and gear. The investment in aquaculture gear and seed to grow out one million oysters in the water column can cost \$50,000 or more (Brian Conrad, NCDMF, personal communication, October 2014).

Estimated water column lease start-up costs for 2013-2014 are:

- Seed cost: one-million 8-15mm seed = \$15,000; one million 15-30mm seed = \$30,000
- Floating bag method: long line system for one million oysters (grow out bags, ground tackle/line, buoys, associated gear): \$40,000; bottom cage method 700 cages for one million oysters at \$80-\$150/each = \$56,000-\$105,000
- Bottom stackable trays: no quotable prices readily available
- Optional floating upweller: \$3,000-\$10,000

(Brian Conrad, NCDMF, personal communication, October 2014)

Due to the cost of maintaining these private culture operations, one of the biggest concerns of shellfish growers is theft of gear and shellfish product from their grow-out location. The issue of theft is not just an issue for water column operations. Bottom culture operations have the same concern. These shellfish growers buy seed and plant on their site for future growth. Some will even transplant both oysters and clams from polluted areas, either by doing it themselves or by paying commercial fisherman to relay during the relay season. Due to the cost of the seed, relaying shellfish, and paying for assistance, these bottom culture growers have significant time and money invested as well, though not as extensive as growers with water column operations.

Currently there are two statutes that deal with larceny of shellfish from private bottom and damage to an aquaculture facility or operation:

G.S. 113-208 Protection of private shellfish rights.

G.S. 113-269 Robbing or injuring hatcheries and other aquaculture operations.

The pertinent part of G.S 113-208 is:

- (a) (2) When the area has been regularly posted and identified and the person knew the area to be the subject of private shellfish rights. A violation of this section shall constitute a Class A1 misdemeanor, which may include a fine of not more than five thousand dollars (\$5,000). The written authorization shall include the lease number or deed reference, name and address of authorized person, date of issuance, and date of expiration, and it must be signed by the holder of the private shellfish right. Identification signs shall include the lease number or deed reference and the name of the holder. (a) (2)

If an individual is convicted of this statute he/she would be guilty of a Class A1 misdemeanor, which may include a fine up to \$5,000. Despite the maximum penalty, the actual fine is ultimately up to the discretion of the individual judge. As shown in Table 2, the average fine over a 20-year period for conviction of taking shellfish from private shellfish bottom is less than \$25. The threat of a fine up to \$5,000 has done little to deter violators from stealing shellfish from leaseholders.

Table 12.5.2 reflects the citations, convictions, and fines issued to individuals for taking shellfish from leases without authorization (under G.S 113-208). The table covers a period of 21 years from 1994 to 2014.

Table 12.5.2. Number of citations, convictions and average fines for violations of G.S.113-208, 1994-2014.

Year	Citations issued	*Convictions	Average fine (\$)
1994	5	4	50.00
1995	2	2	50.00
1996	0	0	0
1997	5	4	31.25
1998	8	4	18.75
1999	2	1	25.00
2000	0	0	0
2001	4	4	42.50
2002	4	3	58.30
2003	4	3	16.67
2004	1	1	0
2005	4	4	25.00
2006	2	1	0
2007	3	3	0
2008	0	0	0
2009	1	1	0
2010	3	3	53.33
2011	0	0	0
2012	1	1	0
2013	0	0	0
2014	0	0	0
Total	49	39	\$24.72

*Of the 49 individuals issued citations, 39 individuals were found guilty, nine had their cases dismissed and one was found not guilty.

G.S. 113-269, Robbing or injuring hatcheries and other aquaculture operations is pertinent to this issue because it gives Marine Patrol officers the ability to charge a subject who willfully destroys or injures an aquaculture operation, whereas G.S. 113-208 would only allow an officer to make a charge when someone steals shellfish from a lease or franchise. However, the current G.S. 113-269 does not provide protection for shellfish leases or franchises that do not have water column amendments.

G.S. 113-269 (b) makes it unlawful for someone to steal species from an aquaculture facility and (c) makes it unlawful for someone to receive or possess stolen species from an aquaculture facility. G.S. 113-269 (d) makes it unlawful for someone to willfully destroy or injure an aquaculture facility which would include shellfish leases franchises that qualify as an aquaculture operation.

G.S. 113-269 (e) establishes the penalty section for those guilty of section (b) or (c) and establishes a dollar value for those subjects who exceed the amount of \$400 dollars to be punished under G.S. 14-72. G.S. 14-72 is the statute that corresponds with all larceny charges; consisting of larceny of property, receiving stolen goods or possessing stolen goods in the State of North Carolina. Part of G.S. 14-72 reads:

- (a) Larceny of goods of the value of more than one thousand dollars (\$1,000) is a Class H felony. The receiving or possessing of stolen goods of the value of more than one thousand dollars (\$1,000) while knowing or having reasonable grounds to believe that the goods are stolen is a Class H felony. Larceny as provided in subsection (b) of this section is a Class H felony. Receiving or possession of stolen goods as provided in subsection (c) of this section is a Class H felony. Except as provided in subsections (b) and (c) of this section, larceny of property, or the receiving or possession of stolen goods knowing or having reasonable grounds to believe them to be stolen, where the value of the property or goods is not more than one thousand dollars (\$1,000), is a Class 1 misdemeanor. In all cases of doubt, the jury shall, in the verdict, fix the value of the property stolen.

The MFC also has a rule, 15A NCAC 03O .0114 that outlines the suspension, revocation, and reissuance of licenses steps that can be taken by the Fisheries Director for certain violations. This rule could be amended to include convictions under G.S. 113-269 and G.S. 113-208 and apply suspensions or revocations of licenses to violations incurred on shellfish leases and franchises. It is under the authority of the Marine Fisheries Commission and would not require statute changes.

IV. AUTHORITY

N.C. General Statutes

14-72	Larceny of property; receiving stolen goods or possessing stolen goods.
113-201.1	Definitions
113-202	New and renewal leases for shellfish cultivation; termination of leases issued prior to January 1, 1966
113-202.1	Water column leases for aquaculture
113-202.2	Water column leases for aquaculture for perpetual franchises.
113-208	Protection of private shellfish rights
113-269	Robbing or injuring hatcheries and other aquaculture operations

N.C. Marine Fisheries Commission Rules May 1, 2015 (15A NCAC)

03O .0114	Suspension, revocation, and reissuance of license
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V. DISCUSSION

Shellfish growers have expressed the need for stricter penalties to discourage theft from shellfish lease and franchises. One option to deter the problem would be to modify G.S. 113-208 to establish a minimum fine of \$250 for the first violation and a minimum fine of \$500 for any second or subsequent violations within three years after the date of the first violation, while retaining the \$5,000 maximum penalty limit. This change would be more of a deterrent than the potential threat of a fine up to \$5,000. The average fine in a twenty-year period has been less than \$25, which is much less than the potential loss incurred by the shellfish grower (Table 2). By establishing minimum fines in the amounts proposed, this would be a deterrent to potential violators compared to the unused escalating fine scale.

G.S. 113-269 could also be modified so that all leases and franchises that meet the definition of an aquaculture facility in accordance with G.S. 106-758 would be included in this statute, and not just those shellfish leases with water column amendments as is currently the case. The following modification to subsection (e) in G.S. 113-269 is also suggested: Increase the four hundred dollar (\$400.00) limit restriction to \$1,000 as it is punishable under G.S 14-72 which carries a \$1,000 limit restriction. This change would be consistent with the dollar amount established in G.S 14-72. In G.S 14-72, when the value of the goods stolen is greater than \$1,000, the violation becomes a Class H felony. If the value is less than \$1,000 the class of misdemeanor should be changed from a Class 1 to a Class A1 misdemeanor. This change in misdemeanor class would bring consistency for other individuals convicted under G.S 113-187.

A minimum fine of \$250 for the first violation and a minimum fine of \$500 for any and all subsequent violations within three years after the date of the first violation should be established for misdemeanor violations. A maximum fine up to \$5,000 should also be added to be consistent with proposed changes to G.S. 113-208. In subsection (f) the class of misdemeanor should be changed from a Class 1 misdemeanor to a Class A1 misdemeanor and a minimum penalty should be established for violations in subsection (d) consistent with proposed penalty changes in subsection (e) of G.S. 113-269. By establishing a minimum fine in the amounts proposed, this would be a greater deterrent to potential violators compared to the threat of an escalating scale that has never approached maximum.

Another option to deter potential violators and put in place stricter penalties is to amend 15A NCAC 03O .0114(c). As this rule is currently written, if a subject is convicted of G.S 113-208 or G.S 113-269 and does not have any marine fisheries convictions within the previous three years, that person would not be subject to any potential license suspensions. There are five options for amending this rule to keep it consistent with other license suspension penalties.

- a. For a first conviction under G.S 113-208 or G.S 113-269, the Fisheries Director shall consider this as a conviction of two separate offenses on different occasions for license suspension or revocation purposes. With this amendment, a subject convicted of G.S 113-208 or G.S 113-269 would have his fishing license suspended on the first conviction for thirty (30) days.
- b. For a first conviction under G.S 113-208 or G.S 113-269 the Fisheries Director shall consider this as a conviction of three separate offenses on different occasions for license suspension or revocation purposes. With this amendment, a subject convicted of G.S 113-208 or G.S 113-269 would have his fishing license suspended for ninety (90) days.
- c. For a conviction under G.S 113-208 or G.S 113-269 the Fisheries Director shall suspend all licenses issued to the licensee for a period of one year.
- d. For a first conviction under G.S 113-208 or G.S 113-269 the Fisheries Director shall suspend all licenses issued to the licensee for a period of one year; for a second or

subsequent conviction, the Fisheries Director shall revoke all licenses issued to the licensee.

- e. For a first conviction under G.S 113-208 or G.S 113-269, the Fisheries Director shall revoke all licenses issued to the licensee. With this amendment, a subject convicted of G.S 113-208 or G.S 113-269 would have his fishing license revoked.

Summary of Proposed Rule Options for 15A NCAC 03O .0114

#	Result of option	. . . and . . .	Comparable to conviction of . . .
1.	Conviction of G.S. 113-208 or 113-269 treated as two separate offenses	30-day suspension for first violation	
2.	Conviction of G.S. 113-208 or 113-269 treated as three separate offenses	90-day suspension for first violation	
3.	Conviction of G.S 113-208 or 113-269: one-year license suspension		G.S. 14-399, felony littering
4.	First conviction of G.S. 113-208 or 113-269: one-year license suspension	Additional conviction: license revocation for minimum of one year	G.S. 113-187(d)(1), taking shellfish from polluted areas
5.	Conviction of G.S. 113-208 or 113-269 results in license revocation for minimum of one year		G.S. 113-209, taking shellfish from polluted areas at night or second or subsequent conviction of 113-187(d)(1) within preceding two years

#	Suspension/Revocation Exceptions *	Schedule	Type of Violation
1.	Conviction treated as two separate offenses		Theft from shellfish lease or robbing or injuring hatcheries or aquaculture facilities**
2.	Conviction treated as three separate offenses		Theft from shellfish lease or robbing or injuring hatcheries or aquaculture facilities**
3.	One-year license suspension		-Felony littering; -Theft from shellfish lease or robbing or injuring hatcheries or aquaculture facilities**
4.	First conviction: one-year suspension; second or subsequent conviction: revocation for minimum of one year		-Taking shellfish from polluted waters; -Theft from shellfish lease or robbing or injuring hatcheries or aquaculture facilities**
5.	License revocation for minimum of one year		-Taking shellfish from polluted waters at night or second conviction or taking shellfish from polluted waters within preceding two years; -Theft from shellfish lease or robbing or injuring hatcheries or aquaculture facilities**
N/A	License revocation for minimum of two years		Assault on marine patrol officer

*Instead of 30-day suspension from second conviction, 90-day suspension from third conviction, and one-year revocation from fourth or subsequent conviction

**Dependent upon proposed option selected for change to 15A NCAC 03O .0114

VI. SUGGESTED STATUTORY CHANGES AND PROPOSED RULE CHANGE

MFC Selected Management Strategy:

A statutory change is proposed with the following example used to show intent.

G.S. 113-208. Protection of private shellfish rights. [Example only]

- (a) It is unlawful for any person, other than the holder of private shellfish rights, to take or attempt to take shellfish from any privately leased, franchised, or deeded shellfish bottom area without written authorization of the holder and with actual knowledge it is a private shellfish bottom area. Actual knowledge will be presumed when the shellfish are taken or attempted to be taken:
- (1) From within the confines of posted boundaries of the area as identified by signs, whether the whole or any part of the area is posted, or
 - (2) When the area has been regularly posted and identified and the person knew the area to be the subject of private shellfish rights. A violation of this section ~~shall constitute~~ is guilty of a Class A1 misdemeanor, ~~which may include a fine of not more than five thousand dollars (\$5,000); punishable by a fine of not less than five hundred dollars (\$500.00) nor more than five thousand dollars (\$5,000.00). Any second or subsequent violations of this section within three years after the date of a prior violation is guilty of a Class A1 misdemeanor punishable by a fine of not less than one thousand dollars (\$1,000.00) nor more than five thousand dollars (\$5,000.00).~~

The written authorization shall include the lease number or deed reference, name and address of authorized person, date of issuance, and date of expiration, and it must be signed by the holder of the private shellfish right. Identification signs shall include the lease number or deed reference and the name of the holder.

- (b) The prosecutor shall dismiss any case brought for a violation of this section if the defendant produces a notarized written authorization in conformance with subsection (a) which states that the defendant had permission to take oysters or clams from the leased area at the time of the alleged violation; except the prosecutor may refuse to dismiss the case if he has reason to believe that the written authorization is fraudulent. (1979, c. 537; 1987, c. 463; 1989, c. 281, s. 2; 1993, c. 539, s. 842; 1994, Ex. Sess., c. 24, s. 14(c); 1998-225, s. 3.7.)

A statutory change is proposed with the following example used to show intent.

G.S. 113-269. Robbing or injuring hatcheries, leases, franchises and other aquaculture ~~operations~~ facilities. [Example only]

- (a) The definitions established in G.S. 106-758 are incorporated by reference into this section. ~~For the purposes of this section, a shellfish lease issued pursuant to G.S. 113-202 is defined as an aquaculture facility only when it has been amended pursuant to G.S. 113-202.1 to authorize use of the water column and when it is or has been regularly posted and identified in accordance with the rules of the Marine Fisheries Commission.~~
- (b) It is unlawful for any person without the authority of the owner of an aquaculture facility to take fish or aquatic species being cultivated or reared by the owner from an aquaculture facility.
- (c) It is unlawful for any person to receive or possess fish or aquatic species stolen from an aquaculture facility while knowing or having reasonable grounds to believe that the fish or aquatic species are stolen.
- (d) It is unlawful for any person to willfully destroy or injure an aquaculture facility or aquatic species being reared in an aquaculture facility.
- (e) Violation of subsections (b) or (c) for fish or aquatic species valued at more than ~~four hundred dollars (\$400.00)~~ one thousand dollars (\$1,000.00) is punishable under G.S. 14-72. Violation of subsections (b) or (c) for fish or aquatic species valued at ~~four hundred dollars (\$400.00)~~ one thousand (\$1,000.00) or less is a Class ~~A1~~ misdemeanor punishable by a fine of not less than five hundred dollars (\$500.00) nor more than five thousand dollars (\$5,000.00). Any second or subsequent violations of this section within three years after the date of a prior violation is guilty of a Class A1 misdemeanor punishable by a fine of not less than one thousand dollars (\$1,000.00) nor more than five thousand dollars (\$5,000.00).
- (f) Violation of subsection (d) is a Class ~~A1~~ misdemeanor punishable by a fine of not less than five hundred dollars (\$500.00) nor more than five thousand dollars (\$5,000.00). Any second or subsequent violations of

this section within three years after the date of a prior violation is guilty of a Class A1 misdemeanor punishable by a fine of not less than one thousand dollars (\$1,000.00) nor more than five thousand dollars (\$5,000.00).

- (g) In deciding to impose any sentence other than an active prison sentence, the sentencing judge shall consider and may require, in accordance with G.S. 15A-1343, restitution to the victim for the amount of damage to the aquaculture facility or aquatic species or for the value of the stolen fish or aquatic species.
- (h) The district attorney shall dismiss any case brought pursuant to subsections (b) and (c) if defendant produces a notarized written authorization for taking fish or aquatic species from the aquaculture facility or if the fish or aquatic species taken from a shellfish lease aquaculture facility was not a shellfish authorized for cultivation on the lease. (1989, c. 281, s. 1; 1993, c. 539, ss. 850, 851; 1994, Ex. Sess., c. 24, s. 14(c).)

The following statute is provided only as a reference for G.S 113-269. No changes are proposed.

G.S. 106-758. Definitions.

In addition to the definitions in G.S. 113-129, the following definitions shall apply as used in this Article,

- (1) "Aquaculture" means the propagation and rearing of aquatic species in controlled or selected environments, including, but not limited to, ocean ranching;
- (2) "Aquaculture facility" means any land, structure or other appurtenance that is used for aquaculture, including, but not limited to, any laboratory, hatchery, rearing pond, raceway, pen, incubator, or other equipment used in aquaculture;
- (3) "Aquatic species" means any species of finfish, mollusk, crustacean, or other aquatic invertebrate, amphibian, reptile, or aquatic plant, and including, but not limited to, "fish" and "fishes" as defined in G.S. 113-129(7);
- (4) "Commissioner" means the Commissioner of Agriculture;
- (5) "Department" means the North Carolina Department of Agriculture and Consumer Services. (1989, c. 752, s. 147; 1993, c. 18, s. 1; 1997-261, s. 71.)

The following statute is provided only as a reference for G.S 113-269. No changes are proposed.

G.S. 14-72. Larceny of property; receiving stolen goods or possessing stolen goods.

- (a) Larceny of goods of the value of more than one thousand dollars (\$1,000) is a Class H felony. The receiving or possessing of stolen goods of the value of more than one thousand dollars (\$1,000) while knowing or having reasonable grounds to believe that the goods are stolen is a Class H felony. Larceny as provided in subsection (b) of this section is a Class H felony. Receiving or possession of stolen goods as provided in subsection (c) of this section is a Class H felony. Except as provided in subsections (b) and (c) of this section, larceny of property, or the receiving or possession of stolen goods knowing or having reasonable grounds to believe them to be stolen, where the value of the property or goods is not more than one thousand dollars (\$1,000), is a Class 1 misdemeanor. In all cases of doubt, the jury shall, in the verdict, fix the value of the property stolen.
- (b) The crime of larceny is a felony, without regard to the value of the property in question, if the larceny is any of the following:
 - (1) From the person.
 - (2) Committed pursuant to a violation of G.S. 14-51, 14-53, 14-54, 14-54.1, or 14-57.
 - (3) Of any explosive or incendiary device or substance. As used in this section, the phrase "explosive or incendiary device or substance" shall include any explosive or incendiary grenade or bomb; any dynamite, blasting powder, nitroglycerin, TNT, or other high explosive; or any device, ingredient for such device, or type or quantity of substance primarily useful for large-scale destruction of property by explosive or incendiary action or lethal injury to persons by explosive or incendiary action. This definition shall not include fireworks; or any form, type, or quantity of gasoline, butane gas, natural gas, or any other substance having explosive or incendiary properties but serving a legitimate nondestructive or nonlethal use in the form, type, or quantity stolen.
 - (4) Of any firearm. As used in this section, the term "firearm" shall include any instrument used in the propulsion of a shot, shell or bullet by the action of gunpowder or any other explosive substance within it. A "firearm," which at the time of theft is not capable of being fired, shall be included within this definition if it can be made to work. This definition shall not include air rifles or air pistols.

- (5) Of any record or paper in the custody of the North Carolina State Archives as defined by G.S. 121-2(7) and G.S. 121-2(8).
- (6) Committed after the defendant has been convicted in this State or in another jurisdiction for any offense of larceny under this section, or any offense deemed or punishable as larceny under this section, or of any substantially similar offense in any other jurisdiction, regardless of whether the prior convictions were misdemeanors, felonies, or a combination thereof, at least four times. A conviction shall not be included in the four prior convictions required under this subdivision unless the defendant was represented by counsel or waived counsel at first appearance or otherwise prior to trial or plea. If a person is convicted of more than one offense of misdemeanor larceny in a single session of district court, or in a single week of superior court or of a court in another jurisdiction, only one of the convictions may be used as a prior conviction under this subdivision; except that convictions based upon offenses which occurred in separate counties shall each count as a separate prior conviction under this subdivision.
- (c) The crime of possessing stolen goods knowing or having reasonable grounds to believe them to be stolen in the circumstances described in subsection (b) is a felony or the crime of receiving stolen goods knowing or having reasonable grounds to believe them to be stolen in the circumstances described in subsection (b) is a felony, without regard to the value of the property in question.
- (d) Where the larceny or receiving or possession of stolen goods as described in subsection (a) of this section involves the merchandise of any store, a merchant, a merchant's agent, a merchant's employee, or a peace officer who detains or causes the arrest of any person shall not be held civilly liable for detention, malicious prosecution, false imprisonment, or false arrest of the person detained or arrested, when such detention is upon the premises of the store or in a reasonable proximity thereto, is in a reasonable manner for a reasonable length of time, and, if in detaining or in causing the arrest of such person, the merchant, the merchant's agent, the merchant's employee, or the peace officer had, at the time of the detention or arrest, probable cause to believe that the person committed an offense under subsection (a) of this section. If the person being detained by the merchant, the merchant's agent, or the merchant's employee, is a minor under the age of 18 years, the merchant, the merchant's agent, or the merchant's employee, shall call or notify, or make a reasonable effort to call or notify the parent or guardian of the minor, during the period of detention. A merchant, a merchant's agent, or a merchant's employee, who makes a reasonable effort to call or notify the parent or guardian of the minor shall not be held civilly liable for failing to notify the parent or guardian of the minor. (1895, c. 285; Rev., s. 3506; 1913, c. 118, s. 1; C.S., s. 4251; 1941, c. 178, s. 1; 1949, c. 145, s. 2; 1959, c. 1285; 1961, c. 39, s. 1; 1965, c. 621, s. 5; 1969, c. 522, s. 2; 1973, c. 238, ss. 1, 2; 1975, c. 163, s. 2; c. 696, s. 4; 1977, c. 978, ss. 2, 3; 1979, c. 408, s. 1; c. 760, s. 5; 1979, 2nd Sess., c. 1316, ss. 11, 47; 1981, c. 63, s. 1; c. 179, s. 14; 1991, c. 523, s. 2; 1993, c. 539, s. 34; 1994, Ex. Sess., c. 24, s. 14(c); 1995, c. 185, s. 2; 2006-259, s. 4(a); 2012-154, s. 1.)

The following statute is provided only as a reference for G.S 113-269. No changes are proposed.

G.S. 15A-1340.23. Punishment limits for each class of offense and prior conviction level.

- (a) Offense Classification; Default Classifications. - The offense classification is as specified in the offense for which the sentence is being imposed. If the offense is a misdemeanor for which there is no classification, it is as classified in G.S. 14-3.
- (b) Fines. - Any judgment that includes a sentence of imprisonment may also include a fine. Additionally, when the defendant is other than an individual, the judgment may consist of a fine only. If a community punishment is authorized, the judgment may consist of a fine only. Unless otherwise provided for a specific offense, the maximum fine that may be imposed is two hundred dollars (\$200.00) for a Class 3 misdemeanor and one thousand dollars (\$1,000) for a Class 2 misdemeanor. The amount of the fine for a Class 1 misdemeanor and a Class A1 misdemeanor is in the discretion of the court.
- (c) Punishment for Each Class of Offense and Prior Conviction Level; Punishment Chart Described. - Unless otherwise provided for a specific offense, the authorized punishment for each class of offense and prior conviction level is as specified in the chart below. Prior conviction levels are indicated by the Roman numerals placed horizontally on the top of the chart. Classes of offenses are indicated by the Arabic numbers placed vertically on the left side of the chart. Each grid on the chart contains the following components:

- (1) A sentence disposition or dispositions: "C" indicates that a community punishment is authorized; "I" indicates that an intermediate punishment is authorized; and "A" indicates that an active punishment is authorized; and
- (2) A range of durations for the sentence of imprisonment: any sentence within the duration specified is permitted.

MISDEMEANOR OFFENSE CLASS	PRIOR CONVICTION LEVELS		
	LEVEL I No Prior Convictions	LEVEL II One to Four Prior Convictions	LEVEL III Five or More Prior Convictions
A1	1-60 days C/I/A	1-75 days C/I/A	1-150 days C/I/A
1	1-45 days C	1-45 days C/I/A	1-120 days C/I/A
2	1-30 days C	1-45 days C/I	1-60 days C/I/A
3	1-10 days C	1-15 days C if one to three prior convictions 1-15 days C/I if four prior convictions	1-20 days C/I/A.

- (d) Fine Only for Certain Class 3 Misdemeanors. - Unless otherwise provided for a specific offense, the judgment for a person convicted of a Class 3 misdemeanor who has no more than three prior convictions shall consist only of a fine. (1993, c. 538, s. 1; 1994, Ex. Sess., c. 24, s. 14(b); 1995, c. 507, s. 19.5(g); 2013-360, s. 18B.13(a).)

PROPOSED RULE CHANGE FOR 15A NCAC 030 .0114

15A NCAC 030 .0114 SUSPENSION, REVOCATION AND REISSUANCE OF LICENSES

(a) All commercial and recreational licenses issued under Article 14A, Article 14B, and Article 25A of Chapter 113 are subject to suspension and revocation.

(b) A conviction resulting from being charged by an inspector under G.S. 14-32, 14-33 or 14-399 shall be deemed a conviction for license suspension or revocation purposes.

(c) Upon receipt of notice of a licensee's conviction as specified in G.S. 113-171 or a conviction as specified in Paragraph (b) of this Rule, the Fisheries Director shall determine whether it is a first, a second, a third or a fourth or subsequent conviction. Where several convictions result from a single transaction or occurrence, the convictions shall be treated as a single conviction so far as suspension or revocation of the licenses of a licensee is concerned. For a second conviction, the Fisheries Director shall suspend all licenses issued to the licensee for a period of 30 days; for a third conviction, the Fisheries Director shall suspend all licenses issued to the licensee for a period of 90 days; for a fourth or subsequent conviction, the Fisheries Director shall revoke all licenses issued to the licensee, except:

- (1) For a felony conviction under G.S. 14-399, the Fisheries Director shall suspend all licenses issued to the licensee for a period of one year;
- (2) For a first conviction under G.S. 113-187(d)(1), the Fisheries Director shall suspend all licenses issued to the licensee for a period of one year; for a second or subsequent conviction under G.S. 113-187(d)(1), the Fisheries Director shall revoke all licenses issued to the licensee;
- (3) For a conviction under G.S. 113-208, 113-209, or 113-269, the Fisheries Director shall revoke all licenses issued to the licensee; and
- (4) For a conviction under G.S. 14-32 or 14-33, when the offense was committed against a marine fisheries inspector the Fisheries Director shall revoke all licenses issued to the licensee; the former licensee shall not be eligible to apply for reinstatement of a revoked license or for any additional license authorized in Article 14A, Article 14B and Article 25A of Chapter 113 for a period of two years.

(d) After the Fisheries Director determines a conviction requires a suspension or revocation of the licenses of a licensee, the Fisheries Director shall cause the licensee to be served with written notice of suspension or revocation. The written notice may be served upon any responsible individual affiliated with the corporation, partnership, or association where the licensee is not an individual. The notice of suspension or revocation shall be served by an inspector or other agent

of the Department or by certified mail, must state the ground upon which it is based, and takes effect immediately upon service. The agent of the Fisheries Director making service shall then or subsequently, as may be feasible under the circumstances, collect all license certificates and plates and other forms or records relating to the license as directed by the Fisheries Director.

(e) Where a license has been suspended, the former licensee shall not be eligible to apply for reissuance of license or for any additional license authorized in Article 14A, Article 14B and Article 25A of Chapter 113 during the suspension period. Licenses shall be returned to the licensee by the Fisheries Director or the Director's agents at the end of a period of suspension.

(f) Where a license has been revoked, the former licensee shall not be eligible to apply for reinstatement of a revoked license or for any additional license authorized in Article 14A, Article 14B and Article 25A of Chapter 113 for a period of one year, except as provided in Paragraph (c)(4) of this Rule. For a request for reinstatement following revocation, the eligible former licensee shall satisfy the Fisheries Director that the licensee will strive in the future to conduct the operations for which the license is sought in accord with all applicable laws and rules by sending a request for reinstatement in writing to the Fisheries Director, Division of Marine Fisheries, P.O. Box 769, Morehead City, North Carolina 28557. Upon the application of an eligible former licensee after revocation, the Fisheries Director may issue one license sought but not another, as deemed necessary to prevent the hazard of recurring violations of the law.

(g) A licensee shall not willfully evade the service prescribed in this Rule.

*History Note: Authority G.S. 113-168.1; 113-171; S.L. 2010-145;
Eff. October 1, 2012;
Amended Eff. May 1, 2017.*

VII. PROPOSED MANAGEMENT OPTIONS

(+potential positive impact of action)

(-potential negative impact of action)

1. Status quo (Continue classifying larceny of shellfish from private bottom and damage to property from an aquaculture facility or operation as a Class A1 misdemeanor, which may include a fine of not more than \$5,000)
 - + No statutory change required
 - Continues fines with minimal deterrent to potential violators
 - Lease holders continue to have product stolen off shellfish leases and franchises
 - Does not provide protection for shellfish leases or franchises that do not have water column amendments under G.S 113-269.
2. Support modification of G.S 113-208 and G.S 113-269 to add minimum fines for violations on shellfish leases and franchises (**requires statutory change**)
 - + Setting minimum fines will potentially be a deterrent to violators
 - + Statutes will be brought into alignment with each other for fines
 - Does not provide fines for violations on shellfish leases and franchise that do not have water column amendments under G.S 113-269.
 - Statutory changes would be required
3. Support modification of G.S 113-269 to include protection to all shellfish leases and franchises, not just those with water column amendments (**requires statutory change**)
 - + Consistency in enforcement for all types of shellfish leases and franchises
 - + Provides fines for violations on shellfish leases and franchises that do not have water column amendments
 - Statutory changes would be required

4. Modify Rule 15A NCAC 03O .0114 so that convictions under G.S. 113-208 or G.S. 113-269 would count as more than one conviction for license suspension or revocation purposes (**rule change required**)
- + No statutory change required
 - + Potential deterrent to violators
 - + A means to stricter penalties for violations to shellfish leases and franchises

VIII. RECOMMENDATION

MFC Selected Management Strategy

- Support modification of G.S. 113-208 and G.S. 113-269 to add minimum fines for violations on shellfish leases and franchises. With minimum fines set at \$500 for the first violation and \$1,000 for the second violation (**requires statutory change**).
- Support modification of G.S. 113-269 to include protection to all shellfish leases and franchises, not just those with water column amendments (**requires statutory change**).
- Modify Rule 15A NCAC 03O .0114, regardless whether statute changes occur, so that a first conviction under G.S. 113-208 or G.S. 113-269 the Fisheries Director shall revoke all licenses issued to the licensee (**rule change required**).

NCDMF and Advisory Committee

- Support modification of G.S. 113-208 and G.S. 113-269 to add minimum fines for violations on shellfish leases and franchises. With minimum fines set at \$500 for the first violation and \$1,000 for the second violation (**requires statutory change**).
- Support modification of G.S. 113-269 to include protection to all shellfish leases and franchises, not just those with water column amendments (**requires statutory change**).
- Modify Rule 15A NCAC 03O .0114, regardless whether statute changes occur, so that a first conviction under G.S. 113-208 or G.S. 113-269 the Fisheries Director shall revoke all licenses issued to the licensee (**rule change required**).

Prepared by: Major Dean Nelson, forrest.nelson@ncdenr.gov, 252-808-8133
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March 23, 2015
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October 1, 2015
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12.6 UTILIZING GPS COORDINATES INSTEAD OF A SURVEY TO DEFINE SHELLFISH LEASE BOUNDARIES¹¹

The following issue was removed from the Hard Clam FMP Amendment 2 and Oyster FMP Amendment 4 for further development due to the passage of Session Law 2015-241 on Sept. 18, 2015 and instead was placed in Appendix 15.4 to maintain the history of its development. Section 14.10 (a) of the Session Law amended G.S. 113-202 (i) to provide that after a lease application is approved by the NCDEQ Secretary the lease applicant shall submit to the NCDEQ Secretary information that conforms to the standards set by the NCDEQ Secretary for the marked boundaries of the lease and the marking may be based on information produced using a device equipped to receive global positioning system data.

12.7 DEFINING ADVERSE IMPACTS TO SUBMERGED AQUATIC VEGETATION FROM SHELLFISH LEASES AND FRANCHISES¹²

February 18, 2016

I. ISSUE

Shellfish lease applicants have been denied proposed shellfish lease locations by the NCDMF due to the presence of SAV on the proposed site. The Regional Conditions of the USACE Nationwide Permit 48 (NWP 48) do not allow for any adverse effects to SAV.

II. ORIGINATION

This issue was brought forward by the NCSGA on March 25, 2013.

III. BACKGROUND

The North Carolina Shellfish Growers Association brought forward concerns regarding the denial of proposed shellfish lease locations due to the presence of SAV. Currently, all shellfish leases and aquaculture activities in North Carolina are permitted under USACE NWP 48 for Shellfish Aquaculture through the NCDMF. NCDMF must ensure compliance with NWP 48 to continue to permit shellfish leases in North Carolina. The regional conditions (USACE Wilmington District) of NWP 48 do not allow the NCDMF to permit new shellfish leases where the proposed lease boundaries contain the presence of SAV at time of sampling or based upon historic documentation of SAV habitat due to private culture operations potentially adversely impacting SAV.

Once NCDMF receives a shellfish lease application, the lease application is reviewed and the investigation process begins. The proposed site is reviewed with regard to specific criteria, one of which is the historic presence of SAV. Historic SAV presence data is based on SAV delineations from the NCDMF Mapping Program and aerial imagery delineations from the NC SAV- Albemarle Pamlico National Estuary Partnership. Proposed shellfish lease sites are sampled during this process, taking 50 meter square samples per acre. The lease investigation

¹¹ Presented to: PDT on 11/6/14 & 8/13/15; AC on 1/5/15 & 9/14/15; RAT on 3/5/15; MRT on 9/21/15.

¹² Presented to: PDT on 11/6/14, 8/13/15, & 1/7/16; AC on 1/5/15, 2/5/15, 9/14/15, & 1/4/16; MRT on 9/21/15 & 1/11/16; MFC on 11/20/15 and 2/18/16.

and sampling effort ensures that the proposed site complies with MFC Rule, North Carolina General Statutes, USACE NWP conditions as well as the USACE NWP Regional Conditions.

Nationwide Permits are an expedited form of individual permits for activities that are relatively common and similar in nature and impacts, and where a few conditions can be applied to all situations. USACE-Wilmington delegated authority to issue leases under NWP 48 to NCDMF after reviewing NCDMF Shellfish Lease and Franchise Program protocols, methods, MFC rules and North Carolina General Statutes with regard to shellfish leases and franchises. If a proposed shellfish lease location contains SAV it does not meet the regional conditions of NWP 48. If the applicant decides not to relocate the proposed lease site, the applicant then has the option of applying for a permit through the USACE Individual Permit process. This lengthy process requires reviews by multiple state and federal resource agencies, as well as incurs a higher permit fee. If an Individual Permit is issued by USACE, the applicant is still required to obtain authorization for the lease through NCDMF.

Under the current process, applicants do not have to apply for an USACE Preconstruction notification (PCN) which takes up to 45 days to process. By being conservative and consistent in the leasing process, NCDMF ensures that the USACE will continue to allow NCDMF the authority to permit leases, resulting in a streamlined process and overall improved customer service for applicants.

Negative impacts to SAV from shellfish aquaculture have been reported in the Pacific Northwest (Pregall 1993; Everett et al. 1995; Wisheart et al. 2007; Tallis et al. 2009). Stake and rack methods of oyster culture in Washington were found to significantly decrease SAV abundance and density compared to control SAV sites after one year due to shading, erosion, or sedimentation. Bottom culture had similar results due to direct physical disturbance and covering of SAV. Comparing the effect of suspended (longline, hand harvest) and bottom oyster (dredge harvest) culture on SAV, Wisheart et al. (2007) found that density of adult plants declined significantly at both treatments compared to the control sites. However, seedling production and density following harvest was significantly greater at the dredged bottom culture sites, and lowest at the longline sites. Tallis et al. (2009) compared bottom culture with dredge harvest, bottom culture with hand harvest, and longline with hand harvest. Longline had no effect on SAV density. Eelgrass (*Zostera marina*) growth rates increased slightly at both bottom culture sites, but density decreased 70% at dredged sites and 30% at hand harvest sites. While impacts may occur to SAV, bivalve aquaculture does not result in a permanent loss of estuarine habitat and can improve water quality (Dambauld et al. 2009).

In contrast, studies in Long Island Sound (Wall et al. 2008, Vaudrey et al. 2009), St. Joseph Bay, Florida (Peterson and Heck 2001), and Westmouth Bay, North Carolina (Powers et al. 2007) documented positive or neutral effects to SAV from bivalve aquaculture. In Long Island Sound, oysters in cages placed over SAV for a three-week period (depuration only) had no negative effect from the cages or foot traffic associated with the operation (Vaudrey et al. 2009). Increased densities of shellfish significantly decreased chlorophyll a in the water column, increased water clarity, and increased SAV leaf area productivity (Wall et al. 2008). Peterson and Heck (2001) found that mussel culture increased SAV productivity by increasing sediment nutrient concentrations. In addition, mussel survival significantly increased in SAV compared to unvegetated bottom, indicating a mutually beneficial relationship. In North Carolina, Powers et al. (2007) compared plant productivity and fish and invertebrate use in SAV habitat, sand flat, and fenced and unfenced clam lease sites to determine if the macroalgae growing on mesh bags in clam bottom culture enhances habitat function in the system. Results indicated that macroalgae biomass per unit area was significantly greater on the clam bags than on the sand flat and similar to SAV biomass. The macroalgae also provided habitat for similar species of mobile

invertebrates and juvenile fish as the SAV habitat and at similar abundances. These results indicate that bivalve aquaculture could offset or enhance ecosystem services provided by SAV.

There are currently two ongoing studies in North Carolina also examining the effect of shellfish culture on SAV, one by the University of North Carolina Coastal Studies Institute in Roanoke Sound and another by UNCW in Topsail Sound. Many factors may affect whether an aquaculture operation has an adverse effect on SAV, including the method used (bottom or off-bottom), extent of shading, density of SAV within and adjacent to the lease area, density of shellfish and equipment within the lease, water depth and method of harvesting or retrieving the shellfish product. Tallis et al. (2009) suggested requiring certain conditions on aquaculture operations (e.g. no bottom culture where SAV present, limit cage density) to minimize impacts to SAV.

The 2012 regional conditions of NWP 48 which apply to North Carolina do not allow the NCDMF to permit new shellfish leases where the proposed lease boundaries contain the presence of SAV, either at time of sampling or based upon historic documentation of SAV habitat, as no adverse effect to SAV, a designated Essential Fish Habitat (EFH), is currently permitted. Under federal law regarding EFH definitions of the Magnuson Stevenson Act (50 C.F.R. §600.810) adverse effect is defined as “any impact that reduces quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions”.

IV. AUTHORITY

N.C. General Statutes

113-134	Rules
113-182	Regulations of fishing and fisheries
113-201	Legislative findings and declaration of policy; authority of Marine Fisheries Commission
143B-289.52	Marine Fisheries Commission – powers and duties
143B-279.8	Coastal Habitat Protection Plans

N.C. Marine Fisheries Commission Rules May 1, 2015 (15A NCAC)

03I .0101	Definitions
03O .0201	Standards for shellfish bottom and water column leases
03O .0202	Shellfish bottom and water column lease applications
03O .0203	Shellfish lease application processing

V. DISCUSSION

Submerged aquatic vegetation growth and shellfish aquaculture require shallow protected waters for optimal success, thus causing a spatial conflict with lease siting in some cases. Both SAV and shellfish are recognized as providing important ecosystem services, such as providing structure for juvenile fish and invertebrates and improving water quality. Consequently, siting of a shellfish lease in an area with SAV may involve a habitat tradeoff rather than a simple negative

impact. Understanding whether shellfish aquaculture has an overall negative and positive effects on SAV is needed to optimize lease siting without causing adverse impacts to an essential fish habitat. From a review of the studies done to date, it is suggested that the aquaculture method used and site conditions influence whether SAV is impacted. The current lease review process does not consider the effect of different aquaculture operation characteristics or indirect benefits to SAV from bivalve aquaculture, but only immediate direct impacts to SAV.

USACE NWP's protect the aquatic environment and the public interest while effectively authorizing activities that have minimal individual and cumulative adverse effects on the aquatic environment. NWP 48 covers all commercial shellfish aquaculture activities. While the Nationwide conditions of NWP 48 authorizes up to ½ acre of SAV to be directly affected by a commercial shellfish aquaculture activity/shellfish lease; the regional conditions issued by the USACE Wilmington Regional District do not allow for any adverse effects (Federal Register 2012). The NMFS provides biological opinions, through consultations, to the USACE Districts on district level implementation and regional conditions of Nationwide Permits. Table 12.7.1 outlines the regional conditions of other mid-Atlantic and South-Atlantic states. In Delaware, Maryland, New Jersey no aquaculture activities are authorized in areas mapped as SAV. In Virginia a preconstruction notification is required in areas of SAV as well possible avoidance measure to reduce impacts to SAV (USACE-Norfolk District 2012).

Table 12.7.1. Regional conditions of NWP 48 for mid- Atlantic and South Atlantic States.

State	Regional Conditions of NWP 48 regarding SAV	Reference
Delaware	Does not authorize activities in any areas mapped as SAV.	http://www.nap.usace.army.mil/Portals/39/docs/regulatory/nwp/REGIONAL%20COND%20for%20DE%28%2016%20Mar%202012%29.pdf
Florida	PCN required prior to the start of any activity proposed within submerged aquatic vegetation, tidal wetlands, and/or coral assemblages. No acreage or linear limits unless new project area than <1/2 acre impact to SAV	http://www.saj.usace.army.mil/Portals/44/docs/regulatory/sourcebook/permitting/nationwide_permit/SAJ-NWP-RegionalConditions_29Mar12.pdf
Maryland	Does not authorize activities located in any areas mapped as submerged aquatic vegetation. In the Baltimore District, the applicant may refer to the Virginia Institute of Marine Science aerial surveys	http://www.nab.usace.army.mil/Portals/63/docs/Regulatory/PN/SPN%2012-32.pdf
New Jersey	Does not authorize activities in any areas mapped as SAV.	http://www.nap.usace.army.mil/Portals/39/docs/regulatory/nwp/reg_cond_NJ_16Mar2012.pdf
North Carolina	Adverse impacts to Submerged Aquatic Vegetation (SAV) are not authorized by any NWP within any of the twenty coastal counties defined by North Carolina's Coastal Area Management Act of 1974 (CAMA).	http://www.saw.usace.army.mil/Portals/59/docs/regulatory/regdocs/NWP2012/SAW_RCs_Final_SAD_approved_2012-03-29.pdf
South Carolina	Requires pre-construction notification (PCN), no mention of SAV in Regional conditions	http://www.sac.usace.army.mil/Portals/43/docs/regulatory/Approved_2012%20%20Regional_%20Conditions_REVISED_17_Jan_2014.pdf
South Carolina - Savannah District	No Mention of SAV in Regional Conditions	http://www.sas.usace.army.mil/Portals/61/docs/regulatory/NWP_Regional_Conditions.pdf
Virginia	A pre-construction notification (PCN) is required if work will occur in areas that contain SAV. Additional avoidance measures, such as relocating a structure or time-of-year restriction may be required to reduce impacts to SAV.	http://www.nao.usace.army.mil/Portals/31/docs/regulatory/nationwidepermits/NAO_2012_NWP_REGIONAL_CONDITIONS.pdf

NMFS and the USACE Wilmington has reviewed North Carolina General Statutes, MFC Rules, and NCDMF shellfish lease investigation sampling protocol and has found that it complies with their current requirements with regard to NWP 48 conditions. It is through this compliance that NCDMF has been granted the authority to issue shellfish leases for aquaculture operations by the USACE Wilmington District under NWP 48.

NCDMF advises shellfish lease applicants to avoid siting proposed shellfish lease locations in areas of historic or current SAV. NCDMF provides consultation services to applicants with regard to lease siting during the application process. NCDMF provides maps of known and historic SAV habitat to shellfish lease applicants, as well as providing the SAV data for use in online viewers, such as the NC Shellfish Siting Tool (<http://uncw.edu/benthic/sitingtool/>). Proposed shellfish lease locations are sampled by NCDMF as part of the lease investigation process. Fifty samples per acre are collected by hydraulic patent tongs or clam rake-quadrant/meter square. The total number of samples are based on the acreage of the proposed shellfish lease. In each sample clams, oysters, scallops, and SAV are identified and counted. SAV presence is determined by the identification of roots, rhizomes or leaf shoots.

In the late 1990s, the Shellfish Lease Program used bottom sampling protocol developed by Mike Marshall that specified the required sampling numbers for rakes and patent tongs along with bushel conversion factors (Craig Hardy, NCDMF, personal communication, 2015). When the initial leases on the banks side of Core Sound were proposed and contested (pre-Core Sound Lease Moratorium – early 1990s) the sampling protocols were evaluated by a statistician and found to be valid for determining presence and density of a resource on a proposed lease. These sampling protocols are still in place and specify taking between 20 and 25 random square meter samples per acre with rakes, or 50 random samples per site with patent tongs. If resource is encountered (SAV or shellfish) the sampling number is increased in the area of the resource to accurately delineate the extent and location of the resource. Preliminary informal site investigations as well as consultation were also offered by staff to the proposed leaseholder. Dredges have also been used for sampling on a few occasions. In these cases, the area sampled was calculated by multiplying dredge width by length of tow. The use of a dredge for sampling provided a tool which covered a lot of area in a short period of time for informal lease investigations. However, dredge sampling does not provide the quality of sampling that rakes provide in shallow water or patent tongs in deeper water. (Craig Hardy, NCDMF, personal communication, 2015).

Lease investigation sampling records from 2008-2011 show that these established protocols may have not been strictly adhered to during this time. In the period from July 2008 – November 2011, sample density ranged from 64 to 137 per acre with meter square/rake; 10 to 51 per acre with patent tongs; and in two incidences a combination of dredge/patent tong samples which were calculated to be 1404 and 1506 meter squares/acre.

In early 2012, the established sampling protocol was reviewed and discussed between Resource Enhancement staff and USACE to ensure that the established sampling protocol and other program protocols met the standards required by the USACE. No changes to the established methods were required at that time by the USACE. It was during this time period that the USACE made NCDMF aware of the regional conditions of NWP48 with regard to no adverse impact of SAV.

To further ensure consistency in the lease investigation sampling process, all lease investigation sampling since 2012 has been achieved by taking 50 samples per acre with patent tongs.

In 2013-2014 NCDMF did sample proposed shellfish lease locations in which less than 50 samples per acre were collected. The reduced number of samples occurred on specific proposed shellfish lease locations due to SAV being found on these proposed lease locations which in turn ended the requirement for further sampling. At some proposed shellfish lease locations when SAV was found; additional samples were taken to ensure that the proposed shellfish lease area could not be moved or reconfigured to avoid areas of SAV. Applicants were contacted for approval with regard to the changing the proposed boundaries and dimensions to ensure that the new dimensions or area were still suitable for their proposed aquaculture efforts.

The current 50 samples per acre protocol provides a higher level of confidence with regard to density and dispersal than collecting fewer samples with a higher level of randomness. One acre equals 4046.86 square meters, and fifty square meter samples only represents 1.26% of the total acre. The USACE reviewed sampling, reporting and delineation of leases by NCDMF and based their authorization on that information.

If SAV is found on a proposed shellfish lease site, NCDMF allows applicants to change their proposed lease boundary corner locations to avoid SAV, or allows the applicant the option to choose another lease location that does not contain SAV. Currently, if the applicant does not wish to change their proposed shellfish lease boundaries or choose a new location, NCDMF recommends that the applicant either withdraw their shellfish lease application, contact the USACE-Wilmington District to apply for an Individual Permit, or request that USACE-Wilmington District provide NCDMF with an exemption from regional requirements regarding SAV relative to lease operations on the proposed lease site.

The USACE Wilmington District solicits input from NMFS Habitat Conservation Division Atlantic Branch - Beaufort, NC with regard to regional conditions. NCDMF has met with NOAA and NMFS staff in 2013 and 2014 to discuss the zero tolerance interpretation of the no adverse effect to SAV issue with regard to shellfish leases. NCDMF and NOAA staff are conducting literature searches with regard to the interaction of shellfish/aquaculture operations with SAV to facilitate future conversations and comments with regard to NWP 48 regional conditions. NWP 48 expires on March 18, 2017, and the USACE currently has no plans on revising or amending the regional conditions of NWP 48 until they reopen the permit for review and comment prior to reissuance.

Since the first discussions by the PDT and AC occurred on this issue in February 2015, the interpretation of no adverse effects to SAV has changed. At the Coastal Habitat Protection Plan Interagency Permit Coordination meeting on April 22, 2015, federal and state resource and regulatory agencies discussed the challenge of permitting leases under the US Army Corps of NWP 48 where SAV is present. At the meeting it was concluded that a working group of resource agency staff would be formed. This working group would meet whenever a lease investigation found SAV in a proposed lease. They would review the data collected by the NCDMF shellfish lease program to evaluate whether locating the lease at the proposed site would cause no or acceptably low impact to SAV based on the prevalence, density and location of SAV, and the methods and gears to be used, such that it could be accommodated under the NWP 48. They would also discuss potential solutions (modifications to lease shape, location, method). On May 18, 2015 the workgroup met to review two proposed leases which were on hold due to SAV presence. Agencies present included National Marine Fisheries Service (Fritz Rohde), USFWS (John Ellis), Wildlife Resources Commission (Maria Dunn), and NCDMF (Anne Deaton and Brian Conrad). Shane Staples, Division of Coastal Management, was unable to attend. The group concluded that as an interim measure, leases could be permitted where all of the following criteria are met:

- 15% or less of the samples had SAV present
- SAV density within all samples was very sparse (10% or less)
- No bottom disturbing gear could be used to harvest product
- Cultch material could not be put on bottom loose because of the subsequent harvest method, unless hand harvest is feasible (very shallow).

These interim measures will provide some sites to be leased, that previously would not. The potential for impacts to SAV will be slight, but may be offset by the ecosystem enhancement benefits of the shellfish. To improve accuracy of the percent cover of SAV, shellfish lease investigations will be modified to complete sampling (50/acre) and to sample during the SAV growing season (April – October). NCDMF staff will continue to work with the applicants to locate leases where no existing SAV or shellfish resource is present. The workgroup will continue to discuss if SAV sampling methods should be modified. The lease program biologist will complete sampling at the affected sites and contact the applicants. When discussions begin for the nationwide five-year renewal in 2017, new studies will be reviewed that may allow further modification of these criteria.

VI. PROPOSED RULE(S)

No recommendations require rule changes at this time.

VII. PROPOSED MANAGEMENT OPTIONS

(+potential positive impact of action)

(- potential negative impact of action)

1. Status quo (Adhere to Regional Conditions of USACE NWP48 with no adverse effect to SAV from shellfish leases and following the 15% sparse SAV measure identified in the interim
 - + Continued ability for NCDMF to issue shellfish leases
 - + NCDMF continues open conversations with USACE and NMFS regarding this issue and the definition of adverse impact
 - + Continued protection of SAV habitat
 - + Possible gain of SAV habitat over time
 - + Provides time to complete literature search, documentation of SAV on leases and possible NC SAV research projects regarding shading and nutrients on shellfish leases
 - + Provides the ability for NCDMF to provide input on more clearly defined regional conditions which adhere with current NCDMF policies and plans
 - + Continue conversations with USACE and NMFS with regard to regional conditions
 - + Provide opportunity to further assess effect of bivalve aquaculture on SAV within different benthic landscape conditions and utilizing different aquaculture methods
 - + Provides opportunity to research alternative bivalve aquaculture methods in deeper water (> 1m) to avoid SAV impacts
 - Proposed shellfish lease locations will continue to be denied based on the presence of SAV higher than the 15% sparse SAV measure identified in the interim
2. NCDMF/NMFS/USACE reevaluate benthic sampling protocol for shellfish lease investigations to ensure that the current sampling density of 50 one meter samples per acre is not excessive
 - + Current sampling protocol is based on sound science methods, principles and standards that meet USACE requirements
 - + Possibly provides further opportunity to issue shellfish leases on proposed shellfish lease sites

- Possible loss of SAV habitat due to more limited sampling protocol and standards
3. NCDEQ/NCDFM issue shellfish leases in areas containing SAV
- + Shellfish lease applicants able to site leases more easily in shallower and/or sheltered waters
 - Possible loss of SAV habitat over time
 - NCDEQ/NCDFM fall out of compliance with regional conditions of NWP48
 - NCDEQ/NCDFM loses the ability to issue shellfish leases through USACE authority

VIII. RECOMMENDATION

MFC Selected Management Strategy

- Status quo (Adhere to Regional Conditions of USACE NWP48 with no adverse effect to SAV from shellfish leases and follow measures identified in the interim).

NCDFM and Advisory Committee

- Status quo (Adhere to Regional Conditions of USACE NWP48 with no adverse effect to SAV from shellfish leases and follow measures identified in the interim).

IX. LITERATURE CITED

- Dumbauld, B. R., J. L. Ruesink, and S. S. Rumrill. 2009. The ecological role of bivalve shellfish aquaculture in the estuarine environment: A review with application to oyster and clam culture in West Coast (USA) estuaries. *Aquaculture* 290 (3-4): 196-223.
- Everett, R. A., G. M. Ruiz, and J. T. Carlton. 1995. Effect of oyster mariculture on submerged aquatic vegetation: An experimental test in a Pacific Northwest estuary. *Marine ecology progress series*. Oldendorf 125 (1-3): 205-217.
- Federal Register. 2012. Reissuance of Nationwide Permits; Notice. Department of Defense Vol. 77 No. 34 Part III: 10228-10232
- Peterson, B. J., and K. L. Heck, Jr. 2001. Positive interactions between suspension-feeding bivalves and seagrass - a facultative mutualism. *Marine Ecology Progress Series* 213:143-155.
- Powers, M. J., C. H. Peterson, H. C. Summerson, and S. P. Powers. 2007. Macroalgal growth on bivalve aquaculture netting enhances nursery habitat for mobile invertebrates and juvenile fishes. *Marine Ecology Progress Series* 339: 109-122.
- Pregnall, M. M., 1993. Regrowth and recruitment of eelgrass (*Zostera marina*) and recovery of benthic community structure in areas disturbed by commercial oyster culture in the South Slough National Estuarine Research Reserve, Oregon. A thesis; Bard College, Annandale-On-Hudson, New York.
- Tallis, H. M., J. L. Ruesink, B. Dumbauld, S. Hacker, and L. M. Wisheart. 2009. Oysters and Aquaculture Practices Affect Eelgrass Density and Productivity in a Pacific Northwest Estuary. *Journal of Shellfish Research* 28 (2): 251-261.

U.S. Army Corp of Engineers. 2012. Norfolk District 2012 Nationwide Permit Regional Conditions. http://www.nao.usace.army.mil/Portals/31/docs/regulatory/nationwidepermits/NAO_2012_NWP_REGIONAL_CONDITIONS.pdf.

Vaudrey, J. M. P., and coauthors. 2009. Effects of Oyster Depuration Gear on Eelgrass (*Zostera marina* L.) in a Low Density Aquaculture Site in Long Island Sound. *Journal of Shellfish Research* 28 (2): 243-250.

Wall, C. C., B. J. Peterson, and C. J. Gobler. 2008. Facilitation of seagrass *Zostera marina* productivity by suspension-feeding bivalves. *Marine Ecology Progress Series* 357: 165-174.

Wisehart, L. M., B. R. Dumbauld, J. L. Ruesink, and S. D. Hacker. 2007. Importance of eelgrass early life history stages in response to oyster aquaculture disturbance. *Marine Ecology Progress Series* 344: 71-80.

50 CFR 600.810 Definitions and word usage.

Prepared by: Brian Conrad (for further information contact Steve Murphey),
steve.murphey@ncdenr.gov, (252) 808-8046
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12.8 BRUNSWICK COUNTY SHELLFISH LEASE MORATORIUM¹³

February 18, 2016

I. ISSUE

A shellfish lease moratorium has existed in Brunswick County since 1949. There is little documentation of the moratorium's origination, nor has there been a recent review of its relevance or need through the public comment process.

II. ORIGINATION

This issue was brought forward during an examination of clam and oyster FMP issues by the PDT with regard to the existing shellfish lease moratorium.

III. BACKGROUND

NCDMF shellfish lease records show that nine shellfish leases, with acreages ranging from 1.5-6.65 acres and totaling 31.29 acres, existed in Brunswick County between 1940 and 2001. Eight of these leases originated in the 1940s and one lease originated in 1966. Locations included Blaines Creek, Brickyard Landing, Clayton Creek, Cooter Creek, Crooked Creek, Dead River, Teagues Creek and Tubbs Sound.

Prior to 1967 various North Carolina General Statutes provided oyster harvest regulations, sales, export, leases, rehabilitation and propagation on a county by county basis. The 1949 North Carolina House Bill 317, which became Session Law Chapter 1030, terminated and disallowed oyster leases in Brunswick County. Section 1 reads:

"The time for filing protest or objection to leases of oyster grounds or gardens in the waters or sounds along the shores of Brunswick County heretofore made or entered into with various persons by the commissioner of commercial fisheries shall be two years from the time the said leases were granted and no more oyster gardens shall hereafter be leased in Brunswick County."

On June 21, 1967, North Carolina House Bill 1137, An Act Providing for the Lease of State-Owned Bottoms for Oyster and Clam Cultivation, was ratified and became law. This bill provided updated opportunity and requirements for shellfish leases throughout North Carolina. Section 2 of this bill clearly states that this Act shall not apply to Brunswick County. Through Section 2, Brunswick County became exempt from G.S. 113-202 which provided new oyster lease regulations.

No further history or documentation can be located that provides more insight into these two acts which restricted shellfish leases in Brunswick County.

IV. AUTHORITY

N.C. Session Laws

Session Law 1967, Chapter 876, House Bill 1137, Section 2

¹³ Presented to: PDT on 12/11/14, 8/13/15, & 1/11/16; AC on 1/5/15, 9/14/15, & 1/4/16; MRT on 9/21/15 & 1/11/16; MFC on 11/20/15 and 2/18/16.

N.C. General Statutes

113-202 New and renewal leases for shellfish cultivation; termination of leases issued prior to January 1, 1966.

N.C. Marine Fisheries Commission Rules May 1, 2015 (15A NCAC)

03O .0201 Standards for shellfish bottom and water column leases

V. DISCUSSION

The reasoning and decision making behind the 1949 moratorium and the 1967 continuation of that moratorium on shellfish leases in Brunswick County may never be known. Perhaps county officials and local commissions made this request on behalf of its citizens due to possible conflict of use issues, public trust issues, or concerns regarding already limited shellfish harvest areas and shellfish populations.

Recent growth and development in Brunswick County continues to contribute to water quality issues. As of October 2014, approximately 66% of its waters were closed (prohibited and conditionally approved closed) to shellfishing (Table 12.8.1).

Table 12.8.1. Status of shellfish waters in acres for Brunswick County, October 2014. From NCDMF Shellfish Sanitation & Recreational Water Quality.

Status	Acres	Percent of total
Approved - Open	11,575.83	27.0%
Conditionally Approved – Open	3,093.98	7.2%
Conditionally Approved - Closed	4,380.16	10.2%
CSHA Prohibited - Closed	23,766.43	55.5%
Total	42,816.40	100.0%

Of the 14,582 acres which remain open for shellfishing in Brunswick County, 3,093.98 acres are in conditionally approved open waters. Some of these conditionally approved waters can temporarily close with only 1 inch of rainfall due to a Conditional Area Management Plan, which shows elevated levels of bacteria after those rainfall events. In 2014 portions of these Conditionally Approved Open waters have been closed for up to 190 days. As an example, the Lockwood Folly River is regularly closed after 1 inch of rain occurs within 24 hours. In 2014 rainfall events have resulted in the Lockwood Folly River being temporarily closed for a total of 118 days. While waters with the status of Conditionally Approved – Open are able to be utilized for shellfish leases, the feasibility of having a productive lease in these areas may be drastically reduced due to the amount of time that these areas are closed to the harvesting of shellfish from rainfall events. Even within Approved and Conditionally Approved – Open waters of Brunswick County, there would be areas not be suitable for the siting of a shellfish lease due to other regulations, conflict of interest, impairment of navigation, submerged aquatic vegetation, existing shell habitat, and water depth.

Since all of Brunswick County coastal waters fall within a Primary Nursery Area (PNA) designation, a shellfish lease area would be able to be no less than 0.5 acres and no larger than 5.0 acres. The shellfish lease application, the proposed site, and any future lease would still

need to meet the requirements of G.S. 113-202 and MFC rules 15A NCAC 03O .0201, 03O .0202, 03O .0203.

In an area with limited and dwindling shellfish resource, such as Brunswick County, shellfish leases could not only provide a much needed economic benefit, but could assist in lessening harvest pressures on public bottom, improving water quality, and performing other vital ecosystem functions. Depending on the ploidy (diploid or triploid) of shellfish seed used, shellfish leases could augment the spawning stock and supplement larval availability to shellfish populations on public bottom.

Within the last three years, NCDMF staff have received over six inquiries regarding siting shellfish leases in Brunswick County, with many more inquiries questioning the moratorium. Currently, the most southern shellfish lease in North Carolina exists in the Federal Point Basin off the Cape Fear River in New Hanover County, just 2,500 feet from Brunswick County waters.

By addressing this issue and allowing public comment, residents, commercial fishermen, regulators and shellfish growers may gain a better understanding of the history and current views on shellfish leases in Brunswick County. This could lead to further growth in the shellfish aquaculture industry in North Carolina.

VI. PROPOSED RULE(S)

No recommendations require rule changes at this time.

VII. PROPOSED MANAGEMENT OPTIONS

(+potential positive impact of action)

(- potential negative impact of action)

1. Status quo (Continue the moratorium of shellfish leases in Brunswick County)
 - + Continues to uphold public trust and use of all approved Brunswick County waters for the public harvest of shellfish
 - + No change in management
 - Disallows business opportunities for aquaculture in Brunswick County
 - Does not provide additional reasoning for 1949 and 1967 Legislative Acts to shellfish growers
 - Continues public perception of unfair restrictions
2. Allow shellfish leases in Brunswick County (**requires statutory change**)
 - + Provides business opportunities for aquaculture in Brunswick County
 - + Provides management consistency with other geographic areas of North Carolina
 - + Possible decrease in harvest pressure on public bottom oyster habitat
 - + Provides ecosystem benefits
 - Possible reduction of area available for public trust use
3. Allow shellfish leases in Brunswick County, limiting acreage and availability (**requires statutory change**)
 - + Provides business opportunities for aquaculture in Brunswick County
 - + Provides management consistency with other geographic areas of North Carolina
 - + Possible decrease in harvest pressure on public bottom oyster habitat
 - + Provides ecosystem benefits

- Possible reduction of area available for public trust use
- Requires determination of limits

VIII. RECOMMENDATION

MFC Selected Management Strategy

- Continue the moratorium of shellfish leases in Brunswick County

NCDMF and Advisory Committee

- Continue the moratorium of shellfish leases in Brunswick County

*Note: The initial AC recommendation was to pursue informal investigations as to why leases are prohibited in Brunswick County and there was a follow up discussion with the AC on 2/2/15. Adam Tyler relayed information he had learned from talking with individuals from Brunswick County, and stated that the wild harvest of clams at the time of the creation of the moratorium was valuable enough that there was no interest in losing public bottom to private leases. Stephen Taylor added that after speaking to one of the last lease holders in Brunswick County, the cost of maintaining the lease and the constant encroachment of the closed polluted lines made it not worth keeping. Because of this discussion and upon further review the AC decided to recommend continue the moratorium like NCDMF.

Prepared by: Brian Conrad (for further information contact Steve Murphey),
steve.murphey@ncdenr.gov, (252) 808-8046
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 November 11, 2014
 December 1, 2014
 December 17, 2014
 April 14, 2015
 September 22, 2015
 February 18, 2016

12.9 CORE SOUND SHELLFISH LEASE MORATORIUM¹⁴

The following issue was removed from the Hard Clam FMP Amendment 2 and Oyster FMP Amendment 4 for further development due to the passage of Session Law 2015-241 on Sept. 18, 2015 and instead was placed in Appendix 15.4 to maintain the history of its development. Section 14.8 of the Session Law states that NCDMF and NCDEQ in consultation with representatives of the commercial fishing industry, shellfish aquaculture industry, and relevant federal agencies, create a proposal to open shellfish cultivation leasing certain areas of Core Sound that are currently subject to a moratorium on shellfish leasing. The NCDMF will submit a report no later than April 1, 2016 to the Joint Legislative Commission on Governmental Operations.

12.10 REDEFINING OFF BOTTOM CULTURE¹⁵

¹⁴ Presented to: PDT on 2/5/15, 8/13/15 & 8/25/15; AC on 3/9/15 & 9/14/15; MRT on 9/21/15.

¹⁵ Presented to: PDT on 5/7/15, 8/13/15, & 8/25/15; AC on 6/15/15, and 9/14/15; Rules Subgroup on 8/31/15; MRT on 9/21/15.

The following issue was removed from the Hard Clam FMP Amendment 2 and Oyster FMP Amendment 4 for further development due to the passage of Session Law 2015-241 on Sept. 18, 2015 and instead was placed in Appendix 15.4 to maintain the history of its development. Section 14.10C.(b) of the Session Law amended G.S. 113-202 (r) to allow shellfish bottom leases to place devices or equipment on the bottom and extend up to 18 inches into the water column. Devices or equipment not resting on the bottom or extending 18 inches above the bottom will require a water column lease under G.S. 113-202.1.

12.11 MODIFY SHELLFISH LEASE PROVISIONS¹⁶

February 18, 2016

I. ISSUE

The NCSGA expressed concern over the current shellfish lease provisions. Specifically, the lease terms, acreage limits, production requirements and sale/resale of seed shellfish. They felt the requirements associated with each of these provisions do not provide an adequate framework for the expansion of the North Carolina Shellfish Aquaculture Industry.

II. ORIGINATION

This issue was brought forward by the NCSGA on March 25, 2013.

III. BACKGROUND

During the 2001 Oyster and Hard Clam FMP planning process, the MFC identified several modifications to the statutory provisions of the Shellfish Lease Program that would provide for increased accountability and public acceptance. The MFC received reports on the Core Sound human use mapping and shellfish mapping pursuant to Session Law 199-209 and used that information to develop recommendations for improving the Shellfish Lease Program in the 2001 Oyster and Hard Clam FMP amendments. In order to get input from current users on shellfish lease issues, a stakeholders committee of ten people representing various interests was appointed to provide recommendations on the issue to the MFC. The MFC found that the recommendations from the stakeholder group would be beneficial in improving the shellfish lease program in not only Core Sound but coast wide. A discussion summarizing the Committee's position from that period and each of the recommendations as they relate to the issue are listed below:

1. Observation: Public sentiment toward the shellfish lease program suffers because unproductive leases are allowed to continue. Some leaseholders are just holding bottom in an attempt to exclude the public.

Recommendation: Enforce shellfish lease production requirements in a timelier manner.

¹⁶ Presented to: PDT on 7/16/15, 8/13/15, 8/25/15, & 1/7/16; AC on 8/10/15, 9/14/15, & 1/4/16; Rules Subcommittee on 8/31/15; RAT on 9/3/15 and 9/15/15; MRT on 9/21/15 & 1/11/16; MFC on 11/20/15 & 2/18/16.

Discussion: It has proven most effective to enforce requirements at time of renewal of the lease contract rather than during the term of the contract. The current lease contract period is ten years, which allows some unproductive leases to be maintained for several years.

Proposed Action: Change the current rule specifying a three year running production average to a five-year production average and change the statutory provision for a ten year lease contract to a five year contract.

Committee Recommendations (2002): Supported by the four regional and Shellfish committees.

2. Observation: If established shellfish leases continue to meet the standards for issuance but cannot be renewed because of lack of production, they should be transferred to shellfish lease applicants to avoid leasing existing public shellfish bottom.
Recommendation: Transfer unproductive leases to new applicants instead of leasing new bottom.

Discussion: Existing leases have gone through an extensive review process and have existed in known locations for several years. Therefore, the public is already accustomed to their existence. If these leases continue to meet the standards for leasing, it would be less intrusive to reissue the existing lease than to have a new site removed from public shellfish harvest.

Proposed Action: Make a statutory provision that allows shellfish leases that would not be renewed due to failure to meet production requirements to be made available to a member of a current pool of lease applicants on a first come, first serve basis.

Committee Recommendations (2002): Supported by the four regional committees. Not supported by the Shellfish Committee. NCDMF staff voiced serious concerns about the administration of this program.

3. Observation: Concern was expressed that, prior to the recent moratorium, several applications had been accepted for clam leases that exceeded the 5 acre per application guideline for maximum lease size because the applicants were allowed to justify the need for more acreage. Stakeholders felt that 5 acres was more than enough acreage for new leases or for expanding lease holdings.

Recommendation: Limit acreage per shellfish lease application to 5 acres with no opportunity to justify additional acreage.

Discussion: Most of the shellfish lease applications received proposes to lease less than 5 acres. Two possible reasons for the large size of the sites applied for in 1995 (10 acres) were pent up demand caused by the 1993 moratorium or fear of future moratoriums.

Proposed Action: Limit acreage per shellfish lease application to 5 acres.

Committee Recommendations (2002): Supported by the four regional and Shellfish committees.

4. Observation: Granting of additional lease acreage to leaseholders that are currently not meeting lease production requirements could create unnecessary proliferation of shellfish leases and creation of unproductive lease acreage.

Recommendation: Require that any current lease acreage held by a shellfish lease applicant meet production requirements prior to issuance of new lease acreage.

Discussion: This recommendation is necessary to prevent circumvention of the recommendation to allow an applicant to apply for no more than 5 acres. This action will cause leaseholders to either meet production requirements or give up their existing lease acreage prior to applying for additional sites.

Proposed Action: A leaseholder holding at least 5 acres of shellfish bottom is required to meet shellfish lease production requirements before being approved for any additional lease acreage.

Committee Recommendations (2002): Supported by the four regional and Shellfish committees.

5. Observation: Even with limitations on shellfish lease application acreage and requirements that acreage be productive prior to issuance of additional leases, there is no limitation on the number of persons that can obtain leases as long as they are state residents. Therefore, shellfish leases could cover large areas of coastal fishing waters over time.

Recommendation: Establish regional caps on the total shellfish lease acreage that can be issued.

Discussion: Even though there is less than 0.1% of coastal waters under shellfish lease, many protestors express concern that granting leases would affect their recreational use of the state waters or in some way limit their ability to fish commercially. (Some protestors feel that leasing public bottoms to individuals is simply inappropriate.) Limiting the acreage that can be leased should help address their concerns.

Proposed Action: Develop regional lease acreage caps based on established use of water bodies.

Committee Recommendations (2002): Supported by the Central and Northeast committees. Supported if implemented on a regional basis considering regional use patterns by the Southeast, Inland and Shellfish Committees.

6. Observation: The apparent intent of G.S. 113-202 (c) is to limit an individual to holding no more than 50 acres of shellfish cultivation leases. Yet, when corporate law is applied to shellfish lease holdings, a person could have an interest in an indefinite amount of shellfish lease acreage.

Recommendation: Limit an individual to an interest in no more than 50 acres of shellfish cultivation leases irrespective of corporate affiliations.

Discussion: A recent example showed that one individual had interest in 105 acres of shellfish bottom leases in Carteret County through personal holdings and by acreage held by corporations in which the individual was the corporation's agent. If all of the corporations are bona fide operations, this situation is legal but clearly outside the intent of the 50-acre

limitation. The feeling of the committee was that, if a member of a corporation already held 49 acres under shellfish lease, the corporation could hold only one acre of shellfish lease thereby limiting any individual from holding more than 50 acres. There was also some concern that family holdings allowed individuals access to more than the 50-acre limit.

Proposed Action: Rewrite the statutory provision limiting the amount of shellfish lease acreage that can be held by an individual to include acreage held by corporations where the individual is a member, or any combination of corporate or family holdings.

Committee Recommendations (2002): Supported by the four regional and Shellfish committees.

Recommended action	Action taken by committees
<ul style="list-style-type: none"> • Change to 5 year contract. • 5 year prod. avg. 	Supported by 4 regional and Shellfish committee. Implemented 2008/09
<ul style="list-style-type: none"> • Change statute to allow terminated leases to be re-assigned. Establish a pool of applicants 	Supported by 4 regional. Not supported by the Shellfish committee. Not Implemented
<ul style="list-style-type: none"> • Limit acreage to 5 acres/lease 	Supported by 4 regional and the Shellfish committee. Implemented 2008/09 – 10 acres allowed in mechanical harvest areas
<ul style="list-style-type: none"> • Require current lease meet production prior to granting more leases 	Supported by 4 regional and the Shellfish committee. Implemented 2008/09
<ul style="list-style-type: none"> • Develop regional lease acreage caps 	Various support from regional committees and Shellfish committee. Not Implemented
<ul style="list-style-type: none"> • Limit individual to an interest of no more than 50 acres irrespective of corporate affiliations 	Supported by 4 regional and Shellfish committee. Implemented 2008/09

During the development of the 2008 amendments to the hard clam and oyster plans the issue was re-visited and with recommendations from stakeholder groups and MFC committees, the MFC recommended to the Joint Legislative Commission on Seafood and Aquaculture that a statutory change be made to change the provision for a ten-year shellfish lease term to a five-year lease term. Once the statutory changes were made, the MFC made rule changes which changed the prior three-year running shellfish production average for shellfish leases to a five year running average, as well as limiting acreage per shellfish lease application to five acres, except in areas open to the mechanical harvest of oysters where the limit is ten acres. Since 2009 all new shellfish leases are contracted for a period of five years with limits on acreage of five acres within mechanical methods prohibited area and ten acres outside of a mechanical methods prohibited area. Lease holders can apply for additional leases as long as their current lease or leases are meeting production/planting requirements and not to exceed fifty acres.

Additional concerns based on current shellfish lease requirements are leases that have been terminated for not meeting planting/production standards as outlined in 15A NCAC 03O .0201 and the ability to waive the natural shellfish bed provision for new lease applicants on those terminated leases. A natural shellfish bed is defined as ten bushels or more shellfish per acre and this designation will deny any proposed lease whether it was once a lease or not. Other concerns propose exceptions that would allow potential lease holders the ability to have leases transferred with grace periods to bring the transferred lease up to planting and production

standards. Currently, if a shellfish lease is transferred late in its renewal period and has not met the production standards up to that point, it is likely not to meet production requirements by the transferee within the lease term.

With the recent expansion of shellfish aquaculture in North Carolina questions regarding the sale and resale of shellfish seed have also become more common. With an approved AOP, an aquaculture operation 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. An aquaculture operation can be a land based hatchery or a field grow out operation. Field grow out operations can potentially facilitate both nursery and grow out functions. A hatchery or aquaculture operation can sell seed to the holder of an AOP, Under Dock Oyster Culture permit holder, or lease holder for further grow out.

Shellfish larvae and seed can be purchased from in-state and out of state shellfish hatcheries for both nursery and grow out operations. During the nursery phase, larvae or small oyster seed are grown to larger sizes, usually within tanks, upwellers or raceways which provide protection, water flow and good food source. Larvae or small oyster seed are also grown in mesh aquaculture nursery bags within the water column on a private culture operation. Oyster seed sizes from the nursery to most grow out operations range from 6mm to 15mm, but can also be grown to larger sizes in the nursery environment. Hard clam seed sizes for grow out operations usually range from 8mm to 30mm.

Private culture operations (shellfish leases, franchises and water columns) have production standards for both planting and harvest based on the acreage of the operation. A possible issue can occur when grow out occurs on a private culture operation and there is a transfer/sale of product to another private culture operation. The initial operation acquires seed through the nursery of larvae via the AOP or the purchase of seed. This initial operation provides purchase/planting effort documentation with regard to shellfish amounts planted. The initial operation grows this seed out and then sells this seed to another private culture operation. There are no size limits unless the hatchery is located in restricted or conditionally approved closed waters. The initial operation then provides harvest/sale documentation to NCDMF via trip tickets, or AOP reporting. The second operation provides proof of purchase of seed/planting effort documentation to NCDMF with regard to shellfish amounts planted. The second operation grows this seed out and then sells it to another private culture operation or for consumption; providing harvest/sale documentation via NCDMF trip ticket. The nursery and/or grow out of seed shellfish may result in multiple resales of the same seed shellfish. Private culture operations with an AOP may result in the ability to sell the same seed numerous times to meet planting and harvest requirements; and lead to multiple trip tickets being generated for the same oysters.

IV. AUTHORITY

N.C. Session Laws

Law 2015-241, House Bill 97

N.C. General Statutes

113-168.4	Sale of fish
113-201	Legislative findings and declaration of policy; authority of Marine Fisheries Commission.

113-202 New and renewal leases for shellfish cultivation; termination of leases issued prior to January 1, 1966.

N.C. Marine Fisheries Commission Rules May 1, 2015 (15A NCAC)

03I .0101 Definitions
03K .0207 Oyster size and harvest limit exemption
03O .0201 Standards for Shellfish Bottom and Water Column Leases
03O .0503 Permit conditions; Specific

V. DISCUSSION

N.C. General Statutes (113-202, 113-202.1, and 113-202.2) make it clear that the public interest must benefit from issuance of leases and superjacent water column, and their subsequent renewal. It is not in the public's best interest for a shellfish leaseholder to maintain a lease for five years and not produce commercial quantities of shellfish. Some of the issues in the past have been novice investors obtaining leases and holding public bottom and ultimately having the lease terminated. Establishing bottom and water column leases can be expensive, and five years according to some groups may not be sufficient to bring all shellfish into commercial production and meet production requirements. Investors feel that having a longer lease term and production average will promote water column aquaculture within North Carolina and allow time for production or gear related issues or issues with production techniques to be overcome. Growth rates of cultured oysters vary depending on several factors such as: diploid vs triploid, temperature, food, and salinity. With average grow out rates for oysters in the water column at 18 to 24 months and bottom culture around three years, current lease terms could be a limiting factor when investing in the lease program.

"Acts of God" such as hurricanes, disease and water quality issues also create an environment of concern that an operation could be shut down after the five-year period if production requirements are not met due to these circumstances. Other states such as Virginia have shellfish lease periods of ten years as per Code of Virginia, Title 28.2-613 with an acreage restriction of 3,000 acres of general oyster-planting grounds in the waters of the Commonwealth other than in the Chesapeake Bay as per Title 28.2-610. A Maryland issued Shellfish Aquaculture lease in the Chesapeake Bay is valid for a term of twenty years. The exceptions are Tidal Wetland Leases (TWLs) which are issued for ten years. Upon renewal, the TWL will be converted to a Shellfish Aquaculture lease with a term of twenty years. Current lease terms and acreage limits may not create an environment conducive for the serious investor however, caution should be taken to prevent acres of public trust bottom to be occupied in leases not producing shellfish. Recent issues associated with Virginia lease structure include waterfront home owners applying for up to 250 acres with hope to block potential lease holders and holding that bottom for ten years (Kobell 2014).

Potential options that could alleviate some of the risks would be to establish in rule for an extension of the lease term due to "Acts of God". This rule would be insurance in case of a natural event that would prevent the lease holder from making production. Back to back extensions should not be allowed due to a lease holder potentially exploiting the exemption. NCDMF currently applies a maximum two-year extension internally. This action is approved by the Director and is a last resort for serious private commercial growers in need of an extension. While each individual situation is different, further guidelines should be established so future staff can continue to provide equality and without bias. Another rule change would be to lengthen the current five-year lease term to an amount that would encourage the investment in the North

Carolina shellfish industry. However, this was just changed in 2008 from the 10-year term now being requested. The majority of the present water column shellfish lease holders are making production within the five-year term and the current term could be considered a removal of applicants or holders that are not serious about the business. One explanation of water column leases making production conditions is due to the current “or” in the production requirement under 15A NCAC 03O .201 (g). Presently water column lease holders can meet production by just planting amounts of seed, whereas bottom lease holders have to produce and plant to meet production for the five years contract period.

The amount of acreage allowed per shellfish lease has changed already once in the recent past and the amount of acreage needed is debatable. Most lease requests are within the Mechanical Method Prohibited Areas so acreage is limited to 5 acres. Just two new bottom leases and one water column amendment were granted in 2013-2014 with acreage over 5 acres. Only the industrious investor will request the maximum allowed and rightly so due to the large monetary investment required for aquaculture start up. Allotted acreage amounts could be adjusted to allow for ten acres in mechanical method prohibited areas. This would have equality with the ten acres in mechanical method areas. Lease holders can hold up to fifty acres of leased bottom, however the lease holder has to apply for amounts of five acres in mechanical method prohibited areas or ten acres within mechanical method harvest areas per increment and each lease has to meet current planting/production requirements before the other is granted. This process is considered burdensome to some investors due to additional lease application fees, surveyor costs and time required to acquire additional leases. Changing the current rule of fifty acres per lease holder would perhaps require the state to consider how much bottom can be allocated for shellfish leases. This increase will need to be studied and estuarine bottom surveyed for the importance and potential of North Carolina shellfish habitat and industry.

Other obstacles that may impede the expanding of North Carolina’s shellfish aquaculture industry is the current natural shellfish bed designation of ten bushels or more of shellfish per acre as it is applied to terminated leases. Currently, a terminated lease that has ten bushels or more of shellfish per acre is considered a natural shellfish bed and is disqualified in becoming a shellfish lease. These terminated leases were originally granted and deemed suitable for leasing by meeting the standard of not containing a natural shellfish bed, however through cultivation may have passed the threshold of ten bushels per acre. Waiving the natural shellfish bed standard on terminated leases could provide an easier pathway in obtaining a lease. Careful attention should be advised with this exception and perhaps only applied on the exact footprint of terminated leases to insure shellfish lease protocols are being followed. Specifying a time period after the lease is terminated in which the natural shellfish bed designation can be waived will provide this opportunity window. Secondly, since these “proposed new leases” are located on existing footprints, options of waiving the survey requirement may be proposed. This action would further provide access to the industry by reducing the impediments faced by private cultivators.

Transfer of interest as it applies to the transfer of shellfish leases late in their renewal term which has not met the production standards is another boundary that could prohibit aquaculture growth. When a shellfish lease is transferred, the new owner inherits the original term and production requirements associated with that lease. If the lease is transferred late in the renewal period and production requirements have not been met, bringing the lease up to standards in the remaining time of the renewal may be impossible. Most of these leases are never renewed and terminated. Exceptions may be needed to allow future lease holders to be granted “grace periods” to bring these leases to compliance so that the costly and timely process of applying for new leases can be forfeited. One recommendation is the lease holder can transfer the lease or allow the state to

initiate the termination process. Once the lease has been transferred the applicant can apply for the same lease, within the original footprint. Within this option, waivers of the natural shellfish bed designation and survey requirements could be applied as stated previously.

In regard to the proposed option of designating leases that have been terminated for failure to meet the planting/production standards and allowing those to become opened for new owners NCDMF policy will have to be developed for whom to issue these leases. The stakeholders committee to the MFC developed during the Core Sound human use mapping study recommended to make available a current pool of lease applicants on a first come, first serve basis.

Current MFC rules and N.C. General Statutes do not contain any language with regard to the distribution/sale or redistribution/resale of shellfish seed. Nor are shellfish seed sizes defined. The only mention of shellfish seed is in G.S. 113-203 (a1) which says that it is lawful to transplant seed clams less than 12 mm in their largest dimension and seed oysters less than 25 mm in their largest dimension and when the seed clams and seed oysters originate from an aquaculture operation permitted by the Secretary. The NC General Statutes were recently modified to allow NCDMF to permit the movement of shellfish seed not to exceed a certain size from restricted or conditionally approved closed areas onto shellfish leases.

History Notes

The Shellfish Lease Program is one of the oldest, and at times controversial, fishery programs in North Carolina and has existed to an extent in its present form since 1905. However, even before the establishment of shellfish leases, several types of shellfish interests were conveyed or granted to individuals or groups dating back to 1859 and even submerged land claims going back to Colonial or State grants. The types of shellfish interests conveyed by North Carolina fall into five categories and are described below to assist the reader in understanding the rule language with regard to shellfish leases and franchises.

1. Licenses to cultivate oysters and clams: This system was created in 1859 and in general empowered clerks of N.C. Superior Court to issue licenses to plant or cultivate oysters. The system continued in some counties until it was repealed in 1907. Although they were considered perpetual interests, licenses were subject to revocation based on prescribed conditions and limits.
2. Perpetual franchises or grants: Under the authority of 1887 Session Laws, Chapters 90 and 119 and 1889 Session Laws, Chapter 298, perpetual franchises to cultivate shellfish were granted in Pamlico Sound and Onslow County. These franchises were similar to licenses in that they were assignable and inheritable and voidable for failure to cultivate.
3. Fee simple interests: One act of the General Assembly, Session Law Chapter 179 authorized the conveyance of shellfish beds expressly in fee simple. Another source of purported fee title to shellfish beds are the Colonial and State grants which describe submerged lands. Other interests, such as licenses or perpetual franchises may also have been converted into fee interests in later conveyances between parties other than the State.
4. Fifty-year leaseholds: In 1852 and again in 1873 the General Assembly granted 50 year leases to corporations or individuals for the purpose of cultivating shellfish. These interests were few in number
5. Leases on public bottom: In 1905 the State began a leasing system for shellfish bottoms, the modern version of which is codified in G.S. 113-202. The power to lease public

bottom land for shellfish cultivation, and the ability to terminate those leases was vested in the MFC until 1983 when that authority was transferred to NCDMF.

The long history and confusion as to the actual legality of these perpetual interests came to a head during the early 1960s when the Division of Commercial Fisheries planted shell material in the Lockwood's Folly River in Brunswick County. The area was closed for a period of several years and when the Division attempted to open it for public harvest they were blocked by a local property owner who claimed that he owned the river bottom along with the oysters growing there.

In 1965 the General Assembly enacted legislation (G.S. 113-205) requiring people to register their private claims to lands beneath navigable waters (submerged lands). Over 6,000 claims were filed prior to the 1970 deadline and between 1970 and 1976 maps were developed and claims indexed by the Division of Marine Fisheries. Submerged lands were transferred to the Division of Coastal Management in the early 1980s and back to the Division of Marine Fisheries in 1987. Today, all 113-205 submerged lands claims have been resolved and the rules in 1G Resolving of Submerged Land Claims have been either repealed or expired pursuant to G.S. 150B-21.3A.

Prior to 1983 leases in the Pamlico Sound could be as much as 200 acres and franchises depended upon the extent of the deeded bottom given at the time of the shellfish interest conveyance. However, in 1994, the N.C. Attorney General office issued an opinion regarding MFC Rule 15A NCAC 03O .0204 that requires that any shellfish franchise that is not being managed and cultivated shall not be marked. This provision means that if a franchise holder is unwilling to cultivate his franchise and market the resulting shellfish, or otherwise meet production requirements, he must take down his marking stakes. By doing so, the franchisee loses his ability to maintain an exclusive claim to the shellfish within his franchise area, which at least temporarily reverts to public use.

The term "natural shellfish bed" was largely undefined in rule for the placement of shellfish leases. From at least the late 1960s to 1982 the inspection of lease sites was done by Division law enforcement officers and the county oysterman who were selected by the county commissions based on their knowledge of shellfish areas. In 1983, the first mention of a bushel definition is mentioned in rule where it refers to a natural shellfish bed being "i.e. an area of public bottom where 10 bushels or more shellfish per acre are found to be growing." Personal communication with Fentress Munden (2015) indicated that this was the amount deemed to be needed at the time for an oysterman to make a day's work. Since that time, oyster prices have risen significantly and last season sold for up to \$50 or more per bushel so the bushel definition for natural shellfish bed may be outdated. However, it is not recommended that we change the 10 bushel per acre estimate at this time.

VI. PROPOSED RULES

MFC Selected Management Strategy:

15A NCAC 03O .0201 STANDARDS AND REQUIREMENTS FOR SHELLFISH BOTTOM LEASES AND FRANCHISES AND WATER COLUMN LEASES

(a) All areas of the public ~~bottoms~~ bottom underlying coastal fishing waters shall meet the following ~~standards~~ standards and requirements, in addition to the standards in G.S. 113-202 in order to be deemed suitable for leasing for shellfish cultivation purposes:

- (1) ~~The the proposed~~ lease area ~~must shall~~ not contain a ~~natural shellfish bed which is defined as~~ "natural shellfish bed", as defined in G.S. 113-201.1 or have 10 bushels or more of shellfish per ~~acre-acre~~.

- (2) ~~The the proposed lease area must shall~~ not be closer than 100 feet to a developed shoreline, except no minimum setback is required when the area to be leased borders the applicant's property or the property of ~~riparian owners~~ "riparian owners", as defined in G.S. 113-201.1 who have consented in a notarized ~~statement. In statement, or is in~~ an area bordered by undeveloped ~~shoreline, no~~ shoreline; and
- (3) ~~The the proposed lease area shall not be less than one-half acre and shall not exceed five-10 acres for all areas except those areas open to the mechanical harvest of oysters where proposed lease area shall not exceed 10 acres.~~ areas.

This Subparagraph shall not be applied to reduce any holdings as of July 1, 1983.

~~(b) Persons holding five or more acres under shellfish lease or franchise shall meet the standards established in Paragraph (c) of this Rule prior to acceptance of applications for additional shellfish lease acreage.~~

(b) To be deemed suitable for leasing for aquaculture purposes, water columns superjacent to leased bottom shall meet the standards in G.S. 113-202.1 and water columns superjacent to franchises recognized pursuant to G.S. 113-206 shall meet the standards in G.S. 113-202.2.

~~(c) Franchises To avoid termination, franchises recognized pursuant to G.S. 113-206 and shellfish bottom leases shall meet the following standards in addition to the standards in G.S. 113-202. In order to avoid termination, franchises and shellfish bottom leases shall requirements, in addition to the standards in G.S. 113-202:~~

- (1) ~~Produce~~ produce and market 10 bushels of shellfish per acre per year; and
- (2) ~~Plant~~ plant 25 bushels of seed shellfish per acre per year or 50 bushels of cultch per acre per year, or a combination of cultch and seed shellfish where the percentage of required cultch planted and the percentage of required seed shellfish planted totals at least 100 percent.

~~(d) To avoid termination, water column leases shall:~~

- (1) ~~produce and market 40 bushels of shellfish per acre per year; or~~
- (2) ~~plant 100 bushels of cultch or seed shellfish per acre per year.~~

~~(d)(e) The following standards shall be applied to determine compliance with Subparagraphs (1) and (2) of Paragraph (e) Paragraphs (c) and (d) of this Rule:~~

- (1) Only shellfish marketed, planted, or produced ~~or marketed according to the definitions as defined in 15A NCAC 03I .0101 as the fishing activities "shellfish marketing from leases and franchises", "shellfish planting effort on leases and franchises", or "shellfish production on leases and franchises" shall be submitted on production/utilization-reporting forms as set forth in 15A NCAC 03O .0207 for shellfish leases and franchises.~~
- (2) If more than one ~~shellfish~~ lease or franchise is used in the production of shellfish, one of the leases or franchises used in the production of the shellfish ~~must shall~~ be designated as the producing lease or franchise for those shellfish. Each bushel of shellfish may be produced by only one ~~shellfish~~ lease or franchise. Shellfish transplanted between leases or franchises may be credited as planting effort on only one lease or franchise.
- (3) Production and marketing information and planting effort information shall be compiled and averaged separately to assess compliance with the ~~standards-requirements~~. The lease or franchise ~~must shall~~ meet both the production requirement and the planting effort requirement within the dates set forth in G.S. 113-202.1 and 202.2 to be ~~judged deemed~~ in compliance with these standards for shellfish bottom leases. The lease or franchise shall meet either the production requirement or the planting effort requirement within the dates set forth in G.S. 113-202.1 and 202.2 to be deemed in compliance for water column leases.
- (4) All bushel measurements shall be in U.S. Standard Bushels.
- ~~(4)(5)~~ In determining production and marketing averages and planting effort averages for information not reported in bushel measurements, the following conversion factors shall be used:
 - (A) 300 oysters, 400 clams, or 400 scallops equal one bushel; and
 - (B) 40 pounds of scallop shell, 60 pounds of oyster shell, 75 pounds of clam ~~shell and shell, or~~ 90 pounds of fossil stone equal one bushel.
- ~~(5) In the event that a portion of an existing lease or franchise is obtained by a new owner, the production history for the portion obtained shall be a percentage of the originating lease or franchise production equal to the percentage of the area of lease or franchise site obtained to the area of the originating lease or franchise.~~
- (6) Production and marketing rate averages shall be computed irrespective of transfer of the lease or franchise. The production and marketing rates shall be averaged:averaged for the following situations using the time periods described:

- (A) for an initial bottom lease or franchise, over the consecutive full calendar years remaining on the bottom lease or franchise contract after December 31 following the second anniversary of the initial bottom leases and franchises; lease or franchise;
- (B) for a renewal bottom lease or franchise, over the consecutive full calendar years beginning January 1 of the final year of the previous bottom lease or franchise term and ending December 31 of the final year of the current bottom lease contract for renewal leases or franchise contract;
- (C) for a water column lease, over the first five-year-five-year period for an initial water column leases-lease and over the most recent five-year-five-year period thereafter for a renewal water column leases-lease; or
- (D) for a bottom lease or franchise issued an extension period under 15A NCAC 03O .0208, over the most recent five-year period.

~~Production and marketing rate averages shall be computed irrespective of transfer of the shellfish lease or franchise.~~

~~(7) All bushel measurements shall be in U.S. Standard Bushels.~~

~~(7) In the event that a portion of an existing lease or franchise is obtained by a new owner, the production history for the portion obtained shall be a percentage of the originating lease or franchise production equal to the percentage of the area of lease or franchise site obtained to the area of the originating lease or franchise.~~

(f) Persons holding five or more acres under all shellfish bottom leases and franchises combined shall meet the requirements established in Paragraph (c) of this Rule prior to the Division of Marine Fisheries accepting applications for additional shellfish lease acreage.

~~(e) Water columns superjacent to leased bottoms shall meet the standards in G.S. 113-202.1 in order to be deemed suitable for leasing for aquaculture purposes.~~

~~(f) Water columns superjacent to franchises recognized pursuant to G.S. 113-206 shall meet the standards in G.S. 113-202.2 in order to be deemed suitable for leasing for aquaculture purposes.~~

~~(g) Water column leases must produce and market 40 bushels of shellfish per acre per year to meet the minimum commercial production requirement or plant 100 bushels of cultch or seed shellfish per acre per year to meet commercial production by planting effort. The standards for determining production and marketing averages and planting effort averages shall be the same for water column leases as for bottom leases and franchises set forth in Paragraph (d) of this Rule except that either the produce and market requirement or the planting requirement must be met.~~

History Note: Authority G.S. 113-134; 113-201; 113-202; 113-202.1; 113-202.2; 113-206; 143B-289.52; Eff. January 1, 1991; Amended Eff. May 1, 1997; March 1, 1995; March 1, 1994; September 1, 1991; Temporary Amendment Eff. October 1, 2001; Amended Eff. May, 2017; October 1, 2008; April 1, 2003.

15A NCAC 03O .0208 ~~CANCELLATION~~ TERMINATION OF SHELLFISH bottom LEASES AND FRANCHISES AND WATER COLUMN LEASES

(a) Procedures for termination of shellfish leaseholds are provided in G.S. 113-202. The Secretary's decision to terminate a leasehold may be appealed by initiating a contested case as outlined in G.S. 150B-23.

~~(a)(b) In addition to~~ Consistent with the grounds for termination established by G.S. 113-202, the Secretary shall begin action to terminate leases and franchises for failure to produce and market shellfish or for failure to maintain a planting effort of cultch or seed shellfish in accordance with 15A NCAC 03O .0201 substantial breach of compliance with the provisions of rules of the Marine Fisheries Commission governing use of the leasehold includes the following, except as provided in Paragraph (c) of this Rule:

- (1) failure to meet shellfish production and marketing requirements for bottom leases or franchises in accordance with 15A NCAC 03O .0201;
- (2) failure to maintain a planting effort of cultch or seed shellfish for bottom leases or franchises in accordance with 15A NCAC 03O .0201;
- (3) failure either to meet shellfish production and marketing requirements or to maintain a planting effort of cultch or seed shellfish for water column leases in accordance with 15A NCAC 03O .0201;

- (4) the Fisheries Director has cause to believe the holder of private shellfish bottom or franchise rights has encroached or usurped the legal rights of the public to access public trust resources in navigable waters, in accordance with G.S. 113-205 and 15A NCAC 03O .0204; or
- (5) the Attorney General initiates action for the purpose of vacating or annulling letters patent granted by the State, in accordance with G.S. 146-63.

~~(b) Action to terminate a shellfish franchise shall begin when there is reason to believe that the patentee, or those claiming under him, have done or omitted an act in violation of the terms and conditions on which the letters patent were granted, or have by any other means forfeited the interest acquired under the same. The Division shall investigate all such rights issued in perpetuity to determine whether the Secretary should request that the Attorney General initiate an action pursuant to G.S. 146-63 to vacate or annul the letters patent granted by the state.~~

~~(c) Action to terminate a shellfish lease or franchise shall begin when the Fisheries Director has cause to believe the holder of private shellfish rights has encroached or usurped the legal rights of the public to access public trust resources in navigable waters.~~

(c) Consistent with G.S. 113-202(11) and 113-201(b), a leaseholder that failed to meet requirements in G.S. 113-202, 15A NCAC 03O .0201 or this Rule may be granted a single extension period of no more than two years per contract period upon sufficient showing of hardship by written notice to the Fisheries Director prior to the expiration of the lease term that one of the following occurrences caused or will cause the leaseholder to fail to meet lease requirements:

- (1) death, illness, or incapacity of the leaseholder or his "immediate family", as defined in G.S. 113-168 that prevented or will prevent the leaseholder from working the lease;
- (2) damage to the lease from hurricanes, tropical storms or other severe weather events recognized by the National Weather Service;
- (3) shellfish mortality caused by disease, natural predators, or parasites; or
- (4) damage to the lease from a manmade disaster that triggers a state emergency declaration or federal emergency declaration.

(d) In the case of hardship as described in Subparagraph (c)(1), the notice shall state the name of the leaseholder or immediate family member, and either the date of death, or the date and nature of the illness or incapacity. The Fisheries Director may require a doctor's verification of the illness or incapacity. Written notice and any supporting documentation shall be addressed to the Director of the Division of Marine Fisheries, P.O. Box 769, 3441 Arendell St., Morehead City, NC 28557-0769.

(e) Requirements for transfer of beneficial ownership of all or any portion of or interest in a leasehold are provided in G.S. 113-202(k).

~~(d) In the event action to terminate a lease is begun, the owner shall be notified by registered mail and given a period of 30 days in which to correct the situation. Petitions to review the Secretary's decision must be filed with the Office of Administrative Hearings as outlined in 15A NCAC 03P .0102.~~

~~(e) The Secretary's decision to terminate a lease may be appealed by initiating a contested case as outlined in 15A NCAC 03P .0102.~~

History Note: Authority G.S. 113-134; 113-201; 113-202; 113-202.1; 113-202.2; 113-205; 143B-289.52; Eff. January 1, 1991; Amended Eff. May 1, 1997; March 1, 1995; March 1, 1994; October 1, 1992; September 1, 1991; Temporary Amendment Eff. January 1, 2002; October 1, 2001; Amended Eff. May 1, 2017; April 1, 2003.

VII. PROPOSED MANAGEMENT OPTIONS

Production Options

1. Status quo (Maintain current lease terms of five years with five-year production average)
 - + Unproductive leases to be terminated, not holding public trust waters for long time period
 - + Few applicants request more than five acres (MMPA) and 10 acres [Mechanical Methods Area (MMA)]
 - + Majority of water column lease holders are able to meet requirements within current terms
 - No reassurance for long term investment

- Possibility of not meeting production due to time constraints
2. Establish a seven-year period for the initial lease with the last five years of the lease averaged for production. Upon renewal, lease period returns to five years **(requires statutory change)**
 - + Favorable atmosphere for investors
 - + Insurance against lease startup cost/production issues
 - Longer time period for unproductive leases to hold public trust waters
 - Record keeping and renewals would be more complicated, especially if lease period was extended (i.e. seven-year lease becomes a nine year lease)
 3. Establish rule to support extensions where “Acts of God” prevent a lease holder from making production, with a two-year extension and only one extension allowed per term **(rule change required)**
 - + Favorable atmosphere for investors
 - + Insurance against lease startup cost/production issues as they relate to nature
 - + Insure equality and non-bias decisions on extensions
 - Increased rules when internal policy already exists
 - Loophole in terminating unproductive leases
 - Potential bias as new staff replaces senior staff

Acreage Options

4. Status quo (Maintain five acres within a MMPA and ten acres within a MMA, not to exceed 50 acres)
 - + Less public trust waters to be held up in nonconforming leases
 - + Process in place to gain more acreage through new leases
 - Increase costs and time delays of reapplying for additional leases
 - Limiting big investors from increasing shellfish production in North Carolina
5. Allowing 10 acres per lease in MMPA **(rule change required)**
 - + Equality with acreage in MMA
 - + Favorable atmosphere for investors
 - + Decrease costs and time delays of reapplying for additional leases (application fee, investigations, survey)
 - Potential of industry holding more public trust bottom; some areas of the state have limited public bottom open to shellfishing
 - Potential conflicts with other user groups due to already reduced acres in MMP
 - Potential higher rate of lease non-compliance due to higher production, planting and rent
6. Increasing maximum of 50 acres of shellfish leased bottom per lease holder **(requires statutory change)**
 - + Favorable atmosphere for investors
 - + Enable private growers to increase shellfish production in North Carolina
 - Public perception and fears of large areas of public trust waters taken for leases
 - Without acreage caps some individual waterbodies can become overcrowded with lease markers and collectively impact water use

Re-issuance of Leases Options

7. Status Quo (Once a lease is terminated it returns to public bottom and is assessed for future leases based on “natural shellfish bed” definition.
 - + Protects public trust waters by returning unproductive leases to public harvest
 - + Allows areas that may not be productive to return to public use
 - Possibly expands areas of public trust waters that will be leased because old lease sites are unavailable due to natural shellfish bed definition
 - Does not allow expedited leasing by using the surveyed boundaries of an older lease site footprint.

8. Waive natural shellfish bed designation after 10 years of a shellfish lease termination date and allow re-application for those leases **(requires statutory change)**
 - + Encourage the use of bottom once deemed as a shellfish lease
 - + Less obstacles faced by private shellfish aquaculture industry to hold a lease
 - + Expedite the shellfish lease process
 - Takes away shellfish beds from potential public bottom harvesters
 - Develop policy on issuing leases without bias

9. Establish grace periods for planting/production requirements when a lease is transferred to meet standards **(requires statutory change)**
 - + Expedite the shellfish lease process
 - + Less startup cost for private culturists that are transferred the lease
 - + Avoid leasing more public trust bottom
 - Could be an incentive for original lease holder to not meet planting/production requirements

- 10 Waive survey requirements on terminated leases when applying within same footprint **(requires statutory change)**
 - + Expedite the shellfish lease process
 - + Less startup cost for private culturists
 - Ability to replicate exact corner locations of pre-existing leases
 - Would require verification of survey before entering into contract; cost

VIII. RECOMMENDATION

MFC Selected Management Strategy

- Establish a rule to support extensions where “Acts of God” prevent a lease holder from making production, with a two-year extension and only one extension allowed per term **(rule change required)**
- Allow leases returned to the state to remain delineated for a period of one year to allow the pre-existing leased bottom to be re-issued to other shellfish growers **(requires statutory change)**
- Improve public notice of proposed lease applications on the physical lease, at fish houses, and/or through electronic notices.
- Allow a maximum of 10 acres in both Mechanical Methods Prohibited Areas and Mechanical Methods Areas **(rule change required)**

NCDMF and Advisory Committee

- Establish a rule to support extensions where “Acts of God” prevent a lease holder from making production, with a two-year extension and only one extension allowed per term **(rule change required)**
- Allow leases returned to the state to remain delineated for a period of one year to allow the pre-existing leased bottom to be re-issued to other shellfish growers **(requires statutory change)**
- Improve public notice of proposed lease applications on the physical lease, at fish houses, and/or through electronic notices.

NCDMF

- Status quo (Maintain five acres within a Mechanical Methods Prohibited Area and ten acres within a Mechanical Methods Area, not to exceed 50 acres)

Advisory Committee

- Allow a maximum of 10 acres in both Mechanical Methods Prohibited Areas and Mechanical Methods Areas **(rule change required)**

IX. LITERATURE CITED

Kobell, R. 2014. Oyster aquaculture in Maryland, Virginia hit some snags in 2014. Bay Journal. Chesapeake Bay Media Service. November 6, 2014.
http://www.bayjournal.com/article/oyster_aquaculture_in_md_va_hit_some_snags_in_2014.

Prepared by: Greg Allen, greg.allen@ncdenr.gov, 252-473-1512 and Steve Murphey, steve.murphey@ncdenr.gov, 252 -726-7021.
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12.12 REQUIREMENTS FOR SHADING MOLLUSCAN SHELLSTOCK¹⁷

February 18, 2016

I. ISSUE

Elevated shellfish temperatures from direct exposure to sunlight can result in heat stress, cold shock, increased mortality, market loss, and rapid growth of environmental pathogens. This issue paper explores the use of shading to reduce these negative effects and provide an additional barrier to adulterants both while on the boat and during vehicle transport to the dealer.

II. ORIGINATION

The Oyster and Hard Clam AC recommended this issue at the September 8, 2014 meeting.

III. BACKGROUND

Certain harvest practices in the North Carolina clam and oyster fishery can result in shellstock (shell-on, live oysters and clams), that are exposed to direct sunlight heating for extended periods. This exposure can occur both on the harvest vessel and in the truck or conveyance used to deliver the product to a shellfish dealer. Shellfish Sanitation inspectors have measured internal temperatures in excess of 95°F in clams and oysters upon delivery to a dealer in a truck. Such occurrences are not uncommon when harvesters expose shellstock to direct sunlight for several hours. Dark colored vessels and truck bodies can increase this heating. Because the peak harvest season for hard clams occurs during summer months, the negative effects of elevated shellfish temperatures are felt most by this industry.

In addition to heat stress, when shellstock clams with internal temperatures above 85°F are rapidly cooled they experience a physiological stress referred to as cold shock (Granata et al. 2014). Granata et al (2014) observed in an experimental trial during a tempering study that clams held at 90°F for 5 hours and then refrigerated at 45°F experienced a 1.8% mortality after one day, 4.6% after 7 days and 89% after 14 days in cold storage. Local dealers often report much higher mortalities than this study. Clams appear fine for a day or two, but significant mortality can occur days after harvest resulting in reduced shelf life or dead clams upon arrival at the shipper's destination.

Oysters can also experience cold shock but appear to be less susceptible to significant mortalities. The FDA have shown success with ice slurry dips for oysters in the Gulf region to reduce growth of *Vibrio* bacteria levels by rapid cooling. Reportedly, little cold shock mortality occurred with the oysters (NSSP Model Ordinance 2013). Because the vast majority of oysters in North Carolina are harvested during October through March, direct sunlight exposure is not as intense and air temperatures are much cooler. However, elevated temperatures in both clams and oysters after harvest can cause rapid growth of environmental *Vibrio* bacteria, some of which can be pathogenic at high levels.

Currently a maximum of 12 hours from harvest to delivery to a dealer are allowed for shellstock clams harvested during the year, and oysters harvested October through May. Once received by a dealer, the shellfish must be under refrigeration within 2 hours. Because of heat stress,

¹⁷ Presented to: PDT on 12/11/14, 8/13/15, & 1/7/16; AC on 1/5/15, 3/9/15, 9/14/15, & 1/4/16; MRT on 9/21/15 & 1/11/16; MFC on 11/20/15 and 2/18/16.

shellfish dealers often have to use this time to “temper” clams by placing them in cool shady locations, blowing cool air on them with fans etc., before putting them into a cooler. This reduces cold shock but is not effective if clams have experienced excessive temperature stress. If clams are received late, it can extend the time-to-temperature requirements and cause dealers to choose between violating this rule, and reducing mortality in their clams. Larger dealers sell clams by volume with a margin of pennies per clam. Significant mortality after shipment from the effects of heat stress and cold shock can reduce or eliminate profits for entire shipments and result in monetary loss to the dealer.

From a public health perspective, shading is required when “deemed appropriate” by a state under new NSSP requirements. These requirements have been put in place to reduce post-harvest growth of environmental *Vibrio* bacteria. The CDC have stated that *Vibrio* illnesses are on the rise and in particular *Vibrio parahaemolyticus* illnesses. *Vibrio* bacteria can grow when exposed to temperatures above 50°F and can double every hour at temperatures above 90°F (Figure 12.12.1). Current language in the NSSP Model Ordinance requires that states “shall consider the need for shading in developing *Vibrio* Control plans. Shading shall be required when deemed appropriate by the Authority” (state).” North Carolina oysters harvested from June through September, from shellfish leases and franchises, fall under a *Vibrio parahaemolyticus* (Vp) control plan which currently does not require shading. Exposure to direct sunlight under this plan is limited due to the five-hour maximum time limit from harvest to temperature control by a dealer. However, direct sunlight is also at its highest intensity during the summer so shading would provide some limited slowing in the post-harvest growth of *Vibrios*.

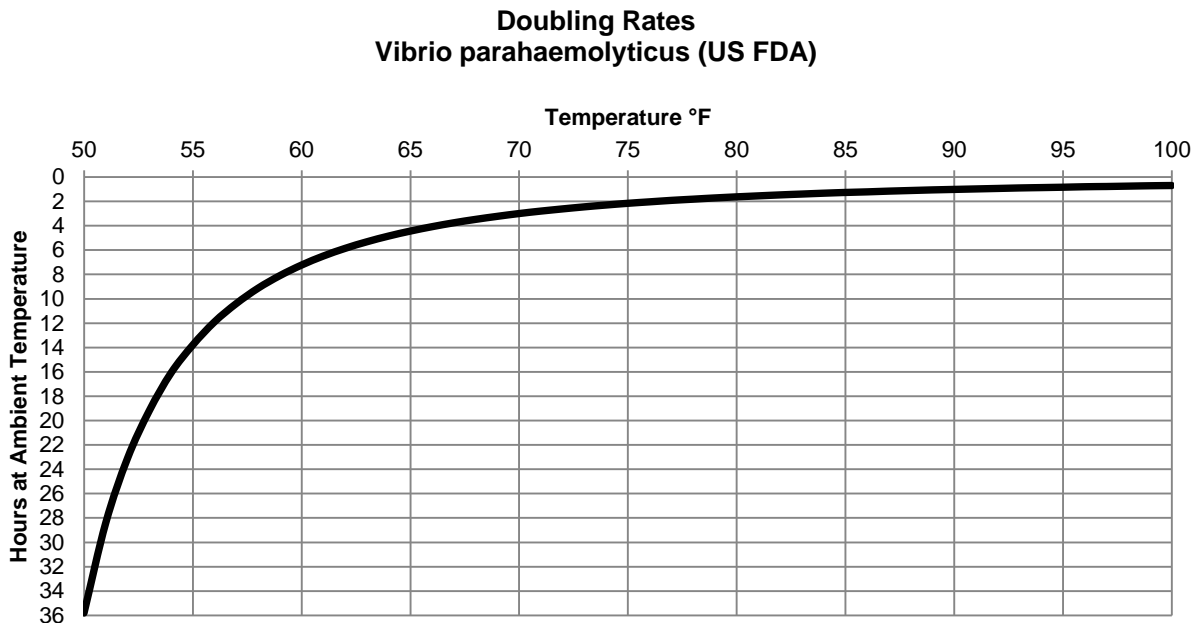


Figure 12.12.1. *Vibrio parahaemolyticus* doubling rates. Interstate Shellfish Sanitation Conference *Vibrio* Control Plan Guidance Template, 2008.

Beginning in 2015 new NSSP requirements will include clams in the *Vibrio* risk assessment required by shellfish producing states. In the event North Carolina has 2 or more *Vibrio parahaemolyticus* cases from consumption of commercially harvested clams from a single growing area, time to temperature requirements similar to those under the oyster Vp Control Plan, or area closures would be required.

There are dozens of environmental *Vibrio* bacteria species. Several have been linked to shellfish consumption illnesses including but not limited to: *V. vulnificus*, *V. parahaemolyticus*, *V. mimicus*, *V. cholera (non-01)*, and *V. alginolyticus*. To date, North Carolina commercially harvested clams have been associated in two *Vibrio mimicus* cases in Maryland in 2014. As the name implies, *V.mimicus* produces symptoms that mimic that of *Vibrio cholera*. In addition to these two cases there has been one confirmed *Vibrio parahaemolyticus* case from recreational harvest in 2004 and one associated recreational harvest *Vibrio* case of unknown species in 2013. North Carolina has had several *Vibrio vulnificus* wound infection cases but no confirmed commercially or recreational harvested shellfish consumption cases. Because most of these illnesses are self-limiting, the CDC estimate the majority of *Vibrio parahaemolyticus* cases go unreported. Studies by Pfeffer et al. (2003), Blackwell and Oliver (2008), Froelich et al. (2012) and others have shown potentially pathogenic species of *Vibrio parahaemolyticus* and *Vibrio vulnificus* are common in North Carolina coastal areas.

Shading is a prudent public health measure to reduce temperatures of clams harvested during the summer and slow post-harvest growth of the bacteria. To some degree, shading is required in many shellfish producing states from the Northeast to the Pacific Northwest. Table 12.12.1 outlines shading requirements for our neighboring states.

Table 12.12.1. Shading requirements for shellfish harvested in Maryland, Virginia, and South Carolina.

State	Shading requirements and supporting information
Maryland	Oysters only (report limited clam harvest) Shading required from June 1 – September 30 for private leaseholder operations anywhere harvested oysters are stored No public harvest during June 1 – September 30.
Virginia	Clams and oysters Shading required May 1 – September 30 on all harvest vessels Required for public or private area harvest
South Carolina	Clams and oysters Shading or covering required during transportation to dealer (vehicle) year round Shading is required when shellfish are left on dock No shading requirement for vessels No oyster harvest outside of oyster season

IV. AUTHORITY

N.C. General Statutes

- 113-134 Rules
- 113-182 Regulation of fishing and fisheries
- 113-221.1 Proclamations; emergency review

N.C. Marine Fisheries Commission Rules May 1, 2015 (15A NCAC)

03K. 0110 Public health and control of oysters, clams, scallops, and mussels

V. DISCUSSION

Shading is a reasonable and cost effective way of reducing heat stress and post-harvest bacterial growth in clams and oysters. By using proper shading during warmer months of the year (May or June through September), dealers could expect lower mortality especially in clams, perhaps also in oysters, and would also result in a safer shellfish product. A pitfall of shading is that improperly deployed shading could actually raise the temperature or trap heat and not allow air cooling. An example would be a dark tarp directly laid over shellfish or storage in dark colored enclosed containers such as truck tool box.

Harvesters in states that require vessel shading use a wide variety of shading methods, but vessel canopy shading appears to be very popular and effective. Canopies can be commercial grade tops or as simple as a PVC frame with a tarp below which the shellfish are stored. Some shading devices are fixed while others are removable or retractable. Basic requirements for materials, spacing above shellfish, and seasonal use would need to be developed for vessel shading to allow industry flexibility in developing workable solutions at a minimal cost.

For shading during open vehicle transport to a dealer (such as a pick-up truck), shading options might include reflective tarps, or wet blanket-tarp combinations. Provided the wetting is done with potable water or seawater from approved sources, this method is safe and may provide some evaporative cooling as well as protection from direct sunlight.

Heat stress and temperature abuse has been observed to be most common during transport of the clams to a certified dealer during the summer months. Pick-up trucks are a common conveyance and clams can be heated to in excess of 90°F in a relatively short period of time. Black truck bed covers can exacerbate heating during the hot days of summer. While oysters harvested during the summer are under strict time to temperature requirements, it would be both reasonable and prudent to explore shading requirements for shellstock clams during these same months because harvesters have up to 12 hours before they have to deliver to a dealer. This requirement would add value by both decreasing mortality due to heat stress and subsequent cold shock, and provide added public health protection by reducing post-harvest growth of *Vibrio* bacteria.

VI. PROPOSED RULE(S)

No recommendations require rule changes at this time.

VII. PROPOSED MANAGEMENT OPTIONS

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

1. Status quo (Continue with no shading requirements)
 - + No additional burden on the harvester
 - + Rules consistent with traditional practices
 - Clams would continue to experience heat stress during summer months, with cold shock and increased mortality as a result
 - There would be no public health benefit from reduced growth of environmental *Vibrio* bacteria in oysters and clams due to shading
 - Loss of revenue to dealers due to heat stress mortality and shelf life impacts
2. Require shading for clams only during June through September on vessel and transport

vehicle to dealer

- + Heat stress to clams would be reduced
- + Reduces the severity of cold shock and associated mortality
- + Provides additional public health benefit of reduced post-harvest growth of environmental *Vibrio* bacteria in clams
- + Reduces revenue loss to dealers due to less heat stress mortality in clams
- Would add costs and burden to the clam fisherman
- Would alter traditional clam harvest practices
- There would be no public health benefit from reduced growth of environmental *Vibrio* in oysters due to shading
- Could exacerbate heat stress if improperly deployed for clams

3. Require shading for clams and oysters during June through September on vessel and transport vehicle to dealer

- + Heat stress to clams and oysters would be reduced
- + Reducing the severity of cold shock in clams and associated mortality.
- + Provides additional public health benefit of reduced post-harvest growth of environmental *Vibrio* bacteria in both oysters and clams
- + Reduces revenue loss to dealers due to reduced heat stress mortality
- +/- Unknown effect on oysters due to reduced heat stress but may be beneficial in reducing mortality
- Would add costs and burden to the fisherman
- Would alter traditional clam harvest practices
- Would require changes to summer oyster harvest practice
- Could exacerbate heat stress if improperly deployed for oysters and clams

4. Require shading for clams and oysters during transport to dealer only (in vehicle) during June through September

- + Provides a reduction in heat stress and associated effects
- + Provides additional public health benefit of reduced post-harvest growth of environmental *Vibrio* bacteria in oysters and clams but to a lesser degree than Option 2 or 3 due to the time the shellfish were exposed to direct sunlight on the vessel
- + Depending on initial shellfish temperature after unloaded from the vessel, shading would reduce loss of revenue due to heat stress mortality
- +/- Unknown effect on oysters due to reduced heat stress but may be beneficial in reducing mortality
- Would add minimal costs and burden to fishermen transporting to dealer
- Could exacerbate heat stress if improperly deployed for oysters and clams

5. Implement shading requirements for clams during transport to a dealer or storage on a dock during June through September. These requirements would be implemented as a public health protection measure under 15A NCAC 03K .0110 by proclamation annually

- + Provides public health protection by reducing post-harvest growth of naturally occurring *Vibrio* bacteria.
- + Provides a reduction in heat stress and associated effects
- + Depending on initial shellfish temperature after unloading from the vessel, shading would reduce loss of revenue due to heat stress mortality.
- Would add minimal costs and burden to fishermen transporting to dealer
- Could exacerbate heat stress if improperly deployed for oysters and clams

VIII. RECOMMENDATIONS

MFC Selected Management Strategy

- Implement shading requirements for clams on a vessel, during transport to a dealer, or storage on a dock during June through September. These requirements would be implemented as a public health protection measure under 15A NCAC 03K .0110 by proclamation (Attachment 12.12.1) annually. *

NCDMF and Advisory Committee

- Implement shading requirements for clams on a vessel, during transport to a dealer, or storage on a dock during June through September. These requirements would be implemented as a public health protection measure under 15A NCAC 03K .0110 by proclamation (Attachment 12.12.1) annually. *

*Note: The AC's initial recommendation included that AC members work with NCDMF staff to develop the shading language. Staff worked with Mr. Cummings and presented the language as seen in Attachment 12.12.1 and took it back to the AC who agreed with what was developed.

IX. LITERATURE CITED

Blackwell, K. D., J. D. Oliver, 2008. The Ecology of *Vibrio vulnificus*, *Vibrio cholera*, and *Vibrio parahaemolyticus* in North Carolina Estuaries. *Journal of Microbiology*. 46 iss. 2: 146-153.

Froelich, B. A., T. Williams, R. T. Noble, J. D. Oliver, 2012. Apparent Loss of *Vibrio vulnificus* from North Carolina Coincides with Drought-Induced Increase in Salinity. *Applied and Environmental Microbiology*. 78 (11): 3885-3889.

Granata, L. A., D. W. Bourne, G. J. Flick Jr., M. Peirson, T. Riley, R. E. Croonenberghs, and J. Kensler. 2013. Effect of Cooling Rates and Temperatures on Quality and Safety of Quahog Clams (*Mercenaria mercenaria*). *Journal of Food Protection*. 77: 843-848.

National Shellfish Sanitation Program (NSSP). 2013. Model Ordinance. Guide for the Control of Shellfish Harvesting. United States Food and Drug Administration, Center for Food Safety and Applied Nutrition. Washington, DC. (www.issc.org)

Pfeffer, C. S., M. F. Hite, J. D. Oliver. 2003. Ecology of *Vibrio vulnificus* in Estuarine Waters of Eastern North Carolina. *Applied Environmental Microbiology*. 69 (6): 3526-3531.

Prepared by: Steve Murphey, steve.murphey@ncdenr.gov, (252) 808-8155
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December 12, 2014
February 13, 2015
April 20, 2015
August 18, 2015
September 22, 2015
February 18, 2016

Attachment 12.12.1.

This language was presented to the Oyster and Hard Clam Advisory Committee on March 9, 2015 for further discussion since it was part of the initial Advisory Committee recommendation to this issue. The initial AC recommendation was: Request the PDT work with the Advisory committee to develop shading language (Oyster and Hard Clam AC meeting on 1/5/15). Steve Murphey gave an update to show the requested follow up on shading requirements for shellfish. Murphey talked with Bob Cummings to develop the shading language. They discussed two styles for shading: 1. canopy type, or 2. covering the product with light colored fabric or tarp. Once the Marine Fisheries Commission recommends a management strategy, then the Division can put the language into proclamation. Keep it in proclamation so that it has flexibility for the industry.

The information provided to the AC on 3/9/12 for the proclamation is provided below.

TIME PERIOD

The following restrictions are in effect for all commercial clam harvesting operations including transportation to a licensed dealer **for the time period beginning June 1, 2015 through September 30, 2015**

Relaying and transplanting activities are not considered harvesting operations

SHADING CLAMS

It is unlawful to fail to protect clams from sun exposure during harvesting, storage and transport to a licensed dealer by:

- (a) Providing shading over the area where the harvested clams are stored on the harvest vessel, any floating container where the clams are not submerged, transportation conveyance or;
- (b) Directly covering the clams with a light colored, non-toxic material such as a tarp or fabric during the operations in (a).
- (c) This restriction will apply at all times during the designated time period

GENERAL INFORMATION

The intent of this proclamation is to prevent heat buildup in clams from direct sunlight radiation following harvest, and during storage and transportation to the dealer. Elevated temperatures in clams can cause rapid growth of pathogenic *Vibrio* bacteria as well as heat stress that causes excessive mortality in the clams.

Adequate air space should be left between shading canopies to reduce heat buildup. Direct coverings such as tarps or fabrics shall be white or a similar light color to prevent heat buildup. During the summer months, direct heating from the sun can occur even on overcast days so shading must be provided from June 1 through September 30 at all times during harvesting, storage and transport to a licensed dealer.

Licensed shellfish dealers are required to keep all shellfish under mechanical refrigeration including delivery conveyances.

13.0 SELECTED MANAGEMENT STRATEGIES AND RESEARCH RECOMMENDATIONS

13.1 SELECTED MANAGEMENT STRATEGIES

The selected management strategies and research needs listed below are organized according to the General Problem Statements in Section 5.2. Each strategy is followed by a reference to the Principal Issue(s) and Management Options from Section 12.0 and indicated in parentheses that supports it, followed by which Objective(s) it addresses from Subsection 4.1.

13.1.1 INSUFFICIENT DATA

NCDMF will only be able to approximate management that prevents overfishing and achieves sustainable harvest until necessary data are collected. Data are lacking from the recreational fishery and some life history aspects of the population to provide a stock assessment. While landings records reflect population abundance to some extent, the relationship is confounded by changes in harvest effort and efficiency. Fishery-dependent and independent monitoring programs to collect biological data to complement trip ticket landings information occurs in Core Sound and needs to be expanded to more areas in the state. Very limited data is collected for the recreational harvest of hard clams. A socioeconomic survey for the recreational hard clam fishery is necessary to determine the economic impacts and demographics of this user group. The socioeconomic survey of the hard clam commercial fishery should be continued and updated periodically to determine the specific business characteristics, the economics of working in the fishery, fishery demographics, issues of importance for commercial participants, and attitudes towards management of the fishery.

[(Section 6.0 and Section 9.0), (Objectives 1, 3, 6, and 7)]

13.1.2 MANAGEMENT OF PUBLIC BOTTOM

The hard clam fishery has been managed through harvest and size limits, and gear and area restriction. The management program needs to be evaluated and modified as new information becomes available. Rules specific to hard clam management on public bottom should be periodically reviewed to clarify the intent and reflect changes concurrent with new information.

[(Section 12.0), (Objectives 1, 4, 6, and 7)]

13.1.2.1 ISSUE: CONSIDER INCREASING THE RECREATIONAL MAXIMUM DAILY HARVEST LIMIT

PROPOSED MANAGEMENT OPTIONS

1. Status quo (Continue the daily harvest limit for recreational purposes at 100 clams per person per day not to exceed 200 per clams per vessel per day)
2. Increase the daily vessel maximum recreational clam harvest limit and maintain the daily personal harvest limit of 100 clams per person per day for all recreational participants **(rule change required)**
3. Increase the daily vessel maximum recreational harvest limit for clams for just recreational participants under a for-hire license with six or fewer participants and maintain the 200 clam maximum daily vessel limit for all other recreational participants **(rule change required)**

4. Eliminate the daily vessel maximum recreational harvest limit for clams but maintain the daily individual harvest limit at 100 clams per person per day for all recreational participants **(rule change required)**
5. Use a volumetric measurement for the individual and vessel recreational clam daily harvest limit **(rule change required)**

MANAGEMENT RECOMMENDATIONS

MFC Selected Management Strategy

- Status quo (Continue the daily harvest limit for recreational purposes at 100 clams per person per day not to exceed 200 per clams per vessel per day)

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- Increase the daily vessel maximum recreational clam harvest limit to 400 clams and maintain the daily personal harvest limit of 100 clams per person per day for all recreational participants **(rule change required)**

13.1.2.2 ISSUE: MANAGEMENT OF PUBLIC MECHANICAL CLAM HARVEST

PROPOSED MANAGEMENT OPTIONS

1. Status quo (Maintain management of the mechanical clam harvest in existing areas from Core Sound south to Topsail Sound, including modifications to the mechanical clam harvest lines to exclude areas where oyster habitat and SAV habitat exist based on all available information)
2. Modify mechanical clam harvest lines to exclude areas no longer fished but are currently open to mechanical clam harvest
3. Modify mechanical clam harvest lines currently open to mechanical clam harvest with a wider buffer between the lines and where oyster habitat and SAV habitat exist, based on all available information
4. Increase rotation of mechanical harvest in existing sites
5. Rotation of current mechanical harvest areas with previously unopened areas **(rule change required)**
6. Shorten the mechanical clam harvest season
7. Eliminate all mechanical clam harvest areas
8. Remove the Pamlico Sound mechanical clam harvest area in rule no longer in use **(rule change required)**
9. Take latitude/longitude coordinates of the poles marking the open mechanical clam harvest area boundary in the New River, still with the flexibility to move a line to avoid critical habitats
10. Shorten or eliminate the minimum 25-foot distance requirement mechanical clam harvesters must maintain from privately marked and maintained navigation channels, docks, and piers
11. Expand the mechanical clam harvest areas **(rule change required)**

MANAGEMENT RECOMMENDATIONS

MFC Selected Management Strategy

- Status quo (Maintain management of the mechanical clam harvest in existing areas from Core Sound south to Topsail Sound, including modifications to the mechanical clam harvest lines to exclude areas where oyster habitat and SAV habitat exist based on all available information)
- Remove the Pamlico Sound mechanical clam harvest areas in rule no longer in use **(rule change required)**

change required)

- Take latitude/longitude coordinates of the poles marking the open mechanical clam harvest area boundary in the New River, still with the flexibility to move a line to avoid critical habitats
- Allow mechanical clam harvesters to have access to the bottom before maintenance dredging occurs

NCDMF and Advisory Committee

- Status quo (Maintain management of the mechanical clam harvest in existing areas from Core Sound south to Topsail Sound, including modifications to the mechanical clam harvest lines to exclude areas where oyster habitat and SAV habitat exist based on all available information)
- Remove the Pamlico Sound mechanical clam harvest areas in rule no longer in use (**rule change required**)
- Take latitude/longitude coordinates of the poles marking the open mechanical clam harvest area boundary in the New River, still with the flexibility to move a line to avoid critical habitats

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- Allow mechanical clam harvesters to have access to the bottom before maintenance dredging occurs

13.1.2.3 ISSUE: THE USE OF POWER HAULING EQUIPMENT IN THE HAND HARVEST OF HARD CLAMS

PROPOSED MANAGEMENT OPTIONS

1. Status quo (Maintain current definitions and enforcement of hand harvest methods)
2. Amend rules to set conditions allowing for the general use of power hauling equipment in the hand harvest of hard clams (**rule change required**)
3. Modify mechanical clam harvest lines to include additional waterbody areas where the use of power hauling equipment is the only mechanical harvest gear allowed through proclamation

MANAGEMENT RECOMMENDATIONS

MFC Selected Management Strategy

- Status quo (Maintain current definitions and enforcement of hand harvest methods)

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- Status quo (Maintain current definitions and enforcement of hand harvest methods)

13.1.2.4 ISSUE: CONSIDER THE ELIMINATION OF THE SHELLFISH LICENSE AND REQUIRE ALL SHELLFISH HARVESTERS TO HAVE A STANDARD COMMERCIAL FISHING LICENSE OR RETIRED STANDARD COMMERCIAL FISHING LICENSE

PROPOSED MANAGEMENT OPTIONS

1. Status quo
2. Increase the cost of the shellfish license to one-half the cost of a SCFL/RSCFL (**requires statutory change**)

3. Maintain the cost of the shellfish license allowing for harvest of all shellfish except oysters; require SCFL/RSCFL with a shellfish endorsement to harvest oysters **(requires statutory change)**
4. Cap the number of available shellfish licenses **(requires statutory change)**
5. Phase out the shellfish license; allowing time for license holders to show participation to be eligible for a SCFL/RSCFL **(requires statutory change)**
6. Eliminate the shellfish license and develop an apprenticeship program in place of a shellfish license **(requires statutory change)**
7. Eliminate the shellfish license and require a SCFL or RSCFL with a shellfish endorsement **(requires statutory change)**

MANAGEMENT RECOMMENDATIONS

MFC Selected Management Strategy

- Maintain the cost of the Shellfish License, establish a daily limit of 2 bushels of oysters per person with a maximum of 4 bushels of oysters per vessel off public bottom with the Shellfish License
- Pursue elimination of the Shellfish License for oysters only and require all oyster harvesters to have a Standard or Retired Commercial Fishing License with shellfish endorsement to harvest commercially **(requires statutory change)**
- Allow Shellfish License holders to be eligible to acquire a Standard Commercial Fishing License after they show a history of sale of shellfish. Continue to allow commercial harvest of all other shellfish as currently allowed

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- Maintain the cost of the shellfish license allowing for harvest of all shellfish except oysters; require Standard/Retired Commercial Fishing License with a shellfish endorsement to harvest oysters from public bottom **(requires statutory change)**
- From Highway 58 Bridge south to NC/SC state line, maintain a daily trip limit of 2 bushels of oysters per person maximum 4 bushels of oysters per vessel off public bottom for holders of the Shellfish License. Maintain the daily trip limit at 5 bushels of oysters per person for Standard/Retired Commercial Fishing License holders in the southern region

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- From Swan Point Marina south to the NC/SC state line, maintain a daily trip limit of two bushels of oysters per person maximum four bushels of oysters per vessel off public bottom from Highway 58 Bridge south only for holders of the Shellfish License. Maintain the daily trip limit at five bushels of oysters per person for SCFL and RSCFL holders in the southern region
- Allow Shellfish License holders to be eligible to acquire a SCFL after they show a history of sale of shellfish

13.1.3 PRIVATE CULTURE

The current shellfish lease program in North Carolina needs to be evaluated and changes implemented in order to be productive for culturists. Improvements in the allocation of leases and requirements for the continuance of leases are needed. Other issues of concern include the protection of shellfish lease and franchise rights, re-visiting the issues on lease prohibitions in certain water bodies, and consider modification to specific lease provisions.

[(Section 12.0), (Objectives 1, 2, 4, 5, 6 and 7)]

13.1.3.1 ISSUE: PROTECTION OF SHELLFISH LEASE AND FRANCHISE RIGHTS

PROPOSED MANAGEMENT OPTIONS

1. Status quo (Continue classifying larceny of shellfish from private bottom and damage to property from an aquaculture facility or operation as a Class A1 misdemeanor, which may include a fine of not more than \$5,000)
2. Support modification of G.S 113-208 and G.S 113-269 to add minimum fines for violations on shellfish leases and franchises **(requires statutory change)**
3. Support modification of G.S 113-269 to include protection to all shellfish leases and franchises, not just those with water column amendments **(requires statutory change)**
4. Modify Rule 15A NCAC 03O .0114 so that convictions under G.S. 113-208 or G.S. 113-269 would count as more than one conviction for license suspension or revocation purposes **(rule change required)**

MANAGEMENT RECOMMENDATIONS

MFC Selected Management Strategy

- Support modification of G.S. 113-208 and G.S. 113-269 to add minimum fines for violations on shellfish leases and franchises. With minimum fines set at \$500 for the first violation and \$1,000 for the second violation **(requires statutory change)**.
- Support modification of G.S. 113-269 to include protection to all shellfish leases and franchises, not just those with water column amendments **(requires statutory change)**
- Modify Rule 15A NCAC 03O .0114, regardless whether statute changes occur, so a first conviction under G.S. 113-208 or G.S. 113-269 the Fisheries Director shall revoke all licenses issued to the licensee **(rule change required)**

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- Support modification of G.S. 113-208 and G.S. 113-269 to add minimum fines for violations on shellfish leases and franchises. With minimum fines set at \$500 for the first violation and \$1,000 for the second violation **(requires statutory change)**.
- Support modification of G.S. 113-269 to include protection to all shellfish leases and franchises, not just those with water column amendments **(requires statutory change)**
- Modify Rule 15A NCAC 03O .0114, regardless whether statute changes occur, so a first conviction under G.S. 113-208 or G.S. 113-269 the Fisheries Director shall revoke all licenses issued to the licensee **(rule change required)**

13.1.3.2 ISSUE: DEFINING ADVERSE IMPACTS TO SUBMERGED AQUATIC VEGETATION FROM SHELLFISH LEASES AND FRANCHISES

PROPOSED MANAGEMENT OPTIONS

1. Status quo (Adhere to Regional Conditions of USACE NWP48 with no adverse effect to SAV from shellfish leases and following the 15% sparse SAV measure identified in the interim)
2. NCDMF/NMFS/USACE reevaluate benthic sampling protocol for shellfish lease investigations to ensure that the current sampling density of 50 one meter samples per acre is not excessive
3. NCDEQ/NCDMF issue shellfish leases in areas containing SAV

MANAGEMENT RECOMMENDATION

MFC Selected Management Strategy

- Status quo (Adhere to Regional Conditions of USACE NWP48 with no adverse effect to SAV from shellfish leases and following measure identified in the interim)

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- Status quo (Adhere to Regional Conditions of USACE NWP48 with no adverse effect to SAV from shellfish leases and following measure identified in the interim)

13.1.3.3 ISSUE: BRUNSWICK COUNTY SHELLFISH LEASE MORATORIUM

PROPOSED MANAGEMENT OPTIONS

1. Status quo (Continue the moratorium of shellfish leases in Brunswick County)
2. Allow shellfish leases in Brunswick County (**requires statutory change**)
3. Allow shellfish leases in Brunswick County, limiting acreage and availability (**requires statutory change**)

MANAGEMENT RECOMMENDATIONS

MFC Selected Management Strategy

- Continue the moratorium of shellfish leases in Brunswick County

NCDMF and Advisory Committee

- Continue the moratorium of shellfish leases in Brunswick County

13.1.3.4 ISSUE: MODIFY SHELLFISH LEASE PROVISIONS

PROPOSED MANAGEMENT OPTIONS

1. Status quo (Maintain current lease terms of 5 years with five-year production average)
2. Establish a seven-year period for the initial lease with the last five years of the lease averaged for production. Upon renewal, lease period returns to 5 years (**requires statutory change**)
3. Establish a rule to support extensions for where “Acts of God” prevent lease holder from making production, with a two-year extension and only one extension allowed per term. (**rule change required**)
4. Status quo (Maintain five acres within a MMPA and ten acres within a mechanical methods area, not to exceed 50 acres)
5. Allow ten acres per lease in MMPA (**rule change required**)
6. Increasing maximum of 50 acres of shellfish leased bottom per lease holder (**requires statutory change**)
7. Status quo (Once a lease is terminated it returns to public bottom and is assessed for future leases based on “natural shellfish bed” definition.)
8. Waive natural shellfish bed designation after ten years of a shellfish lease termination date and allow re-application for those leases (**requires statutory change**)
9. Establish grace periods for planting/production requirements when a lease is transferred to meet standards (**requires statutory change**)
10. Waive survey requirements on terminated leases when applying within same footprint (**requires statutory change**)

MANAGEMENT RECOMMENDATIONS

MFC Selected Management Strategy

- Establish a rule to support extensions for where “Acts of God” prevent lease holder from making production, with a two-year extension and only one extension allowed per term **(rule change required)**
- Allow leases returned to the state to remain delineated for a period of one year to allow the pre-existing leased bottom to be re-issued to other shellfish growers **(requires statutory change)**.
- Improve public notice of proposed lease applications on the physical lease, at fish houses, and/or through electronic notices
- Allow a maximum of ten acres in both mechanical methods prohibited areas and mechanical methods allowed areas **(rule change required)**

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- Establish a rule to support extensions for where “Acts of God” prevent lease holder from making production, with a two-year extension and only one extension allowed per term **(rule change required)**
- Allow leases returned to the state to remain delineated for a period of one year to allow the pre-existing leased bottom to be re-issued to other shellfish growers **(requires statutory change)**.
- Improve public notice of proposed lease applications on the physical lease, at fish houses, and/or through electronic notices

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- Status quo (Maintain five acres within a mechanical methods prohibited area and ten acres within a mechanical methods area, not to exceed 50 acres)

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- Allow a maximum of ten acres in both mechanical methods prohibited areas and mechanical methods allowed areas **(rule change required)**

13.1.4 ENVIRONMENT AND PUBLIC HEALTH

Adequate habitat and suitable water quality are imperative to the hard clam population. Support of the CHPP is essential in collaborating with other agencies such as, the CRC and the EMC to improve habitat and water quality coastwide. Sanitary controls are also established over all phases of the growing, harvesting, shucking, packing, and distribution of fresh and frozen shellfish, based on public health principles designed to prevent human illness associated with the consumption of hard clams. These recommendations should include ways to prevent or minimize potential negative impacts to shellfish growing waters and the prevention of human illnesses associated with the consumption of molluscan shellfish.

[(Sections 11.0 and 12.0), (Objectives 2, 4, and 5)]

13.1.4.1 ISSUE: REQUIREMENTS FOR SHADING MOLLUSCAN SHELLSTOCK

PROPOSED MANAGEMENT OPTIONS

1. Status quo (Continue with no shading requirements)
2. Require shading for clams only during June through September on vessel and transport

vehicle to dealer

3. Require shading for clams and oysters during June through September on vessel and transport vehicle to dealer
4. Require shading for clams and oysters during transport to dealer only (in vehicle) during June through September
5. Implement shading requirements for clams during transport to a dealer or storage on a dock during June through September. These requirements would be implemented as a public health protection measure under 15A NCAC 03K .0110 by proclamation annually

MANAGEMENT RECOMMENDATIONS

MFC Selected Management Strategy

- Implement shading requirements for clams on a vessel, during transport to a dealer, or storage on a dock during June through September. These requirements would be implemented as a public health protection measure under 15A NCAC 03K .0110 by proclamation annually.

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- Implement shading requirements for clams on a vessel, during transport to a dealer, or storage on a dock during June through September. These requirements would be implemented as a public health protection measure under 15A NCAC 03K .0110 by proclamation annually.

13.2 RESEARCH RECOMMENDATIONS

The following research recommendations were compiled from the Status of the Stock Section 6.0, the Socioeconomic Status of the Hard Clam Fishery Section 9.0, and the Environmental Factors Section 11.0 and issue papers listed in the Principal Issues and Management Options Section 12.0. The list below is presented in order as it appears. The PDT reviewed and prioritized the research recommendations in accordance to the suggestion by the Biological Review Team research committee. The AC reviewed the draft research recommendations on 9/14/15 and provided prioritization input as well. The Management Review Team determined the final ranking. If there were differences between the PDT and AC priorities then the middle priority level was chosen between the two, if there was only one level difference the AC priority was chosen. If one group chose to delete the research recommendation but the other prioritized the item then the research recommendation remained with the ranking. The prioritization of each research recommendation is designated either a **HIGH**, **MEDIUM**, or **LOW** standing. A low ranking does not infer a lack of importance but is either already being addressed by others or provides limited information for aiding in management decisions. A high ranking indicates there is a substantial need, which may be time sensitive in nature, to provide information to help with management decisions.

Many environmental considerations are applied throughout the CHPP and are not part of this list but are still considered very important to all shellfish. Specifically, the proposed implementation action on sedimentation within the CHPP are considered a high priority. Proper management of the hard clam resource cannot occur until some of these research needs are met, the research recommendations include:

- Support all proposed implementation actions under the priority habitat issue on sedimentation in the CHPP (Section 11.8) - **HIGH**
- Improve the reliability for estimating recreational shellfish harvest (Section 6.5) - **HIGH**

- Survey commercial shellfish license holders without a record of landings to estimate hard clam harvest from this group (Section 6.5) - **MEDIUM**
- Determine the consequences to hard clams from impacts to habitat due to harvest practices (Section 6.5) - **LOW**
- Develop regional juvenile and adult abundance indices (Section 6.5) - **HIGH**
- Complete socioeconomic surveys of recreational clam harvesters (Section 9.3) - **MEDIUM**
- Continue to complete socioeconomic surveys of commercial clam fishermen (Section 9.3) - **LOW**
- Support collaborative research to more efficiently track bacterial sources for land-based protection and restoration efforts (Section 11.8) - **MEDIUM**
- Quantify the relationship between water quality parameters and the cumulative effect of shoreline development units (Section 11.8) - **MEDIUM**
- Investigate impacts of clam trawls and escalator dredges on sandy bottom environments (Issue 12.2) - **LOW**
- Investigate the effects of mechanical harvest on clam recruitment and clam mortality in the mechanical harvest areas (Issue 12.2) - **MEDIUM**

14.0 LITERATURE CITED

- Abbot, R. T. 1974. American Seashells, 2nd Edition. van Nostrand Reinhold, New York. 663 pp.
- Adams, C., L. Sturmer, and A. Hodges. 2014. *Tracking the Economic Benefits Generated by the Hard Clam Aquaculture Industry in Florida*. University of Florida. Institute of Food and Agricultural Sciences Extension Program. Electronic Data Information Source Document FE961. <http://shellfish.ifas.ufl.edu/wp-content/uploads/2012-Clam-Economic-Impact.pdf>.
- American Fisheries Society (AFS). 2003. AFS Policy Statement #4: Sedimentation. http://www.fisheries.org/Public_Affairs/Policy_Statements.9/30/2003.
- Ansell, A. D. 1968. The rate of growth of the hard clam *Mercenaria mercenaria* (L) throughout the geographical range. *Journale de Conseil International pour l'Exploration de la Mer* . 31: 364-409.
- Ansell, A. D. and F. A. Loosmore. 1963. Preliminary observations on the relationship between growth, spawning and condition in experimental colonies of *Venus mercenaria* L. *Journale de Conseil International pour l'Exploration de la Mer*. 28: 285-294.
- Arnold, W. S., D. C. Marelli, T. M. Bert, D. S. Jones, and I. R. Quitmyer. 1991. Habitat-specific growth of hard clams *Mercenaria mercenaria* (L.) from Indian River, Florida. *Journal of Experimental Marine Biology and Ecology*. 147: 245-265.
- Atlantic States Marine Fisheries Commission (ASMFC). 1989. A procedural plan to control interjurisdictional transfers and introductions of shellfish. *Fisheries Management Report*. 13. 64 pp.
- ASMFC. 1992. South Atlantic commercial fishery monthly landings statistics and detailed shrimp program user documentation. South Atlantic Statistics Committee. Atlantic States Marine Fisheries Commission. Washington, D.C.
- Auster, P. J. and R.W. Langton. 1999. The effects of fishing on fish habitat. In: L. Benaka (ed.). *Fish habitat: essential fish habitat and rehabilitation*. American Fisheries Society. Bethesda, MD. Symposium 22. 150-187.
- Barnette, M. C. 2001. A review of the fishing gear utilized within the Southeast Region and their potential impacts on essential fish habitat. National Marine Fisheries Service.
- Bayer, E. and A. F. Chestnut. 1964. Preliminary report of studies on artificial culture of clams. North Carolina Department of Conservation and Development. Division of Commercial Fisheries, Special Scientific Report. 2. 7 pp.
- Beal, B. F. 1983. Predation of juveniles of the hard clam *Mercenaria mercenaria* (Linne) by the snapping shrimp *Alpheus heterochaelis* Say and *Alpheus normanni* Kingsley. *Journal of Shellfish Research*. 3: 1-10
- Berrigan, M., T. Candies, J. Cirino, R. Dugas, C. Dyer, J. Gray, T. Herrington, W. Keithly, R. Leard, J. R. Nelson, and M. Van Hoose. 1991. The oyster fishery of the Gulf of Mexico, United States: a regional management plan. Gulf States Marine Fisheries Commission. Ocean Springs, Mississippi. 24.

- Blackwell K. D. and Oliver J. D. 2008. The Ecology of *Vibrio vulnificus*, *Vibrio cholerae* and *Vibrio parahaemolyticus* in North Carolina estuaries. *Journal of Microbiology*.46(2): 146-153
- Bower, S. M., S. E. McGladdery, and L. M. Price. 1994. Synopsis of infectious disease and parasites of commercially exploited shellfish. *Annual Review of Fish Diseases*. 4: 1-200.
- Bricelj, V. M. and R. E. Malouf. 1980. Aspects of reproduction of hard clams (*Mercenaria mercenaria*) in Great South Bay, New York. *Proceedings of the National Shellfish Association*. 70: 216-229.
- Brooks, W. K. 1885. On the possibiity of an oyster farming industry in North Carolina. *Executive and Legislative Documents of the State of North Carolina*. Session 1885. 33-35.
- Cabaço, S., A. Alexandre, and R. Santos. 2005. Population-level effects of clam harvesting on the seagrass *Zostera noltii*. *Marine Ecology Progress Series*. 298: 123-129.
- Capuzzo. J. M. 1996. Biological effects of contaminants on shellfish populations in coastal habitat: A case history of New Bedford, MA. *In*: Sherman, K. (ed.). *Marine Ecosystem Management: The Northeast Shellfish*. Blackwell Science. Cambridge, MA.
- Carroll, J., C. J. Gobler, B. J. Peterson. 2008. Resource-restructured growth of eelgrass in New York estuaries: light limitation, and alleviation of nutrient stress by hard clams. *Marine Ecology Progress Series*. 369: 51-62.
- Carriker, M. R. 1959. The role of physical and biological factors in the culture of *Crassostrea* and *Mercenaria* in a salt-water pond. *Ecological Monographs*. 29(3): 219-266.
- Carteret County Crossroads. 2003. *Core Sound Shellfish Moratorium Information Sheet*. Report produced for Carteret County Crossroads.
- Castagna, M. A. 1970. Hard clam culture method developed at VIMS. *Marine Resources Advisory Series 4*. Virginia Institute of Marine Science, Gloucester Point, Va. 3 pp.
- Chanley, P. E. 1958. Survival of some juvenile bivalves in water of low salinity. *Proceedings of the National Shellfish Association*. 48: 52-65
- Chestnut, A. F. 1951a. Growth rates and movements of hard clams, *Venus mercenaria*. *Proceedings of the Gulf and Caribbean Fisheries Institute*. Fourth Annual Session. 49-59.
- Chestnut, A. F. 1951b. The oyster and other mollusks in North Carolina. *In*: Taylor, H. F. (ed.). *Survey of Marine Fisheries of North Carolina*. University of North Carolina Press. Chapel Hill, NC. 141-190.
- Chestnut, A. F. 1955a. A report of the mollusc studies conducted by the University of North Carolina Institute of Fisheries Research, 1948-1954. University of North Carolina. Institute of Fisheries Research. 66 pp.
- Coen, L. D. 1995. A review of the potential impacts of mechanical harvesting on subtidal and intertidal shellfish Resources. South Carolina Department of Natural Resources. Charleston, SC. 46 pp.

- Coen, L. D., R.D. Brumbaugh, D. Bushek, R. Grizzle, M.W. Luckenbach, M.H. Posey, S.P. Powers, and S.G. Tolley. 2007. Ecosystem services related to oyster restoration. *Marine Ecology Progress Series* 341: 303-307.
- Coen, L. D., M. W. Luckenbach, and D. L. Breitburg. 1999. The role of oyster reefs as essential fish habitat: A review of current knowledge and some new perspectives. In: Benaka, L. R. (ed.). *Fish Habitat: Essential Fish Habitat and Rehabilitation*. American Fisheries Society, Bethesda, MD. Symposium. 438-454.
- Crowell, B. 1998. Estuarine Shoreline Initiative: memorandum to the Coastal Resources Commission. Division of Coastal Management. Raleigh, NC. 16 pp.
- Cunningham, P. A., R. J. Curry, R. W. Pratt, and S. J. Stichter. 1992. Watershed planning in the Albemarle-Pamlico estuarine system. Report 92-05 – Fishing practices mapping. North Carolina Department of Environment, Health, and Natural Resources. North Carolina Division of Marine Fisheries. Environmental Protection Agency, National Estuary Program. 227 pp.
- Currin, C.A., W.S. Chappell, and A. Deaton. 2010. Developing alternative shoreline armoring strategies: The living shoreline approach in North Carolina. In: Shipman, H., Dethier, M.N., Gelfenbaum, G., Fresh, K.L., and Dinicola, R.S., eds. 2010. *Puget Sound Shorelines and the Impacts of Armoring—Proceedings of a State of the Science Workshop, May 2009*. U.S. Geological Survey Scientific Investigations Report 2010-5254. p. 91-102.
- Dahl, S. F. M. Perrigault, Q. Liu, J. L. Collier, D. A. Barnes, B. Allam. 2011. Effects of temperature on hard clam (*Mercenaria mercenaria*) immunity and QPX (Quahog Parasite Unknown) disease development: I. Dynamics of QPX disease. *Journal of Invertebrate Pathology*. 106: 314-321.
- Deaton, A., W. S. Chappell, K. Hart, J. O’Neal, and B. Boutin. 2010. North Carolina coastal habitat protection plan. North Carolina Department of Environment and Natural Resources. Division of Marine Fisheries, NC.
- Desbonnet, A., P. Pogue, D. Reis, J. Boyd, J. Willis, and M. Imperial. 1994. Vegetated buffers in the coastal zone - a summary review and bibliography. University of Rhode Island Graduate School of Oceanography. Narragansett, RI. Coastal Resources Center Technical Report. 2064. 72 pp.
- Diehl, S. 1992. Fish predation and benthic community structure: the role of omnivory and habitat complexity. *Ecology*. 73: 1646-1661.
- Duagbjerg, N. Phylogeny of Some of the Major Genera of Dinoflagellates Based on Ultrastructure and Partial LSU rDNA Sequence Data, Including the Erection of Three New Genera of Unarmored Dinoflagellates. *Phycologia*. 2001;39:302-317.
- Dumbauld, B. R., J. L. Ruesink, and S. S. Rumrill. 2009. The ecological role of bivalve shellfish aquaculture in the estuarine environment: A review with application to oyster and clam culture in West Coast (USA) estuaries. *Aquaculture* 290 (3-4): 196-223.
- Eldridge, P. J. and A. G. Eversole. 1982. Compensatory growth and mortality of the hard clam, *Mercenaria mercenaria* (Linnaeus, 1758). *Veliger*. 24: 276-278.

- Ensign, S. E. and M. A. Mallin. 2001. Stream water quality following timber harvest in a Coastal Plain swamp forest. *Water Research*. 35: 3381-3390.
- Environmental Protection Agency (EPA). The Comprehensive Conservation and Management Plan of the Albemarle-Pamlico Estuarine Study.
- Everett, R. A., G. M. Ruiz, and J. T. Carlton. 1995. Effect of oyster mariculture on submerged aquatic vegetation: An experimental test in a Pacific Northwest estuary. *Marine ecology progress series*. Oldendorf 125 (1-3): 205-217.
- Eversole, A. G. 2001. Reproduction in *Mercenaria mercenaria*. In: Kraeuter, J. N. and M. Castagna (eds.). *Biology of the Hard Clam*. Elsevier Science. B.V. Amsterdam. 221- 260.
- Eversole, A. G., C. Cordes, and D. Moran. 1987. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrate (South Atlantic): Hard Clam. United States Fish and Wildlife Service Biological Services Program FWS/OBS-82/11.12. 33 pp.
- Eversole, A. G., L. W. Grimes, and P. J. Eldridge. 1986. Variability in growth of hard clams, *Mercenaria mercenaria* in a South Carolina estuary. *American Malacology Bulletin*. 4: 149-155.
- Eversole, A. G., W. K. Michener, and P. J. Eldridge. 1984. Gonadal condition of hard clams in a South Carolina estuary. *Proceedings from the Annual Conference in the Southeast Associations of Fisheries and Wildlife Agencies*. 38: 495-505.
- Federal Register. 2012. Reissuance of Nationwide Permits; Notice. Department of Defense Vol. 77 No. 34 Part III: 10228-10232.
- Fegley, S. R. 2001. Demography and dynamics on Hard Clam Populations. In: J. N. Kraeuter and M. Castagna (eds.). *Biology of the Hard Clam*. Elsevier Science. B.V. Amsterdam. 383-418.
- Ferguson, R. L. and L. L. Wood. 1994. Rooted vascular aquatic beds in the Albemarle-Pamlico estuarine system. National Marine Fisheries Service. National Oceanic and Atmospheric Administration. Beaufort, NC. 94-02. 103 pp.
- Fonseca, M. S., W. J. Kenworthy, and G. W. Thayer. 1998. Guidelines for the conservation and restoration of seagrasses in the United States and adjacent waters. National Oceanic and Atmospheric Administration. Silver Springs, MD. Coastal Ocean Program Decision Analysis Series. 12. 222 pp.
- Ford, S. E. 2001. Pest, parasites, diseases, and defense mechanisms of the hard clam, *Mercenaria mercenaria*. In: Kraeuter, J. N. and M. Castagna (eds.). *Biology of the Hard Clam*. Elsevier Science. B.V. Amsterdam. 591-628.
- Fowler, P. K. 1989. Impacts of the 1987-88 North Carolina Red Tide. *Journal of Shellfish Resources*. 8: 440.
- Fritz, L. W. 2001. Shell Structure and Age Determination. In: Kraeuter, J. N. and M. Castagna (eds.). *Biology of the Hard Clam*. Elsevier Science. B.V. Amsterdam. 53-76.

- Froelich, B.A., T. Williams, R.T. Noble, J.D. Oliver. 2012. Apparent Loss of *Vibrio vulnificus* from North Carolina Coincides with Drought-Induced Increase in Salinity. *Applied and Environmental Microbiology*. 78 (11): 3885-3889.
- Gerritsen, J., A. F. Holland, and D. E. Irvine. 1994. Suspension-feeding bivalves and the fate of primary production: An estuarine model applied to Chesapeake Bay. *Estuaries*. 17(2): 403-416.
- Gilbert, R.O. 1987. *Statistical methods for environmental pollution monitoring*. Van Nostrand Reinhold, New York. 320 p.
- Gilliam, J. W., D. L. Osmond, and R. O. Evans. 1994. Riparian wetlands and water quality. *Journal of Environmental Quality*. 23: 896-900.
- Grabowski, J.H. 2002. The influence of trophic interactions, habitat complexity, and landscape setting on community dynamics and restoration of oyster reefs. PhD thesis, University of North Carolina, Chapel Hill, NC.
- Granata, L. A., D. W. Bourne, G. J. Flick Jr., M. Peirson, T. Riley, R. E. Croonenberghs, and J. Kensler. 2013. Effect of Cooling Rates and Temperatures on Quality and Safety of Quahog Clams (*Mercenaria mercenaria*). *Journal of Food Protection*. 77: 843-848.
- Groffman, P. M., A. J. Gold, T. P. Husband, R. C. Simmons, and W. R. Eddleman. 1991. An investigation into multiple uses of vegetated buffer strips. Providence, RI. NBP-91-63.
- Gunnell, John R., A. B. Rodriguez, and B. A. McKee. 2013. How a marsh is built from the bottom up. *Geology*, August 1, 2013. 41: 943-944.
- Guthrie, J. F. and C. W. Lewis. 1982. The clam-kicking fishery of North Carolina. *Marine Fisheries Review*. 44(1): 16-21.
- Hackney, C. T., J. G. Grimley, M. Posey, T. Alpin, and J. Hyland. 1998. Sediment contamination North Carolina's estuaries. Center for Marine Research. University of North Carolina-Wilmington. 198. 59 pp.
- Hadley, N. and L. Coen. 2006. Hard clams. *Comprehensive Wildlife Conservation Strategy*. South Carolina Department of Natural Resources. <http://www.dnr.sc.gov/cwcs/pdf/Hardclam.pdf>. 8 pp.
- Harte, M. E. 2001. Systematics and Taxonomy. In: Kraeuter, J. N. and M. Castagna (eds.). *Biology of the Hard Clam*. Elsevier Science. B.V. Amsterdam. 3-51.
- Heil, C. A., and K. A. Steidinger. 2009. Monitoring, management, and mitigation of *Karenia* blooms in the eastern Gulf of Mexico. *Harmful Algae* 8(4):611-617.
- Hogarth, B. 1989. Overview of the mechanical harvest of clams. North Carolina Department of Environment, Health, and Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, NC. 5 pp.

- Hudson, K. and T. Murray. 2014. *Virginia Shellfish Aquaculture Situation and Outlook Report*. Virginia Institute of Marine Science. Virginia Sea Grant Marine Extension Program. VIMS Marine Resource Report No. 2014-5.
http://www.vims.edu/research/units/centerspartners/map/aquaculture/docs_aqua/20140411_Shellfish_Aq_Report.pdf
- Irlandi, E. A. 1994. Large- and small-scale effects of habitat structure on rates of predation: How percent coverage of seagrass affects rates of predation and siphon nipping on an infaunal bivalve. *Oecologia* 98(2):176-183.
- Irlandi, E. 1996. The effects of seagrass patch size and energy regime on growth of a suspension-feeding bivalve. *Journal of Marine Research*. 54(1): 161-185.
- Irlandi, E. A. 1997. Seagrass patch size and survivorship of an infaunal bivalve. *Oikos*. 78(3): 511-518.
- Irlandi, E., and C. Peterson. 1991. Modification of animal habitat by large plants: mechanisms by which seagrasses influence clam growth. *Oecologia* 87(3): 307-318.
- Irlandi, E., and M. Mehlich. 1996. The effect of tissue cropping and disturbance by browsing fishes on growth of two species of suspension-feeding bivalves. *Journal of Experimental Marine Biology and Ecology*. 197(2): 279-293.
- Jernigan, J. A. 1983. Memo to the submerged lands policy task force. October 14, 1983. State of North Carolina. Department of Justice. 7 pp.
- Joergensen, C. B. 1990. Bivalve filter feeding: Hydrodynamics, bioenergetics, physiology and ecology. Olsen and Olsen. Fredensborg, Denmark. 140 pp.
- Kaiser, M. J., Broad, G., & Hall, S. J. 2001. Disturbance of intertidal soft-sediment benthic communities by cockle hand raking. *Journal of Sea Research*. 45(2): 119-130.
- Kelaher, B.P. 2003. Changes in habitat complexity negatively affect diverse gastropod assemblages in coralline algal turf. *Oecologia*. 135: 431–441.
- Kennedy, V. S. and L. L. Breisch. 1981. Maryland's oysters: research and management. University of Maryland Sea Grant Program. College Park, MD. UM-SG-TS-81-04.
- Kerswill, C. J. 1941. Some environmental factors limiting growth and distribution of the quahaug *Venus mercenaria* L. Ph.D. Thesis. University of Toronto. Ontario, Canada. 104 pp.
- Kobell, R. 2014. Oyster aquaculture in Maryland, Virginia hit some snags in 2014. Bay Journal. Chesapeake Bay Media Service. November 6, 2014.
http://www.bayjournal.com/article/oyster_aquaculture_in_md_va_hit_some_snags_in_2014.
- Kraeuter, J. H. 2001. Predators and predation. In: Kraeuter J. N. and M. Castagna (eds). *Biology of the Hard Clam*. Elsevier Science. B.V. Amsterdam. 441-590.
- Kraeuter, J. H. and M. Castagna. 1980. Effects of large predators on the field culture of the hard clam, *Mercenaria mercenaria*. *Fishery Bulletin*. 78: 538-541.

- Kusek, K. M. 1998. *Gymnodinium breve* in the field, in the lab, and in the newspaper--a scientific and journalistic analysis of Florida red tides.
- Lee, D. L., T.A. Dillaha, and J.H. Sherrard. 1989. Modeling phosphorus in grass buffer strips. *Journal of Environmental Engineering* 115: 409-427.
- Lenihan, H. S., and C. H. Peterson. 1998. How habitat degradation through fishery disturbance enhances impacts of hypoxia on oyster reefs. *Ecological Applications* 8. 128-140.
- Lenihan, H. S. and F. Micheli. 2000. Biological effects of shellfish harvesting on oyster reefs: Resolving a fishery conflict by ecological experimentation. *Fishery Bulletin*. 98: 86-95.
- Lenihan, H. S., F. Micheli, S.W. Shelton, and C. H. Peterson. 1999. The influence of multiple environmental stressors on susceptibility to parasites: An experimental determination with oysters. *Limnology and Oceanography*. 44: 910-924.
- Logan, J. M. 2005. Effects of clam digging on benthic macroinvertebrate community structure in a Maine mudflat. *Northeastern Naturalist*. 12(3): 315-324.
- Loosanoff, V. L. and H. C. Davis. 1950. Conditioning *V. mercenaria* for spawning in winter and breeding its larvae in the laboratory. *The Biological Bulletin. Marine Biology Laboratory. Woods Hole, MA*. 98: 60-65.
- Lowrance, R. R. 1997. Water quality functions of riparian forest buffer systems in the Chesapeake Bay watershed. *Environmental Management*. 21(5): 687-712.
- Lupton, B. Y. and P. S. Phalen. 1996. Designing and implementing a trip ticket program. North Carolina Department of Environment, Health, and Natural Resources. North Carolina Division of Marine Fisheries. 305 pp.
- MacKenzie, C. L., Jr. 1977. Predation on hard clam (*Mercenaria mercenaria*) populations. *Transactions of the American Fisheries Society*. 106(6): 530-537.
- MacKenzie, C. L. Jr., A. Morrison, D. L. Taylor, V. G. Burrell Jr., W. S. Arnold, and A. T. Wakida-Kusunoki. 2002. Quahogs in eastern North America: Part II, history by province and state. *Marine Fisheries Review*. 64(3): 1-64.
- MacKenzie Jr, C. L., & R. Pikanowski. 2004. Gear effects on marine habitats: Harvesting northern quahogs in a shallow sandy bed at two levels of intensity with a short rake. *North American journal of fisheries management*. 24(4): 1221-1227.
- Magana, H. A. 2003. Historical Assessment of *Karenia brevis* in the Western Gulf of Mexico. *Harmful Algae*. 2: 163-171.
- Maiolo, J. R. and P. Tschetter. 1981. Relating population growth to shellfish bed closures: a case study from North Carolina. *Coastal Zone Management Journal*. 9(1): 1-18.
- Mallin, M. A. 1998. Land-use practices and fecal coliform pollution of coastal waters. In *Securing the Future of On-Site Wastewater Systems. Proceeding of the 14th annual On-Site Wastewater Treatment Conference*. North Carolina State University. Raleigh, NC. Oct. 27-29, 1998. 81-87.

- Mallin, M. A., J. M. Burkholder, M. R. McIver, G. C. Shank, H. B. Glasgow, B. W. Touchette, and J. Springer. 1997. Comparative effects of poultry and swine waste lagoon spills on the quality of receiving streamwaters. *Journal of Environmental Quality*. 26: 1622-1631.
- Mallin, M. A., K. E. Williams, E. C. Esham, and R. P. Lowe. 2000. Effect of human development on bacteriological water quality in coastal watersheds. *Ecological Applications*. 10(4): 1047-1056.]
- Mallin, M. A., S. H. Ensign, M. R. McIvor, G.C. Shank, and P. K. Fowler. 2001. Demographic, landscape, and meteorological factors controlling the microbial pollution of coastal water. *Hydrobiologia*. 460: 185-193.
- Mattheus, Christopher R., Antonio B. Rodriguez, Brent A. McKee, Carolyn A. Currin. 2010. Impact of land-use change on hard structures on the evolution of fringing marsh shorelines. *Estuarine, Coastal and Shelf Science*, Elsevier Science, London, Volume 88, 365-376.
- Mercaldo-Allen, R. and R. Goldberg. 2011. Review of the Ecological Effects of Dredging in the Cultivation and Harvest of Molluscan Shellfish. NOAA Tech Memo NMFS NE. 220(78): 02543-1026
- Meyer, D.L., E.C. Townsend, G.W. Thayer. 1997. Stabilization and Erosion Control Value of Oyster Cultch for Intertidal Marsh. *Restoration Ecology*. 5: 93-99.
- MFC. 2015. North Carolina Marine Fisheries Commission Rules May 1, 2015. North Carolina Marine Fisheries Commission. North Carolina Department of Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, NC. 304 pp.
- Miller, D. C., R. J. Geider, and H. L. MacIntyre. 1996. Microphytobenthos: The ecological role of the "secret garden" of unvegetated, shallow-water marine habitats. II. Role in sediment stability and shallow-water food webs. *Estuaries*. 19(2A): 202-212.
- Moratorium Steering Committee (MSC). 1996. Final report of the Moratorium Steering Committee to the Joint Legislative Commission on Seafood and Aquaculture of the North Carolina General Assembly. North Carolina Sea Grant College Program, Raleigh, NC, NC-SG-96-11, 155 pp.
- Morris, P.D. 1991. Clinical and Epidemiological Features of Neurotoxic Shellfish Poisoning in North Carolina. *American Journal of Public Health*. 81: 471-474.
- Munari, C., E. Balasso, R. Rossi, and M. Mistri. 2006. A comparison of the effect of different types of clam rakes on non-target, subtidal benthic fauna. *Italian Journal of Zoology*. 73(01): 75-82.
- Munden, F. H. 1975. Rehabilitation of Pamlico Sound oyster producing grounds damaged or destroyed by Hurricane Ginger. North Carolina Department of Natural and Economic Resources. North Carolina Division of Marine Fisheries. Special Scientific Report. 27. 34 pp.
- Munden, F. H. 1981. A review of the North Carolina Oyster Rehabilitation Program. In *Proceedings of the North American Oyster Workshop*. Special Publication No. 1. Louisiana State University. 138-152.

- National Oceanic and Atmospheric Administration (NOAA). 1991. Recreational Shellfishing in the United States. Addendum to 1985 national survey of fishing, hunting, and wildlife-associated recreation. Recreational Shellfishing in the United States. Rockville, MD: NOAA, ORCA, SEA Division. 22 pp.
- National Shellfish Sanitation Program (NSSP). 2013. Model Ordinance. Guide for the Control of Shellfish Harvesting. United States Food and Drug Administration, Center for Food Safety and Applied Nutrition. Washington, DC. (www.issc.org)
- New York State. New York Codes and Statutes. Environmental Conservation 13-0309. <http://www.nycourts.gov/lawlibraries/nycodesstatutes.shtml>
- Noble, E. 1996. Report to the oyster, clam, and scallop committee on Ward Creek field investigation by resource enhancement staff. North Carolina Department of Environment and Natural Resources. North Carolina Division of Marine Fisheries. Unpublished report. 8 pp.
- North Carolina Department of Environment, Health, and Natural Resources (NCDEHNR). 1994. The Comprehensive Conservation and Management Plan of the Albemarle-Pamlico Estuarine Study.
- North Carolina Division of Coastal Management. 2002. Estuarine Biological and Physical Processes Workgroup.
- North Carolina Division of Marine Fisheries (NCDMF). 1991. North Carolina Fishery Management Plan. Hard Clam. North Carolina Department of Environment and Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, NC. 29 pp.
- NCDMF. 1997. North Carolina Fishery Management Plan. Hard Clam. North Carolina Department of Environment, Health, and Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, NC. 58 pp.
- NCDMF. 1999. Shrimp and crab trawling in North Carolina's estuarine waters. Report to NC Marine Fisheries Commission. North Carolina Department of Environment and Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, NC. 121 pp.
- North Carolina Division of Marine Fisheries, 2001a. North Carolina Oyster Fishery Management Plan. North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, North Carolina. 218 pp.
- North Carolina Division of Marine Fisheries, 2001b. North Carolina Hard Clam Fishery Management Plan. North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, North Carolina. 164 pp.
- NCDMF. 2008a. North Carolina Hard Clam Fishery Management Plan. Amendment 1. North Carolina Department of Environment and Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, NC. 158 pp.
- North Carolina Division of Marine Fisheries, 2008b. North Carolina Oyster Fishery Management Plan. Amendment 2. North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, North Carolina. 164 pp.

- NCDMF. 2013. North Carolina license and statistics section summary of statistics of the license and permit program, commercial trip ticket program, North Carolina marine recreational information program, the striped bass creel survey for the central and southern management areas, the North Carolina recreational saltwater activity mail survey. North Carolina Department of Environment and Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, NC.
- North Carolina Division of Water Quality, 2000. A Citizen's Guide to Water Quality Management in North Carolina. North Carolina Department of Environment and Natural Resources, Division of Water Quality, Raleigh, North Carolina. 156 pp.
- North Carolina Division of Water Quality, 2009. Neuse River Basinwide Water Quality Plan. Raleigh, NC, North Carolina Division of Water Quality.
- North Carolina Shellfish Growers Association. 2015. <http://www.ncshellfish.org/>
- Orbach, M. K. 2001. Final Report to the Shellfish Advisory Committee of the North Carolina Marine Fisheries Commission on the Core Sound Human Use Mapping and User Coordination Plan. Report produced pursuant to a directive of the Joint Legislative Commission on Seafood and Aquaculture of the North Carolina General Assembly. Duke University. 35 pp.
- Orth, R. J., J.R. Fishman, D. J. Wilcox, and K. A. Moore. 2002. Identification and management of fishing gear impacts in a recovering seagrass system in the coastal bays of the Delmarva Peninsula, USA. *Journal of coastal Research*. 111-129.
- Pattilo, M. E., D. M. Nelson, T. E. Czapla, and M.E. Monaco. 1997. Distribution and Abundance of Fishes and Invertebrates in Gulf of Mexico Estuaries. Volume II: Species Life History Summaries. NOAA. NOS Strategic Environmental Assessment Division. Silver Springs, Maryland. ELMR 11. 377 pp.
- Peterson, C. H. 1982. Clam Predation by whelks (*Busycon* spp.): experimental tests of the importance of prey size, prey density, and seagrass cover. *Marine Biology*. 66(2): 159-170.
- Peterson, C. H. 1983. A concept of quantitative reproductive senility: application to the hard clam, *Mercenaria mercenaria* (L.). *Oecologia*. 58: 164-168.
- Peterson, C. H. 1986a. Quantitative allometry of gamete production by *Mercenaria mercenaria* into old age. *Marine Ecological Progress Series*. 29: 93-97.
- Peterson, C. H. 1986b. Enhancement of *Mercenaria mercenaria* densities in seagrass beds: Is pattern fixed during settlement season or altered by subsequent differential survival. *Limnological Oceanography*. 31(1): 200-205.
- Peterson, C. H. 2002. Recruitment overfishing in a bivalve mollusk fishery: hard clams (*Mercenaria mercenaria*) in North Carolina. *Canadian Journal of Fisheries and Aquatic Sciences*. 59: 96-104.

- Peterson, C. H., H. C. Summerson, and G. W. Safrit, Jr. 1984. The influence of seagrass cover on population structure and individual growth rate of a suspension-feeding bivalve, *Mercenaria mercenaria*, from a population along the southeastern United States. *Fishery Bulletin*. 81: 765-779.
- Peterson, C. H., H. C. Summerson, and J. Huber. 1995. Replenishment of hard clam stocks using hatchery seed: combined importance of bottom type, seed size, planting season, and density. *Journal of Shellfish Research*. 14(2): 93-300.
- Peterson, C. H., H. C. Summerson, and P. B. Duncan. 1984. The influence of seagrass cover on population structure and individual growth rate of a suspension feeding bivalve, *Mercenaria mercenaria*. *Journal of Marine Resources*. 42: 123-138.
- Peterson, C. H., H. C. Summerson, and S. R. Fegley. 1987. Ecological consequences of mechanical harvesting on clams. *Fishery Bulletin*. 85(2): 281-298
- Peterson, C. H., H. C. Summerson, and S. R. Fegley. 1983. Relative efficiency of two clam rakes and their contrasting impacts on seagrass biomass. *Fishery bulletin-United States, National Marine Fisheries Service (USA)*.
- Peterson, B. J., and K. L. Heck, Jr. 2001. Positive interactions between suspension-feeding bivalves and seagrass - a facultative mutualism. *Marine Ecology Progress Series* 213:143-155.
- Peterson, C. H., P. B. Duncan, H. C. Summerson, and B. F. Beal. 1985. Annual band deposition within shells of the hard clam, *Mercenaria mercenaria*: Consistency across habitat near Cape Lookout, North Carolina. *Fishery Bulletin*. 83: 671-677.
- Pfeffer C. S, Hite M. F., Oliver J. D. 2003. Ecology of *Vibrio vulnificus* in estuarine waters of eastern North Carolina. *Applied Environmental Microbiology*. 69(6): 3526-31
- Porter, H. J. 1964. The North Carolina Marine and Estuarine Mollusca- an Atlas of Occurrence. University of North Carolina. Institute of Marine Science. Morehead City, NC. 351 pp.
- Porter, H. J. and A. F. Chestnut. 1960. The offshore clam fishery of North Carolina. *Proceedings of the National Shellfisheries Association*. 51: 67-73.
- Powers, M. J., C. H. Peterson, H. C. Summerson, and S. P. Powers. 2007. Macroalgal growth on bivalve aquaculture netting enhances nursery habitat for mobile invertebrates and juvenile fishes. *Marine Ecology Progress Series* 339: 109-122.
- Pratt, J. H. 1911. Fishing industry of North Carolina. North Carolina Geological and Economic Survey. Economic Paper. 24. 40 pp.
- Pratt, D. M. and D. A. Campbell. 1956. Environmental factors affecting growth in *Venus mercenaria*. *Limnology and Oceanography*. 1(1): 2-17.
- Pregnall, M. M., 1993. Regrowth and recruitment of eelgrass (*Zostera marina*) and recovery of benthic community structure in areas disturbed by commercial oyster culture in the South Slough National Estuarine Research Reserve, Oregon. A thesis; Bard College, Annandale-On-Hudson, New York.

- R Core Team. 2014. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.
- Reilly, J. D. and W. W. Kirby-Smith. 1999. Development of the technical basis and a management strategy for reopening a closed shellfishing area. Water Resources Research Institute. University of North Carolina. Chapel Hill, NC. WRRRI-99-321. 46 pp.
- Rice, M. A., C. Hickox, and I. Zehra. 1989. Effects of intensive fishing effort on population structure of quahogs, *Mercenaria mercenaria* (Linnaeus 1758) in Narragansett Bay. Journal of Shellfish Research. 14: 293-301.
- Roesijadi, G. 1996. Metallothionein and its role in toxic metal regulation. Comparative Biochemistry and Physiology. 113(2): 117-123.
- Schueler, T. R. 1999. Microbes and urban watersheds- implications for watershed managers. Watershed Protection Techniques. 3(1): 549-620.
- Smolowitz, R., D. Leavitt, and F. Perkins. 1998. Observations of protistan disease similar to QPX in *Mercenaria mercenaria* (hard clams) from the coast of Massachusetts. Journal of Invertebrate Pathology. 71: 9-25.
- Sobel, J. and J. Painter. 2005. Illness Caused by Marine Toxins. Clinical Infectious Diseases. 41(9): 1290-1296.
- South Atlantic Fishery Management Council (SAFMC). 1998. Final Habitat Plan for the South Atlantic Region: Essential Fish Habitat Requirements for Fishery Management Plans of the South Atlantic Fishery Management Council. Charleston, South Carolina. 352 pp.
- Stasinopoulos, M., B. Rigby, and N. Mortan. 2014. gamlss.cens: fitting an interval response variable using gamlss.family distributions. R package version 4.2.7.
- State of Rhode Island and Providence Plantations Department of Environmental Management. 2013. Rhode Island Marine Fisheries Regulations. Part 10: 4-5. <http://www.dem.ri.gov/pubs/regs/regs/fishwild/rimf10.pdf>
- Steidinger, K. A. 1975. Implications of dinoflagellate life cycles on initiation of *Gymnodinium breve* red tides. Environmental Letters. 9(2):129-139.
- Stephan, C. D., R. L. Peuser, and M. S. Fonseca. 2000. Fishing Gear Impacts to Submerged Aquatic Vegetation.
- Street, M. W., A. S. Deaton, W. S. Chappell, and P. D. Mooreside. 2005. North Carolina Coastal Habitat Protection Plan. North Carolina Department of Environment and Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, NC. 656 pp.
- Summerson, H. C. and C. H. Peterson. 1990. Recruitment failure of the bay scallop, *Argopecten irradians concentricus*, during the first red tide, *Ptychodiscus brevis*, outbreak recorded in North Carolina. Estuaries. 13(3): 322-331.

- Sunderstrom, G. T. 1957. Commercial Fishing Vessels and Gear of the United States. Fish and Wildlife circular 48. Bureau of Commercial Fisheries. Fish and Wildlife Service. U. S. Department of the Interior. Washington, D.C.
- Tallis, H. M., J. L. Ruesink, B. Dumbauld, S. Hacker, and L. M. Wisehart. 2009. Oysters and Aquaculture Practices Affect Eelgrass Density and Productivity in a Pacific Northwest Estuary. *Journal of Shellfish Research* 28 (2): 251-261.
- Tester, P. A., and P. K. Fowler. 1990. Brevetoxin contamination of *Mercenaria mercenaria* and *Crassostrea virginica*: A management issue. In: Graneli, E., B. Sundstrom, L. Edler, and D. M. Anderson (eds.). *Toxic Marine Phytoplankton*. Elsevier Science. New York, NY.
- Tester, P. A., R. P. Stumpf, and P. K. Fowler. 1988. Red tide, the first occurrence in North Carolina waters: an overview. *Marine Technology Society Conference Oceans '88*. 4 pp.
- Tester, P. A., R. P. Stumpf, F. M. Vukovich, P. K. Fowler, and J. T. Turner. 1991. An expatriate red tide bloom: Transport, distribution, and persistence. *Limnology and Oceanography*. 36: 1053-1061.
- Therneau, T. 2014. A package for survival analysis in S. R package version 2.37-7.
- Turano, M. J. 2013. *Shellfish Production Methods and Economics - Eastern Oyster*. North Carolina Sea Grant. Presentation for the 2013 North Carolina Aquaculture Development Conference. http://www.ncaquaculture.org/pdfs/2013_marine_session/turano_economics.pdf
- Ulanowicz, R. E. and J. J. Tuttle. 1992. The trophic consequences of oyster stock rehabilitation in the Chesapeake Bay. *Estuaries*. 15(3): 298-306.
- U.S. Army Corp of Engineers (USACE). 2012. Norfolk District 2012 Nationwide Permit Regional Conditions. http://www.nao.usace.army.mil/Portals/31/docs/regulatory/nationwidepermits/NAO_2012_NWP_REGIONAL_CONDITIONS.pdf
- U.S. Commission on Ocean Policy. 2004. An Ocean Blueprint for the 21st Century: The Final Report of the U.S. Commission on Ocean Policy. U.S. Commission on Ocean Policy, Washington, DC
- Van Dolah, F. M. 2000. Marine algal toxins: origins, health effects and their increased occurrence. *Environmental Health Perspective*. 108(1): 133-141.
- Vaudrey, J. M. P., and coauthors. 2009. Effects of Oyster Depuration Gear on Eelgrass (*Zostera marina* L.) in a Low Density Aquaculture Site in Long Island Sound. *Journal of Shellfish Research* 28 (2): 243-250.
- Virginia Institute of Marine Science. 2014. Virginia Shellfish Aquaculture and Outlook Report http://www.vims.edu/research/units/centerspartners/map/aquaculture/docs_aqua/MRR2013_02.pdf
- Wall, C. C., B. J. Peterson, and C. J. Gobler. 2008. Facilitation of seagrass *Zostera marina* productivity by suspension-feeding bivalves. *Marine Ecology Progress Series* 357: 165-174.

Walker, S. T. 1884. Fish Mortality in the Gulf of Mexico. Proceeding of the United States National Museum. 6: 105-109.

Watkins, Sharon M., Andrew Reich, Lora E. Fleming and Roberta Hammond. 2008. Neurotoxic Shellfish Poisoning. MDPI. www.ncbi.nlm.nih.gov/pmc/articles/PMC2579735/. (September 2008).

Wells, H. W. 1957. Status of the name *Venus*. Ecology. 38(1): 160-161.

Williams, R. D. and A. D. Nicks. 1988. Using CREAMS to simulate filter strip effectiveness in erosion control. Journal of Soil and Water Conservation. 43: 108-112.

Winslow, F. 1885. The Oyster Industry. Executive and Legislative Documents of the State of North Carolina. Session 1885. 24-33.

Winslow, F. 1889. Report on the sounds and estuaries of North Carolina, with reference to oyster culture. United States Coast and Geodetic Survey. Bulletin 10. 135 pp.

Wisehart, L. M., B. R. Dumbauld, J. L. Ruesink, and S. D. Hacker. 2007. Importance of eelgrass early life history stages in response to oyster aquaculture disturbance. Marine Ecology Progress Series 344: 71-80.

Zirschky, J. D., D. Crawford, L. Norton, and D. Deemer. 1989. Metals removal in overland flow. Journal of the Water Pollution Control Federation. 16: 470-475.

50 CFR 600.810 Definitions and word usage.

15.0 APPENDICES

15.1 SUMMARY OF MANAGEMENT AND RESEARCH RECOMMENDATIONS FROM THE 2001 HARD CLAM FISHERY MANAGEMENT PLAN

Tier 1 - Management recommendations requiring no additional funding or reallocation of funds/personnel required.

MANAGEMENT STRATEGY	OBJECTIVES	OUTCOME
Insufficient Data		
1. Support adoption of a mechanism that would provide data on recreational shellfish harvest and add "pleasure" category to the existing Shellfish License.	3, 6, and 8	New recreational fishing license does not include shellfish
Management Strategies		
2. Rotate southeast Pamlico Sound area with Core Sound.	1, 2, 3, 4, and 6	Accomplished Began in 2002 by proclamation and defined area in Rule 03K .0302(b)
3. Lower the bag limit in Core Sound to 20 bags. Pamlico Sound area bag limit would also be 20 bags.	1, 2, 3, 4, and 6	Accomplished By proclamation since 2001.
4. Continue to allow all NC residents to purchase a shellfish license.	3 and 8	No action required
5. Status quo on nighttime unloading rule.	6	No action required
Private Culture		
6. Change operational policy to increase use of marginal polluted areas for shellfish leases.	6 and 8	No action
7. Inform public about Department of Agriculture and Department of Environment and Natural Resources roles concerning shellfish culture.	6	No action
8. Formalize and amplify current policy on transfers on out-of-state shellfish into NC waters.	6	Accomplished
9. Recommend adoption of a statutory policy statement supporting shellfish culture insofar as it does not interfere with traditional fishing practices	6	Accomplished G. S. 113-201
10. Amend shellfish lease production rule to require harvest and sale of 10 bushels of shellfish per acre per year and planting of 50 bushels of cultch or 25 bushels of seed per acre per year to maintain lease production.	1, 6, and 8	Accomplished Rule 03O .0201 in 2003.
11. Status quo on opportunities for riparian landowners to culture shellfish.	1 and 6	No action required
12. Recommend water column lease fees change to an amount ten times the fee for bottom leases (\$100 per acre according to current recommendations).	6 and 8	Accomplished G. S. 113-203

15.1 SUMMARY OF MANAGEMENT AND RESEARCH RECOMMENDATIONS FROM THE
2001 HARD CLAM FISHERY MANAGEMENT PLAN (Continued)

Tier 1 - Continued.

MANAGEMENT STRATEGY	OBJECTIVES	OUTCOME
Private Culture		
13. Continue to record clam production units as bushels.	6	No action required
14. Recommend adoption of a statutory requirement for shellfish culture training certification for new applicants for shellfish leases. Training for existing leaseholders meeting production requirements would not be required.	6 and 8	Accomplished G. S. 113-201
15. Recommend shellfish lease fees be set as follows: application fee - \$200 renewal application fee - \$100, rental fee - \$10 per acre per year. Also recommend a change in the term of the lease contract to expire July 1 to facilitate proper renewals.	6 and 8	Accomplished G. S. 113-202
16. Apply Fisheries Reform Act requirements to a revised, organized, upgraded permit system.	3, 6, and 8	Accomplished Rule 030 .501
Habitat and Water Quality		
17. Increase use of existing statutory authority (permit comments, CHPP development) to reverse the trends in closure of shellfish waters to harvest.	6 and 7	In progress under CHPP
18. Develop strategies to restore water quality of Conditionally Approved harvest area and maintain water quality of Approved harvest areas by:	1, 6, and 7	Accomplished MFC letter
- Classifying Conditionally Approved Open shellfish waters Partially Supporting		
- Classifying Conditionally Approved Closed shellfish waters as Not Supporting		
- Adopting standards that limit total impervious cover immediately adjacent to SA waters to 10 percent		Accomplished MFC letter
- Requiring mitigation that results in water quality enhancements in permanently closed areas.		Implemented by policy
19. Recommend specific changes to DWQ and EMC.	1, 6, and 7	

15.1 SUMMARY OF MANAGEMENT AND RESEARCH RECOMMENDATIONS FROM THE 2001 HARD CLAM FISHERY MANAGEMENT PLAN (Continued)

Tier 2 - Management recommendations requiring reallocation of personnel/funds required at Division level; no additional funding required.

MANAGEMENT STRATEGY	OBJECTIVES	OUTCOME
Management Strategies		
1. Continue to relay oysters as normal and increase the intensity of the recent clam relay schedule.	5, 6, and 8	No action
Private Culture		
2. Continue the statutory shellfish lease program and increase relaying to public bottom to address concerns over use of public resources.	6 and 8	No action, affected by funding cuts
3. Designate and plant cultch on managed seed beds for use on leases and franchises.	1, 5, 6, and 8	Cultch planted on Bay River Seed Oyster Management Area
Habitat and Water Quality		
4. Implement additional experimental closures of oyster areas based on habitat value for both oysters and clams.	2 and 4	No action
5. Enhance clam habitat by planting shell and other material.	5 and 9	No action
6. Examine methodologies to potentially enhance clam populations by planting seed clams in combination with habitat enhancement.	2 and 5	No action

Tier 3 - Management recommendations requiring additional funding required.

MANAGEMENT STRATEGY	OBJECTIVE	OUTCOME
Insufficient Data		
1. Expand Shellfish mapping program.	1 and 3	Funding approved in 2006 NCGA budget: 4 pos. \$87,000
2. Expand catch/effort sampling of hard clam catches.	1 and 3	Began fishery dependent sampling in 1999. Have a total of 366 samples from 1999-2005. Investigating data at present for current FMP.
3. Develop a fishery independent sampling program to determine population abundance.	1 and 3	In progress. Still considered a pilot study.
Private Culture		
4. Develop and utilize user coordination plans to assess areas or shellfish leasing.	3, 6, and 8	No additional funding
5. Request funding research, disease, and education centers for shellfish culture.	2, 5, 9, and 10	No additional funding
6. Recommend increased funding to Shellfish Sanitation.	7	No action; Must be approved Legislatively

15.1 SUMMARY OF MANAGEMENT AND RESEARCH RECOMMENDATIONS FROM THE
2001 HARD CLAM FISHERY MANAGEMENT PLAN (Continued)

RESEARCH RECOMMENDATION	OUTCOME
Insufficient Data	
1. Determine which regions in North Carolina have discreet populations.	No action
Management	
2. Evaluate the amount of harvest that can occur without affecting spawning stock in areas harvested with mechanical gear.	No action
3. Evaluate effects and recovery of areas opened to mechanical gear.	No action
4. Analysis of trends in the license universe and trip ticket data to indicate increases in effort	In progress for upcoming FMP update
Private Culture	
5. Quantify effects of shellfish habitat and the benefits of establishing shellfish sanctuaries.	No action
6. Examine the cost:benefit ratio of relaying shellfish to public	No action
7. Examine recovery rates of harvested relay areas for different areas of the coast.	No action
8. Determine the effects of relay on hard clam mortality.	No action
9. Expand human use mapping and shellfish mapping to provide coastwide data.	Funding approved in 2006 NCGA budget: 4 pos. \$87,000
10. Determine areas for block leasing by user coordination studies in various areas.	No additional funding
11. Develop a protocol for defining Best Management Practices (BMP) among water bodies with differing production capacities and differing hydrological dynamics.	
12. Determine ecological benefits from shellfish aquaculture activities.	No action
13. Develop an Internet or correspondence training course for certification or re-certification of shellfish culturists.	No action
14. Determine most effective seedbed shell planting areas, timing of plants and protocol for shellfish larvae and spatfall.	No action
15. Research and develop appropriate extensive and intensive shellfish culture methods, improve genetics and disease resistance of cultured stocks and perform biological monitoring and support services to growers	FRG by Mark Hooper.00-AM-01
16. Stock assessments of clams located in polluted areas geographically to determine if a depuration operation would be feasible and aid in sizing the facility.	No action
17. Review current depuration programs in other states.	No action
Habitat and Water Quality	
18. Continue research on means and methods for reduction of non-point source pollution and mitigation of pollutant effects in the estuary.	Research by other agencies ongoing
19. Develop better databases and database management to enable to quantify use ratings	Refer to #18 in Tier 1 Management Recommendations
20. Determine impacts of clam trawls and escalator dredges on sandy bottom environments.	No action
21. Determine effects of clam recruitment and clam mortality by mechanical harvests.	No action
22. Determine water circulation in different waterbodies studies.	No action
23. Evaluate site selection protocols for best planting sites	No action
24. Determine effects of transplanting spawners.	No action
25. Determine contribution of different enhancement strategies	No action
26. Examine methodologies to reduce predation, increase seed planting efficiencies	No action
27. Perform cost analyses as needed.	No action

15.2 TIMELINE FOR THE HARD CLAM FISHERY MANAGEMENT PLAN AMENDMENT 2

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

Revision approved by DMF Director: Signature:  _____

Date: 4-5-16

Presented to MFC: _____

Date: _____

Revision(s) and reason(s): Substantial changes by the MFC warrant further review by the regional committees to provide input on a preferred management option that was recommended statewide but was initially only addressed for the southern region.

15.3 PUBLIC INPUT AND PLAN DEVELOPMENT TEAM RESPONSES FOR AMENDMENT 4 TO THE OYSTER FMP AND AMENDMENT 2 TO THE HARD CLAM FMP

Public input was received prior to the required 5-year review of both the Oyster and Hard Clam FMPs and during an open period request for input on issues from August 26, 2014 through September 30, 2014. All responses are summarized in this appendix from the original responses if they were received in a written format. The more detailed documents of the public input are available upon request. NCDMF staff provided responses to all input, whether it was included in the both amendments or not and the PDT responses are provided below each.



Pat McCrory, Governor

John E. Skvarla, III, Secretary

N.C. Department of Environment and Natural Resources

Release: Immediate
Date: Aug. 26, 2014

Contact: Patricia Smith
Phone: 252-726-7021

Division of Marine Fisheries seeks comments on oyster and hard clam fisheries issues

MOREHEAD CITY – The N.C. Division of Marine Fisheries is asking the public to submit comments on issues they would like to see addressed in upcoming amendments to the Oyster and Hard Clam Fishery Management Plans.

State law requires the division to prepare a fishery management plan for adoption by the N.C. Marine Fisheries Commission for all commercially and recreationally significant species or fisheries that comprise state coastal waters. These plans provide management strategies designed to ensure long-term viability of the fishery. State law also requires the division to review each fishery management plan every five years.

The division is beginning a mandated five-year review of the N.C. Oyster and Hard Clam Fishery Management Plans that were adopted by the commission in 2008. Since changes in the management strategies and rules are proposed, the division is pursuing plan amendments, where division staff and an advisory committee develop positions on specific issues that need to be addressed. An Oyster and Hard Clam Advisory Committee has been appointed to give input on the issues.

Written comments will be accepted until Sept. 30 and should be addressed to Tina Moore, N.C. Division of Marine Fisheries, P.O. Box 769, Morehead City, N.C. 28557 or Stephen Taylor, N.C. Division of Marine Fisheries, 127 Cardinal Drive Extension, Wilmington, N.C. 28405. People can also comment by sending an email to: Tina.Moore@ncdenr.gov or Stephen.Taylor@ncdenr.gov.

###

Jamie Kritzer, Public Information Officer

Jamie.Kritzer@ncdenr.gov

Phone: (919) 707-8602

<http://www.facebook.com/ncdenr>

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Farm Bureau - 2012

1. We support the right of NC citizens to have access to foods produced on our lands and from our waters.

2. We recommend that aquaculture be classified as agriculture, so that growers have access to federal programs.
3. We support and recognize NC wild caught seafood and farm-raised seafood as an agricultural commodity.
4. We support the right of the commercial fisherman to make a living providing food for the consumer.
5. We support increased vocational, technical and continuing educational opportunities for aquaculture producers.
6. We recommend that we continue educational efforts about the financial options and sources available to growers and about the financial needs, cash flow and production priorities of growers to the lending institutions.
7. We recommend the reinstatement of a grower based advisory committee for the promotion and marketing of North Carolina and national seafood and aquaculture crops.
8. We support the education of the public on the cost of providing and marketing high quality nutritious seafood products.
9. We recommend that inspection of imported seafood be at least 25% of volume. This should help reduce the health outbreak of 45% resulting from imported seafood.
10. We support efforts, like the NC Seafood Lab to develop and promote seafood products.
11. We support the Center for Marine Science Technology (CMAST).
12. We recommend that UNC-W Research Hatchery be leased, if possible, to get some sort of funding for the facility until there is money available to staff the facility.
13. We recommend the stabilization of inlets used by commercial fishermen where life and property are in danger, like the Oregon Inlet.
14. We support basing access of fisheries by commercial fishermen and recreational fishermen on sound science or the best available data.
15. We support trawling in NC estuaries until sound scientific data supports otherwise.
16. We recommend that the legislature establish a uniform state policy that:
 - (1) Mandates the purchases of private-sector hatchery-reared fish and shellfish whenever they are less costly.
 - (2) Establishes an evaluation of state-produced fish that reflects full overhead costs.
 - (3) Encourages the purchase of seed stock from the private sector for stocking public waters.
17. We support the funding of the state law of 2006 requiring the recycling of shells from restaurants, consumers and other users.

18. We recommend comments be provided by AFBF to FDA during the rule making process for implementation of MUMS. Comments should include support for designating early life stages of food fish as non-food fish, indexing of drugs for non-food fish, and drug approved by species grouping.

19. We recommend that in addition to determining the cause of fish kills, there should also be ongoing work to determine the cause of oyster pollution from storm run off or other reasons.

20. We recommend funding shellfish research provided information is distributed to farmers and research is applicable to farm use.

21. We recommend that statewide equality for shellfish lease implementation on rules and guidelines be taken before the shellfish advisory committee and follow recommendations.

22. We recommend shellfish lease duration on lease period and the cost per acre per year be based on replacement on average of three highest income years over the previous ten years. Also, the decision must include representation from shellfish growers.

23. We recommend the following benefits for producers developing oyster beds in waters suitable for production where there are currently no oysters because of the water filtration benefits provided by oysters:

- (1) Shellfish leases of 5-year duration; and
- (2) A 20% reduction in the annual lease cost.

24. We support research that would support finding a sustainable food source from grain growers in our state as a food staple for the fin fish industry.

25. We oppose NC losing any historical quota allocations to another state.

26. We support moving the Division of Marine Fisheries from NCDENR to NCDA&CS.

27. We support a more reasonable and measured approach to the sea turtle restrictions placed on the commercial fishing industry

PDT Response:

The comments your organization provided after adoption of Amendment 2 to the Oyster Fishery Management Plan and Amendment 1 to the Hard Clam Fishery Management Plan were considered by NCDMF staff for the upcoming amendments to the Oyster and Hard Clam Fishery Management Plans. The NCDMF appreciates your comments; however, the majority of your comments are beyond the scope of the plans. I have included a copy of your list of 27 comments for reference.

Comments #1 through #11, #13, #15, #18, and #24 through #27 are not applicable to the amendments.

Comment #12. Leasing of the UNC-W Research Hatchery was discussed with Hatchery staff and was found to be counter to mission/goal of what the Hatchery Program Planning Committee recommended. The committee felt that the hatchery should not compete with private commercial development.

Comment # 14. The NCDMF agrees with basing access of fisheries on sound science, and we always strive to use the best available data for managing fisheries, including hard clams and oysters.

Comment #16. The Oyster-Hard Clam Advisory Committee cannot instruct legislature to create statewide policy mandating where the purchase of at any fish or shellfish takes place, nor can they encourage the purchase of seed stock from the private sector.

Comment # 17. NC General Statute 130A-309.10 prohibits oyster shells from being disposed of in landfills. The program that provided a tax credit to restaurants for their recycled shell was discontinued; however, NCDMF still services high volume restaurants that can store the shell until it can be picked up. While the Oyster Shell Recycling Program lost its state appropriated funding NCDMF still maintains and services several bulk sites. We still encourage the public to drop off all shell at one of the remaining locations. A list of sites is being updated on the website and will be available to the public.

Comment #19. Your concerns of stormwater run-off are addressed and may be found in the Coastal Habitat Protection Plan. This plan is also under review. You may find it on our website at: http://portal.ncdenr.org/c/document_library/get_file?uuid=4cb3ec6a-a5d8-4851-bef0-314ab0d8787c&groupId=38337

Comment #20. Research needs may be found in all fishery management plans located at: <http://portal.ncdenr.org/web/mf/fmps-under-development> . High priority research needs may be found in one document located at: <http://portal.ncdenr.org/web/mf/research-priorities> .

Comment #21. The NCDMF fails to understand what the Farm Bureau is requesting. The lease program strives for fairness to any NC citizen who requests a lease through the lease application process. Modifying the lease provisions of the program as well as several other issues pertaining to the lease program will be examined through the FMP process.

Comment #22. Modifying the lease program will be considered in the FMP process, however we do not have the authority to base any cost of a lease on income. Hard Clam and Oyster Fishery Management Plan Advisory Committee members include lease holders.

Comment #23. Lease cost and lease duration will be examined during the amendment process.

Thank you for your input on these issues. All meetings with the Advisory Committee will be held in the Washington office of NCDMF and are posted on our website at:

<http://portal.ncdenr.org/web/mf/dmf-public-meetings-schedules>. The items on the agenda are posted closer to the meeting date. Again, thank you for your interest in this FMP process and if you have any questions, my contact information is:

Trish Murphey
5285 Highway 70 West
Morehead City, NC 28557

Phone: (252)726-70121
Email: Trish.Murphey@ncdenr.gov

Trish Murphey sent the response through mail on 12/10/2014

Daniel Hoback - November 14, 2012

- Provide incentives to the Under Dock Oyster Culture Program participants, such as cuts on property taxes after passing an online quiz and submit annual progress reports for at least three years
- Allow the program to be available to dock owners in polluted waters to help improve water quality

PDT Response:

The comments you provided were considered by NCDMF staff. The Under Dock Oyster Culture Program is a free permit for which annual documentation is already required. Property taxes are at the discretion of county, town, and city governments; thus, they are not directly under the purview of the state of North Carolina, nor the North Carolina Division of Marine Fisheries. In regard to Under Dock Oyster Culture in polluted waters, it is a public health risk. While it may provide a benefit by improving localized water quality it is too great of a risk to public health and is un-monitorable. As you may already know, it is illegal for anyone to harvest shellfish for consumption in polluted waters as outlined by the National Shellfish Sanitation Program. This program sets strict limits for allowable levels of bacteria and other pollutants, in which shellfishing and culture activities are permitted, to protect the public. As these are federal regulations, the allowance of Under Dock Oyster Culture in polluted waters cannot be permitted and your input provided on the Under Dock Oyster Culture Program will not be addressed during the upcoming oyster amendment.

Thank you for your interest in this FMP process and if you have any questions, my contact information is:

Garry Wright
3441 Arendell Street
Morehead City, NC 28557
Phone: (252)808-80XX
Email: Garry.Wright@ncdenr.gov

Garry Wright sent 1 mail response on 4/10/2015

NC Shellfish Growers Association - March 25, 2013

- Defining adverse impacts to SAV from leases
- Movement of cultured seed shellfish from polluted waters
- Relaying from closed areas and closure of the entire lease
- Combining multiple permits for shellfish aquaculture operations
- Possibly eliminate notification of marine patrol to the sale of product off leases
- Modify shellfish lease provisions (lease term, acreage limits, re-define off-bottom culture, land survey requirements)
- Modify penalties of lease theft

PDT Response: Brian Conrad participated in meeting with the NC Shellfish Growers Association in 2014 to engage in conversation on these recommendations. No specific dates were provided.

James Fletcher - April 4 2013 and September 8, 2014

Mr. Fletcher on April 4, 2013 via phone contacted Brian Conrad and provided Public Comment at the Oyster and Hard Clam Advisory Committee Meeting on September 8, 2014.

He would like to discuss options to open mechanical harvest of clams in the Sounds out past 6 foot of water depth, as well other efforts to manage the clam fishery in NC, besides just allocating clam harvest amounts (April 2013 email of phone conversation).

More specific comments Mr. Fletcher included at the Advisory Committee meeting:

- Open areas to the mechanical harvest of clams in waters at six feet or deeper where they currently are not allowed
- Allow the taking of clams during the mechanical harvest of oysters

PDT Response:

The comments you provided were considered by NCDMF staff. The input you brought forward to consider opening areas to the mechanical harvest of clams in waters at six feet or deeper where they currently are not allowed will be addressed in the upcoming amendment to the Hard Clam Fishery Management Plan within the issue specific to the mechanical clam harvest fishery statewide.

Your input to consider allowing the taking of clams while mechanically harvesting for oysters will not be addressed during the upcoming amendments. This issue was already addressed by the Marine Fisheries Commission in 2011 through a Declaratory Ruling. The Marine Fisheries Commission determined that because the public areas that may be opened for the mechanical harvest of oysters do not include any public areas that may be opened for the mechanical harvest of hard clams, clams of legal size incidentally taken while using mechanical dredges for harvesting oysters in open areas during oyster season may not be retained, but must be returned to the waters from which taken. Regulations 15A NCAC 03K .0300, et seq., that regulate the taking of hard clams do not allow for a by-catch of hard clams taken incidentally while using a mechanical dredge in areas of public bottom open to the mechanical harvest of oysters but not open to the mechanical harvest of hard clams.

All meetings with the Hard Clam and Oyster FMP Advisory Committee will be held in the Washington office of NCDMF and are posted on our website at: <http://portal.ncdenr.org/web/mf/dmf-public-meetings-schedules>. The items on the agenda are posted closer to the meeting date. Again, thank you for your interest in this FMP process and if you have any questions, my contact information is:

Tina Moore

5285 Highway 70 West
Morehead City, NC 28557

Phone: (252)808-8082
Email: Tina.Moore@ncdenr.gov

Tina Moore sent the response through mail on 12/12/2014

Maret Wheeler - July 8, 2013

In a phone conversation with Tina Moore and a follow up email on the same day, Ms. Wheeler requested to consider the use of pot haulers to pull rakes to take hard clams.

PDT Response:

The comments you provided were considered by NCDMF staff and will be addressed in the upcoming amendments to the Oyster and Hard Clam Fishery Management Plans as an issue paper to investigate the use of pot haulers to pull rakes.

Thank you for your input on this issue, the date for its presentation to the Advisory Committee has not been scheduled yet. All meetings with the Advisory Committee will be held in the Washington office of NCDMF and are posted on our website at: <http://portal.ncdenr.org/web/mf/dmf-public-meetings-schedules> . The items on the agenda are posted closer to the meeting date. Again, thank you for your interest in this FMP process and if you have any questions, my contact information is below.

Tina Moore sent an email response on 11/18/2014

Coastal Conservation Association - August 21, 2014

The Coastal Conservation Association of North Carolina (CCA) provided input during the Marine Fisheries Commission meeting in August 2014. The CCA requests no increase oyster dredging, and requests that the MFC work to include a modern aquaculture plan within the FMP similar to Virginia's effort. Alternatively, a separate aquaculture plan should be developed concurrently with the FMP. After the plan is formulated the MFC should implement that plan by seeking appropriate funding from the NC Legislature and the Governor for modern oyster aquaculture training and support for our fishermen. Such a program will not only protect our wild oyster habitat it, will provide an economic stimulus (don't use that word on Jones Street). CCA requests that as part of this aquaculture plan that oyster dredging be phased out.

PDT Response:

The comments you provided were considered by NCDMF staff and will be addressed during development of the amendments to the Oyster and Hard Clam Fishery Management Plans.

The issue of increasing oyster dredging was addressed in two separate issue papers presented to the Oyster/Hard Clam Advisory Committee at its November and December meetings. Those issue papers are attached for your information. The Advisory Committee agreed with the Plan Development Team's recommendations in both papers and may be found at the end of each document. The Advisory Committee also made a research recommendation to support funding of a controlled study of dredge impacts on areas currently closed to mechanical harvest.

The development of a separate aquaculture plan is under consideration by the division for the future, but during this time, oyster and hard clam private culture and issues that pertain to them will be have to be addressed during the development of the both the Oyster FMP Amendment 4 and Hard Clam FMP Amendment 2.

Thank you for your input on these issues and for your interest in this FMP process and if you have any questions, my contact information is below.

Trish Murphey

Biologist Supervisor
N.C. Division of Marine Fisheries
5285 Highway 70 W
Morehead City, NC 28557
800.682.2632
252.726.7021
252.727.5127 fax
Trish.Murphey@ncdenr.gov

Trish Murphey sent an email response on 12/11/2014

North Carolina Wildlife Federation - August 27, 2014

NC Wildlife Federation (NCWF) requests no increase oyster dredging, and requests that the MFC work to include a modern aquaculture plan within the FMP. Develop and include an aquaculture plan in the FMP. After the plan is formulated the MFC should implement that plan by seeking appropriate funding from the NC Legislature and the Governor for modern oyster aquaculture training and support for our fishermen. Such a program will not only protect our wild oyster habitat, but will also provide an economic stimulus for fishermen and markets. NCWF requests that as part of this aquaculture plan oyster dredging be phased out.

PDT Response:

The comments you provided were considered by NCDMF staff and will be addressed during development of the amendments to the Oyster and Hard Clam Fishery Management Plans.

The issue of increasing oyster dredging was addressed in two separate issue papers presented to the Oyster/Hard Clam Advisory Committee at its November and December meetings. Those issue papers are attached for your information. The Advisory Committee agreed with the Plan Development Team's recommendations in both papers and may be found at the end of each document. The Advisory Committee also made a research recommendation to support funding of a controlled study of dredge impacts on areas currently closed to mechanical harvest. The development of a separate aquaculture plan is under consideration by the division for the future, but during this time, oyster and hard clam private culture and issues that pertain to them will have to be addressed during the development of the both the Oyster FMP Amendment 4 and Hard Clam FMP Amendment 2.

Thank you for your input on these issues and for your interest in this FMP process and if you have any questions, my contact information is below.

Trish Murphey
Biologist Supervisor
N.C. Division of Marine Fisheries
5285 Highway 70 W
Morehead City, NC 28557
800.682.2632
252.726.7021
252.727.5127 fax
Trish.Murphey@ncdenr.gov

Trish Murphey sent an email response on 12/11/2014

Robert Schoonmaker - August 27, 2014

- Discontinue the Shellfish License

PDT Response:

The comments you provided were considered by NCDMF staff and will be addressed in the upcoming amendments to the Oyster and Hard Clam Fishery Management Plans in an issue paper to discuss eliminating the Shellfish License and require all shellfish harvesters to have a Standard/Retired Commercial Fishing License.

Thank you for your input on this issue, the date for its presentation to the Advisory Committee has not been scheduled yet. All meetings with the Advisory Committee will be held in the Washington office of NCDMF and are posted on our website at: <http://portal.ncdenr.org/web/mf/dmf-public-meetings-schedules>. The items on the agenda are posted closer to the meeting date. Again, thank you for your interest in this FMP process and if you have any questions, my contact information is below.

Tina Moore sent an email response 11/18/2014

Henry Witney - September 10, 2014

- Address issues with the Shellfish License, such as: impacts to the oyster population with an open license available to all NC residents, selling oysters at a lower cost and impacting local markets, and tracking unsold product
- Close all creeks on the mainland side of the IWW so regulations could be implemented to improve water quality. Possibly consider containment barriers around waterfront properties.

PDT Response:

The issue on the shellfish license will be taken up by our Division's Plan Development Team (PDT) in the issue paper *Eliminate the Shellfish License and require all shellfish harvesters to have a Standard/Retired Commercial Fishing License*. That will be presented in the future. As far as the issue of the division being able to regulate waterfront property owners with the use of containment barriers to improve water quality, that issue is beyond the scope of our group and the Advisory Committee for this particular FMP. At most, we could recommend Better Management Practices (BMPs) be emphasized and education materials distributed on how to best keep runoff and other harmful materials from reaching these tidal creeks and polluting our shellfishing waters.

Thank you for your input on these issues and I will try to let you know when the issue on the Shellfish License will be presented in hopes that you may attend that particular meeting, in the Washington office of NCDMF. Again, thank you for your interest in this FMP process and if you have any questions, my contact information is below.

Stephen Taylor sent an email response on 11/14/2014

William Russell - September 11, 2014

- Allow no more mechanical clam harvest areas to be rotated
- Shrink the mechanical clam harvest areas in Newport and North river due to SAV and oyster encroachment
- Close areas in the Newport and North rivers to oyster harvest
- Increase enforcement for these areas during the open oyster harvest season

PDT Response:

The comments you provided were considered by NCDMF staff and will be addressed in the upcoming amendments to the Oyster and Hard Clam Fishery Management Plans in two separate issue papers. One issue is specific to the mechanical clam harvest fishery statewide and the second issue will identify effort impacts on oyster resources.

Thank you for your input on this issues, the date for their presentations to the Advisory Committee have not been scheduled yet. All meetings with the Advisory Committee will be held in the Washington office of NCDMF and are posted on our website at: <http://portal.ncdenr.org/web/mf/dmf-public-meetings-schedules>. The items on the agenda are posted closer to the meeting date. Again, thank you for your interest in this FMP process and if you have any questions, my contact information is:

Tina Moore
5285 Highway 70 West
Morehead City, NC 28557

Phone: (252)808-8082
Email: Tina.Moore@ncdenr.gov

Tina Moore sent the response through mail on 11/18/2014

Nicole Sandy - September 24, 2014

- Restrict or close oyster harvest in Stump and Topsail sounds for a period until the oysters are replenished
-

PDT Response:

The comments you provided on the impacts to the Stump Sound oyster population from harvest pressure were considered by NCDMF staff, and will be addressed during development of the amendments to the Oyster and Hard Clam Fishery Management Plans (FMPs).

The matter of harvest effort impacts to the oyster population in the southern region of the state will be reviewed in an issue paper presented to the Oyster/Hard Clam Advisory Committee during the April 2015 meeting at the Washington, NC regional office. This meeting begins at 6pm and is open to the public. This issue paper along with the entire oyster fishery management plan document will also be available for review and public comment as a part of the FMP process.

Thank you for your input on this issue and for your interest in the FMP process. If you have any additional questions, concerns, or comments, please contact me anytime.

Joe Facendola sent an email response on 2/6/2015

Brad Scott - September 30, 2014

- Allow shellfish hatcheries and nurseries in prohibited waters.
- Allow for dredging for blood clams in the ocean
- Allow Sunday harvest for clams (not oysters)

PDT Response:

I wanted to provide you with a clarification that we are not working on an issue paper concerning your issue of allowing shellfish hatcheries and nurseries in prohibited waters. We will, however, be incorporating the history of your issue into the private culture section of the FMP.

Patti Fowler sent an email response on 12/2/2014 and had an phone conversations with Mr. Scott

Skip Kemp - September 30, 2014

- Allow the use of GPS to delineate shellfish leases
- Increase the shellfish lease terms to 10 years

PDT Response:

The comments you provided were considered by NCDMF staff and will be addressed in the upcoming amendments to the Oyster and Hard Clam Fishery Management Plans in two separate issue papers. One issue will look at utilizing GPS coordinates instead of a survey to define shellfish lease boundaries and the second issue will consider modifying shellfish lease provisions, which will include the lease term.

Thank you for your input on these issues, the date for their presentations to the Advisory Committee have not been scheduled yet. All meetings with the Advisory Committee will be held in the Washington office of NCDMF and are posted on our website at:

<http://portal.ncdenr.org/web/mf/dmf-public-meetings-schedules>. The items on the agenda are posted closer to the meeting date. Again, thank you for your interest in this FMP process and if you have any questions, my contact information is below.

Tina Moore sent an email response on 11/18/2014

15.4 DISCONTINUED ISSUE PAPERS DEVELOPED BY THE PLAN DEVELOPMENT TEAM AND ADVISORY COMMITTEE DUE TO LEGISLATIVE CHANGES

15.4.1 UTILIZING GPS COORDINATES INSTEAD OF A SURVEY TO DEFINE SHELLFISH LEASE BOUNDARIES¹⁸

September 22, 2015

I. ISSUE

Current shellfish growers and shellfish lease applicants feel that the required certified land survey and description of the shellfish lease location is an expensive component and deterrent to obtaining a shellfish lease and that NCDMF can provide those services utilizing GPS.

II. ORIGINATION

This issue was brought forward by the NC Shellfish Growers Association on March 25, 2013.

III. BACKGROUND

The NCSGA brought forward concerns regarding the associated costs with the requirement for a certified land survey to acquire a shellfish lease. Members felt that NCDMF could provide the survey requirements at a reduced cost since GPS technologies have improved and are in use by NCDMF staff already. Shellfish lease applicants are currently required to provide a certified land survey and legal description of the shellfish lease location within 90 days after the lease is approved by the Secretary/Director. Applicants must contract licensed professional land surveyor (PLS) services at the going market rate to provide the required survey.

The requirement for a shellfish lease to have a certified survey has existed from at least 1909 (1909 N.C. Session Laws ch. 871 section 3). North Carolina's public trust waters are protected under Article XIV, Section 5 of the Constitution of North Carolina and the Public Trust Doctrine. In such, all lands covered by navigable waters of sounds, rivers, and creeks in the coastal counties are held in public trust for free use of all its citizens. Rights to use described areas of public trust waters for limited purposes, such as shellfish cultivation, can be conferred only as authorized by legislative acts. A shellfish lease is a contracted conveyance of a beneficial right ownership of public trust waters from the State to the leaseholder with requirements, obligations and a set contract period in which the State remains the trustee. As trustee, the State has the duty to supervise the trust to preserve public trust rights to include navigation, fishing, recreation and hunting. The ability to accurately locate and enforce the boundaries of a shellfish lease are critical to preserving public trust rights. The current authority to establish shellfish lease and franchise survey requirements is set forth N.C. G.S. 113-202 and 206. North Carolina Marine Fisheries Commission Rule 15A NCAC 03O .0203 (d) sets forth the specific requirements. The requirements follow the Standards of Practice for Land Surveying in North Carolina (21 NCAC 56 .1600).

In order to provide additional customer service and assistance with the shellfish lease survey requirements, NCDMF staff currently advise shellfish lease applicants to avoid proposed lease

¹⁸ Presented to: PDT on 11/6/14 & 8/13/15; AC on 1/5/15 & 9/14/15; RAT on 3/5/15; MRT on 9/21/15.

boundaries which involve multiple corners and irregular shapes because rectangular or square boundaries are generally more economical to survey due to the reduced number of survey points. Applicants are also advised to contact multiple surveyors within their geographic area to obtain the best price and services, and to discuss boat use, equipment type as well as the survey requirements. NCDMF staff utilizes GPS coordinates and GIS to verify shellfish lease corner pole locations and to estimate acreage, but not to meet shellfish lease application requirements.

IV. AUTHORITY

N.C. Session Laws

Law 2015-241, House Bill 97

N.C. General Statutes

89C	Engineering and Land Surveying
113-131	Jurisdiction of Conservation Agencies
113-134	Rules
113-182	Regulations of fishing and fisheries
113-201	Legislative findings and declaration of policy; authority of Marine Fisheries Commission
113-202	New and renewal leases for shellfish cultivation; termination of leases issued prior to January 1, 1966
113-206	Chart of grants, leases and fishery rights; overlapping leases and rights; contest or condemnation of claims; damages for taking of property
143B-289.52	Marine Fisheries Commission – powers and duties
146-12	Easements in land covered by water

N.C. Marine Fisheries Commission Rules May 1, 2015 (15A NCAC)

03O .0203 Shellfish lease application processing

N.C. Occupational Licensing Boards and Commissions Rules (21 NCAC)

56.1600 Standards of practice for land surveying in North Carolina

V. DISCUSSION

The possible change to the requirement for a survey performed by a licensed professional land surveyor for a shellfish lease was discussed with representatives from the NC Geodetic Survey Office as well as the N.C. Department of Administration's State Property Office (NCSPO).

The recommendation to replace a survey provided by a PLS with a GIS map is not in the best interest of the public, and may lead to conflicts, and future legal actions. Using GIS data, collected by NCDEQ/NCDMF staff, for authoritative purposes would exceed the intent and accuracy of the GIS data and would be in conflict with the General Statute 89C. It is key that a licensed professional perform the survey in order to protect the health, safety and welfare of the public in regards to the public conveyance of a shellfish lease; to provide an accurate description of the shellfish lease, an accurate determination of acreage and a certified legal

document that protects the legal interest of all parties; citizens, state and shellfish leaseholders by meeting the standards and requirements of 21 NCAC 56 .1600 (Personal communication Gary Thompson, N.C. Geodetic Survey Chief August 6, 2014). Representatives of the NCSPPO agree that the current system requiring a legal survey is a valid requirement. The surveyor community is regulated by the state to ensure surveys are performed by competent, certified professionals. While there are additional costs, there is a higher level of competency with professional surveyors providing a legal survey map and legal description (Personal Communication with David Keely, NCSPPO August 21, 2014). While NCDMF may utilize GPS equipment which has a higher level of precision and accuracy than recreational GPS, NCDMF staff are not professional land surveyors. General Statute 89C provides the requirements for the collection of coordinate or survey data for the use in the development of a legal description or legal documents. The collection and use of this data, would be within the definition of surveying in North Carolina under General Statute 89C. The collection and use of this data in lieu of a survey, would be practicing surveying without a license (Personal communication Gary Thompson, NC Geodetic Survey Chief October 22, 2014)

The authority to grant use of state owned or public trust waters in North Carolina ultimately comes from the NCSPPO. The NCSPPO is required by N.C. General Statute 146-12 to obtain metes and bounds descriptions or a plat survey for all easements and rights-of-ways of all lands, all lands covered by water and all state property. Shellfish leases are a use right conveyed from the state to the leaseholder. By this requirement, any easement or conveyance of public trust waters or submerged lands, to include shellfish leases shall be suitably recorded by these standards.

VI. PROPOSED RULE(S)

No recommendations require rule changes at this time.

VII. PROPOSED MANAGEMENT OPTIONS

(+potential positive impact of action)

(-potential negative impact of action)

1. Status quo (Continue with certified professional surveys for shellfish lease approval standards)
 - + Meets the current requirements for the conveyance of public trust waters to leaseholders
 - + Is in the best interest of the citizens of North Carolina, the public trust of North Carolina, and protects the legal interest of all parties; citizens, state and shellfish leaseholders
 - /+ The survey is a one-time cost requirement and shellfish lease applicants would continue to pay market rate for professional land survey
2. Require NCDMF to define shellfish lease boundaries with GPS instead of a professional survey for shellfish lease approval standards (**requires statutory change**)
 - + Shellfish lease applicants would have lower initial shellfish lease startup cost
 - Proposed requirement conflicts with other NC General Statute 89C
 - NCDMF staff are not professional land surveyors, and in the opinion of NCGS would be practicing surveying without a license.
 - Additional cost, effort and resource requirements on NCDMF staff
 - Public perception of lower level of protection for public trust waters
 - Possibility of conflicts and legal actions resulting from conflicting data

VIII. RECOMMENDATION

Plan Development Team

- Status quo, continue with certified professional surveys for shellfish lease approval standards

Advisory Committee

- Require NCDMF to define shellfish lease boundaries with GPS instead of a professional survey for shellfish lease approval standards **(requires statutory change)**

Prepared by: Brian Conrad, (for further information contact Steve Murphey),
steve.murphey@ncdenr.gov, (252) 808-8046
September 5, 2014

Dates revised: September 17, 2014
October 1, 2015
October 29, 2014
December 19, 2014
March 3, 2015
September 22, 2015

15.4.2 CORE SOUND SHELLFISH LEASE MORATORIUM¹⁹

¹⁹ Presented to; PDT on 2/5/15, 8/13/15 & 8/25/15; AC on 3/9/15 & 9/14/15; MRT on 9/21/15.

September 22, 2015

I. ISSUE

A shellfish lease moratorium has existed in Core Sound in some form since 1993. The moratorium on new shellfish leases was enacted by the N.C. Legislature in response to a petition from a group of individuals opposing leases of public bottom in Core Sound for private shellfish growing operations. Given the recent growth of shellfish aquaculture in the mid-Atlantic region, changes to Core Sound's commercial fisheries, the sound's potential for successful shellfish growing operations, and multiple inquiries from the public on leasing public bottom in the sound, the moratorium on new shellfish leases is being proposed for review.

II. ORIGINATION

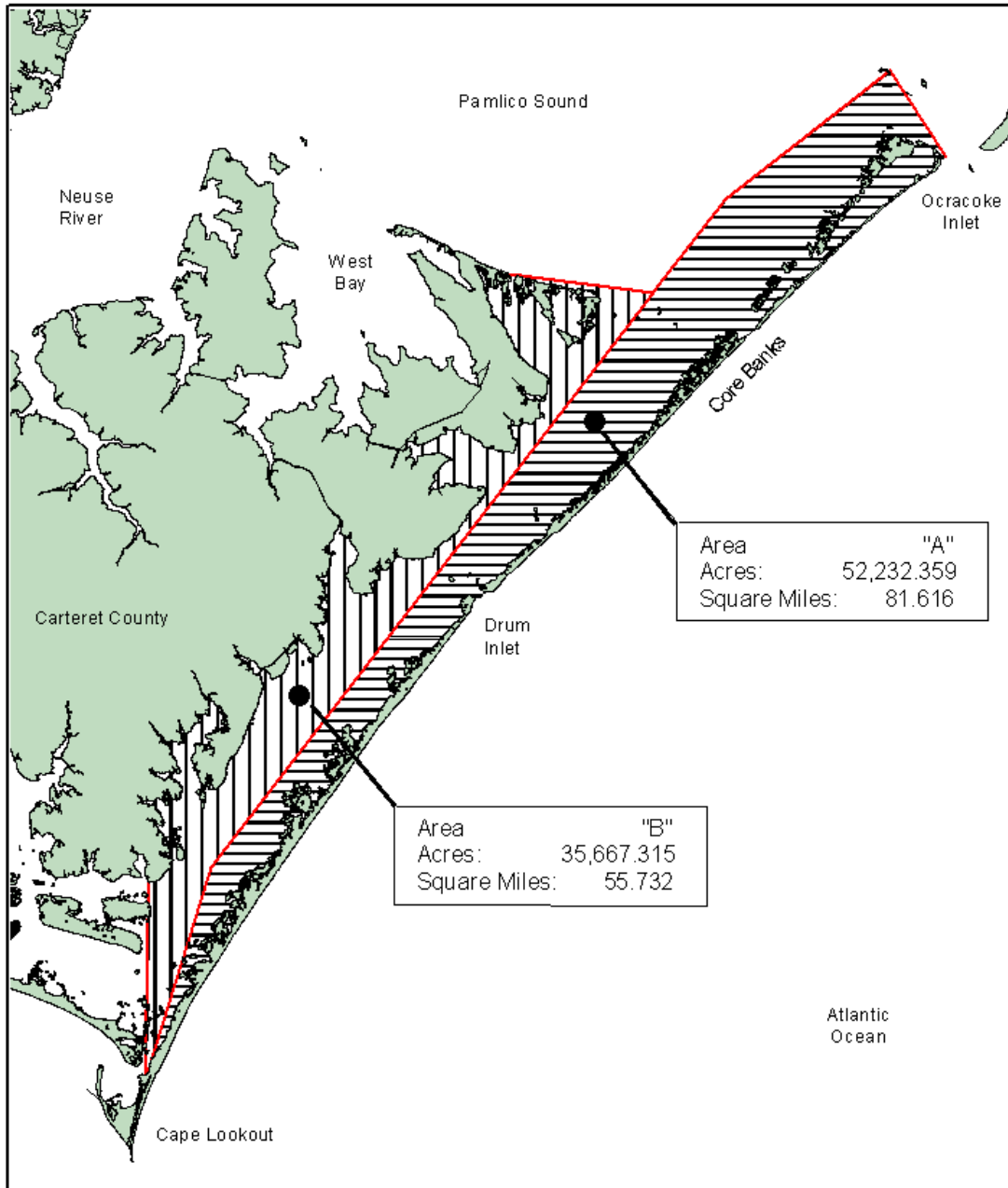
This issue was brought forward during an examination of clam and oyster FMP issues by the PDT with regard to the existing shellfish lease moratorium.

III. BACKGROUND

There is an indefinite ban on shellfish lease issuance covering more than half of the eastern-side of Core Sound and a portion of Pamlico Sound in Carteret County that was initiated in May 1996 (Area A, Figure 12.9.1). In addition, the remainder of the Core Sound area, Western Core Sound, is permanently limited to leased bottom that was under lease when the provisions of Session Law 2003-64 was implemented on June 30, 2003 (Area B, Figure 15.4.2.1).

Legislative action banning shellfish leases in Core Sound began after a seven-acre lease was granted on the eastern side of the sound in 1993 (Session Law 1993-44). The shellfish leases existing at the time were all on the western side of Core Sound near Core Banks. A petition with over 875 names was received to protest the granting of the lease because it interfered with commercial fishing and recreational activities in the area.

The MFC approved the lease over the protest because it found that the application met the statutory standards. In response to the petition, the General Assembly took action and imposed a two-year moratorium on the granting of shellfish leases for all of Core Sound that expired on July 1, 1995. The moratorium legislation included a mandate to study the leasing of shellfish bottoms in the area but no such study was undertaken and no changes were made to shellfish lease rules or statutes. Immediately after the moratorium lifted, the NCDMF received eight applications for lease areas on the East side of Core Sound. More than 400 protests were received on these applications and legislation was enacted permanently banning shellfish leases on the eastern side of the sound (Session Law 1995-547) and a moratorium on the western side of the sound was again enacted until a study could be conducted on the human use of Core Sound (Carteret County Crossroads 2003).



Core Sound Moratorium Areas

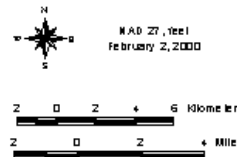


Figure 15.4.2.1. Core Sound shellfish lease indefinite moratorium Area A and restricted lease Area B.

In response, a study entitled *Core Sound Human Use Mapping and User Coordination Plan* was conducted by Dr. Mike Orbach of Duke University and study results were presented to the

NCDMF Shellfish Committee in the spring of 2001. This study utilized responses from multiple public hearings and workshops to obtain input from Core Sound stakeholders on the optimal use of Core Sound. Within this study, three scenarios were examined for shellfish leases in Core Sound, they are: 1) Opening the western side of the sound to new shellfish leases under normal leasing conditions, 2) Keeping the western side of the sound closed to new shellfish leases, and 3) Opening the western side of the sound to new shellfish leases with a 1% to 3% acreage cap on the total amount of Core Sound that can be leased. Each scenario was evaluated based upon the merits of productivity, benefits, equity, tradition, and flexibility. The study results showed that opening the west side of the Core Sound to new shellfish leases under a 1% to 3% cap was the most desirable option that offered the greatest overall benefit to stakeholders, followed by opening the western side of the sound to new leases under normal leasing conditions present in the majority of the state. Keeping the moratorium in place on the western side of the sound was rated as the least desirable option (Table 15.4.2.1) (Orbach 2001).

Table 15.4.2.1. Results from analysis of alternatives for user coordination in Core Sound focusing on shellfish leasing (Orbach 2001).

<u>Alternative</u>	<u>Alt. #1</u> (West side open)	<u>Alt. #2</u> (West side closed)	<u>Alt. #3</u> (1-3% Cap)
<u>Criterion</u>			
Productivity	High	Low	High
Benefits	Medium	Low	High
Equity	Medium	Low	Medium
Tradition	Medium	Medium	High
Flexibility	Medium	Medium	Medium
<u>Overall rating</u>	Medium	Low/Medium	High/Medium

In November 2001, the MFC formed the Core Sound Stakeholder Committee to develop recommendations on shellfish leases in Core Sound. Among other recommendations, this committee suggested opening the western side of Core Sound with a 1% cap on leased bottom and to limit new applications to a maximum of 5 acres. In February 2002, the NCDMF Shellfish Committee reviewed these recommendations and approved them unanimously after making a change to limit the maximum amount of total acreage that one entity could accumulate to no more than 50 total acres (Carteret Count Crossroads 2003).

Another petition with 500 names was sent to state legislators opposing any new shellfish leases in Core Sound. In response, provisions in Session Law 2003-64 were implemented on June 30, 2003 grandfathering currently leased bottom on the western side of Core Sound, but banning the leasing of any additional bottom for aquaculture.

NCDMF shellfish lease records show that within the area of the current moratorium area, that in 1923, 5 shellfish leases with acreages of around 50 acres were granted. In 1952, 8 shellfish leases with acreage ranging from 1.8-10 were granted. In 1981, 36 shellfish leases existed encompassing 192.2 acres. On June 30, 2003, 33 leases existed in Western Core Sound encompassing 92.4 acres and one lease in Eastern Core Sound encompassing 7 acres (Figure 15.4.2.2).

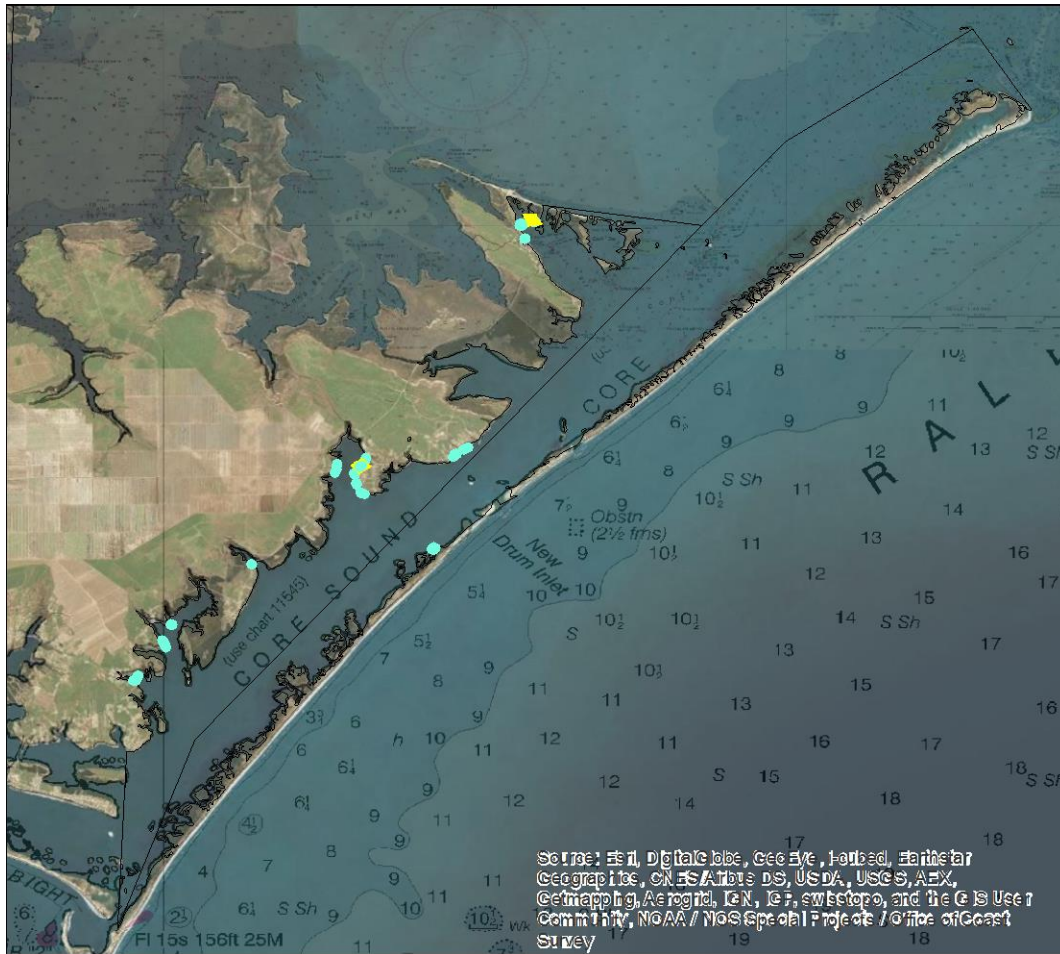


Figure 15.4.2.2 Location of shellfish leases and water columns within the Core Sound Moratorium area as of February 3, 2015.

An important component of re-examining the opening of Core Sound to additional shellfish aquaculture operations is the change in commercial fishing participation that has occurred in the sound since the 1990s and early 2000s when the various shellfish lease bans and moratoriums were put in place. Overall commercial participation has fallen by approximately 60% since 1994 and the use of several commercial gears that may conflict with shellfish leases have decreased as well. Some of the changes that have occurred in the use of Core Sound for commercial fishing purposes can be seen in Tables 15.4.2.2 through 15.4.2.4. With the exception of participants in the oyster fishery and the runaround gill net fishery, most commercial fisheries in the sound have seen substantially reduced participation. This change may decrease the likelihood of user conflict should new shellfish leases be approved in Core Sound.

Table 15.4.2.2 Commercial landings and effort in Core Sound from 1994 to 2013. TTP.

Year	Pounds	Ex-vessel value	Participants	Trips
1994	9,675,334	\$5,754,288	933	24,282
1995	7,002,165	\$6,388,015	1,022	25,814
1996	5,295,615	\$5,625,096	833	21,086
1997	7,015,344	\$5,694,046	852	21,713
1998	6,436,150	\$4,765,799	735	18,481
1999	5,138,589	\$4,524,483	655	16,272
2000	4,356,709	\$3,958,105	726	17,390
2001	4,284,982	\$3,965,297	800	19,236
2002	3,798,021	\$3,275,456	634	13,251
2003	3,755,248	\$3,760,313	542	11,422
2004	3,001,380	\$2,700,167	507	9,987
2005	2,282,633	\$2,220,361	434	7,669
2006	2,178,133	\$2,293,886	408	7,000
2007	1,938,040	\$1,985,501	406	7,731
2008	2,032,529	\$2,522,495	320	7,646
2009	1,734,763	\$1,796,553	421	7,629
2010	1,524,899	\$1,751,783	398	6,182
2011	1,441,963	\$1,536,991	352	5,626
2012	1,592,124	\$2,015,954	338	6,207
2013	1,790,123	\$2,620,098	380	6,721

Table 15.4.2.3. Participation by commercial gear in Core Sound from 1994 to 2013. TTP.

Year	Clam dredge	Clam kicking	Bull rake	Hand rake	Hand tong	By hand	Shrimp trawl	Pound net	Crab pot	Haul seine	Gill net (runaround)
1994	6	71	108	417	20	295	242	108	134	26	81
1995	14	68	75	463	23	334	267	63	131	17	94
1996	14	85	36	388	6	235	204	74	131	30	102
1997	13	77	44	396	4	190	186	43	126	13	79
1998	9	75	27	339	7	161	158	29	110	12	79
1999	10	64	20	272	5	181	164	28	102	13	38
2000	7	46	32	402	2	258	128	24	80	8	58
2001	7	50	35	445	11	263	120	29	71	11	70
2002	7	38	27	267	45	228	122	24	51	8	62
2003	1	42	19	186	22	103	110	14	62	7	65
2004	2	41	11	147	13	104	89	22	72	9	74
2005	6	30	17	139	20	86	79	18	46	8	78
2006	1	14	10	128	26	77	55	23	39	8	93
2007	1	15	15	147	30	71	46	31	36	8	91
2008	1	12	4	70	15	32	50	28	30	7	84
2009	2	14	8	98	24	62	59	20	29	7	82
2010	1	13	5	140	17	43	46	21	22	4	104
2011	2	10	7	110	34	55	25	17	28	7	95
2012	1	5	4	51	24	58	60	21	29	2	105
2013	2	4	5	89	14	73	56	19	40	5	106

Table 15.4.2.4. Landings, trips and participants for the hard clam and oyster fisheries in Core Sound from 1994 to 2013.

Year	Hard clams			Oysters		
	Pounds	Trips	Participants	Pounds	Trips	Participants
1994	180,623	8,359	554	4,342	152	41
1995	200,067	8,245	630	3,651	162	35
1996	160,085	6,596	515	3,873	145	20
1997	179,169	6,872	500	6,560	219	30
1998	153,318	6,293	422	4,868	201	31
1999	146,675	5,035	378	4,939	222	38
2000	163,764	7,736	485	8,322	346	45
2001	188,795	9,332	519	10,432	513	72
2002	126,791	4,560	360	10,915	505	100
2003	82,816	2,449	243	9,351	344	62
2004	93,527	2,233	201	9,478	447	74
2005	62,947	1,319	170	11,374	523	81
2006	45,439	1,014	141	11,333	520	83
2007	28,329	1,221	157	9,885	472	88
2008	16,208	445	67	4,954	263	50
2009	28,355	887	109	4,641	180	48
2010	34,895	1,355	151	11,165	227	56
2011	19,118	659	99	13,630	412	84
2012	9,654	347	48	7,967	235	55
2013	21,449	914	102	14,847	221	50

IV. AUTHORITY

N.C. Session Laws

1995-547, House Bill 1074
 2003-64, Chapter 113, Senate Bill 765
 Law 2009-433, Senate Bill 107
 Law 2015-241, House Bill 97

N.C. General Statutes

113-201 Legislative findings and declaration of policy; authority of Marine Fisheries Commission

V. DISCUSSION

The underlying fear expressed by commercial fishing interests opposing the issuance of shellfish leases was that the uncontrolled proliferation of lease sites would eventually deprive them of their livelihood by overtaking traditional fishing areas or by driving down shellfish prices because of an oversupply from culture operations or control of shellfish culture by large

corporations. In the area of the most recent and intense outcry from the public, approximately 0.1% of the total acres of estuarine bottom were under lease at the time of the protests. Statewide approximately 0.2% of the waters with salinities suitable for oyster and clam growth are under shellfish lease or franchise and that percentage has not changed appreciably for twenty years. Even so, shellfish cultivation has increased substantially in other states like Florida and Virginia, with the ex-vessel value of cultured shellfish topping \$12 million and \$36 million for each state respectively in 2012 (Adams et al 2014; Hudson and Murray 2014).

In an area such as Core Sound, shellfish leases could not only provide a much needed economic benefit, but could assist in lessening harvest pressures on public bottom, improve water quality, and perform other ecosystem functions. Depending on the ploidy (diploid or triploid) of shellfish seed used, shellfish leases could augment the spawning stock and supplement larval availability to shellfish populations on public bottom. Providing opportunity for new shellfish leases in the sound would also offer new business opportunities and ways to earn income for those working the waters of Core Sound. Based on some business feasibility estimates, a three-acre shellfish lease could provide an average of approximately \$20,000 in ex-vessel value of shellfish and \$13,000 annually in pre-tax income for lease holders (Turano 2013). Using these figures, should the amount of leased bottom increase to a 3% cap of total area on the western side of the sound (1,070 acres), there is potential to more than triple the ex-vessel value of seafood originating from Core Sound as well as provide several million dollars of income for the sound's shellfish growers annually.

Currently, the only available means for obtaining a shellfish lease in Western Core Sound is to transfer or re-lease a site that was part of the 92.4 acres (0.3% of the area) under lease at the time of implementation of the 2003 session law. In addition to the rapid growth in shellfish aquaculture observed in other coastal states, Core Sound has seen decreased use of commercial gears that may conflict with shellfish leases such as rakes, dredges, and trawls. This change in public bottom use coupled with the exhibited potential of aquaculture as a means of income, has led some members of the public to inquire about new shellfish leases in the sound. The division has received approximately 20 such inquiries over the last three years. Additionally, Core Sound has superior potential for shellfish aquaculture because of salinities within a suitable range as well as high water quality.

It is important to note the differences of human use and habitat found in eastern and western Core Sound. The eastern side of the sound tends to exhibit an extensive amount of SAV. There is also a buffer present for the Cape Lookout National Seashore. This could potentially be a barrier to citing leases in many areas. However, the extensive presence of SAV on the eastern side of the sound is also accompanied by a historical abundance of bay scallops. In the pending Bay Scallop Fishery Management Plan Amendment 2, rule and statutory changes have been identified that will facilitate bay scallop aquaculture in the state by aligning regulations for the culture of bay scallops with those already present for the culture of clams and oysters. This naturally productive area for bay scallop growth may provide opportunity for bay scallop aquaculture. While SAV is present on the western side of the sound in many areas, it is not as common.

Additionally, the eastern side of Core Sound is currently the site of more pound net operations and waterfowl hunting when compared to the western side. This could lead to greater user conflict on the eastern side of the sound than the western side. While participation in commercial fishing in Core Sound is well below levels present in the 1990s and early 2000s, approximately 300-400 individuals still utilize the sound for commercial fishing activities each year. Should additional shellfish leases be authorized in the sound, consideration of the current

use would be very important for equity among user groups in order to minimize conflict while providing new economic opportunities for those wishing to grow shellfish. As such, a cap on the total area of leased bottom could be implemented to help balance public trust concerns with providing additional opportunities for shellfish aquaculture. Authority to limit total acreage under lease in an area is currently in place as granted in Session Law 2009-433 through an amendment to G.S. 113-201 (b).

For these reasons, a re-examination of the Core Sound shellfish lease moratorium is being brought forth for input. By addressing this issue and allowing public comment from area residents, commercial fishermen, regulators and shellfish growers, current views on shellfish leases in Core Sound may be obtained. Should new shellfish operations be deemed appropriate, new economic opportunities for Core Sound communities may be realized and growth of the shellfish aquaculture industry in North Carolina could occur.

VI. PROPOSED RULE(S)

No recommendations require rule changes at this time.

VII. PROPOSED MANAGEMENT OPTIONS

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

1. Status quo (Continue the moratorium of shellfish leases in Core Sound)
 - + Addresses the concerns of some Core Sound area users
 - + No new catalyst for user conflict
 - + No statutory change
 - + Upholds public trust and use of all approved Core Sound waters for the public harvest of shellfish
 - Disallows additional business opportunities for aquaculture in Core Sound, an area with high shellfish culture potential
 - Continues public perception of unfair restrictions
2. Open all of Core Sound, with a buffer around Cape Lookout, to shellfish leases per guidelines used in the rest of the state (**requires statutory change**)
 - + Provides maximum economic and business opportunities for aquaculture in Core Sound
 - + Provides management consistency with other geographic areas of North Carolina
 - + Possible decrease in harvest pressure on public bottom
 - + Provides ecosystem benefits
 - + Provides more opportunities for shellfish cultivation
 - Requires statutory change
 - Possible source of user conflict
 - Possible reduction of area available for public use
3. Allow shellfish leases in all of Core Sound, with a buffer around Cape Lookout, limiting acreage and availability (**requires statutory change**)
 - + Provides additional economic and business opportunities for aquaculture in Core Sound
 - + Provides some management consistency with other geographic areas of North Carolina
 - + Possible decrease in harvest pressure on public bottom
 - + Provides ecosystem benefits

- + Balances public trust concerns with providing additional economic/business opportunities
 - + Provides more opportunities for shellfish cultivation
 - Requires statutory change
 - Possible source of user conflict
 - Possible reduction of area available for public use
4. Allow shellfish leases only on the eastern side of Core Sound, with a buffer around Cape Lookout, limiting acreage and availability **(requires statutory change)**
- + Provides additional economic and business opportunities for aquaculture in Core Sound
 - + Provides some management consistency with other geographic areas of North Carolina
 - + Possible decrease in harvest pressure on public bottom
 - + Provides ecosystem benefits
 - + Balances public trust concerns with providing additional economic/business opportunities
 - + Provides more opportunities for shellfish cultivation
 - Areas that can be leased may be limited by other public trust uses and widespread presence of SAV
 - Requires statutory change
 - Possible source of user conflict
 - Possible reduction of area available for public use
5. Allow shellfish leases only on the western side of Core Sound, limiting acreage and availability **(requires statutory change)**
- + Provides additional economic and business opportunities for aquaculture in Core Sound
 - + Provides some management consistency with other geographic areas of North Carolina
 - + Possible decrease in harvest pressure on public bottom
 - + Provides ecosystem benefits
 - + Balances public trust concerns with providing additional economic/business opportunities
 - + Provides more opportunities for shellfish cultivation
 - Requires statutory change
 - Possible source of user conflict
 - Possible reduction of area available for public use

VIII. RECOMMENDATION

MFC Selected Management Strategy

-

Plan Development Team

- Pursue opening Core Sound to new shellfish leases in accordance with shellfish leasing requirements **(requires statutory change)**

Advisory Committee

- No recommendation

IX. LITERATURE CITED

Adams, C., L. Sturmer, and A. Hodges. 2014. *Tracking the Economic Benefits Generated by the Hard Clam Aquaculture Industry in Florida*. University of Florida. Institute of Food and Agricultural Sciences Extension Program. Electronic Data Information Source Document FE961. <http://shellfish.ifas.ufl.edu/wp-content/uploads/2012-Clam-Economic-Impact.pdf>.

Carteret County Crossroads (CCC). 2003. *Core Sound Shellfish Moratorium Information Sheet*. Report produced for Carteret County Crossroads.

Hudson, K. and T. Murray. 2014. *Virginia Shellfish Aquaculture Situation and Outlook Report*. Virginia Institute of Marine Science. Virginia Sea Grant Marine Extension Program. VIMS Marine Resource Report No. 2014-5. http://www.vims.edu/research/units/centerspartners/map/aquaculture/docs_aqua/20140411_Shellfish_Aq_Report.pdf.

Orbach, M. K. 2001. *Final Report to the Shellfish Advisory Committee of the North Carolina Marine Fisheries Commission on the Core Sound Human Use Mapping and User Coordination Plan*. Report produced pursuant to a directive of the Joint Legislative Commission on Seafood and Aquaculture of the North Carolina General Assembly.

Turano, M. J. 2013. *Shellfish Production Methods and Economics - Eastern Oyster*. North Carolina Sea Grant. Presentation for the 2013 North Carolina Aquaculture Development Conference. http://www.ncaquaculture.org/pdfs/2013_marine_session/turano_economics.pdf.

Prepared by: John Hadley, john.hadley@ncdenr.gov, 252-808-8107
Brian Conrad (for further information contact Steve Murphey),
steve.murphey@ncdenr.gov, (252) 808-8046
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15.4.3 REDEFINING OFF BOTTOM CULTURE²⁰

September 22, 2015

I. ISSUE

A concise definition of bottom culture or off bottom culture with regard to private culture operations and the use of a shellfish water column lease does not exist within N.C. General Statutes or MFC Rules. Shellfish growers want to know if the use of bottom cages could be considered as on-bottom culture, and if there can be a height limit as to when on-bottom culture would be considered as off-bottom culture.

II. ORIGINATION

This issue was brought forward by the NCSGA on March 25, 2013.

III. BACKGROUND

The NC Shellfish Growers Association brought forward concerns regarding the definition of off bottom culture in North Carolina. In shellfish aquaculture there are two basic methods of culturing during the field nursery and grow out stages: on bottom and off bottom. Historically North Carolina shellfish leases and franchises have used on bottom culture, through natural and remote set, as a means to commercially harvest shellfish. Bottom culture requires a shellfish lease or a franchise which conveys an exclusive right and authorization to use the bottom only. Off bottom culture requires a shellfish lease or franchise as well as a superjacent water column lease. The water column lease conveys an exclusive right of public trust waters and authorization to use the water column superjacent to a shellfish bottom lease or franchise. Legislation authorizing water column use for aquaculture in North Carolina was enacted in 1989, with the first water column lease issued in 1991. Water column operations use gear within the water column and are often referred to as off-bottom culture. Since 2012, water column lease requests have multiplied fivefold. As of April 30, 2015 there are 25 authorized water column leases and 8 other water column lease applications being processed. Current regulations require any private culture operations growing oysters within the water column to have a water column lease superjacent to the shellfish bottom lease or franchise.

The working definition used for an aquaculture operation under MFC rule was derived from the G.S. 106-758. MFC Rule 15A NCAC 03I .0101 (2) (a) defines an aquaculture operation as 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 circulation, utilizing technology not found in the natural environment. NCDMF staff have been interpreting off bottom culture to be the use of any gear which extends above the natural substrate and which uses any type of predator excluding gear.

Current shellfish aquaculture methods use mesh bags, wire cages, trays or a combination of gear during the shellfish nursery and grow out process. Whether the gear is floating or sitting

²⁰ Presented to: PDT on 5/7/15, 8/13/15, & 8/25/15; AC on 6/15/15, and 9/14/15; Rules Subgroup on 8/31/15; MRT on 9/21/15.

on the bottom; these gear types provide predator protection and are using technology not found in the natural environment. Within the last twenty years, the only acceptable gear for use on a shellfish lease or franchise without a superjacent water column lease has been clam bags or clam covers bedded down into the substrate for commercial clam production. The practice of bedding down clams with covers or bags has existed since at least the 1960s. Within the shellfish aquaculture industry, off-bottom gear and methods include the use of gear that sits on or very near to the bottom which extends upward from the benthic substrate.

Gear that sits or rests on the bottom and extends into the water column includes the use of racks, trays and cages, but can also include bag growout methods depending on water depth and tidal range. Most bottom cages used by the shellfish aquaculture industry prior to the late 1990s were made and supplied from the existing shellfish aquaculture industry in New England. Individual shellfish aquaculturist often used this general concept, but adapted the cage to fit their needs. These cages initially were rectangular wire mesh boxes with no legs/feet.

Changes occurred to cage design based on need, knowledge as well as from permit changes in some states with regard to shellfish leases and aquaculture. Legs and feet kept the cages, depending on substrate and cage plus oyster weight, off of the bottom; which increased flow rates, oxygen and nutrient availability and lessened sedimentation. Legs and feet also may have allowed improvements in the handling of the cages. Some growers use stacked cages, while others use single cages of varying heights. There are some cage/bag systems that are both floating and on bottom systems depending on grower use, the cycle of production and growout, as well as food/nutrient availability and salinity gradients.

IV. AUTHORITY

N.C. Session Laws

Law 2015-241, House Bill 97

N.C. General Statutes

106-758 Definitions
113-202.1 Water column leases for aquaculture

N.C. Marine Fisheries Commission Rules May 1, 2015 (15A NCAC)

03I .0101 Definitions
03O .0201 Standards for shellfish bottom and water column
03O .0202 Shellfish bottom and water column lease applications
03O .0203 Shellfish lease application processing

V. DISCUSSION

The use of gears which sits or rests on the bottom as well as gear that floats within the water column continues to change over time due to innovation, changes to state and federal rules; as well as to meet the growing and changing needs of individual growers and the industry. The current requirement for a water column lease for all aquaculture gear provides that a high level of compliance is being met which further ensures that the public trust water rights of citizens of North Carolina are being protected. Once the private culture operation has a water column lease, and it is properly marked, the use of gear is easily able to be discerned by the public, staff and Marine Patrol. The authorization of one type of gear with a maximum size, area or height requirement would be more difficult to discern and to enforce.

The use of gear that sits on the bottom and that extends into the water column is using public trust waters exclusively for private use. A water column lease provides the leaseholder with additional protections, as an aquaculture operation; and exclusive use rights to the water column that a bottom lease does not offer. However, allowing a bottom lease the ability to culture shellfish in gear on the bottom could further promote the aquaculture industry within the state. Bottom gear could provide increased production, by providing predator protection and product containerization to prevent loss due to sedimentation, storm events and possibly even poaching; resulting in possible increased production from bottom leases, which could further lessen the number of leases from being terminated.

Development in shellfish aquaculture occurring in the Chesapeake Bay led to Virginia and Maryland to make changes to their shellfish lease and aquaculture programs, requirements of permits, and state laws. In addition, there were changes associated with the role of the USACE with the permitting process of shellfish leases and aquaculture in those states.

Virginia conducted an analysis of the state's statutes and regulations with regard to shellfish aquaculture operations in the 1990s. An advisory committee discussed the feasibility of developing a general permit for aquaculture structures (racks, trays, cages) placed on the bottom which would specify maximum dimensions and the permissible heights that these structures could rise above the bottom. Maximum height, based on gear dimensions, limits of 6 inches and 12 inches were both discussed. The USACE-Norfolk District provided input on these changes and allowances. The final height of structures cannot extend higher than 12 inches off bottom was approved by Virginia MRC. In Virginia, such structures and apparatus are allowed under USACE Regional Permit # 19. Virginia code 4 VAC 20-335-10 authorizes shellfish aquaculture structures with the requirements and conditions, to include 12 inches, as outlined in 4 VAC 20-335-30. The USACE permit does not establish any specific height. Both the Virginia permit and the USACE regional permit prohibit the placement of such structures where they would impair navigation and on areas with submerged aquatic vegetation. In Delaware, Delaware Administrative Code Title 7 3801 11.4 has restrictions on shellfish aquaculture gear stating that it is unlawful for any gear containing oysters to hold the oysters closer than four inches from the bottom. In Maryland, the use of bottom cages and all other aquaculture gear require a water column lease. New York Statute 48.1 defines off bottom culture to mean the raising, breeding or growing of marine plant or animal life, including containment on, or in, any raft, rack, float, cage, box or other similar device or structure in any natural waters of the state. New York's on-bottom culture is defined as the raising, breeding, growing or planting of marine plant or animal life on, or in, any natural underwater lands of the State. While Title 22, Part 13 Chapter 6 of Mississippi's rules for aquaculture define off bottom culture as floating and/or suspended operations, that include, but are not limited to, long lines and rafts. Mississippi's definition of on-bottom culture of molluscan shellfish in nearshore waters includes any aquaculture operation that involves the use of cultch material, racks, cages or any structures to support shellfish which are located within 750 yards of the shoreline; with requirements that on-bottom culture operations shall be designed to minimize the disruption of the natural movement of sediment in the nearshore areas, with racks and cages arranged in rows with adequate spacing between rows to allow for reasonable ingress and egress to the shoreline. No racks or cages shall be located within two hundred (200) feet of the shoreline unless it can be proven that there will be no conflict with the traditional user groups in the area.

Currently in North Carolina the difference between a bottom lease and a water column lease is easy to distinguish by the identification of the use of aquaculture grow out gear within the private culture operation; and if proper marking of the private culture operation is used as required by 15A NCAC 03O .0204. Changes to allow gear use which rests on the bottom to a maximum

specified height could pose enforcement challenges due to additional site visits that may be necessary to ensure the private culture operations are within the specified gear, size and height requirements. Using the current distinction of gear use between a bottom lease and a water column lease provides a discernable confirmation of compliance and continues to provide a high level of protection to the state's public trust water doctrine while providing the opportunity for shellfish aquaculture within North Carolina.

Any change in the height allowed on leases would need to be addressed through the US Army Corps of Engineer Nationwide Permit 48 with regard to restricted use of public trust waters. During discussion and review of this issue by the Oyster and Clam PDT, it was also determined that the use of structures up to 12 inches from the bottom would require an AOP, and if the structure exceeds 12 inches from the bottom that an AOP plus a water column lease would be required. The 12-inch height primarily addresses the use of 4 inch cages that are stacked in groups of three. However, current practices may use 6 inch legs to elevate the cages to avoid siltation, etc. so 18 inches may be the optimum. Currently, leaseholders bedding clam bags or using clam covers are not required to have an AOP. However, this is not supported in rule and as written, and includes these practices in the requirement of an AOP (i.e. predator protection). The AOP is required by 15A NCAC 30 .0503 (f) (1) and MFC Rule 15A NCAC 03I .0101(2)(a) defines an aquaculture operation as any operation that produces artificially propagated stocks of marine or estuarine resources or obtains such stocks from authorized 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: predator protection, food, water circulation, salinity, or temperature controls utilizing technology not found in the natural environment. The AOP is a free permit which requires yearly renewal.

Concise definitions allow the citizens of North Carolina, regulators and enforcement officers the opportunity to clearly understand, communicate, use, regulate and enforce statutes and rules. With changes in practice and technology that occur over time, rule makers need to ensure that terminology and definitions adequately provide a level of understanding for all user groups. Definitions for water column, off-bottom and on-bottom differ between agencies and states with regard to shellfish aquaculture. Definitions from federal agencies and the Code of Federal Regulations either do not exist, differ between agencies, or are overly vague and left to interpretation. Clear definitions of water column lease gear use requirements as an aquaculture operation and for off- and on-bottom culture are needed to eliminate different interpretations.

VI. PROPOSED RULE(S)

No recommendations require rule changes at this time.

VII. PROPOSED MANAGEMENT OPTIONS

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

1. Status quo (Continue to use the definition of an aquaculture operation to define off bottom/water column culture)
 - + Uses current definition which is already in rule
 - + Private culture operation correctly marked with water column number signs, buoys, etc. are easy to discern to ensure compliance through enforcement
 - + Prevents unauthorized use of nursery and growout gear
 - Does not provide further clarification on its own

2. Define off-bottom culture with height limits from substrate level **(requires statutory changes)**
 - + Provides a clear definition of what off-bottom culture is in North Carolina
 - Requires additional enforcement and monitoring efforts of authorized gear use on private culture operations

VIII. RECOMMENDATION

MFC Selected Management Strategy

-

NCDMF and Advisory Committee

- Define on bottom culture as any structure that extends no higher than 18 inches attached to or resting on the bottom **(requires statutory change)**

Prepared by: Brian Conrad (for further information contact Steve Murphey);
steve.murphey@ncdenr.gov (252) 808-8046
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15.5 OVERVIEW OF THE DRAFT NCDMF AND OYSTER AND HARD CLAM ADVISORY COMMITTEE, MFC REGIONAL AND STANDING ADVISORY COMMITTEES' RECOMMENDATIONS AND PUBLIC COMMENT GAINED IN DECEMBER 2015 ON THE DRAFT AMENDMENT 2 OF THE HARD CLAM FMP

Issue	NCDMF	Advisory Committee	MFC Committees	Public Comment
<p><u>Hard clam only issue:</u> Consider increasing the recreational maximum daily harvest limit for hard clams</p>	<p>Increase the daily vessel maximum recreational clam harvest limit to 400 clams and maintain the daily personal harvest limit of 100 clams per person per day for all recreational participants (rule change required)</p>	<p>Same as NCDMF</p>	<p><u>Shellfish/Crustacean, Southern, & Northern:</u> Same as NCDMF and Advisory Committee</p> <p><u>Habitat and Water Quality:</u> Maintain Status quo (100 clams per person per day, not to exceed <u>200</u> clams per vessel per day)</p>	<p>None</p>
<p><u>Hard clam only issue:</u> The use of power hauling equipment in the hand harvest of hard clams</p>	<p>Status quo (Maintain current definitions and enforcement of hand harvest methods)</p>	<p>Same as NCDMF</p>	<p>All committees agreed with the NCDMF and Advisory Committee recommendation</p>	<p>Deny this request</p>

15.5 OVERVIEW OF THE DRAFT NCDMF AND OYSTER AND HARD CLAM ADVISORY COMMITTEE, MFC REGIONAL AND STANDING ADVISORY COMMITTEES' RECOMMENDATIONS AND PUBLIC COMMENT GAINED IN December 2015 ON THE DRAFT AMENDMENT 2 OF THE HARD CLAM FMP (Continued)

Issue	NCDMF	Advisory Committee	MFC Committees	Public Comment
<p><u>Hard clam only issue:</u> Management of public mechanical clam harvest</p>	<p>Status quo (Maintain management of the mechanical clam harvest in existing areas from Core Sound south to Topsail Sound, including modifications to the mechanical clam harvest lines to exclude areas where oyster habitat and SAV habitat exist based on all available information)</p> <p>Remove the Pamlico Sound mechanical clam harvest area in rule no longer in use (rule change required)</p> <p>Take latitude/longitude coordinates of the poles marking the open mechanical clam harvest area boundary in the New River, still with the flexibility to move a line to avoid critical habitats</p>	<p>Same as NCMDf and this additional recommendation:</p> <p><u>Allow mechanical clam harvesters to have access to the bottom before maintenance dredging occurs</u></p>	<p><u>Shellfish/Crustacean:</u> Same as the Advisory Committee</p> <p><u>Southern:</u> Same as the Advisory Committee <u>except they did not include</u> the recommendation to remove the Pamlico Sound mechanical clam harvest areas in rule no longer in use</p> <p><u>Northern:</u> Same as the Advisory Committee with added language to the last recommendation shown underlined below</p> <p>Allow mechanical clam harvesters to have access to the bottom before maintenance dredging occurs <u>and provide harvesters reasonable prior notification for access</u></p> <p><u>Habitat and Water Quality:</u> Same as NCDMF</p>	<p>Open mechanical clam harvest areas not fished should be closed</p>

15.5 OVERVIEW OF THE DRAFT NCDMF AND OYSTER AND HARD CLAM ADVISORY COMMITTEE, MFC REGIONAL AND STANDING ADVISORY COMMITTEES' RECOMMENDATIONS AND PUBLIC COMMENT GAINED IN DECEMBER 2015 ON THE DRAFT AMENDMENT 2 OF THE HARD CLAM FMP (Continued)

Issue	NCDMF	Advisory Committee	MFC Committees	Public Comment
<p><u>Oyster and hard clam issue:</u> Consider the elimination of the Shellfish License and require all shellfish harvesters to have a Standard/Retired Commercial Fishing License</p>	<p>Maintain the cost of the shellfish license allowing for harvest of all shellfish except oysters; require Standard/Retired Commercial Fishing License with a shellfish endorsement to harvest oysters (requires statutory change)</p> <p><u>From Highway 58 Bridge south to NC/SC state line, maintain a daily trip limit of 2 bushels of oysters per person maximum 4 bushels of oysters per vessel off public bottom for holders of the Shellfish License. Maintain the daily trip limit at 5 bushels of oysters per person for Standard/Retired Commercial Fishing License holders in the southern region</u></p>	<p><u>From Swan Point Marina south to NC/SC state line, maintain a daily trip limit of 2 bushels of oysters per person maximum 4 bushels of oysters per vessel off public bottom for holders of the Shellfish License. Maintain the daily trip limit at 5 bushels of oysters per person for Standard/Retired Commercial Fishing License holders in the southern region</u></p> <p><u>Allow Shellfish License holders to be eligible to acquire a Standard Commercial Fishing License after they show a history of sale of shellfish</u></p>	<p><u>Shellfish/Crustacean:</u> Same as the Advisory Committee</p> <p><u>Southern and Northern:</u> Same as NCDMF</p> <p><u>Habitat and Water Quality:</u> Same as the Advisory Committee with this additional recommendation:</p> <p><u>Require all shellfish harvest by shellfish license holders be reported through the Trip Ticket Program or some other reporting method provided by NCDMF or through MFC rulemaking</u></p>	<p>Support to lower the commercial oyster harvest limit to two bu. per person for holders of the Shellfish License in the southern region (2 separate comments)</p> <p>Discussion needs to be stressed on the \$50 license, which is not means as a full-time license</p>

15.5 OVERVIEW OF THE DRAFT NCDMF AND OYSTER AND HARD CLAM ADVISORY COMMITTEE, MFC REGIONAL AND STANDING ADVISORY COMMITTEES' RECOMMENDATIONS AND PUBLIC COMMENT GAINED IN December 2015 ON THE DRAFT AMENDMENT 2 OF THE HARD CLAM FMP (Continued)

Issue	NCDMF	Advisory Committee	MFC Committees	Public Comment
<p><u>Oyster and hard clam issue:</u> Protection of shellfish lease and franchise rights</p>	<p>Support modification of G.S. 113-208 and G.S. 113-269 to add minimum fines for violations on shellfish leases and franchises. With minimum fines set at \$500 for the first violation and \$1,000 for the second violation (requires statutory change)</p> <p>Support modification of G.S 113-269 to include protection to all shellfish leases and franchises, not just those with water column amendments (requires statutory change)</p> <p>Modify Rule 15A NCAC 03O .0114 so that a first conviction under G.S. 113-208 or G.S. 113-269 the Fisheries Director shall revoke all licenses issued to the licensee for a period of one year (rule change required)</p>	<p>Same as NCDMF</p>	<p><u>Shellfish/Crustacean, Northern, & Habitat and Water Quality:</u> Same as NCMDf and the Advisory Committee</p> <p><u>Southern:</u> Support modification of G.S. 113-269 to include protection to all shellfish leases and franchises, not just those with water column amendments (requires statutory change)</p>	<p>None</p>

15.5 OVERVIEW OF THE DRAFT NCDMF AND OYSTER AND HARD CLAM ADVISORY COMMITTEE, MFC REGIONAL AND STANDING ADVISORY COMMITTEES' RECOMMENDATIONS AND PUBLIC COMMENT GAINED IN DECEMBER 2015 ON THE DRAFT AMENDMENT 2 OF THE HARD CLAM FMP (Continued)

Issue	NCDMF	Advisory Committee	MFC Committees	Public Comment
<u>Oyster and hard clam issue:</u> Defining adverse impacts to submerged aquatic vegetation from shellfish leases and franchises	Status quo (Adhere to Regional Conditions of USACE NWP48 with no adverse effect to SAV from shellfish leases and following the 15% sparse SAV measure identified in the interim)	Same as NCDMF	All committees agreed with the NCDMF and Advisory Committee recommendation	None
<u>Oyster and hard clam issue:</u> Brunswick County shellfish lease moratorium	Continue the moratorium of shellfish leases in Brunswick County	Same as NCDMF	All committees agreed with the NCDMF and Advisory Committee recommendation	None

15.5 OVERVIEW OF THE DRAFT NCDMF AND OYSTER AND HARD CLAM ADVISORY COMMITTEE, MFC REGIONAL AND STANDING ADVISORY COMMITTEES' RECOMMENDATIONS AND PUBLIC COMMENT GAINED IN DECEMBER 2015 ON THE DRAFT AMENDMENT 2 OF THE HARD CLAM FMP (Continued)

Issue	NCDMF	Advisory Committee	MFC Committees	Public Comment
<p><u>Oyster and hard clam issue:</u> Modify shellfish lease provisions</p>	<p>Establish rule to support extensions for where "Acts of God" prevent lease holder from making production, with a two-year extension and only one extension allowed per term (rule change required).</p> <p>Status quo (Maintain five acres within a mechanical methods prohibited area and ten acres within a mechanical methods area, not to exceed 50 acres).</p>	<p>Establish rule to support extensions for where "Acts of God" prevent lease holder from making production, with a two-year extension and only one extension allowed per term (rule change required)</p> <p><u>Allow a maximum of 10 acres in both mechanical methods prohibited areas and mechanical methods allowed areas (rule change required)</u></p> <p><u>Allow leases returned to the state to remain delineated for a period of time to allow the pre-existing leased bottom to be re-issued to other shellfish growers (requires statutory change)</u></p> <p><u>Improve public notice of proposed lease applications on the physical lease, at fish houses, and/or through electronic notices.</u></p>	<p><u>Shellfish/Crustacean & Habitat and Water Quality:</u> Agreed with the NCDMF and Advisory Committee recommendation to support extension for "Acts of God"</p> <p><u>Shellfish/Crustacean & Southern:</u> Agreed with NCDMF for status quo to maintain five acres in the mechanical methods prohibited area and ten acres within a mechanical methods area, not to exceed 50 acres</p> <p><u>Habitat and Water Quality:</u> Agreed with the Advisory Committee to allow a maximum of 10 acres in both mechanical methods prohibited areas and mechanical methods allowed areas</p> <p><u>Shellfish/Crustacean, Southern, & Habitat and Water Quality:</u> Agreed with the Advisory Committee to allow leases returned to the state to remain delineated <u>for one year</u> to be re-issued to other growers. They specified a time period that the Advisory Committee did not</p> <p><u>Shellfish/Crustacean, Southern, & Habitat and Water Quality:</u> Agreed with the Advisory Committee to improve public notice of proposed lease applications</p> <p><u>Northern:</u> No consensus</p>	<p>Better streamline the process for leases</p> <p>Use GPS to delineate the lease</p> <p>Improve outreach on seed sources for leaseholders</p>

15.5 OVERVIEW OF THE DRAFT NCDMF AND OYSTER AND HARD CLAM ADVISORY COMMITTEE, MFC REGIONAL AND STANDING ADVISORY COMMITTEES' RECOMMENDATIONS AND PUBLIC COMMENT GAINED IN DECEMBER 2015 ON THE DRAFT AMENDMENT 2 OF THE HARD CLAM FMP (Continued)

Issue	NCDMF	Advisory Committee	MFC Committees	Public Comment
<p><u>Oyster and hard clam issue:</u> Requirements for shading Molluscan shellstock</p>	<p>Implement shading requirements for clams on a vessel, during transport to a dealer, or storage on a dock during June through September. These requirements would be implemented as a public health protection measure under Rule 15A NCAC 03K .0110 by proclamation annually</p>	<p>Same as NCDMF</p>	<p><u>Shellfish/Crustacean, Southern, & Habitat and Water Quality:</u> Agreed with the NCDMF and Advisory Committee</p> <p><u>Northern:</u> Status quo (continue with no shading requirements)</p>	<p>None</p>

15.6 RULES NECESSARY TO IMPLEMENT HARD CLAM FMP AMENDMENT 2 RECOMMENDATIONS

Management of Public Mechanical Clam Harvest

15A NCAC 03K .0302 ~~MECHANICAL HARVEST SEASON~~ MECHANICAL HARVEST OF CLAMS FROM PUBLIC BOTTOM

(a) It is unlawful to take, buy, sell, or possess any clams taken by mechanical methods from public bottom unless the season is open.

(b) ~~except that the~~ The Fisheries Director may, by proclamation, open and close the season at any time in the Atlantic Ocean and only ~~between from~~ December 1 through March 31 in Internal Coastal Waters. ~~internal waters for the use of mechanical clam harvesting gear. The Fisheries Director is further empowered to impose any or all of the following restrictions:~~

- (1) ~~specify number of days;~~
- (2) ~~specify areas;~~
- (3) ~~specify time period;~~
- (4) ~~specify quantity or size; and~~
- (5) ~~specify means/methods. Any proclamation specifying means or methods must be approved by the Marine Fisheries Commission prior to issuance.~~

~~(b)~~(c) The Fisheries Director may, by proclamation, open to the taking of clams by mechanical methods from public bottom during open seasons only areas that have been opened at any time from January 1979 through September 1988 in:

- (1) Newport, North, White Oak, and New rivers;
- (2) Core and Bogue sounds;
- (3) the Intracoastal Waterway north of "BC" Marker at Topsail Beach; and
- (4) the Atlantic Ocean.

~~in Core and Bogue Sounds, Newport, North, White Oak and New Rivers and the Intracoastal Waterway north of "BC" Marker at Topsail Beach which have been opened at any time from January, 1979, through September, 1988, to the harvest of clams by mechanical methods. The Fisheries Director may, by proclamation, open the Atlantic Ocean and the area or any portion of the area in Pamlico Sound bounded by a line beginning on Portsmouth Island at a point 35° 01.5000' N 76° 06.0000' W; running northerly to a point 35° 06.0000' N 76° 06.0000' W; running westerly to a point 35° 06.0000' N 76° 10.0000' W; running southerly to a point 35° 01.5000' N 76° 10.0000' W; running easterly to the point of beginning to the harvest of clams by mechanical methods. Other areas opened for purposes as set out in 15A NCAC 03K .0301(b) shall open only for those purposes. A list of areas as described in this Paragraph is available upon request at the Division of Marine Fisheries, 3441 Arendell Street, Morehead City, NC 28557.~~

(d) The Fisheries Director may, by proclamation, impose any or all of the following additional restrictions for the taking of clams by mechanical methods from public bottom during open seasons:

- (1) specify time;
- (2) specify means and methods;
- (3) specify size; and
- (4) specify quantity.

*History Note: Authority G.S. 113-134; 113-182; ~~413-221~~; 113-221.1; 143B-289.52;
Eff. January 1, 1991;
Temporary Amendment Eff. October 1, 2001;
Amended Eff. May 1, 2017; April 1, 2003.*

Protection of Shellfish Lease and Franchise Rights (See Appendix 15.7 for related, suggested statutory changes)

15A NCAC 030 .0114 SUSPENSION, REVOCATION AND REISSUANCE OF LICENSES

(a) All commercial and recreational licenses issued under Article 14A, Article 14B, and Article 25A of Chapter 113 are subject to suspension and revocation.

(b) A conviction resulting from being charged by an inspector under G.S. 14-32, 14-33 or 14-399 shall be deemed a conviction for license suspension or revocation purposes.

(c) Upon receipt of notice of a licensee's conviction as specified in G.S. 113-171 or a conviction as specified in Paragraph (b) of this Rule, the Fisheries Director shall determine whether it is a first, a second, a third or a fourth or subsequent conviction. Where several convictions result from a single transaction or occurrence, the convictions shall be treated as a single conviction so far as suspension or revocation of the licenses of a licensee is concerned. For a second conviction, the Fisheries Director shall suspend all licenses issued to the licensee for a period of 30 days; for a third conviction, the Fisheries Director shall suspend all licenses issued to the licensee for a period of 90 days; for a fourth or subsequent conviction, the Fisheries Director shall revoke all licenses issued to the licensee, except:

- (1) For a felony conviction under G.S. 14-399, the Fisheries Director shall suspend all licenses issued to the licensee for a period of one year;
- (2) For a first conviction under G.S. 113-187(d)(1), the Fisheries Director shall suspend all licenses issued to the licensee for a period of one year; for a second or subsequent conviction under G.S. 113-187(d)(1), the Fisheries Director shall revoke all licenses issued to the licensee;
- (3) For a conviction under G.S. 113-208, 113-209, or 113-269, the Fisheries Director shall revoke all licenses issued to the licensee; and
- (4) For a conviction under G.S. 14-32 or 14-33, when the offense was committed against a marine fisheries inspector the Fisheries Director shall revoke all licenses issued to the licensee; the former licensee shall not be eligible to apply for reinstatement of a revoked license or for any additional license authorized in Article 14A, Article 14B and Article 25A of Chapter 113 for a period of two years.

(d) After the Fisheries Director determines a conviction requires a suspension or revocation of the licenses of a licensee, the Fisheries Director shall cause the licensee to be served with written notice of suspension or revocation. The written notice may be served upon any responsible individual affiliated with the corporation, partnership, or association where the licensee is not an individual. The notice of suspension or revocation shall be served by an inspector or other agent of the Department or by certified mail, must state the ground upon which it is based, and takes effect immediately upon service. The agent of the Fisheries Director making service shall then or subsequently, as may be feasible under the circumstances, collect all license certificates and plates and other forms or records relating to the license as directed by the Fisheries Director.

(e) Where a license has been suspended, the former licensee shall not be eligible to apply for reissuance of license or for any additional license authorized in Article 14A, Article 14B and Article 25A of Chapter 113 during the suspension period. Licenses shall be returned to the licensee by the Fisheries Director or the Director's agents at the end of a period of suspension.

(f) Where a license has been revoked, the former licensee shall not be eligible to apply for reinstatement of a revoked license or for any additional license authorized in Article 14A, Article 14B and Article 25A of Chapter 113 for a period of one year, except as provided in Paragraph (c)(4) of this Rule. For a request for reinstatement following revocation, the eligible former licensee shall satisfy the Fisheries Director that the licensee will strive in the future to conduct the operations for which the license is sought in accord with all applicable laws and rules by sending a request for reinstatement in writing to the Fisheries Director, Division of Marine Fisheries, P.O. Box 769, Morehead City, North Carolina 28557. Upon the application of an eligible former licensee after revocation, the Fisheries Director may issue one license sought but not another, as deemed necessary to prevent the hazard of recurring violations of the law.

(g) A licensee shall not willfully evade the service prescribed in this Rule.

History Note: Authority G.S. 113-168.1; 113-171; S.L. 2010-145;
Eff. October 1, 2012;
Amended Eff. May 1, 2017.

Modify Shellfish Lease Provisions (See Appendix 15.7 for related, suggested statutory changes)

15A NCAC 030 .0201 STANDARDS AND REQUIREMENTS FOR SHELLFISH BOTTOM LEASES AND FRANCHISES AND WATER COLUMN LEASES

(a) All areas of the public ~~bottoms-bottom~~ underlying ~~coastal fishing waters-Coastal Fishing Waters~~ shall meet the following ~~standards-standards and requirements~~, in addition to the standards in G.S. 113-202 in order to be deemed suitable for leasing for shellfish cultivation purposes:

- (1) ~~The the proposed lease area must shall~~ not contain a ~~natural shellfish bed which is defined as "natural shellfish bed"~~, as defined in G.S. 113-201.1 or have 10 bushels or more of shellfish per ~~acre-acre~~;
- (2) ~~The the proposed lease area must shall~~ not be closer than 100 feet to a developed shoreline, except no minimum setback is required when the area to be leased borders the applicant's property or the property of ~~riparian owners-"riparian owners"~~, as defined in G.S. 113-201.1 who have consented in a notarized ~~statement. In statement, or is in~~ an area bordered by undeveloped ~~shoreline, no minimum setback is required shoreline; and~~;
- (3) ~~The the proposed lease area shall not be less than one-half acre and shall not exceed five-10 acres for all areas except those areas open to the mechanical harvest of oysters where proposed lease area shall not exceed 10 acres.acres.~~

This Subparagraph shall not be applied to reduce any holdings as of July 1, 1983.

~~(b) Persons holding five or more acres under shellfish lease or franchise shall meet the standards established in Paragraph (c) of this Rule prior to acceptance of applications for additional shellfish lease acreage.~~

~~(b) To be deemed suitable for leasing for aquaculture purposes, water columns superjacent to leased bottom shall meet the standards in G.S. 113-202.1 and water columns superjacent to franchises recognized pursuant to G.S. 113-206 shall meet the standards in G.S. 113-202.2.~~

~~(c) Franchises To avoid termination, franchises recognized pursuant to G.S. 113-206 and shellfish bottom leases shall meet the following standards in addition to the standards in G.S. 113-202. In order to avoid termination, franchises and shellfish bottom leases shall requirements, in addition to the standards in G.S. 113-202:~~

- (1) ~~Produce-produce~~ and market 10 bushels of shellfish per acre per year; and
- (2) ~~Plant-plant~~ 25 bushels of seed shellfish per acre per year or 50 bushels of cultch per acre per year, or a combination of cultch and seed shellfish where the percentage of required cultch planted and the percentage of required seed shellfish planted totals at least 100 percent.

~~(d) To avoid termination, water column leases shall:~~

- (1) ~~produce and market 40 bushels of shellfish per acre per year; or~~
- (2) ~~plant 100 bushels of cultch or seed shellfish per acre per year.~~

~~(d)(e) The following standards shall be applied to determine compliance with Subparagraphs (1) and (2) of Paragraph (e) Paragraphs (c) and (d) of this Rule:~~

- (1) Only shellfish ~~marketed, planted, or produced or marketed according to the definitions as defined in 15A NCAC 03I .0101 as the fishing activities "shellfish marketing from leases and franchises", "shellfish planting effort on leases and franchises", or "shellfish production on leases and franchises"~~ shall be submitted on ~~production/utilization-reporting forms as set forth in 15A NCAC 03O .0207 for shellfish-leases and franchises.~~
- (2) If more than one ~~shellfish~~-lease or franchise is used in the production of shellfish, one of the leases or franchises used in the production of the shellfish ~~must shall~~ be designated as the producing lease or franchise for those shellfish. Each bushel of shellfish may be produced by only one ~~shellfish~~ lease or franchise. Shellfish transplanted between leases or franchises may be credited as planting effort on only one lease or franchise.
- (3) Production and marketing information and planting effort information shall be compiled and averaged separately to assess compliance with the ~~standards.requirements~~. The lease or franchise ~~must shall~~ meet ~~both~~ the production requirement and the planting effort requirement within the dates set forth in G.S. 113-202.1 and 202.2 to be ~~judged-deemed~~ in compliance ~~with these standards for shellfish bottom leases. The lease or franchise shall meet either the production requirement or the planting effort requirement within the dates set forth in G.S. 113-202.1 and 202.2 to be deemed in compliance for water column leases.~~
- (4) ~~All bushel measurements shall be in U.S. Standard Bushels.~~
- ~~(4)(5)~~ In determining production and marketing averages and planting effort averages for information not reported in bushel measurements, the following conversion factors shall be used:
 - (A) 300 oysters, 400 clams, or 400 scallops equal one bushel; and

- (B) 40 pounds of scallop shell, 60 pounds of oyster shell, 75 pounds of clam ~~shell and shell~~, or 90 pounds of fossil stone equal one bushel.
- (5) ~~In the event that a portion of an existing lease or franchise is obtained by a new owner, the production history for the portion obtained shall be a percentage of the originating lease or franchise production equal to the percentage of the area of lease or franchise site obtained to the area of the originating lease or franchise.~~
- (6) Production and marketing rate averages shall be computed irrespective of transfer of the lease or franchise. The production and marketing rates shall be averaged:averaged for the following situations using the time periods described:
- (A) for an initial bottom lease or franchise, over the consecutive full calendar years remaining on the bottom lease or franchise contract after December 31 following the second anniversary of the initial bottom leases and franchises:lease or franchise;
- (B) for a renewal bottom lease or franchise, over the consecutive full calendar years beginning January 1 of the final year of the previous bottom lease or franchise term and ending December 31 of the final year of the current bottom lease contract for renewal leases:or franchise contract;
- (C) for a water column lease, over the first five-year five-year period for an initial water column leases-lease and over the most recent five-year five-year period thereafter for a renewal water column leases-lease; or
- (D) for a bottom lease or franchise issued an extension period under 15A NCAC 03O .0208, over the most recent five-year period.
- ~~Production and marketing rate averages shall be computed irrespective of transfer of the shellfish lease or franchise.~~
- (7) ~~All bushel measurements shall be in U.S. Standard Bushels.~~
- (7) In the event that a portion of an existing lease or franchise is obtained by a new owner, the production history for the portion obtained shall be a percentage of the originating lease or franchise production equal to the percentage of the area of lease or franchise site obtained to the area of the originating lease or franchise.

(f) Persons holding five or more acres under all shellfish bottom leases and franchises combined shall meet the requirements established in Paragraph (c) of this Rule prior to the Division of Marine Fisheries accepting applications for additional shellfish lease acreage.

~~(e) Water columns superjacent to leased bottoms shall meet the standards in G.S. 113-202.1 in order to be deemed suitable for leasing for aquaculture purposes.~~

~~(f) Water columns superjacent to franchises recognized pursuant to G.S. 113-206 shall meet the standards in G.S. 113-202.2 in order to be deemed suitable for leasing for aquaculture purposes.~~

~~(g) Water column leases must produce and market 40 bushels of shellfish per acre per year to meet the minimum commercial production requirement or plant 100 bushels of cultch or seed shellfish per acre per year to meet commercial production by planting effort. The standards for determining production and marketing averages and planting effort averages shall be the same for water column leases as for bottom leases and franchises set forth in Paragraph (d) of this Rule except that either the produce and market requirement or the planting requirement must be met.~~

History Note: Authority G.S. 113-134; 113-201; 113-202; 113-202.1; 113-202.2; 113-206; 143B-289.52; Eff. January 1, 1991; Amended Eff. May 1, 1997; March 1, 1995; March 1, 1994; September 1, 1991; Temporary Amendment Eff. October 1, 2001; Amended Eff. May 1, 2017; October 1, 2008; April 1, 2003.

15A NCAC 03O .0208 ~~CANCELLATION~~TERMINATION OF SHELLFISH BOTTOM LEASES AND FRANCHISES AND WATER COLUMN LEASES

(a) Procedures for termination of shellfish leaseholds are provided in G.S. 113-202. The Secretary's decision to terminate a leasehold may be appealed by initiating a contested case as outlined in G.S. 150B-23.

~~(a)(b) In addition to Consistent with the grounds for termination established by G.S. 113-202, the Secretary shall begin action to terminate leases and franchises for failure to produce and market shellfish or for failure to maintain a~~

planting effort of cultch or seed shellfish in accordance with 15A NCAC 03O .0201 substantial breach of compliance with the provisions of rules of the Marine Fisheries Commission governing use of the leasehold includes the following, except as provided in Paragraph (c) of this Rule:

- (1) failure to meet shellfish production and marketing requirements for bottom leases or franchises in accordance with 15A NCAC 03O .0201;
- (2) failure to maintain a planting effort of cultch or seed shellfish for bottom leases or franchises in accordance with 15A NCAC 03O .0201;
- (3) failure either to meet shellfish production and marketing requirements or to maintain a planting effort of cultch or seed shellfish for water column leases in accordance with 15A NCAC 03O .0201;
- (4) the Fisheries Director has cause to believe the holder of private shellfish bottom or franchise rights has encroached or usurped the legal rights of the public to access public trust resources in navigable waters, in accordance with G.S. 113-205 and 15A NCAC 03O .0204; or
- (5) the Attorney General initiates action for the purpose of vacating or annulling letters patent granted by the State, in accordance with G.S. 146-63.

~~(b) Action to terminate a shellfish franchise shall begin when there is reason to believe that the patentee, or those claiming under him, have done or omitted an act in violation of the terms and conditions on which the letters patent were granted, or have by any other means forfeited the interest acquired under the same. The Division shall investigate all such rights issued in perpetuity to determine whether the Secretary should request that the Attorney General initiate an action pursuant to G.S. 146-63 to vacate or annul the letters patent granted by the state.~~

~~(c) Action to terminate a shellfish lease or franchise shall begin when the Fisheries Director has cause to believe the holder of private shellfish rights has encroached or usurped the legal rights of the public to access public trust resources in navigable waters.~~

(c) Consistent with G.S. 113-202(11) and 113-201(b), a leaseholder that failed to meet requirements in G.S. 113-202, 15A NCAC 03O .0201 or this Rule may be granted a single extension period of no more than two years per contract period upon sufficient showing of hardship by written notice to the Fisheries Director prior to the expiration of the lease term that one of the following occurrences caused or will cause the leaseholder to fail to meet lease requirements:

- (1) death, illness, or incapacity of the leaseholder or his "immediate family", as defined in G.S. 113-168 that prevented or will prevent the leaseholder from working the lease;
- (2) damage to the lease from hurricanes, tropical storms or other severe weather events recognized by the National Weather Service;
- (3) shellfish mortality caused by disease, natural predators, or parasites; or
- (4) damage to the lease from a manmade disaster that triggers a state emergency declaration or federal emergency declaration.

(d) In the case of hardship as described in Subparagraph (c)(1), the notice shall state the name of the leaseholder or immediate family member, and either the date of death, or the date and nature of the illness or incapacity. The Fisheries Director may require a doctor's verification of the illness or incapacity. Written notice and any supporting documentation shall be addressed to the Director of the Division of Marine Fisheries, P.O. Box 769, 3441 Arendell St., Morehead City, NC 28557-0769.

(e) Requirements for transfer of beneficial ownership of all or any portion of or interest in a leasehold are provided in G.S. 113-202(k).

~~(d) In the event action to terminate a lease is begun, the owner shall be notified by registered mail and given a period of 30 days in which to correct the situation. Petitions to review the Secretary's decision must be filed with the Office of Administrative Hearings as outlined in 15A NCAC 03P .0102.~~

~~(e) The Secretary's decision to terminate a lease may be appealed by initiating a contested case as outlined in 15A NCAC 03P .0102.~~

History Note: Authority G.S. 113-134; 113-201; 113-202; 113-202.1; 113-202.2; 113-205; 143B-289.52; Eff. January 1, 1991; Amended Eff. May 1, 1997; March 1, 1995; March 1, 1994; October 1, 1992; September 1, 1991; Temporary Amendment Eff. January 1, 2002; October 1, 2001; Amended Eff. May 1, 2017; April 1, 2003.

15.7 SUGGESTED STATUTE CHANGES NECESSARY TO IMPLEMENT HARD CLAM FMP AMENDMENT 2 RECOMMENDATIONS

- Protection of Shellfish Lease and Franchise Rights: G.S. 113-208, 113-269
- Modify Shellfish Lease Provisions: G.S. 113-202

Note: statutory changes are proposed with the following examples used to show intent.

Protection of Shellfish Lease and Franchise Rights

Note: Proposed statute changes are related to and in support of full implementation of the recommendation to increase penalties for theft from shellfish leases and franchises via proposed changes to 15A NCAC 03O .0114; however, the statutes do not have to change to implement the rule changes.

MFC Selected Management Strategies: Support modification of G.S. 113-208 and G.S. 113-269 to add minimum fines for violations on shellfish leases and franchises with minimum fines set at \$500 for the first violation and \$1,000 for the second violation. Support modification of G.S. 113-269 to include protection to all shellfish leases and franchises, not just those with water column amendments.

G.S. 113-208. Protection of private shellfish rights.

- (a) It is unlawful for any person, other than the holder of private shellfish rights, to take or attempt to take shellfish from any privately leased, franchised, or deeded shellfish bottom area without written authorization of the holder and with actual knowledge it is a private shellfish bottom area. Actual knowledge will be presumed when the shellfish are taken or attempted to be taken:
- (1) From within the confines of posted boundaries of the area as identified by signs, whether the whole or any part of the area is posted, or
 - (2) When the area has been regularly posted and identified and the person knew the area to be the subject of private shellfish rights. A violation of this section ~~shall constitute is guilty of~~ a Class A1 misdemeanor, ~~which may include a fine of not more than five thousand dollars (\$5,000). punishable by a fine of not less than five hundred dollars (\$500.00) nor more than five thousand dollars (\$5,000.00). Any second or subsequent violations of this section within three years after the date of a prior violation is guilty of a Class A1 misdemeanor punishable by a fine of not less than one thousand dollars (\$1,000.00) nor more than five thousand dollars (\$5,000.00).~~

The written authorization shall include the lease number or deed reference, name and address of authorized person, date of issuance, and date of expiration, and it must be signed by the holder of the private shellfish right. Identification signs shall include the lease number or deed reference and the name of the holder.

- (b) The prosecutor shall dismiss any case brought for a violation of this section if the defendant produces a notarized written authorization in conformance with subsection (a) which states that the defendant had permission to take oysters or clams from the leased area at the time of the alleged violation; except the prosecutor may refuse to dismiss the case if he has reason to believe that the written authorization is fraudulent. (1979, c. 537; 1987, c. 463; 1989, c. 281, s. 2; 1993, c. 539, s. 842; 1994, Ex. Sess., c. 24, s. 14(c); 1998-225, s. 3.7.)

G.S. 113-269. Robbing or injuring ~~hatcheries~~ hatcheries, leases, franchises and other aquaculture operations. ~~facilities.~~

- (a) The definitions established in G.S. 106-758 are incorporated by reference into this section. ~~For the purposes of this section, a shellfish lease issued pursuant to G.S. 113-202 is defined as an aquaculture facility only when it has been amended pursuant to G.S. 113-202.1 to authorize use of the water column and when it is or has been regularly posted and identified in accordance with the rules of the Marine Fisheries Commission.~~
- (b) It is unlawful for any person without the authority of the owner of an aquaculture facility to take fish or aquatic species being cultivated or reared by the owner from an aquaculture facility.

- (c) It is unlawful for any person to receive or possess fish or aquatic species stolen from an aquaculture facility while knowing or having reasonable grounds to believe that the fish or aquatic species are stolen.
- (d) It is unlawful for any person to willfully destroy or injure an aquaculture facility or aquatic species being reared in an aquaculture facility.
- (e) Violation of subsections (b) or (c) for fish or aquatic species valued at more than ~~four hundred dollars (\$400.00)~~ one thousand dollars (\$1,000.00) is punishable under G.S. 14-72. Violation of subsections (b) or (c) for fish or aquatic species valued at ~~four hundred dollars (\$400.00)~~ one thousand (\$1,000.00) or less is a Class ~~A1~~ A1 misdemeanor punishable by a fine of not less than five hundred dollars (\$500.00) nor more than five thousand dollars (\$5,000.00). Any second or subsequent violations of this section within three years after the date of a prior violation is guilty of a Class A1 misdemeanor punishable by a fine of not less than one thousand dollars (\$1,000.00) nor more than five thousand dollars (\$5,000.00).
- (f) Violation of subsection (d) is a Class ~~A1~~ A1 misdemeanor punishable by a fine of not less than five hundred dollars (\$500.00) nor more than five thousand dollars (\$5,000.00). Any second or subsequent violations of this section within three years after the date of a prior violation is guilty of a Class A1 misdemeanor punishable by a fine of not less than one thousand dollars (\$1,000.00) nor more than five thousand dollars (\$5,000.00).
- (g) In deciding to impose any sentence other than an active prison sentence, the sentencing judge shall consider and may require, in accordance with G.S. 15A-1343, restitution to the victim for the amount of damage to the aquaculture facility or aquatic species or for the value of the stolen fish or aquatic species.
- (h) The district attorney shall dismiss any case brought pursuant to subsections (b) and (c) if defendant produces a notarized written authorization for taking fish or aquatic species from the aquaculture facility or if the fish or aquatic species taken from a shellfish lease aquaculture facility was not a shellfish authorized for cultivation on the lease. (1989, c. 281, s. 1; 1993, c. 539, ss. 850, 851; 1994, Ex. Sess., c. 24, s. 14(c).)

The following statutes are provided only as a reference for G.S 113-269. No changes are proposed.

G.S. 106-758. Definitions.

In addition to the definitions in G.S. 113-129, the following definitions shall apply as used in this Article,

- (1) "Aquaculture" means the propagation and rearing of aquatic species in controlled or selected environments, including, but not limited to, ocean ranching;
- (2) "Aquaculture facility" means any land, structure or other appurtenance that is used for aquaculture, including, but not limited to, any laboratory, hatchery, rearing pond, raceway, pen, incubator, or other equipment used in aquaculture;
- (3) "Aquatic species" means any species of finfish, mollusk, crustacean, or other aquatic invertebrate, amphibian, reptile, or aquatic plant, and including, but not limited to, "fish" and "fishes" as defined in G.S. 113-129(7);
- (4) "Commissioner" means the Commissioner of Agriculture;
- (5) "Department" means the North Carolina Department of Agriculture and Consumer Services. (1989, c. 752, s. 147; 1993, c. 18, s. 1; 1997-261, s. 71.)

G.S. 14-72. Larceny of property; receiving stolen goods or possessing stolen goods.

- (a) Larceny of goods of the value of more than one thousand dollars (\$1,000) is a Class H felony. The receiving or possessing of stolen goods of the value of more than one thousand dollars (\$1,000) while knowing or having reasonable grounds to believe that the goods are stolen is a Class H felony. Larceny as provided in subsection (b) of this section is a Class H felony. Receiving or possession of stolen goods as provided in subsection (c) of this section is a Class H felony. Except as provided in subsections (b) and (c) of this section, larceny of property, or the receiving or possession of stolen goods knowing or having reasonable grounds to believe them to be stolen, where the value of the property or goods is not more than one thousand dollars (\$1,000), is a Class 1 misdemeanor. In all cases of doubt, the jury shall, in the verdict, fix the value of the property stolen.
- (b) The crime of larceny is a felony, without regard to the value of the property in question, if the larceny is any of the following:
 - (1) From the person.
 - (2) Committed pursuant to a violation of G.S. 14-51, 14-53, 14-54, 14-54.1, or 14-57.

- (3) Of any explosive or incendiary device or substance. As used in this section, the phrase "explosive or incendiary device or substance" shall include any explosive or incendiary grenade or bomb; any dynamite, blasting powder, nitroglycerin, TNT, or other high explosive; or any device, ingredient for such device, or type or quantity of substance primarily useful for large-scale destruction of property by explosive or incendiary action or lethal injury to persons by explosive or incendiary action. This definition shall not include fireworks; or any form, type, or quantity of gasoline, butane gas, natural gas, or any other substance having explosive or incendiary properties but serving a legitimate nondestructive or nonlethal use in the form, type, or quantity stolen.
- (4) Of any firearm. As used in this section, the term "firearm" shall include any instrument used in the propulsion of a shot, shell or bullet by the action of gunpowder or any other explosive substance within it. A "firearm," which at the time of theft is not capable of being fired, shall be included within this definition if it can be made to work. This definition shall not include air rifles or air pistols.
- (5) Of any record or paper in the custody of the North Carolina State Archives as defined by G.S. 121-2(7) and G.S. 121-2(8).
- (6) Committed after the defendant has been convicted in this State or in another jurisdiction for any offense of larceny under this section, or any offense deemed or punishable as larceny under this section, or of any substantially similar offense in any other jurisdiction, regardless of whether the prior convictions were misdemeanors, felonies, or a combination thereof, at least four times. A conviction shall not be included in the four prior convictions required under this subdivision unless the defendant was represented by counsel or waived counsel at first appearance or otherwise prior to trial or plea. If a person is convicted of more than one offense of misdemeanor larceny in a single session of district court, or in a single week of superior court or of a court in another jurisdiction, only one of the convictions may be used as a prior conviction under this subdivision; except that convictions based upon offenses which occurred in separate counties shall each count as a separate prior conviction under this subdivision.
- (c) The crime of possessing stolen goods knowing or having reasonable grounds to believe them to be stolen in the circumstances described in subsection (b) is a felony or the crime of receiving stolen goods knowing or having reasonable grounds to believe them to be stolen in the circumstances described in subsection (b) is a felony, without regard to the value of the property in question.
- (d) Where the larceny or receiving or possession of stolen goods as described in subsection (a) of this section involves the merchandise of any store, a merchant, a merchant's agent, a merchant's employee, or a peace officer who detains or causes the arrest of any person shall not be held civilly liable for detention, malicious prosecution, false imprisonment, or false arrest of the person detained or arrested, when such detention is upon the premises of the store or in a reasonable proximity thereto, is in a reasonable manner for a reasonable length of time, and, if in detaining or in causing the arrest of such person, the merchant, the merchant's agent, the merchant's employee, or the peace officer had, at the time of the detention or arrest, probable cause to believe that the person committed an offense under subsection (a) of this section. If the person being detained by the merchant, the merchant's agent, or the merchant's employee, is a minor under the age of 18 years, the merchant, the merchant's agent, or the merchant's employee, shall call or notify, or make a reasonable effort to call or notify the parent or guardian of the minor, during the period of detention. A merchant, a merchant's agent, or a merchant's employee, who makes a reasonable effort to call or notify the parent or guardian of the minor shall not be held civilly liable for failing to notify the parent or guardian of the minor. (1895, c. 285; Rev., s. 3506; 1913, c. 118, s. 1; C.S., s. 4251; 1941, c. 178, s. 1; 1949, c. 145, s. 2; 1959, c. 1285; 1961, c. 39, s. 1; 1965, c. 621, s. 5; 1969, c. 522, s. 2; 1973, c. 238, ss. 1, 2; 1975, c. 163, s. 2; c. 696, s. 4; 1977, c. 978, ss. 2, 3; 1979, c. 408, s. 1; c. 760, s. 5; 1979, 2nd Sess., c. 1316, ss. 11, 47; 1981, c. 63, s. 1; c. 179, s. 14; 1991, c. 523, s. 2; 1993, c. 539, s. 34; 1994, Ex. Sess., c. 24, s. 14(c); 1995, c. 185, s. 2; 2006-259, s. 4(a); 2012-154, s. 1.)

G.S. 15A-1340.23. Punishment limits for each class of offense and prior conviction level.

- (a) Offense Classification; Default Classifications. - The offense classification is as specified in the offense for which the sentence is being imposed. If the offense is a misdemeanor for which there is no classification, it is as classified in G.S. 14-3.
- (b) Fines. - Any judgment that includes a sentence of imprisonment may also include a fine. Additionally, when the defendant is other than an individual, the judgment may consist of a fine only. If a community punishment

is authorized, the judgment may consist of a fine only. Unless otherwise provided for a specific offense, the maximum fine that may be imposed is two hundred dollars (\$200.00) for a Class 3 misdemeanor and one thousand dollars (\$1,000) for a Class 2 misdemeanor. The amount of the fine for a Class 1 misdemeanor and a Class A1 misdemeanor is in the discretion of the court.

- (c) Punishment for Each Class of Offense and Prior Conviction Level; Punishment Chart Described. - Unless otherwise provided for a specific offense, the authorized punishment for each class of offense and prior conviction level is as specified in the chart below. Prior conviction levels are indicated by the Roman numerals placed horizontally on the top of the chart. Classes of offenses are indicated by the Arabic numbers placed vertically on the left side of the chart. Each grid on the chart contains the following components:
- (1) A sentence disposition or dispositions: "C" indicates that a community punishment is authorized; "I" indicates that an intermediate punishment is authorized; and "A" indicates that an active punishment is authorized; and
 - (2) A range of durations for the sentence of imprisonment: any sentence within the duration specified is permitted.

MISDEMEANOR OFFENSE CLASS	PRIOR CONVICTION LEVELS		
	LEVEL I No Prior Convictions	LEVEL II One to Four Prior Convictions	LEVEL III Five or More Prior Convictions
A1	1-60 days C/I/A	1-75 days C/I/A	1-150 days C/I/A
1	1-45 days C	1-45 days C/I/A	1-120 days C/I/A
2	1-30 days C	1-45 days C/I	1-60 days C/I/A
3	1-10 days C	1-15 days C if one to three prior convictions 1-15 days C/I if four prior convictions	1-20 days C/I/A.

- (d) Fine Only for Certain Class 3 Misdemeanors. - Unless otherwise provided for a specific offense, the judgment for a person convicted of a Class 3 misdemeanor who has no more than three prior convictions shall consist only of a fine. (1993, c. 538, s. 1; 1994, Ex. Sess., c. 24, s. 14(b); 1995, c. 507, s. 19.5(g); 2013-360, s. 18B.13(a).)

Modify Shellfish Lease Provisions

Note: Proposed statute changes are broadly related to proposed changes to 15A NCAC 030 .0201 and .0208; however, the statute does not have to change to implement the rule changes.

MFC Selected Management Strategy: Allow leases returned to the state to remain delineated for one year to allow the pre-existing leased bottom to be re-issued to other shellfish growers.

G.S. 113-202. New and renewal leases for shellfish cultivation; termination of leases issued prior to January 1, 1966.

(a) To increase the use of suitable areas underlying coastal fishing waters for the production of shellfish, the Secretary may grant shellfish cultivation leases to persons who reside in North Carolina under the terms of this section when the Secretary determines, in accordance with his duty to conserve the marine and estuarine resources of the State, that the public interest will benefit from issuance of the lease. Suitable areas for the production of shellfish shall meet the following minimum standards:

- (1) The area leased must be suitable for the cultivation and harvesting of shellfish in commercial quantities.
- (2) The area leased must not contain a natural shellfish bed.
- (3) Cultivation of shellfish in the leased area will be compatible with lawful utilization by the public of other marine and estuarine resources. Other public uses which may be considered include, but are not limited to, navigation, fishing and recreation.
- (4) Cultivation of shellfish in the leased area will not impinge upon the rights of riparian owners.
- (5) The area leased must not include an area designated for inclusion in the Department's Shellfish Management Program.
- (6) The area leased must not include an area which the State Health Director has recommended be closed to shellfish harvest by reason of pollution.

(b) The Secretary may delete any part of an area proposed for lease or may condition a lease to protect the public interest with respect to the factors enumerated in subsection (a) of this section. The Secretary may not grant a new lease in an area heavily used for recreational purposes. Except as prohibited by federal law, the Secretary shall not exclude any area from leasing solely on the basis that the area contains submerged aquatic vegetation and shall make specific findings based on the standards set forth in subsection (a) of this section prior to reaching a decision not to grant or renew a lease for shellfish cultivation for any area containing submerged aquatic vegetation.

(c) No person, including a corporate entity, or single family unit may acquire and hold by lease, lease renewal, or purchase more than 50 acres of public bottoms under shellfish cultivation leases. For purposes of this subsection, the number of acres of leases held by a person includes acres held by a corporation in which the person holds an interest. The Marine Fisheries Commission may adopt rules to require the submission of information necessary to ensure compliance with this subsection.

(d) Any person desiring to apply for a lease must make written application to the Secretary on forms prepared by the Department containing such information as deemed necessary to determine the desirability of granting or not granting the lease requested. Except in the case of renewal leases, the application must be accompanied by a map or diagram made at the expense of the applicant, showing the area proposed to be leased.

(d1) The map or diagram must conform to standards prescribed by the Secretary concerning accuracy of map or diagram and the amount of detail that must be shown. If on the basis of the application information and map or diagram the Secretary deems that granting the lease would benefit the shellfish culture of North Carolina, the Secretary, in the case of initial lease applications, must order an investigation of the bottom proposed to be leased. The investigation is to be made by the Secretary or his authorized agent to determine whether the area proposed to be leased is consistent with the standards in subsection (a) of this section and any other applicable standards under this Article and the rules of the Marine Fisheries Commission. In the event the Secretary finds the application inconsistent with the applicable standards, the Secretary shall deny the application or propose that a conditional lease be issued that is consistent with the applicable standards. In the event the Secretary authorizes amendment of the application, the applicant must furnish a new map or diagram meeting requisite standards showing the area proposed to be leased under the amended application. At the time of making application for an initial lease, the applicant must pay a filing fee of two hundred dollars (\$200.00).

(e) The area of bottom applied for in the case of an initial lease or amended initial lease must be as compact as possible, taking into consideration the shape of the body of water, the consistency of the bottom, and the desirability of separating the boundaries of a leasehold by a sufficient distance from any known natural shellfish bed to prevent

the likelihood of disputes arising between the leaseholder and members of the public taking shellfish from the natural bed.

(f) Within a reasonable time after receipt of an application that complies with subsection (d), the Secretary shall notify the applicant of the intended action on the lease application. If the intended action is approval of the application as submitted or approval with a modification to which the applicant agrees, the Secretary shall conduct a public hearing in the county where the proposed leasehold lies. The Secretary must publish at least two notices of the intention to lease in a newspaper of general circulation in the county in which the proposed leasehold lies. The first publication must precede the public hearing by more than 20 days; the second publication must follow the first by seven to 11 days. The notice of intention to lease must contain a sufficient description of the area of the proposed leasehold that its boundaries may be established with reasonable ease and certainty and must also contain the date, hour and place of the hearing.

(g) After consideration of the public comment received and any additional investigations the Secretary orders to evaluate the comments, the Secretary shall notify the applicant in person or by certified or registered mail of the decision on the lease application. The Secretary shall also notify persons who submitted comments at the public hearing and requested notice of the lease decision. An applicant who is dissatisfied with the Secretary's decision or another person aggrieved by the decision may commence a contested case by filing a petition under G.S. 150B-23 within 20 days after receiving notice of the Secretary's decision. In the event the Secretary's decision is a modification to which the applicant agrees, the lease applicant must furnish an amended map or diagram before the lease can be issued by the Secretary.

(h) Repealed by Session Laws 1993, c. 466, s. 1.

(i) After a lease application is approved by the Secretary, the applicant shall submit to the Secretary information sufficient to define the bounds of the area approved for leasing with markers in accordance with the rules of the Commission. The information shall conform to standards prescribed by the Secretary concerning accuracy and the amount of detail to be shown. When information is submitted, the boundaries are marked and all fees and rents due in advance are paid, the Secretary shall execute the lease on forms approved by the Attorney General. The Secretary is authorized, with the approval of the lessee, to amend an existing lease by reducing the area under lease or by combining contiguous leases without increasing the total area leased. The information required by this subsection may be based on coordinate information produced using a device equipped to receive global positioning system data.

(j) Initial leases begin upon the issuance of the lease by the Secretary and expire at noon on the first day of July following the tenth anniversary of the granting of the lease. Renewal leases are issued for a period of 10 years from the time of expiration of the previous lease. At the time of making application for renewal of a lease, the applicant must pay a filing fee of one hundred dollars (\$100.00). The rental for initial leases is one dollar (\$1.00) per acre until noon on the first day of July following the first anniversary of the lease. Thereafter, for initial leases and from the beginning for renewals of leases entered into after that date, the rental is ten dollars (\$10.00) per acre per year. Rental must be paid annually in advance prior to the first day of April each year. Upon initial granting of a lease, the pro rata amount for the portion of the year left until the first day of July must be paid in advance at the rate of one dollar (\$1.00) per acre per year; then, on or before the first day of April next, the lessee must pay the rental for the next full year.

(k) Except as restricted by this Subchapter, leaseholds granted under this section are to be treated as if they were real property and are subject to all laws relating to taxation, sale, devise, inheritance, gift, seizure and sale under execution or other legal process, and the like. Leases properly acknowledged and probated are eligible for recordation in the same manner as instruments conveying an estate in real property. Within 30 days after transfer of beneficial ownership of all or any portion of or interest in a leasehold to another, the new owner must notify the Secretary of such fact. Such transfer is not valid until notice is furnished the Secretary. In the event such transferee is a nonresident, the Secretary must initiate proceedings to terminate the lease.

(l) Upon receipt of notice by the Secretary of any of the following occurrences, he must commence action to terminate the leasehold:

- (1) Failure to pay the annual rent in advance.
- (2) Failure to file information required by the Secretary upon annual remittance of rental or filing false information on the form required to accompany the annual remittance of rental.
- (3) Failure by new owner to report a transfer of beneficial ownership of all or any portion of or interest in the leasehold.
- (4) Failure to mark the boundaries in the leasehold and to keep them marked as required in the rules of the Marine Fisheries Commission.
- (5) Failure to utilize the leasehold on a continuing basis for the commercial production of shellfish.
- (6) Transfer of all or part of the beneficial ownership of a leasehold to a nonresident.

- (7) Substantial breach of compliance with the provisions of this Article or of rules of the Marine Fisheries Commission governing use of the leasehold.
- (8) Failure to comply with the training requirements established by the Marine Fisheries Commission pursuant to G.S. 113-201(c).

(11) The Marine Fisheries Commission is authorized to make rules defining commercial production of shellfish, based upon the productive potential of particular areas climatic or biological conditions at particular areas or particular times, availability of seed shellfish, availability for purchase by lessees of shells or other material to which oyster spat may attach, and the like. Commercial production may be defined in terms of planting effort made as well as in terms of quantities of shellfish harvested. Provided, however, that if a lessee has made a diligent effort to effectively and efficiently manage his lease according to accepted standards and practices in such management, and because of reasons beyond his control, such as acts of God, such lessee has not and cannot meet the requirements set out by the Marine Fisheries Commission under the provisions of this subsection, his leasehold shall not be terminated under subdivision (5) of subsection (1) of this section.

(m) In the event the leaseholder takes steps within 30 days to remedy the situation upon which the notice of intention to terminate was based and the Secretary is satisfied that continuation of the lease is in the best interests of the shellfish culture of the State, the Secretary may discontinue termination procedures. Where there is no discontinuance of termination procedures, the leaseholder may initiate a contested case by filing a petition under G.S. 150B-23 within 30 days of receipt of notice of intention to terminate. Where the leaseholder does not initiate a contested case, or the final decision upholds termination, the Secretary must send a final letter of termination to the leaseholder. The final letter of termination may not be mailed sooner than 30 days after receipt by the leaseholder of the Secretary's notice of intention to terminate, or of the final agency decision, as appropriate. The lease is terminated effective at midnight on the day the final notice of termination is served on the leaseholder. The final notice of termination may not be issued pending hearing of a contested case initiated by the leaseholder.

Service of any notice required in this subsection may be accomplished by certified mail, return receipt requested; personal service by any law-enforcement officer; or upon the failure of these two methods, publication. Service by publication shall be accomplished by publishing such notices in a newspaper of general circulation within the county where the lease is located for at least once a week for three successive weeks. The format for notice by publication shall be approved by the Attorney General.

(n) Upon final termination of any leasehold, the bottom in question is ~~thrown~~ open to the public for use in accordance with laws and rules governing use of public grounds generally. Within 30 days of final termination of the leasehold, the former leaseholder shall remove all remaining gear, stakes, nets, aquaculture equipment, and abandoned markers denominating the area of the leasehold as a private bottom. The State may, after 10 days' notice to the owner of the abandoned markers thereof, remove the abandoned structure and have the area cleaned up. The cost of such removal and cleanup shall be payable by the owner of the abandoned markers and the State may bring suit to recover the costs thereof.

(n1) If the Secretary determines the terminated lease remains a suitable location for shellfish aquaculture, the site shall be made available for lease for a period of one year. The Marine Fisheries Commission may adopt rules necessary to ensure compliance with this subsection to issue pre-existing leased bottom. For the purpose of this subsection, pre-existing leased bottom shall be treated as a renewal lease, not an initial lease. If, within one year after final termination of a leasehold, an application for leasing pre-existing leased bottom has not been submitted in accordance with rules of the Marine Fisheries Commission, the bottom in question is open to the public for use in accordance with laws and rules governing use of public grounds generally.

(o) Every year between January 1 and February 15 the Secretary must mail to all leaseholders a notice of the annual rental due and include forms designed by him for determining the amount of shellfish or shells planted on the leasehold during the preceding calendar year, and the amount of harvest gathered. Such forms may contain other pertinent questions relating to the utilization of the leasehold in the best interests of the shellfish culture of the State, and must be executed and returned by the leaseholder with the payment of his rental. Any leaseholder or his agent executing such forms for him who knowingly makes a false statement on such forms is guilty of a Class 1 misdemeanor.

(p) All leases and renewal leases granted after the effective date of this Article are made subject to this Article and to reasonable amendment of governing statutes, rules of the Marine Fisheries Commission, and requirements imposed by the Secretary or his agents in regulating the use of the leasehold or in processing applications of rentals. This includes such statutory increase in rentals as may be necessitated by changing conditions and refusal to renew lease after expiration, in the discretion of the Secretary. No increase in rentals, however, may be given retroactive effect.

The General Assembly declares it to be contrary to public policy to the oyster and clam bottoms which were leased prior to January 1, 1966, and which are not being used to produce oysters and clams in commercial quantities to continue to be held by private individuals, thus depriving the public of a resource which belongs to all the people of the State. Therefore, when the Secretary determines, after due notice to the lessee, and after opportunity for the lessee to be heard, that oysters or clams are not being produced in commercial quantities, due to the lessee's failure to make diligent effort to produce oysters and clams in commercial quantities, the Secretary may decline to renew, at the end of the current term, any oyster or clam bottom lease which was executed prior to January 1, 1966. The lessee may appeal the denial of the Secretary to renew the lease by initiating a contested case pursuant to G.S. 150B-23. In such contested cases, the burden of proof, by the greater weight of the evidence, shall be on the lessee.

(q) Repealed by Session Laws 1983, c. 621, s. 16.

(r) A lease under this section shall include the right to place devices or equipment related to the cultivation or harvesting of marine resources on or within 18 inches of the leased bottom. Devices or equipment not resting on the bottom or extending more than 18 inches above the bottom will require a water column lease under G.S. 113-202.1. (1893, c. 287, s. 1; Rev., s. 2371; 1909, c. 871, ss. 1-9; 1919, c. 333, s. 6; C.S., ss. 1902-1911; Ex. Sess. 1921, c. 46, s. 1; 1933, c. 346; 1953, cc. 842, 1139; 1963, c. 1260, ss. 1-3; 1965, c. 957, s. 2; 1967, c. 24, s. 16; c. 88; c. 876, s. 1; 1971, c. 447; 1973, c. 476, s. 128; c. 1262, ss. 28, 86; 1983, c. 601, ss. 1-3; c. 621, ss. 4-16; 1985, c. 275, ss. 1-3; 1987, c. 641, s. 16; c. 773, s. 11; c. 827, s. 98; 1989, c. 423, s. 2; c. 727, s. 99; 1991 (Reg. Sess., 1992), c. 788, s. 2; 1993, c. 466, s. 1; c. 539, s. 840; 1994, Ex. Sess., c. 24, s. 14(c); 2004-150, ss. 2, 3, 4; 2009-433, ss. 4, 5; 2011-398, s. 35; 2015-241, ss. 14.10(a), (b), 14.10C(b); 2015-263, s. 11(a).)