Issues/Reports

N.C. FISHERY MANAGEMENT PLANS

November 2015

DRAFT

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North Carolina
Oyster
Fishery Management Plan

AMENDMENT 4

By

North Carolina Division of Marine Fisheries

North Carolina Department of Environmental Quality
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October 2015

July	2013	Timeline begins
September	2015	Internal Review with DMF comments
September	2015	Revised with NCDMF recommendations
		First draft approved by MFC for public comment
		MFC selects preferred management options
		Reviewed by DENR Secretary
		Reviewed by the Joint Legislative Commission on Governmental Operations
		Draft rules approved for Notice of Text
		Plan and rules adopted by the MFC

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1.0 ACKNOWLEDGMENTS

Amendment 4 to the North Carolina (NC) Oyster Fishery Management Plan (FMP) was developed by the NC Department of Environment and Natural Resources (DENR)□ Division of Marine Fisheries (DMF) under the direction of the NC Marine Fisheries Commission (MFC) with the advice of the Shellfish Advisory Committee (AC). Deserving special recognition are the members of the Shellfish Advisory Committee and the Plan Development Team who contributed their time and knowledge to this effort.

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2.0 TABLE OF AMENDMENTS AND SUPPLEMENTS

2.1 AMENDMENT I

The Criteria for the Designation of Oyster Harvest Methods adopted as an appendix to the 2001 Oyster FMP as part of the management strategy to adopt criteria for the further designation of areas limited to hand harvest methods and designate those areas by rule was amended 1/31/2003 to change the depth criterion from 10 feet to 6 feet. This change was made to more accurately reflect the depths customarily used by North Carolina hand harvest fishermen.

2.2 AMENDMENT II

The following are the oyster management strategies selected by the MFC after a thorough review of the issues affecting the NC eastern oyster stock during the statutory five-year FMP review. These strategies comprise Amendment II to the NC Oyster Fishery Management Plan adopted June 26, 2008. A more complete listing of the issues and management strategies is presented in Table 4.1 and rules to implement Amendment II are found in Section 13.1.

MFC SELECTED MANAGEMENT STRATEGIES OYSTER FMP AMENDMENT II
HARVEST ISSUES
Recommend no change to the open shellfish harvest license
Supplement A adopted 11/4/2010 by the MFC modified the selected management strategy for issue 10.1.2 as follows: Proclamation authority up to 20 bushels per fishing operation in Pamlico Sound with a harvest closure trigger when sampling indicates the number of legal-size oysters in the area has declined to 26% of the live oysters sampled, 10 bushel hand/mechanical harvest limit in the bays and in the Mechanical Methods Prohibited area along the Outer Banks of Pamlico Sound.
Define recreational shellfish gear
Allow no sale of weekend shellfish harvest except from leases
Propose repeal of G.S. 113-169.2 license exemption.
Set recreational limits in rule and proclamation
Require all shellfish to be tagged at the dealer level
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
10 bushel mechanical gear harvest limit in the Pamlico Sound bays with a six week (mid November through December) season
Collect more data comparing the effects of 50 and 100 pound dredges prior to making a decision on this issue
Change existing rule to set the latest season closure date at March 31
PRIVATE CULTURE ISSUES
Leave regulations as is for depuration facilities.
Utilize user coordination plans for shellfish lease issuance coast wide
Support private oyster larvae monitoring programs

Support construction of an integrated system of shellfish hatcheries and remote-setting sites
Develop a subsidized, fee-for-service disease diagnosis program.
Update seed oyster management in statutes and rule.
Monitor seeded oyster sanctuaries for cownose ray predation.
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
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
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
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
Encourage harvesters to take volunteer time and temperature control measures on their product.
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
Limit acreage per shellfish lease application 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 Lat./Long. 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 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
No change to rules affecting the issuance of permits for culturing shellfish in closed harvest areas
INSUFFICIENT DATA
Recommend no change (status quo) to collect information on recreational harvest of shellfish through a license
ENHANCEMENT ACTIVITIES
Expand and evaluate the number of designated oyster sanctuaries to increase oyster populations
Include current and future oyster sanctuaries into North Carolina Fisheries Rules For Coastal Waters Subchapter 03R.
Plant and monitor seed oysters on existing oyster sanctuary/artificial reef sites.
ENVIRONMENTAL ISSUES

Review the results of the completed USACE EIS on the proposed introduction of Suminoe oysters in Chesapeake Bay and consult with sister states concerning use of these non-native oysters
Support DWQ's efforts to improve stormwater rules through permit comments and CHPP implementation and co-ordinate with sister agencies
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
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 those waters
Recommend to the DWQ to accept a lower threshold of 10,000 square feet to coastal stormwater rules
Recommend a naturally vegetative riparian buffer width of 50 feet
Recommend the exclusion of all wetlands (coastal and non-coastal), from the built-upon area calculations
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
Leave current management practices in place for Ward Creek
Recommend repeal of G.S. 113-207 (a) and (b) to end the requirement that all oyster rocks must be posted by the Department
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

2.3 SUPPLEMENT A TO AMENDMENT II

The Supplement to Amendment II was a proposal to change the management measure setting the harvest limit for the mechanical harvest oyster fishery at 15 bushels per commercial fishing operation to a per license holder limit. The result was the management strategy for the Director to have proclamation authority up to 20 bushels per fishing operation with a harvest closure trigger when sampling indicates the number of legal-sized oysters in the area has declined to 26% of the live oysters sampled.

2.4 AMENDMENT III

A petition for rulemaking was submitted by shellfish lease and franchise holders in Onslow County to add a seed oyster management area in the vicinity of New River Inlet to reduce travel time and costs compared to using existing seed oyster management areas in Carteret and Pender counties. The MFC accepted the petition for rule making and oyster seed management areas were created at Swan Point and Possum Bay in Onslow County.

3.0 TABLE OF CONTENTS

3.1 LIST OF TABLES

3.2 LIST OF FIGURES

3.3 LIST OF ACRONYMS

AC – Advisory Committee

AEC – Areas of Environmental Concern

ASMFC – Atlantic States Marine Fisheries Commission

BMP – Best Management Practice

BRACO – Blue Ribbon Advisory Committee on Oysters

CAMA – Coastal Area Management Act

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

DEH - North Carolina Department of Environmental Health

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

DENR – North Carolina Department of Environment and Natural Resources

DMF – North Carolina Division of Marine Fisheries

DO – Dissolved Oxygen

DWQ- North Carolina Division of Water Quality

EFH – Essential Fish Habitat

EMC – North Carolina Environmental Management Commission

EPA – United States Environmental Protection Administration

FDA – United States Food and Drug Administration

FMP – Fishery Management Plan

FRA – Fishery Reform Act

FRG – Fishery Resource Grant

FY – Fishing Year

GIS – Geographical Information System

GS – General Statute

HBR – Hatchery Based Restoration

HQW- High Quality Waters

IWW – Intracoastal Waterway

ISSC – Interstate Shellfish Sanitation Conference

JLCSA – Joint Legislative Commission for Seafood and Aquaculture

MFC – North Carolina Marine Fisheries Commission

MRFSS- Marine Recreational Fisheries Statistical Survey

MSC – Moratorium Steering Committee

MSX – Multinucleated Sphere Unknown

NC – North Carolina

NCAC – North Carolina Administrative Code

NCOHP – North Carolina Oyster Hatchery Program

NMFS – National Marine Fisheries Service

NOAA – National Oceanic and Atmospheric Administration

NPDES - National Pollution Discharge Elimination System

NSSP – National Shellfish Sanitation Program

NSW – Nutrient Sensitive Waters

ORW – Outstanding Resource Waters

PDT – Plan Development Team

PNA – Primary Nursery Area

PPI – Producer Price Index

PPT – Parts Per Thousand

RAT – Rules Advisory Team

RCGL – Recreational Commercial Gear License

RSCFL – Retired Standard Commercial Fishing License

SAFMC – South Atlantic Fishery Management Council

SAV – Submerged Aquatic Vegetation

SCFL – Standard Commercial Fishing License

SHA – Strategic Habitat Area

SMA – Shellfish Management Area

SOMA – Seed Oyster Management Area

SR – Shellfish Resource Waters

SSR – Stock Status Report

TSS – Total Suspended Solids

UDOC – Under Dock Oyster Culture

UNC – University of North Carolina

UNC-CH – University of North Carolina, Chapel Hill

UNCW – University of North Carolina, Wilmington

URW – Use Restoration Waters

USFWS – United States Fish and Wildlife Service

USMP- Universal Stormwater Management Program

VMPB – Virginia Marine Products Board

WRC – North Carolina Wildlife Resources Commission

WS – Water Supply

4.0 EXECUTIVE SUMMARY

To be added after the MFC selects their preferred management strategies

4.1 GOAL AND OBJECTIVES

The goal of the N.C. Oyster FMP is to manage the state's oyster population so that it achieves sustainable harvest and maximizes its role in providing ecological benefits to North Carolina's estuaries. To achieve this goal, it is recommended that the following objectives be met:

1. Identify, restore, and protect oyster populations as important estuarine habitat.

2. Manage and restore oyster populations to levels capable of maintaining sustained production through judicious use of natural oyster resources, enhancement of oyster habitats, and development and improvement of oyster production on shellfish leases and franchises.

3. Minimize the impacts of oyster parasites and other biological stressors through better understanding of oyster disease, better utilization of affected stocks, and use of disease and other biological stress resistant oysters.

4. Consider the socioeconomic concerns of all oyster resource user groups, including market factors.

5. Recommend improvements to coastal water quality to reduce bacteriological-based harvest closures and to limit other pollutants to provide a suitable environment for healthy oyster populations.

6. Identify and encourage research to improve understanding of oyster population ecology and dynamics, habitat restoration needs, and oyster aquaculture practices.

7. Identify, develop, and promote efficient oyster harvesting practices that minimize damage to the habitat.

8. Initiate, enhance, and continue studies to collect and analyze economic, social, and fisheries data needed to effectively monitor and manage the oyster resource.

9. Promote public awareness regarding the ecological value of oysters and encourage public involvement in management and enhancement activities.

4.2 MARINE FISHERIES COMISSION PREFERRED MANAGEMENT STRATEGIES

To be added after the MFC selects their preferred management strategies

5.0 INTRODUCTION

The Eastern oyster (*Crassostrea virginica*) occupies a unique position in the estuaries of North Carolina because its colonization of bottomlands creates a productive habitat and the animal itself is harvested as a food item. Oyster harvest has been an important source of food in coastal areas since before recorded history. Oyster harvesting in North Carolina was the most valuable shellfishery in the state until the 1970s. Until recently, most of the focus on oysters has been on means and methods of continuing their exploitation. As oyster stocks continue to decline in many areas, scientists are beginning to realize their value as a source of turbidity reduction, nitrogen and phosphorus release, food for filter feeders and predators, substrate for other filter feeders and bacteria, and as a stabilizing force in the sediments of the estuary. The Eastern oyster has been called the quintessential estuarine animal. It can tolerate a wide range of salinity, temperature, turbidity, and dissolved oxygen levels, making it well adapted to the ever-changing conditions of the estuary. The genus *Crassostrea* has survived for 135 million years. The health of North Carolina's oyster populations is a good indicator of the overall health of our estuaries, and all prudent measures should be taken to ensure a viable oyster resource

5.1 MANAGEMENT AUTHORITY

All authority for management of North Carolina's oysters is vested in the State of North Carolina. Management of the oyster fishery includes all activities associated with maintenance, improvement, and utilization of the oyster population and their habitats in the coastal area, including research, development, regulation, enhancement, and enforcement. Oyster harvest occurs from coastal waters and is under rules of the North Carolina Marine Fisheries Commission (MFC). However, the North Carolina Department of Environment and Natural Resources (DENR) is the agency directed by North Carolina General Statute 113-182.1 (G.S. 113-182.1) to prepare Fishery Management Plans 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 DENR is provided in G.S. 113-131. The NCDMF is the branch of the DENR 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). 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

Oyster harvest has fluctuated over time because of response to changes in demand, improved harvesting, and increases in polluted shellfish area closures. A major issue for oyster recovery is the continued degradation and loss of habitat. The Oyster and Hard Clam Advisory Committee (AC) along with the Oyster and Hard Clam Plan Development Team (PDT) examined specific problems affecting oyster production and found many of the same problems continue to exist. Habitat destroyed by oyster harvesting has not been adequately replaced by oyster enhancement programs. The southern areas of coastal NC have especially been overharvested and are currently suffering the effects of this degradation. Public trust waters have not been effectively developed for oyster culture. Coastal lands have been developed for agriculture, forestry and residences with little regard for impact on oysters or other aquatic resources. Furthermore, the problems that have afflicted oysters in North Carolina are geographically widespread. The ongoing decline of the Eastern oyster throughout its range can be attributed to outbreaks of oyster disease, failure to preserve oyster reef habitat against degradation to overharvest, and to deterioration of coastal water quality. With the passage of Session Law 2015-241 on September 18, 2015 studies have been introduced for NCDMF to provide reports in 2016 to benefit oyster restoration and culture activities. The reports specifically are to provide ways to improve oyster restoration activities and identify the changes needed to support and encourage the ecological restoration and economic stability of the shellfish industry.

5.2.1 Insufficient Data

The data necessary for a robust estimate of oyster standing stock and sustainable harvest still does not exist and very limited data are collected for the recreational harvest of oysters. Socioeconomic surveys of recreational participants need to be performed to determine specific characteristics of the user group, to determine which issues are important to them, attitudes toward management of the fishery, as well as general demographics. The statutory obligation to maintain sustainable harvest in the oyster fishery cannot be calculated 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 trip ticket program, initiated in 1994, provides commercial landings as well as individual trip information. Fishery-dependent and independent monitoring programs continue, yet data in some areas still are not enough.

5.2.2 Oyster Management

The N.C. Oyster FMP was adopted in 2001 and amended in 2003, 2010 and 2013. The 2010 FMP, Amendment 2 provided both a general framework and specific guidance for implementing a strategic, coordinated management effort for oysters throughout the state. The FMP defined several strategies for rebuilding and managing native oyster populations: evaluating the use of sanctuaries to obtain optimum ecological and economic benefits; rebuilding habitat; managing harvest, through size and quantity limits; increasing lease production; evaluating the impediments to aquaculture; improving coordination among the oyster partners; and developing a statewide database to track restoration projects. Amendment 3 to the FMP was adopted in 2013. This amendment created a new Oyster Seed Management Area (SMA) approximately

halfway between two existing SMAs allowing closer access to oystermen from that area. Funding has recently provided for expansion activities within the sanctuary program (areas closed to shellfish harvest and areas with focused restoration activities); with new reef development in the southern part of the state.

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.

5.2.4 Environment and Public Health

Oysters are the primary component of shell bottom habitat described in detail in the Coastal Habitat Protection Plan, or CHPP (Deaton et al. 2010). Adequate habitat and suitable water quality are imperative for a healthy oyster population. Support of the 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 oysters. 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, especially raw oysters. Environment and public health issues include requirements for shading molluscan shellstock.

5.2.5 Enhancement Activities

In order to improve ecosystem function, oyster restoration and enhancement activities are essential. In recognition of this need, NCDMF coordinates restoration activities to improve statewide oyster populations and subsequently enhance the ecosystem services they provide. Cultch planting efforts are highly variable as the limiting factors are funding and cultch material availability. In recent years, the amount of cultch planting has decreased due to budget cuts, increased cost, and a shortage of cultch material. As of 2015, the Oyster Sanctuary program has expanded to consist of 15 permitted sites, including 13 completed or under development, and two in design. Currently standing sanctuaries are spread throughout Pamlico Sound in locations near Pea Island, Hatteras Island, Ocracoke, West Bay, Point of Marsh, Turnagain Bay, Pamlico Point, Deep Bay, Bluff Point, Engelhard, Long Shoal River, Stumpy Point, Roanoke Island. New sanctuaries are planned for the Neuse and Cape Fear rivers.

Passage of Session Law 2015-241 in September 2015 has introduced a study for NCDMF to develop a plan to construct and manage additional oyster habitat. The plan should outline a 10-year development project to accomplish the expansion of a sanctuary network in Albemarle and Pamlico sounds, means to supply a reliable State-based supply of oyster seed, and expansion of cultch plantings to increase areas suitable for development of wild oyster harvest. The plan must provide outreach and education, promote public-private partnerships, and a monitoring plan

to evaluate the success and cost benefit of the sanctuary network and harvestable enhancement sites.

5.3 DEFINTION OF THE MANAGEMENT UNIT

The management unit includes all Eastern oysters (*Crassostrea virginica)* occurring within North Carolina coastal waters.

5.4 EXISTING PLANS, STATUTES, AND RULES

5.4.1 Plans

The 1994 Session of the NC General Assembly created the Blue Ribbon Advisory Council on Oysters (BRACO) to study and make recommendations concerning policies and management of the States oyster resources. Senate Bill 1403 established the nineteen-member council to assist the MFC and the Joint Legislative Commission on Seafood and Aquaculture (JLCSA) by making recommendations on:

- Restoration of oyster production on public beds
- Development of aquaculture production of oysters
- Management of oyster reefs to maximize production
- Zoning and protective measures concerning oyster reefs and culture operations
- Marketing and economic development of oysters
- Development of value-added products and processing
- Changes in the leasing of oyster bottoms and water columns for culture
- Expenditure of public funds in relation to private funding of oyster production
- Development of a management plan for the restoration of the oyster resource

An Oyster Restoration and Fishery Management Plan was produced in October 1995 to answer the ninth charge given by the General Assembly. The plan contained detailed recommendations on the first eight charges. The general objectives of the plan were to: 1. examine past and current management, enhancement, and harvest strategies; 2. discuss possible causes of the decline in oyster harvests; 3. propose new management, enhancement, and harvest strategies to improve production and utilization of existing resources; and 4. develop a plan for the restoration of the oyster resource.

In August 2001 a state FMP for oysters was approved for North Carolina (see Appendix 14.1 for a summary of actions taken). Amendment 1 of the FMP was adopted in 2003 and simply changed one of the criteria for designation of hand harvest areas from waters generally less than 10 feet deep to waters less than six feet deep. The Oyster 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 2 include adopting a 15 bushel harvest limit in Pamlico Sound and a 10 bushel harvest limit for all gears in designated areas around the sound, reducing the available harvest season, changed the way lease production averages are calculated, limited lease applications to five acres and a recommendation to expand oyster sanctuary construction efforts. Supplement A raised the potential harvest limit in Pamlico Sound to 20 bushels and created a monitoring system for when to close mechanical harvest in that area. Amendment 3 was a focused amendment which created two seed oyster management areas in Onslow County. Any revisions to the plan resulting from this 5-year review will be designated as Amendment 4.

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

North Carolina General Statutes (G.S.) 113-134, 113-182, and 143B-289.52 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 DENR 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 Fisheries Rules for Coastal Waters 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 fee for dealing in oysters. Dealer licenses are restricted to North Carolina residents.

G.S. 113-182.1 Fishery Management Plans (FMP)

This requires the Department to prepare and the MFC to adopt FMPs for all commercially or recreationally significant species.

G.S. 1134-184 Possession and transportation of prohibited oyster equipment

During the regular closed oyster season, scoops, scrapes, dredges, or winders that can be used fort eh taking of oysters are not allowed on boats except for use on privately held shellfish bottoms.

G.S. 113-187 Penalties for violations of Subchapter and rules

Penalties for shellfishing in an area closed because of suspected pollution or using mechanical methods for oysters 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 oysters 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

Regular closed oyster season. March 31 through October 15, unless amended by the Fisheries Director through proclamation authority (15A NCAC 03I .0101(1)(g)).

Seed Oyster Management Area is defined as an open harvest area that, by reason of poor growth characteristics, predation rates, overcrowding, or other factors, experiences poor utilization of oyster populations for direct harvest and sale to licensed dealers and is designated by the MFC as a source of seed for public and private oyster culture (15A NCAC 03I .0101(1)(i)).

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 oystering is defined as dredges, patent tongs, stick rakes, and 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 oysters (15A NCAC 03I .0101(3)(m)).

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 oysters from prohibited (polluted) areas in or out of North Carolina. The Fisheries Director may close areas to the taking of oysters in order to protect shellfish populations for management purposes or for public health purposes (15A NCAC 03K .0101).

The size of the rake to take oysters is limited to no more than 12 inches in width or weighing more than six pounds (15A NCAC 03K. 0102(1)).

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 shellfish 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 oysters from polluted public bottom to privately controlled bottom may only occur between a six week period at the end of oyster season 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 oysters on Sundays from public bottoms except during open seasons and for recreational purposes (15A NCAC 03K .0105 (a)(1) and (2)).

Commercial oyster harvest is prohibited on Sunday, and any oyster harvest is illegal between sunset and sunrise on any day. An exception for unloading oysters until two hours after sunset is made for New Hanover, Brunswick, and Pender counties (15A NCAC 03K .0106).

Oysters 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)).

Oysters 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 oysters 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 oysters 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 Oysters

The oyster season from public bottom may begin on October 15 and may extend to March 31. The specific dates are set by proclamation and the Fisheries Director may also specify days, areas, harvest methods, daily time periods, and limit the quantity. A maximum daily harvest limit or 50 bushels per fishing operation is set (15A NCAC 03K .0201).

The size limit for oysters is set by proclamation authority but can be no less than two and one-half inches (15A NCAC 03O .0201).

Oysters less than the legal size limit, dead shell, and any oyster cultch material must be culled from the catch where the harvest took place (15A NCAC 03K .0202).

Dredges and mechanical methods prohibited areas include: Roanoke Sound, the shallow area behind the Outer Banks from Oregon Inlet to Core Sound, Pamlico Sound bays generally less than 6 feet deep, Core Sound and its tributaries, Back Bay, The Straits, Back Sound, North River, Newport River, Bogue Sound, White Oak River, and all of the coastal waters of Onslow, Pender, New Hanover, and Brunswick counties are closed to mechanical harvest of oysters except on private bottom by permit. Only one oyster dredge may be used per vessel and mechanical methods for oyster harvest are not allowed between sunset and sunrise. Oyster dredges can weigh no more than 100 pounds (15 A NCAC 03K .0204, 03J .0303, and 03R .0108).

Establishes current oyster sanctuaries in rule and prohibits the use of trawl nets, long haul seines, swipe nets, or mechanical methods to take oysters or clams from Oyster Sanctuaries designated in 15A NCAC 03R .0117 (15A NCAC 03K .0209)

Requires an Under Dock Oyster Culture permit to conduct recreational oyster culture under private docks (15A NCAC 03O .0503(h)).

5.4.3.4 Nursery Areas

It is unlawful to use mechanical methods for the harvest of clams in a primary nursery area described in 15A NCAC 3R .0103 (15A NCAC 03N .0104).

5.4.3.5 Leases and Franchises

It is unlawful to use mechanical methods for oysters on a lease or franchise without a permit. Procedures and requirements for obtaining permits are found in 15A NCAC 03O .0501 (15A NCAC 03K .0111).

Culling of oysters from private beds to the minimum size limit is required during the regular open oyster season. A permit for harvesting from private beds is required at any time and a certification form must accompany oysters sold during the closed season (15A NCAC 3K .0205).

Establishes a size limit exemption for oysters raised by a hatchery or oyster aquaculture operation 15A NCAC 03K .0207).

It is unlawful to take oysters from Seed Oyster Management Areas designated in 15A NCAC 03R 0.116 for planting on shellfish leases and franchises without first obtaining a permit. Procedures and requirements for obtaining permits are found in 15A NCAC 03O .0501 (15A NCAC 03K .0208).

All areas of public bottoms must meet certain criteria in order to be deemed suitable for leasing for shellfish cultivation purposes (15A NCAC 03O .0201 (a)).

All leases greater than five or more acres and 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 prior to acceptance of additional lease acreage (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 standards in G.S. 113-202.1 in order to be deemed suitable for leasing 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).

Makes it unlawful to use a trawl, long haul, swipe net, dredge, or mechanical methods for oysters or clams 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 US 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 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 eastern oyster (Crassostrea virginica) is a sessile filter feeding bivalve mollusk occurring naturally along the western Atlantic Ocean from the Gulf of St. Lawrence to the Gulf of Mexico, and the Caribbean Islands (Figure 6.1) (Bahr and Lanier 1981; Carlton and Mann 1996; Jenkins et al. 1997; MacKenzie et al. 1997). Eastern oysters have also been described from Panama, Venezuela, Brazil and Argentina (Wallace 2001). Carriker and Gaffney (1996) report eastern oysters are distributed in the western Atlantic from Brazil northward through the Caribbean, and Gulf of Mexico to the St. Lawrence River estuary in eastern Canada, a range of some 8,000 km. However, Gaffney (2005) in testimony to the Eastern Oyster Biological Review Team reported that the southern distribution of C. virginica can only be verified genetically to the northern Yucatan Peninsula of the Gulf of Mexico, and other genetically distinct Crassostrea species might occur in the Caribbean. Recent morphological analysis does suggest several similar and related species of Crassostrea are distributed throughout the Caribbean and coastal South America, with the southern range of the eastern oyster being limited to the Caribbean (Amaral and Simone 2014).

Across this wide geographic range, eastern oysters inhabit varied habitat types in waters that may reach between 0 to 32 °C annually (Butler 1954). Oysters may be found growing in salinities as low as 5 parts per thousand (ppt) and as high as 40 ppt, however opinion for optimum salinity range for the species varies but falls between 14 and 28 ppt (Galtsoff 1964; Wallace 1966; Shumway 1996). Oysters can tolerate extremes in salinity for varying periods depending on temperature, with greatest negative effects occurring at high temperatures (>32^0 C) and low salinity (<5 ppt) (Loosanoff 1965; Rybovich 2014). In the central Atlantic region eastern oysters are found from intertidal areas to depths up to eight meters (MacKenzie et al. 1997).

The distribution and survival of eastern oysters within habitat types is influenced by abiotic factors such as salinity, tide, oxygenation, and flow (Stanley and Sellers 1986; Roegner and Mann 1995; Kennedy et al. 1996; Lenihan 1999) as well as biotic factors such as disease, bioeroders, and predation (Barnes et al. 2010; Johnson and Smee 2012; Pollack et al. 2012; Dunn et al. 2014). More information on the impacts of introduced pathogens and native bioeroders may found in Section 11.3.4: Biological Stressors.

In North Carolina, oysters are found from extreme southeastern Albemarle Sound near the northern end of Roanoke Island southward through Croatan, Roanoke, and Pamlico sounds and the estuaries of the southern part of the state to the South Carolina border (Figure 6.2). North Carolina's oyster stocks are composed of both intertidal (oysters growing between the mean high and low tide levels) and subtidal (oysters growing below the mean low water level) populations. The intertidal populations are characteristic of the oyster stocks of the South Atlantic Bight (Figure 6.3). These intertidal populations are found principally from Cape Lookout southward. However, notable exceptions are the subtidal oyster rocks found in the Newport, White Oak, and New river systems (Figure 6.2). Other scattered subtidal populations are found in some of the larger systems farther south. North of Cape Lookout, oyster resources are almost exclusively subtidal. This region is primarily influenced by wind driven tides, and the few

intertidal oysters found in the area are in close proximity to inlets. The horse or crested oyster, (Ostrea equestris), may be confused with small eastern oysters, and can be locally abundant

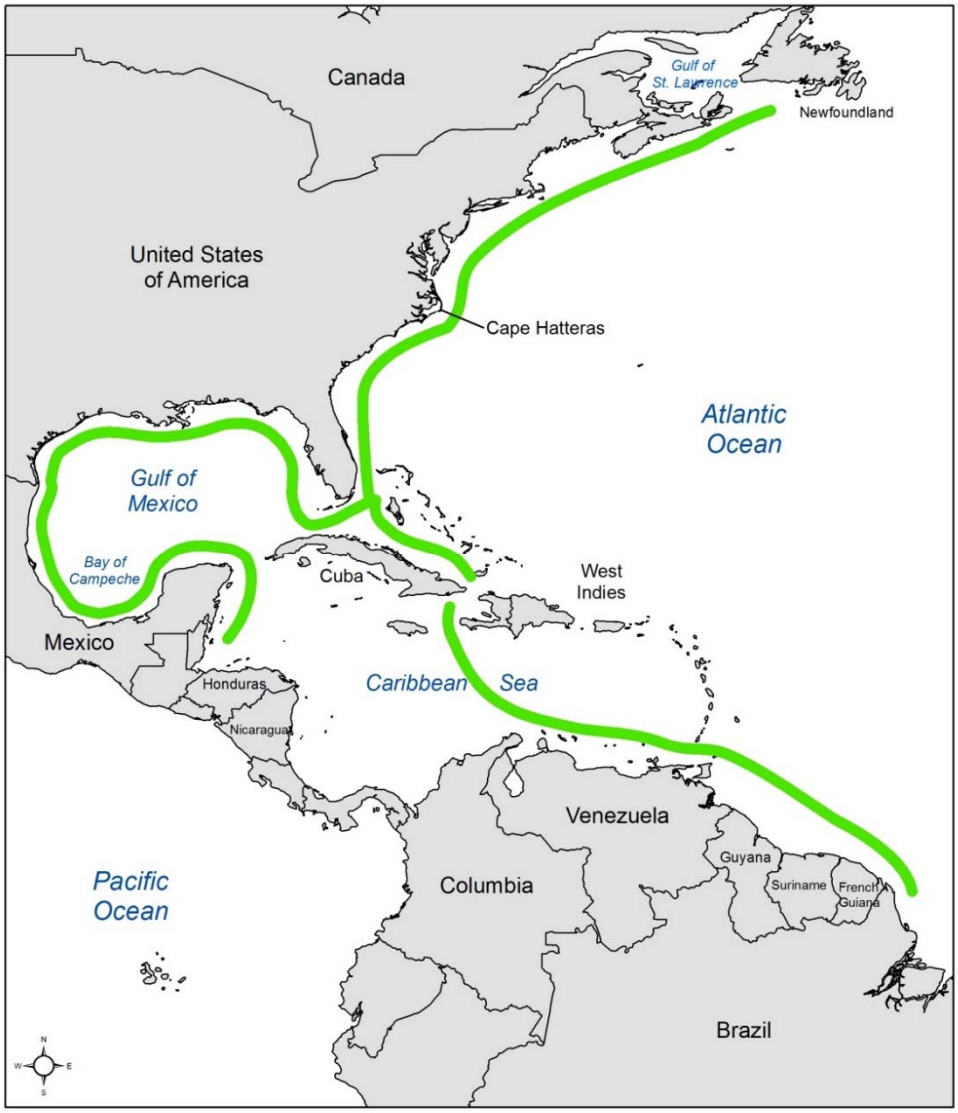

Figure 6.1. Distribution of Crassostrea virginica (shaded line) as adapted from Bahr and Lanier (1981). Current research suggests the range of the eastern oyster does not extend south of the Caribbean Sea (Amaral and Simone 2014).

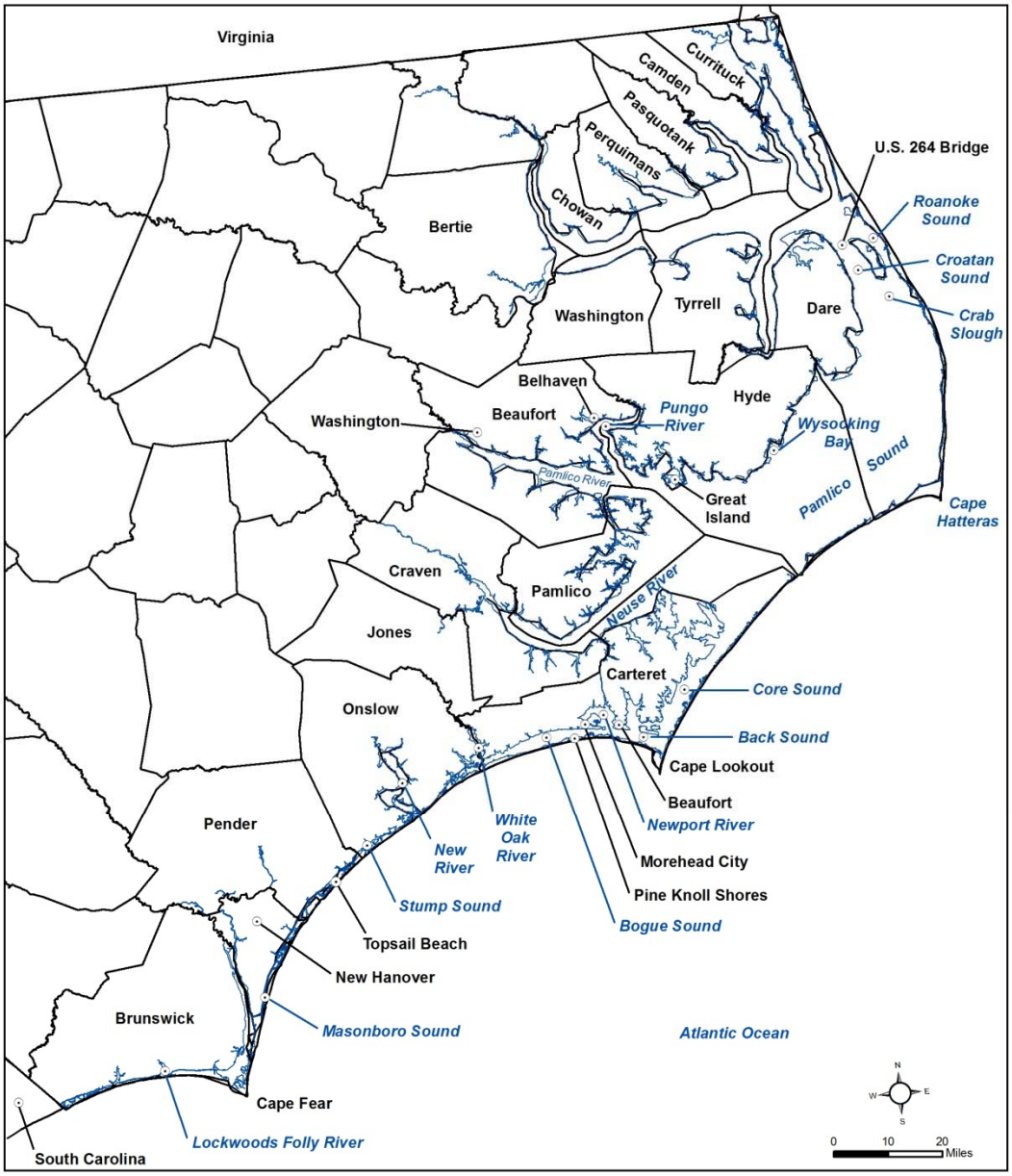

Figure 6.2. Coastal North Carolina showing locations referenced in this document.

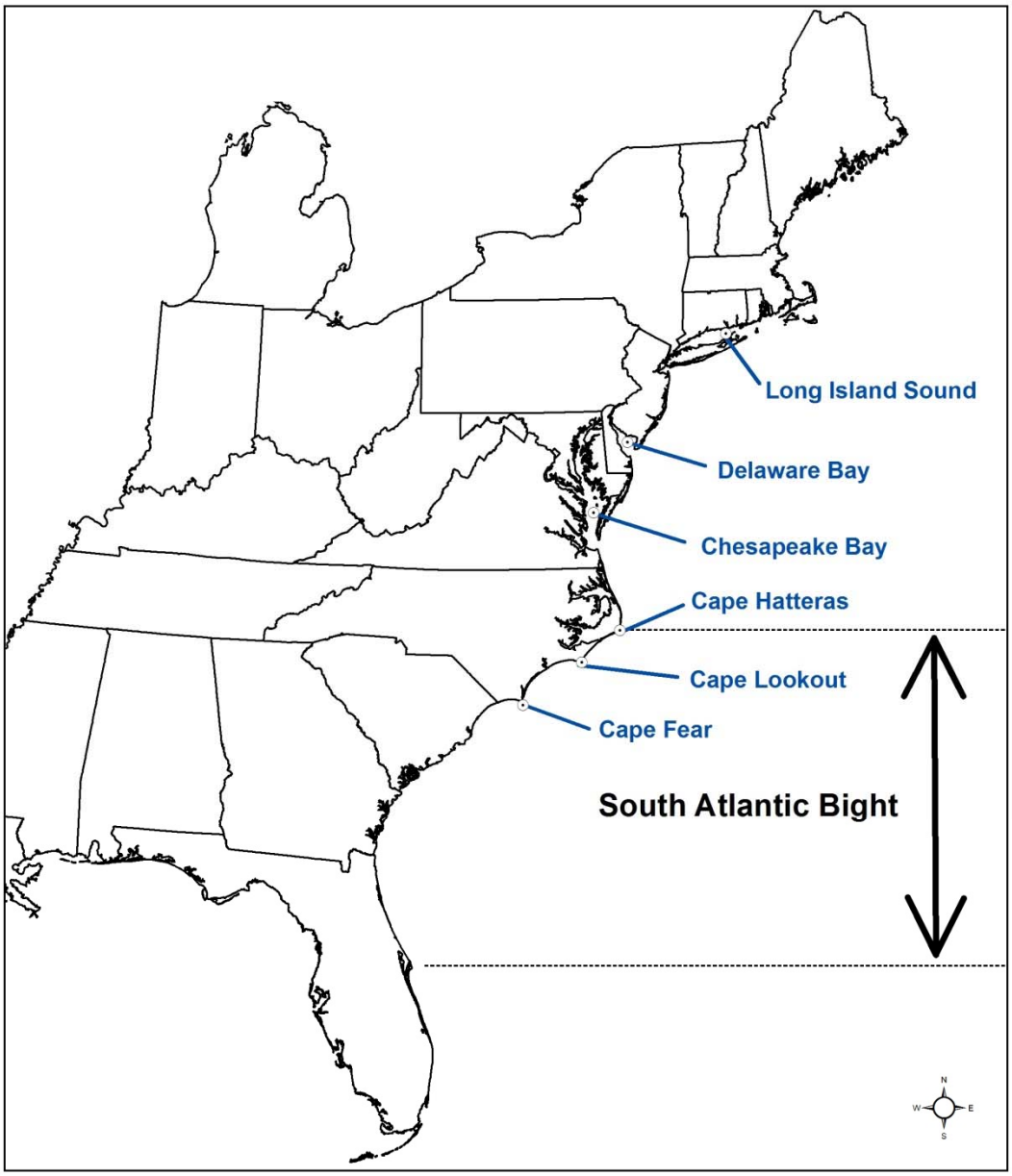

Figure 6.3. A map of the east coast of the United States showing locations of oyster harvest activity prior to 1900, and the location of the South Atlantic Bight.

(comprising 50-100% of live oysters) at both intertidal and subtidal habitats in southeastern North Carolina (Markwith et al. 2009).

6.1.2 Morphology

Eastern oyster bodies (meats) have no siphon, a small foot, a relatively small adductor muscle and fillibranch gills with interlamellar junctions (Galtsoff 1964). These characteristics differentiate the species from other North Carolina bivalves except the crested oyster, Ostrea equestris. The interior of the eastern oyster shell contains a purple-pigmented adductor muscle scar that does differentiate eastern oysters from other similar species within its range (Figure 6.4). Shell morphology can vary greatly depending on substrate and habitat conditions. Eastern oyster shells tend to be elongated and thin and have few radial ridges where they grow in intertidal and in high salinity areas. Shells of oysters grown in subtidal and lower salinity environments tend to be rounded and thick with visible radial ridges (Stanley and Sellers 1986). In the presence of predators eastern oysters have been shown to allocate more energy to shell growth, resulting in thicker and heavier shells (Johnson and Smee 2012; Lord and Whitlach 2012). Shell thickness has also been found to correlate with latitude and water temperature along the Atlantic coast, with southern warmer locations having oysters with thicker shells than northern colder locations (Lord and Whitlatch 2014). Eastern oyster larvae settle on the left valve and this valve is generally more cupped than the right that is normally found on top. There is no gap between the shells when the two valves are completely closed (Yonge 1960; Galtsoff 1964).

Figure 6.4. Left and right valves of a subtidal eastern oyster from Stump Sound North Carolina, illustrating the purple pigmented adductor muscle scar in the interior of the cupped left valve, and radial ridges on the exterior of the right valve.

6.1.3 Population Structure

Due to the variation of morphology, eastern oyster stocks cannot be identified on the basis of physical differences. Initial electrophoretic analysis indicated there were three stocks of oysters on the East and Gulf coasts. North Carolina's stock is thought to be part of the Atlantic coast stock, which extends from Maine to Key Biscayne, Florida. Other stocks were identified along the West Coast of Florida to Corpus Christi, Texas, and in the lower Laguna Madre, Mexico (ASMFC 1988).

The previous view which asserted there is insufficient information to conclude that distinct physiological races of *Crassostrea virginica* exist (Kennedy et al. 1996), has been challenged by a growing a growing body of molecular evidence. Analysis of genetic markers has identified a distinction between Atlantic and Gulf of Mexico populations, with the transition zone between the two occurring south of Cape Canaveral near Stuart and West Palm Beach, Florida (Reeb and Avise 1990; Karl and Avise 1992; Hare and Avise 1996; Hoover and Gaffney 2005; Murray and Hare 2006). However, no physiological reproductive barriers have been demonstrated between the two populations in cross breeding experiments (Zhang et al. 2010). This population boundary along the eastern coast of Florida also falls along the division of the Carolinean and Caribbean marine provinces separating temperate and subtropical groups of organisms (Briggs 1974). Differences in genetic frequencies between Gulf and Atlantic populations has also been found in other species including red drum, hermit crab, southern

flounder, king mackerel and snapping shrimp. This biological phenomenon was initiated 1.2 million years ago when sea level retreat during glacial events in the Quaternary period created physical land barriers, isolating the Gulf of Mexico from the Atlantic Ocean (Eastern Oyster Biological Review Team 2007).

Further evidence of genetic structure within the Gulf of Mexico has been described across specific areas within that geographic region (Groue and Lester 1982; Hoover and Gaffney 2005; Anderson et al. 2014). Within the Laguna Madre area of Texas, the distinct genetic structure may be due to adaptation to the hyper saline conditions in this water body as well as isolation from oyster populations to the north (Groue and Lester 1982).

Additional genetic analysis techniques suggest a second population division occurs in the Mid-Atlantic region, separating the Atlantic coast stock into northern and southern Atlantic groups (Wakefield and Gaffney 1996; Hoover and Gaffney 2005; Varney and Gaffney 2008). North Carolina represents a transition zone within the Atlantic stock of eastern oyster, with a shift between northern and southern types occurring approximately at the southern boundary of the Pamlico Sound (Sackett 2002). Cape Hatteras marks the southern range extent for numerous cool water marine species and northern extent for many temperate species, as well as delineates the boundary between the Carolinian and Virginian marine provinces (Briggs 1974).

6.1.4 Reproduction and Recruitment

Oysters are typically dioecious (separate sexes) but have the ability to change sexes (hermaphroditic) once each year when the gonad is undifferentiated (Thompson et al. 1996). Kennedy 1983 found that natural oyster populations maintain relatively balanced sex ratios but other researchers suggest that stress such as food limitation results in a higher ratio of males (Bahr and Hillman 1967; Davis and Hillman 1971). Oysters found at the extreme ends of salinity gradients also tend to have skewed sex ratios, with greater numbers of males found higher in the estuary (Powell et al. 2013). The sex of nearby oysters may also influence individual oyster sex determination (Smith 1949; Menzel 1951). Oysters first develop and spawn as males, with larger older oysters tending to be composed of a higher percentage of individuals spawning as females (Galtsoff 1964; Kennedy 1983). Gonads may be developed in oysters only two to three months old (Kennedy 1983). Fully developed oysters entering their first summer season may spawn, but substantial portions of young-of-the-year oysters are not sexually mature (Galtsoff 1964). Age or size selective mortality from disease and harvest pressure can alter oyster population demographics and result in an earlier shift from male to female gonads (Harding et al. 2012).

Formation of eggs and sperm is stimulated by increasing water temperatures during the spring of the year (Galtsoff 1964; Kennedy et al. 1996). Fecundity estimates range from 2 million eggs for a 4 cm (1.5 in) oyster to 45 million for an oyster 7 cm (2.8 in) in length (Kennedy et al. 1996). Oysters may spawn several times per season making absolute determination of fecundity difficult. Fecundity estimates are also complicated because the gonad is diffuse and invades other tissues (Kennedy et al. 1996). Larger oysters allocate a greater percentage of their food intake to egg production (Kennedy et al. 1996). In oysters collected from no take sanctuaries across Pamlico Sound from 2006 to 2008, fecundity increased exponentially with oyster size and reached the highest levels during May (Mroch et al. 2012).

Based on optimum spawning temperatures, there are three recognized spawning groups of oysters: one from the Gulf of Mexico and Florida that spawns near 25°C, and two from the east

coast that spawn at 16°C and 23°C respectively (Atlantic States Marine Fisheries Commission 1988). Chestnut (1954) reported oyster spawning taking place in North Carolina beginning at 20°C (June), with peak spawning at 25°C (August/September). Salinities greater than 10 ppt are also typically required for spawning (Breuer 1962). Under normal conditions, male oysters spawn first in response to various physical stimuli and environmental conditions. Female oysters are stimulated to spawn specifically by the presence of oyster sperm. Fertilization must take place shortly thereafter in the surrounding waters, or the unfertilized eggs lose their viability. Fertilized eggs develop through trochophore and veliger larval stages typically over a period of two to three weeks but may last up to two months (Hopkins 1931). The more popular larval development stage names, straight hinge (early stage) and umbo, eyed, and pediveleger (advanced stages), refer to obvious morphological characteristics at the different stages.

According to Galtsoff (1964), larvae can migrate vertically in the water column and may be able to maintain their position in the estuary by avoiding certain temperature or salinity changes. On the other hand, Korringa (1952) conducted laboratory experiments that showed oyster larvae had little control over the ultimate direction of their movement. Oyster larvae have been documented to travel at least 30 miles (Bahr and Lanier 1981). Andrews (1983) found that larval dispersion and the ultimate fate of the larvae are strongly dependent on prevailing currents and flushing rates of estuaries. Kennedy et al. (1996) concluded that larval swimming might supplement the effects of passive transport and enhance larval retention in estuaries. Patterns of larval distribution in North Carolina estuaries remain relatively unstudied. However, predictive models of Pamlico Sound larval dispersal from oyster sanctuaries have been developed (Haase et al. 2012).

As the larval stage ends, oysters must locate a suitable attachment point or perish. Several sites may be investigated before an oyster larva cements itself to the substrate (Kennedy 1996). Several environmental factors, including light, salinity, temperature, and current velocity, may influence the setting of larval oysters (Hidu and Haskins 1971). Oyster larvae also respond positively to a protein on the surface of oyster shells and tend to set more readily near other recently set spat (Kennedy et al. 1996). It has been suggested that oyster larvae may also settle in response to the specific acoustic signature of oyster reefs, with laboratory and field experiments demonstrating higher settlement in the presence of reef sounds (Lillis et al. 2013). These adaptations are apparently important to a reef-building animal that requires close proximity for successful spawning. Larval oysters tend to set in the intertidal zone where salinities are above 20 ppt (Mackin 1946; Menzel 1955) and set subtidally when salinities are below 20 ppt (Loosonoff 1952; Menzel 1955). Generally, spatfall is higher in intertidal areas and in areas where salinities are in the high range of spat tolerance (Bahr and Lanier 1981). Ortega et al. (1990) found higher spatfall on deep-water cultch planting sites in the Albemarle-Pamlico estuary, although these results could be influenced by a difference in cultch planting methods between deep and shallow subtidal sites.

Chestnut (1954) reported recruitment peaks generally occurring in June, the latter part of August and possibly another peak in October. Ortega et al. (1990) found recruitment in western Pamlico Sound to be continuous, concentrated in one or two peaks depending on year and location. Generally peaks occurred in June (lesser) and September-October (greater). Munden (1975) reported that spat monitors located in Morehead City and Wilmington did not show a decline in availability of spat during the summer of 1972 until September. Kennedy (1986) examined spawning and recruitment literature from various locations between Prince Edward Island, Canada, and the west coast of Florida and found that intensity and success of spawning and settlement varied with location and year in an essentially unpredictable manner.

6.1.5 Growth

Oyster growth is highest during the first six months after setting and gradually declines throughout the life of the oyster (Galtsoff 1964). Seasonally, adult oysters grow most rapidly during spring and fall in North Carolina. Shell growth was found to cease when water temperatures reach 28°C and slowed when temperatures decreased to 5°C (Chestnut 1954). Ortega et al. (1990) examined data from 1979-1989 and found that spat from all western Pamlico Sound sites attained lengths of 10-40 mm during the first year and reached marketable size (76 mm) by the end of three years. Godwin (1981) reported growth rates of transplanted intertidal seed oysters averaging 10 to 20 mm per quarter with a maximum of 40 mm in three months. Varying growth rates have been observed in different areas and under different conditions in North Carolina. Between 2006 and 2008, Puckett and Eggleston (2012) found differing growth rates across six oyster sanctuaries in Pamlico Sound. Regional differences in oyster growth have been reported in Chesapeake Bay (Kennedy and Breisch 1981). Roegner and Mann (1995) found no correlation between daily growth rates of juvenile oysters and oyster density, suggesting that competition through crowding does not affect oyster growth rates for the densities tested. Growths rates in other East and Gulf coast regions produce market size oysters in time periods ranging from 18-24 months in the Gulf of Mexico (Hofstetter 1977; Berrigan et al. 1991) to 4-5 years in Long Island Sound (Shumway et al. 2003).

6.2 STATUS OF THE STOCK

6.2.1 Unit Stock

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

6.2.2 Assessment Data & Methods

Data are not available to perform a traditional assessment so it was not possible to estimate population size or fishing mortality rates. Currently, the only data representative of the stock are the commercial landings and associated effort. For this reason, the current assessment focuses on trends in catch rates in the commercial oyster 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 6.6).

The North Carolina commercial Eastern oyster fishery is subject to trip limits, which could bias catch rates (Mike Wilberg, UMCES, pers. comm.; John Walter, NOAA Fisheries, pers. comm.); 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 was attempted to calculate an index of relative abundance (numbers harvested per transaction) using data collected from a fishery with trip limits.

Data were obtained from the North Carolina Trip Ticket Program for 1994 through 2013. The censored response variable (catch per unit effort) 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 Eastern oysters are harvested where sufficient data were available. Data are summarized by fishing year (October through March for hand harvest and November through March for mechanical harvest). Only landings from public bottoms were examined.

6.2.3 Trends in Catch Rates

Catch rates were expressed as bushels harvested per transaction. The censored regression approach failed for both hand and mechanical harvest data despite trying three different distributional assumptions (lognormal, gamma, t). This failure is believed to be due to the large number of trips (transactions) that meet or exceed the trip limit in both fisheries (Figures 6.5, 6.6). Similar work found that when ≥ about 50% of the trips equaled or exceeded the trip limits, there was not enough information from the uncensored trips to produce a reliable model. Here, 51.4% of trips by hand gears equaled (39.3%) or exceeded (12.1%) the trip limits over all water bodies and fishing years combined; the number of trips equaling or exceeding the trip limits for mechanical gears was 43.5% (42.9% equaled and < 1% exceeded).

6.2.4 Fishing Mortality

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

6.2.5 Stock Status

North Carolina commercial oyster landings have been in decline for most of the past century (Figure 7.10). This decline was likely initiated by overharvest and compounded by habitat disturbance, pollution, and biological and environmental stressors. The NCDMF has designated Eastern oyster as a species of concern. Species designated by the NCDMF with a concern status exhibit one or more of the following: increased effort (Figure 6.7), declining landings, truncated age distribution, or are negatively impacted by biotic and/or abiotic factors (e.g., water quality, habitat loss, disease, life history, predation, etc.)Oysters are believed to be vulnerable to overharvest because several factors negatively impact their survival. There are insufficient data to conduct a traditional stock assessment for the Eastern oyster in North Carolina. Until that time, the NCDMF Oyster Plan Development Team recommends that the status of Eastern oyster in North Carolina continue to be defined as a species of concern.

6.2.6 Special Comments

Trends observed in fishery-dependent indices must be interpreted carefully. 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 oyster 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. If, for example, recruitment and survival patterns for oysters in Pamlico Sound are independent of patterns in Stump Sound, they are probably discreet unit stocks and each should be analyzed and managed separately. If the existence of multiple unit stocks is unknown, and stocks are managed based on a statewide assessment (i.e., one assuming all Eastern oysters in the state belong to a single, unit stock), the risk of over- or under-harvesting will exist in regions where conditions differ from the statewide trend. It is quite probable that multiple oyster stocks exist in North Carolina waters and, therefore, responsible management should include their identification. GIS technology may also be helpful in determining hydrodynamic processes and larval transport that would be necessary to determine the unit stocks. Polymerase Chain Reaction methods for oyster disease assessments should also be acquired to more quickly and efficiently process samples and test for multiple diseases since natural mortality rates are necessary to assess oyster populations. Outside labs have been used and should be used periodically to test for diseases other than Dermo.

6.3.7 Research Recommendations

- Support improving the reliability for estimating recreational shellfish harvest
- Survey commercial shellfish license holders without a record of landings to estimate oyster harvest from this group
- Determine the effects of harvest on the suitability of habitat for oysters
- Develop regional adult abundance indices (fisheries-independent)

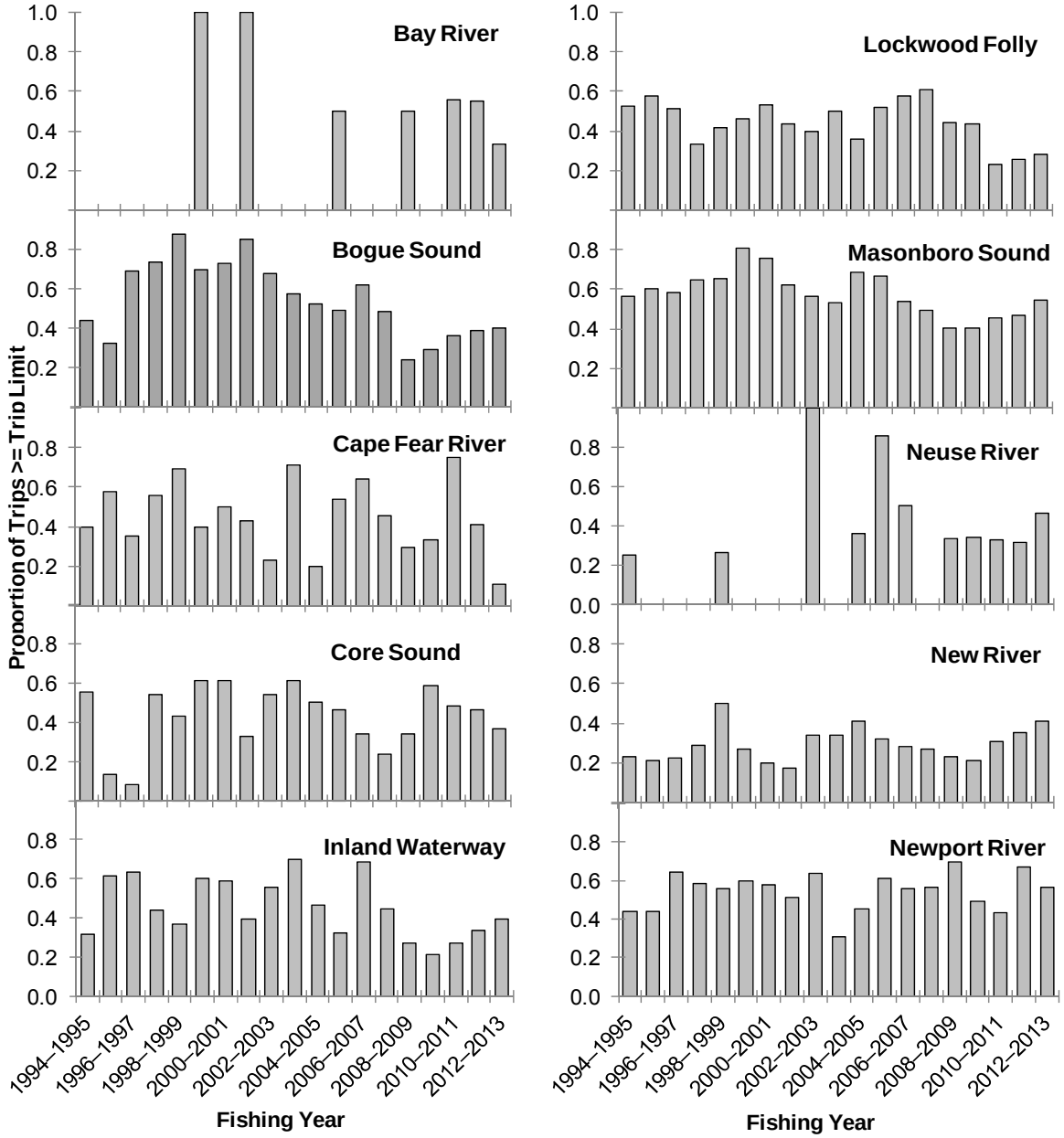

Figure 6.5. Annual proportion of trips ≥ trip limit for Eastern oysters commercially landed by hand harvest from public bottom by fishing year (October through March).

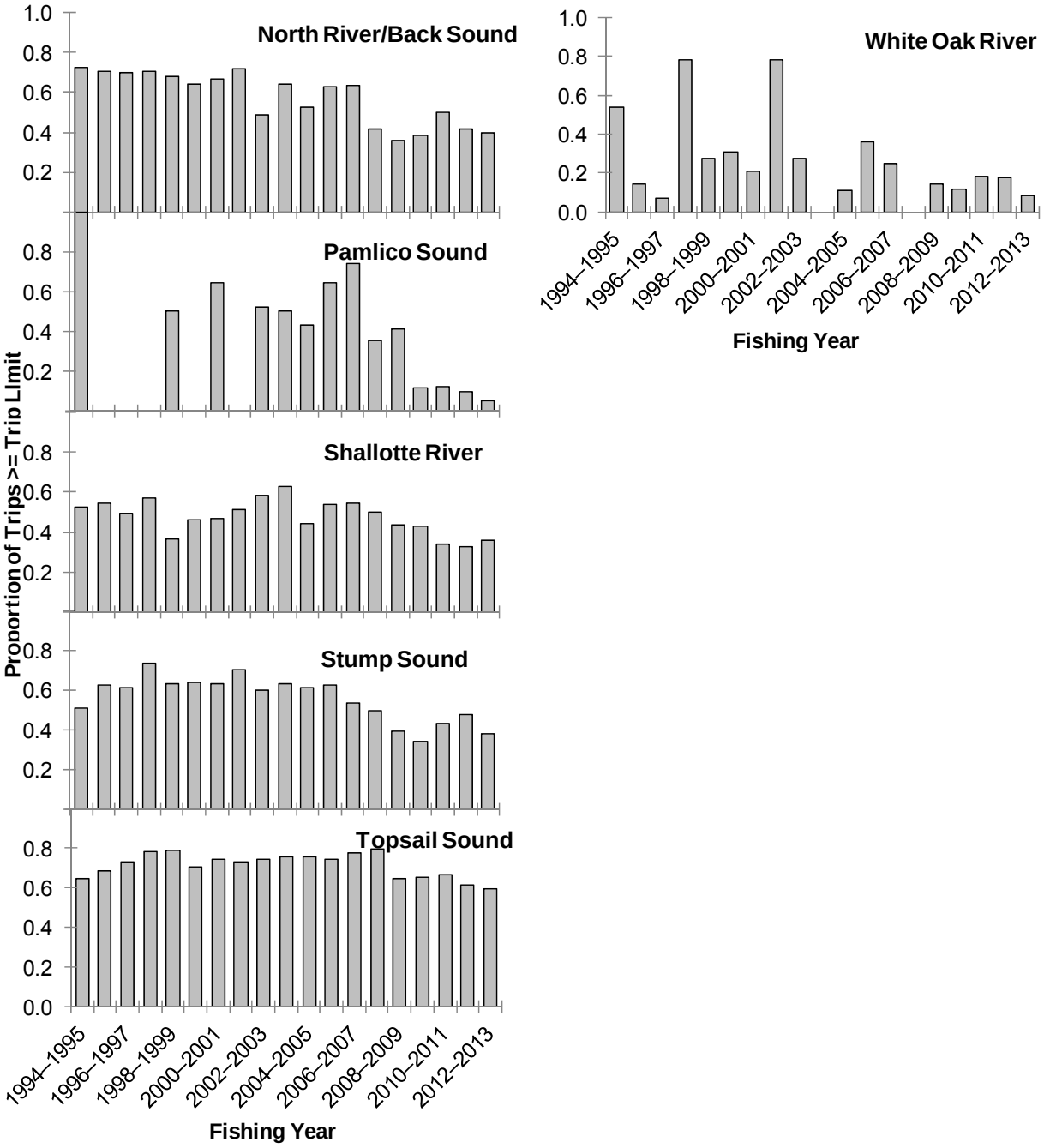

Figure 6.5. Continued

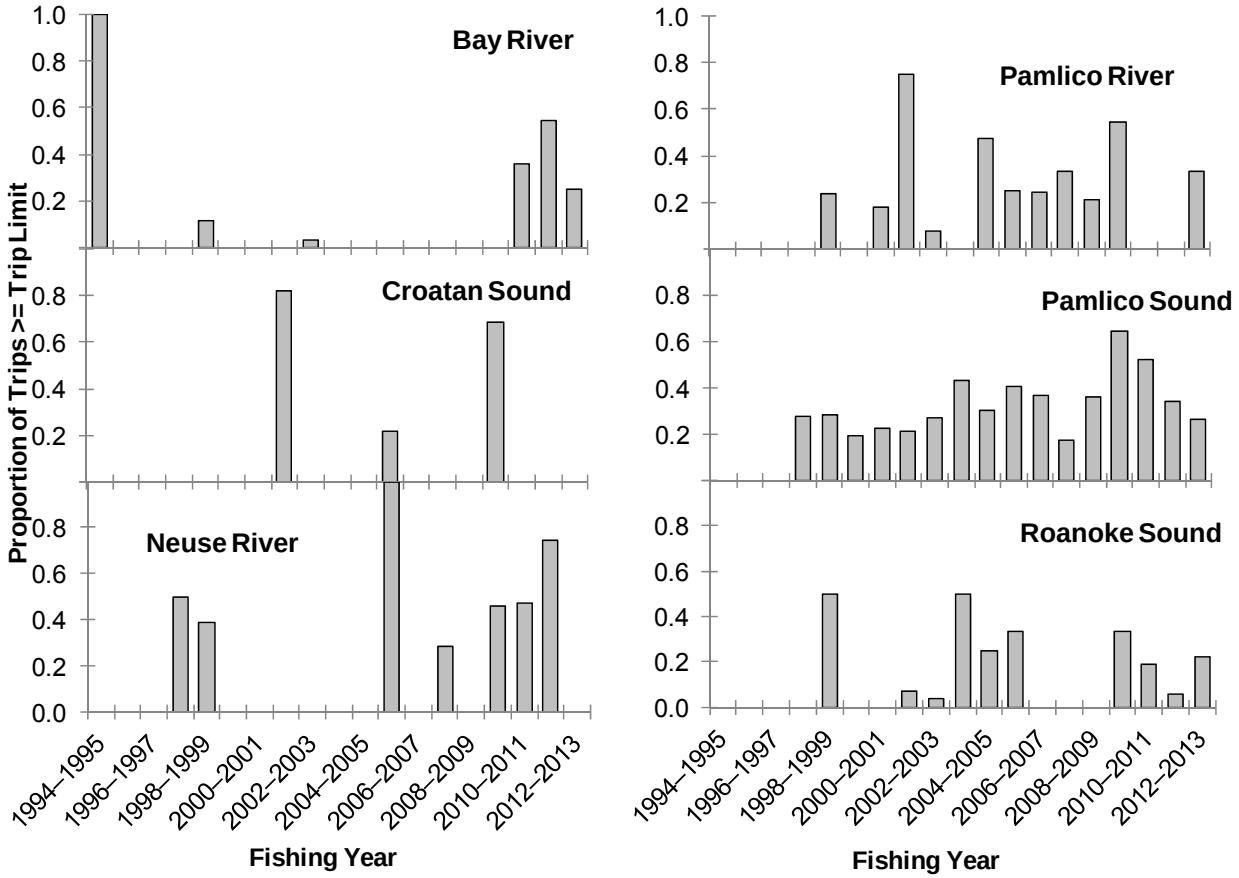

Figure 6.6. Annual proportion of trips ≥ trip limit for Eastern oysters commercially landed by mechanical harvest from public bottom by fishing year (November through March).

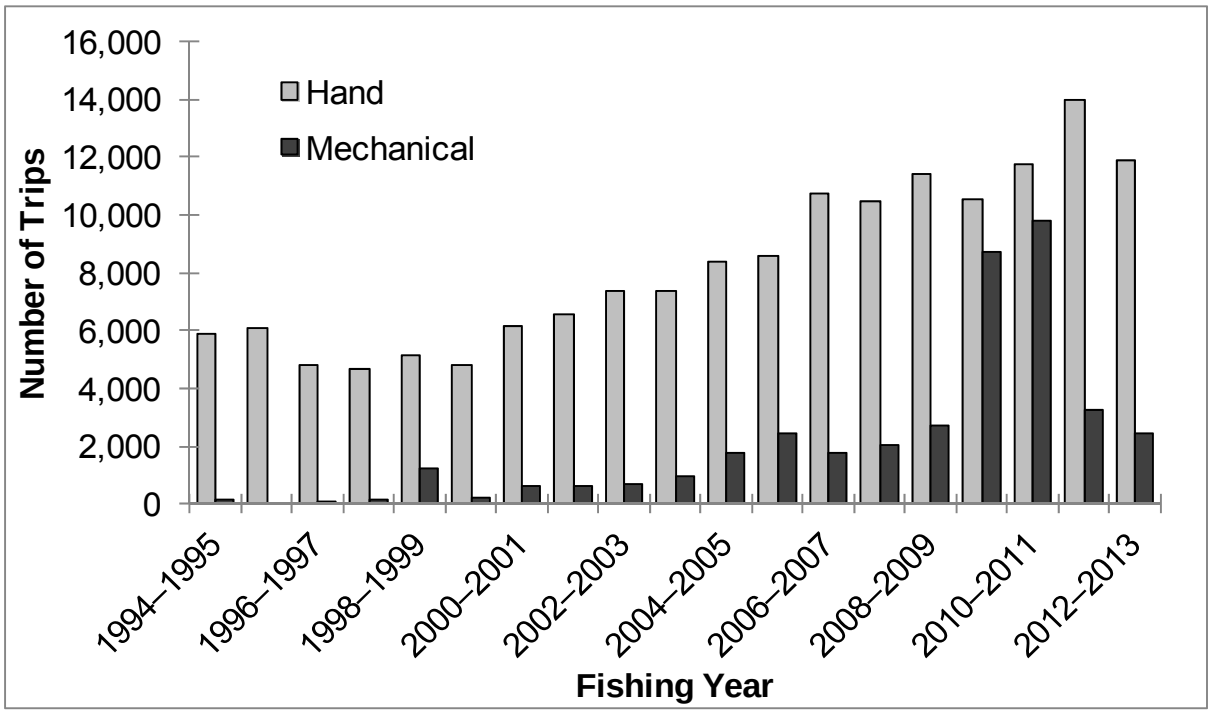

Figure 6.7. Annual number of trips (transactions) by gear type and fishing year

7.0 STATUS OF THE FISHERIES

7.1 COMMERCIAL FISHERY

7.1.1 Historical Public Bottom Fishery

The early North Carolina oyster fishery was legally conducted using hand methods only, and oysters were prohibited from being sold out of state until 1872 (Thorsen 1982). Prior to 1880, New Bern and Wilmington were the state's major oyster markets. Beaufort and Washington were also sites for significant oyster trade. Between 1872 and 1889, oysters were not shipped from North Carolina to the large eastern cities, even though the law allowed, because the abundance of oysters in Long Island Sound, Delaware Bay and Chesapeake Bay supplied their needs (Figure 6.2) (Chestnut 1951).

Winslow (1889) reported that 170,000 bushels of oysters were landed in 1880, and that fishermen interviewed in the Pamlico Sound area reported heavy mortality and poor condition of oysters. The season ran from September through April, and oyster dredging was not allowed on public bottom at that time. It should be noted, however, that dredging was allowed on private gardens as early as 1855 and there was no marine law enforcement agency to enforce these laws (Thorsen 1982). It is generally accepted that the landings in 1880 and the 167,950 and 161,423 bushels landed in 1887 and 1888, respectively, were landed primarily by hand harvest methods and from relatively shallow water. It was not until 1889, after depleting their own resources, fishermen from northern states entered North Carolina and fully exploited North Carolina's deep-water Pamlico Sound oyster resources with dredges and efficient mechanical tongs (Chestnut 1951).

A loophole in an 1887 law, which allowed dredging only in waters greater than eight feet deep in Pamlico and Roanoke sounds, pertained only to residents, with no restrictions to prevent out-of-state fishermen from dredging anywhere in North Carolina waters. This situation led to a conflict known as the "Oyster Wars," when dredgers from northern states caught large amounts of oysters from virgin stocks in Pamlico Sound. Residents relied heavily on tonging and were not familiar with dredging methods. Finally, after many attempts, a law prohibiting any harvesting by non-residents was passed and enforced in 1891. Consequently, over 300 out-of-state oyster boats left North Carolina waters at one time. Attempts to return to hand-harvest-only management from 1892 to 1895 and limited dredging in 1896 resulted in huge declines in oyster production and closing of many of the oyster canneries that opened during the "Oyster Wars." In 1897 the dredging law was amended, allowing limited dredging, a longer dredging season, and more law enforcement, resulting in a great increase in landings and reopening of the canneries. From 1887 to the present, landings reached their highest level in 1902 at 806,363 bushels and approached 800,000 bushels only one other time on record (789,849 bushels in 1889) (Table 7.1). All of the oyster landings prior to 1931 were accomplished using hand methods and sail-powered oyster dredge boats.

While the series of events around the turn of the century readily shows the relationship between harvesting with dredges and its pronounced effect on the volume of oyster landings, management measures taken after the decline in landings beginning in the early 1900s appear to have had little long-term effect. There appear to be several contributing factors which allowed for the continuing decline. Coon oysters (long, slender oysters shaped like a raccoon footprint; typically found in intertidal areas) were exempt from size limits until 1971. There was also no definition of a coon oyster, and enforcement was apparently at the discretion of

Table 7.1. North Carolina oyster landings in pounds of meat and bushels, 1880-2013. (Chestnut and Davis 1975; National Marine Fisheries Service unpublished data; NCDMF Trip Ticket Program)

YEAR	POUNDS	BU. (x 1,000)	YEAR	POUNDS	BU. (x 1,000)
1880	938,400	134	1970	382,500	79
1887	1,175,650	168	1971	423,400	88
1888	1,129,960	161	1972	470,112	103
1889	5,528,942	790	1973	548,351	112
1890	4,456,075	637	1974	558,821	109
1897	4,740,675	677	1975	424,831	84
1902	5,645,928	807	1976	333,315	61
1908	4,159,320	594	1977	365,714	69
1910	1,834,058	262	1978	449,544	84
1918	1,197,630	171	1979	665,439	132
1923	3,089,146	441	1980	723,099	139
1927	2,397,750	343	1981	550,502	119
1928	2,286,610	327	1982	611,998	155
1929	2,828,420	404	1983	724,509	123
1930	2,205,674	537	1984	724,557	128
1931	1,500,571	353	1985	545,439	100
1932	1,201,356	275	1986	745,548	120
1934	1,160,700	271	1987	1,425,584	226
1936	2,480,500	651	1988	913,100	157
1937	1,940,900	457	1989	529,858	92
1938	1,426,900	334	1990	328,850	52
1939	1,055,600	313	1991	319,040	48
1940	690,400	204	1992	293,956	50
1945	1,707,100	586	1993	223,136	35
1950	1,322,100	238	1994	183,704	35
1951	1,531,900	253	1995	220,661	42
1952	1,620,900	331	1996	210,931	40
1953	1,525,300	310	1997	218,970	41
1954	998,400	210	1998	224,214	42
1955	731,000	150	1999	216,858	41
1956	1,318,000	285	2000	203,427	38
1957	1,086,500	239	2001	258,086	49
1958	1,041,500	228	2002	243,775	46
1959	1,311,000	287	2003	261,043	49
1960	1,216,200	289	2004	367,961	70
1961	1,209,100	233	2005	378,014	71
1962	961,400	192	2006	447,889	85
1963	694,000	133	2007	441,415	83
1964	727,700	153	2008	466,176	88
1965	863,700	166	2009	573,630	108

Table 7.1 Continued

1966	626,200	119	2010	1,040,407	197
1967	514,900	98	2011	800,517	151
1968	402,600	84	2012	440,063	83
1969	370,300	80	2013	586,619	111

individual officers. Taking oysters for personal consumption was also allowed year-round until 1966. These harvest factors were extremely harsh on oyster resources in the southern estuaries (A. F. Chestnut, UNC-Institute for Marine Sciences, pers. comm. 1991). Also, adequate enforcement seemed to be lacking, allowing for harvest of undersize oysters for sale and for planting on private oyster beds in Chesapeake and Delaware bays (Thorsen 1982; Chestnut 1951). The lack of harvest limits and lack of restrictions on oyster dredge weight until 1947 probably had a pronounced effect on oyster habitat as well.

Even though oyster dredging was blamed for overharvesting and depletion of oyster resources in Delaware Bay and Chesapeake Bay, North Carolina fishermen adopted the practice and laws were passed allowing its use. Early attempts at regulating this fishery limited the dredging areas to open sound waters in depths over certain limits. The 1887 law allowed oyster dredging only in Pamlico and Roanoke sounds in waters 8 feet deep or greater (Thorsen 1982). This law was abolished in 1891 due primarily to the non-resident dredgers. Dredging was reinstated in 1895 after oyster landings dropped drastically, but only from February 1 through May 1 in Pamlico Sound waters ten feet in depth or greater (Thorsen 1982). A heavy tax was also placed on dredge boats, discouraging re-entry into the fishery, and oyster landings were again very low the following season (Thorsen 1982). In 1897 the season was lengthened by two months and landings rose to 677,239 bushels.

In 1903, 1905, and 1909, changes were made in the statutes that better defined the area where oyster dredging was allowed. The new laws dropped the depth restriction and reduced the open area. By 1909, only the open waters of Pamlico Sound outside the mouth of all tributaries, offshore of the shoal area behind the Outer Banks, outside of Carteret County, and southwest of Bluff Shoal were available for dredging (Figure 7.1). Oyster landings during this period also fell, reaching a low of 171,090 bushels during 1918.

Available rulebooks indicate that by 1927, the Fisheries Commission reopened Pamlico Sound north of Bluff Shoal, West Bay (then known as Cedar Island Bay), East Bluff Bay, West Bluff Bay, Juniper Bay, Neuse River, Pungo River, and Great Island Narrows to oyster dredging (Figure 7.2). Only sail powered boats were allowed. The Fisheries Commission was given rule-making authority in 1915. It is not known exactly when between 1915 and 1927 the change in areas available for taking oysters with dredges occurred. These rules were in conflict with the statutes until 1950 when the statutes were repealed. It is thought that the rules were made available to the fishermen and were used for enforcement purposes.

The areas where oyster dredging was allowed by sail power remained relatively unchanged except for openings and closings of a few Hyde and Pamlico county bays until 1952. The distinction between power and sailboat dredging disappeared by 1955.

While power boats had been around since before World War I, they were not allowed for dredging oysters until 1931, when Pamlico Sound north of Long Shoal, Wysocking Bay, Cunning Harbor, West Bluff Bay, Great Island Narrows, Rose Bay, Juniper Bay, and Swan Quarter Bay were exempted from the general rule of sail power only for dredging (Figure 7.3). These powerboats were restricted to a length of 30 feet and hand dredges only (no power winches allowed for raising dredges). Pamlico Sound north of Long Shoal and Wysocking Bay remained open, but several Hyde and Pamlico county bays opened and closed to power boat dredging between 1931 and 1944. In 1944 power boats 32 feet long and under were allowed to pull hand dredges in Pamlico Sound, Pamlico River, Neuse River, Wysocking Bay, East Bluff Bay, West Bluff Bay, Juniper Bay, Great Island Narrows, Swan Quarter Bay, Rose Bay, Deep Bay, Mouse Harbor, Middle Bay, Jones Bay, Bay River, Turnagain Bay, Long Bay, Point of Marsh, and Cedar Island Bay (now known as West Bay) (Figure 7.4). This change represented a significant expansion, probably caused by World War II and resultant increases in price and demand for oysters. In 1946, the hand dredge restriction was dropped, and in 1948 the boat size restriction was also removed.

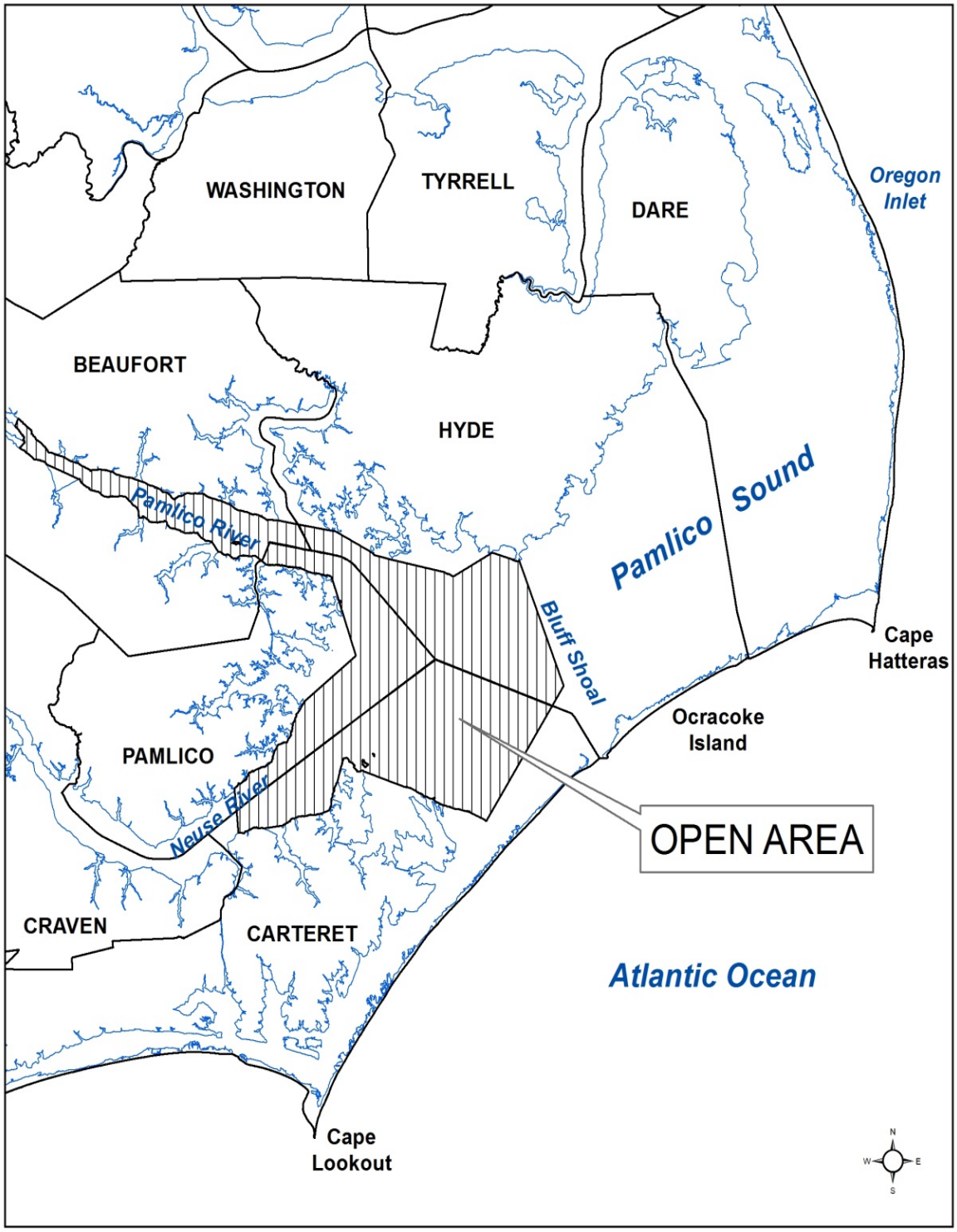

Figure 7.1. Open oyster dredging area 1909 (hatched), sail power only (Marshall 1995, NCDENR GIS database).

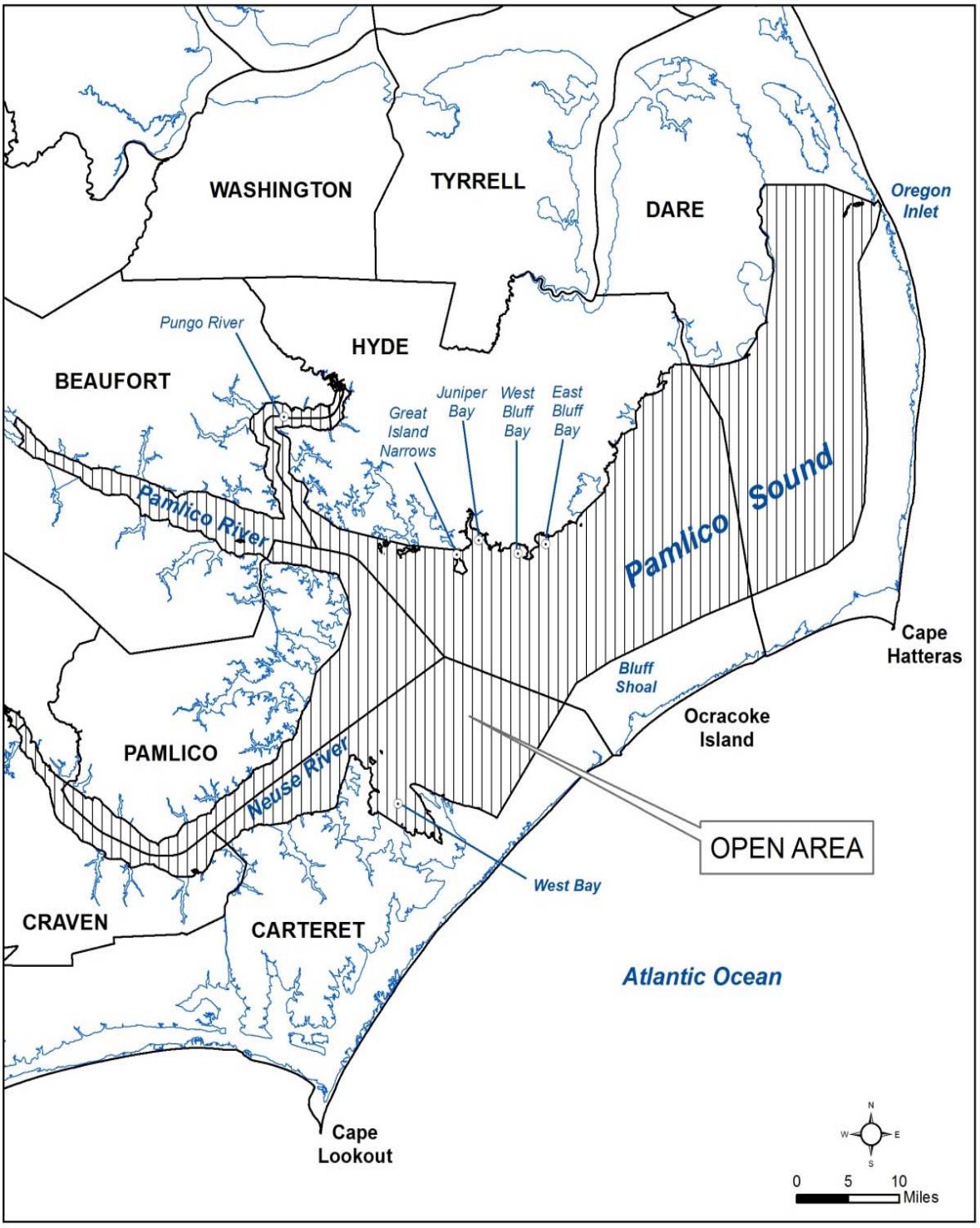

Figure 7.2. Open oyster dredging area 1927 (hatched) sail power only (Marshall 1995, NCDENR GIS database).

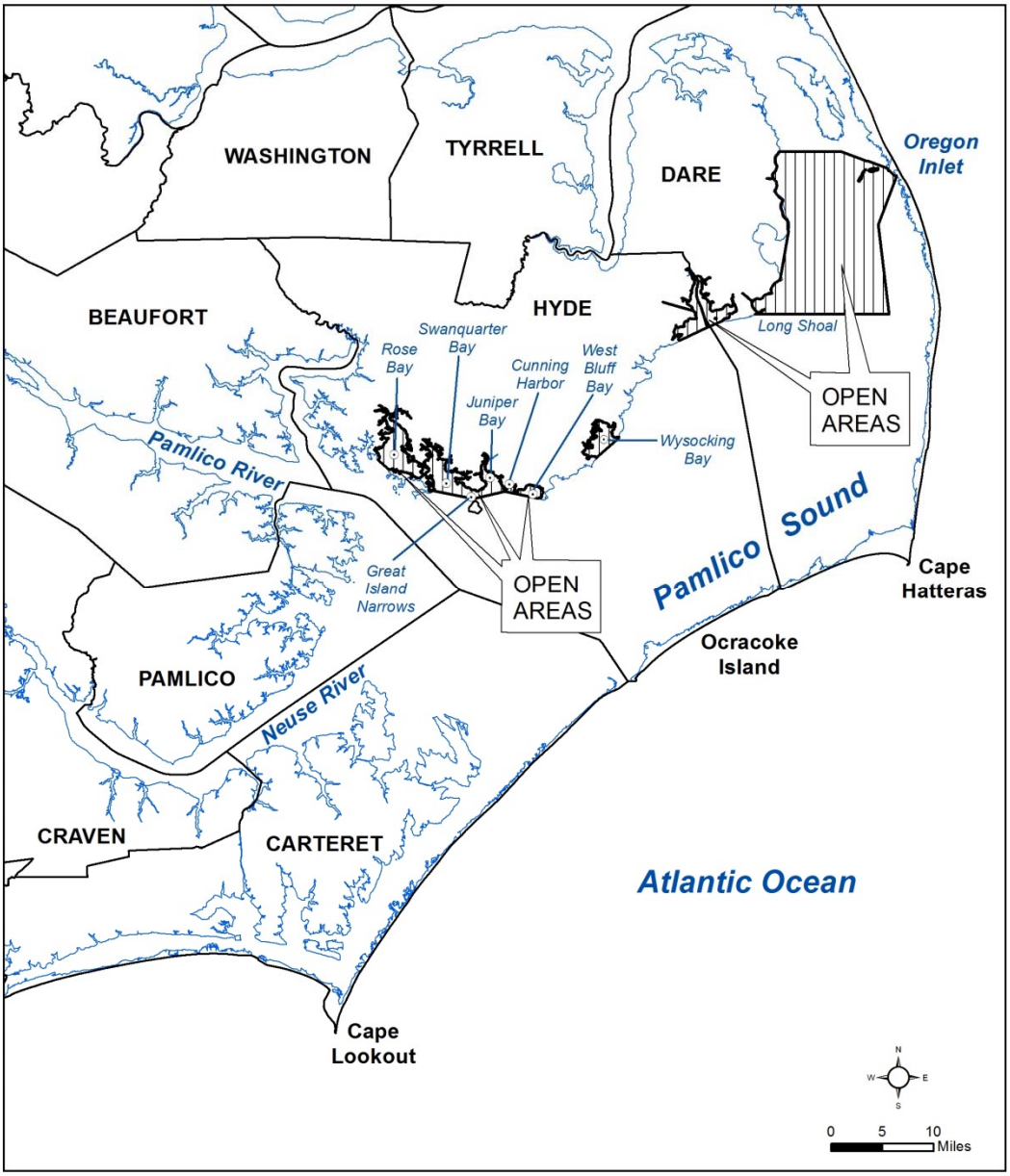

Figure 7.3. Open oyster dredging area for powerboats (hatched), 1931 (Marshall 1995, NCDENR GIS database).

The North Carolina General Assembly also made changes in oyster laws during this time period. Beginning in 1947, powerboats were limited to pulling one dredge weighing no more than 100 pounds and a daily take of no more than 75 bushels of oysters. Sailboats were allowed to pull two dredges of any weight with the same daily harvest limit.

Another significant change in the rules occurred in 1955, which reversed the approach to wording the restriction on dredging areas. The 1955 rulebook described the areas that were closed to oyster dredging instead of describing the open areas. The only closed areas were

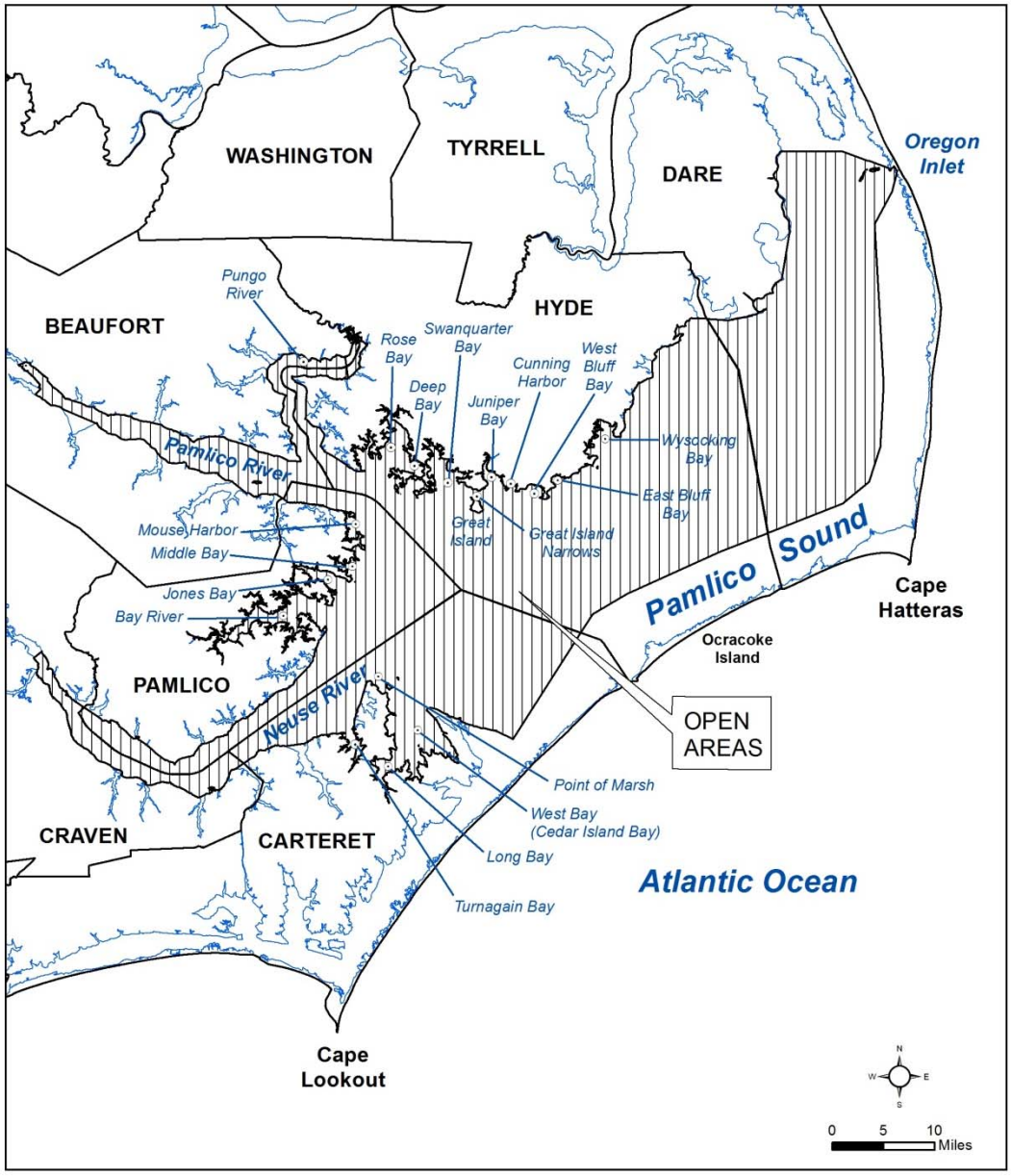

Figure 7.4. Open dredging area for powerboats (hatched), 1944 (Marshall 1995, NCDENR GIS database).

the reef area behind Ocracoke Inlet and Portsmouth Island down to the Swash and several Carteret County areas, including Core Sound, Back Sound, Bogue Sound, Straits, North River, Newport River, and Back Bay (Figure 7.5).

During the 1960s, several areas were added to the list that prohibited oyster dredging, including New River, Shallotte River, Lockwoods Folly River, South River, White Oak River, Saucepan

Creek, and Currituck County (Figure 7.6). North Bay was added in 1974, and South River was reopened to dredging in 1975. The formally designated primary nursery areas were added to the list of prohibited dredging territories in 1977.

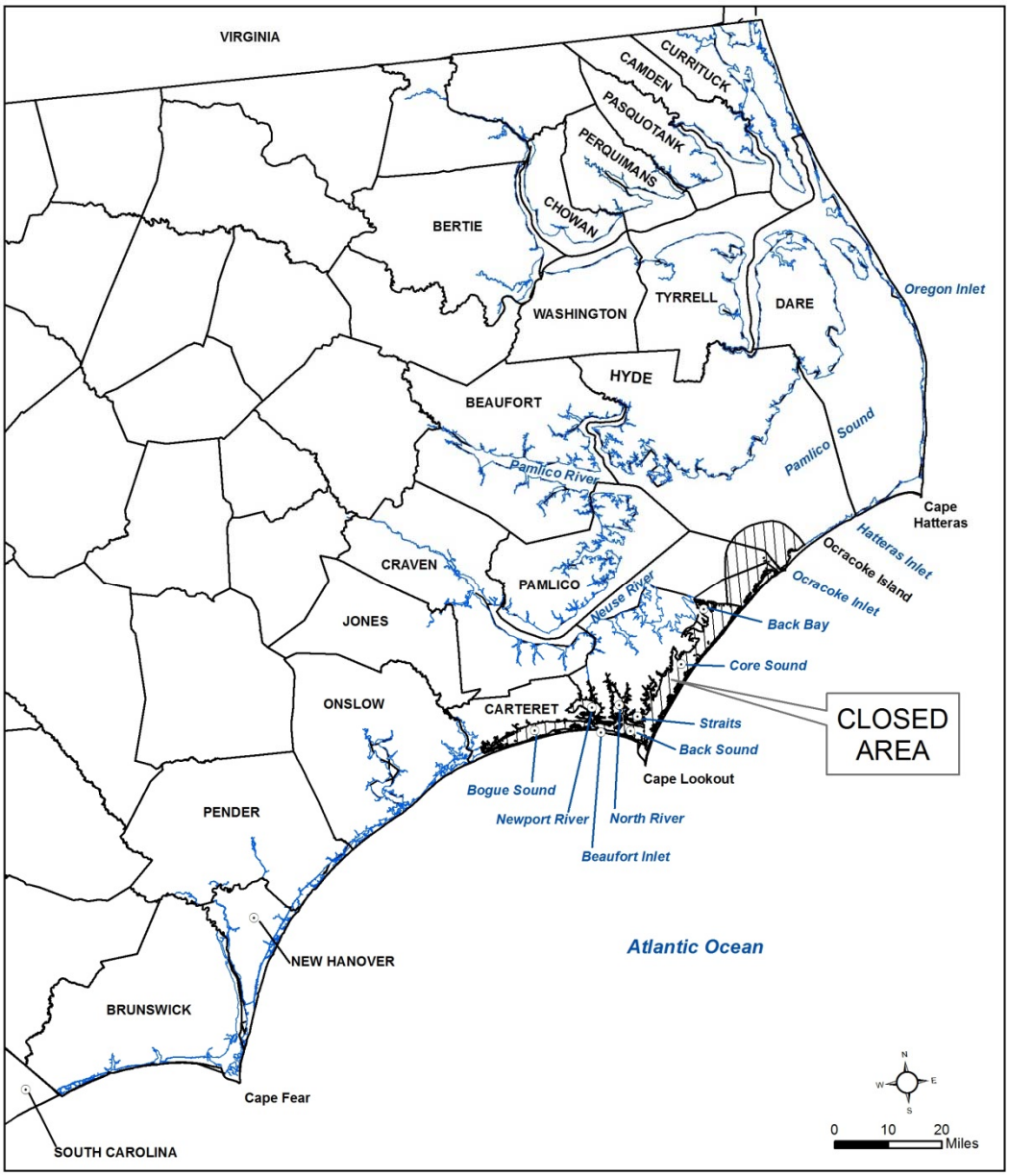

Figure 7.5. Closed oyster dredging area (hatched), 1955 (Marshall 1995, NCDENR GIS database).

In 1981, proclamation authority was established that allowed the reef area (waters generally inside the six foot depth contour) behind Ocracoke Island and Hatteras Island from Hatteras Inlet up to Cape Channel to be closed to dredging. These areas were closed by proclamation annually until 1988 when dredging was prohibited by rule for this area. The remainder of the reef area up to Oregon Inlet was closed to oyster dredging by rule in 1991 (Figure 7.7).

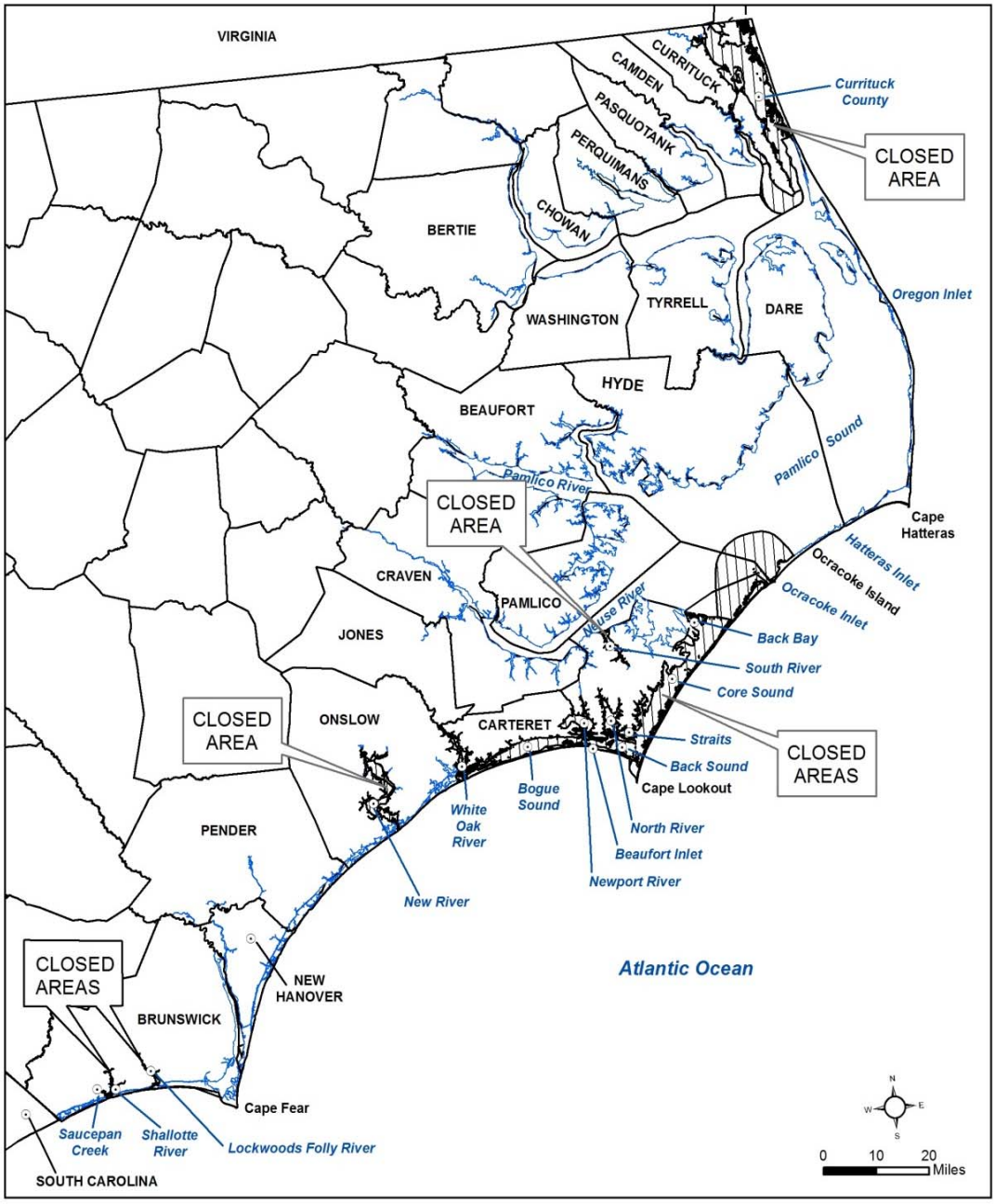

Figure 7.6. Closed oyster dredging area (hatched), 1960-1975 (Marshall 1995, NCDENR GIS database).

Based on recommendations and criteria in the 2001 Oyster Fishery Management Plan, portions of bays generally less than 6 feet deep were closed to oyster dredging in Dare, Hyde, Beaufort, Pamlico, and Carteret counties in October 2004 (Figure 7.8) (NCDMF 2001). The total area closed to dredging was approximately 30,000 acres.

The hand dredge only provision resurfaced in 1967 for the waters of Roanoke Sound. That provision was dropped in 1976, again allowing dredges weighing up to 100 pounds.

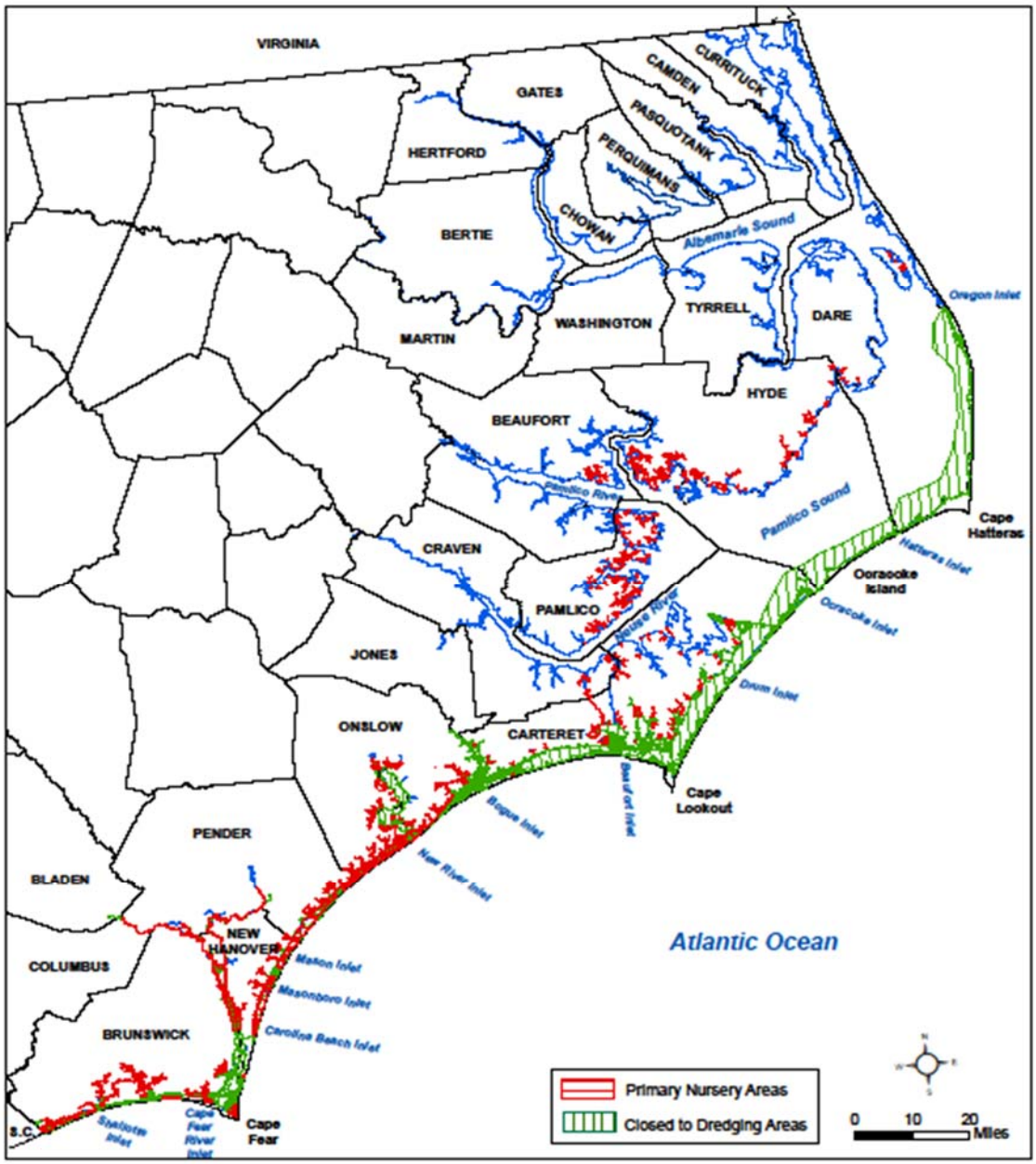

Figure 7.7. Area closed to oyster dredging 1991- 2004 and Primary Nursery Areas. Areas restricted to hand harvest of oysters by proclamation are not shown (Marshall 1995, NCDEQ GIS database).

The one dredge per boat law was apparently abolished in the early 1970s when that section of the session laws was changed. Since then the use of more than one dredge was allowed from time to time, depending on NCDMF policy. During 1988, the provision for one dredge per boat was adopted by rule. The 75 bushel per day harvest limit existed either in statute or rule from 1947 until 1984. Since 1985 the limit has been set below 75 bushels, and currently the maximum limit allowed by rule is 50 bushels. Proclamation authority allows the Fisheries Director to establish the limit up to 50 bushels by area or by gear.

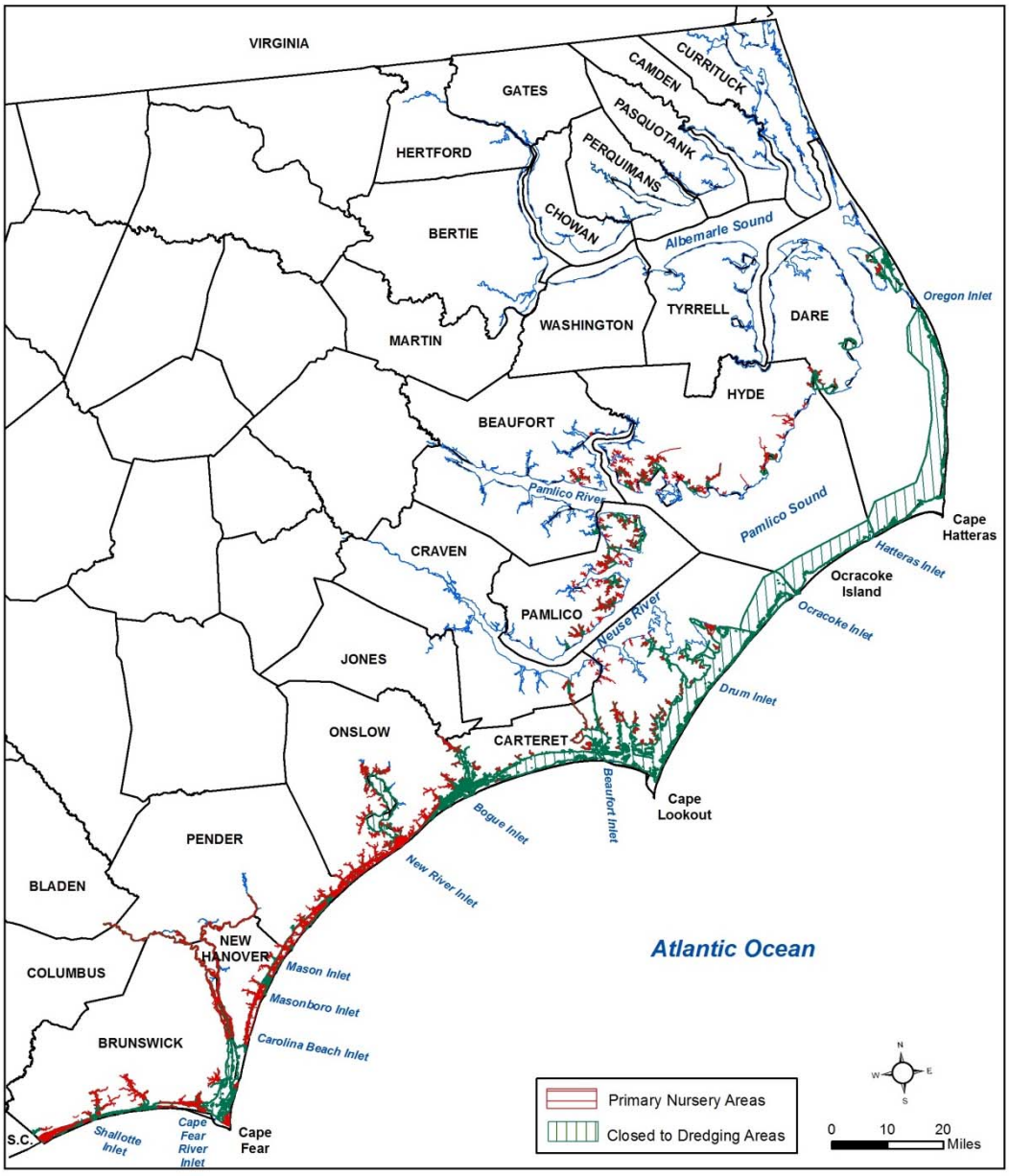

Figure 7.8. Current area closed to mechanical harvest of oysters showing areas added in October, 2004 (NCDENR GIS database).

Except for seasons, some local laws, and size limits on non-coon oysters, the hand harvest fishery was virtually unrestricted until 1947 when, presumably, the 75 bushel per boat limit was applied. This limit probably had little effect. The first meaningful attempt at regulating the hand harvest fishery occurred in 1989 when a harvest limit of seven bushels per person was established. The early view of hand harvesting of oysters was that it could never affect the stock or habitat. Furthermore, the intertidal oysters of the southern part of the state were seen as inferior and no size limit was adopted until 1971 when a 2 1/2-inch limit was imposed. In contrast, a 2 1/2-inch size limit was initiated on subtidal oysters in 1893 and a further increase to

three inches was made between 1931 and 1934. The three-inch size limit was not applied to all oysters until 1981.

The gear for hand harvest of oysters (hand tongs, hand rakes, and by hand) has also been largely unregulated. Early laws refer to the use of regular oyster tongs but have no definition. An old Newport River rule prohibited the use of pitchforks and a local New River rule limited tongs to no more than six teeth. The threat of destruction of oyster rocks by fishermen with bull rakes from northern states prompted the adoption of limitations on rakes for taking oysters in 1981. Originally a ten-pound weight restriction was applied to bull rakes and it was later modified to the current limit of rakes no more than 12 inches wide nor weighing more than six pounds. Hand harvest methods currently include hand tongs, hand rakes, and by hand. Hand tongs are generally used in shallow subtidal areas. Hand rakes and actual picking up by hand are normally used in intertidal areas. Some specialized uses of rakes and modified tongs occur in subtidal areas. Hand methods are allowed in all approved waters during the open season.

The hand harvest fishery has at many times enjoyed a longer harvest season and no management restrictions on open harvest areas. The two major factors affecting the hand harvest fishery appear to be loss of harvest area due to pollution closures and the loss of habitat from clam harvesting.

The culling tolerance that applies to oysters harvested by hand or mechanical means has been incorporated in rule at least since 1927. During the early years it was set at 5%. The culling tolerance changed to 10% around the same time as the change in size limit from 2 1/2 to 3 inches, between 1931 and 1934. Except for a brief four-year period between 1971 and 1975, when the culling tolerance for the 2 1/2 inch coon oysters was 15%, the culling tolerance has remained at 10%. Prior to 1971, there was no size limit on coon oysters and therefore no culling tolerance.

The number of days available to harvest oysters has varied considerably over the years. The first oyster season was set at 32 weeks between the dates of September 1 and April 1, 1872-73. Prior to 1872, oyster harvest was allowed year-round. The next change occurred in 1891, when the season was shortened to 28 weeks by limiting oyster harvest to October 1 through April 1 (Thorsen 1982).

The management action of restricting oyster dredging to a shorter season than hand harvest methods began in 1895 (Thorsen 1982). This concept was in use in regions of the main portion of Pamlico Sound and for other local areas until significant rule changes took place around 1950. Differential openings and closings of regions of the coastal area to oyster harvest by proclamation authority beginning in 1966 had virtually the same effect due to regional harvest restrictions. Between 1988 and 1996, the hand methods harvest season was opened two weeks prior to the mechanical gear season by rule. The differentiation in harvest opening dates continued after 1996 at fishermen's request even though the rules allowed both types of gear to be used beginning October 15.

Based on available rule records, the oyster season has varied between 20 and 28 weeks. Since proclamation authority was established in 1966, records are not available to determine the exact number of weeks harvest was allowed. However, the trend since 1966 has been to lengthen the oyster season. Between 1946 and 1965, the season was set at 20 weeks between October 1 and March 1. Between 1966 and 1972, the oyster season was set between the dates

of October 1 and March 15 or 22 weeks. From 1973 to 1987, the season was lengthened to twenty-four weeks by adding the last two weeks in March.

Data on landings by gear indicate that, prior to 1960, most of the oysters were taken by dredge when compared to all hand methods (Figure 7.9). Chestnut (1955a) reported that ninety percent of the oysters landed in North Carolina came from Pamlico Sound. The previous discussion on dredging areas shows that the harvest in the Pamlico Sound area is largely dependent on dredging. The resurgence of the dredge landings in 1987 was due, in part, to increased oyster populations and in part to increased effort, as displaced mechanical harvest clammers turned to oyster dredging due to closure of southern clamming areas by a red tide which affected 98% of the clam harvesting areas and had its greatest impact on the clam fishermen. The red tide was a dinoflagellate bloom that caused closure of over 361,000 acres of public bottoms to shellfish harvest from November 1987 to May 1988. The dinoflagellate (*Karenia brevis*) produced a neurotoxin, which was concentrated in shellfish, making them unfit for consumption. Hand harvest landings of oysters failed to reach their potential that same year due to the fact that a majority of the hand-harvest-only areas were also closed because of the red tide. (Figure 7.9).

Hand harvest landings are the most consistent contributor to the State's oyster fishery. Hand harvest landings exceeded the dredge landings for significant periods between 1961 and 1970 and between 1989 and 2008 (Figure 7.9).

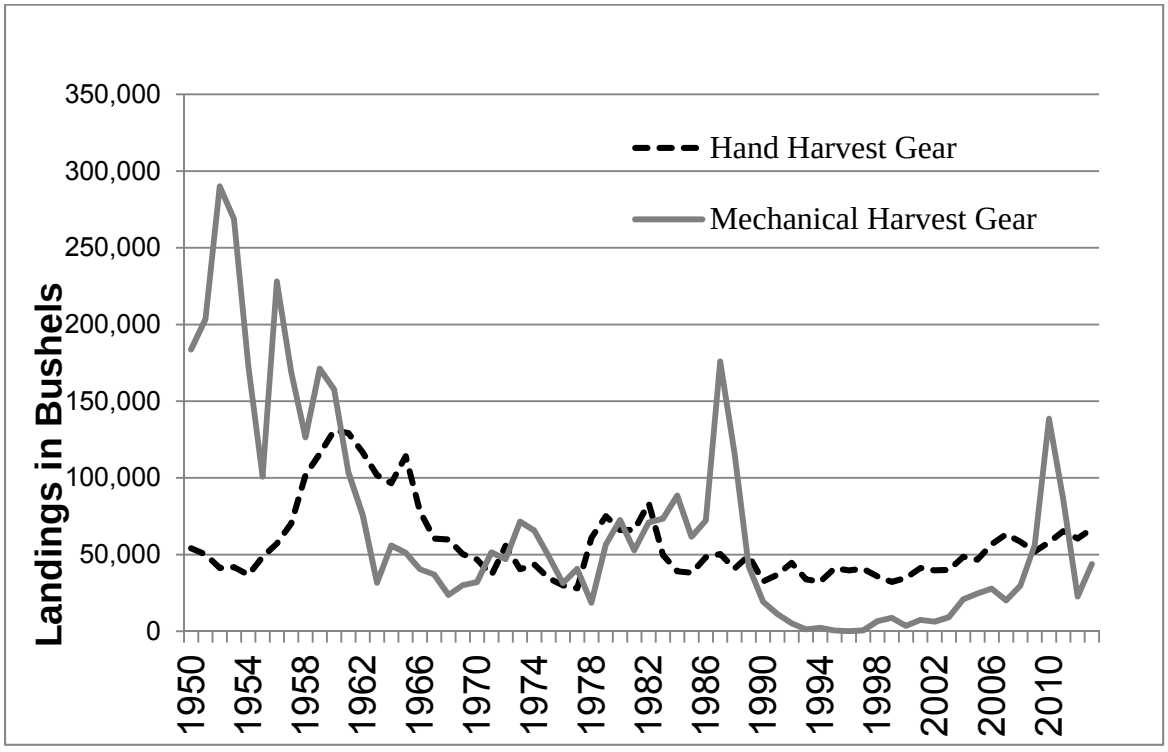

Figure 7.9. Commercial oyster landings by gear 1950-2013 (Chestnut and Davis 1975; National Marine Fisheries Service unpublished data; NCDMF Trip Ticket Program).

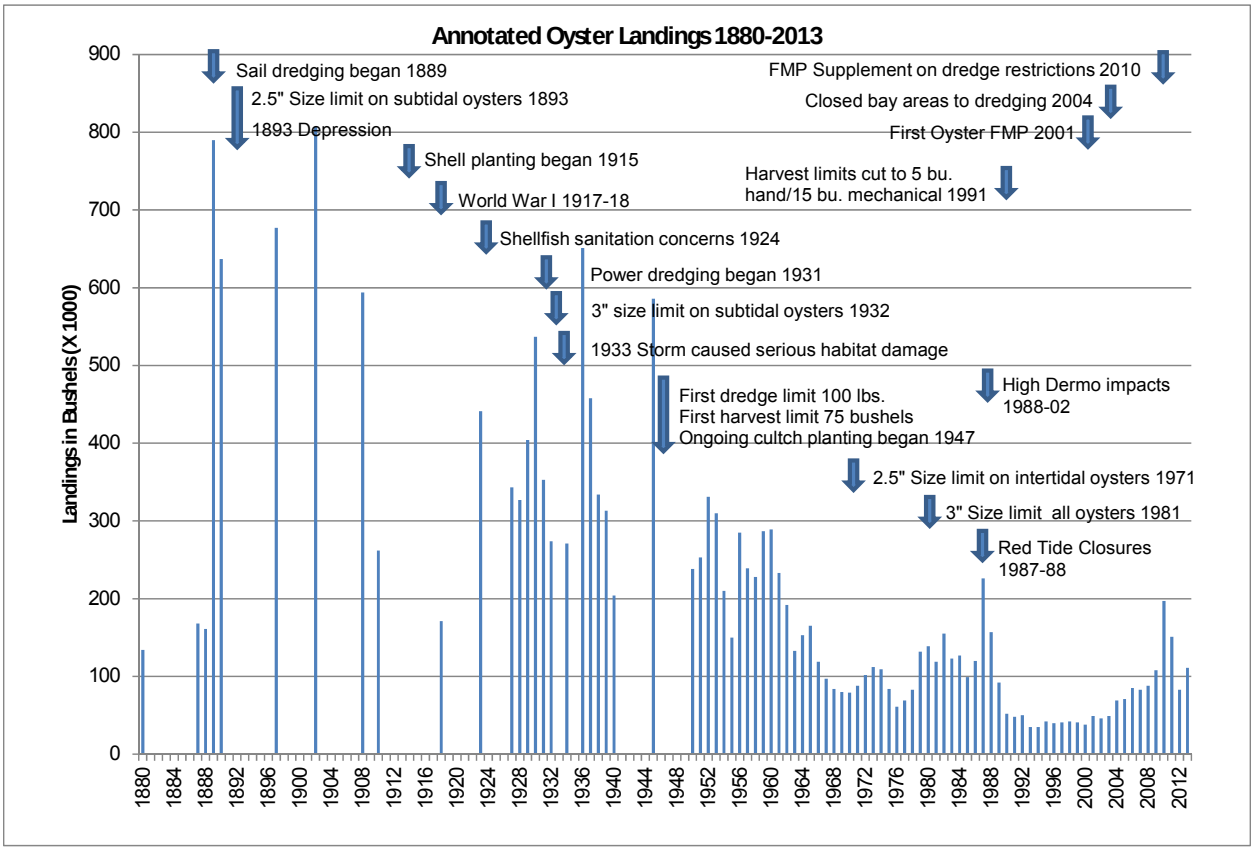

Figure 7.10. Factors affecting the North Carolina oyster fishery, 1880-2013. Not shown: 1872– first oyster season established.

7.1.2 Present Public Bottom Fishery

7.1.2.1 Mechanical Harvest Methods

Harvest of oysters by mechanical methods is accomplished almost exclusively with oyster dredges in North Carolina. Areas where mechanical harvest gear is allowed are restricted to deeper portions of the sounds, rivers, and bays north of Core Sound. These areas are designated in N.C. Marine Fisheries Commission Rule 15A NCAC 03R .0108. The most recent changes in mechanical harvest gear management included reducing the area open to mechanical gear by approximately 30,000 acres by closing the upper portions of the bays around Pamlico Sound and part of Roanoke Sound. The closures were accomplished under a framework established in the original Oyster FMP (NCDMF 2001). Another change was the reduction of the harvest limit to match the hand harvest limit in the remaining portion of those areas in Amendment 2 (NCDMF 2008). A supplement to the Oyster FMP adopted in November 2010 established a monitoring system for determining the closure of mechanical harvest areas and changed the management strategy on mechanical harvest limits to allow for up to 20 bushels to be harvested per commercial fishing operation per day (NCDMF 2010). The bays around Pamlico Sound are opened for a six-week season normally from mid-November through December with a 10-bushel-per-commercial-fishing-operation-per-day harvest limit as adopted in the original N.C. Oyster FMP.

The N.C. Oyster FMP Amendment 2 noted a reduction in *Perkinsus marinus* (Dermo) infection levels and a resultant increase in mechanical harvest oyster landings of around 10,000 bushels in 2005. Dermo infection intensity has remained low and mechanical harvest landings continued to recover from the extremely high Dermo mortality levels and hurricane impacts of the mid-1990s until additional environmental impacts began affecting the fishery in 2011 (Figure 7.11). Mechanical harvest season and landings information is presented in the remainder of this section by harvest season instead of by calendar year to give a better picture of how the described conditions affected the fishery (Figure 7.12). Area locations referenced in this section are represented in Figure 7.3

Interest by some oyster dealers in cultivating more long term markets led to an early mechanical harvest season opening in 2008. The bays and smaller rivers remained closed until the typical mid-November opening but the larger waterbodies opened on October 15, the earliest date allowed by rule. The initial opening was for three days per week which was extended to five days per week on October 30. The early opening did not appear to have any effect on landings and the season remained open until closed by rule on March 31, 2009. The 2008-09 mechanical harvest oyster season produced 33,133 bushels of oysters and continued the recent improvement in landings from this fishery (Figure 7.12).

During the early 2009-10 mechanical harvest oyster season, the Great Island Narrows area between Great Island and the mainland in Hyde County experienced intensive oyster harvest (Figure 7.13). Staff observations indicate 50 to 60 oyster dredge boats were working this small area and some of the operations were harvesting the 15-bushel limit, offloading, returning to the area with a new crew and harvesting another limit the same day. The harvest limit of 15 bushels per commercial fishing operation per day did not apply to vessels that replaced the crew since the new crew constituted a new commercial fishing operation according to standing division policy. Staff investigation of this intensive harvest indicated that substantial shell damage was occurring on the remaining oysters and the area was closed after six weeks of harvest. The oyster dredge fleet moved out into the open sound and continued to have good catches for the rest of the 2009-10 mechanical harvest oyster season that totaled 113,235 bushels (Figure 7.12).

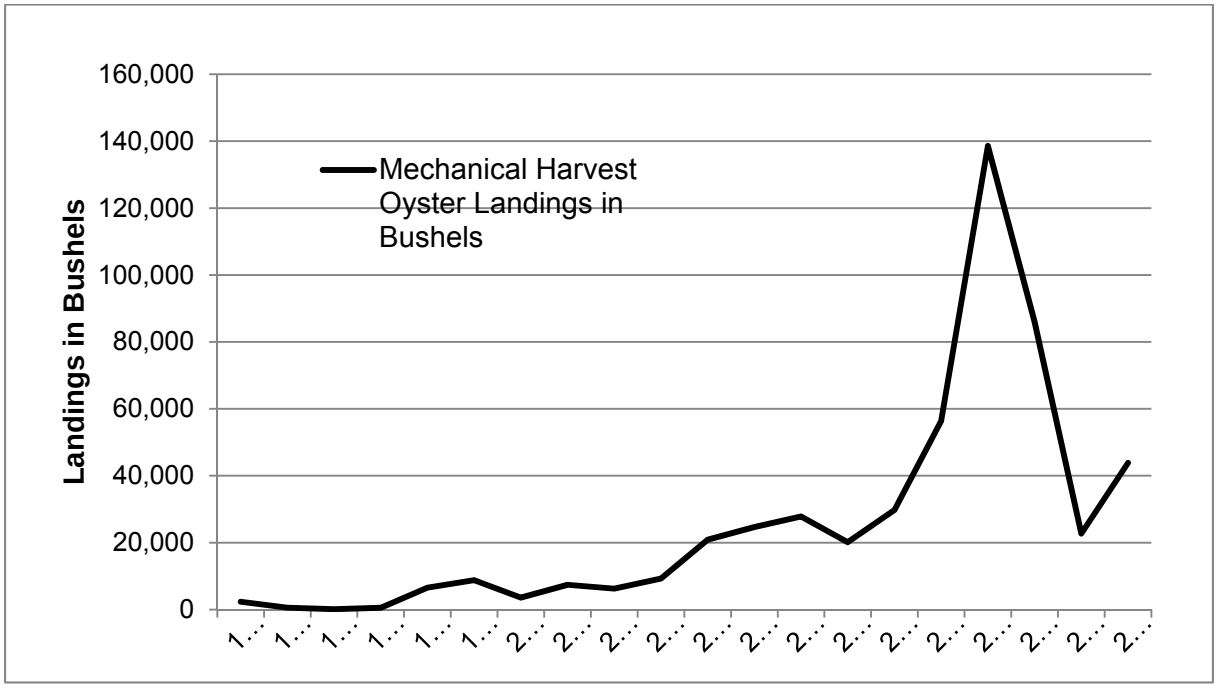

Figure 7.11. Annual mechanical harvest oyster landings in bushels 1994-2013 (DMF Trip Ticket Program).

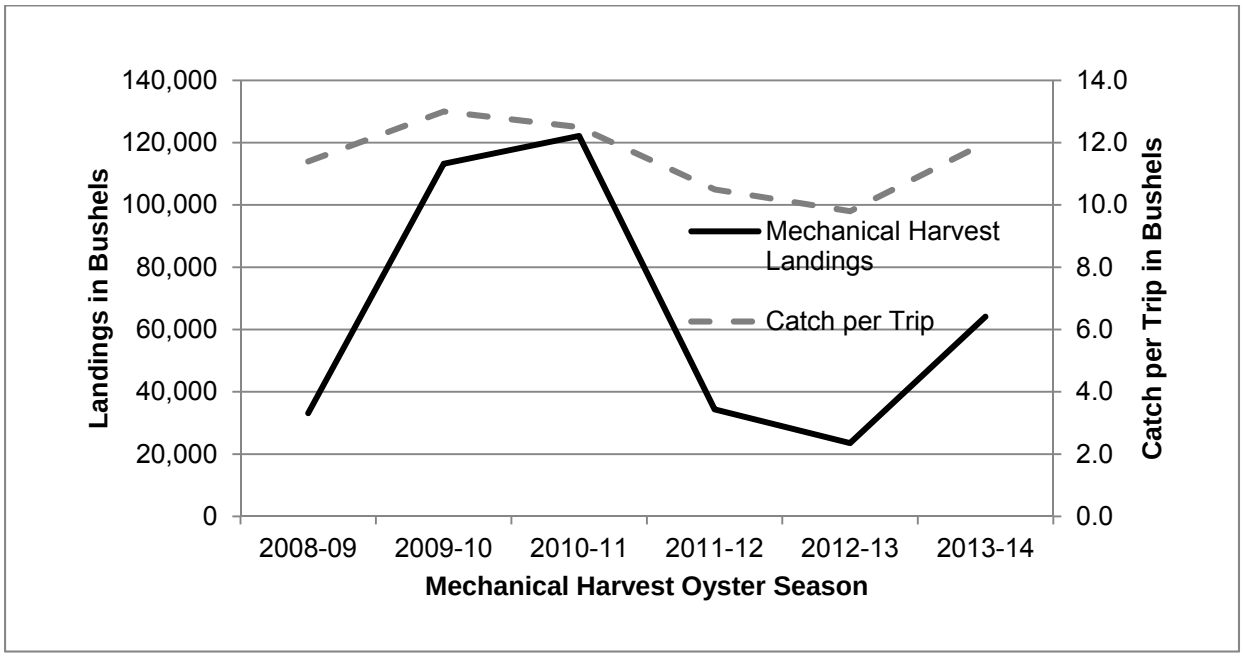

Figure 7.12. Mechanical harvest oyster landings by season 2008-09 through 2013-14. A monitoring system for determining the closure of mechanical harvest areas began in the 2010-11 season (DMF Trip Ticket Program).

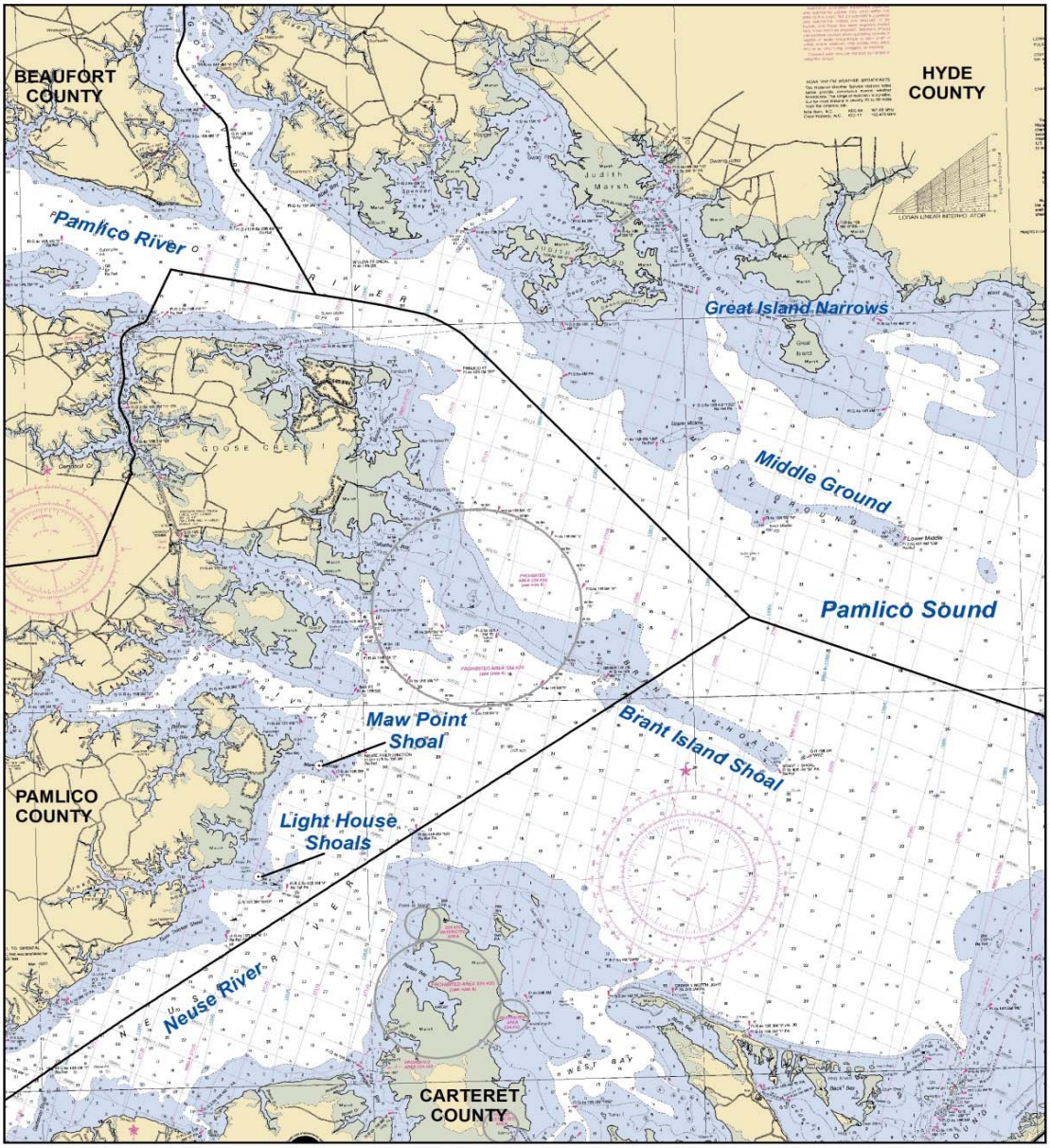

Figure 7.13. Map of areas referenced in this section (DENR GIS database).

The 2010-11 season began with a 2:00 pm time limit on dredging to stop the two-trips-per-day loophole but it probably had little impact on mechanical harvest since experienced dredgers could take their limit in a few hours and there appeared to be many new entrants into the fishery. The traditionally harvested oyster rocks in the deeper waters of western Pamlico Sound contributed greatly to the increased landings in the 2009-10 and 2010-11 seasons but the Middle Ground area in 2010-11 provided another unexpected source of significant oyster production similar to the Great Island Narrows in 2009 (Figure 7.13). Also, interest in taking advantage of expected high market demand caused by closure of oyster harvest areas in the

Gulf of Mexico due to the Deepwater Horizon oil spill lengthened the season slightly with a November 1 mechanical harvest season opening in the fall of 2010. Supplement A to the N.C. Oyster FMP Amendment 2 adopted November 3, 2010 provided for a variable mechanical harvest limit of up to 20 bushels per day and a monitoring system for determining the closure of mechanical harvest areas. The 20-bushel limit was put in place for November 18 through 24 in 2010 and likely increased landings. The normal 15-bushel limit was also raised to 20 bushels from March 16 through March 31 in 2011 although a large portion of the harvesters stopped fishing prior to the end of the season. The Neuse River area was closed to dredging from January 7 to February 14, 2011 because samples failed to meet the minimum 26-percent legal size criterion set in Supplement A. Effort in the Neuse River area appeared to be much lower after the re-opening. Mechanical harvest oyster landings were 122,172 bushels for the 2010-11 season.

The last significant production of oysters from a non-traditional harvest area was reported by local fishermen to have occurred more than 20 years prior to the 2010-11 season or around the time of another large increase in mechanical harvest landings in 1987-88. That production came from Brant Island Shoal and like the Middle Ground is an area in western Pamlico Sound generally around 12 feet deep and characterized by hard sandy bottom (Figure 7.3). Dredge samples and sonar observations from the Middle Ground oyster producing area revealed that there were no typical oyster rock formations and the cultch material producing the oysters was typically large “fossil” clam shells. Nearby oyster rocks are found in areas around 18 feet deep and on mounds of oyster shell cultch. The oysters tended to be very large with most samples averaging more than the 3-inch (76 mm) size limit and up to 80 percent of some samples legal for harvest. There were reports that some shucking houses complained the oysters were too large. These Middle Ground oysters also displayed an unusual shell characteristic with very long, thin umbos, or beaks, not normally seen on Pamlico Sound oysters.

At the end of the 2010-11 mechanical harvest oyster season, prospects were good for the next season due to a high percentage of the oyster population at or near legal harvestable size remaining in the major mechanical harvest areas. However, Hurricane Irene hit the North Carolina coast on August 27, 2011 and had major impacts on the mechanical harvest area for oysters. The oyster resources on the Middle Ground could not be located after the storm probably due to sedimentation or physical relocation caused by waves or currents. Many of the deeper water oyster resources located near Brant Island Shoal were also significantly damaged (Figure 7.3). Most of the damage was oyster mortality caused by detritus covering the oyster rocks. Oyster resources in the Neuse and Pamlico rivers did not appear to suffer much damage but also did not show any of the typical growth characteristics during the following fall and winter months. These factors had a pronounced effect on the mechanical harvest oyster season in 2011-12 and the mechanical harvest area in western Pamlico Sound was closed on January 2, 2012. Mechanical harvest landings declined to near 2008-09 levels at 34,383 bushels. Regular sampling of oyster sizes to fulfill the requirements of Supplement A to the N.C. Oyster FMP has made it clear that oyster growth during the harvest season is essential to sustain acceptable harvest levels.

Prior to the 2012-13 mechanical harvest season, division oyster sampling indicated an apparent, severe low dissolved oxygen event occurred in the Neuse River that caused virtually 100 percent mortality of the oyster resources at 18 feet or greater depths. A few oyster rocks in shallower waters between Maw Point Shoal and Light House Shoal were spared as well as some division oyster habitat enhancement projects in other shallow areas (Figure 7.3). The Pamlico River area also had not recovered from the effects of Hurricane Irene at this time. The

Neuse River area was available for mechanical harvest until the adjacent bays closed on December 21 although there was no harvest activity in the river during the time it was open. The Pamlico River area closed to mechanical harvest on February 1, 2013 based on failure to meet the 26-percent trigger although effort was much reduced since early January. The 2012-13 mechanical harvest oyster landings declined further to 23,541 bushels.

There was little evidence of any recovery of the Neuse River oyster resources prior to the 2013-14 season but the Pamlico River area appeared to be recovering and growth indicators were good during the season. The Dare County area in northern Pamlico Sound also supported some significant mechanical harvest activity throughout the season and when oyster harvests began to decline in the western sound in early February, 20 to 25 boats moved to Dare County to finish the season. The remaining productive areas in the Neuse River closed on February 28, 2014 and most of the harvesters left the Pamlico River area by mid-February. Mechanical harvest in Dare County continued until the season ended on March 31, 2014. The overall result was a significant increase in mechanical harvest oyster landings with 64,137 bushels for the season.

Changes to Mechanical Harvest Means and Methods

The higher abundance of oysters beginning in 2009-10 and lasting until 2011-12 appeared to bring many inexperienced oyster dredgers into the fishery and several new restrictions were required to maintain traditionally accepted harvest and culling techniques. The 2:00 pm time limit on dredging discussed earlier created a situation where harvesters would quit culling their catch as it came on board early in the day and cull it after 2:00 pm often depositing cultch where it could no longer function as oyster habitat. North Carolina has a rule in place (Marine Fisheries Commission Rule 15A NCAC 03K .0202) requiring culling on site. The following restrictions were put in place beginning with the 2012-13 oyster season to discourage those practices.

It is unlawful to possess more than five bushels of unculled catch onboard a vessel. Only material on the culling tray is exempt from culling restrictions. It is unlawful to possess unculled catch or culled cultch material while underway and not engaged in mechanical harvesting.

Also some harvesters did not have vessels or dredges rigged for circular dredging patterns which work best with towing points over the side of the vessel or for short tows to allow for culling between pickups. The following restrictions were put in place to encourage circular dredging patterns and shorter tows to keep the cultch and culled oysters on the existing rocks.

It is unlawful for the catch container (bag, cage) attached to a dredge to extend more than two feet in any direction from the tooth bar. It is unlawful to tow a dredge unless the point where the tow line or cable exits the vessel and goes directly into the water is on the port or starboard side of the vessel forward of the transom.

7.1.2.2 Hand-Harvest Methods

Hand-harvest methods for the commercial harvest of oysters consist primarily of hand tongs, hand rakes and by hand in North Carolina. Hand-harvest methods to take oysters are allowed in all areas found suitable for shellfish harvest by the Shellfish Sanitation and Recreational Water Quality Section of the NCDMF during the open season. Some shellfish management areas may remain closed for management purposes.

The hand-harvest season for commercial and recreational harvest begins on October 15 each year with commercial harvest limited to Monday through Friday each week. The season typically continues until closed by rule on March 31 although some locations may close earlier due to perceived excessive harvest. Brunswick County is the only area frequently closed early due to this concern and it closed prior to March 31 eleven times between the1996-97 and 2013-14 seasons.

The southern portion of the coast from Core Sound south to the North Carolina-South Carolina border (Coastal Fishing Waters in Brunswick, New Hanover, Pender, Onslow, and portions of Carteret counties) currently operates under a harvest limit of five bushels per person per day not to exceed 10 bushels per vessel per day. This limit has been in place since the 1991-92 oyster season and was implemented to protect oyster resources after heavy Dermo related mortalities impacted harvest beginning in 1988. However, southern North Carolina oyster resources did not suffer the long term mortality from Dermo that affected oyster resources in the northern part of the state. Hand-harvest oyster landings have generally increased since 1994 under this limit (Figure 7.14). Effort has greatly increased with the number of trips more than doubling over the 20 year period from 1994 through 2013 (Figure 7.14). However, a reduction in catch-per-unit-effort after 2006 may be a concern (Figure 7.15).

Oyster harvest areas north of Core Sound also operated under the five-bushels-per-person-not to-exceed-10-bushels-per-vessel-per-day limit until the 2009-10 season. At that time, Amendment 2 to the N.C. Oyster FMP changed the limit in that area to 10 bushels per fishing operation in typical hand-harvest waterbodies including bays, small rivers and shallow sounds designated by proclamation. A 15-bushel limit is specified for Pamlico Sound, Neuse and Pamlico rivers, and Croatan Sound, but oysters in these areas are seldom harvested by hand methods. The practical application of the 10-bushels-per-fishing-operation limit results in each hand harvester working alone with the opportunity to take 10 bushels each day. The rationale for that change was to encourage hand harvesting by making mechanical and hand-harvest limits the same in areas where they overlap. The increased limit was justified because hand-harvest oyster resources in the northern area are widely dispersed and much more difficult to locate than in the southern area making excessive harvest less likely.

Hand-harvest oyster landings from areas north of Core Sound accounted for less than 10 percent of the total hand-harvest landings for North Carolina from 1994 through 2013 (range: 0% to 9.8%) but the percentage has increased since 2004 (Figure 7.16). Analysis of the landings data to determine if the higher hand-harvest limits had any effect was inconclusive. It appears that the variable nature of the oyster populations in this area caused by disease and environmental conditions dominated hand-harvest oyster landings in a manner similar to mechanical harvest oyster landings (Figure 7.17).

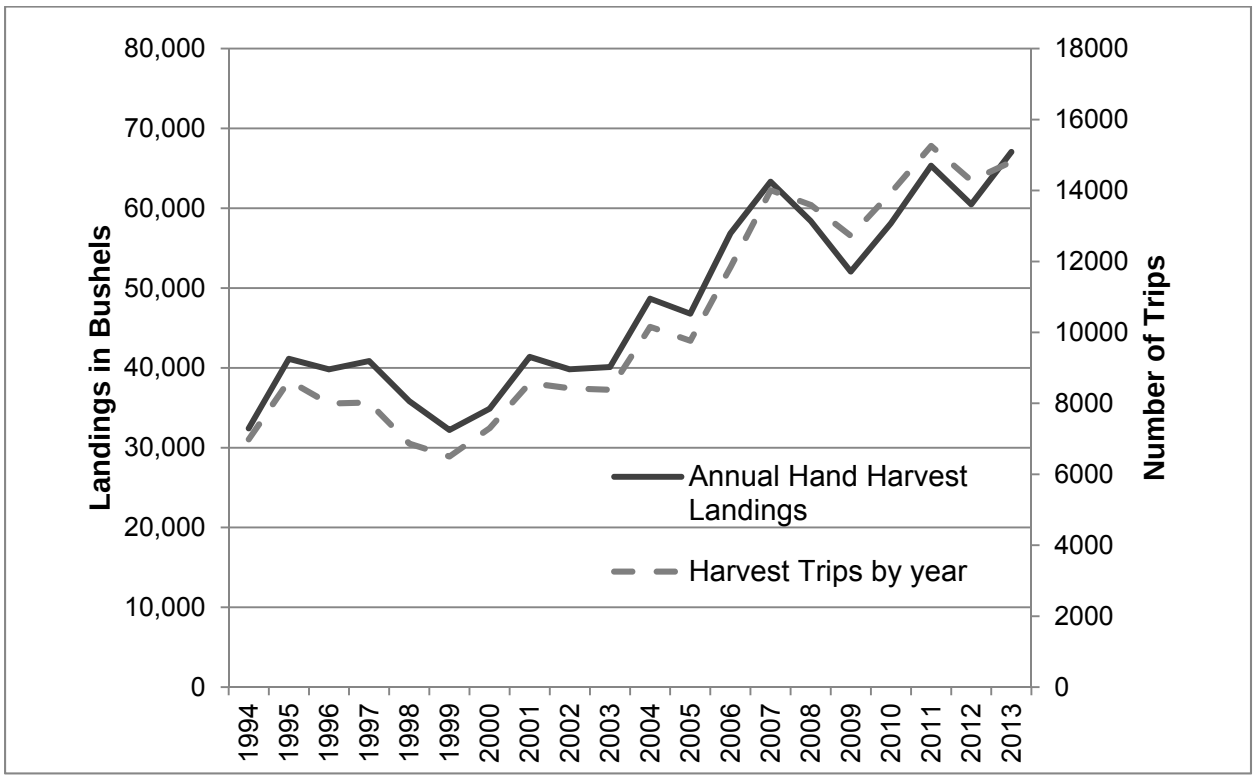

Figure 7.14. Hand harvest oyster landings and trips 1994-2013 (DMF Trip Ticket Program).

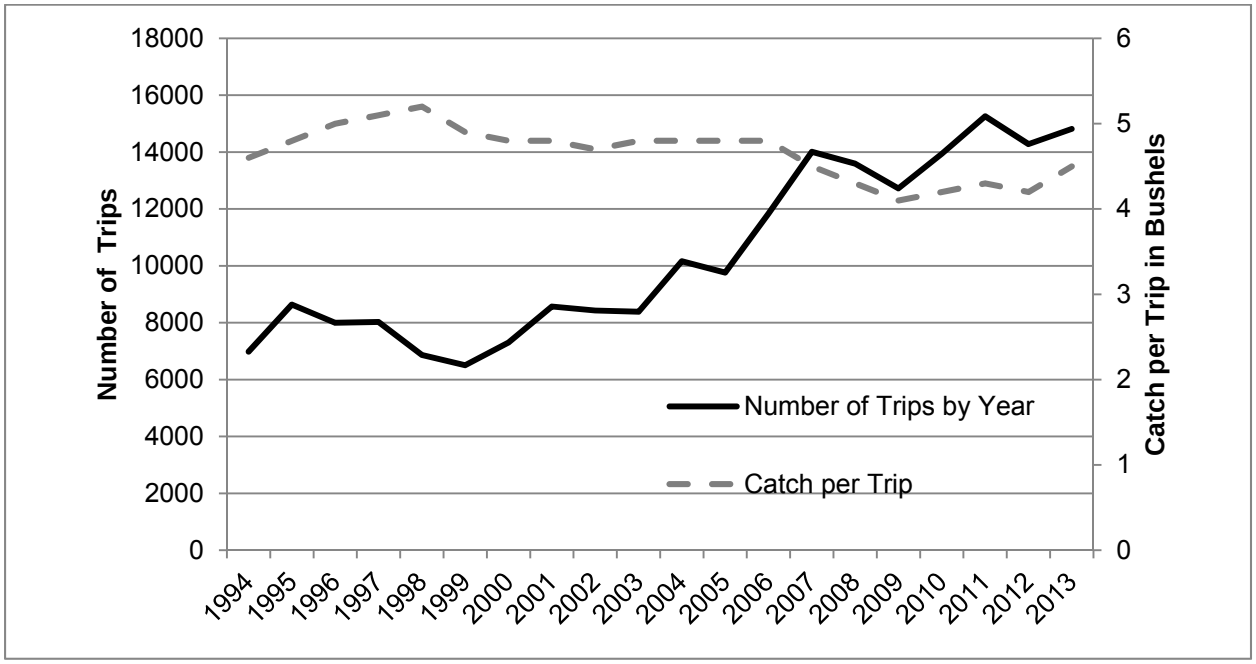

Figure 7.15. Number of trips and catch-per-trip for the hand harvest oyster fishery1994-2013 (DMF Trip Ticket Program).

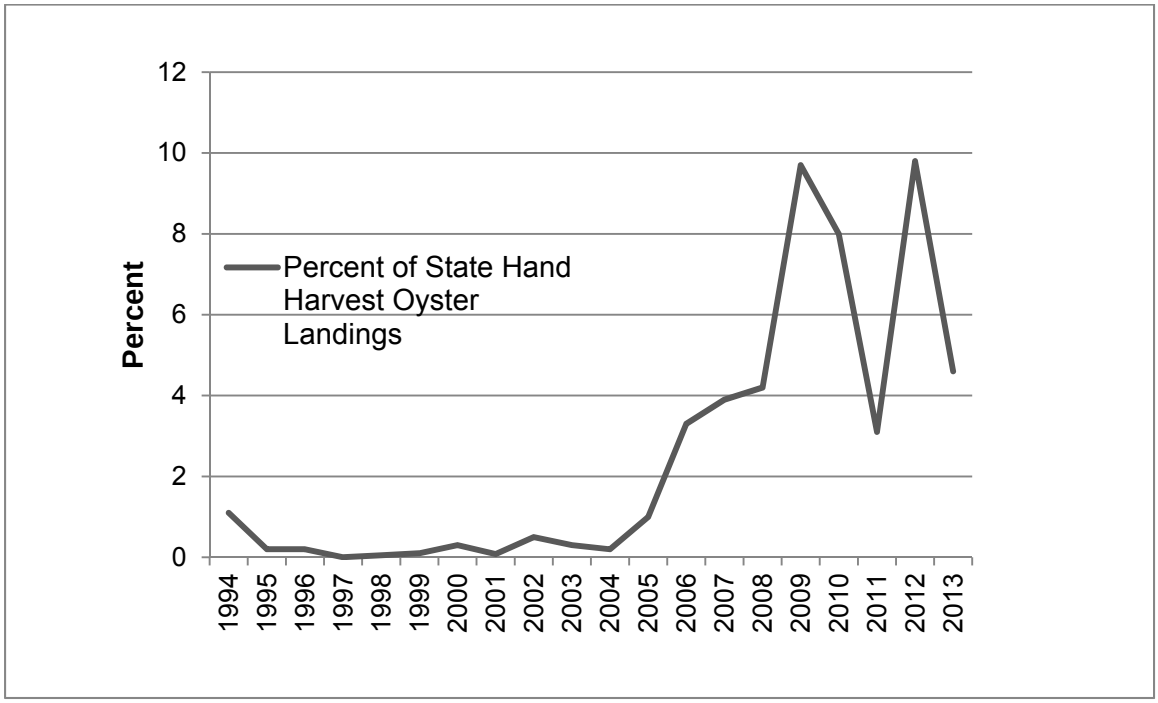

Figure 7.16. Hand harvest oyster landings north of Core Sound as a percentage of total hand harvest oyster landings (DMF Trip Ticket Program).

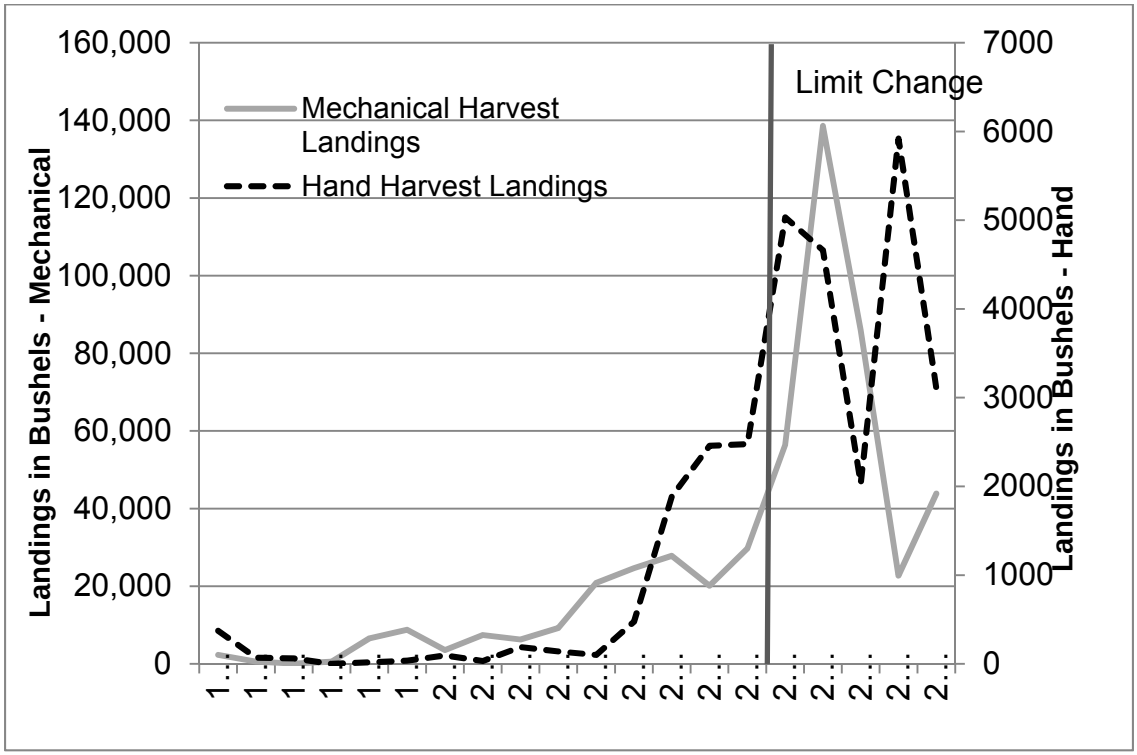

Figure 7.17. Hand and mechanical oyster landings north of Core Sound indicating the similarity of disease/environmental effects on landings (DMF Trip Ticket Program).

7.1.3 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 from1982 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)).

A shellfish lease moratorium has existed in Brunswick County since 1949 and existed in some form in Core Sound since 1993. The Brunswick Count lease moratorium was due to public opposition by county residents with regard to an already limited area available to shellfish on public bottom. Provisions in Session Law 2003-64 were implemented on June 30, 2003 grand-fathering currently leased bottom on the western side of Core Sound, but banning the leasing of any additional bottom for aquaculture in this area. Both areas remain unable to issue shellfish leases.

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 specific recommendation in the 2008 amendments 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.

Amendment 3 adopted in 2014 created seed oyster management areas at Swan Point and Possum Bay in Onslow County to reduce travel time and costs compared to using existing seed

oyster management areas in Carteret and Pender counties. Seed oyster management areas are open to public harvest during the regular oyster season. Shellfish lease and franchise holders are limited to transplanting no more than 100 bushels from seed oyster management areas for each acre of area held under lease or franchise with a maximum of 1000 bushels for the entire lease or franchise.

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 NC 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
Adaptive Management to industry	Sample, map, designate and manage	Creation of 2 new Seed Oyster Management Areas (SOMA) in New River area.	2014
Adaptive Management to changes in industy/Legistlative Acts	Create permit and permit conditions	Aquaculture Seed Transplant Permit (instate transplant of seed from nurseries in polluted waters)	2014/2015

7.1.3.1 Historical Aquaculture

Despite North Carolina having oyster leases since 1858, oyster cultivation methods were based on the natural recruitment of spat on existing shell or through the planting of cultch material to provide for increased opportunity for the natural setting of oyster spat. The practice of oyster aquaculture in North Carolina was not authorized until 1989. In 1989 legislation was enacted which provided for the use of public trust waters above shellfish bottom leases for the commercial cultivation, rearing and grow out of shellfish species using gear within the water column. Early research of methods, gear and techniques to be used in North Carolina were provided through Fisheries Research Grants and NC Sea Grant funding in the early 1990s. The first water column application was approved in 1991. The number of water column leases increased slowly over the next two decades. Since 2012 the interest in oyster aquaculture in North Carolina has grown; with 25 water column leases producing oysters through aquaculture methods and techniques.

Oyster aquaculture depends on the availability of oyster larvae and/or seed from hatcheries. In 2001, only three private shellfish hatcheries in North Carolina provided oyster seed for sale. Due to the lack of oyster larvae and seed production in North Carolina, the importation of shellfish seed has become an integral part of many aquaculture operations and shellfish growers in North Carolina. The few shellfish hatcheries that had existed in North Carolina were unable to produce sufficient number of seed to meet the demands of shellfish growers for either oysters or clams. Since 2012, only one private shellfish hatchery in North Carolina has provided oyster seed for sale. Therefore shellfish growers used 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 oyster larvae and seed into North Carolina has been substantial in recent years. In 2012, eight importation permits were issued allowing 30,500,060 oyster larvae and oyster seed to be imported; in 2013 nine were issued 48,423,050 and in 2014 sixteen importation permits were issued, allowing the import of 126,600,000 oyster larvae and seed (Table 7.3). All oyster larvae and seed imports to North Carolina during this period were from Maryland and Virginia.

Table 7.3. Importation of Oyster Larvae and Seed

Year	Importation permits issued	Amount	States of origination
2012	8	30,500,060	Maryland, Virginia
2013	9	48,423,050	Maryland, Virginia
2014	16	126,600,000	Maryland, Virginia

7.1.3.2 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 Marine Fisheries Commission 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 North Carolina Division of Marine Fisheries administers the Shellfish Lease and Franchise Program for the purposes of shellfish cultivation, aquaculture within the State of North Carolina.

An Aquaculture Operation Permit 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 Division of Marine Fisheries through authority of 15A NCAC 3O .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 Aquaculture Operations Permits. The NCDMF is the agency responsible for issuing and ensuring compliance of Aquaculture Operations Permits for marine or estuarine fish and shellfish species. The Aquaculture Operations Permit 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 Aquaculture Operations Permit is an annual permit that requires renewal. In 2012, thirty two Aquaculture Operations Permits were issue, with eighteen relating to oysters.

Despite the addition of water column use on approved lease sites in 1989, increased NC 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. As of April 2015, only one private production hatchery producing oyster seed existed in North Carolina.

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. A 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 Shellfish Research Hatchery (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. Additional oysters were spawned in 2013 from four other locations. 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 (personal communication Ami Wilbur, UNCW). In 2007, Senate Bill 1813 proposed $8,243,658for capital and operating expenses for the SRH, but did not pass 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.

In 2013 the Horn Point Lab Oyster Hatchery produced 1.25 billion oyster spat and 4 billion eyed oyster 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 expediential growth of aquaculture and restoration efforts in Maryland. The Horn Point Laboratory provides oyster larvae, cultchless seed, spat on shell, shell sales and oyster fines to the aquaculture industry. As of April 1, 2015, Maryland had 272 submerged lands leases encompassing 3,915 acres and 55 water column leases on 213 acres (K. Roscher, MDDNR, personal communication).

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 oyster aquaculture industry in Virginia is partially due to research and culture methods that initially occurred at VIMS in the 1970s and which are still ongoing today. Oyster research, monitoring and development efforts have been conducted at VIMS for over fifty years. VIMS continues research in disease resistance and monitoring, oyster genetics, breeding and brood stock development; oyster aquaculture training; as well as other research which directly relates to oyster aquaculture. Oyster research continues at VIMS as well as through private hatcheries in Virginia. Since 2005, Virginia's oyster aquaculture has grown tremendously. In 2013 Virginia aquaculturist planted 106 million oyster for growout, an increase of over 39 million from 2012 (VIMS 2013). In 2014, 257,000 bushels of oysters were harvested from private culture operations in Virginia.

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. The USDA'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.

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.

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.

7.1.4 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 40% of all private culture operations harvested only oysters (Table 7.4).

Table 7.4. Private culture operations harvesting specific species (clams or oysters), 2003-2013. NCDMF Trip Ticket Program.

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 DENR 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 the Division of Marine Fisheries. The educational package is based on NCGS and NCMFC 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 holders must harvest and market 10 bushels of shellfish per year. Lease holders with water column amendments must both 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.

Seed supply is critical to successful oyster production. The supply of seed oysters occurs through either natural set or through the purchase and planting of seed oysters on private culture operations. Shellfish growers usually purchase larvae (~0.25mm) or seed oysters (2-25mm) from hatcheries or nurseries. As of 2015, only one private hatchery produced oyster seed in North Carolina. However, there are no large-scale shellfish hatcheries in the state that can supply the industry's current needs, thus most oyster larvae and seed are imported from other states. An importation permit is required to bring oyster seed in from other states.

Most shellfish growers using gear in the water column rely on hatchery-produced triploid seed oysters for planting. Triploid oyster seed are the result of a manipulated fertilization process which contain (3) chromosomes and are sterile. The resulting triploids, with no reproductive cycle, use their resources for growth. Both diploids and triploids are used for growout methods within oyster aquaculture on private culture operations as bottom culture or within the water column. Diploid oyster seed, are the result of naturally or normally oysters which contain the same number (2) of chromosomes as the parents.

Within the hatchery and nursery phases, a controlled environment is achieved through the use of upwellers, downwellers, or tanks to allow for control of variables such as water flow, food source, predation, and temperature. Oyster larvae are able to set to microcultch or oyster shell in a little over two weeks; where they are grown out from oyster spat to larger seed oysters prior either being sold as seed oysters or put into bags for further growout. Hatchery, nursery and growout operations require an approved Aquaculture Operations Permit and allow oysters to grow in high densities while offering controlled nutrients, water flow and protection from predation. Within the nursery stage, smaller seed are usually grown to 5 mm or until they can be sold or moved into the desired growout method on the private culture operation.

In North Carolina, any use of bags, racks or cages for oyster growout requires a water column lease superjacent to a bottom lease. The operation’s location, water depth, wind, waves, environmental conditions, labor availability, gear availability, vessel capabilities and personal preference are some reasons one type of gear is used over another on a private culture operation. Oyster grow out can be accomplished using a variety of methods or combinations of

methods. The predominant methods of oyster growout within the water column are floating bags, rack and bag, bottom cages, floating cages and trays. For the growout of oysters using mesh bags, the size of the oyster seed dictates the size mesh and bags used. Smaller oysters are stocked on smaller mesh sizes at larger volumes. The growout phase of oyster aquaculture is labor intensive requiring scheduled removal of biofouling, growout gear maintenance as well as the constant grading and sorting of product. During the growout phase seed are sorted and graded multiple times reducing the density of oysters providing additional space for growth, greater water flow and availability of nutrients. Oyster seed stocking densities using growout bags can start at around 50,000 oysters per bag to a final growout density of 150 to 200 per bag.

All private culture operations have required production standards outlined in 15A NCAC 03O.0201. As part of the planting requirement shellfish growers must either plant cultch or shellfish to meet production standards. Within shellfish bottom culture, cultch plantings are used to attract natural settlement of oyster spat. Harvesting is allowed by hand and mechanical gear that require adherence to regulations established by MFC. Often shellfish growers rotate through harvest and planting cycles on the private culture operation to use all available space and maintain a steady supply of marketable product.

The majority of shellfish growers continue to use the natural set of free swimming, native stock, diploid oyster larvae onto shell cultch or oyster beds through bottom culture methods on private culture operations. The long term reliance on the natural set of oyster spat for the commercial production of oysters may not provide steady harvest quantities over time; nor provide the full production potential of the bottom lease or franchise. The use of spat collectors have not been widely used in North Carolina.

Some shellfish growers using bottom culture have purchased and planted larger diploid or triploid oyster seed to supplement production, though other remote setting methods (spat on shell, microcultch) have not yet been widely used for bottom culture. Many private culture operations continue to use the opportunities provided through no cost permits for the relay of shellfish from polluted areas and seed oyster management areas onto private culture operations.

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.

The Polluted Area Relay permit provides the opportunity to relay of clams and oyster out of specific polluted areas to private culture operations with NCDMF coordination. Oysters 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	Permitees reporting relay
Shell cultch	1,972	43
Hard clams	459	40
Blood clams	15	40
Oysters	14,543	43

The use of prohibited waters for the taking or raising of seed shellstock, live in-shell bivalve mollusks, is permitted under the National Shellfish Sanitation Program (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) that may harbor pathogenic viruses, marinas, heavy metals, pesticides, poisonous or deleterious substances, that may or may not purge after a standard relaying process.

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. The Division 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 Aquaculture Operations Permit in the prohibited waters of the marina, the Division 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 (USEPA) 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 the Department of Environment and Natural Resources to the request for the Aquaculture Operations Permit 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.

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, UDOC’s and other Aquaculture Operations Permits that are classified “approved” (open) with an Aquaculture Seed Tranplant 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.

Issues of concern with leases also include lease limitations imposed in some areas, conflicts, and theft. 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. 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.

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. Issue papers are provided on both the Core Sound and Brunswick County lease moratoriums (Section 15 and 12), and the protection of shellfish lease and franchise rights (Section 12) for further consideration under this amendment.

Since 1994 there has been an overall increase in oyster harvest from private culture operations. Oyster harvest from private culture operations in the period from 1994 to 2013 account for twelve percent of all oyster landings (Table 7.6). 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, 108 private culture operations harvested and sold 14,123 bushels of oysters.

Oysters may be harvested from lease sites by hand or mechanical gear depending on the environmental characteristics of the site and determination of conflicts with Primary Nursery Area designations. The number and acreage of private culture operations has remained relatively consistent in the period of 1994-2013, while the planting of oyster seed and the relaying of oysters have greatly fluctuated over time (Figure 7.18). If mechanical harvesting on the lease site does not pose a threat to critical habitats or nearby resources, leaseholders may use mechanical methods to harvest oysters even if public bottom mechanical harvest is prohibited in the general area. Leaseholders may also harvest oysters during the closed oyster season and harvest during this period is increasing. A form certifying the oysters were harvested from a shellfish lease or franchise is required to be delivered to the purchaser during the closed season. Lease and franchise holders are also exempt from size limit restrictions during the regular closed oyster season.

Figure 7.18 Number of private culture operations and associated acreages by year (1994-2013). NCDMF Shellfish Lease and Franchise Program Fisheries Information Network FIN data

Table 7.6. Reported number of leases (not species specific), planting, and harvesting activities, 1994-2013. NCDMF Shellfish Lease and Franchise Program Fisheries Information Network (FIN) data and Form the NC Trip Ticket programs. Calculations based on verified planting effort reporting (in bushels) from annual lease rent notices and trip tickets.

			PLANTED (bu)											HARVESTED (bu)					
			CULTCH						SEED		Adult								
Year	Number of Private Culture Operations	Private Culture Operation Acreage	Oyster	Marl	Rock	Shell	Surf Clam	Unknown	Clam Seed	Oyster	Clam Relay	Blood Clam	Oyster	Clam	% of State's Clam Landings	Oyster	% of State's Oyster Landings	Blood Clam	% of State's Blood Clam Landings
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%

7.2 RECREATIONAL FISHERY

Oysters are commonly harvested recreationally in North Carolina from October to May by hand, rake, and tong. The limit allowed for personal consumption is one bushel of oysters per person, not to exceed two bushels per boat with a minimum shell length of 3-inches.

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 Fisheries Reform Act (FRA) implemented the Recreational Commercial Gear License (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 Trip Ticket Program 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 North Carolina Trip Ticket Program 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 oyster harvest was reported from 64 waterbodies throughout coastal North Carolina (Table 7.7). Seventy-four percent of reported oyster harvesting effort originated from private residence, private boat ramp, or shore (Table 7.8). Given that only 23.7% 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. Oyster harvesting effort was concentrated between October and March accounting for over 96% of reported trips (Table 7.9). This trend was also reflected in the number of oysters harvested during the same interval (Table 7.9). Overall survey results demonstrate a distinct seasonality for the recreational harvest of oysters, with peak activity observed between October and March. This trend is not surprising as oyster harvest is only permitted during this time. However, some individuals reported recreational harvest of oysters during the summer months despite state imposed restrictions on harvest during this time. This suggests unfamiliarity with state regulations.

Table 7.7. Distribution of North Carolina recreational oyster harvest trips by waterbody fished, 2010-2013. From NCDMF recreational statistics.

Waterbody fished	Number of reported trips	Percent of reported trips
Pamlico Sound	63	11.0
Stump Sound	50	8.8
Intracoastal Waterway (New Hanover County)	39	6.8
Topsail Sound	38	6.7
Bogue Sound	22	3.9
Intracoastal Waterway (Pender County)	22	3.9
Masonboro Sound	21	3.7
New River	20	3.5
Core Sound	19	3.3
Chadwick Bay	18	3.2
Roanoke Sound	18	3.2
Bogue Inlet	16	2.8
Rich Inlet	16	2.8
Back Sound	14	2.5
(blank)	13	2.3
Wade Creek	12	2.1
Albemarle Sound	11	1.9
Masonboro Channel	10	1.8
Old Topsail Creek	10	1.8
Shallotte River	10	1.8
Newport River	9	1.6
Lockwood Folly	8	1.4
The Straits	7	1.2
Intracoastal Waterway (Brunswick County)	6	1.1
Jarrett's Bay	6	1.1
South River	6	1.1
Intracoastal Waterway (Carteret County)	5	0.9
Intracoastal Waterway (Onslow County)	5	0.9
Bay River	4	0.7
Bonner Bay	4	0.7
Courthouse Bay	4	0.7
North River (Carteret County)	4	0.7
Other Waterbody	4	0.7
Spencer Bay	4	0.7
Bald Head Creek	3	0.5
Cape Fear River	3	0.5
Dawson Creek	3	0.5
Little Shallotte River	3	0.5

Waterbody fished	Number of reported trips	Percent of reported trips
Neuse River	3	0.5
Broad Creek	2	0.4
Bull Bay	2	0.4
Cedar Island Bay	2	0.4
Greens Channel	2	0.4
Jarrett Bay	2	0.4
Mouse Harbor	2	0.4
Old Channel	2	0.4
Oyster Creek	2	0.4
Pamlico River	2	0.4
Pungo River	2	0.4
Second Bay	2	0.4
Virginia Creek	2	0.4
White Oak River	2	0.4
Atlantic Ocean <3 mi (North of Hatteras)	1	0.2
Beard Creek	1	0.2
Calabash Creek	1	0.2
Creeks back of Topsail Beach	1	0.2
Croatan Sound	1	0.2
Goose Creek	1	0.2
Lockwood's Folly River	1	0.2
Marshes behind Topsail Island	1	0.2
Middle Marshes	1	0.2
Shallotte Inlet	1	0.2
Stones Bay	1	0.2
Tar Landing Bay	1	0.2

Table 7.8. Distribution of North Carolina recreational oyster harvest trips by access type, 2010-2013. From NCDMF recreational statistics.

Access type	Reported trips	Percent reported trips
Marina	34	6
Private ramp	169	29.6
Public ramp	101	17.7
Residence	158	27.7
Shore	94	16.5
Other	15	2.6
All	571	100

Table 7.9. Recreational oyster harvest trips reported, percent, bushels reported, percent, mean catch per trip, 2010-2013. From NCDMF recreational statistics.

Month	Trips reported	Perecent trips reported	Mean number of trips per respondent	Bushels reported	Percent bushels reported	Mean catch per trip (bushels)
January	134	23.5	2.9	44	23.3	0.3
February	49	8.6	2.7	16	8.5	0.3
March	56	9.8	2.3	23	12.2	0.4
April	4	0.7	1.0	4	2.1	1.0
May	-	-	-	-	-	-
June	4	0.7	2.0	2	1.1	0.5
July	10	1.8	5.0	2	1.1	0.2
August	4	0.7	2.0	2	1.1	0.5
September	-	-	-	-	-	-
October	46	8.1	3.5	13	6.9	0.3
November	40	7.0	1.8	21	11.1	0.5
December	224	39.2	3.5	62	32.8	0.3
Total	571	100.0	2.9	189	100.0	0.3

8.0 PROTECTED SPECIES INTERACTIONS IN THE OYSTER FISHERY

The major gears used to commercially harvest oysters in NC are oyster tongs, by hand, and oyster dredges. Hand harvest methods have accounted for approximately 50% of oyster harvest over the period from 2009 through 2013. Currently, NMFS classifies the Atlantic Ocean shellfish dive, hand/mechanical collection and U.S. Mid-Atlantic/Gulf of Mexico oyster dredge 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 have had no documented interactions with protected resources (http://www.nmfs.noaa.gov/pr/interactions/lof/final2014.htm#table2).

The current management strategy limits the use of both oyster dredges and hand harvest methods seasonally in North Carolina waters. The oyster season which runs from October through March 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 OYSTER FISHERY

9.1 ECONOMIC ASPECTS OF THE FISHERY

9.1.1 Ex-vessel value and price

The oyster fishery in North Carolina has a long history. As far back as the late 1800s, the vast areas of shallow saltwater protected by the barrier islands recognized as a resource that could rival or eclipse the oyster production of the northern states. In 2013, oysters represent about 4.2% of the total value of commercially landed species in North Carolina, making them the fifth most commercially important species in the state. As a species landed primarily during the winter months, oysters provide income to commercial fishermen at a time when other species are not present in harvestable amounts.

The nominal value (the value that is not adjusted for inflation) of North Carolina oyster landings generally increased from 1972 to 1987, before decreasing through the remainder of the 1980s and early 1990s. This was followed by an increasing trend in the ex-vessel value of landings that peaked in 2010 at approximately $5.1 million. The nominal value of landings decreased from the 2010 peak, but has remained relatively high, with the ex-vessel value of oyster landings in 2013 reaching $3.35 million. Inflation adjusted values followed a very similar trend, however the overall peak in inflation adjusted landings value occurred in 1987 rather than 2010 (Figure 9.1, Table 9.1).

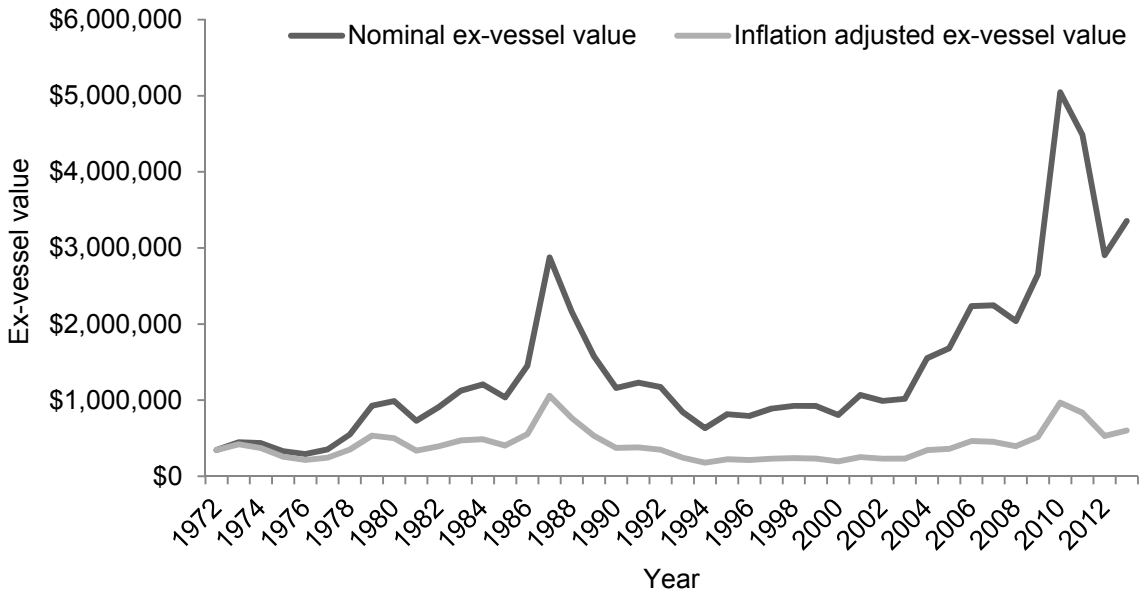

Figure 9.1. Annual ex-vessel value of clam landings in North Carolina, 19772-2013. NCDMF Trip Ticket Program.

Table 9.1 Annual bushels landed, nominal ex-vessel value, inflation adjusted ex-vessel value, nominal price per bushel, and inflation adjusted price per bushel for oysters landed in North Carolina, 1972-2013. NCDMF Trip Ticket Program.

Year	Total bushels	Nominal ex-vessel value	Inflation adjusted ex-vessel value	Nominal price per bushel	Inflation adjusted price per bushel
1972	102,869	$344,217	$344,217	$3.35	$3.35
1973	111,908	$446,485	$420,339	$3.99	$3.76
1974	109,358	$435,804	$369,505	$3.99	$3.38
1975	83,959	$329,794	$256,234	$3.93	$3.05
1976	61,384	$292,058	$214,552	$4.76	$3.50
1977	68,743	$353,581	$243,889	$5.14	$3.55
1978	83,558	$547,783	$351,186	$6.56	$4.20
1979	131,770	$925,964	$533,131	$7.03	$4.05
1980	138,525	$987,958	$501,173	$7.13	$3.62
1981	118,899	$730,293	$335,822	$6.14	$2.82
1982	154,545	$908,676	$393,603	$5.88	$2.55
1983	123,216	$1,124,147	$471,781	$9.12	$3.83
1984	127,563	$1,207,277	$485,700	$9.46	$3.81
1985	99,897	$1,037,153	$402,909	$10.38	$4.03
1986	120,444	$1,452,056	$553,795	$12.06	$4.60
1987	226,283	$2,875,406	$1,058,028	$12.71	$4.68
1988	157,431	$2,162,931	$764,248	$13.74	$4.85
1989	91,671	$1,575,634	$531,141	$17.19	$5.79
1990	51,869	$1,160,171	$371,042	$22.37	$7.15
1991	48,193	$1,229,293	$377,272	$25.51	$7.83
1992	49,908	$1,172,397	$349,296	$23.49	$7.00
1993	35,442	$843,617	$244,036	$23.80	$6.89
1994	34,727	$632,634	$178,435	$18.22	$5.14
1995	41,713	$815,070	$223,556	$19.54	$5.36
1996	39,874	$793,123	$211,297	$19.89	$5.30
1997	41,393	$888,963	$231,518	$21.48	$5.59
1998	42,385	$925,559	$237,352	$21.84	$5.60
1999	40,994	$922,910	$231,558	$22.51	$5.65
2000	38,455	$804,212	$195,215	$20.91	$5.08
2001	48,788	$1,068,352	$252,158	$21.90	$5.17
2002	46,082	$991,004	$230,261	$21.51	$5.00
2003	49,347	$1,017,887	$231,237	$20.63	$4.69
2004	69,558	$1,551,870	$343,400	$22.31	$4.94
2005	71,458	$1,682,646	$360,136	$23.55	$5.04
2006	84,667	$2,234,558	$463,316	$26.39	$5.47
2007	83,443	$2,244,626	$452,515	$26.90	$5.42
2008	88,124	$2,039,175	$395,896	$23.14	$4.49
2009	108,437	$2,655,463	$517,386	$24.49	$4.77
2010	196,674	$5,045,127	$967,120	$25.65	$4.92
2011	151,326	$4,486,593	$833,735	$29.65	$5.51
2012	83,188	$2,906,267	$529,116	$34.94	$6.36
2013	110,892	$3,353,095	$601,653	$30.24	$5.43

The nominal ex-vessel price per bushel for oysters exhibited an overall steady increase from the early 1970s through the early 1990s, regardless of the number of bushels landed. There was a

drop in the nominal price per bushel in the mid-1990s, but this was followed by a general increasing trend between themed 1990s and 2013 and peaking in 2012 at $34.94 per bushel. It is interesting to note that this increase in price occurred as the production of oysters for human consumption increased as well. Not only in North Carolina, but also in the Chesapeake Bay region, reflecting a strong demand for oysters that seems to be relatively inelastic. When adjusted for inflation, the price per bushel exhibited a different trend, increasing trend until the early 1990's, but remaining relatively flat since that time (Figure 9.2).

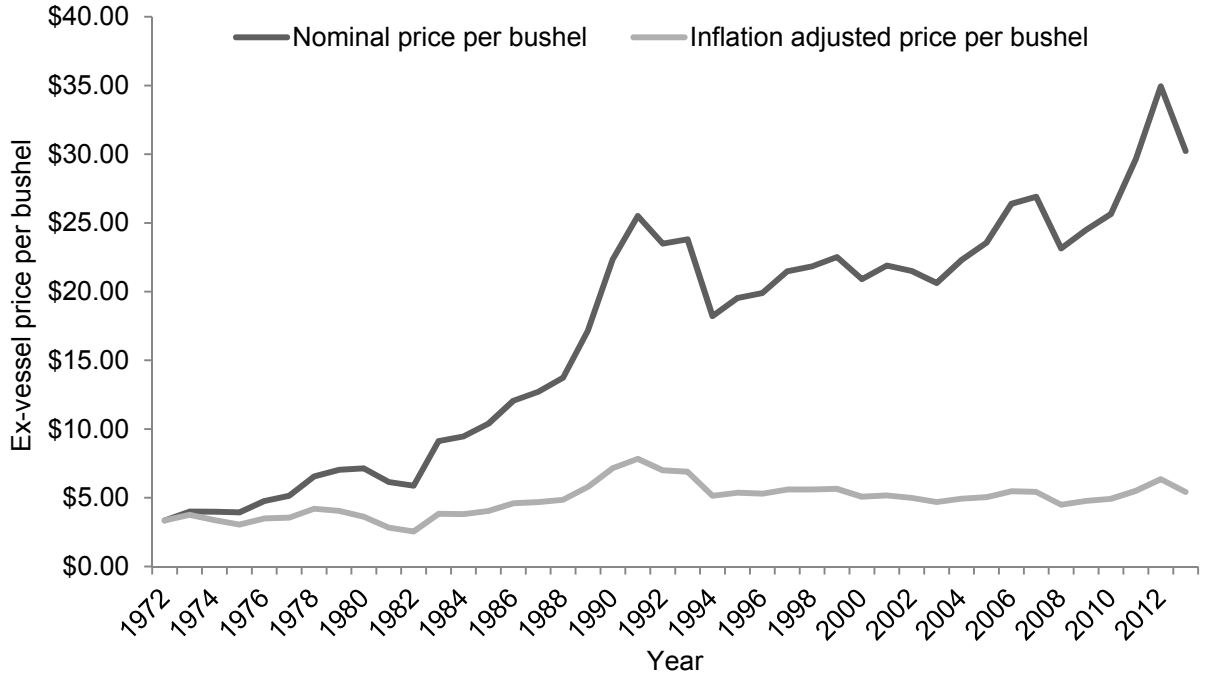

Figure 9.2 Average annual nominal and inflation adjusted price per oyster in North Carolina. 1972-2013. NCDMF Trip Ticket Program.

9.1.2 Harvest Area

While there are several shellfish lease operations that grow oysters, the majority of the oysters harvested in North Carolina are collected from public bottom. Oysters from public bottom have accounted for an average of 82% of the ex-vessel value of the commercial oyster harvest from 1994 to 2013. Since the late 1990s, the percent of the harvest value of oysters from public bottom has mostly increased, with a peak of 94% of the harvest value originating from public bottom in 2010 (Figure 9.3).

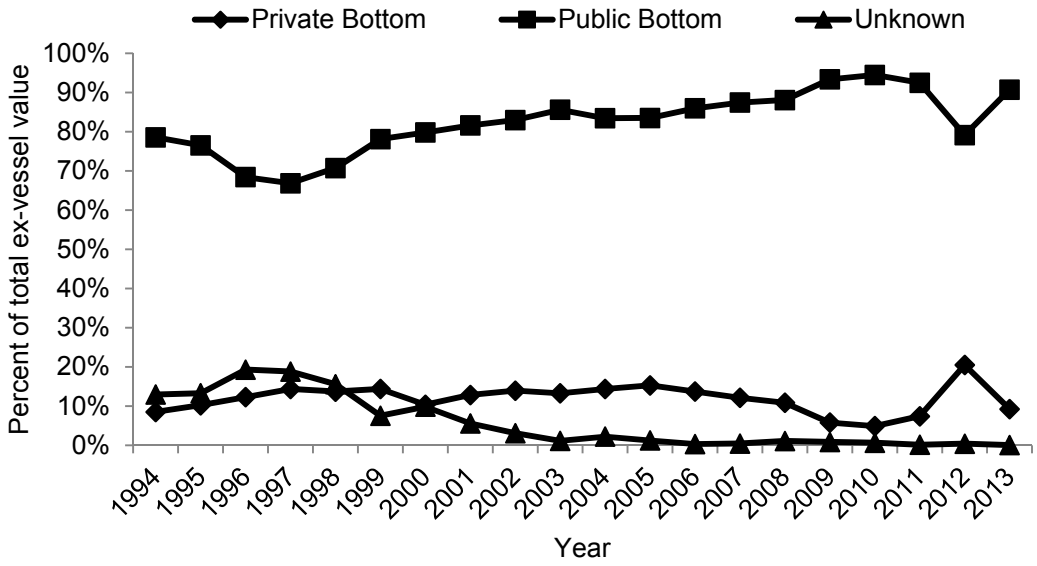

Figure 9.3 Percent of annual total commercial oyster harvest value from public versus private bottom, 1994-2013. NCDMF Trip Ticket Program.

Table 9.2 shows the percent of the total oyster 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 oyster fisheries in the Shallote River, North River/Back Sound, Lockwood Folly River, and Masonboro Sound have seen a decreasing contribution. Oyster harvest in the Pamlico Sound made a notable gain, increasing from less than a tenth of the overall oyster harvest value to more half of the overall harvest value in some recent years.

Table 9.2. Percent of total annual commercial oyster harvest value by water body, 1994-2013. NCDMF Trip Ticket Program.

	Year																				
Water body	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average
Bay River	<1%	<1%			<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%		<1%	<1%	<1%	1%	1%	4%	3%	1%
Bogue Sound	<1%	1%	1%	4%	3%	4%	6%	4%	4%	4%	3%	4%	3%	3%	2%	1%	1%	2%	2%	3%	3%
Cape Fear River	3%	4%	1%	<1%	1%	1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	1%
Core Sound	2%	2%	2%	3%	2%	2%	4%	4%	4%	4%	3%	3%	3%	2%	1%	1%	1%	2%	12%	1%	3%
Croatan Sound	<1%	<1%							<1%			<1%	<1%			<1%	<1%	<1%	<1%	1%	<1%
Inland Waterway	2%	2%	5%	3%	1%	1%	2%	2%	1%	<1%	<1%										2%
Inland Waterway (Brunswick)									<1%	1%	1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Inland Waterway (Onslow)									<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	1%	1%	<1%
Lockwood's Folly	15%	19%	17%	13%	6%	3%	6%	7%	8%	8%	5%	3%	4%	7%	7%	7%	2%	2%	3%	5%	7%
Masonboro Sound	11%	10%	11%	10%	10%	10%	12%	9%	8%	7%	6%	6%	4%	4%	5%	3%	2%	3%	5%	5%	7%
Neuse River	<1%	<1%	<1%	<1%	3%	2%	<1%	<1%	<1%		<1%	<1%	<1%	<1%	<1%	2%	1%	<1%	1%	2%	1%
New River	6%	7%	7%	7%	14%	10%	12%	7%	6%	9%	9%	11%	7%	10%	8%	5%	2%	5%	5%	4%	8%
Newport River	6%	6%	6%	6%	3%	3%	3%	6%	10%	7%	6%	4%	4%	5%	7%	3%	1%	2%	5%	4%	5%
North River/Back Sound	6%	5%	3%	1%	2%	2%	2%	2%	2%	7%	7%	10%	15%	12%	5%	3%	2%	2%	3%	1%	5%
Pamlico River		<1%			<1%	<1%	<1%	<1%	<1%	<1%	<1%	1%	1%	<1%	1%	<1%	<1%	<1%	<1%	<1%	<1%
Pamlico Sound	7%	1%	<1%	1%	12%	19%	9%	14%	12%	17%	29%	33%	34%	27%	35%	54%	70%	56%	25%	39%	25%
Roanoke Sound	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	1%	<1%	<1%	1%	<1%	<1%	<1%	<1%	<1%	<1%	1%	<1%	<1%
Shallotte River	14%	13%	18%	19%	8%	8%	10%	9%	8%	10%	5%	3%	3%	3%	4%	4%	3%	2%	4%	3%	8%
Stump Sound	7%	9%	11%	15%	19%	22%	14%	19%	16%	12%	13%	11%	10%	11%	9%	5%	5%	8%	9%	7%	12%
Topsail Sound	17%	20%	19%	16%	14%	13%	19%	13%	17%	13%	11%	11%	12%	16%	15%	12%	8%	13%	21%	22%	15%
White Oak River	2%	1%	<1%	1%	<1%	<1%	<1%	1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
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 Gears

In the 1990s and early 2000s, the majority of the oyster 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% to almost 100% of the oyster landings in the state in this timeframe. In the mid-2000s mechanical gears began to makeup a larger portion of the overall catch, with mechanical gears eventually accounting for more landings than hand harvest gears from 2009 to 2011. Since then, hand harvest gears have made up the majority of the value of the oyster fishery, however mechanical gears still account for a large portion of the oyster harvest annually (Figure 9.4).

Table 9.3 Annual nominal ex-vessel value and percent of total ex-vessel value of oyster landings by gear type, 1994-2013. NCDMF Trip Ticket Program.

Year	Gear type	Nominal value	Percent of nominal value	Year	Gear type	Nominal value	Percent of nominal value
1994	Hand harvest	$590,213	93%	2004	Hand harvest	$1,086,105	70%
	Mechanical	$42,161	7%		Mechanical	$465,765	30%
1995	Hand harvest	$803,990	99%	2005	Hand harvest	$1,101,962	65%
	Mechanical	$11,079	1%		Mechanical	$580,601	35%
1996	Hand harvest	$791,700	99.8%	2006	Hand harvest	$1,500,318	67%
	Mechanical	$1,323	0.2%		Mechanical	$734,240	33%
1997	Hand harvest	$877,417	99%	2007	Hand harvest	$1,703,250	76%
	Mechanical	$11,460	1%		Mechanical	$541,376	24%
1998	Hand harvest	$782,214	85%	2008	Hand harvest	$1,351,176	66%
	Mechanical	$143,127	15%		Mechanical	$687,999	34%
1999	Hand harvest	$725,323	79%	2009	Hand harvest	$1,274,959	48%
	Mechanical	$197,520	21%		Mechanical	$1,380,382	52%
2000	Hand harvest	$729,373	91%	2010	Hand harvest	$1,480,974	29%
	Mechanical	$74,787	9%		Mechanical	$3,564,153	71%
2001	Hand harvest	$906,077	85%	2011	Hand harvest	$1,932,152	43%
	Mechanical	$162,023	15%		Mechanical	$2,554,440	57%
2002	Hand harvest	$856,274	86%	2012	Hand harvest	$2,199,599	76%
	Mechanical	$134,729	14%		Mechanical	$706,668	24%
2003	Hand harvest	$827,105	81%	2013	Hand harvest	$1,969,022	59%
	Mechanical	$190,782	19%		Mechanical	$1,383,884	41%

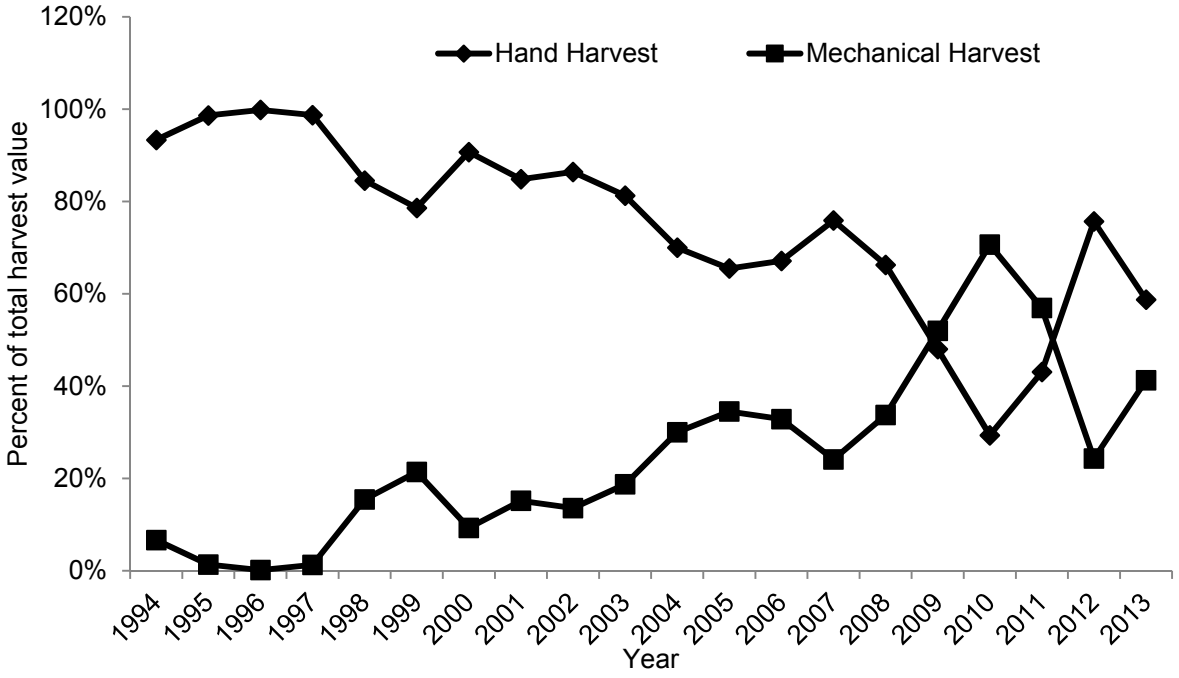

Figure 9.4 Annual percent of total landings value by gear type used to harvest oysters, 1994-2013. NCDMF Trip Ticket Program.

9.1.4 Participants and Trips

The Division of Marine Fisheries 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 oyster fishery reported $15.1 million in total seafood landings, with blue crabs (37%) making up the majority of this catch by ex-vessel value followed by oysters (22%), clams (8%), shrimp (14%), and flounders (4%). On trips recording landings of oysters, oysters (98%) made up the vast majority of the total ex-vessel value, with catches of hard clams (2%) also accounting for a noteworthy portion of the trip catch.

Table 9.4 shows the number of commercial oyster fishermen 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 the exception of a decrease in the proportion of fishermen taking one trip per year and an increase in the proportion of fishermen taking 21 to 50 trips per year. Unlike many other commercial fisheries in the state, the fishery has seen a general increase in the number of participants since 1994 (Figure 9.5). There has been a decrease in the number of participants from 2011 to 2013, however participation remains high relative to the 1990s and early 2000s.

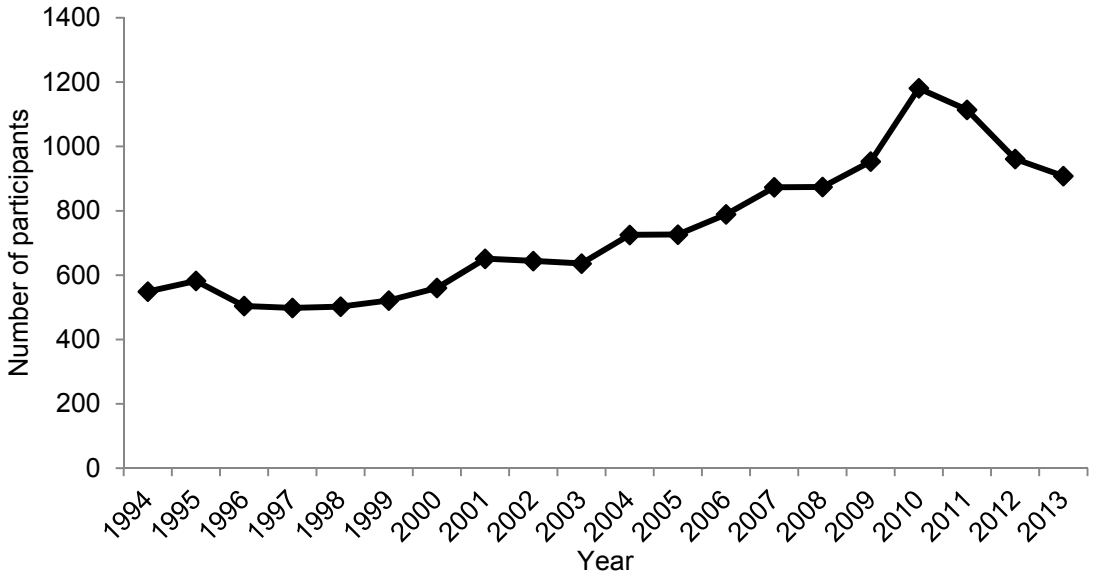

Figure 9.5. Annual number of commercial participants reporting landings of oysters from 1994-2013.

Table 9.5 breaks down participants in this fishery by annual individual ex-vessel value of oyster harvest. Few people make their living solely from harvesting oysters, with between 40% and 70% of all commercial oyster harvesters' annual catch fetching $1,000 or less in any given year. The number of people receiving over $10,000 in gross revenue annually from oysters has grown substantially in recent years. These individuals contribute greatly to the overall oyster harvest. In 2013, almost half of the oyster harvest value (47%) could be attributed to the 107 individuals recording more than $10,000 in ex-vessel value of oyster landings.

There has been a general increase in participants using hand harvest and mechanical gears to land oysters from 1994 to 2013 (Figure 9.6). Hand harvest gears did see a decrease in participants in the late 1990s, followed by a general increase in participation since then. Mechanical gears saw a spike in participants in 2009 and 2010, followed by a decrease in the number of participants using these gears. The number of hand harvest participants has increased by approximately 40% over the time series while the number of participants using mechanical gears has increased over 600%.

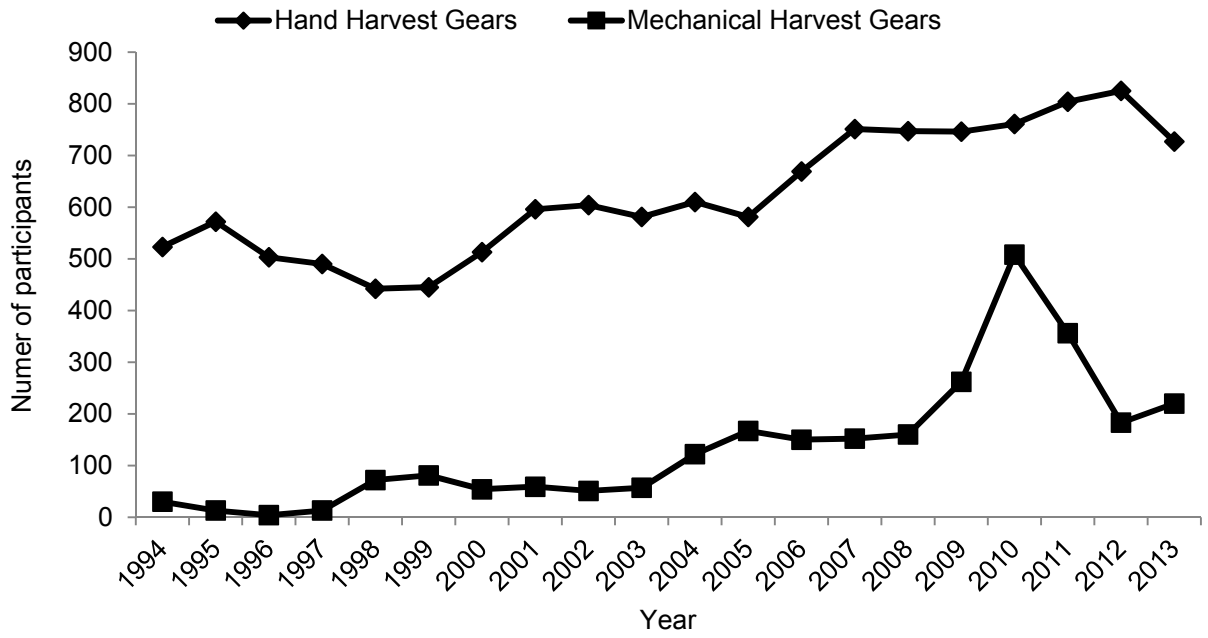

Figure 9.6 Annual participant count by gear category for oyster harvest, 1994-2013. NCDMF Trip Ticket Program.

The number of commercial hand harvest and mechanical harvest trips landing oysters exhibited similar trends to participants in the fisheries respectively. Both gears have seen a considerable increase in use for harvesting oysters. Through the time series (1994-2013), effort has increased over 100% for hand harvest gears and over 1,400% for mechanical gears landing oysters (Figure 9.7).

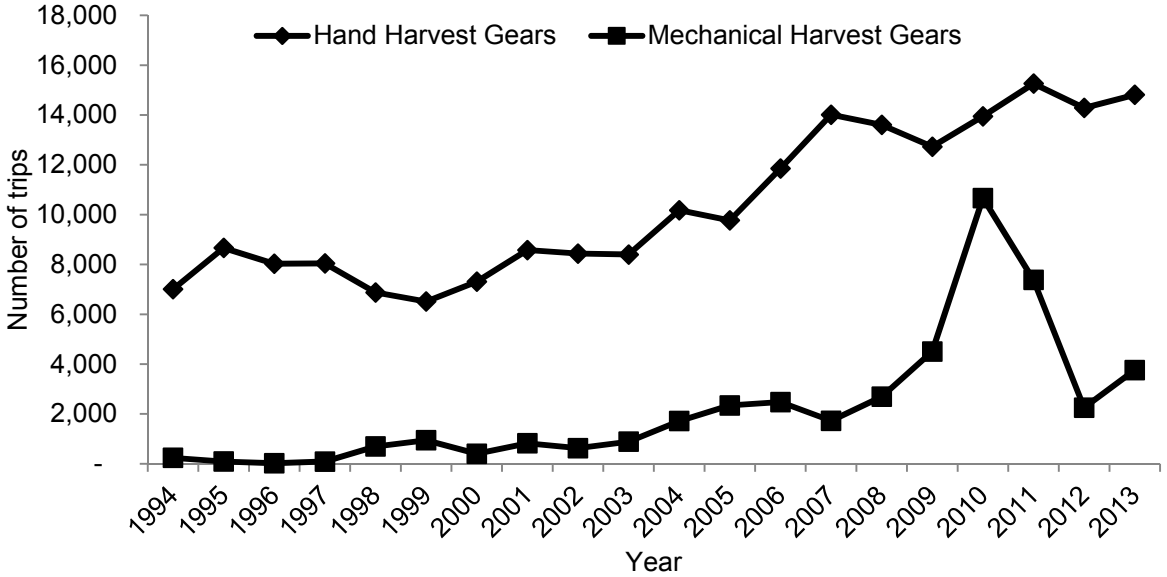

Figure 9.7. Annual total number of commercial trips landing oysters by gear category, 1994-2013. NCDMF Trip Ticket Program.

As is the case in all commercial fisheries in the state, oyster fishermen may only sell their catch to licensed seafood dealers. The number of dealers who deal in oysters remained stable from 1994 to 2007, with an increase each year since then (Figure 9.8). Many of these seafood dealers are likely oyster 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 wholesalers or consumer. Seafood dealers purchasing oysters were located throughout the coast and some inland counties, with the majority of dealers (58%) being located in the southern part of the coast (Onslow, Pender, New Hanover, and Brunswick counties). As can be seen in Table 9.6, the number of dealers buying $5,000 or less in oysters has generally decreased over the time series while the number of seafood dealers purchasing more than $30,000 in clams has increased. In 2013, the majority of the oyster harvest in North Carolina was sold through these top-tier seafood dealers (69%).

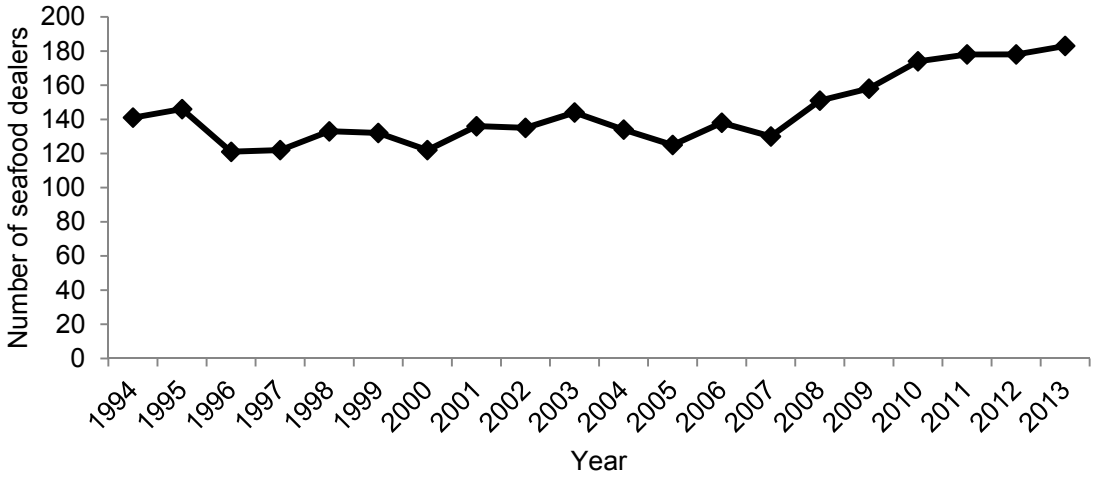

Figure 9.8 Annual number of seafood dealers reporting landings of oysters, 1994-2013. NCDMF Trip Ticket Program.

Table 9.4. Number of participants in the oyster fishery by number of trips taken and year in North Carolina, 1994-2013. NCDMF Trip Ticket Program.

	Year																				
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average
1 Trip	144	151	136	132	114	123	130	120	146	126	128	122	127	163	160	167	168	143	146	123	138
% within year	26%	26%	27%	27%	23%	24%	23%	18%	23%	20%	18%	17%	16%	19%	18%	18%	14%	13%	15%	14%	20%
2-10 Trips	221	230	179	166	202	206	226	286	269	274	308	299	293	329	322	340	459	405	379	324	286
% within year	40%	40%	36%	33%	40%	40%	40%	44%	42%	43%	42%	41%	37%	38%	37%	36%	39%	36%	39%	36%	39%
11-20 Trips	77	63	65	69	64	70	76	110	89	88	110	109	134	138	124	138	165	173	148	144	108
% within year	14%	11%	13%	14%	13%	13%	14%	17%	14%	14%	15%	15%	17%	16%	14%	14%	14%	16%	15%	16%	14%
21-50 Trips	76	92	79	91	90	84	96	89	100	109	115	135	158	162	175	213	219	265	212	219	139
% within year	14%	16%	16%	18%	18%	16%	17%	14%	16%	17%	16%	19%	20%	19%	20%	22%	19%	24%	22%	24%	18%
51-100 Trips	28	40	41	37	28	36	30	40	36	35	56	55	73	71	87	91	159	121	71	83	61
% within year	5%	7%	8%	7%	6%	7%	5%	6%	6%	6%	8%	8%	9%	8%	10%	10%	13%	11%	7%	9%	8%
More than 100 Trips	3	6	4	3	4	2	2	6	4	4	8	6	4	10	6	4	11	7	5	15	6
% within year	1%	1%	1%	1%	1%	0%	0%	1%	1%	1%	1%	1%	1%	1%	1%	0%	1%	1%	1%	2%	1%
Total	549	682	504	498	502	521	560	651	644	636	725	756	789	873	874	953	1,181	1,114	961	908	738

Table 9.5. Number of participants in the oyster fishery by value of landings and year in North Carolina, 1994-2013. NCDMF Trip Ticket Program.

	Year																				
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average
$1-$500	322	324	281	259	238	258	294	333	330	309	311	293	280	330	366	343	387	331	332	274	310
% within year	59%	56%	56%	52%	47%	50%	53%	51%	51%	49%	43%	40%	35%	38%	42%	36%	33%	30%	35%	30%	44%
$501-$1,000	66	73	51	47	67	66	74	82	93	91	100	90	91	117	103	134	147	122	121	114	92
% within year	12%	13%	10%	9%	13%	13%	13%	13%	14%	14%	14%	12%	12%	13%	12%	14%	12%	11%	13%	13%	13%
$1,001-$2,000	64	63	55	63	70	65	67	96	85	89	113	103	125	120	120	129	148	155	145	102	99
% within year	12%	11%	11%	13%	14%	12%	12%	15%	13%	14%	16%	14%	16%	14%	14%	14%	13%	14%	15%	11%	13%
$2,001-$5,000	66	77	73	78	75	77	83	84	84	88	106	138	141	160	151	155	204	222	176	191	121
% within year	12%	13%	14%	16%	15%	15%	15%	13%	13%	14%	15%	19%	18%	18%	17%	16%	17%	20%	18%	21%	16%
$5,001-$10,000	27	36	34	43	41	39	36	39	36	44	65	70	102	89	94	139	152	141	128	120	74
% within year	5%	6%	7%	9%	8%	7%	6%	6%	6%	7%	9%	10%	13%	10%	11%	15%	13%	13%	13%	13%	9%
More than $10,000	4	9	10	8	11	16	6	17	16	15	30	32	50	57	40	53	143	143	59	107	41
% within year	1%	2%	2%	2%	2%	3%	1%	3%	2%	2%	4%	4%	6%	7%	5%	6%	12%	13%	6%	12%	5%
Total	549	582	504	498	502	521	560	651	644	636	725	726	789	873	874	953	1181	1114	961	908	738

Table 9.6. Number of seafood dealers in the oyster fishery by ex-vessel value of oysters purchased and year in North Carolina, 1994-2013. NCDMF Trip Ticket Program.

	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	56	50	38	37	45	35	33	39	29	38	30	20	20	18	31	29	24	14	28	32	32
% within year	40%	34%	31%	30%	34%	27%	27%	29%	21%	26%	22%	16%	14%	14%	21%	18%	14%	8%	16%	17%	23%
$1,001-$5,000	54	63	44	40	46	55	48	43	58	56	46	40	44	45	53	54	53	61	49	49	50
% within year	38%	43%	36%	33%	35%	42%	39%	32%	43%	39%	34%	32%	32%	35%	35%	34%	30%	34%	28%	27%	35%
$5,001-$10,000	19	19	23	23	21	22	24	26	19	24	23	20	30	24	23	29	34	31	36	38	25
% within year	13%	13%	19%	19%	16%	17%	20%	19%	14%	17%	17%	16%	22%	18%	15%	18%	20%	17%	20%	21%	18%
$10,001-$30,000	8	7	11	16	14	14	11	21	25	20	24	32	26	27	27	23	29	37	45	34	23
% within year	6%	5%	9%	13%	11%	11%	9%	15%	19%	14%	18%	26%	19%	21%	18%	15%	17%	21%	25%	19%	15%
More than $30,000	4	7	5	6	7	6	6	7	4	6	11	13	18	16	17	23	34	35	20	30	14
% within year	3%	5%	4%	5%	5%	5%	5%	5%	3%	4%	8%	10%	13%	12%	11%	15%	20%	20%	11%	16%	9%
Total	141	146	121	122	133	132	122	136	135	144	134	125	138	130	151	158	174	178	178	183	144

9.1.5 Processing, Marketing, and Distribution

The NCDMF does not keep track of oyster 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 view among oyster dealers expressed stability in the market. None of these dealers dealt exclusively in oysters, but handled it as a seasonal crop for the winter season when other fishing is slow. No dealers exported oysters out of state or had difficulty keeping up with demand. Two dealers had imported oysters in small quantities exclusively during the off-season in North Carolina.

9.1.6 Economic Impact of the Commercial Fishery

Table 9.7 shows the estimated economic impact of the commercial oyster 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*[1], and IMPLAN economic impact modeling software. In 2013, the commercial oyster fishery in North Carolina supported an estimated 286 fulltime and part time jobs, $5.4 million in income, and $12.9 million in sales impacts.

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

				Estimated Economic Impacts		
Participants[1]	Trips[1]	Bushels landed[1]	Ex-vessel value[1]	Jobs[2,3]	Income impacts (in thousands)[3]	Sales impacts (in thousands)[3]
908	18,576	110,892	$3,353,095	286	$5,413.4	$12,940.8

[1]As reported by the North Carolina Division of Marine Fisheries (NCDMF) trip ticket program.
[2]Represents both full-time and part-time jobs.
[3]Economic impacts calculated using the NCDMF commercial fishing economic impact model.

9.1.7 Recreational Fishery Economics

The NCDMF collects data on 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 oyster fishing, including the number of participants and the extent of their economic activity. For details, see the Recreational Fishery Section 7.2.

[1] 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.

9.2 SOCIAL IMPORTANCE 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 coast [2], 168 of the fishermen reported that they commercially harvest oysters. That group is used to provide a snapshot of the North Carolina commercial oyster fishermen in this section.

9.2.1.1 Demographic Characteristics of Commercial Fishermen

Table 9.9 shows the demographic characteristics of the 168 oyster harvesters surveyed by the Fisheries Economics Program. Nearly all were white males, with an average age of 50 and 28 years of commercial fishing experience. Two thirds had a high school diploma and 21% had at least some college education. Almost half had more than $30,000 in household income when surveyed, with 17% indicating $50,000 or more. Approximately a fifth of the survey respondents had less than $15,000 in annual household income (Table 9.8).

On average, commercial fishing accounted for 68% of the personal income for these fishermen, and 46% reported that commercial fishing was their sole source of personal income. These values are higher than presented in the previous update of this fishery management plan. The majority (77%) of commercial fishermen that targeted oysters fished all year long. These values are all slightly 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 ten commercial oyster fishermen did not indicate having a registered commercial fishing vessel.

[2] 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), the Atlantic Ocean (last surveyed in 2009), and Albemarle and Pamlico sounds (last surveyed in 2014).

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

	Frequency	Percent		Frequency	Percent
Gender			Race		
Male	162	96%	White	163	98%
Female	6	4%	African American	4	2%
Marital Status			Number of People in Household		
Married	114	68%	1	25	15%
Divorced	27	16%	2	80	48%
Widowed	5	3%	3	30	18%
Separated	16	10%	4	22	13%
Never Married	6	4%	5	4	2%
Education			6 or more	4	2%
Less than High School	54	32%	Years in Community		
High School Graduate	78	47%	Average	35.6	
Some College	21	13%	Minimum	84	
College Graduate	14	8%	Maximum	2	
Household Income			% of Individual Income from Commercial Fishing		
Less than $15,000	35	21%	Average		68%
$15,001-$30,000	42	25%	Minimum		0%
$30,001-$50,000	35	21%	Maximum		100%
$51,001-$75,000	19	11%	Fisherman Status		
More than $75,000	10	6%	Full Time	110	65%
Refuse to answer	25	15%	Part Time	58	35%
Age			Years Fishing		
Average	50		Average	28	
Minimum	20		Minimum	70	
Maximum	85		Maximum	1	

9.2.1.2 Historical Importance

A historical overview of the oyster 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 oyster fishermen interviewed was 9.7 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 by oyster fishermen at an average of 7.6 on the scale previously mentioned, with 20% 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 8.2, indicating that the survey respondents generally felt strongly that their communities rely on commercial fishing.

The 168 commercial oyster fishermen that participated in the survey lived in 58 different communities. Table 9.9 shows the communities that were most often cited by the survey participants. The largest number of commercial oyster fishermen lived in Sneads Ferry, followed by Newport, Beaufort, and Wilmington.

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

Community	Percent of Respondents
Sneads Ferry	9%
Newport	8%
Beaufort	8%
Wilmington	5%
Engelhard	4%
Hampstead	4%
Supply	4%
Belhaven	3%
Jacksonville	3%
Holly Ridge	2%
Morehead City	2%
Scranton	2%
Swansboro	2%
Atlantic	2%
Cedar Island	2%
Mill Creek	2%
Shallote	2%
Wanchese	2%
Other	32%

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 oyster fishermen (59%) 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 (25%), followed by federal regulations (20%), other commercial fishermen (13%), and state regulations (11%). Several fishermen reported more than one type of conflict, therefore the percentages do not add up to 100% (Figure 9.9).

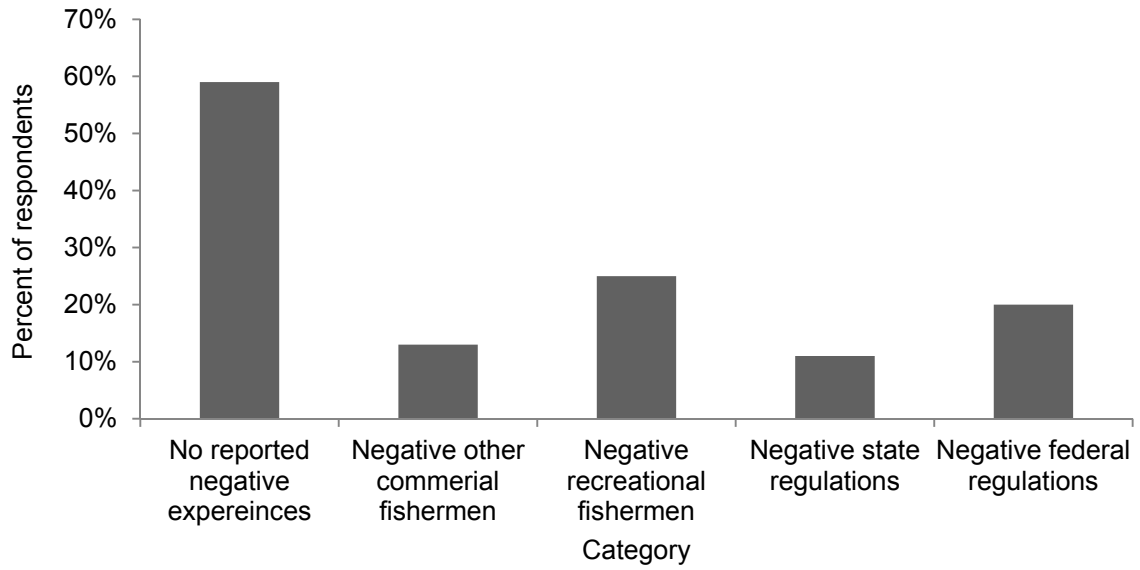

Figure 9.9. Reported conflicts of North Carolina commercial clam fishermen. NCDMF Fisheries Economics Program.

9.2.1.5 Perception of Important Issues

Oyster 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 low prices for seafood which are also related to competition from imported seafood. Another key issue for oyster fishermen was development of the coast. Several areas of coastal North Carolina have undergone intense development in recent decades. Water quality impairments are often associated with coastal 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 oyster fishermen. Keeping up with rule changes and proclamations, overfishing, bag limits, size limits and quotas were not seen as important issues effecting commercial oyster harvesters (Table 9.10).

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

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

9.3 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.

9.4 RESEARCH RECOMMENDATIONS

There are currently no data on demographics, perceptions, or expenditures of recreational oyster harvesters in the state. Collecting this information from recreational oyster harvesters would improve knowledge of the recreational fishery as well as allow an assessment to be conducted on the economic impact of the recreational oyster fishery. Additionally, socioeconomic surveys of commercial oyster 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.

9.5 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 North Carolina Division of Marine Fisheries (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 more clear 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 OYSTER HABITAT ENHANCEMENT

10.1 PURPOSE AND NEED

Recognized as an ecosystem engineer, oysters play an important ecological role, delivering a variety of ecosystem services, such as improving water quality through water filtration, bottom consolidation, benthic-pelagic coupling, shoreline stabilization, and essential fish habitat (Coen et al. 2007; Mackenzie 2007; Mann 2001; Peterson et al. 2003; Pierson and Eggleston 2014; Posey et al. 1999; Soniat et al. 2004). Fully developed coastal oyster reefs can support high oyster population density, mature size structure, and subsequently high reproductive output (Peters 2014; Peters et al. in review; Puckett and Eggleston 2012).

A consequence of historical overfishing, habitat destruction, disease, and pollution is extensive population decline of oysters worldwide (Cooper et al. 2004; Lenihan and Peterson 1998; Pinckney et al. 1998). Globally, an estimated 85 percent of historic oyster reefs have been lost (Beck et al. 2011). Similarly in the United States, present oyster populations have 64% less spatial extent and 88% less total biomass, relative to historical surveys (zu Ermgassen et al. 2012). More locally, population decline has been observed, especially on sub-tidal reefs along the US East Coast (Ault et al. 1994; Hargis and Haven 1988; NCDMF 2001; Rothschild et al. 1994). In 2007, a National Oceanic and Atmospheric Administration biological review team found that current east coast oyster harvest is 2 percent of peak historical volume and suggested that oyster restoration and enhancement efforts are “necessary to sustain populations” (EOBRT 2007). Oyster harvest in North Carolina has shown a similar trend of decline (Street et al. 2005; Deaton et al. 2010). For example, in the Neuse River Estuary, oyster habitat loss is particularly apparent where viable oyster beds have been “displaced downstream roughly 10-15 miles” since the late 1940s (Jones and Sholar 1981; Steel 1991). Natural expansion of healthy oyster reefs is not expected in this area because adjacent bottom lacks attachment substrate, and any shell that is sloughed from an existing reef might be subject to deep water hypoxia and sediment burial, where reef establishment is unlikely (Lenihan 1999; Lenihan and Peterson 1998). In order to improve ecosystem function, oyster restoration is essential. In recognition of this need, NCDMF coordinates habitat enhancement activities to improve statewide oyster populations and subsequently enhance the ecosystem services they provide.

10.2 ESSENTIAL FUNCTIONS AND SERVICES OF RESTORED REEFS

10.2.1 Larval Source

A fully developed oyster reef can support high population density, mature size structure, and subsequently high reproductive output relative to non-protected areas. Restored protected reefs have the potential to support up to two orders of magnitude greater larval output than open-harvest reefs, per square meter (Peters 2014; Peters et al. in review; Puckett and Eggleston 2012). Current flow distributes oyster larvae from high productivity sanctuaries to historical oyster fishing areas for grow-out and future harvest (Haase et al. 2012; Puckett et al. 2014).

10.2.2 Essential Fish Habitat

North Carolina oyster sanctuaries not only serve the ecosystem service and larval subsidy functions described above, but will also benefit recreationally and commercially important finfish species. The oyster is considered an ecosystem engineer because it is one of the few faunal

organisms in an estuary that serves as habitat for other species. The complex nature of oyster reefs serves as nursery habitat for numerous marine and estuarine species during key phases of their life cycles (Pierson and Eggleston 2014; Ross and Epperly 1985). Restored nursery habitat will result in healthier fisheries since many of the state's fishery species are estuarine dependent at some point in their life cycles. Further, adult finfish species utilize reef habitats for refuge and feeding, therefore oyster reefs are popular recreational fishing destinations (NCDMF unpub. data).

Oyster reefs support a large variety of marine and estuarine fish species by providing refuge and foraging opportunities, among other reasons (Coen et al. 1999; Grabowski et al. 2005; Lenihan et al. 2001; Peterson et al. 2003). Estuarine fish can be grouped into three categories: estuary-dependent species, permanent resident species, and seasonal migrant species (Deaton et al. 2010; Street et al. 2005). The most abundant are the estuary-dependent species, which inhabit the estuary as larvae and the ocean as juveniles or adults. This group includes species that spawn offshore as well as species that spawn in the estuary. Common migrant species also utilize oyster reef habitat (Table 10.1).

Table 10.1. List of all observed and known estuarine species which utilize oyster reefs (Coen et al. 1999; Deaton et al. 2010, Grabowski et al. 2005, Lenihan et al. 2001, Lowery and Paynter 2002, NCDMF Prg.118 unpub. data, Peterson et al. 2003, Street et al. 2005)

Common Name	Scientific Name
Jellyfish	*Cnidaria spp.*
Ctenophore	*Ctenophora*
Crabs , Spider	*Majidae spp.*
*Shrimp, Penaeid	*Farfantepenaeus spp. Litopenaeus spp.*
*Crab, Blue	*Callinectes sapidus*
*Crab, Florida Stone	*Menippe mercenaria*
Shark, Atlantic Sharpnose	*Rhizoprionodon terraenovae*
*Dogfish, Spiny	*Squalus acanthias*
Dogfish, Smooth	*Mustelus canis*
Shark, Finetooth	*Carcharhinus isodon*
Skate, Clearnose	*Raja eglanteria*
Stingray, Southern	*Dasyatis americana*
Stingray, Bullnose	*Myliobatis freminvillei*
Stingray, Cownose	*Rhinoptera bonasus*
Eel, Conger	*Conger oceanicus*
Herring, Blueback	*Alosa aestivalis*
Menhaden, Atlantic	*Brevoortia tyrannus*
Shad, Threadfin	*Dorosoma petenense*

Table 10.1 continued

Common Name	Scientific Name
Herring, Atlantic Thread	*Opisthonema oglinum*
Lizardfish, Inshore	*Synodus foetens*
Skilletfish	Gobiesox strumosus
*Mullets	*Mugil spp.*
Toadfish, Oyster	*Opsanus tau*
Needlefish, Houndfish	*Tylosurus crocodilus*
Silverside, Atlantic	*Menidia menidia*
Searobins (Prionotus)	*Prionotus spp.*
Searobin, Striped	*Prionotus evolans*
Cobia	*Rachycentron canadum*
*Sea Bass, Black	*Centropristis striata*
Sea Bass, Rock	*Centropristis philadelphica*
*Grouper, Gag	*Mycteroperca microlepis*
Perch, Sand	*Diplectrum formosum*
*Bluefish	*Pomatomus saltatrix*
Jack, Crevalle	*Caranx hippos*
Jack, Bar	*Caranx ruber*
Bumper, Atlantic	*Chloroscombrus chrysurus*
Lookdown	*Selene vomer*
*Palometa	*Trachinotus goodei*
*Pompano, Florida	*Trachinotus carolinus*
*Pigfish	*Orthopristis chrysoptera*
Pinfish	*Lagodon rhomboides*
*Sheepshead	*Archosargus probatocephalus*
Pinfish, Spottail	*Diplodus holbrookii*
*Seatrout, Spotted	*Cynoscion nebulosus*
*Seatrout, Gray	*Cynoscion regalis*
Seatrout, Sand	*Cynoscion arenarius*
Perch, Silver	*Bairdiella chrysoura*
*Spot	*Leiostomus xanthurus*
*Kingfish, Southern	*Menticirrhus americanus*
*Kingfish, Northern	*Menticirrhus saxatilis*
*Croaker, Atlantic	*Micropogonias undulatus*
*Drum, Black	*Pogonias cromis*
Drum, Star	*Stellifer lanceolatus*

Table 10.4 continued

Common Name	Scientific Name
*Drum, Red	*Sciaenops ocellatus*
*Spadefish, Atlantic	*Chaetodipterus faber*
Sennet, Northern	*Sphyraena borealis*
*Tautog	*Tautoga onitis*
Slippery Dick	*Halichoeres bivittatus*
Gobies	*Gobiosoma spp.*
Blennies	*Blenniidae*
*Mackerel, King	*Scomberomorus cavalla*
*Mackerel, Spanish	*Scomberomorus maculatus*
Butterfish	*Peprilus triacanthus*
Harvestfish	*Peprilus paru*
*Flounder, Summer	*Paralichthys dentatus*
*Flounder, Gulf	*Paralichthys albigutta*
*Flounder, Southern	*Paralichthys lethostigma*
Filefish, Scrawled	*Aluterus scriptus*
*Triggerfish, Gray	*Balistes capriscus*
Filefish, Planehead	*Stephanolepis hispidus*
Puffer, Northern	*Sphoeroides maculatus*
Burrfish, Striped	*Chilomycterus schoepfii*

*Commercially and recreationally important species

Increased habitat diversity and habitat complexity provided by restored reefs benefit finfish communities within the estuary by providing emergent structure and thus, increased habitat complexity. The creation of habitat heterogeneity serves to baffle currents, aggregate prey, and provide refuge; deposition of food for benthic fauna may also be enhanced (Diehl 1992, Grabowski 2002, Kelaher 2003).

10.2.3 Fishery Opportunities

Recreational fishing and commercial fishing are important economic activities in North Carolina. Important fisheries include flounder, striped bass, red drum, spotted sea trout, blue crabs, and oysters (Deaton et al. 2010; Street et al. 2005). Harvest of these species is conducted with a variety of gear types, including long-haul seines, shrimp trawls, crab trawls, crab pots, oyster dredges, drift gill nets, bait fish pound nets, eel pots, and hook and line. According to the NCDMF's 2014 Stock Status Report, "Saltwater fish populations in North Carolina are stable and, in many cases, improving but with some species showing declines. Oysters, while remaining listed as concern, have shown signs of improvement with increased landings in the last 10 years and harvest levels have stayed relatively constant in recent years" (NCDMF 2014). In support of recreational and commercial fisheries, no-take oyster sanctuaries have the potential to supply ~65-times more larvae per square meter than non-protected reefs, which contribute to harvested reef persistence (Peters 2014; Peters et al. in review). Furthermore, the creation of long term sustainable oyster reefs is anticipated to increase and support the abundance of commercially valuable finfish available for harvest. For example, the estimated commercial fish value supported by a hectare of oyster reef is $4,123 annually (Grabowski et al.

2012). A 20-acre protected oyster reef could provide an annual commercial fish value of $33,370 and have a larval oyster supply functionally equivalent to 1,300 acres of non-protected oyster reef (adapted from Grabowski et al. 2012; Peters 2014; Peters et al. in review).

10.2.4 Water Quality

Oyster habitat offers a variety of direct and indirect ecosystem services related to water quality. Because non-degraded oyster reefs contain high densities of filter-feeding bivalves, they can modify water quality in shallow waters by their intense filtration. Adult oysters have been reported to filter as high as 10 L h-1g-1 dry tissue weight (Jordan 1987 as cited in Newell and Langdon 1996). Water-filtering oysters reduce phytoplankton and microbial biomass, as well as suspended solids in the water column, effectively improving water clarity (Cressman et al. 2003; Grizzle et al. 2006; Nelson et al. 2004; Porter et al. 2004; Prins et al. 1997). Oysters concentrate these materials as pseudofeces in the sediments, which stimulates sediment denitrification and produces microphytobenthos (Dame et al. 1989). The decimation of many oyster populations in the eastern U.S. has coincided with increased external nutrient loading in many coastal systems (Paerl et al. 1998). Loss of oyster reefs and subsequent population filtering capacity is exemplified by the case of the Chesapeake Bay. There, in the late 1800's, oysters were abundant enough to filter the entire Bay every 3.3 days. With present day oyster populations, filtering the Bay would take 325 days (Newell 1988). Consequential to reduced filtration, bottom-water hypoxia has increased and food webs are now dominated by phytoplankton, microbes, and pelagic consumers. Dominant pelagic consumers in particular include many nuisance species rather than benthic communities, which support species of commercial and recreational value (Breitburg 1992; Jackson et al. 2001; Lenihan and Peterson 1998; Paerl et al. 1998; Ulanowicz and Tuttle 1992).

In some parts of the state (Pamlico and Neuse River estuaries), deep water hypoxia events frequently affect benthic resources. Hypoxic or anoxic conditions are defined as low oxygen conditions. Those conditions are the combined effect of stratification from a lack of wind mixing and excess nutrients. Hypoxia can occur under natural conditions but is thought to occur more often in the Pamlico and Neuse River Basins because of increased nutrient loading to the from the larger watersheds. High-relief, shell bottom habitat provides an elevated refuge from hypoxia events for estuarine species.

10.2.5 Other Benthic Resources

Benthic microalgae are a key part of the food chain in estuarine soft-bottom and shell-bottom habitats. Furthermore, these habitats support a high diversity of benthic invertebrates. Soft bottoms support clams and polychaete worms with larger, mobile invertebrates living on the surface of soft bottoms. Fiddler crabs use intertidal flats and submerged flats, and shallow bottoms support blue crab and other crustaceans and shellfish. Other mobile invertebrates inhabiting soft bottoms include horseshoe crabs, whelks, tulip snails, moon snails, shrimp, and hermit crabs Most of soft bottom species listed above also inhabit shell bottoms, however shell bottom support additional benthic macroinvertebrates, including mud crabs, pea crab, barnacles, soft-shelled clams, mussels, anemones, hydroids, bryozoans, flatworms, and sponges (Deaton et al. 2010; Street et al. 2005).

10.2.7 Research

Restored oyster reefs can be used to address critical unanswered questions regarding oyster restoration, including optimal reef design, reef placement, oyster disease and stress tolerance,

community function, ecosystem services, and socioeconomic impacts, among other research priorities. No- harvest sanctuaries provide reference to harvested reefs in these research scenarios. For example, studies may be conducted to assess stress differences between sanctuaries and open harvest areas associated with various bottom-disturbing fishing gears. Cultch-planted reefs provide an opportunity to make comparisons between restored and natural harvest-impacted oyster habitat.

10.3 HABITAT ENHANCMENT INITIATIVES

10.3.1 Cultch Planting

10.3.1.1 Program History

The State of North Carolina has been interested in increasing oyster production in the estuarine waters suitable for shellfish cultivation since the 1880's. The State's early efforts promoted private oyster culture and resulted in the granting of approximately 50,000 acres of oyster franchises. The franchises were minimally successful and state efforts were shifted to enhancing public bottom for oyster production. Relatively small amounts of shell were planted (10,000 – 12,000 bushels per year) between 1915 and 1920 with excellent results. The Fisheries Commission Board requested and received $10,000 in funding for oyster enhancement for the next two years. Approximately 100,000 bushels of shells and seed oysters were planted in 1921 and 1922 (Thorsen 1982). Oyster enhancement efforts (planting of seed oysters and shells) in the early 1920's and in 1934 were credited with significant increases in oyster production. The only significant reference to oyster enhancement activities in the period between 1926 and 1946 occurred during 1934. The 1934 project was the largest annual oyster enhancement project in North Carolina and resulted in 825,000 bushels of seed oysters and 78,567 bushels of shells being planted. These planted areas were closed until 1936. Oyster landings more than doubled from 271,192 bushels in 1934 to 651,050 bushels in 1936 (*adapted from* Chestnut 1951). In this case, the 1934 restoration efforts likely provided for substantially increased harvest landings.

Governor Cherry created a special oyster commission in 1946. The legislation resulting from the oyster commission's recommendations contained landmark changes in oyster management in North Carolina (Chestnut 1955). The renewed enhancement effort was known as the Oyster Rehabilitation Program. Provisions were made for an ongoing, large-scale shell and seed oyster planting program on natural oyster rocks, an oyster tax to support the program, a requirement that 50% of the shell from shucking operations be contributed to the program, a 50 cents per bushel tax on shell stock shipped out-of-state, and a $100,000 appropriation to initiate the program. Plantings during the first ten years of the program totaled 838,000 bushels of shell and 350,734 bushels of seed oysters (Chestnut 1955). By the mid 1950's appropriations were exhausted, landings and oyster tax collection had not increased and a request for an $80,000 annual appropriation was presented to the 1956 legislature with plans to increase oyster enhancement efforts to 500,000 bushels per year. This request was approved, as were additional increases in annual appropriations in 1972, 1977, and 1979. The Oyster Rehabilitation Program was revised by the legislature in 1997 to the Shellfish Rehabilitation Program with an annual budget of approximately $268,650 and the additional responsibility of enhancing hard clam production.

10.3.1.2 Program Implementation

Oyster rehabilitation efforts have utilized various methods in seed oyster and cultch material (shells: oyster, bay scallop, calico scallop, sea scallop, surf clam and marl) deployment including hiring fishermen to gather and transplant seed oysters, contracted private tugs, barges and labor, the use of enforcement vessels and personnel and in 1972, with the purchase of self-propelled barges, support equipment, and the use of NCDMF staff. Oyster enhancement activities before 1954 were conducted with contracted fishermen. In 1954, the program acquired a 40-foot wooden barge which was towed with larger enforcement vessels. Shells were deployed by washing overboard with high-pressure water pumps. Due to the scarcity of shell cultch, available experimental plantings were begun using marl as an alternative cultch material in 1968. The plantings were successful and a tug and barge was contracted to continue marl deployment in 1970. The contracted tug and barge utilized a bulldozer to push the marl overboard in piles. These piles create mounds of various heights on the bottom depending on the movement of the vessel. Research has shown that oyster reefs with higher relief receive higher spat set and increased survival (Ortega et al. 1990; Lenihan et al. 1999).

In 1972, increased appropriations and a one-time grant provided funds for the purchase of a Hatteras class ferry (110 foot converted landing craft) and a bulldozer. This vessel replaced the contracted tug and barge but the planting techniques were retained. Also purchased with these funds was a 50-foot self-propelled shallow draft barge to be used in the enhancement activities in the southern part of the state. Operations in this area involve the enhancement of intertidal oyster habitat requiring a shallow draft vessel. These vessels have been replaced by four vessels designed for the specific areas which they work. Two small (32 and 36 foot) shallow draft self-propelled barges equipped with inboard/outboard power are assigned to the southern area of the state. Three medium size (40- 65 foot) flat bottomed self-propelled barges conduct activities primarily in the bays and rivers adjacent to Pamlico and Core sounds. A 130-foot ex-military landing craft works the deeper areas of the sounds and adjacent waters. The five smaller vessels utilize high-pressure water pumps to wash the shell overboard. A front-end loader is used for cultch deployment on the landing craft.

Cultch planting activities are typically conducted between the first of May and the end of August to correlate with the period of oyster spawning and spat settlement. Planting sites are selected based on criteria including bottom type, salinity, currents, historical production, input from local fishermen, and effects of fishing operations in the area. The planting sites are monitored for three years for oyster recruitment and survival. Selected sites older than three years are sampled for production, survival and the presence or level of oyster disease. Recent planting efforts have incorporated mound construction techniques and increased planting site size to increase recruitment and reduce the effects of anoxic events, siltation, and subsidence. Efforts to increase the size of planting sites have reduced the total number of sites planted per year, but the integrity and effectiveness of the sites seem to have improved. The increased relief and size is intended to extend effective life of the sites.

A continued refining of vessels, equipment, and techniques has produced a rehabilitation program capable of deploying in excess of half a million bushels of cultch and relaying 20,000+ bushels of oysters per season.

10.3.1.3 Current Status

2015 marks 100 years of cultch planting in North Carolina for restoration purposes. In that time, about 19 million bushels of cultch material have been planted in North Carolina waters (Street et

al. 2005). From 1981 to 2014 the state has constructed 1,637 cultch planting sites, totaling 8,585,840 bushels of cultch material, have been planted throughout coastal counties (Table 10.2). Cultch sites, ranging in size from 0.1-10 acres with less than 100 acres of accumulative impact per year and distributed throughout the state, are made publically available as harvestable bottom. Most cultch planting sites maintain or exceed the threshold of 10 oysters per meter squared, and mean population density for cultch-planted sites is 247 oysters per square meter (Peters 2014; Peters et al. in review; Powers et al. 2009). Some sites are exceptions, presumably due to low spat fall, catastrophic events, or depletion (Powers et al. 2009).

10.3.1.4 Monitoring

Each year cultch planting sites are monitored by NCDMF with only sites from the last three planting seasons sampled. A sample consists of a minimum of 30 pieces of cultch collected from each site. The number and size of each spat on each piece of cultch is recorded. Data is summarized by the number of spat per piece of cultch. Spat recruitment onto cultch planting sites is variable among years, areas, and salinities with no clear trends. Long term monitoring of cultch planting sites has not conducted due to funding and staffing limitations.

10.3.1.5 Recycled Shell

The N.C. Oyster Shell Recycling Program was established in the fall of 2003 in an effort to supplement purchased material for cultch planting. The purpose of the oyster shell-recycling program was to recover post-consumer oyster shells that are lost to driveways, landscaping, construction, and landfills and utilize them to create or enhance oyster habitat in cultch planting, hatcheries, and sanctuaries. The recycling program also accepted other calcium-based shells for rebuilding oyster habitat such as clam, scallop, mussel, and conch shells. On July 1, 2013, funding for the Oyster Shell Recycling Program was discontinued and the program became defunct. However, some recycling responsibilities have been absorbed by other programs within NCDMF's Habitat & Enhancement and Fisheries Management staff. Historically high yield recycling sites have been maintained, while low yield collections sites have been closed. Convenient drop-off locations, with containers and bins at recycling centers, are provided for individuals who may have 20 bushels or less from small oyster roasts. Collections of oyster shells from larger oyster roasts (i.e., church, community, civic organizations, and festivals) require use of trailers or dump trucks. Staff coordinates pickup and delivery of shells to stockpile sites, enlisting help from solid waste disposal facilities and private waste companies (Table 10.3).

Since 2003, NCDMF restoration efforts have benefitted from 211,255 bushels of donated oyster shells. However, recycled shell volume has decreased substantially since the termination of the program (Table 10.4, Figure 10.1).

Table 10.2. Bushels of cultch material deployed by county and time period from 1980 to present.

	Time Period				
County	1981 - 1989	1990 - 1999	2000 - 2009	2010+	Total
Beaufort			3,320		3,320
Brunswick	31,700		39,662	29,766	101,128
Carteret	829,625	846,168	585,114	220,350	2,481,257
Dare	464,400	843,420	451,203	223,426	1,982,449
Hyde	730,600	799,830	471,538	293,668	2,295,636
New Hanover	14,450		34,927	11,614	60,991
Onslow	68,200		211,680	157,556	437,436
Pamlico	285,500	368,323	262,135	112,860	1,028,818
Pender	1,600		20,655		22,255
Unknown	114,000	58,550			172,550
All Counties	2,540,075	2,916,291	2,080,234	1,049,240	8,585,840

Table 10.3. List of active shell recycling locations

Site Name	Address	City	County
Washington DOT Yard	258 Clarks Neck Rd.	Washington	Beaufort
Beaufort County Landfill	1342 Hawkins Beach Rd.	Washington	Beaufort
Magnolia School Rd., GDS	1057 Magnolia School Rd.	Washington	Beaufort
Washington Crab & Oyster Co.	321 N. Pierce St.	Washington	Beaufort
Abbottsburg - County Trash Site	13887 Twisted Hickory Rd.	Bladenboro	Bladen
Bladenboro - County Trash Site	46 Webb Faulk Rd.	Bladenboro	Bladen
Sandy Grove - County Trash Site	3206 Horse Shoe Rd.	Bladenboro	Bladen
Council - County Trash Site	120 Carvers Creek Rd.	Council	Bladen
Dublin - County Trash Site	6771 Hwy 41 W	Dublin	Bladen
East Arcadia - County Trash Site	77 Kennedy Store Rd.	East Arcadia	Bladen
Bladen County Transfer Station	1522 Mercer Mill Rd.	Elizabethtown	Bladen
Wards - County Trash Site	370 NC Hwy 53 W	Elizabethtown	Bladen
Kelly - County Trash Site	19867 N.C. Hwy 53 E	Kelly	Bladen
Libson - County Trash Site	2373 White Plains Church Rd.	Lisbon	Bladen
Tar Heel - County Trash Site	423 Tar Heel Ferry Rd.	Tar Heel	Bladen
White Oak - County Trash Site	13763 NC Hwy 53 W	White Oak	Bladen
Tobemory - County Trash Site	1852 Tobemory Rd.	St. Pauls	Bladen
Ammon - County Trash Site	119 Ammon Com. Center Rd.	Garland	Bladen
Garland - County Trash Site	80 Hwy 210 W	Garland	Bladen
Bay Tree - County Trash Site	10431 NC 41 Hwy E	Harrells	Bladen
Rowan - County Trash Site	16956 Hwy 210 E	Ivanhoe	Bladen
Brunswick Community College	50 College Rd.	Bolivia	Brunswick
Brunswick County Landfill	170 Landfill Rd.	Bolivia	Brunswick
Calabash -County Trash Site	736 Seaside Rd.	Seaside	Brunswick
Southport - County Trash Site	8392 River Rd.	Southport	Brunswick
Supply - County Trash Site	1709 Oxpen Rd.	Supply	Brunswick
Cabarrus County Landfill	4441 Irish Potato Rd.	Can	Carbarrus
Town of Beaufort Public Works	512 Hedrick St.	Beaufort	Carteret
Hwy 58, GDS	Fire Tower Rd. Hwy 58	Cape Carteret	Carteret
DMF Office - Morehead City	3441 Arendell St.	Morehead City	Carteret
Hibbs Rd., GDS	365 Hibbs Rd.	Newport	Carteret
Otway, GDS	501 Harker's Island Rd.	Otway	Carteret
South River Stockpile Site	229 Tosto Rd.	Beaufort	Carteret
Jordan's Restaurant	8106 Emerald Dr.	Emerald Isle	Carteret
Morehead City State Port	111 Arendell St.	Morehead City	Carteret
Cedar Island Stockpile	2660 Cedar Island Rd	Cedar Island	Carteret
Edenton Fish Hatchery	1102 W. Queen St	Edenton	Chowan
Columbus County Landfill	354 Landfill Rd.	Whiteville	Columbus
Hwy 55, County Trash Site	681 Highway 55	Bridgeton	Craven
Old Cherry Point Rd., County Trash Site	4001 Old Cherry Point Road	New Bern	Craven
Cumberland County Landfill	698 Ann St.	Fayetteville	Cumberland
Moyock Recycling Center	101 Panther Landing Road	Moyock	Currituck
Barco Recycling Center	183 Shortcut Rd	Barco	Currituck
Grandy Recycling Center	6815 Caratoke Hwy	Grandy	Currituck
Dare County Trash Site - Buxton	47015 Buxton Back Rd.	Buxton	Dare
Kill Devil Hills Recycling Ctr.	701 Bermuda Bay Blvd.	Kill Devil Hills	Dare
Kitty Hawk Recycling Center	4190 Bob Perry Rd.	Kitty Hawk	Dare
Dare County Public Works	1018 Driftwood Dr.	Manteo	Dare
Rodanthe/Waves/Salvo Recycling Center	23176 Myrna Peters Rd.	Rodanthe	Dare
DMF stockpile site - Wanchese	604 Harbor Rd.	Wanchese	Dare
Leggett - County Trash Site	1500 Spivey Rd.	Leggett	Edgecombe
33 Grill & Oyster Bar	3309 NC Hwy 33N	Tarboro	Edgecombe
Edgecombe County Landfill	1601 Colonial Rd.	Tarboro	Edgecombe
Rocky Mount - County Trash Site	1136 Baie Rd.	Rocky Mount	Edgecombe
Swan Quarter Ferry Teminal	748 Oyster Creek Rd	Swan Quarter	Hyde
Johnston County Landfill	680 County Home Rd.	Smithfield	Johnston
Seaview Crab Company	6458 Carolina Beach Rd.	Wilmington	New Hanover
Trails End Park	613 Trails End Rd.	Wilmington	New Hanover
Carolina Beach - State Park	1010 State Park Rd.	Carolina Beach	New Hanover
Airlie Gardens	300 Airlie Rd.	Wilmington	New Hanover
New Hanover County Landfill	5210 Hwy 421 N.	Wilmington	New Hanover
Wrightsville Beach DMF Lab	Causeway Dr.	Wrightsville Beach	New Hanover
Onslow County Landfill	415 Meadowview Rd.	Jacksonville	Onslow
Morris Landing Preserve	898 Morris Landing Rd.	Holly Ridge	Onslow
Sturgeon City Education Ctr.	4 Court St.	Jacksonville	Onslow
T&W Oyster Bar	2383 NC Hwy 58	Swansboro	Onslow
Mile Hammock Bay - TLZ Bluebird	NC 172	Jacksonville	Onslow
Orange County Landfill	1514 Eubanks Rd.	Chapel Hill	Orange
Pamlico County Transfer Station	Hwy 306 N.	Grantsboro	Pamlico
Hobucken	NC 33	Hobucken	Pamlico
Vandemere	NC 307	Vandemere	Pamlico
DMF Office - Elizabeth City	1367 Hwy 17	Elizabeth City	Pasquotank
Bells Fork Collection Site	4554 County Home Rd.	Greenville	Pitt
Pitt County Landfill	3025 Landfill Rd.	Greenville	Pitt
Port Terminal Rd. Collection Site	970 Port Terminal Rd.	Greenville	Pitt
Sampson County Landfill	7434 Roseboro Hwy.	Roseboro	Sampson
Sampson County Trash Site	285 Potato House Rd	Keener	Sampson
New Manteo Dump Trailer #1	TBD	TBD	TBD
New Wilmington Dump Trailer	TBD	TBD	TBD
Bennett's Stockpile	TBD	TBD	TBD
Wake County Trash Site	10505 Old Stage Rd.	Raleigh	Wake

Table 10.3 continued

Site Name	Address	City	County
Wake County Trash Site	5051 Wendell Blvd	Wendell	Wake
Wake County Trash Site	3401 Holleman Rd.	New Hill	Wake
Wake County Landfill	6025 Old Smithfield Rd	Apex	Wake
Wake County Trash Site	3600 Yates Mill Rd.	Raleigh	Wake
Wake County Trash Site	8401 Battle Bridge Rd.	Raleigh	Wake
Wake County Trash Site	266 Aviation Pkwy	Morrisville	Wake
Wake County Trash Site	9008 Deponie Dr.	Raleigh	Wake
Wake County Trash Site	3931 Lillie Liles Rd	Wake Forest	Wake
Wake County Trash Site	2001 Durham Rd	Wake Forest	Wake
Washington County Landfill	718 Landfill Rd.	Roper	Washington
Wilson County Landfill	4536 Landfill Rd.	Wilson	Wilson

Table 10.4. Bushels of donated shell collected by the Oyster Shell Recycling Program 2003/04 to 2013/14. Year is from July through June.

Year	Total Bushels
2003-04	817.64
2004-05	2,139.29
2005-06	22,096.72
2006-07	23,713.52
2007-08	25,814.54
2008-09	26,931.08
2009-10	20,663.46
2010-11	24,931.52
2011-12	27,384.06
2012-13	27,345.00
2013-14	9,419.00
Total	211,255.41

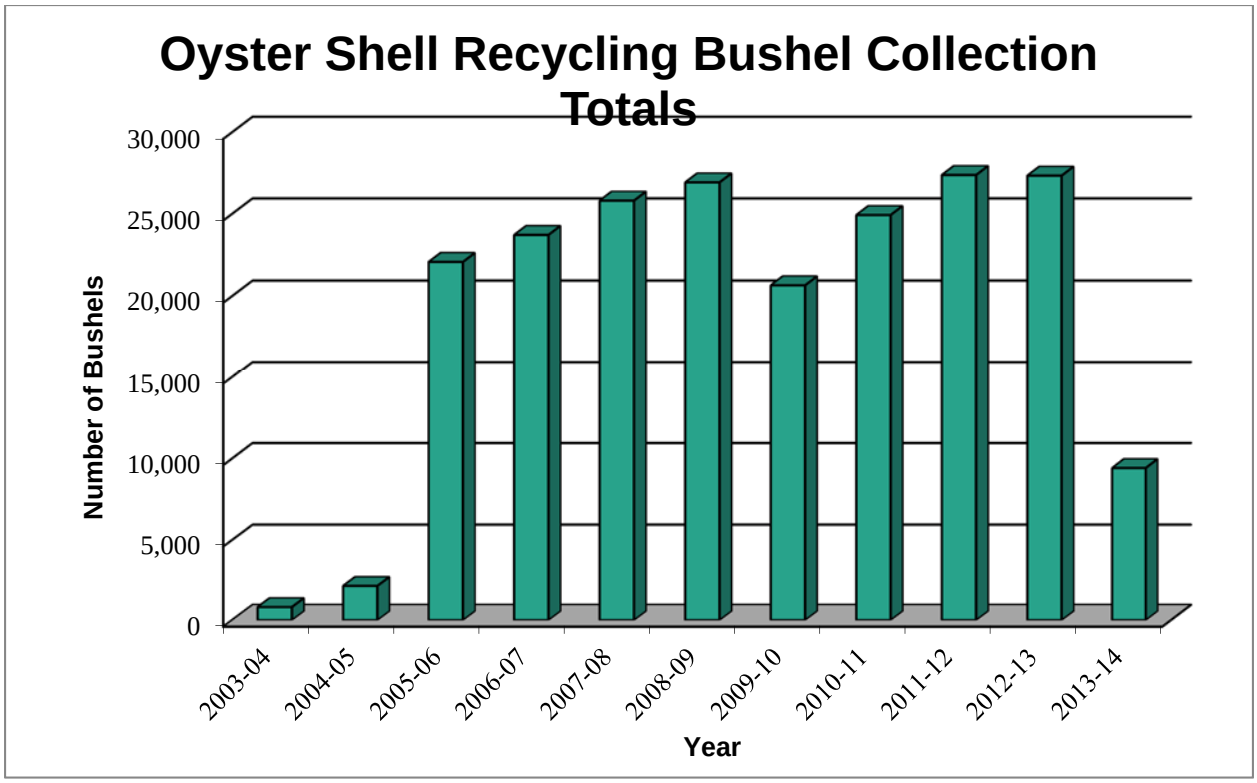

Figure 10.1. Bushels of donated shell collected by the Oyster Shell Recycling Program 2003-2014.

10.3.1.6 Recent Trends

Cultch planting efforts are highly variable as the limiting factors are funding and cultch material availability. In recent years, the amount of cultch planting has decreased due to budget cuts, increased cost, and a shortage of cultch material. Eastern oyster shells are the preferred cultch material for planting operations; however, in recent years it has become increasingly difficult to secure them. This has been exasperated by restoration efforts in Virginia, Maryland, and South Carolina as they spend considerably more for restoration than North Carolina. Virginia and Maryland are reportedly paying as much as $4.00 per bushel for oyster shells, including transportation and $2.20 per bushel without transportation. In comparison, North Carolina only has funds to pay about $1.00 per bushel and financially cannot compete with neighboring states for available shell.

As a result, North Carolina supplements oyster shell with 2”-4” limestone marl, scallop shells, and any other suitable material; however, this is also limited due to funding. This reduces North Carolina’s ability to restore harvestable oyster reefs. In response, alternative materials such as processed recycled concrete are being considered as they are considerably less expensive than oyster shell. Still, even with lower cost alternative materials, funding shortages will continue to limit cultch planting efforts.

10.3.2 Shellfish Relay

10.3.2.1 History

Relaying seed oysters has been an integral component of the state's enhancement activities. Early oyster relays accounted for a greater percentage of the enhancement efforts than cultch plantings. For example, in 1934, 825,000 bushels of seed oysters were relayed and 78,567 bushels of shells were planted. Oyster relays or seed oyster plantings exceeded cultch plantings eight times in the years between 1954 and 1971. A reduction in available cultch material and reluctance by fishermen in the Pamlico Sound area to participate in oyster relays shifted efforts to the southern area of the state in the late 1950's. The loss of habitat and closures due to pollution in the southern counties redirected efforts north to the Pamlico Sound area in 1970.

Shellfish relay efforts were also intensified from December 1987 through March 1988 when North Carolina had its first occurrence of red tide. The Governor of North Carolina and Director of North Carolina Division of Marine Fisheries initiated a welfare program to aid full-time commercial shellfishermen who had become unemployed as a result of the red tide disaster. Fishermen were paid $1 per bushel with a maximum of $100 per day and $500 per week for gathering oysters and clams from polluted areas designated by the DMF and transporting to locations open for harvest. Relay permits were issued to 146 commercial shellfishermen who qualified. Throughout the harvest season, participation in the central region of the state had averaged 25 to 30 participants daily (J. French and T. Piner, NCDMF, personal communication).

Bill Hogarth, former North Carolina Division Marine Fisheries Director, considered the relay a "valuable program" as it did not only provide immediate economic help for the affected commercial shellfishermen but also provided additional resources for harvest once the shellfish went through the depuration process. Between the dates of December 15th and 23rd, 1987, 16,725 bushels were relayed, which paid shellfishermen $16,725 by December 24th. Relaying operations continued through the harvest season (S. Murphy and J. Holland, NCDMF, personal communication). The director of Marine Fisheries stated, through a news release, that relaying operations in areas of the White Oak River closed on March 18th, 1988 due to the decreased number of participants and quantity of readily available polluted oysters.

More recently, a request in 2007 for an Aquaculture Operation Permit (AOP) involving the nursery of shellstock in prohibited waters of a marina was denied by DMF. The North Carolina Marine Fisheries Commission reviewed the denial of the permit through the Declaratory Ruling process, and upheld the denial of the permit. In 2011, the Commission again reviewed the use of prohibited waters for raising of seed shellstock and agreed by consensus that the nursery of shellstock in prohibited waters to be transferred to leases is an unacceptable practice.

From a public health perspective the National Shellfish Sanitation Program requires that all sources of seed shellfish be sanctioned by the Authority (State). While this should ensure that seed sources are grown in waters that are not impacted by known or point source discharges or poisonous or deleterious substances, source water for seed should be at the level of restricted or conditionally approved as determined by the state shellfish control authority.
In 2014, legislation was passed to modify G.S. 113-203: Transplanting of Oysters and Clams. The legislation now allows seed oysters or seed clams to be transplanted from a permitted aquaculture operation in "restricted" or "conditionally approved" waters, to private culture operations through an Aquaculture Seed Transplant Permit.

10.3.2.1 Current Status

General Statute 113-203 stipulates that shellfish seed coming from permitted hatcheries or nurseries using restricted or conditionally approved classified waters can be transferred to private beds provided seed clams are less than 12 millimeters and seed oysters are less than 25 millimeters. This legislation also allows transfer of seed oysters and seed clams to a private lease outside the standard relay season in accordance with the Aquaculture Seed Transplant Permit issued by the Division.

The oyster relay program continues as a small-scale relay project concentrating efforts in areas with high densities of easily available polluted seed. The oyster relays continue to utilize contracted fishermen. 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.

10.3.3 Oyster Sanctuaries

10.3.3.1 Impetus and Status

In 1995, the Blue Ribbon Advisory Council on Oysters recommended the development of oyster sanctuaries in North Carolina waters. The objective of this program is to establish a self-sustaining network of protected oyster broodstock sanctuaries. These sanctuaries are intended to provide larval subsidies to other reefs throughout Pamlico Sound, including the Neuse River, through larval transport and connectivity. Construction began in 1996 and was initially administered by the Artificial Reef and Oyster Rehabilitation programs. Five oyster/artificial reef sanctuaries were constructed in North Carolina prior to the 2001 Oyster FMP adoption. These sanctuaries were developed in Bogue Sound, West Bay (Cedar Island), Deep Bay (Swan Quarter), Croatan Sound, and Clam Shoal behind Hatteras Village. However, the site in Bogue Sound has become covered with sand by natural processes while all other sites still have bottom relief. As of 2015, the Oyster Sanctuary program has expanded to consist of 15 permitted sites, including 13 completed or under development, and two in design (Table 10.5). Currently standing sanctuaries are spread throughout Pamlico Sound in locations near Pea Island, Hatteras Island, Ocracoke, West Bay, Point of Marsh, Turnagain Bay, Pamlico Point, Deep Bay, Bluff Point, Engelhard, Long Shoal River, Stumpy Point, and Roanoke Island. New sanctuaries are planned for the Neuse and Cape Fear rivers (Figure 10.2; NCDMF Program 601, unpub. data; J. Peters and M. Jordan, NCDMF, personal communication, February 2015).

Table 10.5. Summary of oyster sanctuaries in North Carolina. (*) permitted but not established, (**) verbally agreed upon with USACE.

	Sanctuary Name	Latitude	Longitude	Permitted Area (acres)	Developed Area (acres)	Intentional Void (acres)	Available Area (acres)	Material Type	Total Tons of Material
1	Croatan Sound	35.804737	-75.638933	7.7	5.4	1.6	0.7	Limestone Marl Riprap Reef Balls	2,093
2	Crab Hole	35.381877	-76.369353	30.5	30.5	0	0.0	Limestone Marl Riprap	36,489
3	Gibbs Shoal	34.980862	-76.356053	30	30	0	0.0	Limestone Marl Riprap Reef Ball Reef Cube	22,447
4	Deep Bay	35.291333	-75.619667	17.2	5.69	6.9	4.6	Limestone Marl Riprap Reef Balls	1,749
5	West Bluff	35.728055	-75.675138	19.9	9.1	3.8	7.0	Limestone Marl Riprap Reef Balls	10,162
6	Clam Shoal	35.180250	-75.993867	58.2	31.4	0	26.8	Limestone Marl Riprap	38,359
7	Middle Bay	35.235967	-76.502967	4.6	0.4	0	4.2	Limestone Marl Riprap	900
8	Ocracoke	35.007903	-76.532583	76	25.44	0	50.6	Limestone Marl Riprap Reef Balls Precast Concrete Processed Recycled Concrete (3) 65'-130' Vessels	15,183
9	Neuse River	35.305000	-76.168150	5.7	5.3	0	0.4	Limestone Marl Riprap	7,357
10	West Bay	35.455928	-75.930723	6.7	2.23	3.9	0.6	Limestone Marl Riprap Reef Balls	2,329
11	Long Shoal	35.563450	-75.830600	10	6.6	2.3	1.1	Reef Balls	2,173
12	Raccoon Island	35.090366	-76.391233	10	7	3	0.0	Reef Balls Precast Concrete Processed Recycled Concrete	1,824
13	Little Creek	35.043600	-76.514820	20.7*	9.8 (proposed)	10.9	0.0	Limestone Marl Reef Balls Precast Concrete Processed Recycled Concrete Concrete Blocks Reef Pyramids Granite Riprap Basalt Riprap	5,880 (proposed)
14	Pea Island	35.666000	-75.615670	32	18.6	13.4	0.0	Reef Balls Precast Concrete Processed Recycled Concrete	3,420
15	Cape Fear River	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
16-17	USACE Mitigation**	TBD	TBD	20 (proposed)	20 (proposed)	TBD	TBD	TBD	TBD
	Total			329.2	177.7		95.9		144,485

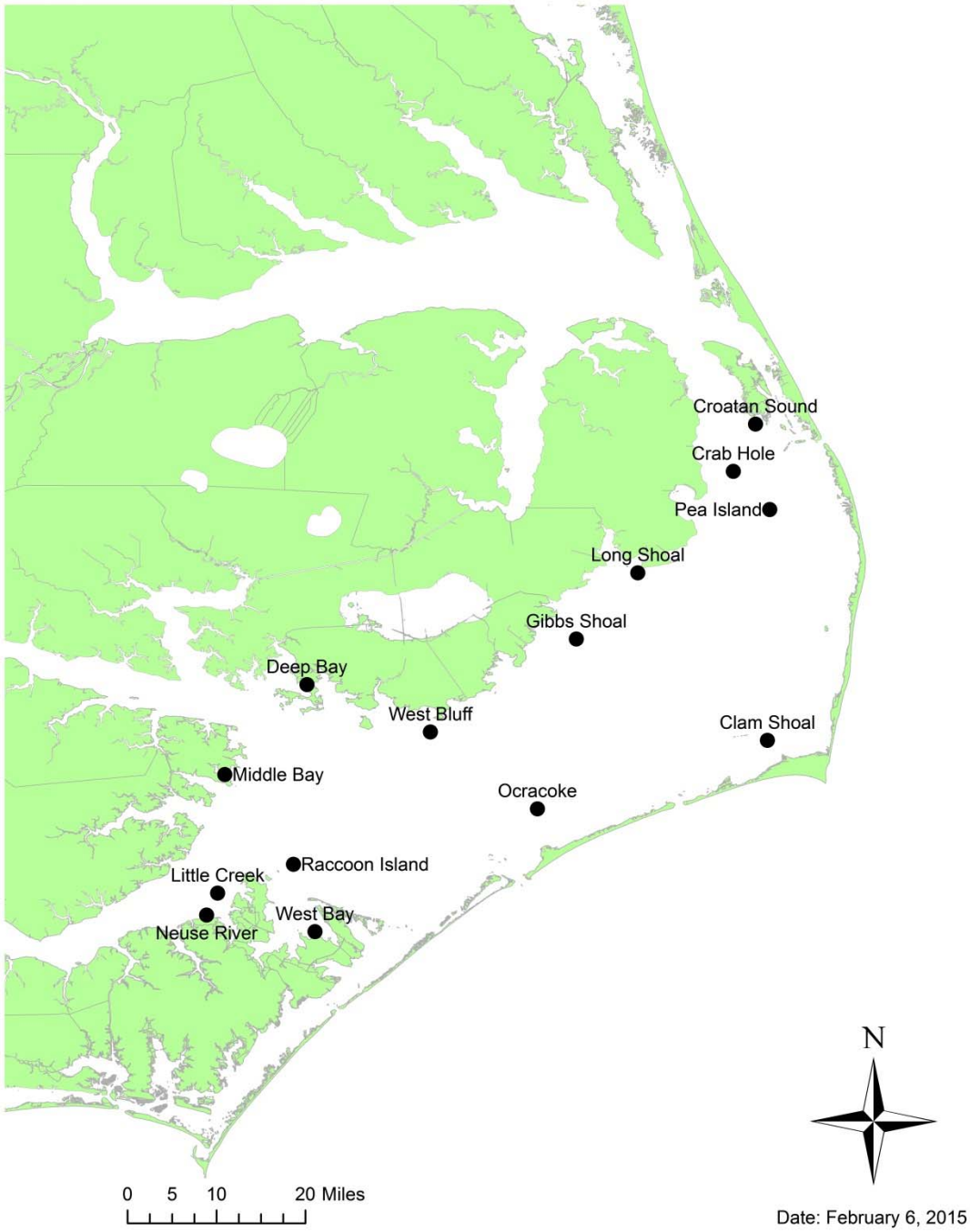

Figure 10.2. North Carolina Permitted Sanctuary Locations.

To supplement NCDMF planned and implemented sanctuaries, the United States Corps of Engineers (USACE) will be constructing 20 acres of additional sanctuary bottom as environmental mitigation. Post-construction, NCDMF will monitor reef biology (see section 10.3.3.2 *Monitoring*).

As a strategic plan to withstand catastrophic events (e.g. hurricane or anoxic event), a network of small oyster sanctuaries was established in lieu of only a few larger ones. This strategy should prevent one catastrophic event from damaging or causing mass mortalities throughout

the oyster sanctuary network. Additionally, a network of oyster reefs is necessary to ensure reef connectivity through larval supply. Since spat do not usually recruit to the same reef on which they were spawned, larval connectivity is essential to maintain oyster populations (Geraldi et al. 2013). Site locations are selected based on physical and biological environmental conditions, individual project goals, regulatory stipulations, preservation of active fishing grounds, existing resources (such as sea grass or oyster beds), and cultural value.

North Carolina oyster sanctuaries were traditionally constructed of multiple, high profile mounds using mostly Class-B Riprap (fossil stone). Recently constructed sanctuaries more consideration to material diversity has occurred to provide better opportunities to recruiting fish and better settlement habitat for recruiting oysters. Contemporary sanctuaries utilize recycled concrete products, such as reinforced concrete pipe and other prefabricated structures. Limestone is no longer used as a dominant material type, as it is prone to supporting marine boring sponges, which are detrimental to healthy oyster populations (See section 10.3.3.4 *Recent Trends*). Within permitted boundaries, material is typically arranged in mound or grid patterns with void, interstitial space between grids and around the perimeter. While reef height (vertical relief) is an important design consideration, sanctuaries adhere to minimum vertical clearance requirements of the US Coast Guard. Existing sanctuaries range in size from 4.6 to 40 acres in size (Table 10.5), and sanctuary area, including proposed USACE projects, will incorporate approximately 349.2 acres.

Oyster sanctuaries are protected under North Carolina Marine Fisheries Rule 15A NCAC 03K .0209 and delineated in 15A NCAC 03R .0117, which prohibits harvest of oysters and use of trawls, long haul seines, and swipe nets therefore promoting growth and enhancing survivability of large oysters within the sanctuaries. Oyster sanctuaries under construction but not yet incorporated into 15A NCAC 03R .0117 can be protected under Rule 15A NCAC 03H .0103 and 15A NCAC 03K. .0103 through proclamation authority.

10.3.3.2 Monitoring

Annual data collection and monitoring are ongoing at all sanctuaries. At present, monitoring is designed around sampling limestone marl mounds, which may provide challenges to future sampling efforts. Under current protocol, NCDMF staff visits each sanctuary on an annual basis. On site, staff records water quality and recovers marl rock samples from the reef for analysis via SCUBA. For each site, three old and three new mounds are sampled. On each mound, samples are recovered from both top and bottom strata. Sample analysis for each rock includes recording rock dimensions, counting/measuring all live oysters, and quantifying all other biota. All of the historical monitoring of oyster sanctuaries is documented in the Division's biological database under Program 611. With the deployment of various materials to serve as settlement substrate the current biological sampling protocol is in the process of incorporating new methods of collecting information.

10.3.3.3 Sanctuary Efficacy

The effective size of an oyster sanctuary is largely unknown and subjective as limited data exists to this effect and goals are not clearly defined (Geraldi et al. 2013). However, with respect to sanctuaries as broodstock habitat and larval sources, consideration must be paid to environmental conditions such as system hydrodynamics and water quality (Garrison 1999, Paynter and Dimichele 1990, Puckett et al. 2014, Shumway 1996, Wells 1961), which influence population dynamics. In a hypothetical hierarchy of requirements for sanctuary efficacy in the capacity of a larval source, connectivity is first necessary to supply a sanctuary with recruiting

larvae. Connectivity is largely attributed to reef location, larval supply, and system hydrodynamics. System hydrodynamics play an important role in larval dispersal through transport. Each oyster reef and oyster sanctuary relies on currents or tides to disperse larvae throughout coastal waters. In the absence of these currents oyster larvae would not be transferred from reef to reef for settlement. In many instances, natural oyster reefs provide larvae to oyster sanctuaries, especially for initial spat sets. In turn, the oyster sanctuaries provide an unfished biomass of oysters which provide larvae to both natural reefs and other sanctuaries. Second in the hierarchy of requirements, suitable settlement substrate for planktonic larvae must be available and settlement cues for those larvae must be present. Once settled, water quality must be adequate for survival and growth to broodstock size. At this point, the combination of high recruitment, growth, and survival (optimal population demographics), will support high population density and size structure with multiple size-based cohorts (including large broodstock oysters). Maintenance of these characteristics is also dependent on no harvest pressure or subsequent size selection. Larval production of a whole sanctuary is then determined by the size of the sanctuary. Among sanctuaries with equal population density and size structure, the assumption is the larger sanctuary will have higher larval production. The final hierarchical requirement for sanctuary efficacy might be, again, connectivity through hydrodynamics. Fertilized larvae from a sanctuary must be distributed to other reefs in order to support the goal of providing larval subsidies to the rest of the system. Without connectivity, high production sanctuaries have little value to system-wide restoration. Since inception of the oyster sanctuary network, one major study has been conducted comparing population demographics among the sanctuaries. At the time of publication, eight of the existing ten sanctuaries expressed a nearly 400% increase in population density (Puckett and Eggleston 2012). Population density at each sanctuary is variable, ranging from 418.7 ± 82.1 to 6,585.3 ± 204.8 oysters per square meter, though mean density among sanctuaries was 3,781.7 oysters per square meter (Puckett and Eggleston 2012). Growth and survival at sanctuaries follows a gradient consistent with, and likely driven by, a persistent salinity gradient present in Pamlico Sound waters (Lin et al. 2007; Puckett and Eggleston 2012; Wells 1961; White and Wilson 1996). Lower salinity (10-18 PSU) western Pamlico Sound sanctuaries exhibit higher survival though slower growth rates, whereas eastern Pamlico Sound sanctuaries experience higher salinity (18-26 PSU) and subsequently maintain faster growth rates and lower survival rates (Peters et al. in review; Puckett and Eggleston 2012). In further analysis of North Carolina sanctuary efficacy, larval connectivity among sanctuaries has been validated, however modeled intrinsic growth rate is unsustainable, suggesting sanctuary network sustainability is dependent on subsidies from non-protected reefs (D. Eggleston and B. Puckett, NCSU-CMAST, personal communication; Haase et al. 2012; Peters 2014; Puckett and Eggleston 2012).

Research in Pamlico Sound has indicated that the existing network of sanctuaries is not self-sustaining, though oyster densities within sanctuaries are overall increasing over time (Puckett and Eggleston 2012). This suggests sanctuary sustenance is reliant on larval subsidies from non-protected reefs in the system, including natural and enhanced (cultch-planted) reefs. In Pamlico Sound, population density is considerably lower at non-protected reefs versus sanctuaries; however the expansive total area of non-protected reefs far surpasses that of sanctuaries. Oyster size is directly related to gamete and larval production, with larger individuals producing a higher number of gametes (Mroch et al. 2012). Relative to non-protected reefs, sanctuaries exhibit ~72-times greater oyster densities and a size structure favoring larger oysters. Therefore, reproductive potential of reserves is estimated to be ~30-times greater than non-protected reefs (Peters 2014). Peters et al. (in review.) noted that due to areal coverage of natural reefs compared to oyster sanctuaries that the potential larval output was similar. This is attributed to about two orders of magnitude difference in natural reefs areal coverage compared to oyster sanctuaries.

Relative to non-protected (cultch-planted and natural) oyster reefs, North Carolina oyster sanctuaries have demonstrated the capacity to maintain higher population density and greater abundance of large, fecund oysters. There is a striking decrease in oyster densities going from no-take to non-protected oyster reefs, with mean total oyster density ~72- and 8-times higher in sanctuaries than natural and cultch-planted reefs, respectively (Peters 2014; Peters et al. in review; Puckett and Eggleston 2012). Non-protected reefs, in general, exhibit truncated size structure and few oysters of legally harvestable size (75 mm, 3 inches). In combination of size structure, population density, and per-capita fecundity at length, the average reproductive potential per square meter of oyster sanctuaries is up to 30-times greater than non-protected reefs (Peters 2014; Peters et al. in review). For perspective, an estimated 5,929 ha of non-protected oyster reef exists in Pamlico Sound and at the time of study, 57.18 ha of sanctuary area existed (Peters 2014). Integrating total reef area in the estuary and reproductive potential per square meter, oyster sanctuaries potentially provide 26.2% of all larvae to the system while only accounting for 1% of all reef area (Mroch et al. 2012; Peters 2014; Peters et al. in review; Puckett and Eggleston 2012). This a testament to not only the stand-alone value of sanctuaries in this case, but also the degraded state of natural and cultch-planted reefs, which serves to boost the importance of protected reefs as a mitigation measure.

10.3.3.4 Recent Trends

The total required sanctuary area for restoration is a major consideration in North Carolina. While it is unknown how much protected acreage is really needed, North Carolina has included sanctuaries as major component of its restoration effort. In other states, Virginia and Maryland, sanctuaries are also emphasized as important to restoration. In 2000, an agreement was reached among scientists, managers, watermen, and environmentalists on an appropriate acreage for oyster sanctuary designation in the Chesapeake Bay. The agreement, known as the Chesapeake Bay 2000 Agreement, called for setting aside at least ten percent of traditional oyster reef acreage as sanctuaries (*in* Keiner 2009). In North Carolina, 16,106 acres of subtidal reef area has been mapped, to date, statewide (B. Conrad, NCDMF unpub. data). Using the Chesapeake Bay's model, an estimated 1,600 acres of sanctuary area should be designated. By recommendation of the North Carolina Coastal Federation, a goal was established to create 500 acres of sanctuary area by 2020, though there is no formal agreement to this effect. To accomplish this goal, sanctuary network design has moved toward creating a network, whereby many small reefs are built, rather than a few large areas. Environmental considerations have also become increasingly important to accomplishing this goal with effective results (i.e. high oyster production).

Certain environmental stressors have emerged as impediments to subtidal reef restoration in North Carolina. Despite a steep increase in population density overall, two sanctuaries in high salinity areas experienced dramatic population decline following the Puckett and Eggleston (2012) study (D. Eggleston and B. Puckett NCSU-CMAST, personal communication). Coincident with this decline was an increased percent cover of marine boring sponge on limestone marl reef material (*Cliona* spp.; D. Eggleston, NCSU-CMAST, personal communication; N. Lindquist, UNC-CH, personal communication). *Cliona* boring sponge is a bioeroder of calcareous materials and linked to reduced oyster gamete viability and possibly increased oyster mortality rates (Ringwood et al. 2004). This sponge is endemic to North Carolina, though recently more pervasive, especially on limestone marl rocks (D. Eggleston and B. Puckett, NCSU-CMAST, personal communication; N. Lindquist, UNC-CH, personal communication; Peters 2014; Wells 1959). To improve reef design in high salinity waters and throughout North Carolina estuaries, NCDMF is conducting research on alternative settlement

substrates for oyster restoration. The objective is to identify construction materials which maximize oyster recruitment, growth, and survival, while offering high resistance to environmental stressors, such as *Cliona* boring sponge. In addition marl riprap and concrete precast structures (reef balls, reef cubes, recycled pipe, boxes, manholes, etc.), granite riprap, basalt riprap, and reef pyramids will be used as experimental construction materials. These materials will also be assessed for their quality as fish habitat.

Monitoring protocol is currently under revision to address challenges associated with new material types. Harvest sampling is not possible with large materials, therefore the Oyster Sanctuary program is exploring options for in-situ monitoring protocol. Current proposals include (1) photo/video sampling coupled with image analysis and (2) using scaled modular sampling units.

10.4 FUNDING NEEDS

Current funding of the Oyster Sanctuary program is sufficient to support monitoring of existing sanctuaries with little margin, but development and future increased monitoring load will be hampered with the reduction in state appropriated funds. Learning from other inter- and intra-state agency monitoring efforts is crucial, with limited funding. Further, with increased development and monitoring load, staff requirements must be addressed with additional technical and biological positions.

10.5 RESEARCH PRIORITIES

- Determine alternative substrates for larval settlement on intertidal and subtidal reefs (cost-benefit analysis for reefs and cultch planting)
- Identify number and size of sanctuaries needed
- Identification of larval settlement cues which influence recruitment to restored reefs (i.e. sound, light, current, etc.).

10.6 POACHING

Observations by NCDMF staff, both biological and enforcement, as well as reports by working watermen, have indicated an increase in poaching activity within sanctuaries. Poaching by means of dredging is most commonly observed in these locations. Conservatively, restored and protected oyster reefs provide up to $40,234 per acre per year in ecosystem benefits (Grabowski et al. 2012). Bottom disturbing gear is destructive of costly state property and extremely detrimental to the function of sanctuaries. .

11.0 ENVIRONMENTAL FACTORS

11.1 HABITAT

The fundamental requirement of the eastern oyster is the mixture of salt water from the ocean, and fresh water from upland drainage that occurs in estuarine systems. Oysters have established themselves as one of the true estuarine species and, given their other requirements for clean, hard substrate necessary for settlement of oyster larvae; they survive the harsh and constantly changing conditions found in the sounds and rivers of North Carolina.

The ecological functions of oyster reefs related to oyster production are well known (Coen et al. 1999). These functions include aggregation of spawning stock, chemical cues for successful spat settlement, and refuge from predators and siltation. Oysters are considered a keystone species and contribute greatly to the integrity of the estuarine system by maintaining the health and stability of the estuarine system. Through the formation of oyster reefs, they add species diversity, community stability, and perform other ecological services by improving water quality and recycling nutrients (Eastern Oyster Biological Review Team 2007). They create biogenic reef habitat important to estuarine biodiversity, benthic-pelagic coupling, and fishery production (Lenihan and Peterson 1998).

Although harvest records suggest a decline in North Carolina's oyster-producing habitat, oyster rocks are still formed on sites where no oysters previously existed. Therefore, oyster habitat should include potentially productive areas where substrate, water flow, salinity patterns, and sedimentation will allow their development.

Threats to oyster habitat include mobile bottom disturbing fishing gear, hand harvest methods, point and non-point source run-off from coastal development that degrade water quality and increase sedimentation, dredge material disposal, severe weather events, disease and introduced or nuisance species (Eastern Oyster Biological Review Team 2007).

11.1.1 Description and Distribution

Oysters are the primary component of shell bottom habitat described in detail in the Coastal Habitat Protection Plan, or CHPP (Deaton et al. 2010). Shell bottom is defined in the CHPP as “estuarine intertidal and subtidal bottom composed of surface shell concentrations of living or dead oysters (Crassostrea virginica), hard clams (Mercenaria mercenaria), and other shellfish.” As such, the primary reference for this section is Deaton et al. (2010) unless otherwise noted. While the interdependency of all habitats is important to oysters, some habitats are of particular importance because they are inhabited by oysters. Those habitats include water column, estuarine soft bottom that support the oyster’s growing or accumulative community weight (Jenkins et al. 1997), and wetlands. Coastal wetlands are attractive to intertidal oysters, and soft bottom areas are included for their potential in shell bottom restoration. Because eastern oysters are the primary biological component of shell bottom habitat, oysters are the only fishery species that is also a habitat. As such, the discussion and recommendations must consider the relationship of shell bottom and other fishery species.

In order to identify threats to oyster habitat, the current distribution and quality of oysters and shell bottom must be documented. The DMF shellfish habitat and abundance mapping program has been ongoing since 1988. Maps are compiled using standardized surveys from the South Carolina border north through Core Sound, along the perimeter of Pamlico Sound, and in Croatan/Roanoke sound. The program delineates all bottom habitats, including shell bottom,

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. This program defines shell habitat (shell bottom) as significant cover (>30% of bottom) of living or dead shells. The program also maps salt marsh, submerged aquatic vegetation, and 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.

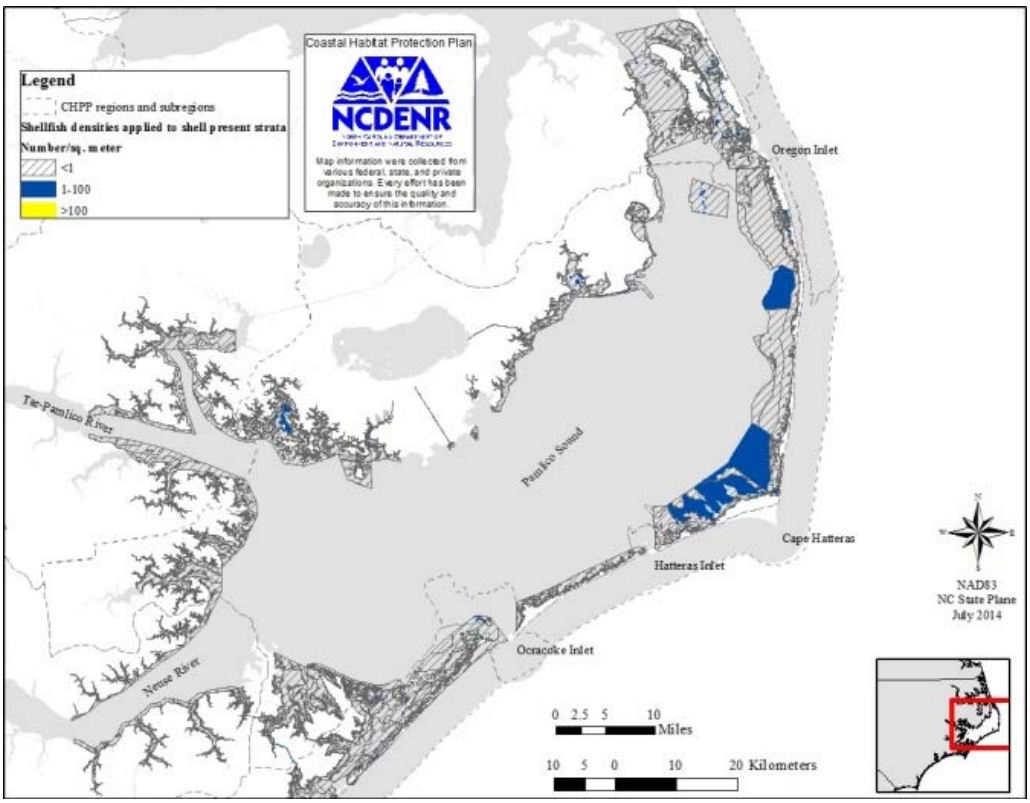

Figure 11.1a. Shellfish Density, NCDMF Shellfish Habitat and Abundance Mapping Program, 2014

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 areas mapped to date. Cape Fear 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 (3436 ac), New/White Oak (3,145 ac), and Southern Estuaries

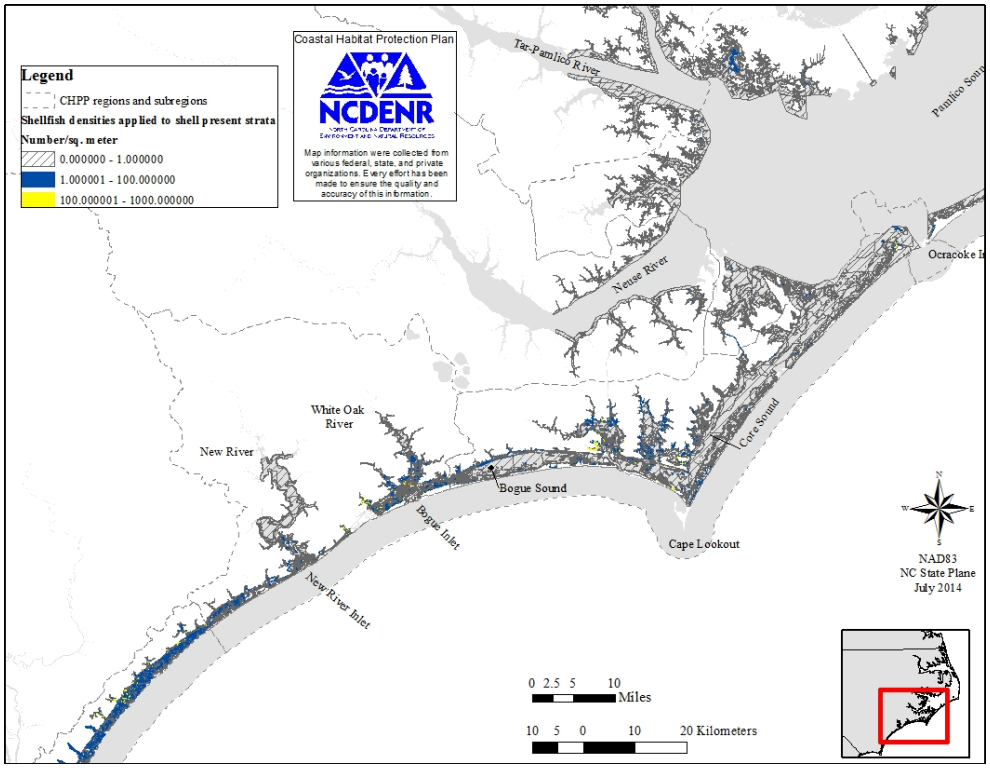

Figure 11.1b. Shellfish Density, NCDMF Shellfish Habitat and Abundance Mapping Program, 2014.

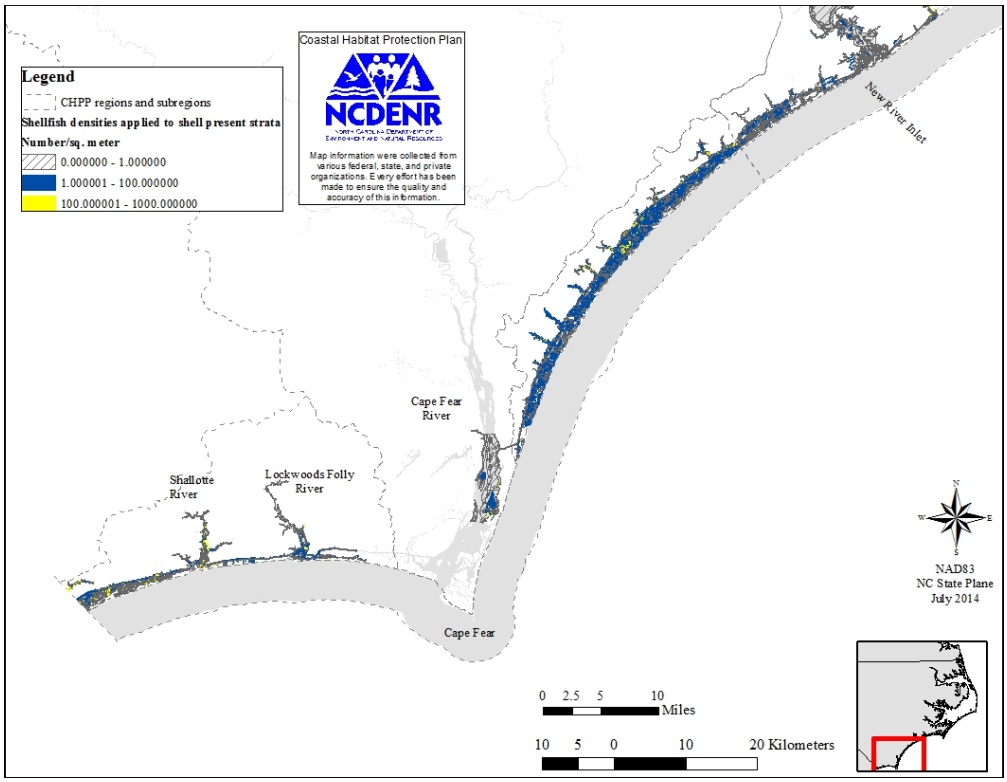

Figure 11.1c. Shellfish Density, NCDMR Shellfish Habitat and Abundance Mapping Program, 2014.

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 at Wanchese Marshes, 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 11.2).

Table 11.1. Shell bottom habitat mapped within Coastal Habitat Protection Management Units y the North Carolina Division of Marine Fisheries' Shellfish Habitat and Abundance Mapping Program, October 2014.

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%	3,436.92	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%	21,221.08	3.59%

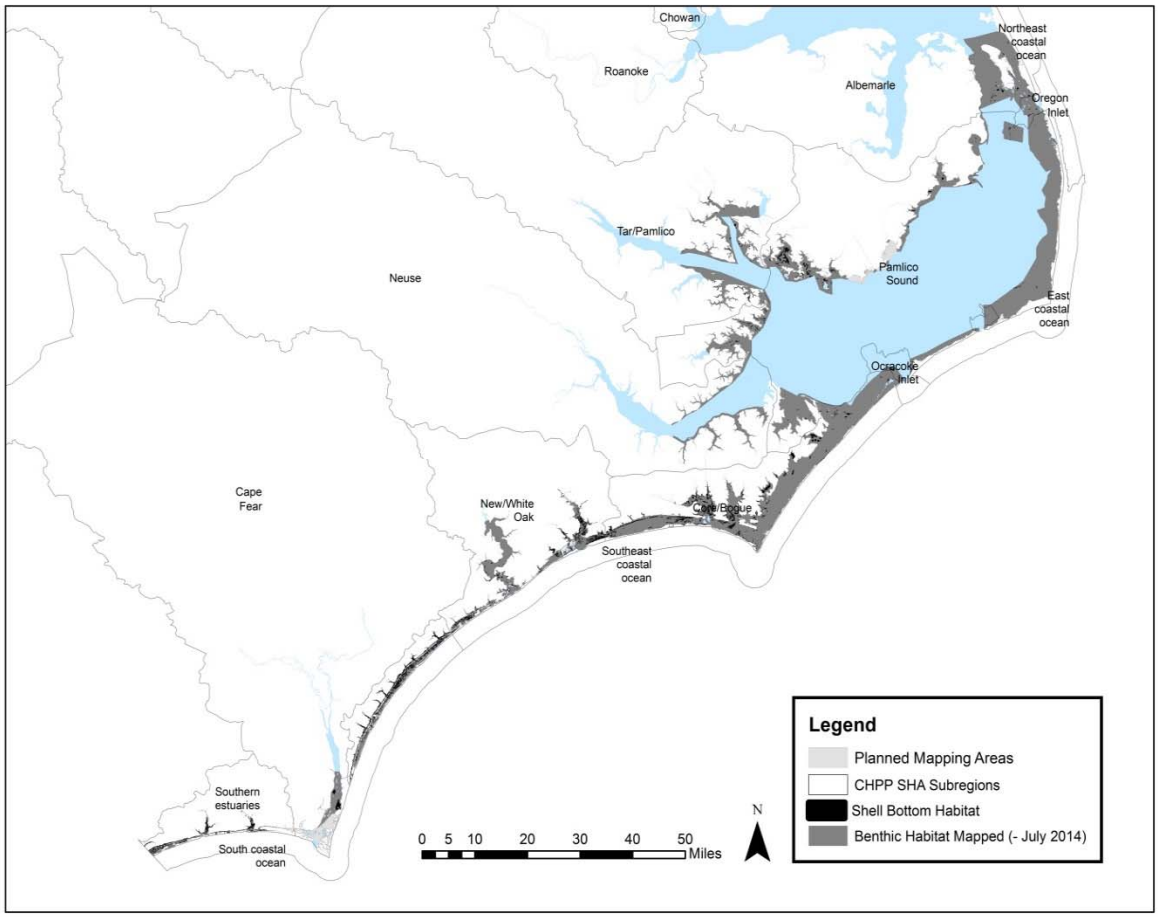

Figure 11.2. Distribution of mapped shell bottom, Habitat and Enhancement Section Bottom Mapping Program, NCDMF, 2014.

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.

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%	3278,01.01	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 ECOSYSTEM ENHANCEMENT

As a keystone species, oysters contribute to the integrity and functionality of the estuarine system. Oysters contribute through the formation of oyster reefs and rocks. These reefs provide structured habitat for refuge and forage, for a diversity of species. Oyster reefs also affect circulation and flow patterns and improves water quality and nutrient recycling.

11.2.1 Habitat Modification

The oyster's structural modification of habitat is important to the estuarine system. Oyster reefs range in shape and size, varying from small patchy mounds to long and wide ridges (Eastern Oyster Biological Review Team 2007). As shell bottom increases, wave energy decreases, stabilizing sediment and decreasing erosion (Lowery and Paynter 2002). High-relief shell bottom alters currents and water flows, influencing patterns of fish settlement, predation and predator feeding success (Breitburg et al. 1995; Coen et al. 1999). On the down-current side of the reef, flow velocity is reduced and larval fish species can maintain their positions during the high-flow portions of the tidal cycle (Breitburg et al. 1995). Oyster reefs can also constrict tidal flow to certain areas, resulting in island formation (Bahr and Lanier 1981). By reducing wave energy along the shoreline, shell bottom aids in stabilizing creek banks and reducing salt marsh erosion (Bahr and Lanier 1981; Dame and Patten 1981; Marshall 1995; Breitburg et al. 2000).

The presence of shell bottom reduces turbidity by filtering water and physically trapping and stabilizing large quantities of suspended sediment as well as organic matter with the shell structure (Haven and Morales-Alamo 1970; Dame et al. 1989; Coen et al. 1999; Grabowski et al. 2000). This, in turn, improves water clarity, which increases productivity of the water column and SAV. The reduction in turbidity has a positive effect on SAV by increasing light penetration to the plants, creating more suitable conditions for SAV growth, survival, and expansion (Meyer and Townsend 2000). As an example, prior to large-scale losses of shell bottom in the Chesapeake Bay, the waters were reported to be much less turbid than current conditions, which allowed submerged aquatic vegetation to thrive (Coen et al. 1999; Jackson et al. 2001). Due to the ecosystem benefits provided by oysters to other habitats, Lenihan and Peterson (1998) proposed that oysters might now be more economically valuable as a habitat than a fishery.

In North Carolina, oysters occur in both subtidal and intertidal habitats. Oysters tend to be more intertidal in the southern and central coast where tides are more lunar driven and become more subtidal in the rivers and Pamlico Sound where tide is driven more by winds. Growth of intertidal reefs is limited by feeding; however reproduction, fecundity and recruitment are high (Eastern Oyster Biological Review Team 2007). Johnson and Smee (2014) conducted cage experiments comparing intertidal oyster mortality to subtidal oyster mortality in Corpus Christi Bay, Texas. They found that intertidal oyster mortality was due to abiotic conditions based on no significant differences between caged and non-caged mortalities of spat. Comparisons between caged subtidal oysters with non-caged subtidal oysters showed higher mortality in non-caged oysters due to predation than those caged in small mesh cages.

11.2.2 Fish Utilization

Oyster reefs provide critical fisheries habitat not only for oysters, but also for recreationally and commercially important finfish, other mollusks, and crustaceans. Data quantifying fish use of habitats vary from presence/absence and numerical abundance, to actual fish production value. In North Carolina, 18 fishery species have been documented utilizing both natural and restored oyster reefs in Pamlico Sound, including Atlantic croaker (*Micropogonias undulatus*), southern flounder (*Paralichthys lethostigma*), Spanish mackerel (*Scomberomorus maculatus*), spotted seatrout (*Cynoscion nebulosus*), weakfish (*Cynoscion regalis*), American eel (*Anguilla rostrata*), and black sea bass (*Centropristis striata*) (Lenihan et al. 2001). Numerical abundance and production compared to other habitats provides additional information on the importance of habitat for fish. The species found most abundantly on oyster reefs compared to adjacent soft bottom were silver perch (*Bairdiella chrysoura*), sheepshead (*Archosargus probocephalus*),

pigfish (*Orthopristis chrysoptera*), pinfish (*Lagodon rhomboides*), toadfish (*Opsanus* spp.), and Atlantic croaker. Southern flounder were collected on both oyster reefs and adjacent soft bottom areas, while bluefish (*Pomatomus saltatrix*) and Atlantic menhaden (*Brevoortia tyrannus*) were not collected near oyster reefs (Lenihan et al. 2001).

Several studies have found higher abundance and diversity of fish on oyster reefs adjacent to soft bottom, particularly pinfish, blue crabs (*Callinectes sapidus*), and grass shrimp (*Palaemonetes* spp.) (Harding and Mann 1999; Posey et al. 1999; Lenihan et al. 2001). A study in Back Sound also found that crabs were more abundant on oyster reefs than restored SAV beds (Elis et al. 1996). Breitburg (1998) concluded that the importance of oyster reefs to highly mobile species is likely underestimated, partially due to the difficulty in sampling oyster reefs.

Peterson et al. (2003) estimated the amount of fish production that oyster reefs provide in addition to adjacent soft bottom habitats. Using results from numerous studies, they compared the density of fish at different life stages on oyster reefs and adjacent soft bottom habitats. The published growth rates of species were then used to determine the amount of production gained from oyster reefs. The species were separated into recruitment-enhanced, growth-enhanced, and not enhanced groups. Recruitment-enhanced species are those having early life stages showing almost exclusive association with oyster reefs. For other species with higher abundance on oyster reefs, diet and life history studies were used to determine the fraction of their production associated with the consumption of shell bottom-enhanced species. Species consuming relatively more shell bottom-enhanced species were classified as growth-enhanced. Analysis of the studies revealed that every $10m^2$ of newly constructed oyster reef in the southeast United States is expected to yield a benefit of an additional 2.6 kg of fish production per year for the lifetime of the reef (Peterson et al. 2003).

Fish that utilize shell bottom can be classified into three categories: resident, transient, and facultative (Coen et al. 1999; Lowery and Paynter 2002). Resident species live on oyster reefs and depend on it as their primary habitat. Transient species are wide-ranging species that use oysters for refuge and forage along with other habitats. Facultative species depend on oyster reefs for food, but utilize other habitats with vertical relief or shelter sites. At least seven fish species have been identified as resident species—naked goby (*Bobiosoma bosc*), striped blenny (*Chasmodes bosquianus*), feather blenny (*Hypsoblennius bentz*), freckled blenny (*Hypsoblennius ionthius*), skilletfish (*Gobiesox strumosus*), and oyster toadfish (*Opsanus tau*) (Coen et al. 1999, Lowery and Paynter 2002). These species were also considered recruitment-enhanced by Peterson et al. (2003). Resident fish are important prey for transient and facultative predator species (Coen et al. 1999). For example, Breitburg (1998) found high densities of juvenile striped bass (*Morone saxatilis*) (15.4 individuals/m^2 of reef surface) aggregating near the reef surface feeding on naked goby larvae congregated on the down-current side of the reef. Other common predator species sampled on oyster reefs in North Carolina are red drum (*Sciaenops ocellatus*) black drum (*Pogonias cromis*), Atlantic croaker, sheepshead, weakfish, spotted seatrout, summer (*Paralichthys dentatus*) and southern flounder, blue crab, and oyster toadfish. Of these species, however, only sheepshead, southern flounder, and oyster toadfish were considered shell bottom-enhanced by Peterson et al. (2003). Production of black drum, Atlantic croaker, blue crab, and summer flounder were classified as not enhanced by shell bottom. Oyster reefs in higher salinity waters are critical habitat for predators such as juvenile gag *(Mycteroperca microlepis*), snappers (*Lutjanus* spp.) and stone crab (*Menippe mercenaria*) (Wenner et al. 1996; Peterson et al. 2003).

There is some variation in fish use among salinity gradients as well. Oyster reefs in higher salinity waters tend to support a greater number of associated species than reefs in lower

salinity waters (Sandifer et al. 1980). Studies summarized by Coen et al. (1999), which included work in North Carolina, identified 72 facultative, resident and transient fish species in close proximity to oyster reefs. The ASMFC-managed species categorized as transient and also important to North Carolina's coastal fisheries are American eel, Atlantic croaker, Atlantic menhaden, black sea bass, bluefish, red drum, spot, striped bass, summer flounder, tautog, and weakfish. Only black sea bass and tautog were considered shell-bottom enhanced by Peterson et al. (2003). A partial list of macrofaunal species observed in collections from oyster habitat is provided in Table 11.3. Those species that use oyster reefs as spawning and/or nursery areas are identified, as are those species that forage on shell bottom habitat and/or use it as a refuge (SAFMC 1998; Lenihan et al. 1998; Coen et al. 1999; Grabowski et al. 2000). More than 30 species are listed in Table 11.3, emphasizing the importance of shell bottom as fisheries habitat.

Kingsley-Smith et al. (2012) compared the nekton community found on intertidal oyster reefs compared to an adjacent control plot of bare sand or mud bottom. Nekton abundance and community composition was significantly greater on the intertidal reef plots compare to control plots in three sites. Abundances also varied with season with highest numbers in the summer compared to spring and fall. Species richness was significantly great on the oyster reefs compared to the control plots but species diversity was higher on the control plots. The high abundance of a small number of species on the reef plots accounted for lower evenness and lower diversity. Overall community structure was more site driven than treatment (oyster reef, bare bottom), however the occurrences of some species seasonally on the reef demonstrates oyster reef's importance as fish habitat.

11.2.3 Water Quality

The direct and indirect ecosystem services of the oyster reef, such as filtering capacity, transfer of production between bottom and water column, nutrient dynamics and sediment stabilization, have been largely ignored or underestimated (Coen and Luckenbach 1998). Oyster reefs indirectly benefit the fisheries by providing water filtration. Kennedy (1991) suggested that the filtering activities of the massive concentrations of oysters historically present in the Chesapeake Bay might have resulted in different assemblages of plankton, with fewer sea nettles, microplankton and bacterioplankton. Before the end of the 19th century, oysters in the Chesapeake Bay could theoretically filter the entire volume of the bay in a little more than three days (Newell 1988). Newell's estimate of the filtering capacity of Chesapeake Bay oyster populations in 1988 was 325 days. Other researchers agree that the loss of oyster populations removes one potentially important means of controlling nuisance phytoplankton blooms and other negative impacts of nutrient enrichment and coastal eutrophication (Officer et al. 1982; Dame et al. 1984; Lenihan and Peterson 1998; Coen et al. 1999; Jackson et al. 2001). Jackson et al. (2001) attributed much of the decline in water quality in Pamlico Sound and Chesapeake Bay to loss of bio-filtration capacity attributable to the drastic decline (>90%) in oyster harvest and presumable biomass.

Shell bottom enhances water quality by transferring phytoplankton production to benthic production through filter feeding (Officer et al. 1982; Cloern 2001; DMF 2001; Newell et al. 2002). Increased shell bottom and oyster biomass reduce the impacts of eutrophication. Based on environmental conditions, carbon and nitrogen can have different biogeochemical fates. After being filtered by oysters, biodeposits may be a source of carbon for denitrification and nitrogen in these deposits can be mineralized to stimulate coupled nitritrification-denitification (Hoellein and Zarnoch 2014). Increases water clarity from filtration will stimulate growth of SAVs. Nutrients and organic matter from these biodeposits can be mineralized microbes, assimilated by plankton and microalgae, or resuspension with possible uptake by adjacent SAV

(Peterson and Peterson 1979; Hoellein and Zarnoch 2014). With more nutrients denitrified or stored in the sediment, the frequency of hypoxia (<2 mg/L of dissolved oxygen) and anoxia (no dissolved oxygen) events in the water column should decrease. The oyster shells themselves also store carbon in the form of calcium carbonate (Hargis and Haven 1999). The sequestered carbon is thus taken out of atmospheric circulation, serving as one means to partially offset the observed trend of increasing concentrations of COB_{2B}, an important greenhouse gas associated with global warming.

Table 11.3. Partial listing of finfish and shellfish species observed in collections from shell bottom in North Carolina, and ecological functions provided by the habitat.

Species	Shell bottom functions [1]					Fishery [2]	Stock Status [3]
	Refuge	Spawning	Nursery	Foraging	Corridor		
Anadromous & catadromous fish							
American eel*	X		X	X	X	X	D
Striped bass*			X	X		X	C - Albemarle Sound, Atlantic Ocean, O - Central/Southern
Estuarine and inlet spawning and nursery							
Anchovies (striped, bay)*		X	X	X			
Blennies*	X	X	X	X			
Black drum*				X		X	U
Blue crab*	X	X	X	X	X	X	C
Oyster*	X	X	X	X		X	C
Gobies*	X	X	X	X			
Grass shrimp*	X	X	X	X			
Hard clam*	X	X	X	X		X	U
Mummichog	X	X			X		
Oyster toadfish*	X	X	X	X		X	
Red drum*	X		X	X	X	X	R
Sheepshead minnow*		X		X			
Silversides*				X			
Skilletfish*	X		X	X			
Spotted seatrout*				X		X	D
Stone crab*	X		X	X		X	
Weakfish	X		X	X	X	X	D
Marine spawning, low-high salinity nursery							
Atlantic croaker				X		X	C
Brown shrimp*	X		X	X	X	X	V
Southern flounder*				X		X	D
Spot	X		X	X	X	X	C
Striped mullet				X		X	V
Marine spawning, high salinity nursery							
Atlantic spadefish						X	C [4]
Black sea bass*	X		X	X	X	X	R - north of Hatteras, V - south of Hatteras
Gag*	X		X	X	X	X	C
Gulf flounder						X	
Pigfish*				X		X	
Pinfish*	X		X	X	X	X	
Pink shrimp*	X		X	X	X	X	V
Sheephead*	X		X	X	X	X	U
Spanish mackerel						X	V
Summer flounder	X			X	X	X	V

* Species whose relative abundances have been reported in the literature as being generally higher in shell bottom than in other habitats.
[1] Sources: Pattilo et al. 1997; SAFMC 1998; Lenihan et al. 1998, 2001; Coen et al. 1999; Grabowski et al. 2000; Peterson et al. 2003; Barrios 2004; ASMFC 2007; A. Barrios unpub. data
[2] Existing commercial or recreational fishery. Fishery and non-fishery species are also important as prey.
[3] V=viable, R=recovering, C=Concern, D=Depleted, U=unknown (DMF 2014).
[4] Status of reef fish complex as a whole. Sheepshead and Atlantic spadefish have not been evaluated in NC.

11.3 PHYSICAL THREATS

11.3.1 Mobile Bottom Disturbing Fishing Gear

Of the factors affecting the condition of oyster habitat, oyster harvest is the most obvious. Both Chestnut (1955) 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). Marshall (1954) studied oyster reefs in the James River, Virginia and found that half of the loss in vertical profile (6 inches) was due to oyster harvesting. By 1987, an estimated 75% of the oyster reef area in the James River had disappeared due to burial and possibly dredging activity (Selizer and Boggs 1988). Oysters are protected within Mechanical Methods Prohibited Areas (15A NCAC 03R .0108). These areas cover over 407,000 acres (30%) of the 1.4 million acres considered to have salinities suitable for oyster survival (NCDMF unpublished data). Mechanical harvest of oysters is allowed in the deep water bays during a limited 6-week season. During the 2008 Oyster FMP amendment, hand harvest limits changed from five bushels per person to 10 bushels per operation in the bays and 15 bushels per operation in the open sound.

Oyster rocks and cultch plantings also provide an excellent habitat for hard clam settlement and growth in areas where salinity regimes and water flow are suitable for clam survival. Hard clam harvesting by hand in oyster rocks involves overturning or sifting through the shells and oysters overlying the hard clams, potentially damaging the oysters. Oyster rocks are protected from mechanical harvest of clams and bull rakes by MFC rules (North Carolina Fisheries Rules for Coastal Waters 15A NCAC 03K .0304 and 03K .0102). However, most harvesting of clams in relation to oysters occurs around the base of oyster beds, where they are most abundant (Noble 1996). 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 closure and marking of areas closed to the 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. Therefore, clam kicking is only allowed in designated harvest areas that do not contain significant SAV or oyster resources.

Other fishing gears also impact oyster habitat. Shrimp and crab trawling can result in removing oysters and cultch material from rocks and firm bottom and depositing them on unsuitable bottoms where they will be covered by sediments (Berrigan et al. 1991; Chestnut 1955). However, commercial fishermen generally avoid oyster beds because they damage towed nets. Intentional disturbance of oyster habitat is more probable over scattered oysters. Frequent disturbance could prevent the formation of larger oyster rocks in the future, especially where there are historical losses. Ongoing efforts to identify suitable areas for oyster restoration may include currently trawled areas. The impact of current fishing practices on oyster habitat suitability has not been quantified in North Carolina.

State posted oyster plantings are protected from any type of trawling or seining when designated as a shellfish management area under North Carolina Fisheries Rules for Coastal Waters 15A NCAC 03K .0103. This includes both 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 sufficient resources and enforcement to

keep them marked and patrolled. The DMF has designated some areas as Shellfish Management Areas where enhancement activities are conducted (shell is added and/or oysters are 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 afterward. The posted areas are mostly south of New River.

11.3.2 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 to not only living oysters but also 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 (DMF 2001). 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 by being smothered beneath sediments associated with clam digging. Conversely, oyster harvesting had little effect on clam populations. DMF conducted field investigations of 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 1995 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 shellfish harvest limits. This allows hand rakes and tongs to be used to take the legal limits of oysters and clams. The proclamation was issued after DMF sampling indicated that legal sized subtidal oysters were present in sufficient quantity to open harvest. The Southern District has a long history of managing SMAs from New River south by allowing oyster harvest on planted rocks first, and then allowing clam harvest. This protects the oyster rocks from being damaged or destroyed by tongs and rakes digging for clams. Currently almost 90% of the bottom mapping area is open to hand harvest methods (Deaton et al. 2010)

11.3.3 Introduced and Nuisance Species

Nuisance and non-native aquatic species are becoming more of a problem throughout the United States. North Carolina shell bottom is at risk from the accidental or intentional introduction of these species. Non-native species enter North Carolina waters through river systems, created waterways such as the IWW, ships discharging ballast water of foreign origin, boats entering North Carolina waters from other areas, and the sale of live fish and shellfish for bait or aquaculture (North Carolina Sea Grant 2000). Oysters have already been impacted by the introduction of the parasites Dermo and MSX. It is suspected that the MSX parasite was introduced with Pacific oysters (*Crassostrea gigas*) (DMF 2001a). Intentional introductions of non-native species are covered under state laws and rules of several commissions. A Permit to Introduce, Transfer or Hold Imported Marine and Estuarine Organisms is required to place a live marine or estuarine organism not native to the state (considered an introduction) or native to the state but originated outside of the state's boundary (considered a transfer) into North Carolina waters. This permit is also required to sell bait imported into the state or to hold or maintain live marine or estuarine organisms imported into the state as live bait, in a quarantine or isolation system or for use in an aquaculture operation. An applicant must provide a certification from a pathologist from the proposed shipments are disease free or from a governmental veterinary

service that the organisms to be shipped were produced in an area or facility free of diseases. The applicant must also provide a certification from a biologist or veterinarian that macroscopic and microscopic examination indicates the shipment contains only those species identified on the permit application. This provides information to the Fisheries Director to determine the action will not pose a significant danger to any native marine resource or the environment. The Director may require an applicant to conduct additional analyses to aid in evaluation of the application, and hold public meetings concerning the application to determine whether or not to issue the requested permit.

11.3.3.1 Non-Native Oysters

During the late 1990s, as oyster populations declined, there was interest in establishing non-native oyster populations in the Chesapeake Bay region. While some oyster introductions have revived or expanded oyster fisheries in some parts of the world (especially in Europe), others failed or caused problems, such as the destruction of native species by exotic diseases (Andrews 1980; DMF 2001). It was thought that if native oyster stocks could not recover naturally, establishment of non-native oyster populations may provide complex structure for fish habitat (if the introduced species were reef-builders), water filtration functions, and preserve a traditional fishery.

Overboard testing of both the Pacific oyster (*Crassostrea gigas*) and the Suminoe oyster (*Crassostrea ariakensis*) was carried out by researchers in North Carolina (NCDMF 2008). The results indicated that the shells of Pacific oyster were too thin to resist predation by native oyster drills and boring worms. (DeBrosse and Allen 1996). The Suminoe oyster was more promising. Laboratory and field studies conducted on the Sumino oyster in Chesapeake Bay indicate rapid growth and survival under a wide range of coastal and estuarine conditions (Richards and Ticco 2002). *C. ariakensis* also shows greater disease resistance than native oysters. However, the Suminoe oyster was found to be susceptible to *Bonamia* sp., a parasitic protest in high salinities.

There is much debate and uncertainty regarding the introduction of non-native oysters (Richards and Ticco 2002). Since 2001, concerns of introduction included long-term survival of introduced species, competition with native oysters, unknown reef-building attributes, cross-fertilization with native species (reducing viability of spat and decreasing reproductive success), and introduction of non-native pests with the introduced oysters (DMF 2008). A comprehensive study of non-native oyster introductions was completed by the National Research Council of the National Academy of Science in 2003 (NRC 2003). The study identified several concerns that should be addressed by decision-makers while considering any introduction of a non-native oyster is under consideration but concluded that *C. ariakensis* is probably well suited for growth and reproduction in the Chesapeake Bay and similar estuarine habitats on the Atlantic coast.

In 2003, legislation was introduced in Virginia and Maryland legislatures to establish breeding populations of Suminoe oysters in Chesapeake Bay if within three years scientists failed to prove that the introduction would be harmful to the Chesapeake Bay ecosystem. This action was taken in response to promising preliminary testing results with Suminoe oysters and fear of a total loss of the oyster industry in the region without a revival of the oyster fishery. The US Fish and Wildlife Service and National Marine Fisheries Service stated their opposition to the proposed diploid introduction and their intention to block it. The US Army Corps of Engineers (USACE) became the middle man in this controversy since they would require permits for the cages used to grow the Suminoe oysters and the fact that escapement of non-native

aquaculture species has been ruled a violation of the Clean Water Act. Escaped non-native species are considered to be a biological pollutant.

Later in 2003, Virginia and Maryland requested the USACE develop an environmental impact statement (EIS) to assess the proposed introduction and the impacts of other oyster restoration alternatives. In August of 2009 the USACE issued a Record of Decision to disallow introduction of the Suminoe oyster and instead encouraged enhanced restoration and aquaculture using the native oyster.

11.3.4 Biological Stressors

11.3.4.1 Dermo Disease (*Perkinsus marinus*)

The oyster parasite *Perkinsus marinus*, also known as Dermo disease, has been responsible for major oyster mortalities in North Carolina during the late 1980s to mid 1990s. Dermo, a protist, similar to dinoflagellates, causes degradation of oyster tissue. Once infected, oysters suffer reduced growth, poor condition, diminished reproductive capacity and ultimately mortality resulting from tissue lysis and occlusion of hemolymph vessels (Ford and Figueras 1988; Ford and Tripp 1996; Haskin et al. 1966; Ray and Chandler 1955). Optimum conditions for infection are during extended periods of time when salinities are greater than 20 ppt and water temperatures are greater than 20ºC. Salinities below 10 ppt are energetically stressful to Dermo when persisting for two weeks or more (DMF 2008; La Peyre et al. 2006; VIMS 2002). Environmental stressors, such as low dissolved oxygen, sediment loading, and anthropogenic pollution, increase the susceptibility of oysters to parasitism and disease (Barber 1987; Kennedy et al. 1996; Lenihan et al. 1999). Research on experimental subtidal oyster reefs in the Neuse River estuary found that oysters with the highest Dermo prevalence, infection intensity, and mortally were located at the base of reefs, where currents and food quality were lowest and sedimentation rates highest (Lenihan et al. 1999). Oysters located at the crest of reefs, however were much less susceptible to parasitism and Dermo-related mortality (Lenihan et al. 1999). Chestnut (1955) may have been the first to report its occurrence in North Carolina. However, no extensive assessments were attempted until large-scale oyster mortalities prompted investigations during the fall of 1988. Oyster samples from 11 sites were sent to the Virginia Institute of Marine Science (VIMS) and the Cooperative Oxford Laboratory. Results showed that Dermo infection was the major cause of mortalities (DMF 2008).

In 1989 DMF began diagnosing Dermo infections. All diagnoses were made using the rectal thioglycolate method described by Ray (1952). Beginning in 1991, DMF began a formal dermo monitoring program that has collected samples annually. New categories of infection intensity were applied to all existing Dermo samples in this analysis, based on recommendations from oyster disease experts from VIMS. Intensity of Dermo is rated by counting number cells per field under the microscope; 10's-light,100's-moderate, 1,000's-heavy. A weighted incidence (W.I.) is then determined and is used for comparison of intensity levels of other sites. Weighted incidence is determined by multiplying the number of lightly infected individuals by 1, the number of moderate by 3, and the number of heavy by 5. Then adding those numbers together and dividing by the number of individuals in the sample (NCDMF Program 675). Categories of infection intensity were established based on Mackin (1962) but with only four breakdowns used: uninfected = no infected oysters in sample; low = 0.1-1.5; moderate=1.51-2.5; and high= >2.5. Low, moderate, and high refer to the expected mortality rates at the respective infection intensities. Samples with moderate and high categories of infection intensity are expected to have mortality rates that considerably affect harvest if optimum conditions for parasitic growth and dispersal continue to persist.

During 1990, the southern estuaries and Pamlico County had high numbers of high intensity Dermo infections, with heaviest mortalities in Pamlico County and northern Carteret County. Sampling during this time also revealed overwintering infections. Mortalities in Pamlico County were found to begin in June of 1990, probably due to the mild winter weather (Sherman et al. 1991). In Virginia, Dermo infections could not be detected during the winter months while South Carolina experienced infections on a year-round basis. North Carolina appears to have some overwintering infections during mild years, although few samples are taken during winter months.

All sites sampled in 1991 showed some level of infection with infection intensities much higher than previous years. Hyde County oysters were impacted by disease mortalities for the first time in 1991. High infection levels continued in most areas, and mortality of a smaller size class of oysters was observed. Dermo infections continued to be widespread in 1992. Infection intensity decreased at some sites; however, while some areas improved, the overall infection intensity remained high in 1992. Infection intensity dropped significantly during 1993 and infection levels capable of causing significant impacts on harvest were low from the mid 1990s to mid 2000s. However, the parasite remains prevalent, indicating that a return to the very high oyster mortalities of 1991 and 1992 is possible.

Staff observed in the southern estuaries, that during late summer, moderate and high dermo infection levels did not reduce oyster populations. Hand harvest landings in the south from 1991 through 2002 did not decline in the same manner as landings from Pamlico Sound during the same time. It is suspected that the small, high salinity estuaries may inhibit mortality by flushing out parasites at a higher rate or by exceeding the salinity tolerance of the Dermo parasite, allowing for a higher survival rate compared to Pamlico Sound. The link between low dissolved oxygen, increased availability of iron, and increased parasite activity may also be a factor in the different mortality rates as the smaller, high salinity estuaries are less prone to low dissolved oxygen events than the Pamlico Sound (Leffler et al. 1998). Dermo infection intensity levels since 2005 have remained low; however prevalence appears to be increasing (DMF unpublished data).

11.3.4.2 MSX or Multinucleate Sphere X (*Haplosporidium nelson*)

MSX is a pathogen that originally caused oyster populations to experience high mortality rates in the 1950s in Delaware Bay and Chesapeake Bay and is prevalent today. It is believed to have been introduced by experimental transfers of the Pacific oyster (*Crassostrea gigas*), which is resistant to this disease. Oyster mortalities are highest in the summer months, and increase in higher salinity waters. Salinities below 10 ppt are lethal to MSX when persisting for two weeks or more (DMF 2008; La Peyre et al. 2006; VIMS 2002). Further, MSX can infect all ages of oysters (Andrews 1966; Barber et al. 1991). MSX-infected oysters have truncated reproductive potential, caused by carbohydrate deficiency from reduced feeding rates.

MSX, was found in Crab Slough and Wysocking Bay in Pamlico Sound in 1988. These two sites had high infection levels during 1988 but showed little or no infection in 1989. A total of 11 of the 36 sites sampled in 1989 were positive for MSX. Only two sites, Middle Ground and Great Island, showed infections at levels causing mortality. Sampling conducted by the North Carolina State University College of Veterinary Medicine during 1990 through 1992 indicated no high intensity MSX infections (unpublished data). Occasional sampling from 1993 to 1995 did not indicate any infections and since 1996, heavy rainfall from intense hurricane activity and

other weather events have reduced Pamlico Sound salinities periodically so sampling has been discontinued.

11.3.4.3 Boring Sponge (*Clionia spp*)

The boring sponge (*Clionia* spp) is considered a bioeroder in systems of calcified skeletons such as corals and oyster reefs. These sponges can chemically etch out canal systems within oyster reefs, as well as incrust and smother them. Boring sponges range in color from yellow to dark brown or black and can cause mortality by weakening the shell. As the shell becomes weak, the oyster is unable to protect itself from predators. Once the oyster reef has been compromised, there is a loss of substrate, reduction in vertical relief and loss of structural integrity.

Boring sponges are linked to salinity gradients with some species found in high salinity waters while other species are found in the low to mid-range salinities but typically are not found in waters with less than 10 ppt. Intertidal oysters have some refuge from boring sponge.

Lindquist et al. (2012) examined the distribution and abundance of oyster reef bioerosion by *Clionia* in North Carolina. The study examined levels of boring sponge infestations across salinity gradients in multiple oyster habitats from New River through the southern portions of Pamlico Sound. Results provide in the study quantified infestation levels, activity levels of infestation, and also noted the presence of gemmules which are produced by the boring sponge in response to adverse environmental conditions such as the occurrence of freshlets. In addition the presence of the bioeroding polycheate worm *Polydora* was also noted.

The study found boring sponge infestations in all oyster communities sampled with the exception of those found in the upper reaches of some tidal creeks in the Newport and North Rivers in Carteret County, North Carolina. Low salinity that had mean salinity levels of approximately 15 ppt while the higher salinity areas with a mean salinity of 20 ppt or greater were infested by the high salinity tolerant boring sponge *Clionia celata*. He found that as salinities increased, infestations increased and subtidal reefs disappeared (Lindquist et al. 2012).

Freshlets that occurred in White Oak River and New River prior to initial surveys demonstrated the resilience of boring sponges. Sample sites in both of these areas had no active infestations but gemmules were observed. Sampling seven to eight months later, found moderate to high levels of active sponge infestation. *Polydora* worms were also more abundant in the lower salinity areas and decreased in areas where salinities were higher (Lindquist et al. 2012).

11.3.5 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 water-dependent structures may actually increase substrate for oysters, activities associated with water-dependent development can harm shell bottom. Dredging of channels for navigational purposes can remove, damage, or degrade existing shell bottom. Dredging

creates turbidity that can clog oyster gills or cover the oysters completely. Even low levels of siltation affect growth of oyster beds by reducing larval attachment.

Although there are no new major channels being constructed at this time in North Carolina's estuarine waters, maintenance dredging, construction of new marinas and docking facilities, and new dredging for deep water access continue to be potential problems. Primary Nursery Areas are currently protected from dredging projects for deep-water access. However, there are other areas with shallow oyster beds that are not protected from such dredging.

In accordance with Coastal Resources Commission 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)(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.

11.4 WATER QUALITY DEGRADATION

11.4.1 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 Division of Water Quality (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 2000a). 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 ranking for impaired waters). All of these river basins contain shell bottom habitat.

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 oyster reefs indirectly by re-suspending sediment. As sediment disperses away from the disturbance and settles to the bottom, it can bury oyster larvae, adults, or shell, deterring successful recruitment of larvae due to lack of an exposed hard substrate (Coen et al. 1999). Excessive sedimentation can also harm shellfish by clogging gills, increasing survival time of pathogenic bacteria, or increasing ingestion of non-food particles (SAFMC 1998). Oyster eggs and larvae are most sensitive to suspended sediment loading (Davis and Hidu 1969).

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 would live in clear waters (Schueler 1999). While fecal coliform bacteria do not affect the viability of oysters, pathogenic bacteria can make oysters unfit for human consumption. The primary sources of microbial contamination in coastal waters are thought to occur within on 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. These activities include, but are not limited to, construction of residential, commercial, or transportation structures; forestry operations; and agricultural activities. There were many thousands of wetland acres lost to agricultural drainage before the "Swampbuster" provisions of the 1985 Farm Bill (Deaton et al. 2010). 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, NCMFC 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 selected river basins. Although definitions and characteristics of vegetated buffers vary, a buffer is generally a vegetated transitional zone, situated between upland land use and aquatic habitats that functions as a filter of surface water runoff (Crowell 1998). Vegetated buffers are very effective in trapping sediment as well as other pollutants from stormwater runoff (Williams and Nicks 1988; Lee et al. 1989; Gilliam et al. 1994; Lowrance 1997; DWQ 2000b). 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 CAMA. This buffer begins at the water's edge, and allows clearing of vegetation as long as no soil disturbance occurs. Although this buffer has positive environmental benefits throughout the coast, the science suggests that it will be inadequate in significantly reducing pollutant loading from nonpoint runoff (Lee et al. 1989; 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 clearcut, found that the clearcut caused violations of ambient N.C. water quality standards for turbidity, chlorophyll a, fecal coliform bacteria and DO 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 clearcut. The buffer was less than the state BMP recommending a 50 ft minimum buffer.

In the Neuse, Tar-Pamlico, and Catawba river basins, there is a mandatory buffer of 50 ft from mean high water, with exemptions for managed forests and selective harvesting of high value trees. The Neuse and Tar-Pamlico riparian buffer rules include a zonal design. Zone 1 must be a 30 ft wide forested area, beginning at mean high water (MHW), where the first 10 ft remain completely 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 are allowed. The rule applies to all perennial and intermittent streams, lakes, ponds, and estuaries. All man-made ditches are exempt from this rule [EMC 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 (NCDWQ 2009).

Shoreline erosion can also be a source of sediment in coastal estuarine systems. This is a natural process except where bulkheads have hardened the shoreline. While bulkheads can retain some upland sediment, such structures can increase erosion at the base of and downstream from the hardened structures, causing chronic increased turbidity in those areas (McDougal et al. 1987). Oysters are indirectly affected where marsh grass substrate is lost in front of the bulkheads that are less suitable as substrate.

11.4.2 Chemical Contamination

Marine bivalves have been shown to accumulate chemical contaminates, such as hydrocarbons and heavy metals, in high concentrations. Exposure to organic contaminates 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 contaminates is difficult, the presence of these contaminants in many of the state's estuaries is cause for concern for clam stocks.

11.4.3 Microbial Contamination

Microbial contamination from fecal matter is important to DMF 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 including humans, wildlife and domesticated livestock. While these bacteria are not necessarily harmful to humans or other animals, their presence in water or in filter-feeding shellfish may indicate the presence of other bacteria that are detrimental to human health (DWQ 2000a). 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), studied water quality in several tidal creeks in New Hanover County, and 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 are associated 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 must be closed to shellfish harvest when fecal coliform counts increase above the standard 14 MPN/100ml [Marine Fisheries Commission Rules 15A NCAC 18A Section .0900 Classification of Shellfish Waters], where MPN denotes "most probable number." The NCDMF closes waters where a high potential for bacterial contamination exists, such as around marinas and point source discharges. Shellfish harvest closures have continued to occur over time (NCDMF 2001a; 2001b), which has led to a reduction in available shellfish harvest areas. Long term shellfish closures due to bacterial contamination remove available harvest area for shellfish and concentrate those activities on remaining resources compounding harvest related impacts on the oyster habitat in those areas. While closures may protect shell bottom habitat from harvesting, water quality degradation associated with high bacterial contamination is not advantageous for other aquatic organisms and fish. However, because shellfish filter organisms from the water column, unharvested shellfish may provide an important water quality enhancement function to the water column.

Microbial contamination 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 are 33 NPDES wastewater dischargers within .5mi of SA waters and 72 permitted wastewater non-discharge facilities within half mile SA waters (Heather Patt; Personal communication Division of Water Resources 2015).

Non-point source pollution generally results from precipitation and the resultant land runoff. This stormwater runoff can include microbial pollution from livestock, pet wastes and faulty septic systems among other sources. Stormwater permits are issued by the NC Division of Energy, Mineral and Land Resources' Stormwater Permitting Program. The number of stormwater permits issued in CAMA counties increased from over 500/year from 2001 through 2004, to around 800/year in 2005 through 2007 when the issuance of new permits began to decreased. The downward trend has continued through the year 2013 (Table 11.4).

Table 11.4. 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).

DWQ studies of shellfish closures found significant increases in conditionally closed harvesting waters between 1988 and 2005 (Tom Reeder/DWQ, personal communication, 2007; see also Mallin 2009). The implementation of existing stormwater rules was apparently ineffective at preventing shellfish closures in North Carolina‘s highest quality waters. Between 2004 and 2014, there were 1,869 additional acres of water permanently closed to shellfish harvesting in North Carolina.

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 water segments 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 water segments 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 11.5). 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 in lower resource areas as a result 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 results show the area has returned to normal conditions. Large storms, such as hurricanes, result 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.

Table 11.5. 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 will be 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

11.5 ENVIRONMENTAL PATHOGENS

11.5.1 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, Sharon M., et al.). 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 KA; Kusek KM). 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 CA). 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 FM; Gilbert PM; Peperzak L).

The first recorded blooms of red tide from the Gulf of Mexico were in the 1840's (Walker ST, Magana, HA). The largest reported outbreak of NSP in the US occurred in North Carolina after K. brevis was carried into that region (Tester, PA, Morris, PD, and Sobel J). 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, PK). 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 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 also has a contingency plan to conduct aerial surveillance of offshore waters, collecting samples, and closing and patrolling areas closed to harvest because of red tide (Patti Fowler, Shellfish Sanitation Section, personal communication 2015).

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 04, 2014).

11.5.2 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 hemachromatosis (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 DMF 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.

11.6. GREEN GILL

An organism that can affect the market of shellfish, including oysters is green gill. Green gill in oysters 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. Oysters 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 oysters, 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 US, shellfish markets have a hard time selling them because the typical American consumer considers them undesirable.

11.7 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 DENR are responsible for providing technical and financial assistance, planning, permitting, certification, monitoring, and regulatory activities that have a direct or indirect impact on coastal water quality and habitat. Various federal and state environmental and resource agencies, including DMF, evaluate proposed projects and provide comments and recommendations on potential water quality and resource impacts. Water quality protection relies on enforcement, the ability of commenting agencies to evaluate impacts, and whether recommendations are incorporated 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 adjacent public trust resources and estuarine water quality.

11.7.1 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 at 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 to protect these resources. Through designation of Primary 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 shell bottom (Table 11.5). Other protections for shell bottom are actually

based on protecting oyster rock– see, “Physical Threats,” subsection on, “Mobile bottom disturbing fishing gear,” for more information on mechanical methods prohibited areas and shellfish/seed management areas.

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 western 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.

11.7.2 Environmental Management Commission

By Environmental Management Commission (EMC) rules, all shellfish waters with significant resources are classified as SA waters and are, by definition, High Quality Waters (HQW). In addition, some waters that are classified SA also carry the Outstanding Resource Waters (ORW) classification based on recreational or environmental special uses. These waters are afforded additional protection from construction and runoff under EMC, CRC and Sedimentation Control Commission rules.

The North Carolina Division of Resources haves established water quality classifications and standards program for "best usage." Water quality classifications and standards have recently 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 nonpoint 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 CHPP, achievement of basinwide water quality management objectives by the DWQ should also improve coastal water quality.

11.7.3 Coastal Habitat Protection Plan

The FRA of 1997 mandated the DENR 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 CHPP was approved in December 2004 by CRC, EMC, and MFC and the Department in July 2005 and implementation plans were developed for each Commission and the Department. The CRC, EMC, and the MFC must each

implement the plan for it to be effective. These three Commissions have regulatory jurisdiction over the coastal resources, water, and marine fishery resources. Actions taken by all three commissions pertaining to the coastal area, including rule making, are to comply, "to the maximum extent practicable" with the plans. The CHPP will help to ensure consistent actions among these three commissions as well as their supporting DENR agencies and will be 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" (Deaton et al. 2010). Fish habitat also includes land areas that are adjacent to, and periodically flooded by riverine and coastal waters. Six fish habitats were discussed and designated based on distinctive physical properties, ecological functions, and habitat requirements for living components of the habitat: 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 may be especially important to fish viability and productivity. Protection of these areas would therefore be 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.

11.7.4 Restoration Activities

Restoration efforts are another form of oyster management designed to address the decline in oyster harvest and associated population size. The Oyster 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 1955; Munden 1975; and Munden 1981). State-sponsored cultch plantings begin in 1915. The primary purpose of the DMF cultch-planting program since it began has been oyster fishery enhancement, which provides only temporary habitat value. Recent research showing the important ecological and economic value of oyster reefs has prompted DMF enhancement efforts 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).

In honor of the former Senator Jean Preston, the N.C. General Assembly identified its intent to establish a marine shellfish sanctuary in the Pamlico Sound. Session Law 2014 – 120 Section 44 tasked the Division of Marine Fisheries with designating an area of appropriate acreage within Pamlico Sound as a recommendation to the Environmental Review Commission for the establishment of the "Senator Jean Preston Marine Shellfish Sanctuary" and to create a plan for managing the sanctuary. The plan is required to address the location and delineation of the sanctuary; administration with prices for the leased areas and administration fees; identification of funding necessary for the construction, seeding, and monitoring of the restoration areas; and provision of relief to commercial fishermen that meet specific license and income criteria through free or discounted leases. The plan should also include recommendations for statutory or regulatory changes to expedite the expansion of shellfish restoration and harvesting to improve water quality, restore ecological habitats, and expand the coastal economy. This initial report will provide background information relative to the charge of legislation and identify the actions that will be necessary to fulfill the legislative intent (NCDMF 2014).

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 (UNC-W 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.

11.8 STATUS OF 2008 ENVIRONMENTAL FACTORS RECOMMENDATIONS

Since the 2008 recommendations, there have been many movements in a positive direction for oyster habitat. Strategic Habitat Areas 1, 2, and 3 have all have been mapped and nominated for designation from the Virginia border to New River/Stump Sound. 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 through CRFL and other grants and collaborative projects with the US Navy and The Nature Conservancy.

11.9. HABITAT AND WATER QUALITY 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 impact of current fishing practices on oyster habitat suitability in North Carolina.
- Quantify the relationship between water quality parameters and the cumulative effect of shoreline development units (e.g., docks, bulkhead sections)
- Develop peer reviewed, standardized monitoring metrics and methodologies for oyster restoration and stock status assessments.

12.0 PRINCIPAL ISSUES AND MANAGEMENT OPTIONS

12.1 OYSTER MANAGEMENT STRATEGIES

12.1.1 Re-Open Shallow Bays (< 6 Ft) Of Pamlico Sound to Mechanical Harvest

I. ISSUE

Consider re-opening the shallow bays (< 6ft.) in Pamlico Sound that were closed to mechanical harvest through the 2001 Oyster Fishery Management Plan (FMP). Prohibited areas that fishermen have requested to re-open include Long Shoal River and Stumpy Point Bay. Consider re-opening the deep bays (>6 ft.) that are subject to mechanical harvest method restrictions and are currently opened by proclamation for a six-week period beginning in November.

II. ORIGINATION

This issue originated from oyster dredge fishermen in Pamlico Sound.

III. BACKGROUND

Before the development of the 2001 Oyster FMP, there were concerns about reduced oyster habitat and long-term declines in harvest. Mechanical harvest, in the form of oyster dredging has had a detrimental impact on oyster habitat. Historically, Chestnut (1955) 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. Further research has shown that 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).

To address the concerns of oyster dredging on oyster habitat, the 2001 FMP management strategy was to adopt criteria for the further designation of areas limited to hand harvest, to designate those areas by rule, and to conduct public meetings on those designated areas. Other recommendations included increasing cultch plantings in hand harvest areas and maintaining cultch plantings in mechanical harvest areas. It was also recommended that trawling and long-haul seining be prohibited on marked cultch and seed planting sites and designate them as shellfish management areas.

Criteria were developed and maps were made and presented to the public in a series of public meetings held in October 2002. During these meetings, the public consistently complained about the depth of 10 feet used as part of the designation criteria because it was too deep for hand harvest gear, stating that depths less than six feet were better for hand harvest. Based on this input and additional input concerning designating these hand harvest areas by proclamation instead of rule, the division began development of Amendment 1 for consideration of changing the 10-foot criteria to six-foot and designating hand harvest areas by proclamation instead of rule. The final Amendment 1 put into place the six-foot criterion (Table 12.1) and based on these criteria, approximately 30,000 acres were closed to mechanical harvest (Figure 12.1). However, the hand harvest areas were put in place by rule and not by proclamation.

Table 12.1. Amendment 1 criteria used to designate hand harvest areas

	Criteria
Habitat	The impact of particular harvest methods on existing habitats should be addressed. Areas where movement of sediments would be detrimental to the habitat should employ non-bottom disturbing gear. Primary Nursery Areas (PNA) are protected by rule. Submerged aquatic vegetation, some Secondary Nursery Areas and oyster beds with thin bases should be considered for hand harvest designations. Higher profile subtidal oyster rocks should be designated for mechanical harvest methods if practical. Monitoring and management of mechanical harvest areas should be conducted to maintain the integrity of the habitat.
Physical factors	Currents, wave action, and water depth have significant effects on the gear suitable for use in specific areas. Hand harvest gears lose effectiveness where these physical effects are excessive. Currently, in North Carolina, hand tonging is generally conducted in waters less than 6 feet deep, in deeper estuaries less than 2 miles in width, and generally away from inlets where tidal currents are reduced. Careful consideration should be given to existing in-state expertise in hand harvest techniques prior to any designations. Expanded parameters could be considered if projected management schemes expand available habitat suitable for hand harvest shellfishing.
Consistency determination	Oyster bottoms that should be protected from mechanical harvest methods should also be protected from other bottom disturbing gear harmful to oyster habitat. Existing uses and dependency on bottom disturbing gear in proposed areas should be carefully considered.
Resource enhancement prospects	Although many existing oyster rehabilitation sites are available to hand tongs, most sites in areas open to mechanical harvest have been planted in areas typically harvested by oyster dredging. A shift to shallower water where hand tonging is more efficient would require increased planting with shallow draft vessels. An assessment of the Division's capability to plant cultch or relay seed into an area should be made prior to any re-designation of harvest methods.
Enforcement potential	The overall number of designated areas, their configurations, and accessibility for enforcement purposes should be considered in any new harvest area designations.

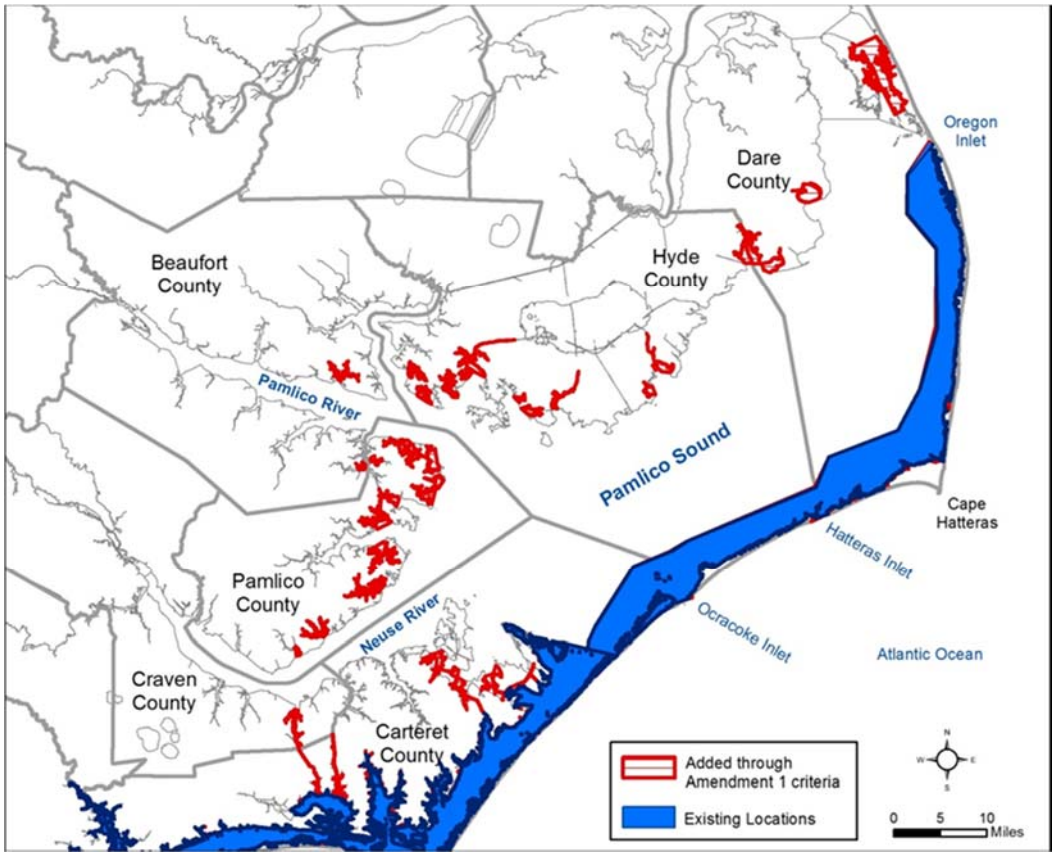

Figure 12.1. Areas closed through Amendment 1 of the Oyster FMP.

During development of Amendment 2 of the Oyster FMP, the issue of hand harvest and mechanical harvest trip limits was addressed. There was no harvest limits on oysters prior to the institution of a 75-bushel per day vessel harvest limit in 1947. The 75-bushel per day per vessel harvest limit existed either in statute or rule until 1984 when proclamation authority was established for oyster limits. Between 1984 and 1989, the oyster harvest limit was 50-bushels per vessel per day. An addition to the proclamation authority in 1989 placed an upper harvest limit of 50-bushels of oysters per commercial fishing operation but allowed the director to set lower harvest limits. Harvest limits for the mechanical fishery were 20 bushels per fishing operation from 1990 through spring 1992. During this time, a five-bushel hand harvest limit per person/10-bushels per operation limit was also put in place. Mechanical harvest oyster limits have been set at 15 bushels per fishing operation since the 1992/93 season, except for a brief period during the 2004/05 season when the limit was increased to 20 bushels, primarily due to large increases in fuel costs and for 17 days during the 2010/11 season after adoption of Supplement A. Setting the oyster harvest limit at 15 bushels for mechanical harvesters and five bushels for hand harvesters was in response to low population levels observed due to *Perkinsus marinus* (Dermo) induced mortalities.

With the closure of shallow bays (<6 ft.) to mechanical harvest in the northern region, and the increase of cultch plantings in hand harvest areas, hand harvest limits remained at five-bushels per person/10-bushels per operation and provided no incentive to mechanical harvesters to take up hand harvest. To further promote habitat friendly hand harvest gears, the hand harvest trip limits were increased in areas north of Carteret County from five bushels to 15-bushels per

operation in the open waters of Pamlico Sound, and 10 bushels per operation in the deep bays (>6 ft.), making them the same as mechanical harvest limits in those areas. Hand harvest limits were also increased to 10-bushels per operation in the shallow bays (<6 ft.). The five-bushel limit per person/10-bushels per operation remained in the southern area from Carteret County to the South Carolina line.

Concerns about dredge weights and tooth bar lengths were raised by the Marine Fisheries Commission Shellfish Advisory Committee in 2004. This led to a proposed amendment recommending changes in mechanical harvest management. The proposed amendment contained recommendations changing dredge weight limits from 100 lb with no tooth bar limit, to 50 lb with a 36-inch tooth bar limit. It also recommended that dredging in the deep bays (≥6ft.) be restricted to three days a week, from sunrise to 2:00 pm, and to limit the fishery to six-bushels per operation from November to January 1. Based on public comment and the need for further study on impacts of dredges of different weights, the amendment did not pass. However, while addressing this issue in Amendment 2, it was recommended that more data be collected on 100-lb versus 50-lb dredges. It was also recommended that a 10-bushel mechanical harvest limit in the deep bays (≥6 ft.) of Pamlico Sound be put in place for six weeks from November to December (Figure 12.2).

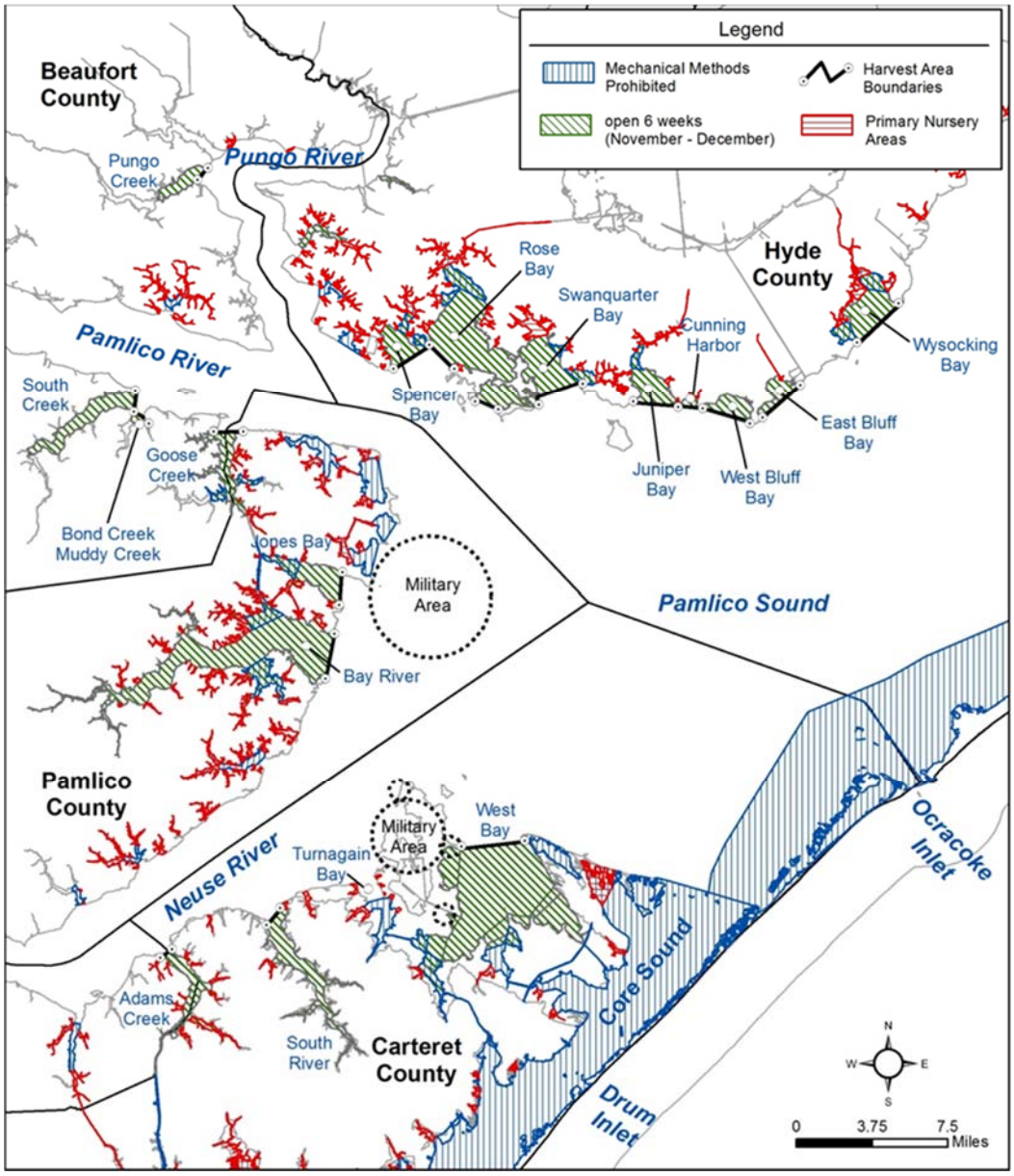

Figure 12.2 Bays that are open for six weeks in November-December

IV. AUTHORITY

N.C. General Statutes

113-134 Rules
113-182 Regulation of fishing and fisheries
113-221.1 Proclamations; emergency review.

V. DISCUSSION

With the decrease in Dermo infections and implementation of the 2008 FMP Amendment 2, and the 2010 Supplement to Amendment 2, the northern mechanical oyster fishery has shown signs of improvement. Environmental conditions from Hurricane Irene in 2011 and low dissolved oxygen episodes during 2011 and 2012, most likely impacted the oyster populations during the 2011/12 and 2012/13 seasons when landings decreased. The Division will continue to monitor mechanical harvest of oysters around the areas of Brant Island Shoal, Middle Grounds, and northern Hyde and Dare counties to ensure minimal fishing impacts to the stock and habitat. The protection of the oyster habitat is imperative to the production of oysters and monitoring these areas has proven to be beneficial to the fishery.

Poor water quality and physical disturbances have been shown to be detrimental to oyster habitat. Shallow bays (<6 ft.) are closed to mechanical harvest to protect the habitat from impacts from the oyster dredge. These areas are open to hand harvest only with limits the same as mechanical harvest limits in the deep bays ($\geq$ 6 ft), in order to encourage hand harvest.

Additional dredge restrictions implemented through Amendment 2 restrict harvest to six-weeks in November and December with a 10-bushel limit in the deep bays ($\geq$6 ft.). This was put in place to further protect the oyster habitat in the bays. Lengthening the fishing period greater than six weeks will allow for additional harvest and also an opportunity to harvest on days when weather is too rough to work in the sound. Shortening the six-week time frame will allow for greater protection of oyster habitat but may remove opportunities for fishermen with smaller boats to fish in times of poor weather conditions.

Another option would be change when to open the six-week season in the deep bays ($\geq$6 ft.). Currently it opens at the beginning of the season. Opening later in the season may allow for fishermen to take advantage of areas to fish during bad weather that tends to be more prevalent later in the season. Opening the areas until sampling indicates the fishery is reaching the 26% trigger may be another option to consider, elongating the fishing season. Opening at the end of the season, six weeks before the closure in March may be another option.

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 shallow bays (< 6ft) as defined in 15A NCAC 03R .0108)
+ Continued protection of oyster habitat in the bays from dredges
+ Allows for hand harvest of oysters
- Unavailable harvest areas to mechanical harvesters in bad weather

2. Re-open all shallow bays (< 6 ft.) previously closed to mechanical harvest as listed in 15ANCAC 03R .0108
+ More areas open to mechanical harvest
+ Available protected areas for mechanical harvesters to operate during bad weather
- Detrimental impacts to oyster habitat by oyster dredges

- Possible conflict between hand harvesters and mechanical harvesters

3. Consider changing criteria used to designate hand harvest areas
+ Potential for more areas opened to mechanical harvest
+ Available protected areas for mechanical harvesters to operate during bad weather
- Detrimental impacts to oyster habitat by oyster dredges
- Possible conflict between hand harvesters and mechanical harvesters

4. Status quo (Maintain opening of deep bays (≥ 6ft) during the November-December timeframe)
+ Continued protection of oyster habitat in the bays from dredges
+ Allows for hand harvest of oysters
- Unavailable harvest areas to mechanical harvesters in bad weather

5. Increase the time frame for opening the deep bays (≥ 6 ft.) from 6 weeks
+ More time for mechanical harvest
+ Available protected areas for mechanical harvesters to operate during bad weather
- Detrimental impacts from increase of dredging time on oyster habitat
- Possible conflict between hand harvesters and mechanical harvesters

6. Decrease the time frame for opening the deep bays (≥ 6 ft.) from 6 weeks
+ Less detrimental impacts from decrease of dredging time on oyster habitat
- Less time for mechanical harvest
- Less available protected areas for mechanical harvesters to operate during bad weather

7. Change the time frame for opening the deep bays (≥ 6 ft.) from the November-December to allow flexibility within the season
+ Continued protection of oyster habitat in the bay from dredges
+ Allows for flexibility in management
+ Based on sampling
+ Available protected areas for mechanical harvesters to operate during bad weather
- Possible conflict between hand harvesters and mechanical harvesters

8. Remove the six-week time frame for opening deep bays (≥ 6 ft.) and manage by a trigger (Refer to Supplement A)
+ Possibly increase time for mechanical harvest
+ Possibly provide protected areas for mechanical harvesters to operate during bad weather
- Possible increase in detrimental impacts from additional dredging time due to large number of vulnerable cultch plantings in the bays
- Possible conflict between hand harvesters and mechanical harvesters
- Significant increase in sampling effort on reduced staff and budgets

9. Close all bays to mechanical harvest
+ Maximum protection from mechanical harvest by dredging
+ Maximum available areas for hand harvest
- No mechanical harvest areas to work during bad weather
- Significant oyster resources will be unavailable for harvest due to water depths

VIII. RECOMMENDATION

MFC Preferred Management Strategy

-

NCDMF

- Status quo (Maintain shallow bays (< 6ft) as defined in 15A NCAC 03R .0108)
- Change the time frame for opening the deep bays (≥ 6 ft.) from the November-December to allow flexibility within the season

Advisory Committee

- Same as NCDMF
- Recommend a controlled study of dredges impacts on areas currently closed to mechanical harvest

IX. LITERATURE CITED

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12.1.2 Assessing and Mitigating Harvest Effort Impacts on Oyster Resources in the Southern Region

I. ISSUE

There is growing concern over the extent of harvest pressure and its impact to the long term sustainability to the oyster fishery occurring in the southern region (Onslow, Pender, New Hanover, and Brunswick counties) of North Carolina.

II. ORIGINATION

Public comments made by both recreational and commercial oyster harvesters in the southern region of the state.

III. BACKGROUND

Currently an estimate of abundance or standing stock biomass does not exist for oysters in North Carolina. Downward trends in NC oyster landings data over the last century, as well as their vulnerability to over harvest, disease, habitat loss, and pollution, have lead their species status to be designated as that of "concern" by the North Carolina Division of Marine Fisheries (NCDMF).

North Carolina's oyster stocks are composed of both intertidal and subtidal populations. Oyster populations in the southern region of the state (water bodies south of the Highway 58 Bridge) are primarily intertidal reefs. Exceptions include subtidal oysters found within the White Oak, New, and Cape Fear River systems, as well as Stump Sound and Alligator Bay. Mechanical harvest is prohibited for oysters from Core Sound south to the NC/SC state line.

However the shallow subtidal and exposed intertidal oyster resources in this region are easily accessible to harvest by hand. Hand harvest in this region is dominated by individuals who walk out onto exposed oyster reefs and manually collect legal sized oysters. Intertidal oysters typically grow in clusters displaying longer thinner shells with the valves oriented vertically, and are known locally as "coon oysters". These clusters are "knocked" or broken into individuals, and legal sized (3 inches or greater) oysters are retained. Due to the reef building life history of oysters, legal sized oysters will typically have several smaller sublegal adult, or juvenile "spat" adhered to their shells. Presently there is a 10% by volume culling tolerance of sublegal oysters allowed per bushel landed, and culled material is required to immediately be returned to the area being fished (Rule 15A NCAC 03K .0202). Prior to 1971 there was no size or culling tolerance on intertidal oysters. Law Enforcement Officers inspect fishermen for exceeding the tolerance limit by using a certified metric bushel tub and a keeler which is 10% of the tub by volume. A bushel of oysters is dumped into the metric bushel tub. The officer culls sub-legal oysters from the bushel and places them into the 10% keeler. If the keeler becomes full before the metric bushel is empty the catch is over the 10% tolerance. The officer will dump the keeler into another container and continue grading the rest of the oysters to find the total percent of undersized product.

In the southern region a 5 bushel per person, 10 bushel per vessel commercial trip limit is in place, and the fishery is restricted to operating Monday - Friday. Commercial harvest of oysters in North Carolina requires a Standard Commercial Fishing License (SCFL) or a Retired Standard Commercial Fishing License (RSCFL) with a shellfish endorsement, or a commercial shellfish license. The number of SCFL/RSCFL available within the state is capped, making most commercial fisheries within the state limited participation. The cap on the number of licenses available is based on the number of endorsement-to-sell licenses on June 30, 1999. If a fisherman does not possess a SCFL or RSCFL, he or she must apply for one through the eligibility pool. A pre-determined amount of available licenses are then annually awarded to persons in that pool who meet established criteria each year. A SCFL can be obtained through a transfer from an established license holder on the open market, usually at a higher cost than obtaining one through the eligibility pool. The shellfish commercial license, which was instated in 1999, is not limited to a maximum number of participants, and is available at a much reduced cost than the SCFL or RSCFL. However, the shellfish license is only available to NC state residents. Effort and landings data are captured for this fishery through the trip ticket program when catch is sold through a dealer. At this time an unknown amount of oysters are being landed by individuals holding commercial shellfish licenses for personal or recreational use without making a sale and therefore no record of this catch exists on a trip ticket. Oysters may be harvested during the open season recreationally without any license at a limit of 1 bushel per person per day not to exceed 2 bushels per vessel per day, seven days a week. Without

licensing or reporting requirements, estimates on the total amount of recreational harvest are unavailable.

The southern region of North Carolina consistently contributes to the overall public landings of oyster within the state (Figure 12.3). From 1994 to 2013 the southern region produced 47% of the total harvest. However, patterns in southern region oyster landings do not appear to mirror those displayed in statewide landings. Over the last 20 years harvest from the southern region has comprised between 20 and 90 percent of total annual NC landings, and averages 57 percent across these years. Despite contributing significant landings to the oyster fishery, the southern region encompasses only 5.7 percent of the total coastal water body area of the state, and only 4.5 percent of the area open to shellfishing (Table 12.2). The smaller narrow sounds, coupled with the often highly developed coastal drainages has resulted in 48.2% of the shellfish waters in the southern region to be classified as permanently or conditionally closed due to bacterial contamination. In comparison, 34.1% are classified as closed or prohibited to harvest statewide. Oysters collected in closed polluted areas can be relayed onto open public or leased bottom after the end of the oyster season for a specified time period with oversight from Marine Patrol or other division staff and following marking requirements (Rule 15A NCAC 03K .0104). These oysters are left in the open areas through the remainder of the closed oyster season to depurate and grow, and serve to augment the amount of resource available to harvesters in the subsequent oyster season. Oyster relay has historically played a larger role in North Carolina's shellfish rehabilitation program in the southern region, utilizing contracted commercial fishermen when funding is available to pay for their effort.

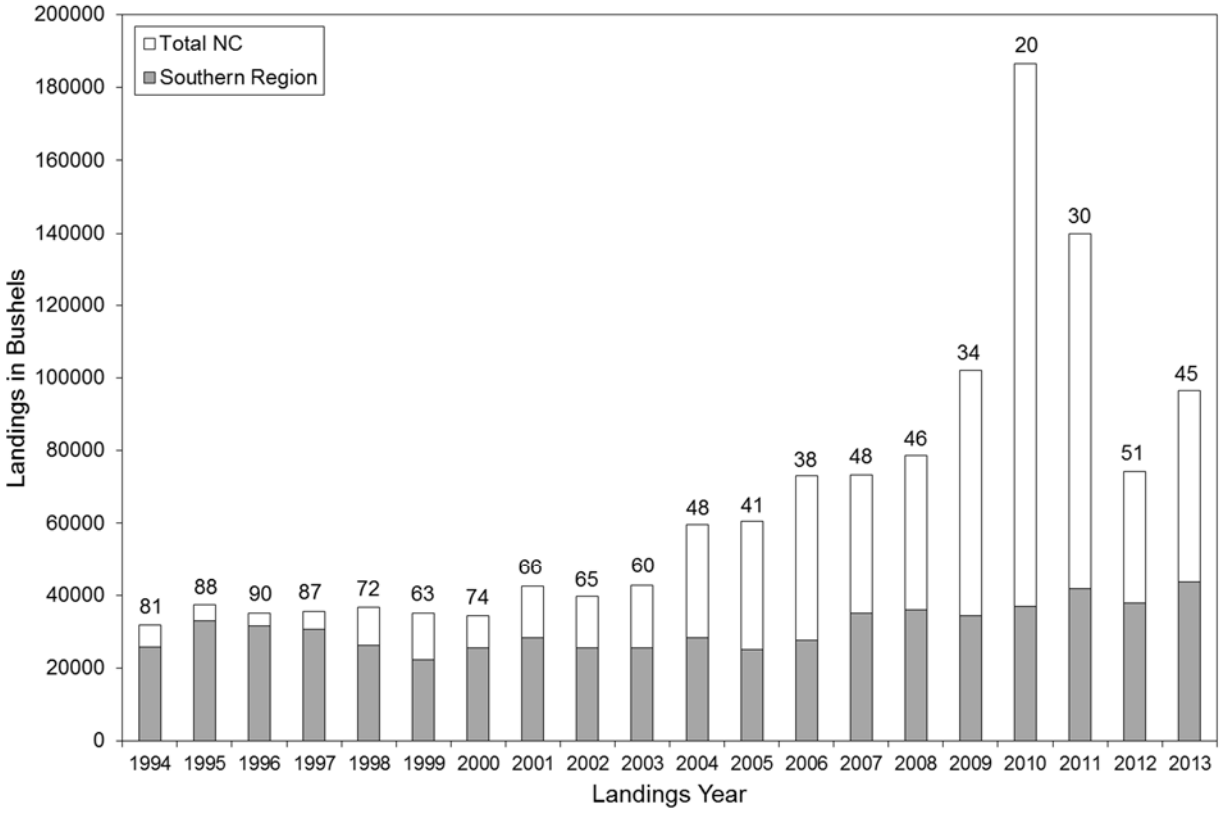

Figure 12.3. Commercial landings of oysters from public bottom in North Carolina from 1994 to 2013, showing the total annual landings (total bar area) in bushels as well as the proportion of landings originating from the southern region (shaded bar area). Numbers above each bar signify the percent of total annual landings contributed by the southern region (water bodies south of Highway 58 Bridge).

Table 12.2. Shellfish water classification acreage and area percentage of southern counties (Onslow, Pender, New Hanover, Brunswick) and the total State of North Carolina.

	Southern Counties	Total State
Open Area (acres)	65,748	1,462,222
Closed Area (acres)	61,232	756,908
Percent of Total Area	5.7%	100%
Percent Open	51.8%	65.9%
Percent Open of Total Open Area	4.5%	100%

The shellfish rehabilitation program also engages in annual cultch planting efforts. Suitable substrate for oyster spat settlement is loaded onto barges and placed in open shellfishing water to enhance oyster recruitment and biomass in systems that may be considered substrate limited. In the southern region, materials which have proven to have the greatest spat settlement consist of empty oyster, clam, or scallop shell. This shell material is planted both inter and sub tidally depending on water body. Public input gathered from stakeholders, as well as data from annual disease and spat fall monitoring are used to inform cultch planting site location selection. The amount of material planted annually varies greatly according to

availability and funding. Between 2003 and 2013, 487,000 bushels of cultch material were planted across the southern region of the state (Figure 2). Plantings do not immediately translate into or correlate with landings, as it may take up to three years post planting for new cultch material to produce legal sized oysters. Average yield per unit cultch planted is not known and is likely highly variable across and within systems. However, some division cultch planting sites have been observed to continue to yield harvest for decades.

Significant intertidal populations of oysters exist across the entire coastal southern region of the state. The amount of oysters harvested from public bottom and landed in this region of the state has generally increased since 2000, as has the proportion of these landings made by shellfish license holders (Figure 12.3). Harvest effort has also increased, mirroring annual landings trends in this region. However, average bushel amounts landed per individual trip have declined as landings have increased (Figure 12.4). Four bodies of water, Lockwood Folly River, Masonboro Sound, Shallotte River, and Topsail Sound, have contributed 71% of the region's total commercial oyster landings from public bottom since 1994, and are representative of the intertidal hand harvest fisheries in the region. Since 2000, landings have fluctuated in Brunswick County rivers, and have generally increased in Topsail and Masonboro sounds (Figures 12.5 – 12.8). Yearly bushel landings from these water bodies appear to reflect the number of participants in the fishery annually. The Lockwood Folly and Shallotte rivers (Brunswick County) both display similar peaks in annual volume of landings which correspond with peaks in the number of participants that year. Landings from Masonboro and Topsail Sounds also appear to increase with the number of participants, which have increased nearly 200% since 2000. Participant license type composition has also changed through time, with an increasing proportion of participants having a commercial shellfish license after it was created. Recent declines in participants in the public oyster fishery in Brunswick County appeared after periods of lowered harvest efficiency (bushels landed per trip), which followed years of high participants and landings. Brunswick County participant efforts may have shifted to water bodies in New Hanover, and Pender counties, and is reflected in recent increases in participation in Topsail and Masonboro sounds (Figures 12.5 – 12.8). Despite overall variable trends in participation and landings in the region, the number of bushels landed per commercial trip has decreased for all four locations from 2000 onward. Consistent declines in catch rates (bu/trip) suggest that the oyster resources in the southern region may not be able to sustain recent increases in fishery participation and landings.

The existing management strategy to address harvest impacts on oyster resources in the southern region relies on the proclamation authority of the Marine Fisheries Director to close the oyster season before the standard closure date of March 31st at sunset. In the Pamlico Sound oyster dredge fishery, a minimum 26% legal threshold has been established to trigger the opening and closing of fishing activity during the season as a habitat protection measure. No such management trigger exists for hand harvest areas. Some locations may close earlier due to perceived excessive harvest. Brunswick County is the only area frequently closed early due to this concern, and oyster harvest has closed prior to March 31st eleven times between the1996/97 and 2013/14 seasons. This closure is prompted by public request from harvesters and dealers, as well as the status of the resource being verified by Marine Patrol and division biologists.

Recent public concern regarding increasing participation in the oyster fishery, decreases in the amount of open shellfish water, and the decreasing average number of bushels being landed per individual per trip, has prompted the need to examine additional management options for the oyster fishery in the southern region.

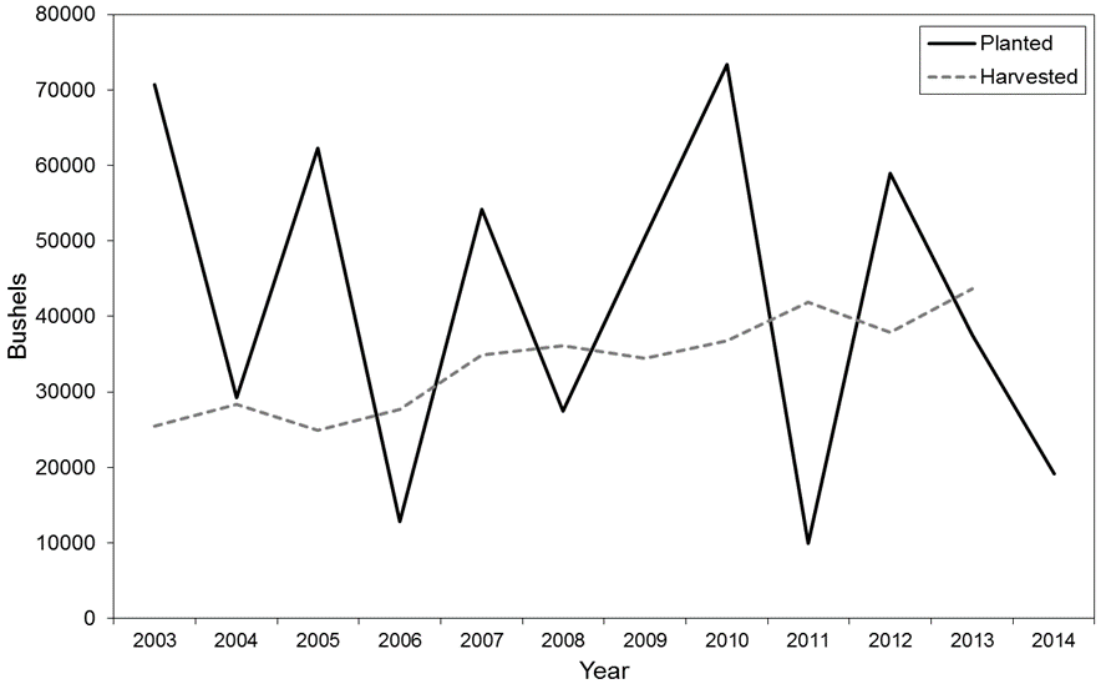

Figure 12.4. North Carolina commercial oyster landings from public bottom and cultch material planted for water bodies south of the Highway 58 Bridge.

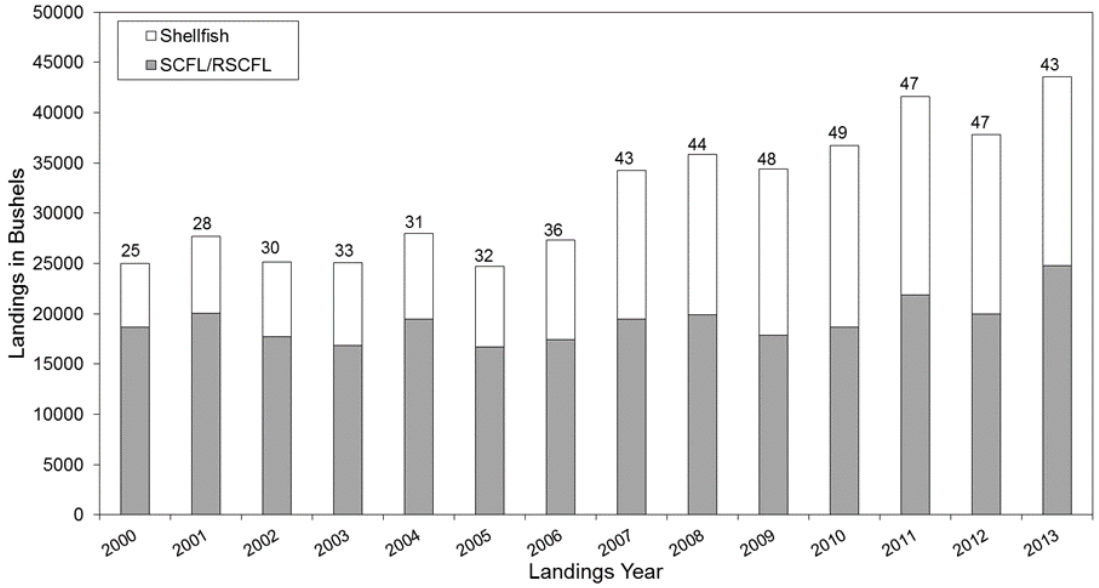

Figure 12.5. Commercial landings of oysters from public bottom in southern waterbodies south of the Highway 58 bridge (White Oak River to SC state line), showing the landings of SCFL/RSCFL holders (white bars) in bushels as well as the proportion of landings from shellfish licenses (shaded bars). Numbers above each bar signify percentage of shellfish license landings from total.

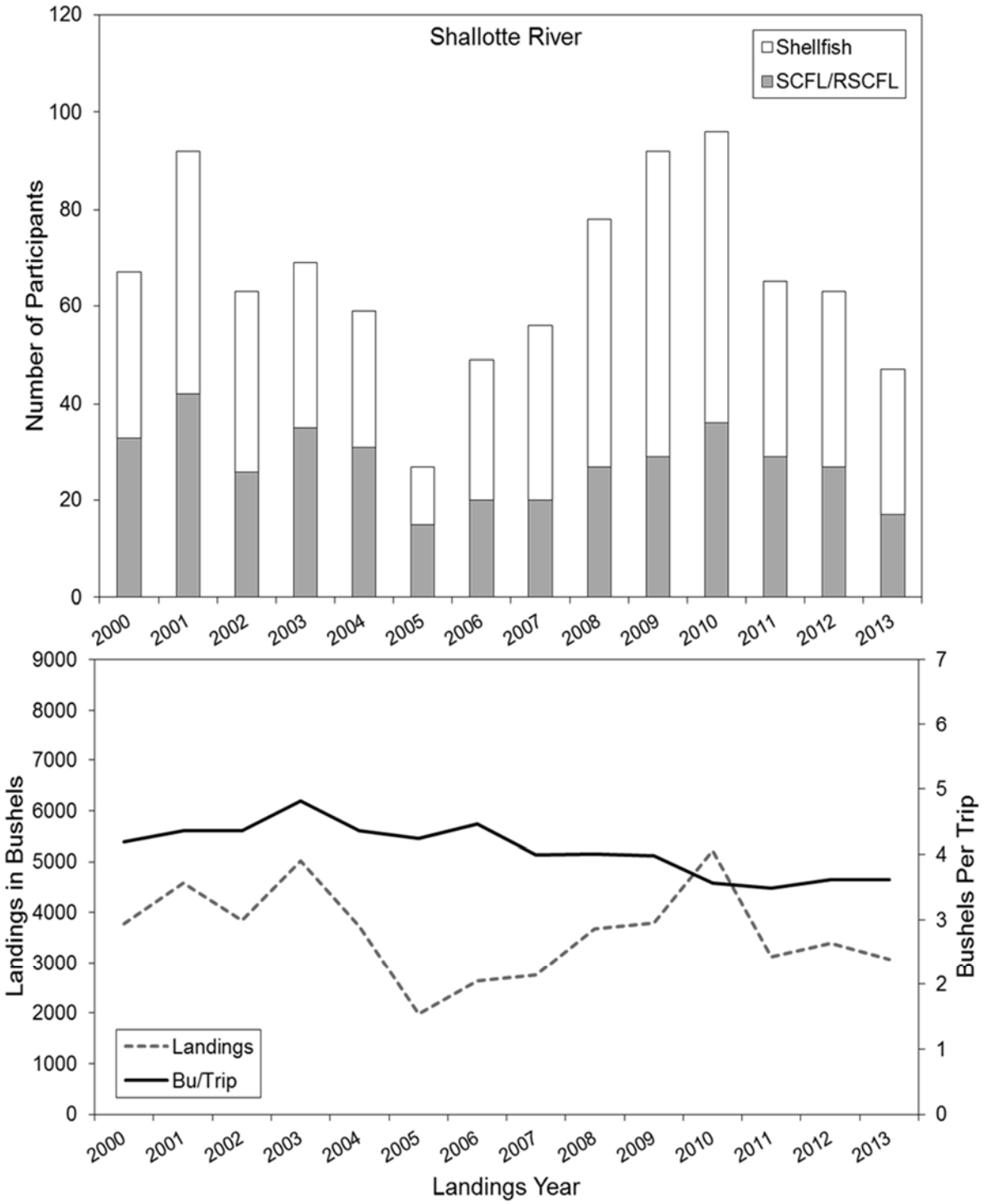

Figure 12.6. The upper panel shows annual number of total participants in the Shallotte River public bottom oyster fishery, with shaded portion of the bar representing SCFL/RSCFL holders, and the white portion representing shellfish commercial license holders. The lower panel shows total number of bushels landed as a dotted line on the left axis, and the average annual number of bushels landed per individual for each trip as the solid line on the right axis.

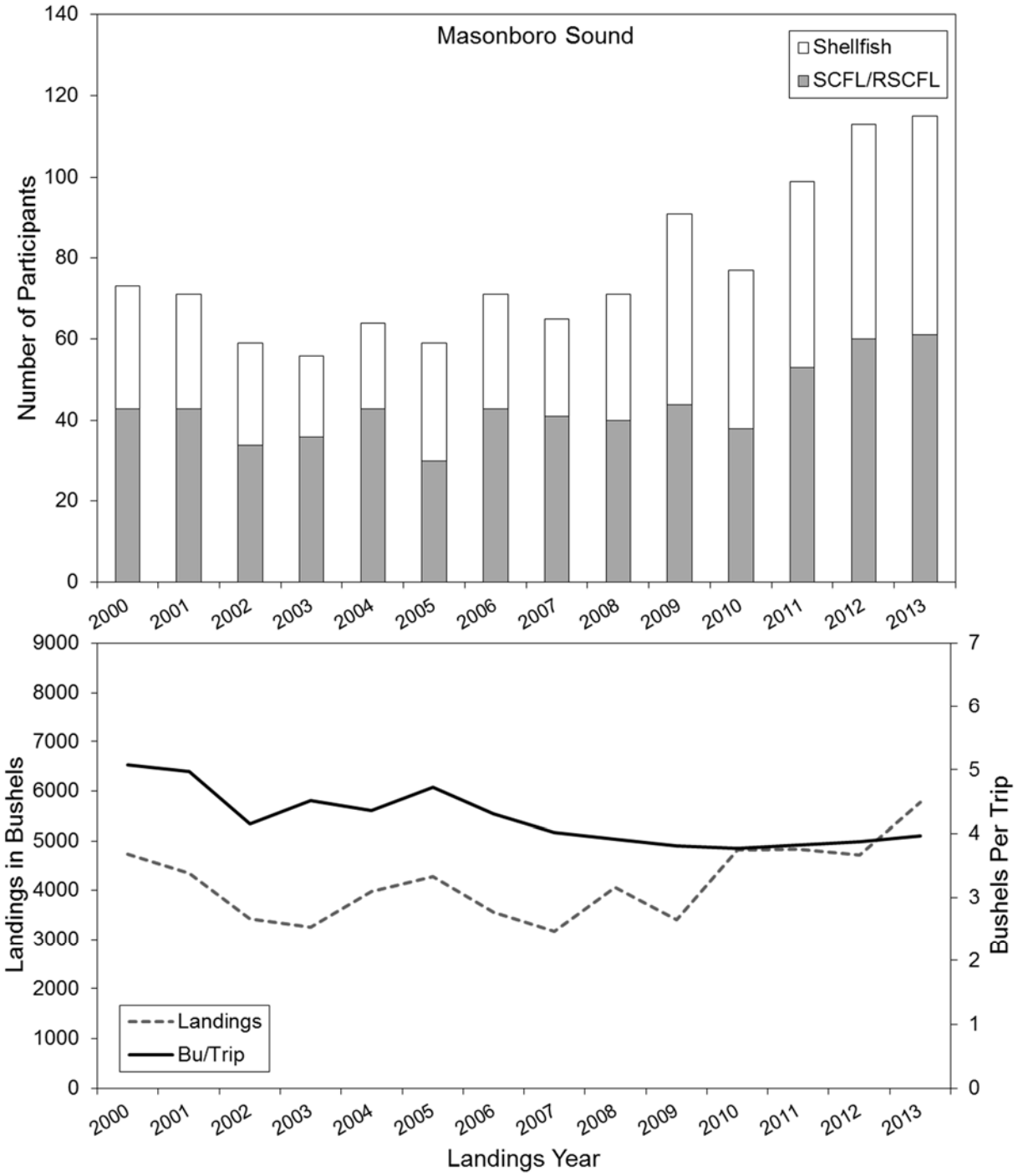

Figure 12.7. The upper panel shows annual number of total participants in the Masonboro Sound public bottom oyster fishery, with shaded portion of the bar representing SCFL/RSCFL holders, and the white portion representing shellfish commercial license holders. The lower panel shows total number of bushels landed as a dotted line on the left axis, and the average annual number of bushels landed per individual for each trip as the solid line on the right axis.

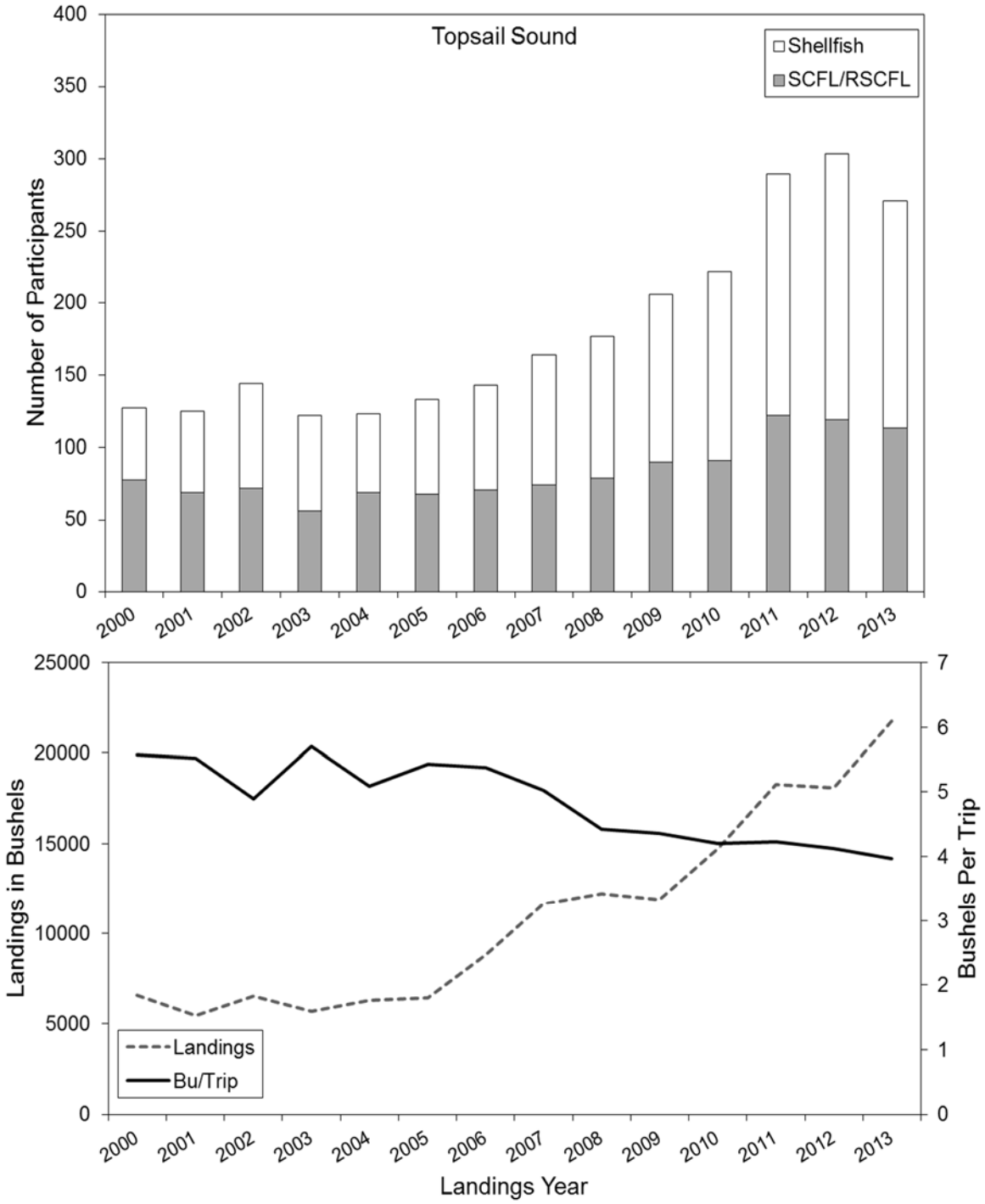

Figure 12.8. The upper panel shows annual number of total participants in the Topsail Sound public bottom oyster fishery, with shaded portion of the bar representing SCFL/RSCFL holders, and the white portion representing shellfish commercial license holders. The lower panel shows total number of bushels landed as a dotted line on the left axis, and the average annual number of bushels landed per individual for each trip as the solid line on the right axis.

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.
113-221.1	Proclamations; emergency review
143B-289.52	Marine Fisheries Commission – powers and duties.

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

03K .0201	Open season and possession limit
03K .0202	Size limit and culling tolerance

V. DISCUSSION

Due to the ease and efficiency at which exposed intertidal oysters can be harvested, reefs or "oyster rocks" in the southern region are vulnerable to over harvest from increasing pressure. The 3-inch minimum size limit is intended to prevent excessive habitat damage by allowing sub legal mature oysters to remain unharvested and encouraging harvesters to move to more productive areas. This would allow live oysters to remain and serve as broodstock or settlement sites for future spat recruitment. With increasing participation and pressure on the fishery, harvesters are forced to more thoroughly break up clusters of oysters and multiple individuals may work in an area longer. Each bushel of landed oysters has an allowance of up to 10% by volume sublegal oysters. With this culling tolerance, there is the possibility that as a particular oyster reef is fished by multiple individuals, a significant portion of sublegal oysters and cultch material can be removed. A reduction to a 5% culling tolerance would reduce the possibility of removing a significant number of sublegal oysters from habitat, and require harvesters to more carefully inspect and cull their catch. Enforcement of the current 10% by volume rule by Marine Patrol is now extremely problematic with clusters of intertidal oysters. Changing from the 10% tolerance to the 5% tolerance will require finer separation of sub-legal from legal clustered oysters, and could result in higher culling mortality from the difficulty of removing small oysters from legal individuals without severe shell damage. Both commercial oyster harvesters and Marine Patrol would have to modify culling and enforcement practices if the tolerance was reduced. This measure would also have to be implemented statewide to ensure enforcement consistency between areas, as harvesters often take oysters from one waterbody and transport them for sale to other areas of the state.

Growing participation in the oyster fishery in the southern region has caused some to question the availability of shellfish licenses to all state residents, effectively creating open entry to a fishery on a finite resource. The increase in overall public oyster landings in the southern region may be attributed to increased landings from shellfish license holders, as the amount of SCFL/RSCFL landings remained relatively stable while the amount and proportion of shellfish license landings increased (Figure 12.3). This issue and possible management options are developed fully in the issue paper to "Consider Elimination of the Shellfish License and Require All Shellfish Harvesters to Have a SCFL or RSCFL".

Relay of oysters from closed areas typically occurs after the end of the oyster season, employing contracted harvesters to transfer the polluted shellfish into designated management

areas. These areas are then proclaimed closed to the harvest of any shellfish, and treated as polluted areas for a period of at least 21 days to protect public health. With the relay of polluted shellfish being a public health safety concern, this activity must be closely monitored and documented by Marine Patrol or other Division staff. As funding for shellfish rehabilitation programs has been reduced in recent years, interest in the volunteer relay of shellfish has been minimal. One possible management option to increase participation in seed shellfish relays in the southern region would be to require shellfish license holders to relay a specific minimum amount of polluted area oyster into shellfish management areas as a condition of retaining their license. Such an expansion of the relay program would require significant oversight and documentation by Marine Fisheries staff. Given the large percentage of polluted shellfish waters (48%) within the southern region, these closed areas have been previously viewed as de facto sanctuaries and a protected source of spawning oyster stocks. However, all polluted closed areas may not necessarily function as broodstock reserves, given stressors associated with urbanized drainages may lead to altered sex ratios and higher incidence of disease (Ravit et al. 2014). Increased relay from closed areas may help to reduce pressure on oyster resources in open areas. However, the total oyster resource is limited, and additional relay efforts may not be able to meet harvest demands of a future growing fishery participant pool. The benefit of ecosystem services currently provided by unharvested oyster populations in closed waters must also be considered when proposing any expansion of effort into these areas.

Cultch planting efforts statewide are limited by cultch material availability and funding. Increasing budget cuts, loss of the oyster shell recycling program, and the increasing cost of available shell cultch material have resulted in recent declines in the amount of cultch material planted. The amount of cultch planted between 2003 and 2013 represents 131% of the total bushels landed (371,941) for the same time period in the southern region. The cultch planting program does not function as a put and take oyster fishery. Yield of harvestable oysters per bushel of successful cultch planting is not currently known, but is highly likely to be less than 1:1 due to variability in oyster recruitment, environmental factors, and cutch material (shell) loss. The current rate of cultch planting mitigates the amount of shell removal occurring in the southern region through harvest. Bivalve populations have been demonstrated to have a positive relationship with shell aggregations, and the importance of shell budgets within a system to oyster populations is beginning to be understood (Waldbusser et al. 2013). Oyster restoration activities in neighboring Atlantic coastal states has driven up the cost of oyster shell, the preferred cultch material, resulting in North Carolina unable to compete in purchasing ability with better funded state programs to the north and south. A significantly cheaper alternative material, processed recycled concrete, has been demonstrated to successfully recruit and grow spat, as well as not impact water quality standards (Theuerkauf et al. 2014). This material has also shown to be a preferable alternative cultch material in higher salinity subtidal areas where boring sponge is a problem (Dunn et al. 2014). Present language in Department of Coastal Management “cultch planting exemption” does not permit the Division to employ this available and cost effective material. Planting locations in the southern region are further limited to areas near one of three cultch stockpile locations, Mile Hammock Bay (Onslow County), Morris Landing (Onslow County), and Shallotte (Brunswick County). High property values and rates of coastal development in southeastern North Carolina have made locating additional areas to store and load cultch material problematic. Due to tidal cycles and the speed at which loaded barges travel, planting locations are generally limited to within 10 miles of existing stockpile sites.

Reduced fishing days, lower harvest limits, and area closures are all management tools available to mitigate excessive harvest impacts to oyster resources. Currently, the commercial

harvest of oysters is only allowed Monday through Friday, and recreational harvest is allowed 7 days per week. Eliminating additional days which commercial harvest is allowed may reduce impacts on the oyster resource. However, due to the dependence of fisherman on low tide to harvest intertidal oysters, additional reductions in fishing days may have varying negative impact to harvesters throughout the season. Additionally, a reduction of open fishing days may serve to concentrate efforts on days that are open. A reduction in bushel harvest limits may also serve to reduce harvest impacts to the oyster resource. However, any reduction would create an even greater inequity of limits between northern and southern areas. The number of trips fished per harvester may also increase to minimize any reduction in landings that could occur from a reduced trip limit. At present, early closures through proclamation (e.g. Brunswick Co.) are made at the urging of the public once harvest effort impact to the resource has been considered to be excessive, and verified by Division staff. No objective management trigger exists for intertidal hand harvest areas as it does for the Pamlico Sound dredge fishery.

Rotational scheduled seasonal area closures could be employed across the southern region, opening and closing specific areas on a set time frame without having the need for a management trigger in place. These closures would allow specific regions to be free of harvest pressure for one season to recover from impacts from the previous year. Rotational management area or total water body closures may however function to further concentrate fishery effort into an even smaller region, potentially exacerbating present issues. The development of an effective and biologically relevant management trigger would require significant baseline data to be collected across the region for a period of time. The establishment of sentinel sites, or standardized sampling stations, would be the foundation for a fishery independent index of oyster abundance. Sites located in both open and closed shellfishing waters could be employed to assess the impacts of harvest on the regions oyster resources. Trends from this independent abundance index, as well as input from harvesters and dealers would be used to inform and enact any closures or other management actions. Due to highly variable oyster demographics within regions of a specific oyster reef, and across reefs in a water body, careful consideration must be given to abundance index sampling strategies, and to the scale to which any management action is applied. Two superficially similar and adjacent oyster reefs may vary greatly in the percentage comprised of legal oysters, and interpreting local size distributions as representative of entire regions can be erroneous. Oyster abundance should also play an important role in determining closures, as solely relying on percent legal composition as a trigger may result inappropriate management actions. Significant time and energy will need to be spent by division staff to design and implement an effective and robust abundance index.

VI. PROPOSED RULE(S)

To be determined dependent on recommendations.

VII. PROPOSED MANAGEMENT OPTIONS

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

1. Status quo
+ Landings may continue to occur at current levels from the southern region
+ No additional regulation on the fishery
- Average number of bushels landed per person may continue to decline in the southern region

- Continued unassessed and unmitigated effort impacts to the oyster resource
- Harvest may occur at unsustainable levels

2. Reduce the culling tolerance for oysters statewide to 5% (**rule change required**)
+ Reduces the amount of sublegal oysters incidentally harvested in the fishery
+ Increases the amount of cultch material left on oyster reefs after harvest occurs
- Additional regulation on the fishery
- Could impact harvesters by reducing harvest efficiency and causing additional "knocking" damage to product
- Increase cost to Marine Patrol in acquiring separate standardized 1/20 bushel containers
- Difficult to enforce due to the morphology of intertidal oysters

3. Implement relay participation as a requirement to retain a commercial shellfish license (**requires statutory change**)
+ May reduce some effort impacts in waters currently open to shellfish
+ Will potentially mitigate continued expansion of closed polluted areas
- Additional monitoring and coordination required by Marine Patrol and other division staff
- Poses public health concerns
- Finite supply of oyster available in closed areas
- Oysters not harvested in closed areas still provide ecosystem services
- Reduce relay product available to leaseholders

4. Increase efforts to plant available cultch materials in the southern region
+ Can enhance oyster stock biomass by providing available substrate for spat settlement
+ Recycled concrete is available, and at lower cost than other suitable cultch material
+ Reduced competition between other states for available cultch material
- Cost of cultch planting program
- Current state permitting process does not allow the use of recycled processed concrete
- Limited to planting from established loading and stockpile areas

5. Institute rotational area closures for both commercial and recreational oyster harvest from public bottom annually
+ Reduce effort impacts to habitat
+ Reduce impacts on some of the oyster population
+ No additional resources required to implement
-/+ No criteria to determine closure
- Additional regulation on the fishery
- May concentrate participants into open areas and result in greater effort impacts overall
- May adversely impact some fishermen more than others

6. Explore a preliminary fishery independent index of oyster abundance to inform future management actions
+ Establishes a baseline of fishery independent abundance data
+ Provides data for future oyster management decisions
- Will not immediately have mitigating effects on harvest impacts
- Significant cost to the division in time for development and implementation

7. Reduce the number of fishing days south of Highway 58 Bridge for both commercial and recreational oyster harvest from public bottom
+ Reduces impacts from walking on the habitat
- Effort could increase during open harvest days

8. Reduce daily commercial harvest limit from public bottom for all oyster harvesters south of Highway 58 Bridge
+ Limits effort and harvest for a concerned stock across all oyster harvesters
- Inequity in harvest limits between areas

9. Reduce the daily oyster harvest limit from public bottom south of Highway 58 Bridge for Shellfish License holders only
+ Limits effort and harvest for a concerned stock across some oyster harvesters
- Inequity in harvest limits between license holders in the same area

VIII. RECOMMENDATION

MFC Preferred Management Strategy
-

NCDMF
- Increase efforts to plant available cultch materials in the southern region
- Explore a preliminary fishery independent index of oyster abundance to inform future management actions

Advisory Committee
- Increase efforts to plant and monitor available cultch materials in the southern region and to emphasize the review and approval by regulatory agencies of the use of alternative cultch material
- Explore a preliminary fishery independent index of oyster abundance to inform future management actions

IX. RESEARCH RECOMMENDATIONS

- Estimate oyster mortality associated with relay
- Estimate longevity and yield of oysters on cultch planting sites
- Develop methods to monitor abundance of the oyster population

X. LITERATURE CITED

Dunn, R.P., Eggleston, D.B., and Lindquist, N. 2014. Effects of Substrate Type on Demographic Rates of Eastern Oyster (*Crassostrea virginica*). Journal of Shellfish Research. 33(1): 177-185

Ravit, B., Cooper, K., Buckley, B., Comi, M. and McCandlish, E. 2014. Improving management support tools for reintroducing bivalve species (Eastern oyster [*Crassostrea virginica* Gmelin]) in urban estuaries. Integrated Environmental Assessment and Management. 10: 555–565.

Theuerkauf, S.J., Burke, R.P., and Lipcius, R.N. 2014. Settlement, growth and survival of eastern oysters on alternative reef substrates. North Carolina State University. Raleigh, NC. 31 pp.

Waldbusser, G.G, Powell, E.N., and Mann, R. 2013. Ecosystem effects of shell aggregations and cycling in coastal waters: an example of Chesapeake Bay oyster reefs. Ecology. 94: 895–903.

12.1.3 DIFFERENCES IN HAND HARVEST LIMITS STATEWIDE

I. ISSUE

Carteret County fishermen commented about the differences in harvest limits when it was realized a larger daily limit was available for hand harvesting oysters in Pamlico Sound than in eastern and southern Carteret County.

II. ORIGINATION

Carteret County fishermen

III. BACKGROUND

The 2008 Oyster Fishery Management Plan Amendment 2 put in place a 15 bushel per day hand/mechanical harvest limit per commercial fishing operation in Pamlico Sound mechanical harvest areas outside the bays, a 10 bushel per day hand/mechanical harvest limit per commercial fishing operation in the bays and in the Mechanical Methods Prohibited area along the Outer Banks of Pamlico Sound. This management option raised the limits of hand harvest to encourage less destructive harvest methods in those particular areas of bays and open waters. However, harvest limits remained five bushels per person, not exceeding 10 bushels per commercial fishing operation from Core Sound south to the North Carolina-South Carolina border (see Attachment 1 for 2013 proclamation). Carteret County fishermen requested that the Division consider raising the limit to 10 bushels per commercial fishing operation in the southern area as well.

The NCDMF Director has proclamation authority under Marine Fisheries Commission Rule 15A NCAC 03K .0201 to specify days of the week, areas, means and methods, time periods, quantity (not to exceed 50 bushels) and minimum size limits (not less than 2 ½ inches). Currently the hand harvest season for oysters opens on October 15 and continues into March with different harvest limits for different areas described above.

Hand harvest gear accounts for the majority of the landings and has been the dominant harvest gear for oysters in North Carolina since the 1960s. Hand harvest oyster landings are also less variable than landings from mechanical gears. These higher, more consistent landings come from Core Sound south to the North Carolina-South Carolina border. The hand harvest areas in the northern region of the state are exclusively subtidal reefs with depths of 2 to 6 feet in which hand tongs are used. Hand harvest gear has not been extensively used in the northern area since oyster dredging was allowed in 1887. In Amendment 2 to the N.C. Oyster FMP in 2008, the MFC adopted the strategy to promote a more habitat friendly fishery by increasing the hand harvest limits to match dredging limits in the Northern bay areas The MFC also adopted a recommendation to increase cultch plantings in hand harvest areas. These management strategies predominantly affected the northern region of the state including Roanoke Sound, eastern Pamlico Sound (MMP area) and the bays around Pamlico Sound. The harvest limits remained the same in the southern areas, from Core Sound south to the North Carolina-South

Carolina border. Areas in the southern region from Carteret County south are closed to mechanical harvest of oysters. See Figure 1.

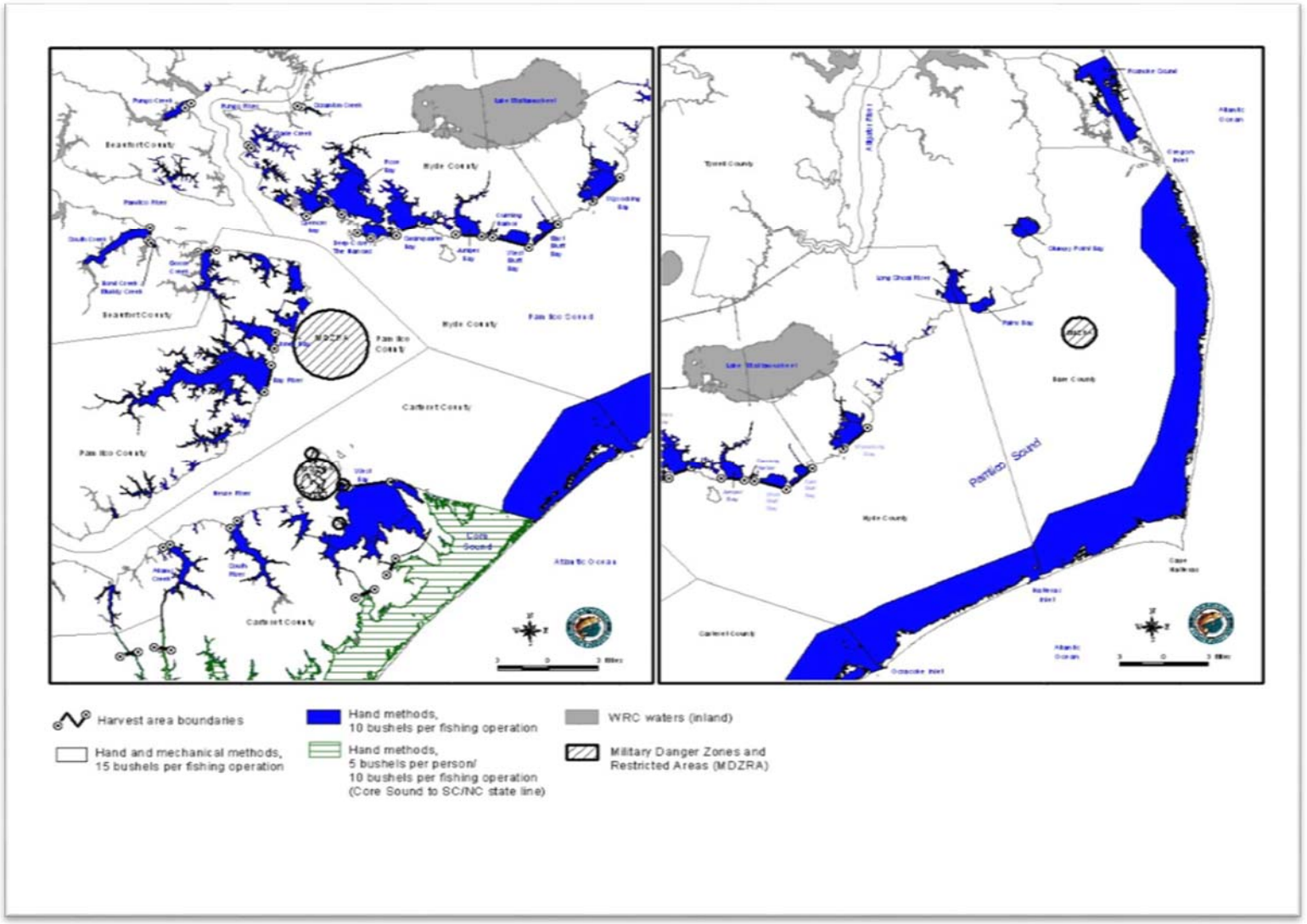

Figure 12.9. Map of the Oyster Line in Carteret County and Bays of Pamlico Sound.

IV. AUTHORITY

N.C. General Statutes

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

V. DISCUSSION

Increasing the harvest limits southward into Carteret County and south may have a negative impact on oyster populations of the southern areas. Hand harvest landings and effort have increased steadily since 1994 throughout the entire state (Figure 12.10). Intertidal oyster reefs such as those found in the southern coastal region of North Carolina are more vulnerable to over harvest due to the nature of the fishery. Harvest of oysters in the southern intertidal areas allow fishermen to easily locate oyster rocks for harvest and to visibly select oysters 3" or greater for harvest. This shortens the cull time and makes hand harvest a very efficient harvest method. The oyster harvest areas of the southern areas are generally characterized by narrow intertidal marsh creeks, draining into larger inlets or river heads located on both the inland and ocean sides of the Intracoastal Waterway as it winds southward through the southeastern part of the state. Oyster areas available for hand harvest north of Core Sound are not visible, greatly dispersed, more difficult to harvest, and not as plentiful as those from Core Sound south.

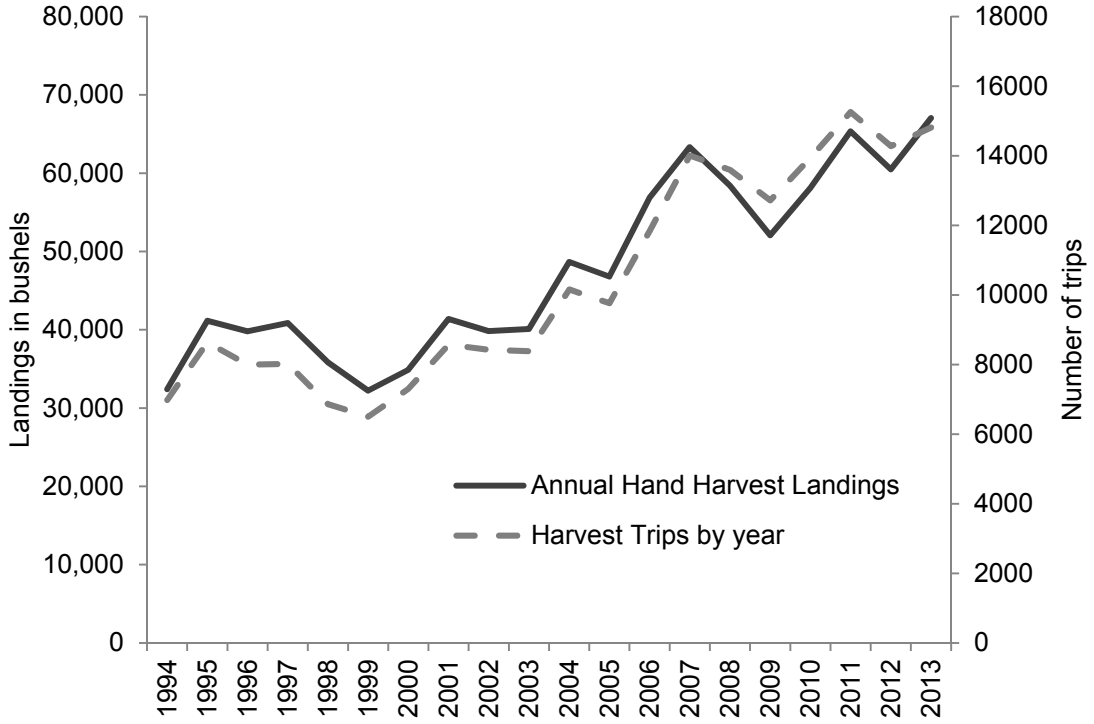

Figure 12.10. Coastwide hand harvest oyster landings and trips 1994-2013 (NCDMF Trip Ticket Program).

Other factors affecting the hand harvest fishery are the loss of harvest area due to pollution closures and the loss of habitat from clam harvesting. Many shellfish waters in North Carolina are permanently or conditionally closed due to bacterial contamination associated with urban

development. The greatest proportion of closed shellfish waters occur in the southern district (Onslow, Pender, New Hanover, and Brunswick counties) where over half of the waters are closed (52.4%) and can be attributed to small, narrow waterbodies and more developed watersheds. In contrast, 21% are closed or prohibited to harvest coast-wide (Table 12.3).

Table 12.3. Table shows classifications acreage of the open/closed acres by Fisheries Management Areas (NCDMF Shellfish Sanitation 2013).

	Areas					
Classification	Southern	Central	Pamlico	Northern	Grand Total	% Acreage
Open	58,993.11	315,568.49	600,665.25	804,695.41	1,779,922.27	78.40
Approved	44,015.77	285,899.86	600,665.25	804,695.41	1,735,276.29	76.40
Conditionally - Open	14,977.35	29,668.63			44,645.98	1.96
Closed	65,032.94	45,636.39	80,931.11	299,024.65	490,625.10	21.60
Conditionally - Closed	6,283.50	5,560.68			11,844.18	0.52
CSHA - Prohibited	58,749.44	40,075.72	80,931.11	299,024.65	478,780.92	21.08
Grand Total (acres)	124,026.06	361,204.89	681,596.37	1,103,720.05	2,270,547.37	100.00

Brunswick County is one of the fastest growing counties in the nation. With that growth, comes development and associated pollution. Brunswick County has seen a drastic amount of closures to traditional shellfishing waters. In Brunswick County alone, over 65% of its waters are closed to shellfishing (Table 12.4).

Table 12.4. Brunswick County status and number of acres affected.

Status	Acres	Percent of total
Open	14,582.89	34.1%
Closed	28,233.51	65.9%
Total	42,816.40	100.0%

The area north of Core Sound with the higher hand harvest limits does not have the same problem with large percentages of the available harvest area closed by reason of pollution so oyster harvest is not impacted.

The harvest of hard clams also affects the intertidal oyster resources of the southern part of the state. Hard clam larvae often settle in the shell substrate of oyster rocks to protect themselves from predation and spend the rest of their lives there. Observations by staff indicate that clam harvesters overturn oysters and redistribute the oyster rock material when harvesting these clams causing mortality of oysters living on the rock and reducing oyster habitat. These effects are so intense in some areas that oyster rocks and cultch plantings have to be closed to hard clam harvest or oyster populations will be reduced to the point that they are not valuable for harvest. Salinities are too low for consistent hard clam survival in most of the area north of Core Sound so this stress is not a factor in oyster management there.

The state has been planting oyster cultch materials consistently since 1947 to enhance oyster resources. These enhancement efforts have significantly contributed to the oyster harvest over time. However, today it is harder to obtain the cultch material needed for enhancement projects. Cultch planting efforts around the New Hanover/Pender County areas have been reduced in the last decade with the loss of stockpile sites for cultch materials. Many of the traditional management areas that used to be planted on a regular basis have not been planted

in several years. Last year cultch planting efforts in Pender and New Hanover counties were increased when the state's large LCU barge came down and planted two loads. This greatly enhances spat recruitment and settlement in these areas. Despite these enhancement efforts, any increase in hand harvest limits along with the increasing fishing effort observed in the southern area will increase the stress on a concerned stock, potentially shortening the season and reduce landings.

One option to consider is to raise the trip limit to 15 bushels for hand harvest methods for all areas north of the Core Banks line to allow equity among harvest gears above that line. This would make regulations less confusing in those areas and possibly, more economically feasible for the hand harvester.

Another option is to manage by regions on a case by case basis. One case would be to allow a 10 bushel hand harvest trip limit from Core Sound south to the to the Emerald Isle Bridge (US Hwy 58) and maintain the five bushel per person not to exceed 10 bushels per commercial fishing operation limit south of the bridge to the NC/SC line. This option addresses Carteret County shell fishermen's request but at the same time this option may be detrimental to the subtidal oyster areas in Carteret County that do exist. It may also be setting a precedent to increase the size limits statewide.

Yet another option is to return to the limit of five bushels per person not exceeding 10 bushels per commercial fishing operation, coast wide. The vast majority of the hand-harvest oyster landings have been made under that limit for the past 20 years and landings have generally increased during that time period and persist at relatively high levels. Additionally, the average number of bushels being landed in the area under the higher limit is only a little over six bushels per trip per year since the new limit was put in place and that harvest rate has not varied much despite fluctuations in landings in the area (Figure 12.11).

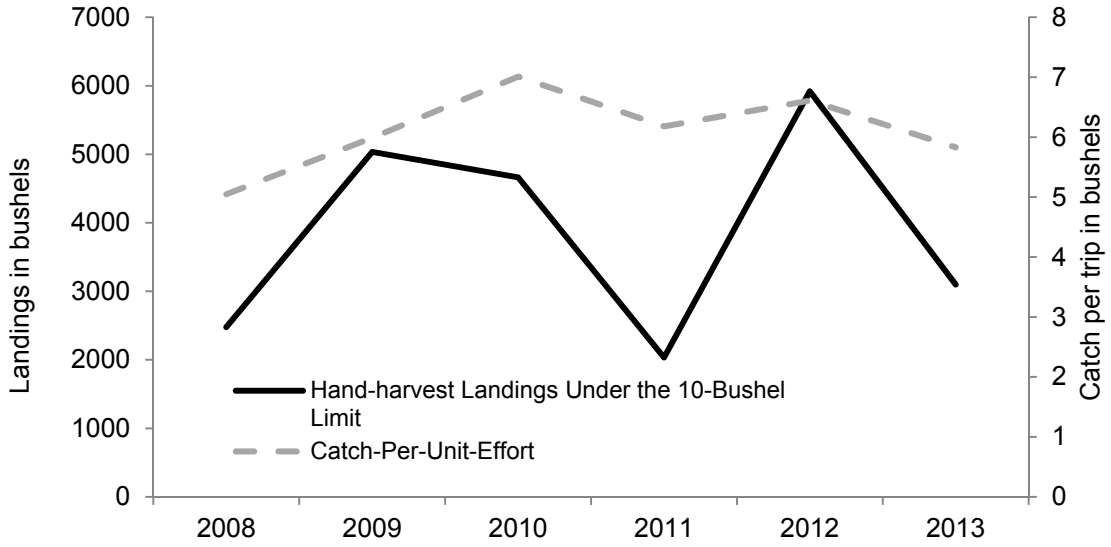

Figure 12.11. Hand-harvest oyster landings and catch per trip for hand-harvest gears north of Core Sound under the 10-bushel harvest limit 2008-2013

In looking at data from the southern area waters and the number of bushels harvested per trip we see that the region below the Core Sound line to the SC border only averages 4.29 bushels per trip, not even averaging the 5 bushel per person trip limit. This option would save the resource and not be an imposition on the harvester.

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 maintain the 15 bushel hand/mechanical harvest limit in Pamlico Sound mechanical harvest areas outside the bays, 10 bushel hand/mechanical harvest limit in the bays and in the Mechanical Methods Prohibited area along the Outer Banks of Pamlico Sound)

+ No changes in management
+ May provide incentive to harvest by hand methods
+ Limiting harvest for a concerned stock
+ Limit provides for regional hand harvest considerations
- Public perception of unfair treatment

2. Raise all harvest to 15-bushel trip limit for hand harvest methods for areas north of Core Sound and maintain 5/person – 10/operation from Core Sound south

+ Equity among harvest gears north of Core Sound
+ Less confusion over regulations
- Decreased mechanical harvest limit with possible economic strains
- No equity with southern region harvester

3. Allow all harvest to 10-bushel trip limit for hand harvest methods for all areas from Core Sound south

+ Equity among harvest areas
+ Less confusion over regulations
+ Possible increase in oyster harvest
- Increased harvest pressure on a concerned stock
- Potential decrease in southern area season
- Increased impacts to southern area oyster habitat

4. Expand 10-bushel hand harvest trip limit for hand harvest methods from Core Sound south to US Hwy. 58 Bridge at Emerald Isle

+ More economical fishing effort for individual harvester
+ Potential decreases in the exploitation of intertidal oyster reefs in the more southern areas
- No equity with southern region harvester
- Increased harvest pressure on a concerned stock
- Perceived inequity would remain and perhaps increase
- Risky change to a successful management strategy

5. Return to five bushels per person/10 bushel per commercial fishing operation for all hand harvest, statewide
+ A proven harvest limit that has provided viable oyster harvests for 20 years
+ Less pressure on oyster stock in northern areas
+ Equity among all oyster harvesters
+ No significant hardship to the majority of harvesters
- Northern harvesters would have to adjust to lower limits
- May increase the mechanical harvest pressure in northern areas

VIII. RECOMMENDATION

MFC Preferred Management Strategy
-

NCDMF
- Status quo (continue to maintain the 15 bushel hand/mechanical harvest limit in Pamlico Sound mechanical harvest areas outside the bays, 10 bushel and/mechanical harvest limit in the bays and in the Mechanical Methods Prohibited area along the Outer Banks of Pamlico Sound)

Advisory Committee
- Same as the NCDMF

Attachment 1. Oyster hand harvest restrictions for 2013.

SF-7-2013

PROCLAMATION

RE: 2013 OYSTER HAND HARVEST RESTRICTIONS

Dr. Louis B. Daniel III, Director, Division of Marine Fisheries, hereby announces that effective at **sunrise, Tuesday, October 15, 2013,** the following restrictions shall apply to the oyster fishery:

I. HARVEST RESTRICTIONS

A. MEANS AND METHODS

1. Oysters may be taken by hand and hand operated implements only. See General Information Section III. C. for further gear restrictions.

2. Oysters may not be transferred from the harvesting vessel to any other vessel during oyster harvesting operations or be transported by any vessel other than the vessel in which they are harvested.

3. It is unlawful to possess commercial and recreational limits of oysters aboard the same vessel.

4. It is unlawful to sell oysters taken on Saturday and Sunday from public bottom.

B. HARVEST DAYS - Oyster harvest will be allowed **Monday through Friday of each week** except as provided in C. 3. below.

C. COMMERCIAL AND RECREATIONAL HARVEST LIMITS

1. Properly licensed persons may take or possess no more than five (5) bushels of oysters per day and may not exceed a total of ten (10) bushels in any combined commercial fishing operation, regardless of the number of persons or boats that may be involved, in coastal fishing waters in the following area:

South and west of a line beginning at a point 35°00.1000' N - 76°14.8667'W near Hog Island Reef; running easterly to a point 34°58.7853'N - 76°09.8922'W on Core Banks; and east and south of the Highway 12 bridges on Thorofare and Nelson bays; and south of the Highway 101 bridges on Core and Harlowe creeks.

2. Properly licensed persons may take or possess no more than fifteen (15) bushels in any combined commercial fishing operation, regardless of the number of persons or boats that may be involved, in the following area except as specified in Section II below:

North and east of a line beginning at a point 35°00.1000' N - 76°14.8667'W near Hog Island Reef; running easterly to a point 34°58.7853'N - 76°09.8922'W on Core Banks; and west and north of the Highway 12 bridges on Thorofare and Nelson bays, and north of the Highway 101 bridges on Core and Harlowe creeks.
3. Unlicensed persons and harvesters taking oysters only for personal consumption may take one bushel of oysters per person per day not to exceed two bushels per vessel per day for recreational purposes seven days a week (see I.A.3. above).

D. MINIMUM SIZE LIMIT - The size limit will be three (3) inches shell length for oysters taken on public or private grounds. (See General Information Section II. F. below)

II. AREA RESTRICTIONS

Properly licensed persons may take or possess no more than ten (10) bushels of oysters per fishing operation per day in the following areas regardless of the number of persons or vessels involved:

A. **Wysocking Bay** - northwest of a line beginning at a point 35° 22.9684' N - 76° 03.7129' W on Benson Point, running northeasterly to a point 35° 24.6895' N - 76° 01.3155' W on Long Point;
B. **East Bluff Bay** – northwest of a line beginning at a point 35□ 19.5333' N - 76□ 09.3333' W on Bluff Point; running northeasterly to a point 35□ 21. 2784' N - 76□ 06. 7572' W on North Bluff Point;
C. **West Bluff Bay** – north of a line beginning at a point 35□ 20.3413' N - 76□ 12.3378' W on the east shore of Cunning Harbor; running easterly to a point 35□ 19.5333' N - 76□ 09.3333' W on Bluff Point;
D. **Juniper Bay-Cunning Harbor** - north of a line beginning at a point 35° 20.6217' N - 76° 15.5447' W on the west shore of Juniper Bay, running easterly to a point 35° 20.4372' N - 76° 13.2697' W; running easterly to a point 35° 20.3413' N - 76°12.3378' W on the east shore of Cunning Harbor;

E. **Swanquarter Bay** - north of a line beginning at a point 35° 20.9500' N – 76° 20.6409' W at The Narrows, running easterly to a point 35° 21.5959' N - 76° 18.3580' W on the east shore;
F. **Deep Cove** - **The Narrows** - north and east of a line beginning at a point 35° 20.9790' N - 76° 23.8577' W on the west shore; running southeasterly to a point 35° 20.5321' N - 76° 22.7869' W on Swanquarter Island, and west of a line at The Narrows beginning at a point 35° 20.9500' N - 76° 20.6409' W on the north shore, running southerly to a point 35° 20.7025' N - 76° 20.5620' W on Swanquarter Island;
G. **Rose Bay** - north of a line beginning at a point 35° 23.3404' N - 76° 26.2491' W on Long Point, running southeasterly to a point 35° 22.4891' N - 76° 25.2012' W on Drum Point;
H. **Spencer Bay** – northwest of a line beginning at a point 35° 22.3866' N - 76° 27.9225' W on Roos Point, running northeasterly to a point 35° 23.3404' N - 76° 26.2491' W on Long Point;
I. **Jones Bay** - west of a line beginning at a point 35° 13.4968' N - 76° 31.1040' W on Mink Trap Point; running southerly to a point 35° 12.3253' N - 76° 31.2767' W on Boar Point;
J. **Slade Creek** - east of a line beginning at a point 35° 27.8879' N - 76° 32.9906' W on the west shore; running southeasterly to a point 35° 27.6510' N - 76° 32.7361' W on the east shore;
K. **Scranton Creek** - south and east of a line beginning at a point 35° 30.6810' N - 76° 28.3435' W on the west shore; running easterly to a point 35° 30.7075' N - 76° 28.6766' W on the east shore;
L. **Pungo Creek** - west of a line beginning at a point 35° 30.7633' N - 76° 38.2831' W on Persimmon Tree Point; running southwesterly to a point 35° 31.1546' N - 76° 37.7590' W on Windmill Point;
M. **South Creek** - west of a line beginning at a point 35° 21.7385' N - 76° 41.5907' W on Hickory Point; running southerly to a point 35° 20.7534' N - 76° 41.7870' W on Fork Point;
N. **Bond Creek/Muddy Creek** - south of a line beginning 35° 20.7534' N - 76° 41.7870' W on Fork Point; running southeasterly to a point 35° 20.5632' N - 76° 41.4645' W on Gum Point;
O. **Goose Creek** – south of a line beginning at a point 35 19.7932’ N - 76 37.5347’ W on the north shore of Lower Spring Creek; running easterly to a point 35 19.8667’ N - 76 35.9333’ W on Fulford Point;
P. **Bay River** – west of a line beginning at a point 35 11.0333’ N - 76 31.5666’ W on Bay Point; running southerly to a point 35 09.0333’ N - 76 32.1500’ W on Maw Point;
Q. **Adams Creek** – south of a line beginning at a point 34 57.3104’ N - 76 41.1292’ W on the north shore of Godfrey Creek; running westerly to a point 34 57.5226’ N - 76 40. 5630’ W on the east shore;
R. **South River** – southeast of a line beginning at a point 34 58.6524’ N - 76 35. 4240’ W; running northeasterly to a point 34 59.1936’ N - 76 34.7657’ W on the west shore of Horton Bay;
S. **West Bay** – south of a line beginning at a point 35 01.5700’ N - 76 25.2850’ W on Newstump Point; running westerly to a point35 01.8982’ N - 76 21.7135’ W on Point of Grass.
T. In the Mechanical Methods Prohibited areas specified in 15A NCAC 03R .0108 (1) and (2) (a), (b), (c), and (d).

III. GENERAL INFORMATION

A. This proclamation is issued under the authority of N.C.G.S. 113-170.4; 113-170.5; 113-182; 113-221.1; 143B-289.52; and N.C. Marine Fisheries Commission Rules 15A NCAC 3H .0103, 3K .0201, 3K .0202 and 3K .0205. N.C. Marine Fisheries Commission Rules 15A NCAC 3K Sections .0100 *et seq.* and .0200 *et seq.* specify conditions, restrictions and authority granted to the Fisheries Director for management of oyster stocks.

B. It is unlawful to violate the provisions of any proclamation issued by the Fisheries Director under his delegated authority pursuant to N.C. Marine Fisheries Commission Rule 15A NCAC 3H .0103.

C. N.C. Marine Fisheries Commission Rule 15A NCAC 3K .0102 prohibits the taking of oysters with rakes more than 12 inches wide or weighing more than six pounds.

D. N.C Marine Fisheries Commission Rule 15A NCAC 3K .0207 exempts permitted aquaculture operations from bag and size limit restrictions.

E. N.C. Marine Fisheries Commission Rule 15A NCAC 3K .0209 prohibits the taking of oysters from oyster sanctuaries designated in N.C. Marine Fisheries Commission Rule 15A NCAC 3R .0117.

F. Maps are provided to aid in the identification of the specified harvest areas. Maps do NOT supersede existing rules or supersede proclamations closing areas to harvest by reason of pollution. Polluted Area maps can be found at http://portal.ncdenr.org/web/mf/shellfish-closure-maps.

By: _____

Dr. Louis B. Daniel III, Director
DIVISION OF MARINE FISHERIES
October 3, 2013
2:00 P.M.
SF-7-2013
/sab

234 copies of this public document were printed at a cost of 20 cents per copy.

12.1.4 ADOPTING SUPPLEMENT A TO AMENDMENT 2 INTO THE N.C. OYSTER FISHERY MANAGEMENT PLAN

I. ISSUE

Supplement A to Amendment 2 of the N.C. Oyster FMP must be adopted into Amendment 4 of the plan or it will no longer be a selected management strategy and used to manage the mechanical harvest of oysters in Pamlico Sound (G.S. 113-182.1). Supplement A established a trigger for closing areas to mechanical harvest and allowed the Fisheries Director to set the harvest limit up to 20 bushels per commercial fishing operation. These actions were taken to protect oyster resources and habitat from the effects of excessive mechanical harvest but allow additional harvest when oysters could be taken while avoiding excessive harvest impacts.

II. ORIGINATION

The Marine Fisheries Commission received a petition from oyster dealers and fishermen from Hyde County in January 2010, requesting a change in oyster harvest limits so each licensee can take a harvest limit rather than each fishing operation taking only one limit regardless of the number of licensees on board. Hyde County commissioners supported the petition. A recovery of oyster landings to pre red tide levels of the late 1980s and higher market demand for oysters also resulted in increased requests for raising the daily harvest limit set at 15 bushels in the FMP for mechanically harvested oysters. Supplement A also examined the issue of establishing triggers for closing the mechanical harvest oyster season recommended in Amendment 2 to the N.C. Oyster Fishery Management Plan

III. BACKGROUND

There were no limits on oyster harvest volume until 1947 when a 75-bushel daily limit per vessel was imposed. The 75-bushel per day per vessel harvest limit existed either in statute or rule until 1984 when proclamation authority was established for oyster limits. Between 1984 and 1989, the oyster harvest limit was 50 bushels per vessel per day. An addition to the proclamation authority in 1989 placed an upper harvest limit of 50 bushels of oysters per commercial fishing operation but allowed the director to set lower harvest limits. Harvest limits for the mechanical harvest fishery were 20 bushels per fishing operation from 1990 through spring 1992. Prior to Supplement A, mechanical harvest oyster limits were set at 15 bushels per fishing operation from the 1992-93 season through the 2009-10 season except for a brief period during the 2004-05 season when the limit was increased to 20 bushels due primarily to large increases in fuel costs. Setting of the oyster harvest limit at 15 bushels for mechanical harvesters (and 5 bushels for hand harvesters) was in response to low population levels observed due to *Perkinsus marinus* (Dermo) induced mortalities.

The harvest management measures adopted in the 2001 FMP focused on further designation of areas limited to hand harvest methods using enhancement measures and harvest restrictions to support success of those designations. There was no directive to remove flexibility in setting mechanical harvest limits for oysters. The 2008 Amendment 2 to the Oyster FMP contained a plan for setting limits and designating additional mechanical harvest limit areas in Pamlico Sound and its tributaries. Lower mechanical harvest limits of ten bushels per commercial fishing operation were established for the bays around Pamlico Sound. The established mechanical harvest limit for Pamlico Sound waters of 15 bushels per commercial fishing operation was also adopted as a management strategy with a recommendation that triggers for closing the mechanical harvest season should be established.

Supplement A to Amendment 2 of the N.C. Oyster FMP established the trigger for closing areas to mechanical harvest when sampling indicates the number of legal-sized oysters in the area has declined to 26 percent of the live oysters sampled and allowed the Fisheries Director to set the harvest limit up to 20 bushels per commercial fishing operation. The 26-percent harvest trigger was selected after three seasons of sampling oyster size distribution in Pamlico Sound yielded end-of-season legal percentages of 20, 19 and 26 percent for the 2006-07, 2007-08 and 2008-09 seasons, respectively. The mechanical harvest season closure at 26 percent in 2008-09 came after effort began to decline and supported a harvest of 113,000 bushels in 2009-10. The upper mechanical harvest limit of harvest 20-bushels was the highest limit supported by the data within the comfort zone of the Fisheries Director and the Marine Fisheries Commission. Sampling efforts and data analysis used to establish the trigger and set harvest limits are presented in Supplement A (NCDMF 2010). Supplement A only established changes to harvest limits for Pamlico Sound, harvest limits for bay and Outer Banks areas around Pamlico Sound were not addressed. Supplement A management areas are shown in Figure 12.12.

Management under Supplement A has been in effect beginning with the 2010-11 mechanical harvest oyster season. The 20-bushel limit was put in place for November 18 through 24 in 2010 and likely increased landings. The normal 15-bushel limit was also raised to 20 bushels from March 16 through March 31 in 2011 although a large portion of the harvesters stopped fishing prior to the end of the season. The Neuse River Area was closed to dredging from January 7 to February 14, 2011 because samples failed to meet the minimum 26-percent legal-sized criterion set in Supplement A. Effort in the Neuse River Area appeared to be much lower after the re-opening. Mechanical harvest oyster landings were 122,172 bushels for the 2010-11 season. These landings were aided by an early mechanical harvest season opening date on November 1, reported extraordinary oyster growth and substantial harvest of unusually large oysters from an area that typically exhibits sporadic oyster production (NCDMF unpublished data).

Results of monitoring to assess compliance with the harvest closure trigger for the 2010-11 season are presented in Figure 2. Only the Neuse River and Pamlico River areas are shown for clarity since other areas did not contribute significantly to the mechanical harvest fishery in 2010-11. The percentage of legal-sized oysters in the samples is plotted against harvest trips and should give some indication of how the mechanical harvest oyster fishery performed with respect to the harvest trigger measure. However, since the percentage of legal-sized oysters in the samples uncharacteristically, generally increased throughout the 2010-11 season, the percentage of legal-sized oysters should not have affected the number of trips or the ability to reach 15 bushels of harvest.

The lack of effect from the supply of legal-sized oysters provides an opportunity to observe variability in the number of trips caused by other factors during the 2010-11 mechanical harvest season (Figure 12.13). The high number of trips in weeks two and three was likely influenced by the prospect of high oyster prices due to closure of oyster harvest areas in the Gulf of Mexico due to the 87 day oil spill from the Deepwater Horizon which occurred in April of 2010. The drop in effort around week four coincides with a drop in demand after the Thanksgiving holiday and the same drop in demand is typically experienced after Christmas; in week eight for 2010-11. The large decease in trips in week 11 was at least partially caused by the closure of the Neuse River Area for falling below the harvest trigger due to the abundance of undersize oysters in that area. The area reopened in week 16 after oyster sizes increased to legal percentages above the 26 percent trigger but trips decreased in all areas about that time,

presumably due to low demand and the emergence of spring fisheries; most likely blue crabs which command a premium price in

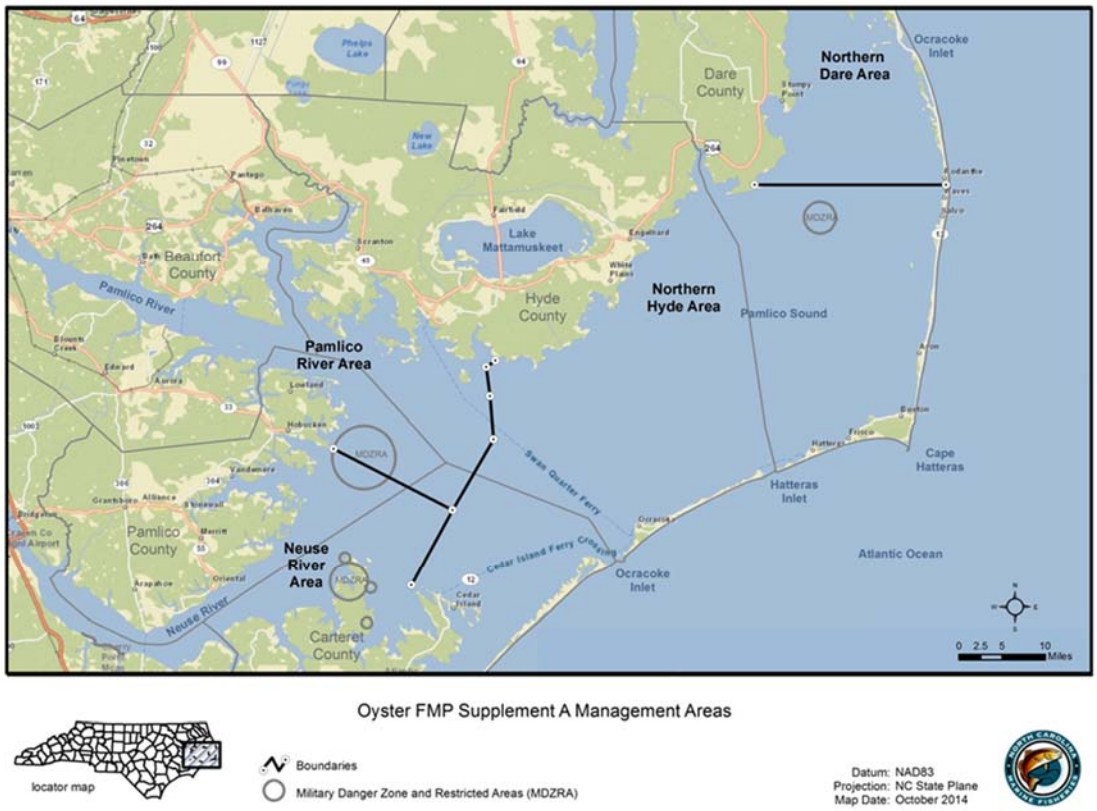

Figure 12.12. Areas used for management under the provisions of Supplement A.

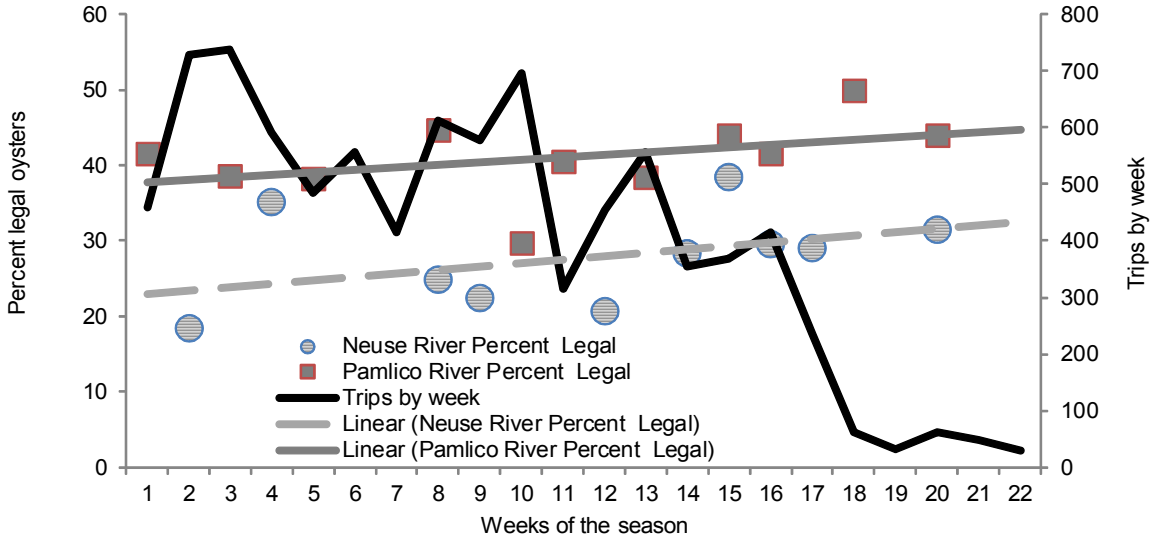

Figure 12.13. Mechanical harvest trips per week and percent legal oysters 2010-11 (NCDMF Trip Ticket data).

March. These factors and weather will affect most mechanical harvest seasons irrespective of the magnitude of the harvest.

Except for the five-week mechanical harvest closure in the Neuse River Area, the percentages of legal-sized oysters did not fall below the harvest closure trigger (two consecutive pooled samples of legal-sized oysters below 26 percent) and the season was not closed prior to the March 31 closure in rule. Closures like the one in the Neuse River Area were anticipated in Supplement A as highly successful spatfall events can impact the harvest of pre-existing populations of harvestable oysters. Even though the season was not closed, oyster limits were at the higher 20-bushel level and the percentage of legal-sized oysters was very high; harvest trips dropped dramatically in mid-March.

Hurricane Irene hit the North Carolina coast on August 27, 2011 and had major impacts on the mechanical harvest area for oysters. The oyster resources on the Middle Ground could not be located after the storm probably due to sedimentation or physical relocation caused by waves or currents. Many of the deeper water oyster resources located near Brant Island Shoal were also significantly damaged. Most of the damage was oyster mortality caused by detritus covering the oyster rocks. Oyster resources in the Neuse and Pamlico rivers did not appear to suffer much damage but also did not show any of the typical growth characteristics during the following fall and winter months. These factors had a pronounced effect on the mechanical harvest oyster season in 2011-12 and the mechanical harvest area in western Pamlico Sound was closed on January 2, 2012. Mechanical harvest landings declined to near 2008-09 levels at 34,383 bushels. Regular sampling of oyster sizes to fulfill the requirements of Supplement A to the N.C. Oyster FMP has made it clear that oyster growth during the harvest season is essential to sustain harvest levels of legal-sized oysters above the trigger.

Results of monitoring to assess compliance with the harvest closure trigger for the 2011-12 season are presented in Figure 12.14. Only the Neuse River and Pamlico River areas are shown for clarity since other areas did not contribute significantly to the mechanical harvest fishery in 2011-12. The mechanical harvest season opened a little later than normal on 14 November. Trips were down by more than 50 percent compared to the start of the previous season. The proportion of legal-sized oysters in the samples dropped relatively quickly and even though the decrease in trips after Christmas is expected, the magnitude of the decrease indicates that some harvesters did not feel that further harvesting was advisable. The mechanical harvest oyster season for the Neuse and Pamlico River areas closed on January 2, 2012 due to failure to meet the 26-percent trigger. Continued sampling after the closure indicated the proportion of legal-sized oysters did not increase enough to re-open these areas to mechanical harvest due to poor growth.

Prior to the 2012-13 mechanical harvest season, division oyster sampling indicated an apparent, severe low dissolved oxygen event occurred in the Neuse River that caused virtually 100 percent mortality of the oyster resources at 18 feet or greater depths. A few oyster rocks in shallower waters between Maw Point Shoal and Light House Shoal were spared as well as some division oyster habitat enhancement projects in other shallow areas. The Pamlico River Area also had not recovered from the effects of Hurricane Irene at this time. The Neuse River Area was available for mechanical harvest until the adjacent bays closed on December 21 although there was no harvest activity in the river during the time it was open. The Pamlico River Area closed to mechanical harvest on February 1, 2013 based on failure to meet the 26-percent trigger although effort was much reduced since early January. The 2012-13 mechanical harvest oyster landings declined further to 23,541 bushels.

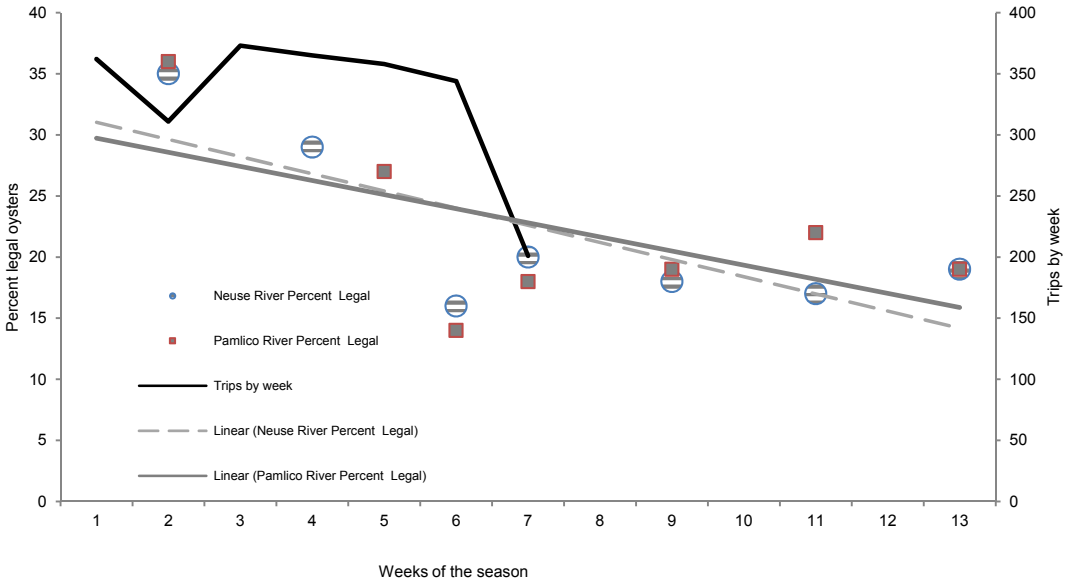

Figure 12.14. Mechanical harvest trips per week and percent legal oysters 2011-12 (NCDMF Trip Ticket data).

Results of monitoring to assess compliance with the harvest closure trigger for the 2012-13 season are presented in Figure 12.15. Only the Pamlico River area is shown for clarity since other areas did not contribute significantly to the mechanical harvest fishery in 2012-13. The mechanical harvest season opened on 12 November. Trips were down similar to the start of the previous season but decreased much more rapidly. The proportion of legal-sized oysters in the samples remained relatively high until the tenth week of the season but the percent of trips reaching 15 bushels was lower than the previous year indicating the drop in trips may have been due to low volumes of harvestable oysters. This situation of having a relatively high percentage of legal-sized oysters but low overall numbers of oysters was anticipated in Supplement A as poor spatfall events and loss of oysters due to environmental conditions and disease can create situations where the trigger allows harvest to continue even though the effort necessary to reach the harvest limit is high. However, in these situations the number of vessels participating tends to be low.

Results of monitoring to assess compliance with the harvest closure trigger for the 2013-14 season are presented in Figure 12.16. Only the Pamlico River and northern Dare areas are shown for clarity since other areas did not contribute significantly to the mechanical harvest fishery in 2013-14. There was little evidence of any recovery of the Neuse River oyster resources prior to the 2013-14 season but the Pamlico River area appeared to be recovering and growth indicators were good during the season. The northern Dare area in northern Pamlico Sound also supported some significant mechanical harvest activity throughout the season and when oyster harvests began to decline in the western sound in early February, 20 to 25 boats moved to Dare County to finish the season. The few productive areas in the Neuse River closed on February 28, 2014. The Pamlico River Area closed March 24, 2014.

Mechanical harvest in Dare County continued until the season ended on March 31, 2014. The overall result was a significant increase in mechanical harvest oyster landings with 64,137 bushels for the season.

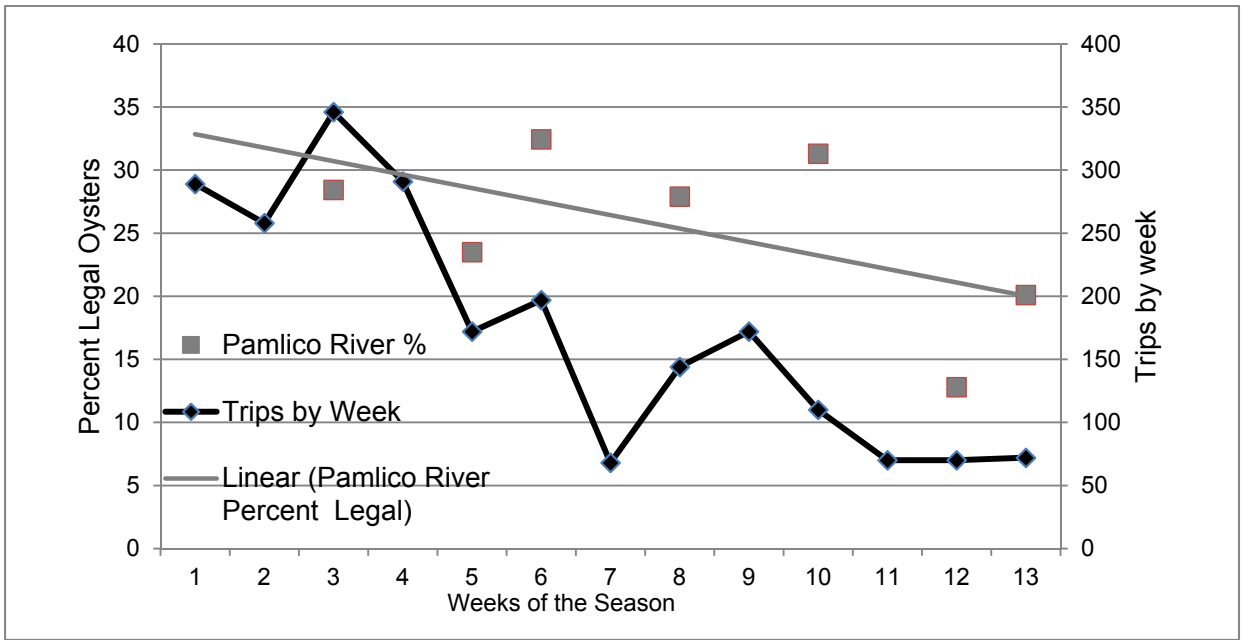

Figure 12.15. Mechanical harvest trips per week and percent legal oysters 2012-13 (NCDMF Trip Ticket data).

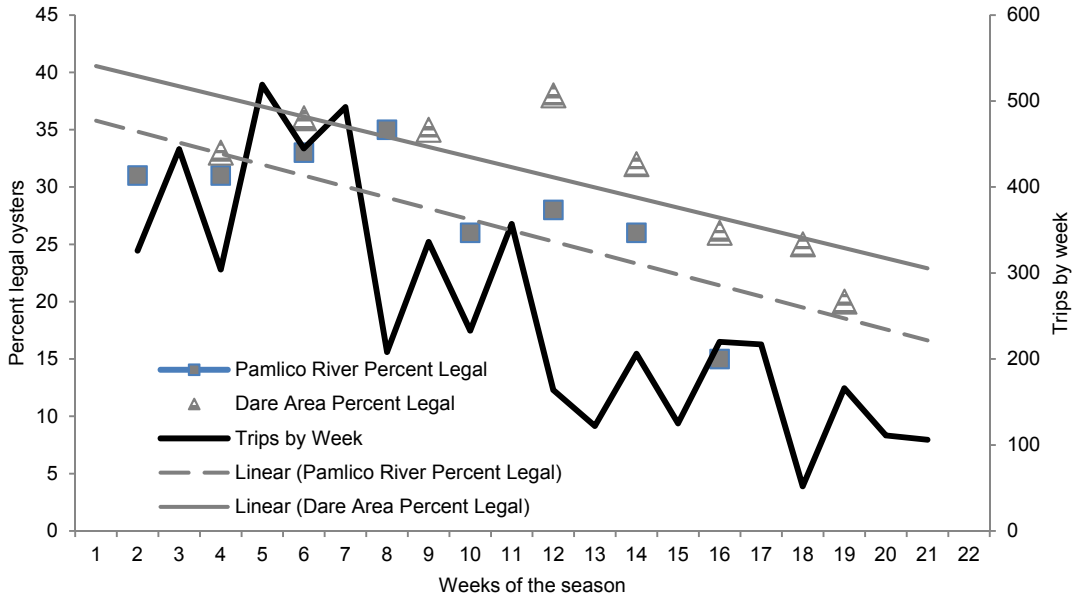

Figure 12.16. Mechanical harvest trips per week and percent legal oysters 2013-14 (NCDMF Trip Ticket data).

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.
113-221.1	Proclamation; emergency review.
143B-289.52	Marine Fisheries Commission – powers and duties.

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

03K .0201	Open season and possession limit

V. DISCUSSION

Since the division does not have the means to measure and monitor habitat impacts caused by oyster harvesting, it is difficult to determine the success of limiting the mechanical harvest oyster season through the use of the harvest trigger. The conclusions drawn from the data obtained during the 50 and 100 pound dredge comparison studies documented in the Amendment 2 to the N.C. Oyster FMP (NCDMF 2008, Section 10.16) support the actions taken but there are no data on current changes in oyster reef habitat to verify those conclusions or to establish that a minimum of 26 percent legally-harvestable oysters is the proper trigger for closing mechanical harvest of oysters. Even if the division was able to collect the necessary data, it is unlikely that four harvest seasons is adequate time to discern significant changes in the habitat and there is no adequate control data on which to base those comparisons. Furthermore, it is uncertain if use of the harvest closure trigger actually changed mechanical harvest season management since it was implemented. Season closures prior to the March 31 limit on the season in rule occurred five times between 2002 and 2009 or about the same rate as the early closures after implementation of Supplement A that began in 2010. Still, a decision must be made on whether to adopt Supplement A into the plan and continue to use its provisions for management of the mechanical harvest oyster fishery.

To this end, the percentage of trips reaching a 15-bushel harvest could be used as an indirect measure of the amount of mechanical harvesting activity occurring with the assumption that higher percentages of operations reaching that harvest would indicate that legal-sized oysters were more available requiring less harvest effort and creating less impact on the habitat. Seasons with higher percentages of trips reaching 15 bushels would be expected to have a longer harvest season while those percentages persisted and those with lower percentages would be shorter. This information could also be used to review the success of the trigger.

The percentage of trips reaching 15 bushels by week for the four mechanical harvest seasons managed under Supplement A are shown in Figure 6. The two seasons with higher percentages of trips reaching 15 bushels (generally greater than 40 percent) were not closed early while the two seasons that began with less than 40 percent of the trips reaching15 bushels had much shorter seasons. This situation appears to indicate the harvest closure trigger was operating close to the level intended. The notable exception is shown by the circled area on the 2012-13 season data where mechanical harvest operated for four weeks in the Pamlico River Area with very low numbers of trips reaching the 15 bushel level. Sampling indicated that very low spatfall in 2012-13 skewed the oyster size distribution toward the legal sizes.

While all of the management situations encountered during the first four seasons of use of the harvest trigger to set the season for the mechanical harvest oyster fishery were anticipated in Supplement A, the intra-season closure in Neuse River in 2010-11, the very early season closure in the Neuse River and Pamlico River areas in 2011-12, and the failure to close the season earlier in 2012-13 were all unpopular with a large percentage of mechanical harvesters. These situations were encountered because the size of oysters in the population can be skewed due to high spat sets and oyster mortality events causing closure of mechanical harvest areas for failure to meet the trigger when there are economically significant numbers of oysters present.

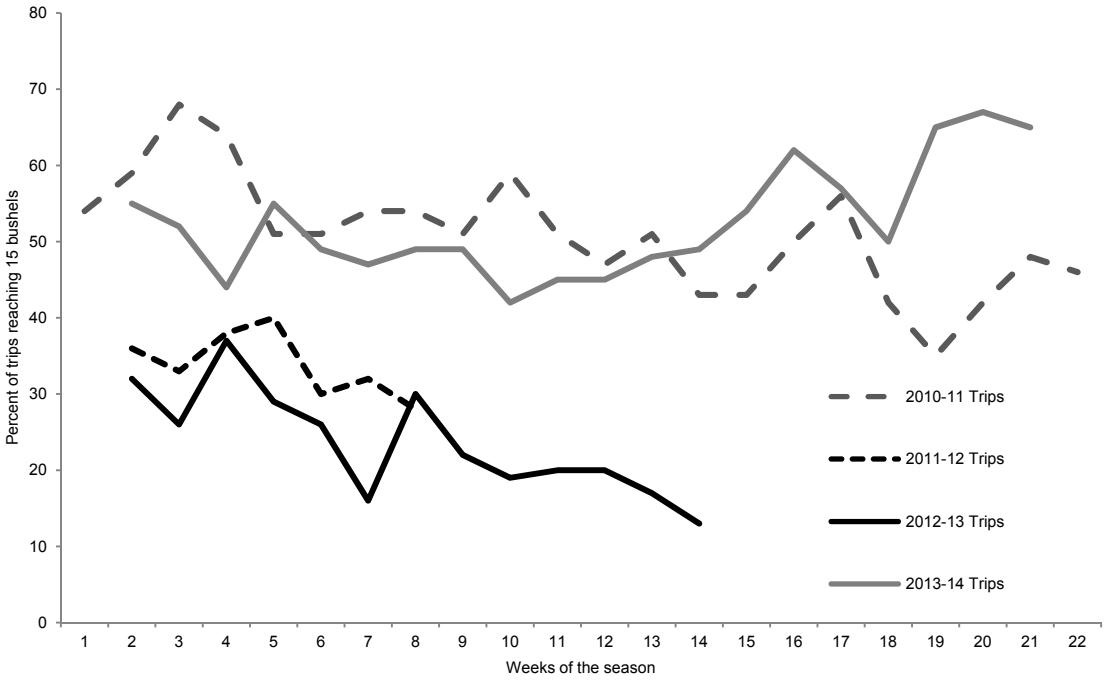

Figure 12.17. Percentage of trips reaching 15 bushels by week for the four mechanical harvest seasons managed under Supplement A (NCDMF Trip Ticket data).

Mechanical harvesters have suggested that the division exclude small spat from the trigger calculations to avoid closures like the one in Neuse River in 2010-11 that affected a large number of participants. Excluding recently set oysters less than 25 mm (~1 inch) would have increased the percentage of legal oysters by up to three percent during the seasons under Supplement A management measures but would not have made a significant difference in mechanical harvest closures. However, legal-size percentages hovering around the 26 percent level could be affected and late season or extremely heavy spatsets could still cause closures. On the other hand, exclusion of the oysters less than 25 mm could further extend seasons where overall low numbers of oysters inflate the percentage of legal sizes. Other harvesters have suggested the 26 percent trigger is too high or that no trigger is needed since we have a minimum size. Other fishing groups have expressed the opinion that mechanical harvest of oysters is too damaging to the oyster habitat at any level and should be phased out.

There are not enough years in the time series collecting the oyster size information for the harvest closure trigger to indicate whether modifications are justified. As with any new management strategy it often takes a more long term approach to understand how changes impact the resource, habitat, and the fishery. Management of mechanical harvest of oysters with the harvest trigger has not shown significant modifications to the season closure, but the trigger does provide a real-time look at the resource while the fishery is occurring.

Rule 15A NCAC 03K .0201 contains regulations for oyster harvest management. The rule is proposed for amendment to set the upper mechanical harvest limit at 20 bushels. Setting the upper mechanical harvest limit at 20-bushels is the highest limit supported by the data. Additional proposed changes to the rule clarify the Fisheries Director's proclamation authority of allowing the director to specify a minimum size of two and one-half inches for harvest to prevent loss of oysters due to predators, pests or disease. The rule changes align with the original intent of the provision currently in the rule that allows for a minimum size limit as small as two and one-half inches, as well as the minimum size limit of three inches that is intended in the absence of predators, pests or disease. Any other catastrophic environmental conditions affecting oysters would be rare events that can be handled under Rule 15A NCAC 03I .0102 which allows the Fisheries Director to suspend in whole or in part, any rule regarding oysters which may be affected by variable conditions, and Rule 15A NCAC 03H .0103 which provides the variable conditions. Additional proposed amendments make the rule consistent with other rules containing proclamation authority.

VI. PROPOSED RULES

15A NCAC 03K .0201 ~~OPEN SEASON AND POSSESSION LIMIT~~ OYSTER HARVEST MANAGEMENT

(a) It is unlawful to take or possess oysters from public ~~bottoms~~ bottom except from October 15 through March 31.

(b) The Fisheries Director may, by proclamation, ~~close and open the season within the time period stated herein or close and open any of the various waters to the taking of oysters depending on the need to protect small oysters and their habitat, the amount of saleable oysters available for harvest, the number of days harvest is prevented due to unsatisfactory bacteriological samples and weather conditions, and the need to prevent loss of oysters due to parasitic infections and thereby reduce the transmission of parasites to uninfected oysters or other variable conditions and may~~ impose any ~~or all~~ of the following restrictions on the taking of ~~commercial and recreational oyster harvest:~~ oysters:

(1) Specify ~~days of the week harvesting will be allowed;~~ time;

(2) Specify ~~areas;~~ area;

(3) Specify means and ~~methods which may be employed in the taking;~~ methods;

(4) Specify ~~time period;~~ season within the period set forth in Paragraph (a) of this Rule;

~~(5) Specify the quantity, but shall not exceed possession of more than 50 bushels in a commercial fishing operation; and~~

(5) Specify size, but the minimum size specified shall not be less than three inches, except the minimum size specified shall not be less than two and one-half inches to prevent loss of oysters due to predators, pests, or infectious oyster diseases; and

~~(6) Specify the minimum size limit by shell length, but not less than 2 1/2 inches.~~

(6) Specify quantity, but shall not exceed possession of more than 20 standard U.S. bushels in a commercial fishing operation per day.

History Note: Authority G.S. 113-134; 113-182; 113-201; ~~113-221;~~ 113-221.1; 143B-289.52;
Eff. January 1, 1991;
Amended Eff. April 1, 2017; October 1, 2008; March 1, 1996; September 1, 1991.

VII. PROPOSED MANAGEMENT OPTIONS

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

1. Status quo – Reinstate the 15-bushel per operation mechanical harvest limit for oysters and close the season based on public perception and increases in law enforcement actions

+ Conservative limit that allowed for oyster recovery after Dermo abated
+ 15-bushel limit extends the harvest season providing markets with local oysters
+/- May aid in protecting oyster habitat depending on season closure criteria
- Lack of flexibility in harvest limits does not allow for higher harvests during years with increased production or lower limits when production is poor
- Early season closures have been necessary under this limit
- Public opinion varies greatly on the need to close the mechanical harvest season

2. Adopt the provisions of Supplement A – a flexible harvest limit up to 20 bushels, a trigger of 26 percent legal-sized oysters for closing an area to mechanical harvest and set the upper harvest limit of 20 bushels in rule

+ Requires staff to collect field data and communicate with harvesters/dealers
+ Provides more flexibility for responding to varying population levels of oysters and variable environmental/market conditions
+ Reduces the potential for overharvesting the resource and damaging oyster habitat
+ The limited information available indicates the current restrictions are reasonably effective at limiting mechanical harvest
+/- May subject the director to pressure from diverse groups trying to influence harvest limits
- Higher available limits could lead to early season closure and impacts to markets
- Adequate staff may not be available to conduct the additional sampling required
- Success of this habitat protection measure cannot be quantitatively evaluated

3. Change the Supplement A harvest trigger calculation to exclude oysters less than 25 mm

+ May reduce mechanical harvest closures
- Could further extend seasons where overall low numbers of oysters inflate the percentage of legal sizes
- May increase the risk for oyster habitat damage from mechanical harvest
- Insufficient data to accurately predict the effect of this change

4. Phase out mechanical harvest of oysters

+ Eliminates any possibility of negative oyster habitat impacts from mechanical harvest gear
- Eliminates a traditional oyster fishery
- Greatly reduces the gears that can effectively harvest oysters in areas where mechanical gear is commonly used
- Current management practices are designed to reduce negative habitat impacts from mechanical harvest gear

VIII. RECOMMENDATION

MFC Selected Management Strategy

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NCDMF

- Adopt the provisions of Supplement A – a flexible harvest limit up to 20 bushels, a trigger of 26 percent legal-sized oysters for closing an area to mechanical harvest and set the upper harvest limit of 20 bushels in rule
- Develop a fishery dependent metric of effort to help assist with management decisions

Advisory Committee

- Adopt the provisions of Supplement A – a flexible harvest limit up to 20 bushels, a trigger of 26 percent legal-sized oysters for closing an area to mechanical harvest and set the upper harvest limit of 20 bushels in rule

VIII. RESEARCH RECOMMENDATIONS

- Further studies on the effects of dredge weight and size on habitat disturbance and oyster catches
- Develop a program to monitor oyster reef height, area and condition

IX. LITERATURE CITED

North Carolina Division of Marine Fisheries (NCDMF). 2010. Supplement A to Amendment II of the NC Oyster Fishery Management Plan. Changing Management Measures for Harvest Limits in the Mechanical Harvest Oyster Fishery. North Carolina Department of Environment and Natural Resources. North Carolina Division of Marine Fisheries.. Morehead City, NC. 14 p.

NCDMF. 2008. North Carolina Oyster Fishery Management Plan Amendment 2. North Carolina Department of Environment and Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, NC. 282 p.

12.1.5 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 LICENSE

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 Standard Commercial Fishing License (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 Fishery Reform Act of 1997 (FRA).

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 Standard Commercial Fishing License (SCFL) and a Retired Standard Commercial Fishing License (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 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 12.5). Regardless of license type, the Trip Ticket Program 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 12.5. 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 Trip Ticket Program are much higher than the number of shellfish license holders that commercially landed shellfish (Figure 12.18). This is also true for license holders from southern counties (Figure 12.19). 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.

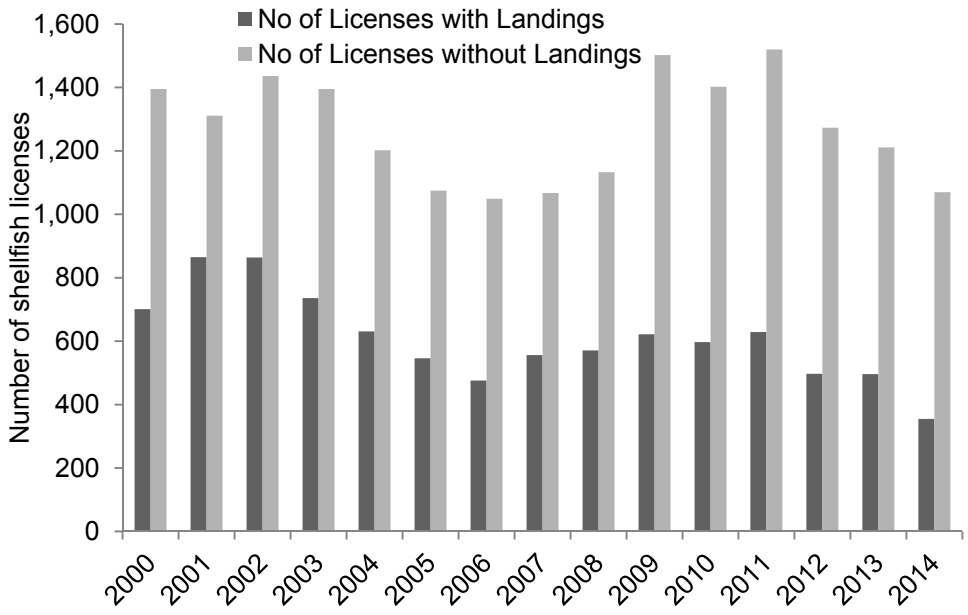

Figure 12.18. Comparison of shellfish licenses holders statewide with and without Trip Ticket landings, 2000-2014.

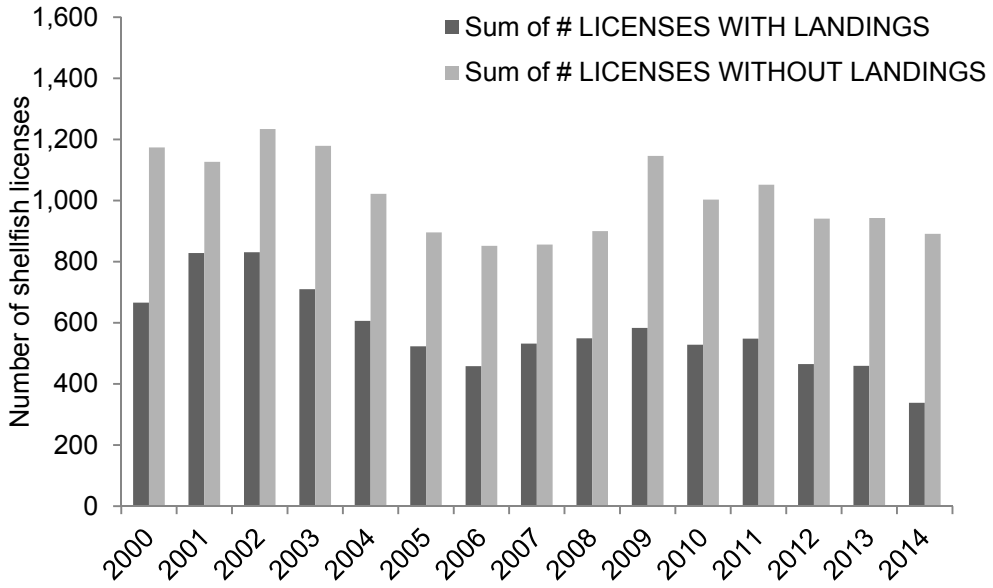

Figure 12.19. Comparison of shellfish licenses holders from southern counties* with and without Trip Ticket Landings, 2000-2014 *Carteret, Jones, Onslow, Duplin, Pender, Brunswick, Bladen, Columbus, Robeson, Cumberland, Sampson, New Hanover.

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 12.6); 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 12.5; Figure 12.20). 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 12.5; Figure 12.20). 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 12.5. Effort (trips) and harvest (bushels) of oysters by license type in southern and northern counties, 2000-2014.

	NORTHERN						SOUTHERN					
	SCFL		RSCFL		Shellfish w/o SCFL		SCFL		RSCFL		Shellfish w/o SCFL	
YEAR	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 12.6. Effort (trips) and harvest (number) of hard clams by license type in southern and northern counties, 2000-2014.

	NORTHERN						SOUTHERN					
	SCFL		RSCFL		Shellfish w/o SCFL		SCFL		RSCFL		Shellfish w/o SCFL	
YEAR	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

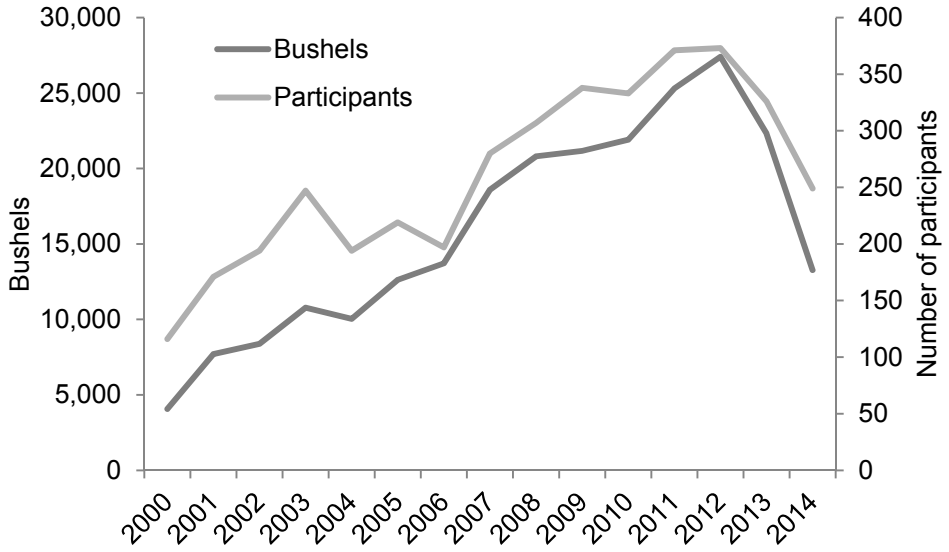

Figure 12.20. Number of participants and oyster bushels harvested by shellfish license holders from southern coastal counties, 2000-2014

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 12.5).

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 quality for a SCFL/RCFL. 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 12.5).

When comparing license prices and requirements with Maryland, Virginia, and South Carolina, North Carolina prices are overall, considerably less (Table 12.7). 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 12.7). 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 12.7. 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 Yes: for mechanical	N/A $250 ($400 in 2015/16)	$31.25 ($50 in 2015/16) N/A
MD	Yes	$215	$100: oysters $100: clams
VA	Yes	$190	*Oyster Resource Use fees:* $50: hand harvest only $50: aquaculture operation $300: one or more gear types *Clam harvest licenses:* $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 12.8). 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 12.8 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 Preferred Management Strategy

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NCDMF

- 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)**

Advisory Committee

- Establish a daily trip limit of 2 bushels of oysters per person with a maximum of 4 bushels of oysters per vessel off public bottom from Highway 58 Bridge south only for holders of the Shellfish License. The daily trip limit of 5 bushels of oysters per person for

SCFL and RSCFL holders will be maintained in this area. Shellfish License holders will be eligible to acquire a SCFL after they show a history of sale of shellfish **(requires statutory change)**

12.1.6 REQUIREMENTS FOR SHADING MOLLUSCAN SHELLSTOCK

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 Clam Advisory Committee 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 a1.8% 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 U.S. Food and Drug Administration 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, 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 National Shellfish Sanitation Program (NSSP) requirements. These requirements have been put in place to reduce post harvest growth of environmental *Vibrio* bacteria. The Centers for Disease Control (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 12.21). 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 5 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.*

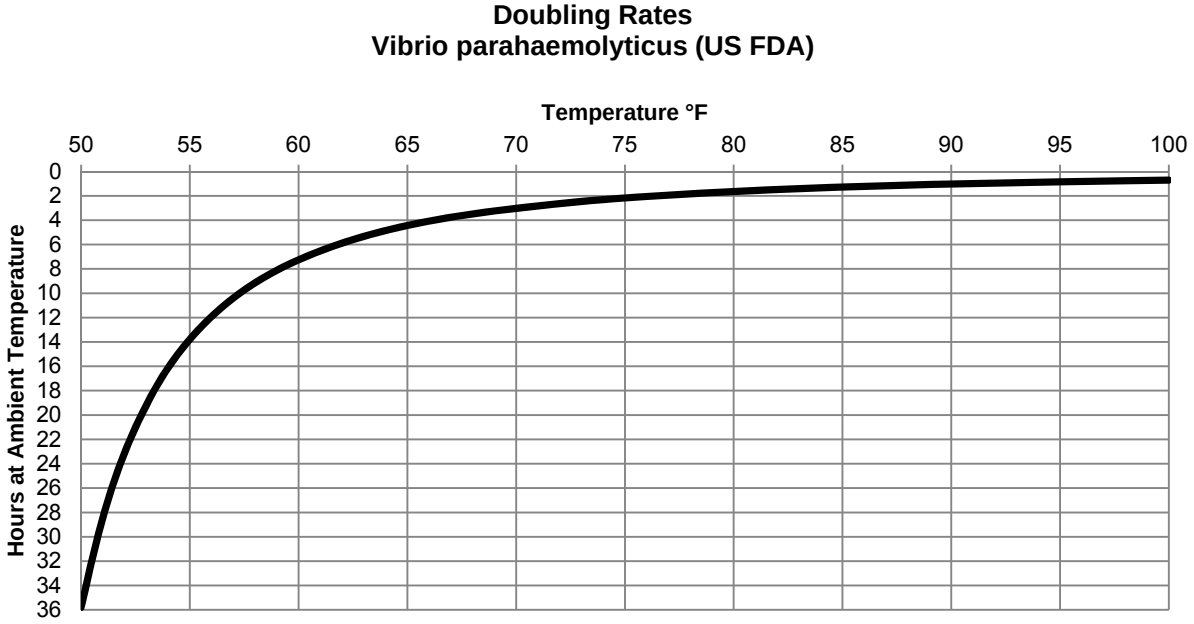

Figure 12.21. *Vibrio parahaemolyticus* doubling rates. Interstate Shellfish Sanitation Conference Vibrio Control Plan Guidance Template, 2008.

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 12.9 outlines shading requirements for our neighboring states.

Table 12.9. 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 this 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 Preferred Management Strategy

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NCDMF

- 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.

Advisory Committee

- Same as NCDMF*

*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

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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 ofQuahog Clams (*Mercenaria mercenaria*). Journal of Food Protection. 77: 843-848.

National Shellfish Sanitation Program(NSSP). Guide for the Control of Molluscan Shellfish: Guidance Documents, 2013. (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.

Attachment 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:
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;
Directly covering the clams with a light colored, non-toxic material such as a tarp or fabric during the operations in (a).
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.

12.2 PRIVATE CULTURE

12.2.1 Protection of Shellfish Lease and Franchise Rights

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 North Carolina Division of Marine Fisheries (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.

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 Marine Fisheries Commission 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

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 Schedule Exceptions *	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

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 ~~1~~ 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 ~~1~~ 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 03O .0114

15A NCAC 03O .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. April 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 Preferred Management Strategy

-

NCDMF

- 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
- 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.

Advisory Committee

- Same as the NCDMF

12.2.2 Utilizing GPS Coordinates Instead of a Survey to Define Shellfish Lease Boundaries

The following issue was removed from the Oyster FMP Amendment 4 and Hard Clam FMP Amendment 2 for further development due to Session Law 2015-241 passed on September 18, 2015 and placed in Appendix 15.4 to maintain the history of its development. The new law under G.S. 113-202 (i) states that after a lease application is approved by the DEQ Secretary the lease applicant shall submit to the DEQ Secretary information that conforms to the standards set by the DEQ 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.

12.2.3 Defining Adverse Impacts to Submerged Aquatic Vegetation from Shellfish Leases and Franchises

I. ISSUE

Shellfish lease applicants have been denied proposed shellfish lease locations by the North Carolina Division of Marine Fisheries (NCDMF) due to the presence of submerged aquatic vegetation (SAV) on the proposed site. The Regional Conditions of the US Army Corps of Engineers (USACE) Nationwide Permit 48 (NWP 48) do not allow for any adverse effects to SAV.

II. ORIGINATION

This issue was brought forward by the North Carolina Shellfish Growers Association 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 Partnership-Albemarle Pamlico National Estuary Partnership. Proposed shellfish lease sites are sampled during this process, taking 50 meter square samples per acre. The lease investigation and sampling effort ensures that the proposed site complies with NCMFC Rule, North Carolina General Statutes, USACE Nationwide Permit (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, NCMFC 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 (Pregnall 1993; Everett et al. 1995; Wisehart 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, Wisehart 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 looking at the effect of shellfish culture on SAV, one by the University of North Carolina (UNC) Coastal Studies Institute in Roanoke Sound and another by UNC Wilmington 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

SAV 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 NWPs 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 National Marine Fisheries Service (NMFS) provides biological opinions, through consultations, to the USACE Districts on district level implementation and regional conditions of Nationwide Permits. Table 12.12 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 12.12. 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-construtction 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 aras 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, NCMFC 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 consult 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 provided by Mike Marshall that specified the required sampling numbers for rakes and patent tongs along with bushel conversion factors (C.H. 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 – 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 to provide the quality of sampling that the rakes provide in shallow water or patent tongs in deeper water. (C.H. 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). Division 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. DENR/NCDMF 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
- DENR/NCDMF fall out of compliance with regional conditions of NWP48
- DENR/NCDMF loses the ability to issue shellfish leases through USACE authority

VIII. RECOMMENDATION

MFC Preferred Management Strategy
-

NCDMF

- 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).

Advisory Committee

- 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.

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50 CFR 600.810 Definitions and word usage.

12.2.4 BRUNSWICK COUNTY SHELLFISH LEASE MORATORIUM

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 between1940-2001. 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

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 12.13).

Table 12.13. 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 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 NCGS 113-202 and NCMFC 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 of 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
+ 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
+ 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 Preferred Management Strategy
-

NCDMF
- Continue the moratorium of shellfish leases in Brunswick County

Advisory Committee
- Same as NCDMF*

*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.

12.2.5 Core Sound Shellfish Lease Moratorium

The following issue was removed from the Oyster FMP Amendment 4 and Hard Clam FMP Amendment 2 for further development due to Session Law 2015-241 passed on September 18, 2015 and placed in Appendix 15.4 to maintain the history of its development. The new law under Section 14.8 states that NCDMF and DEQ 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 of Governmental Operations.

12.2.6 Redefining Off Bottom Culture

The following issue was removed from the Oyster FMP Amendment 4 and Hard Clam FMP Amendment 2 for further development due to Session Law 2015-241 passed on September 18, 2015 and placed in Appendix 15.4 to maintain the history of its development. The new law under Section 14.10C.(c) amended General Statute 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 <u>not</u> resting on the bottom or extending 18 inches above the bottom will require a water column lease under G.S. 113-202.1. The draft issue that was taken out for

12.2.7 MODIFY SHELLFISH LEASE PROVISIONS

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.

   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 the 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
• Change to 5 year contract. • 5 year prod. avg.	Supported by 4 regional and Shellfish committee Implemented 2008/09
• 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
• Limit acreage to 5 acres/lease	Supported by 4 regional and the Shellfish committee Implemented 2008/09 – 10 acres allowed in mechanical harvest areas
• Require current lease meet production prior to granting more leases	Supported by 4 regional and the Shellfish committee Shellfish committee Implemented 2008/09
• Develop regional lease acreage caps	Various support from regional committees and Shellfish committee. Not Implemented
• 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 5 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 the 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 where 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 Statues 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 a 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

NCDMF recommendations:

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 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 acres for all areas except those areas open to the mechanical harvest of oysters where the proposed lease area shall not exceed 10 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 (c)~~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. April 1, 2017; October 1, 2008; April 1, 2003.

Advisory Committee recommendations:
[Note: only difference from the NCDMF version is found in Paragraph (a)(3)]

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 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.~~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 (c)~~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. April 1, 2017; October 1, 2008; April 1, 2003.

NCDMF and Advisory Committee recommendations:

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(l1) 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. April 1, 2017; April 1, 2003.

VII. PROPOSED MANAGEMENT OPTIONS

Production Options

1. Status quo (Maintain current lease terms of 5 years with 5 year production average)
+ Unproductive leases to be terminated, not holding public trust waters for long time period
+ Few applicants request more than 5 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 7 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)**
+ 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. 7 year lease becomes a 9 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 exist
- 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 Preferred Management Strategy

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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)**

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)**
- 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)**
- Improve public notice of proposed lease applications on the physical lease, at fish houses, and/or through electronic notices.

IX. LITERATURE CITED

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13.0 PREFERRED MANAGEMENT STRATEGIES AND RESEARCH RECOMMENDATIONS

13.1 PREFERRED MANAGEMENT STRATEGIES

13.1.1 Insufficient Data

The data necessary for a robust estimate of oyster standing stock and sustainable harvest still does not exist and very limited data are collected for the recreational harvest of oysters. Socioeconomic surveys of recreational participants need to be performed to determine specific characteristics of the user group, to determine which issues are important to them, attitudes toward management of the fishery, as well as general demographics. The statutory obligation to maintain sustainable harvest in the oyster fishery cannot be calculated 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 trip ticket program, initiated in 1994, provides commercial landings as well as individual trip information. Fishery-dependent and independent monitoring programs continue, yet data in some areas still are not enough.

13.2.1 Oyster Management Strategies

13.2.1.1 Re-Open Shallow Bays (< 6 Ft) Of Pamlico Sound to Mechanical Harvest

Proposed Management Options

1. Status quo (Maintain shallow bays (< 6ft) as defined in 15A NCAC 03R .0108)
2. Re-open all shallow bays (< 6 ft.) previously closed to mechanical harvest as listed in 15ANCAC 03R .0108
3. Consider changing criteria used to designate hand harvest areas
4. Status quo (Maintain opening of deep bays (≥ 6ft) during the November-December timeframe)
5. Increase the time frame for opening the deep bays (≥ 6 ft.) from 6 weeks
6. Decrease the time frame for opening the deep bays (≥ 6 ft.) from 6 weeks
7. Change the time frame for opening the deep bays (≥ 6 ft.) from the November-December to allow flexibility within the season
8. Remove the six-week time frame for opening deep bays (≥ 6 ft.) and manage by a trigger (Refer to Supplement A)
9. Close all bays to mechanical harvest

Management Recommendations

MFC Preferred Management Strategy

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NCDMF

- Status quo (Maintain shallow bays (< 6ft) as defined in 15A NCAC 03R .0108)
- Change the time frame for opening the deep bays (≥ 6 ft.) from the November-December to allow flexibility within the season

Advisory Committee

- Same as NCDMF
- Recommend a controlled study of dredges impacts on areas currently closed to mechanical harvest

13.2.1.2 Assessing and Mitigating Harvest Effort Impacts on Oyster Resources in the Southern Region

Proposed Management Options

1. Status quo
2. Reduce the culling tolerance for oysters statewide to 5% (**rule change required**)
3. Implement relay participation as a requirement to retain a commercial shellfish license (**requires statutory change**)
4. Increase efforts to plant available cultch materials in the southern region
5. Institute rotational area closures for both commercial and recreational oyster harvest from public bottom annually
6. Explore a preliminary fishery independent index of oyster abundance to inform future management actions
7. Reduce the number of fishing days south of Highway 58 Bridge for both commercial and recreational oyster harvest from public bottom
8. Reduce daily commercial harvest limit from public bottom for all oyster harvesters south of Highway 58 Bridge
9. Reduce the daily oyster harvest limit from public bottom south of Highway 58 Bridge for Shellfish License holders only

Management Recommendations

MFC Preferred Management Strategy

-

NCDMF

- Increase efforts to plant available cultch materials in the southern region
- Explore a preliminary fishery independent index of oyster abundance to inform future management actions

Advisory Committee

- Increase efforts to plant and monitor available cultch materials in the southern region and to emphasize the review and approval by regulatory agencies of the use of alternative cultch material
- Explore a preliminary fishery independent index of oyster abundance to inform future management actions

13.2.1.3 Differences in hand harvest limits statewide

Proposed Management Options

1. Status quo (continue to maintain the 15 bushel hand/mechanical harvest limit in Pamlico Sound mechanical harvest areas outside the bays, 10 bushel hand/mechanical harvest limit in the bays and in the Mechanical Methods Prohibited area along the Outer Banks of Pamlico Sound)
2. Raise all harvest to 15-bushel trip limit for hand harvest methods for areas north of Core Sound and maintain 5/person – 10/operation from Core Sound south
3. Allow all harvest to 10-bushel trip limit for hand harvest methods for all areas from Core Sound south

4. Expand 10-bushel hand harvest trip limit for hand harvest methods from Core Sound south to US Hwy. 58 Bridge at Emerald Isle
5. Return to five bushels per person/10 bushel per commercial fishing operation for all hand harvest, statewide

Management Recommendations

MFC Preferred Management Strategy

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NCDMF

- Status quo (continue to maintain the 15 bushel hand/mechanical harvest limit in Pamlico Sound mechanical harvest areas outside the bays, 10 bushel and/mechanical harvest limit in the bays and in the Mechanical Methods Prohibited area along the Outer Banks of Pamlico Sound)

Advisory Committee

- Same as the NCDMF

13.2.1.4 Adopting Supplement A to Amendment 2 into the N.C. Oyster Fishery Management Plan

Management Options

1. Status quo – Reinstate the 15-bushel per operation mechanical harvest limit for oysters and close the season based on public perception and increases in law enforcement actions
2. Adopt the provisions of Supplement A – a flexible harvest limit up to 20 bushels, a trigger of 26 percent legal-sized oysters for closing an area to mechanical harvest and set the upper harvest limit of 20 bushels in rule
3. Change the Supplement A harvest trigger calculation to exclude oysters less than 25 mm
4. Phase out mechanical harvest of oysters

Management Recommendations

MFC Selected Management Strategy

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NCDMF

- Adopt the provisions of Supplement A – a flexible harvest limit up to 20 bushels, a trigger of 26 percent legal-sized oysters for closing an area to mechanical harvest and set the upper harvest limit of 20 bushels in rule
- Develop a fishery dependent metric of effort to help assist with management decisions

Advisory Committee

- Adopt the provisions of Supplement A – a flexible harvest limit up to 20 bushels, a trigger of 26 percent legal-sized oysters for closing an area to mechanical harvest and set the upper harvest limit of 20 bushels in rule

13.2.1.5 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 License

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 Preferred Management Strategy

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NCDMF

- 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)**

Advisory Committee

- Establish a daily trip limit of 2 bushels of oysters per person with a maximum of 4 bushels of oysters per vessel off public bottom from Highway 58 Bridge south only for holders of the Shellfish License. The daily trip limit of 5 bushels of oysters per person for SCFL and RSCFL holders will be maintained in this area. Shellfish License holders will be eligible to acquire a SCFL after they show a history of sale of shellfish **(requires statutory change)**

13.2.1.6 REQUIREMENTS FOR SHADING MOLLUSCAN SHELLSTOCK

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 Recommendation

MFC Preferred Management Strategy

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NCDMF

- 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 03K .0110 by proclamation annually.

Advisory Committee

- Require shading for clams only during June through September on vessel and transport vehicle to dealer
- Request the NCDMF work with the Advisory committee to develop shading language (see Attachment 1 for details).

13.3.1 PRIVATE CULTURE

The current shellfish lease program in North Carolina needs to be evaluated and changes implemented in order 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.

13.3.1.1 Protection of Shellfish Lease and Franchise Rights

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
3. Support modification of G.S 113-269 to include protection to all shellfish leases and franchises, not just those with water column amendments
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

Management Recommendations

MFC Preferred Management Strategy

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NCDMF

- 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

- 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.

Advisory Committee
- Same as the NCDMF

13.3.1.2 Defining Adverse Impacts to Submerged Aquatic Vegetation From Shellfish Leases And Franchises

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. DENR/NCDMF issue shellfish leases in areas containing SAV

Management Recommendations

MFC Preferred Management Strategy
-

NCDMF
- 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).

Advisory Committee
- 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.

13.3.1.3 Brunswick County Shellfish Lease Moratorium

Management Options

1. Status quo (Continue the moratorium of shellfish leases in Brunswick County)
2. Allow shellfish leases in Brunswick County
3. Allow shellfish leases in Brunswick County, limiting acreage and availability

Management Recommendations

MFC Preferred Management Strategy
-

NCDMF
- Continue the moratorium of shellfish leases in Brunswick County

Advisory Committee

- Pursue informal investigations as to why leases are prohibited in Brunswick County

13.3.1.4 Modify Shellfish Lease Provisions

Management Options

1. Status Quo (Maintain current lease terms of 5 years with 5 year production average)
2. Establish a 7 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. Established 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. **(requires statutory change)**
4. Status Quo (Maintain five acres within a mechanical methods prohibited area and ten acres within a mechanical methods area, not to exceed 50 acres)
5. Allowing 10 acres per lease in Mechanical Method Prohibited Area (MMP) **(requires statutory change)**
6. Increasing maximum of 50 acres of shellfish leased bottom per lease holder **(requires statutory change)**
7. Waive natural shellfish bed designation after 10 years of a shellfish lease termination date and allow re-application for those leases **(requires statutory change)**
8. Establish grace periods for planting/production requirements when a lease is transferred to meet standards **(requires statutory change)**
9. Waive survey requirements on terminated leases when applying within same footprint **(requires statutory change)**

Management Recommendations

MFC Preferred Management Strategy

-

NCDMF and Advisory Committee

- 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)**.

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 allowed areas **(requires statutory change)**.
- 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)**.
- Improve public notice of proposed lease applications on the physical lease, at fish houses, and/or through electronic notices.

13.4.1 Research Recommendations

The following research recommendations were compiled from the Status of the Stock Section 6.0, the Socioeconomic Status of the Oyster 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 and provided input to prioritize these recommendations 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 oysters. Specifically the proposed implementation actions on sedimentation within the CHPP are considered a high priority.

Proper management of the oyster 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 - HIGH
- Improve the reliability for estimating recreational shellfish harvest (Section 6.0) - HIGH
- Survey commercial shellfish license holders without a record of landings to estimate oyster harvest from this group (Section 6.0) - HIGH
- Develop regional juvenile and adult abundance indices (fisheries-independent)(Section 6.0) - HIGH
- Complete socioeconomic surveys of recreational oyster harvesters (Section 9.X) - MEDIUM
- Continue to complete socioeconomic surveys of commercial oyster fishermen (Section 9.X) - LOW
- Determine alternative substrates for reef development and monitoring of intertidal and subtidal reefs (cost-benefit analysis for reefs and cultch planting)(Section 10.x) - HIGH
- Identify number and size of sanctuaries needed (Section 10.x) - LOW
- Identification of larval settlement cues which influence recruitment to restored reefs (i.e. sound, light, current, etc.)(Section 10.x) - LOW
- Support collaborative research to more efficiently track bacterial sources for land-based protection and restoration efforts (Section 11.3) - MEDIUM
- Quantify the impact of current fishing practices on oyster habitat suitability in North Carolina (Section 11.9) - HIGH
- Quantify the relationship between water quality parameters and the cumulative effect of shoreline development units (e.g., docks, bulkhead sections)(Section 11.9) - MEDIUM
- Develop peer reviewed, standardized monitoring metrics and methodologies for oyster restoration and stock status assessments (Section 11.9) - MEDIUM
- Further studies on the effects of dredge weight and size on habitat disturbance and oyster

catches (Issue 12.x Supplement A) - LOW

- Develop a program to monitor oyster reef height, area and condition (Issue 12.x Supplement A) - HIGH
- Estimate oyster mortality associated with relay (Issue 12.x Effort Impacts) - LOW
- Estimate longevity and yield of oysters on cultch planting sites (Issue 12.x Effort Impacts) – HIGH
- Develop methods to monitor abundance of the oyster population (Issue 12.x Effort Impacts) - HIGH

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15.0 APPENDICES

15.1 SUMMARY OF MANAGEMENT AND RESEARCH RECOMMENDATIONS FROM THE 2001 OYSTER FISHERY MANAGEMENT PLAN

The strategies listed below are grouped into those that: (Tier 1) can be accomplished with n increase in funding and no reallocation of personnel/funds, (Tier 2) can be accomplished with no increase in funding but will require reallocation of personnel/funds at the division level, and (Tier 3) can only be accomplished with additional funding. Since the management of oysters is not subject to federal and regional management groups, funding for oyster work is almost exclusively a state responsibility. Oyster management is also different from finfish and crustacean management because habitat restoration and creation and transplanting of stocks are central to maintaining the population and optimizing harvest. These activities are funding dependent. Therefore, strategies to improve oyster management include funding requests so that the best plan for management of the oyster resource could be produced. A prioritization of strategies requiring funding and consequences of failure to fund those strategies follows Tier 3.

TIER 1 – No additional funding or reallocation of funds/personnel required

STRATEGY	REQUIRED ACTION
HARVEST ISSUES	
1. Adopt criteria for the further designation of hand harvest areas and designate those areas by rule	Existing Authority
2. Conduct public meetings on harvest area designation	Existing Auth.
3. Maintain cultch planting in mechanical harvest area	Existing Auth.
4. Prohibit trawling and long hauling on cultch and seed planting areas	Existing Auth.
5. Status Quo on unloading oysters and clams at night	Existing Auth.
6. Status Quo on the use of depuration plants for shellfish	Existing Auth.
7. Status Quo on the current license structure until more licensing data is available	Existing Auth.
PRIVATE CULTURE	
1. Change operational policy to increase use of marginal polluted areas for Shellfish leases	MOA with DEH
2. Inform public about Department of Agriculture and Department of Environment and Natural Resources roles concerning shellfish culture	MOU with Dept. of Ag.
3. Formalize and amplify current policy on transfers on out-of-state shellfish into NC waters	Existing Auth.
4. Continue testing of non-spawning nonnative oysters for aquaculture purposes	Existing Auth.

5. Recommend adoption of a statutory policy statement supporting shellfish culture insofar as it does not interfere with traditional fishing practices	**Statute Change**
6. 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	**Rule Change**
7. Status Quo on opportunities for riparian landowners to culture shellfish	Existing Auth.
8. Recommend water column lease fees change to an amount **ten** times the fee for bottom leases ($100 per acre according to current recommendations)	**Statute Change**
9. Eliminate size restrictions on oysters raised in aquaculture operations	**Rule change**
10. 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	**Statute Change**
11. 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	**Statute Change**
12. Apply Fisheries Reform Act requirements to a revised, organized, upgraded permit system	Existing Auth.
13. Allow a fee in lieu of cultch planting to satisfy shellfish lease use requirements	**Statute Change**
INSUFFICIENT ASSESSMENT DATA	
1. Support adoption of a mechanism that would provide data on recreational shellfish harvest and add "pleasure" category to the existing Shellfish License	**Statute change**
2. Allow oyster harvest to continue at current catch/trip limits without a harvest cap until improved data collection indicates a change in harvest policy is necessary	Existing Auth.

ENHANCEMENT ACTIVITIES	
1. Enhance existing sanctuaries and develop mechanisms for expanding sanctuaries	Existing Auth.
2. Formally adopt site selection criteria for oyster rehabilitation efforts	Existing Auth.
3. Investigate alternative cultch sources for oyster habitat enhancement	Existing Auth.
4. Continue support for research on optimum cultch planting strategies and mound formation to maximize oyster recruitment and implement as data become available	Existing Auth.
5. Tailor planting efforts to minimize the effect of any new management actions on fishermen by providing enhanced habitat in areas available to particular	Existing Auth.

harvest techniques and user groups	
6. Continue research with universities on use of hatchery reared oyster stock and implement findings as appropriate	Existing Auth.
7. Establish enhancement priorities: oyster vs. clam, product vs. habitat	Existing Auth.
8. Limit the number of new planting sites to a maximum of 30 per year in the northern area to facilitate greater size and relief of cultch mounds	Existing Auth.
ENVIRONMENTAL ISSUES	
1. Increase use of existing statutory authority (permit comments, CHPP development) to reverse the trends in closure of shellfish waters to harvest	Existing Auth.
2. Develop strategies to restore water quality of Conditionally Approved harvest area and maintain water quality of Approved harvest areas by: - Classifying Conditionally Approved Open shellfish waters as 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 - Requiring mitigation that results in water quality enhancements in permanently closed areas	Resolution to EMC
3. Endorse actions by other natural resource agencies that seek to improve and protect water quality	Existing Auth.

Tier 2 – Reallocation of personnel/funds required at Division level; no additional funding required

STRATEGY	REQUIRED ACTION
PRIVATE CULTURE	
1. Continue the statutory shellfish lease program and increase relaying to public bottoms to address concerns over use of public resources	Existing Auth.
2. Develop a collaborative protocol with the shellfish culture industry to monitor the availability of oyster larvae to facilitate cultch planting	Existing Auth.
3. Designate and plant cultch on managed seed beds for use on leases and franchises	Existing Auth.

ENVIRONMENTAL ISSUES	
1. Develop a protocol for identification and designation of oyster rock/shell bottom as critical fisheries habitat where fishing activities would be restricted. Conduct monitoring of selected areas to evaluate relative success of protected habitat	Existing Auth.
2. Decrease impacts to areas not designated as critical fisheries habitat by selecting limited pilot study areas where: - mechanical harvest of oysters is prohibited, - cultch and oyster seed sites are closed to trawling and long haul seining, - hand harvest clamming methods are restricted on designated, sensitive oyster habitats	Existing Auth.
3. Implement additional experimental closures of oyster areas based on habitat value for both oysters and clams on a pilot scale basis	Existing Auth.

TIER 3 – Additional funding required

PRIORITY 1 – Required for management according to statutory standards

PRIORITY 2 – Needed to enhance oyster habitat and rebuild the resource

PRIORITY 3 – Needed to facilitate or regulate oyster harvesting and support private culture

STRATEGY	REQUIRED ACTION	PRIORITY
HARVEST ISSUES		
1. Increase cultch planting in hand harvest areas	Existing Auth. **Funding Required**	3
PRIVATE CULTURE		
1. Develop and utilize user coordination plans to assess areas for shellfish leasing	**Rule Change** **Funding Required**	3
2. Request funding research, disease, and education centers for shellfish culture	Existing Auth. **Funding Required**	3
INSUFFICIENT ASSESSMENT DATA		
1. Increase data collection efforts to allow for more precise assessment of oysters population	Existing Auth. **Funding Required**	1

parameters and harvest effects according to statutory standards		
2. Expand the Shellfish Mapping Program to provide complete and timely data for estimating MSY for the oyster resource	Existing Auth. **Funding Required**	1
ENHANCEMENT ACTIVITIES		
1. Recommend adoption of the BRACO recommendation to increase cultch planting to planting efforts for oysters to a minimum of 400,000 bushels per year	Existing Auth. **Funding Required.**	2
ENVIRONMENTAL ISSUES		
1. Initiate research on the effects of bottom disturbing gear on oyster reefs	Existing Auth. **FundingRequired.**	2
2. Increase Shellfish Sanitation capability to respond to temporary shellfish closures	Existing Auth. FundingRequired	3

DRAFT

YSTER FISHERY MANAGEMENT PLAN AMENDMENT 4

HERY MANAGEMENT PLAN AMENDMENT 4 AND AGEMENT PLAN AMENDMENT 2 (June 2, 2014; Revised March 30, 2015)			
	INTERNAL GUIDELINES	**TABLES 1&2 STEP**	**PROJECTED COMPLETION DATE**
Goal and	III. B.	9/5	June 2014
Objectives to sues	III. D.	11/7	August 2014
ublic Input on	III. D.	12-15/8-11	September 2014
national e FMP and	III. D - F	16-19/12-14	September 2014 -September 2015
ew of FMP	III. F.	20/15	November 2015
of FMP	III. F.	21-24/16-18	December 2015-January 2016
or Selection of	IV. A.	25/20	February 2016
JLCGO	IV. A.	26-29/21-24	March 2016
pproval of C	IV. A.	30-32/25-27	May 2016
	IV. B.	33/28	August-October 2016
by MFC	IV. C.	34-35/29-30	November 2016
es Effective	N/A	N/A	48 Hours if proclamation; April 1, 2017 if rule

Signature:_____ Date:_____

Date:_____

r: Signature:_____ Date:_____

Date:_____

nal time is needed for milestones 4-7 to await the outcome of draft legislation introduced in the 2015 long session that potentially affects issues Oyster and Hard Clam fishery management plan

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.

DRAFT

NCDENR
North Carolina Department of Environment and Natural Resources

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.

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Jamie Kritzer, Public Information Officer
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Twitter:
http://twitter.com/NCDENR

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 Statue 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 ICW 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 Boundaries

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 NC Shellfish Growers Association 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 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 NC 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 DENR/DMF 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, NC Geodetic Survey Chief August 6, 2014). Representatives of the NCSPO 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, NC Department of Administration-State Property Office 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 NCSPO. The NCSPO is required by NC 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 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
+ 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

MFC Preferred Management Strategy

NCDMF
- 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

15.4.2 Core Sound Shellfish Lease Moratorium

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 12.22). 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 12.22).

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 North Carolina Marine Fisheries Commission (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 North Carolina Division of Marine Fisheries (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 (CCC 2003).

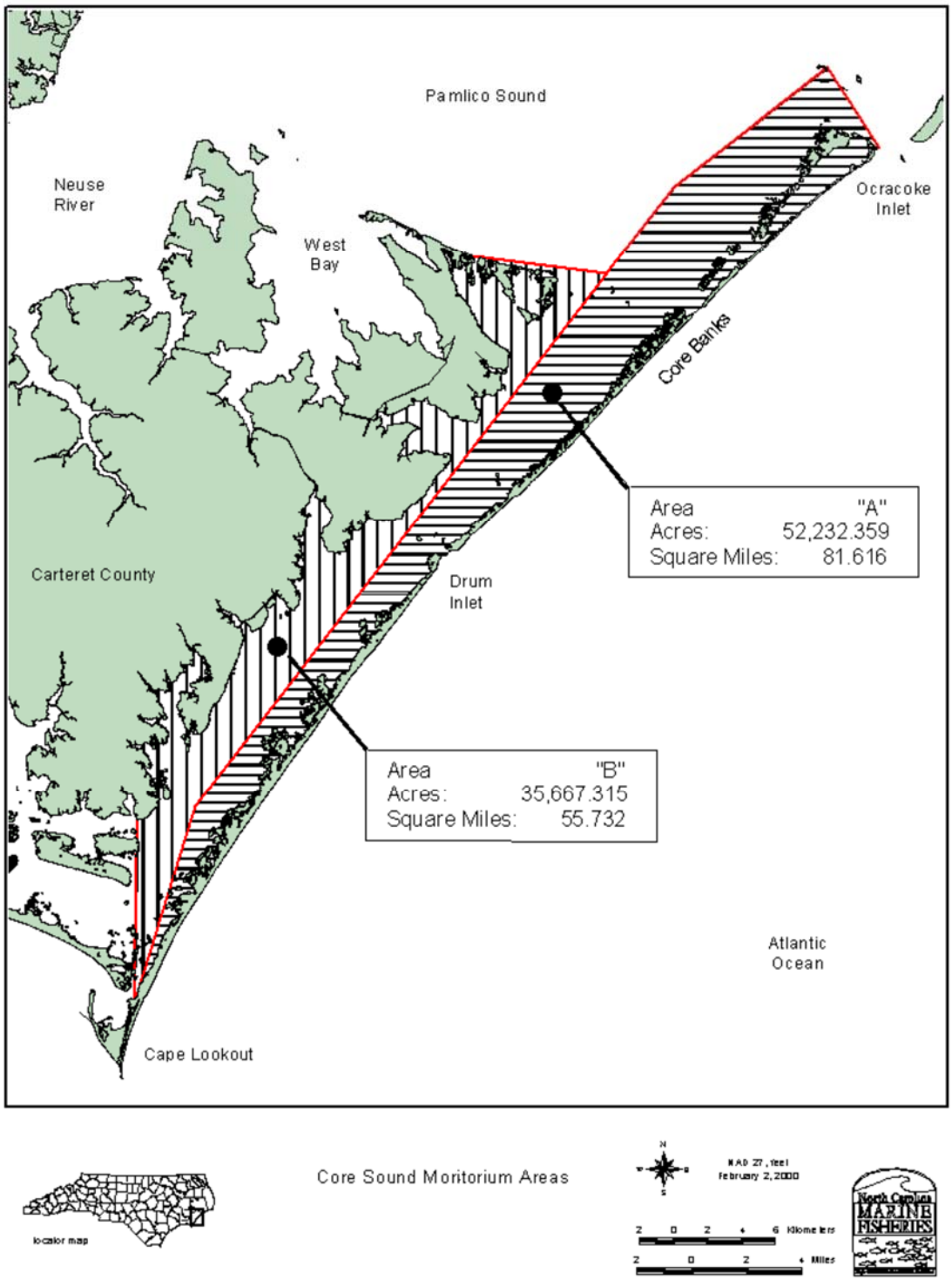

Figure 12.22. Core Sound shellfish lease indefinite moratorium Area A and restricted lease Area B.

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, and keeping the moratorium in place on the western side of the sound was rated as the least desirable option (Table 12.14) (Orbach 2001).

Table 12.14. Results from analysis of alternatives for user coordination in Core Sound focusing on shellfish leasing (Orbach 2001).

Alternative	Alt. #1 (West side open)	Alt. #2 (West side closed)	Alt. #3 (1-3% Cap)
Criterion			
Productivity	High	Low	High
Benefits	Medium	Low	High
Equity	Medium	Low	Medium
Tradition	Medium	Medium	High
Flexibility	Medium	Medium	Medium
Overall rating	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 (CCC 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 grand-fathering 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 12.23).

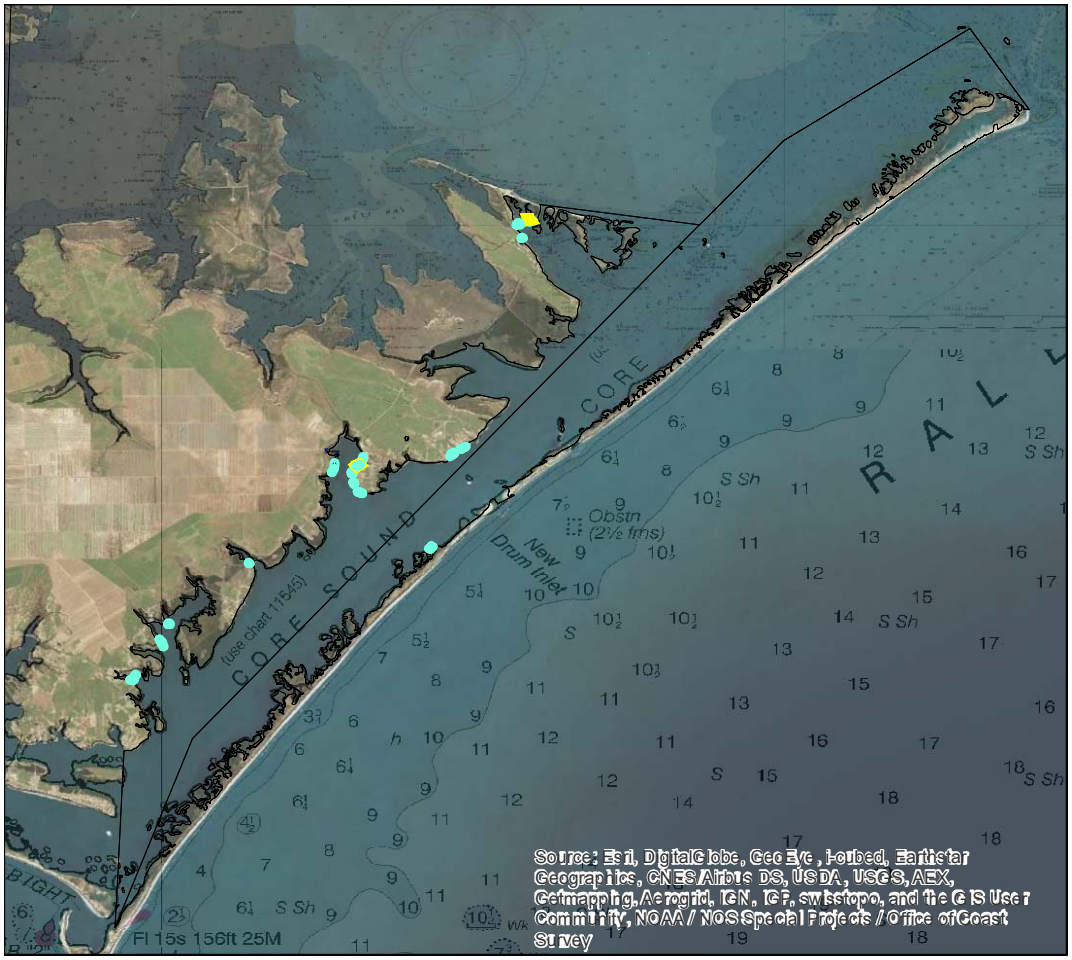

Figure 12.23. Location of shellfish leases and water columns within the Core Sound Moratorium area as of February 3, 2015.

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 12.15-12.17. 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 12.15. Commercial landings and effort in Core Sound from 1994 to 2013. NCDMF Trip Ticket Program.

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 12.16. Participation by commercial gear in Core Sound from 1994 to 2013. NCDMF Trip Ticket Program.

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 12.17. Landings, trips and participants for the hard clam and oyster fisheries in Core Sound from 1994 to 2013.

	Hard clams			Oysters		
Year	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 3 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 submerged aquatic vegetation (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
+ 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
+ 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
+ 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
+ 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 Preferred Management Strategy
-

NCDMF
- Pursue opening Core Sound to new shellfish leases in accordance with shellfish leasing requirements **(requires statutory change)**

Advisory Committee
- No recommendation

IX. LITERATURE CITED

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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.

15.4.3 Redefining Off Bottom Culture

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 NC 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 NC Shellfish Growers Association 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 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 US Army Core of Engineers (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 are 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 Aquaculture Operations Permit (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 3O .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)

To be determined dependent on recommendations.

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
+ 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 Preferred Management Strategy
-

NCDMF
- Define on bottom culture as any structure that extends no higher than 18 inches attached to or resting on the bottom

Advisory Committee
- Same as the NCDMF

15.5 OVERVIEW OF THE MFC REGIONAL AND STANDING ADVISORY COMMITTEES RECOMMENDATIONS AND PUBLIC COMMENT ON DRAFT AMENDMENT 4 OF THE OYSTER FMP

To be added once completed.

15.6 RULES NECESSARY TO IMPLEMENT THE OYSTER FMP AMENDMENT 4 RECOMMENDATIONS

To be added after the MFC selects their preferred management strategy.

15.7 SUGGESTED STATUTE CHANGES NECESSARY TO IMPLEMENT THE OYSTER FMP AMENDMENT 4 RECOMMENDATIONS

To be added after the MFC selects their preferred management strategy.

DRAFT

All parts of this document are subject to change until final adoption.

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
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October 2015

July 2013	Timeline begins
September 2015	Internal review comments
September 2015	Revised with NCDMF recommendations
	First draft approved by MFC for public comment
	MFC selects preferred management options
	Reviewed by DENR Secretary
	Reviewed by the Joint Legislative Commission on Governmental Operations
	Draft rules approved for Notice of Text
	Plan and rules adopted by the MFC

1.0 ACKNOWLEDGEMENTS

Amendment 2 of the North Carolina Hard Clam Fishery Management Plan (FMP) was developed by the North Carolina Department of Environment and Natural Resources 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.

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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	Accomplsiehed; 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 .0201and 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 invesigation 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 defintion 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 Are 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

3.0 TABLE OF CONTENTS

3.1 LIST OF TABLES

3.2 LIST OF FIGURES

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

DEQ – North Carolina Department of Environmental Quality

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

NCDMF – North Carolina Division of Marine Fisheries

NCCF – North Carolina Coastal Federation

NCSGA – North Carolina Shellfish Growers Association

NCSPO – 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.

4.0 EXECUTIVE SUMMARY

To be added after the MFC selects their preferred management strategy.

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 PREFERRED MANAGEMENT OPTIONS

To be added after the MFC selects their preferred management strategy

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 ……NOTE: To be determined after the MFC selects their preferred management strategy

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 (DEQ) 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 DEQ is provided in G.S. 113-131. The NCDMF is the branch of the DEQ 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 1in 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. NOTE: May be modified after the MFC selects their preferred management strategy.

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. NOTE: May be modified after the MFC selects their preferred management strategy.

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 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. Environment and public health issues include requirements for shading molluscan shellstock.

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

5.3 DEFINTION 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 DEQ 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 f 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 rakes 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 ^{o}C and ceases at 9 ^{o}C and 31 ^{o}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 ºC (68 ºF) (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).

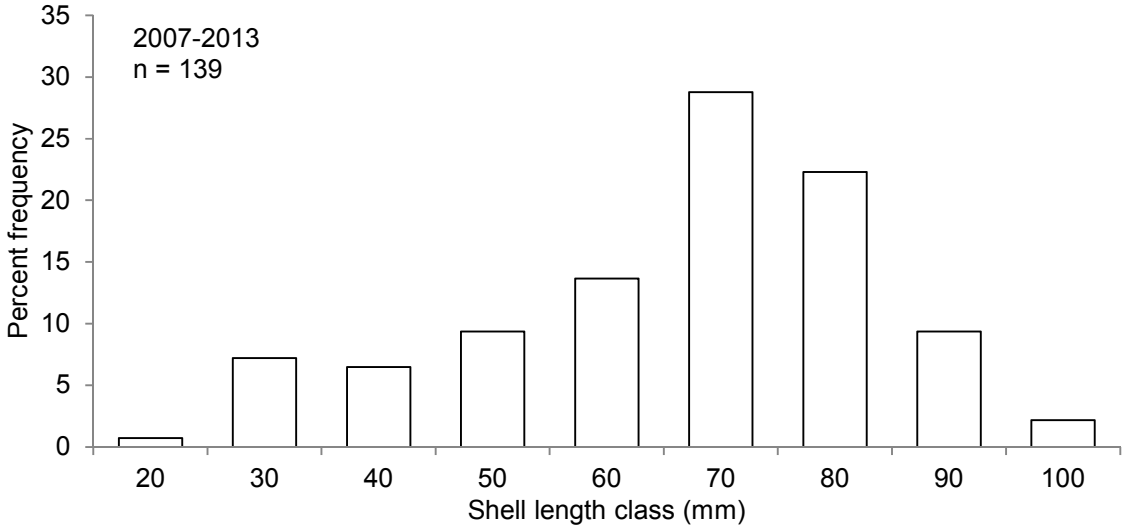


Figure 6.1. Shell length class (mm) frequency distribution of hard clams from the independent sampling program in Core Sound, 2007-2013. NCDMF biological database.

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 BIOLGICAL 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.

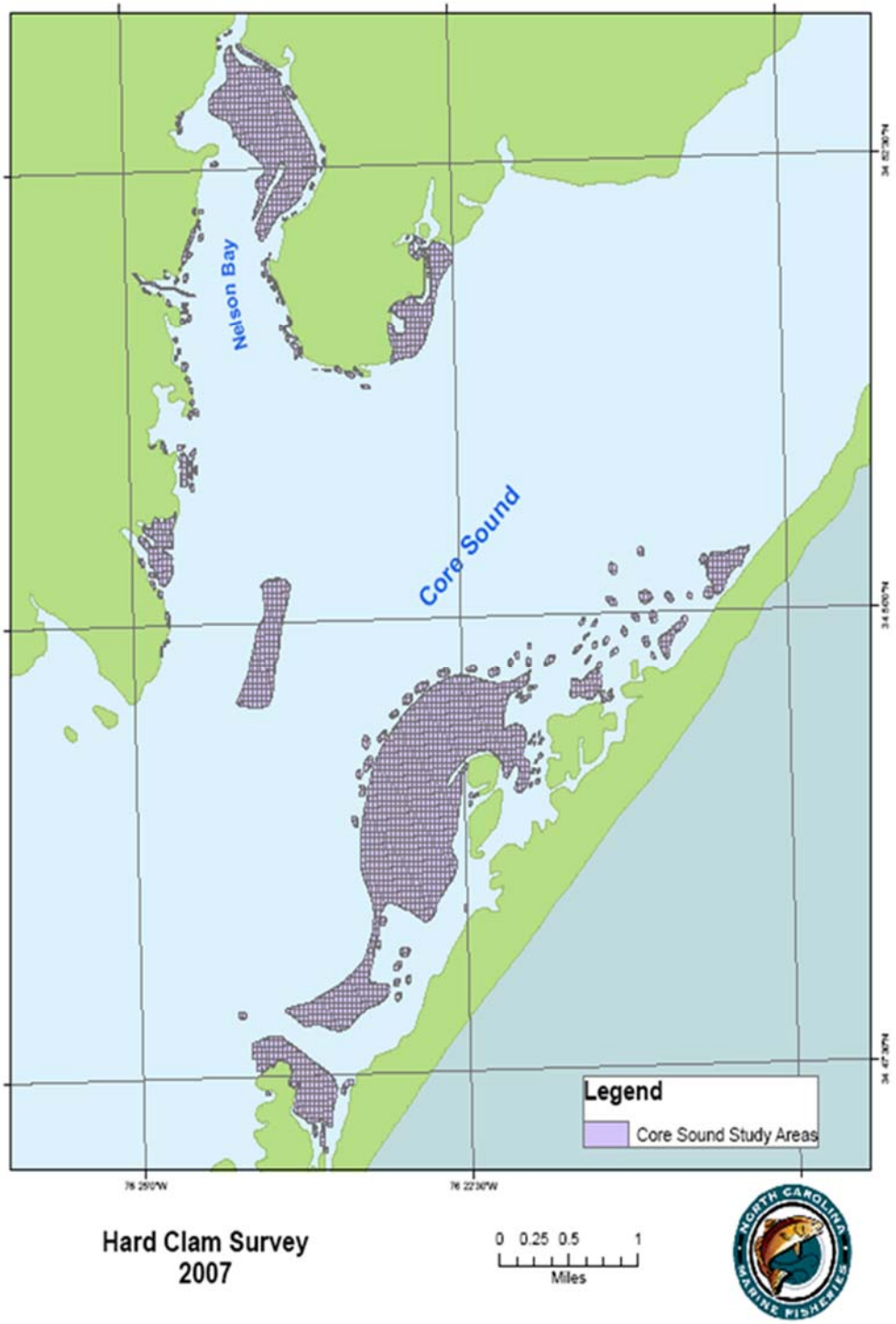


Figure 6.2. Map of grid system for NCDMF's fishery-independent hard clam survey (Program 640). NCDMF biological database.

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 □ = 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).

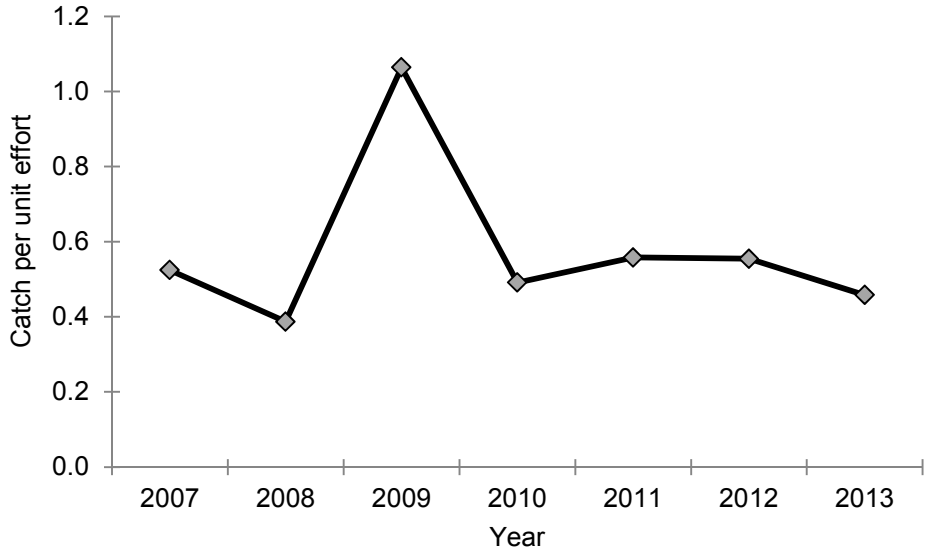


Figure 6.3. Annual fishery-independent index of relative abundance (average numbers caught per grab) for hard clams in Core Sound based on data collected from NCDMF's fishery-independent hard clam survey (Program 640).

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).

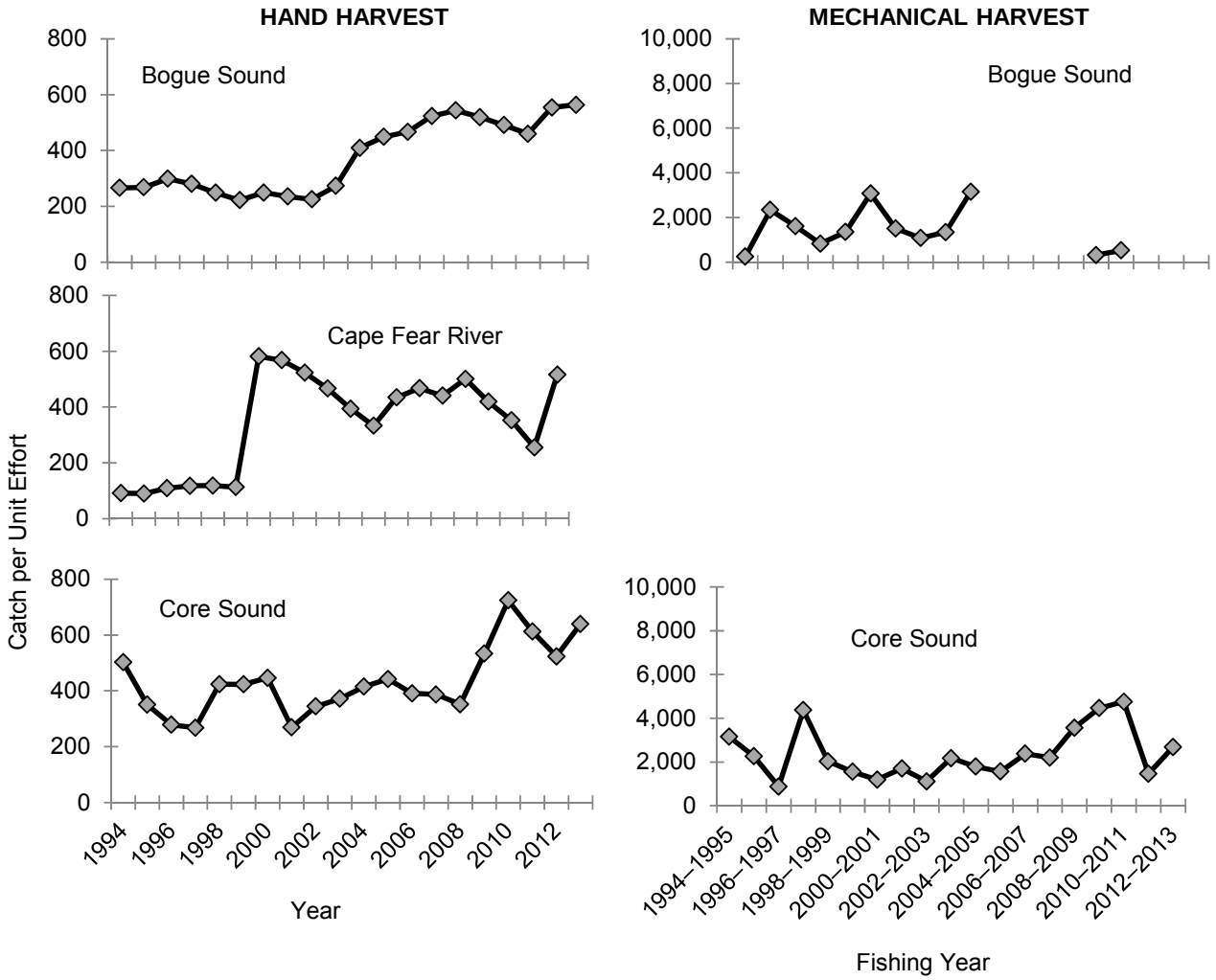


Figure 6.4. Annual fishery-dependent catch rates (number harvested per transaction) for hard clams commercially landed by hand (calendar year, Jan–Dec) and mechanical (fishing year, Dec–Mar) gears from public bottom.

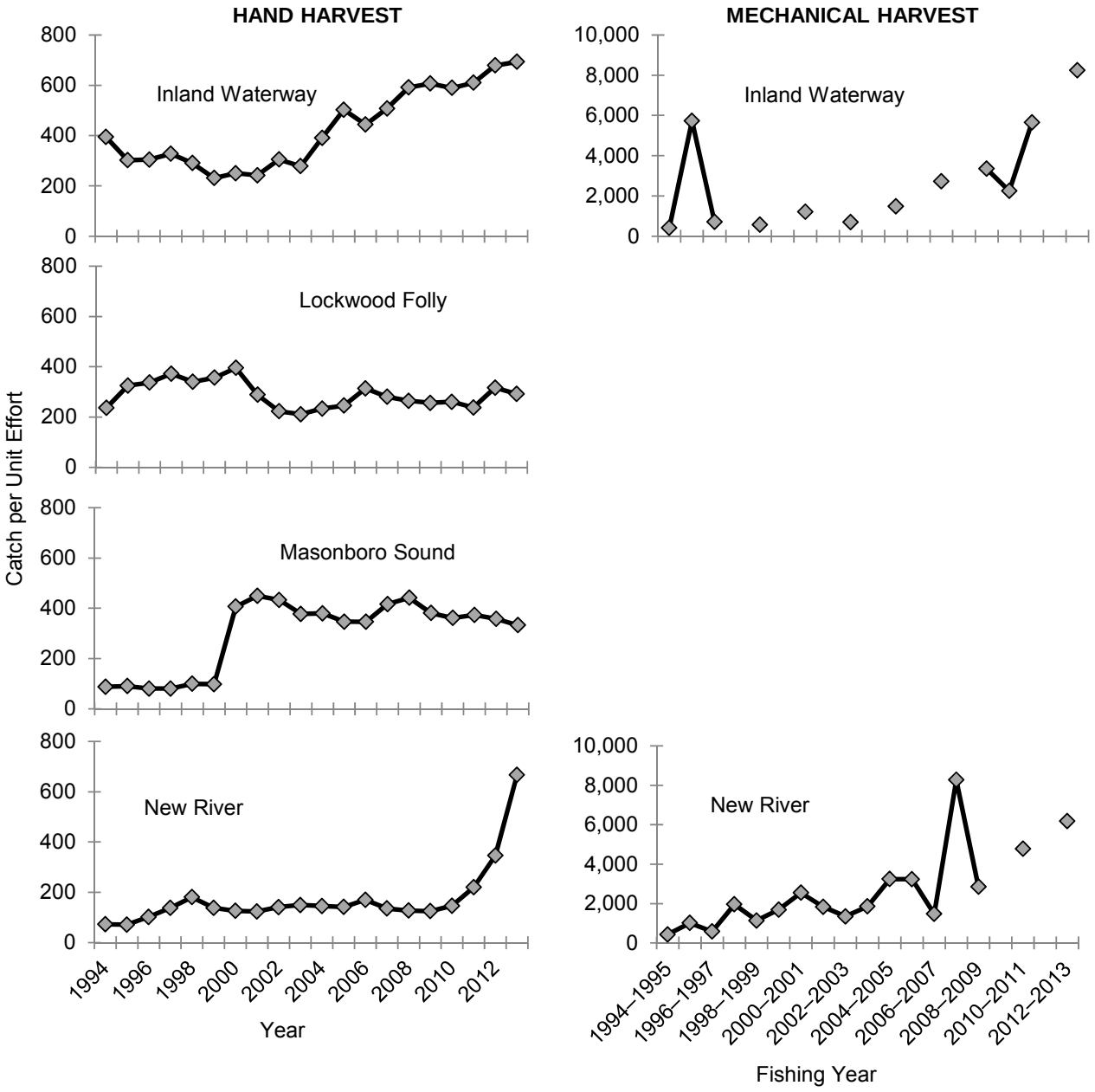


Figure 6.4. Continued.

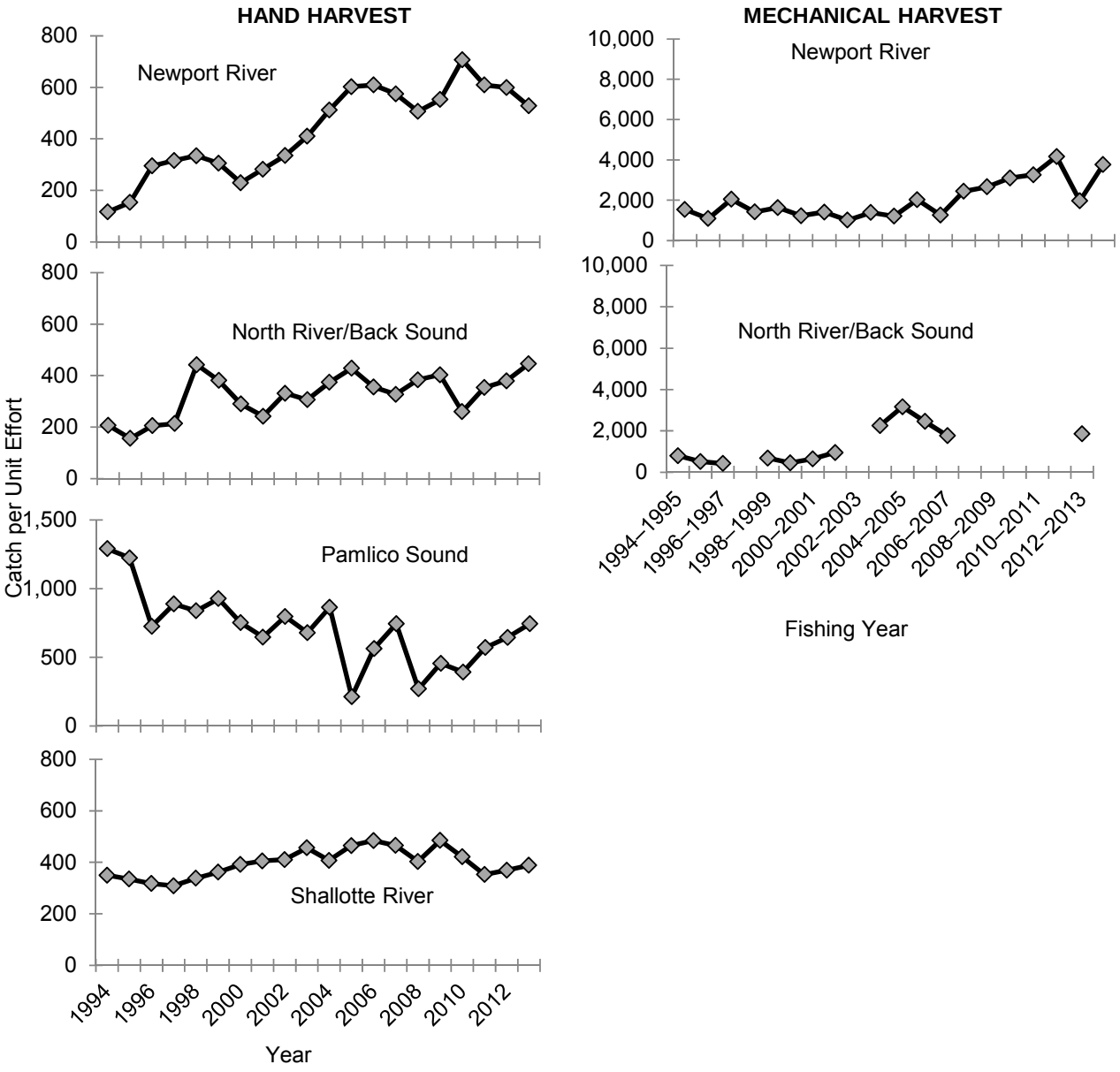


Figure 6.4. Continued.

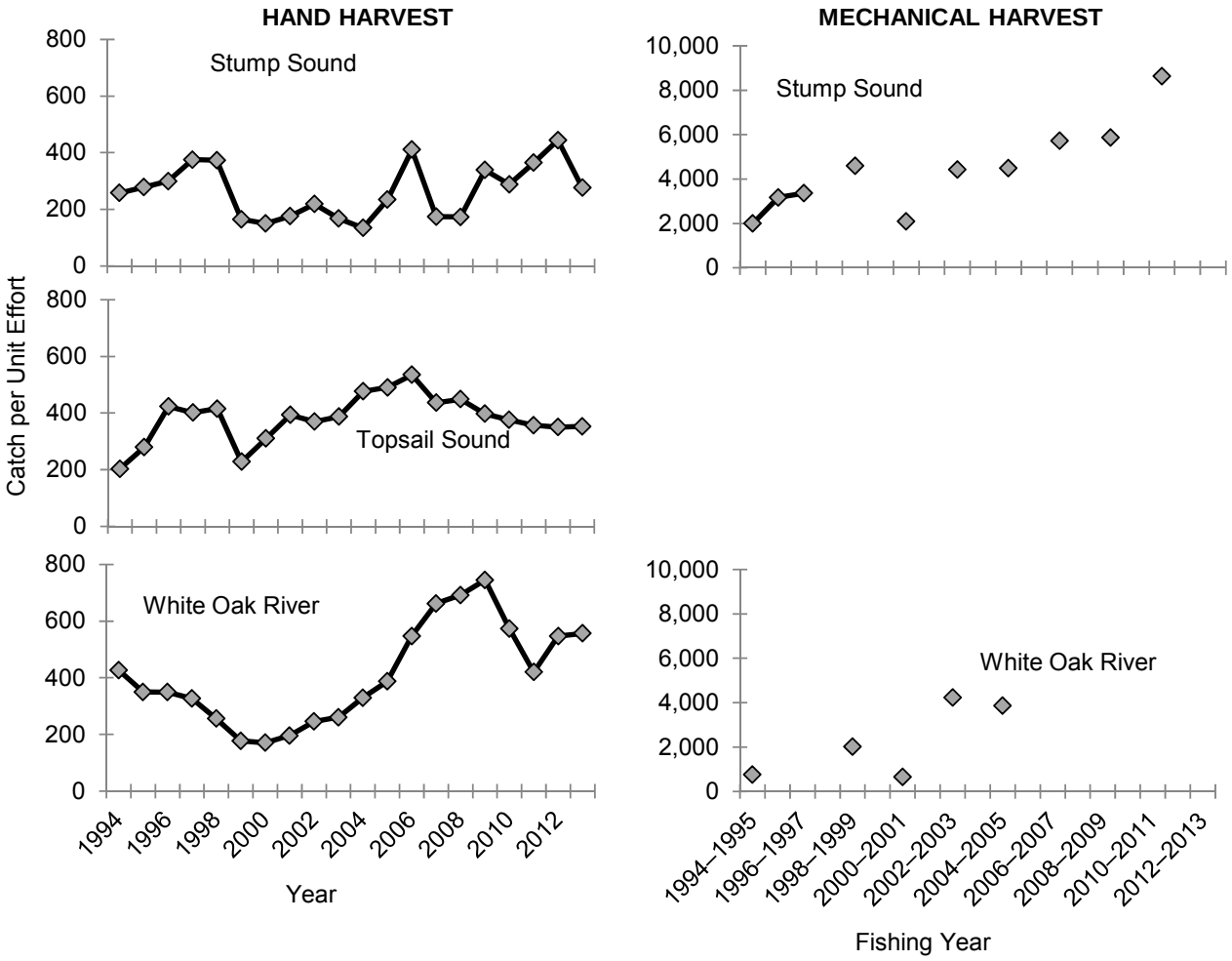


Figure 6.4. Continued.

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 < □/2; □ = 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	□
Shallotte 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 < □/2; □ = 0.05); NS = not significant.

Area	*P*-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).

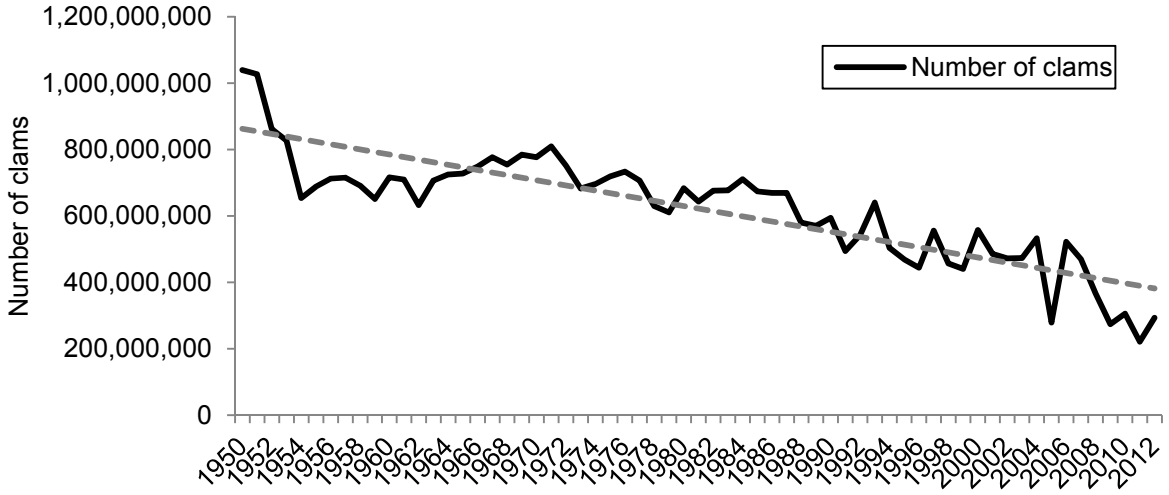


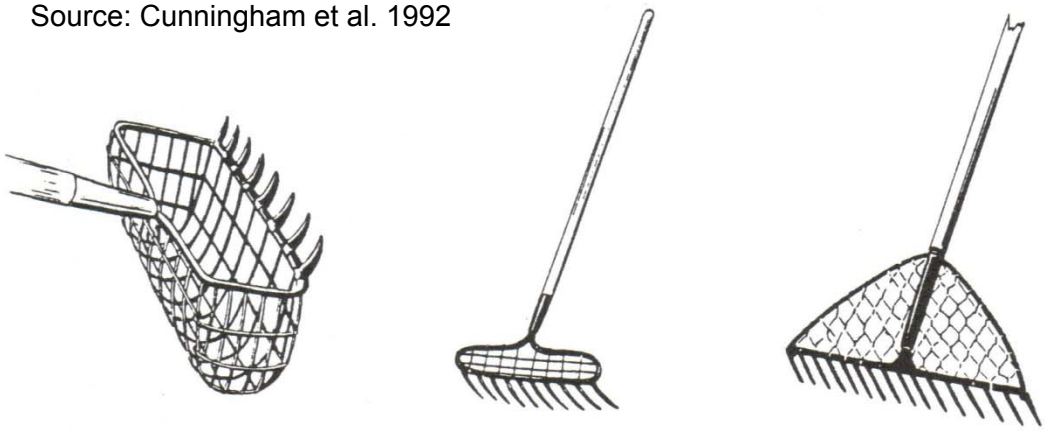
Figure 7.1. Commercial hard clam landings (Number of clams, using a conversion factor of 0.32 oz per individual; ASFMC 1992) along the Atlantic East Coast (Maine south to Florida east coast), 1950-2012. Source: NMFS commercial fisheries landings database, except for NC landings from 1994 to2012 using TTP.

7.1.1 GEAR TYPES

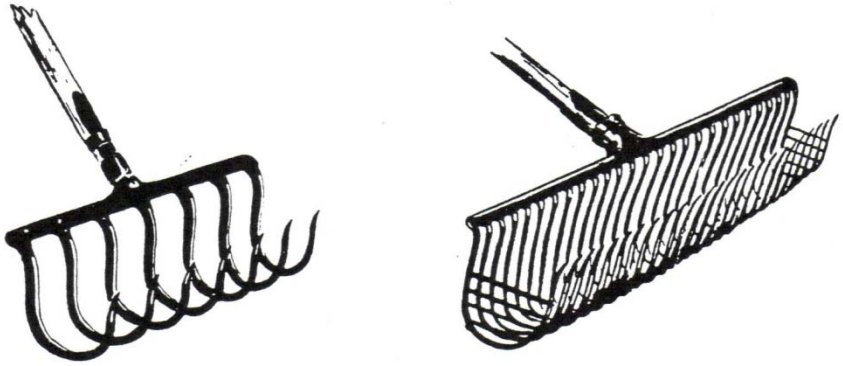
7.1.1.1 HAND HARVEST

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

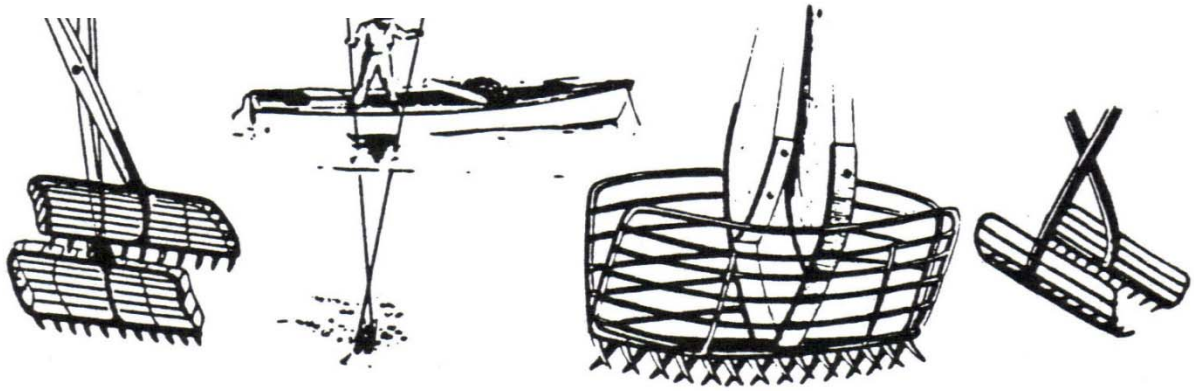
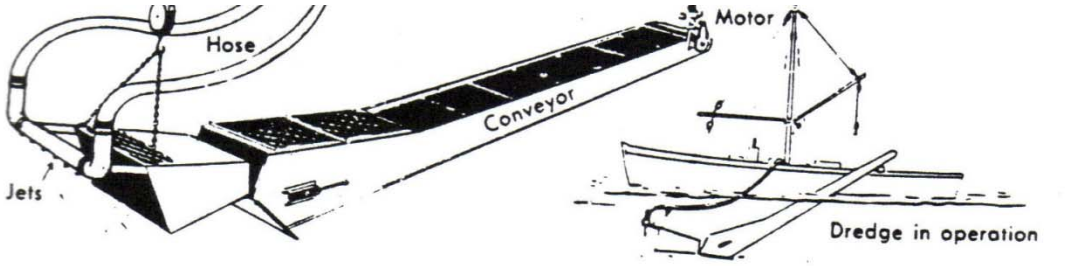


Figure 7.2. Hard clam hand harvest gears (Dumont and Sundstrom 1961; Cunningham et al. 1992).

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

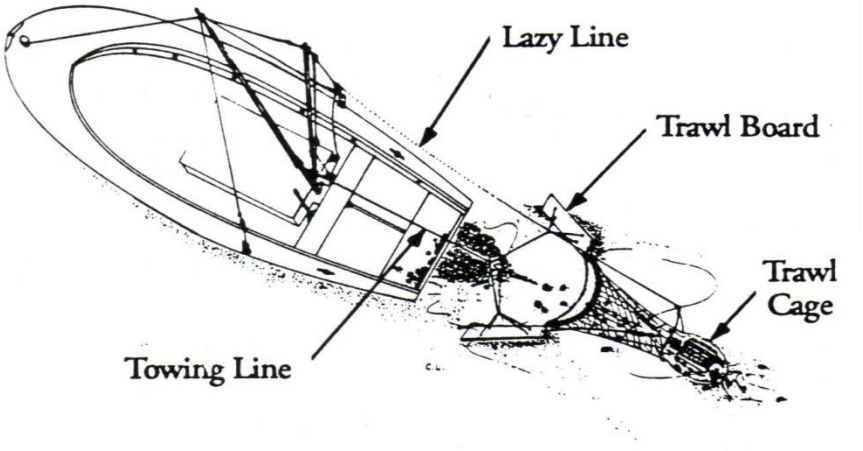


Figure 7.3. Hard clam mechanical harvest gears (Sundstrom 1957; Guthrie and Lewis 1982; Cunningham et al. 1992).

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.

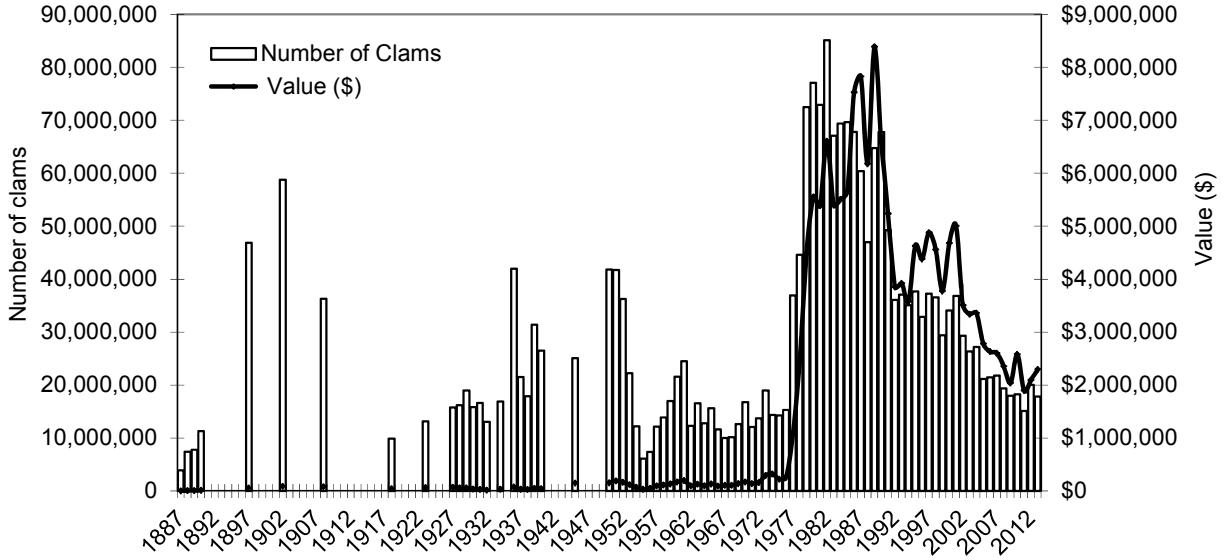


Figure 7.4. Hard clam historical annual landings (Number of clams) from both public harvest and private production combined and value ($), 1887-2013. TTP and Chestnut and Davis (1975).

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 (m^2) 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).

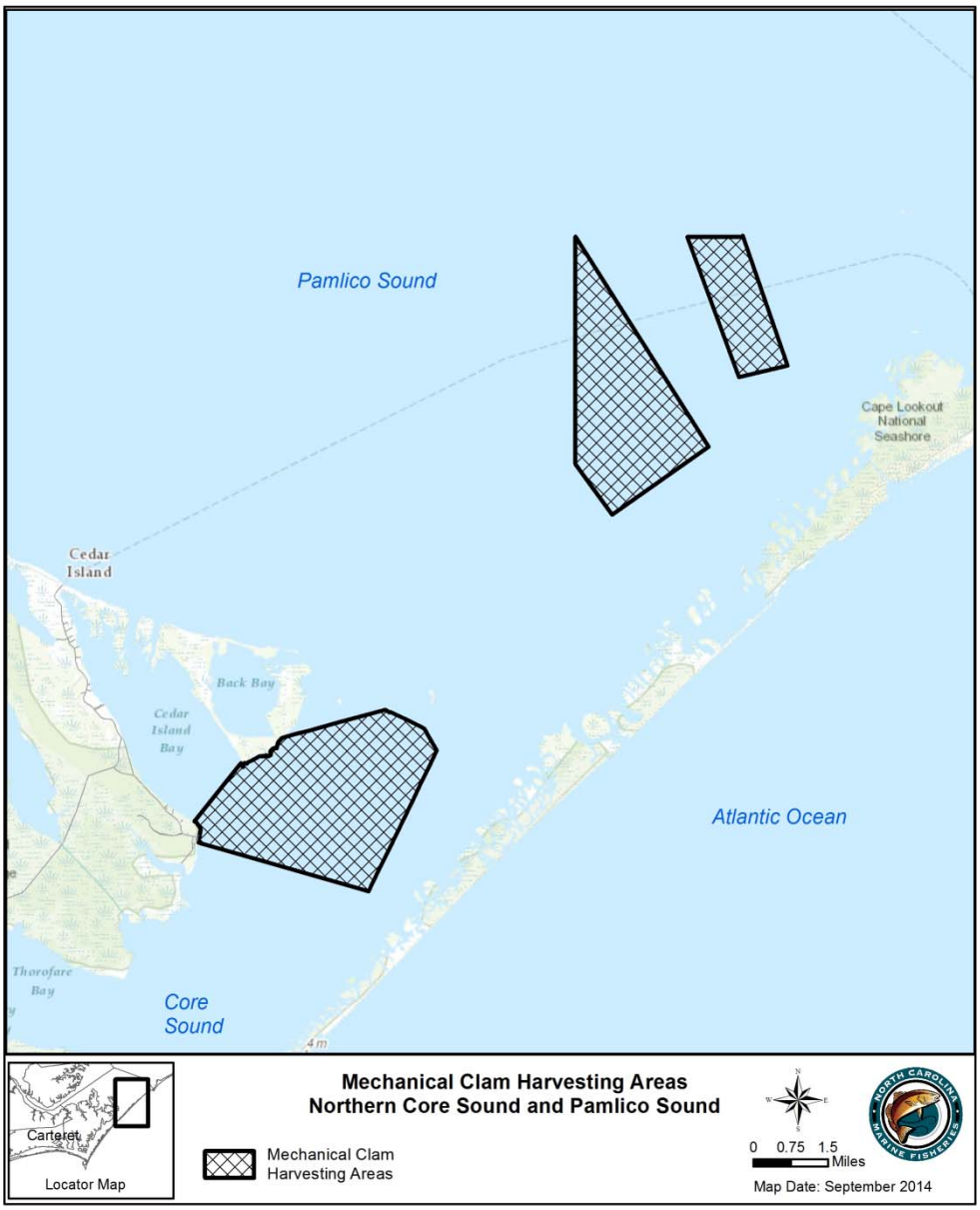


Figure 7.5. Public mechanical harvest areas in Northern Core Sound and Pamlico Sound. These areas were rotated two years on and then two years off with each other starting in the 2001/2002 harvest season and discontinued in 2008. NCDMF Geographic Information System (GIS) database.

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)(Tale 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 Onlsow/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.

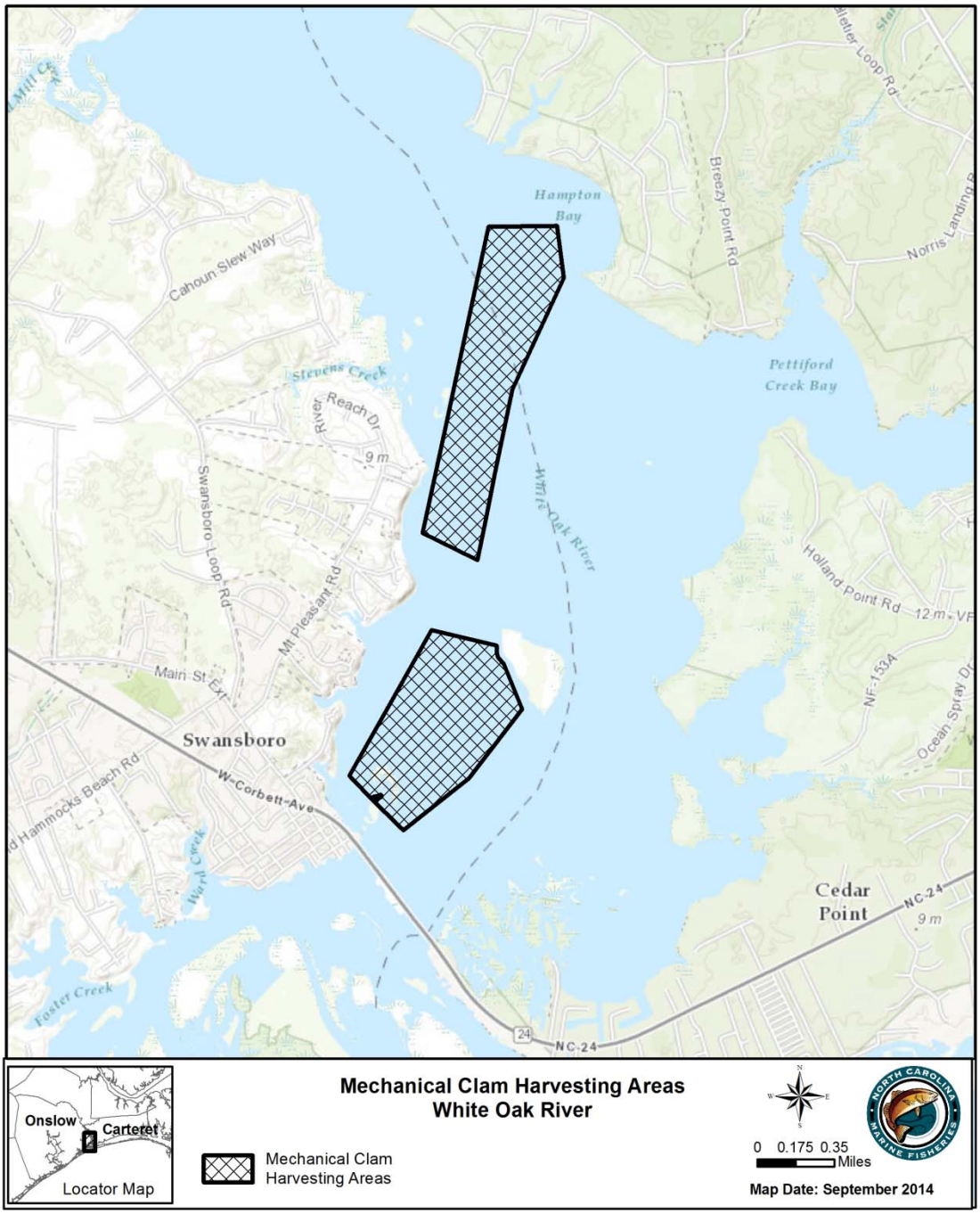


Figure 7.6. The current public mechanical harvest area in White Oak River. This area is rotated one year on and then one year off opposite the open and closed season for the mechanical harvest area in New River. NCDMF GIS database.

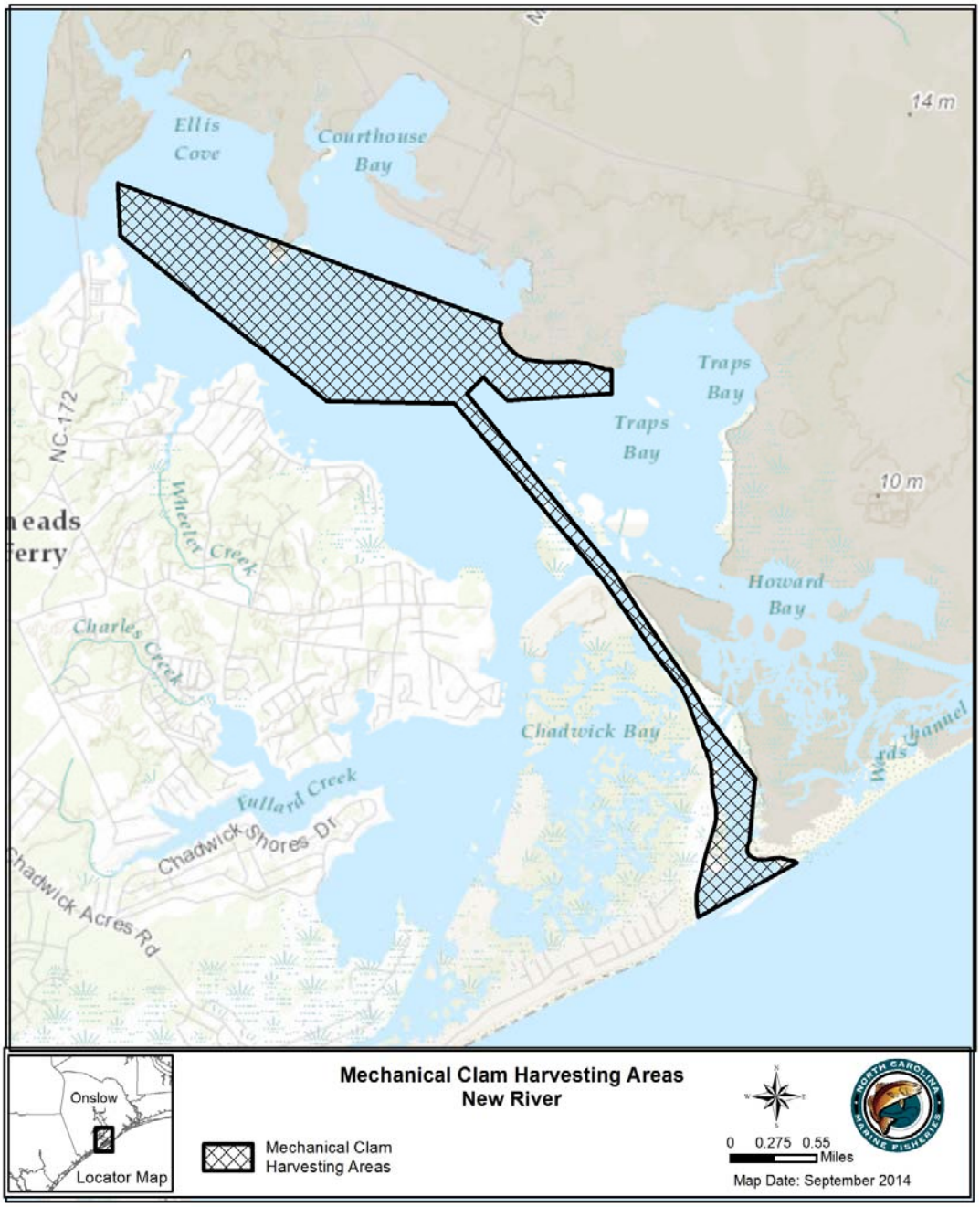


Figure 7.7. The current public mechanical harvest area in New River and the Intracoastal Waterway Marker #72A to the New River Inlet. The New River area is rotated one year on and then one year off opposite the open and close season for the mechanical harvest area in White Oak River. NCDMF GIS database.

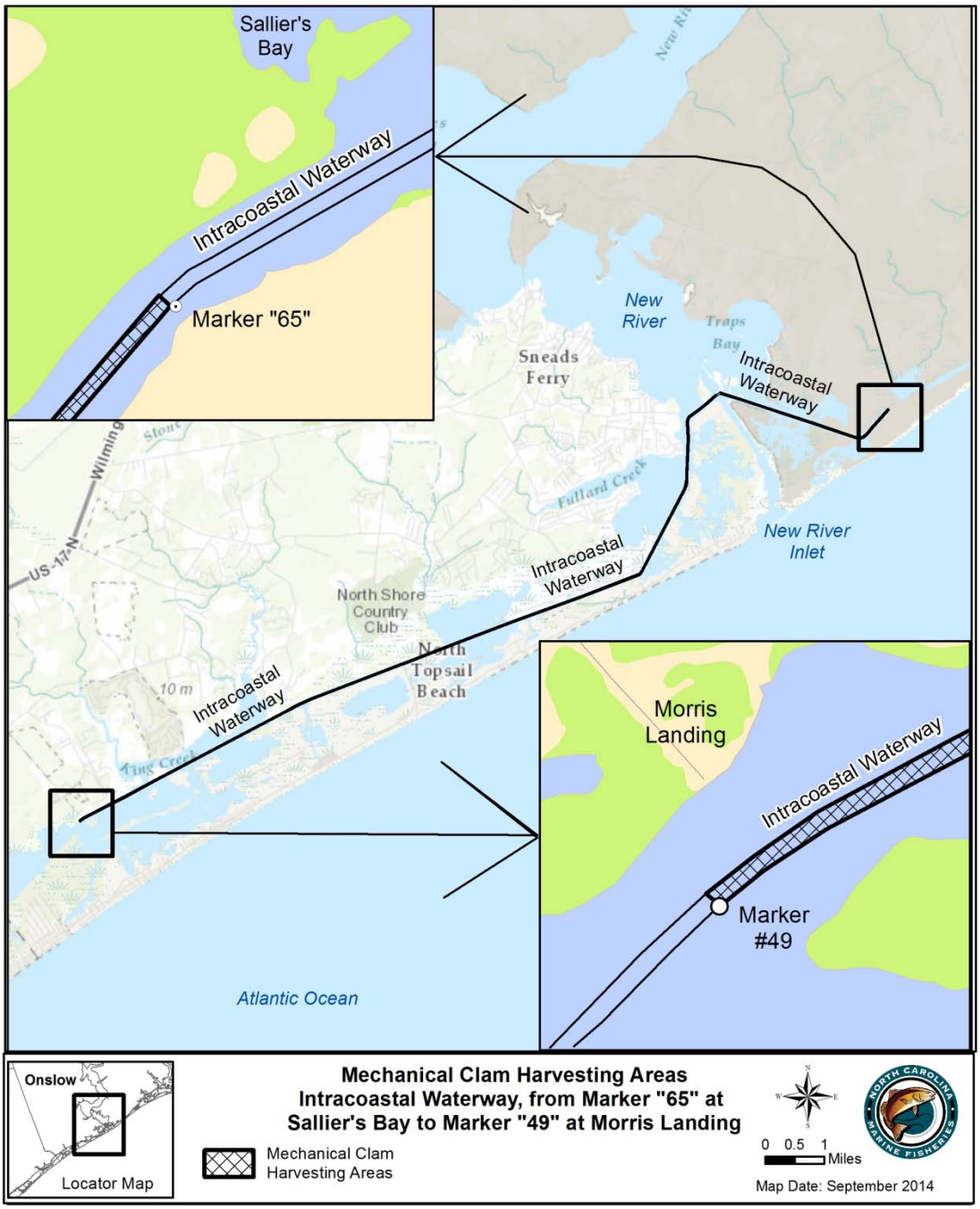


Figure 7.8. The current public mechanical harvest area in the Intracoastal Waterway (maintained marked channel only) from Marker #65, south of Sallier's Bay, to Marker #49 at Morris Landing. NCDMF GIS database.

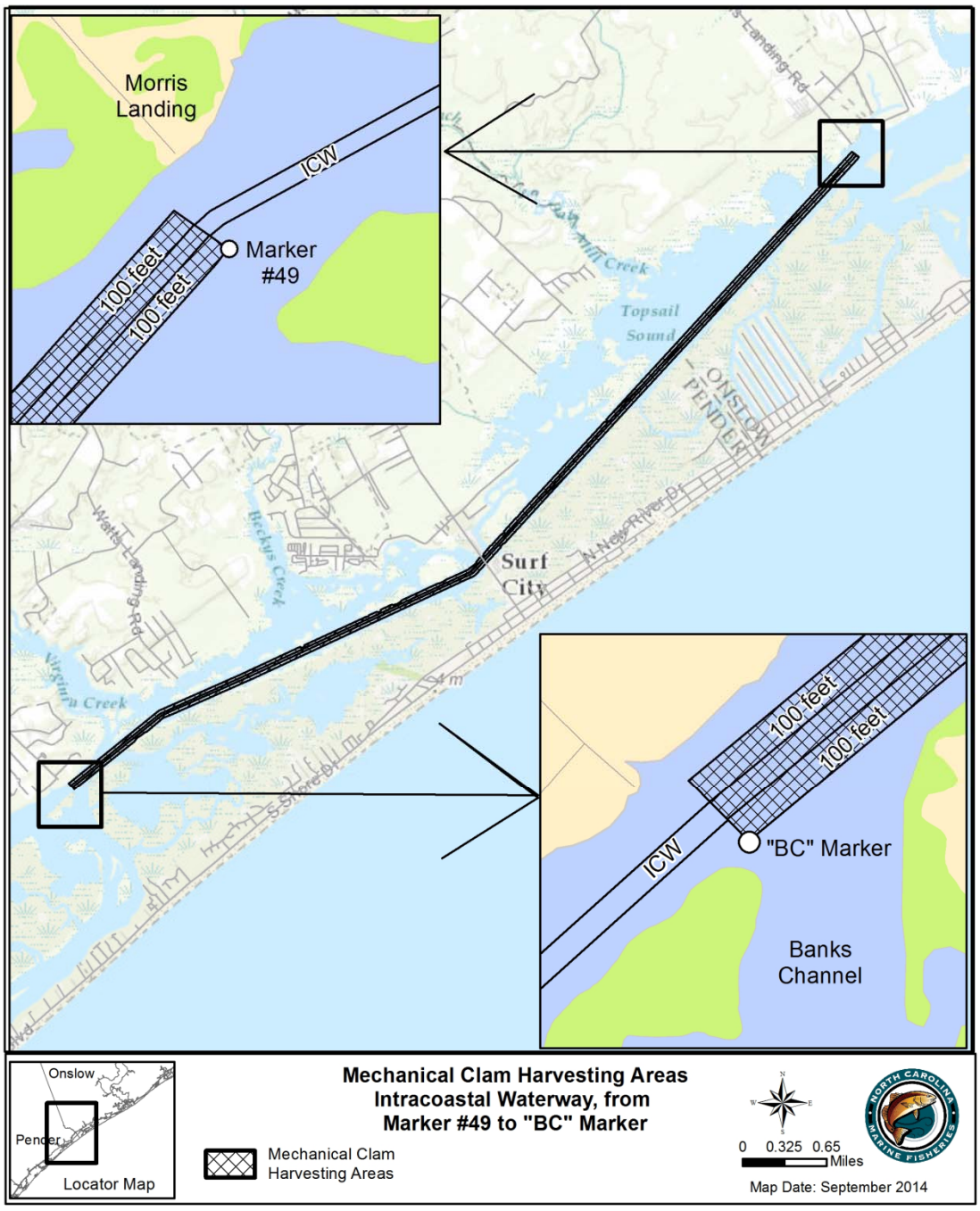


Figure 7.9. The current public mechanical harvest area within and 100 feet on either side of the Intracoastal Waterway from Marker #49 at Morris Landing to the "BC" Marker at Banks Channel. NCDMF GIS database.

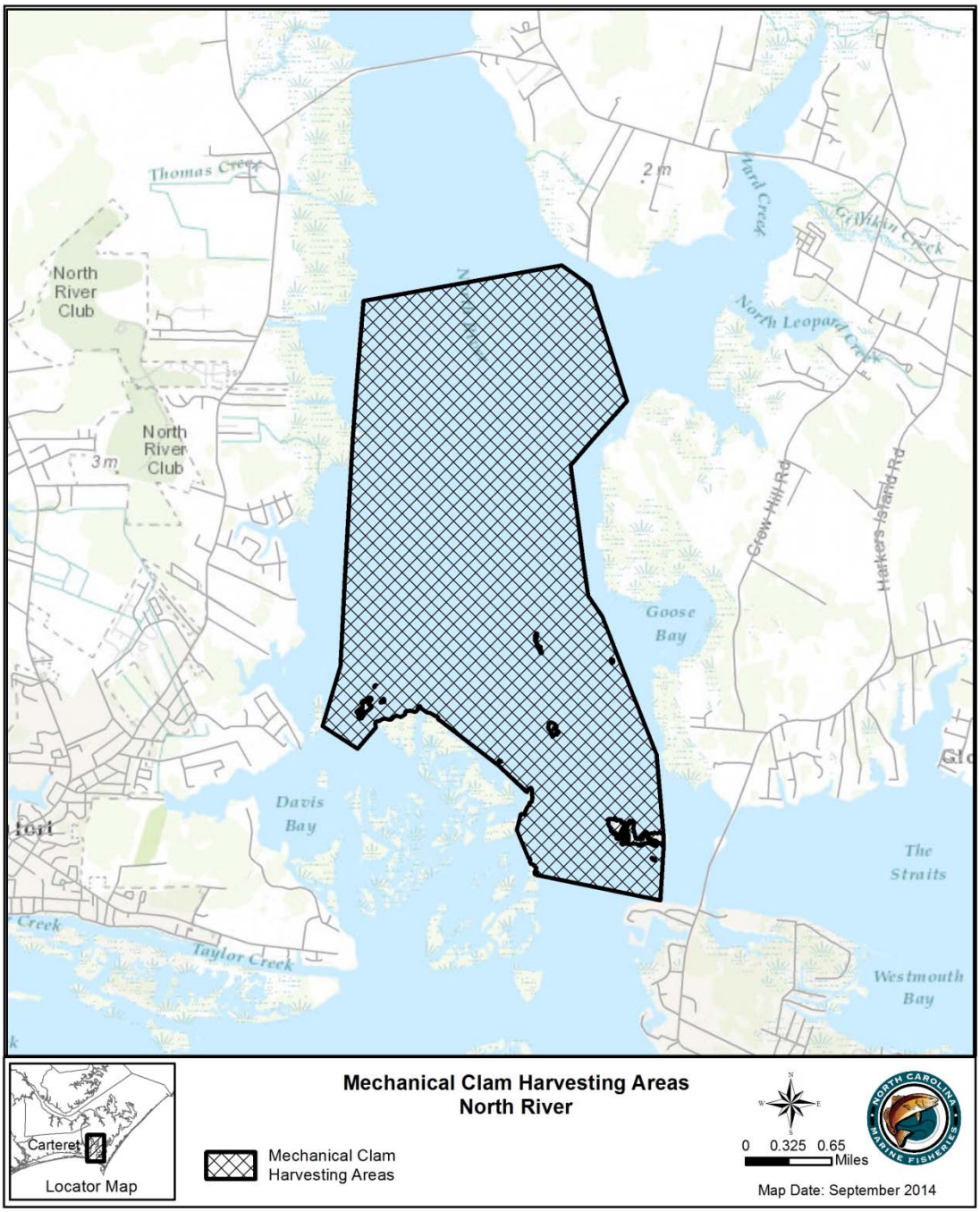


Figure 7.10. The current public mechanical harvest area in North River. NCDMF GIS database.

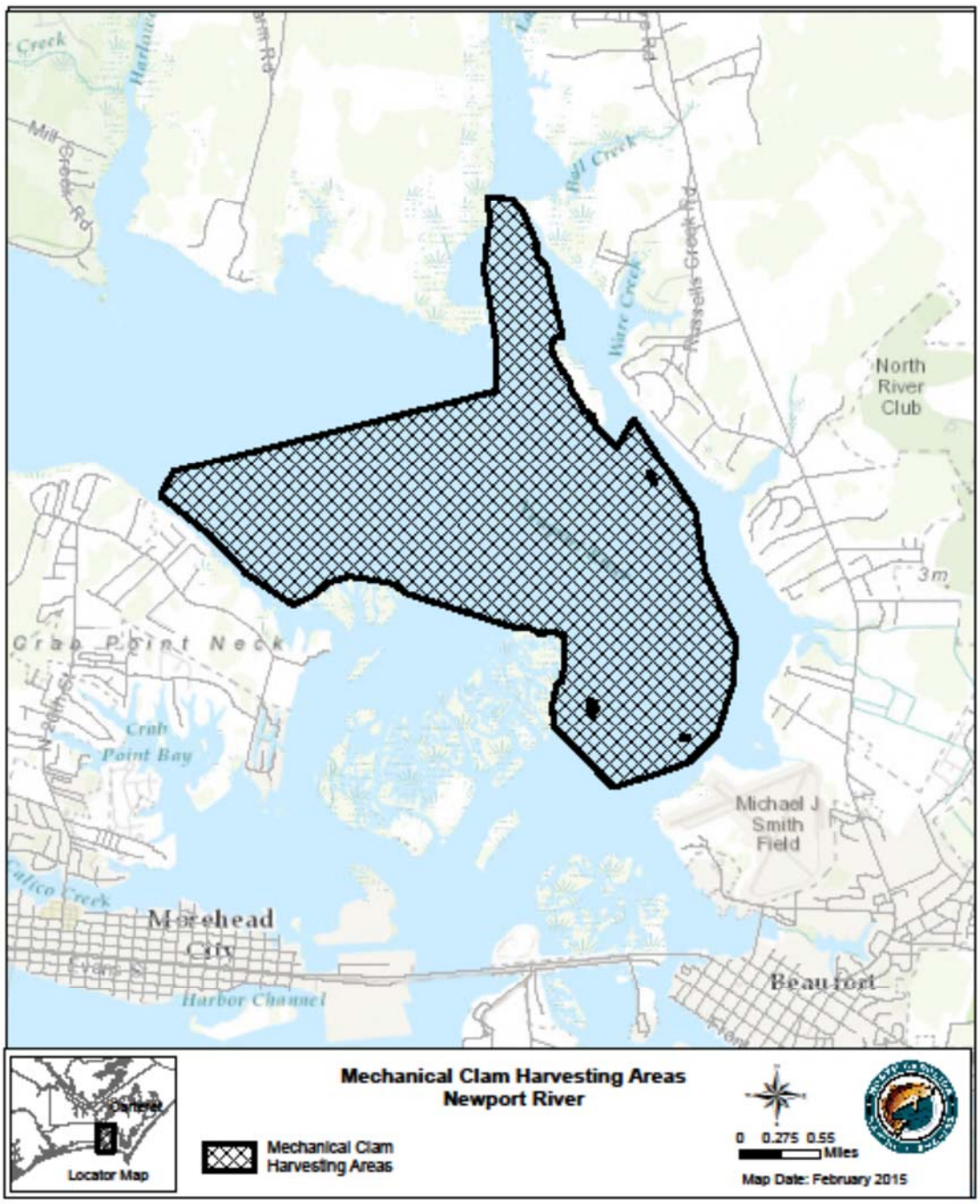


Figure 7.11. The current public mechanical harvest area in Newport River. NCDMF GIS database.

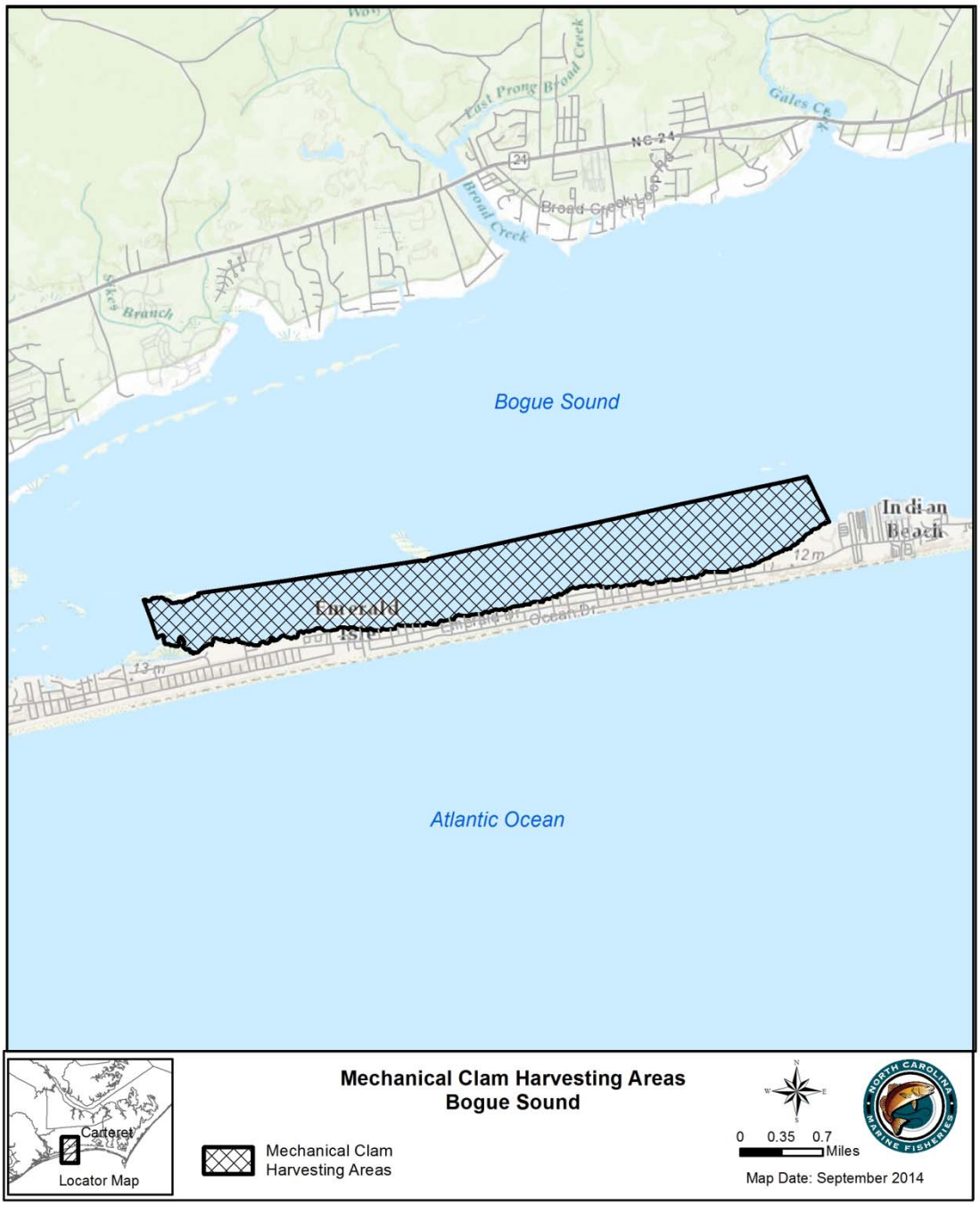


Figure 7.12. The current public mechanical harvest area in Bogue Sound. NCDMF GIS database.

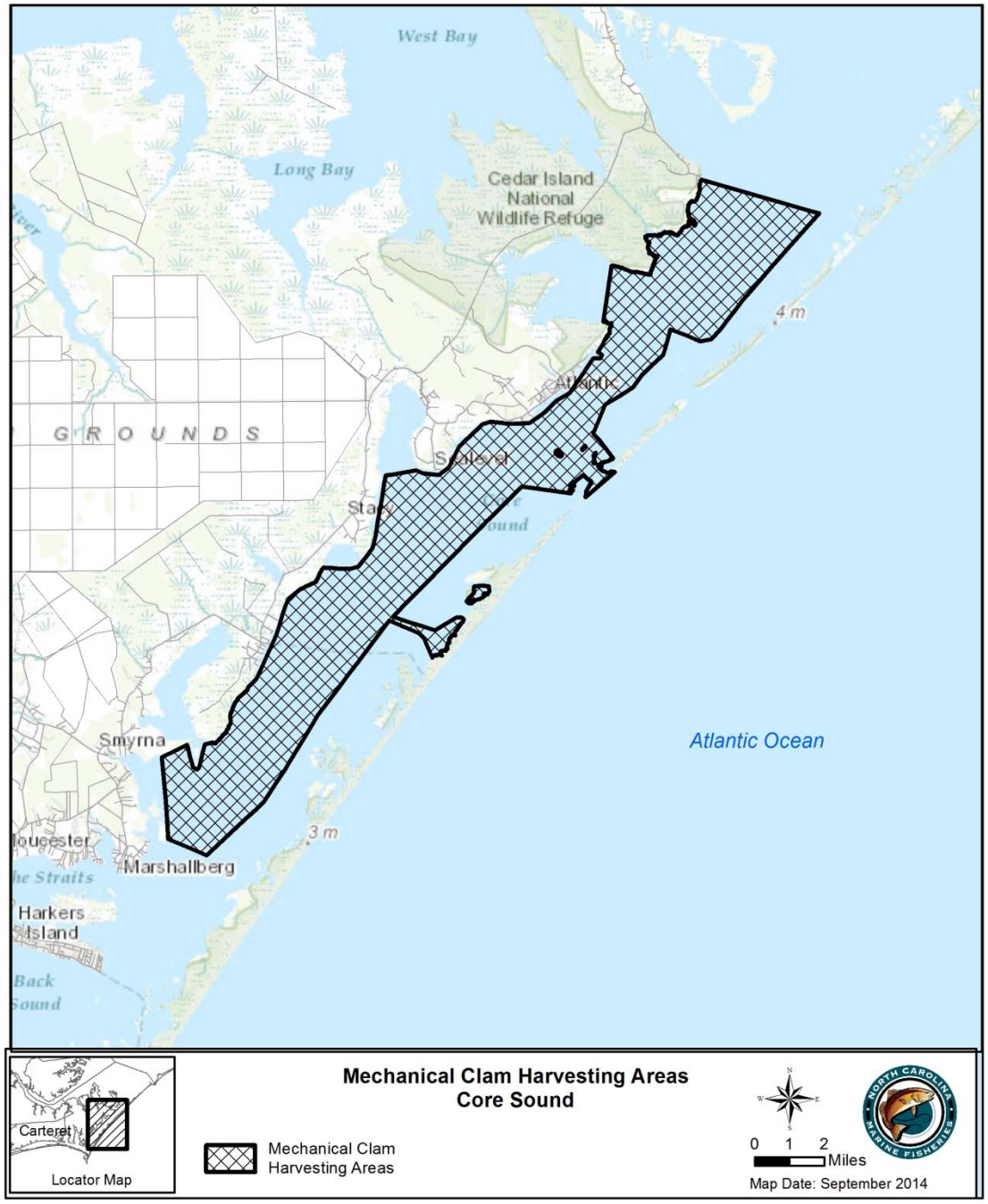


Figure 7.13. The current public mechanical harvest area in southern Core Sound. Opened every year. NCDMF GIS database.

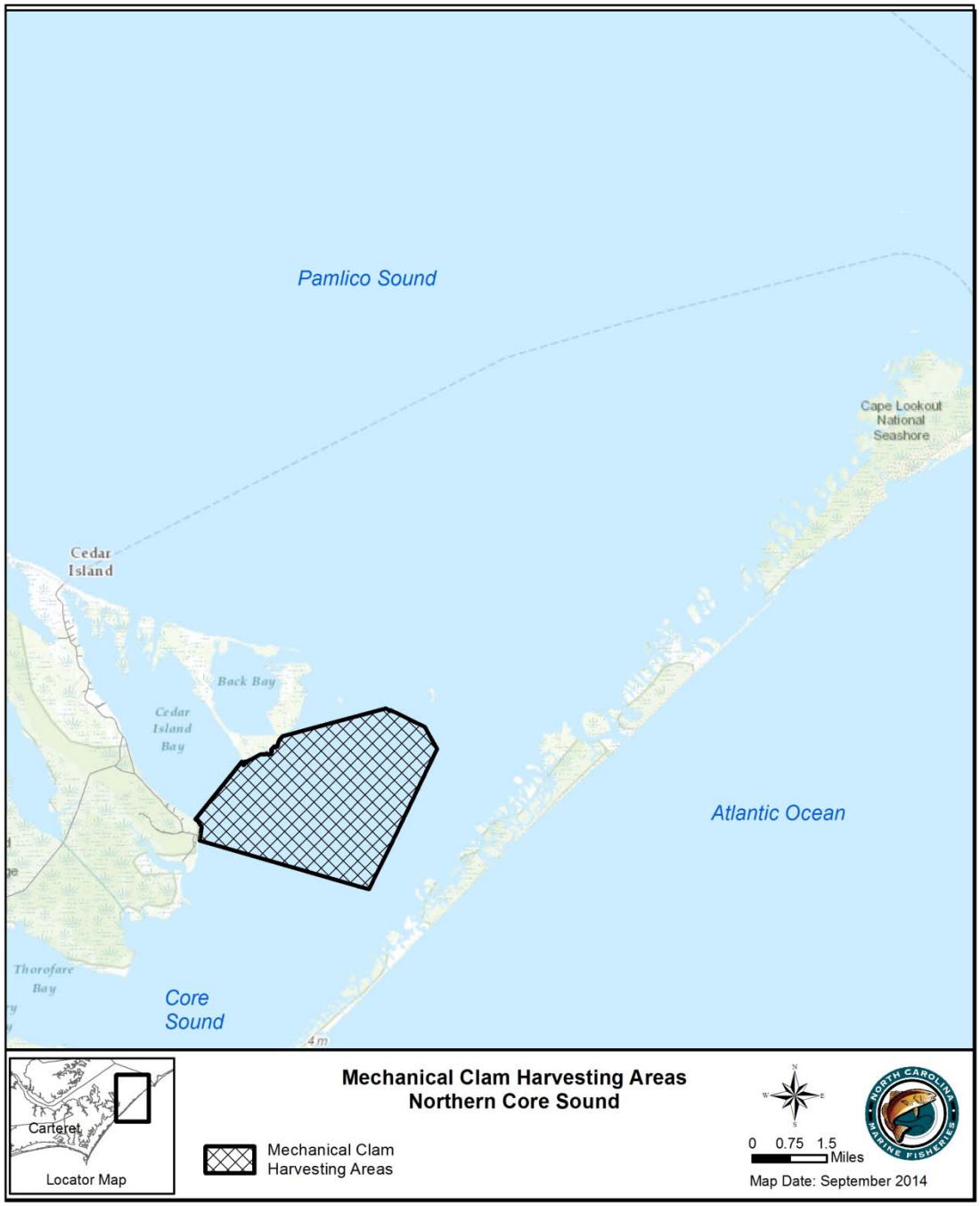


Figure 7.14. The current public mechanical harvest area in northern Core Sound open every other year, opposite the open and close season for the mechanical harvest area in the New River. NCDMF GIS database.

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 km^2) 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 clams 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.

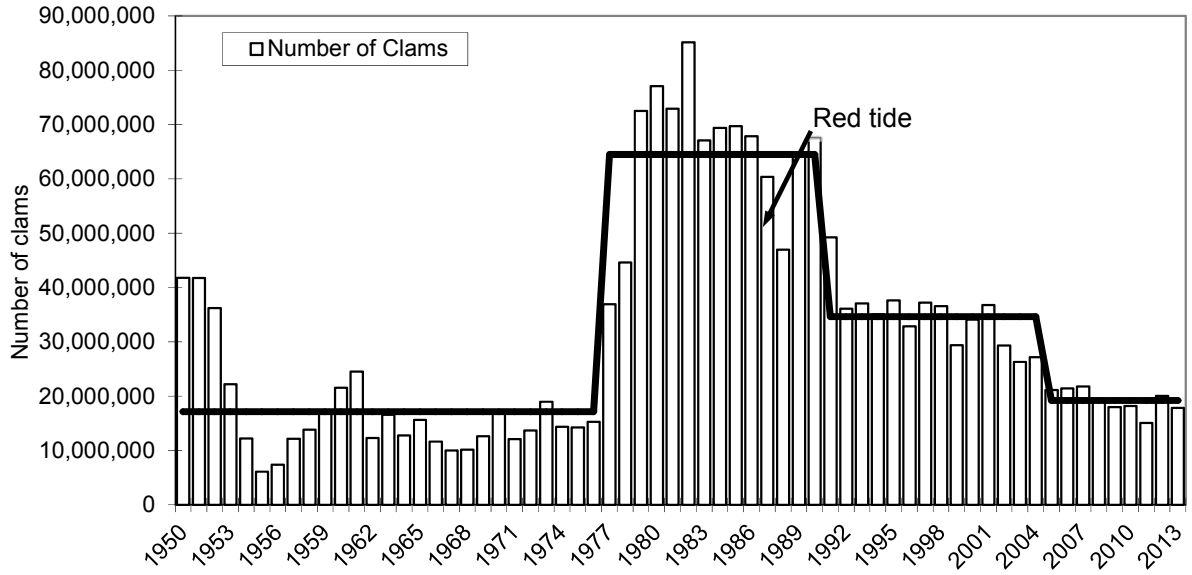


Figure 7.15. Hard clams landings (Number of clams) from public harvest and private production showing the average annual landing trends for specific time periods, 1950-2013. TTP.

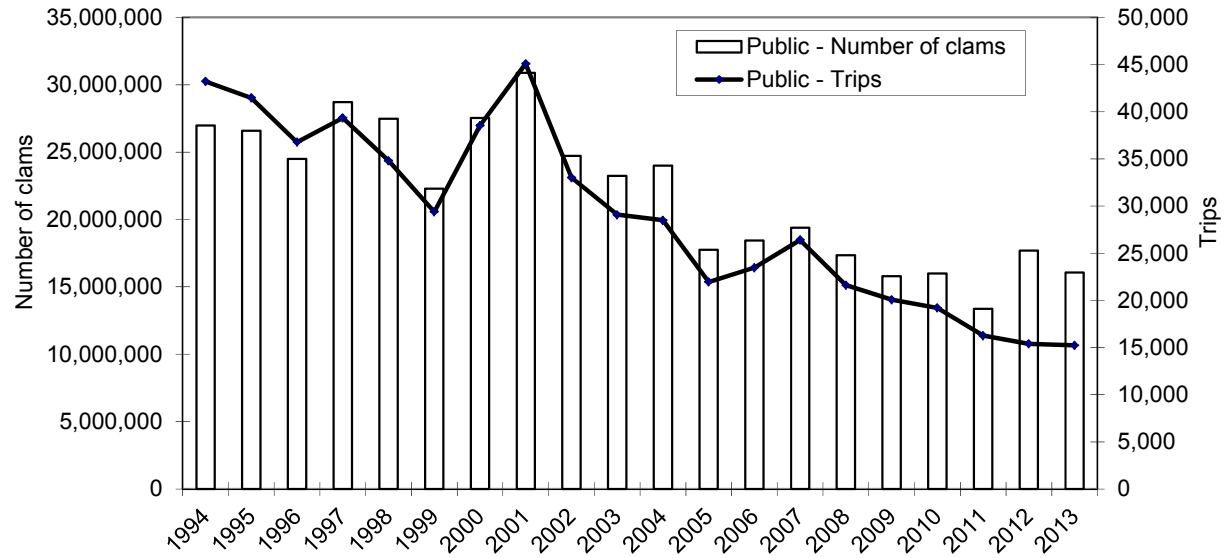


Figure 7.16. North Carolina annual commercial hard clam landings (Number of clams) and trips from public harvest, 1994-2013. TTP.

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.

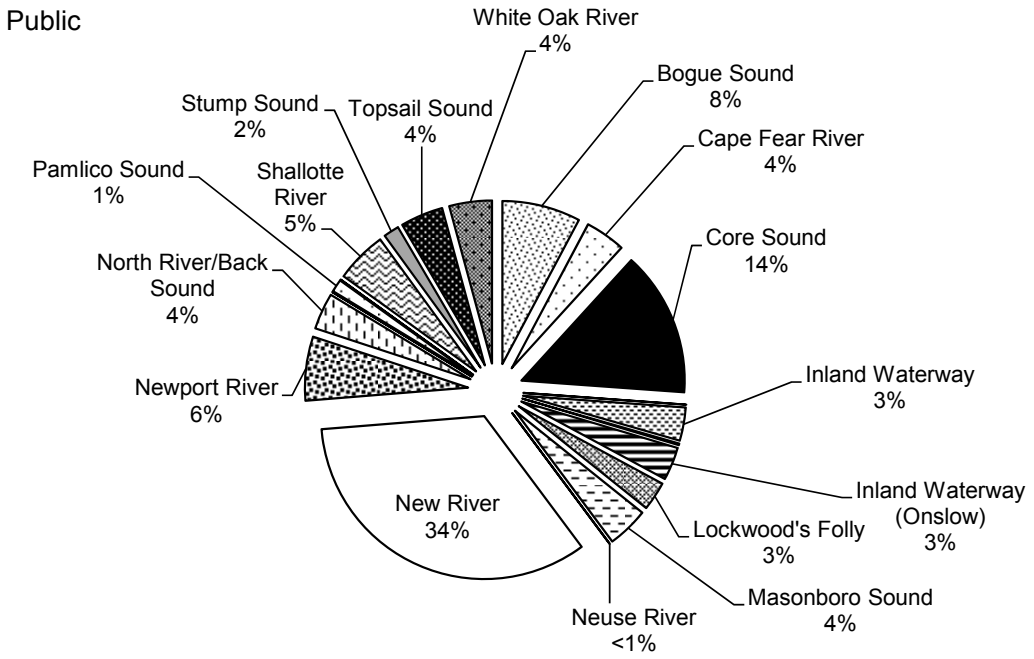
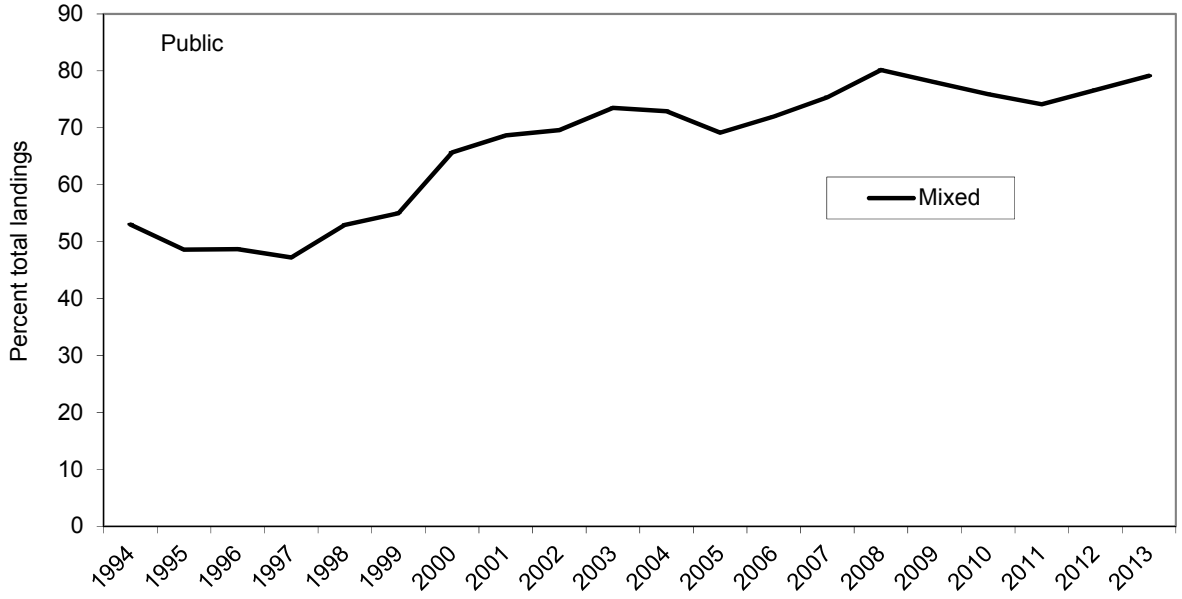


Figure 7.17. Commercial hard clam landings (Percent of total landings) by waterbody from public harvest 1994 to 2013 combined. TTP.

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).

A.



B.

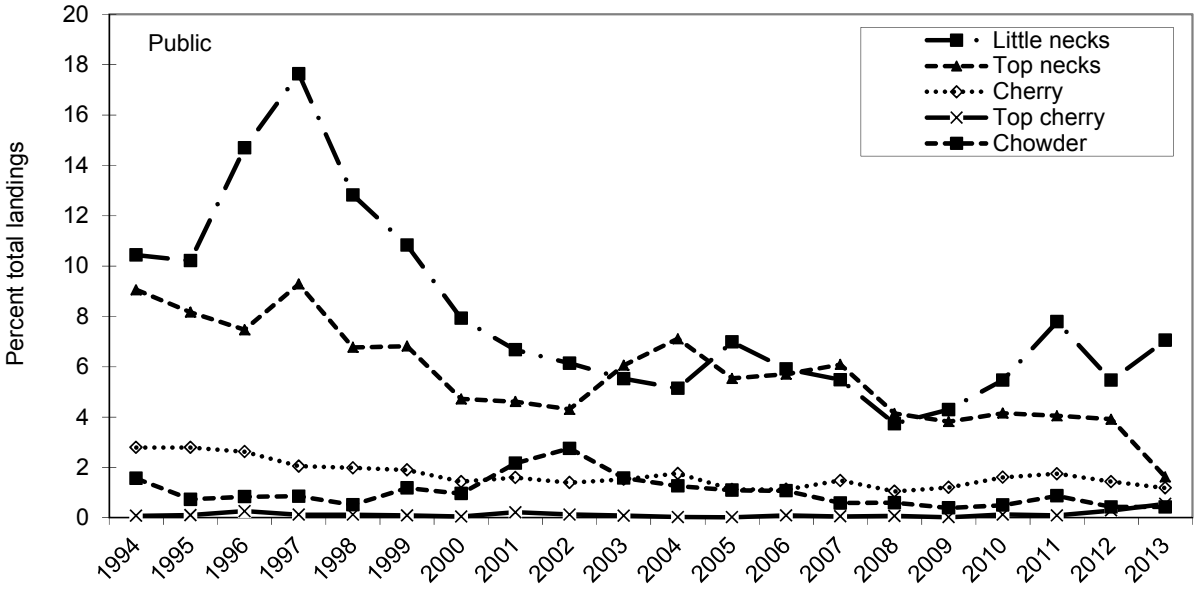


Figure 7.18. Annual landings (Percent to total annual landings) from public harvest by market grade, 1994-2013 combined. A. Mixed grade only; B. All other market grades. TTP.

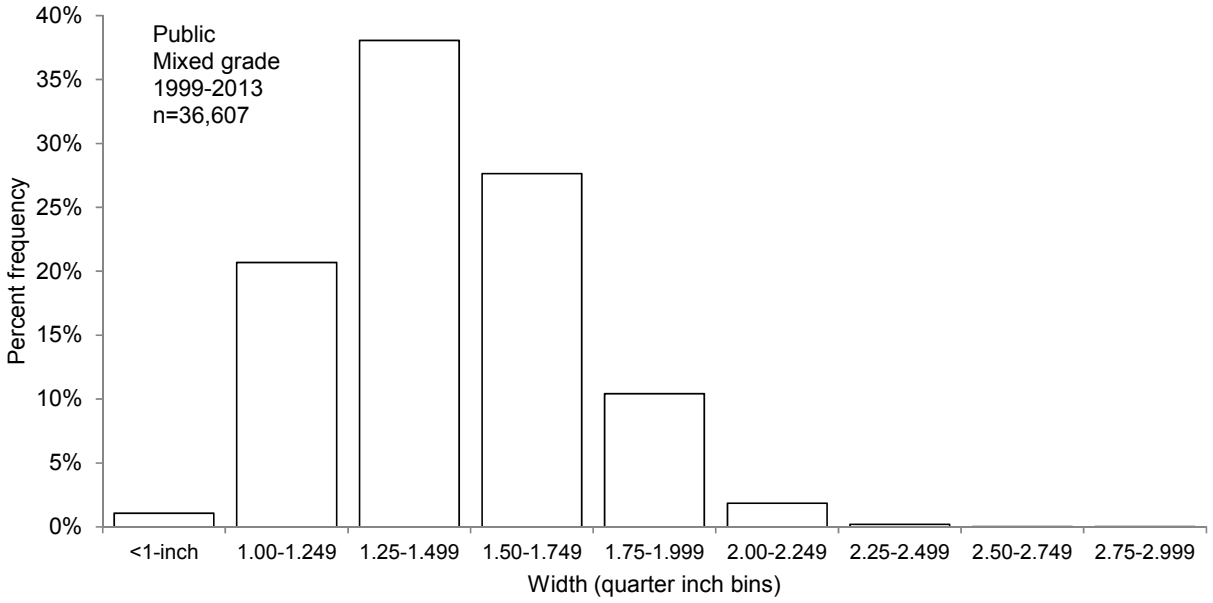


Figure 7.19. Size class (width in quarter-inch bins) distribution of hard clams in the unclassified market category from public harvest. Samples collected from commercial fish houses, 1999-2013 combined. NCDMF biological database.

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).

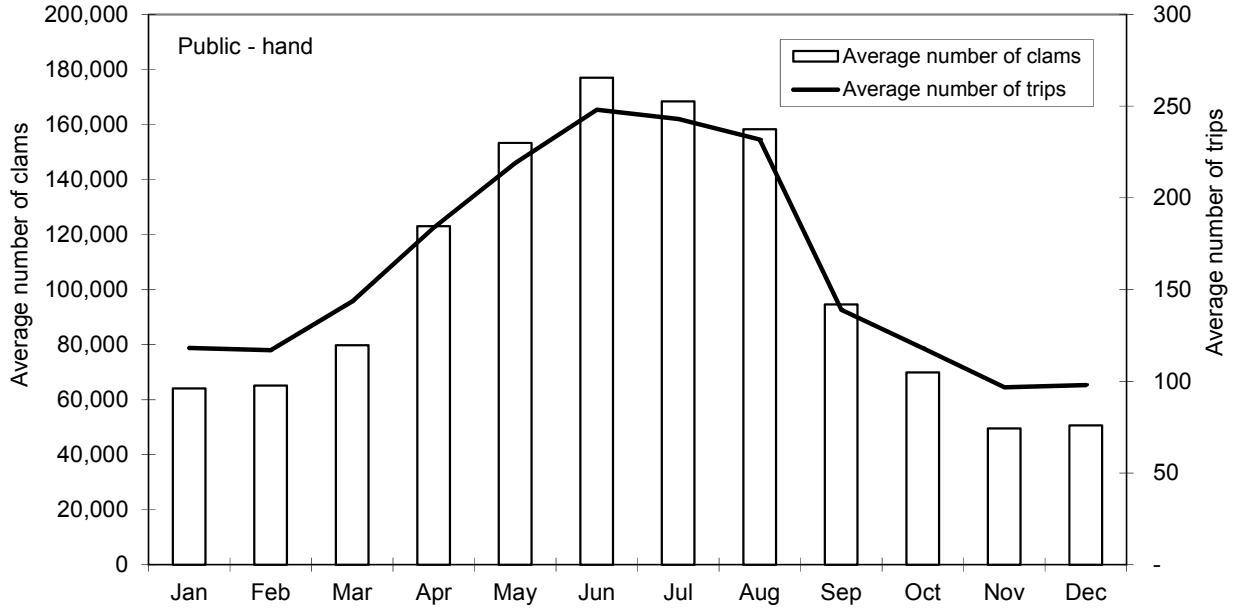


Figure 7.20. Average hard clam landings (Number of clams) and average number of trips by month from public harvest using hand gears, 1994-2013. TTP.

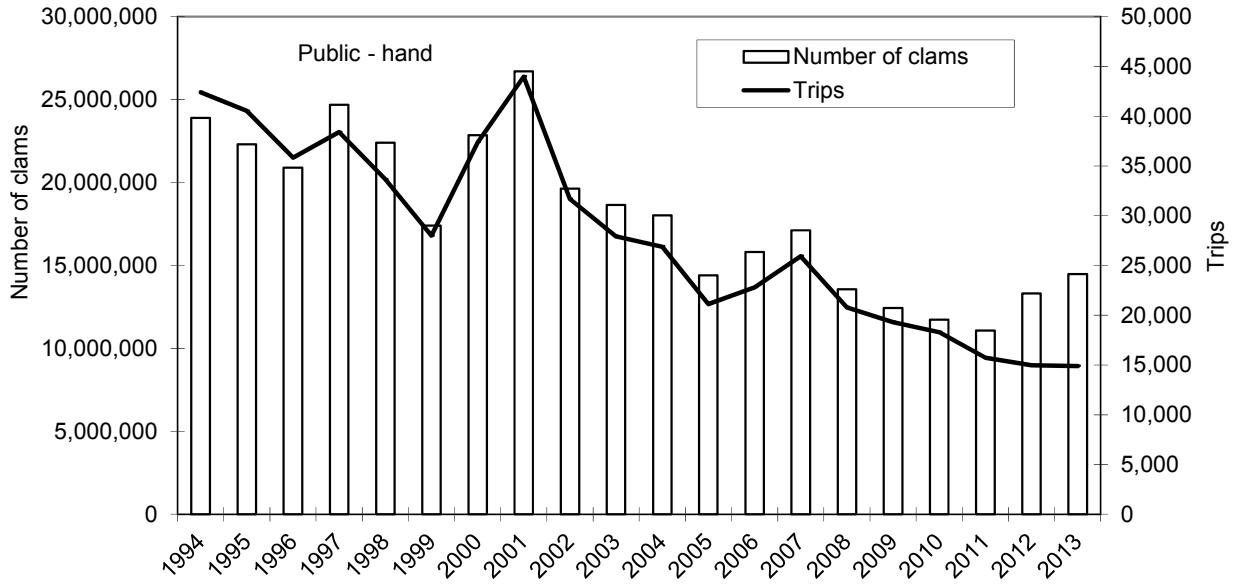


Figure 7.21. Annual hard clam landings (Number of clams) and trips from public harvest using hand gears, 1994-2013. TTP.

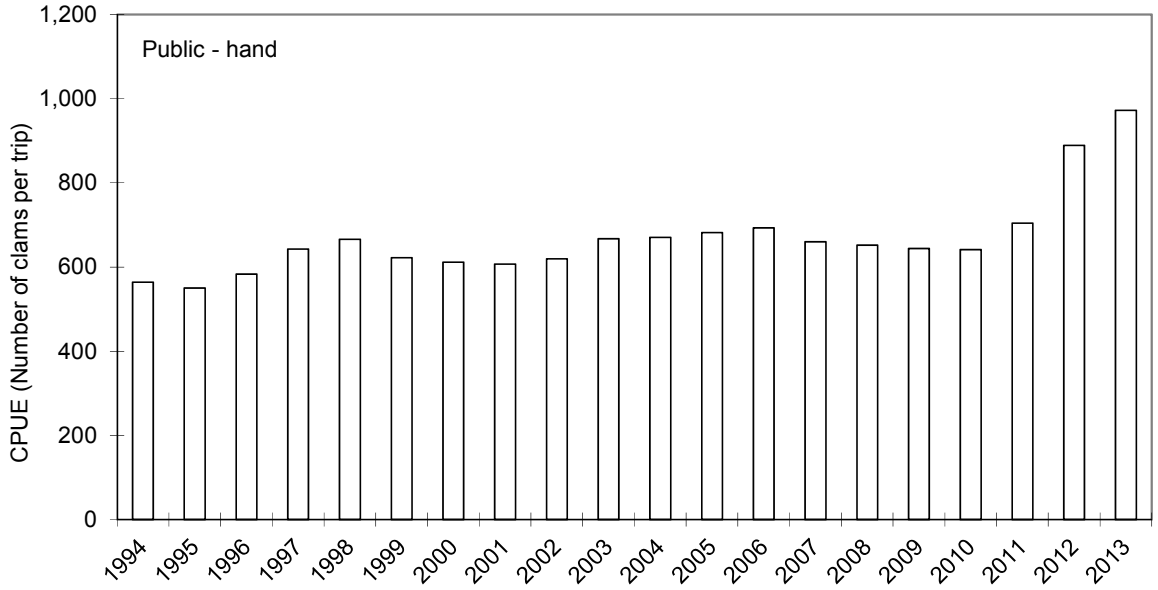


Figure 7.22. Annual catch per unit effort (CPUE; number of clams per trip) of hand harvest from public areas, 1994-2013. TTP

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.

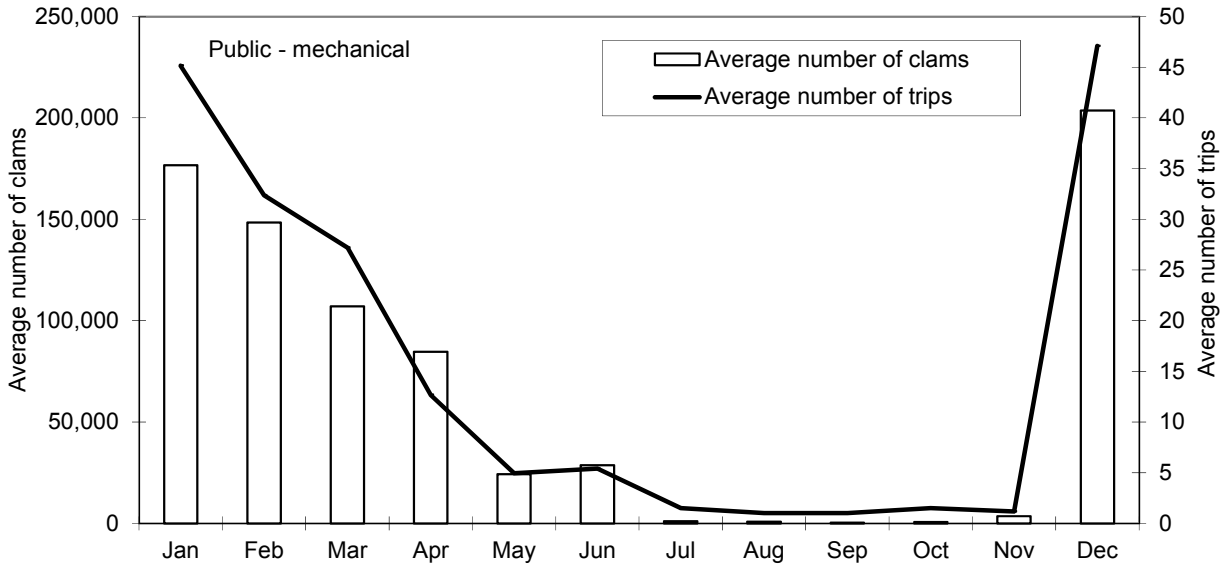


Figure 7.23. Average hard clam landings (Number of clams) and average number of trips by month from public harvest using mechanical gears, 1994/95-2012/13. TTP.

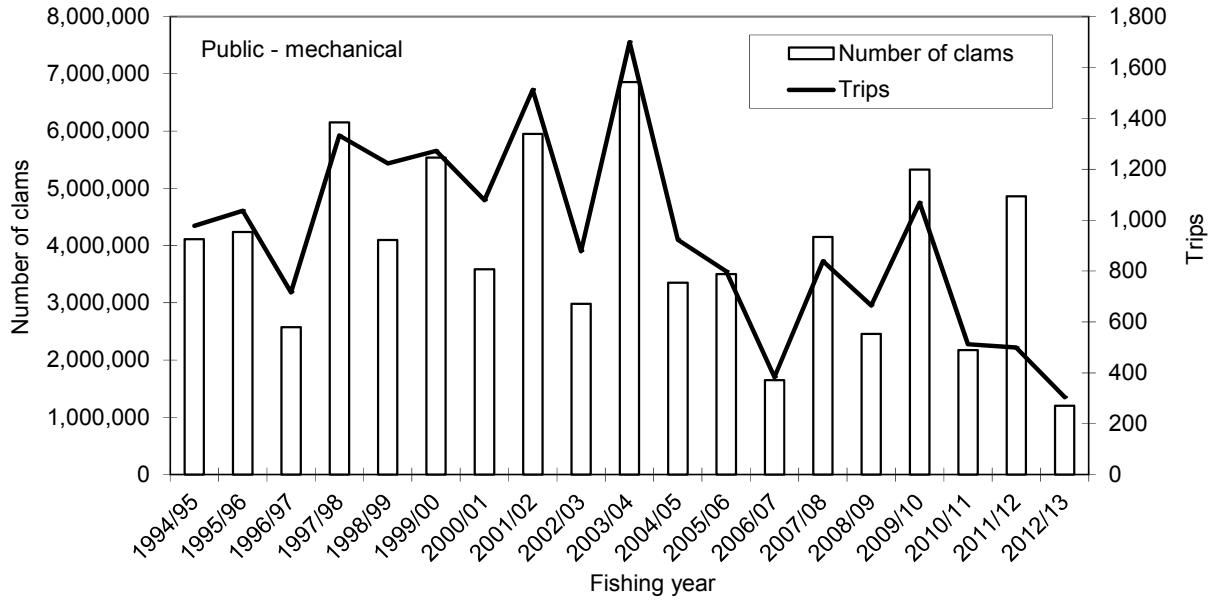


Figure 7.24. Hard clam landings (Number of clams) and trips from public harvest using mechanical gears by fishing year (Dec-Nov), 1994/95-2012/13. TTP.

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 from1982 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 2003-3013, 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 DEQ 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 Statues 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).

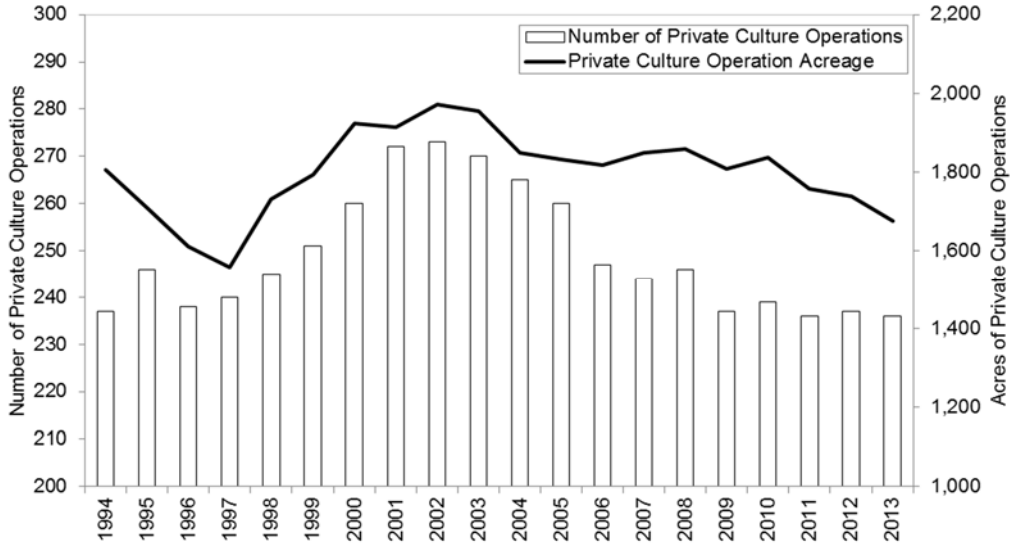


Figure 7.25. Number of private culture operations and associated acreages by year (1994-2013). NCDMF Shellfish Lease and Franchise Program Fisheries Information Network data.

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.

			PLANTED (bu)											HARVESTED (bu)					
			CULTCH						SEED		Adult								
Year	Number of Private Culture Operations	Private Culture Operation Acreage	Oyster	Marl	Rock	Shell	Surf Clam	Unknown	Clam Seed	Oyster	Clam Relay	Blood Clam	Oyster	Clam	% of State's Clam Landings	Oyster	% of State's Oyster Landings	Blood Clam	% of State's Blood Clam Landings
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	Permitees 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 proclamated and occurs in April of each year. The private culture operations permited 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 initated 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 DEQ 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 Tranplant 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 bivalue 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).

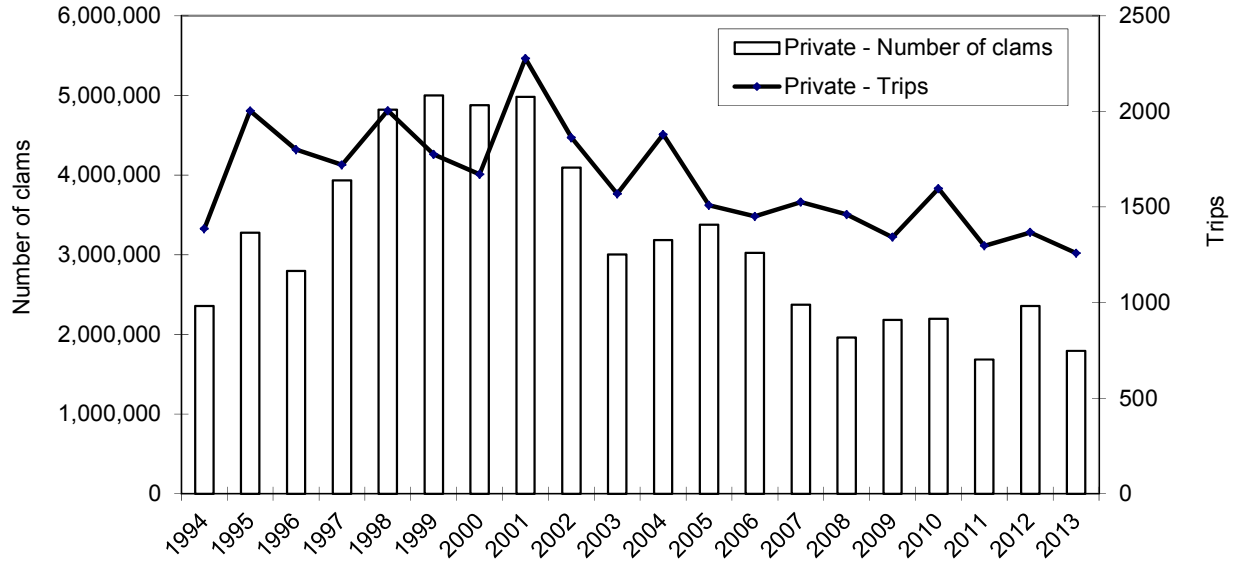


Figure 7.26. North Carolina commercial hard clam landings (Number of clams) and trips from private production, 1994-2013. TTP.

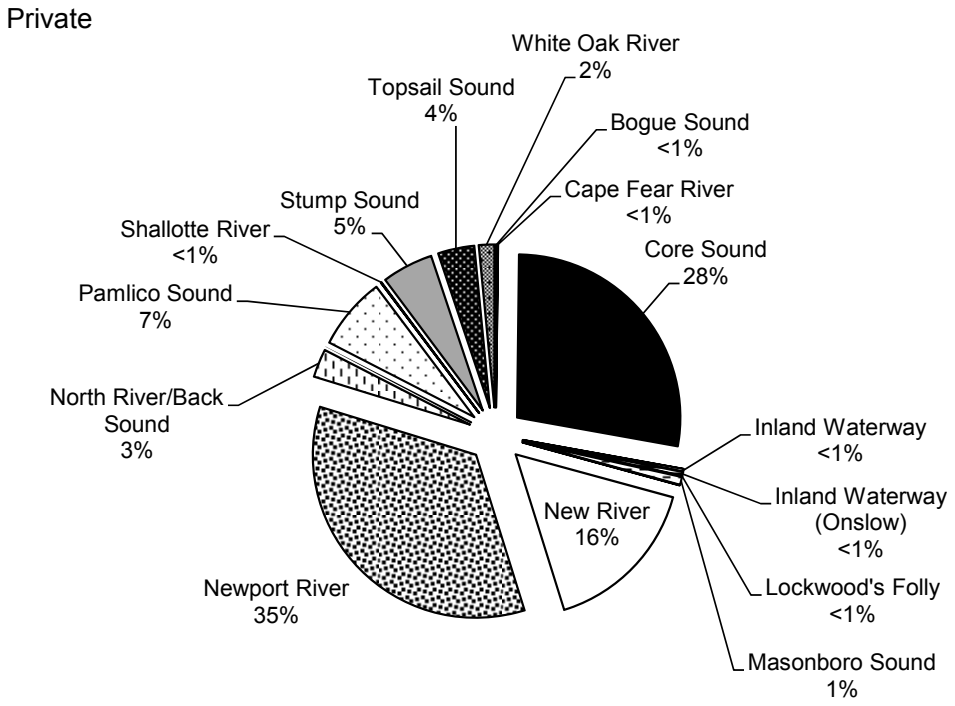
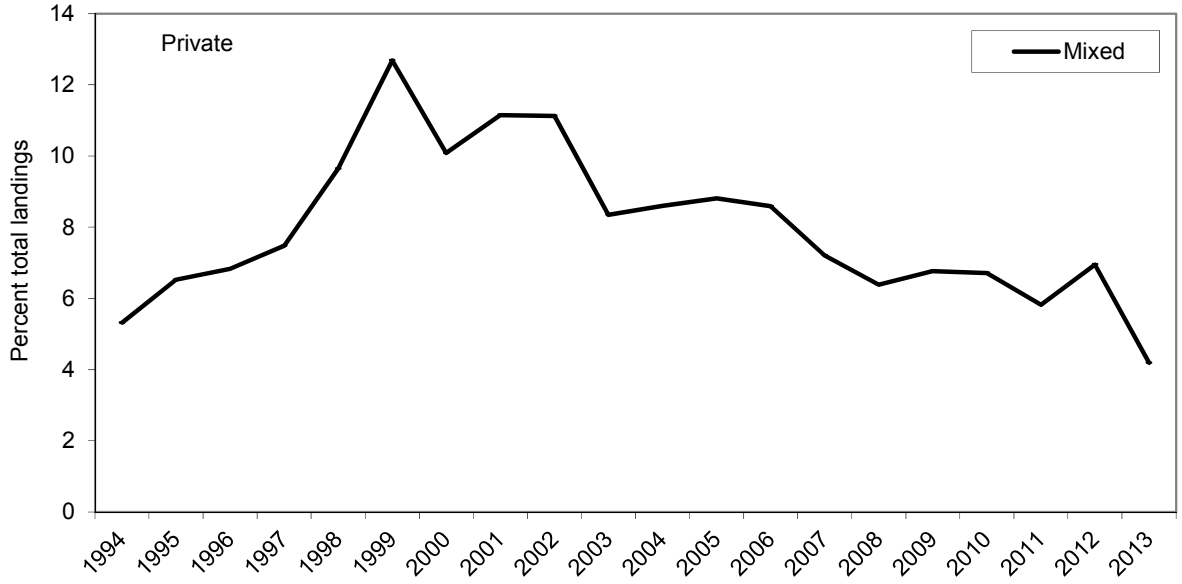


Figure 7.27. Commercial hard clam landings (percent to total) by waterbody from private culture operations, 1994-2013 combined. TTP.

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.

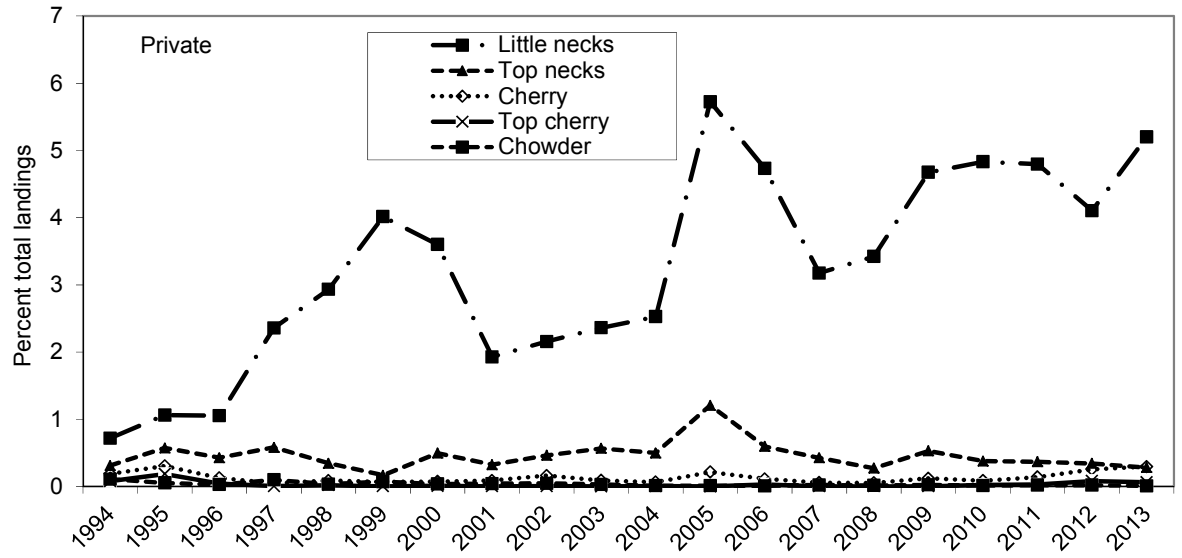


Figure 7.28. Total annual hard clam landings (Percent of annual total landings) from private production by market grade, 1994-2013. A. Mixed grade only; B. All other market grades. TTP.

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).

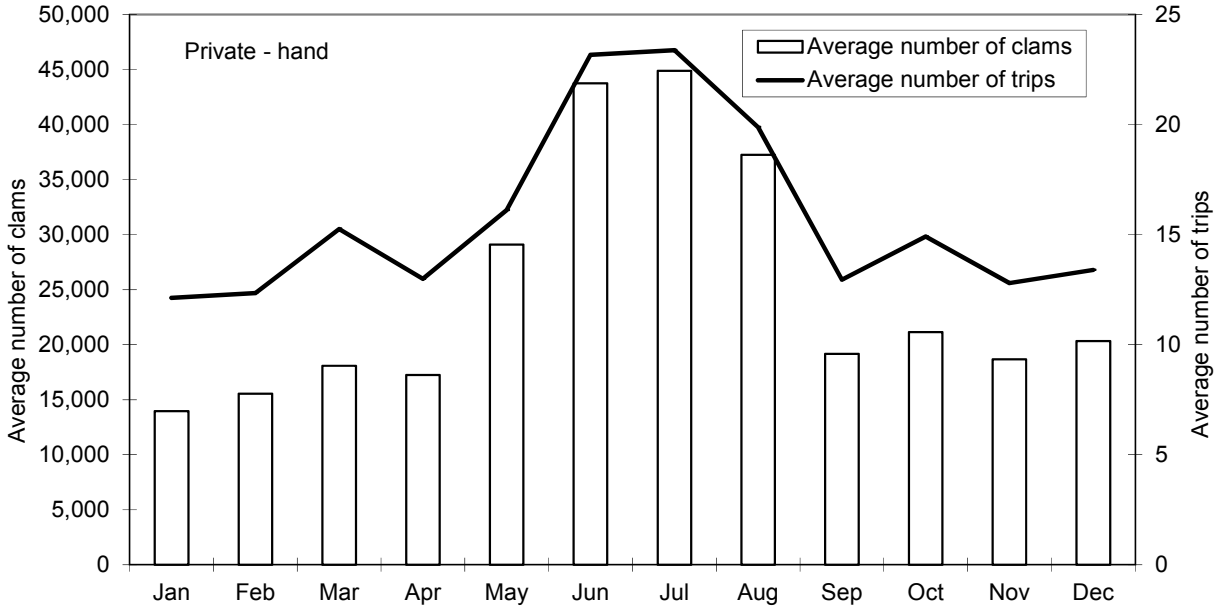


Figure 7.29. Average monthly hard clam landings (Number of clams) and average number of trips from private production using hand gears, 1994-2013. TTP.

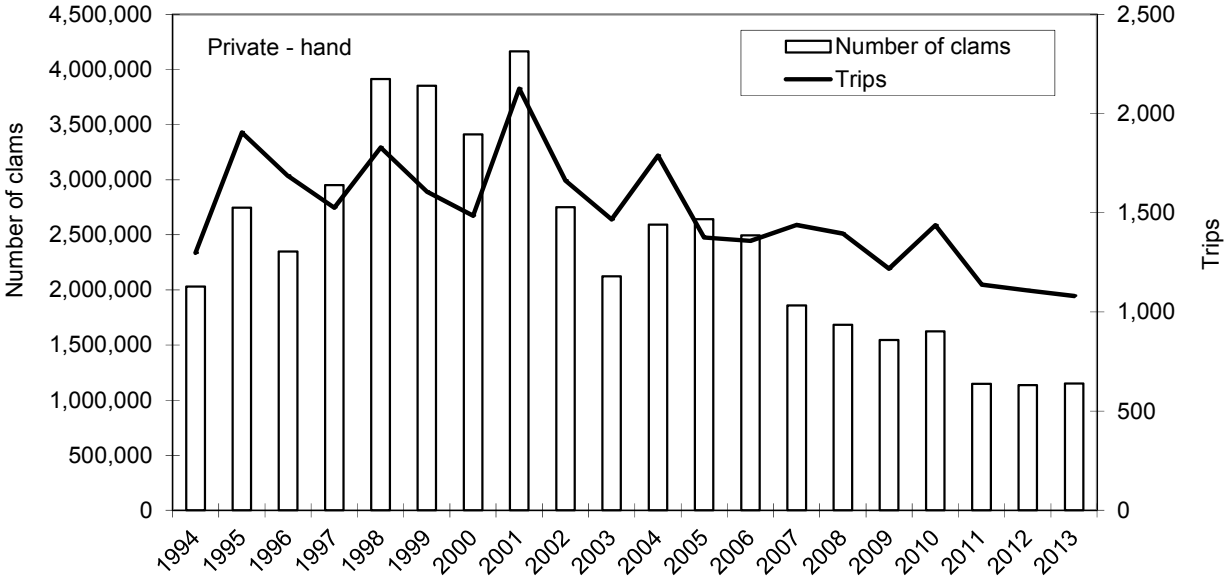


Figure 7.30. Annual hard clam landings (Number of clams) and trips from private production using hand gears, 1994-2013. TTP.

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.

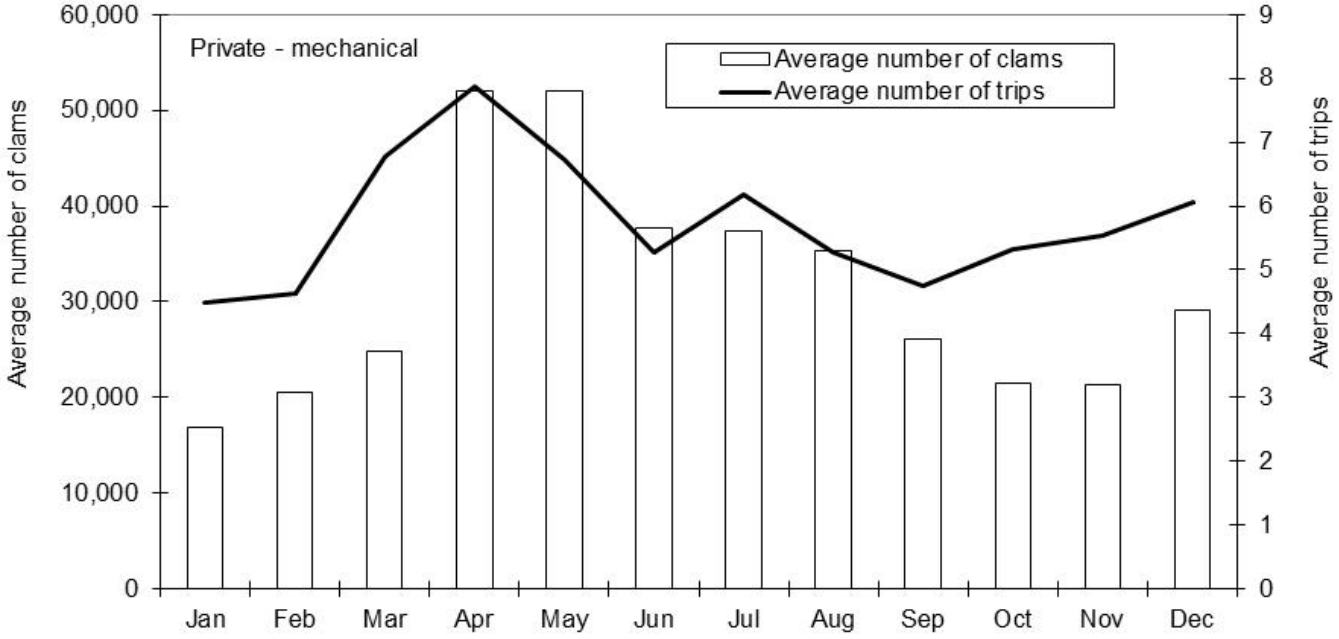


Figure 7.31. Average monthly hard clam landings (number of clams) and average number of trips from private production using mechanical gears, 1994-2013 combined. TTP.

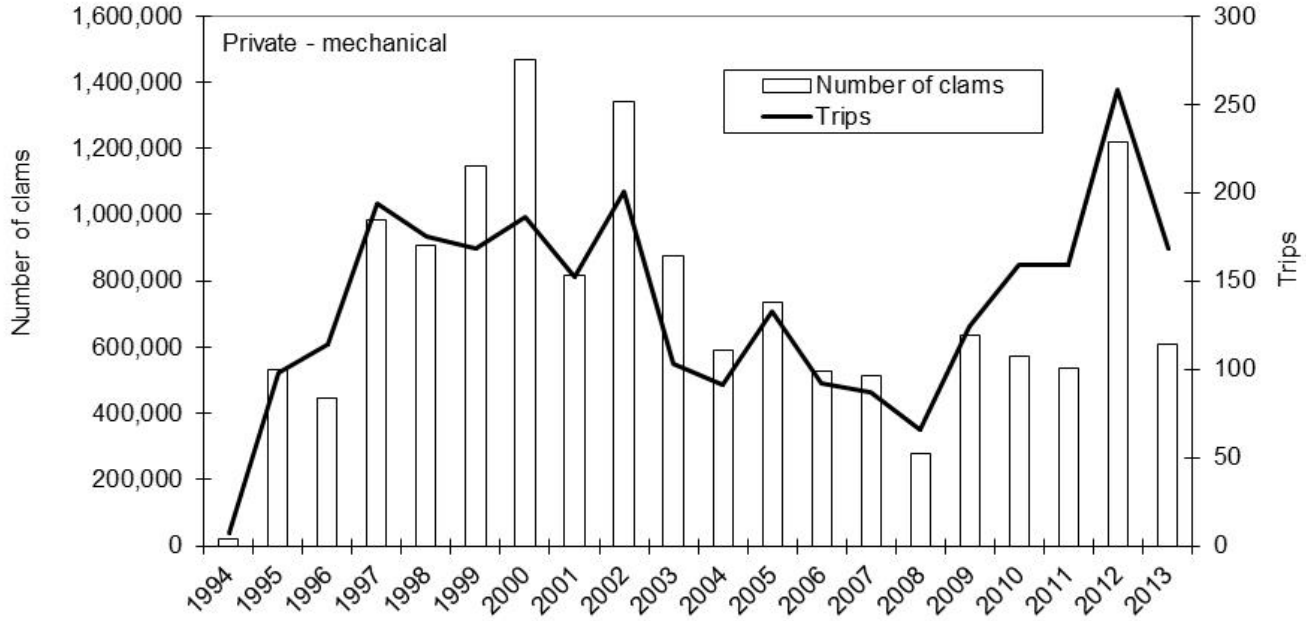


Figure 7.32. Annual hard clam landings (Number of clams) and trips from private production using mechanical gears, 1994-2013. TTP.

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. A 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 expediential 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 Sciense (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
Shallotte 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 inflation[3], 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).

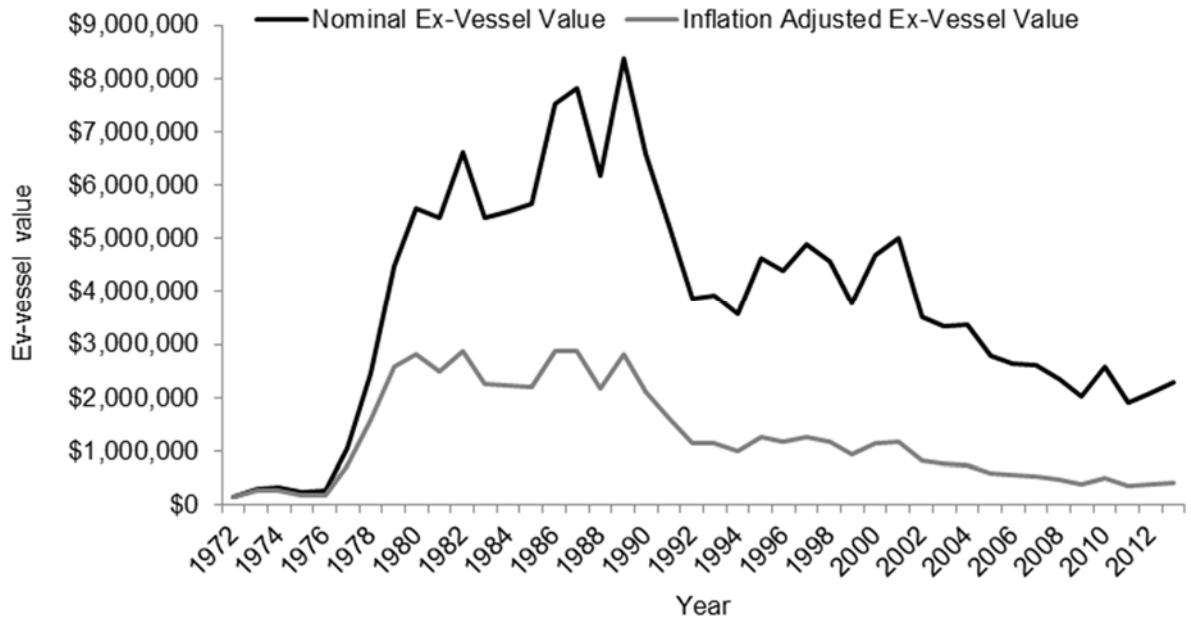


Figure 9.1. Annual ex-vessel value of clam landings in North Carolina, 1972-2013. TTP.

[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).

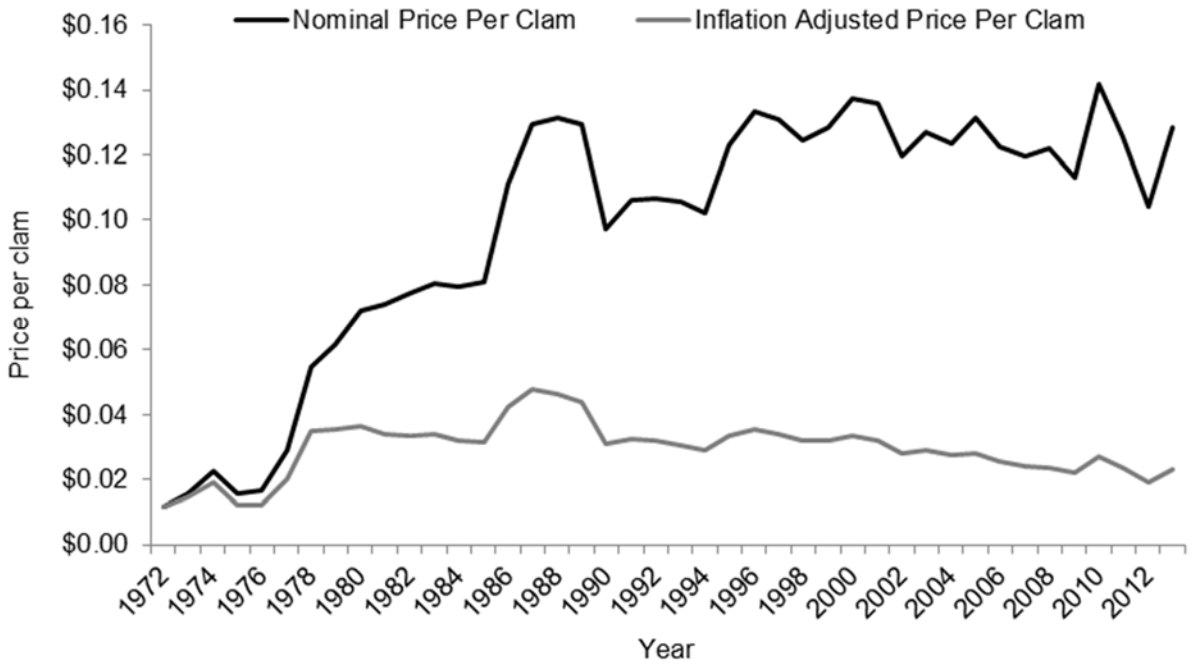


Figure 9.2. Annual average nominal and inflation adjusted price per clam in North Carolina, 1972-2013. TTP.

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).

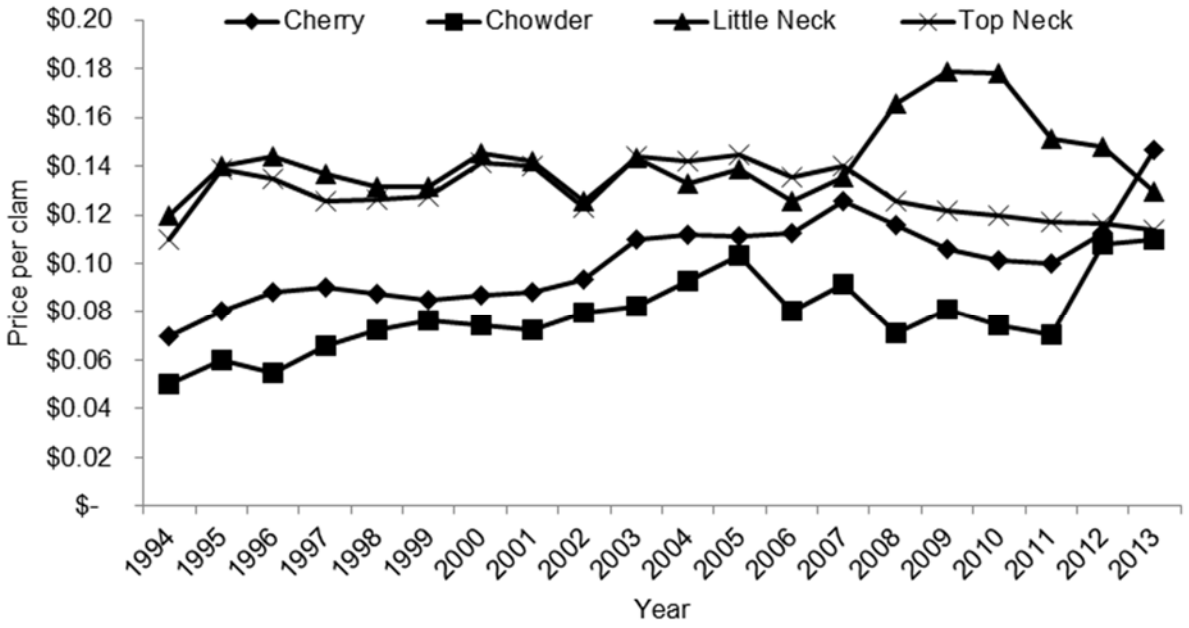


Figure 9.3. Annual average ex-vessel grade prices in North Carolina, 1994-2013. TTP.

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.

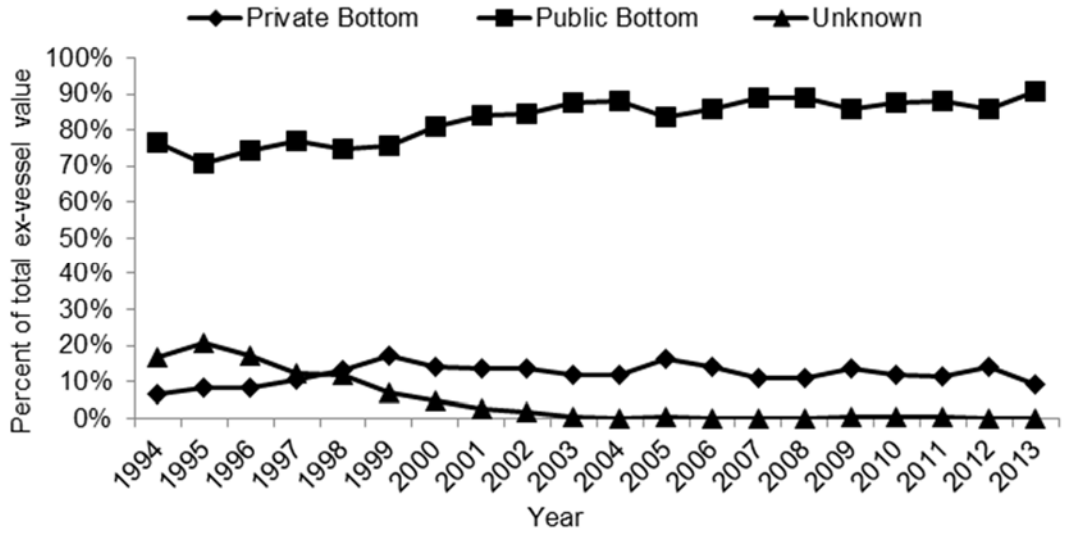


Figure 9.4. Percent of annual total commercial clam harvest value from public versus private bottom, 1994-2013. TTP.

Table 9.3 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 9.3. Percent of total annual commercial clam harvest value by waterbody, 1994-2013. TTP.

	Year																				
Water body	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average
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%
Shallotte 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 9.4). 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 9.4. 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%

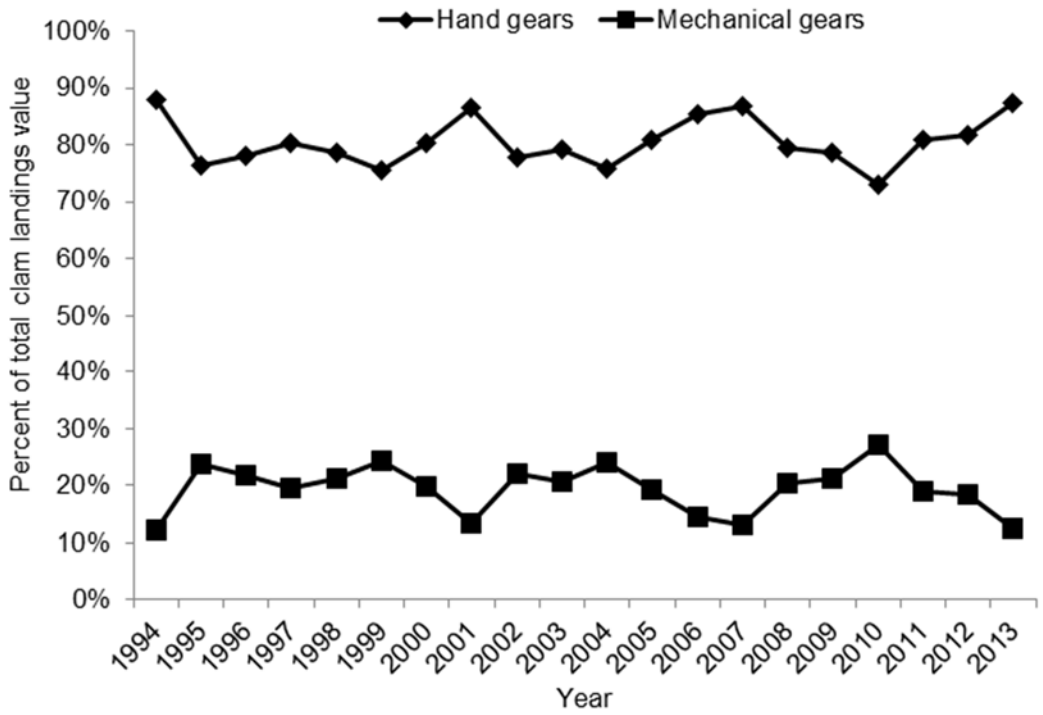


Figure 9.5 Annual percent of total landings value by gear type used to harvest hard clams, 1994-2013. TTP.

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 9.5 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).

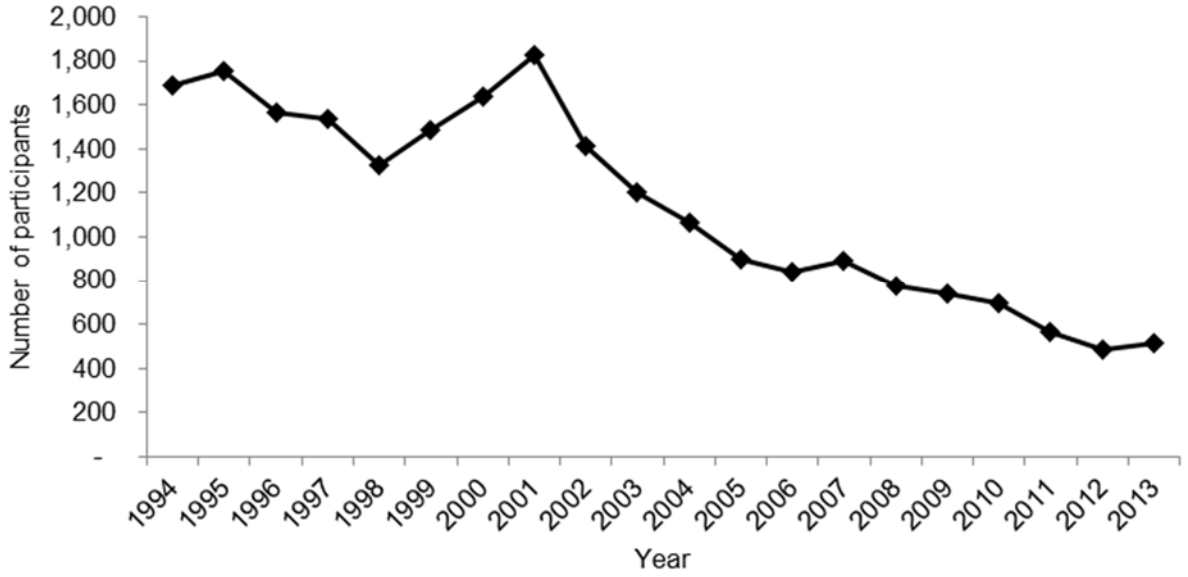


Figure 9.6. Annual number of commercial participants reporting landings of clams from 1994-2013. TTP.

Table 9.6 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.

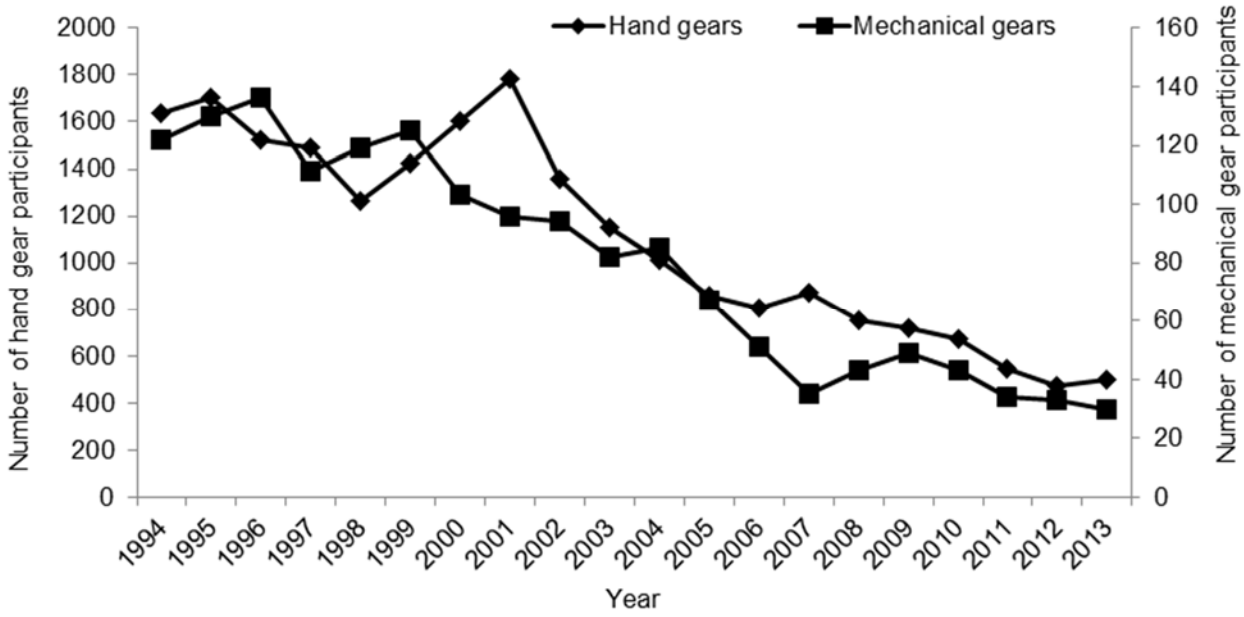


Figure 9.7. Participant count by gear category for hard clam harvest, 1994-2013. TTP.

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).

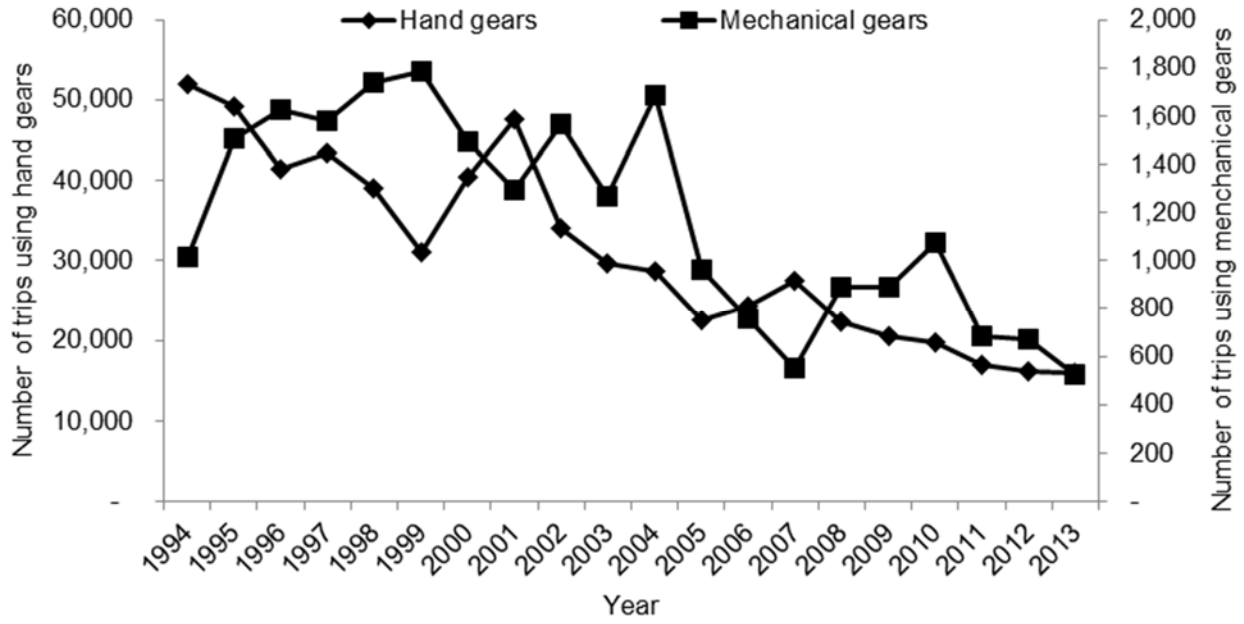


Figure 9.8. Annual total number of commercial trips landing clams by gear category, 1994-2013. TTP.

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 wholesalers 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%).

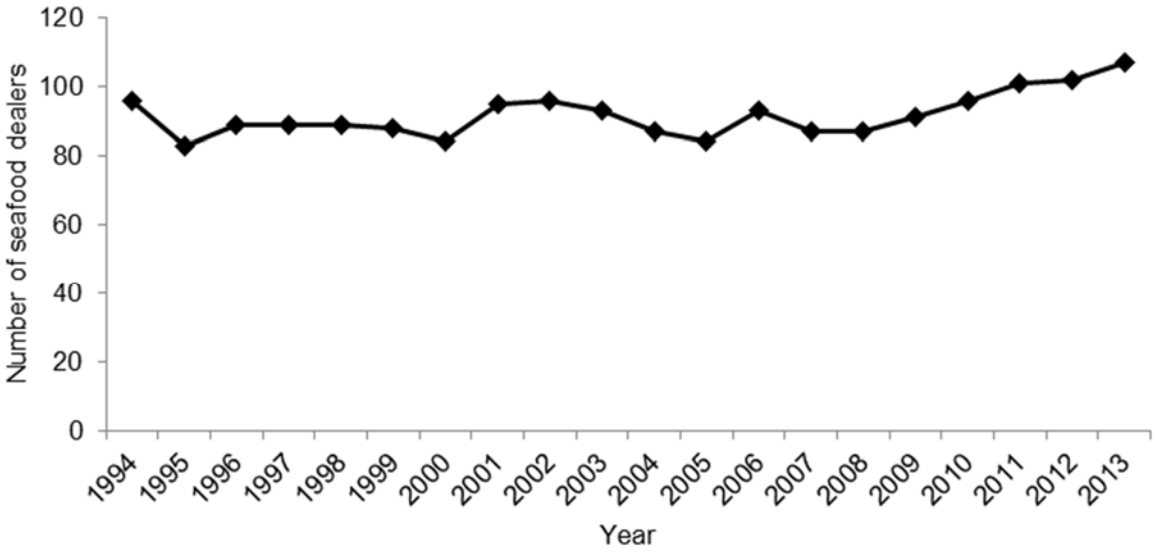


Figure 9.9. Number of seafood dealers reporting landings of clams from 1994-2013. TTP.

Table 9.5. Number of participants and the number of trips taken that landed clams 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 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%	11%	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 9.6. Number of participants in the clam fishery by value of landings 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-$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 9.7. 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 9.8 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 9.8. Economic impact of the commercial hard clam fishery in North Carolina, 2013. NCDMF Fisheries Economics Program.

				Estimated Economic Impacts		
Participants[1]	Trips[1]	Clams landed[1]	Ex-vessel value[1]	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

[1]As reported by the North Carolina Division of Marine Fisheries trip ticket program.
[2]Represents both full-time and part-time jobs.
[3]Economic impacts calculated using the NCDMF commercial fishing economic impact model.

[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.

9.1.5 RECREATIONAL FISHERY ECONOMICS

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 coast[5], 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 9.9).

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 clammers 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 9.9. Demographic and fishing characteristics of clam harvesters. NCDMF Fisheries Economics Program.

	Frequency	Percent		Frequency	Percent
Gender			Race		
Male	126	97%	White	127	98%
Female	4	3%	African American	3	2%
Marital status			Number of people in household		
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%
Education			6	1	0.8%
Less than high school	41	32%	Years in community		
High school graduate	59	45%	Average	32	
Some college	17	13%	Minimum	2	
College graduate	13	10%	Maximum	84	
Household income			Percent of individual income from commercial fishing		
Less than $15,000	32	25%	Average		65%
$15,001-$30,000	38	29%	Minimum		1%
$30,001-$50,000	28	22%	Maximum		100%
$51,001-$75,000	14	11%	Fisherman status		
More than $75,000	7	5%	Full time	80	62%
Refuse to answer	11	8%	Part time	49	38%
Age			Years fishing		
Average	51		Average	28	
Minimum	20		Minimum	2	
Maximum	84		Maximum	70	

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 9.10 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 9.10. 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).

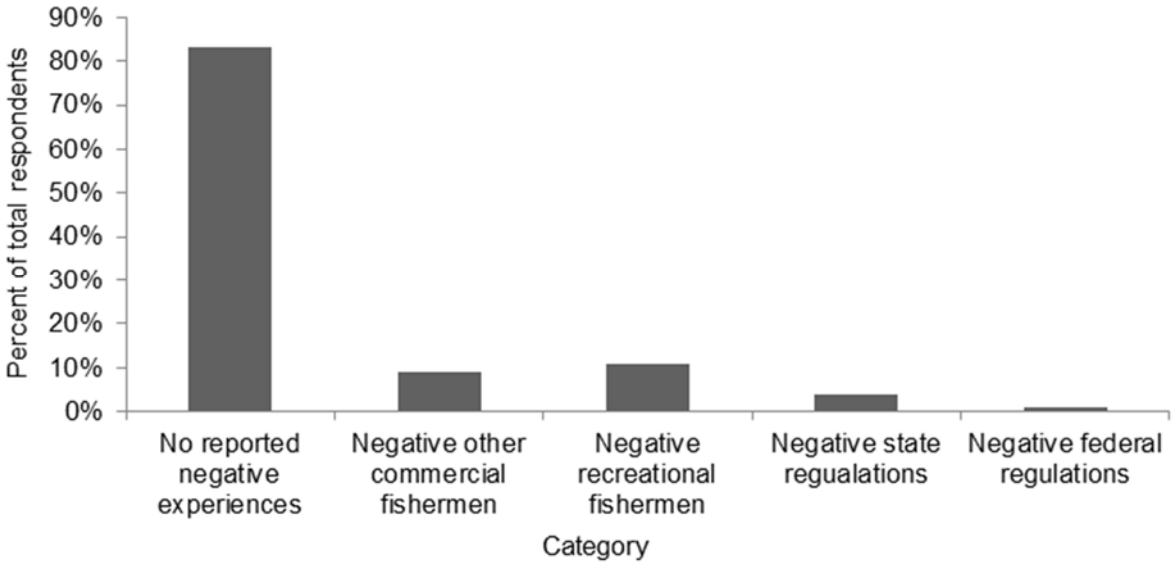


Figure 9.10. Reported conflicts of North Carolina commercial clam fishermen. NCDMF Fisheries Economics Program.

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 9.11). 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 9.11. 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 more clear 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 ENHANCMENT 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).

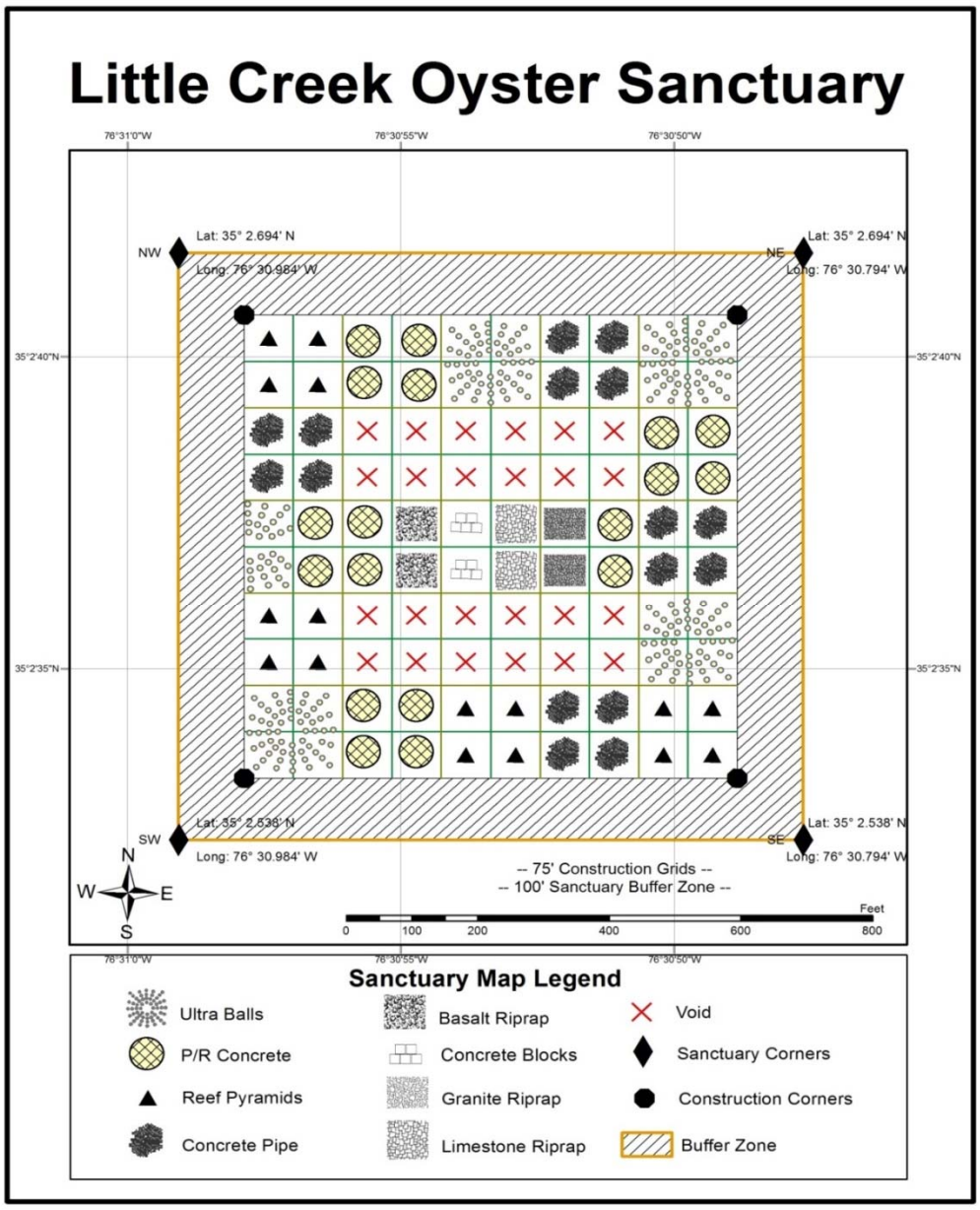


Figure 10.1. Little Creek Oyster Sanctuary conceptual map demonstrating the use of soft bottom habitat between hard substrate patches. All intentional void areas and areas between material types serve to provide unconsolidated soft bottom and hard substrate.

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 (Jǧrgensen 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).

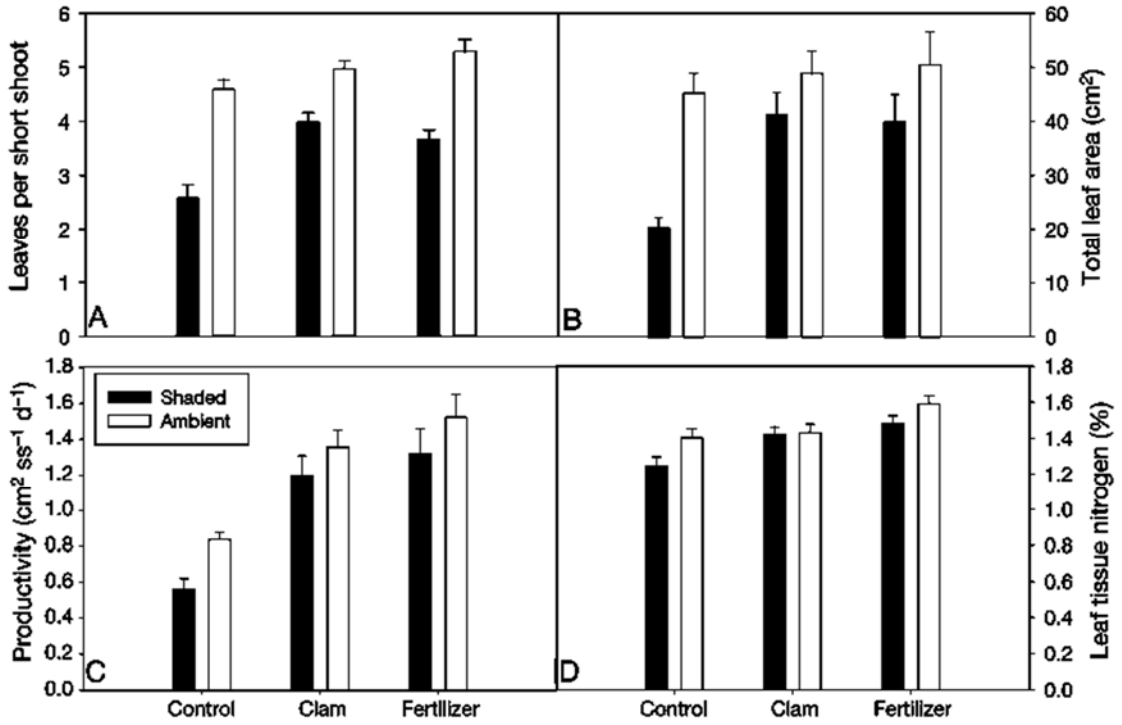


Figure 11.1 *Zostera marina*. Response variables (mean + standard error) for different nutrient treatments, ambient light conditions, and shaded light conditions. (A) total number of leaves per short shoot (ss), (B) total leaf area per short shoot (ss), (C) areal productivity per short shoot (ss), and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

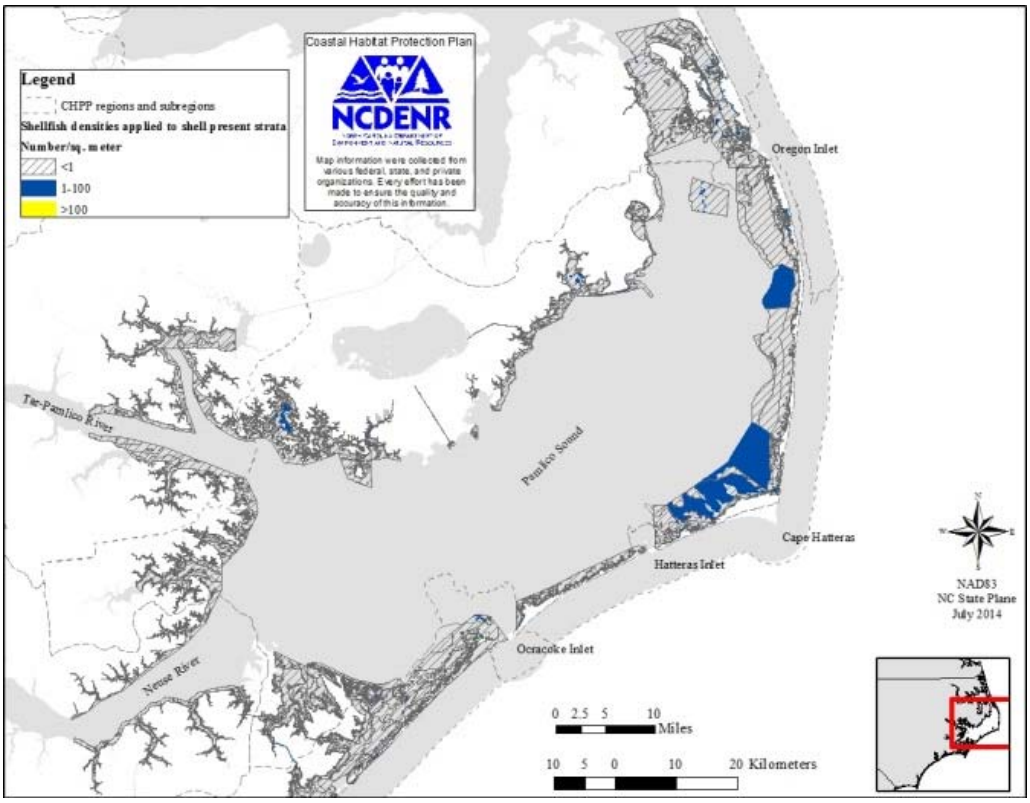
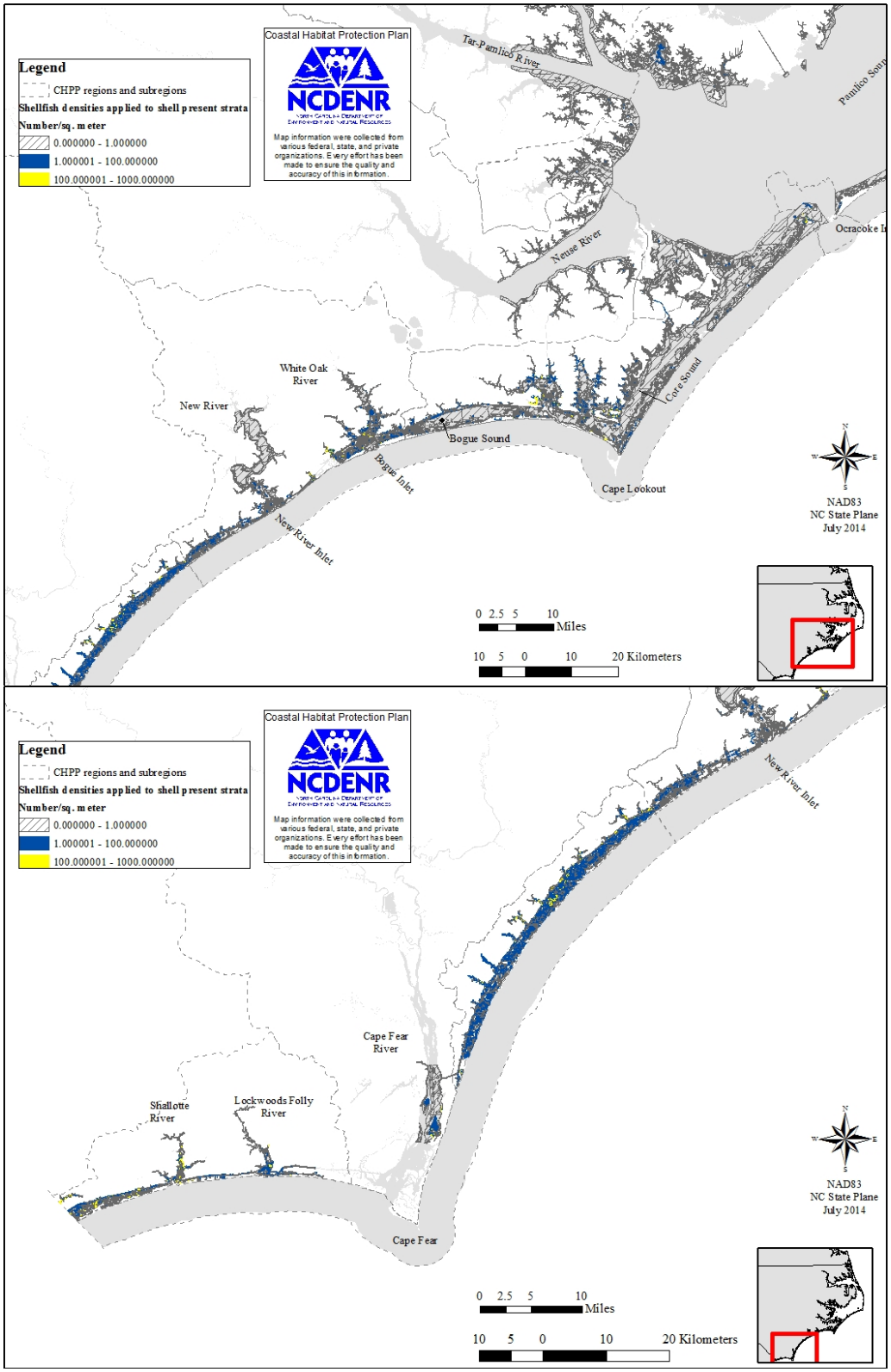


Figure 11.1a. Shellfish density, NCDMF Shellfish Habitat and Abundance Mapping Program, 2014.



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 (3145 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).

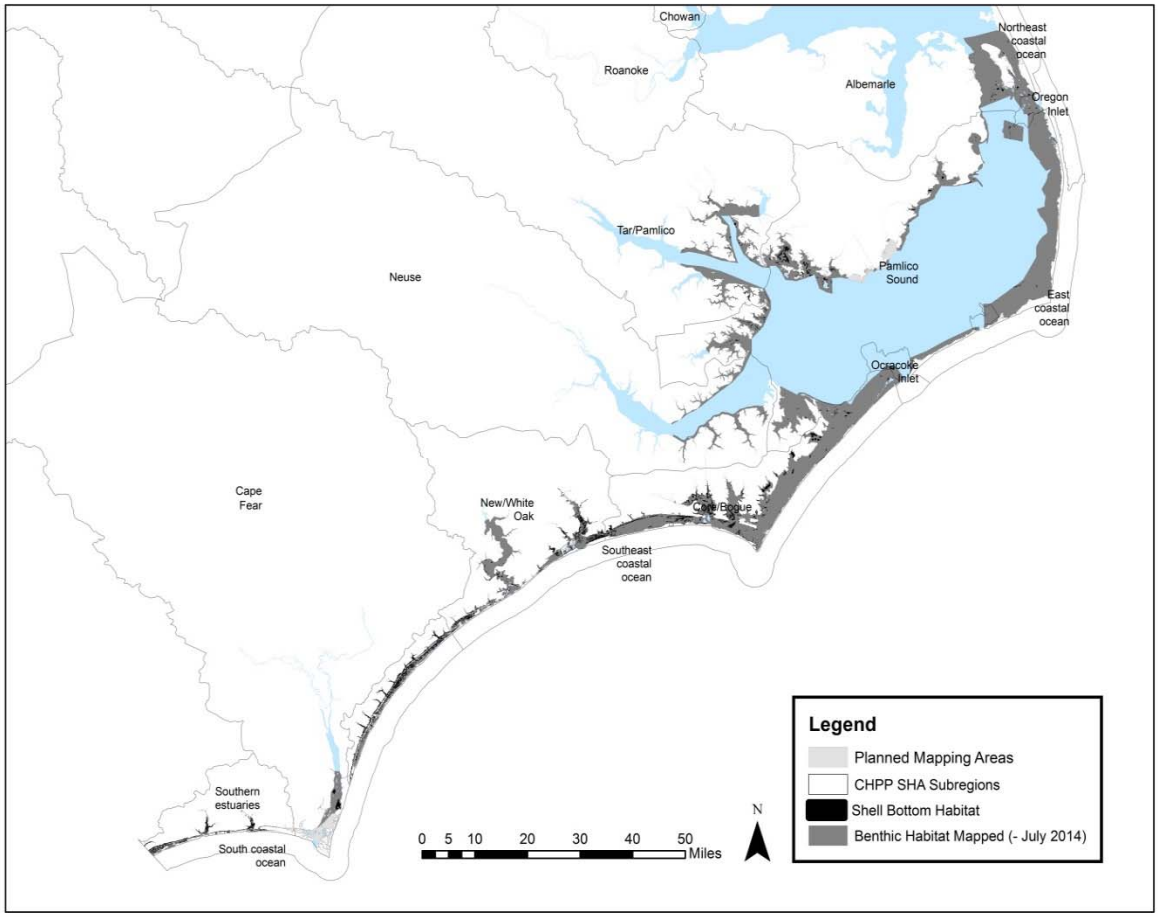


Figure 11.2. Distribution of mapped shell bottom, Habitat and Enhancement Section Bottom Mapping Program, NCDMF, 2014.

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.

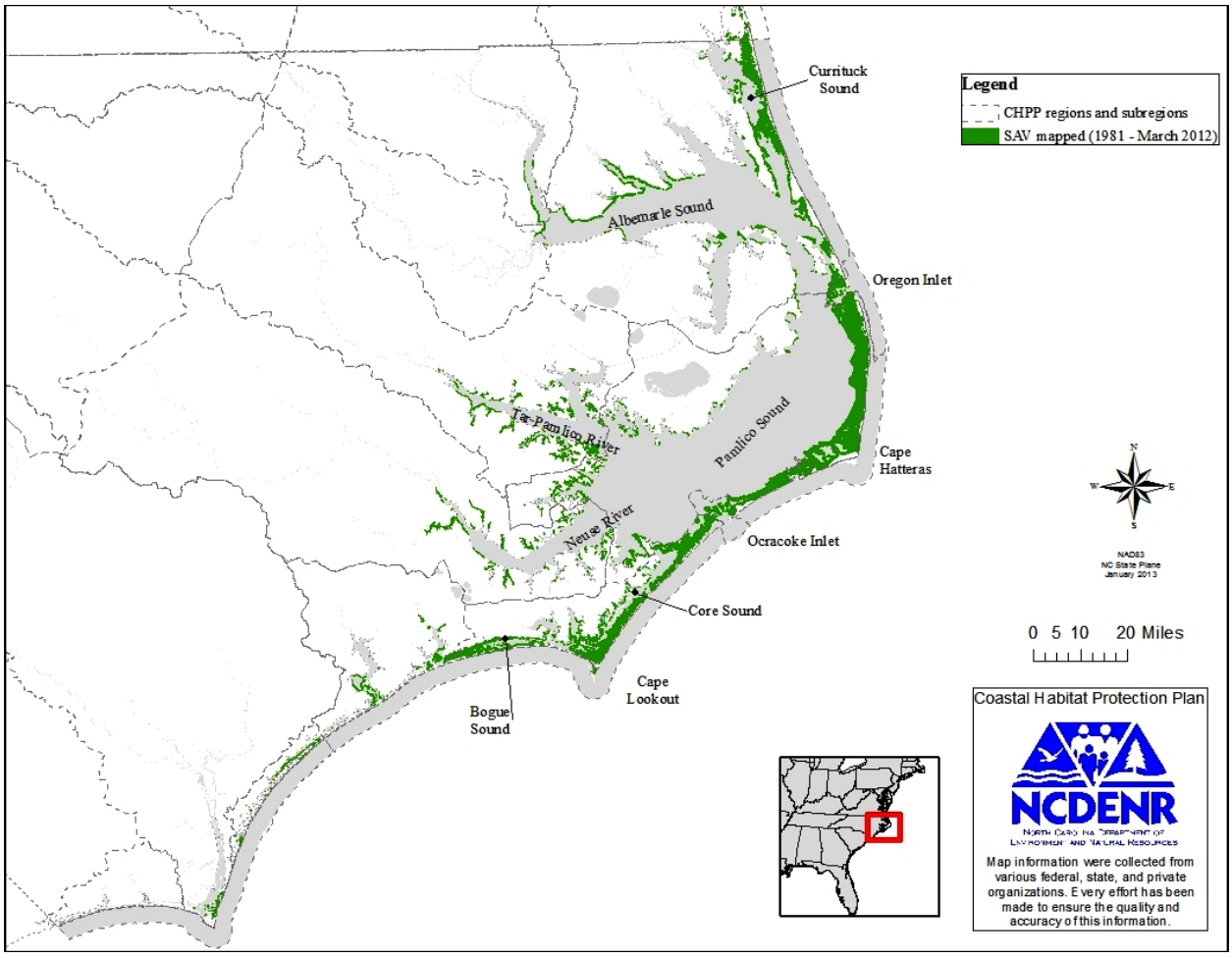


Figure 11.3. Submerged aquatic vegetation mapped from 1981 to 2012. Absence of SAV beds in a given area does not suggest actual absence of SAV as surveys have not been conducted in all areas. Presence of SAV does not reflect current presence of SAV as data shows resource dating to 1981, and beds may 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 Rule15A 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)(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 contaminates, such as hydrocarbons and heavy metals, in high concentrations. Exposure to organic contaminates 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 contaminates 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 DEQ.

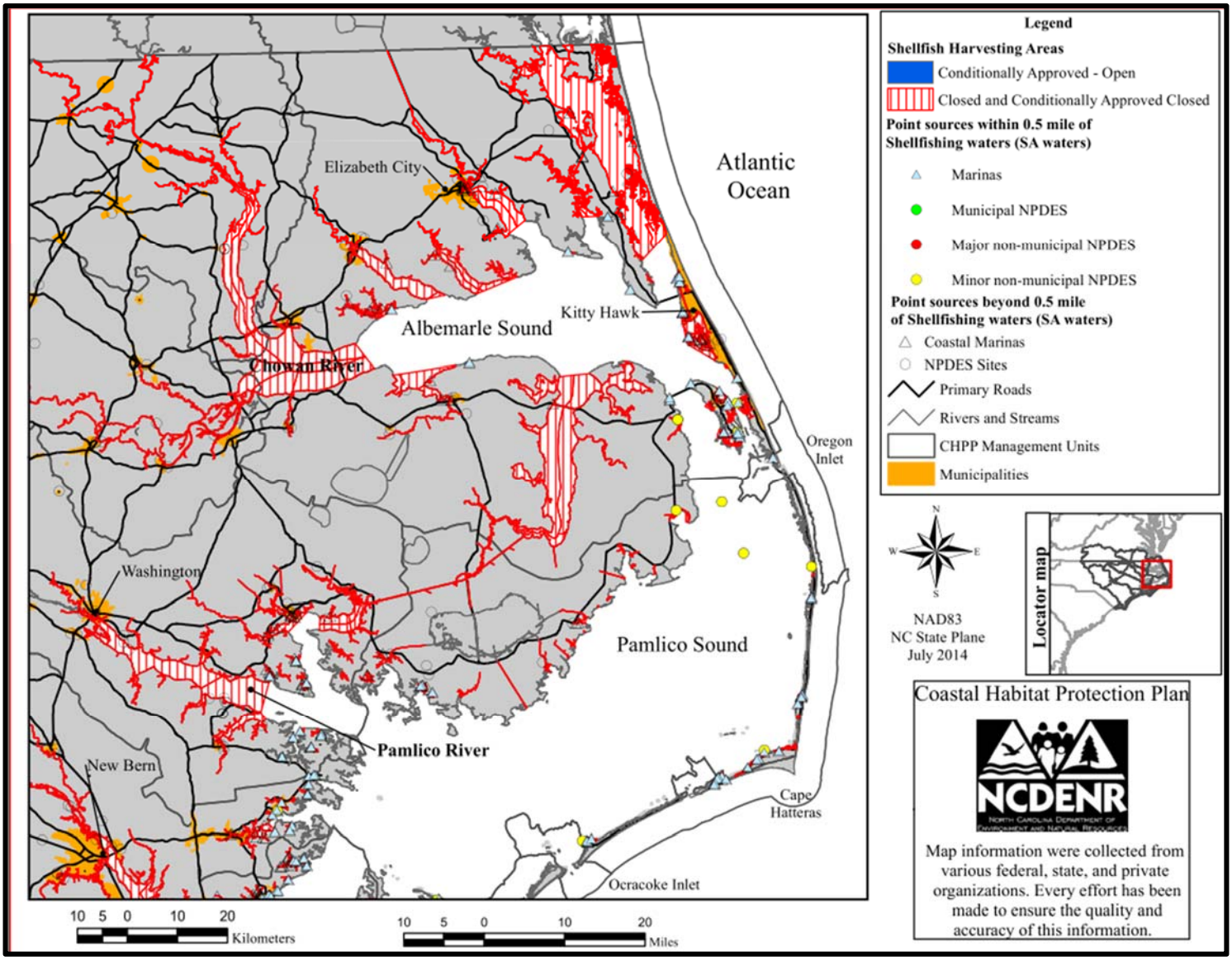


Figure 11.5a. Locations of point source discharges within 0.5 miles of Shellfishing Waters

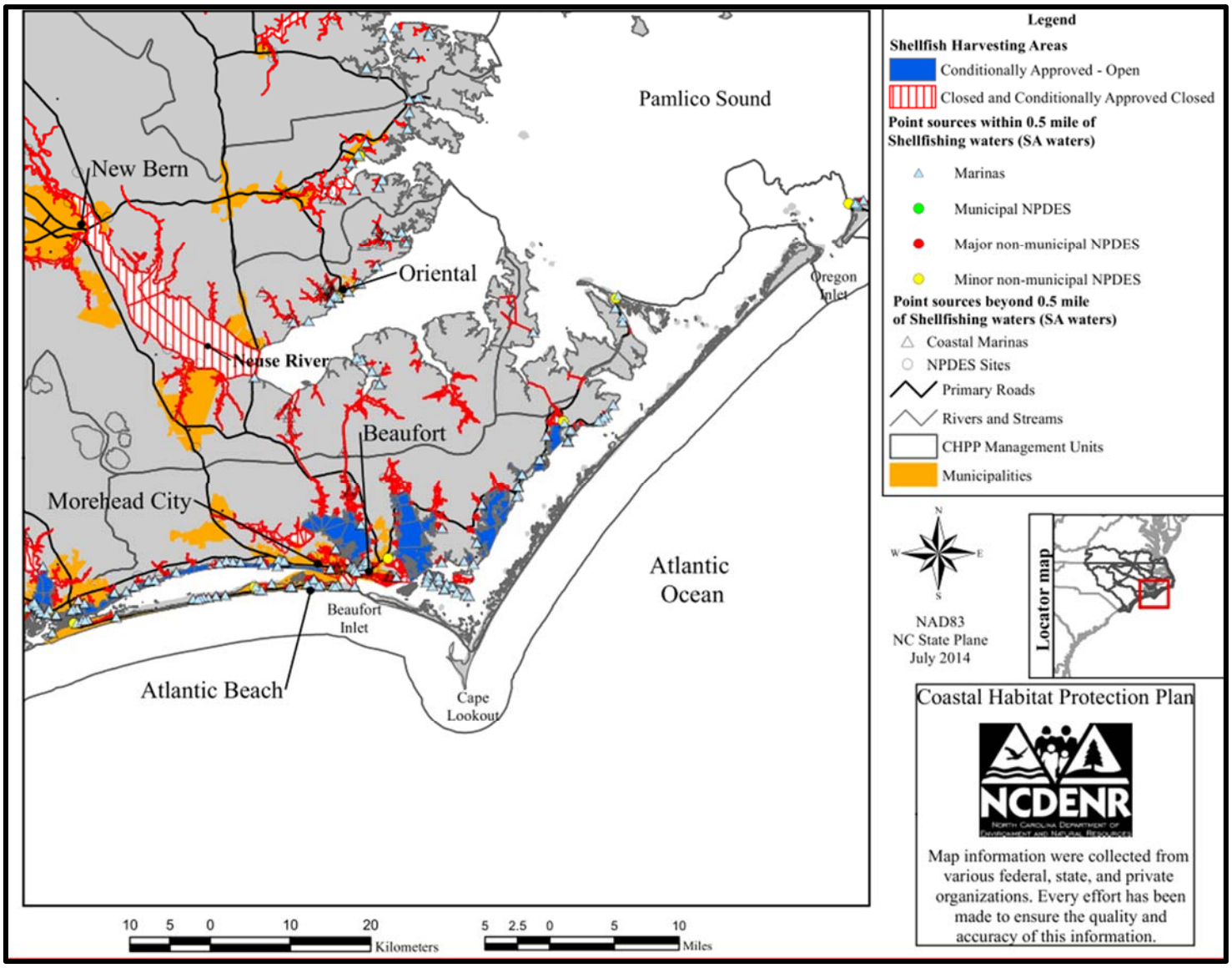


Figure 11.5b. Locations of point source discharges within 0.5 miles of Shellfishing Waters.

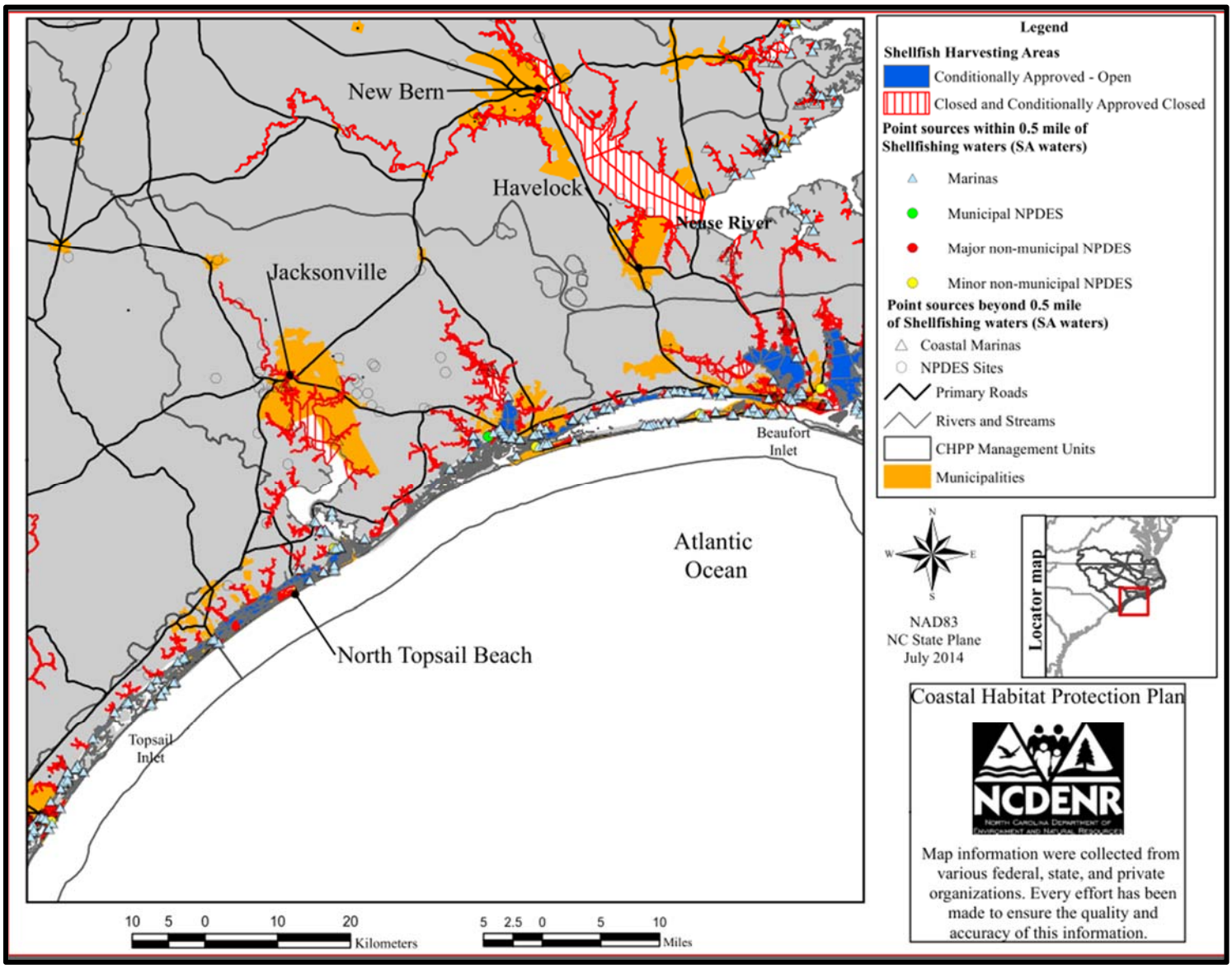


Figure 11.5c. Locations of point source discharges within 0.5 miles of Shellfishing Waters.

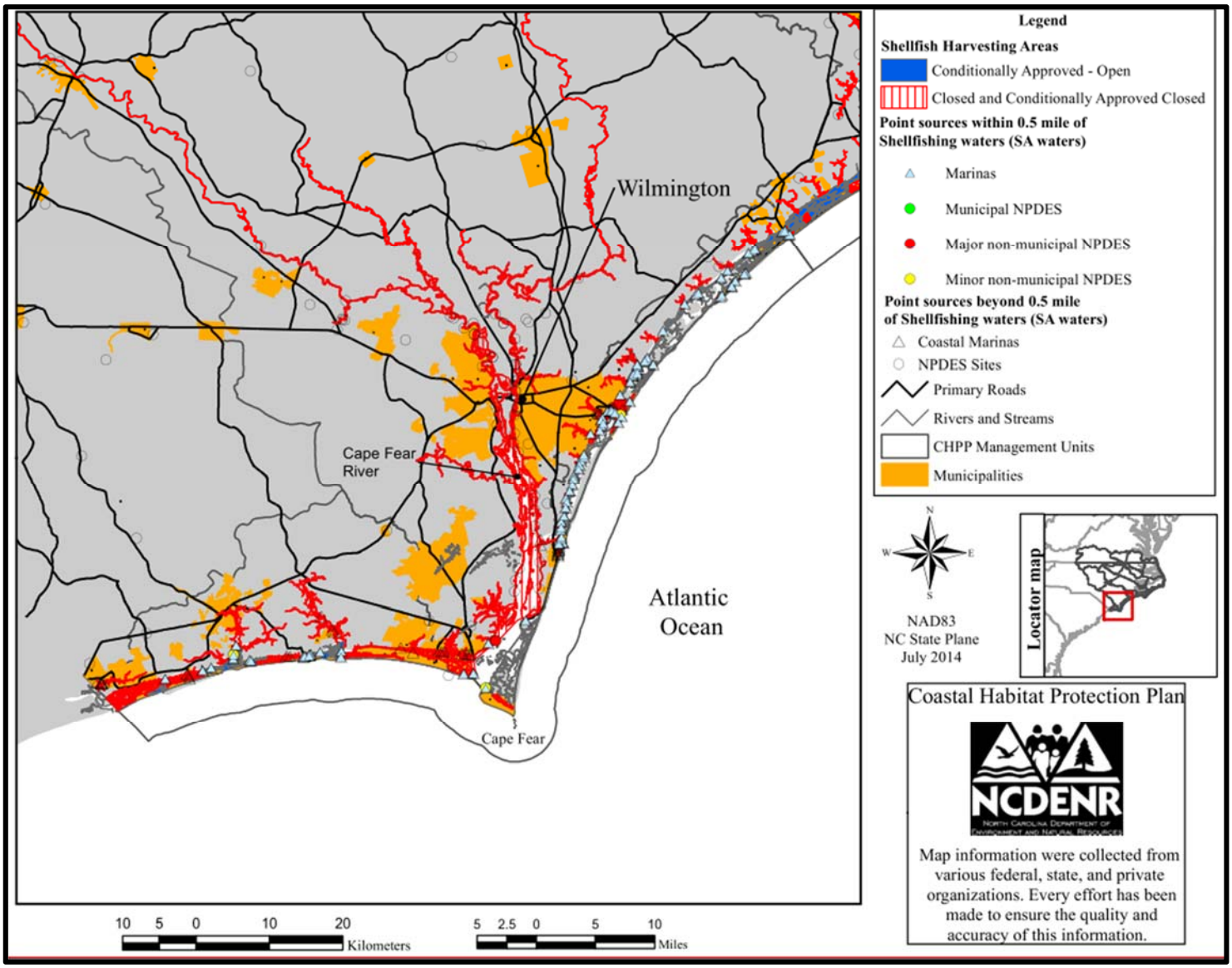


Figure 11.5d. Locations of point source discharges within 0.5 miles of Shellfishing Waters.

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 11.6). 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 11.6 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 hemachromatosis (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 DEQ 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 DEQ 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 DEQ 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 DEQ 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 CLAMS [6]

October 7, 2015

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

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

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). 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, Shallote 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 12.2.1. 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)

NCDMF and Advisory Committee recommendation:

15A NCAC 03K .0105 RECREATIONAL HARVEST OF SHELLFISH

(a) It is unlawful to take oysters or clams from public ~~bottoms~~bottom on ~~Sundays~~Sunday, and scallops from public ~~bottoms~~bottom on ~~Saturdays~~Saturday and ~~Sundays~~Sunday except:

(1) during open ~~seasons, and,~~seasons; and

(2) for recreational purposes.

(b) It is unlawful to possess, for recreational purposes, more than:

(1) 10 conchs or whelks per person per day, not to exceed 20 conchs or whelks per vessel per ~~day, and~~day;

(2) 100 mussels per person per day, not to exceed 200 mussels per vessel per ~~day, and~~day; and

(3) 100 clams per person per day, not to exceed ~~200~~400 clams per vessel per day.

History Note: *Authority G.S. 113-134; 113-169.2; 113-182; 143B-289.52;*
Eff. January 1, 1991;
Amended Eff. March 1, 1994; February 1, 1992; September 1, 1991;
Temporary Amendment Eff. October 9, 1995 for a period of 180 days or until the permanent rule becomes effective, whichever is sooner;
Amended Eff. May 1, 1997; March 1, 1996;
Temporary Amendment Eff. July 1, 1999;
Amended Eff. April 1, 2017; October 1, 2008; August 1, 2000.

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
-

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.

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December 11, 2014
January 30, 2015
February 4, 2015
February 12, 2015
March 5, 2015
October 7, 2015

12.2 MANAGEMENT OF PUBLIC MECHANICAL CLAM HARVEST[7]

October 1, 2015

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 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)). 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

[7] Presented to: PDT on 1/7/15 & 8/13/15; AC on 2/2/15 and 9/14/15; 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; MFC on X/X/15 and X/X/16.

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 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).

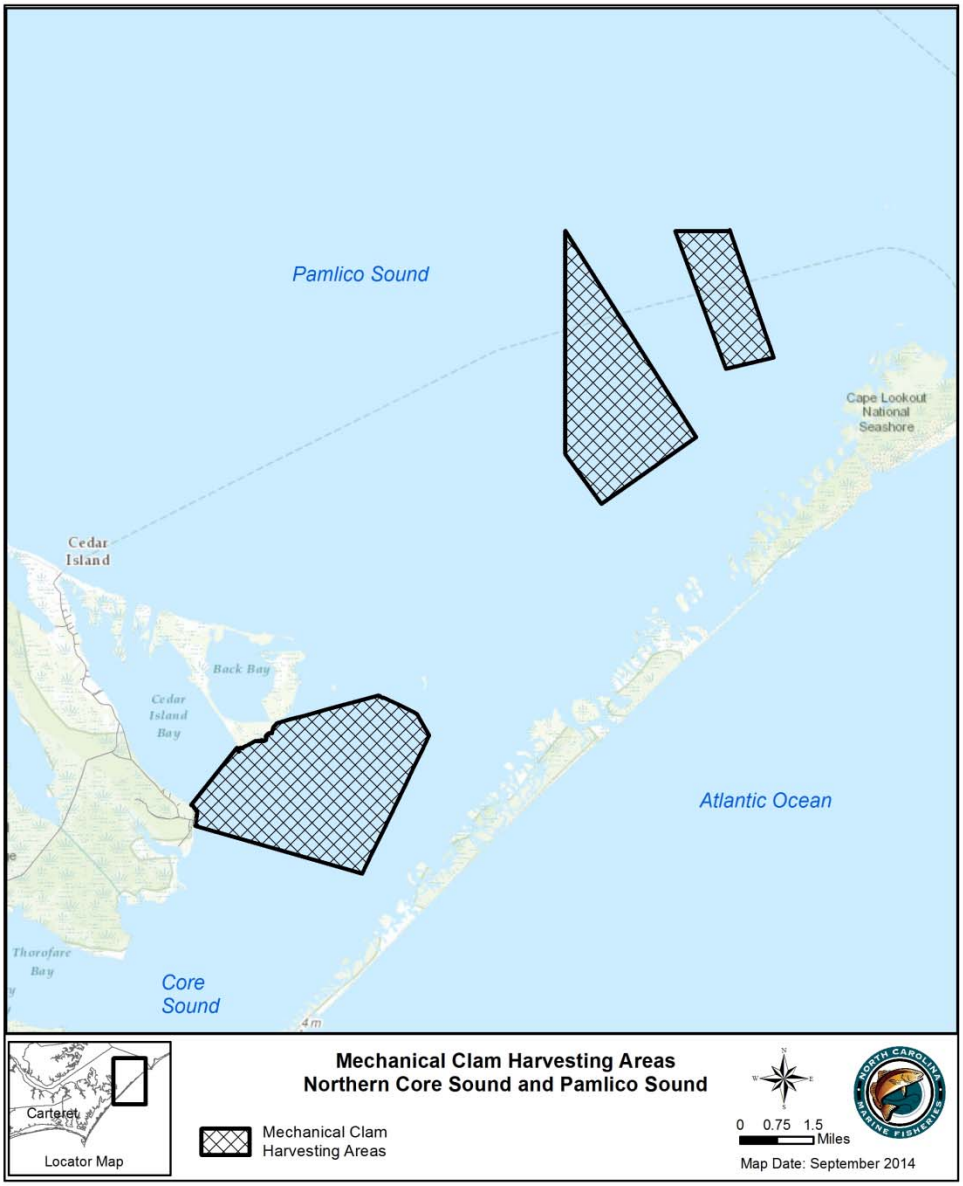

Figure 12.2.1. Public mechanical harvest areas in Northern Core Sound and Pamlico Sound. The Pamlico Sound open area to mechanical clam harvest was discontinued in 2008. NCDMF GIS database.

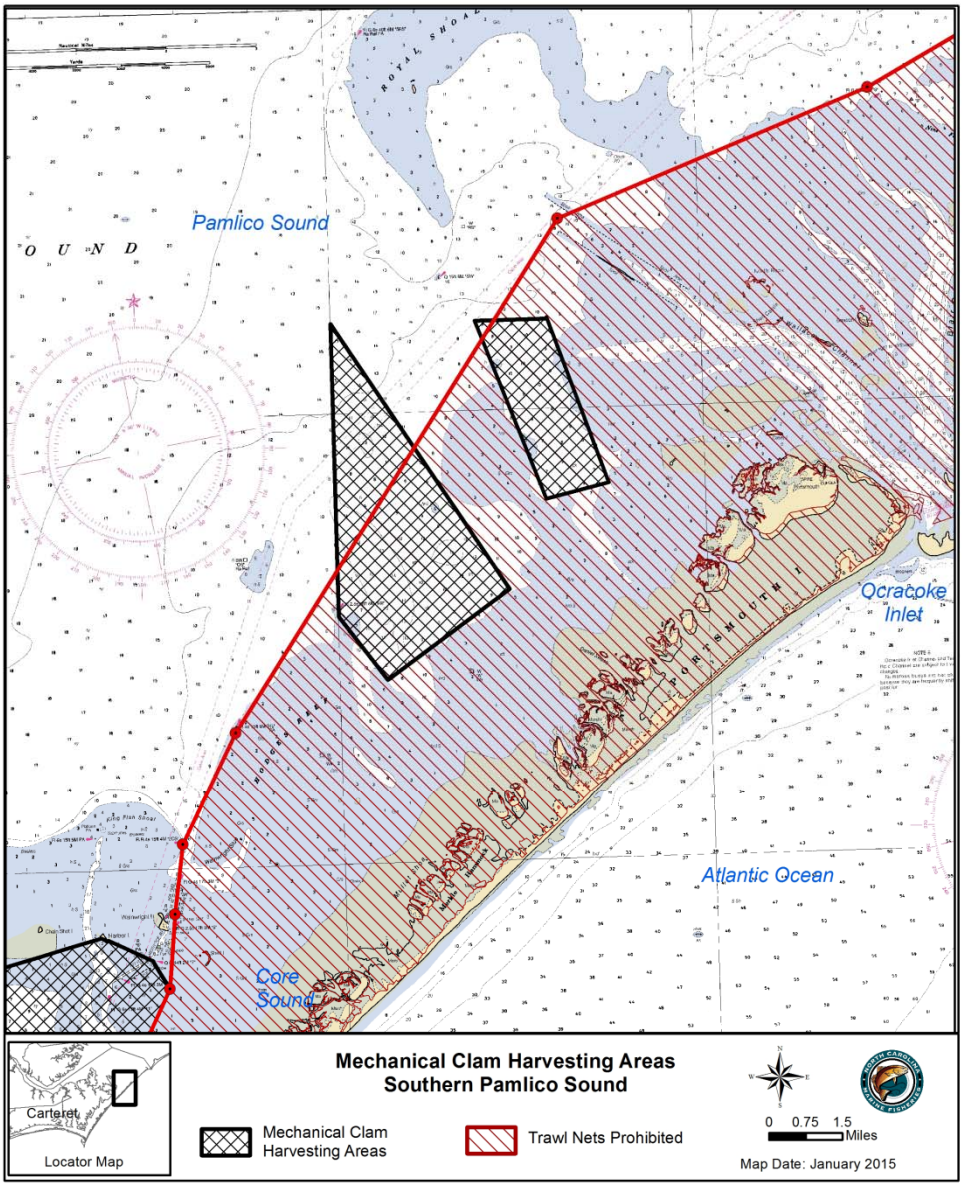

Figure 12.2.2. The no trawl area (15A NCAC 03R .0106) and the public mechanical clam harvest area in Pamlico Sound (15A NCAC 03K .0302 (b)) discontinued in 2008.

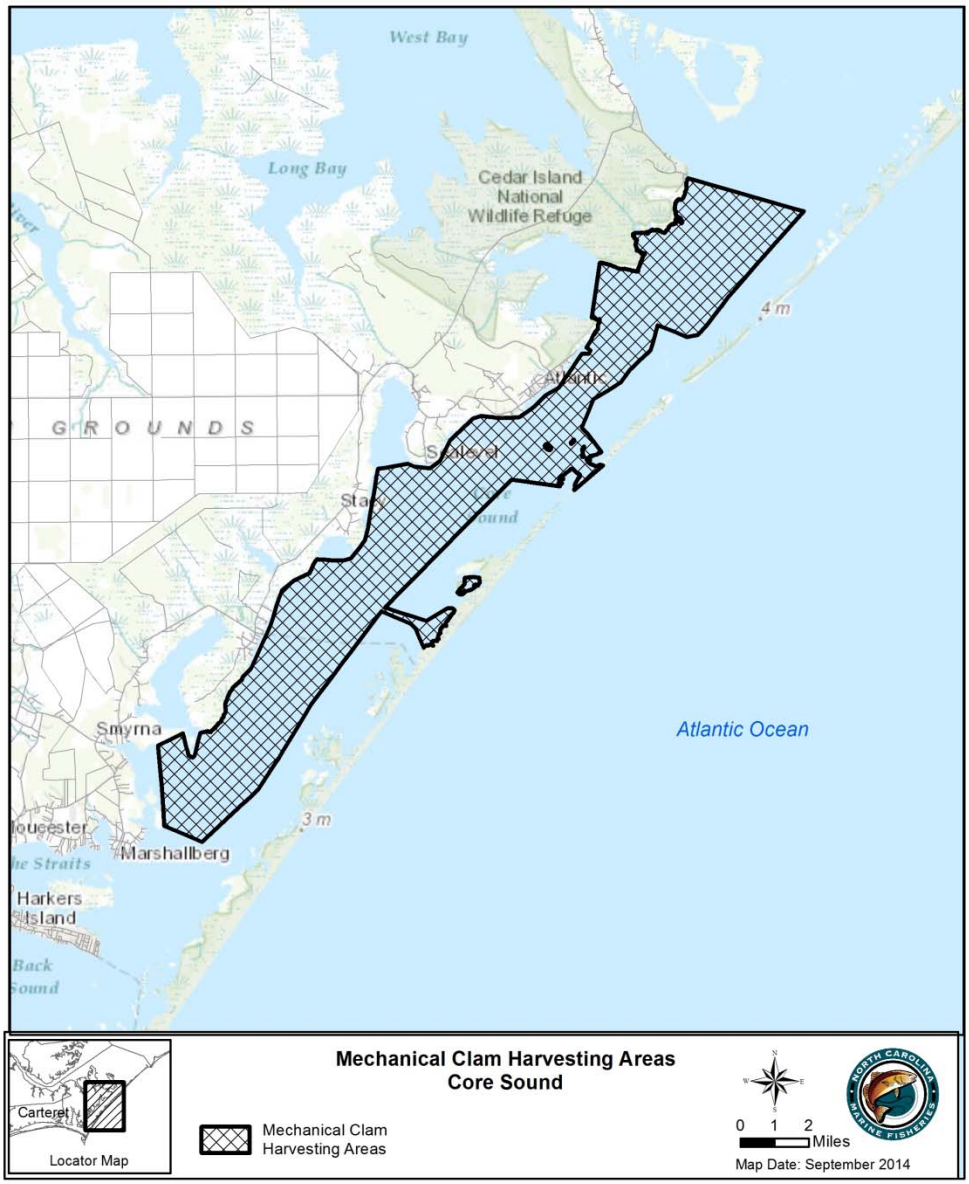

Figure 12.2.3. The current public mechanical harvest area in southern Core Sound. Opened every year. NCDMF GIS database.

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 theses 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)

NCDMF and Advisory Committee recommendation:

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. April 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-yard 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 have 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 Preferred Management Strategy
-

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

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12.3 THE USE OF POWER HAULING EQUIPMENT FOR THE HAND HARVEST OF HARD CLAMS[8]

September 22, 2015

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.

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 an 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

[8] Presented to: PDT on 1/7/15 & 8/13/15; AC on 2/2/15 and 9/14/15; MRT on 9/21/15; MFC on X/X/15 and X/X/X.

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 5 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 Statues 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 Preferred Management Strategy

-

NCDMF and Advisory Committe

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

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DRAFT

All parts of this document are subject to change until final adoption.

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Dates revised: January 12, 2015
January 14, 2015
April 14, 2015
September 22, 2015

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 in 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 LICENSE[9]

September 22, 2015

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; AC on 7/13/15 & 9/14/15; MRT on 9/21/15; MFC on x/x/15 & x/x/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.

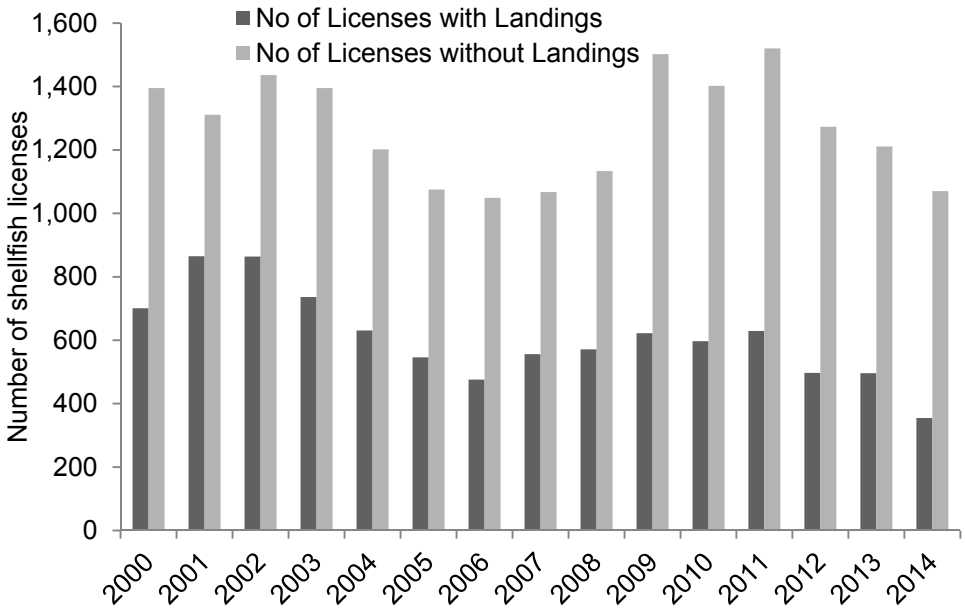

Figure 12.4.1. Comparison of shellfish licenses holders statewide with and without Trip Ticket landings, 2000-2014.

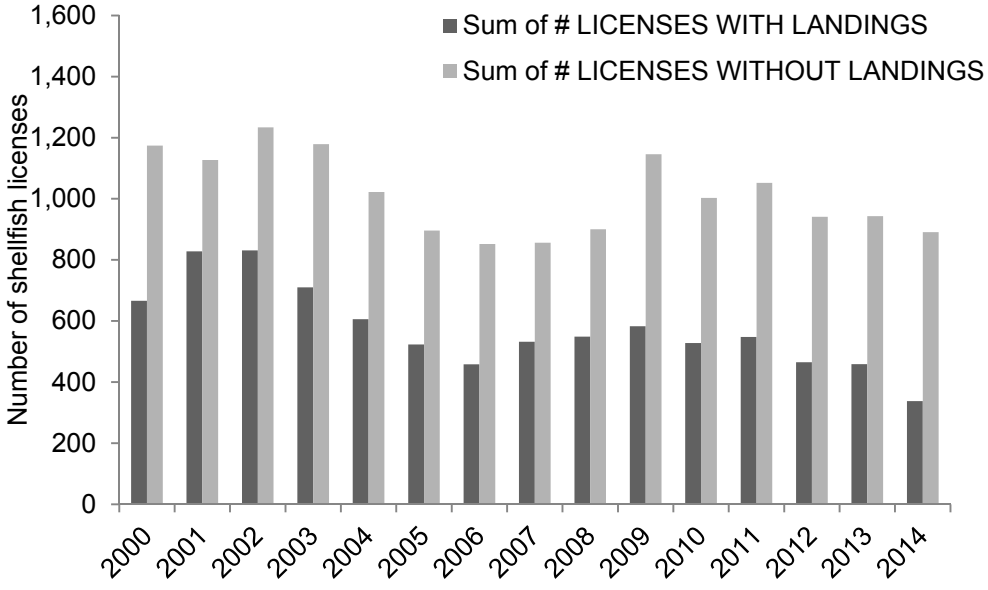

Figure12.4. 2. Comparison of shellfish licenses holders from southern counties* with and without Trip Ticket Landings, 2000-2014 *Carteret, Jones, Onslow, Duplin, Pender, Brunswick, Bladen, Columbus, Robeson, Cumberland, Sampson, New Hanover.

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.

	NORTHERN						SOUTHERN					
	SCFL		RSCFL		Shellfish w/o SCFL		SCFL		RSCFL		Shellfish w/o SCFL	
YEAR	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.

	NORTHERN						SOUTHERN					
	SCFL		RSCFL		Shellfish w/o SCFL		SCFL		RSCFL		Shellfish w/o SCFL	
YEAR	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

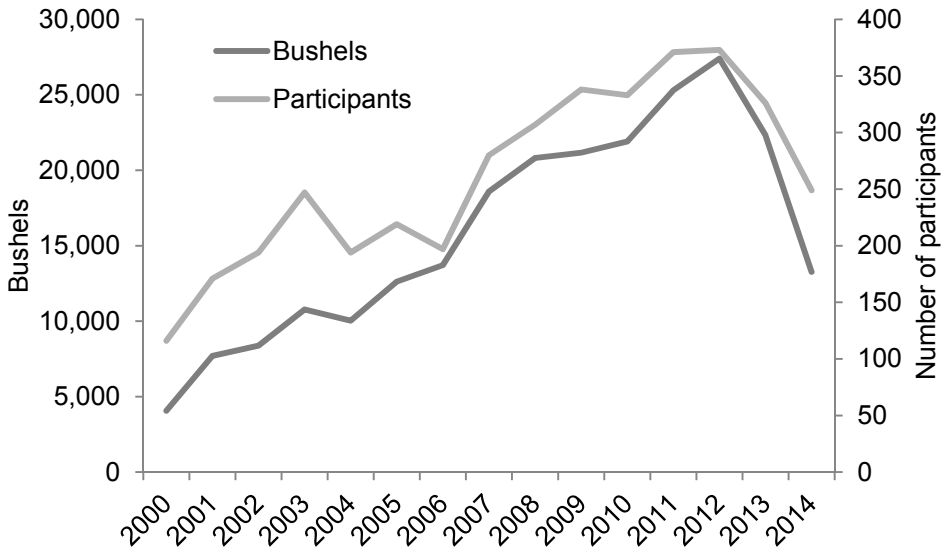

Figure 12.4.3. Number of participants and oyster bushels harvested by shellfish license holders from southern coastal counties, 2000-2014.

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 quality for a SCFL/RCFL. 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	*Oyster Resource Use fees:* $50: hand harvest only $50: aquaculture operation $300: one or more gear types *Clam harvest licenses:* $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 Preferred Management Strategy

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NCDMF

- 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)**

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 **(requires statutory change)**

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12.5 PROTECTION OF SHELLFISH LEASE AND FRANCHISE RIGHTS[10]

October 1, 2015

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; AC on 12/8/14, 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; MFC on X/X/15 and X/X/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

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 Schedule Exceptions *	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

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 ~~1~~ 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 ~~1~~ 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.

	PRIOR CONVICTION LEVELS		
MISDEMEANOR OFFENSE CLASS	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 03O .0114

15A NCAC 03O .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. April 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 Preferred Management Strategy
-

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
- 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.

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12.6 UTILIZING GPS COORDINATES INSTEAD OF A SURVEY TO DEFINE SHELLFISH LEASE BOUNDARIES[11]

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 DEQ Secretary the lease applicant shall submit to the DEQ Secretary information that conforms to the standards set by the DEQ 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.

[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.

12.7 DEFINING ADVERSE IMPACTS TO SUBMERGED AQUATIC VEGETATION FROM SHELLFISH LEASES AND FRANCHISES[12]

September 22, 2015

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 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.

[12] Presented to: PDT on 11/6/14 & 8/13/15; AC on 1/5/15, 2/5/15, and 9/14/15; MRT on 9/21/15; MFC on X/X/15 and X/X/16.

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 (Pregnall 1993; Everett et al. 1995; Wisehart 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, Wisehart 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 NWPs 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-construtction 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 aras 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. DEQ/NCDMF 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
   - DEQ/NCDMF fall out of compliance with regional conditions of NWP48
   - DEQ/NCDMF loses the ability to issue shellfish leases through USACE authority

VIII. RECOMMENDATION

MFC Preferred Management Strategy

-

NCDMF and Advisory Committee

- 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).

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50 CFR 600.810 Definitions and word usage.

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September 22, 2015

12.8 BRUNSWICK COUNTY SHELLFISH LEASE MORATORIUM[13]

September 22, 2015

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 between1940 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

[13] Presented to: PDT on 12/11/14 & 8/13/15; AC on 1/5/15 & 9/14/15; MRT on 9/21/15; MFC on X/X/15 and X/X/16.

> 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

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 Preferred Management Strategy
-

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.

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12.9 CORE SOUND SHELLFISH LEASE MORATORIUM[14]

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 DEQ 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 CULTURE[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 PROVISIONS[16]

October 8, 2015

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

[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.

[16] Presented to: PDT on 7/16/15, 8/13/15, & 8/25/15; AC on 8/10/15 and 9/14/15; Rules Subcommittee on 8/31/15; RAT on 9/3/15 and 9/15/15; MRT on 9/21/15; MFC on x/x/15 & X/X/16.

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.

   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 the 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
• Change to 5 year contract. • 5 year prod. avg.	Supported by 4 regional and Shellfish committee Implemented 2008/09
• 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
• Limit acreage to 5 acres/lease	Supported by 4 regional and the Shellfish committee Implemented 2008/09 – 10 acres allowed in mechanical harvest areas
• Require current lease meet production prior to granting more leases	Supported by 4 regional and the Shellfish committee Shellfish committee Implemented 2008/09
• Develop regional lease acreage caps	Various support from regional committees and Shellfish committee. Not Implemented
• 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 5 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 the 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 where 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 Statues 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 a 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

NCDMF recommendations:

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 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 acres for all areas except those areas open to the mechanical harvest of oysters where the proposed lease area shall not exceed 10 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 (c)~~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.

~~(c) 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. April 1, 2017; October 1, 2008; April 1, 2003.

Advisory Committee recommendations:
[Note: only difference from the NCDMF version is found in Paragraph (a)(3)]

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 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.~~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 (c)~~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. April 1, 2017; October 1, 2008; April 1, 2003.

NCDMF and Advisory Committee recommendations:

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(l1) 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. April 1, 2017; April 1, 2003.

VII. PROPOSED MANAGEMENT OPTIONS

Production Options

1. Status quo (Maintain current lease terms of 5 years with 5 year production average)
   + Unproductive leases to be terminated, not holding public trust waters for long time period
   + Few applicants request more than 5 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 7 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)**
   + 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. 7 year lease becomes a 9 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 exist
   - 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 Preferred Management Strategy
-

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)**

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)**
- 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)**
- Improve public notice of proposed lease applications on the physical lease, at fish houses, and/or through electronic notices.

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March 19, 2015
March 20, 2015
July 17, 2015
August 20, 2015
September 24, 2015
October 8, 2015

12.12 REQUIREMENTS FOR SHADING MOLLUSCAN SHELLSTOCK[17]

September 22, 2015

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.

[17] Presented to: PDT on 12/11/14 & 8/13/15; AC on 1/5/15, 3/9/15, and 9/14/15; MRT on 9/21/15; MFC on X/X/15 and X/X/16.

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, 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 5 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.*

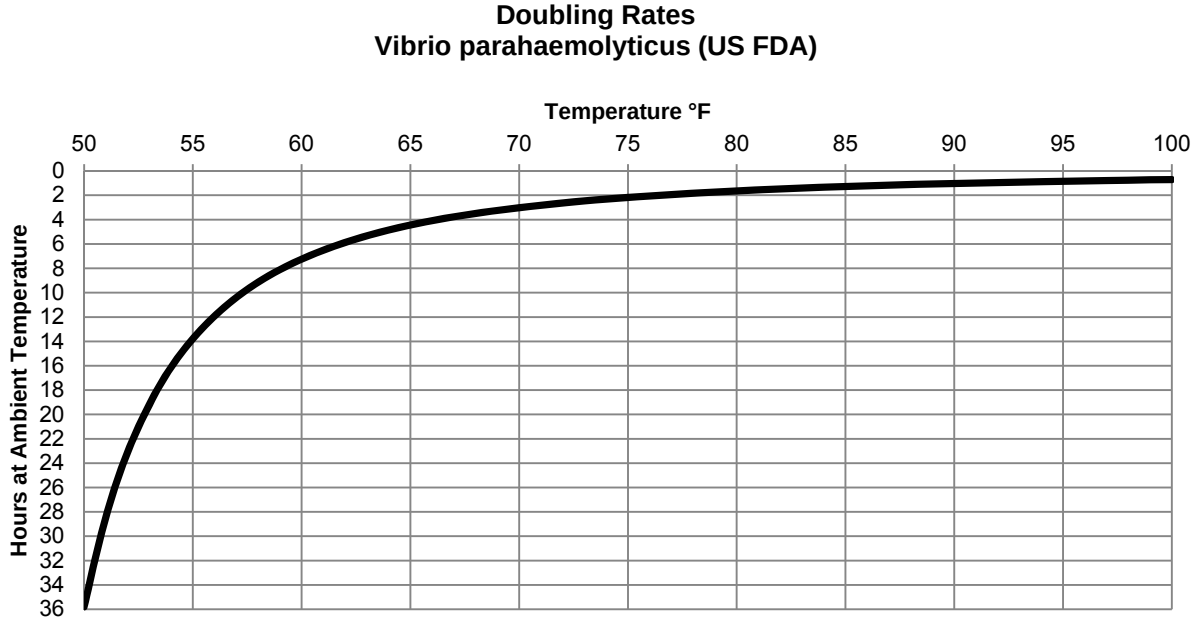

Figure 12.12.1. *Vibrio parahaemolyticus* doubling rates. Interstate Shellfish Sanitation Conference Vibrio Control Plan Guidance Template, 2008.

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 SouthCarolina.

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 Preferred Management Strategy

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NCDMF and Advisory Committ

- 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

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October 22, 2014

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December 12, 2014
February 13, 2015
April 20, 2015
August 18, 2015
September 22, 2015

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 PREFERRED MANAGEMENT STRATEGIES AND RESEARCH RECOMMENDATIONS

13.1 PREFERRED 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 clams 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 Preferred Management Strategy

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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)**

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-yard 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 Preferred Management Strategy

-

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

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 Preferred Management Strategy

-

NCDMF and Advisory Committee

- 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 Preferred Management Strategy

-

NCDMF

- 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)**

Advisory Committee

- 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 **(requires statutory change)**

13.1.3 PRIVATE CULTURE

The current shellfish lease program in North Carolina needs to be evaluated and changes implemented in order 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, and 4)]

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 changes required)**

MANAGEMENT RECOMMENDATIONS

MFC Preferred Management Strategy
-

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)**

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. DEQ/NCDMF issue shellfish leases in areas containing SAV

MANAGEMENT RECOMMENDATION

MFC Preferred Management Strategy

-

NCDMF and Advisory Committee

- 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).

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
3. Allow shellfish leases in Brunswick County, limiting acreage and availability

MANAGEMENT RECOMMENDATIONS

MFC Preferred Management Strategy

-

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 5 year production average)
2. Establish a 7 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 Preferred Management Strategy

-

NCDMF and Advisory Committee

- 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)**

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 ten acres in both mechanical methods prohibited areas and mechanical methods allowed areas **(requires statutory change)**
- 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)**.
- Improve public notice of proposed lease applications on the physical lease, at fish houses, and/or through electronic notices

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 Preferred Management Strategy

-

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 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

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50 CFR 600.810 Definitions and word usage.

15.0 APPENDICES

Appendices will begin on the next page.

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

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

Presented to MFC: Date:_____

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

Presented to MFC: Date:_____

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

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.

DRAFT

Highlighted portions still under construction or include new information to the Advisory Committee. All parts of this document are subject to change until final adoption.

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.

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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 Statue 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

12.6 UTILIZING GPS COORDINATES INSTEAD OF A SURVEY TO DEFINE SHELLFISH LEASE BOUNDARIES[18]

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).

[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.

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 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 DEQ/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 NCSPO 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, NCSPO 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 NCSPO. The NCSPO 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 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

12.9 CORE SOUND SHELLFISH LEASE MORATORIUM[19]

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.

[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.

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 12.9.1).

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).

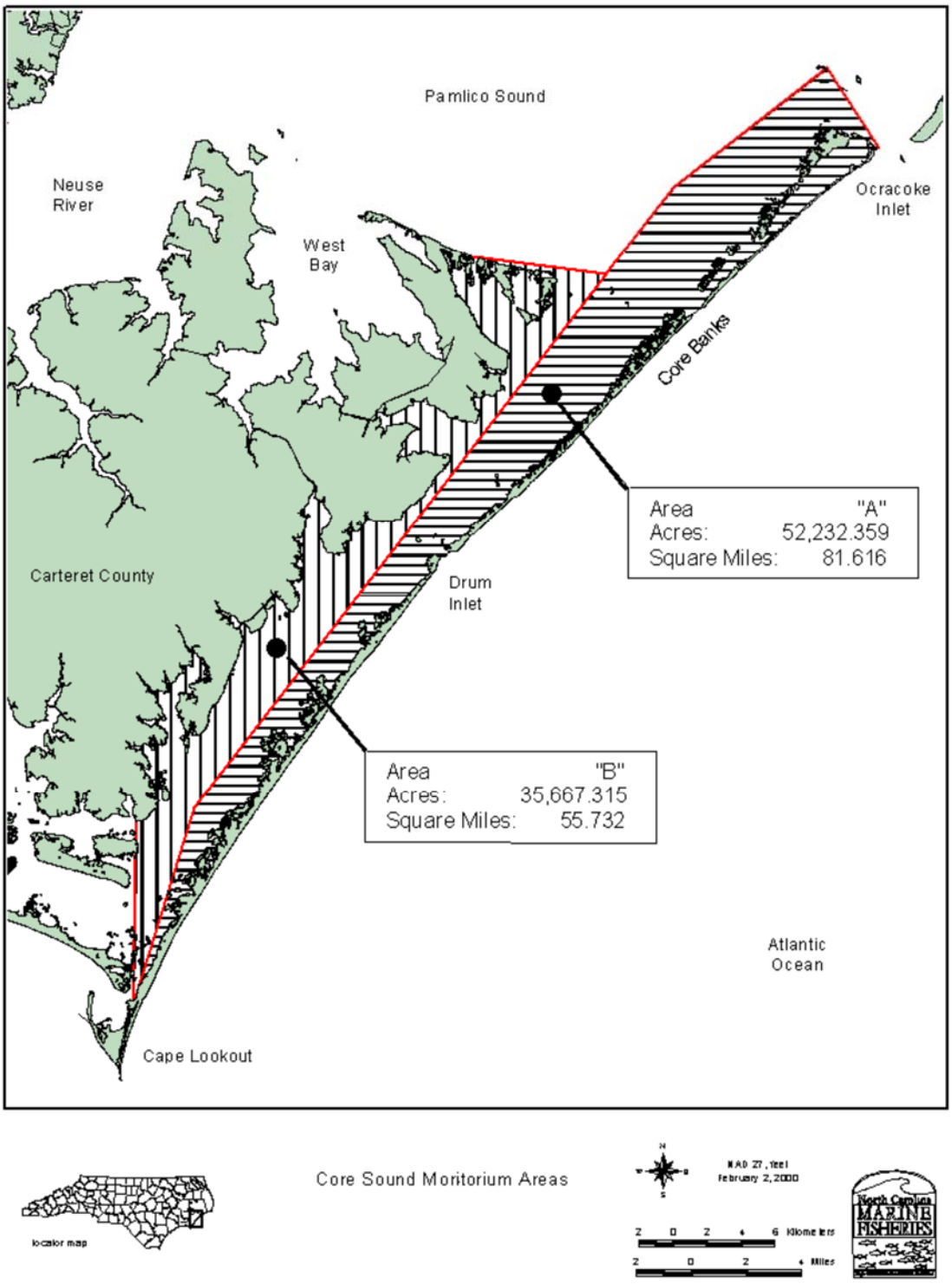

Figure 12.9.1. Core Sound shellfish lease indefinite moratorium Area A and restricted lease Area B.

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 12.9.1) (Orbach 2001).

Table 12.9.1. Results from analysis of alternatives for user coordination in Core Sound focusing on shellfish leasing (Orbach 2001).

Alternative	Alt. #1 (West side open)	Alt. #2 (West side closed)	Alt. #3 (1-3% Cap)
Criterion			
Productivity	High	Low	High
Benefits	Medium	Low	High
Equity	Medium	Low	Medium
Tradition	Medium	Medium	High
Flexibility	Medium	Medium	Medium
Overall rating	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 grand-fathering 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 12.9.2).

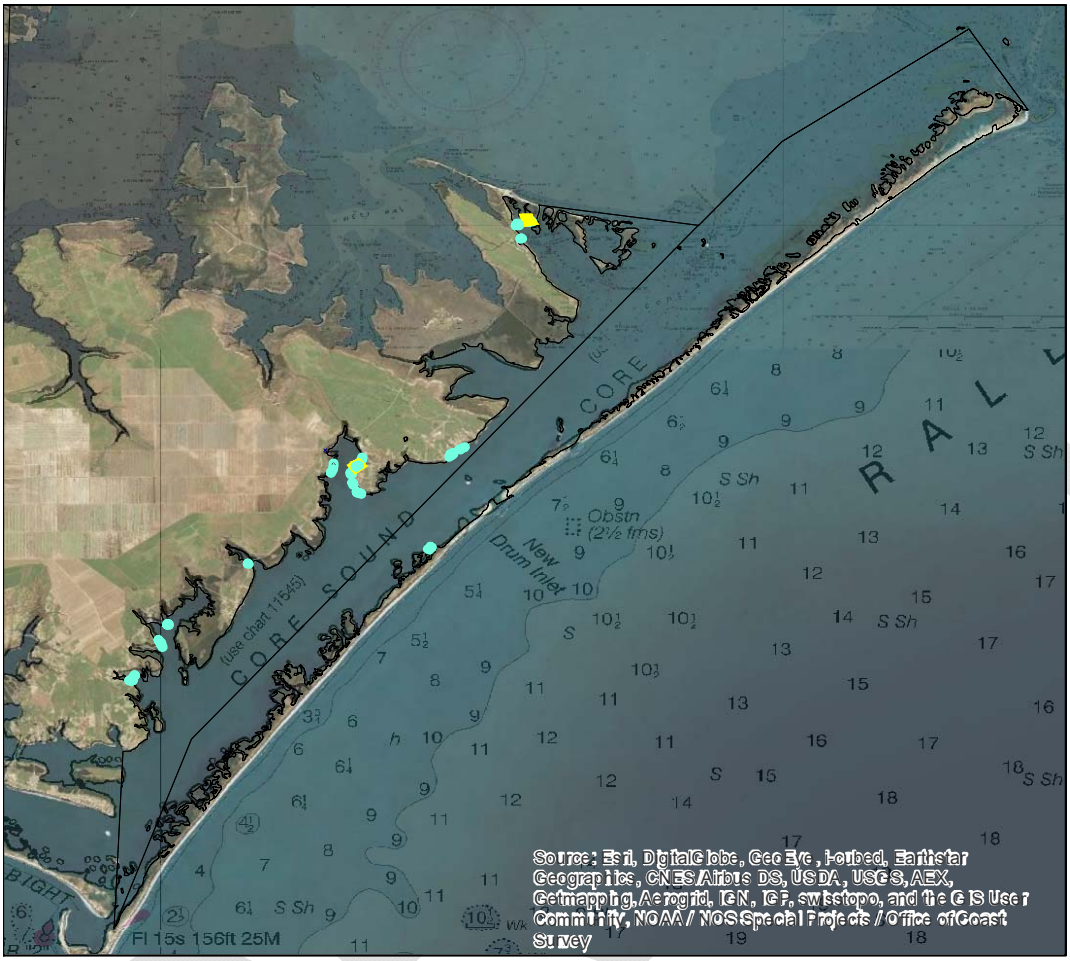

Figure 12.9.2. Location of shellfish leases and water columns within the Core Sound Moratorium area as of February 3, 2015.

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 12.9.2 and 12.9.4. 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 12.9.2. 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 12.9.3. 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 12.9.4. Landings, trips and participants for the hard clam and oyster fisheries in Core Sound from 1994 to 2013.

	Hard clams			Oysters		
Year	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 Preferred 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.

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12.10 REDEFINING OFF BOTTOM CULTURE[20]

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.

[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.

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 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 are 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 3O .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
   + 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 Preferred 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

Prepared by: Brian Conrad (for further information contact Steve Murphey);
steve.murphey@ncdenr.gov (252) 808-8046
April 30, 2015

Dates revised: May 6, 2015
May 13, 2015
May 29, 2015
August 19, 2015
August 25, 2015
September 22, 2015

15.5 OVERVIEW OF THE MFC REGIONAL AND STANDING ADVISORY COMMITTEES' RECOMMENDATIONS AND PUBLIC COMMENT ON DRAFT AMENDMENT 2 OF THE HARD CLAM FMP

To be added once completed.

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15.6 RULES NECESSARY TO IMPLEMENT HARD CLAM FMP AMENDMENT 2 RECOMMENDATIONS

To be added after the MFC selects their preferred management strategy.

15.7 SUGGESTED STATUTE CHANGES NECESSARY TO IMPLEMENT HARD CLAM FMP AMENDMENT 2 RECOMMENDATIONS

To be added after the MFC selects their preferred management strategy.

Environmental Quality

PAT MCCRORY
Governor

DONALD R. VAN DER VAART
Secretary

MEMORANDUM

TO: N.C. Marine Fisheries Commission

FROM: Michelle Duval and Katy West
Division of Marine Fisheries, NCDEQ

DATE: Nov. 19, 2015

SUBJECT: Interjurisdictional Fisheries Management Plan Information Update

A draft Information Update to the Interjurisdictional Fisheries Management Plan is being provided for your review and consideration as the final document in this review cycle. This is the document that the commission voted to take out for public comment at its last meeting on Aug. 20, 2015. This draft of the Information Update was made available on the division's website (http://portal.ncdenr.org/web/mf/fmps-under-development) for public comment on Aug. 27, 2015 with a comment period lasting through Sept. 28, 2015. Since this document is an Information Update, the public was asked to comment on the thoroughness of the content, but not on any management issues as no changes to the management strategies or measures were proposed. No comments on the document were received during the 30-day comment period.

Because there were no comments from the public, this document was only edited for format, and has been updated. If the Marine Fisheries Commission votes to accept this document as the final 2015 Interjurisdictional Fisheries Management Plan Information Update, the current management strategy of adopting federal and interstate fishery management plans by reference, consistent with N.C. law, to meet the statutory mandate of development of plans for all commercially and recreationally important species will be maintained and the division would be on schedule to review this plan again in 2020.

/md
Enclosure

Environmental Quality

PAT MCCRORY
Governor

DONALD R. VAN DER VAART
Secretary

MEMORANDUM

TO: N.C. Marine Fisheries Commission

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

DATE: Nov. 19, 2015

SUBJECT: Kingfish Fishery Management Plan Information Update

A draft Information Update to the Kingfish Fishery Management Plan is being provided for your review and consideration as the final document in this review cycle. This is the document that the commission voted to take out for public comment at your last meeting on Aug. 20, 2015. This draft of the Information Update was made available on the division's website (http://portal.ncdenr.org/web/mf/fmps-under-development) for public comment on Aug. 27, 2015 with a comment period lasting through Sept. 28, 2015. Since this document is an Information Update, the public was asked to comment on the thoroughness of the content, but not on any management issues as no changes to the management strategies or measures were proposed. No comments on the document were received during the 30-day comment period.

Because there were no comments from the public, this document was only edited for format, and has been updated. If the Marine Fisheries Commission votes to accept this document as the final 2015 Kingfish Fishery Management Plan Information Update the current kingfish management strategy for determining stock sustainability through the use of trend analysis and management triggers will be maintained and the division would be on schedule to review this plan again in 2020.

/be
Enclosure

N.C. Marine Fisheries Commission
2015-2016 Annual Rulemaking Cycle

November 2015

Time of Year	Action
January 2015	Last opportunity for a new issue to be presented to DMF Rules Advisory Team
February 2015	Second review by DMF Rules Advisory Team
February-April 2015	Fiscal analysis of rules prepared by DMF staff and approved by Office of State Budget and Management
May 2015	MFC considers approval of Notice of Text for Rulemaking
August 2015	Publication of proposed rules in the North Carolina Register
September 2015	Public hearing held *
November 2015	MFC considers approval of permanent rules
January 2016	Rules reviewed by Office of Administrative Hearings Rules Review Commission
(January)	(Last opportunity for a new issue to be presented to DMF Rules Advisory Team)
(February)	(Second review by DMF Rules Advisory Team)
February 1, 2016	Earliest possible effective date of rules
February/March 2016	Rulebook supplement prepared
April 1, 2016	Actual effective date of new rules
April 1, 2016	Rulebook supplement available online and for distribution
April 15, 2016	Commercial license sales begin

* Marine Fisheries Commission Public Hearing for Proposed Rules
Wed., Sept. 9, 2015, 6 p.m.
Division of Marine Fisheries
5285 Highway 70 West
Morehead City, NC 28557

N.C. Department of Environment and Natural Resources

Release: Immediate
Date: Aug. 3, 2015

Contact: Patricia Smith
Phone: 252-726-7021

Public comments sought on proposed rules for gill nets, mechanical oyster harvest

MOREHEAD CITY – The N.C. Marine Fisheries Commission is accepting public comments on proposed rule changes pertaining to gill nets and mechanical oyster harvesting.

The commission will hold a public hearing on the proposed rule changes at 6 p.m. Sept. 9 at the N.C. Division of Marine Fisheries Central District Office, 5285 U.S. 70 West, Morehead City.

The public may also comment on the proposed rules in writing to Catherine Blum, Rulemaking Coordinator, N.C. Division of Marine Fisheries, P.O. Box 769, Morehead City, N.C. 28557 or send comments by email to Catherine.Blum@ncdenr.gov or fax to 252-726-0254. The public comment period will close at 5 p.m. Oct. 2.

Gill Nets

Two proposed rule changes impacting gill nets would implement Amendment 1 to the N.C. Striped Mullet Fishery Management Plan.

The first proposal would amend the Marine Fisheries Commission rule 15A NCAC 03J .0103 to establish one of the same restrictions for runaround or non-stationary gill nets as already exist for anchored gill nets. The change is meant to address user conflicts between gill net fishermen and shoreline residents and recreational hook-and-line fishermen in smaller coastal creeks by prohibiting non-stationary gill nets from blocking more than two-thirds of a water body or interfering with navigation or other traditional uses of the area.

The second proposal would amend rule 15A NCAC 03R .0112 to remove the Newport River Trawl Net Prohibited Area as a small mesh gill net attendance area, making attendance requirements consistent with similar areas of the state.

Mechanical Oyster Harvesting

The third proposed rule amends the existing rule for mechanical methods for oyster harvesting (15A NCAC 03R .0108) to clarify that it only applies to internal coastal waters, not the Atlantic Ocean.

The Marine Fisheries Commission is scheduled to vote on the proposed rules at its Nov. 18-20 meeting. It is anticipated the rules would become effective April 1, 2016.

For more information on the proposed rules, go to http://portal.ncdenr.org/web/mf/mfc-proposed-rules-links or contact Blum at 252-808-8014 or Catherine.Blum@ncdenr.gov.

###

NORTH CAROLINA REGISTER

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August 3, 2015

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Contact List for Rulemaking Questions or Concerns

For questions or concerns regarding the Administrative Procedure Act or any of its components, consult with the agencies below. The bolded headings are typical issues which the given agency can address, but are not inclusive.

Rule Notices, Filings, Register, Deadlines, Copies of Proposed Rules, etc.

Office of Administrative Hearings
Rules Division
1711 New Hope Church Road (919) 431-3000
Raleigh, North Carolina 27609 (919) 431-3104 FAX

contact:	Molly Masich, Codifier of Rules	molly.masich@oah.nc.gov	(919) 431-3071
	Dana Vojtko, Publications Coordinator	dana.vojtko@oah.nc.gov	(919) 431-3075
	Lindsay Woy, Editorial Assistant	lindsay.woy@oah.nc.gov	(919) 431-3078
	Kelly Bailey, Editorial Assistant	kelly.bailey@oah.nc.gov	(919) 431-3083

Rule Review and Legal Issues

Rules Review Commission
1711 New Hope Church Road (919) 431-3000
Raleigh, North Carolina 27609 (919) 431-3104 FAX

contact:	Abigail Hammond, Commission Counsel	abigail.hammond@oah.nc.gov	(919) 431-3076
	Amber Cronk May, Commission Counsel	amber.may@oah.nc.gov	(919) 431-3074
	Amanda Reeder, Commission Counsel	amanda.reeder@oah.nc.gov	(919) 431-3079
	Jason Thomas, Commission Counsel	jason.thomas@oah.nc.gov	(919) 431-3081
	Julie Brincefield, Administrative Assistant	julie.brincefield@oah.nc.gov	(919) 431-3073
	Alexander Burgos, Paralegal	alexander.burgos@oah.nc.gov	(919) 431-3080

Fiscal Notes & Economic Analysis and Governor's Review

Office of State Budget and Management
116 West Jones Street (919) 807-4700
Raleigh, North Carolina 27603-8005 (919) 733-0640 FAX
Contact: Anca Grozav, Economic Analyst osbmruleanalysis@osbm.nc.gov (919) 807-4740

NC Association of County Commissioners
215 North Dawson Street (919) 715-2893
Raleigh, North Carolina 27603
contact: Amy Bason amy.bason@ncacc.org

NC League of Municipalities (919) 715-4000
215 North Dawson Street
Raleigh, North Carolina 27603
contact: Sarah Collins scollins@nclm.org

Legislative Process Concerning Rule-making

Joint Legislative Administrative Procedure Oversight Committee
545 Legislative Office Building
300 North Salisbury Street (919) 733-2578
Raleigh, North Carolina 27611 (919) 715-5460 FAX

contact:	Karen Cochrane-Brown, Staff Attorney	Karen.cochrane-brown@ncleg.net
	Jeff Hudson, Staff Attorney	Jeffrey.hudson@ncleg.net

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NORTH CAROLINA REGISTER

Publication Schedule for January 2015 – December 2015

FILING DEADLINES			NOTICE OF TEXT		PERMANENT RULE			TEMPORARY RULES
Volume & issue number	Issue date	Last day for filing	Earliest date for public hearing	End of required comment Period	Deadline to submit to RRC for review at next meeting	Earliest Eff. Date of Permanent Rule	Delayed Eff. Date of Permanent Rule 31st legislative day of the session beginning:	270th day from publication in the Register
29:13	01/02/15	12/08/14	01/17/15	03/03/15	03/20/15	05/01/15	05/2016	09/29/15
29:14	01/15/15	12/19/14	01/30/15	03/16/15	03/20/15	05/01/15	05/2016	10/12/15
29:15	02/02/15	01/09/15	02/17/15	04/06/15	04/20/15	06/01/15	05/2016	10/30/15
29:16	02/16/15	01/26/15	03/03/15	04/17/15	04/20/15	06/01/15	05/2016	11/13/15
29:17	03/02/15	02/09/15	03/17/15	05/01/15	05/20/15	07/01/15	05/2016	11/27/15
29:18	03/16/15	02/23/15	03/31/15	05/15/15	05/20/15	07/01/15	05/2016	12/11/15
29:19	04/01/15	03/11/15	04/16/15	06/01/15	06/22/15	08/01/15	05/2016	12/27/15
29:20	04/15/15	03/24/15	04/30/15	06/15/15	06/22/15	08/01/15	05/2016	01/10/16
29:21	05/01/15	04/10/15	05/16/15	06/30/15	07/20/15	09/01/15	05/2016	01/26/16
29:22	05/15/15	04/24/15	05/30/15	07/14/15	07/20/15	09/01/15	05/2016	02/09/16
29:23	06/01/15	05/08/15	06/16/15	07/31/15	08/20/15	10/01/15	05/2016	02/26/16
29:24	06/15/15	05/22/15	06/30/15	08/14/15	08/20/15	10/01/15	05/2016	03/11/16
30:01	07/01/15	06/10/15	07/16/15	08/31/15	09/21/15	11/01/15	05/2016	03/27/16
30:02	07/15/15	06/23/15	07/30/15	09/14/15	09/21/15	11/01/15	05/2016	04/10/16
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30:07	10/01/15	09/10/15	10/16/15	11/30/15	12/21/15	02/01/16	05/2016	06/27/16
30:08	10/15/15	09/24/15	10/30/15	12/14/15	12/21/15	02/01/16	05/2016	07/11/16
30:09	11/02/15	10/12/15	11/17/15	01/02/16	01/20/16	03/01/16	05/2016	07/29/16
30:10	11/16/15	10/23/15	12/01/15	01/15/16	01/20/16	03/01/16	05/2016	08/12/16
30:11	12/01/15	11/05/15	12/16/15	02/01/16	02/22/16	04/01/16	05/2016	08/27/16
30:12	12/15/15	11/20/15	12/30/15	02/15/16	02/22/16	04/01/16	05/2016	09/10/16

EXPLANATION OF THE PUBLICATION SCHEDULE

This Publication Schedule is prepared by the Office of Administrative Hearings as a public service and the computation of time periods are not to be deemed binding or controlling. Time is computed according to 26 NCAC 2C .0302 and the Rules of Civil Procedure, Rule 6.

GENERAL

The North Carolina Register shall be published twice a month and contains the following information submitted for publication by a state agency:

(1) temporary rules;
(2) text of proposed rules;
(3) text of permanent rules approved by the Rules Review Commission;
(4) emergency rules
(5) Executive Orders of the Governor;
(6) final decision letters from the U.S. Attorney General concerning changes in laws affecting voting in a jurisdiction subject of Section 5 of the Voting Rights Act of 1965, as required by G.S. 120-30.9H; and
(7) other information the Codifier of Rules determines to be helpful to the public.

COMPUTING TIME: In computing time in the schedule, the day of publication of the North Carolina Register is not included. The last day of the period so computed is included, unless it is a Saturday, Sunday, or State holiday, in which event the period runs until the preceding day which is not a Saturday, Sunday, or State holiday.

FILING DEADLINES

ISSUE DATE: The Register is published on the first and fifteen of each month if the first or fifteenth of the month is not a Saturday, Sunday, or State holiday for employees mandated by the State Personnel Commission. If the first or fifteenth of any month is a Saturday, Sunday, or a holiday for State employees, the North Carolina Register issue for that day will be published on the day of that month after the first or fifteenth that is not a Saturday, Sunday, or holiday for State employees.

LAST DAY FOR FILING: The last day for filing for any issue is 15 days before the issue date excluding Saturdays, Sundays, and holidays for State employees.

NOTICE OF TEXT

EARLIEST DATE FOR PUBLIC HEARING: The hearing date shall be at least 15 days after the date a notice of the hearing is published.

END OF REQUIRED COMMENT PERIOD An agency shall accept comments on the text of a proposed rule for at least 60 days after the text is published or until the date of any public hearings held on the proposed rule, whichever is longer.

DEADLINE TO SUBMIT TO THE RULES REVIEW COMMISSION: The Commission shall review a rule submitted to it on or before the twentieth of a month by the last day of the next month.

FIRST LEGISLATIVE DAY OF THE NEXT REGULAR SESSION OF THE GENERAL ASSEMBLY: This date is the first legislative day of the next regular session of the General Assembly following approval of the rule by the Rules Review Commission. See G.S. 150B-21.3, Effective date of rules.

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15A NCAC 02L .0515 DISCHARGES OR RELEASES FROM OTHER SOURCES

This Section shall not relieve any person responsible for assessment or cleanup of contamination from a source other than a non-UST petroleum release from its obligation to assess and clean up contamination resulting from such discharge or releases.

Authority G.S. 143-215.2; 143-215.3(a)(1); 143B-282.

* * * * * * * * * * * * * * * * * * * *

***Notice** is hereby given in accordance with G.S. 150B-21.2 that the Marine Fisheries Commission intends to amend the rules cited as 15A NCAC 03J .0103; 03R .0108, .0112.*

Link to agency website pursuant to G.S. 150B-19.1(c): *http://portal.ncdenr.org/web/mf/mfc-proposed-rules-links*

Proposed Effective Date: *April 1, 2016*

Public Hearing:
Date: *September 9, 2015*
Time: *6:00 p.m.*
Location: *NC Division of Marine Fisheries, 5285 Highway 70 West, Morehead City, NC 28557*

Reason for Proposed Action:
15A NCAC 03J .0103 GILL NETS, SEINES, INDENTIFICATION, RESTRICTIONS
In accordance with the NC Striped Mullet Fishery Management Plan Amendment 1, proposed amendments established restrictions for using runaround or non-stationary gill nets to address user conflicts.
15A NCAC 03R .0108 MECHANICAL METHODS PROHIBITED
Proposed amendments clarify that the rule for mechanical methods for oystering only applies to internal coastal waters, not the Atlantic Ocean.
15A NCAC 03R .0112 ATTENDED GILL NET AREAS
In accordance with the NC Striped Mullet Fishery Management Plan Amendment 1, proposed amendments remove the Newport River Trawl Net Prohibited Area as a small mesh gill net attendance area, making attendance requirements consistent with other similar areas of the state.

Comments may be submitted to: *Catherine Blum, P.O. Box 769, Morehead City, NC 28557, phone 252-808-8014, fax 252-726-0254, email Catherine.Blum@ncdenr.gov*

Comment period ends: *October 2, 2015*

Procedure for Subjecting a Proposed Rule to Legislative Review: If an objection is not resolved prior to the adoption of the Rule, a person may also submit written objections to the Rules Review Commission after the adoption of the Rule. If the Rules Review Commission receives written and signed objections after the adoption of the Rule in accordance with G.S. 150B-21.3(b2) from 10 or more persons clearly requesting review by the legislature and the Rules Review Commission approves the Rule, the Rule will become effective as provided in G.S. 150B-21.3(b1). The Commission will receive written objections until 5:00 p.m. on the day following the day the Commission approves the Rule. The Commission will receive those objections by mail, delivery service, hand delivery, or facsimile transmission. If you have any further questions concerning the submission of objections to the Commission, please call a Commission staff attorney at 919-431-3000.

Fiscal impact (check all that apply).
☐ **State funds affected**
☐ **Environmental permitting of DOT affected**
Analysis submitted to Board of Transportation
☐ **Local funds affected**
☐ **Substantial economic impact (≥$1,000,000)**
☐ **Approved by OSBM**
☒ **No fiscal note required by G.S. 150B-21.4**

CHAPTER 03 - MARINE FISHERIES

SUBCHAPTER 03J - NETS, POTS, DREDGES, AND OTHER FISHING DEVICES

SECTION .0100 - NET RULES, GENERAL

15A NCAC 03J .0103 GILL NETS, SEINES, IDENTIFICATION, RESTRICTIONS

(a) It is unlawful to use gill nets:
(1) ~~With~~ with a mesh length less than ~~2 ½~~ two and one-half inches.
(2) ~~In internal waters~~ in Internal Coastal Waters from April 15 through December 15, with a mesh length ~~5~~ five inches or greater and less than ~~5 ½~~ five and one-half inches.

(b) The Fisheries Director may, by proclamation, limit or prohibit the use of gill nets or seines in ~~coastal waters,~~ Coastal Fishing Waters, or any portion thereof, or impose any or all of the following restrictions on gill net or seine fishing operations:
~~(1) Specify area.~~
~~(2) Specify season.~~
~~(3) Specify gill net mesh length.~~
~~(4) Specify means/methods.~~
~~(5) Specify net number and length.~~
(1) specify time;
(2) specify area;
(3) specify means and methods, including:
(A) gill net mesh length, but the maximum length specified shall not exceed six and one-half inches in Internal Coastal Waters; and
(B) net number and length, but for gill nets with a mesh length four inches or greater, the maximum length specified shall not exceed 2,000 yards per vessel in Internal Coastal Waters regardless of the number of individuals involved; and

(4) specify season.

(c) It is unlawful to use fixed or stationary gill nets in the Atlantic Ocean, drift gill nets in the Atlantic Ocean for recreational purposes, or any gill nets in ~~internal waters~~ Internal Coastal Waters unless nets are marked by attaching to them at each end two separate yellow buoys which shall be of solid foam or other solid buoyant material no less than five inches in diameter and no less than five inches in length. Gill ~~nets, which~~ nets that are not connected together at the top ~~line,~~ line are considered as individual nets, requiring two buoys at each end of each individual net. Gill nets connected together at the top line are considered as a continuous net requiring two buoys at each end of the continuous net. Any other marking buoys on gill nets used for recreational purposes shall be yellow except one additional buoy, any shade of hot pink in color, constructed as specified in this Paragraph, shall be added at each end of each individual net. Any other marking buoys on gill nets used in commercial fishing operations shall be yellow except that one additional identification buoy of any color or any combination of colors, except any shade of hot pink, may be used at either or both ends. The owner shall be identified on a buoy on each end either by using engraved buoys or by attaching engraved metal or plastic tags to the buoys. Such identification shall include owner's last name and initials and if a vessel is used, one of the following:

(1) ~~Owner's~~ owner's N.C. motor boat registration ~~number,~~ number; or

(2) ~~Owner's~~ owner's U.S. vessel documentation name.

(d) It is unlawful to use gill nets:

(1) ~~Within~~ within 200 yards of any flounder or other finfish pound net set with lead and either pound or heart in use, except from August 15 through December 31 in all ~~coastal fishing waters~~ Coastal Fishing Waters of the Albemarle Sound, including its tributaries to the boundaries between ~~coastal and joint fishing waters,~~ Coastal and Joint Fishing Waters, west of a line beginning at a point 36° 04.5184' N - 75° 47.9095' W on Powell Point; running southerly to a point 35° 57.2681' N - 75° 48.3999' W on Caroon Point, it is unlawful to use gill nets within 500 yards of any pound net set with lead and either pound or heart in use; and

(2) ~~From~~ from March 1 through October 31 in the Intracoastal Waterway within 150 yards of any railroad or highway bridge.

(e) It is unlawful to use gill nets within 100 feet either side of the center line of the Intracoastal Waterway Channel south of the entrance to the Alligator-Pungo River Canal near Beacon "54" in Alligator River to the South Carolina line, unless such net is used in accordance with the following conditions:

(1) ~~No~~ no more than two gill nets per vessel may be used at any one time;

(2) ~~Any~~ any net used must be attended by the fisherman from a vessel who shall at no time be more than 100 yards from either net; and

(3) ~~Any~~ any individual setting such nets shall remove them, when necessary, in sufficient time to permit unrestricted ~~boat~~ vessel navigation.

(f) It is unlawful to use ~~drift gill nets in violation of 15A NCAC 03J .0101(2) and Paragraph (e) of this Rule.~~ runaround, drift, or other non-stationary gill nets, except as provided in Paragraph (e) of this Rule:

(1) to block more than two-thirds of any natural or manmade waterway, sound, bay, creek, inlet, or any other body of water; or

(2) in a location where it will interfere with navigation or with existing, traditional uses of the area other than navigation.

(g) It is unlawful to use unattended gill nets with a mesh length less than five inches in a commercial fishing operation in the gill net attended areas designated in 15A NCAC 03R .0112(a).

(h) It is unlawful to use unattended gill nets with a mesh length less than five inches in a commercial fishing operation from May 1 through November 30 in the ~~internal coastal and joint waters~~ Internal Coastal Waters and Joint Fishing Waters of the state designated in 15A NCAC 03R .0112(b).

~~(i) For gill nets with a mesh length five inches or greater, it is unlawful:~~

~~(1) To use more than 3,000 yards of gill net per vessel in internal waters regardless of the number of individuals involved.~~

~~(2) From June through October, for any portion of the net to be within 10 feet of any point on the shoreline while set or deployed, unless the net is attended.~~

(i) It is unlawful for any portion of a gill net with a mesh length five inches or greater to be within 10 feet of any point on the shoreline while set or deployed, unless the net is attended from June through October in Internal Coastal Waters.

(j) For the purpose of this Rule and 15A NCAC 03R .0112, ~~shoreline~~ "shoreline" is defined as the mean high water line or marsh line, whichever is more seaward.

Authority G.S. 113-134; 113-173; 113-182; 113-221.1; 143B-289.52.

SUBCHAPTER 03R - DESCRIPTIVE BOUNDARIES

SECTION .0100 - DESCRIPTIVE BOUNDARIES

15A NCAC 03R .0108 MECHANICAL METHODS PROHIBITED TO TAKE OYSTERS

The dredges and mechanical methods prohibited areas referenced in 15A NCAC 03K .0204 are delineated in the following ~~coastal water areas:~~ Internal Coastal Waters:

(1) In Roanoke Sound and tributaries, south of a line beginning at a point 35° 55.1461' N – 75° 39.5618' W on Baum Point, running easterly to a point 35° 55.9795' N - 75° 37.2072' W and north and east of a line beginning at a point 35° 50.8315' ~~N – 75°~~ N - 75° 37.1909' W on the west side of the mouth of Broad Creek,

running easterly to a point 35° 51.0097' N - 75° 36.6910' W near Beacon "17", running southerly to a point 35° ~~48.6145"~~ 48.6145' N - 75° 35.3760' W near Beacon "7", running easterly to a point 35° 49.0348' N - 75° 34.3161' W on Cedar Point.

(2) In Pamlico Sound and tributaries:

(a) Outer Banks ~~area,within~~ area, within the area described by a line beginning at a point 35° 46.0638' N - 75° 31.4385' W on the shore of Pea Island; running southwesterly to a point 35° 42.9500' N - 75° 34.1500' W; running southerly to a point 35° 39.3500' N - 75° 34.4000' W; running southeasterly to a point 35° 35.8931' N - 75° 31.1514' W in Chicamacomico Channel near Beacon "ICC"; running southerly to a point 35° 28.5610' N - 75° 31.5825' W on Gull Island; running southerly to a point 35° 22.8671' N - 75° 33.5851' W in Avon Channel near Beacon "1"; running southwesterly to a point 35° 18.9603' N - 75° 36.0817' W in Cape Channel near Beacon "2"; running westerly to a point 35° 16.7588' N - 75° 44.2554' W in Rollinson Channel near Beacon "42RC"; running southwesterly to a point 35° 14.0337' N - 75° 45.9643' W southwest of Oliver Reef near the quick-flashing beacon; running westerly to a point 35° 09.3650' N - 76° 00.6377' W in Big Foot Slough Channel near Beacon "14BF"; running southwesterly to a point 35° 08.4523' N - 76° 02.6651' W in Nine Foot Shoal Channel near Beacon "9"; running westerly to a point 35° 07.1000' N - 76° 06.9000; running southwesterly to a point 35° 01.4985' N - 76° 11.4353' W near Beacon "HL"; running southwesterly to a point 35° 00.2728' N - 76° 12.1903' W near Beacon "2CS"; running southerly to a point 34° 59.4383' N - 76° 12.3541' W in Wainwright Channel immediately east of the northern tip of Wainwright Island; running easterly to a point 34° 58.7853' N - 76° 09.8922' W on Core Banks; running northerly along the shoreline and across the inlets following the COLREGS Demarcation lines to the point of beginning;

(b) Stumpy Point Bay, north of a line beginning at a point 35° 40.9719' N - 75° 44.4213' W on Drain Point; running westerly to a point 35° 40.6550' N - 75° 45.6869' W on Kazer Point;

(c) Pains Bay, east of a line beginning at a point 35° 35.0666' N - 75° 51.2000' W on Pains Point, running southerly to a point 35° 34.4666' N – 75° 50.9666' W on Rawls Island; running easterly to a point 35° 34.2309' N - 75° 50.2695' W on the east shore;

(d) Long Shoal River, north of a line beginning at a point 35° 35.2120' N - 75° 53.2232' W at the 5th Avenue Canal, running easterly to a point 35° 35.0666' N - 75° 51.2000' W on the east shore on Pains Point;

(e) Wysocking Bay:

(i) Wysocking Bay, north of a line beginning at a point 35° 25.2741' N - 76° 03.1169' W on Mackey Point, running easterly to a point 35° 25.1189' N - 76° 02.0499' W at the mouth of Lone Tree Creek;

(ii) Mount Pleasant Bay, west of a line beginning at a point 35° 23.8652' N - 76° 04.1270' W on Browns Island, running southerly to a point 35° 22.9684' N - 76° 03.7129' W on Bensons Point;

(f) Juniper Bay, north of a line beginning at a point 35° 22.1384' N - 76° 15.5991' W near the Caffee Bay ditch, running easterly to a point 35° 22.0598' N - 76° 15.0095' W on the east shore;

(g) Swan Quarter Bay:

(i) ~~Cafee~~ Caffee Bay, east of a line beginning at a point 35° 22.1944' N - 76° 19.1722' W on the north shore, running southerly to a point 35° 21.5959' N - 76° 18.3580' W on Drum Point;

(ii) Oyster Creek, east of a line beginning at a point 35° 23.3278' N - 76° 19.9476' W on the north shore, running southerly to a point 35° 22.7018' N - 76° 19.3773' W on the south shore;

(h) Rose Bay:

(i) Rose Bay, north of a line beginning at a point 35° 25.7729' N - 76° 24.5336' W

on Island Point, running southeasterly and passing near Beacon "5" to a point 35° 25.1854' N - 76° 23.2333' W on the east shore;

(ii) Tooleys Creek, west of a line beginning at a point 35° 25.7729' N - 76° 24.5336' W on Island Point, running southwesterly to a point 35° 25.1435' N - 76° 25.1646' W on Ranger Point;

(i) Spencer Bay:

(i) Striking Bay, north of a line beginning at a point 35° 23.4106' N - 76° 26.9629' W on Short Point, running easterly to a point 35° 23.3404' N - 76° 26.2491' W on Long Point;

(ii) Germantown Bay, north of a line beginning at a point 35° 24.0937' N - 76° 27.9348' W; on the west shore, running easterly to a point 35° 23.8598' N - 76° 27.4037' W on the east shore;

(j) Abel Bay, northeast of a line beginning at a point 35° 23.6463' N - 76° 31.0003' W on the west shore, running southeasterly to a point 35° 22.9353' N - 76° 29.7215' W on the east shore;

(k) Pungo River, Fortescue Creek, east of a line beginning at a point 35° 25.9213' N - 76° 31.9135' W on Pasture Point; running southerly to a point 35° 25.6012' N - 76° 31.9641' W on Lupton Point;

(l) Pamlico River:

(i) North Creek, north of a line beginning at a point 35° 25.3988' N - 76° 40.0455' W on the west shore, running southeasterly to a point 35° 25.1384' N - 76° 39.6712' W on the east shore;

(ii) Campbell Creek (off of Goose Creek), west of a line beginning at a point 35° 17.3600' N - 76° 37.1096' W on the north shore; running southerly to a point 35° 16.9876' N - 76° 37.0965' W on the south shore;

(iii) Eastham Creek (off of Goose Creek), east of a line beginning at a point 35° 17.7423' N - 76° 36.5164' W on the north shore; running southeasterly to a point 35° 17.5444' N - 76° 36.3963' W on the south shore;

(iv) Oyster Creek-Middle Prong, southwest of a line beginning at a point 35° 19.4921' N - 76° 32.2590' W on Cedar Island; running southeasterly to a point 35° 19.1265' N - 76° 31.7226' W on Beard Island Point; and southwest of a line beginning at a point 35° 19.5586' N - 76° 32.8830' W on the west shore, running easterly to a point 35° 19.5490' N - 76° 32.7365' W on the east shore;

(m) Mouse Harbor, west of a line beginning at a point 35° 18.3915' N - 76° 29.0454' W on Persimmon Tree Point, running southerly to a point ~~35° 17.1825N~~ 35° 17.1825' N - 76° 28.8713' W on Yaupon Hammock Point;

(n) Big Porpoise Bay, northwest of a line beginning at a point 35° 15.6993' N - 76° 28.2041' W on Big Porpoise Point, running southwesterly to a point 35° 14.9276' N - 76° 28.8658' W on Middle Bay Point;

(o) Middle Bay, west of a line beginning at a point 35° 14.8003' N - 76° 29.1923' W on Deep Point, running southerly to a point 35° 13.5419' N - 76° 29.6123' W on Little Fishing Point;

(p) Jones Bay, west of a line beginning at a point 35° 14.0406' N - 76° 33.3312' W on Drum Creek Point, running southerly to a point 35° 13.3609' N - 76° 33.6539' W on Ditch Creek Point;

(q) Bay River:

(i) Gales Creek-Bear Creek, north and west of a line beginning at a point 35° 11.2833' N - 76° 35.9000' W on Sanders Point, running northeasterly to a point 35° 11.9000' N - 76° 34.2833' W on the east shore;

(ii) Bonner Bay, southeast of a line beginning at a point 35° 09.6281' N - 76° 36.2185' W on the west shore; running northeasterly to a point 35°

10.0888' N - 76° 35.2587' W on Davis Island Point;

(r) Neuse River:

(i) Lower Broad Creek, west of a line beginning at a point 35° 05.8314' N - 76° 35.3845' W on the north shore; running southwesterly to a point 35° 05.5505' N - 76° 35.7249' W on the south shore;

(ii) Greens Creek - north of a line beginning at a point 35° 01.3476' N - 76° 42.1740' W on the west shore of Greens Creek; running northeasterly to a point 35° 01.4899' N - 76° 41.9961' W on the east shore;

(iii) Dawson Creek, north of a line beginning at a point 34° 59.5920' N - 76° 45.4620' W on the west shore; running southeasterly to a point 34° 59.5800' N – 76° 45.4140' W on the east shore;

(iv) Clubfoot Creek, south of a line beginning at a point 34° 54.5424' N - 76° 45.7252' W on the west shore, running easterly to a point 34° 54.4853' N - 76° 45.4022' W on the east shore;

(v) Turnagain Bay, south of a line beginning at a point 34° 59.4065' N - 76° 30.1906' W on the west shore; running easterly to a point 34° 59.5668' N - 76° 29.3557' W on the east shore;

(s) West Bay:

(i) Long Bay-Ditch Bay, west of a line beginning at a point 34° 57.9388' N - 76° 27.0781' W on the north shore of Ditch Bay; running southwesterly to a point 34° 57.2120' N - 76° 27.2185' W on the south shore of Ditch Bay; then south of a line running southeasterly to a point 34° 56.7633' N - 76° 26.3927' W on the east shore of Long Bay;

(ii) West Thorofare Bay, south of a line beginning at a point 34° 57.2199' N - 76° 24.0947' W on the west shore; running easterly to a point 34° 57.4871' N - 76° 23.0737' W on the east shore;

(iii) Merkle Bay, east of a line beginning at a point 34° 58.2286' N - 76° 22.8374' W on the north shore, running southerly to a point 34° 57.5920' N - 76° 23.0704' W on Merkle Bay Point;

(iv) North Bay, east of a line beginning at a point 35° 01.8982' N - 76° 21.7135' W on Point of Grass, running southeasterly to a point 35° 01.3320' N - 76° 21.3353' W on Western Point.

(3) In Core Sound and its tributaries, southwest of a line beginning at a point 35° 00.1000' N - 76° 14.8667' W near Hog Island Reef; running easterly to a point 34° 58.7853' N - 76° 09.8922' W on Core Banks; and in the following waterbodies and their ~~tributaries:Back~~ tributaries: Back Bay, the Straits, Back Sound, North River, Newport River, Bogue ~~Sound~~ Sound, and White Oak River.

(4) In ~~any of the coastal waters of~~ Onslow, Pender, New Hanover, and Brunswick counties.

Authority G.S. 113-134; 113-182; 143B-289.52.

15A NCAC 03R .0112 ATTENDED GILL NET AREAS

(a) The attended gill net areas referenced in 15A NCAC 03J .0103(g) are delineated in the following areas:

(1) Pamlico River, west of a line beginning at a point 35° 27.5768' N - 76° 54.3612' W on Ragged Point; running southwesterly to a point 35° 26.9176' N - 76° 55.5253' W on Mauls Point;

(2) Within 200 yards of any shoreline in Pamlico River and its tributaries east of a line beginning at a point 35° 27.5768' N - 76° 54.3612' W on Ragged Point; running southwesterly to a point 35° 26.9176' N - 76° 55.5253' W on Mauls Point; and west of a line beginning at a point 35° 22.3622' N - 76° 28.2032' W on Roos Point; running southerly to a point at 35° 18.5906' N - 76° 28.9530' W on Pamlico Point;

(3) Pungo River, east of the northern portion of the Pantego Creek breakwater and a line beginning at a point 35° 31.7198' N - 76° 36.9195' W on the northern side of the breakwater near Tooleys Point; running southeasterly to a point 35° 30.5312' N - 76° 35.1594' W on Durants Point;

(4) Within 200 yards of any shoreline in Pungo River and its tributaries west of the northern portion of the Pantego Creek breakwater and a line beginning at a point 35° 31.7198' N - 76°

36.9195' W on the northern side of the breakwater near Tooleys Point; running southeasterly to a point 35° 30.5312' N - 76° 35.1594' W on Durants Point; and west of a line beginning at a point 35° 22.3622' N - 76° 28.2032' W on Roos Point; running southerly to a point at 35° 18.5906' N - 76° 28.9530' W on Pamlico Point;

(5) Neuse River and its tributaries northwest of the Highway 17 highrise bridge;

(6) Trent River and its tributaries; and

(7) Within 200 yards of any shoreline in Neuse River and its tributaries east of the Highway 17 highrise bridge and south and west of a line beginning on Maw Point at a point 35° 09.0407' N - 76° 32.2348' W; running southeasterly near the Maw Point Shoal Marker "2" to a point 35° 08.1250' N - 76° 30.8532' W; running southeasterly near the Neuse River Entrance Marker "NR" to a point 35° 06.6212' N - 76° 28.5383' W; running southerly to a point 35° 04.4833' N - 76° 28.0000' W near Point of Marsh in Neuse River. In Core and Clubfoot creeks, the Highway 101 Bridge constitutes the attendance boundary.

(b) The attended gill net areas referenced in 15A NCAC 03J .0103(h) are delineated in the following ~~coastal and joint waters~~ Internal Coastal Waters and Joint Fishing Waters of the state south of a line beginning on Roanoke Marshes Point at a point 35° 48.3693' N - 75° 43.7232' W; running southeasterly to a point 35° 44.1710' N - 75° 31.0520' W on Eagles Nest Bay to the South Carolina State line:

(1) All primary nursery areas described in 15A NCAC 03R .0103, all permanent secondary nursery areas described in 15A NCAC 03R .0104, and no-trawl areas described in 15A NCAC 03R .0106(2), (4), (5), ~~(7),~~ (8), (10), (11), and (12);

(2) In the area along the Outer Banks, beginning at a point 35° 44.1710' N - 75° 31.0520' W on Eagles Nest Bay; running northwesterly to a point 35° 45.1833' N - 75° 34.1000' W west of Pea Island; running southerly to a point 35° 40.0000' N - 75° 32.8666' W west of Beach Slough; running southeasterly and passing near Beacon "2" in Chicamicomico Channel to a point 35° 35.0000' N - 75° 29.8833' W west of the Rodanthe Pier; running southwesterly to a point 35° 28.4500' N - 75° 31.3500' W on Gull Island; running southerly to a point 35° 22.3000' N - 75° 33.2000' W near Beacon "2" in Avon Channel ; running southwesterly to a point 35° 19.0333' N - 75° 36.3166' W near Beacon "2" in Cape Channel; running southwesterly to a point 35° 15.5000' N - 75° 43.4000' W near Beacon "36" in Rollinson Channel; running southeasterly to a point 35° 14.9386' N - 75° 42.9968' W near Beacon "35" in Rollinson Channel; running southwesterly to a point 35° 14.0377' N - 75° 45.9644' W near a "Danger" Beacon northwest of Austin Reef; running southwesterly to a point 35° 11.4833' N - 75° 51.0833' W on Legged Lump; running southeasterly to a point 35° 10.9666' N - 75° 49.7166' W south of Legged Lump; running southwesterly to a point 35° 09.3000' N - 75° 54.8166' W near the west end of Clarks Reef; running westerly to a point 35° 08.4333' N - 76° 02.5000' W near Nine Foot Shoal Channel; running southerly to a point 35° 06.4000' N - 76° 04.3333' W near North Rock; running southwesterly to a point 35° 01.5833' N - 76° 11.4500' W near Beacon "HL"; running southerly to a point 35° 00.2666' N - 76° 12.2000' W; running southerly to a point 34° 59.4664' N - 76° 12.4859' W on Wainwright Island; running easterly to a point 34° 58.7853' N - 76° 09.8922' W on Core Banks; running northerly along the shoreline and across the inlets following the ~~Colregs~~ COLREGS Demarcation ~~line~~ Line to the point of beginning;

(3) In Core and Back sounds, beginning at a point 34° 58.7853' N - 76° 09.8922' W on Core Banks; running northwesterly to a point 34° 59.4664' N - 76° 12.4859' W on Wainwright Island; running southerly to a point 34° 58.8000' N - 76° 12.5166' W; running southeasterly to a point 34° 58.1833' N - 76° 12.3000' W; running southwesterly to a point 34° 56.4833' N - 76° 13.2833' W; running westerly to a point 34° 56.5500' N - 76° 13.6166' W; running southwesterly to a point 34° 53.5500' N - 76° 16.4166' W; running northwesterly to a point 34° 53.9166' N - 76° 17.1166' W; running southerly to a point 34° 53.4166' N - 76° 17.3500' W; running southwesterly to a point 34° 51.0617' N - 76° 21.0449' W; running southwesterly to a point 34° 48.3137' N - 76° 24.3717' W; running southwesterly to a point 34° 46.3739' N - 76° 26.1526' W; running southwesterly to a point 34° 44.5795' N - 76° 27.5136' W; running southwesterly to a point 34° 43.4895' N - 76° 28.9411' W near Beacon "37A"; running southwesterly to a point 34° 40.4500' N - 76° 30.6833' W; running westerly to a point 34° 40.7061' N - 76° 31.5893' W near Beacon "35" in Back Sound; running westerly to a point 34° 41.3178' N -76° 33.8092' W near Buoy "3"; running southwesterly to a point 34° 39.6601' N - 76° 34.4078' W on Shackleford Banks; running easterly and northeasterly along the

shoreline and across the inlets following the COLREGS Demarcation lines to the point of beginning;

(4) Within 200 yards of any shoreline in the area upstream of the 76° 28.0000' W longitude line beginning at a point 35° 22.3752' N - 76° 28.0000' W near Roos Point in Pamlico River; running southeasterly to a point 35° 04.4833' N - 76° 28.0000' W near Point of Marsh in Neuse River; and

(5) Within 50 yards of any shoreline east of the 76° 28.0000' W longitude line beginning at a point 35° 22.3752' N - 76° 28.0000' W near Roos Point in Pamlico River; running southeasterly to a point 35° 04.4833' N - 76° 28.0000' W near Point of Marsh in Neuse River, except from October 1 through November 30, south and east of Highway 12 in Carteret County and south of a line from a point 34° 59.7942' N - 76° 14.6514' W on Camp Point; running easterly to a point at 34° 58.7853' N - 76° 09.8922' W on Core Banks; to the South Carolina State Line.

Authority G.S. 113-134; 113-173; 113-182; 113-221; 143B-289.52.

TITLE 21 – OCCUPATIONAL LICENSING BOARDS AND COMMISSIONS

CHAPTER 23 – IRRIGATION CONTRACTORS' LICENSING BOARD

***Notice** is hereby given in accordance with G.S. 150B-21.3A(c)(2)g. that the North Carolina Irrigation Contractors' Licensing Board intends to readopt with substantive changes the rule cited as 21 NCAC 23 .0104 and readopt without substantive changes the rules cited as 21 NCAC 23 .0206, .0207, .0406, and .0505.*

Pursuant to G.S. 150B-21.2(c)(1), the text of rules to be readopted without substantive changes are not required to be published. The text of the rules are available on the OAH website: http://reports.oah.nc.us/ncac.asp.

Link to agency website pursuant to G.S. 150B-19.1(c): *www.nciclb.org*

Proposed Effective Date: *December 1, 2015*

Public Hearing:
Date: *August 19, 2015*
Time: *10:00 a.m.*
Location: *State Board of Examiners, 1109 Dresser Court, Raleigh, NC 27609*

Reason for Proposed Action: *The Board identified 21 NCAC 23 .0206, .0207, .0406, and .0505 as being "Necessary with substantive public interest" as a part of its periodic review process because these rules would be of substantive interest to its regulated public and subject to comment. Since no comments were received previously, the Board, having identified these rules as necessary to the enforcement of the governing statute, now seeks to readopt these rules and prevent them from expiring.*
21 NCAC 23 .0104 – The Board would like to readopt with changes, this rule to do away with the carryover of continuing education hours as it is cumbersome and administratively difficult to track.

Comments may be submitted to: *Barbara Geiger, P.O. Box 41421, Raleigh, NC 27629, phone (919) 872-2229, fax (919) 872-1598, email info@nciclb.org*

Comment period ends: *October 2, 2015*

Procedure for Subjecting a Proposed Rule to Legislative Review: If an objection is not resolved prior to the adoption of the rule, a person may also submit written objections to the Rules Review Commission after the adoption of the Rule. If the Rules Review Commission receives written and signed objections after the adoption of the Rule in accordance with G.S. 150B-21.3(b2) from 10 or more persons clearly requesting review by the legislature and the Rules Review Commission approves the rule, the rule will become effective as provided in G.S. 150B-21.3(b1). The Commission will receive written objections until 5:00 p.m. on the day following the day the Commission approves the rule. The Commission will receive those objections by mail, delivery service, hand delivery, or facsimile transmission. If you have any further questions concerning the submission of objections to the Commission, please call a Commission staff attorney at 919-431-3000.

Fiscal impact (check all that apply).
☐ **State funds affected**
☐ **Environmental permitting of DOT affected**
Analysis submitted to Board of Transportation
☐ **Local funds affected**
☐ **Substantial economic impact (≥$1,000,000)**
☐ **Approved by OSBM**
☐ **No fiscal note required by G.S. 150B-21.4**
☒ **No fiscal note required by G.S. 150B-21.3A(d)(2)**

SECTION .0100 - LICENSING

21 NCAC 23 .0104 CONTINUING EDUCATION

(a) Continuing Education (CEU) credit shall not be obtained for the same course more frequently than every three years.

(b) Each individual licensee must earn ten hours of approved continuing education each calendar year. The 10 hours shall include at least two but not more than four hours of business education. The remaining hours of continuing education shall consist of training in landscape and turf irrigation technology.

~~(c) A licensed contractor may carry forward from the year earned to the following year up to 10 hours of continuing education.~~

~~(d)~~(c) A licensed contractor shall provide proof of attendance for all continuing education upon request by the Board.

From:	Blum, Catherine
To:	"Capt Dave Stewart"; Daniel, Louis
Cc:	anna@pamlicoguide.com; joe@captainjoefishing.com; chuck laughridge; specialemichael@gmail.com; Senator Norman Sanderson; joe albea
Subject:	RE: Gill net proposals
Date:	Wednesday, August 05, 2015 1:49:00 PM

Dear Capt. Stewart,

Thank you for your comments on the Marine Fisheries Commission proposed rules. Your comments will be forwarded to the full commission for its consideration prior to voting on permanent approval of the rules. This action is scheduled for the commission's November business meeting in Nags Head.

Sincerely,
Catherine Blum

Catherine Blum
Fishery Management Plan & Rulemaking Coordinator
N.C. Division of Marine Fisheries
P.O. Box 769 / 3441 Arendell Street
Morehead City, NC 28557-0769
catherine.blum@ncdenr.gov
252-808-8014 (phone)
252-726-0254 (fax)

From: Capt Dave Stewart [mailto:specfever@hotmail.com]
Sent: Monday, August 03, 2015 12:58 PM
To: Blum, Catherine <catherine.blum@ncdenr.gov>; Daniel, Louis <louis.daniel@ncdenr.gov>
Cc: anna@pamlicoguide.com; joe@captainjoefishing.com; chuck laughridge <chl3@ec.rr.com>; specialemichael@gmail.com; Senator Norman Sanderson <Norman.Sanderson@ncleg.net>; joe albea <carolinawoodduck@aol.com>
Subject: Gill net proposals

I see we are speaking to the nets being placed in ways to block and or interfere with water traffic flow. How can we address the current growing issue of depleting progress of our fisheries. This is by far the worst year we have had in the 35+ years I have fished these water - internal. Noone seems to address this or even that we have a problem. Look at trip tickets, boat ramps ect and you can see it is dead.

We need action now - not 10 years down the road. Continued studies are doing nothing but delaying the revival of our waters.

Powers to be need to get out of political realm and do what is needed even if it hurts for a while.

Other states are doing fine with changes - lets do the same

Plenty of options to fill voids

From: Blum, Catherine
To: "Sunset Pier"
Subject: RE: Public comments sought on proposed rules for gill nets, mechanical oyster harvest
Date: Wednesday, August 05, 2015 1:49:00 PM

Dear Ms. Kaplan,

Thank you for your comments on the Marine Fisheries Commission proposed rules. Your comments will be forwarded to the commission for its consideration prior to voting on permanent approval of the rules. This action is scheduled for the commission's November business meeting in Nags Head.

Sincerely,
Catherine Blum

Catherine Blum
Fishery Management Plan & Rulemaking Coordinator
N.C. Division of Marine Fisheries
P.O. Box 769 / 3441 Arendell Street
Morehead City, NC 28557-0769
catherine.blum@ncdenr.gov
252-808-8014 (phone)
252-726-0254 (fax)

From: Sunset Pier [mailto:sunsetpier@atmc.net]
Sent: Tuesday, August 04, 2015 10:37 AM
To: Blum, Catherine <catherine.blum@ncdenr.gov>
Subject: Public comments sought on proposed rules for gill nets, mechanical oyster harvest

All for the implementation of the first proposal. Can't tell you how many times in my boat I have to try and guess if I will be forced to run a ground trying to get around these people as they think they own the water. PLEASE put this one into effect.

Sincerely,
Becky Kaplan
Sunset Beach, NC

From: Blum, Catherine
To: "Stuart Creighton"
Subject: RE: gill net rules
Date: Thursday, August 06, 2015 3:56:00 PM

Dear Mr. Creighton,

Thank you for your comments on the Marine Fisheries Commission proposed rules. Your comments will be forwarded to the commission for its consideration prior to voting on permanent approval of the rules. This action is scheduled for the commission's November business meeting in Nags Head.

Sincerely,
Catherine Blum

Catherine Blum
Fishery Management Plan & Rulemaking Coordinator
N.C. Division of Marine Fisheries
P.O. Box 769 / 3441 Arendell Street
Morehead City, NC 28557-0769
catherine.blum@ncdenr.gov
252-808-8014 (phone)
252-726-0254 (fax)

-----Original Message-----
From: Stuart Creighton [mailto:stu.creighton@gmail.com]
Sent: Wednesday, August 05, 2015 9:17 PM
To: Blum, Catherine <catherine.blum@ncdenr.gov>
Subject: gill net rules

Catherine,

In response to your request for comments on the gill net rules changes, I feel that DENR and the state of North Carolina are not addressing the real issue, which is the unrelenting commercial pressure on our estuarine creeks, rivers, and sounds.

To begin with, the simple fact that gill nets are allowed in our coastal creeks is absurd. When placed across ANY part of a creek where the fish CONCENTRATE during the late fall through early spring is simply allowing the netters to remove an overwhelming majority of those fish from that particular area. It is no wonder that the numbers of over a dozen finfish (and blue crabs) are either declining or depleted as of 2014 (from the NCDENR webpage). It is not a sustainable practice to allow this to continue. I'm sure you are aware the North Carolina is the ONLY state in the southeast that still allows this destructive practice to continue.

I have seen numerous pictures, videos, and have witnessed the practice all too many times of homeowners having gill nets anchored to their docks, boat ramps, seawalls, etc...to know that the netters have little regard for their property or for their ability to navigate in and out of their own docks and ramps. "Limiting" either anchored or non-anchored gill nets to 2/3 of a creek is too much. If you are not going to address the issue correctly by removing the nets, then these nets should cover NO MORE THAN 1/3 of any creek.

Next, to think that these nets are used strictly for mullet is laughable. Does that mean that we are regarding the speckled trout, flounder, and redfish as bycatch?? If so, DENR is not properly monitoring the netters, nor is it managing the fishery in any manner. Based on pounds caught compared to money generated, striped mullet are

only worth a few cents per pound. But, trout, flounder, and redfish are each worth over two dollars per pound. (Again, these numbers come directly from the DENR stats for 2014.) It is ludicrous to think that these fishermen are targeting only mullet when these other fish are imminently more profitable to the fishermen.

I would close by saying that I strongly recommend that NCDENR take swift action to stop these destructive commercial practices in our estuarine waters. Many of our river systems, especailly the Neuse, are in dire straits. I have been fishing this river for over 40 years, and I have never seen fishing so poor. The reason for the drastic decline is the excessive pressure put on the system by the commercial netters. I have not even mentioned the damage done by the shrimp trawlers in this email, I'll save that for another time. Please heed these words, as I would like to see our estuaries reach their potential. If we can get the commercial fishermen out of these waters, we could have a recreational fishing industry that would rival, even exceed, that of Florida and Louisiana.

Sincerely,

Stuart Creighton

From: Blum, Catherine
To: "Beth Long"
Subject: RE: Public comments sought on proposed rules for gill nets, mechanical oyster harvest
Date: Monday, August 10, 2015 3:21:00 PM

Dear Mr. Webb,

Thank you for your comments on the Marine Fisheries Commission proposed rules. Your comments will be forwarded to the commission for its consideration prior to voting on permanent approval of the rules. This action is scheduled for the commission's November business meeting in Nags Head.

Sincerely,
Catherine Blum

Catherine Blum
Fishery Management Plan & Rulemaking Coordinator
N.C. Division of Marine Fisheries
P.O. Box 769 / 3441 Arendell Street
Morehead City, NC 28557-0769
catherine.blum@ncdenr.gov
252-808-8014 (phone)
252-726-0254 (fax)

From: Beth Long [mailto:blong40@hotmail.com]
Sent: Saturday, August 08, 2015 10:23 PM
To: Blum, Catherine <catherine.blum@ncdenr.gov>
Subject: Public comments sought on proposed rules for gill nets, mechanical oyster harvest

I AM ASKING THAT YOU DO AWAY WITH ALL GILL NETS IN OUR CREEKS AN ESTUARIES

KEVIN WEBB
103 E WILSON ST
MACCLESFIELD NC 27852

MARINE FISHERIES COMMISSION
SUMMARY OF PUBLIC HEARING FOR PROPOSED RULES
DIVISION OF MARINE FISHERIES
MOREHEAD CITY CENTRAL DISTRICT OFFICE
MOREHEAD CITY, N.C.
SEPT. 9, 2015, 6 PM

Marine Fisheries Commission:	Sammy Corbett
Division of Marine Fisheries Staff:	Catherine Blum, Louis Daniel, Nancy Fish
Public:	David Kielmeier, Thomas C. McArthur III, Glenwood P. Montgomery, Lauren Morris, Adam Tyler
Media:	None

Commission Chairman Sammy Corbett opened the public hearing for Marine Fisheries Commission proposed rules at 6 p.m. Chairman Corbett explained the proposed rules have an intended effective date of April 1, 2016. He said public comments on the proposed rules will be presented to the Marine Fisheries Commission at its November 18-20 meeting prior to its vote on final approval of the rules. Written comments will be accepted through Oct. 2. He reviewed guidelines of the public hearing process and explained the hearing is a formal process to receive public comments only about the proposed rules published in the *N.C. Register*.

Division staff member Catherine Blum reviewed the proposed rules by explaining the reason for proposed action for each of the three rules in the package.

Chairman Corbett opened the floor for the public to provide comments.

One member of the public in attendance had comments on the two proposed rules for the Striped Mullet Fishery Management Plan. Adam Tyler said he supports the proposed amendments to 15A NCAC 03R .0112. The proposed change would remove the Newport River Trawl Net Prohibited Area as a small mesh gill net attendance area September through November, making attendance requirements consistent with other similar areas of the state. Regarding the proposed amendments to 15A NCAC 03J .0103, specifically paragraph (f)(2), Mr. Tyler suggested that the phrase "existing, traditional uses of the area" could be confusing and may be interpreted differently by various user groups. He expressed his concern about that phrase remaining in the rule without being defined. (After the hearing, division staff evaluated the language and determined the phrase is unnecessary and could be removed from the rule.)

Mr. Tyler went on to share his thoughts about the striped mullet fishery more generally, along with the spiny dogfish fishery. He said these are commercial fisheries that continue to flourish, even though the fisheries rely mainly on the use of gill nets for harvest and despite the fact the striped mullet fishery focuses on harvesting eggs. He said these stocks do not appear to be in trouble. Mr. Tyler said it seems like the point at which a fishery opens up to the recreational sector is when a fishery crashes. He wanted to bring this point to the attention of the commission and the division.

Hearing no further comments on the proposed rules, Chairman Corbett closed the hearing at 6:12 p.m.

/cb

15A NCAC 03J .0103 is amended with changes as published in 30:03 NCR 291-292 as follows:

15A NCAC 03J .0103 GILL NETS, SEINES, IDENTIFICATION, RESTRICTIONS

(a) It is unlawful to use gill nets:

(1) ~~With~~ with a mesh length less than ~~2 ½~~ two and one-half inches.

(2) ~~In internal waters~~ in Internal Coastal Waters from April 15 through December 15, with a mesh length ~~5~~ five inches or greater and less than ~~5 ½~~ five and one-half inches.

(b) The Fisheries Director may, by proclamation, limit or prohibit the use of gill nets or seines in ~~coastal waters,~~ Coastal Fishing Waters, or any portion thereof, or impose any or all of the following restrictions on gill net or seine fishing operations:

~~(1) Specify area.~~

~~(2) Specify season.~~

~~(3) Specify gill net mesh length.~~

~~(4) Specify means/methods.~~

~~(5) Specify net number and length.~~

(1) specify time;

(2) specify area;

(3) specify means and methods, including:

(A) gill net mesh length, but the maximum length specified shall not exceed six and one-half inches in Internal Coastal Waters; and

(B) net number and length, but for gill nets with a mesh length four inches or greater, the maximum length specified shall not exceed 2,000 yards per vessel in Internal Coastal Waters regardless of the number of individuals involved; and

(4) specify season.

(c) It is unlawful to use fixed or stationary gill nets in the Atlantic Ocean, drift gill nets in the Atlantic Ocean for recreational purposes, or any gill nets in ~~internal waters~~ Internal Coastal Waters unless nets are marked by attaching to them at each end two separate yellow buoys which shall be of solid foam or other solid buoyant material no less than five inches in diameter and no less than five inches in length. Gill ~~nets, which~~ nets that are not connected together at the top ~~line,~~ line are considered as individual nets, requiring two buoys at each end of each individual net. Gill nets connected together at the top line are considered as a continuous net requiring two buoys at each end of the continuous net. Any other marking buoys on gill nets used for recreational purposes shall be yellow except one additional buoy, any shade of hot pink in color, constructed as specified in this Paragraph, shall be added at each end of each individual net. Any other marking buoys on gill nets used in commercial fishing operations shall be yellow except that one additional identification buoy of any color or any combination of colors, except any shade of hot pink, may be used at either or both ends. The owner shall be identified on a buoy on each end either by using engraved buoys or by attaching engraved metal or plastic tags to the buoys. Such identification shall include owner's last name and initials and if a vessel is used, one of the following:

(1) ~~Owner's~~ owner's N.C. motor boat registration ~~number,~~ number; or

(2) ~~Owner's~~ owner's U.S. vessel documentation name.

(d) It is unlawful to use gill nets:

(1) ~~Within~~ within 200 yards of any flounder or other finfish pound net set with lead and either pound or heart in use, except from August 15 through December 31 in all ~~coastal fishing waters~~ Coastal Fishing Waters of the Albemarle Sound, including its tributaries to the boundaries between ~~coastal and joint fishing waters,~~ Coastal and Joint Fishing Waters, west of a line beginning at a point 36° 04.5184' N - 75° 47.9095' W on Powell Point; running southerly to a point 35° 57.2681' N - 75° 48.3999' W on Caroon Point, it is unlawful to use gill nets within 500 yards of any pound net set with lead and either pound or heart in use; and

(2) ~~From~~ from March 1 through October 31 in the Intracoastal Waterway within 150 yards of any railroad or highway bridge.

(e) It is unlawful to use gill nets within 100 feet either side of the center line of the Intracoastal Waterway Channel south of the entrance to the Alligator-Pungo River Canal near Beacon "54" in Alligator River to the South Carolina line, unless such net is used in accordance with the following conditions:

(1) ~~No~~ no more than two gill nets per vessel may be used at any one time;

(2) ~~Any~~ any net used must be attended by the fisherman from a vessel who shall at no time be more than 100 yards from either net; and

(3) ~~Any~~ any individual setting such nets shall remove them, when necessary, in sufficient time to permit unrestricted ~~boat~~ vessel navigation.

(f) It is unlawful to use ~~drift gill nets in violation of 15A NCAC 03J .0101(2) and Paragraph (e) of this Rule.~~ runaround, drift, or other non-stationary gill nets, except as provided in Paragraph (e) of this Rule:

(1) to block more than two-thirds of any natural or manmade waterway, sound, bay, creek, inlet, or any other body of water; or

(2) in a location where it will interfere with [~~navigation or with existing, traditional uses of the area other than~~]navigation.

(g) It is unlawful to use unattended gill nets with a mesh length less than five inches in a commercial fishing operation in the gill net attended areas designated in 15A NCAC 03R .0112(a).

(h) It is unlawful to use unattended gill nets with a mesh length less than five inches in a commercial fishing operation from May 1 through November 30 in the ~~internal coastal and joint waters~~ Internal Coastal Waters and Joint Fishing Waters of the state designated in 15A NCAC 03R .0112(b).

~~(i) For gill nets with a mesh length five inches or greater, it is unlawful:~~

~~(1) To use more than 3,000 yards of gill net per vessel in internal waters regardless of the number of individuals involved.~~

~~(2) From June through October, for any portion of the net to be within 10 feet of any point on the shoreline while set or deployed, unless the net is attended.~~

(i) It is unlawful for any portion of a gill net with a mesh length five inches or greater to be within 10 feet of any point on the shoreline while set or deployed, unless the net is attended from June through October in Internal Coastal Waters.

(j) For the purpose of this Rule and 15A NCAC 03R .0112, ~~shoreline~~ "shoreline" is defined as the mean high water line or marsh line, whichever is more seaward.

Authority G.S. 113-134; 113-173; 113-182; ~~113-221;~~ 113-221.1; 143B-289.52

TIMELINE FOR STRIPED MULLET FISHERY MANAGEMENT PLAN AMENDMENT 1 (Revised October 17, 2013)			
MILESTONES	**INTERNAL GUIDELINES**	**TABLES 1&2 STEP**	**PROJECTED COMPLETION DATE**
1. Orient AC and Discuss Issues, Goal and Objectives	III. B.	9/5	October 2013
2. Present Timeline and Goal and Objectives to MFC; Get MFC input on Issues	III. D.	11/7	February 20, 2014
3. Completion of PIB development and review process or news release	III. D.	12-15/8-11	March 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	October 2013-July 2014
5. Obtain MFC Approval for Review of FMP	III. F.	20/15	August 2014
6. Public and Committee Review of FMP	III. F.	21-24/16-18	September 2014
7. Present Revised FMP to MFC for Selection of Preferred Management Options	IV. A.	25/20	November 2014
8. Review of FMP by DENR and JLCGO	IV. A.	26-29/21-24	December 2014
9. Procedural Approval of FMP; Approval of Notice of Text for Rules by MFC	IV. A.	30-32/25-27	May 2015
10. Direct Rules through APA Process	IV. B.	33/28	August-October 2015
11. Final FMP and Rule Approval by MFC	IV. C.	34-35/29-30	November 2015
12. Selected Management Measures Effective Date	N/A	N/A	48 Hours if proclamation; April 1, 2016 if rule

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

Presented to MFC: Date:_____

Revision approved by DMF Director: Signature:_____ Date: 10/21/13

Presented to MFC: Date:_____

Revision(s) and reason(s): The original stock assessment scientist for this FMP resigned from her position prior to completion of the assessment. Additionally, the remaining stock assessment scientists were needed to work on protected species issues instead of the striped mullet stock assessment. The resulting delays in the completion of the stock assessment caused the timeline to be adjusted accordingly. The option of issuing a news release instead of a PIB was also added, consistent with recent practice.

Draft
2015 North Carolina Coastal Habitat Protection Plan

Draft version presented to the Environmental Review Commission, Coastal Resources Commission, and Marine Fisheries Commission

November 2015

By

North Carolina Department of Environmental Quality

The 2015 North Carolina Coastal Habitat Protection Plan

North Carolina's approximately 2.3 million acres of estuarine waters comprise the largest estuarine system of any state along the Atlantic seaboard. Located at the confluence of warm southern and cool northern currents, North Carolina's waters support a high diversity of aquatic species and six distinct, but interdependent, marine habitats. These waters are vital not only for the state's important fish species, but also to fish that migrate along the East Coast.

North Carolina, with its billion dollar commercial and recreational fishing industries, ranks among the nation's highest seafood producing states. Aquatic species important to these industries depend on sufficient quality and quantity of habitats in our rivers, sounds, and ocean waters. From shellfish beds in the lower estuary, to swamps in the upper estuary, fish habitats are at risk. Activities causing habitat loss and degradation threaten more than the fishing industry vital to North Carolina's economy. They also threaten coastal tourism, outdoor recreation, and residential development.

Recognizing the critical importance of healthy fish habitat, the NC General Assembly passed the Fisheries Reform Act (GS.143B-279.8), requiring three of the state's regulatory commissions - the Marine Fisheries, Environmental Management, and Coastal Resources commissions - to adopt a plan to protect and restore resources critical to North Carolina's fisheries. The Department of Environmental Quality (DEQ) developed a Coastal Habitat Protection Plan (CHPP) through a cooperative, multiagency effort. The CHPP was written by DEQ staff, adopted by the three commissions in 2004, and updated in 2010.

The CHPP is a guidance document that provides the latest science on North Carolina's coastal fish habitats, their ecological functions, value, threats, goals, and recommendations to protect, enhance, and restore fish habitat.

Value of NC's coastal fish habitats: *

- 2013 Economic impact of North Carolina's fisheries: commercial - $305 million; recreational - $1.7 billion.
- Submerged aquatic vegetation produces food, improves water quality. In Bogue Sound, NC, pollution removal services value - $3,000/ac/yr. Ecosystem services of seagrass and algae - $7,700/ac/yr.
- Oyster reefs remove pollutants, increase oyster and fish production, stabilize shorelines – ecosystem services estimated $2,200 - $40,200/ac/yr, without value of fishery. Recreational fishing from reef restoration value estimated - $640,000/yr
- Coastal wetlands provide storm protection valued at $25.6 billion per year.
- Property values adjacent to open shellfish harvest waters are higher than next to closed waters.
- NC hard bottom fishery generated more than $4.2 million average annually for each of three years between 2011-2013.
- For every $1 invested in land conservation in NC, ~$4 return from natural resource goods and services.
- Beach property 80' wide ~35% more valuable than same property 79' wide.

* Refer to the Source Document for details and literature references.

By adopting the revised plan, the commissions are committing to implement these goals and recommendations. To do this, each DEQ division develops a biennial implementation plan that includes tangible and achievable actions to progress forward.

In this 2015 plan, information is presented on past implementation progress, updated recommendations, and priority issues to focus actions. Background on the six fish habitats, their status, and influencing threats is also included. Full details are included in the 2015 CHPP Source Document. A key to acronyms is provided at the end of this document.

Water Column | Shell Bottom | Submerged Aquatic Vegetation | Wetlands | Hard Bottom | Soft Bottom

EXECUTIVE SUMMARY

This document is intended as a resource and guide for implementation of the goals and recommendations of the Coastal Habitat Protection Plan.

GS. 143B-279.8 requires that a Coastal Habitat Protection Plan (CHPP) be drafted by the Department of Environmental Quality, formerly Department of Environment and Natural Resources, and reviewed every five years. The purpose of the plan is to recommend actions to protect and restore habitats critical to enhancement of North Carolina's coastal fisheries. This is the third iteration of the plan. The Marine Fisheries, Coastal Resources, and Environmental Management Commissions are required to approve of the plan recommendations.

The 2015 Coastal Habitat Protection Plan summarizes the economic and ecological value of coastal fish habitats to North Carolina, their status, and potential threats to their sustainability. Goals and recommendations to protect and restore fish habitat, including water quality, are included. The appended Source Document, compiled by staff of the Department of Environmental Quality, provides the science to support the need for such recommendations. Throughout the plan, there are references to the chapter of the source document where more details and references can be found.

The 2015 plan and source document describe many of the accomplishments that have occurred since the first iteration of the plan in 2005. Most have been non-regulatory, collaborative efforts across divisions. While a lot has been accomplished, there is still work to be done. Continued progress will require cooperation across additional agencies, including the Departments of Commerce, Transportation, Agriculture & Consumer Services, Cultural and Natural Resources.

2015 Goals and Recommendations

Goal 1. Improve effectiveness of existing rules and programs protecting coastal fish habitats.

Includes 5 recommendations regarding enhancement of compliance, monitoring, outreach, coordination across commissions, and management of invasive species.

Goal 2. Identify and delineate strategic coastal habitats.

Includes 2 recommendations regarding mapping and monitoring fish habitat, assessing their condition, and identifying priority areas for fish species.

Goal 3. Enhance and protect habitats from adverse physical impacts.

Includes 8 recommendations on expanding habitat restoration, managing ocean and estuarine shorelines, protecting habitat from destructive fishing gear and dredging and filling impacts.

Goal 4. Enhance and protect water quality.

Includes 8 recommendations to reduce point and non-point sources of pollution in surface waters through encouragement of Best Management Practices, incentives, assistance, outreach, and coordination. This applies not only to activities under the authority of the Department of Environmental Quality, such as development and fishing, but for all land use activities, including forestry, agriculture and road construction.

CHPP Implementation

The overarching goal of the CHPP is to enhance fisheries by protecting and restoring important coastal habitats. The plan includes ***recommendations*** that fall under four broad goals and address issues such as minimizing habitat impacts from fishing gear and channel dredging as well as reducing water quality impacts from point and nonpoint sources.

To fulfill these recommendations, each DEQ division and department develops biennial ***implementation plans*** that include tangible achievable actions. Implementation actions have varied over time based on needs and changing priorities. Implementation actions are carried out by DEQ, the Marine Fisheries Commission (MFC) and Division of Marine Fisheries (DMF), the Coastal Resources Commission (CRC) and Division of Coastal Management (DCM), the Environmental Management Commission (EMC) and Division of Water Resources (DWR), the Sedimentation Control Commission (SCS) and Division of Energy, Mineral, and Land Resources (DEMLR), and other partnering agencies. Implementation progress is tracked on a regular basis (Ch. 1).

In the 2015 CHPP, four ***priority habitat issues*** were selected for the focus of implementation plans. Suggested implementation actions for these issues were developed and are included in the plan. The four issues are **oyster restoration, living shorelines, sedimentation, and developing metrics to assess habitat trends and management effectiveness** (Ch. 12)**.**

Department of Environmental Quality

DEQ is the lead stewardship agency for the preservation and protection of North Carolina's outstanding natural resources. The organization, which has offices from the mountains to the coast, administers programs designed to protect and enhance water quality, aquatic resources, public health, fish, wildlife, and wilderness areas.

The department is responsible for drafting the habitat plan. The CHPP Team, consisting of staff from DEQ divisions, draft the plan with guidance from the department.

DEQ implementation actions include those of the Albemarle-Pamlico National Estuary Partnership, Office of Land and Water Stewardship, and Division of Mitigation Services. Other participating state agencies include the Division of Soil and Water Conservation, NC Forest Service, Wildlife Resources Commission, and the Department of Agriculture and Consumer Services.

CHPP Steering Committee

The CHPP Steering Committee consists of two commissioners from each of the three commissions specified in the Fisheries Reform Act - MFC, CRC, and EMC. Their role is to review and approve of the draft plan, be an advocate for the plan to their full commission, meet regularly as a committee to discuss solutions for difficult and cross-cutting habitat and water quality issues, and review implementation progress to ensure that the plan is implemented.

CHPP Implementation

The primary divisions responsible for implementing CHPP recommendations are the Division of Marine Fisheries, Division of Coastal Management, Division of Water Resources, and Division of Energy, Minerals, and Land Resources (Ch. 1).

Division of Marine Fisheries

The division, under the rulemaking authority of the MFC, manages the commercial and recreational fisheries in North Carolina's estuarine and ocean waters. The division protects habitats through fishing gear rules, planning, research, and enhancement activities. The division's mission is to ensure sustainable marine and estuarine fisheries for the benefit of the people of North Carolina.

Division of Coastal Management

Under the rulemaking authority of the CRC, this division establishes policies and adopts rules for enforcing the NC Coastal Area Management Act and the NC Dredge and Fill Law. The DCM works to protect, conserve, and manage North Carolina's coastal resources through an integrated program of planning, permitting, education, and research.

Division of Water Resources

The DWR's mission is to protect, preserve, enhance, and manage North Carolina's surface water and groundwater resources for the health and welfare of the citizens of North Carolina and the economic well-being of the state. This division functions under the rulemaking authority of the EMC.

Division of Energy, Mineral, and Land Resources

The division, under the rulemaking authority of the SCC and the EMC, manages and provides technical assistance related to sediment and erosion control, stormwater management, mining, dams, and energy. The mission of DEMLR is to promote the wise use and protection of North Carolina's land and geologic resources.

Implementation Progress

Substantial implementation progress has been made over the past ten years, with some positive habitat signs evident. In addition, some fishery species' populations have rebounded or are showing strong signs of recovery. Examples include spotted sea trout, red drum, gag, black sea bass, oysters, and bay scallops. While this advancement cannot be directly or solely related to habitat improvement, it is a positive indication for management overall. Some examples of implementation success are below (Ch. 1).

Mapping and assessing habitat condition

- Since 2005, much progress has been made in submerged aquatic vegetation (SAV) mapping. Through a coordinated partnership of APNEP, DMF, DCM, DWR, and other agencies, the entire coast was mapped in 2007-2008, and portions were repeated in 2013 and 2015. A monitoring plan was developed to improve mapping methods in low salinity waters and allow repeat mapping to evaluate change over time (Ch. 4).
- DMF accelerated estuarine shellfish bottom mapping (to a maximum water depth of 15 ft). Mapping is now over 95% complete (Ch. 3).
- DCM mapped the coastal estuarine shoreline and shoreline structures such as bulkheads and piers (Ch.8).
- DMF has developed and begun a process to identify a subset of strategic habitats, based on their condition and location. This will allow conservation measures to focus on priority areas (Ch. 13).

Oyster restoration

- Since 2005, oyster sanctuary development has greatly expanded. DMF has constructed 13 oyster sanctuaries in the Pamlico Sound system, each ranging from 5 - 60 acres of permitted area, and totaling 159 acres of developed reef (Ch. 3 & 12).
- Creation of an oyster shell recycling program provided additional shell material to supplement the division's shell planting activities. Recycled and purchased shell and rock material was used to create additional oyster reef habitat that supports the oyster fishery and provides fish habitat. The area of oyster reef created annually through shell planting varies based on funding and availability of material. Despite budget cuts, efforts continue through partnerships, grant funding, and mitigation contract work (Ch. 3 & 12).

Improving strategies to reduce nonpoint runoff

- EMC adopted coastal stormwater rules to reduce further degradation of receiving waters (Ch. 14).
- DWR and DEMLR incorporated low impact development techniques as acceptable Best Management Practice options for controlling runoff from development (Ch. 14).

Implementation Progress

Managing shorelines

- DCM developed sediment criteria for beach nourishment and a Beach and Inlet Management Plan that provides guidelines for ocean beach nourishment to minimize ecological impacts and address socioeconomic concerns (Ch. 8).
- DCM has taken several actions to encourage greater use of living shorelines for estuarine shoreline stabilization. Working with DMF, DWR, and other agencies, DCM surveyed existing living shorelines for success, and agencies worked to simplify the permitting process. Outreach to multiple audiences through workshops, written material, and websites continues (Ch. 8).

Coordination and compliance

- Regular CHPP Steering Committee meetings and CHPP quarterly permit reviewer meetings have greatly improved collaboration among divisions and problem solving on cross-cutting issues. New compliance positions were established in several divisions through appropriated funds, allowing greater assessment of compliance. Many of these positions have been cut in recent years due to budget shortfalls (Ch. 1).

Research and outreach

- Coastal Recreational Fishing License Funds were awarded as grants to research topics that will expand our understanding of the link between habitat condition and fish use and will help implement recommendations of the CHPP (Ch. 1).
- The National Estuarine Research Reserve has produced educational materials on the value of different fish habitats and environmentally friendly shoreline stabilization techniques. The Reserve also held workshops to promote living shorelines (Ch. 14).
- Several educational kiosks and displays on the value of fish habitat were constructed at a variety of museums and public access locations using Coastal Recreational Fishing License funds (Ch. 14).

Restoring fish passage

- In 2012, a rock ramp fish passage was constructed around Lock and Dam #1 on the Cape Fear River by the US Army Corps of Engineers to allow anadromous fish to migrate further upstream to spawn. The work was done collaboratively with DMF, Wildlife Resources Commission, and other partners (Ch. 9).

Goals and Recommendations

GOAL 1:

IMPROVE EFFECTIVENESS OF EXISTING RULES AND PROGRAMS PROTECTING COASTAL FISH HABITATS

North Carolina has a number of programs already in place to protect coastal fisheries and the natural resources that support them. The Marine Fisheries Commission has adopted rules addressing the impacts of certain types of fishing gear and fishing practices that may damage fish habitats. The Coastal Resources Commission regulates development impacts on certain types of critical habitat, such as saltwater marshes and primary nursery areas. The Environmental Management Commission has issued water quality standards that address pollution of all waters from direct discharges and wetland dredge and fill impacts. The Division of Energy, Mineral, and Land Resources addresses erosion and sediment control from land development or mining, and regulates energy activities. The Coastal Habitat Protection Plan identifies strategies that could continue to improve rule compliance, coordination of environmental monitoring, and outreach, which in turn will result in greater success in protecting critical fish habitats (Ch. 15).

RECOMMENDATIONS:

1. Continue to ensure compliance with Coastal Resources Commission (CRC), Environmental Management Commission (EMC), and Marine Fisheries Commission (MFC) rules and permits.
2. Coordinate and enhance:
    a. monitoring of water quality, habitat, and fisheries resources (including data management) from headwaters to the nearshore ocean.
    b. assessment and monitoring of effectiveness of rules established to protect coastal habitats.
3. Enhance and expand educational outreach on the value of fish habitat, threats from land use and other activities, and explanations of management measures and challenges.

4. Continue to coordinate among commissions and agencies on coastal habitat management issues.
5. Enhance management of invasive species with existing programs. Monitor and track status in affected waterbodies.

Goals and Recommendations

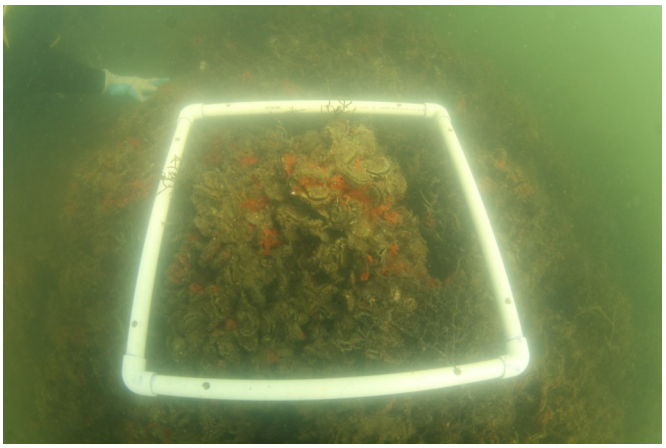
GOAL 2:

IDENTIFY AND DELINEATE STRATEGIC COASTAL HABITATS

Maintaining healthy coastal fisheries requires consideration of the entire ecosystem and the way different types of fish habitats work together. For example, coastal marshes help prevent erosion of shallow soft bottom habitat, which provides a food source and corridor for juvenile finfish. Shell bottom reduces sediment and nutrients in the water column, which enhances conditions for submerged aquatic vegetation. Together these habitats provide different functions for fish and protective stepping stones for their migration through coastal waters. Fragmenting these habitats, or damaging one of a series of interrelated habitats, makes it more difficult for aquatic systems to support strong and healthy coastal fisheries. The Marine Fisheries Commission identified a need to locate strategic habitats. These areas are a subset of all coastal habitats and consist of strategically located complexes of fish habitat that provide exceptional ecological functions or are particularly at risk due to vulnerability, rarity, or an imminent threat. These areas merit special attention and should be given high priority for conservation (Ch. 15).

RECOMMENDATIONS:

1. Support assessments to classify habitat value and condition by:
    a. coordinating, completing, and maintaining baseline habitat mapping (including seagrass, shell bottom, shoreline, and other bottom types) using the most appropriate technology.
    b. selectively monitoring the condition and status of those habitats.
    c. assessing fish-habitat linkages and effects of land use and other activities on those habitats.
2. Continue to identify and field groundtruth strategic coastal habitats.



Goals and Recommendations

GOAL 3:

ENHANCE AND PROTECT HABITATS FROM ADVERSE PHYSICAL IMPACTS

The CHPP identifies a number of ways in which fish habitats can be damaged by direct physical impacts. Some examples include filling of wetlands, dredging of soft bottom habitat, destruction of shell bottom and hard bottom areas, damage to submerged aquatic vegetation by use of certain types of fishing gear, and physical obstructions that block fish movement to and from spawning areas. While large impacts can directly contribute to the loss of habitat functions, the accumulation of many small impacts can make a habitat more vulnerable to injuries from which it might otherwise recover quickly. In some cases, historic damage to a habitat can be mitigated through the creation of sanctuaries where the resource can recover. One such program involves creation of protected oyster reefs. In other cases, the cumulative impacts of multiple projects can be more effectively managed through comprehensive planning (Ch. 15).

RECOMMENDATIONS:

1. Expand habitat restoration in accordance with restoration plan goals, including:
    a. creating subtidal oyster reef sanctuaries.
    b. re-establishing riparian wetlands and stream hydrology.
    c. restoring SAV habitat and shallow soft bottom nurseries.
    d. developing a mitigation process to restore lost fish habitat function.
2. Sustain healthy barrier island systems by maintaining and enhancing ecologically sound policies for ocean and inlet shorelines and implement a comprehensive beach and inlet management plan that provides ecologically based guidelines to protect fish habitat and address socioeconomic concerns.
3. Protect habitat from adverse fishing gear effects through improved compliance.

Goals and Recommendations

GOAL 3:

ENHANCE AND PROTECT HABITATS FROM ADVERSE PHYSICAL IMPACTS

RECOMMENDATIONS:

4. Improve management of estuarine and public trust shorelines and shallow water habitats by revising shoreline stabilization rules to include consideration of site specific conditions and advocate for alternatives to vertical shoreline stabilization structures.
5. Protect and restore habitat for migratory fishes by:
    a. incorporating the water quality and quantity needs of fish in water use planning and management.
    b. restoring fish passage through elimination or modification of stream obstructions, such as dams and culverts.
6. Ensure that energy development and infrastructure is designed and sited to minimize negative impacts to fish habitat, avoid new obstructions to fish passage, and, where possible, provide positive impacts.
7. Protect and restore important fish habitat functions from damage associated with activities such as dredging and filling.
8. Develop coordinated policies including management adaptations and guidelines to increase resiliency of fish habitat to ecosystem changes.

Seasonal restrictions on navigational dredging are an effective means of protecting fish during critical times of their lives, such as during spawning periods or when early juvenile fish are growing in nursery areas.

Goals and Recommendations

GOAL 4:

ENHANCE AND PROTECT WATER QUALITY

Clean water is essential to coastal fisheries. Water conditions necessary to support coastal fish include the right combination of temperature, salinity, and oxygen, as well as the absence of harmful pollutants. Achieving and maintaining good water quality for purposes of fish productivity requires management of both direct discharges to surface waters and nonpoint runoff from land activities. While there have been great improvements to water quality management, support through funding and technological advances is needed to sustain water quality as coastal uses increase. The CHPP recommends strategies to address water quality impacts by maintaining rule compliance through inspections, local government incentives, and developing new technology to reduce point and nonpoint pollution through voluntary actions. Maintaining the water quality necessary to support vital coastal fisheries will benefit not only the fishing industry but also a large sector of the entire coastal economy that is built around travel, tourism, recreational fishing, and other outdoor activities (Ch. 15).

RECOMMENDATIONS:

1. Reduce point source pollution discharges by:
    a. increasing inspections of wastewater discharges, treatment facilities, collection infrastructure, and disposal sites.
    b. providing incentives and increased funding for upgrading all types of discharge treatment systems and infrastructure.
    b. developing standards and treatment methods that minimize the threat of endocrine disrupting chemicals on aquatic life.
2. Address proper reuse of treated wastewater effluent and prohibit new wastewater discharges (excluding reverse osmosis and nanofiltration effluent).
3. Prevent additional shellfish closures and swimming advisories through:
    a. conducting targeted water quality restoration activities.
    b. prohibiting new or expanded stormwater outfalls to coastal beaches and to coastal shellfishing waters (EMC surface water classifications SA and SB) except during times of emergency (as defined by the Division of Water Resource's Stormwater Flooding Relief Discharge Policy) when public safety and health are threatened.
    b. continuing to phase out existing outfalls by implementing alternative stormwater management strategies .
4. Enhance coordination with, and provide financial/technical support for, local government/private actions to effectively manage stormwater, stormwater runoff, and wastewater.

Goals and Recommendations

GOAL 4:

ENHANCE AND PROTECT WATER QUALITY

RECOMMENDATIONS:

5. Continue to improve strategies throughout the river basins to reduce nonpoint pollution and minimize cumulative losses of fish habitat through voluntary actions, assistance, and incentives, including:
    a. improving methods to reduce pollution from construction sites, agriculture, and forestry.
    b. increasing on-site infiltration of stormwater.
    c. documenting and monitoring of small but cumulative impacts to fish habitats from approved, unmitigated activities.
    d. encouraging and providing incentives for implementation of low-impact development practices.
    e. increased inspections of onsite wastewater treatment facilities.
    f. increasing use of reclaimed water and recycling.
    g. Increasing voluntary use of riparian vegetated buffers for forestry, agriculture, and development.
    h. increasing funding for strategic land acquisition and conservation.
6. Maintain effective regulatory strategies throughout the river basins to reduce nonpoint pollution and minimize cumulative losses of fish habitat, including use of vegetated buffers and established stormwater controls.
7. Maintain adequate water quality conducive to the support of present and future mariculture in public trust waters.
8. Reduce nonpoint source pollution from large-scale animal operations by the following actions:
    a. Ensuring proper oversight and management of animal waste management systems.
    b. Ensuring certified operator compliance with permit and operator requirements and management plan for animal waste management systems.

For every $1 invested in land conservation in NC, there is estimated to be a $4 return in economic value from natural resource goods and services alone, without considering other economic benefits.

Priority Habitat Issue - *Oyster Restoration*

Oyster populations in NC have declined by as much as 90% from their historic levels. Historical overfishing, habitat destruction, disease, and pollution have contributed to the significant decline and slow recovery rates of oyster reefs. Recognized as an ecosystem engineer, oyster reefs are critical economically for the seafood industry and ecologically for improving water quality and providing fish habitat. For 100 years, the DMF has been "planting" oyster shell in open harvest areas to provide additional hard substrate for oyster recruitment. The planted shell soon becomes a living oyster reef, enhancing the oyster fishery and providing fish habitat. Since 1998, DMF has constructed 13 subtidal oyster sanctuaries where shellfish harvest is not allowed. Oysters growing in the protected sanctuaries serve as broodstock, providing larvae that recruit onto other hard substrate in surrounding waters. Despite these efforts, oyster populations remain well below historic levels, fishing pressure increases, and water quality declines. Lack of additional funding to purchase and deploy hard material and conduct research limits the ability to expand oyster restoration activities. The CHPP Steering Committee considers this one of the most important activities that could be done to improve habitat and water quality in NC's coastal waters (Ch. 12).

Proposed Implementation Actions

Cultch Planting

- ◊ Increase spending limit per bushel of shell to compete with other states.
- ◊ Develop a cooperative public/private, self-sustaining shell recycling program by providing financial incentives in exchange for recycled shell.
- ◊ Work with the shellfish industry to institute an "oyster use fee" to help support the cultch planting program.
- ◊ Identify alternative substrates for larval settlement in intertidal and subtidal reefs, including a cost-benefit analysis.
- ◊ Establish long term monitoring program to support future decision making.
- ◊ Utilize new siting tools and monitoring protocols to maximize reef success.

Hatchery Oyster Seed Production

- ◊ Explore options for increasing funds to support UNCW oyster hatchery.
- ◊ Identify regional genetic variability within NC.
- ◊ Improve availability of seed oysters genetically suited to respective regions.

Oyster Sanctuaries

- ◊ Identify alternative substrates for larval settlement in intertidal and subtidal reefs, including a cost-benefit analysis.
- ◊ Identify the size and number of sanctuaries needed.
- ◊ Develop reefs that are resistant to poaching.
- ◊ Utilize new siting tools to maximize reef success.
- ◊ Explore options for in situ sampling protocol to incorporate alternative construction materials.

Priority Habitat Issues - *Living Shorelines*

Living shorelines is the term used for a type of designed shoreline stabilization technique that incorporates live components such as marsh plants, frequently in combination with rock or oyster sill structure. Wetland and shell bottom habitat along the shoreline have declined in many areas due to natural erosion and vertical shoreline hardening with bulkheads. Living shorelines offer an effective alternative for protecting waterfront property, while restoring fish habitat and ecosystem services. Since 2005 progress has been made to better understand the benefits and limitations of living shorelines. Research in NC has found that living shorelines supported a higher diversity and abundance of fish and shellfish than bulkheaded shorelines, effectively deterred erosion, and survived storm events well. Outreach efforts have been done to increase awareness of this technique to the public and contractors. Nonprofit organizations and DCM have constructed several demonstration projects. However, despite these efforts, only approximately 60 living shorelines have been permitted coastwide, in contrast to 93 miles of bulkheads (based on 2012 DCM mapping). The CHPP Steering Committee requested that efforts continue to focus on encouraging living shorelines as a win-win-win solution: protecting property, restoring shoreline habitat, and improving water quality (Ch. 12).

Proposed Implementation Actions

Outreach

- ◊ Seek funding and partnerships to increase the number of highly visible demonstration projects.
- ◊ Develop case studies that property owners can relate to that discuss site conditions, initial and ongoing costs, and performance of the structure.
- ◊ Actively engage with contractors, realtors, and homeowners associations in the design and benefits of living shorelines.
- ◊ Enhance communications, marketing, and education initiatives to increase awareness of and build demand for living shorelines among property owners.

Research

- ◊ Examine the effectiveness of natural and other structural materials for erosion control and ecosystem enhancement.
- ◊ Examine the long-term stability of living shorelines and vertical structures, particularly after storm events.
- ◊ Map areas where living shorelines would be suitable for erosion control.
- ◊ Investigate use of living shorelines as a BMP or mitigation option.

Permitting

- ◊ Continue to simplify the federal and state permitting process for living shorelines.

Priority Habitat Issue - *Sedimentation*

Sedimentation in creeks, particularly in nursery areas, is a continuing concern. While a moderate amount of sediment input is necessary to maintain shallow soft bottom habitat that supports wetlands, excessive amounts can silt over existing oyster beds and submerged aquatic vegetation, smother invertebrates, clog fish gills, reduce survival of fish eggs and larvae, reduce recruitment of new oysters onto shell, and lower overall diversity and abundance of marine life. Pollutants such as toxins, bacteria, and nutrients bind to sediment particles and are transported into estuarine waters, where they can accumulate in the sediment and impact aquatic organisms. Sediment enters the upper estuary via runoff and ditching due to land clearing activities associated with agriculture, forestry, and development. Shoreline erosion, tidal inflow, and dredging also contribute sediment in the lower estuary. Studies done in NC indicate that relatively high sedimentation has occurred in the past. The effect on estuarine productivity is uncertain. More assessment on the extent and effect of sedimentation in NC coastal creeks and rivers is needed, along with current rates of sediment inputs, to determine the best way to address sedimentation (Ch. 12).

Proposed Implementation Actions

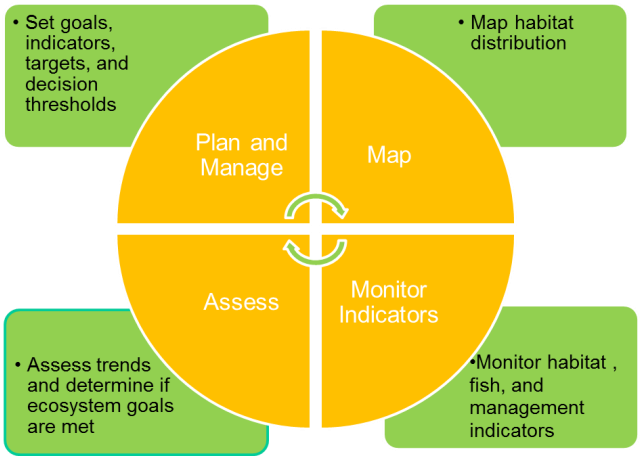
- ◊ Determine magnitude and change in sedimentation rates and sources over time at sufficiently representative waterbodies and regions.
- ◊ Determine the effect of sedimentation in the upper estuaries on primary and secondary productivity and juvenile nursery function.
- ◊ Encourage research for innovative and effective sediment control methods in coastal river basins.
- ◊ Encourage expanded use of voluntary stormwater BMPs and low impact development (LID) to reduce sediment loading into estuarine creeks.
- ◊ Partner with NC Department of Transportation to retrofit road ditches that drain to estuarine waters.
- ◊ Improve effectiveness of sediment and erosion control programs by:
  - ♦ Encouraging development of effective local erosion control programs to maintain compliance and reduce sediment from reaching surface waters.
  - ♦ Enhancing monitoring capabilities for local and state sediment control programs (e.g., purchase turbidity meters and train staff to use them).
  - ♦ Continuing to educate the public, developers, contractors, and farmers on the need for sediment erosion control measures and techniques for effective sediment control.
  - ♦ Provide education and financial/technical support for local and state programs to better manage sediment control measures from all land disturbing activities.

In 2014, 6,290 acres were impaired by turbidity for the aquatic life use support classification in coastal subbasins (DWR 2014 Integrated Report).

Priority Habitat Issue - *Developing Metrics*

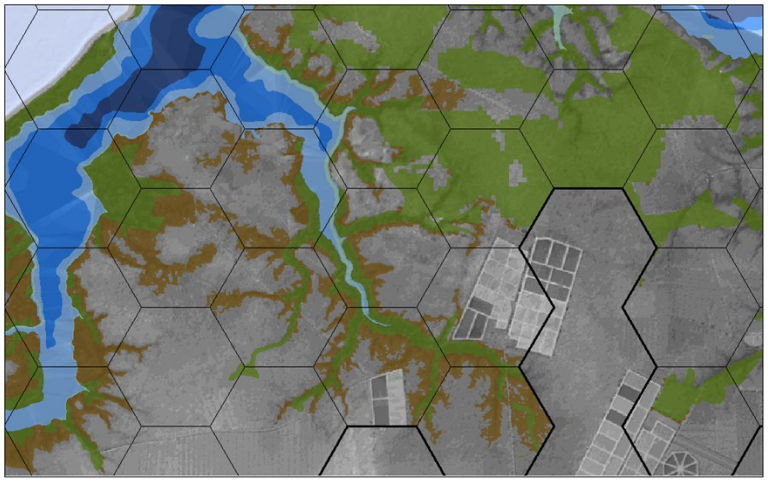
Developing metrics to assess habitat trends and management effectiveness is the cornerstone of habitat protection and restoration. Without them, needed habitat conservation initiatives are unknown. Ecosystem-based management is the process where monitoring of ecosystem indicators is done to assess the condition of the resource and the effectiveness of management strategies; management actions are modified based on monitoring results. This process requires mapping all habitat to assess trends in distribution, developing and monitoring representative indicators to assess habitat condition, monitoring fish use of habitats in priority areas, and developing management performance criteria for measuring success of management actions. The DEQ has already initiated mapping and monitoring of some habitats but has not established continual monitoring of habitat to evaluate management effectiveness. The Albemarle-Pamlico National Estuary Partnership established ecosystem indicators in 2012 to help determine the status of that system. The DMF has identified strategic coastal habitats in most of the coastal waters that are high priority for protection so that fish populations are sustained. More work is needed to establish a cyclic process to monitor, assess, and successfully and efficiently manage NC's coastal resources.

The lack of quantified trends in habitat condition and success of management actions was identified as a priority concern of the CHPP Steering Committee (Ch. 12).



Proposed Implementation Actions

- ◊ Develop indicator metrics for monitoring the status and trends of each of the six habitat types within North Carolina's coastal ecosystem (water column, shell bottom, SAV, wetlands, soft bottom, hard bottom).
- ◊ Establish thresholds of habitat quality, quantity, or extent similar to limit reference points or traffic lights, which would initiate predetermined management actions.
- ◊ Develop indicators for assessing fish utilization of strategic coastal habitats.
- ◊ Develop performance criteria for measuring success of management decisions.



"When one tugs at a single thing in nature, he finds it attached to the rest of the world."

John Muir

NC Coastal Habitats

North Carolina's coastal fish habitats provide important functions for the plants and animals living in them. This diversity of interconnected habitats provides food, shelter, and places to reproduce and grow for a tremendous variety of fish, shellfish, and crustaceans. Protecting and restoring these habitats is essential to the survival of North Carolina's fisheries.

While poor water quality puts the ability of habitats to function and support fish populations at risk, physical damage caused by humans is also a serious threat. Conversion of wetlands by draining, filling, and water control projects are the major sources of wetland loss in eastern North Carolina. Shell bottom habitat along our coast has been decimated by a century of excessive mechanical harvests and diseases. More recently, dredging for navigation channels and marinas, as well as damage from bottom-disturbing fishing gear, threatens remaining shell bottom and submerged aquatic vegetation habitat and impedes establishment of those habitats. Submerged aquatic vegetation is also vulnerable to uprooting by boat propellers and to shading by docks and piers. These and other types of physical impacts affect the ability of fish habitats to sustain fisheries and increase their vulnerability to water quality problems (Ch. 2-7).

The CHPP identifies six fish habitats that need protection or enhancement:

- Water Column
- Shell Bottom
- Submerged Aquatic Vegetation (SAV)
- Wetlands
- Soft Bottom
- Hard Bottom

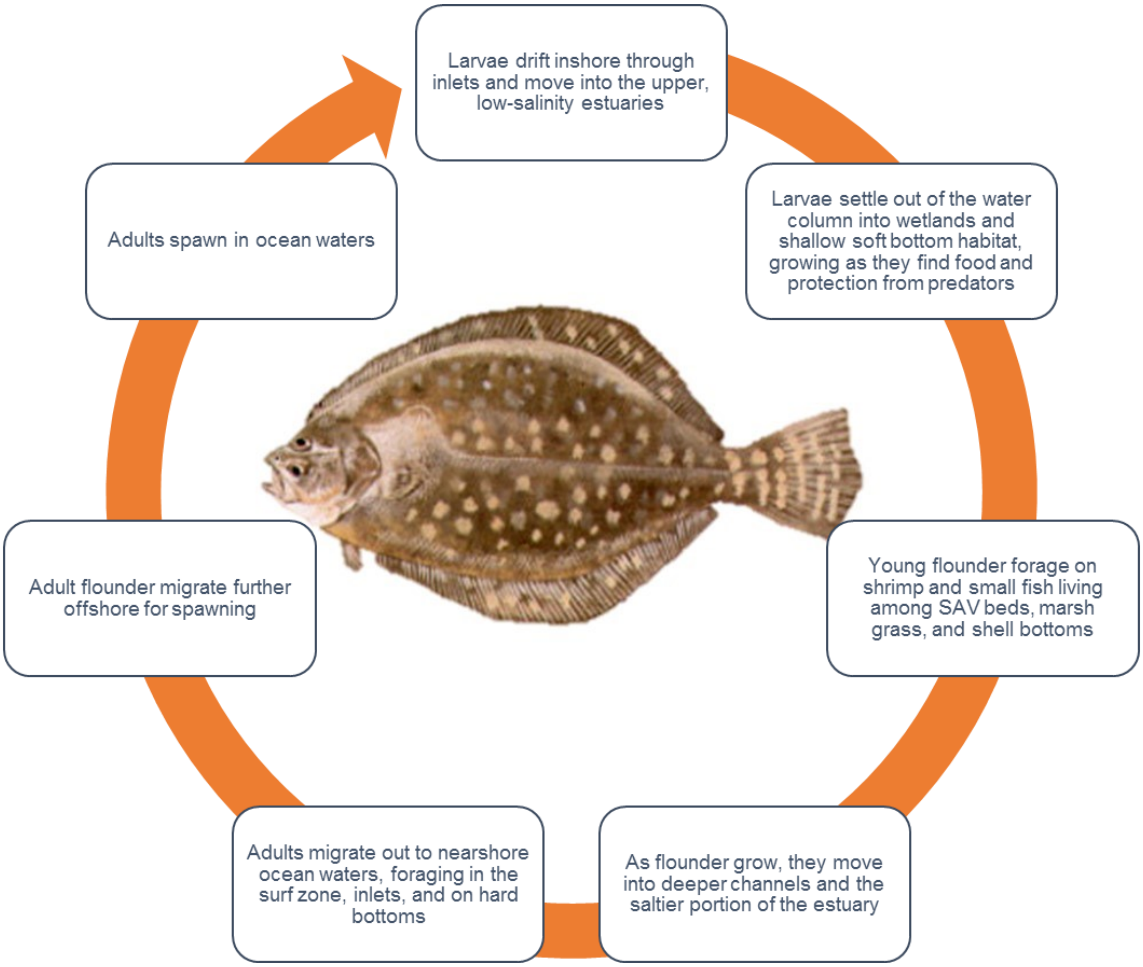
Habitats provide important functions for fish species.

Refuge:	shelter for fish at various life stages and a place for plants and animals to attach
Nursery:	refuge and foraging habitat suitable for development of juvenile life stages of fish, shellfish, and crabs
Spawning:	conditions that allow adults to reproduce
Foraging:	presence and accessibility of food sources
Corridor:	connectivity for safe passage among foraging, spawning, and refuge areas

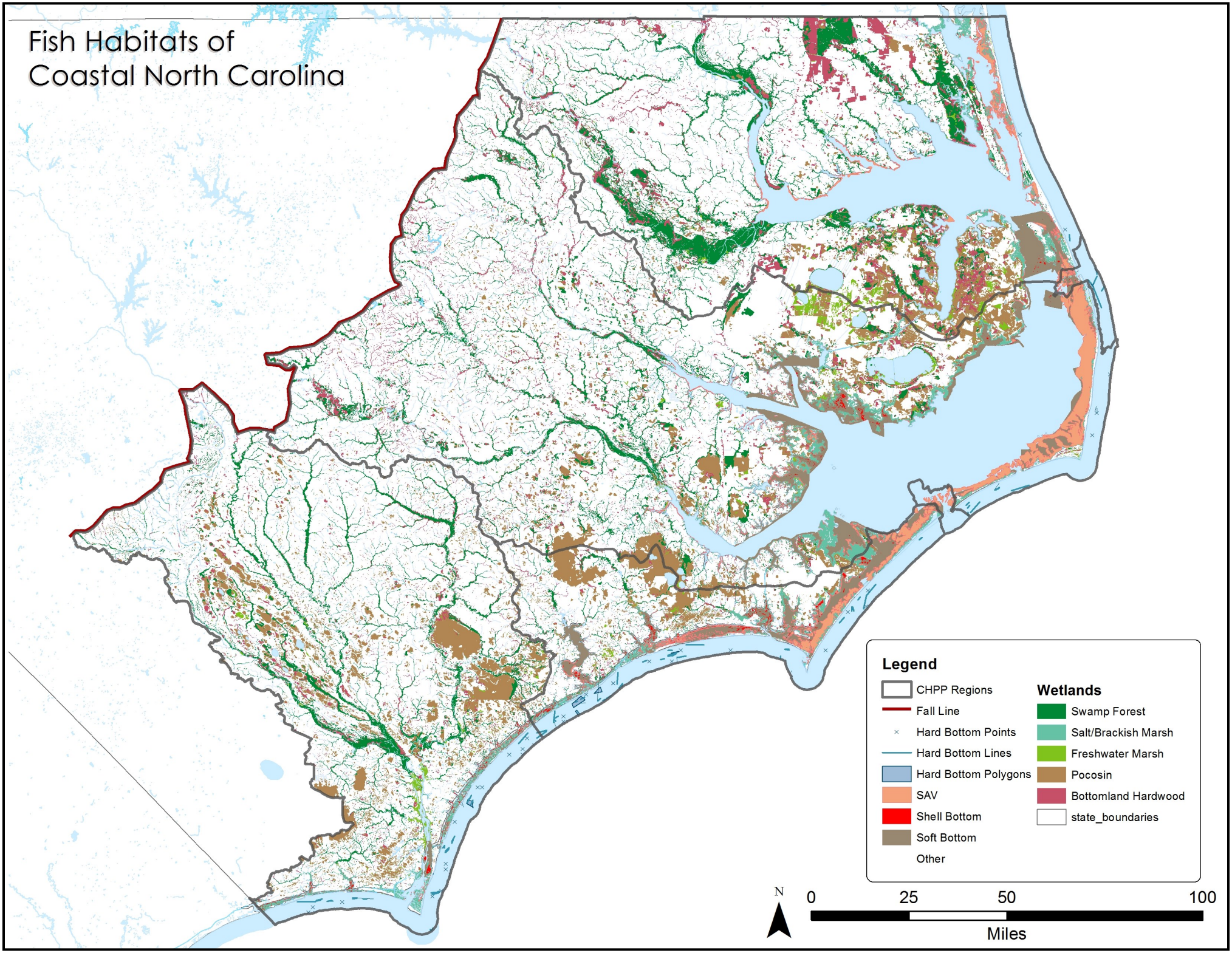
Habitat: "a place, or set of places, in which a fish or fish population finds the physical, chemical, and biological features needed for life."

NC Coastal Habitats

All fish habitats are integral components of the entire aquatic ecosystem because species require use of multiple habitats throughout their life history; the water column connects them all. Organisms occupy specific areas or habitats that meet their needs for each particular life stage. Certain areas, such as nursery areas, are especially important to fish production, and some, such as shallow grass beds are particularly vulnerable to human impacts. To maintain a healthy coastal ecosystem that provides all the ecological functions necessary for NC's coastal fish populations, it is more effective to address the entire system of interdependent habitats, rather than a single habitat type (Ch. 2-7).



The relationship between habitat conditions and populations of fishery species is complex. In the past, the decline of a particular fish stock was often attributed to overfishing. We know now that the quality and quantity of fish habitats is important to healthy fish populations. Habitat loss and degradation make fish populations more susceptible to overfishing and can cause a delay in recovery even after management actions have successfully reduced fishing pressures. River herring and shortnose sturgeon are examples of species that have not recovered despite lengthy fishing moratoriums. Thus, the status of fisheries can be an indicator of impacts to fish habitats. Successful implementation of the CHPP recommendations is a necessary component to sustaining productive fisheries for future generations.


Fish Habitats of
Coastal North Carolina
Legend
CHPP Regions
Fall Line
Hard Bottom Points
Hard Bottom Lines
Hard Bottom Polygons
SAV
Shell Bottom
Soft Bottom
Other
Wetlands
Swamp Forest
Salt/Brackish Marsh
Freshwater Marsh
Pocosin
Bottomland Hardwood
state_boundaries
N
0
25
50
100
Miles

Water Column - *The Most Essential Habitat*

Water column is the medium through which all aquatic habitats are connected and affects all other habitats and the distribution and survival of fish. The water column includes riverine, estuarine, lacustrine, palustrine, and marine systems. Properties affecting fisheries resources and distribution include: temperature, salinity, dissolved oxygen (DO), total suspended solids (TSS), nutrients (nitrogen, phosphorus), chlorophyll a, pollutants, pH, velocity, depth, movement, and clarity. Within a river basin, these properties change as you move from the headwaters to the ocean (Ch. 2).

Fish **distribution** in the water column is often determined by salinity and proximity to inlets. The potential **productivity** of fish and invertebrates begins with energy and nutrient production at the base of the food chain. Productivity in the water column comes from phytoplankton, floating plants, macroalgae, benthic microalgae, and detritus.

Economic Benefits

U.S. commercial and recreational saltwater fishing generated more than $199 billion in sales in 2012, according to the Fisheries Economics of the United States. In North Carolina, the recreational and commercial fishery generated $1.87 billion in 2011.

Habitat Functions and Fish Use

The corridor between freshwater creeks or rivers and estuarine/marine systems is important to all fish, particularly species whose life spans more than one system, such as species that must migrate upstream to spawn (anadromous) or marine-spawning estuarine-dependent species.

Water column provides **nursery habitat** for juvenile pelagic species, such as kingfish and pompano in the surf zone. Optimum physical and chemical properties, such as currents, temperature and salinity determine survival and settlement of larvae. The water column is a food source for all size organisms, supporting microscopic plants and animals (phytoplankton and zooplankton), and prey species of all sizes.

The ability of the water column to provide predatory refuge varies relative to area, depth, water quality, and vegetation. Juvenile fishes are protected in shallow areas that larger fish cannot access. Turbidity and DO can provide refuge for pelagic species by excluding predators that feed visually or are not tolerant of low DO.

FACT: 76,927 acres of coastal water column are designated as Primary Nursery Areas. 82,000 acres are designated as Secondary or Special Secondary Nursery Areas.

Habitat Profile

Water Column Functions

- Connects all habitat types
- Allows fish to move among habitats
- Surrounds and supports aquatic animals and habitats

How Fish Use the Water Column

- Transports eggs, larvae, and oxygen
- Nursery area for all fish species
- Foraging area for all fish species
- Spawning area for all fish species

Water Column - *The Most Essential Habitat*

Status and Trends

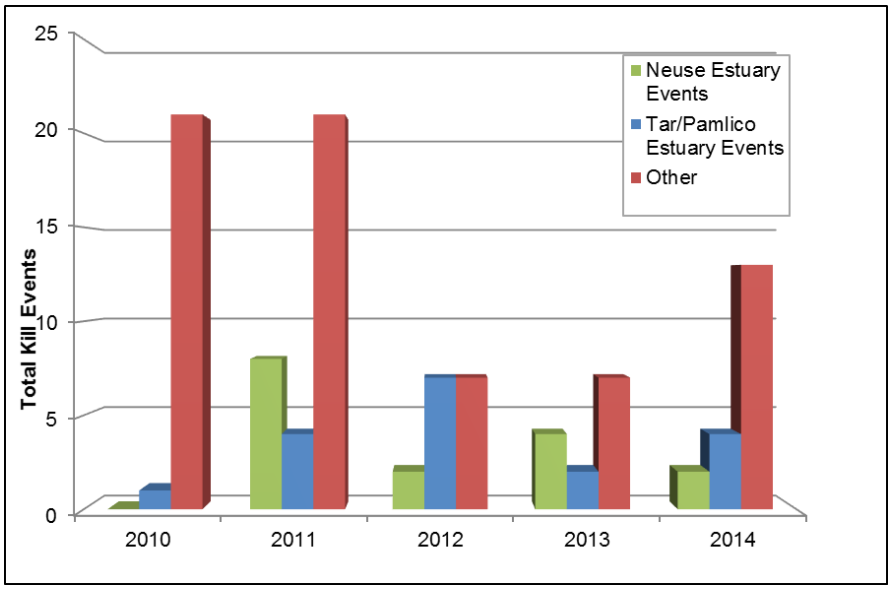
The condition of the water column is described by physical and chemical properties, pollution indicators, and the status of pelagic fisheries. However, evaluating the status and trends of water column characteristics is difficult. The number of monitoring agents, monitoring site distribution, frequency of data collection, and parameters measured are not conducive to comprehensive water quality assessments. Monitoring for microbial contamination of shellfish harvesting waters remains the most abundant measurement of estuarine water quality. Data collected from monitoring stations within the CHPP area include those from ±1,020 shellfish growing area stations, 240 recreational water quality stations, and ±256 DWR ambient stations. Change in water quality at selected stations throughout the coast are shown in the CHPP source document.

The health of pelagic fishery species can be an indicator of water quality. Kingfish and menhaden are positive examples of species with improving or stable populations.

FACT: As of March 2014, over 442,106 acres of shellfish harvesting waters, or 20% of classified shellfish waters, were closed in North Carolina due to high levels of fecal coliform or the potential risk of bacterial contamination. As an adaptive measure to reduce permanent closures, 55,628 acres are conditionally opened and closed based on rainfall and sampling.

Threats to Water Column

Whether certain species will thrive and reproduce is strongly affected by conditions such as water clarity, DO, and nutrient levels. Fish kills and harmful algal blooms during the 1980s and 1990s were visible signs of coastal water quality problems. Most frequently reported species in fish kills are Atlantic menhaden, spot, flounder, and croaker. Large fish kills and algal blooms have diminished somewhat in recent years, but many coastal waters remain impaired. Excess sediment loading is the largest cause of impairment.



Human activities often change the chemistry of the water, reducing water quality. These changes can originate from point sources, such as industrial or wastewater discharges, or from non-point runoff from construction or industrial sites, development, roads, agriculture or forestry. Any number of sources can result in pollutants and sediment entering surface waters. It is apparent when excess sediment clouds the water and fills a waterway, but beneath the water's surface, these particles also clog fish gills and bury plants, shellfish, and other aquatic species.

All coastal habitats are connected by water. Clean water is essential to aquatic life.

Shell Bottom - *Building Reefs & Cleaning Water*

Shell bottom is unique because it is the only coastal fish habitat that is also a fishery species (oysters). Shell bottom is estuarine intertidal or subtidal bottom composed of surface shell concentrations of living or dead oysters, hard clams, and other shellfish. Oysters, the primary shell-building organism in North Carolina estuaries, are found throughout the coast, from southeast Albemarle Sound to the South Carolina border. The protection and restoration of living oyster beds is critical to the restoration of numerous fishery species, as well as to the proper functioning and protection of surrounding coastal fish habitats. Historically, restoration was managed for oyster fishery enhancement. Current efforts mix fishery and ecosystem enhancement with sanctuary development (Ch. 3).

Habitat Profile

Shell Bottom Functions

- Provides structure, shelter, and food source
- Filters pollutants and other particles from water
- Protects shoreline by slowing wave energy

How Fish Use Shell Bottom

- Place for oysters and other shellfish to attach
- Nursery area for blue crab, sheepshead, and stone crab
- Foraging area for drum, black sea bass, and southern flounder
- Spawning area for hard clams, toadfish, and goby
- Refuge for goby, grass shrimp, and anchovy

Economic Benefits

Conservatively, restored and protected oyster reefs provide up to $40,200 per acre per year (2012 dollars) in ecosystem benefits, including water filtration and sediment stabilization. The dollar benefit of the nitrogen removal service provided by oyster reefs was estimated to be $3,167 per acre per year (2014 dollars).

Habitat Functions and Fish Use

Shell bottom is widely recognized as **essential fish habitat** (EFH) for oysters and other reef-forming mollusks and provides critical fish habitat for ecologically and economically important finfish, mollusks, and crustaceans. In North Carolina, over 40 species of fish and crustaceans have been documented to use natural and restored oyster reefs, including American eel, Atlantic croaker, Atlantic menhaden, black sea bass, sheepshead, spotted seatrout, red drum, and southern flounder. Oysters are **ecosystem engineers** that alter current and flows, protect shorelines, and trap and stabilize large quantities of suspended solids, reducing turbidity by building high relief structures. The interstitial spaces between and within the shell matrix of oyster reefs are critical **refuges** for the survival of recruiting oysters and other small, slow-moving macrofauna, such as worms, crabs, and clams. Shell bottom is also valuable **nursery** habitat for juveniles of commercially and recreationally important finfish, such as black sea bass, sheepshead, gag, and snappers. Additionally, shell bottom is important **foraging** ground for many economically and ecologically important species. The **proximity** and **connectivity** of oyster beds enhances the fish utilization of nearby habitats, especially SAV. Shell bottom contributes primary production indirectly from plants on and around it, but it is more important for its high secondary productivity contribution from the biomass of oysters and other macroinvertebrates living among the shell structure. This in turn supports a high density of mobile finfish and invertebrates, which were found to be more than two times higher than in marshes, soft bottom, and SAV.

Shell bottom areas include reefs made of living oysters or shells, located in the subtidal or intertidal zone of sounds and estuaries

Shell Bottom - *Building Reefs & Cleaning Water*

Status and Trends

North Carolina oyster stocks were declining for most of the twentieth century. Poor harvesting practices led to initial degradation and loss of shell bottom habitat in the Pamlico Sound area. After 1991, oyster stocks and harvests began to collapse from disease mortalities and low spawning stock biomass. Harvests began to rise again around 2002, and the trend has continued. Between 2000 and 2013, oyster dredging trips have risen substantially with increasing harvest, as have hand harvest trips. A trend of stable or increasing spatfall coastwide is indicative of increasing larval availability, connectivity, and recruitment potential to restored and existing reefs. As of January 2015, there were 13 established oyster sanctuaries, with an additional two proposed.

Fact: Oyster beds were once so abundant that they were considered a navigation hazard.

Threats to Shell Bottom

Shell bottom is occasionally susceptible to diseases and microbial stressors. Neurotoxic Shellfish Poisoning (NSP), also called **"Florida red tide,"** is a disease caused by consumption of molluscan shellfish contaminated with brevetoxins produced by the dinoflagellate, *Karenia brevis*. Blooms of *K. brevis* occur frequently along the Gulf of Mexico, but the largest reported outbreak of NSP in the US occurred in North Carolina beginning in 1987. The protozoan pathogen *Perkinsus marinus*, also called **"dermo"** has been responsible for major oyster mortalities in North Carolina. Monitoring of dermo disease by DMF shows a declining trend in heavy prevalence, with an increasing trend in overall infection.

Boring sponge, sponges belonging to the genus *Cliona*, are found in North Carolina shell bottom habitats. Boring sponges compromise the integrity of shells and are linked to reduced oyster gamete viability and possibly increased oyster mortality rates. Two North Carolina oyster sanctuaries experienced dramatic population declines since 2012, coinciding with increasing percent cover of marine boring sponge. *Cliona* is endemic to North Carolina but has recently become more pervasive, especially on limestone marl rocks. To improve reef design in high salinity waters, DMF is conducting research on alternative substrates to identify materials that maximize oyster recruitment, growth, and survival, while offering high resistance to environmental stressors, such as Cliona boring sponge.

The protection and restoration of living oyster beds is critical to the restoration of numerous fishery species, as well as to the proper functioning and protection of surrounding coastal fish habitats. Historically, restoration was managed for oyster fishery enhancement. Current efforts mix fishery and ecosystem enhancement with sanctuary development.

Shell bottom is considered to be one of the most threatened habitats because of its greatly reduced extent.

SAV - Underwater Gardens

Submerged aquatic vegetation (SAV) is a fish habitat dominated by one or more species of underwater vascular plants that occur in patches or extensive beds in shallow estuarine waters. The presence and density of SAV varies seasonally and inter-annually. A key factor affecting distribution is adequate light penetration; therefore, SAV occurs in shallow clear water. Sediment composition, wave energy, and salinity are also determining factors (Ch. 4).

Habitat Profile

SAV Functions

- Provides refuge for fish and other aquatic animals
- Serves as food for fish and waterfowl
- Produces dissolved oxygen
- Reduces wave energy and limits erosion
- Uses nutrients and traps sediments

How Fish Use SAV

- Nursery area for blue crab, pink shrimp, and red drum
- Foraging area for spotted sea trout, gag, and flounder
- Spawning area for spotted sea trout, grass shrimp, and bay scallop
- Refuge for bay scallop and hard clam

Economic Benefits

SAV habitat has a very high economic value due to the ecosystem services it provides. The estimated value of SAV and algal beds combined is $7,700/acre/year. This estimate takes into account services such as seafood production, wastewater treatment, climate regulation, erosion control, recreation, and others. The value of SAV for denitrification services (wastewater treatment) is estimated at $3,000/acre/year compared to approximately $400/acre/year for subtidal soft bottom. With North Carolina having the second largest expanse of SAV on the east coast, protection and enhancement of this valuable resource should be a high priority for the state.

Habitat Functions and Fish Use

Submerged aquatic vegetation is recognized as **essential fish habitat** because of five interrelated features – **primary production**, **structural complexity**, **modification of energy regimes**, **sediment and shoreline stabilization**, and **nutrient cycling**. Water quality enhancement and fish utilization are especially important ecosystem functions of SAV relevant to the enhancement of coastal fisheries. Seagrasses produce large quantities of organic matter. Many fish species occupy SAV at some point in their life for **refuge**, **spawning**, **nursery**, **foraging**, and **corridors**. SAV is considered essential fish habitat for red drum, shrimp, and species in the snapper-grouper complex. Spotted seatrout are also highly dependent on SAV, and bay scallops occur almost exclusively in SAV beds.

Due to its stringent water quality requirements, SAV presence is considered a barometer of water quality.

SAV - Underwater Gardens

Status and Trends

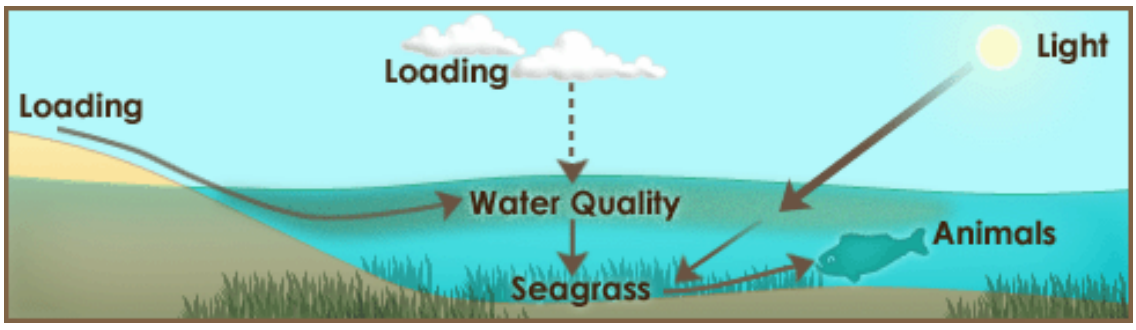
There has been a global and national tend of declining SAV habitat, with seagrasses disappearing at rates similar to coral reefs and tropical rainforests. In North Carolina, SAV loss has not been quantified, but anecdotal reports indicate that the extent of SAV may have been reduced by as much as 50%, primarily on the mainland side of coastal sounds. Mapping of SAV has been done by several entities since the 1980s, but often with different methods and not coastwide. Comprehensive mapping of SAV habitat in coastal North Carolina was initiated in 2007 by a joint effort of federal and state agency and academic institutions. In 2013, mapping protocols for high and low salinity areas was developed so that mapping can be repeated approximately every five years on a rotational basis among five coastal areas. This mapping, in combination with sentinel sampling, will allow trends to be assessed. In 2013 high salinity SAV from Currituck Sound to Bogue Sound were mapped using aerial photography and field groundtruthing. In Albemarle Sound and Tar-Pamlico River SAV was mapped in 2014-15 using a newly developed method for low salinity turbid waters using side scan data and low light underwater photography for groundtruthing. In 2015, SAV south of Bogue Sound was mapped.

Fact: Over 196,000 acres of SAV have been mapped in coastal North Carolina.

While a quantified change analysis is not yet available, preliminary review of core areas of SAV, such as behind the Outer Banks in Pamlico Sound and Core Sound, did not detect large changes since previous imagery for those areas in 2004. Expansion of SAV has been observed in Albemarle Sound and south of Bogue Inlet. Bay scallop abundance in the southern area is increasing in areas of increasing SAV.

Threats to SAV

Major threats to SAV habitat are channel dredging and water quality degradation from excessive nutrient and sediment loading. Natural events, human activities, and an ever-changing climate influence the distribution and quality of SAV habitat. Natural events include shifts in salinity due to drought and excessive rainfall, animal foraging, storm events, temperature, and disease. Submerged vegetation is vulnerable to water quality degradation, in particular, suspended sediment and pollutant runoff. Large amounts of algae and sediment make the water so cloudy that sufficient light cannot reach the plants, reducing their growth, survival, and productivity. Dredges and boat propellers can also have a direct effect on SAV habitat by uprooting and destroying the plants.



Wetlands - *Nature's Nurseries*

Wetlands are essential breeding, rearing, and feeding grounds for many species of fish and wildlife. They provide critical ecosystem services that contribute to healthy ecosystems and fisheries habitat. Coastal wetlands cover 40 million acres in the continental United States, with 81% in the Southeast. Wetlands require the presence of water at or near the surface and vegetation adapted to wet soils. Wetlands occupy low areas, often marking the transition between uplands and submerged bottom, in areas subject to regular or occasional flooding by tides, including wind tides. Wetlands are vegetated with marsh plants such as cordgrass and black needle rush, or forested wetland species like sweet gum, cypress, and willows (Ch. 5).

Habitat Functions and Fish Use

The services provided by wetlands include improving the quality of habitats through water control and filtration; protecting upland habitats from erosion; providing abundant food and cover for finfish, shellfish, and other wildlife; and contributing to the economy. By storing, spreading, and slowly releasing waters, wetlands are linked to reduced risk of flooding, and wetland loss has been linked to increased hurricane flood damage. Wetland communities are among the most productive ecosystems in the world. The plant matter decays into detritus, where it is exported to other waters and provides food for numerous organisms. Additionally, wetlands provide food, ideal growing conditions, and predator refuges for larval, juvenile and small organisms.

Economic Benefits

As the saying goes, "No wetlands, no seafood." It is estimated that over 95% of the finfish and shellfish species commercially harvested in the United States, and over 90% in North Carolina, are wetland-dependent. Consequently, wetlands significantly contribute to the productivity of North Carolina's seafood and fishing industries.

The economic benefit of wetlands in providing flood control, stabilizing shorelines, and trapping and filtering pollutants has been extensively studied. By providing flood control and reducing shoreline erosion, wetlands protect coastal property. Wetlands also protect property by deterring shoreline erosion. Studies have shown that even narrow (7-25m) marsh borders reduce wave energy by 60-95%. These services explain why wetland habitat has been linked to reducing hurricane damage. One study estimated that the loss of 1 acre of coastal wetlands could result in a $13,360 loss in gross domestic product ($14,759 in 2014 dollars), and that U.S. coastal wetlands could provide as much as $23.2 billion/year (25.63 billion/year in 2014 dollars) in storm protection services.

Habitat Profile

Wetland Functions

- Provide refuge and food for fish and other animals
- Filter pollutants
- Trap sediments
- Shoreline erosion control
- Hold and slowly release flood waters

How Fish Use Wetlands

- Nursery area for blue crab, shrimp, and southern flounder, spot, and croaker
- Foraging area for spotted sea trout, red drum, and flounder
- Spawning area for river herring, killifish, and grass shrimp
- Refuge for blue crab and grass shrimp

Wetlands - *Nature's Nurseries*

Status and Trends

The 2015 CHPP Source Document summarizes wetlands within the CHPP region based on two data sources, the National Land Cover Dataset (NLCD) and the National Wetlands Inventory (NWI). According to the 2011 NLCD, there were ±3,759,729 acres of woody and emergent herbaceous wetlands within the CHPP regions. This represents a 2.7% decrease in woody wetlands and an 18.9% increase in emergent herbaceous wetlands since 2001. During the same time and area, developed land increased approximately 30%. The US Fish and Wildlife Service (FWS) has produced a NWI since the mid 1970s. The distribution of these wetlands is presented in Table 5.1 of the 2015 CHPP Source Document. Populations of spotted sea trout and red drum, two wetland-dependent species, have shown great improvements in the past few years.

Fact: It has been estimated that over 95 percent of the United States' commercially harvested finfish and shellfish are wetland dependent.

Threats to Wetlands

In the late 1800s and early 1900s, large amounts of wetland loss resulted from ditching and draining for agriculture and forestry. Over the years, wetland loss has also occurred due to ditching — conversion to deep-water habitat for boat basins and navigation channels — followed by upland development, erosion, and shoreline hardening.

Statewide wetlands losses/gains and compensatory mitigation during FY 2012/13, 2013-14, and 2014-15. Data reflect permitting by DEQ and compensatory mitigation by Division of Mitigation Services.

	Permitted gains and losses		
Linear feet of streams	**2012-13**	**2013-14**	**2014-15**
Losses	81,473.0	117,694.0	59,498.9
Gains	48,712.0	78,024.0	22,620.0
Net change	-32,761.0	-39,670.0	-36,878.9
Acres of wetlands			
Losses	203.6	98.9	102.1
Gains	197.8	59.9	104.5
Net change	-5.8	-39.0	2.4
Acres of riparian buffers			
Losses	75.6	48.0	56.1
Gains	37.9	21.2	18.2
Net change	-37.8	-26.9	-37.9

*Data provided by DWR and DMS

Wetland impacts are now regulated by numerous federal and state laws including the US River and Harbors Act, the US Clean Water Act, the NC Coastal Area Management Act (CAMA), and the NC Dredge and Fill Law, among others. Wetland filling for development and wetland loss due to erosion and rising water levels are currently the primary threats. Changes in legislation in the past few years that increase the threshold for permitted allowable impacts will likely contribute to increased wetland impacts. Mitigation is required for larger wetland impacts. Offsetting historic wetland loss may now be possible through opportunities such as wetland restoration on conservation lands, rebuilding marsh islands, and constructing living shorelines.

Coastal wetlands are critical nursery areas and serve as the primary buffer between land and water-based impacts.

Soft Bottom - *The Dynamic Habitat*

Soft bottom is unconsolidated, unvegetated sediment that occurs in freshwater, estuarine, and marine systems. Mud flats, sand bars, inlet shoals, and intertidal beaches are specific types of soft bottom. Grain size distribution, salinity, DO, and flow characteristics affect the condition of soft bottom habitat and the type of organisms that use it. Soft bottom covers approximately 1.9 million acres. North Carolina's coast can be divided into geologically distinct northern and southern provinces. In the northern province (north of Cape Lookout), the seafloor consists of a thick layer of unconsolidated mud, muddy sand, and peat sediments. The low slopes of the bottom result in an extensive system of drowned river estuaries, long barrier islands, and few inlets. The southern province has a thin and variable layer of surficial sands and mud, with underlying rock platforms, a steeper sloping shoreline with narrow estuaries, short barrier islands, and numerous inlets (Ch. 6).

Habitat Functions and Fish Use

Soft bottom is important as a storage reservoir of nutrients, chemicals, and microbes in coastal ecosystems, allowing for both deposition and resuspension of nutrients and toxic substances. The surface of soft bottom supports benthic microalgae, contributing substantial primary production to the coastal system. Estuarine soft bottom supports over 400 species of benthic invertebrates in North Carolina. Juvenile stages of species such as summer and southern flounder, spot, Atlantic croaker, and penaeid shrimp use the shallow unvegetated flats, which larger predators cannot access, as important **nursery** habitat. As fish get larger, they will venture out of protective cover to forage in soft bottom. Fishery independent data from shallow creeks and bays in Pamlico Sound documented 78 fish and invertebrate species. Eight of those — spot, bay anchovy, Atlantic croaker, Atlantic menhaden, silver perch, blue crab, brown shrimp, and southern flounder — comprised > 97% of the total nekton abundance. Soft bottom between structured habitat (SAV, wetlands, shell bottom) acts as a barrier to **connectivity**, which can be beneficial to small invertebrates by reducing predation risk. Fish and invertebrates that commonly occur in this habitat, including hard clams, flatfish, skates, rays, and other small cryptic fish such as gobies, avoid predation by burrowing into the sediment, thus camouflaging themselves from predators. Ocean soft bottom, particularly in the surf zone and along shoals and inlets, serves as an important **feeding ground** for fish that forage on benthic invertebrates. These predators generally have high economic value as recreational and commercial fisheries, and include Florida pompano, red drum, kingfish, spot, Atlantic croaker, weakfish, Spanish mackerel, and striped bass. Many demersal and estuary-dependent fish **spawn** over soft bottom habitat in North Carolina's coastal waters.

Habitat Profile

Soft Bottom Functions

- Stores and recycles nutrients, chemicals
- Is a source of sand for other habitats
- Provides an area for marine animals to burrow

How Fish Use Soft Bottom

- Nursery area for blue crab, flounder, and croaker
- Foraging area for sea trout, red drum, and flounder
- Spawning area for shrimp, sturgeon, and kingfish
- Refuge area for hard clam, shrimp, and flounder

Soft bottom includes features such as mud flats, inlets, shoals, channel bottoms, and ocean beaches.

Soft Bottom - *The Dynamic Habitat*

Economic Benefits

Soft bottom benefits the economy by providing habitat for critical food sources, cycling nutrients, burying pollutants, and dampening wave energy. Beaches are extremely valuable for tourism and recreation, including surf fishing, surfing, and beach going. One study, averaging data from seven beaches in North Carolina, found the net economic benefits of a day at a North Carolina beach ranged from $14 to $104 for single day trips and $14 to $53 for users that stay onsite overnight.

Status and Trends

Comprehensive mapping of soft bottom habitat has not been completed. The loss of more structured habitat, such as SAV, wetlands, and shell bottom, has undoubtedly led to gains in soft bottom habitat. The quality of soft bottom habitat is a better indicator of soft bottom status than quantity. The best available information on sediment quality comes from EPA's latest National Coastal Condition Report (NCCR IV). The report rated the coast from North Carolina to Florida at 3.6 (fair) overall, while sediment quality was rated 2 (fair to poor), which was lower than in previous reports. Sediment quality is based on toxicity, contaminants, and total organic carbon (TOC). The percentage of area determined to be in poor condition was 13%. The primary reason for the low rating was sediment toxicity. The quality of soft bottom habitat can affect species abundance and diversity. Sediments in soft bottom habitat can accumulate both chemical and microbial contaminants, potentially affecting benthic organisms and the community structure. Tidal creeks are sensitive to various aspects of human development, but sensitivity depends on the size and location of the creeks. Because tidal creeks are the nexus between estuaries and land-based activities, the potential for contamination is great. Smaller intertidal creeks closer to headwaters demonstrate greater concentrations of nonpoint source contamination than larger systems closer to the mouth. The degree of contamination also depends on the amount of impervious cover surrounding the land.

Fact: Soft bottom covers about 2.1 million acres of estuarine and ocean bottom within state waters.

Threats to Soft Bottom

Inadequate information is available to determine the current condition of soft bottom. Many human activities aimed at enhancing the "coastal experience" can inadvertently degrade this habitat. The ecological functions provided by soft bottom can be altered by activities such as dredging for channels or marinas, shoreline stabilization, water churning in marinas, and use of certain types of fishing gear. Along the oceanfront, jetties form barriers to the movement of sand, altering the natural sediment cycle. Excess nutrient concentrations in coastal rivers, in combination with certain environmental conditions, can lead to no or low oxygen levels near the bottom, killing the benthic organisms in the sediment, which reduces food availability for larger invertebrates and fish. Sediment contaminated with toxins can affect reproduction and growth of shellfish and other aquatic animals. Soft bottom habitat is relatively resistant to a changing environment.

Soft bottom strongly influences the water column by the constant cycling of nutrients and sediments.

Hard Bottom - *Rocks, Reefs, and Wrecks*

Hard bottom habitat, also referred to as live bottom or reef, consists of exposed areas of rock or consolidated sediments that may or may not be characterized by a thin veneer of live or dead biota and is generally located in the ocean rather than in the estuarine system. Natural hard bottom is colonized to a varying extent by algae, sponges, soft coral, hard coral, and other sessile invertebrates. In South Atlantic waters, hard bottom can consist of exposed rock ledges or outcrops with vertical relief or can be relatively flat and covered by a thin veneer of sand.

Artificial reefs are structures constructed or placed in waters for the purpose of enhancing fishery resources. Because artificial reefs become colonized by algae, invertebrates, and other marine life, they provide additional hard bottom habitat and serve similar ecological functions for fish. Some of the materials used in artificial reef construction are vessels, concrete pipe, or prefabricated structures such as reef balls. The DMF Artificial Reef Program is responsible for deployment and maintenance of artificial reef sites in state and federal waters. There are 50 DMF-managed artificial reefs of varying construction in North Carolina, of which 29 are located in federal ocean waters, 13 in state ocean waters, and eight in estuarine waters (Ch. 7).

Habitat Functions and Fish Use

Exposed hard substrate provides stable attachment surfaces for **colonization** by numerous marine invertebrates and algae. This productive three-dimensional habitat is often the only source of structural **refuges** in open shelf waters and a source of concentrated food. Most reef fish spend almost their entire life cycle on hard bottom, which serves as nursery, spawning, and foraging grounds. The presence of ocean hard bottom off North Carolina, along with appropriate water temperatures, allows for the existence of a temperate-to-subtropical reef fish community and a snapper-grouper fishery. Because of their importance for spawning, nursery, and foraging, all of the nearshore hard bottoms off North Carolina have been federally designated as Habitat Areas of Particular Concern for the snapper-grouper complex.

Habitat Profile

Hard Bottom Functions

- Provides a place for sponges, algae, and coral to attach
- Offers refuge for reef fish
- Supplies new sand through erosion

How Fish Use Wetlands

- Nursery area for grouper, snapper, and black sea bass
- Foraging area for king mackerel, gag, and snapper
- Spawning area for black sea bass, grouper, and tropicals
- Refuge area for gag and black sea bass

Economic Benefits

Between 2011 and 2013, the North Carolina commercial snapper-grouper fishery harvested an annual average of 1,638,434 lbs of fish (total of 5,015,570 lbs) with an annual market value of over $4.2 million (total for 3 years - $12,567,964). During that same time period, recreational fisherman (private boats, charter boats, and head boats) harvested an average of 568,146 lbs of fish in the snapper-grouper complex/year, for a total of 1,204,439 lbs. Economic benefits also include revenue from the dive industry, since hard bottom reefs are popular dive sites.

Hard Bottom - Rocks, Reefs, and Wrecks

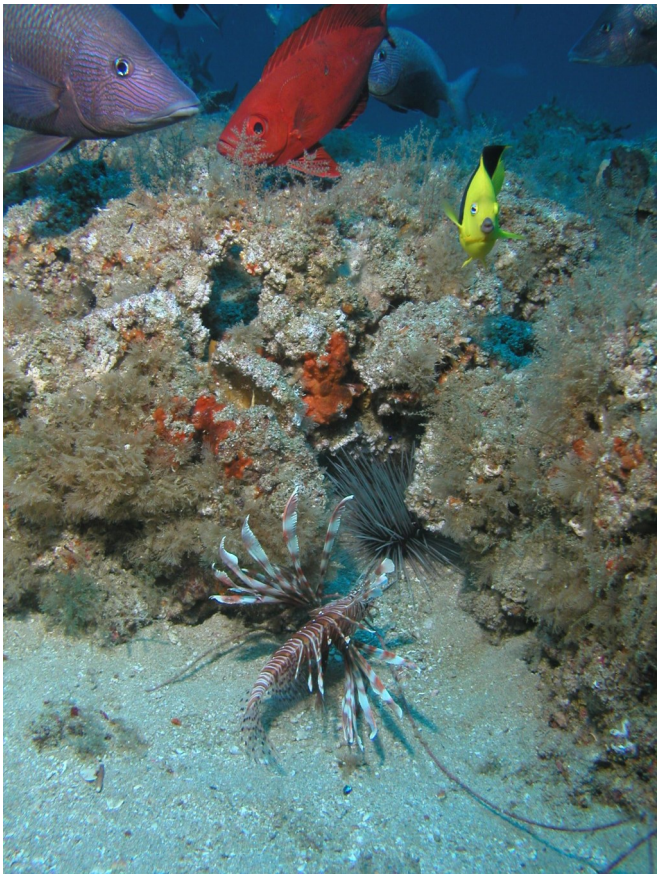
Status and Trends

The condition of shallow hard bottom in North Carolina state territorial waters is of particular importance to the health and stability of estuary-dependent snapper-grouper species that utilize this habitat as "way stations" or protective stopping points as they emigrate offshore. Because of market value, high recreational participation and the associated fishing tackle industry, the offshore snapper-grouper complex supports productive commercial and recreational fisheries. The South Atlantic Fishery Management Council reported that nearshore hard bottoms in the South Atlantic were considered to be in "good general" condition overall in 2002. Although adequate information exists on the distribution of hard bottom off the North Carolina coast, little information is available to evaluate the status and trends of hard bottom habitat in state territorial waters. The black sea bass populations north and south of Cape Hatteras and gag grouper have improved in the past few years.

Fact: 50 artificial reefs are located in ocean waters along North Carolina's coast and 8 are located in estuarine waters. In addition, there are numerous shipwrecks along the coast providing habitat for reef-dwelling species.

Threats to Hard Bottom

Threats to nearshore hard bottom habitat in North Carolina include beach nourishment, certain fishing gear, and water quality degradation. Sand from nourished beaches can also cover hard bottom structures. Some areas have already been lost to the effects of beach nourishment, such as hard bottom habitat off the coast of Wrightsville Beach, NC. Boat anchors and bottom trawls can uproot coral and tear loose chunks of rock. Poor water quality can affect growth or survival of the invertebrates living on hard bottom structure. A growing threat to hard bottom is the impact of the highly invasive Pacific lionfish on the reef community. This species has rapidly expanded in range from more southerly waters to NC and has exhibited extremely high predation rates on snapper and grouper species. Ocean acidification is another concern. More acidic ocean water over time is expected with increasing carbon dioxide levels and can cause calcium based organisms like corals and sponges to disintegrate.



The hard bottom habitat of the North Carolina coast is considered crucial spawning and foraging habitat for many commercially important species of grouper and snapper.

Habitat Threats

There are many activities that can impact coastal fish habitats. These impacts can be positive or negative. Negative impacts are considered threats. Threats can alter the physical structure, modify flows that are critical to sustaining fish functions, or degrade water quality through point and nonpoint sources. Some threats may have a severe impact when they occur but occur rarely or to a small area. Others may be minor but ubiquitous and frequent. The extent and severity of all threats in an area affect the cumulative impact to the ecosystem. The CHPP Source Document provides the science regarding known threats to each habitat. The table below is a subjective rating of threat categories by habitat (Ch. 8-11).

Threat category	Source and/or impact	Water column	Shell bottom	SAV	Wetlands	Soft bottom	Hard bottom
Physical threats/ hydrologic modifications	Boating activity						
	Channelization						
	Dredging (navigation channels, boat basins)						
	Fishing gear impacts						
	Infrastructure						
	Jetties and groins						
	Mining						
	Obstructions (dams, culverts, locks)						
	Shoreline stabilization						
	Upland development						
	Water withdrawals						
Water quality degradation — sources	Land use and nonpoint sources						
	Water dependent development (marinas and docks)						
	Point sources						
Water quality degradation — causes	Marine debris						
	Microbial contamination						
	Nutrients and eutrophication						
	Saline discharge						
	Suspended sediment and turbidity						
	Toxic chemicals						
Disease and microbial stressors							
Nonnative, invasive or nuisance species							
Weather events							

APNEP:	Albemarle-Pamlico National Estuary Partnership
BMPS:	Best Management Practices
CAMA:	NC Coastal Area Management Act
CHPP:	Coastal Habitat Protection Plan
CRC:	Coastal Resource Commission
CRFL:	Coastal Recreational Fishing License
DACS:	Department of Agriculture and Consumer Services
DCM:	Division of Coastal Management
DEMLR:	Division of Energy, Mineral, and Land Resources
DENR:	Department of Environment and Natural Resources
DEQ:	Department of Environmental Quality (formerly DENR)
DMF:	Division of Marine Fisheries
DMS:	Division of Mitigation Services
DO:	Dissolved Oxygen
DOT:	Department of Transportation
DSWC:	Division of Soil and Water Conservation
DWR:	Division of Water Resources
EBM:	Ecosystem-Based Management
EFH:	Essential Fish Habitat
EMC:	Environmental Management Commission
EPA:	US Environmental Protection Agency
FWS:	US Fish and Wildlife Service
LID:	Low Impact Development
MFC:	Marine Fisheries Commission
NCCR:	National Coastal Condition Report
NCFS:	NC Forest Service
NLCD:	National Land Cover Database
NSP:	Neurotoxic Shellfish Poisoning
NWI:	National Wetlands Inventory
SAFMC:	South Atlantic Fishery Management Council
SAV:	Submerged Aquatic Vegetation
SCC:	Sedimentation Control Commission
SCH:	Strategic Coastal Habitats
SWCC:	Soil and Water Conservation Commission
TOC:	Total Organic Carbon
TSS:	Total Suspended Solids
USACE:	US Army Corps of Engineers
WRC:	Wildlife Resources Commission

For more information or to download the plan, go to www.portal.ncdenr.org/web/mf/

Albemarle - Pamlico National Estuary Program

NORTH CAROLINA MARINE FISHERIES

DWR Division of Water Resources

NC DIVISION OF COASTAL MANAGEMENT