

# North Carolina Fishery Management Plan

# Oyster



**August 2001**

# **North Carolina Oyster Fishery Management Plan**

By

The North Carolina Division of Marine Fisheries

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### 3.0 EXECUTIVE SUMMARY

**Oyster Stock Status:** Concern. Most shellfish staff and advisors felt oyster stocks were in a very serious condition and an overfished status was initially assigned. However, since a stock assessment of oysters could not be performed and the overfished condition could not be verified mathematically, the stock status was changed to concern.

<b>Stock Status Factors:</b> <u>Northern Area</u>	<u>Southern Area</u>
Reduced spatfall	High harvest pressure
High Dermo Mortality	Oyster habitat disturbance
Low catch-per-unit-effort	
Limited spawning stock	

**Problem Areas:** (A) Harvest issues – (1) Mechanical harvest and clam harvest concerns, (2) High potential for large number of harvesters in license system, (3) Habitat value higher than harvest value. (B) Private culture – (1) Insufficient industry support, (2) Opposition over water use concerns. (C) Insufficient data – (1) Cannot calculate optimum yield. (D) Enhancement activities – (1) Improve, increase methods, (2) Plant seed on mounds. (E) Environmental issues – (1) Increase efforts to restore water quality, (2) Set up pilot study areas to test restoration of habitat effects.

**Public Fishery Aspects:** Historical landings dominated by mechanical gear primarily in Pamlico Sound. Area and power of dredges increased from 1890s until 1955. Mechanical harvest area has decreased since 1955. Current landings are comprised of 94% hand-harvest landings primarily from the southern part of the state.

**Private Fishery Aspects:** Early cultivation programs of up to 50,000 acres were unsuccessful. Investigation of other states with successful programs showed NC does not adequately support private oyster cultivation. Currently, 11% of the State's oysters are produced on shellfish leases. The Blue Ribbon Advisory Council on Oysters (BRACO) recommended emphasis on oyster culture as the best measure to overcome disease effects.

**Recreational Fishery:** The size and extent of the recreational fishery are unknown but considered to be significant in the southern area.

**Economic Status:** The oyster fishery still produces close to \$1 million despite reduced harvest.

**Management Options:** Section 9.0 in the FMP provides background and discussion of the 28 issues considered by the staff and advisory committee in drafting the recommendations.

**Optimum Yield:** Although there is insufficient data to calculate optimum yield for the oyster fishery, the available indicators show that harvest is not excessive. The plan recommends maintaining current catch limits with no harvest cap until changes occur. The plan also recommends increases in shellfish sampling programs and creation of a recreational fishing license to acquire the necessary data for a complete oyster population assessment.

### 3.1 GOAL AND OBJECTIVES

The goal of the North Carolina Oyster Fishery Management Plan is to restore the State's oyster population so that it might produce the optimum yield and regain its role in providing ecological benefits to North Carolina's estuaries. To achieve these goals, it is recommended that the following objectives be met:

1. To identify, restore, and protect oyster habitats for oyster production and as a critical habitat in North Carolina's estuaries.
2. To 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 the private oyster fishery.
3. To minimize the impacts of oyster parasites through better understanding of oyster disease, better utilization of affected stocks, and use of disease resistant oysters.
4. To consider the socioeconomic concerns of all groups utilizing the oyster resource, including market factors.
5. To recommend improvements to coastal water quality to reduce bacteriologically based harvest closures and to provide a suitable environment for oyster survival and recovery.
6. To identify and encourage research to improve understanding of oyster population ecology and dynamics, habitat restoration needs, oyster aquaculture requirements and relay mortality.
7. To identify, develop, and promote oyster harvesting practices that reduce harvest costs and minimize damage to the habitat.
8. To initiate, enhance, or continue studies to collect and analyze economic, social, and fisheries data needed to effectively monitor and manage the oyster resource.



### 3.2 MFC SELECTED MANAGEMENT STRATEGIES

The MFC adopted the following as the selected management strategies for the Draft Oyster Fishery Management Plan. Comments from the Secretary of DENR have also been incorporated in this draft. Potential wording for changes in statutes, rules or policy necessary to implement the proposed changes can be found in **Appendix 1**.

#### 3.2.1 OPTIMUM YIELD STRATEGY

**It is recommended that oyster harvest be allowed to continue at current catch/trip limits without a harvest cap until available data indicate a change in harvest policy is necessary.**

#### 3.2.2 MFC SELECTED MANAGEMENT STRATEGIES AND REQUIRED ACTIONS

The strategies listed below are grouped into those that: (Tier 1) can be accomplished with no 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
<b>HARVEST ISSUES</b>	
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.
<b>PRIVATE CULTURE</b>	
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 <b>ten</b> 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
<b>INSUFFICIENT ASSESSMENT DATA</b>	
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 until improved data collection indicates a change in harvest policy is necessary	Existing Auth.

<b>ENHANCEMENT ACTIVITIES</b>	
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 harvest techniques and user groups	Existing Auth.
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.
<b>ENVIRONMENTAL ISSUES</b>	
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: <ul style="list-style-type: none"> <li>- Classifying Conditionally Approved Open shellfish waters as Partially Supporting</li> <li>- Classifying Conditionally Approved Closed shellfish waters as Not Supporting</li> <li>- Adopting standards that limit total impervious cover immediately adjacent to SA waters to 10 percent</li> <li>- Requiring mitigation that results in water quality enhancements in permanently closed areas</li> </ul>	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
<b>PRIVATE CULTURE</b>	
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.
<b>ENVIRONMENTAL ISSUES</b>	
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**

<b>STRATEGY</b>	<b>REQUIRED ACTION</b>	<b>PRIORITY</b>
<b>HARVEST ISSUES</b>		
1. Increase cultch planting in hand harvest areas	Existing Auth. Funding Required	3
<b>PRIVATE CULTURE</b>		
1. Develop and utilize user coordination plans to assess areas for shellfish leasing	<b>Rule Change</b> Funding Required	3
2. Request funding research, disease, and education centers for shellfish culture	Existing Auth. Funding Required	3
<b>INSUFFICIENT ASSESSMENT DATA</b>		
1. Increase data collection efforts to allow for more precise assessment of oysters population parameters and harvest effects according to statutory standards	Existing Auth. Funding Required	1
2. Expand the Shellfish Mapping Program to provide complete and timely data for estimating MSY for the oyster resource	Existing Auth. Funding Required	1
<b>ENHANCEMENT ACTIVITIES</b>		
1. Recommend adoption of the BRACO recommendation to increase cultch planting to a minimum of 400,000 bushels per year	Existing Auth. Funding Required.	2
<b>ENVIRONMENTAL ISSUES</b>		
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

### **3.2.3 CONSEQUENCES OF AND ALTERNATIVES FOR FAILURE TO FUND THE TIER 3 OYSTER FMP STRATEGIES**

#### **PRIORITY 1 STRATEGIES**

Currently, the basis for management of oyster resources relies on landings data, localized surveys of oyster populations and disease data. Analysis of existing data indicates that a standing stock estimate of oyster populations is not possible. Standing stock estimates have commonly been used as the basis for establishing maximum sustainable yield (MSY) for bivalve mollusk fisheries. Optimum yield cannot be calculated without MSY and statutory standards require management to achieve optimum yield. Therefore, current management does not satisfy statutory mandates.

The best alternative to funding priority 1 strategies is to use a proxy MSY as discussed in section 5.3.1 Determination of Optimum Yield. This alternative is basically the same as current DMF oyster management. It should be clear however, that using landings data as a means of setting harvest limits, particularly with a species that is at 2% of its historical peak landings, may increase risks of overharvesting or conversely could grossly underestimate the population and unduly curtail harvesting.

#### **PRIORITY 2 STRATEGIES**

Each time an oyster is harvested, the harvester gains one piece of oyster meat and two pieces of oyster habitat (shells) are removed from the estuary. These shells must be replaced or oyster habitat, and eventually oyster production, is reduced. Increased sedimentation from runoff and boating and fishing impacts also reduce oyster habitat by covering or scattering the substrate so that it no longer supports oyster survival. These impacts must be reduced and lost habitat must be rebuilt to maintain a viable oyster resource. Funding for rebuilding oyster habitat was reduced in 1997 and in 1998 other commercial shellfish were included in the program which allows for shell and seed shellfish planting and transplanting. If additional funding is not received for the two strategies in this priority, recovery of the oyster resource will be prolonged and potential benefits from restoring hard bottom habitat in the estuary will be delayed. No additional funding to quantify the effects of bottom disturbing fishing gear on shellfish habitat will likely have the greatest effect on oyster harvesters since many areas will remain unprotected and reduced oyster populations will result in continuation of strict harvest limits.

Since reduced funding is available for cultch planting, the best alternative for this strategy is to continue with current funding until more funding is available. The best alternative for the research strategy is to continue to seek funding from other sources.

### **PRIORITY 3 STRATEGIES**

Three of the four strategies under the third priority are designed to help wild and private culture oyster harvesters overcome existing problems or ease the effect of changes recommended in the FMP. The fourth strategy to develop research, disease and education centers is aimed at increasing the private production of shellfish but the proposal has implications for wild harvest as well. Lack of additional funding to carry out strategies that increase resource availability for wild harvest and private culture and that reduce conflict in the shellfish lease program will maintain or increase economic hardships already being experienced by shellfishermen and culturists. Current situations that mitigate the economic hardship on shellfish harvesters include the fact that there are fewer fishermen depending on the oyster resource for winter income particularly around Pamlico Sound, there are other measures in the FMP that are aimed at increasing productivity of shellfish leases, and data on human uses of Core Sound have already been gathered and Core Sound has been the most contentious area for shellfish leasing.

The most viable alternative for the cultch planting recommendations is to divert a small portion of existing cultch planting funds for those purposes until more funding becomes available. The other strategies will have to be completely delayed until a decision on funding can be made.

## **4.0 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.

### **4.1 MANAGEMENT AUTHORITY**

The North Carolina Marine Fisheries Commission (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. 143B-289.51). North Carolina General Statutes 113-134, 113-182 and 143B-289.52 give the MFC broad authority to promulgate rules for the management of marine and estuarine resources, including oysters, in coastal fishing waters. 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 both from public grounds and private beds. The authority to implement rules governing sale, possession, transportation, storage, planting, and handling of oysters as necessary to regulate the lawful transplanting of oysters and oyster seed is also vested in the MFC.

General Statute 143B-289.52 allows the MFC to delegate authority to implement its rules governing fishing practices “which may be affected by variable conditions” to the Director of DMF by issuing public notices called “proclamations.” Proclamation authority has been established for the Director of DMF to manage the oyster fishery providing a powerful and flexible tool for oyster fishery management. Other authorities for management of the State’s oyster resources have been given to the Secretary of DENR including the authority to grant shellfish bottom leases under G.S. 113-202 and water column leases over existing shellfish bottom leases and franchises under G.S. 113-202.1 and G.S. 113-202.2. Propagation of shellfish by DENR both for public harvest or planting on private beds is authorized under General Statute 113-204.

The Fisheries Reform Act of 1997 (FRA) establishes a process for preparation of coastal fisheries management plans in North Carolina. 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 fishing 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 the 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 prevent overfishing, while achieving on a continuing basis, the optimal yield from each fishery.”



Optimal yield is defined in the FRA as “The amount of fish that:

- a. Will provide the greatest overall benefit to the State, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems;
- b. Is prescribed on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor; and
- c. In the case of an overfished fishery, provides for rebuilding to a level consistent with producing the maximum sustainable yield in the fishery.” (FRA; G.S. 113-182.1)

## **4.2 GENERAL PROBLEM STATEMENT**

The BRACO examined the problems affecting oyster production and found the following. “The council concludes that there is no single explanation for the progressive loss of oysters over the past century. It is clear that many aspects of the state’s development contributed to the decline. Habitat destroyed by oyster harvesting has not been adequately replaced by oyster enhancement programs. Public trust waters have not been effectively developed for oyster mariculture. Coastal lands have been developed for agriculture, forestry and residences with little regard for impact on oysters or other aquatic resources. Currently used systems for treatment of human and animal wastes do not assure adequate water quality for oyster growing areas. Markets for oysters have declined as consumers have responded to reports of adverse effects of eating raw oysters. Furthermore, the problems that have afflicted oysters in North Carolina are geographically widespread. They are especially critical in neighboring mid-Atlantic regions with similar climatic conditions, such as the Chesapeake Bay. The ongoing decline of the Eastern oyster throughout its range can be attributed to outbreaks of oyster diseases, in large part weather-driven; to failure to preserve oyster reef habitat against degradation; to overharvest; and to substantial deterioration of coastal water quality.” (Frankenberg 1995)

### **4.2.1 HARVEST ISSUES**

The use of mechanical gear to harvest oysters has been a controversial issue since its introduction. The perception is that mechanical harvesting damages oyster rocks and therefore, long term oyster growth and survival. More recently, oyster fishermen have cited clam harvesting as damaging to oysters and their habitat in intertidal areas. Quantitative research is needed to address both of these issues.

The current licensing structure is of concern for two reasons: (1) commercial shellfish harvest is available to all state residents without restriction and (2) recreational shellfish harvest is suspected to be significant yet is unknown because of no license or permit requirement.

The habitat value that oysters provide has also brought into question the wisdom of allowing any

oyster harvest. Since oysters are the primary source of natural, hard substrate in North Carolina's coastal waters and are responsible for significant amounts of water filtration, it may be prudent to restrict some oyster habitat from any harvesting disturbances. Specific issues, options, and potential actions are outlined in Section 9.0.

#### **4.2.2 PRIVATE CULTURE**

The BRACO analyzed information from states and countries with successful oyster culture programs and concluded that North Carolina did not provide sufficient support, either in access to resources or technical services, to establish a productive oyster culture industry. Oyster culturists often encounter difficulties obtaining a shellfish leases and find the requirements for maintaining and managing the lease site burdensome. The BRACO found that the best hope for maintaining the oyster resource in the face of current disease challenges is through private culture and recommended that improvements to the shellfish lease program be given the highest priority.

The shellfish lease program has suffered because of a general lack of productivity and the perception that some lease areas are simply being held to exclude the public from personal shellfish gardens. Opposition to shellfish leases for oyster culture has come from commercial fishermen who fear that increased leasing of bottomlands will overtake their fishing grounds and tourist industry/residential groups that feel shellfish leases are unsightly and restrict their access to water resources. Specific issues, options, and potential actions are outlined in Section 9.0.

#### **4.2.3 INSUFFICIENT ASSESSMENT DATA**

The data necessary for a robust estimate of oyster standing stock and maximum sustainable yield do not yet exist. Recreational harvest data is totally lacking. Collection of appropriate data will need to be initiated in order for future oyster stock status designations to be based on quantitative assessments of population trends. **The statutory obligation to manage oysters according to optimum yield cannot be met until the appropriate data are collected.** Specific issues, options, and potential actions are outlined in Section 9.0. A discussion of options for gathering data necessary to determine optimum yield appears in section 5.3.1.

#### **4.2.4 ENHANCEMENT ACTIVITIES**

Preliminary research indicates that oyster survival can be increased through manipulation of the size and shape of shell mounds created to restore oyster habitat. Seeding restoration sites with hatchery-reared oyster stock also shows promise in increasing oyster populations at the site (Lenihan 1998; Lenihan et al. 1999). The BRACO recommended further research on these topics and a possible increase in the scope of North Carolina's oyster rehabilitation efforts. Since those recommendations were made, the funding for oyster habitat restoration has been cut and the remaining funding must be spread to cover all commercially important shellfish species. Clear criteria for operation of the program are needed and funding appears inadequate to meet research and restoration needs. Specific issues, options, and potential actions are outlined in

## Section 9.0.

### **4.2.5 ENVIRONMENTAL ISSUES**

Oyster survival is dependent on waters with sufficient oxygen, stable salinity patterns, suitable attachment substrate, adequate food supplies, and sufficient water flow but, without significant concentrations of petroleum products, heavy metals, pesticides, chlorine and detergents. Oyster harvest is dependent on maintaining waters which meet established standards limiting bacteriological contamination. The extent to which decreased water quality is affecting oyster populations is not known. Shellfishing closures are taking an increasing amount of oyster harvest area from the public. The combined effect of disease, reduced water quality, and increased harvest pressure due to reduced resources is poorly understood. Specific issues, options, and potential actions are outlined in Section 9.0.

### **4.3 DEFINITION OF MANAGEMENT UNIT**

The management unit includes the Eastern oyster (*Crassostrea virginica*) and its fisheries in all waters of coastal North Carolina.

### **4.4 EXISTING PLANS, STATUTES, AND RULES**

#### **4.4.1 PLANS**

The 1994 Session of the NC General Assembly created a Blue Ribbon Advisory Council on Oysters 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:

- (1) Restoration of oyster production on public beds
- (2) Development of aquaculture production of oysters
- (3) Management of oyster reefs to maximize production
- (4) Zoning and protective measures concerning oyster reefs and culture operations
- (5) Marketing and economic development of oysters
- (6) Development of value-added products and processing
- (7) Changes in the leasing of oyster bottoms and water columns for culture
- (8) Expenditure of public funds in relation to private funding of oyster production
- (9) 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. Much of the material presented in this plan is drawn from the plan prepared by the BRACO.

#### **4.4.2 STATUTES** (North Carolina General Statutes)

- G.S. 113-168.2      Standard Commercial Fishing License
- A \$200 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.
- 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 \$1.00 to \$6.00 per foot.
- G.S. 113-169.2      Shellfish license for NC residents without a SCFL.
- There is an annual \$25.00 license for individuals to commercially harvest shellfish. This license is available only to residents of North Carolina. This statute also sets the limits for taking shellfish for personal use without a license.
- G.S. 113-169.3      License for fish dealers.
- This General Statute establishes a license requirement and establishes a \$50.00 fee for dealing in oysters. Dealer's licenses are restricted to North Carolina residents.
- G.S. 113-182.1      Fishery Management Plans (FMP)
- Requires the Department to prepare and the MFC to adopt FMPs for all commercially or recreationally significant species.
- G.S. 113-184      Possession and transportation of prohibited oyster equipment.
- During the regular closed oyster season, oyster dredges are not allowed on

- boats except for use on privately held shellfish bottoms. The maximum oyster dredge weight is set at 100 pounds for internal waters.
- G.S. 113-187 Penalties for violations of Article and Rule.
- The penalties for shellfishing in areas closed due to pollution are set in this statute.
- G.S. 113-202 New and renewal leases for shellfish cultivation; termination of leases issued prior to January 1, 1966.
- Allows shellfish leases meeting certain standards to be granted in coastal fishing waters except in Brunswick County and eastern Core Sound.
- G.S. 113-202.1 Water column leases for aquaculture.  
Allows shellfish lease holders 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.
- 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.
- Requirements for transplanting shellfish to private beds are established in this statute. The procedure for establishing seed oyster management areas is also defined.
- G.S. 113-205 Registration of grants in navigable waters; exercise of private fishery rights.
- Authority is established in this statute for the MFC to make rules governing utilization of private shellfish bottomlands arising out of shellfish franchises.
- G.S. 113-206 Chart of grants, leases and fishery rights; overlapping leases and rights; contest or condemnation of claims; damages for taking of property.
- This statute provides for resolution of submerged lands conflicts including shellfish leases and franchises.
- G.S. 113-207 Clamming on posted oyster rocks forbidden; penalty.
- This statute prohibits damage to oysters and oyster rocks by clam

harvesting on posted areas.

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

This statute establishes a maximum \$5,000 fine and six months in prison for theft from a shellfish lease.

G.S. 113-209 Taking polluted shellfish at night or with prior conviction forbidden; penalty.

This statute establishes the act of taking polluted shellfish under certain conditions as a Class I felony.

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

Fines and punishment for robbing or injuring aquaculture operations are set forth in this statute.

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

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, Coastal Resources Commission, and MFC to adopt and follow the plans.

#### **4.4.3 RULES**

North Carolina Rules (All references are from North Carolina Fisheries Rules for Coastal Waters 1999-2000)

##### 1. Open Season (15A NCAC 3K.0201)

The oyster season may begin on October 15 and may extend through May 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 limit of 50 bushels per fishing operation is set.

##### 2. Size Limit and Culling Tolerance (15A NCAC 3K.0202)

The size limit for oysters is set by proclamation but can be no less than a shell length of 2.5 inches. 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. A 10 percent tolerance limit by volume is allowed. Oysters imported for shucking purposes are exempt from this rule.

##### 3. Trawling Across Oyster Management Areas Prohibited (15A NCAC 3K.0203)

Oyster beds planted and posted by the state are protected from bottom disturbing gear.

4. Dredges/Mechanical Methods Prohibited (15A NCAC 3K.0204) (15A NCAC 3R.0108)  
(15A NCAC 3J.0303) (15A NCAC 3N.0104)

The shallow area behind the Outer Banks from Oregon Inlet to Core Sound, North Bay, 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. Dredges or mechanical methods for oyster harvest are prohibited in any of the primary nursery areas described in 15A NCAC 3R .0103.

5. Definitions (15A NCAC 3I .0101)

- a. Dredge: a device towed by engine power consisting of a frame, tooth bar, or smooth bar, and catch bag used in the harvest of oysters, clams, crabs, scallops, or conchs.
- b. Mechanical methods for oystering: includes but is not limited to dredges, patent tongs, stick rakes, and other rakes when towed by engine power and any other method that utilizes mechanical means to harvest oysters.
- c. Depuration: purification or the removal of adulteration from live oysters, clams, and mussels by any natural or artificially controlled means.
- d. Aquaculture operation: an operation that produces artificially propagated stocks of marine and estuarine resources or obtains such stocks from authorized sources for the purpose of rearing in a controlled environment.
- e. Shellfish producing habitats are those areas in which economically important shellfish, such as, but not limited to clams, oysters, scallops, mussels, and whelks whether historically or currently, reproduce and survive because of such favorable conditions as bottom type, salinity, currents, cover and cultch.
- f. Intertidal oyster bed: a formation regardless of size or shape, formed of shell and live oysters of varying density.

6. Prohibited Shellfish Areas/Activities (15A NCAC 3K.0101)

This rule establishes proclamation authority to prohibit taking, possessing or selling oysters from prohibited (polluted) areas as recommended by the Division of Environmental Health. Out-of-state oysters taken from polluted waters may not be possessed or sold in this state.

7. Prohibited Rakes (15A NCAC 3K.0102)

The size of a rake used to take oysters is limited to no more than 12 inches in width or weighing more than six pounds.

8. Shellfish/Seed Management Areas (15A NCAC 3K.0103)

Proclamation authority is established to close and open oyster management areas and designate time, place, character, or dimensions of harvest methods.

9. Harvest of Crabs and Shellfish (15A NCAC 3K.0105)

This rule allows harvest of one bushel of oysters per person per day, not to exceed two bushels per vessel per day to be taken without a commercial license during regular open seasons including Sundays.

10. Taking or Unloading Oysters and Clams on Sunday or At Night (15A NCAC 3K.0106)

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.

11. Depuration of Shellfish (15A NCAC 3K.0107)

Oysters may be taken from prohibited areas for depuration in an approved depuration plant only when the oysters would otherwise be lost due to maintenance dredging operations. Specifications for approved depuration plants can be found in Rules Governing the Sanitation of Shellfish 15A NCAC 18A Section .0700. Proclamation authority, permits, and transportation guidelines are established. Supervision by DMF and the Division of Environmental Health is required.

12. Permits for Planting Shellfish from Polluted Area (15A NCAC 3K.0104)

This rule establishes a six-week season for relaying of prohibited (polluted) oysters from designated areas to privately controlled bottomlands. Permits and closure of private bottomlands to harvest is required.

13. Marketing Oysters Taken from Private Shellfish Bottoms (15A NCAC 3K.0205)

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.

14. Standards for Shellfish Bottom and Water Column Leases (15A NCAC 3O .0201)



Standards are established for obtaining a new shellfish lease and meeting lease utilization requirements. Proposed lease sites cannot contain 10 or more bushels of shellfish per acre, impinge upon riparian rights within 100 feet of a developed shoreline, or exceed certain acreage guidelines without justification. Shellfish bottom leases must produce or plant 25 bushels of shellfish per acre to meet utilization requirements. Water column amendment requirements are four times the bottom use requirements. Shellfish franchise utilization requirements are also included. Conversion factors and specific situations are covered.

15. Shellfish Bottom and Water Column Lease Applications (15 A NCAC 3O .0202)

Application maps, management plans and marking of the proposed site are specified.

16. Shellfish Lease Application Processing (15A NCAC 3O .0203)

Inspection for compliance with standards, modification of sites, notification of approval, and surveying requirements are specified.

17. Marking Shellfish Leases and Franchises (15A NCAC 3O .0204)

Specifications for making poles, signs, spacing of markers, and removal of markers is given.

18. Lease Renewal (15A NCAC 3O .0205)

Management plan, survey, application of standards, and appeal-of-denial information is given.

19. Lease Protest (15A NCAC 3O .0206)

Commenting and formal protest procedures are specified.

20. Production Reports (15A NCAC 3O .0207)

Production information requirements and reporting dates are given.

21. Cancellation (15A NCAC 3O .0208)

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.

22. Transfer of Interest (15A NCAC 3O .0209)

Minimum size of transfers, 30-day notification requirement, prohibition on water column transfers and resident requirements for transfers are given.

#### 23. Shellfish Franchises (15A NCAC 3O .0210)

Survey requirements, management plans, and production requirements for recognized franchises are specified.

#### 24. Protection of Private Shellfish Interest (15A NCAC 3O .0211)

Makes it unlawful to use a trawl, long haul seine, swipe net, dredge or mechanical method for oysters or clams on a lease or franchise unless it is duly authorized.

### **4.4.4 OTHER JURISDICTIONS**

The Department of Health and Human Services Commission for Health Services is responsible for regulation of human health concerns related to harvest of shellfish for raw consumption by humans. The State Health Director is responsible for North Carolina's compliance with the National Shellfish Sanitation Program (NSSP) of the U.S. Food and Drug Administration. Based on data from his staff (Shellfish Sanitation Section of the Division of Environmental Health), the State Health Director recommends closures of coastal waters to shellfish harvest; the DMF implements closures by proclamation, and enforcement of those closures is conducted by DMF Marine Patrol officers.

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 Service enforces the Lacey Act, which prohibits import, export, and interstate transport of illegally taken fish and wildlife, which includes illegally-possessed oysters.

The Atlantic States Marine Fisheries Commission approved a plan in 1989 to control the transfer and introduction of shellfish, although it has no authority over shellfish in the states. The plan supports state regulation. A key plan provision 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.

## 5.0 STATUS OF THE STOCK

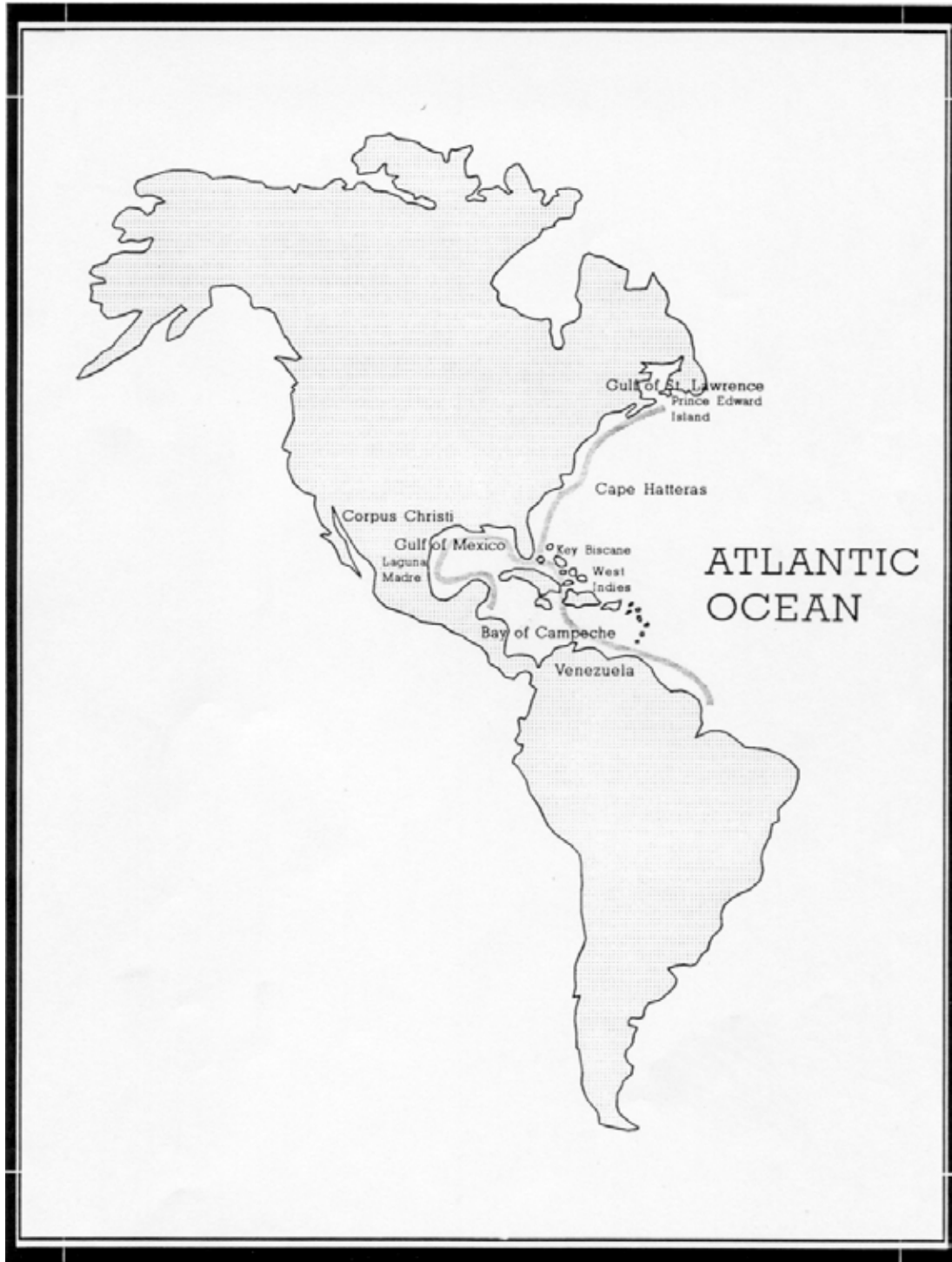
### 5.1 GENERAL LIFE HISTORY

#### 5.1.1 DISTRIBUTION

The American or Eastern oyster (*Crassostrea virginica*) ranges from the Gulf of St. Lawrence in Canada through the Gulf of Mexico to the Bay of Campeche, Mexico and to the West Indies (Figure 1) (Bahr and Lanier 1981). Opinion on optimum salinity range for the species varies but falls between 10 and 30 parts per thousand (ppt), although oysters may be found growing in salinities as low as 5 ppt and as high as 42 ppt. Oysters can tolerate extremes in salinity for varying periods depending on temperature (Loosanoff 1965).

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 2). North Carolina's oyster stocks are composed of both intertidal and subtidal populations. The intertidal populations (oysters growing between the mean high and low tide levels) are characteristic of the oyster stocks of the South Atlantic Bight (Figure 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 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 (oysters growing below the mean low water level). This region is primarily influenced by wind driven tides, and the few intertidal oysters found in the area are in close proximity to inlets. In the immediate vicinity of inlets, the horse oyster, *Ostrea equestris*, is often confused with small eastern oysters.

Oyster morphology varies greatly depending on substrate and habitat conditions. Oyster stocks cannot be identified on the basis of morphological differences. Initial electrophoretic analysis indicated there were three stocks of oysters on the East and Gulf coasts. North Carolina's stock was thought to be part of the Atlantic coast stock, which extends from Maine to Key Biscayne, Florida (Figure 3). Other stocks were identified along the West Coast of Florida to Corpus Christi, Texas, and in the lower Laguna Madre, Mexico. More recent work has identified four stocks as follows: eastern Canada, Cape Cod to Corpus Christi, Laguna Madre, and southern Gulf of Mexico. However, the predominant view currently maintains that there is insufficient information to conclude that distinct physiological races of *Crassostrea virginica* exist (Kennedy et al. 1996).



**Figure 1.** Distribution of *Crassostrea virginica* (shaded line) (Bahr and Lanier 1981).



**Figure 2.** Coastal North Carolina.



**Figure 3.** United States East Coast showing locations of oyster harvest activity prior to 1900 and the South Atlantic Bight.

### 5.1.2 REPRODUCTION

Oysters are typically dioecious (separate sexes), but have the ability to change sexes once each year. Gonads may be developed in oysters only two to three months old. Fully developed oysters entering their first summer season may spawn, but a substantial portion of young –of-the-year oysters are not sexually mature. A large number of first year spawners are typically males (Galtsoff 1964).

Formation of eggs and sperm is stimulated by increasing water temperatures during the spring of the year (Galtsoff 1964; Kennedy et al. 1996). One female can produce several thousand to 66 million eggs per spawn depending on size and condition (Kennedy et al. 1996). Oysters may spawn several times per season.

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).

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 takes place shortly thereafter in the surrounding waters, or the unfertilized eggs sink quickly to the bottom and perish. Fertilized eggs develop through trochophore and veliger larval stages over a period of two to three weeks. The more popular larval development stage names, straight hinge (early stage) and umbo, eyed, and pediveliger (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 may supplement the effects of passive transport and enhance larval retention in estuaries. Patterns of larval distribution in North Carolina estuaries have not been documented.

As the larval stage ends, oysters must locate a suitable attachment point or perish. Several sites may be investigated before an oyster larvae cements itself to the substrate. 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). 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 either continuous, concentrated in one peak or concentrated in 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.

### **5.1.3 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 down 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 but are undocumented. Regional differences in oyster growth have been reported in Chesapeake Bay (Kennedy and Breisch 1981).

### **5.2 HISTORICAL ABUNDANCE**

North Carolina's oyster fishery has never approached the magnitude or reputation of the fisheries of its northern neighbors. For example, North Carolina's highest oyster landings were 1.8 million bushels in 1902, while Maryland alone landed 15 million bushels in one year prior to the turn of the century. Oyster dredging practices that migrated southward from northern states resulted in North Carolina's highest landings. A pattern of increased landings following the introduction of mechanical harvest methods succeeded by an unrelenting decline in wildstock harvest over many years was seen in all Mid-Atlantic States. The area opened to oyster dredging in North Carolina gradually expanded from its beginnings late in the 1880s until 1955, when only a few Hyde and Carteret county areas were closed to harvest by dredging. Since 1955, available mechanical harvest area has declined.



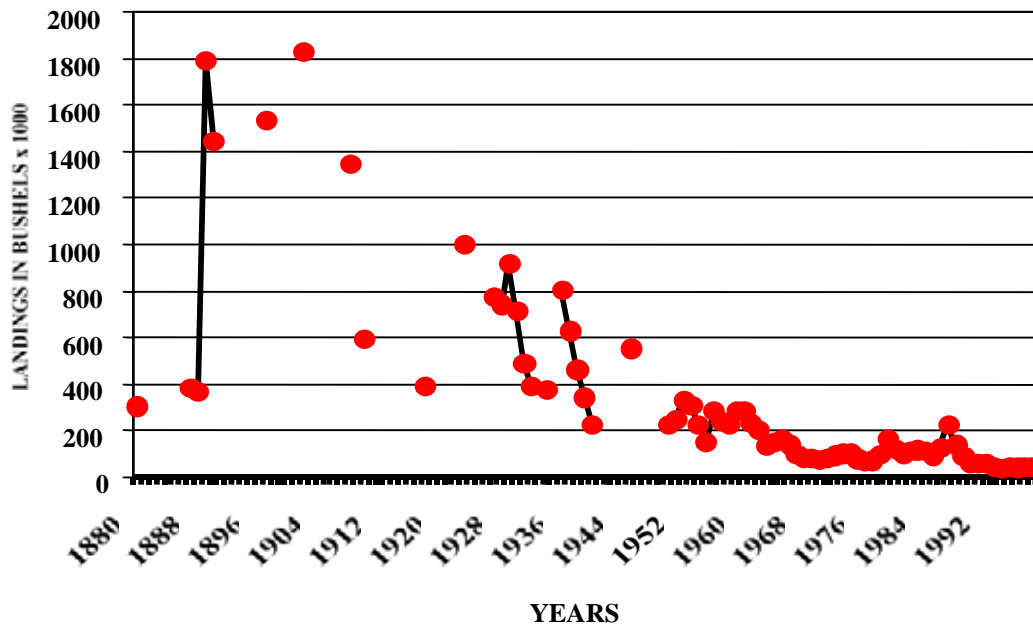
Winslow (1889) examined the 1880 landings and interviewed oystermen in the area of his survey and found the oyster industry insignificant (170,000 bushels) and the public beds to be in poor condition. However, by 1889, northern oystermen moved into Pamlico Sound with dredges and efficient tongs, and oyster landings rose to 1.8 million bushels. These fishermen may have been working on virgin stocks, since North Carolina residents were restricted to hand harvest methods in most areas, and the oyster survey conducted by Winslow may have led them to the most productive areas in Pamlico Sound. Thorson (1982) also reported that in 1894 all the oyster canneries were closed and insufficient oyster taxes were collected to pay the inspectors. Oyster landings that year were estimated to be 60,000 bushels, and in 1896 the estimate was only 40,000 bushels. Harvesting oysters by dredging was not allowed in 1894 or 1896. The following year, 1897, federal statistics showed a harvest of over 1.5 million bushels (Figure 4). This increase in production followed the reinstatement of the oyster dredge fishery.

This discussion appears to indicate that oyster resources available to hand tonging may have been harvested at or above their potential before the turn of the century. It should be noted that the oyster size limit was increased to 2 1/2 inches in 1893. It is not known to what extent this increase changed the fishery. The dramatic effect that oyster dredging had on fishery production can be easily seen. It also reinforces the point that oyster abundance cannot be established solely from landings data.

North Carolina's oyster landings have generally declined from a peak coinciding with the introduction of the oyster dredge to today's low harvests (Figure 4). Since 1924, closures due to poor bacteriological water quality have reduced the harvest area. Oyster parasites are now known to have a pronounced effect on oyster stocks in many areas of the state. These parasites have probably been affecting North Carolina's oyster populations for forty years, as has been documented in other states. Unfortunately, no historical documentation exists on this subject for North Carolina.

### **5.3 PRESENT STOCK STATUS**

North Carolina oyster stocks have been in a state of decline for most of the 20<sup>th</sup> century. This decline is thought to have been initiated by aggressive harvest practices. More recently, however, habitat disturbance, pollution and disease have been recognized as contributing to the reduction in oyster numbers. Therefore, the current stock status for oysters is listed as concern. Oysters are suspected to be vulnerable to overharvest, however, given the number of different factors that affect their survival.



**Figure 4.** North Carolina oyster landings in bushels 1880-1998 (Chestnut and Davis 1975; National Marine Fisheries Service unpublished data; NC Division of Marine Fisheries unpublished data).

### 5.3.1 DETERMINATION OF OPTIMUM YIELD

An oyster stock assessment was attempted in 1999, however, the data necessary for an estimate of maximum sustainable yield (MSY) were found to be lacking. Collection of appropriate data will need to be initiated in order to meet the statutory obligation to manage oysters according to optimum yield (OY).

Since increased data collection on oysters is imminent, every effort should be made to recognize the costs and benefits associated with available data collection methods and choose one that will best serve the management goals and obligations recognized in this plan. Because the biological program chosen to collect population data on oysters will need to be in place for several years, a very thoughtful approach should be taken in selecting the appropriate methodology. Table 1 summarizes the advantages, disadvantages, and data requirements for several approaches that could be used to estimate oyster MSY in the future. Although age-based analysis is commonly used in finfish stock assessments, this method should probably be considered inappropriate until the difficulties involved in age determination for oysters are overcome. Biomass-based analysis should be considered as a possible assessment method for oysters since the necessary data could

be collected fairly easily. A noteworthy disadvantage to this approach (that is not unique to oysters) is that estimating MSY is often difficult unless the data include periods when the stock was overfished and periods when the stock was underfished. For both age-based and biomass-

**Table 1.** Oyster stock assessment options and corresponding advantages, disadvantages, and data demands.

	Advantages	Disadvantages	Data Demands
Age-Based Analysis	<p>provides detailed information about population structure</p> <p>state-of-the-art</p>	<p>age data cannot be collected from oysters</p> <p>several years before data can be used to estimate MSY</p> <p>new biological program will need to be initiated</p>	<p>-catch at age matrix</p> <p>-natural mortality estimate</p>
Biomass-Based Analysis	<p>simplicity</p>	<p>sufficient contrast often lacking if stock has not been both overfished and underfished</p> <p>several years before data can be used to estimate MSY</p> <p>new biological program will need to be initiated</p>	<p>-total catch</p> <p>-effort</p>
Standing Stock Survey	<p>intuitively understandable results</p> <p>results may be immediately useful for estimating MSY</p>	<p>shellfish mapping will need to be completed</p> <p>monitoring of oyster densities in all areas must be initiated</p>	<p>-oyster density estimates for fished and unfished areas</p>

based approaches, several years' worth of data must be collected before analysis can begin. A standing stock survey, or density estimate, is consistent with mollusk assessments conducted by NMFS and several other states (MAFMC 1998, Mann and Wesson 1998) and could give results that are both immediately useful and easy to understand.

Integration of GIS technology into the management of oysters in North Carolina should be examined since it would allow coordination of population monitoring with habitat management and shellfish sanitation harvest closures. GIS data are currently being gathered through the

ongoing Shellfish Mapping Project.

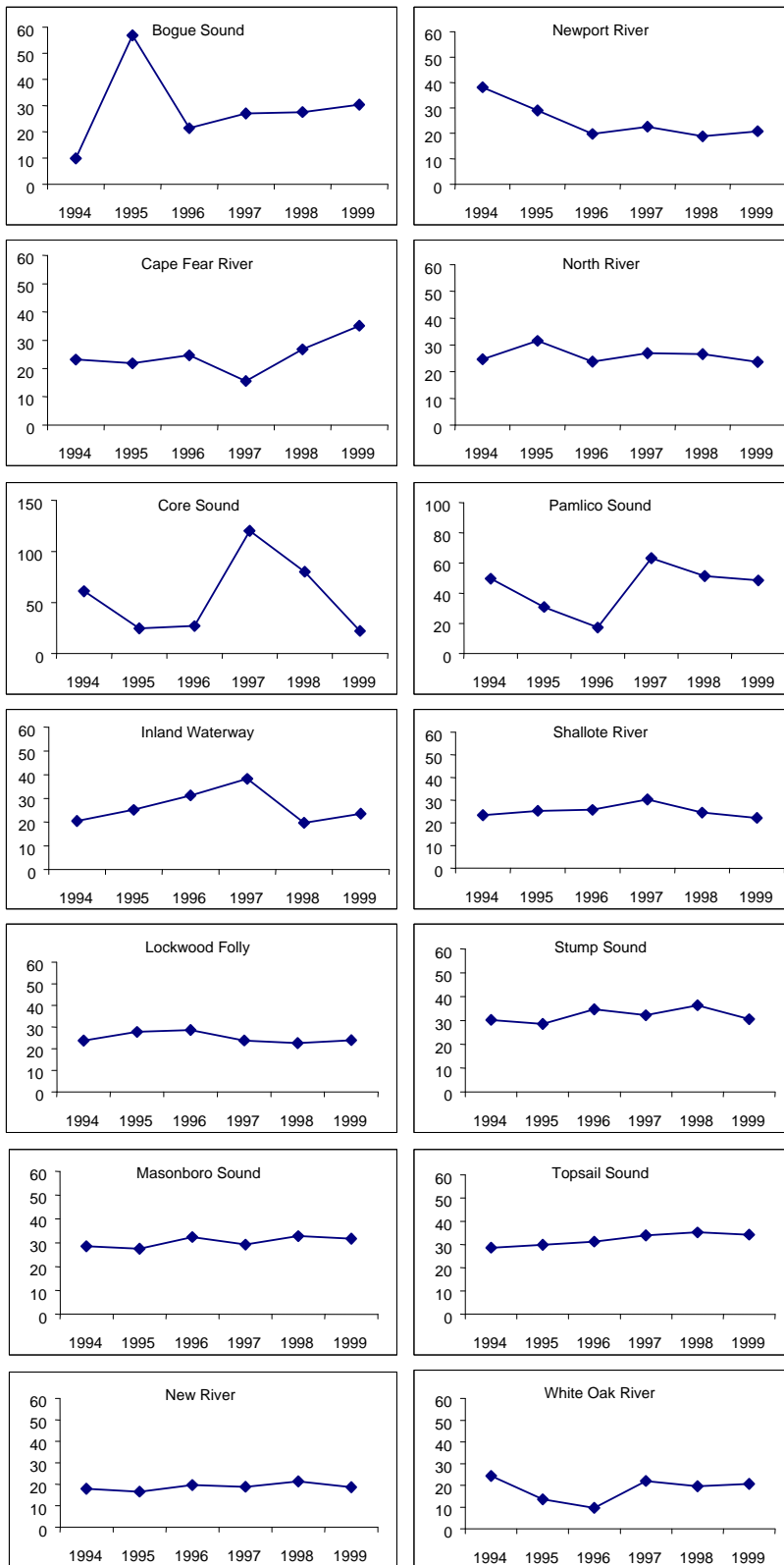
Because extensive numbers of oysters exist in permanently closed areas, a reserve of the total spawning stock is essentially protected from fishing pressure. The contribution of oysters in unfished areas to overall oyster production is currently unknown. Mapping and survey data will address this question by indicating the proportion of the total adult biomass that is protected.

Regardless of how oyster data are collected and analyzed, an important issue that will need to be settled is that of stock identification. A stock, for assessment purposes, consists of a population (of a single species) for which population processes (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 discrete unit stocks and each should be analyzed and managed separately. If the existence of multiple unit stocks is ignored, and stocks are managed based on a statewide assessment, 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.

Given that current data are inadequate for calculation of MSY, it may be prudent to examine methods for calculating a proxy MSY. Federal and other state management agencies often use information from logbooks, fishery independent surveys, and other sources to establish MSY proxies. In North Carolina, the data that could be used currently consist of landings data and trip ticket data. Landings data for oysters go back as far as 1887, although considerable gaps occur in the data set. Trip tickets cover a much shorter time frame (1994 – present), however, if the total number of trips/year is used as an index of annual harvest effort, the apparent sustainability of current harvest levels may be examined. Under this approach, recent harvest levels appear to be sustainable since total catch does not decrease while assumed effort is fairly constant (Figure 5). The error involved in this approach is potentially quite large, however, since the amount of effort expended in an average trip may differ from year to year and because we do not know the magnitude of the unreported (recreational) take. Regional quotas may be more appropriate for the reasons given above, and harvest ranges for regional water bodies are given in Table 2.

Caution should be used in establishing any harvest cap for oysters since environmental conditions play such an important role in their availability for harvest. For example, the amount of rainfall in a given year can determine the number of days a given region is open. Under a quota system, oyster harvesters may be prevented from taking advantage of increases in the availability of oysters in drier years.

Figure 5. Catch per trip for major oyster producing regions in North Carolina 1994-1999.

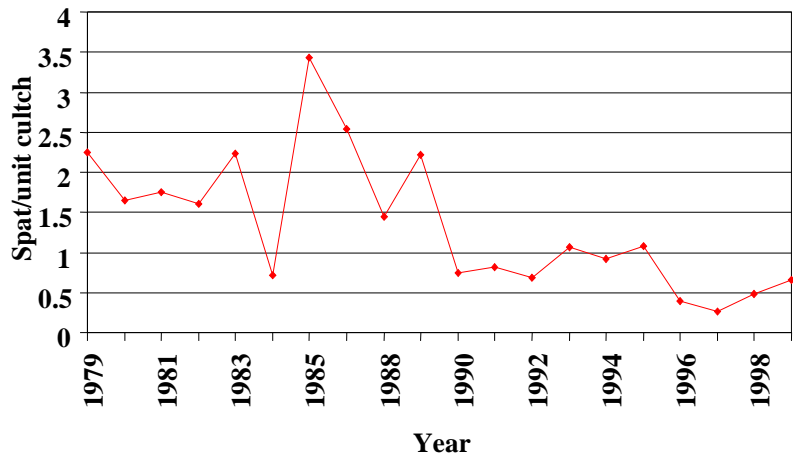


**Table 2.** Landings (lbs meats) for major oyster producing regions in North Carolina from 1994-1999.

	1994	1995	1996	1997	1998	1999
Bogue Sound	423	6031	2761	8720	5964	8393
Cape Fear River	5476	7854	3010	701	1770	1722
Core Sound	9690	4021	3873	26308	16076	4787
Inland Waterway	3583	5182	11289	9451	2523	3121
Lockwood Folly	27090	44351	38305	28504	14540	5479
Masonboro Soun	21712	23014	23264	21790	23324	23055
New River	12333	15339	16671	16240	32092	18179
Newport River	15428	13829	12897	12996	7257	5968
North River	11860	12885	5475	2342	5106	5148
Pamlico Sound	13690	3277	344	1958	35128	43794
Shalote River	26391	28966	37271	46263	18765	16261
Stump Sound	13589	20534	24039	33853	42098	43579
Topsail Sound	31630	44208	39364	37424	30835	27479
White Oak River	4818	2931	847	2459	566	435
Statewide Total	197713	232422	219410	249009	236044	207400

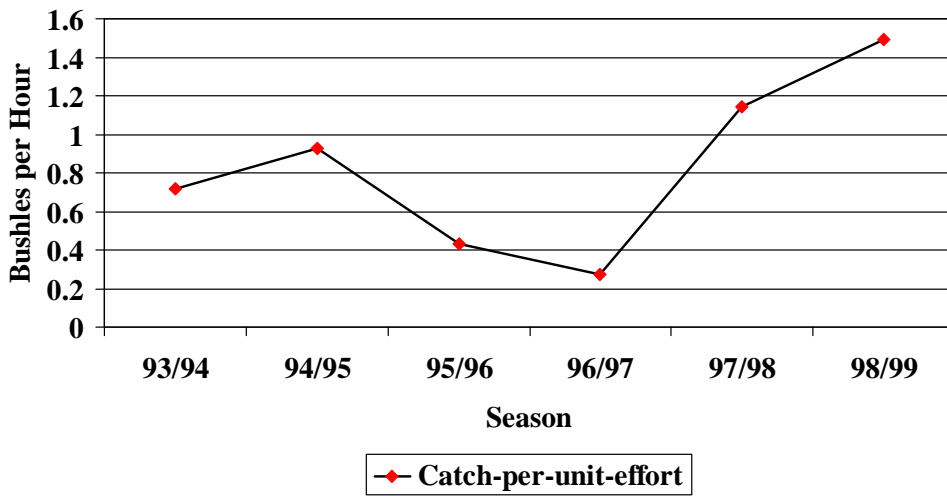
### 5.3.2 STOCK STATUS INDICATORS

While there is insufficient information to assess the standing stock of oysters or to calculate the maximum sustainable yield for the fishery, data do exist that indicate oyster populations are in a very vulnerable condition. In the Pamlico Sound area, average spatfall for 1989 through 1998 is less than half the value for 1979 through 1988 (Figure 6). Some researchers suspect that oysters are becoming spawner limited however, another explanation for the decline in spatfall may be a decline in gamete production and fecundity caused by stress from Dermo (*Perkinsus marinus*) infections (Choi et al. 1994; Dittman 1993). High Dermo infection prevalence and intensity also appears to be removing an extremely high percentage of the larger, typically more fecund oysters from Pamlico Sound populations (see section 5.3.3). Oysters typically begin suffering Dermo related mortality at 2+ years of age and around 2.5 inches in shell height. This situation could be affecting recruitment also, but more importantly, it concerns managers because it indicates that the Pamlico Sound stock of oysters is relying on a limited spawning stock to replenish the population and spawning success can be highly variable depending on environmental conditions.



**Figure 6.** Northern area spatfall data from the Shellfish Rehabilitation Program 1979-1999 (NC Div. of Marine Fisheries unpublished data)

Another indication of stock stress and the lack of productive spawners is the low catch-per-unit effort in the mechanical harvest fishery for oysters which is limited to taking oysters 3 inches or greater in length (Figure 7). Catch-per-unit-effort increased after Hurricane Fran and significant rainfall during the winter of 1997/98 decreased salinities and curtailed Dermo growth in Pamlico Sound. However, catch rates of four bushels per hour were not uncommon prior to the onset of Dermo mortalities in mechanical harvest areas in 1991.



**Figure 7.** Catch-effort data taken from a survey of Mechanical Harvest of Oysters on Public Bottom permit holders 1993/94-1998/99 (NC Div. of Marine Fisheries unpublished data)

Factors on which to base a concern status for oysters in the smaller, more saline estuaries of the central and southern area of North Carolina are not as well documented. A perception of extreme harvest pressure and oyster habitat disturbance caused by recreational oyster harvest and hard clam harvesting, respectively account for most of the concern. The lack of restrictions on entry into commercial oyster fishing created by the recently adopted licensing system is also of great concern in this region.

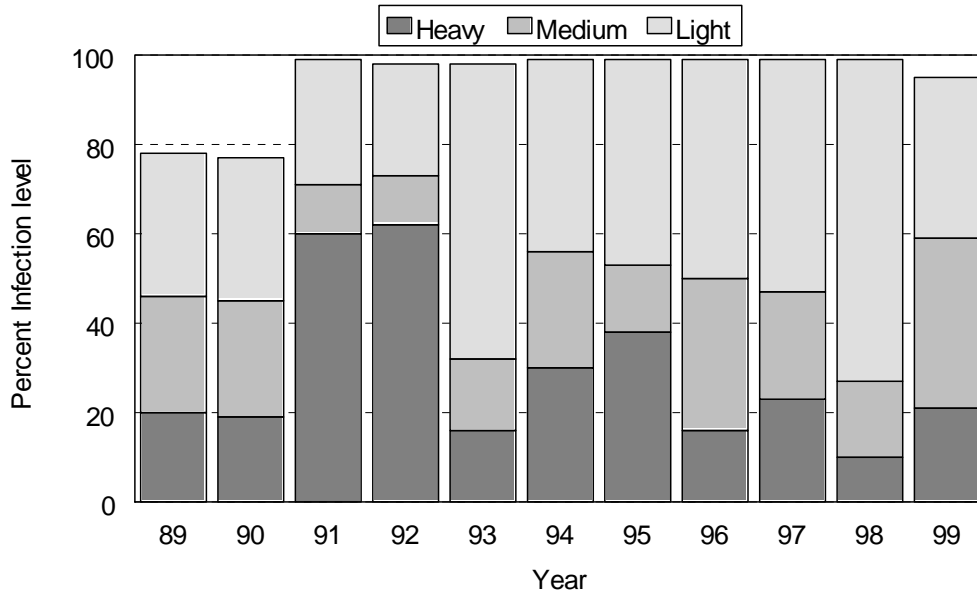
### 5.3.3 OYSTER DISEASE

The oyster parasite *Perkinsus marinus*, also known as Dermo disease, has been responsible for major oyster mortalities in North Carolina in recent years. Chestnut (1955) may have been the first to report that it occurred in this state. However, no extensive assessments were attempted until large-scale oyster mortalities during the fall of 1988 prompted investigations. Oyster samples from various locations were sent to the Virginia Institute of Marine Science (VIMS) and the Cooperative Oxford Laboratory. Results showed that while both MSX (*Haplosporidium nelsoni*) and Dermo were found, Dermo was the major cause of mortalities. During 1988, only eleven sites were sampled for oyster parasites. Dermo was found at nine of the sites, and MSX was found at the other two. Mortalities were reported primarily from New River south to the South Carolina border (Figure 2).

In 1989 DMF began operating a small laboratory to diagnose Dermo infections. Results of DMF Dermo sampling are shown in Figure 8. All diagnoses were made using the rectal thioglycolate method described by Ray (1952). High values in the figure are a conservative indication of expected mortality rates. During the first year of sampling, Topsail Sound and Core Sound areas had the greatest numbers of heavy Dermo infections. The heaviest mortalities during 1990 were found in Pamlico County and northern Carteret County (Figure 2). Earlier sampling in 1990 also revealed some intensive overwintering infections. Mortalities in Pamlico County were found to begin in June that year, probably due to the mild winter weather. All 113 sites sampled during 1991 showed some level of infection. Infection levels were much higher than previous years (Sherman et al. 1991). Hyde County was impacted by disease mortalities for the first time since sampling began. 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 and one location near Hatteras Inlet changed from a light infection in 1991 to no infection during 1992 (unpublished data). However, while some areas improved, the overall infection intensity remained high in 1992 (Figure 8).

Infection intensity dropped significantly during 1993, increased and remained relatively constant from 1994 through 1997, and dropped to the lowest levels seen during the ten-year period in 1998. The decline in infection intensity in 1998 may be attributable to lowered salinity caused by large rainfall amounts during the winter of 1997/98. The prevalence of the parasite remained at 98 to 100% from 1993 to 1998 indicating that a return to the very high oyster mortalities of 1991 and 1992 could be expected if environmental conditions became optimum for parasite

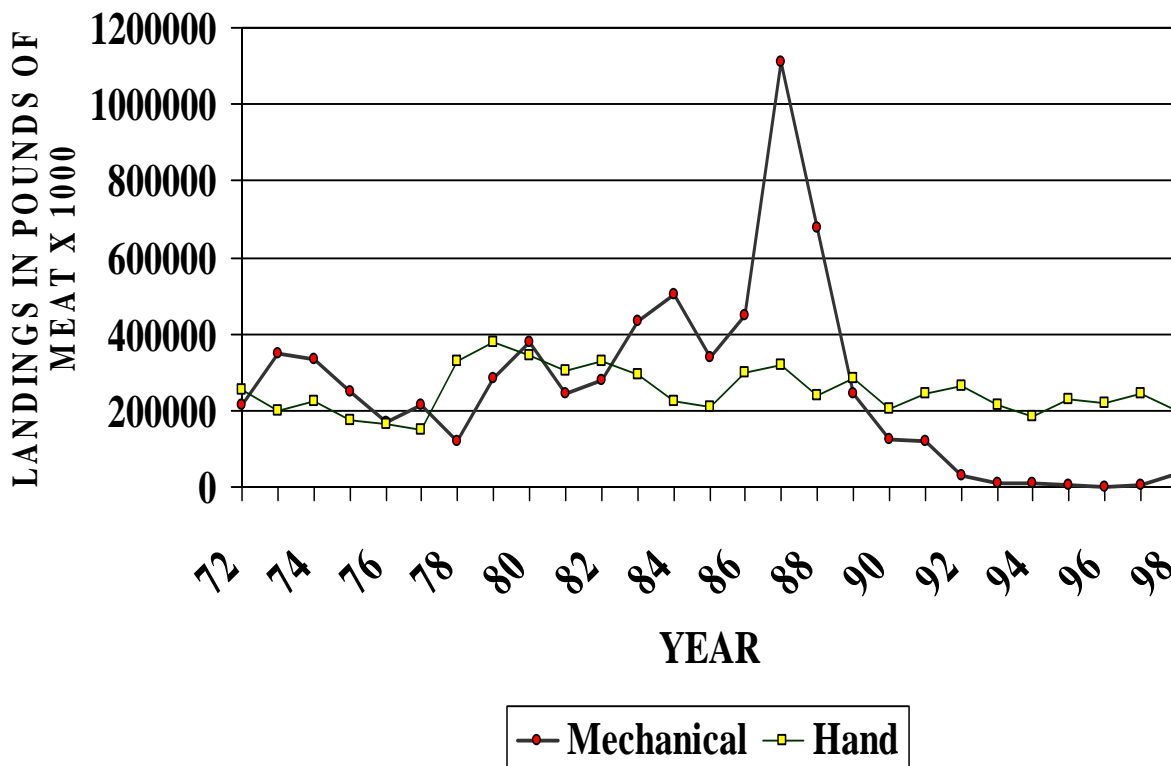




**Figure 8.** Weighted incidence values for *Perkinsus marinus* infections in North Carolina 1989-1999 (NC Div. of Marine Fisheries unpublished data).

growth. During this period it also became evident that oysters in the smaller, more saline southern estuaries were maintaining higher survival rates at infection intensities similar to Pamlico Sound stocks. This situation is in evidence in the landings figures from 1991 to 1998 where hand harvest landings exceeded mechanical harvest landings during the period (Figure 9). Mechanical harvest is practiced almost exclusively in Pamlico Sound while hand harvest is the only oyster harvest method allowed in the southern estuaries. Research experts suspect 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. The recently discovered link between low DO, 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 DO events.

Personal communication with Dr. Gene Bureson of VIMS and Dr. Michael Crosby of the Baruch Marine Institute (South Carolina) indicated that in Virginia, Dermo infections cannot 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 have been taken during winter months.



**Figure 9.** Oyster landings by gear type 1972-1998 (NC Div. of Marine Fisheries unpublished data).

*Haplosporidium nelsoni*, the causative agent of MSX, was found at two of the eleven sites examined in 1988. These two sites, Crab Slough in Dare County and Wysocking Bay in Hyde County (Figure 2), had high level infections 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 (Figure 2) (Morrison et al. 1989). Sampling conducted by the North Carolina State University College of Veterinary Medicine during 1990-92 indicated no high intensity MSX infections (unpublished data). Analyses from 1989 to 1992 were conducted using hemolymph analysis (Burreson et al. 1988).

MSX does not survive if salinities fall below 10 ppt for a period of at least two weeks. Heavy rainfall from the intense hurricane activity experienced in North Carolina since 1996 has reduced Pamlico Sound salinities periodically so that sampling has not been necessary. Occasional sampling during 1993-95 did not indicate any infections.

## **6.0 STATUS OF THE FISHERIES**

### **6.1 COMMERCIAL FISHERY**

#### **6.1.1 HISTORICAL PUBLIC 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 3) (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 had not yet been allowed on public bottom. 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 382,000 and 367,000 bushels landed in 1887 and 1888, respectively, were landed primarily by hand harvest methods and from relatively shallow water. It was not until 1889 when, after depleting their own resources, fishermen from northern states entered North Carolina with dredges and efficient mechanical tongs and North Carolina's deep-water Pamlico Sound oyster resource was fully exploited (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, while there were 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 1892-1895 and limited dredging in 1896 resulted in huge declines in oyster production and closing of many of the oyster canneries opened during the northerners' invasion. 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 1897 to the present, landings reached their highest level in 1902 at 1,833,000 bushels and exceeded one million bushels only one other time on record (1,003,000 bushels in 1923) (Table 3). All of the early oyster landings were accomplished using hand methods and sail-powered oyster dredge boats.

**Table 3.** North Carolina oyster landings in pounds of meat and bushels, 1880-1998.

YEAR	TOTAL		YEAR	TOTAL	
	LB.	BU. (x 1,000)		LB.	BU. (x 1,000)
1880	938,400		1963	694,000	133
1887	1,175,650	382	1964	727,700	153
1888	1,129,960	367	1965	863,700	166
1889	5,528,942	1,795	1966	726,209	138
1890	4,456,075	1,447	1967	518,514	100
1897	4,740,675	1,539	1968	402,959	84
1902	5,645,928	1,833	1969	369,928	81
1908	4,159,320	1,350	1970	381,978	78
1910	1,834,058		1971	423,675	83
1918	1,197,630	389	1972	470,112	93
1923	3,089,146	1,003	1973	548,351	101
1927	2,397,750	779	1974	558,821	105
1928	2,286,610	743	1975	424,831	79
1929	2,828,420	918	1976	333,315	66
1930	2,205,674	716	1977	365,714	70
1931	1,500,571	487	1978	449,544	97
1932	1,201,356	390	1979	665,439	168
1934	1,160,700	377	1980	723,099	123
1936	2,480,500	805	1981	550,502	97
1937	1,940,900	630	1982	611,998	112
1938	1,426,900	463	1983	724,509	117
1939	1,055,600	343	1984	724,557	115
1940	690,400	224	1985	545,439	94
1945	1,707,100	554	1986	745,548	129
1950	1,322,100	225	1987	1,425,584	225
1951	1,531,900	247	1988	913,100	138
1952	1,620,900	331	1989	529,858	90
1953	1,525,300	310	1990	328,850	58
1954	1,008,400	223	1991	319,040	61
1955	731,000	150	1992	293,956	57
1956	1,318,000	285	1993	223,199	43
1957	1,086,500	239	1994	197,905	37
1958	1,041,500	228	1995	232,498	44
1959	1,311,000	287	1996	219,411	41
1960	1,216,200	289	1997	249,007	47
1961	1,209,100	233	1998	236,043	45
1962	961,400	192	1999	216,329	41

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 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 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 (Chestnut, pers. comm.). 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 and the eventual invasion into North Carolina of fishermen from those areas, North Carolina fishermen adopted the practice and laws were passed allowing its use (Figure 3). 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. 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. 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 1,539,000 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 10). Oyster landings during this period also fell, reaching a low of 389,000 bushels during 1918.

Available rulebooks indicate that by 1927, the Fisheries Commission had 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 Swan Quarter Narrows to oyster dredging (Figure 11). 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 felt that the rules were made available to the fishermen and that the rules were used for enforcement purposes.

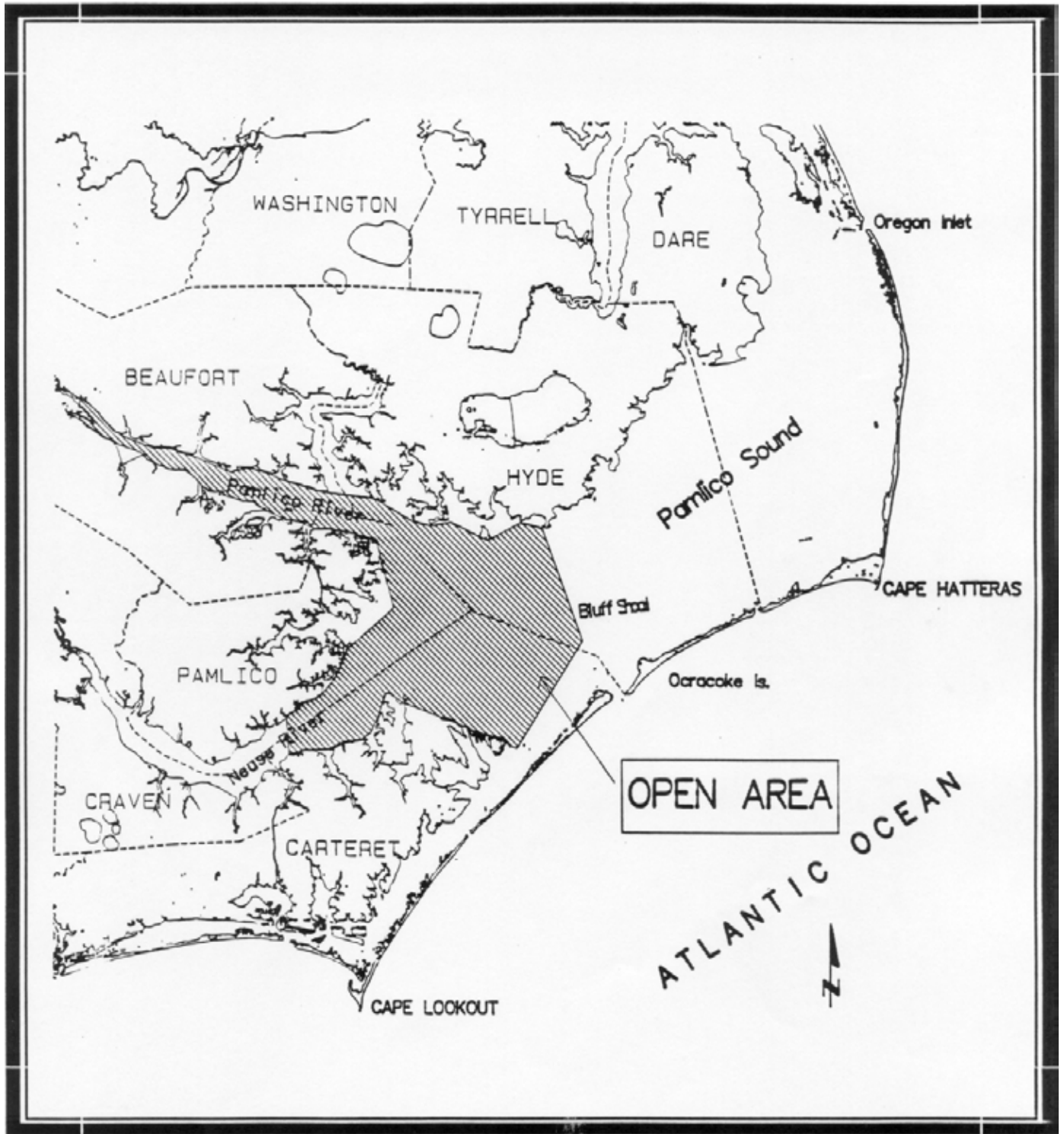


Figure 10. Open oyster dredging area 1909 (hatched), sail power only.



**Figure 11.** Open oyster dredging area 1927 (hatched), sail power only.

The areas where oyster dredging was allowed by sail power remained relatively unchanged except for openings and closings of a few Hyde County 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 12). These powerboats were restricted to a length of 30 feet and hand dredges only (no power winches allowed for raising dredges) were allowed to be pulled. 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, 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 13). 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 deleted.

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 had occurred by 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 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 14).

During the 1960s several areas were added to the list which prohibited oyster dredging, including New River, Shallotte River, Lockwoods Folly River, South River, White Oak River, Saucepan Creek, and Currituck County (Figure 15). 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.

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 16).





Figure 12. Open oyster dredging area for powerboats (hatched), 1931.



Figure 13. Open dredging area for powerboats (hatched), 1944.



Figure 14. Closed oyster dredging area (hatched), 1955.

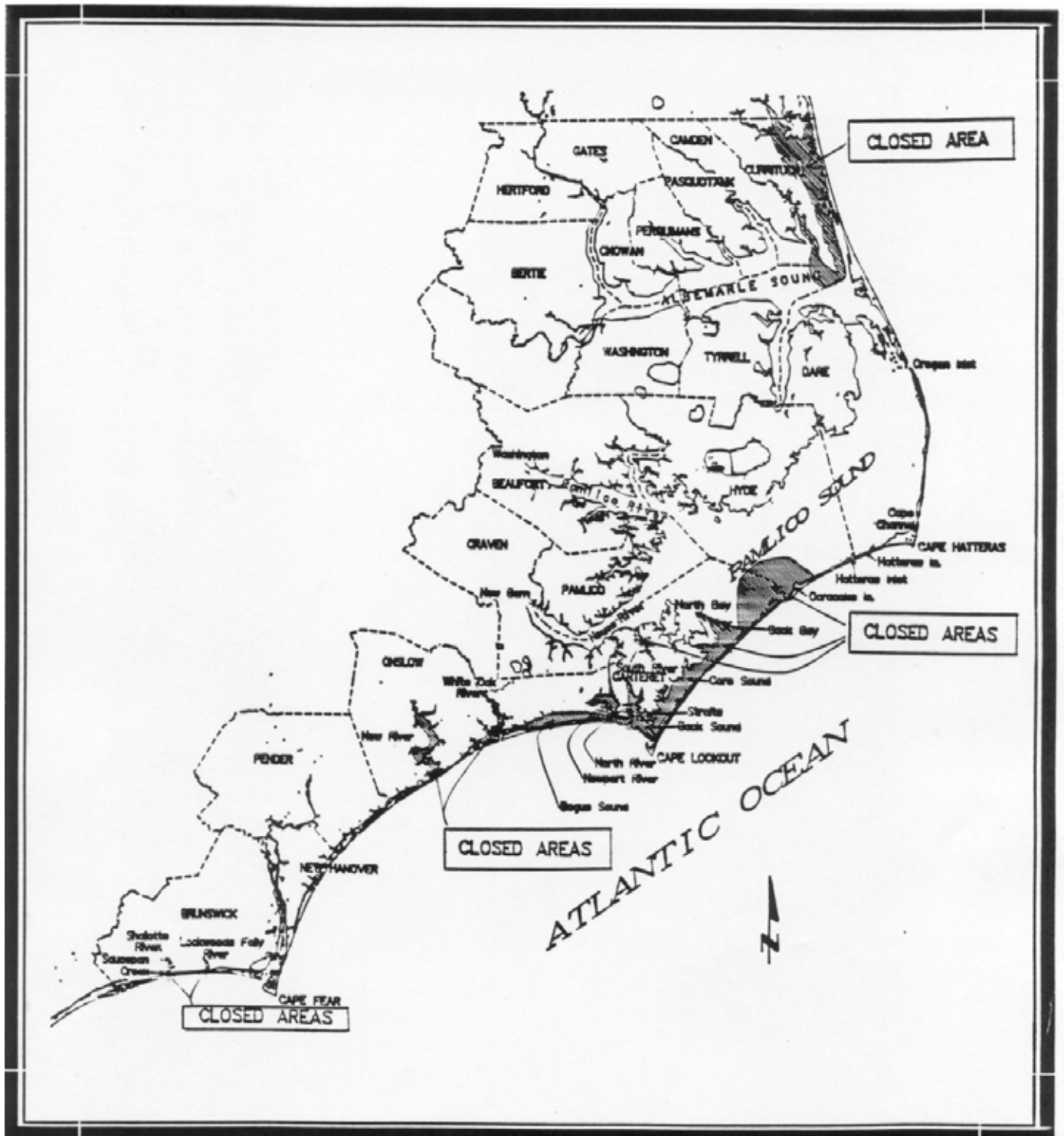


Figure 15. Closed oyster dredging area (hatched), 1960-1975.



**Figure 16.** Current area closed to oyster dredging (hatched) and Primary Nursery Areas (black). Areas restricted to hand harvest of oysters by proclamation are not shown.

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.

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 Division 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.

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 cull law was initiated on subtidal oysters in 1893 and a further increase to three inches was made between 1931 and 1934. The three-inch cull law was not applied to all oysters until 1980.

The gear for hand harvest of oysters 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 immigrants with bull rakes from northern states prompted the adoption of limitations on rakes for taking oysters in 1981. Originally a ten-pound weight restriction, 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 and therefore no culling tolerance on coon oysters.

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).

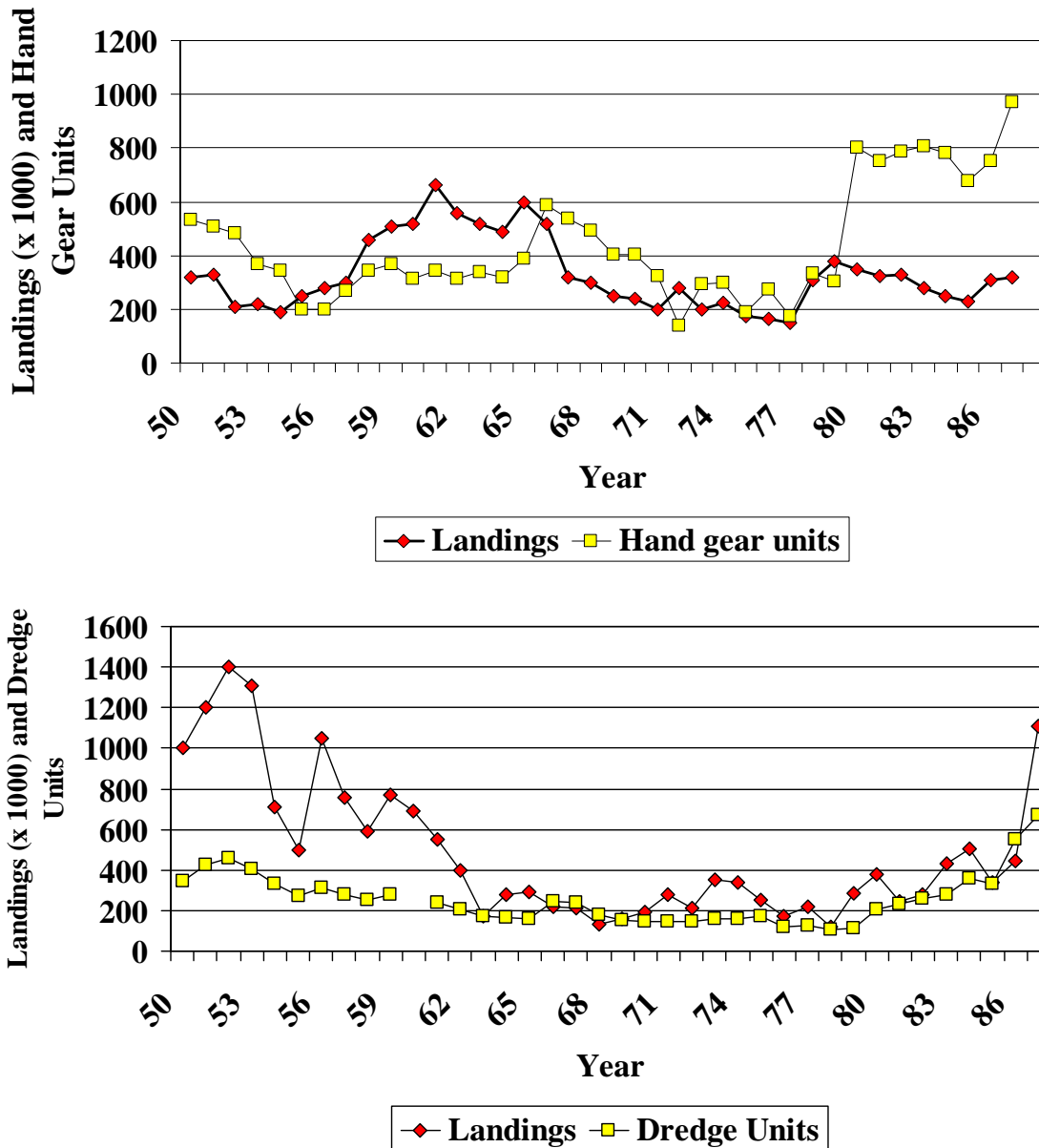
The management action of restricting oyster dredging to a shorter season than hand harvest methods began in 1895 (Thorsen 1982). This concept was in use in regions of the main portion of Pamlico Sound and for other local areas until significant rule changes took place around 1950. Differential openings 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.

While the length of the season may give some indication of the harvest pressure on oyster resources, data from the National Marine Fisheries Service Boat-And-Shore Survey show that the operating units or numbers of types of fishing gear for oyster harvest gear generally follows oyster landings (Figure 17). This information indicates that opportunistic fishermen are able to enter the fishery to take advantage of productive years, but they move to other fisheries during periods of low harvest. However, between 1977 and 1987, the operating units climbed to very high levels relative to the landings, particularly for dredges.

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 17). Chestnut (1955) 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 clambers turned to oyster dredging due to closure of southern clamming areas by a red tide. Hand harvest landings failed to reach their potential that same year due to the fact that a majority of the hand-harvest-only area was also closed because of the red tide and a large crop of oysters in that area was not

harvested (Figure 17). The red tide was an algae bloom which caused closure of over 361,000 acres of public bottoms to shellfish harvest from November, 1987 to May, 1988. The algae (*Gymnodinium breve*) produced a neurotoxin, which was concentrated in shellfish, making them unfit for consumption.



**Figure 17.** Operating units of oyster harvesting gear compared to oyster landings by gear in pounds of meat (Chestnut and Davis 1975; National Marine Fisheries Service unpublished data; NC Div. of Marine Fisheries unpublished data).

Hand harvest landings contributed significantly and exceeded the dredge landings at times



between 1955 and 1965. It is interesting to note that following the adoption of size limits on coon oysters in 1971 and 1980, landings declined for hand harvest.

Economic upheavals, world wars, and severe weather events have also affected the commercial oyster fishery by reducing the market, reducing the labor force, or by affecting the fishery or the habitat. During the course of this review, the following occurrences were noted as having a marked effect on the fishery (Figure 18).

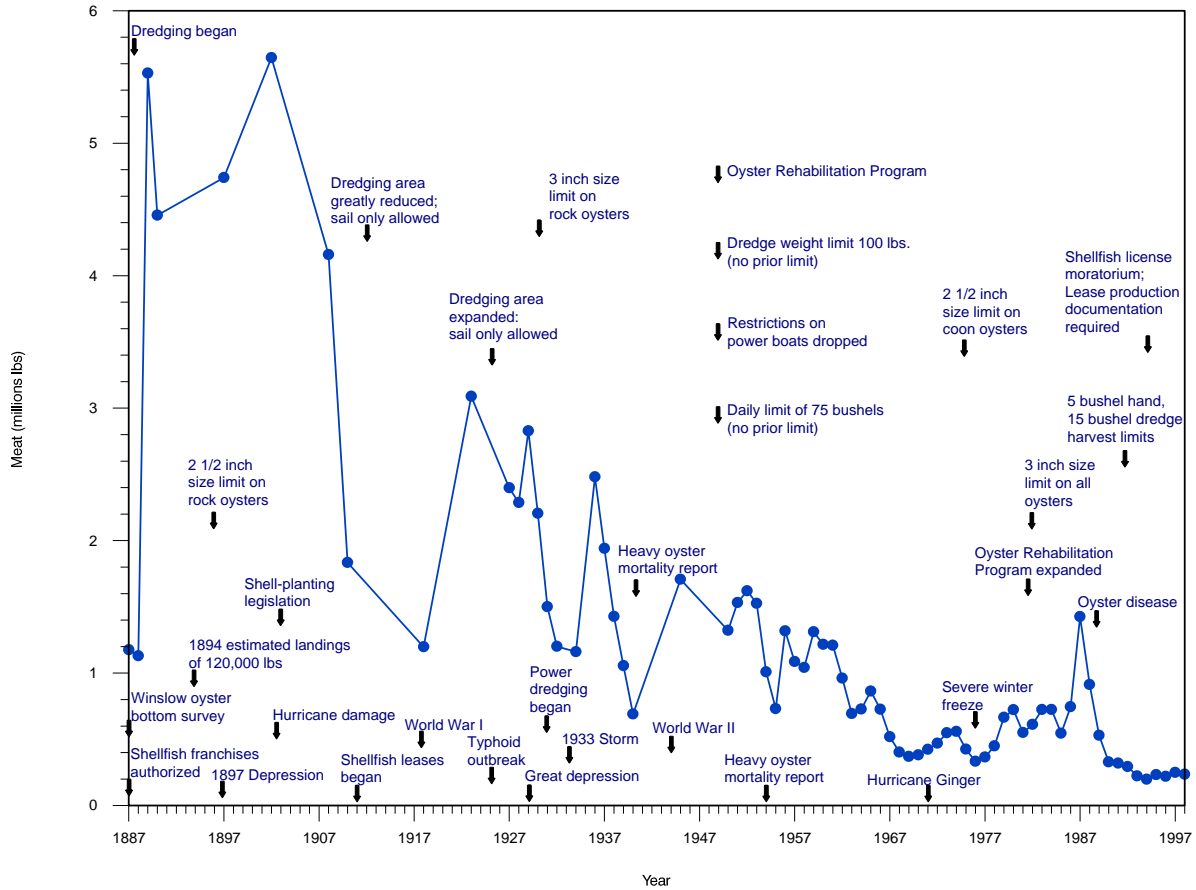


Figure 18. Factors affecting the North Carolina oyster fishery 1887-1992 (Not shown: 1855 - first private oyster culture license; 1872 - first oyster season established).

- 1893 An economic depression severely reduced the market for oysters.
- 1899 Hurricanes in August and October killed many oysters due to excessive rainfall.
- 1917-18 A severe December and January freeze curtailed

harvest; manpower was lost due to World War I.

- 1924 A typhoid outbreak was traced to east coast oysters reducing markets. The Shellfish Sanitation Program began, and polluted areas were closed to harvest.
- 1929 The Great Depression caused oyster markets to fall off dramatically.
- 1933 The 1933 storm destroyed oyster beds around Ocracoke and Portsmouth which had been the most productive in the state since the mid 1800s.
- 1940 An unexplained heavy mortality of oysters was reported.
- 1942-46 Production increased due to high prices caused by World War II.
- 1949 Heavy rains in June, 1949 caused severe oyster mortalities in Hyde and Dare counties which affected landings through 1951.
- 1953-55 Oyster resources were damaged due to hurricanes Hazel, Connie, Diane, and Ione.
- 1972 Hurricane Ginger caused an estimated 33% mortality of oysters in Pamlico Sound.
- 1976-77 A severe freeze curtailed the winter oyster harvest.
- 1987-88 Oyster harvest from Core Sound south to the South Carolina border was severely curtailed due to a red tide outbreak.
- 1988-98 Significant oyster mortalities were found to be caused by the oyster parasite *Perkinsus marinus* (Dermo).

In contrast, some efforts to rehabilitate the oyster fishery were cited for large increases in landings:

- 1921-24 Approximately 1.5 million bushels of seed oysters and shells were planted and given credit for the great increase in landings around 1923.

1934 Plantings of 825,000 bushels of seed and 78,567 bushels of shell in 1934 were closed until 1936, when landings rose to around 800,000 bushels.

### **6.1.2 PRESENT PUBLIC FISHERY**

The harvest of oysters from public bottoms has been managed in the same manner since approximately 1988. Hand harvest oyster season opens on or about October 15<sup>th</sup> each year and mechanical harvest opens near mid November. The few changes that have been made in the season involved two early closures due to input from fishermen and dealers that most of the harvestable oysters had been taken. A rule change occurred in 1996 that allowed the oyster season to remain open for an additional six week period between March 31 and May 15 to allow for the harvest of Dermo infested oysters. To date the extended season provision has not been utilized due to an inability to identify threatened oyster stocks at that time of year.

The areas designated for mechanical harvest of oysters has not changed since 1991 when an area along the Outer Banks in Pamlico Sound was closed. Three bays and several Shellfish Rehabilitation sites in Pamlico Sound are closed to mechanical harvesting by proclamation annually.

The harvest limits for both the mechanical and hand harvest fisheries have not changed since the 1992/93 oyster season when hand harvest was limited to 5 bushels per person not to exceed 10 bushels per boat and mechanical harvesters were limited to 15 bushels per fishing operation. Both of these limits are considered to be the minimum that will support commercial activity given the prevailing market conditions. As noted earlier in this document, hand harvesters have supported the bulk of the public bottom landings in recent years taking 94% of the harvest for the period 1996 through 1998. A resurgence of landings from dredges in 1998 of 6,526 bushels kept the total hand harvest landings from being more than 99 percent. Data from the Permit for the Mechanical Harvest of Oysters indicates that the landings have been low in that fishery due to very low effort and very low catch-per-unit-effort (Figure 7). Modifications to the season to limit effort in the mechanical harvest fishery would have been necessary if effort was higher because there are an average of 250 mechanical harvest permits issued each year.

The number of shellfish licenses and shellfish and crab licenses issued decreased from 6,610 in 1995 to 3,507 in 1999. Beginning July 1, 1999, the shellfish license was made available to any North Carolina resident for \$25.00 while SCFLs were made available only to those fishers with endorsements to sell. The wide availability of the Shellfish License is to enable those subsistence fishers who only shellfish to continue to do so with a low-priced license. A free shellfish endorsement was also made available to SCFL holders. A total of 7,545 shellfish licenses and shellfish endorsements were sold in fiscal year 2000. Out of 5,775 standard commercial fishing licenses sold, 5,456 have shellfish endorsements (95%), while only 2,089 shellfish licenses were sold. The number of fishermen actually selling shellfish as documented in trip ticket data was much lower than the license data would indicate. See Section 7.1.2.

### 6.1.3 HISTORICAL PRIVATE CULTURE FISHERY

Although North Carolina law did not formally prescribe the methods for obtaining private oyster bottoms until 1858, laws existed giving private oyster growers special privileges in harvesting and selling their oysters as early as 1855. Evidently, early cultivation sites were based on “squatters” rights.

The 1858 law provided for licenses to oyster and clam bottoms to be issued by the Clerk of Superior Court of the respective county at no charge. The grant 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).

Winslow (1889) reported that there were 250 such licenses in the state. He described the plots as "gardens," a term which is still in use today to describe shellfish leases. The production from these gardens was normally limited to amounts adequate to supply the licensee's table (Winslow 1889). Although subsequent laws for oyster 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, which 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 for 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 on 12 April 1886 to determine the extent and condition of North Carolina's oyster- producing habitat. The survey was conducted under the direction of Lieutenant Francis Winslow. Winslow found 8,327.9 acres of oyster producing bottom in Dare, Hyde, Pamlico, Carteret and portions of Onslow counties. He also identified some 583,000 acres of bottom suitable for oyster cultivation (Winslow 1889). In his report, Winslow proposed an entirely new system for allowing private cultivation of oysters on public bottomlands. 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 (Jernigan 1983).

Under these laws, the natural beds were to be established by a board of three Shellfish Commissioners to be held in the public trust in much the same manner that the Baylor Grounds were set aside in Virginia. Shellfish franchises were to be approved by the Secretary of State who issued the grant. Application fees were \$2.05, and franchises were purchased at a cost of 25 cents per acre. Surveys of each grant were conducted for the applicant by a state surveyor at set rates. The grounds were recorded for tax purposes (Winslow 1889).

These grants were required to 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.

Joseph Hyde Pratt, State Geologist for North Carolina, evaluated the success of this initiative in oyster culture and found that, by 1900, practically all of the beds had been abandoned, except for a few acres being cultivated for private use (Pratt 1911). He found that those purchasing the grants were not familiar with oyster cultivation, that these owners chose poor bottoms, or that they were unwilling to put forth the necessary efforts. Others bought oyster grounds simply for speculation. On the other hand, experienced oyster growers found that not only were the laws inadequate to protect them, but their bottomlands could be taken from them if any two witnesses swore that the area was a natural oyster rock (Pratt 1911). A detailed discussion of more recent problems with the issuance of shellfish leases is found in Section 9.2.1.

Grave (1904) provided the information on which Pratt based his report to the General Assembly. While Grave found that he could not find a single private bed anywhere in North Carolina, that was being cultivated or was yielding a return for the investment, he conducted oyster culture experiments on public bottom that showed oyster culture could be productive. Other investigations followed which further demonstrated the productive potential of Pamlico Sound (Pratt 1911).

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 an investigation of existing oyster stocks was conducted by qualified personnel 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. The acreage of shellfish leases was limited to ten acres in the bays and smaller sounds. A single leasehold could be up to fifty acres in size 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 seed per acre after the first two years and an average of 125 bushels per acre after four years.

Chestnut (1951) reviewed the shellfish lease system that had operated under this basic legislation until 1949. At the time there were 264 leased areas totaling 3,232 acres. Chestnut (1951) stated

"Except for a relatively few grounds under lease, the majority are being used primarily for the same purpose as fifty years ago, merely to keep a small amount of oysters to supply the family needs." This poor showing occurred despite the fact that the state had operated an Oyster Demonstration Farm in North River, Carteret County, during the late 1930s and early 1940s.

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.

In 1965 the 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 3C.0311). The produce and market wording was intended to emphasize the commercial purpose. This production requirement remains in rule today.

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. There have not been any other significant changes in the leasing of shellfish bottomlands to date.

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

During the period 1982-86, 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 during 1982-86. Furthermore, by policy, the Division 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 meet neither of the 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. Oyster cultivation efforts and harvest from leased areas are shown in Table 4.

A generalized analysis for the present similar to past analyses of Winslow (1889), Pratt (1911), and Chestnut (1951) would state that the majority of the shellfish leases today are used by commercial fishermen to supplement their income from public area harvests and to provide opportunities for holding shellfish for better meat condition or better market. Beginning in the early 1980s, there has been a move to fully utilize shellfish lease potential by full-time shellfish culturists, but due to market and available technology, they have largely cultured clams. Recent demonstration projects with off-bottom oyster culture may boost oyster production.

Other states have been more successful than North Carolina at establishing an oyster industry based on private cultivation. Virginia, Delaware, Louisiana and Connecticut all have had success with oyster cultivation by private interests. These states all have made available large resources of seed oysters to private bottom holders. Some of the areas are naturally occurring and some are augmented substantially by the expenditure of state funds to plant cultch for spat attachment that is then allowed to be moved to private cultivation sites. Oyster cultivation by artificial spawning and rearing of larvae similar to clam culture has been effective on the West Coast with the Pacific oyster but has not been very effective in the Mid-Atlantic region.

Available rules and statutes indicate that early private oyster growers may have had access to the same type of large seed resources as those in other states. Private bottom holders were allowed to take oysters of any size from the public grounds of the state during a period immediately following the close of oyster season. [However, Dr. A. F. Chestnut (pers. comm.) stated that, although the rules appeared to give great latitude, the actual practice was to restrict the areas to coon oysters and stunted growth areas.] By the late 1960s oyster transplants could be obtained only from polluted areas and three relatively small seed oyster management areas - two in Dare County and one in Pender County. The number of available polluted sites has increased over the years, and two seed oyster management areas were added - one in White Oak River in 1972 and one in Virginia Creek in 1982. While all these transplanting sites comprise a relatively large area, without cultch planting and management the oyster resources in these areas have been slow to recover from depletion by transplanting activities. The period for transplanting polluted oysters has been set from April 1 through May 15 each year (North Carolina Fisheries Rules for Coastal Waters 15A NCAC 3K.0104). Seed oysters can be moved to private areas from April 1 through September 30 (North Carolina General Statute 113-203).

**Table 4.** Reported oyster planting and harvesting activity on North Carolina shellfish leases, 1979-1997. (DMF unpublished data)

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LEASES NUMBER	PLANTING OYSTER(BU)	HARVEST (BU)	% STATE OYSTER LANDINGS
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YEAR	ACREAGE	CULTCH(BU)		
1979	246 2,185	9,929 15,622	28,165	20%
1980	260 2,233	24,257 27,667	58,792	48%
1981	262 2,257	20,126 21,248	17,535	18%
1982	262 2,257	34,122 20,386	17,155	15%
1983	265 2,286	24,130 27,685	12,457	11%
1984	269 2,291	18,263 16,184	11,382	10%
1985	272 2,304	20,968 17,693	11,384	12%
1986	282 2,380	19,240 17,108	12,734	10%
1987	279 2,354	16,746 15,010	6,041	3% (RED TIDE YEAR)
1988	285 2,330	20,092 19,402	13,962	10%

**Table 4 (continued).** Reported oyster planting and harvesting activity on North Carolina shellfish leases, 1979-1997. (DMF unpublished data)

YEAR	LEASES <u>NUMBER</u> ACREAGE	PLANTING <u>OYSTER(BU)</u> CULTCH(BU)	HARVEST (BU)	% STATE OYSTER LANDINGS
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1989	276 2,232	4,799 28,794	9,555 (OYSTER RELAY CURTAILED DUE TO DERMO)	11%
1990	276 2,214	17,036 32,218	13,425	23%
1991	281 2,435	21,402 25,355	9,930	16%
1992	280 2,191	22,508 34,057	9,668	17%
1993	300 2,441	21,680 46,252	7,669	18%
1994	285 2,282	21,421 62,219	4,231	11%
1995	279 2,216	18,112 27,409	4,348	10%
1996	295 2,193	18,070 33,790	4,633	11%
1997	295 2,196	24,120 24,932	5,263	11%
1998	284 2,149	18,689 22,375	5,585	12%
1999	284 2,121	21,130 35,242	5,914	14%

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Some shellfish franchises (private culture areas obtained for a one-time fee under the 1889 laws) issued prior to the shellfish leasing program still exist and are currently going through a process to evaluate their validity under North Carolina General Statutes 113-205 and 113-206. Those that are recognized as valid claims to bottomlands were required beginning 1 January 1991, to meet the requirements for surveys, management plans, and commercial shellfish production set for shellfish leases. Currently, 46 shellfish franchises have been so recognized. Production data from these franchises began showing up in the 1991 statistics but is not differentiated from the shellfish lease landings. Franchises that are not recognized may be subject to special leasing provisions. It is unknown what portion of the approximately 300 franchise claimants may be issued a shellfish lease.

In 1989 legislation was enacted to allow the use of the water column above shellfish leases. At this time, only eight water column leases exist. The high rental fee of \$500 per acre per year has probably excluded many leaseholders. However, this opportunity will prove to be a valuable tool for oyster culture if current off-bottom culture techniques are adopted by leaseholders. A summary of the opportunities for obtaining space in coastal waters to grow shellfish is shown in Table 5.

**Table 5.** Comparison of shellfish lease and amendment types currently authorized by NC General Statutes 113-202, 113-202.1 and 113-202.2 for shellfish cultivation.

	Bottom Lease	Water Column	Demonstration Project
Application Fee	\$100	\$100	\$0
Renewal Fee	\$50	\$50	\$0
Survey Requirement	yes	yes <sup>1</sup>	variable
Rental Fee	\$5/acre/yr.	\$500/acre/yr. <sup>2</sup>	\$0 <sup>3</sup>
Term	10 yrs.	5 yrs.	2yrs.
Renewals	indefinite	indefinite	one
Production Requirements	25 bu./acre	100 bu./acre	none

1 - Unless area is identical to bottom lease

2 - Fees are additive

3 - Unless commercial production occurs

#### 6.1.4 PRESENT PRIVATE CULTURE FISHERY

Due to the addition of water column use on approved lease sites, increased Sea Grant

involvement, and funds provided by the Fisheries Resource Grant Program, interest in utilizing hatchery-reared seed and aquaculture of oysters is rising. Aquaculture techniques can circumvent the effects of Dermo parasites and the major impediment to increasing aquaculture production of oysters is locating markets willing to pay the higher prices necessary to offset increased labor, rental, and materials costs.

However, most leaseholders utilize cultch planting and relaying techniques that have been in use for over 100 years. Production of oysters from leases dropped about 75% with the onset of Dermo. Leaseholders have maintained production of approximately 11% of the State's oyster harvest in recent years although many leaseholders do not meet the minimum production or planting requirements. The production requirements may be met by producing oysters, clams, scallops or mussels and many leaseholders choose to culture hard clams. There are currently no data to determine the amount of oysters produced per acre on shellfish leases targeting oyster production.

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. 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. An average of 20 leaseholders take advantage of the mechanical harvesting permit annually. A permit is required for leaseholders to take oysters from their leases during the public oyster season. Permit holders choose the maximum amount of oysters they can harvest on any given day. This permit allows leaseholders to possess more than the public bottom harvest limits when travelling to and from the lease site. Leaseholders may also harvest oysters during the closed oyster season although this option has been used sparingly in recent years.

Relaying of oysters from polluted areas to leases for depuration occurs between April 1 and May 15 each year. Relaying continues to be a significant component of oyster culture efforts despite diminished returns. In 1998, 80 leaseholders relayed 18,714 bushels of oysters to lease sites. Cultch planting has exceeded relaying in volume by a ratio of almost 2:1 in recent years. Traditional cultch supplies have diminished since oyster production is down forcing leaseholders to use other types of shell material and marl (fossil stone). Leaseholders using aquaculture techniques planted only 176,800 hatchery reared oyster seed in 1998 down from 2,270,00 in 1997 and 767,000 in 1996. By way of comparison, hard clam culturists planted 7,372,000 seed clams in 1998 and planted more than 21, 000,000 per year in 1996 and 1997.

## **6.2 RECREATIONAL FISHERY**

In North Carolina, one bushel of oysters per person, not to exceed two bushels per boat, may be taken per day during the regular oyster season with no licenses (North Carolina Fisheries Rules for Coastal Waters 15A NCAC 3K.0105). The harvest of oysters under this rule is unknown. However, in traditional fishing communities it is a customary practice and southern area Marine Patrol officers report that in many areas the recreational harvest is substantial. According to the

1991 Addendum to the 1985 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, (U. S. Fish and Wildlife Service, 1991), 129,973 shellfishermen aged 16+ expended 1,009,000 days shellfishing in North Carolina in 1985. Shellfishing included both molluscs (oysters, clams, scallops) and crustaceans (shrimp, crabs). North Carolina ranked twelfth and eleventh nationally in those two categories, respectively.

During 1991, the telephone survey portion of the North Carolina Recreational Fishery Statistics Survey included a question on the number of recreational shellfishing trips taken. Results indicate there were more than one million trips to harvest shellfish in North Carolina in 1991. No data on shellfish harvest was given.

There are no other known data on recreational shellfishing in North Carolina and no data on oyster harvest by recreational fishermen. Taking oysters for personal consumption was allowed year round in North Carolina until 1966. Since 1966, it has been allowed only during the open season, including Sundays. Available records indicate both hand and mechanical gear have been allowed in the respective open areas for taking shellfish for home consumption.

## **7.0 SOCIOECONOMIC CHARACTERISTICS OF THE OYSTER FISHERY**

### **7.1 COMMERCIAL FISHERY AND AQUACULTURE**

#### **7.1.1 EX-VESSEL VALUE AND PRICE**

The value of oysters harvested in North Carolina gradually increased from \$344,000 in the early 1970s to a peak of approximately \$2.9 million in 1987 and then decreased to a low of \$682,000 in 1994. Subsequently, landed value has increased. The value of landings was \$920,658 in 1999 (Figure 19).

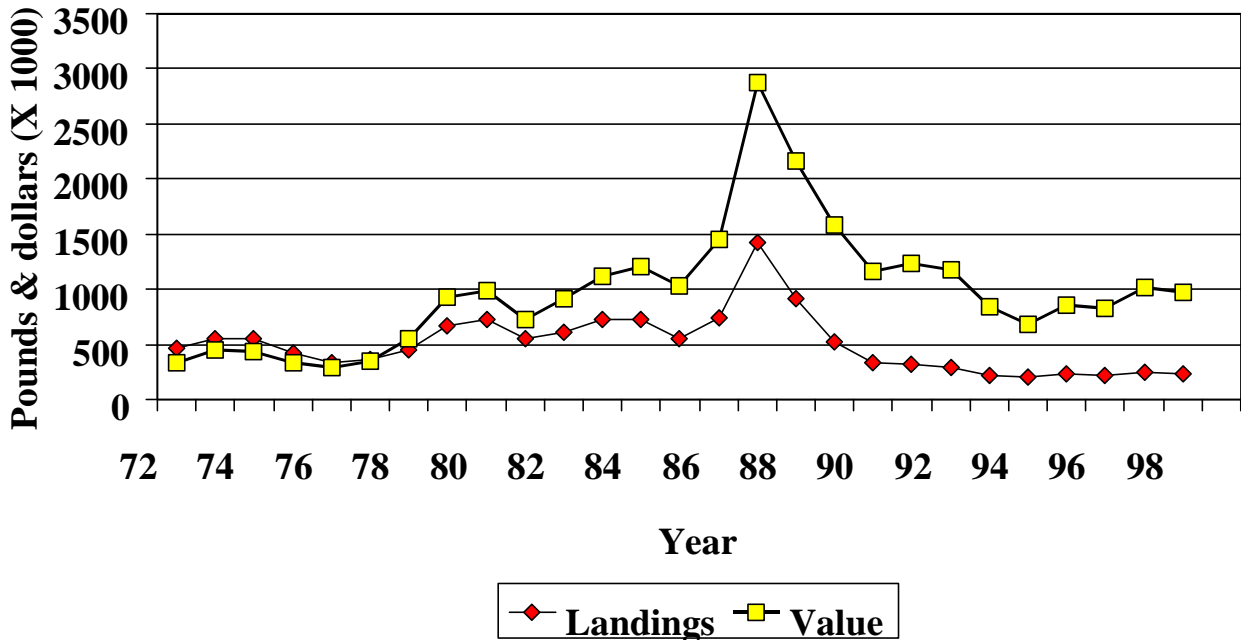
The price per pound of meats received by North Carolina oystermen exhibited an upward trend when evaluated on both a nominal or real (corrected for inflation) basis. The nominal price per pound increased from \$0.73 in 1972 to almost \$4.00 per pound of meats in 1992. Prices peaked during 1998-1999, although total production in North Carolina continued to decline. After adjusting for inflation, the price of oysters was \$2.23 per pound of meats in 1999, or 118% higher than it was in 1972 (Figure 19).

#### **7.1.2 FISHING INCOME**

Total gross fishing income as indicated in Table 6 varied substantially among fishermen during 1998-1999. For example, total income from fishing ranged from \$200 to more than \$46,000 and the average income was about \$13,000 in 1998. Similarly, income earned from oystering averaged \$1,590 and ranged from \$136 to \$2,989 during the same period.

Oystering accounted for approximately 15% of the total fishing income with average annual landed value of \$1,645. However, it contributed at least 50% of the total fishing income for fishermen earning less than \$1,000. By contrast, oyster fishing provided only 6-9% of the total

fishing income. This result indicates that the majority of oyster fishermen participate in more than one fishery during the year. By comparison, aquaculture (i.e., hard clam and oyster) provided 22.5% of the total household incomes for leaseholders (Diaby 1997).



**Figure 19.** North Carolina oyster landings in pounds of meat and value 1972-1998 (NC Div. of Marine Fisheries unpublished data).

**Table 6.** Distribution of fishermen’s oyster revenues, 1998-1999.

INCOME	1998 Averages				1999 Averages			
	NUMBER	ALL SPECIES	OYSTER	% INCOME	NUMBER	ALL SPECIES	OYSTER	% INCOME
Under \$500	118	\$204	\$147	72	76	\$200	\$136	68
\$500-\$1,000	44	757	435	57	31	751	390	52
\$1,000-\$2,000	51	1511	542	36	47	1396	832	60
\$2,000-\$3,000	41	2485	1256	51	30	2531	1060	42
\$3,000-\$4,000	44	3427	1132	33	20	3406	1142	34
\$4,000-\$5,000	22	4504	1208	28	26	4452	1590	36
\$5,000-\$10,000	92	7235	2124	28	71	7499	2121	28
\$10,000-\$20,000	86	14705	2949	20	69	14483	1930	13
\$20,000 & up	115	48439	2896	6	38	41941	2709	6
<b>Total</b>	<b>613</b>	<b>13027</b>	<b>1589</b>	<b>12</b>	<b>408</b>	<b>8553</b>	<b>1334</b>	<b>16</b>

### 7.1.3 NUMBER OF COMMERCIAL FISHERMEN

The number of commercial oyster fishermen can only be estimated because the license or endorsement for commercially harvesting oysters in North Carolina has traditionally included other species of shellfish such as clams and scallops. However, the number of individual fishermen, using one or more endorsement-to-sell (ETS) licenses to report sales of oysters on trip tickets, declined slightly from 1998 (613) to 1999 (408). Fishermen participating in the fishery can be divided into two groups: non-lease fishermen and leaseholders. Although the exact number of oyster lessees is unknown, the total number of leaseholders ranged from 246 in 1979 to 295 in 1997, with an average of 277. Overall, the oyster fishery is dominated by non-lease fishermen in North Carolina.

#### **7.1.4 MARKETING, DISTRIBUTION, AND PROCESSING**

The numbers of oyster seafood dealers/processors licensed decreased overall during 1984-1998. The number of dealer licenses decreased from 192 in 1985 to 44 in 1993, then increased to 179 in 1994 with a slight decline in the following years. Similarly, the total number of oyster processors licensed decreased from 26 in 1985 to seven in 1993, then fluctuated in the 12-19 range during 1994-1998.

#### **7.2 RECREATIONAL FISHING**

The extent of recreational oyster fishing activity in North Carolina is unknown, including number of participants and estimated catch data. Data on recreational fishing activity is collected on finfish species.

#### **7.3 DEMOGRAPHIC CHARACTERISTICS**

##### **7.3.1 COMMERCIAL FISHERMEN**

Although there is no specific information on the socioeconomic characteristics of non-lease oyster fishermen, it can be assumed that their profiles may be similar to those of other commercial fishermen in North Carolina. Johnson and Orbach (1996) provided a detailed description of fishermen's profiles across coastal counties. In a survey of aquaculture operations, Diaby (1997) indicated that leaseholders tended to be middle-aged, with an average age of 50 years. Their average level of education corresponds to more than a high school diploma, with 21% of the leaseholders holding college degrees.

##### **7.3.2 RECREATIONAL FISHERMEN**

No data exist concerning socioeconomic characteristics of recreational oyster fishermen in North Carolina.

### **8.0 ENVIRONMENTAL STATUS**

## 8.1 ESSENTIAL HABITAT

The fundamental requirement of the eastern oyster is the mixture of salt water from the oceans with 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 critical habitat need for clean, hard substrate necessary for oyster larvae settlement, they survive the often harsh and constantly changing conditions found in the sounds and rivers of North Carolina.

The most critical areas for oyster populations are the oyster beds or rocks that they form by the accumulation of shells and oysters over the course of many years. Significant concentrations of oysters can also be found on outcroppings of fossil shell beds and on natural accumulations of wedge rangia (*Rangia cuneata*), hard clam (*Mercenaria mercenaria*) and bay scallop (*Argopectin irradians*) shells in North Carolina. Oysters have also been found to settle on exposed roots along the edges of *Spartina* marshes. Pilings, seawalls, and rip rap areas also provide habitat for oyster populations especially in areas with high estuarine salinities.

Although it is generally believed that the size of North Carolina's oyster-producing habitat is decreasing, natural oyster rocks are still being formed today on sites where no oysters existed previously. Therefore, critical areas in the overall natural development of oyster populations should include the potentially productive areas where substrate, water flow, salinity patterns, and sedimentation will allow their development.

The protection and restoration of oyster habitats is crucial to achieving the goals and objectives of this plan.

## 8.2 HABITAT PROTECTION STATUS

Since the shell material of the existing oyster rock is the most abundant and attractive substrate for the settlement of larval oysters, the condition of those oyster rocks is the most important habitat condition affecting oyster stock abundance. Oyster cultch plantings also artificially increase oyster stock abundance, and in some locations landings are significantly increased.

Of the factors affecting the condition of oyster rocks, 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. Oyster reefs that have been heavily fished lose vertical profile and are more likely to be affected by sedimentation which can smother live oysters and inhibit oyster recruitment (Kennedy and Breisch 1981). 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. Selizer and Boggs (1988) found 75% of the oyster reef area in the James River had disappeared due to burial and possibly dredging activity. 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 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 3K.0304 and 3K.0102). Intensive hand harvest methods can also be destructive to oyster rocks and in 1977 the North Carolina General Assembly enacted legislation to forbid the taking of clams by rakes or tongs on oyster rocks that had been posted by DENR (North Carolina General Statutes 113-207). Oyster cultch planting sites in the intertidal areas of the southernmost estuaries in North Carolina are closed to oystering and clamming. As the oysters reach harvestable size, the areas are opened to oyster harvest first. Clamming is allowed only after the oyster harvest, or the oysters would be lost due to clamming activities.

Other fishing gears also impact oyster habitat. Shrimp and crab trawling can result in oysters and cultch material being removed from rocks and firm bottom and deposited on unsuitable bottoms where they will be covered by sediments (Berrigan et al. 1991; Chestnut 1955). Oyster beds which have been planted and posted by the state are protected from any type of trawling (North Carolina Fisheries Rules for Coastal Waters 15A NCAC 3K.0203). The impact of these fishing practices on the habitat has not been quantified in North Carolina.

Natural processes, such as subsidence and sedimentation, also affect oyster reef habitat. The water quality problems mentioned previously may also affect the habitat because there are fewer oysters setting and surviving. Since oyster shell is the most abundant oyster habitat, this reduces the maintenance or growth of that habitat.

Habitat loss can result from natural occurrences such as storms and floods or from man's activities, including dredging and filling. Thousands of acres were lost due to uncontrolled habitat alteration prior to implementation of state controls in the early 1970s.

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). However, planted areas are subject to the same environmental and habitat effects as natural rocks, and it is doubtful that the existing level of rehabilitation effort is sufficient to overcome the sources of depletion of the resource.

Oyster shell habitat has not only been recognized as being important to oysters, hard clams and colonizing organisms but also as essential fish habitat by the South Atlantic Fishery Management Council. The Council's Habitat Plan for the South Atlantic Region (1998) cites red and black drum, striped bass, sheepshead, weakfish, spotted seatrout, summer and southern flounder, oyster toadfish, and other finfish as users of the food and protection supplied by this habitat. In this plan, Section 8.4 Ecological Relationships also shows the importance of oyster habitat as a food source and as an important substrate and stabilizing force in the estuary. The Habitat Plan for the South Atlantic Region makes the same findings. The MFC has also recognized oyster habitat as one of the fragile estuarine and marine areas that support juvenile and adult populations of economically important seafood species, as well as forage species important in the food chain. Shellfish producing habitats have been defined as critical habitat areas in North Carolina Fisheries Rules for Coastal Waters.

### **8.3 WATER QUALITY**



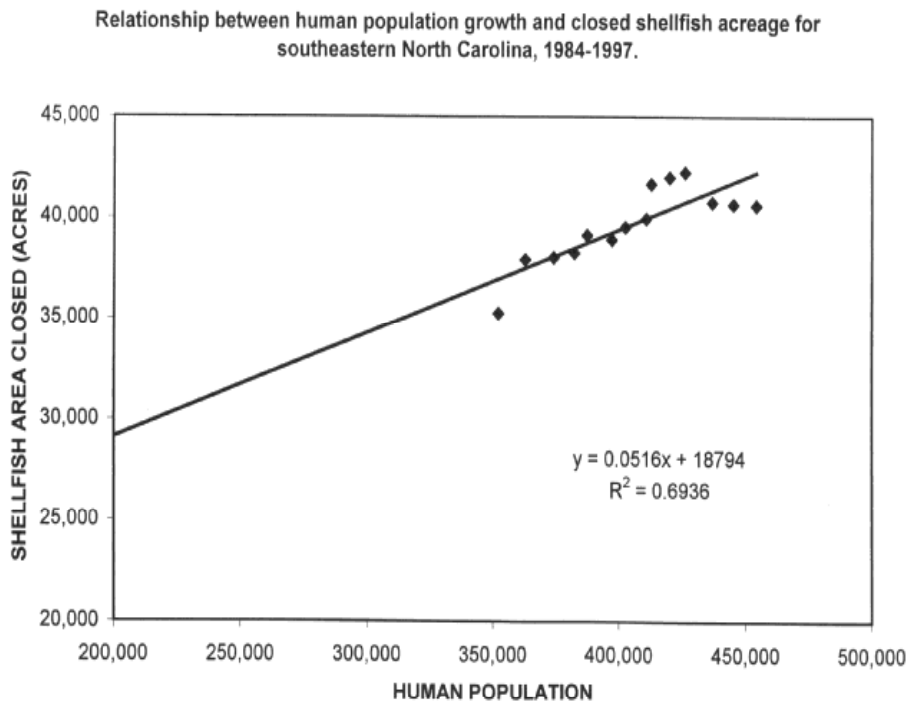
### 8.3.1 HARVEST/CONSUMPTION

Oysters are very effective bioaccumulators and will concentrate harmful organisms such as bacteria and viruses when those pathogens are present in the surrounding waters. These pathogens can cause serious illness in humans when contaminated oysters are consumed raw. The Shellfish Sanitation Section of the NC Division of Environmental Health (DEH) classifies coastal waters as to their suitability for shellfish harvesting in accordance with guidelines set by the Interstate Shellfish Sanitation Conference, which is administered by the US Food and Drug Administration. Sanitary surveys are conducted of all potential shellfish growing areas in coastal North Carolina and recommendations are made to DMF on which areas should be closed for shellfish harvesting.

Closures of harvest areas due to pollution began affecting the oyster fishery around 1924, when an outbreak of typhoid fever in Chicago, New York, and Washington, DC was traced back to East Coast shellfish. As a result Morehead City Harbor, Beaufort Harbor and a small section of Masonboro Sound (Figure 2) were closed to harvesting (Thorson 1982). Since 1966, North Carolina has had a majority of its classified waters open to harvest on a regular basis. Classified waters include all waters even though they may not have salinity ranges necessary for commercial shellfish growth. In 1966, 95% of the waters were open for harvest. A total of 69% was open in 1971, 65% in 1974, 83% in both 1980 and 1985, and 79% in 1990 (United States Department of Commerce 1990). A closer examination of state waters reported by Leonard et al. (1989) showed that in 1986, 657,000 acres had a salinity range capable of producing shellfish, and 602,000 acres or 92 percent were approved for harvesting.

Despite this bright analysis, the North Carolina Department of Human Resources (1988) studied trends in closures and found an increase in closures since 1981, which were caused by urban runoff, septic systems, agricultural runoff, and marinas. They found that North Carolina has been affected by a series of suburban, vacation home, and condominium developments along the narrow coastal zone (Leonard et al. 1989). These closures have primarily affected the central and southern areas of the coast. Most recently, however, additional closures have been made in the Pamlico Sound area.

Studies done by Mallin et al. (1998) in New Hanover County have shown that fecal coliform abundance was significantly correlated with watershed population and percent of developed land (Figure 20). Specifically, the most important factor contributing to fecal coliform abundance was percent impervious surface cover. In areas with urban development, non-point source runoff from impervious surfaces was considered a major source of many pollutants. The removal of vegetated, pervious surfaces also removed the natural filtering and groundwater recharge capabilities of these areas and forced runoff into smaller pervious surface areas. These smaller areas are quickly overwhelmed by the increased runoff leading to flooding and standing water. As amounts of impervious surface increase, so does the amount of runoff and flooding.



**Figure 20:** Relationship between human population growth and closed shellfish acreage for southeastern NC, 1984-1997. Source: Mike Mallin UNC-Wilmington

Young and Thackston (1999) compared sewered and unsewered basins and found that sewered basins had much higher levels of *E. coli*, fecal coliform bacteria, and fecal *streptococci* than unsewered basins. Their findings showed fecal densities to be related to housing densities, development, population density and domestic animal density and not failing septic systems. Like Mallin et al. (1998) they found a relationship between the amount of impervious area and bacterial density. Fecal bacteria data collected from surface runoff in urban neighborhoods also demonstrate that a relationship may exist between various urban land uses and potential bacterial loading.

Turbidity is another source of poor water quality. Since oysters are filter feeders, they take in turbidity particles which can contain nutrients, heavy metals and fecal coliform bacteria and accumulate those substances in their bodies. Turbidity also provides a safe haven for fecal coliform bacteria by protecting it from ultraviolet radiation from the sun (Phillips, 2000).

Sanitary surveys conducted by the Shellfish Sanitation Section indicate stormwater runoff as the primary cause of water quality contamination. Bacteria and other contaminants from development activities, animal operations, agricultural croplands, wildlife, domestic pets, marinas, forestry operations and failing septic tank systems are washed into coastal estuaries by

stormwater. The destruction of wetlands adds to the problem because of the loss of natural filtering of contaminants from stormwater prior to reaching the waterways provided by wetlands.

DEH is charged with the responsibility of monitoring shellfish growing areas and classifying those areas as to their suitability for shellfish harvesting. Sanitary surveys are conducted and shellfish growing waters are regularly sampled and analyzed for fecal coliform bacteria contamination. Areas are classified as Approved, Conditionally Approved, Restricted or Prohibited (Table 7). The majority of waters normally open to shellfishing between Cedar Island and the South Carolina state line are classified as conditionally approved (approximately 40,000 acres).

If, after completion of a sanitary survey, sampling results indicate shellfish growing area stations exceed approved area standards, a recommendation is made to the Director of DMF to close those areas to shellfish harvesting. DMF then issues proclamations closing those areas to harvesting. Wild growing oysters can be moved from restricted areas to leases in approved harvest areas during a 6-week period in April and May. This transplanting, called relay, allows oysters to depurate or cleanse themselves of bacteria in open waters.

Temporary closures of conditionally approved open harvest areas can occur following storm water runoff from heavy rainfall events while temporary openings of conditionally approved closed harvest areas may occur after extended periods of dry weather. The temporary closures or openings are accomplished through proclamation authority delegated to the Fisheries Director to implement recommendations from the Division of Environmental Health. Proclamations to protect the public health can effect immediate closures and open areas with only 12 hours notice. Proclamations for other types of fisheries management must give 48 hours notice. Prohibited shellfish growing areas are necessary where sampling consistently indicates high fecal concentrations regardless of rainfall events and exist primarily around sewage treatment plant outfalls. Excessive shoreline development often results in these permanent closures in adjacent growing waters. Removal of vegetated buffers along shorelines, introduction of impermeable surfaces (concrete driveways, paved streets, etc.), and to a lesser degree failing septic tank systems, add to increased fecal contamination in many areas. Runoff from areas with high concentrations of domesticated or wild animals can also lead to closures of adjacent waters.

Currently there are just over 364,000 acres of coastal waters (both salt and brackish) closed to shellfish harvesting in North Carolina. Approximately 56,191 of the closed acres are suitable for shellfish production, representing approximately 3.9 percent of the total acreage (1,425,675 acres) capable of producing shellfish (DEH, unpublished data). It should be noted, however, that this total includes the open waters of Pamlico Sound (nearly 1,000,000 acres) where little shellfish production currently occurs.

**Table 7. Classification of Shellfish Growing Areas**

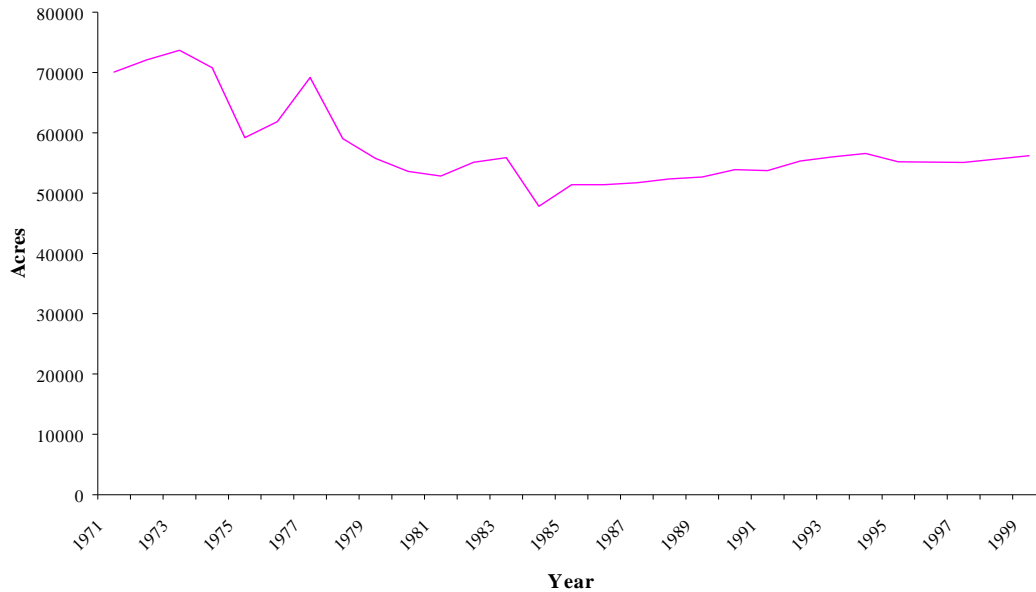
<b>Classification</b>	<b>Criteria</b>
<b>Approved</b>	No contamination with fecal material, pathogenic organisms, poisonous or deleterious substances or marine biotoxins. Fecal coliform median MPN or geometric mean not to exceed 14 per 100 ml and not more than 10% of the samples exceed an MPN of 43 per 100ml Each station must have a minimum of 15 sets of samples during the three year evaluation period.
<b>Conditionally Approved Open</b>	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time and the pollutant event is known and predictable and can be managed by a plan
<b>Conditionally Approved Closed</b>	Sanitary Survey indicates an area can meet approved area criteria on occasion and the pollutant event is known and predictable and can be managed by a plan
<b>Restricted</b>	Sanitary Survey indicates limited degree of pollution and the area is not contaminated to the extent that consumption of shellfish could be hazardous after controlled depuration or relaying.
<b>Prohibited</b>	No Sanitary Survey Point source discharges Marinas Data does not meet criteria for Approved, Conditionally Approved, or Restricted Classification

Between 1971 and 1985 the number of acres of shellfish waters with salinities suitable for oyster survival that were closed to harvesting declined (Figure 21). This decline was due primarily to increased sampling efforts by DEH resulting in refinements to growing area classifications and reductions in point source discharges in coastal waters. Since 1985, the annual average of acreage closed to shellfishing has been 54,156 acres (DEH, unpublished data). A net increase of 4,787 acres of closed shellfishing areas was also seen during this same period (1985-1999).

Most seafood related illnesses in the US are caused by the consumption of raw molluscan shellfish. Most of these illnesses are caused by pathogens such as *Vibrio vulnificus* bacteria and Norwalk viruses that occur in open waters and are unrelated to fecal contamination closures. There is no shellfish or water-monitoring program for these pathogens. Most illnesses occur in persons who already have weak immune systems and are caused by raw oysters harvested from the Gulf of Mexico areas during warmer summer seasons. North Carolina oysters have not been implicated in outbreaks of these illnesses.

Another condition that affects marketing of oysters is a condition known as “green gill.” Green

gill in oysters comes from the single-celled alga *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 blueish color. Oysters pick it up while filtering the blue colored water, which combines with the oysters'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 actually culture the alga to produce a somewhat nuttier tasting shellfish. However, in the US, shellfish markets have a hard time selling them because the American consumer thinks they are inedible.



**Figure 21.** Number of shellfish producing areas closed to shellfishing.

### 8.3.2 ENVIRONMENTAL

A recent study by Hackney et al. (1998) surveyed 165 sites within the sounds and rivers of North Carolina during the period 1994 through 1997 to evaluate environmental conditions. These investigations found that 37.5 to 75.8% of surface sediment in North Carolina waters were contaminated and that 19.0-36.0% was highly contaminated. Contaminants surveyed included nickel, arsenic, DDT, PCBs and mercury. Finally, it was estimated that 13.4% of the estuarine bottoms were incapable of supporting benthic production. Sediments from many sites were toxic to biological organisms in laboratory bioassays. There is now a large body of evidence suggesting that a major portion (37.5-75.8%) of North Carolina estuaries may not fully support food chains that sustain our commercial fisheries.

Petroleum products, heavy metals, pesticides, chlorine, and detergents can negatively impact oyster

populations. The increased use of these compounds on and around the estuary has been shown to increase the quantity entering the estuary (Quast et al. 1998).

Petroleum products affect oyster abundance by increasing mortality and reducing reproductive success. Crude oil is generally less toxic than partially refined oils. Heavy metals can stress or kill oysters by decreasing their resistance to diseases and parasites. Poor larval and spat growth, reduced recruitment, poor shell growth and larval mortality have been reported due to the presence of heavy metals. Pesticides reduce growth rate, diminish reproductive capabilities, and lower disease resistance. Chlorine and chlorine derivatives are extremely toxic to oyster larvae at concentrations as low as 0.005 ppm (Haven et al. 1978). Chlorine is used to purify municipal water supplies, disinfect sewage effluents and as a biocidal antifouling agent in industrial cooling water. Thus, chlorine is common in estuarine areas with oyster populations (Zoellner 1977).

Low levels of dissolved oxygen (DO) can also prevent recruitment and cause mortality of set oysters. Adult oysters can survive for several days when DO concentrations are less than 1.0 ppm, but survival times vary inversely with temperature (Sparks et al. 1958). Because resistance of larvae to stress is less than that of adults, larvae probably cannot tolerate low DO concentrations for long either, and can be quickly killed by anoxic conditions (Abbe 1986). Larvae are normally most abundant during the period of occurrence of the warmest water temperatures of the year, when DO levels are lowest. Although numerous hypoxic and anoxic events have been found in North Carolina waters, they have not been directly linked to larval oyster mortalities. Recently low DO has been linked to increased activity by Dermo parasites since reduced oxygen releases iron from naturally occurring compounds and iron is a limiting factor in parasite feeding processes (Leffler et al. 1998). Low DO is caused by excessive nutrients, primarily nitrogen, in estuarine waters which fuels algae blooms. These blooms die and their decay uses up oxygen in stratified waters (Pearl et al. 1998).

The above statements partly illustrate the culmination of the impacts of poor water quality on the estuarine environment. Similar to habitat, the protection and restoration of good water quality is essential in fully achieving the goals and objectives of this plan.

### **8.3.3 WATER QUALITY PROTECTION**

Federal and state laws mandate water quality protection activities 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.

An increase in population and land-based development, demands on water resources for various uses, and an inadequate understanding of impacts on estuaries have caused water quality degradation in spite of management efforts. The principal problems are a lack of strict pollutant standards, inadequate pollution abatement, and insufficient monitoring to protect water quality and the complex ecology of estuarine systems.

North Carolina has established a water quality classification and standards program for "best usage." Recent 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 High Quality Waters (HQW), Outstanding Resource Waters (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. Many of these recommendations have not been accomplished. Achievement of basinwide water quality management planning by the DWQ will hopefully improve coastal water quality.

Various public agencies (state and federal) and private groups have established parks, refuges, reserves, sanctuaries, and natural areas that help to protect adjacent public trust estuarine water quality.

## **8.4 ECOLOGICAL RELATIONSHIPS**

### **8.4.1 PHYSICAL**

The natural tendency of oysters to build "rocks" or "reefs" in both the intertidal and subtidal areas of estuaries has a stabilizing effect on erosional processes and may modify currents and tidal flow (Bahr and Lanier 1981). Oyster shells and intact living oysters provide a large portion of the natural hard substrate required as habitat for sessile filter feeding organisms in the estuary, including other oysters. Oyster reefs serve as cover for small fish and it has been shown that these areas are among the best "artificial fishing reefs" in the estuary (Myatt and Myatt 1990). Cultch plantings for oyster habitat enhancement also attract fish (Arve 1960). In addition, oyster reefs are densely populated with polychaetes, protozoa and bacteria (Bahr and Lanier 1981).

### **8.4.2 PREDATION**

The trophic role of the oyster community is to assimilate carbon derived from phytoplankton and detrital sources and make it available to higher consumers (Bahr and Lanier 1981). During the spawning season, oysters create enormous quantities of high quality protein in the form of gametes and larvae and release it into the water column. There it becomes food for protozoans, coelenterates, barnacles, and mollusks. Ctenophores feed heavily on oyster larvae (Bishop 1967), and adult oysters also prey on their own larvae (Andrews 1983). The effect that larval predation causes on oyster populations in North Carolina is unknown.

Gastropods, primarily oyster drills, are among the most destructive oyster predators. Oyster drills are found in high salinity areas, and while their destruction of oysters may be great, they have never been linked to serious oyster mortalities in North Carolina (Chestnut 1955). Both the southern oyster drill (*Thais haemastoma*) and the Atlantic oyster drill (*Urosalpinx cinerica*) are found in North Carolina (Porter 1974). Other gastropods, such as whelks (*Busycon sp.*) and moon snails (*Polinices duplicatus*), have also not been documented as major oyster predators in North Carolina although their oyster predation is well known (Chestnut 1951).

Blue crabs (*Callinectes sapidus*) readily consume oyster spat. Blue crabs can consume up to 19 oyster spat per day (Menzel and Hopkins 1955). Krantz and Chamberlin (1978) reported 79 to 99% oyster mortality from blue crabs one month after planting 3-40 mm cultchless oysters in unprotected treatments. The large populations of blue crabs in North Carolina estuaries may have an effect on oyster populations, but no data exist on this topic.

Of the fish that are known to feed on oysters, perhaps the most impressive is the black drum (*Pogonias cromis*). Oysters up to 112 mm have been consumed by large drum (90+ cm), and oysters of legal harvestable size (76mm) may be crushed and ingested by much smaller drum (Cave and Cake 1980). Other fish that consume oysters, primarily spat, are Atlantic croaker (*Micropogonias undulatus*), spot (*Leiostomus xanthurus*), oyster toadfish (*Opsanus sp.*), and sheepshead (*Archosargus probatocephalus*). The cownose ray (*Rhinoptera bonasus*) has been found to prey on oysters as well (Haven et al. 1978; Krantz and Chamberlin 1978; St. John and Cake 1980). The effect of predation by fish on oyster stocks in North Carolina is unknown.

Bahr and Lanier (1981) reported that in intertidal populations, raccoons and birds (such as oyster catchers and grackles) are predators on oyster reefs.

Chestnut (1951) reported that Pamlico Sound was virtually free of oyster predators, except crabs and some species of fish. He also found that predation by oyster drills, starfish, and whelks in Core Sound, Bogue Sound, and other estuaries is, perhaps, small in comparison with that in other states.

### **8.4.3 COMPETITION**

Ortega et al. (1990) analyzed the fouling community which interfered with oyster recruitment on



cultch planting sites in western Pamlico and Core sounds. At low salinity sites in Hyde and Pamlico counties, shells were fouled with ciliate protozoans and diatoms (e.g. *Bacillaria paradoxa*, *Nitzschia* sp., and *Navicula* spp.) on their lower surface. Barnacles (*Balanus* spp.) and an encrusting bryozoan, *Schizoporella unicornis*, were also found at three sites. At the high salinity sites, the fouling community consisted of the serpulid polychaete (*Hydroides dianthus*), *Balanus* spp., *Schizoporella unicornis* and, occasionally, the tunicate *Styela plicata*, the sponge *Halichondria bowerbanki*, and the sobellid polychaete *Sabellaria vulgaris*.

Chestnut (1951) found the boring sponge (*Cliona*) to cause damage to oysters in North River, New River and the Beaufort area. The mud worm, *Polydora*, was reported to be prevalent in oysters from widely distributed areas in North Carolina (Chestnut 1951). Slipper shells (*Crepidula formicata*) and jingle shells (*Anomia simplex*) can also be major competitors for suitable substrate (MacKenzie 1970). All of these organisms compete with oysters for space to set and grow. Filter feeding organisms also compete with oysters for food. The extent that competition affects oyster populations in North Carolina is unknown.

#### **8.4.4 ENVIRONMENTAL INFLUENCES ON STOCK ABUNDANCE**

Naturally occurring environmental conditions can have pronounced effects on oyster stock abundance. Salinities less than 10 to 12 ppt can prevent larval setting even though adult oysters and competent larvae continue to exist in the affected area (Davis 1958). Large areas of Pamlico Sound can be affected during years with above average rainfall. On the other hand, salinities from 5 to 15 ppt can benefit oyster stocks by reducing predators and parasites. Since 1991, large portion of the state has been affected by salinities greater than 20 ppt and summertime temperatures of 20°C or above, which allows for rapid development of the oyster parasite *Perkinsus marinus* which has been responsible for significant oyster mortalities.

Low levels of dissolved oxygen (DO) can also prevent recruitment and cause mortality of set oysters. Adult oysters can survive for several days when DO concentrations are less than 1.0 ppm, but survival times vary inversely with temperature (Sparks et al. 1958). Because resistance of larvae to stress is less than that of adults, larvae probably cannot tolerate low DO concentrations for long either, and can be quickly killed by anoxic conditions (Abbe 1986). Larvae are normally most abundant during the period of occurrence of the warmest water temperatures of the year, when DO levels are lowest. Numerous hypoxic and anoxic events have been found in North Carolina waters but, they have only recently been directly linked to oyster mortalities (Lenihan and Peterson 1998).

Although water temperature may affect larval development and is important in the annual growth and development of parasites, it affects oyster stocks directly only in extremes. Oysters can tolerate ambient water temperatures from 1 to 36°C (Galtsoff 1964). Internal temperatures of intertidal oysters at low tide have been recorded at 46 to 49°C (Galtsoff 1964). Atlantic Coast oyster stocks tolerate partial freezing of their tissues (Loosanoff 1965).

## **9.0 PRINCIPAL ISSUES AND MANAGEMENT OPTIONS**

The principal issues concerning management of the oyster resource and options for resolving those issues are presented in a series of individual issue papers in this section. The issue papers are grouped according to their capacity to address the five problem areas identified in Section 4.2 General Problem Statement. The individual issue papers may address very specific management questions (e.g. Unloading Oysters and Clams at Night) or broad areas of management (e.g. Review and Modify Shellfish Leasing) depending on their origination and staff's ability to efficiently provide background and discussion information. Each issue paper has the following format:

**TITLE**  
**ISSUE**  
**BACKGROUND**  
**CURRENT AUTHORITY**  
**DISCUSSION**  
**MANAGEMENT OPTIONS/IMPACTS**  
**RESEARCH NEEDS**  
**DMF RECOMMENDATION**  
**ADVISORY COUNCIL RECOMMENDATION**

### **9.1 HARVEST ISSUES – ISSUE PAPERS**

#### **9.1.1 OYSTER MANAGEMENT MEASURES**

##### **ISSUE**

The use of management measures needed to insure protection and production of oysters in shellfish management and designated harvest areas was suggested by the Oyster and Clam Fishery Management Plan Advisory Committee.

##### **BACKGROUND**

Although there are increasing concerns about reduced oyster producing habitat and long-term harvest declines, the management of oysters in North Carolina has been dependent on designating harvest areas to different gear types and planting cultch material to enhance oyster production as primary management practices. New measures intended to prevent further deterioration in the fishery and maintain the well being of the stock must be balanced with the needs of various user groups.

It is generally believed that the amount of oyster producing habitat is decreasing, however natural oyster rocks are still being formed today on sites where oysters previously did not exist. The Division annually plants cultch material in hand and mechanical harvest areas to promote production in the fishery and in some locations

landings have been significantly increased. Much debate surrounds the state's cultch planting program with regard to whether the plantings should continue and if the amount of material planted is sufficient to enhance oyster production. Also, in question is where cultch should be planted to receive the maximum benefit to the users of the resource.

There are several contributing factors affecting the condition of oyster rocks, however, oyster harvest is the most pronounced. 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. There may be a need to evaluate areas for harvest designation in order to preserve and promote critical habitat management needed to insure a viable long-term fishery. Other fishing practices also impact oyster habitat. Shrimp and crab trawling can result in oysters and cultch material being removed from rocks and firm bottom and deposited on unsuitable bottoms where they will be covered by sediments (Berrigan et al. 1991; Chestnut 1995). Long haul seining may also adversely affect the condition of both natural and cultch planted oyster rocks by the same processes as mentioned above. Conflicts may arise if harvest areas become more limited, and harvest methods on existing habitats begin to compete for a limited resource.

#### **CURRENT AUTHORITY**

North Carolina Fisheries Rules for Coastal Waters (15A NCAC)

3K .0103 Shellfish/Seed Management Areas  
3K .0201 Open Season and Possession Limit  
3R .0108 Mechanical Methods Prohibited

#### **DISCUSSION**

North Carolina has five oyster sanctuaries encompassing less than two acres with no immediate plans to increase the size or number of sanctuaries. On the other hand, in 1994 the Chesapeake Bay Program adopted goals to designate 5000 acres each in Maryland and Virginia as oyster habitat and create reefs in those areas by the year 2000. Oyster rehabilitation efforts in North Carolina have mainly focused on cultch planting in mechanical harvest areas. This management program has been responsible for a large fraction of the production in certain areas. There is some disagreement with the fishing public on the value and habitat benefits associated with the program. The BRACO endorsed the value of oyster shell cultch planting and suggested perhaps even expanding the program. However, with funds available for enhancement programs limited, DMF can not approach the magnitude of other state's restoration efforts. Therefore, with limited resources, the idea of increasing cultch planting in designated areas where oyster harvest methods and other bottom disturbing fishing practices are less detrimental to habitat may increase productivity of the plantings. A review of DMF data on oyster settlement and production of sites that are now in hand harvest areas could provide insight on this theory. The BRACO also concluded that oyster reef habitat and oyster

production have been better sustained in intertidal reefs in the southern part of the state where only hand harvest methods are allowed and shrimp and crab trawling seldom impact oyster habitat. The shift in more restoration to hand harvest areas could contribute to a long term fishery with less mortality on sublegal oysters and secondly, establish a higher priced market for a hand selected product.

The increased concern over bottom disturbing harvest gear on oyster rocks may bring further designations of hand-harvest only areas. Criteria will be needed to ensure proper selection of new areas. Currently hand harvest areas are established in North Carolina Fisheries Rule 15A NCAC 3R.0108, which excludes the use of mechanical methods.

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 are already protected by rule. Submerged aquatic vegetation, some secondary nursery areas and oyster beds with thin bases should be considered for hand harvest designations. High profile subtidal oyster rocks should be designated for mechanical harvest methods if practical. Monitoring of mechanical harvest areas should be conducted to protect the habitat.

Physical factors such as currents, wave action, and water depth have significant effects on gear suitable for specific areas. Hand harvest gears lose effectiveness where these physical factors are excessive. Currently in North Carolina, hand tonging is generally conducted in waters less than 10 feet deep, in deeper estuaries less than 2 miles wide and usually 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 are successful.

Oyster bottoms that should be protected from mechanical oyster harvest methods should also be protected from other bottom disturbing gear. Existing uses and dependency on bottom disturbing gear in proposed areas should be carefully considered.

Although many existing rehabilitation sites are available to hand tongs, most have been planted where dredging is used. 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 redesignation. The overall number of designated areas, their configurations and accessibility for enforcement purposes should be considered in any new area designations.

Designating restoration sites with Shellfish Management Area status would prohibit trawling and long hauling as described in rule 15A NCAC 3K.0103. The Fisheries Director has proclamation authority to designate Shellfish/Seed management areas. The BRACO found that various fisheries that disturb the seafloor were incompatible with

sustaining oyster production which includes trawling for shrimp, crabs, and long hauling. Recent actions have been taken by the MFC to protect certain primary and secondary nursery areas from trawling, however trawling still exists on natural and cultch planting sites in Pamlico Sound where productive oyster reefs once existed. Concern has been noted on the effects of restricting economically valuable fisheries (shrimp and crab trawling) in hopes of restoring a fishery that is currently much less valuable. Trawling effects on oyster reefs need to be quantified. Research on making trawling more compatible with oyster habitat and cultch planting also needs to be conducted.

Input from public meetings and fisherman offers valuable knowledge on the sometimes complex issues associated with restoration and management of a fishery. Economic loss of capital incorporated in the fishery is protected by G.S. 113-221 by scheduling rule change dates to minimize potential loss. The commercial fishing public has hands on experience on how and why a fishery operates and measures needed to sustain the fishery. The state is charged to sustain the cultural heritage of all user groups. Public involvement is the state's most valuable tool and should continue to benefit the resource.

## MANAGEMENT OPTIONS / IMPACTS

### A. Status Quo

- + Less conflicts between user groups
- No needed management actions to increase production
- No management actions to protect habitat and harvest areas

### B. Pursuant to G.S. 113-221, conduct public meetings on the adoption of harvest area designations.

- + Minimize economic loss to fisherman due to equipment invested in the fishery
- + Allow public input on harvest areas and planting sites

### C. Adopt criteria for the further designation of areas limited to hand harvest methods and designate those areas by rule. **Rule change required.**

- + Protect areas where movement of sediments by bottom disturbing gear would be detrimental to the habitat.
- + Increase hand harvest area
- Decrease of mechanical harvest area
- Potential user conflict

### D. Increase cultch plantings in hand harvest areas

- + Promote harvest that is less destructive to planting sites

- + Promote areas that have not been traditional hand harvest areas
  - Less monies for cultch planting in mechanical areas
  - Assess Division's ability to plant in shallow areas
- E. Maintain cultch planting in mechanical harvest areas
- + Provide critical habitat for recovery of oyster productivity
  - + Lessen impact of proposed management measures
  - Potential to cover existing oyster habitat and Submerged Aquatic Vegetation
  - Distributing non-native material on bottoms
- F. Prohibit trawling and long haul seining on cultch or seed planting sites by marking with buoys or signs and designating sites as shellfish management areas
- + Limit potential impact of scattering oysters and cultch to unsuitable bottom where they may be covered by sediments
  - + Decrease turbidity and stress during spawning seasons
  - Loss of traditional fishing grounds
  - Increase management related activities(buoy maintenance, law enforcement)
- G. Allow harvesting of 2 ½" oysters in certain areas to increase production
- + Increase harvest
  - + Harvest of oysters before disease mortality
  - Decrease oyster's ability to grow to be disease resistant
  - Potential decrease in spawning stock

## **RESEARCH NEEDS**

1. Effects of bottom disturbing fishing practices on oyster rocks.
2. Fishing mortality and substrate disturbances caused by different oyster harvesting techniques.

## **DMF RECOMMENDATION**

- B. Pursuant to G.S. 113-221, conduct public meetings on the adoption of harvest area designations.
- C. Adopt criteria for the further designations of areas limited to hand harvest methods and designate those areas by rule.

- D. Increase cultch plantings in hand harvest areas
- E. Maintain cultch planting in mechanical harvest areas
- F. Prohibit trawling and long haul seining on cultch or seed planting sites by marking with buoys or signs and designating sites as shellfish management areas

#### **ADVISORY COMMITTEE RECOMMENDATION**

- D. Increase cultch plantings in hand harvest areas
- G. Allow harvesting of 2 ½” oysters in certain areas to increase production

#### **MFC SELECTED MANAGEMENT STRATEGY**

Agreed with DMF recommendation

### **9.1.2 UNLOADING OYSTERS AND CLAMS AT NIGHT**

#### **ISSUE**

Shellfishermen feel that the provision that requires oysters and clams to be unloaded from vessels in northern counties before sundown is too restrictive due to present fishing conditions. The issue was raised by the Oyster and Clam FMP Committee.

#### **BACKGROUND**

The rule prohibiting the unloading of oysters at night first appeared in 1967. There were no exemptions cited in the original rule except that oyster-unloading operations partially completed before sundown could be completed after sundown in the presence of a Fisheries Inspector. In 1971 the rule was amended to include a total exemption for the unloading of oysters in Brunswick and New Hanover counties. The origination of the unloading after dark rule for hard clams did not occur until 1988 when the current wording was adopted for both species. The 1988 amendment dropped the total exemption from the unloading provisions for Brunswick and New Hanover counties and instituted the two-hour past sundown extension for unloading oysters and clams in Brunswick, New Hanover, and Pender counties. Unloading after sundown is prohibited in all other areas. The oyster and clam rules concerning unloading at night were combined during recodification of the rulebook in 1991.

Recollection of long term staff indicates that the reason for implementing the rule prohibiting unloading oysters and clams at night is to aid in the prevention of harvest of oysters and clams from polluted areas and poaching of oysters and clams from shellfish

leases and franchises. The special provisions for unloading up to two hours after sunset for the three southern counties were enacted to address problems with late afternoon low tides. Many harvesters could not work on days with late low tides due to the fact that they could not harvest and return to the dock before sunset since there was no navigable water in the harvest areas for several hours around low tide. Tidal amplitudes in Brunswick, New Hanover and Pender counties are the largest in the state and almost all shellfish harvesting is done by hand around low tide.

Advisors report that in recent years shellfishermen in northern areas must travel long distances to locate suitable shellfish resources during the winter and that the reduced daylight hours and extended travel periods shorten available harvest time to a point where commercial harvest is not feasible. Advisors also state that they can see no difference between the prohibitions on fishing crab pots at night and shellfishing at night with respect to being able to unload after sundown. They also find that if special conditions warrant an exception in one part of the state, similar special conditions deserve similar exceptions in other parts of the state.

## **CURRENT AUTHORITY**

### North Carolina Fisheries Rules for Coastal Waters (15A NCAC)

3K .0106 Taking or Unloading Oysters and Clams on Sunday or at Night

## **DISCUSSION**

The incentive to harvest shellfish from polluted areas and poach shellfish off of private culture sites increases when stocks are down and prices are high. This situation occurs most often during the winter months when daylight hours are short in duration. The cover of darkness also provides the greatest opportunity for successfully committing rules violations. For these reasons, the prohibition on harvesting oysters and clams at night appears to be justified. The additional step of adding the prohibition on unloading of these two shellfish species after dark ensures that there will be no wanton violations of the rule prohibiting nighttime harvest. Of course, poachers could simply hide their illegal catch until several hours after sunrise the next day and appear to comply with the unloading provisions.

Low harvests in both the hand and mechanical oyster fisheries have necessitated that shellfishermen travel long distances from home to locate harvestable resources. In some areas fishermen are able to locate local dealers where they can sell their catch. However, in other areas and, in particular, with oyster dredgers, this option is often not available. This requires that harvest hours be considerably reduced to allow for the long trip back to home port. The same situation occurs to a lesser degree in the mechanical harvest fishery for clams.



Marine Patrol officers find that the prohibition on unloading oysters and clams between sundown and sunrise is a significant enforcement tool and recommend that if any changes are proposed that they not exceed the two hour after sundown extension now in place in the southern coastal counties.

## MANAGEMENT OPTIONS/IMPACTS

### A. Status Quo

- + Current rule provides maximum protection from illegal harvest
- Does not address current situation
- Current rules do not treat all users equally
- Continues an inconsistent enforcement situation

### B. Allow all oysters and clams to be unloaded until 2 hours after sunset.

#### **Rule change required**

- + Addresses current shellfish harvest situations
- + Provides for equal treatment of users
- + Removes an inconsistent enforcement situation
- Weakens enforcement for illegal shellfish harvesting
- 2 hour time extension is not needed in all seasons and all areas

### C. Allow all counties to unload until 2 hours after sunset during Eastern Standard Time (last Sunday in October to the first Sunday in April) and continue to allow Brunswick, New Hanover, and Pender counties to unload until 2 hours after sunset year round. **Rule change required.**

- + Addresses current shellfish harvest situations
- + Continues traditional harvesting practices in southern counties
- + Provides for equal treatment of users
- Weakens enforcement for illegal shellfish harvesting for a 5month period
- Continues an inconsistent enforcement situation although less than present one

### D. Only allow oysters and clams to be unloaded until 2 hours after sunset during the period of Eastern Standard Time in all counties (removes year round exception for Brunswick, New Hanover, and Pender counties) **Rule change required.**

- + Addresses current shellfish harvest situations
- + Provides for equal treatment of users
- + Removes an inconsistent enforcement situation
- + Only weakens enforcement for approx. 5 months coast wide
- Weakens enforcement for illegal shellfish harvesting for 7 months

- Limits harvest time in Brunswick, New Hanover, and Pender counties
- E. Allow oysters and clams to be unloaded at any time. **Rule change required.**
  - + Addresses current shellfish harvest situations
  - + Provides for equal treatment of users
  - + Removes an inconsistent enforcement situation
  - Totally removes an enforcement tool which works to prevent illegal shellfish harvesting

#### **RESEARCH NEEDS**

None

#### **DMF RECOMMENDATION**

A. Status Quo

#### **ADVISORY COMMITTEE RECOMMENDATION**

Agreed with DMF

#### **MFC SELECTED MANAGEMENT STRATEGY**

Agreed with DMF recommendation

### **9.1.3 EFFECTS OF AN OPEN HARVEST LICENSE ON SHELLFISH FISHERIES**

#### **ISSUE**

What are the effects of an open license for shellfish on shellfish fisheries? The issue was raised by the MFC.

## **BACKGROUND**

During the fisheries moratorium, it was decided that the shellfish license would be open to the citizens of North Carolina at a low cost so those subsistence fishers would be able to afford a license. Also, during the moratorium, many hand harvesters did not have an Endorsement to Sell (ETS) and their shellfish were sold by an ETS holder. These fishers did not have access to a Standard Commercial Fishing License (SCFL). It was also decided that to allow for flexibility of the commercial fisher the shellfish endorsement would be free on the SCFL.

## **CURRENT AUTHORITY**

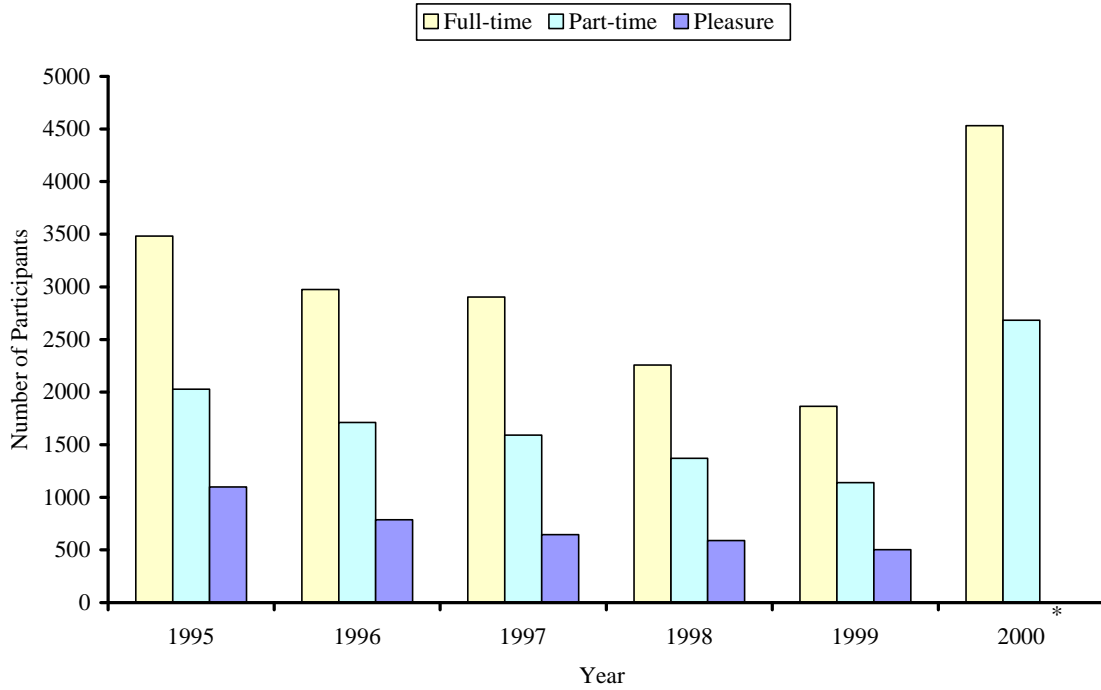
### General Statutes of North Carolina

113-168.5 License endorsements for Standard Commercial Fishing License.

113-169.2 Shellfish license for North Carolina residents without a SCFL.

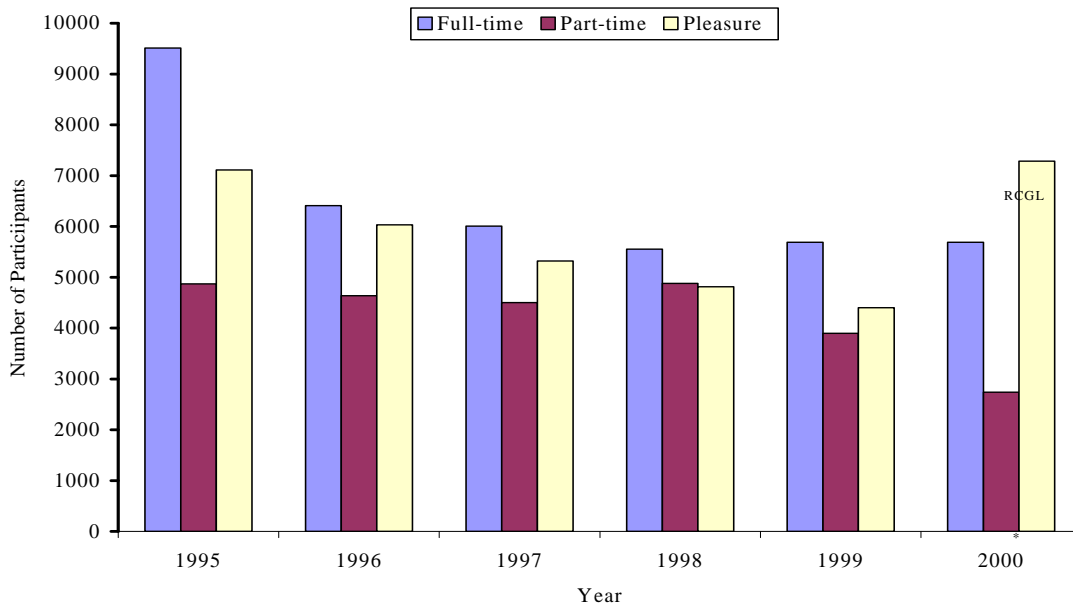
## **DISCUSSION**

DMF license data indicate that total number of shellfish licenses issued between 1995 and 1999 has decreased (Figure 22). For the 1995 license year, 4,294 Shellfish and Crab Licenses and 2,360 Shellfish Only licenses were issued. Number of licenses decreased every year afterward and by the 1999 license year, only 2,150 Shellfish and Crab licenses and 1,542 Shellfish Only licenses were issued. The number of fishers who considered themselves as either full-time, part-time, or pleasure also decreased over time (Figure 22). Vessel license data shows the same trend with an overall decrease of vessel licenses issued by the state from 1995 to 1999 (Figure 23).



\*New License System Implemented. Data may not be comparable

**Figure 22.** Shellfish licenses issued by category 1995 -2000.

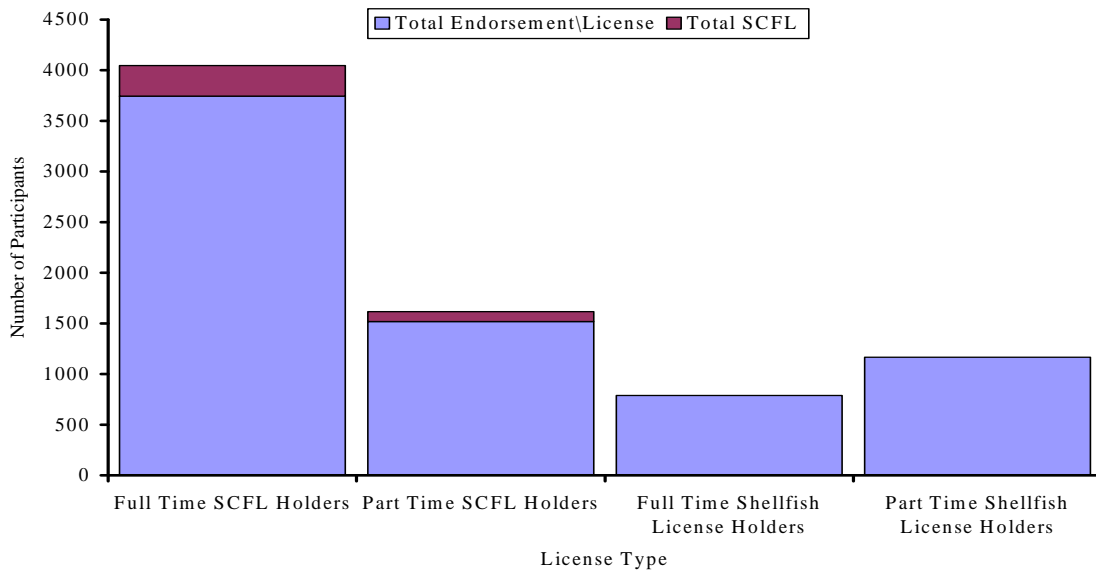


\*New License System Implemented. Data may not be comparable

**Figure 23.** Total number of vessel licenses issued 1995 - 2000.

By the year 2000, with the implementation of the new license system, the number of participants

able to harvest shellfish does increase, however, it must be noted that this number includes those fishers with a SCFL who elected to have the free shellfish endorsement on their license along with those fishers who purchased only a shellfish license. When this number is broken down into number of free endorsements and number of licenses (Figure 24), there is a decline in the number of participants who purchased a shellfish license. These data indicate no apparent increase in effort in the fisheries because of the decrease in number of participants in the fisheries over time. Because of the change in the licensing system and the short amount of time since implementation (one year), more time is needed to establish a trend before limited entry can be considered.



**Figure 24.** Number of shellfish licenses and shellfish endorsements issued during 1999/2000.

## MANAGEMENT OPTIONS/IMPACTS

A. Status Quo until enough license data gathered to make a management decision

- + No additional regulation on fishery
- Possible increase in number of fishermen harvesting shellfish

B. Limited Entry

- + Reducing fishing effort can protect viability of shellfish
- + Enhance fishery by reducing costs and increasing earnings
- + More efficient management
- No data to support limited entry
- Displace fishing effort to other fisheries
- Additional regulation

## **RESEARCH NEEDS**

Because the implementation of the open shellfish license is new, we are currently unable to predict effects on the fishery. Time is needed to analyze trip ticket data for an increase or decrease in effort because of the open license system recently implemented. The Division needs time to see what trends occur in the license universe. After trends have been established, then management options may be considered.

## **DMF MANAGEMENT RECOMMENDATION**

- A. Status Quo until enough license data is gathered to make a management decision

## **ADVISORY COMMITTEE RECOMMENDATION**

Agreed with DMF.

## **MFC SELECTED MANAGEMENT STRATEGY**

Agreed with DMF recommendation

### **9.1.4 SHELLFISH DEPURATION PLANTS**

#### **ISSUE**

There are no shellfish depuration facilities located in North Carolina at this time. The establishment of depuration plants in this State could potentially increase shellfish production by utilizing shellfish from public bottom and private culture areas currently closed to harvesting due to pollution. This issue was raised during public comment, and by staff.

#### **BACKGROUND**

Depuration is defined by the Interstate Shellfish Sanitation Conference as *“the process of reducing the pathogenic organisms that may be present in shellstock by using a*

*controlled aquatic environment as the treatment process*". NC Marine Fisheries Rules define depuration as "*purification or the removal of adulteration from live oysters, clams, and mussels by any natural or artificially controlled means*". DEH rules define depuration as "*mechanical purification or the removal of adulteration from live shellstock by any artificially controlled means*". The latter meaning best describes the use of the term depuration in this issue paper.

The issue originates from shellfish leaseholders that have had their leases closed to harvest by reason of pollution and are looking for a means to maintain their shellfish production. Although the term "pollution" can carry various definitions, for the purposes of this issue paper, the term is restricted to fecal coliform bacteria contamination. Fecal coliform standards are used in North Carolina and across the country to regulate shellfish growing waters and subsequent shellfish. Staff sees depuration as a conceivable option for better management of shellfish resources in closed harvest areas. The idea of a state managed depuration facility has also surfaced occasionally but has not gathered much support.

New York, New Jersey, Connecticut, and Massachusetts currently have depuration facilities located within their states. These facilities are used in some cases to process only shellfish harvested from certain areas closed to harvesting and in some cases to process all shellfish harvested, those from open as well as closed harvest areas.

Currently, North Carolina fisheries rules only allow the harvest of shellfish from closed waters for the purpose of depuration for shellfish that would otherwise be destroyed in maintenance dredging operations. The provisions for depuration in the current rule were developed in 1987 in response to a situation where shellfish were transported to a depuration plant in South Carolina. No shellfish have been depurated under the existing rule. In the recent past, polluted shellfish threatened by maintenance dredging operations on public bottoms have been transplanted to open harvest areas by DMF for cleansing. Typically this has involved the harvest of shellfish (usually clams) from a navigation channel by DMF staff or commercial shell fishermen and relaying the product to an open area that would be kept closed until the shellfish meet consumption standards.

In lieu of mechanical shellfish depuration from public bottoms, North Carolina Fisheries Rules allow for the relaying of shellfish from polluted areas to private shellfish leases during a six week period each year, and the DMF also conducts a relay program each spring in the southern area of the State in which oystermen are paid to move oysters from polluted areas to open public bottom. These programs constitute the extent of shellfish cleansing operations in North Carolina.

## **CURRENT AUTHORITY**

North Carolina Fisheries Rules for Coastal Waters  
15A NCAC 3K .0107 Depuration of Shellfish

North Carolina Environmental Health Rules

15A NCAC 18A .0700-.0713 Requirements for Operation of a Depuration Facility

National Shellfish Sanitation Program Guide for the Control of Molluscan Shellfish

Chapter XV. FDA Requirements for Operation of Depuration Plants

**DISCUSSION**

As previously noted, several states currently utilize shellfish depuration plants. A New Jersey plant processes more clams than any other in the country, approximately 250 bushels per day operating year round. Depuration has been utilized in New Jersey to reduce the numbers of clams in one very large polluted area in the state in an effort to limit the potential for those shellfish to directly reach the market (Gary Wolff, NJ Dept. of Health, personal communication).

New Jersey officials indicate that oversight of the two depuration plants in the state and associated monitoring of harvest and transport of shellfish have imposed substantial financial and manpower demands on the departments involved. They also indicate that approximately 60 clambers are regularly involved in harvesting strictly for depuration and that most were currently unhappy with the reduced prices they received for their clams due to high depuration costs.

Since the early 1990s, ten depuration plants in Florida have closed due to high costs of operation, primarily the costs associated with laboratory analysis for quality control (David Wiggins, USFDA, personal communication). Most often depuration plants are responsible for contracting with private FDA certified laboratories to process the substantial number of water and product samples required by state and federal rules. DEH laboratories would not be available to process samples from a depuration plant due to current staffing and workload levels.

For a depuration plant to be feasible, a constant supply of polluted shellfish would be required, preferably from a singular location. With the scattering of relatively small, polluted areas throughout the coastal counties, as in North Carolina, the oversight of transport of shellfish to the depuration plant would require a substantial commitment from, most likely, NC Marine Patrol. The varying concentrations of shellfish in each of these polluted areas may also make it difficult to “guarantee” a constant supply of shellfish for plant operators. In addition, some closed areas are opened temporarily from time to time for public harvest when conditions permit. Such areas would most likely not be included as source sites for depuration operations.

New Jersey officials indicated that the two depuration plants operating in their state at this time require enough attention that they easily justify a single state inspector position for those plants alone. Current NCDEH workloads are such that an additional shellfish



inspector position would most likely be required if a depuration plant were established in the State.

## MANAGEMENT OPTIONS/IMPACTS

### A. Status quo

- + No risk of contaminated shellfish reaching the market through incomplete depuration treatment or during transfer from harvest area to depuration plant
- + No increase in workloads for DMF or DEH
- + Concentrations of shellfish in polluted areas that may act as spawning stocks not removed or disturbed
- Risk of contaminated shellfish reaching market directly from poaching in closed areas remains
- Allows no additional use of polluted areas for shellfish harvesting
- Fails to allow use of all available methods to purify contaminated shellfish

### B. Change DMF rules to allow harvest of shellfish from polluted areas for processing in depuration facility. **Rule change required.**

- + Allows additional use of polluted areas for shellfish harvesting
- + Allows use of all available methods to purify contaminated shellfish
- + Reduces potential of contaminated shellfish reaching market from poaching in polluted areas
- Risk of contaminated shellfish reaching the market through incomplete depuration treatment or during transfer from harvest area to depuration plant
- Substantial increase in DMF enforcement and DEH inspection and sampling burdens
- Potential to disrupt / destroy shellfish spawning stocks in polluted areas

### C. Amend North Carolina Fisheries Rules to allow harvest of shellfish from shellfish leases and franchises in polluted areas for processing in depuration facilities.

#### **Rule change required.**

- + Allows continued use of shellfish leases and franchises in polluted areas for shellfish cultivation
- + Allows use of all available methods to purify contaminated shellfish
- + Reduces potential of contaminated shellfish reaching the market through incomplete depuration treatment or during transfer from harvest area to plant
- Substantial increase in DMF enforcement and DEH inspection and sampling burdens

D. Establish State-operated depuration facilities

- + Removes the need to have a constant supply of product for depuration
- + Mitigates the State's failure to maintain water quality
- Likely to have a low cost:benefit ratio
- Removes the focus on maintaining and restoring water quality

**RESEARCH NEEDS**

Stock assessments of clams and oysters located within polluted areas, overall, and geographic distribution, would be very beneficial in determining if a depuration operation would be feasible and aid in sizing the facility. A thorough review of current depuration programs in other states would be advisable in fully researching the pros and cons associated with such programs. This would help educate all involved including regulators, industry, and harvesters, prior to initiating such a program here. Review of current DEH rules and possibly updating the rules may be necessary to fully reflect current technologies.

**DMF RECOMMENDATION**

- C. Amend North Carolina Fisheries Rules to allow harvest of shellfish from shellfish leases and franchises in polluted areas for processing in depuration facilities.

**After discussing the above recommendation with the committee, DMF decided to change its recommendation to Status Quo.**

**ADVISORY COMMITTEE RECOMMENDATION**

- A. Status quo

**MFC SELECTED MANAGEMENT STRATEGY**

Agreed with DMF recommendation (Status Quo)

**9.2 PRIVATE CULTURE – ISSUE PAPERS**

## **9.2.1 ALLOCATION OF AREAS FOR SHELLFISH LEASES**

### **ISSUE**

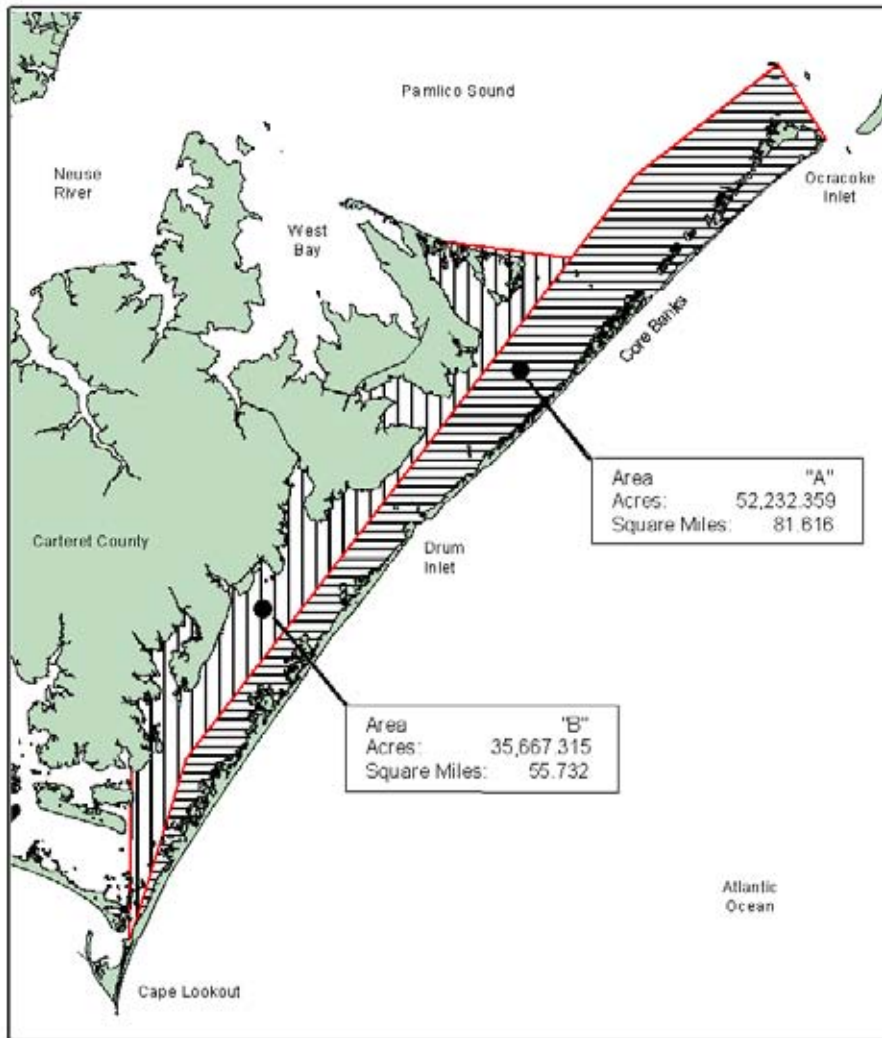
Investigation into the allocation of areas for shellfish leases to reduce protests by concerned citizens and relieve the burden placed on prospective leaseholders was raised by the Plan Development Team, Shellfish Advisory Committee, and through public comment.

### **BACKGROUND**

The granting of exclusive shellfishing rights to State residents is controversial in several coastal areas. Commercial fishers and some tourist industry/residential groups oppose shellfish leasing because they feel it infringes on their use of public trust resources. Shellfish lease applicants complain because they are often criticized in their own communities for selecting a site for a shellfish lease even though it meets the statutory standards.

Available records indicate that the selection of shellfish lease sites has always been the responsibility of the applicant. The site is then judged on several standards that have been fairly constant through the various statutes and amendments that have governed private shellfish cultivation. While there have been several provisions governing the size of individual site applications and the total area that could be held by an individual, family or corporation, there has never been a cap on the total acreage that could be leased in the state. There have also never been any areas set aside for individual shellfish leases although the idea has been discussed for over a decade.

There are currently two areas where the leasing of shellfish bottoms is indefinitely banned. The coastal waters of Brunswick County have been exempt from the shellfish lease statute since 1967. No history could be located on the events that preceded this action. An indefinite ban on shellfish lease issuance covering more than half of Core Sound and a portion of Pamlico Sound in Carteret County was initiated in May of 1996. The remainder of Core Sound is also under a moratorium on shellfish leasing that expires on October 1, 2001 (Figure 25). 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. The shellfish leases existing at the time were all on the western side of Core Sound and a petition with over 875 names was received to protest the granting of the lease near Core Banks because it interfered with fishing and recreational activities in the area. The



**Figure 25.** Core Sound shellfish lease indefinite moratorium area A and moratorium area B which expires October 1, 2001.

MFC approved the lease over the protest because it found that the application met the statutory standards. 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 work was accomplished and no changes were made to shellfish lease rules or statutes. Immediately after the moratorium lifted, DMF received eight applications for lease areas also on the East Side of Core Sound. More than 400 protests were received on these applications and the legislation presently in place banning shellfish leases in the area was passed before any leases were granted.

A similar situation existed in Hyde County in 1989 when a fishermen's organization was formed to fight the granting of four shellfish leases near Swan Quarter. The Hyde County group was unsuccessful at getting legislation passed banning shellfish leasing in that county. The towns of Pine Knoll Shores and Topsail Beach have also attempted to stop shellfish leases in nearby waters but have been unsuccessful.

The failure to address the causes for the moratorium enacted in 1995 may have been due to an underestimation of the magnitude of the problem. In many cases during the lease application process in the above examples, tensions were high among the protestors, applicants and staff. This was evident in the emotional comments made at public hearings and extended into the daily lives of all involved. Reports of threats, discriminatory actions, and general ill will were made by many involved in the proceedings. It appears that changes to the shellfish lease system are necessary to resolve the problems in areas where protests to lease issuance have been intense.

On the other hand, the Onslow County Commissioners passed a resolution asking the Governor to take steps to increase private shellfish culture in their county but gave no specifics on amount or locations. The BRACO also encouraged expanded shellfish culture and more user-friendly means for obtaining shellfish leases but only identified large areas in Pamlico Sound as areas for pre-approved shellfish lease sites.

The 1988 version of the Oyster, Clam and Scallop Committee (now know as the Shellfish Committee) recommended that changes be made in the shellfish lease rules and statutes to allow for block leasing which consisted of one mile square lease blocks containing 64 ten-acre lease sites. They proposed that DMF select the areas using the existing criteria and that state surveyors survey the sites. They reasoned that lease blocks would reduce the improper marking problems commonly found on shellfish leases and encourage a community watch system that would eliminate the significant poaching problem. They did not offer guidance on how the leaseholders in these areas would be selected.

An attempt at solving the problems surrounding the selection of shellfish lease sites was conducted by the Shellfish Working Group – a subcommittee of the Joint Legislative Commission on Seafood and Aquaculture. The 15 member subcommittee met during the

fall of 1996 under a legislative charge to study the shellfish lease program and consider specific issues; among them (1) establishment of a maximum percentage of available water body for leases and (2) preservation of areas used substantially by commercial and recreational fisherman. The group drafted a suite of recommendations concerning the shellfish lease program and made major recommendations concerning the selection of shellfish lease areas. The recommendations included the establishment of shellfish culture zones with pre-approved lease sites or areas within the zone. Corridors for access by the public would be maintained within the zones. A cap on shellfish leasing of an additional 2% of the State's shellfish waters was also recommended. The cap was to be applied to each of the 89 Shellfish Sanitation growing areas to avoid disproportionate growth in any local area.

The JLCSA accepted the recommendation on capping shellfish lease growth but failed to act on the shellfish culture zone proposal. The Commission also chose to recommend funding a human use mapping pilot project for Core Sound to answer the charge of preserving areas of substantial use by commercial and recreational fishermen. The human use mapping proposal was approved by the NC General Assembly but the cap on shellfish lease growth was not.

## **CURRENT AUTHORITY**

### North Carolina General Statutes

G.S. 113-201. Authority of the Marine Fisheries Commission

G.S. 113-202. New and renewal leases for shellfish cultivation

G.S. 113-202.1. Water column leases for aquaculture

G.S. 113-202.2. Water column leases for aquaculture for perpetual franchises

### North Carolina Fisheries Rules for Coastal Waters (15A NCAC)

30 .0201 Standards for Shellfish Bottom and Water Column Leases

## **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, 0.1% of the total acres of estuarine bottom were under lease at the time of the protests. Statewide, 0.18% of the waters with salinities suitable for oyster and clam growth is 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 the best approach for managed growth appears to be careful

identification of existing uses, shellfish resources and environmental parameters necessary for shellfish cultivation.

The human use mapping project funded by the legislature included a provision for a user coordination plan to be developed using the human use data, DMF shellfish mapping data and input from the public about problems and issues in the area. The results of the project (see Appendix 2) appear to be a template for establishing managed shellfish lease growth in North Carolina. Areas of heavy public use are recognized and public preferences for resolution of the current leasing bans are identified. However, long-term data is needed for better trends analysis. The provision for a cap on lease acreage is also included.

The approach of identifying areas where leasing is not suitable rather than designating suitable shellfish lease sites is appealing from a management perspective because it continues to allow a degree of flexibility for shellfish lease applicants who have needs outside the statutory standards. It also removes the possibility that unsuitable sites could be identified by staff that could result in attempts at recourse by dissatisfied leaseholders.

Utilization of human use mapping and user coordination planning information would involve identification of incompatible fishing and recreational uses in the water body and establishment of a incompatible use threshold above which the sampling block would not be used for shellfish leasing. The legislation that spawned the idea for human use mapping also indicated an overall standard should be adopted that preserves areas of substantial use by commercial and recreational fishermen. So, a two tiered approach assessing individual use conflicts and cumulative conflicts could be developed. Since only one water body has been sampled, data is not conclusive as to what the appropriate thresholds might be or whether use levels are comparable between different areas. Adoption of threshold levels of use should be accomplished through rule making if possible.

## **MANAGEMENT OPTIONS/IMPACTS**

### **A. Status Quo**

- + Provides maximum flexibility for selecting lease sites
- Highly contentious method for lease site selection
- Fails to address concerns expressed by the public
- Hinders shellfish culturists seeking to expand operations
- Data to address all issuance standards is not presently available

### **B. Establish predetermined shellfish lease sites. **Statute and Rule changes required.****

- + Removes site selection responsibility from applicants

- + Conducive to manageable boundaries and shared responsibility
- + Lease groups can be shaped to conform to standards
- Removes flexibility to address applicant's needs
- Requires a mechanism for selecting successful applicants (i.e. eligibility pool)
- Places burden for selecting successful sites on DMF
- Data to address all standards is not presently available

C. Utilize user coordination plans for shellfish lease issuance. **Rule change required.**

- + Gathers and utilizes data necessary to address issuance standards
- + Likely to retain some flexibility for applicants in site selection
- + Addresses water usage in a comprehensive manner
- + Addresses public concerns
- Much time and funding needed to expand coastwide
- Site selection responsibility remains on applicant

D. Enact a prohibition on issuance of shellfish leases in all NC waters. **Statute and Rule changes required.**

- + Removes a contentious program
- + Maximizes public use of public trust waters
- + Addresses concerns of some fishing groups and municipalities
- May eliminate a traditional fishing occupation
- Eliminates potential growth of a seafood industry
- May create a high demand for existing shellfish leases

**RESEARCH NEEDS**

The human use mapping and user coordination plan has only recently been presented to the MFC and the JLCSA so the project has not been accepted at this point and may require further work to meet the needs of regulators and legislators. If this method of acquiring the necessary data is approved, the greatest research needs will be expansion of human use mapping and shellfish mapping to provide coastwide data.

**DMF RECOMMENDATION**

C. Utilize user coordination plans for shellfish lease issuance.

**ADVISORY COMMITTEE RECOMMENDATION**

Agreed with DMF.



The committee also recommended that additional information be added to explain how the human use mapping data would be used. That information has been added.

## **MFC SELECTED MANAGEMENT STRATEGY**

Agreed with DMF recommendation

### **9.2.2 ALLOW SHELLFISH LEASES IN PROHIBITED (POLLUTED) AREAS**

#### **ISSUE**

An increasing number of shellfish leases are being closed to shellfish harvesting due to pollution. Shellfish leases that do not meet certain criteria concerning percentage of days closed to harvest cannot be renewed under the existing statutory and rule standards. Some new applicants would also like to obtain new leases in areas currently closed due to pollution because many are good growing areas and many closed areas are near habitable shorelines offering better opportunities for surveillance and access. The governing statutes prohibit issuance of new shellfish leases in areas closed to shellfish harvest by reason of pollution. This issue was identified through public comment and by the BRACO.

#### **BACKGROUND**

The problem concerning renewing shellfish leases in prohibited shellfishing areas arose in 1987 when a shellfish leaseholder being denied renewal for failure to meet shellfish production requirements appealed because his lease was in a polluted area and he was unable to market his shellfish. The administrative law judge found that the lease should not be renewed because it did not meet the statutory standards by being in an area closed by reason of pollution not because of a failure to produce commercial quantities of shellfish. Available records indicate that the polluted area standard had not been applied to shellfish lease renewals prior to that finding. The MFC upheld the judge's recommendation and all subsequent shellfish renewal applications have included review of the shellfish harvesting closure status of renewals.

In an effort to minimize the effects of harvesting closures, the Shellfish Sanitation Section of DEH has implemented management plans and utilized classification systems that allow for conditional closures of open harvest areas and temporary openings of closed areas. The use of these measures benefit public and private bottom shellfish harvesters but it made absolute identification of "an area closed by reason of pollution" difficult. Also, some leaseholders are able to utilize leases in closed harvest areas by

transplanting polluted shellfish to leases in open harvest areas for cleansing, further complicating application of the statutory standard. The MFC realized these difficulties and further defined an area closed to shellfish harvest by reason of pollution as areas closed for more than 50% of the days during the final four years prior to renewal. They also adopted language that made an exception for leases that were closed for more than 50% of the specified days but were able to meet production requirements by lawful sale of shellfish cultured on the lease site (15A NCAC 3O .0205).

New shellfish leases are allowed in closed shellfish harvesting areas in Virginia and are under consideration in Florida. Virginia shellfish growers cite increased patrol by law enforcement as an added benefit of shellfish culture in closed harvest areas. Containerized culture techniques are favored in these areas to facilitate transfer of the shellfish to open areas for cleansing.

Other than the recommendation in the Blue Ribbon Advisory Council's report, there has been no action to change the statutory prohibition on shellfish leasing in polluted areas in North Carolina. There are serious concerns related to congregating dangerous food products in high concentrations in areas identified as shellfish culture sites. However, there may be certain areas where shellfishing is not currently allowed that may be suitable for shellfish culture. DEH and DMF have discussed increasing sampling efforts in closed harvest areas if there is interest in shellfish leasing there and the area has a reasonable chance for significant temporary openings. In order to maximize sampling efforts, the current DEH policy is to concentrate sampling for temporary openings in areas with high existing resource and high probability for conditional opening. Therefore, some areas that might be suitable for shellfish leases due to low existing shellfish resources are not sampled with sufficient frequency to allow them to be classified as conditionally approved areas. Identification of these areas could increase their use for shellfish production and relieve some of the problems relative to granting of shellfish leases in controversial areas.

## **CURRENT AUTHORITY**

### North Carolina General Statutes

G.S. 113-201. Authority of the Marine Fisheries Commission

G.S. 113-202. New and renewal leases for shellfish cultivation

### North Carolina Fisheries Rules for Coastal Waters (15A NCAC)

3K .0101 Prohibited Shellfish Areas/Activities

3K .0104 Permits for Planting Shellfish from Polluted Areas

3K .0205 Lease Renewal

## DISCUSSION

While DMF staff was represented on the BRACO, they did not agree with the recommendation to allow shellfish leasing in areas closed by reason of pollution and made those comments to the JLCSA. Staff found that the new methods of growing shellfish in bags, cages and densely packed under nets created too large a risk for contaminated shellfish reaching the market. The diversity and year-round nature of fishing activity in North Carolina does not allow Marine Patrol officers enough time to adequately patrol increasing numbers of high intensity culture sites in closed harvesting waters. Indeed, one of the reasons for allowing leaseholders to transplant shellfish from closed harvest areas to leases is to remove the potential for poaching of contaminated shellfish. North Carolina has never had a documented case of illness due to shellfish borne pathogens. Recent difficulty in marketing shellfish due to publicity surrounding contaminated flood waters from hurricane Floyd indicate that a case of real shellfish related illness would be devastating to the North Carolina shellfish industry.

The expanded definition of an area closed by reason of pollution was put in place in October 1992. The number of shellfish leases rescued from non-renewal due to pollution closures since then have been minimal, mostly due to the fact that leaseholders must also meet the harvest and sale portion of the production requirements. Leaseholders have argued that the six-week relay period does not allow sufficient time for managing multiple shellfish lease sites and that they would prefer moving shellfish from leases in closed harvest areas during periods when survival may be higher. Permit rules also need to be amended to address lease-to-lease relaying operations.

## MANAGEMENT OPTIONS/IMPACTS

### A. Status Quo

- + Allows use of existing prohibited-harvest lease sites
- + Minimal increase in enforcement burden
- + Maintains minimal risk of poaching of contaminated product
- Fails to recognize use of marginal polluted areas
- Fails to allow use of all available methods to purify contaminated shellfish and maintain lease productivity
- Allows no additional use of areas closed to harvest for leasing

### B. Change operational policy and rules to increase lease use of marginal polluted areas. **Memorandum of Agreement required.**

- + Allows use of existing prohibited-harvest lease sites
- + Minimal increase in enforcement burden

- + Maintains minimal risk of poaching of contaminated product
  - + Recognizes use of marginal polluted areas
  - Allows no additional use of areas closed to shellfish harvest for leasing
  - Potential increase in Shellfish Sanitation workload
- C. Allow new and renewal shellfish leases in areas closed to shellfish harvest by reason of pollution. **Statute and rule changes required.**
- + Allows use of existing prohibited-harvest lease sites
  - + Recognizes use of marginal polluted areas
  - + Allows additional use of areas closed to shellfish harvest for leasing
  - Potential large increase in enforcement burden
  - Increases risk of poaching of contaminated product

### **RESEARCH NEEDS**

None

### **DMF RECOMENDATION**

- B. Change operational policy to increase lease use of marginal polluted areas.

### **ADVISORY COMMITTEE RECOMMENDATION**

Agreed with DMF

### **MFC SELECTED MANAGEMENT STRATEGY**

Agreed with DMF recommendation

## **9.2.3 LEAD AGENCY FOR SHELLFISH AQUACULTURE IDENTIFICATION PROBLEM**

### **ISSUE**

The NC Department of Agriculture and DENR both have roles in the development of shellfish aquaculture in North Carolina. There is confusion over the responsibilities of each agency. Public comment at PID meetings identified this issue.

### **BACKGROUND**

The 1989 session of the North Carolina General Assembly passed the Aquaculture Development Act, which named the NC Department of Agriculture as the lead agency for

all types of aquaculture in North Carolina. The statutory (G.S.106-758) definition of aquaculture in the act is broad and includes the propagation and rearing of aquatic species in controlled or selected environments. This broad wording brings all types of private shellfish culture under the definition of aquaculture. G.S. 113-201 gives the MFC authority to make rules and take all steps necessary to develop and improve the cultivation, harvesting and marketing of shellfish from private beds in North Carolina. And, G.S. 113-202 gives the Secretary of Environment and Natural Resources the authority to grant shellfish cultivation leases. This situation has led to confusion over the roles of the different agencies in shellfish culture activities.

## **CURRENT AUTHORITY**

### North Carolina General Statutes

G.S. 106-759. Lead agency; powers and duties. (Aquaculture Development Act)

G.S. 113-132. Jurisdiction of fisheries agencies.

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

G.S. 113-131. Resources belonging to the public; stewardship of conservation agencies; grant and delegation of powers; injunctive relief.

## **DISCUSSION**

The Aquaculture Development Act was drafted from recommendations made by the Governor's Task Force on Aquaculture in the Aquaculture Development Plan for North Carolina (1988). The act gave the NC Department of Agriculture specific powers and duties in its role as the lead State agency in matters pertaining to aquaculture:

- (1) To provide aquaculturists with information and assistance in obtaining permits related to aquaculture activities;
- (2) To promote investment in aquaculture facilities in order to expand production and processing capacity; and
- (3) To work with appropriate state and federal agencies to review, develop and implement policies and procedures to facilitate aquacultural development.

In order to clarify the role of the MFC, the act broadened the jurisdiction of the MFC in G.S. 113-132(a) to include regulation of aquaculture facilities as defined in G.S. 106-758, which cultivate or rear marine and estuarine resources. Therefore, the role of the MFC did not change relative to the Aquaculture Development Act nor did the role of the Secretary of Environment and Natural Resources.

The intent of the act seems clear particularly when read with the Aquaculture Development Plan for North Carolina. The NC Department of Agriculture is to serve as

a facilitator and coordinator for permit information; permit, policy and procedure development; and investment in aquaculture. DENR is to retain its role as steward of the marine and estuarine resources of the State and protector of the public trust rights of the people of the State (G.S. 113-131). Also, the MFC is to keep its jurisdiction over the conservation of (all) marine and estuarine resources.

The major problem appears to be that the public has not been adequately informed about the roles of the various agencies. DMF and the NC Division of Aquaculture and Natural Resources of the Department of Agriculture need to coordinate an educational initiative to resolve this issue. The Agriculture extension agents, Sea Grant specialists, and DMF staff working with shellfish aquaculture would benefit from this initiative.

### **MANAGEMENT OPTIONS/IMPACTS**

#### **A. Status Quo**

- + No action or expenditure of funds required by agencies
- Public confusion over agency roles will persist

#### **B. Inform the public about agency roles concerning aquaculture**

- + Public confusion will be reduced
- Action and expenditure of funds required by agencies

### **RESEARCH NEEDS**

None

### **DMF RECOMENDATION**

- #### **B. Inform the public about agency roles concerning aquaculture.**

### **ADVISORY COMMITTEE RECOMMENDATION**

Agreed with DMF.

### **MFC SELECTED MANAGEMENT STRATEGY**

Agreed with DMF recommendation

## **9.2.4 IMPORTATION OF MARINE AND ESTUARINE ORGANISMS**

## **ISSUE**

Improve criteria for the testing of marine and estuarine organisms prior to introduction into NC waters to ensure safety of native species and habitats and facilitate timely processing. This issue was raised by staff, the Shellfish Advisory Committee, and the Shellfish Growers Association.

## **BACKGROUND**

The importation of shellfish seed has become an integral part of many mariculture operations in North Carolina. The few shellfish hatcheries in NC are unable to produce sufficient numbers of seed to meet the demand of shellfish growers. Therefore growers must utilize out-of-state sources for shellfish seed. The importation of shellfish seed into NC was not regulated prior to 1986. The Atlantic States Marine Fisheries Commission (ASMFC) addressed the potential danger of spreading shellfish pests, predators, and disease in their October, 1986 meeting. A cooperative agreement was endorsed by the States of Maine, New Hampshire, Massachusetts, Rhode Island, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida. This agreement which provided primary control of imports would lie with the importing state, and would retain the ultimate authority to accept or reject any shipment of shellfish. The exporter would have the responsibility of proving the health status of shipments. The ASMFC Interstate Shellfish Transport Committee was to draft a plan implementing the Cooperative Agreement for Interstate Transfer of Shellfish. Although the agreement was endorsed by the member states, the implementation of the plan has not been consistent for all states. DMF policy is to follow the guidelines set forth in the ASMFC Cooperative Agreement. DMF requires certification that a shellfish seed shipment is free of shellfish pests, predators, pathogens or parasites, or documentation that the exporting facility uses sterile hatchery procedures that would preclude the above from contaminating 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 responsibility for obtaining the certification lies with the applicant. This policy is consistent with the policies in Maine, Rhode Island, and South Carolina although not as restrictive. North Carolina's policy also lacks detailed procedures leaving managers to make some decisions on a case-by-case basis.

## **CURRENT AUTHORITY**

North Carolina Fisheries Rules for Coastal Waters (15A NCAC)  
3I .0104 Introduction and Transfers of Marine and Estuarine Organism

## **DISCUSSION**

The intent of this rule is to protect the waters of NC from the introduction of pest species, parasites, pathogens and exotics. Some shellfish growers are concerned over the DMF policy due to the time limitations for holding and shipping shellfish seed and the time necessary to perform the required testing. The applicants view this policy as a burden for the applicant and the hatchery and an unnecessary obstacle to the importation of shellfish seed. However, at least one hatchery maintains disease certifications on each batch of shellfish seed and can send documentation and ship seed within days after the order is placed. Better dissemination of information to other vendors could improve coordination of seed sales between states.

Shellfish growers as well as exporters argue that testing for *Perkinsus marinus* (Dermo) is unnecessary because NC is already heavily infested and probably more so than the hatchery location. There is also the argument that Dermo cannot be transferred by oyster larvae. These statements may be true, but the concerns of DMF are not solely with transfer of *P. marinus* but of any pest, parasite or pathogen. The histology to be performed should investigate the presence of any nuisance species or pathogen. The introduction of any competitor, parasite, or pathogen into the waters of NC presents a grave risk to the survival or recovery of the native species and a precautionary approach to imported seed must be maintained.

## **MANAGEMENT OPTIONS/IMPACTS**

### **A. Status Quo**

- + Requires no changes in policy or rule
- + Allows flexibility to deal with unforeseen circumstances
- Does not provide adequate detail for new users –
- Causes delays due to lack of clear testing protocols

### **B. Formalize/amplify policy and send to vendors**

- + Gives clear guidance on testing procedures and requirements
- + Allows for pre-planning by vendors for NC shipments
- + Increases protection of native NC species
- Unforeseen circumstances and new developments not addressed

### **C. Develop criteria and recertification schedule for shellfish seed vendors**

- + Pre-approved vendors could provide lower costs and faster shipments of seed
- + Less administration required for staff and shellfish growers
- Lack of batch testing increases risk of accidental importations of unwanted species



- D. Prohibit importation of all out of state shellfish
  - + Provides maximum protection for native species
  - + Increases incentive to develop in-state seed suppliers
  - + Removes administration and law enforcement burdens
  - Does not address current seed supply problems
  - Does not allow for improvements in breeding in other states
  
- E. Allow unrestricted importation of shellfish products
  - + Reduce costs and speed delivery of shellfish seed
  - + Removes administrative and law enforcement burden
  - Reduces incentive to develop in-state seed suppliers
  - Maximum risk to native resources

**RESEARCH NEEDS**

None

**DMF RECOMMENDATION**

- B. Formalize/amplify policy and send to vendors

**ADVISORY COMMITTEE RECOMMENDATION**

Agreed with DMF

**MFC SELECTED MANAGEMENT STRATEGY**

Agreed with DMF recommendation

**9.2.5 NONNATIVE OYSTER INTRODUCTION ISSUE**

**ISSUE**

Consider the introduction of non-native oysters into North Carolina waters as a means of restoring the oyster resource. The issue was raised during public comments.

**BACKGROUND**

The International Council for Exploration of the Seas (ICES) defines movement within the natural range of a species as a “transfer” and movements outside the species’ natural

range as an “introduction” (Carlton 1992). The introduction of foreign oysters has been of concern in North Carolina since at least 1947. The 1947 session of the North Carolina General Assembly passed Senate Bill 236 which authorized the Board of Conservation and Development to adopt rules and regulations to regulate, control, or prohibit the importation of new species of molluscs such as the Pacific oyster, *Ostrea gigas*. Oyster introductions have revived or expanded oyster fisheries in many parts of the world including France, Australia, the West Coast of the United States and Maine (Shatkin et al. 1997). Other oyster introductions, both intentional and accidental, have failed or caused problems in the host area (Andrews 1980). Unfortunately, many exotic pests have also accompanied oyster introductions (Shatkin 1997).

There have been numerous, mostly anecdotal, accounts of attempts to introduce and establish populations of Pacific oysters (*Crassostrea gigas*) along the southeast Atlantic and Gulf coasts (Hopkins 1946; Dean 1979; Carlton 1992). There were no known breeding populations or pest/parasite problems established by these introductions. However, it is suspected that the oyster parasite *Haplosporidium nelsoni*, which causes MSX disease, was introduced with Pacific oysters (Mann et al. 1991).

As oyster populations in the mid-Atlantic region have continued to decline, there have been renewed efforts to consider establishing a nonnative oyster population (Mann et al. 1991). The ICES Code of Practice calls for a complete assessment of the need for these introductions as well as a thorough review of the biology and life history of the introduced organism and how it will impact native populations and environments. States involved in oyster introduction testing have chosen to follow the ICES guidelines. The necessary ICES assessments have been delayed due to difficulties in anticipating impacts without the use of overboard testing of the oysters. Genetic manipulations to prevent spawning have been used to overcome objections to overboard testing but early attempts proved to be unreliable causing further delays. Improved genetic methods and vigilant monitoring are allowing overboard tests in North Carolina and Virginia. Previous tests have yielded mixed results. One of the species being tested (Pacific oysters) in North Carolina is apparently resistant to the two oyster parasites active in the mid-Atlantic region and appears to be capable of spawning in local environments (Barber 1996). Problems have occurred because the shell of the Pacific oyster is less dense than native oysters and boring worms have inflicted serious damage (Debrosse et al. 1996). Less is known about the Suminoe oyster (*Crassostrea ariakensis*) but it is resistant to endemic diseases. Questions remain about the ability of the oyster species being tested to survive over the long term since it is suspected they are more susceptible to predation, low dissolved oxygen, and pollutants than native oysters.

## **CURRENT AUTHORITY**

### General Statutes of North Carolina

G. S. 113-182. Regulation of fishing and fisheries

G. S. 143B-289.52. Marine Fisheries Commission – powers and duties

### North Carolina Fisheries Rules for Coastal Waters (15A NCAC)

3I .0104 Introduction and Transfer of Marine and Estuarine Organisms

## **DISCUSSION**

ICES protocols require that only quarantined offspring that have been immediately separated from their parents, washed and thoroughly examined be introduced into host waters. There have been no occurrences of an introduced disease or pest associated with an introduction following ICES guidelines since their inception in 1973 (Peterson 1999).

Based on oyster introductions in other areas, there are additional concerns and several positive factors to judge in considering the introduction of a nonnative oyster.

Additional concerns include competition with remaining native oyster populations. Nonnative oysters introduced successfully in other parts of the world have faster growth rates, better reproductive success, and higher resistance to parasites and diseases than our native oysters. The possibility that nonnative oysters could eliminate future recovery of native stocks through their superior physiology is a concern to managers. On the other hand, nonnative oysters have generally not responded well to the harsh environmental conditions found in the mid-Atlantic area and may compete with native oysters for settlement habitat then suffer heavy mortality prior to full development. This scenario could lead to a situation where there are no harvestable shellfish resources and nuisance nonnative shellfish populations. Native and nonnative oysters may also spawn at similar temperatures causing cross-fertilization between species. The offspring of these crosses are not likely to be viable thereby reducing the reproductive potential of both native and nonnative oysters.

If there is no hope for reviving native oyster stocks, then the positive aspects of establishing a nonnative oyster population should be considered. Since it is possible to select a reef-building oyster for introduction, the ability of that oyster to restore and maintain the habitat services provided by Eastern oysters is vital to maintaining healthy estuaries. A viable nonnative oyster population would also provide for the restoration of water filtration capabilities formerly provided by native oysters. Water filtration by oysters decreases suspended sediments and promotes denitrification. Calculated clearance rates indicate Pacific oysters have double the water filtration capacity of native eastern oysters (Peterson 1999). Filtration capacity of Suminoe oysters is expected to be similar to that of Pacific oysters. The reestablishment of a viable oyster fishery would

also help preserve a traditional way of life in coastal communities.

This discussion assumes that a complete introduction by establishing a breeding population in the wild is suggested. Public comments were nonspecific on the type or extent of the proposed introduction. Current testing of nonnative oysters is being conducted based on aquaculture use only. Recent testing with the Suminoe oyster in the Virginia portion of Chesapeake Bay has been so successful that testing by traditional oyster growers is being conducted. For a complete discussion of the concerns and positive effects relating to the current experiments, see Peterson et al. 1999.

## **MANAGEMENT OPTIONS/IMPACTS**

- A. Oppose nonnative oyster introductions and withdraw support of current nonnative testing
  - + Maintains direct focus on reestablishing native oysters
  - + Requires solving environmental problems affecting native oysters
  - + Removes environmental risks associated with use of nonnatives
  - Provides no options if oyster decline continues
  
- B. Continue current testing for aquaculture use of non-spawning, nonnative oysters
  - + Provides data on future options for oyster aquaculture
  - + May provide data applicable to consideration of an introduction into the wild
  - + Adds to the body of knowledge concerning safe nonnative testing
  - Weakens the focus on native oyster problems
  - Introduces some small risk to native populations and environments
  
- C. Expand testing using reproductively competent nonnative oysters in wild settings
  - + Provides the best data on which to base a decision to introduce the nonnative
  - Creates an extreme risk for an accidental introduction which may have irreversible negative effects on estuarine habitats and other species
  
- D. Introduce nonnative oysters without further testing
  - + May provide a rapid end to oyster production problems
  - Creates an extreme risk for native oysters
  - Requires large scale expenditures with no prediction of results
  - Will likely be opposed by other states – legal action

- May have irreversible negative effects on estuarine habitats and other species

## **RESEARCH NEEDS**

Continue research into the security of polyploidy (manipulation of the number of sets of chromosomes) as a means of safe overboard testing. Continue the search for information on the effects of oyster introductions with candidate species.

## **DMF RECOMMENDATION**

- B. Continue current testing for aquaculture use of non-spawning, nonnative oysters.

## **ADVISORY COMMITTEE RECOMMENDATION**

Agreed with DMF after much discussion.

## **MFC SELECTED MANAGEMENT STRATEGY**

Agreed with DMF recommendation

### **9.2.6 DO PRIVATE SHELLFISH CULTURE ACTIVITIES VIOLATE THE PUBLIC TRUST DOCTRINE?**

#### **ISSUE**

The exclusive use of certain shellfish resources and submerged bottomlands by private shellfish culturists violates the Public Trust Doctrine. The issue was raised during public comment at PID meetings.

#### **BACKGROUND**

Members of the public, including commercial and recreational fishermen and riparian property owners, have often questioned how DMF could lease areas of submerged bottomland to individuals when the marine and estuarine resources of the State belong to the people of the State as a whole. Commercial fishermen are also concerned because shellfish lease and franchise holders are allowed to take oysters and clams from areas closed to public harvest because of pollution for cleansing on their leases and franchises and subsequent sale. DMF expends a small percentage of its Shellfish Rehabilitation budget to move shellfish from polluted areas to public bottoms for cleansing however; these shellfish are available, under certain restrictions, to any member of the public and

the results are significant only in the few counties where it occurs.

The use of public trust areas in coastal fishing waters is essential to the culture of shellfish because the cost of raising shellfish in upland facilities increases the production costs to a point where the cost of production exceeds the market value. Private culture of shellfish is practiced in many locations around the world. All U.S. coastal states have some form of private shellfish culture either through ownership or leasing of submerged lands. Washington, Louisiana and Connecticut produce over 50% of the oysters grown in the U.S. on privately held culture sites.

## **CURRENT AUTHORITY**

### Constitution of North Carolina

Article 1, Section 32. Exclusive Emoluments

### General Statutes of North Carolina

113-201. Authority of the Marine Fisheries Commission

113-202. New and renewal leases for shellfish cultivation

113-202.1. Water column leases for aquaculture

113-202.2. Water column leases for aquaculture for perpetual franchises

113-203. Transplanting of oysters and clams

### North Carolina Fisheries Rules for Coastal Waters (15A NCAC)

3K .0104 Permits for Planting Shellfish from Polluted Areas

3O .0201 Standards for Shellfish Bottom and Water Column Leases

## **DISCUSSION**

The Exclusive Emoluments Clause of the Constitution of North Carolina appears to support those claiming that shellfish leasing and relaying to leases and franchises violates the Public Trust Doctrine by proclaiming “No person or set of persons is entitled to exclusive emoluments or privileges from the community....” However, it goes on to state that there is an exception “...but in consideration of public services.” The North Carolina courts have established two tests to determine whether the exclusive privilege meets the public services intent of the state constitution. The privilege must (1) provide a significant benefit to the general public welfare above the benefit to the individual and (2) the legislature in granting the privilege must show reasonable basis to conclude it served the public interest.

DMF and the MFC determined that the public benefit test was met because private shellfish culture would promote the growth of the shellfish industry in the State and foster an increase in the market quantity of shellfish being sold for public consumption.

Under the authority of G. S. 113-201, the MFC adopted rules concerning production requirements on shellfish leases and franchises (15 NCAC 30 .0201) that serve to strengthen the position that private shellfish culture provides public benefit. The North Carolina General Assembly devised standards for issuing shellfish bottom leases in G. S. 113-202 that assured the granting of a lease would not significantly affect the public's rights to access public trust resources and provide for compliance with the second test. Similar standards were put in place for issuing water column use amendments above bottom leases and franchises in G. S. 113-202.1 and 202.2, respectively. Therefore, it appears that private shellfish cultivation does not violate the Public Trust Doctrine. The further concerns of those opposed to shellfish leasing can best be addressed in the issue paper on investigating allocation of areas for shellfish leases.

Transplanting of shellfish from prohibited (polluted) areas to shellfish leases and franchises for cleansing (relaying) is authorized by G. S. 113-203 and implemented in 15A NCAC 3K .0104. Shellfish from polluted areas can only be harvested if they are kept in approved harvesting waters for a specified period of time to allow for pollutants to be naturally purged from their systems (deuration). Under current rules deuration can be accomplished by allowing lease and franchise holders to relay shellfish to their sites, state funded programs moving shellfish to public bottoms which must be monitored until deuration is complete, or by placing polluted shellfish in an approved deuration facility. Deuration facilities are rarely used and are the subject of a separate issue paper.

Shellfish lease and franchise holders have virtually unrestricted access to polluted oyster resources and report relaying between 15- 20,000 bushels per year. Public bottom relaying provides 5,000 to 10,000 bushels of oysters for harvest annually. Hard clam relay is strictly controlled on a few sites because clams must be monitored to prevent them from being sold to consumers since there is no closed season for hard clam harvest. Few hard clam harvest sites are available because the predominant harvest method for hard clam relay is with mechanical gear which is only allowed in limited areas. Hard clam relay to leases and franchises has varied widely but in recent years has averaged about 5,000 bushels per year. Public bottom relay of hard clams occurs sporadically in response to special circumstances leaving yearly averages below 1,000 bushels. Pilot projects are underway to increase public bottom hard clam relay.

The public's concern that relaying shellfish to leases and franchises is exclusive use of shellfish resources implies that the general public is unable to obtain a shellfish lease. Shellfish leases may be granted or transferred to any state resident provided the issuance standards are met. Therefore, this is not a closed fishery. Also, many lease and franchise holders hire local, licensed fishermen to work with them relaying shellfish. However, other states approach relaying programs in a more open manner. During the relay season, Connecticut opens selected polluted areas to harvest by licensed fishermen who then sell their catch to lease and franchise holders. Another option to achieve a perception of balance in the allocation of shellfish resources would be to increase the scope and extent

of the current public bottom shellfish relay programs. All shellfish relay sites are monitored and, if prolonged recovery of oyster resources or damage to the habitat appear to be occurring, harvest from the area is restricted. Any expansion of the transplanting of oysters to public bottom must be accomplished in conjunction with the preservation of oyster habitat functions.

## MANAGEMENT OPTIONS/IMPACTS

### A. Status quo

- + No rule or statutory changes required
- Does nothing to improve concerns about shellfish lease program

### B. Retain the statutory shellfish lease program

- + Continues a traditional fishery
- + Supported by the Aquaculture Development of 1998
- + Complies with the intent of the North Carolina Constitution

### C. Eliminate shellfish relaying/depuration. **Statute and rule changes required.**

- + Eliminates perceived shellfish resource allocation problem
- + Reduce administrative and law enforcement responsibilities
- + Effectively makes polluted (prohibited) areas shellfish sanctuaries
- + Increase shellfish habitat effects in polluted (prohibited) areas
- Eliminates a traditional shellfish culture tool
- Reduce the amount of shellfish available for market
- Creates an underutilized resource
- Increases potential for poaching from polluted (prohibited) areas

### D. Allow relay harvesting by any SCFL or Shellfish License holder

- + Reduce perceived shellfish resource allocation problem
- Invalid for hard clams unless closed season is implemented
- Increases administrative and law enforcement burden
- Currently no means for limiting the number of participants
- Increased stress on the resource and the habitat
- Reduces sanctuary function of polluted (prohibited) areas

### E. Increase public bottom shellfish relay while observing concepts established in other sections of this plan

- + Reduce perceived shellfish resource allocation problem
- + Increase amount of shellfish available for market



- + Reduce polluted shellfish poaching potential
- + Increase use of underutilized resource
- Increases stress on the resource and the habitat
- Reduces sanctuary function of polluted (prohibited) areas

## **RESEARCH NEEDS**

Research is needed to quantify the habitat effects of shellfish habitat and the benefits of establishing shellfish sanctuaries. The cost:benefit ratio of relaying shellfish to public bottom also needs to be examined. Recovery rates of harvested relay areas need to be established for different areas of the coast. The effects of relaying on hard clam mortalities also needs to be studied.

## **DMF RECOMMENDATION**

- B. Retain the statutory shellfish lease program
- E. Increase public bottom shellfish relay

## **ADVISORY COMMITTEE RECOMMENDATION**

Agreed with DMF

## **MFC SELECTED MANAGEMENT STRATEGY**

Agreed with DMF recommendation

### **9.2.7 REVIEW AND MODIFY SHELLFISH BOTTOM LEASE REQUIREMENTS TO SIMPLIFY MANAGEMENT, ENFORCEMENT, PERMITTING AND LICENSING**

#### **ISSUE**

Review and modify shellfish bottom lease requirements to simplify management, enforcement, permitting and licensing. Consider a new lease category for docks and/or riparian shoreline owners. Resolve the concern over use of planting effort to meet shellfish lease production requirements. The various facets of this issue come from the Oyster and Clam FMP Advisory Committee, public comment, MFC Shellfish Committee and BRACO.

#### **BACKGROUND**

Laws allowing private shellfish cultivation first appeared in North Carolina in 1858.

There have been three separate programs for issuing exclusive rights for shellfish culture on submerged lands since then. The initial program substantially limited the acreage that could be held and was described as an oyster gardening program where the bottom holder consumed most of the shellfish production. The second program was similar to the oyster culture initiative in Virginia that set aside natural oyster grounds but otherwise allowed large acreage for cultivation and wide participation. The third and current program started in 1909. [A complete history of private shellfish culture in North Carolina can be found in the section entitled Historical Private Culture Fishery in the Oyster FMP and Private Culture in the Hard Clam FMP.]

The BRACO studied systems for private shellfish production in the United States and around the world. The council found that North Carolina's efforts failed because the state did not provide access to sufficient shellfish resources to support traditional culture methods and technological support for private culture was also lacking. Despite this finding, the number one recommendation of the BRACO for restoration of the oyster resource was improved and expanded oyster culture.

The standards and requirements for private shellfish cultivation areas have varied over the years as attempts to force higher production and achieve better accountability were undertaken. The amount of acreage that can be held for cultivation has generally declined. Utilization requirements have changed from standards specifying the amount of seed and cultch to be planted to shellfish harvest and sale provisions. When the proposal to amend the existing production rule to include both harvest and planting effort provision was made, Commission members expressed concern that leaseholders could keep unproductive leases as long as they wished simply by planting approximately \$12.50 worth of cultch per acre and paying the \$5.00 per acre rental fee. They did not feel this was sufficient effort and chose to insert a sunset provision to insure the public was getting a good return for its loss of use of public trust bottomlands. The provision to allow planting effort went into effect in 1994 and expired on March 1, 1999. The North Carolina Shellfish Growers Association successfully petitioned the MFC in January of 1999 and requested an extension of the sunset provision until the matter could be considered in the FMP process. The provision was included in the FMP issues and a temporary rule was put into effect that removed the sunset clause. That interim measure needs to be resolved during the FMP process.

Fees have modestly increased and lease terms for holding bottomlands for culture purposes have decreased. Authority to use the water column above an existing shellfish lease was granted in 1989 in an attempt to increase production. The current specifications for these matters are shown in Table 5.

Recently shellfish culturists have become more vocal about recognizing the beneficial effects that shellfish culture can have on the estuarine environment and other species that utilize shellfish habitat. The BRACO made the same recommendation. Researchers studying shellfish habitat have recently theorized that the value of shellfish habitat may

be greater than the value of the shellfish found there when used as a seafood product. Since the BRACO recommendation, suggestions have been made that shellfish lease fees should be reduced or eliminated in recognition of the benefits provided by shellfish culture. Other recommendations such as increasing the lease term, planting cultch for seed oyster resources, and relaxing the prohibition on leasing natural shellfish bed areas were also suggested by the BRACO and have been carried on by shellfish culture groups.

Some areas of the state have groups that support shellfish culture and leasing is not contentious. However, there has been increased tension over leasing bottoms in other areas. Those opposed to shellfish leases cite the lack of production on leases, lack of enforcement of lease production requirements, and disagreement with DMF's methods for determining the presence of a natural shellfish bed as reasons to reduce or eliminate private shellfish cultivation. Some groups are opposed to the leasing program in general. They feel that shellfish leases will eventually overtake their fishing grounds. Sometimes unproductive leases are not terminated and new ones are being granted in areas where they catch other fisheries resources. Production from private culture sites averages about 10 bushels per acre and provides 10% of the state's oyster harvest and 15% of the state's hard clam harvest. However, successful shellfish culturists produce many times more than natural shellfish beds can produce.

## **CURRENT AUTHORITY**

### North Carolina General Statutes

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.

113-205 Registration of grants in navigable waters; exercise of private fishery rights

113-206 Chart of grants, leases and fishery rights; overlapping leases and rights; contest or condemnation of claims; damages for taking of property.

113-208 Protection of private shellfish rights.

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

### North Carolina Fisheries Rules for Coastal Waters (15A NCAC)

3K .0205 Marketing Oysters Taken from Private Shellfish Bottoms

3K .0305 Clam Size and Harvest Size Exemption

3O .0200 Leases and Franchises (entire section)

## **DISCUSSION**

The findings from the BRACO (Frankenberg 1995) are adopted, in part, below. The BRACO found that aquaculture accounts for most oyster production in the U.S. and worldwide. Shellfish aquaculture also provides major sources of other products such as clams, scallops and mussels. Shellfish occurs in leased public trust waters rather than on

private property except in Washington state where most shellfish growing areas are privately owned.

The states with active lease programs or private ownership using large acreage have spawned fast growth in shellfish culture industries. In North Carolina, only about 2,600 acres are leased for shellfish production. Of the leading oyster producing states, Louisiana leases 360,000 acres, Connecticut leases 65,000 acres, and Washington uses 220,000 acres. The recent development of oyster mariculture in Connecticut is responsible for the highest harvests since 1953. And in Virginia, a newly developed permit that allows shellfish culture along and near the docks of shoreline property owners now accounts for most of the cultured oysters grown in the state.

Clam mariculture in the states of Florida, Virginia, New Jersey, New York, Massachusetts, Maine and Washington has increased recently. In Florida the growth is largely a response to the availability of leases and other factors such as new restrictions on commercial fishing activity. The presence of large shellfish hatcheries in those states also has had a significant impact on the growth of the industry.

The state's regulatory and leasing system needs to be improved and updated to accommodate new technology and encourage shellfish farming. Production requirements and cost of the water column are restrictive to leasing. Required permitting is excessive and confusing. The BRACO was tasked to address leasing; by default clam leases are included in many of the recommendations. An effective law enforcement program is critical to maintaining private shellfish culture systems. A system of support for shellfish aquaculture would improve access to lease sites and increase shellfish production in the state.

Shellfish beds, both naturally occurring and those created by shellfish culture activities, serve as nursery areas for juvenile marine species and serve other ecologically important functions. [See issue paper on Management of North Carolina's Oysters as Habitat or for Production for documentation.] The leasing system in North Carolina does not recognize the ecological public benefits that accrue from private shellfish production. If these benefits were to be quantified economically, they may actually be worth more than the shellfish produced on the leases. Additional research would be required in order to determine the economic value of ecological benefits from mariculture.

Leases are issued for the purposes of production, harvest and marketing of shellfish yet additional licenses are required to accomplish this. The lease should automatically include the licenses required to complete oyster production activities. If the lease itself were to include, grant, or confer the additional provisions currently licensed separately, it would streamline the system for both DMF and the shellfish producer. [The aquaculture license issue is also addressed in the Licensing and Permits issue paper.]

Similarly, many permits are required for shellfish production activities in addition to the

licenses. A blanket permit for the above activities could be issued to leases or included in the lease license. [This is also addressed in the Licensing and Permits issue paper.]

Potential shellfish culture yields and risks differ between oysters and clams yet rules require the same production requirements. Risk of disease loss is not as serious for clams as for oysters yet there is no exemption to account for disease-caused crop failures or losses. Oyster cultivation methods have lower potential yields than clams yet production requirements are identical. These differences are not recognized in guidelines for leases and rules. Eliminating production requirements in favor of an operational management plan using best management practices would simplify and reduce restrictions on leasing.

Although cultivated clams are exempt from size limitations for marketing, cultivated oysters are regulated to the same size standards as oysters harvested from public beds during the open oystering season. And length is not always an accurate measure of marketability. Cultivated oysters are often shaped differently due to culture methods and may contain marketable size meats even at small sizes. Oysters from leases should be exempt from length limits imposed on wild stocks and should be treated as farm crops.

Production requirements are not realistic considering the problems with current oyster culture methods and may be unnecessary if other public benefits are considered. Educating leaseholders about best management practices along with filing and following a management plan can replace production requirements. The uncertainty of environmental conditions can make compliance with three-year production averages impossible. The concerns expressed by MFC members that 25 bushels of cultch is not sufficient effort for tying up public bottoms could be resolved by increasing planting requirements instead of dropping them. This would allow shellfish culturists to continue cultivation efforts and focus on long term production; or production efforts could be gauged by using the best three of the most recent five years production. That would help account for uncertain conditions and uneven year-to-year harvests. Additionally, if leases were to be issued for longer terms, i.e. 20-year term instead of 10-year term, it would encourage long-term investments. Documented adherence to the management plan would eliminate non-use and ensure public benefits from the leases areas.

Water column use is a requirement for off-bottom oyster culture methods and is an integral part of some intensive culture leases. The annual fee for water column leases is \$500 per acre, which is one hundred times (100 X) higher than the equivalent fee for bottom leases. This high cost of water column leases is restrictive to most potential shellfish growers. The term of water column leases is only 5 years compared to 10 years for bottom leases. After almost ten years availability, very few water column leases have actually been issued in the state. The cost of leasing water columns for shellfish culture should be lowered so that it is more in line with the other requirements and the terms should be increased to match that of bottom leases.

Production requirements for water column leases are currently set at four times that of

bottom leases or 100 bushels per acre. If lease fees were set at the same multiple, that would result in a fee of \$20 per acre of water column.

Areas around private docks are a source of much potential mariculture activity yet there is no separate category to lease them or to permit mariculture for personal use. A new category of leases or permit is needed for dock owners to grow oysters or clams for personal consumption. Alabama riparian rights include control and utilization of the bottom 600 feet from shore for shellfish culture with no lease. Virginia waterfront owners can obtain a riparian lease permit for \$1.50 and grow shellfish for personal consumption. More people use this category than any other form of shellfish culture in Virginia and it accounts for most of the seed oysters purchased. If shellfish culture along docks were permitted for personal consumption in NC the cumulative environmental effects of small amounts of shellfish growing at numerous locations could be substantial.

This new option could be accomplished with a permit or by changing the minimum size of leases. Currently the minimum lease size is 1/2-acre. Changing that to 1/4-acre could allow dock owners to apply for leases in and around their docks where they could grow shellfish for personal consumption. They would still be subject to the commercial intent of the leasing program and would need to market and sell the minimum production requirements.

A new permit allowing a certain square footage surrounding docks to be used to grow shellfish for personal consumption could also accomplish that option. Rules similar to ones enacted in Virginia would be required. The permit in Virginia is \$1.50 and allows 160 square feet of area to be used for growing shellfish for personal consumption. These permits are also allowed for docks in polluted areas, but the shellfish cannot be consumed from those areas.

Another option is a new lease category for docks that could be issued for the water columns under private docks. The allowed area could be designated as a certain fixed size area such as 1/10-acre. The lease/permit would allow the dock owner to cultivate shellfish for personal consumption under and immediately adjacent to the dock. Docks already impact navigation but by State Statute are a riparian right. Shellfish cultivation associated with private docks would not increase problems with navigation but could significantly increase production of shellfish and reduce fishing pressure on wild stocks.

## **MANAGEMENT OPTIONS/IMPACTS**

- A. Status Quo for shellfish lease planting and production requirements
  - + Requires a high level of return for use of public resources
  - Data indicates that current production levels are unrealistic
  
- B. Adopt a new policy statement by amending the General Statutes officially finding

it in the public interest to encourage and develop shellfish culture for its public benefits. That shellfish culture provides these public benefits: (1) increasing seafood production and associated long-term economic and employment activity, (2) increasing ecological services to the natural environment by promoting natural water filtration and increased fishery habitats. **Statute change required.**

- + Creates a new atmosphere to encourage and facilitate private shellfish production in public waters
- + Recognizes the public benefits from private shellfish culture efforts
- Requires statutory changes

C. Require harvest and sale of 10 bushels of shellfish per acre to maintain lease production. **Rule change required.**

- + Reduces the production efforts requirement for leaseholders
- + Matches lease production requirements to current production levels and aligns production requirements with minimum-level natural shellfish beds
- + Allows for natural year-to-year variations in production
- May reduce habitat creation and ecological services
- Requires recognition of other public benefits to equal current situation
- May reduce the amount of shellfish reaching markets

D. Require harvest and sale of 10 bushels of shellfish AND planting effort of 50 bushels of seed or cultch to maintain lease production. **Rule change required.**

- + Increases the management efforts of leaseholders and resultant benefits
- + Increases leaseholder efforts which may address prior concerns evidenced in the sunset provision on planting effort
- + Requires a higher level of production effort than previous requirements
- + Considers current production problems and natural variations in production areas and species

E. Require only planting efforts of 50 bushels of seed or cultch to maintain lease requirements. **Rule change required.**

- + Simplifies the production effort requirement for leaseholders
- + Requires a higher level of input effort that may result in greater output levels than currently producing
- + Allows for yearly or unforeseen crop variations
- + Recognizes the ecological public benefits of private culture efforts
- Removes requirement for harvest and sale and resulting public benefit

F. Require the submission of and activation of best management plan in lieu of production requirements. **Rule and Statute change required.**

- + Accounts for variation in natural production capacity among leased areas
- + Requires leaseholder knowledge of production methods (education/certification)
- + Accounts for the ecological public benefits from mariculture activities
- Requires some form of verification for culture activities, such as receipts
- Requires research to determine BMP's for different areas and species

G. Drop Production Requirements Entirely. **Rule and Statute change required.**

- + Eliminates unnecessary rules
- + Mirrors the successful lease programming of other states
- + Reduces lease terminations due to production anomalies
- No documentation of any lease benefits
- May not meet North Carolina constitutional requirements for use of public resources

H. Change present shellfish lease statute to allow a minimum size for leases of ¼-acre to allow shellfish culture for riparian shoreline owners. **Statute and rule changes required.**

- + Allows for increased effort at shellfish cultivation with resultant ecological benefits
- + Increased public awareness of water quality and shellfish issues
- + Would not significantly increase navigational hazards
- Statute changes required
- May create conflicts with existing uses of shorelines or dock areas including existing leaseholders
- May create further issues related to shellfish cultivation in closed areas
- Personal consumption would be allowed but retain commercial harvest and sale provisions
- Would not be allowed if dock areas have pre-existing shellfish beds

I. Develop a special permit for dock owners to grow shellfish for personal consumption in limited-size (1/10-acre) areas under and around their docks. **Statute and rule changes required.**

- + Allows for increased effort at shellfish cultivation with resultant ecological benefits
- + Increased public awareness of water quality and shellfish issues
- + Would not significantly increase navigational hazards
- + Would not require harvest and sale provision of commercial leases
- May require other rule and statute changes
- May create conflicts with existing uses of shorelines or dock areas



including existing leaseholders

- J. Status Quo on opportunities for riparian shoreline owners to culture shellfish
- + Maintains focus on creating a documented shellfish production program showing returns to the public
  - + Avoids potential conflicts over public trust issues
  - + Avoids concerns over riparian owner's use of shellfish during temporary closures
  - Fails to increase public awareness of water quality and shellfish issues
  - Does not allow for increased shellfish culture with resultant ecological benefits
- K. Set fees for water column leases at four times bottom lease fees. **Statute and rule changes required.**
- + Reduces the financial burden of the high water column lease price
  - + Sets water column lease fee in line with the increased production requirements over bottom leases
  - + Recognizes the ecological public benefits from private shellfish culture
  - May encourage water column amendments for the purpose of limiting public access
- L. Eliminate size restrictions on oysters raised in an aquaculture operation. **Rule change required.**
- + Allows oyster producers to maintain existing accounts and sales
  - + Recognizes the increased value of oysters reared in aquaculture operations
  - + Aligns size limit exemption for oysters with clams reared in aquaculture operations
  - Requires tagging of product and verification of documentation by Marine Patrol
  - May increase opportunities for undersize, wild oysters to be harvested and sold
- M. Extend lease terms to 20 years. Renewals submit approved management plan and document production activities. **Statutory change required.**
- + Gives leaseholder greater incentive to invest for long-term returns
  - May maintain inactive leases in the system longer, unless documented adherence to management plan
  - May prevent addressing public trust conflicts for extended periods
- N. Provide four-year exemption of fees for new leases. **Statutory change required.**

- + Allows for a reasonable period of start-up expenses and returns
  - May not recoup cost for administration of shellfish lease program
- O. Require shellfish culture training certification for new lease applicants. Grandfather existing leaseholders that meet production requirements. **Statutory change required.**
- + Helps assure competency of new applicants
  - + Increases the likelihood of BMP's in shellfish culture
  - + Adds course elements for community colleges or other approved educators/courses
  - Temporarily restricts new entrants
  - Educational institutions may not be available in all areas of the coast. This may require development of an Internet or correspondence training course.

#### **RESEARCH NEEDS:**

Continue researching best ways to determine areas for block leasing by user coordination studies in various areas. Develop a protocol for defining BMP's among water bodies with differing production capacities and differing hydrological dynamics. Continue research on the ecological benefits from shellfish mariculture activities. Develop an Internet or correspondence training course for certification or re-certification of shellfish culturists.

#### **DMF RECOMMENDATION**

- B. Adopt a new policy statement by amending the General Statutes officially finding it in the public interest to encourage and develop shellfish culture for its public benefits. That shellfish culture provides these public benefits: (1) increasing seafood production and associated long-term economic and employment activity, (2) increasing ecological services to the natural environment by promoting natural water filtration and increased fishery habitats. **Statute change required.**
- D. Require harvest and sale of 10 bushels of shellfish AND planting effort of 50 bushels of seed or cultch to maintain lease production. **Rule change required.**
- J. Status Quo on opportunities for riparian owners to culture shellfish
- K. Set fees for water column leases at four times bottom lease fees. **Statutory change required.**
- L. Eliminate size restrictions on oysters raised in an aquaculture operation. **Rule**

**change required.**

- O. Require shellfish culture training certification for new lease applicants. Grandfather existing leaseholders that meet production requirements. **Statutory change required.**

#### **ADVISORY COMMITTEE RECOMMENDATION**

The Advisory Committee rejected H and recommended adoption of B, K, L, and O and modification of D and I as follows:

- D. Require harvest and sale of 10 bushels of shellfish AND planting effort of 50 bushels of cultch or 25 bushels of seed per acre per year to maintain lease production. **Rule change required.**
- I. Develop a special permit for dock owners to grow shellfish for personal consumption under their docks in floating culture. **Statute and rule changes required.**

**DMF staff agreed with the recommended changes in D and subsequently changed their recommendation on riparian shellfish culture to from H to J. *After DENR review, it was decided to recommend that leaseholders could pay a fee to DMF for planting cultch on public bottom in lieu of planting cultch on their leases.***

#### **MFC SELECTED MANAGEMENT STRATEGY**

Agreed with DMF recommendations except on the proposal to reduce water column lease fees to an amount four times that of bottom lease fees. **The MFC decided to reduce the fees to an amount ten times that of bottom lease fees. The MFC also added wording to recommendation B above indicating that interference with commercial fishing practices was not intended in this finding. During final approval of the plan, the MFC concurred with the DENR recommendation to allow an additional fee in lieu of cultch planting.**

### **9.2.8 SHELLFISH LEASE PROGRAM - AUDIT RECOMMENDATIONS**

#### **ISSUE**

DMF should request changes to the NC General Statutes to recoup expenses for the Shellfish Lease Program and provide for proper execution of lease renewal contracts. The issue was raised by the Office of the State Auditor of North Carolina.

## **BACKGROUND**

A performance audit of DMF was requested by the JLCSA and mandated by the Fisheries Reform Act of 1997. The audit was conducted by the Office of the State Auditor during 1997. An interim report was submitted in May of 1997 and the final performance audit report was issued in January 1998. The primary reason for the audit was to give an assessment of the current status of DMF operations and to determine DMF's capacity to assume additional responsibilities. Auditors utilized 14 sources of information to evaluate their charges, including a review of existing planning documents, organization charts, policies and procedures, contractual arrangements, and financial data. In the course of their review, the auditors found problems where the current General Statutes did not allow DMF to adequately recover expenses in processing shellfish bottom leases or to complete shellfish lease renewals according to legal principles governing issuance of contracts. The auditors made specific recommendations to resolve these problems and are conducting subsequent reviews of DMF programs to assess compliance with all of the recommendations. The recommendations have been reported in informal discussions in JLCSA subcommittee meetings but have never been raised to an action issue status.

## **CURRENT AUTHORITY**

### North Carolina General Statutes

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

## **DISCUSSION**

Auditors examined DMF records and recommended that the initial application fee for a shellfish bottom lease be raised to \$500 with an annual rental fee of \$10 per acre and a renewal application fee of \$100. In the auditor's opinion, these increases would allow the program to be self-supporting. Current statutory fees for shellfish bottom leases are a \$100 application fee, \$5 per acre rental fee, and a \$50 renewal application fee. Shellfish lease fees are received through the License and Statistics Section and all fees are credited in Marine Patrol budgets. The fees help offset the cost of additional patrol required for some shellfish lease activities but provide no support for the program's substantial administrative expenditure.

The auditor's examination of the shellfish lease contract process revealed that G.S. 113-202 requires that shellfish lease production reports and rental payments be filed by April 1 each year. During the tenth year of a shellfish lease contract the expiration date of the contract also falls on April 1. Therefore, DMF is unable to assess leaseholder compliance with shellfish production standards for leases until after the contract expires. Consequently, DMF has no choice except to issue renewal contracts for leases after the expiration of the previous contract, which is not in keeping with sound fiscal

management. The auditors recommended that rental fees and production reports continue to be required by April 1 of each year and that the expiration date for lease contracts be changed to July 1. In the auditor's opinion, this change would allow time for DMF personnel to determine that the lessee has met all lease requirements, approve the renewal, and process the new contract before the prior contract expires.

## MANAGEMENT OPTIONS/IMPACTS

### A. Status Quo

- + Maintains low lease fees for shellfish culturists experiencing low production (Dermo) and restricted harvest (temporary closure) situations
- Legal action could cause current contracts to be ruled invalid
- Failure to act on Auditor's recommendations will likely cause further action by the State Auditor

### B. Recommend retaining current shellfish lease fees and changing contract expiration dates to the Joint Legislative Commission on Seafood and Aquaculture. **Statutory change required.**

- + Maintains low lease fees for shellfish culturists experiencing low production (Dermo) and restricted harvest (temporary closure) situations
- + Follows auditor's recommendation to resolve contract expiration dilemma
- Failure to act on Auditor's recommendations on lease fees will likely cause further action by the State Auditor

### C. Affirm recommendations of the State Auditor [\$500 Application fee; \$100 renewal application fee; \$10/acre rental fee; and revised contract expiration date] and recommend same to the Joint Legislative Commission on Seafood and Aquaculture. **Statutory changes required.**

- + Follows auditor's recommendation, i.e. no further action
- + Recovers costs for administration of the shellfish lease program
- + Resolves contract expiration dilemma
- + Increased fees may help eliminate unproductive shellfish leases
- Increase in funds will not directly offset costs of the shellfish lease program
- Increase in fees will place additional burden on leaseholders already dealing with production problems
- Efforts to establish additional value of shellfish cultivation to public trust resources are currently being considered which may substitute for some of the additional fees requested

## **RESEARCH NEEDS**

None

## **DMF RECOMMENDATION**

- C. Affirm recommendations of the State Auditor [\$500 Application fee; \$100 renewal application fee; \$10/acre rental fee; and revised contract expiration date] and recommend same to the Joint Legislative Commission on Seafood and Aquaculture and Environmental Review Commission. **Statutory changes required.**

## **ADVISORY COMMITTEE RECOMMENDATION**

The Advisory Committee recommended a change in the application fee from \$500 to \$200. The other provisions of the recommendation were accepted.

- C. Adopt the following fees for shellfish leases: 1) \$200 Application fee, 2) \$100 renewal application fee, 3) \$10 per acre rental fee, and adopt a new shellfish lease contract expiration date of July 1.

**DMF staff agreed with the revised recommendation.**

## **MFC SELECTED MANAGEMENT STRATEGY**

Agreed with DMF recommendation

## **9.2.9 TECHNICAL SUPPORT FOR SHELLFISH CULTURE**

### **ISSUE**

Should North Carolina provide support for private shellfish culture? Shellfish culture industries in other states and/or countries are sometimes enhanced by successful partnerships between the state and the industry. Some of the ideas are: (1) plant cultch for oyster seed areas and directly on private leases, (2) monitor oyster larvae or spatfall abundance or, (3) provide funding for shellfish culture hatchery and grow-out research, disease diagnostic labs, and education/training programs for shellfish growers. Finally, with the problems posed by oyster diseases, should the state operate disease diagnostic laboratories to monitor the oyster disease levels on private oyster beds? These issues have been raised by the public, staff, advisory committees, and the Blue Ribbon Advisory Council on Oysters.

## **BACKGROUND**

Shellfish culture is a successful industry in other parts of the US and the world. It has succeeded other places because much effort has been put into developing methods and support services for growers. User friendly systems, appropriate culture methods and scientific support services are common elements of and essential to those successful culture programs. North Carolina has unique environmental conditions and needs to develop its own best shellfish culture methods. The state could provide research and technical support services to develop and enhance the industry.

Research is needed to continue the development of BMP's for shellfish culture and to continue development of appropriate cultivation methods. Additional research is required to develop disease-resistant or fast growing strains of shellfish.

Of the leading oyster producing states, Louisiana and Connecticut assist private oyster growers by planting cultch for seed production beds. Some New England states such as Maine and Massachusetts enhance clam production in public areas. The local communities in those states plant seed clams and manage the clam beds for subsequent public harvests. In France and Japan, the oyster industry is supported by state monitoring of larval shellfish abundance.

Three states that have increased production-- Washington, Louisiana and Connecticut-- have developed appropriate culture systems using private leases and best management practices. These states have active lease programs or private ownership using large acreage. The recent development of private oyster culture in Connecticut is responsible for the highest oyster harvests in New England since 1953. Private oyster culture in Louisiana and Washington provides 30 and 20 percent respectively of the United States oyster production. Worldwide oyster markets rely on private oyster production for supplies. Japan, Korea and France among other countries have successful oyster culture industries. Korean oyster culture production accounts for over 60 percent of oyster imports to the US.

North Carolina, with 1.8 million acres available for oyster production, is second only to Louisiana in usable area but has never ranked above fifth in oyster landings. After early private oyster culture attempts were unsuccessful, the state began and has maintained public oyster enhancement projects. Oyster landings are at historic low levels despite these restoration efforts.

The total North Carolina oyster harvests in 1998 amounted to about \$900,000 from all sources including private and public harvests. Private culture creates employment and increased tax base to the economies where it is successfully implemented. For comparison, wholesale values from U.S. shellfish culture industries in 1998 were \$28 million in Washington; \$25 million in Louisiana; \$40 million in Connecticut; \$11 million

in Florida; \$11 million in Virginia. Other countries with exceptional oyster culture industries are France with \$60 million in production and Japan with \$220 million in production.

Two levels of shellfish culture exist: extensive methods that use large areas of bottom at low densities and intensive methods that use smaller areas of bottom or water column at higher planted densities. Research must be conducted to develop and improve unique culture methods for both categories.

Extensive oyster cultivation is used in Connecticut, Louisiana and Washington. Louisiana and Connecticut plant cultch in areas of high larvae abundance to collect seed. The cultch with spat attached is then harvested and moved to better areas for grow-out. These methods require heavy machinery, large capital investments, and large areas of leased bottom for grow-out. The Washington industry relies on large hatcheries to produce eyed-larvae oysters (oyster larvae that are at the eye-spot stage of development). The eyed-larvae are allowed to set on cultch at the growers' sites. This process is called remote setting. The resulting seeded cultch is planted on large bottom areas for grow-out.

In North Carolina there are few natural seed areas and few planted seedbeds to collect seed for oyster culture. Also, oyster growers cannot plant cultch in designated seeding areas for later relay to leases for grow-out. Oyster growers using the extensive level of production in NC must plant cultch on their own leases and hope for a good spat set. Oyster spat sets vary over space and time and there is no predictability for the best setting areas. There is no monitoring of oyster larvae abundance to determine the most appropriate times for cultch planting.

Intensive oyster production plants higher densities of oyster seed per unit of area and maintains the crop above the bottom in the "water column" zone. These methods usually require a smaller acreage (and water column use) except in France, where about 50,000 acres are farmed. French methods place seed oysters in plastic mesh bags on off-bottom racks. In Japan and Korea, seed oysters are grown on wires suspended from floating rafts. Some preliminary work has been done by NC Sea Grant to develop intensive methods of oyster culture in North Carolina using mesh bags floating at the water surface. Surface culture has shown promise to grow oysters in less time than bottom culture, however, water column oyster production methods still require much labor and investment and are continually being improved through research.

Intensive clam production plants higher densities of clam seed per unit of area and maintains mesh netting covers over the beds to reduce predation. Most clam production in NC is done on an intensive scale however, some research has been done on extensive clam production. Continued research is needed for improving survival and growth of cultured clams.



As previously mentioned, seed supply is important to successful oyster production. Only four natural oyster seed areas and two planted seed areas are available in North Carolina for relay to leases. Managed seedbeds are a requirement for successful large-scale bottom oyster culture. North Carolina does little to manage seed areas for relay; thus seed supplies for extensive oyster culture are only available in some areas of the state. Polluted resources are available in southern areas of NC and can be relayed to leases.

Intensive operations use seed collected from natural spawns or obtained from hatcheries. Wild collection uses natural selection to obtain the hardiest seed as in Japan. Hatchery seed often contains both the strongest and weakest seed from a spawn. Research in NC has yet to develop wild oyster seed collection techniques or genetically improved hatchery seed for culture.

Many shallow areas that are suitable for planted seedbeds are closed due to pollution. Some polluted areas where we allow relay are already used as "seed areas" due to the fact that relaying can occur there. If additional areas were managed as seed areas, the increased oyster growth and filtering can actually help improve the water quality conditions as well as function as habitat for other marine life and as oyster spawning stocks. Because the intent is for the oysters to be relayed to leases for growing, the problem of harvests from these areas is abated.

Consumer demand for oysters has decreased somewhat due to safety concerns. An economically sound strategy is to increase demand while simultaneously increasing production. Consumers have greater confidence in cultured oyster products. Oysters from Connecticut and Long Island Sound are marketed as farm-raised products and command higher prices than wild harvested oysters. The value of Connecticut oysters exceeds that from both Louisiana and Washington with even lower production levels. France and Japan have been culturing oysters so long that consumers understand the production and marketing systems. The state could become involved in educational or marketing efforts to increase consumer demand for shellfish products.

Recent marketing efforts are paying off for Florida farm-raised clams. Of more than 100 million clams produced per year at the farm level, a very large portion are marketed in-state and helped by a large statewide marketing campaign for farm-raised clams.

## **CURRENT AUTHORITY**

### North Carolina General Statutes

113-203 Transplanting of oysters and clams.

113-204 Propagation of shellfish.

106-756 Aquaculture Development Act

### North Carolina Fisheries Rules for Coastal Waters 15A NCAC

3K .0103 Shellfish/Seed Management Areas

3O .0201 Standards for Shellfish Bottom and Water Column Leases

## **DISCUSSION**

What level of technical support should the state offer to private shellfish culture operations? Should it subsidize private shellfish culturists who are investing risk capital in the enterprise? The state could add services that would assist private shellfish culture with necessary information and resources. Some services such as larvae monitoring and disease diagnosis could help reduce some of the inherent risks of shellfish production. The state could take the approach of participating as a partner in private shellfish culture operations by using heavy state equipment for some required culture activities such as cultch planting.

Oyster larvae monitoring is successfully used in France and Japan where large oyster industries are operating. The government monitors larvae for abundance and stage of development. This is done collaboratively with industry monitoring programs and the information is shared to determine the best areas for collecting oyster seed. Cultch or seed collectors are placed in the best areas for seed collection. Larvae monitoring can be time consuming and/or relatively expensive for the returns of a small industry. North Carolina could begin monitoring oyster larvae or it could develop standard protocols for doing this task and then collaborate with industry members to obtain and share the information statewide. A larvae monitoring program could also be helpful to ongoing state oyster restoration efforts. If larvae information was available, it could increase the effectiveness of existing state cultch planting programs by determining the best timing for cultch plants.

Mortality of oysters from disease and other causes is a serious detriment to wild and cultured oyster crops. Cultured oyster stocks need genetic improvements for resistance to disease and improved growth. DMF currently has a program for monitoring disease levels of many areas in the state. The NCSU School of Veterinary Medicine also has facilities for oyster and fish disease diagnostics. There is little ongoing genetics research for producing disease resistant stocks for cultured shellfish crops.

The state currently has an oyster disease monitoring program for Dermo. The state could additionally provide diagnostic services to shellfish growers through the DMF or NCSU School of Veterinary Medicine. Routine disease assessments of cultured oysters could suggest crop harvest dates in advance of possible mass mortalities from a diagnosed infection of MSX or Dermo. In addition, the state could provide for research of disease resistant stocks for shellfish culture.

Cultch manipulation requires heavy equipment in the form of barges for planting and suction dredges for relaying seeded cultch for grow-out. This equipment is expensive and has a single-purpose use. The Louisiana and Connecticut industries have been operating for many years and maintain privately owned equipment for this purpose however, the states also maintain and utilize similar equipment for use in public areas. The cultch is planted in designated areas that are better for spatfall, then removed by dredges and transferred to leases that are better for growth. Cultch is a valuable commodity and if there is a poor spat set it may be dredged back up and piled back onshore to dry for later re-planting.

Cultch manipulation is used in Louisiana and Connecticut for extensive oyster culture but it has not been utilized in North Carolina. There is no reliable prediction of whether there will be a good spat set in that area. Currently, most oyster growers plant cultch on their leases whether or not the lease is in a good area for seed collection. Leaseholders must develop a management plan on how their lease will produce prior to granting or renewal. They can obtain assistance from NC Sea Grant and NC Dept. of Agriculture in developing management plans.

If the state were to designate seed areas in locations that generally have good spat settlement, such as high salinity estuaries, it could routinely plant cultch in those areas specifically for seed collection. Then leaseholders could remove the seeded cultch after spatfall and relay to their leases for grow-out. Likewise, the state could also remove the seeded cultch to public restoration areas or created reefs. Many growers relay oysters from polluted areas to leases during a six-week season in late winter. However, planted seedbeds would give growers an additional source of seedstock to increase oyster production. Also, in France and Japan, oyster spats are collected on artificial collectors hung in the water column. Artificial collection could be an additional avenue for growers to obtain seed for oyster cultivation in North Carolina.

It has also been suggested that the state could use its equipment to plant cultch directly onto private leases for oyster production. That would take time away from state cultch planting efforts and would bear an undetermined cost to the leaseholder, however, the cost may be less than purchasing the appropriate equipment.

Specific best management culture methods used by each successful industry still need to be developed for North Carolina. The state could work to provide a suitable regulatory climate and oyster seed resource for private oyster culture. State funded support services for oyster growers such as biological and environmental monitoring that are important to other oyster industries should be available in North Carolina.

Research, development and education initiatives are essential to a successful shellfish culture industry. The state of Virginia is currently operating shellfish culture hatchery and research facilities in addition to providing disease diagnostic services to growers. The state also provides educational centers for the training of shellfish growers to

increase proficiency. North Carolina should provide these services to foster the shellfish culture industry.

## **MANAGEMENT OPTIONS/IMPACTS**

- A. Status Quo for technical support of shellfish culture
  - No improvement in the situation
- B. State to provide oyster larvae monitoring services
  - + Helps oyster industry with spat collection and production
  - + Helps provide data for oyster management
  - Adds costs to the program
  - Requires research to develop monitoring protocol
- C. Develop protocol for monitoring oyster larvae presence collaboratively with industry
  - + Helps oyster industry with spat collection and production
  - + Helps provide data for oyster management
  - + Shares cost of the program with users of the program
  - Adds costs to the program
  - Requires research to develop monitoring protocol
- D. Designate and plant managed seed bed areas for subsequent relay to leases
  - + Provides necessary resources for traditional shellfish culture
  - + Temporarily creates habitat and ecological services
  - Further reduces the funding available for the several facets of oyster resource restoration and harvest management
  - The dedicated use of a portion of the resource to one user group is opposed by some fishing groups
- E. State assistance with planting efforts on shellfish leases: Cultch planting with state-owned equipment, subsidized shell purchases, and cost share programs for BMPs
  - + Provides major assistance in shellfish lease management particularly for new leaseholders
  - + Increases habitat and ecological services provided by planted lease areas
  - Reduces amount of habitat that can be restored in natural areas

- Reduces the amount of enhancement efforts for production of harvestable shellfish in public areas
  - The expenditure of state funds for one user group is opposed by some fishing groups
- F. Increase funding of research, development and education initiatives as follows:
1. University-based shellfish culture hatchery and research facilities for development of cultivation methods, improved genetics, disease resistance, and performance of biological monitoring and support services.
  2. Shellfish disease laboratory for research and diagnostic services for growers
  3. Educational centers within the University and Community College systems for education of the public and training of shellfish culture students.
- + Provides excellent support and an atmosphere for growth of a shellfish culture industry
  - + Services provided may have application to wild harvest problems
  - Significant expenditures for shellfish culture may remove the focus on natural shellfish population problems

## **RESEARCH NEEDS**

General research and development of BMPs for most effective seed bed shell planting areas, timing of plants and protocol for monitoring oyster larvae and spatfall. 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

## **DMF RECOMENDATION**

- C. Develop protocol for monitoring oyster larvae presence collaboratively with industry
- D. Designate and plant managed seed bed areas for subsequent relay to leases
- F. Increase funding of research, development and education initiatives as follows:
1. University-based shellfish culture hatchery and research facilities for development of cultivation methods, improved genetics, disease resistance, and performance of biological monitoring and support services.
  2. Shellfish disease laboratory for research and diagnostic services for

- growers
3. Educational centers within the University and Community College systems for education of the public and training of shellfish culture students.

### **ADVISORY COMMITTEE RECOMMENDATION**

Agreed with DMF

### **MFC SELECTED MANAGEMENT STRATEGY**

Agreed with DMF recommendation

## **9.2.10 SHELLFISH PERMITS**

### **ISSUE**

The modification of shellfish permits to comply with the Fisheries Reform Act was raised as an issue by the MFC, DMF, and Oyster and Clam FMP Committee.

### **BACKGROUND**

The Fisheries Reform Act (FRA) of 1998 re-institutes the requirement for obtaining permits to conduct activities that are not normally allowed by either rules or statutes. The Act also authorizes permits that are required to collect data under a quota/allocation system. The legislation also specified that the Division charge a fee for permits to recoup their administrative cost. The provision for fees was later dropped. The Division undertook a comprehensive review of the existing permits including the need for the permits, the effort required of the Division to issue these permits, and the data collected under the permits. This review was conducted by the Rules Review Committee of the Division and included all permits issued for shellfish related activities. In its review, the Division has identified shellfish permits that it feels are necessary to continue, as well as permits which are believed to be no longer necessary. The MFC has requested that the Division prepare a recommendation for all shellfish related permits for them to consider in as a part of the FMP process.

Prior to the Fisheries Reform Act, the BRACO considered the permit system in place for oyster harvest and shellfish lease activities and found it to be too burdensome on shellfish growers. They recommended that a blanket permit for all currently permitted shellfish culture activities be developed or that a separate mariculture license be instituted that included all the permitted activities.

### **CURRENT AUTHORITY**

FRA - Establishes authority for permits

3O.0503 - Aquaculture Operations/Collection Permits

3K.0103 - Permit to Transplant Oysters from Seed Oyster Management Areas

3K.0104 - Permit for Planting Shellfish from Polluted Areas

3K.0107(c) - Harvest Permit for Depuration of Shellfish

3K.0205(b) - Permit to take Oysters from Private Beds

3K.0206 - Permit to use Mechanical Methods for Oysters or Clams on Shellfish Leases and Franchises

3K.0303 - Permit to use Mechanical Methods for Oysters or Clams on Shellfish Leases and Franchises

3K.0401 - Permit to take Rangia Clams by Mechanical Methods and from Polluted Areas.

## **DISCUSSION**

A thorough review of all permits currently issued by the Division has been completed. In assessing the necessity of each permit some of the factors considered were: number of each permit issued, duration of permit, current rules, inspection and reporting requirements, renewal process, license and other qualifying requirements, the rationale for the permit, whether it is still needed and improvements to the permit.

As a result of this examination, the Division is recommending that the following shellfish related permits remain in effect in some form: aquaculture operation, aquaculture collection, transplanting polluted shellfish, harvest of shellfish for depuration purposes, transplanting oysters from seed management areas, Rangia clam harvest from polluted areas, and harvesting oysters and clams from leases and franchises by mechanical methods. Both permits for taking shellfish from public bottom by mechanical methods are being recommended to be dropped as well as the permit to take oysters from private shellfish bottoms.

The regional and standing committees of the MFC have discussed the permit system that is being developed. During these discussions a recommendation was made that as many permits as possible be included as endorsements to a general permit. For example, lease and franchise holders would obtain a general permit that has the options of, taking shellfish from polluted areas, harvesting from Seed Management Areas and using mechanical gear for harvest which would be included as approved activities on the general permit.

## **MANAGEMENT OPTIONS**

- A. Apply FRA requirements to current permit system. **Rule change required.**
  - + Allows currently permitted activities to continue
  - Some unnecessary permits would be continued
  - Disorganized permit system would continue
  
- B. Apply FRA requirements to an organized, upgraded permit system (current DMF initiative). **Rule change required.**
  - + Allows currently permitted activities to continue
  - + Will do away with unnecessary permits
  - + May allow some streamlining of the permit process
  
- C. Recommend a separate license and permit system for shellfish culture activities. **Statute and Rule changes required.**
  - + Specifically addresses shellfish culture activities
  - + Designed to reduce fee burdens
  - Recreates an unstandardized permit system
  - Further complicates shellfish license system and enforcement
  - If implemented, insufficient data will be generated for analysis of new license prior to expiration of current license system in 2003

## **RESEARCH NEEDS**

Continued analysis of the need for permits.

## **DMF MANAGEMENT RECOMMENDATION**

- B. Apply FRA requirements to an organized, upgraded permit system and reconsider license/permit system specifically for shellfish at scheduled FMP review which will coincide with the new license system implementation schedule.

## **ADVISORY COMMITTEE RECOMMENDATION**

Agreed with DMF

## **MFC SELECTED MANAGEMENT STRATEGY**

Agreed with DMF recommendation



## **9.3 INSUFFICIENT ASSESSMENT DATA – ISSUE PAPERS**

### **9.3.1 HARVEST MANAGEMENT OPTIONS FOR THE OYSTER FISHERY**

#### **ISSUE**

The Plan Development Team and FMP Advisory Committee recommended consideration of various harvest limit restrictions to aid in recovery of the oyster resource.

#### **BACKGROUND**

There were no limits on the daily harvest of oysters in North Carolina until 1947. There were also no limits on dredge weights or restrictions on the number of fishermen during that time. This means during the period of highest market demand and harvest, oyster resources were receiving their greatest impacts from harvest operations. A 75 bushel per day oyster harvest limit was set by statute in 1947 and remained in effect until 1984 when proclamation authority for oyster harvest limits was established. A restriction on proclamation authority was added in 1988 that limited the harvest to no more than 50 bushels per day. Available proclamations indicate that the oyster harvest limit was 50 bushels per day between 1984 and 1989. Separate harvest limits for hand and mechanical harvest began in 1990 with a seven bushel limit for hand harvesters and a 20 bushel limit for mechanical gear fishermen. These lower limits were put in place primarily due to high mortality of oysters due to Dermo. Those limits remained in place for three seasons and in 1993 the current limits of five bushels for hand harvesters and 15 bushels for mechanical harvesters was established.

Factors other than harvest limits must also be considered when addressing the impacts of harvest on oyster populations. A discussion of designating additional area for hand-harvest only methods is presented in the issue paper entitled “Oyster Management Measures” (10.1.1). The harvest limit issue is also related to licensing concerns addressed in the issue paper entitled “Effects of an Open Shellfish Harvest License on Shellfish” (10.1.3). Any further gear restrictions must also be considered when addressing harvest limits. The impacts of gear type, number of harvesters, and amount of area where certain gears are allowed can affect the amount of harvest allowed.

A complete history of the management of oyster harvest on public bottoms in North Carolina is presented in sections 6.1.1 and 6.1.2.

## **CURRENT AUTHORITY**

### North Carolina Fisheries Rules for Coastal Waters (15A NCAC)

3K .0201 Open Season and Possession

## **DISCUSSION**

Anecdotal information from harvesters indicate that harvesters have seldom been able to reach the established daily harvest limits except for areas in the extreme southern portion of the state. Therefore, it is likely that previous daily harvest limits have been unsuccessful at protecting oyster resources. Setting meaningful daily harvest limits would require collecting data necessary for oyster population estimates, calculating the optimum number of legal-size oysters available for harvest, setting daily harvest limits that minimize impacts on oyster habitat and sublegal oysters, and closely monitoring oyster landings to implement appropriate closures. Since oyster nursery areas and harvest areas occur on the same sites, the mortality rates of sublegal oysters caused by the various harvesting gears and culling is also essential information in developing harvest limits.

The number of harvesters can also have a significant effect on the daily harvest limit of oysters and excessive numbers of harvesters could require very restrictive daily harvest limits. Conversely, limiting the number of oyster fishers could maximize harvest limits and reduce impacts on the oyster resource and habitats. Currently there is no limit on the number of recreational harvesters and any State resident may obtain a commercial shellfish license. Therefore, there is a high potential for oyster resource impacts and continued low harvest limits.

The presence of Dermo throughout oyster harvest areas in North Carolina has greatly complicated oyster management including harvest limits. Conventional wisdom on management of Dermo infested oyster stocks maintains that oysters at high risk of Dermo mortality should be completely harvested to reduce risk of parasite transmission to uninfected oysters. Harvest of these oysters also makes use of a resource that would otherwise be lost. This management philosophy was developed in Virginia where a large percentage of the oyster harvest has come from private beds and in many cases oyster farmers deliberately killed any remaining oysters after an area was harvested to prevent infection of subsequent plantings.

The management of oysters on public bottoms is not conducive to some of these methods since natural oyster rocks are involved and the production of next year's crop is dependant on the sublegal oysters on that rock and not from a distant seed oyster area. However, North Carolina oyster harvest has been continued, even in areas where populations appear to be very low, to remove potential infectious agents and to utilize

oysters that would otherwise be lost. However, the size limit of three inches has been maintained and the harvest limits have been conservative to provide for population recovery and habitat protection. Harvesters have argued against this philosophy recommending extreme options of either a finite moratorium on oyster harvest or a reduced size limit of 2.5 inches and increased harvest limits. These options would either provide the optimum protection from harvest for recovery (moratorium) or take a much more aggressive approach to Dermo elimination (increased harvest of potential disease vectors). DMF has not acted on these recommendations because harvest does not appear to be the major factor affecting oyster survival and recovery, and it would take a massive effort to achieve any influence on Dermo prevalence through harvesting or killing infected individuals on a coastwide or regional basis. Dermo prevalence has been near 100% since 1991 and the only reductions in Dermo related mortality appear to have been in response to decreases in water temperature and salinity levels. As soon as water temperatures and salinity resumed above average values, Dermo mortality returned to high levels.

The current proclamation authority concerning the oyster season provides for highly adaptable management measures that cover most of the conceivable options except limited entry. Therefore, changes in oyster harvest can be accomplished by changes in implementation of the existing rule.

## **MANAGEMENT OPTIONS/IMPACTS**

### **A. Status Quo**

- + Conservative measures recognizing limited assessment data
- + Lessens impact on fishers by allowing harvest
- Unknown impacts on habitat and resource
- No apparent results utilizing this option

### **B. Limited entry/Permits/Control dates**

- + Set finite limits on currently unlimited number of harvesters and effort
- + Maximize resource use by traditional harvesters
- + Possible habitat and resource benefits
- Some traditional harvesters cannot document participation
- Could limit future growth of oyster industry
- Could limit aquaculture

### **C. Implement harvest management measures recommended in this plan until data collection efforts allow for more precise assessment of population parameters and harvest effects**

- + Utilize up to date analytic measures to set harvests
- + Harvest management tailored to specific areas
- + Provide for maximum recovery and maintenance of the resource
- Insufficient data collection/manpower to provide necessary data
- Research is needed to provide all necessary data

D. Institute more aggressive management measures

- + Current management schemes have shown little effect
- Oyster harvest does not appear to be a major factor affecting oyster survival and recovery
- Massive management efforts would be needed to affect changes in Dermo prevalence through harvesting

**RESEARCH NEEDS**

The mortality of sublegal oysters by various harvest gears and under variable harvest intensity needs to be established. Baseline data and methods for estimating oyster populations also need to be established.

**DMF RECOMMENDATION**

- C. Modify harvest as needed to meet management objectives

**ADVISORY COMMITTEE RECOMMENDATION**

Agreed with DMF.

**MFC SELECTED MANAGEMENT STRATEGY**

Agreed with DMF recommendation

**9.3.2 NO DATA ON RECREATIONAL HARVEST OF SHELLFISH**

**ISSUE**

The Oyster and Clam FMP Committee expressed great concern because no recreational shellfish harvest data are currently being collected.

**BACKGROUND**

Despite the importance of the commercial shellfish fisheries (molluscan and crustacean) to the state, very little data exists on recreational shellfish harvest. A 1991 phone survey conducted by Marine Recreational Fisheries Statistics Survey (MRFSS) indicated 3% of households in coastal North Carolina participated in recreational shellfishing (D. Mumford, DMF, personal comment). Recreational data are being collected by MRFSS for finfish but does not currently collect shellfish data. This lack of recreational landings knowledge of shellfish makes it impossible to estimate the impacts of recreational harvest on each species. In addition, the 1997 Fisheries Reform Act requires DMF to prepare Fishery Management Plans (FMPs) for all of the state's commercially and recreationally significant species. The shellfish fisheries are under North Carolina jurisdiction alone, so effective state FMPs will be very important. The Reform Act did create a new annual licence for recreational fishermen who use limited amounts of commercial gear to harvest seafood for personal consumption. However, no shellfish gear was approved under the Recreational Commercial Gear License since fishers could obtain a shellfish license at a lower cost and use any commercial shellfish harvesting gear. Unfortunately, data from recreational harvest by shellfish license holders will not be captured.

#### **CURRENT AUTHORITY**

None

#### **DISCUSSION**

It is imperative to collect high quality recreational data to address potential management issues such as harvest limits, size limits, and gear restrictions. To better manage shellfish fisheries, information on recreational harvest such as effort and size distribution for each species by area are needed.

The collection of shellfish recreational harvest data, along with commercial landings data available through the North Carolina Trip Ticket Program would provide data for a better estimate of maximum sustainable yield (MSY) and fishing mortality (F) along with increased knowledge of the recreational fisheries in the state. MSY and F would be expected to increase if landings from recreational harvest were added to total landings. These estimates, along with the more accurate accounting of landings would allow managers to examine the proportional harvest of the recreational and commercial fisheries and make better decisions on management strategies for both harvest sectors.

#### **MANAGEMENT OPTIONS/IMPACTS**

##### **A. Status Quo**

- + No additional regulation on recreational fishery
- Information not available for OSY estimates

B. Intercept survey

- + Catch/effort data per species collected
- + Gear data collected
- + Species identification and size data collected
- + Ability to gather social economic data
- Expensive to implement
- Difficult to intercept shoreline fishers
- Unable to intercept fishers originating from private residence

C. Phone survey

- + Kinds of species caught
- + Gear data collected
- + Some effort information (number of trips)
- + Ability to gather social economic data
- Sampling universe not defined
- Expensive to implement
- Unable to get individual species data (lengths, etc)
- Survey dependent on recollective memory
- Intercept survey required to adjust trip data

D. Recreational License

- + Defines a sampling universe
- + Provides revenue for phone survey
- + Ability to gather socioeconomic data
- Additional regulation on the recreational fishery
- Additional financial burden on the recreational fisher

E. Recreational Shellfish Permit

- + Defines a sampling universe
- + Ability to gather social economic data
- No revenue for phone survey

F. Add “pleasure” category to shellfish license

- + Defines sampling universe
- + Easily implemented
- Leaves out those recreational fishers who do not buy a license

## **RESEARCH NEEDS**

None

## **DMF RECOMMENDATION**

- F. Add “pleasure” category to current shellfish license.
- D. Recommend adoption of a recreational fishing license that would provide data on recreational shellfish harvest

## **ADVISORY COMMITTEE RECOMMENDATION**

Agreed with DMF.

## **MFC SELECTED MANAGEMENT STRATEGY**

Agreed with DMF recommendation on F. and modified D. to read: Recommend adoption of a mechanism that would provide data on recreational shellfish harvest

## **9.4 ENHANCEMENT ACTIVITIES – ISSUE PAPERS**

### **9.4.1 OYSTER SANCTUARY DEVELOPMENT/CONSTRUCTION**

#### **ISSUE**

Research Institutions working on oyster recovery and the BRACO recommend the development and construction of oyster sanctuaries to increase oyster populations.

#### **BACKGROUND**

Currently, there are five constructed oyster/artificial reef sanctuaries in North Carolina. These sanctuaries are located in Bogue Sound, West Bay (Tump Island), Deep Cove (Swan Quarter), Croatan Sound, and behind Hatteras Village. The sites were planted with large fossil stone and funded with Artificial Reef monies. There have been no separate funds allocated for oyster sanctuaries in the restoration efforts of the state. Oyster /artificial sanctuaries have been designated under North Carolina Marine Fisheries Rule 15A NCAC 3K .0103 as oyster management areas, which prohibit harvest of oysters and the use of trawls, long haul seine, and swipe nets. Data collecting and monitoring have been ongoing on these areas with reasonable sign of oyster attachment however, no significant abundance has been noted. These sanctuary reefs were not established just for the restoration of oysters, but as artificial habitat for finfish also. The site in Bogue Sound has been sanded over however, all other sites have bottom relief. Perhaps the location, size, cultch material, and construction methods need to be evaluated before additional sanctuaries are constructed to ensure desired results.

The BRACO recommended the establishment of oyster sanctuaries in the Albemarle/Pamlico system. Oyster sanctuaries were not recommended in the southern coastal area of North Carolina due to the large amount of oyster habitat in that region that is already closed to oyster harvest and already serving as a sanctuary. Other states such as Virginia and Maryland have sanctuaries that are a major component of their restoration efforts. Sanctuaries provide a protected haven from harvest and fishing practices that promotes the growth and enhances survivability of large oysters. Large disease-resistant oysters have the potential to establish populations beyond the sanctuary boundaries, which in turn could have long-term benefits on a sustainable fishery. Permanent reef sanctuaries also provide a means to conduct research to address critical unanswered questions including whether the impact of oyster diseases are a function of stress inflicted by various bottom disturbing fishing gear. Secondly, transplanting large surviving oysters to sanctuaries may encourage passage of their disease resistant traits on to future populations. Additionally, sanctuaries could provide protected bottom for the stocking of disease free spat from hatcheries so they could be monitored for production. And finally, oyster sanctuary sites may provide other baseline information needed to enhance the understanding of how oyster communities function in North Carolina.

With the introduction of additional oyster sanctuaries, traditional fishing grounds could be impacted. Sanctuaries require acres of bottom in order to function properly and just how much protected acreage is needed is yet unknown. Scientists in the Chesapeake Bay region have suggested setting aside at least ten percent of traditional oyster reef acreage (50,000 acres) for sanctuaries. Valuable input from commercial watermen is needed in the development of these areas.

## **CURRENT AUTHORITY**



Marine Fisheries Rules for Coastal Waters (15A NCAC)  
3K .0103 Shellfish/Seed Management Areas

No new rules or rule changes would be needed to designate and establish oyster sanctuaries.

**DISCUSSION**

Current funding of the Shellfish Rehabilitation Program is not sufficient to support fishery and habitat needs. Learning from other states sanctuary restoration efforts and success is crucial with limited funding. The potential loss of fishing grounds due to sanctuaries needs to be addressed through public meetings. Criteria for the location of oyster sanctuaries should be implemented to lessen impact to certain fisheries while still allowing brood stock to populate surrounding harvest locations.

Sampling will be needed to monitor the sanctuaries and establish their ecological importance in the estuary. Reef construction with different cultch material and dimensional qualities should be researched. Planting certified seed, seed oysters with no detectable trace of disease, or relaying large surviving oysters to sanctuaries could promote characteristics needed to suppress the trends in *Perkinsus marinus* (Dermo) mortality. Marking sanctuaries with buoys will require increased maintenance and increase the burden on Marine Patrol to enforce regulations.

**MANAGEMENT OPTIONS/IMPACTS/PROPOSED AUTHORITY CHANGE**

A. Status Quo

- + Some level of habitat protection
- No sanctuaries design especially for oyster enhancement
- Continue traditional restoration

B. Establish new designated oyster sanctuaries to increase oyster populations

- + Promote larger oysters with increased fecundity
- + Promote development of disease-resistant oysters
- + Provide protected habitat for future stocking efforts
- + Reduce bottom disturbing gear on enhanced bottom
- Potential loss of traditional fishing grounds
- Increased law enforcement responsibility
- Use of funds that could be utilized elsewhere

C. Enhance existing oyster/artificial reef sites with cultch material and monitor results before construction of new sanctuaries

- + Use of existing funds to promote development of present sanctuaries
- + No loss of traditional fishing grounds
- + Research needed to evaluate results for the evolution of new sanctuaries
- Delay of new sanctuaries while monitoring is underway
- Increase sampling of sanctuaries by DMF
- Cultch material use for unharvestable bottom vs. harvestable bottom

D. Plant seed oysters on existing oyster/artificial reef sites

- + Quicker grow-out to breeding stock
- + Possible planting of certified disease free seed to suppress diseases
- Unproven method for Division staff
- Increase sampling effort by DMF
- Availability of funding

E. Discontinue existing oyster/artificial reef sanctuary program

- + Increase harvest areas
- + Free-up funds for other projects
- No protected area for oyster recovery
- No protected area for potential disease-resistant oysters

**RESEARCH NEEDS**

1. Areas of sanctuary placement (shallow/deep)
2. Sanctuary size, profile, and amount cultch needed
3. Success of other states sanctuary programs
4. Cost of sanctuary project (private vs. state)

**DMF RECOMMENDATION**

- C. Enhance existing oyster/artificial reef sites with cultch material and monitor results before construction of new sanctuaries.
- D. Plant seed oysters on existing oyster/artificial reef sites as research indicates.

**ADVISORY COMMITTEE RECOMMENDATION**

Agreed with DMF.

**MFC SELECTED MANAGEMENT STRATEGY**

Enhance existing sanctuary sites and develop a mechanism for expanding sanctuaries

## **9.4.2 OYSTER ENHANCEMENT ACTIVITIES**

### **ISSUE**

The Plan Development Team recommended evaluation and consideration of oyster enhancement activities.

### **BACKGROUND**

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 in 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 when landings doubled to approximately 800,000 bushels (Chestnut 1951).

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 a current total annual budget of approximately \$268,650 and the additional responsibility of enhancing hard clam production.

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 and support equipment, and the use of DMF 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 spatset and increased survival (Ortega, Et. al 1990, Lenihan, Et. al Draft 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. Two medium size (50 and 65 foot) flat bottomed self-propelled barges conduct activities primarily in the bays and rivers adjacent to Pamlico and Core sounds. A 115-foot ex-military landing craft works the deeper areas of the sounds and adjacent waters. The four 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 has 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.

The relaying of 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. In 1934 for example, 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. 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.

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.

The success of these efforts has varied with area and through time. Some of the main factors limiting the success of this program have been the recent increased incidence of Dermo, deteriorated water quality, disturbance by fishing gear and sedimentation by hurricanes. A complete history of North Carolina oyster restoration efforts can be found in *Oyster Reef Habitat Restoration: A synopsis and synthesis of approaches*. M. W. Luckenbach, R. Mann, J. A. Wesson, editors. Virginia Institute of Marine Science Press, Gloucester Point, Va.

## **CURRENT AUTHORITY**

North Carolina Fisheries Rules for Coastal Waters (15A NCAC)

15A NCAC 3H .0102 SCOPE AND PURPOSE

15A NCAC 3K .0103 SHELLFISH/SEED MANAGEMENT AREAS

General Statutes of North Carolina

Chapter 113 –201 AUTHORITY OF MARINE FISHERIES COMMISSION

Chapter 113 – 204 PROPAGATION OF SHELLFISH

## **DISCUSSION**

Landings data and monitoring substantiate the concern status of the oyster stock in North Carolina. Opinions vary as to the role that enhancement activities should play in oyster management. Some factions believe the oyster stocks are so depressed that any efforts to maintain or enhance the population are wasted. They think environmental conditions, disease prevalence, harvest pressure and habitat disturbance are obstacles too great for the species to overcome. Other opinions include redirecting enhancement efforts toward polluted stock relays and greater support of private mariculture. Other states, such as

Connecticut and Virginia, encourage and support private mariculture and leases, but continue to conduct enhancement activities such as seed and cultch planting in amounts which dwarf North Carolina's efforts. The status quo option includes continuation of current activities at current levels utilizing experience and methodology gained from ongoing DMF activities and outside researchers. This option attempts to maintain oyster stocks until environmental factors (water quality, disease, etc.) become more favorable. To increase oyster stocks under current conditions would require expanding current efforts including increasing the relaying of polluted stock, increasing cultch planting, and incorporating the seeding of selected areas. This proactive strategy will necessitate increased funding, but it will also increase oyster habitat which benefits not only oyster but numerous species that utilize oyster reef habitats and the environmental benefits associated with them.

The BRACO made numerous recommendations directed toward the protection and restoration of oyster habitat. The following actions have been taken by DMF to incorporate some BRACO recommendations into the Shellfish Rehabilitation Program, implementation of others are pending.

Recommendation #1: The continuation or expansion of the cultch planting program including sampling for oyster settlement and production to help direct future cultch planting to most productive sites. >DMF is continuing cultch planting and spatset and production monitoring at levels that have been reduced since the BRACO recommendations were published due to funding cuts.

Recommendation #3: The continued support for the research to complete an ongoing UNC study on:

- (1) How the size and water depth of cultch plantings influences their effectiveness
- (2) How oyster harvest techniques can be used to minimize damage to shell habitat and thus sustain future harvest
- (3) How oyster reefs provide other ecosystem services such as water purification and fish habitat

>DMF has continued to support this research and has incorporated several techniques tested in this study such as utilizing mound forming construction techniques for cultch plantings on deep-water sites and locating some sites in areas where mechanical harvest methods are restricted.

Recommendation #4: The planting of cultch material for private recreational users.

>Several sites have been constructed in Hyde, Pamlico and Carteret counties in areas which are conducive to recreational access and harvest and where mechanical harvest methods are restricted.

Recommendation #8: The BRACO suggested that the DMF manage cultch plantings for oysters or for hard clams and to provide protection of natural live oyster rocks from habitat degrading action of certain damaging clamming activities. >DMF has marked certain

planting sites where clam harvest is restricted, created experimental sites for clam habitat enhancement, and supported a change in funding to allow funds to be expended on clam enhancement projects.

Recommendation#10: The establishment of oyster sanctuaries on reconstructed reefs. >DMF has constructed five oyster sanctuaries and continues to monitor and enhance these sites.

The BRACO made several other recommendations including planting cultch material in polluted areas where relay programs exist, enforcement of regulations to protect oyster rocks from trawling, the restriction of trawling in conjunction with restoration through cultch planting in a sufficiently large area to test the impact of spatial displacement of the shrimp fleet, and whether the protection from trawl damage enhances and sustains oyster production on those protected reefs. The council also recommends that the General Assembly enact stiffer penalties for trawling in areas containing oyster rocks where trawling has been prohibited by regulation.

## **MANAGEMENT OPTIONS/IMPACTS**

### **A. Status Quo**

- + Current reduced levels of effort are maximum possible with existing funding
- + No new research required
- Current efforts are not adequate to support the habitat or the fishery
- Current execution of the program does not fully comply with recommendations of prior planning efforts

### **B. Abandon oyster enhancement efforts in favor of more valuable and disease-free hard clam resource enhancement**

- + Hard clam harvest is currently about 5 times more valuable than oyster harvest
- + Hard clam populations are not currently affected by disease outbreaks
- + Hard clam resources are receiving increased harvest pressure due to the decline in oyster harvests
- Oyster enhancement work significantly supports oyster harvest in the area of current highest production
- Recovery of oyster resources will be aided by oyster enhancement efforts
- Oyster enhancement activities help maintain hard bottom habitat during a period when natural habitat creation by oysters is low

- C. Dedicate Shellfish Rehabilitation funds used for wild-harvest oyster resource enhancement primarily to habitat creation and oyster sanctuary projects
  - + Provides for maximum creation of ecological services and survival of spawning stock oysters
  - Will reduce already record low oyster harvests and place more effort on other resources, especially hard clams
  - Eliminates support for restoration of a traditional fishery which is important to fishing communities in many areas
  
- D. Substantially increase the percentage of Shellfish Rehabilitation funding expended to enhance seed oyster resources used by oyster growers
  - + May provide for oyster harvests at a higher rate than wild harvest
  - + May increase compliance with shellfish lease production requirements
  - Habitat and ecological benefits associated with seed oyster areas will likely be short lived compared to sanctuary and habitat creation efforts
  - Some commercial fishing interests are opposed to the expenditure of state funds for the benefit of specific groups
  
- E. Modify the Shellfish Rehabilitation Program by executing the following:
  1. Formally adopt existing site selection criteria for oyster rehabilitation efforts
    - + Provide definite procedures for oyster rehabilitation activities
    - + Utilize knowledge and observations of the public
    - + Lessen area conflicts with other fishing operations
  
  2. Investigate alternative cultch sources for oyster habitat enhancement
    - + Improved oyster settlement
    - + More cost effective
    - Loss of traditional cultch sources
  
  3. Continue support of research on optimum cultch planting strategies and mound formation to maximize oyster recruitment and implement as data become available (Lenihan, et. al)
    - + Increase survival (minimize effects of anoxic events)
    - + Decrease effects of sedimentation and subsidence
    - + Increase planting efficiency
    - Increase conflicts with navigation and other fishing operations



4. Tailor planting efforts to minimize the effect of any new management actions on the fishermen by providing enhanced habitat in areas available to particular harvest techniques and user groups
  - + Increased habitat in hand harvest areas
  - + Increased habitat available for recreational harvesters
  - Possible loss of convenient local harvest areas for mechanical harvesters
  
5. Continue research with universities on use of hatchery reared oyster stock and implement findings as appropriate
  - + Development of more resilient oyster
  - + Increased oyster recruitment
  - Loss of natural local adaptations
  
6. Establish enhancement priorities (oyster vs. clam and product vs. habitat)(see issue paper entitled Management of North Carolina's Oysters as Habitat or for Production)
  - + Increased clam habitat
  - + Possible increase in clam recruitment, stock and harvest
  - Decreased oyster habitat
  - Possible decrease in oyster recruitment, stock and harvest
  
7. Adopt the Blue Ribbon Advisory Council on Oysters' recommendation to increase cultch planting efforts to a minimum of 400,000 bushels per year
  - + Increased oyster habitat
  - + Possible increase in oyster recruitment, stock and harvest
  - + Increased clam habitat
  - + Possible increase in clam recruitment, stock and harvest
  - Necessitates additional funds or reduction of other activities
  
8. Continue to limit the number of new planting sites to a maximum of 30 per year in the northern area by increasing the amount of cultch material per site (to increase area and relief)
  - + Increases planting efficiency
  - + Increases monitoring efficiency
  - + Reduces the effects of sedimentation and subsidence
  - + Reduces the effects of anoxic events

- + Reduces conflicts with other user groups (fewer sites)
- Possibly increases conflicts with other user groups (larger sites with higher profile)

## **RESEARCH NEEDS**

Strategy to minimize the effects of Dermo and detrimental environmental conditions on oyster enhancement activities

## **DMF RECOMMENDATION**

- E. Modify the Shellfish Rehabilitation Program by executing the following:
1. Formally adopt existing selection criteria for oyster rehabilitation efforts
  2. Investigate alternative cultch sources for oyster habitat enhancement
  3. Continue support of research on optimum cultch planting strategies and mound formation to maximize oyster recruitment and implement as data become available (Lenihan, et. al)
  4. Tailor planting efforts to minimize the effect of any new management actions on the fishermen by providing enhanced habitat in areas available to particular harvest techniques and user groups
  5. Continue research with universities on use of hatchery reared oyster stock and implement findings as appropriate
  6. Establish enhancement priorities (oyster vs. clam and product vs. habitat) (see issue paper entitled Management of North Carolina's Oysters as Habitat or for Production)
  7. Adopt the Blue Ribbon Advisory Council on Oyster's recommendations to increase cultch planting efforts to a minimum of 400,000 bushels per year
  8. Continue to limit the number of new planting sites to a maximum of 30 per year in the northern area by increasing the amount of cultch material per site (to increase area and relief)

## **ADVISORY COMMITTEE RECOMMENDATION**

Agreed with DMF recommendation.

## **MFC SELECTED MANAGEMENT STRATEGY**

Agreed with DMF recommendation

## **9.5 ENVIRONMENTAL ISSUES – ISSUE PAPERS**

## 9.5.1 WATER QUALITY DEGRADATION AND INCREASED AREA CLOSURES

### ISSUE

Evaluate water quality issues as they relate to the harvest/consumption of shellfish resources. This issue originated from the Oyster and Clam Fishery Management Plan Committee and public comment.

### Background

Laws, regulations, and commissions exist to ensure proper balance among all user groups such as fishermen, swimmers, boaters and developers, along with providing adequate protection of the environment. The federal Clean Water Act, enacted by Congress in 1972 establishes standards to maintain and restore the integrity of the nation's waters. There are provisions that address pollution of shellfishing waters as well as other water quality issues. One of the most powerful provisions is the protection of the existing uses of public waters in order to prevent further degradation of water quality. Any development permits, dredge and fill permits, or waste water treatment plant permits, issued by the Division of Coastal Management (DCM) must comply with these water quality standards. Within the state of North Carolina, there is a set of water quality classifications for both salt water and fresh water determined by the Environmental Management Commission (EMC) and codified in Classifications and Water Quality Standards Applicable to Surface Waters and Wetlands of North Carolina (15A NCAC 2B .0100 and .0200). These classifications are based on the use that is being protected. Classifications cannot be downgraded if the change eliminates the existing use or the use can be regained (North Carolina Coastal Federation, 1992).

**Class SA Waters: suitable for commercial shellfishing and all other tidal saltwater uses [15A NCAC 2B .0101 (d) (3)].** These waters are protected for market purpose shellfishing and have stringent bacteriological standards. Molluscan shellfish, like clams and oysters, are water quality sensitive and are often utilized as environmental indicators because of their sessile lifestyle and ability to concentrate various biological and chemical pollutants many times greater than the concentration of those pollutants found in their surrounding environment. Sewage spills and storm water runoff into shellfish growing areas, which may not adversely affect shellfish, can lead to human illness when shellfish from those areas are consumed. The national standard uses fecal coliform bacteria as an indicator to assess the risk of contracting a human pathogen from consuming raw or partially cooked shellfish. Therefore, fecal coliform bacteria numbers must be low in SA waters. Special requirements for controlling runoff from new development are necessary to insure this standard is met (North Carolina Coastal Federation, 1992).

**Class SB Waters: saltwaters protected for primary recreation which includes on a frequent or organized basis and all Class SC uses [15A NCAC 2B .0101 (d) (2) .**

These waters are classified for swimming, skiing, aquatic life protection and fish propagation. Wastewater treatment plants in these areas must have backup systems to insure no untreated sewage is allowed into these waters (North Carolina Coastal Federation, 1992).

**Class SC Waters: : saltwaters protected for secondary recreation, fishing, aquatic life including propagation and survival, and wildlife. All saltwaters shall be classified to protect these uses at a minimum [15A NCAC 2B .0101 (d) (1)].** These waters are classified for incidental swimming, aquatic life protection, and fish propagation. These waters are safe for swimming but in certain areas there is a higher risk of pollution and human illness than in SB waters. Treated sewage is allowed into these waters if it does not affect the use of the waters. Any treated sewage in SC class waters must not affect SB or SA waters farther downstream (North Carolina Coastal Federation, 1992).

**Outstanding Resource Waters (ORW): unique and special waters of exceptional state or national recreational or ecological significance which require special protection to maintain existing uses [15A NCAC 2B .0101 (e) 4)].** This designation is an addition to the above classifications and provides additional protection for the state's highly valued waters. It was implemented by North Carolina to carry out federal requirements that exceptionally valuable waters be protected (North Carolina Coastal Federation, 1992). This classification allows for protection of waters without significant pollution sources and other special values or uses as specified in 15A NCAC 2B .0225.

**Nutrient Sensitive Waters (NSW): waters subject to growths of microscopic or macroscopic vegetation requiring limitations on nutrient inputs [15A NCAC 2B .0101 (e) (3)].** This designation is applied to subject areas in addition to the basic classification and provides for development of nutrient discharge management strategies by the EMC (North Carolina Coastal Federation, 1992).

**High Quality Waters (HQW): waters which are rated as excellent based on biological and physical/chemical characteristics through Division monitoring or special studies, native and special native trout waters ( and their tributaries) designated by the Wildlife Resources Commission, primary nursery areas (PNA) designated by the MFC and other functional nursery areas designated by the MFC, all water supply watersheds which are either classified as WS-I or WS-II or those for which a formal petition for reclassification as WS-I or WS-II has been received from the appropriate local government and accepted by the DWQ and all class SA waters [15A NCAC 2B .0101 (e) (5)].** This designation includes all SA waters and fish nursery areas and is applicable to streams with biological and chemical characteristics higher than the adopted standards (North Carolina Coastal Federation, 1992).

The Coastal Zone Management Act was also enacted by the federal government in 1972 to encourage states to develop coastal management programs that balance wise development with protection of natural resources. These programs must meet federal requirements in return for funding and a voice in federal actions affecting their coasts. The North Carolina Coastal Area Management Act (CAMA), established in 1974, meets these federal requirements and applies to 20 coastal counties. Through this act, Areas of Environmental Concern (AEC) are established along with local land use plans. This ensures balancing environmental preservation with economic growth. AECs are sensitive valuable areas that require special protection. AECs include estuarine waters and public trust areas, estuarine shoreline, coastal wetlands, ocean hazard areas, public water supplies and natural and cultural resource areas. For any development in AECs that requires land or water disturbance, a permit is required from Division of Coastal management. Exceptions to this permit requirement include some agricultural and forestry activities and maintenance of existing public roads and utilities. Construction of energy facilities and emergency repairs if life or property are in imminent danger are also exempt from CAMA permitting (North Carolina Coastal Federation, 1992).

### **Current Authority**

#### North Carolina General Statutes

143B-279.8. Coastal Habitat Protection Plans

143B-289.52. Marine Fisheries Commission - powers and duties

### **Discussion**

In spite of the state's effort to balance economic growth with environmental protection, population growth has resulted in increased land disturbing activities in the coastal areas. This has caused increased closures of a significant amount of shellfish growing waters due to fecal coliform contamination. More than 56,000 acres of shellfish growing waters are regularly closed to shellfishing in North Carolina (DEH unpublished data). Other areas may be temporarily closed during periods of excessive rainfall. As temporary closures have increased in frequency and duration, they have become an area of great concern to shellfishers and seafood dealers particularly in the southern area of the coast. An additional 1.5 inches of rainfall in a 24-hour period can cause temporary harvesting closures in an additional 50,000 acres and closures may last from several days to more than a month ( DEH, Shellfish Sanitation Section, Conditional Opening Management Plans).

One situation that hampers efforts at slowing or reversing the trend toward increased shellfishing closures is the separation of responsibility for activities impacting water quality in the coastal area between three state commissions (Environmental Management Commission, Coastal Resources Commission and Marine Fisheries Commission). However, recently mandated Coastal Habitat Protection Plans (CHPP) will provide an

avenue that will bring these three commissions together in order to implement the long term enhancement of coastal fisheries such as the shellfish fisheries associated with each coastal habitat and will include protection of shellfish producing waters. The Habitat and Water Quality Committee of the MFC has already begun to take a proactive role by establishing several recommendations directed at both the CHPPs and the Oyster and Hard Clam FMP.

Stormwater run off accounts for more than 90% of shellfish harvest closures (G. Gilbert, DEH, Shellfish Sanitation, personal comment). Mallin et al. (1998) goes on to state that impervious surfaces account for 95% of the variability in the average amount of fecal coliform in the estuarine systems in New Hanover county. He also found that covering more than 10 percent of an area with pavement, sidewalks, roofs and other hard surfaces induces runoff that will degrade the quality of a stream . Impervious surface in excess of 30 percent is usually devastating to the water body that receives the runoff. Ninety-four percent of the increase in fecal coliform counts in New Hanover County’s tidal creeks was attributed to built-upon surfaces.

The Environmental Management Commission has established rules for built upon surfaces in the coastal region. However, these rules have not prevented additional closures of shellfishing waters since they were adopted in the late 1980s. Table 8 lists closures occurring in ORWs alone. As development activities continue so will the amount of shellfish area closings and because of the extent of coastal development to date, many of the areas closed to shell fishing will be difficult if not impossible to fully reclaim.

The MFC Habitat and Water Quality Committee recently recommended that the EMC place top priority on maintaining and restoring Approved and Conditionally Approved Shellfish waters. This can only be accomplished by preventing increased amounts of surface runoff that carry fecal coliform from natural and human sources into SA waters. In order to more fully protect water quality, the EMC would have to adopt water quality standards that limit the total impervious cover within small watersheds that are immediately adjacent to SA waters to 10 percent. To restore SA waters that are prohibited to shellfishing, the EMC would have to strengthen stormwater rules so that mitigation is required resulting in water quality enhancements from any newly permitted land use activities.

**Table 8.** Closures of Outstanding Resource Waters. Source: NC Div. of Shellfish Sanitation

ORW	Acres Opened and Closed
Masonboro Sound	No Change
Topsail and Middle Sound	130 acres closed in Howe Cr (12/6/91) 50 acres closed in Futch Cr (4/27/93) 73 acres closed in Mill Cr (4/27/93) 202 acres closed in Old Topsail Cr (4/27/93) 38 acres opened in Futch Creek (5/30/96)

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	<b>417 Acres closed</b>
Stump Sound	25 acres closed in Turkey Creek (5/5/92) 25 acres closed in Galleon Bay (8/4/94) 50 acres closed in Spicer Bay (8/3/95) <u>20 acres opened in ICWW(1/9/96)</u> <b>80 Acres Closed</b>
Western Bogue Sound	20 acres closed in Archer Cr(7/21/95) <u>77 acres closed in Sanders Cr(3/22/96)</u> <b>97 Acres Closed</b>
Roosevelt Natural Area	No Change
Core and Back Sounds	2 acres closed – Marinas (7/30/90) 40 acres closed in Cedar Cr (4/26/94) 25 acres closed in Glover Cr (4/26/94) 2 acres opened in Taylor Harbor(4/26/94) <u>2 acres closed -Yeomans Fish House(9/8/94)</u> <b>67 Acres Closed</b>
Swanquarter and Juniper Bays	405 acres closed in Swanquarter Bay(5/17/90) 155 acres closed in Juniper Bay(7/30/90) 300 acres opened in Swanquarter Bay(11/17/93) <u>100 acres closed in Swanquarter Bay(4/23/98)</u> <b>360 Acres Closed</b>

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Waters with the SA designation that are classified as conditionally approved open to shellfish harvest can be temporarily closed due to suspected high levels of fecal coliforms based on rainfall events. These waters continue to maintain the SA classification but during closure periods they are not meeting their uses. Section 303(d) of the Clean Water Act requires states to develop a list of impaired waters every two years. For all waterbodies on the list, the source of pollution must be determined and controlled by developing management strategies and numeric Total Maximum Daily Loads (TMDLs). Development of TMDLs for fecal coliforms in impaired estuarine waters has been delayed due to a lack of resources for the sophisticated modeling and monitoring required to characterize the complex water flows, as well as the difficulty in pinpointing the sources. Developing a technically defensible limit for fecal coliforms in estuarine waters may not be feasible at this time.

Historically, conditionally approved open and conditionally approved closed SA waters have been rated as “Support Threatened.” In 2000, the EPA required “Support Threatened” waters to be treated as impaired. Also during 2000, N.C. Division of Water Quality (DWQ) dropped the “Support Threatened” rating because of conflict between state and federal definitions of the term. During the early stages of development of this plan there were concerns that conditionally approved open areas would be rated as “Fully Supporting” and conditionally approved closed areas would be rated as “Partially Supporting” in response to the EPA mandate that impaired waters be restored. By rating

conditionally approved open areas as “Fully Supporting”, rather than “Support Threatened”, these waters would not be targeted for protection or restoration. The MFC sent a resolution to EMC that conditionally approved open SA waters be rated as “Partially Supporting”. It is only through the use of management plans that automatically close areas after rainfall thresholds are exceeded that conditionally approved open areas are allowed to have a baseline status of open to shellfishing. Without these management plans and diligent monitoring, conditionally approved open areas would be classified as Restricted shellfish harvest areas.

DWQ did not change the rating of conditionally approved open waters from “Fully Supporting” to “Partially Supporting”. Instead, DWQ made an agreement with EPA that those waters rated as conditionally approved open would be looked at further and management plans created for those areas by 2002. However, these tools will not be available for some time. Starting with the 2001 White Oak River basinwide assessment, an interim methodology will be applied using existing databases. This methodology is based on a percentage frequency of closures within a five-year period (1994-1999). Conditionally approved open areas that are closed greater than 10% but less than 25% of the five-year period will be rated as “Partially Supporting.” Conditionally approved open areas closed greater than 25% of the time will be rated as “Not Supporting”. Once the new database is in place, DWQ will be rating many conditionally approved open waters as “Impaired.” The White Oak River Basin Plan is the first to identify any shellfish waters as “Not Supporting” with this methodology. This interim method will also be applied to the 2002 Neuse River basin assessment and the 2003 Lumber River basin assessment (NCDWQ 2001).

Conditionally approved closed SA waters are seldom, if ever open for shellfishing. These waters were listed by DWQ as impaired and rated as Partially Supporting their intended uses. The MFC also recommended that conditionally approved closed SA waters be rated as Not Supporting their intended uses.

Several projects are listed in the draft 2000 list of impaired waters which are aimed at controlling some of the sources of fecal coliform impairment, such as best management practices to reduce stormwater runoff in coastal areas. However, as mentioned previously, coastal development is projected to increase in the upcoming years, and is the overriding source of the problem. North Carolina does not appear to have an effective strategy for addressing the impacts of coastal development on water quality, particularly since the CAMA land-use planning process has been halted pending reevaluation by DCM.

Point source discharges from municipal or community wastewater treatment plants can degrade water quality in or near shellfish waters. The Clean Water Act requires states to establish anti-degradation policies. North Carolina’s anti-degradation policy sets three tiers of protection from degradation of water quality. Under the policy, Tier 1 protects existing uses that were attained or for which water quality was suitable to be attained on



or after November 28, 1975. Tier 2 protects the levels of water quality that are higher than required to support propagation of fish, shellfish and wildlife, and recreation. Tier 3 protects the quality of outstanding national resources, such as waters of exceptional recreational or ecological significance. Closure of waters to shellfishing is a clear discrete event that contravenes the anti-degradation policy.

The MFC's Habitat and Water Quality Committee also recommended that prior to the construction of any new or expanded wastewater treatment plants within 10 miles upstream or downstream of a shellfish area that was or could have been productive at any time after November 28, 1975, Phase II NPDES (National Pollutant Discharge Elimination System) stormwater permits shall be required within the area serviced by the new or expanded sewer systems. Permits issued should require the implementation of stormwater management plans that will protect SA waters from fecal coliform pollution. They also recommended that the current ban on allowing discharges of treated sewage to SA waters also be maintained.

Because the loss of wetlands can also contribute significantly to the degradation of shellfish areas, the MFC's Habitat and Water Quality Committee also recommended that Army Corps of Engineers' nationwide permits that would cause further loss of wetlands, including nationwide permits #39 for residential and commercial activities, # 41 for reshaping existing drainage ditches, #42 for recreational facilities like golf courses, #43 for stormwater management facilities; and #44 for mining activities not be certified. Nationwide permits should not be certified if they do not control cumulative impacts. Nationwide permits are "general" permits issued by the Corps that allow small acreage wetland impacts for activities deemed to have a minimal adverse effect on the aquatic environment. The recommendations on use of Phase II NPDES stormwater permits and certification of nationwide permits represent increased use of statutory authority to comment on activities that affect water quality.

Other strategies for coping with shellfish harvesting closures involve acceptance of the fact that closures are going to continue to occur and that different standards could be adopted concerning oyster consumption. The present National Shellfish Sanitation Program standard for bacteriological water quality of shellfish harvest areas assumes that all shellfish could be consumed raw. This assumption requires a very high standard for the waters where shellfish are harvested. In Japan there are standards for cooked consumption and raw consumption. Even though Japan is heavily populated and highly developed in many areas, they are able to utilize almost all of their waters for shellfish production. Most of these waters would be closed to harvest if they occurred in the United States.

There has also been discussion of researching different indicator organisms to assess the contamination of shellfish harvest waters. While fecal coliform bacteria are found in the intestinal tract of all warm blooded animals and indicate the presence of fecal contamination from those animals, they are not specific to the organisms of primary

concern to human health which are viral disease pathogens. More specific indicators of potential human health risks could lead to a reduction in the area of closed shellfishing waters. However, early attempts at locating such an organism have failed and the present system provides a risk averse approach to protecting human health.

Studies have been conducted indicating actions that can be initiated now which can reduce the extent of some closed harvesting areas, or at least slow or halt the overall increase in closures. By developing an assessment of water quality and shellfish resources in different growing areas, management strategies could be developed in order to protect the designated uses of each growing area (Robinson and Horzepa, 1988). In order to do this, all available information on water quality and shellfish resources in a growing area must be gathered and evaluated. The results of this assessment would be used to establish management goals and objectives for each growing area. This would insure a consistent and defensible framework for use by the various state agencies as they comment on permit applications that may affect coastal water quality.

Reilly and Kirby-Smith (1999) assessed a polluted area in a tributary of North River, Carteret County and developed management strategies to reopen the area. By identifying the sources of pollution and any correlation between fecal coliforms and the physical parameters of the tributary, four different management strategies were considered. These included no action, remove the shellfish from the area, control the sources of fecal coliforms and control the flow of fecal coliforms. It was concluded that controlling the amount of fecal coliform deposited and where it was deposited can be addressed. Increasing exposures of fecals to sunlight and salt along with increasing the amount of time it takes for a fecal coliform to get to the shellfish source can also be addressed.

### **Management Options/Impacts**

- A. Status quo
  - + No additional funds or staff needed to implement
  - Continued degradation of water quality and increased shellfishing closures
  
- B. Increase use of existing statutory authority (permit comments, CHPP development)
  - + Makes use of increased authority to protect water quality
  - + Ensures coordination with sister agencies
  - + Utilizes existing procedures and information
  - Based on a system that has failed in the past
  - No defined mechanism for restoration of water quality
  
- C. Accept closures and develop new standards for shellfish consumption  
**(Recommend changes through the Interstate Shellfish Sanitation**

### **Conference)**

- + Places little burden on the public
- + Could potentially reopen many areas to shellfish harvest
- Greatly increases potential for water quality problems other than shellfish harvesting closures
- Requires vast modifications to harvesting and marketing rules and enforcement
- Requires a substantial public education effort
- May increase public health risk especially until new consumption habits are learned

D. Develop strategies to restore water quality of Conditionally Approved harvest areas and maintain water quality of Approved harvest areas by:

1. Rating Conditionally Approved Open shellfish waters as Partially Supporting
2. Rating Conditionally Approved Closed shellfish waters as Not Supporting
3. Adopting standards that limit total impervious cover immediately adjacent to SA waters to 10 percent
4. Requiring mitigation that results in water quality enhancements in permanently closed areas

### **Recommend specific changes to DWQ and the EMC**

- + Would decrease number of acres of shellfish areas closed because of pollution.
- Would require large amounts of funding and manpower to perform assessments and implement strategies.

### **Research Needs**

Continue research on means and methods for reduction of non-point source pollution and mitigation of pollutant effects in the estuary. Days closed, better mapping, database management. Quantify ratings

### **DMF Management Recommendation**

B. Increase use of existing statutory authority (permit comments,

- CHPP development).
- D. Develop strategies to restore water quality of Conditionally Approved harvest areas and maintain water quality of Approved harvest areas by:
1. Classifying Conditionally Approved Open shellfish waters as Partially Supporting
  2. Classifying Conditionally Approved Closed shellfish waters as Not Supporting
  3. Adopting standards that limit total impervious cover immediately adjacent to SA waters to 10 percent
  4. Requiring mitigation that results in water quality enhancements in permanently closed areas

#### **Advisory Committee Recommendation**

Agreed with DMF (Note: D was changed after the AC made its recommendation)

#### **MFC SELECTED MANAGEMENT STRATEGY**

Agreed with DMF recommendation. The final round of public meetings revealed the need for more sampling to reduce temporary shellfishing closures. The MFC added that suggestion as a management strategy.

### **9.5.2 MANAGEMENT OF NORTH CAROLINA'S OYSTERS AS HABITAT OR FOR PRODUCTION**

#### **ISSUE**

Experience of DMF staff and Fisheries Resource Grant Program recommendations indicate that a management strategy that balances the competing need for oyster production as fishery products and as a critical habitat in North Carolina's estuaries is needed.

#### **BACKGROUND**

North Carolina's wild oyster stocks have experienced a significant decline in recent years. At the same time, there has been an increased awareness and acceptance that oyster beds provide critical fisheries habitat not just for oysters, but also for

recreationally and commercially important finfish, molluscs, and crustaceans. Despite management efforts to enhance oyster stocks, landings continue a forty-year decline.

The first objective in the Oyster Public Information Document (PID) for the Oyster and Clam Fishery Management Plan (FMP) is to identify, restore and protect oyster habitats for oyster production and as a critical habitat (NCDENR 1999). Lenihan and Peterson (1998) refer to oysters as “ecosystem engineers that create biogenic reef habitat important to estuarine biodiversity, benthic-pelagic coupling, and fishery production”. Oysters play an important ecological role in the estuary by providing hard substrate, and by capturing large quantities of suspended organic and inorganic particles through bio-filtration. Nutrients are consumed and recycled, and harmful bacteria and viruses are removed from the water column.

Evidence that topography, morphology and structural heterogeneity often control recruitment, persistence and diversity of species in coral reefs, seagrass meadows, salt marshes and kelp beds has led to regulations that protect these critical fisheries habitats from direct anthropogenic disturbances (Lenihan and Peterson 1998). Intertidal and subtidal oyster beds and their associated communities warrant the same consideration and protection.

## **CURRENT AUTHORITY**

### North Carolina Fisheries Rules for Coastal Waters (15A NCAC )

- 3I .0101 Critical\_Habitat Areas defined.
- 3I .0101 Shellfish Producing Habitats defined.
- 3I .0101 Intertidal Oyster Bed defined.
- 3J .0303 Dredges Mechanical Methods Prohibited
- 3K .0103 Shellfish/Seed Management Areas.
- 3K .0204 Dredges/Mechanical Methods Prohibited
- 3K .0304 Prohibited Taking
- 3N .0104 Prohibited Gear, Primary Nursery Areas
- 3R .0108 Mechanical Methods Prohibited

## **DISCUSSION**

There are many incentives for making the rehabilitation of oyster grounds as critical fisheries habitat a management goal. Scientists and natural resource agencies believe that oysters in the Chesapeake Bay can once again become a major natural resource by initiating a management concept that recognizes the vital ecological function of oyster reefs to the health of the estuary. Oysters are highly adapted to estuarine existence, resistant to all but the most extreme environmental fluctuations. The oyster’s reproductive, morphological,

physiological and behavioral adaptations have in the past allowed it to persist in immense numbers (Kennedy 1991). Environmental conditions in many of North Carolina's estuaries are conducive to sustained reproduction, settlement and growth of oysters. Kennedy (1991) recommends making resources available to rebuild oyster beds into formerly highly productive habitat.

Shell habitat provides structure for attachment, cover from predators, and food to the estuarine community. The South Atlantic Fishery Management Council (1998) designated intertidal and subtidal shell bottom as Essential Fish Habitat. The three-dimensional oyster reef provides more area for attachment of oysters and other sessile organisms and creates more habitat niches than occur on the surrounding flat or soft bottom habitat. Clams, mussels, anemones, polychaetes, amphipods, sponges, shrimp, and many species of crabs contribute to the reef structure. They recycle nutrients and organic matter, and are prey for many finfish. Red and black drum, striped bass, sheepshead, weakfish, spotted seatrout, summer and southern flounder, oystertoads, and other finfish frequent the reef (Bahr and Lanier 1981). Lenihan and Peterson (1998) propose that oysters may now be more economically valuable for the habitat they provide for other economically valued species than they are for the oyster fishery.

Kennedy (1991) suggested that the filtering activities of the massive concentrations of oysters present in the Chesapeake Bay prior to their over-exploitation might have resulted in different assemblages of plankton, with fewer sea nettles, microplankton and bacterioplankton. The Bay waters were also probably much less turbid than at the present, allowing for submerged aquatic vegetation to thrive. Other researchers (Officer et al. 1982, Dame et al. 1984, Newell 1988, Lenihan and Peterson 1998) agree that the loss of oyster populations removes one potential means of controlling nuisance phytoplankton blooms and other negative impacts of nutrient enrichment and coastal eutrophication.

Research (Lenihan et al.) suggests that increased mortalities in the Eastern oyster from *Perkinsus marinus* (Dermo) can be correlated with an increase in environmental stresses, lowering the animal's resistance to the disease. The oyster dredge fishery dominated North Carolina's oyster landings from 1887 until around 1960 by mechanically harvesting oysters in Pamlico Sound. Since 1991, oysters harvested by hand, especially from the southern counties, have provided the majority of oyster landings (NCDENR 1999). Since 1991 oyster harvests from Pamlico Sound have collapsed, with high mortalities from Dermo. The southern area oyster populations have suffered only moderately from the disease (NCDENR 1999). Cumulative and secondary effects from severe infestations, coupled with continued decline in habitat suitability have seriously impacted oyster stocks.

Perhaps the most important and intrinsic outcome of the proposed shift in management strategies would be the enhancement of oyster stocks (e.g. improved oyster habitat equals improved oyster stocks). Marshall (1995) identified the most critical areas for oyster populations as the oyster beds or rocks which the oysters themselves formed by accumulation of shells and oysters over time. The removal and degradation of oyster

habitat has contributed to the decline in oyster landings.

Restoration and protection of oyster beds as critical fisheries habitat would benefit the estuarine community ecology along with numerous coastal fisheries, as well as the oyster fishery. Declining water quality (i.e. increased siltation, low dissolved oxygen) and physical disturbances to the habitat's structure (i.e. dredging, bottom disturbing gears) are identified threats to shellfish beds. Actions needed to address these threats would be more effective with official designation and protection of oyster/shell habitat.

Possible management options range from status quo to a total fishing moratorium on all public oyster habitat. The extreme options require little clarification while the compromise positions need full explanation. One approach would be to identify and protect specific oyster beds as critical fisheries habitats. Selection criteria could include habitat suitability (e.g. substrate, salinity, hydrology), shellfish standing stock, potential for enhancement/restoration or degradation (impending threats), density and diversity of associated benthic and pelagic biotic communities, commercial and recreational shellfishing activity, and socioeconomic impacts. Management goals would be to protect the physical and biological components of selected shellfish beds. North Carolina Fisheries Rules 3K .0103 (Shellfish/Seed Management Areas) provides regulatory basis for designation and protection of these areas. No rule change would be required but selection criteria would need to be developed.

Marshall (1995) reports that, although it is believed that the size of oyster producing habitat is decreasing, natural oyster rocks are still being formed where no oysters existed previously. He recommends that critical areas include potentially productive bottom where substrate, waterflow, salinity patterns and sedimentation allow for oyster settlement, development and reproduction.

Data would need to be collected on the temporal variability in oyster and clam densities, reproductive success, spat settlement, growth, and mortality. Changes in the size and shape of the shell formation, as well as in the diversity and density of associated species should also be monitored. Research on disease would be a high priority. Water quality monitoring should accompany biological data collection. Long-term research could be conducted in designated areas undisturbed by harvesting or other disturbances.

Oyster rocks/shell beds would need to be selected in each District and/or watershed. To best characterize and understand the stock status of oysters, the Oyster PID (NCDENR 1999) recommends defining discrete sampling regions due to the high spatial variability in oyster abundance and causes of mortality. Sampling design should also consider data needs outlined in the FMP for robust estimates of oyster standing stock and maximum sustainable yield so future stock status designations can be based on quantitative assessments of population trends.

## Management Options

- A. Status Quo
  - + No impacts on commercial or recreational fishermen
  - No recognition of habitat benefits provided by oyster growth
  - Little opportunity to increase habitat benefits
  
- B. 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.
  - + Recognizes habitat function of oyster growth
  - + Monitors scale of habitat effects of designated oyster habitat areas
  - + Identifies resources for both harvest and protection
  - May create significant impacts on oyster harvesters
  - Requires considerable costs in staff time and marking of areas
  - Increases drain on inadequate Shellfish Rehabilitation funds
  
- C. Decrease impacts to areas not designated as critical fisheries habitat by expanding areas where mechanical harvest of oysters is prohibited, closing cultch and oyster seed sites to trawling and long haul seining, and restricting hand harvest clamming methods on designated, sensitive oyster habitats.
  - + Reduces fishing gear impacts to oyster habitat
  - + Identifies resources for all types of harvest methods
  - May create significant impacts on oyster harvesters
  - Requires considerable costs in staff time and marking of areas
  - Increase drain on inadequate Shellfish Rehabilitation funds
  
- D. Endorse actions by other natural resource agencies that seek to improve and protect water quality; such as Coastal Resources Commission's designated Areas of Environmental Concern which help control erosion between the estuary and the uplands.
  - + Helps protect oyster habitat from effects of land based activities
  - + May reduce restrictions required on harvesters
  - Past restrictions have resulted in impacts
  
- E. Moratorium on all public oyster harvest with cultch planting for oyster habitat enhancement only. **Rule changes required.**
  - + Recognizes habitat function of oyster growth



- + Maximizes use of oyster productivity for habitat
- + Reduces enforcement burden
- Eliminates a traditional and valuable fishery

## **RESEARCH NEEDS**

Research should concentrate on the physical and biological components of the habitat, and over time, its success as a critical fisheries habitat. Data needed for oyster stock assessments should be a priority, as well as research to answer questions of disease and genetics to understand and battle the incidence of Dermo. To improve management and rehabilitation of the oyster fishery, Kennedy (1991) recommended research of three components of oyster habitat – broodstock, seed and cultch supply, and growing and setting areas.

## **DMF RECOMMENDATION**

- B. 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.
- C. Decrease impacts to areas not designated as critical fisheries habitat by selecting limited pilot study areas where: (1) mechanical harvest of oysters is prohibited, (2) cultch and oyster seed sites are closed to trawling and long haul seining, and (3) hand harvest clamming methods are restricted on designated, sensitive oyster habitats.
- D. Endorse actions by other natural resource agencies that seek to improve and protect water quality; such as Coastal Resources Commission's designated Areas of Environmental Concern which help control erosion between the estuary and the uplands.

## **ADVISORY COMMITTEE RECOMMENDATION**

The Advisory Committee recommended including wording limiting the scope of closures to pilot scale. DMF agreed and included the proposed wording.

## **MFC SELECTED MANAGEMENT STRATEGY**

Agreed with DMF recommendation

### **9.5.3 RESTRICT CLAM HARVEST IN OYSTER HABITAT**

#### **ISSUE**

Public comments from oyster harvesters indicate that additional restrictions on clam harvest are necessary to protect oyster habitat.

#### **BACKGROUND**

The effects of harvesting clams by hand methods on and around oyster rocks has been an issue among shellfishermen and the Division for many years. The perception of many oyster harvesters is that clamming on oyster rocks damages oyster habitat. This has been a problem where oysters and hard clams co-exist, principally around the inlets in the northern part of the state and on oyster rocks in the south. The competition for these two resources increased with the beginning of a significant market for North Carolina hard clams in the 1970's which put more pressure on these stocks and, as other areas were depleted of clams harvesters moved to less desirable harvest areas such as oyster rocks. Concurrently, more shellfishing areas, primarily in the southern portion of the state, were closed to harvest because of bacterial contamination in the waters. Additionally, the incidence of Dermo and its associated mortality has caused significant decrease in oyster harvest in some years. These factors have combined to compress the harvest of these two species of shellfish into smaller and smaller areas increasing the occurrence of clamming in oyster habitat. There is no current estimate of the magnitude of the impact of the clamming on oyster rocks

The North Carolina General Assembly and the MFC have both recognized that clamming can have a negative impact on oyster habitat and have adopted statutes and rules which forbid the harvest of clams on posted oyster rocks as well as restricting the areas and gear which can be used to take clams and oysters. The posting of natural oyster rocks has never been attempted on a large scale because of the large number of rocks and the lack of sufficient resources to keep them marked. Because of the difficulty in trying to post oyster rocks the Division has created Shellfish Management Areas in which enhancement activities are conducted and clamming is either restricted or prohibited. The MFC has also passed rules regarding the types of equipment that can be used to take both oysters and clams in any live oyster bed as well as prohibiting the taking of oysters and clams by mechanical methods in some areas of the state.

#### **CURRENT AUTHORITY**

##### North Carolina Fisheries Rules for Coastal Waters (15 NCAC)

- 3I.0101 Shellfish Producing Areas defined
- 3I.0101 Intertidal Oyster Bed defined
- 3K.0101 Prohibited Shellfish Areas/Activities
- 3K.0102 Prohibited Rakes

- 3K.0103 Shellfish/Seed Management Areas
- 3K.0204 Dredges/Mechanical Methods Prohibited
- 3K.0304 Prohibited Taking

North Carolina General Statutes

G.S. 113-207 Clamming on posted oyster rocks forbidden; penalty.

## **DISCUSSION**

The harvest of clams by hand methods, rakes, tongs, and by hand, on oyster habitat can cause mortality of oysters by turning over and burying live oysters. Studies by Noble (1995) and Lenihan (in press) have confirmed and quantified the effects of both oyster and clam harvest on oyster rocks. Lenihan recommended that “both clamming and oyster harvesting should be permitted on some reefs, but maintaining large populations of oysters and clams on intertidal oyster reefs will require protection of some reefs from both types of harvesting”.

The ecological merits of oyster habitat have been discussed in another issue paper. Large areas of the southern part of the state are closed to the harvest of shellfish and the oysters in these areas provide spawning stock as well as fulfilling an ecological function which may be sufficient in some of these smaller systems. The value of the clam resource is greater than that of oysters from an economic standpoint and some have questioned the wisdom of closing additional areas to clamming. The Division has reservations about being able to effectively mark and maintain additional oyster habitat given the constraints of time and materials. The closing of additional area to either oyster or clam harvest will further compress these fisheries into a smaller area and increase the social conflicts that currently exist.

The options to address this issue range from no action to prohibiting clamming on all oyster rocks in the State.

## **MANAGEMENT OPTIONS**

- A. Status quo
  - + No additional impact on clam fishery
  - Continued damage to oyster rocks from clamming
  
- B. Implement additional experimental closures of oyster areas based on habitat value for both oysters and clams.
  - + Positive effect on oyster and clam populations
  - + Positive effect on oyster habitat
  - Negative impact on oyster and clam fisheries

- C. Provide additional protection of oyster rocks from clamming by modifying allowable gear, seasons and/or closing additional area. **Rule changes required.**
- + Reduction or elimination of damage to oysters from clamming activities
  - + Positive impact on oyster fishery
  - + Positive impact on habitat value
  - Negative economic impact on clam fishery
  - Increased enforcement problems
  - Lack of funds to mark and maintain these areas

### **RESEARCH NEEDS**

Monitoring of experimental areas to assess effects of clam harvesting closures

### **DMF RECOMMENDATION**

- B. Implement additional experimental closures of oyster areas based on habitat value for both oysters and clams.

This would be initiated as a pilot project because of personnel and budget constraints and to test the concept.

### **ADVISORY COMMITTEE RECOMMENDATION**

Agreed with DMF.

### **MFC SELECTED MANAGEMENT STRATEGY**

Agreed with DMF recommendation

## **9.5.4 HARVEST GEAR CONCERNS RELATIVE TO OYSTER HABITAT**

### **ISSUE**

The issue to evaluate the effects of various bottom disturbing harvest gear on natural oyster rocks and cultch planting sites was raised by staff and heard in public comment.

## **BACKGROUND**

Oysters in North Carolina range from the NC – SC State line to north of Roanoke Island. Oysters occurring south of Cape Lookout are primarily inter-tidal with scattered sub-tidal rocks in deep water areas such as White Oak and New rivers. Oysters north of Cape Lookout are primarily sub-tidal. Native Americans in NC utilized oysters prior to colonial times as evidenced by the shell piles located at coastal campsites. Early colonial settlers also harvested oysters for food and used the shell for construction material. Oyster harvest in NC was by hand or with the use of rakes or tongs. The early harvest in the Pamlico Sound area occurred mainly in the shallow waters of the adjacent rivers and bays. Lt. Francis Winslow, USN, described the commercial oyster fishery in NC as insignificant in his 1889 report on the area of NC estuaries suitable for shellfish cultivation. A shortage of oysters in the Chesapeake Bay in 1889 resulted in numerous vessels, which had been engaged in the oyster-dredging fishery in that area to migrate to Pamlico Sound and begin to dredge for oysters. The increase in oyster landings, which coincided with the introduction of the oyster dredge, was significant and led to the prohibition of non-residents from the oyster-dredging fishery. NC oystermen incorporated the dredging techniques used by the Chesapeake Bay oystermen and expanded the oyster fishery in NC. A decline in oyster landings became apparent by the 1910's; due perhaps to dredge harvests occurring on virgin deep-water oyster rocks, which were not capable of sustaining the rate of exploitation. Early dredges were operated from sail powered vessels with little regulation. In 1931, power vessels were allowed to utilize hand dredges only, which limited the weight of dredges used. In 1948 restrictions were enacted to limit dredges to 100 pounds and limit harvest to 75 bushels per day per boat. The 100-pound weight restriction on dredges remains today, however the 75 bushel per day harvest limit was decreased in 1984 to 50 bushels. The decline in the oyster stock in recent years has caused the mechanical harvest limit to be adjusted to today's level of 15 bushels per day as a conservation measure.

The shrimp and blue crab fisheries are the primary trawl fisheries in NC's estuarine waters. The use of trawls and long haul nets made an appearance in NC estuarine waters shortly after the commercial fishing industry converted from sail powered vessels to vessels powered by internal combustion engines. Early vessels and nets (trawls and long haul seines) were limited in size by available power plants. In the 1950's with larger more powerful diesel engines becoming available both vessels and nets increased in size. Today, it is not uncommon for vessels in the 70' to 80' range to tow trawls with a total leadline length of 200 feet. These large trawls necessitate the use of larger heavier trawl doors to properly open the nets.

## **CURRENT AUTHORITY**

North Carolina Fisheries Rules for Coastal Waters (15A NCAC)  
3J .0303 Dredges and Mechanical Methods Prohibited

3K .0203 Trawling Across Oyster Management Areas Prohibited  
3K .0204 Dredges/Mechanical Methods Prohibited

## **DISCUSSION**

The oyster dredge is the primary gear used to harvest oysters in the deeper areas of Pamlico Sound and surrounding waters. The harvest of oysters with mechanical gear removes legal size live oysters and disrupts the integrity of the oyster reef (Lenihan 1998). The use of dredges over time will reduce the vertical relief of the oyster rock making it more susceptible to the effects of anoxic events (low dissolved oxygen levels in deeper waters), sedimentation and subsidence. Other potentially detrimental effects of dredging include the scattering of undersized oysters and shell from the rock into less suitable substrates, and the disturbance of the reef matrix making it less stable and more susceptible to damage by natural events such as hurricanes. The removal of live oysters and the upper layers of shell may also decrease the settlement rate of larval oysters due to the absence of live oysters which have a function in attracting oyster larvae for settlement and the exposure of older shells which may not be as suitable a substrate for spat settlement.

The effects of trawls, trawl doors, and long haul nets are similar to the effects of dredges. The weight and orientation of trawl doors as they are towed can disrupt the structure of the oyster rock. Trawls and long haul nets can remove the upper layers of shells and either move them off the rock into the surrounding substrate or deposit them when the nets are retrieved or footed. The overall effect of these bottom disturbing harvest gears on oyster rocks is to lower the height, displace live oysters and the productive upper layer of shell.

The BRACO recognized the potential for oyster habitat degradation on the deeper sub-tidal oyster reefs by bottom disturbing gear such as dredges (oyster and crab), trawls (shrimp and crab), and long haul seines. They considered a substantial part of the decline in oyster production in the northern part of the state to be a consequence of fisheries management that fails to protect the oyster reef habitat. The following BRACO recommendations are in the oyster habitat section of their report addressing the use of bottom disturbing fishing gear and the effects on oyster habitat.

**OYSTER HABITAT RECOMMENDATION NUMBER 6:** We urge the General Assembly of the State of North Carolina to enact stiffer penalties for trawling in areas containing oyster rocks where such trawling has been prohibited by regulation of the MFC. Present fines do not represent a sufficient deterrent to allow effective oyster reef habitat.

**OYSTER HABITAT RECOMMENDATION NUMBER 7:** We urge the DMF to enforce the regulations now in place to protect oyster rocks from trawling and we urge the MFC to make any slight adjustments possible to protect additional oyster rocks from trawling.

For example, the Turtle Rock is closed to trawling but this closure is not enforced. In the same river, the White Rock deserves protection from trawling by adjustment of the boundary line and subsequent enforcement of that new line.

**OYSTER HABITAT RECOMMENDATION NUMBER 9:** We conclude that various other fisheries that disturb the seafloor are locally incompatible with the preservation of oyster reef habitat necessary for sustaining oyster production. These bottom-disturbing fisheries include explicitly trawling for shrimp, crabs, and finfishes, long-hauling, and dredging for crabs. Of these practices, the most significant because of its intensity is shrimp trawling. We acknowledge that recent actions taken by the MFC to protect certain primary and secondary nurseries from trawling have served to extend some additional measure of protection to traditional reef areas. However, these protections are incomplete in that intense shrimp trawling and crab and finfish trawling continues over bottom in tributaries of Pamlico Sound where productive oyster reefs once existed. Although it would seem unreasonable to jeopardize the returns of an economically valuable fishery (shrimping) just in hopes of restoring a fishery now of little economic value (oystering), we propose the establishment in some region of the Albemarle/Pamlico system a bold adaptive management experiment to test whether shrimping can be made compatible with oyster habitat preservation. There is general agreement that effort in the shrimp fishery greatly exceeds what is necessary to catch those shrimp. Furthermore, because shrimp migrate toward the inlets and out to sea, it is possible in concept to catch those same shrimp later in their migration path away from the regions where oyster reefs are present. We propose establishment of restrictions on trawling in conjunction with restoration through shell cultch planting of some oyster reefs in a sufficiently large area so as to test whether income from shrimping can still be maintained despite the spatial displacement of the shrimping fleet and whether that protection from trawl damage enhances and sustains oyster production on those protected reefs.

**OYSTER HABITAT RECOMMENDATION NUMBER 10:** We recommend establishment of oyster sanctuaries on reconstructed reefs in multiple locations in the Albemarle/Pamlico system. These sanctuaries would be closed to oyster fishing and to other bottom-disturbing activities such as trawling, long-hauling, and dredging for an indefinite period. The purpose of establishing such sanctuaries is not only to build some functional reefs but also to allow research to address the critical unanswered question of whether the incidence, intensity, and impact of oyster diseases are function of the stresses inflicted on oysters by the multiple disturbances of their habitat. The impacts of disease are typically greatest when combined with other physiological stresses. Evaluation of the disease status, health, and fate of oysters on sanctuaries would permit a test of whether effects of oyster diseases, MSX and Dermo, can be controlled by limiting other stresses. This protocol would examine oyster health under the most ideal conditions to see if disease is still a dominant influence on oyster mortality. One appropriate area for such a sanctuary might be the region around Newstump Point in West Bay in Carteret County.

The Shellfish Rehabilitation Program has taken steps to implement some of the

recommendations of BRACO. Oyster sanctuaries have been constructed in Dare, Hyde and Carteret Counties. These sites are marked and bottom disturbing gears are prohibited. Research, monitoring and enhancement on the sanctuaries are continuing. Efforts have been made to improve the cultch planting site markings to insure that the buoys will remain on site. When adequately marked, smaller trawlers will usually avoid these sites due to the damage to the nets by the cultch material. Public meetings are held annually prior to the cultch planting season to solicit input from the public on locations for cultch planting sites. Input from trawl and long-haul fishermen could reduce the impacts on cultch planting sites by locating new sites in areas not utilized by these fisheries. The meetings provide a forum for fisherman; however, to date these meetings have had limited participation from the commercial fishing industry.

The DMF Director through proclamation authority can designate cultch planting sites as Shellfish Management Areas thereby protecting them from bottom disturbing gears. The formal designation of long haul areas, which would exclude both natural and reconstructed oyster reefs, should reduce the impact of that gear on oyster habitat. The prohibition of a fishery in a large area as suggested in the BRACO Recommendation Number 10 should be considered carefully due to the potential economic ramifications to the small boat shrimping fleet in Pamlico Sound. Further research on the effects of the various bottom disturbing gears on oyster habitat may be correlated with research on oyster reefs located in areas where bottom disturbing gear is already prohibited prior to closing areas to other fisheries.

## **MANAGEMENT OPTIONS/IMPACTS**

### **A. Status Quo**

- + No impact on fishers (continuation of traditional gear use in traditional areas)
- Does not address degradation of oyster habitat
- Does not provide for needed research

### **B. Prohibit bottom disturbing gear from natural and constructed oyster reefs**

- + Preserves the integrity of oyster reefs
- + Allows for natural recovery of oyster reefs
- Insufficient manpower to locate natural reefs, maintain markers, and enforce closures
- Removes dredges from the oyster fishery – economic impact on oyster dredge fishermen
- Increases closed bottom – impacts users of bottom disturbing gear

### **C. Formally designate long haul areas excluding areas containing natural or**



constructed reefs

- + Eliminates long haul operations from impacting oyster reefs
- + Reduces user conflicts
- Possible reduction in area available to long haul operations

D. Initiate research on effects of bottom disturbing gear on oyster reefs

- + Provides data for management decisions
- Insufficient funding/manpower to conduct research

### **RESEARCH NEEDS**

Research on oyster reef degradation by various bottom disturbing gears.

### **DMF RECOMMENDATION**

A. Status Quo

D. Initiate research on the effects of bottom disturbing gear on oyster reefs

### **ADVISORY COMMITTEE RECOMMENDATION**

Agreed with DMF recommendation.

### **MFC SELECTED MANAGEMENT STRATEGY**

Agreed with DMF recommendation

## **10.0 RECOMMENDED MANAGEMENT PROGRAM AND RESEARCH NEEDS**

### **10.1 GOAL AND OBJECTIVES**

The goal of the North Carolina Oyster Fishery Management Plan is to restore the State's oyster population so that it might produce the optimum yield and regain its role in providing ecological benefits to North Carolina's estuaries. To achieve these goals, it is recommended that the following objectives be met:

1. To identify, restore, and protect oyster habitats for oyster production and as a critical habitat in North Carolina's estuaries.
2. To 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 the private oyster fishery.
3. To minimize the impacts of oyster parasites through better understanding of oyster disease, better utilization of affected stocks, and use of disease resistant oysters.
4. To consider the socioeconomic concerns of all groups utilizing the oyster resource, including market factors.
5. To recommend improvements to coastal water quality to reduce bacteriologically based harvest closures and to provide a suitable environment for oyster survival and recovery.
6. To identify and encourage research to improve understanding of oyster population ecology and dynamics, habitat restoration needs, oyster aquaculture requirements and relay mortality.
7. To identify, develop, and promote oyster harvesting practices that reduce harvest costs and minimize damage to the habitat.
8. To initiate, enhance, or continue studies to collect and analyze economic, social, and fisheries data needed to effectively monitor and manage the oyster resource.

The strategies listed below should be judged on their contribution to realizing the objectives and achieving the goal.

## **10.2 OPTIMUM YIELD RECOMMENDATION**

Based on the discussion in Section 5.3.1 DETERMINATION OF OPTIMUM YIELD, it is recommended that oyster harvest be allowed to continue at current catch/trip limits without a harvest cap until available data indicate a change in harvest policy is necessary. Furthermore, since the most expedient and commonly used method for estimating MSY for this species utilizes data that can be gathered through the Shellfish Mapping Program, expansion of that program to provide complete and timely information is strongly

recommended.

### **10.3 STRATEGIES**

The strategies listed below are organized according to the General Problem Statements (Section 4.2) they are intended to resolve. Each numbered strategy is followed by a reference to the Principal Issue and Management Options section that supports it, e.g. (10.1.1) and the Goal and Objective(s) it addresses, e.g. [3,8]

#### **10.3.1 HARVEST ISSUES**

The primary harvest issue addressed deals with the effects of mechanical harvesting practices on natural or enhanced oyster stocks and the strategies proposed in this edition of the Oyster FMP recommend action exclusively on that issue. Recommendations in other sections of the FMP propose data gathering activities to provide a basis for more informed actions relative to oyster harvest management in the future. However, an analysis of the available harvest data indicates that current management measures are not allowing oyster harvests to exceed acceptable levels.

#### **PROPOSED ACTIONS**

1. Adopt criteria for the further designation of hand harvest areas and designate those areas by rule (9.1.1)[2,7]
2. Conduct public meetings on harvest area designation (9.1.1)[4,8]
3. Increase cultch planting in hand harvest areas (9.1.1)[2,4]
4. Maintain cultch planting in mechanical harvest area (9.1.1)[2,4]
5. Prohibit trawling and long hauling on cultch and seed planting areas (9.1.1)[1,2]

**Note:** The FMP Advisory Committee recommended only number 3 above and experimental use of the 2 ½ inch size limit option on oyster harvests to determine the effects on Dermo transmission (9.1.1). Unloading oysters and clams at night (9.1.2) and use of depuration plants (9.1.4) were also examined as issues but Status Quo was recommended on both. Discussions on the current licensing situation for shellfish (9.1.4) resulted in a recommendation to continue with Status Quo until more licensing data under the current system is available.

#### **10.3.2 PRIVATE CULTURE**

A majority of the issues concerning private culture came from public comments at the Public Information Document public meetings. However, most of the recommendations came from

issues that originated in BRACO meetings although the recommendations presented here are different from the findings of that group. Shellfish permits are included here due to requirements of the Fisheries Reform Act of 1997 and because of concerns expressed by leaseholders.

## **PROPOSED ACTIONS**

1. Develop and utilize user coordination plans to assess areas for shellfish leasing (9.2.1)[2,4,6,8]
2. Change operational policy to increase use of marginal polluted areas for shellfish leases (9.2.2)[1,2]
3. Inform public about Department of Agriculture and Department of Environment and Natural Resources roles concerning shellfish culture (9.2.3)[6]
4. Formalize and amplify current policy on transfers on out-of-state shellfish into NC waters (9.2.4)[2]
5. Continue testing of non-spawning nonnative oysters for aquaculture purposes (9.2.5)[2,3]
6. Continue the statutory shellfish lease program and increase relaying to public bottoms to address concerns over use of public resources (9.2.6)[4]
7. Recommend adoption of a statutory policy statement supporting shellfish culture insofar as it does not interfere with traditional fishing practices (9.2.7)[2]
8. 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 (9.2.7)[2]
9. Status Quo on opportunities for riparian landowners to culture shellfish (9.2.7)[2]
10. Recommend water column lease fees change to an amount ten times the fee for bottom leases (9.2.7)[2]
11. Eliminate size restrictions on oysters raised in aquaculture operations (9.2.7)[2,3]
12. 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 (9.2.7)[2]
13. 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 June 30 to facilitate proper renewals (9.2.8)[2]
14. Develop a collaborative protocol with the shellfish culture industry to monitor the availability of oyster larvae to facilitate cultch planting (9.2.9)[2,6]
15. Designate and plant cultch on managed seed beds for use on leases and franchises (9.2.9)[2]
16. Request funding research, disease, and education centers for shellfish culture (9.2.9)[2]
17. Apply Fisheries Reform Act requirements to a revised, organized, upgraded permit system including associated fees (9.2.10)[2]

**Note:** The FMP Advisory Committee made the following recommendation on riparian shellfish culture. **Develop a special permit for dock owners to grow shellfish for personal**

**consumption under their docks in floating culture.**

### **10.3.3 INSUFFICIENT ASSESSMENT DATA**

DMF will only be able to approximate management that prevents overfishing and achieves optimal yield from the oyster fishery until programs to collect the necessary data are put in place. Data are lacking from both the recreational and commercial oyster fisheries on which to base the required assessments. The discussion in 5.3.1 outlines the data needs for oyster stock assessments. The need for recreational data was highly recommended by the FMP Advisory Committee.

#### **PROPOSED ACTIONS**

1. Implement harvest management measures recommended in this plan until data collection efforts allow for more precise assessment of population parameters and harvest effects(9.3.1)[2,3,6,8]
2. Support adoption of a mechanism that would provide data on recreational shellfish harvest and add a “pleasure” category to the existing Shellfish License(9.3.2)[2,8]
3. 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(10.2)[4,6]
4. Expand the Shellfish Mapping Program to provide complete and timely data for estimating MSY for the oyster resource(10.2)[6,8]

### **10.3.4 ENHANCEMENT ACTIVITIES**

The enhancement activity issues were mainly driven by staff concerns to better document decisions made on allocation of enhancement resources and to continue work on projects already begun based on recommendations by the BRACO.

#### **PROPOSED ACTIONS**

1. Enhance existing sanctuaries and develop a mechanism for expanding oyster sanctuaries (9.4.1)[1,2]
2. Formally adopt site selection criteria for oyster rehabilitation efforts (9.4.2)[1,2]
3. Investigate alternative cultch sources for oyster habitat enhancement (9.4.2)[2]
4. Continue support for research on optimum cultch planting strategies and mound formation to maximize oyster recruitment and implement as data become available (9.4.2)[1,6]
5. Tailor planting efforts to minimize the effect of any new management actions on fishermen by providing enhanced habitat in areas available to particular harvest techniques and user groups (9.4.2)[4]
6. Continue research with universities on use of hatchery reared oyster stock and implement findings as appropriate (9.4.2)[2,6,8]
7. Establish enhancement priorities: oyster vs. clam, product vs. habitat (9.4.2)[6]

8. Recommend adoption of the BRACO recommendation to increase cultch planting efforts for oysters to a minimum of 400,000 bushels per year (9.4.2)[1,2]
9. 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 (9.4.2) [1,2]

### **10.3.5 ENVIRONMENTAL ISSUES**

The issues of oysters as habitat and the protection of that habitat from detrimental levels of oyster and clam harvest are the most complex and problematic issues facing managers of the oyster fishery. The strategies proposed below are an attempt to coordinate experimental work to assess the effects of different types of oyster habitat protection. The problems with increasing closures of waters to shellfish harvesting due to human health concerns continue and management of oysters in affected areas presents extraordinary dilemmas for managers and fishers.

#### **PROPOSED ACTIONS**

1. Increase use of existing statutory authority (permit comments, CHPP development) to reverse the trends in closure of shellfish waters to harvest(9.5.1)[1,5]
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 (9.5.1)[1,5]
3. 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 (9.5.2)[1,6,8]
4. 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 (9.5.2)[1,2,6,8]
5. Endorse actions by other natural resource agencies that seek to improve and protect water quality (9.5.2)[5]
6. Implement additional experimental closures of oyster areas based on habitat value for both oysters and clams on a pilot scale basis (9.5.3)[1,2,6,8]
7. Initiate research on the effects of bottom disturbing fishing gear on oyster reefs (9.5.4)[1,2,6,8]

8. Endorse an increase in Shellfish Sanitation capability to respond to temporary shellfishing closures.

#### **10.4 RESEARCH NEEDS SUMMARY**

The following research needs were compiled from those listed in the issue papers in Section 9.0. Proper management of the oyster resource cannot occur until most of these research needs are met.

1. Establish methods for standing stock surveys of oysters in fished and unfished areas.
2. Analyze shellfish license sales, shellfish endorsements and oyster harvest effort data
3. Characterize and quantify the effects of bottom disturbing fishing practices on oyster habitat and oysters, including oyster harvesting
4. Complete Human Use Mapping of all coastal waters
5. Investigate the security of polyploidy as a means of safe testing of nonnative oysters
6. Characterize and quantify the beneficial effects of oyster habitats (wild and cultured), oyster sanctuaries, and protecting oyster habitats impacted by fishing practices
7. Examine the oyster production capabilities of different areas and methods
8. Develop methods for predicting oyster spatfall peaks
9. Identify areas for maximum seed oyster production
10. Continue research to optimize oyster culture methods
11. Conduct research to improve oyster disease resistance and survival
12. Continue analysis of the need for and cost of permits for oyster culture and harvest activities
13. Establish optimum areas, configuration and extent of oyster sanctuaries
14. Continue research on means and methods for reduction of non-point source pollution and mitigation of current pollutant effects

#### **10.5 REVIEW CYCLE**

As provided in the Fisheries Reform Act of 1997, the Oyster Fishery Management Plan will be reviewed and revised at least every five years with the support of advisors.

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## APPENDIX 1

### STATUTORY CHANGES NECESSARY TO IMPLEMENT MARINE FISHERIES COMMISSION PREFERRED MANAGEMENT OPTIONS

**NOTE: A proposal for a recreational saltwater fishing license is not included here. The proposal made by the Department of Environment and Natural Resources during the May 2000 session of the General Assembly for a recreational saltwater fishing license contained language that satisfies the needs recognized in this plan.**

**NOTE: The MFC approved of the use of Human Use Mapping and User Coordination Plans to develop rules to resolve conflicts over areas selected for the issuance of shellfish leases. Use of this assessment tool may require statutory changes and development of use standards. Significant mapping of coastal waters will need to be conducted prior to implementation therefore, no attempt at proposed changes or standards is presented here.**

**NOTE: The moratorium on issuance of shellfish leases in western Core Sound will expire on October 1, 2001 and changes should be made to address concerns over leasing in that**



**area prior to expiration of the moratorium.**

**G.S. 113-202 is proposed for amendment as follows:**

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

(a) The General Assembly recognizes that shellfish cultivation provides increased seafood production, associated long-term economic and employment activity, and increased ecological benefits to the estuarine environment by promoting natural water filtration and increased fishery habitats. Therefore, the General Assembly finds that it is in the public interest to encourage and develop commercial shellfish culture. To increase the use of suitable areas underlying coastal waters for the production of shellfish, the Secretary may grant shellfish cultivation leases to persons who reside in North Carolina under the terms of this section when the Secretary determines, in accordance with his duty to conserve the marine and estuarine resources of the State, that the public interest will benefit from the issuance of the lease. Suitable areas for the production of shellfish shall meet the following minimum standards:

- (1) The area leased must be suitable for the cultivation and harvesting of shellfish in commercial quantities.
- (2) The area leased must not contain a natural shellfish bed.
- (3) Cultivation of shellfish in the leased area will be compatible with the lawful utilization by the public of other marine and estuarine resources. Other public uses which may be considered include, but are not limited to, navigation, fishing, and recreation.
- (4) Cultivation of shellfish in the leased area will not impinge upon the rights of riparian owners.
- (5) The area leased must not include an area designated for inclusion in the Department's Shellfish Management Program.
- (6) The area leased must not include an area which the State Health Director

has recommended be closed to shellfish harvest by reason of pollution.

(d) Any person desiring to apply for a lease must make written application to the Secretary on forms prepared by the Department containing such information as deemed necessary to determine the desirability of granting or not granting the lease requested. The applicant must also submit documentation from a college, university or community college accredited by a regional accrediting institution certifying training in aquaculture (mariculture), wildlife biology, marine biology, fishery technology, or a closely related field showing sufficient coursework for proficient lease management. Applicants already holding shellfish leases and currently meeting shellfish production requirements established by the Marine Fisheries Commission are not required to submit the lease management training certification. Except in the case of renewal leases, the application must be accompanied by a map or diagram made at the expense of the applicant, showing the area proposed to be leased.

The map or diagram must conform to standards prescribed by the Secretary concerning accuracy of map or diagram and the amount of detail that must be shown. If on the basis of the application information and map or diagram the Secretary deems that granting the lease would benefit the shellfish culture of North Carolina, the Secretary, in the case of initial lease applications, must order an investigation of the bottom proposed to be leased. The investigation is to be made by the Secretary or his authorized agent to determine whether the area proposed to be leased is consistent with the standards in subsection (a) and any other applicable standards under this Article and the rules of the Marine Fisheries Commission. In the event the Secretary finds the application inconsistent with the applicable standards, the Secretary shall deny the application or propose that a conditional lease be issued that is consistent with the applicable standards. In the event the Secretary authorizes amendment of the application, the applicant must furnish a new map or diagram meeting requisite standards showing the areas proposed to be leased under the amended application. At the time of making application for an initial lease, the applicant must pay a filing fee of ~~one~~two hundred dollars ~~(\$100.00)~~(\$200.00).

(j) Initial leases begin upon the issuance of the lease by the Secretary and expire at noon on the first day of ~~April~~ July following the tenth anniversary of the granting of the lease. Renewal leases are issued for a period of 10 years effective from the time of expiration of the previous lease. At the time of making application for renewal of a lease, the applicant must pay a filing fee of ~~five~~ one hundred dollars ~~(\$50.00)~~ (\$100.00). The rental for initial leases is one dollar (\$1.00) per acre for all leases entered into before July 1, 1965, and for all other leases until noon on the first day of April following the first anniversary of the lease. Thereafter, for initial leases entered into after July 1, 1965, and from the beginning for renewals of leases entered into after said date, the rental is ~~five-ten~~ dollars ~~(\$5.00)~~ (\$10.00) per acre per year. Rental must be paid annually in advance prior to the first day of April each year. Upon initial granting of a lease, the pro rata amount for the portion of the year left until the first day of ~~April~~ July must be paid in advance at the rate of one dollar (\$1.00) per acre per year; then, on or before the first day of April next, the lessee must pay the rental for the next full year.

(l) Upon receipt of notice by the Secretary of any of the following occurrences, he must commence action to terminate the leasehold:

- (1) Failure to pay the annual rental in advance.
- (2) Failure to file information required by the Secretary upon annual remittance of rental or filing false information on the form required to accompany the annual remittance of rental.
- (3) Failure by new owner to report a transfer of beneficial ownership of all or any portion of or interest in the leasehold.
- (4) Failure to mark the boundaries in the leasehold and to keep them marked as required in the rules of the Marine Fisheries Commission.
- (5) Failure to utilize the leasehold on a continuing basis for the commercial production of shellfish.
- (6) Transfer of all or part of the beneficial ownership of a leasehold to a

nonresident.

- (7) Substantial breach of compliance with the provisions of this Article or of the rules of the Marine fisheries Commission governing the use of the leasehold.
- (8) Failure by a new owner to obtain shellfish lease management training and submit acceptable documentation consistent with subsection (d) of this section within 365 days of receipt of transfer of beneficial ownership of a leasehold.

**G.S. 113-202.1 is proposed for amendment as follows:**

**G.S. 113-202.1. Water column leases for aquaculture.**

(d) Amendments of shellfish cultivation leases to authorize use of the water column are issued for a period of five years or the remainder of the term of the lease, whichever is shorter. The annual rental for ~~an initial~~ a new or renewal water column amendment is one hundred dollars (\$100) an acre, ~~for each of the first four years for which the amendment is issued and five hundred dollars (\$500) an acre for the fifth year for which the amendment is issued.~~ If a year for which a water column amendment is issued is less than a 12-month period, the rental for that year shall be prorated based on the number of months in the year. The annual rental for an amendment is payable at the beginning of the year. The rental is in addition to that required in G.S. 113-202.

#### **RULE CHANGES NECESSARY TO IMPLEMENT MARINE FISHERIES COMMISSION PREFERRED MANAGEMENT OPTIONS**

**NOTE: Rules are not proposed here to integrate Human Use Mapping data into the standards for granting shellfish cultivation leases. Larger databases are required before representative values can be established and rules can be promulgated.**

**NOTE: If the proposal to adopt criteria and designate more hand harvest only areas for oysters is adopted, those criteria must be applied and areas that meet the criteria will be added to the areas where mechanical harvest of oysters is prohibited by rule.**

**15A NCAC 3I .0120 is proposed for amendment in a temporary action as follows:**

**.0120 POSSESSION OR TRANSPORTATION LIMITS**

(a) It is unlawful to possess any species of fish which is subject to size or harvest restrictions, while actively engaged in a fishing operation, unless all fish are in compliance with the restrictions for the waterbody and area being fished.

(b) It is unlawful to import into the state species of fish native to North Carolina for sale in North Carolina that do not meet established size limits, except as provided in 15A NCAC 3K ~~.0202 (e)~~ .0202 (c), 3K .0207, and 3K .0305.

*History Note: Authority G.S. 113-134; 113-170; 113-170.4; 113-170.5; 113-182; 143B-289.52; Temporary Adoption Eff. July 1, 1999; Eff. August 1, 2000; ~~2000~~.; Temporary Amendment Eff. ?, 2001.*

**15A NCAC 3K .0101 is proposed for amendment in a temporary action as follows:**

**.0101 PROHIBITED SHELLFISH AREAS/ACTIVITIES**

(a) It is unlawful to possess, sell, or take oysters, clams or mussels from areas which have been designated as prohibited (polluted) by proclamation by the Fisheries Director except as provided in 15A NCAC 3K .0103, ~~.0104~~, .0104, .0107, and .0401. The Fisheries Director shall issue such proclamations upon notice by the Division of Environmental Health that duly adopted criteria for approved shellfish harvest areas have not been met. The Fisheries Director may reopen any such closed area upon notification from the Division of Environmental Health that duly adopted criteria for approved shellfish harvest areas have been met. Copies of these proclamations and maps of these areas are available upon request at the Division of Marine Fisheries, 3441 Arendell St., Morehead City, NC 28557; (252) 726-7021.

(b) The Fisheries Director may, by proclamation, close areas to the taking of oysters, clams, scallops and mussels in order to protect the shellfish populations for management purposes or for public health purposes not specified in Paragraph (a) of this Rule.

(c) It is unlawful to possess or sell oysters, clams, or mussels taken from polluted waters outside North Carolina.

(d) It is unlawful to possess or sell oysters, clams, or mussels taken from the waters of North Carolina except as provided in G.S. 113-169.2(i) without a harvest tag affixed to each container of oysters, clams or mussels. Harvest tags shall be affixed by the harvester and shall meet the following criteria:

- (1) Tags shall be identified as harvest tags. They shall be durable for at least 90 days, water resistant, and a minimum of two and five-eighths inches by five and one-fourth inches in size.
- (2) Tags shall be securely fastened to the outside of each container in which shellstock is transported. Bulk shipments in one container and from the same source may have one tag with all required information attached. Harvesters who are also certified shellfish dealers may use only their dealers tag if it contains the required information. The required information shall be included on all lots of shellfish subdivided or combined into market grades or market quantities by a harvester or a certified shellfish dealer.
- (3) Tags shall contain legible information arranged in the specific order as follows:
  - (A) The harvester's name, address and shellfish license or standard or retired standard commercial fishing license with shellfish endorsement number.
  - (B) The date of harvest.
  - (C) The most precise description of the harvest location as is practicable (e.g., Long Bay, Rose Bay) that can be easily located by maps and charts.
  - (D) Type and quantity of shellfish.
  - (E) The following statement will appear in bold, capitalized type: "THIS TAG IS REQUIRED TO BE ATTACHED UNTIL CONTAINER IS EMPTY AND THEREAFTER KEPT ON FILE FOR 90 DAYS".

*History Note: Authority G.S. 113-134; 113-168.5; 113-169.2; 113-182; 113-221; 143B-289.52; Eff. January 1, 1991; Amended Eff. July 1, 1993; Temporary Amendment Eff. July 1, 1999; Amended Eff. August 1, 2000*

**15A NCAC 3K .0103 is proposed for amendment in a temporary action as follows:**

**.0103 SHELLFISH OR SEED SHELLFISH/SEED MANAGEMENT AREAS**

(a) The Fisheries Director may, by proclamation, designate Shellfish Management Areas which meet any of the following criteria. The area has:

- (1) Conditions of bottom type, salinity, currents, cover or cultch necessary for shellfish growth;
- (2) Shellfish populations or shellfish enhancement projects which may produce commercial quantities of shellfish at ten bushels or more per acre;
- (3) Shellfish populations or shellfish enhancement projects which may produce shellfish suitable for transplanting as seed or for relaying from prohibited (polluted) ~~polluted~~

areas.

(b) It is unlawful to use a trawl net, long haul seine, or swipe net in any designated Shellfish or Seed Shellfish/Seed Management area. ~~area which has been designated by proclamation.~~ These areas will be marked with signs or buoys. Unmarked and undesignated tributaries shall be the same designation as the designated waters to which they connect or into which they flow. No unauthorized removal or relocation of any such marker shall have the effect of changing the designation of any such body of water or portion thereof, nor shall any such unauthorized removal or relocation or the absence of any marker affect the applicability of any rule pertaining to any such body of water or portion thereof.

(c) It is unlawful to take oysters or clams from any Shellfish/Seed Management Area which has been closed and posted, except that the Fisheries Director may, by proclamation, open specific areas to allow the taking of oysters ~~or~~ and clams and may designate time, place, character, or dimensions of any method or equipment that may be employed.

(d) It is unlawful to take oysters ~~or clams~~ from Seed Management Areas for planting on shellfish leases or franchises private bottoms without first obtaining a Permit to Transplant Oysters from Seed Management Area permit from the Fisheries Director. The procedures and requirements for obtaining permits are found in 15A NCAC 3O .0500.

*History Note: Authority G.S. 113-134; 113-182; 113-221; 143B-289.4;*

*Eff. January 1, 1991;*

*Amended Eff. March 1, 1994; 1994.*

*Temporary Amendment Eff. ?, 2001.*

**15A NCAC 3K .0104 is proposed for amendment in a temporary action as follows:**

**.0104 PERMITS FOR PLANTING SHELLFISH FROM PROHIBITED/POLLUTED POLLUTED AREAS**

(a) It is unlawful to take oysters or clams from prohibited (polluted) polluted public waters for planting on leases and franchises except as private bottoms except: (1) As authorized by G.S.

113-203, provided such person shall first obtain a permit from the Fisheries Director setting forth the time, area, and method by which such shellfish may be taken. The procedures and requirements for obtaining permits are found in 15A NCAC 30 .0500.

(b) ~~(2)~~The season for relaying clams shall be between ~~Between~~ April 1 ~~and through~~ May 15 ~~for~~ clams and the season for relaying oysters shall be for a specified six week period between the date of ~~beginning at~~ the statewide closure of oyster season and June 30, as determined by the Fisheries Director. ~~season.~~

(c) For areas designated by the Fisheries Director as sites where shellfish would otherwise be destroyed in maintenance dredging operations, the season as set out in Paragraph (b) of this Rule may not apply.

(d) ~~(b)~~ The Fisheries Director, acting upon recommendations of the Division of Environmental Health, shall close and reopen by proclamation any private shellfish beds for which the owner has obtained a permit to relay oysters and clams from prohibited (polluted) ~~polluted~~ public waters.

*History Note: Authority G.S. 113-134; 113-182; 113-203; 113-221; 143B-289.4;*

*Eff. January 1, 1991;*

*Amended Eff. March 1, 1996; September 1, 1991; 1991.*

*Temporary Amendment Eff. ?, 2001.*

#### **.0107 DEPURATION OF SHELLFISH**

(a) It is unlawful to take ~~elams, clams or~~ clams, clams or oysters ~~or mussels~~ from the public or private prohibited (polluted) waters of the state for the purpose of depuration in an approved depuration operation except when the harvest will utilize shellfish that would otherwise be destroyed in maintenance dredging operations. All harvest and transport activities within the State of North Carolina related to depuration shall be under the direct supervision of the Division of Marine Fisheries or ~~and/or~~ the Division of Environmental Health.

(b) The Fisheries Director, may, by proclamation, impose any or all of the following restrictions on the harvest of ~~shellfish~~ clams or oysters for depuration:



- (1) Specify species,
- (2) Specify areas except harvest will not be allowed from designated buffer zones adjacent to sewage outfall facilities,
- (3) Specify harvest days,
- (4) Specify time period,
- (5) Specify quantity and/or size,
- (6) Specify harvest methods,
- (7) Specify record keeping requirements.

(c) Depuration Harvest permits:

- (1) It is unlawful for individuals to harvest ~~All persons harvesting clams, clams or oysters or mussels~~ from prohibited (polluted) waters for the purpose of depuration unless they have obtained a Depuration Permit or are listed as designees on ~~shall first obtain a Depuration Permit permit~~ from the Division of Marine Fisheries and Division of Environmental Health setting forth the method of harvest to be employed. Permits will be issued to licensed North Carolina Clam or Oyster Dealers only. Permittees and designees harvesting under Depuration Permits must have a current Shellfish License or Shellfish Endorsement on a Standard or Retired Standard Commercial Fishing License.
- (2) In addition to information required in 15A NCAC 3M .0501, the ~~The~~ permit application shall provide the name, address, location and telephone number of the depuration operation where the shellfish will be depurated.
- (3) Clam or Oyster Dealers ~~Persons~~ desiring to obtain prohibited (polluted) clams or oysters ~~harvest polluted shellfish~~ for depuration shall apply for a depuration harvest permit at least 15 days prior to initiation of operation. ~~harvest.~~

(d) Transport of clams or elams, oysters ~~or mussels~~ for depuration:

- (1) Clams or Clams, oysters ~~or mussels~~ harvested from prohibited (polluted) waters for depuration in an approved depuration operation located within the State of North Carolina shall be transported under the direct supervision of the Division of Marine Fisheries or ~~and/or~~ the Division of Environmental Health.
- (2) Clams or Clams, oysters ~~or mussels~~ harvested from prohibited (polluted) waters for

deputation in an approved deputation operation outside the State of North Carolina shall not be transported within the State of North Carolina except under the direct supervision of the Division of Marine Fisheries or the Division of Environmental Health.

- (e) It is unlawful to ship clams or oysters ~~shellfish~~ harvested for deputation to deputation 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.
- (f) The procedures and requirements for obtaining permits are found in 15A NCAC 3O .0500.

*History Note: Authority G.S. 113-134; 113-182; 113-201; 143B-289.4;*

*Eff. January 1, 1991; 1991-*

*Temporary Amendment Eff. ?, 2001.*

**15A NCAC 3K .0205 is proposed for amendment in a temporary action as follows:**

**.0205    MARKETING OYSTERS TAKEN FROM PRIVATE SHELLFISH BOTTOMS**

(a) It is unlawful to take, possess, buy, or sell oysters from shellfish leases or franchises ~~private beds~~ during the open season unless such oysters have been culled in accordance with Rule 15A NCAC 3K .0202.

~~(b) It is unlawful to take, possess, or sell oysters from private beds without first securing from the Fisheries Director a permit showing the name of the person or persons taking the oysters, the location of the private bed, the daily quantity to be taken, and the method of harvest. It is unlawful to sell, purchase or possess oysters during the regular closed season without the lease or franchise holder permittee delivering to the purchaser or other recipient a certification, on a form provided by the Division, certification that the oysters were taken from a valid shellfish lease or franchise. pursuant to a valid permit. Certification forms shall be furnished by the Division to lease and franchise holders upon request. Department to each permittee upon issuance of a permit.~~

(c) It is unlawful for lease or franchise holders or their designees to take or possess oysters from public bottom while possessing aboard a vessel oysters taken from shellfish leases or franchises.

*History Note: Authority G.S. 113-134; 113-182; 113-201; 143B-289.4;*

*Eff. January 1, 1991;*

*Amended Eff. September 1, 1991; ~~1991~~.*

*Temporary Amendment Eff. ?, 2001.*

**15A NCAC 3K .0207 is proposed for adoption in a temporary action as follows:**

**.0207 OYSTER SIZE AND HARVEST LIMIT EXEMPTION**

Possession and sale of oysters by a hatchery or oyster aquaculture operation and purchase and possession of oysters from a hatchery or oyster aquaculture operation shall be exempt from bag and size limit restrictions set under authority of 15A NCAC 3K .0201 and 3K .0202 . It is unlawful to possess, sell, purchase, or transport such oysters unless they are in compliance with all conditions of the Aquaculture Operations Permit.

*History Note: Authority G.S. 113-134; 113-182; 143B-289.52;*

*Temporary Adoption Eff., ?, 2001.*

**15A NCAC 3O .0201 is proposed for amendment in a temporary action as follows:**

**.0201 STANDARDS FOR SHELLFISH BOTTOM AND WATER COLUMN**

**LEASES**

(a) All areas of the public bottoms underlying coastal fishing waters shall: ~~(1)~~ meet the following standards in addition to the standards in G.S. 113-202 in order to be deemed suitable for leasing for shellfish purposes:

~~(A)~~ (1) The lease area must not contain a natural shellfish bed which is defined as 10 bushels or more of shellfish per acre.

~~(B)~~ (2) The lease area must not be closer than 100 feet to a developed shoreline. In an area bordered by undeveloped shoreline, no minimum setback is required. When the area to be leased borders the applicant's property or borders the property of riparian owners who have consented in a notarized statement, the Secretary may reduce the distance from shore required by this Rule.

~~(C)~~ (3) Unless the applicant can affirmatively establish a necessity for greater acreage through the management plan that is attached to the application and other evidence submitted to the Secretary, the lease area shall not be less than one-half acre and shall not exceed:

~~(i)~~ (A) 10 acres for oyster culture;

~~(ii)~~ (B) 5 acres for clam culture; or

~~(iii)~~ (C) 5 acres for any other species.

This Subparagraph shall not be applied to reduce any holdings as of July 1, 1983.

(b) Shellfish bottom leases shall meet the following standards in addition to the standards in G.S. 113-202. In order to avoid termination the leasehold, shellfish bottom leases shall:

~~(2)(1) Produce and market 10 25 bushels of shellfish per acre per year; and to meet the minimum commercial production requirement or~~

~~(2) pPlant 25 bushels of cultch or 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. to meet commercial production by planting effort. Planting effort shall be considered in lieu of commercial production for five consecutive years beginning March 1, 1994, or for the first five consecutive years for any lease granted after March 1, 1994.~~

(3) The following standards shall be applied to determine compliance with subsections (1) and (2) above:

(A) Only shellfish planted, produced or marketed according to the definitions in 15A NCAC 3I .0101 (26), (27) and (28) shall be submitted on production/utilization forms for shellfish leases and franchises.

(B) 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 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.

- (C) Production and marketing information and planting effort information are compiled and averaged separately to assess compliance with the standards. The lease or franchise must meet ~~either~~ the production requirement and ~~or~~ the planting effort requirement within the dates set forth to be judged in compliance with these standards.
  - (D) In determining production and marketing averages and planting effort averages for information not reported in bushel measurements, the following conversion factors shall be used:
    - (i) 300 oysters, 400 clams, or 400 scallops equal one bushel;
    - (ii) 40 pounds of scallop shell, 60 pounds of oyster shell, 75 pounds of clam shell and 90 pounds of fossil stone equal one bushel.
  - (E) 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) All bushel measurements shall be in U.S. Standard Bushels.~~
  - (F) These production and marketing rates shall be averaged over the most recent three-year period after January 1 following the second anniversary of initial bottom leases and recognized franchises and throughout the terms of renewal leases. For water column leases, these production and marketing rates shall be averaged over the first five year period for initial leases and over the most recent three year period thereafter. Three year averages for production and marketing rates shall be computed irrespective of transfer of the shellfish lease or franchise.
  - (G) All bushel measurements shall be in U.S. Standard Bushels
- ~~(b)~~ (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.

(e) (d) Water columns superjacent to duly recognized perpetual franchises shall meet the standards in G.S. 113-202.2 in order to be deemed suitable for leasing for aquaculture purposes.

~~(d)~~ (e) Water column leases must produce and market ~~40~~ 100 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 as determined by Division biologists to meet commercial production by planting effort. ~~Planting effort shall be considered in lieu of commercial production for five consecutive years beginning March 1, 1994, or for the first five consecutive years for any lease granted after March 1, 1994.~~ The rules 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 ~~(a)~~ (b) 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;*

*143B-289.52; Eff. January 1, 1991;*

*Amended Eff. May 1, 1997; March 1, 1995; March 1, 1994; September 1,*

*1991; ~~1991.~~*

*Temporary Amendment Eff. ?, 2001.*

**15A NCAC 30 .0202 is proposed for amendment in a temporary action as follows:**

**.0202 SHELLFISH BOTTOM AND WATER COLUMN LEASE APPLICATIONS**

(a) Application forms are available from the Division's office headquarters referenced in 15A NCAC 3H .0101 for persons desiring to apply for shellfish bottom and water column leases. Each application must be accompanied by a map or diagram prepared at the applicant's expense and must meet the information requirements contained in the application including an inset vicinity map showing the location of the proposed lease with detail sufficient to permit on-site identification and location.

(b) As a part of the application, the applicant must submit a management plan for the area to be

leased on a form provided by the Division which meets the following standards:

- (1) States the methods through which the applicant will cultivate and produce shellfish consistent with the minimum requirement in 15A NCAC 3O .0201;
- (2) States the time intervals during which various phases of the cultivation and production plan will be achieved;
- (3) States the materials and techniques that will be utilized in management of the lease;
- (4) Forecasts the results expected to be achieved by the management activities; and
- (5) Describes the productivity of any other leases or franchises held by the applicant.

(c) The completed application, map or diagram, and management plan for the requested lease shall not be accepted by the Division unless accompanied by a non-refundable filing fee of one hundred dollars (\$100.00) for water column amendments and two hundred dollars (\$200) for shellfish bottom leases. An incomplete application shall be returned and not considered further until re-submitted complete with all required information.

(d) Immediately after an application is deemed to have met all requirements and is accepted by the Division, the applicant must identify the area for which a lease is requested with stakes at each corner in accordance with 15A NCAC 3O .0204(a)(1)(A). The applicant shall firmly attach to each stake a sign, provided by the Division containing the name of the applicant, the date the application was filed, and the estimated acres.

*History Note: Authority G.S. 113-134; 113-201; 113-202; 143B-289.4;*

*Eff. January 1, 1991;*

*Amended Eff. May 1, 1997; September 1, 1991; ~~1991~~.*

**Temporary Amendment after change in statutes.**

**15A NCAC 3O .0205 is proposed for amendment in a temporary action as follows:**

**.0205 LEASE RENEWAL**

(a) Lease renewal applications shall be provided to lessees as follows:

- (1) For shellfish bottom leases, renewal applications shall be provided in January of the year of

expiration. Applications must be returned to the Division no later than April 1.

- (2) For water column leases, renewal applications shall be provided at least 90 days prior to expiration dates. Applications must be returned to the Division no later than 90 days before expiration.

(b) Lease renewal applications shall be accompanied by management plans meeting the requirements of 15A NCAC 3O .0202(b). A filing fee of one hundred fifty dollars \$100.00 (~~\$50.00~~) shall accompany each renewal application for shellfish bottom leases.

(c) A survey for renewal leases shall be required at the applicant's expense when the Division determines that the area leased to the renewal applicant is inconsistent with the survey on file.

(d) When it is determined, after due notice to the lessee, and after opportunity for the lessee to be heard, that the lessee has not complied with the requirements of this Section or that the lease as issued is inconsistent with this Section, the Secretary may decline to renew, at the end of the current terms, any shellfish bottom or water column lease. The lessee may appeal the Secretary's decision by initiating a contested case as outlined in 15A NCAC 3P .0102.

(e) Pursuant to G.S. 113-202(a)(6), the Secretary is not authorized to recommend approval of renewal of a shellfish lease in an area closed to shellfishing by reason of pollution. Shellfish leases partially closed due to pollution must be amended to exclude the area closed to shellfishing prior to renewal. For purposes of lease renewal determinations, an area shall be considered closed to shellfish harvest by reason of pollution when the area has been classified by the State Health Director as prohibited or has been closed for more than 50 percent of the days during the final four years prior to renewal except shellfish leases in areas which have been closed for more than 50 percent of the days during the final four years prior to renewal and continue to meet established production requirements by sale of shellfish through relay periods or other depuration methods shall not be considered closed due to pollution for renewal purposes.

(f) If the Secretary declines to renew a lease that has been determined to be inconsistent with the standards of this Section, the Secretary, with the agreement of the lessee, may issue a renewal lease for all or part of the area previously leased to the lessee that contains conditions necessary to conform the renewal lease to the minimum requirements of this Section for new leases.



*History Note: Authority G.S. 113-134; 113-201; 113-202; 113-202.1; 113-202.2; 143B-289.4;  
Eff. January 1, 1991;*

*Amended Eff. May 1, 1997; March 1, 1995; March 1, 1994; October 1, 1992;  
September 1, 1991; 1991.*

**Temporary Amendment Eff. After statute changes**

**15A NCAC 30 .0208 is proposed for amendment in a temporary action as follows:**

**.0208 CANCELLATION**

(a) In addition to the grounds 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 ~~at the following rates:~~ in accordance with 15A NCAC 3K .0201

~~(1) For shellfish bottom leases and franchises, 25 bushels per acre per year.~~

~~(2) For water column leases, 100 bushels per acre per year.~~

~~These production and marketing rates shall be averaged over the most recent three year period after January 1 following the second anniversary of initial bottom leases and recognized franchises and throughout the terms of renewal leases. For water column leases, these production and marketing rates shall be averaged over the first five year period for initial leases and over the most recent three year period thereafter. Three year averages for production and marketing rates shall be computed irrespective of transfer changes of ownership of the shellfish lease or franchise.~~

(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.

(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 3P .0102.

(e) The Secretary's decision to terminate a lease may be appealed by initiating a contested case as outlined in 15A NCAC 3P .0102.

*History Note: Authority G.S. 113-134; 113-201; 113-202; 113-202.1; 113-202.2; 143B-289.52;  
Eff. January 1, 1991;  
Amended Eff. May 1, 1997; March 1, 1995; March 1, 1994; October 1,  
1992; September 1, 1991; ~~1991~~.  
Temporary Amendment Eff. ?, 2001.*

**15A NCAC 30 .0501 is proposed for amendment in a temporary action as follows:**

**.0501 PROCEDURES AND REQUIREMENTS TO OBTAIN PERMITS**

- (a) To obtain any Marine Fisheries permit, the following information is required for proper application from the permittee, a responsible party or person holding a power of attorney:
- (1) Full name, physical address, mailing address, date of birth, and signature of the permittee on the application. If the permittee is not appearing before a license agent or the designated Division contact, the permittee's signature on the application must be notarized;
  - (2) Current picture identification of permittee, responsible party and, when applicable, person holding a power of attorney; acceptable forms of picture identification are driver's license, state identification card, military identification card, resident alien

- card (green card) or passport or if applying by mail, a copy thereof;
- (3) Full names and dates of birth of designees of the permittee who will be acting under the requested permit where that type permit requires listing of designees;
  - (4) Certification that the permittee and their designees do not have four or more marine or estuarine resource convictions during the previous three years;
  - (5) For permit applications from business entities, the following documentation is required:
    - (A) Business Name;
    - (B) Type of Business Entity: Corporation, partnership, or sole proprietorship;
    - (C) Name, address and phone number of responsible party and other identifying information required by this Subchapter or rules related to a specific permit;
    - (D) For a corporation, current articles of incorporation and a current list of corporate officers when applying for a permit in a corporate name;
    - (E) For a partnership, if the partnership is established by a written partnership agreement, a current copy of such agreement shall be provided when applying for a permit;
    - (F) For business entities, other than corporations, copies of current assumed name statements if filed and copies of current business privilege tax certificates, if applicable.
  - (6) Additional information may also be required by the Division for specific permits.
- (b) A permittee must hold a valid Standard or Retired Standard Commercial Fishing License in order to hold a:
- (1) Pound Net Permit;
  - (2) Permit to Waive the Requirement to Use Turtle Excluder Devices in the Atlantic Ocean.
- (c) A permittee and their designees must hold a valid Standard or Retired Standard Commercial Fishing License with a Shellfish Endorsement or a Shellfish License in order to hold a:
- (1) Permit to Transplant (Prohibited) Polluted Shellfish;
  - (2) Permit to Transplant Oysters from Seed Management Areas;

- (3) Permit to Use Mechanical Methods for Oysters or Clams on Shellfish Leases or Franchises;
  - (4) Permit to Harvest Rangia Clams from Prohibited (Polluted) Areas.
  - (5) Depuration Permit
- (d) A permittee must hold a valid: ~~Fish Dealer License in the proper category in order to hold Dealer Permits for Monitoring Fisheries Under a Quota/Allocation for that category.~~
- (1) Fish Dealer License in the proper category in order to hold Dealer Permits for Monitoring Fisheries Under a Quota/Allocation for that category.
  - (2) Standard Commercial Fishing License with a Shellfish Endorsement, Retired Standard Commercial Fishing License with a Shellfish Endorsement or a Shellfish License in order to harvest clams or oysters for depuration.
- (e) Aquaculture Operations/Collection Permits:
- (1) A permittee must hold a valid Aquaculture Operation Permit issued by the Fisheries Director to hold an Aquaculture Collection Permit.
  - (2) The permittee or designees must hold appropriate licenses from the Division of Marine Fisheries for the species harvested and the gear used under the Aquaculture Collection Permit.
- (f) Applications submitted without complete and required information shall be considered incomplete and shall not be processed until all required information has been submitted. Incomplete applications will be returned to the applicant with deficiency in the application so noted.
- (g) A permit will be issued only after the application has been deemed complete by the Division of Marine Fisheries and the permittee certifies to fully abide by the permit general and specific conditions established under 15A NCAC 3J .0107, 3K .0103, 3K .0104, 3K .0107, 3K .0206, 3K .0303, 3K .0401, 3O .0502, and 3O .0503 as applicable to the requested permit.
- (h) The Fisheries Director, or his agent may evaluate the following in determining whether to issue, modify or renew a permit:
- (1) Potential threats to public health or marine and estuarine resources regulated by the

Marine Fisheries Commission;

- (2) Applicant's demonstration of a valid justification for the permit and a showing of responsibility as determined by the Fisheries Director;
  - (3) Applicant's history of habitual fisheries violations evidenced by eight or more violations in 10 years.
- (i) The applicant shall be notified in writing of the denial or modification of any permit request and the reasons therefor. The applicant may submit further information, or reasons why the permit should not be denied or modified.
  - (j) Permits are valid from the date of issuance through the expiration date printed on the permit. This timeframe may be based on calendar year, fiscal year, or other as deemed appropriate by the Division.
  - (k) To renew a permit, the permittee shall file a certification that the information in the original application is still currently correct, or a statement of all changes in the original application and any additional information required by the Division of Marine Fisheries.
  - (l) For initial or renewal permits, processing time for permits may be up to 30 days unless otherwise specified in 15A NCAC 3.
  - (m) It is unlawful for a permit holder to fail to notify the Division of Marine Fisheries within 30 days of a change of name or address.
  - (n) It is unlawful for a permit holder to fail to notify the Division of Marine Fisheries of a change of designee prior to use of the permit by that designee.
  - (o) Permit applications shall be available at all Division Offices.
  - (p) Any permit which is valid at time of adoption of this Rule will be valid until the expiration date stated on the permit.

*History Note: Authority G.S. 113-134; 113-169.1; 113-169.3; 113-182; 143B-289.52;  
Temporary Adoption Eff. ?, 2001; September 1, 2000; May 1, 2000.  
Eff. April 1, 2001.*

**CRITERIA NECESSARY TO IMPLEMENT MARINE FISHERIES  
COMMISSION PREFERRED MANAGEMENT OPTIONS**

**DRAFT  
DIVISION OF MARINE FISHERIES  
CRITERIA FOR THE DESIGNATION OF OYSTER HARVEST METHODS**

North Carolina General Statutes 113-134, 113-182 and 143B-289.52 give the Marine Fisheries Commission broad authority to promulgate rules for the management of marine and estuarine resources in coastal fishing waters including oysters. General Statute 113-201 also empowers the Marine Fisheries Commission to make rules and take all steps necessary to develop and improve the cultivation, harvesting and marketing of shellfish in North Carolina both from public grounds and private beds. Propagation and utilization of shellfish by the Department for both public and private beds is authorized under General Statutes 113-203 and 113-204.

The Marine Fisheries Commission has adopted by rule (15A NCAC 3R .0108) the exclusion of mechanical harvest methods for taking oysters along the Outer Banks from Oregon Inlet to the Wainwrights and most of the sounds and river systems from Core Sound south. The Marine Fisheries has also given the Fisheries Director proclamation authority under 15A NCAC 3K .0201 to restrict the taking of oysters by specifying the means and methods which may be employed. In this regard, the Division shall have the responsibility to insure the best utilization of oyster resources by doing the following:

- 1. GATHERING PUBLIC INPUT RELATIVE TO THE DESIGNATION OF OYSTER HARVEST METHODS FOR SPECIFIC AREAS.**
  
- 2. MAKING INVESTIGATION OF OYSTER HARVEST AREAS ADDRESSING THE FOLLOWING SPECIFIC CRITERIA:**
  - I. 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. PNAs are already 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.

- II. 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 10 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.
- III. 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.
- IV. 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 redesignation of harvest methods.
- V. Enforcement Potential - The overall number of designated areas, their configurations and accessibility for enforcement purposes should be considered in any new harvest area designations.

## **DRAFT**

### **DIVISION OF MARINE FISHERIES CRITERIA FOR SITE SELECTION AND PLANTING PROCEDURES IN THE SHELLFISH REHABILITATION PROGRAM**

The Division of Marine Fisheries is responsible for the rehabilitation of shellfish resources in the coastal waters of North Carolina through cultch and seed stock planting programs. The Division is charged with locating resources for enhancement programs, overseeing the distribution of resources, and identifying areas, suitable for planting and relocation efforts, and the management of those areas. In order to determine the success and effectiveness of rehabilitation efforts, the Division is responsible for monitoring the productivity of planted sites and soliciting public input on site selection and distribution methods. To insure the best utilization of the available resources, the

Division shall be responsible for the following:

**1. HOLDING ANNUAL PUBLIC MEETINGS TO SOLICIT INPUT ON SHELLFISH REHABILITATION ACTIVITIES.**

**2. MAKING INVESTIGATIONS OF PROPOSED REHABILITATION SITES ADDRESSING THE FOLLOWING CRITERIA:**

- I. **PHYSICAL FACTORS** – Sites should be selected which will provide adequate support for the material used. Firm bottom sediments consisting of sand-mud mixtures, clay, or mixtures of clay and other sediments should be selected when available. Areas exposed to strong currents and shifting bottom sediments should be avoided. Consideration should be given to water depth according to the harvest methods employed in the area.
- II. **HABITAT** – Sites should be selected in areas that are historically productive. The maintenance of currently productive shellfish beds and the planting of potentially productive areas should be considered. Investigations of current productivity on each site shall be made prior to any planting operations. Sites should not be selected which are likely to be affected by closures recommended by the Division of Environmental Health, Shellfish Sanitation Section. Long term salinity patterns should be considered when selecting sites in areas where recent productivity is traditionally low.
- III. **USE COMPATIBILITY** – Sites should not be selected which would interfere with other established, significant commercial fishing activity. Consideration should also be given to the effect of local commercial fishing activities on the site. Sites selected in primary nursery areas should be available to non-bottom disturbing harvest gear.
- IV. **SELECTION OF SITES** – Planning for the planting activities should include a wide distribution of effort to provide as many locations as possible with access to rehabilitation efforts. This criterion may involve experimental plantings but in no instances supersede the previous criteria. Knowledgeable local shellfishermen will be requested to provide the Division assistance in the selection of specific planting sites, planting rates and distribution methods.
- V. **MATERIALS** – Fresh shell material free of viscera and trash will be sought for cultch and will be the primary cultch material. Other materials will be evaluated as to their suitability and cost and will be used accordingly. Whenever possible materials suited to the particular physical factors of the site will be used, i.e. lightweight shells on softer bottom types, oyster shells and marl in high energy areas. Relaying of seed stocks will be from slow growth areas or from prohibited areas approved by Shellfish



Sanitation to better growing areas. Seed stock relocation will be under the supervision of the Division. The Division may utilize commercial fishermen to relocate seed stocks if the shellfish can be moved at reasonable costs. Hatchery-reared seed may be used if conditions warrant.

- VI. MARKING – Sites not being managed under proclamation authority will still be marked insofar as may be practicable to provide location by the general public and to warn operators of commercial fishing gear that bottom obstructions exist in the area.
- VII. DISEASE – Disease assessments will be performed on samples of shellfish identified for transplanting to avoid movement of disease vectors into uninfected areas and to assure that survival of transplanted stock is maximized.