



PAT MCCRORY
Governor

DONALD R. VAN DER VAART
Secretary

MEMORANDUM

TO: HOUSE OF REPRESENTATIVES APPROPRIATIONS SUBCOMMITTEE ON AGRICULTURE
AND NATURAL AND ECONOMIC RESOURCES
The Honorable Jimmy Dixon, Co-Chairman
The Honorable Pat McElraft, Co-Chairman
The Honorable Roger West, Co-Chairman

SENATE APPROPRIATIONS SUBCOMMITTEE ON NATURAL AND ECONOMIC
RESOURCES
The Honorable Andrew Brock, Co-Chairman
The Honorable Bill Cook, Co-Chairman
The Honorable Trudy Wade, Co-Chairman

FISCAL RESEARCH DIVISION

FROM: Brad Knott, Deputy Director of Legislative Affairs

SUBJECT: Shellfish Aquaculture Plan

DATE: March 1, 2016

Pursuant to Session Law 2015-241, section 14.10D, "No later than March 1, 2016, the Division of Marine Fisheries shall report to the Environmental Review Commission, the chairs of the House and Senate appropriations committees with responsibility for natural and economic resources, and the Fiscal Research Division regarding the Division's recommendations for policy and statutory changes needed to support and encourage the ecological restoration and economic stability of the shellfish aquaculture industry." The attached document satisfies this reporting requirement.

If you have any questions or need additional information, please contact Brad Knott by phone at 919-707-9335 or via email at Brad.Knott@ncdenr.gov.

cc: John Evans, Chief Deputy Secretary, DEQ
Jim Kelley, Acting Director of Marine Fisheries, DEQ
Dee Lupton, Deputy Director of Marine Fisheries, DEQ



**Recommendations for Implementation of the Senator Jean Preston Oyster Sanctuary Network
10-Year Plan, as required by S.L. 2015-241 Section 14.9
N.C. Department of Environmental Quality, Division of Marine Fisheries**

Due to Legislature: March 1, 2016

Introduction

The N.C. General Assembly's 2015 Session, Section 14.9 of Session Law 2015-241 states that it is the intent of the General Assembly "to enhance shellfish habitat within the Albemarle and Pamlico Sounds and their tributaries to benefit fisheries, water quality, and the economy." Lawmakers want this to be achieved by the establishment of a network of oyster sanctuaries, harvestable enhancement sites, and coordinated support for the development of shellfish aquaculture. The network of sanctuaries is to be named in honor of Senator Jean Preston.

The legislature required the development of a 10-year plan to construct and manage this additional oyster habitat. The plan shall include recommendations for statutory or regulatory changes needed to expedite its implementation. At this time the Division does not request any funding for the recommendations outlined in the FY 16-17 budget. Estimated fiscal impacts are included for informational purposes only. It is required to include the following components:

1. Location and delineation of oyster sanctuaries
2. Enhancement of oyster habitat
3. Economic relief for shellfish aquaculture
4. Outreach and education
5. Monitoring
6. Funding

Background

Restoration Activities

The N.C. Division of Marine Fisheries has conducted shellfish restoration projects (oyster sanctuaries) since the 1990s and shellfish enhancement projects (cultch planting) in shellfish growing waters all along the coast since the 1900s. Cultch planting entails spreading a thin layer (up to 18 inches) of suitable substrate, such as oyster shell, marl, concrete, or various other shell types, on the bottom in oyster growing areas. This allows for the settlement of oyster larvae onto the substrate, eventually turning the substrate into a functional oyster reef. Oyster sanctuaries are constructed by deploying suitable substrate, such as marl or concrete in mounds, or by placing precast concrete structures on the bottom so that a vertical profile of six to eight feet is achieved. This allows for oyster larvae to settle onto the substrate, becoming a functional oyster reef and then providing a larval supplement to other reefs. Oyster sanctuaries are closed to harvest, which allows for maximum survivability, increasing the age class structure for maximum larval output. To date, the state has developed a network of 14 sanctuaries built with state, federal and private funds. Implementation of the Jean Preston Sanctuary Network would incorporate the existing sanctuaries and expand the network making it more self-sustaining.

University monitoring of subtidal oyster reefs, created by the division, concluded that the majority of the restoration projects met or exceeded the minimum criteria for success established by Powers et al. (2009)

of at least 10 live oysters per square meter. More recently, monitoring by Peters et al. (personal communication) found the average density of live oysters on the division's cultch planting sites and oyster sanctuaries to be 24 and 193 times greater, respectively, than the minimum criteria of success. However, the scale of the division shellfish restoration projects is small compared to Maryland, Virginia, Mississippi, Louisiana and Texas.

These states invest significantly more money in their oyster industries. Virginia allocates nearly \$2 million in state funds, and \$300,000 from oyster use fees, for oyster restoration projects, annually. Maryland budgets millions of dollars per year for oyster restoration. Several federal agencies and private organizations provide funds for restoration in the Chesapeake Bay. In 2014 alone, \$24.57 million was spent on one oyster restoration project in Maryland's portion of the Chesapeake Bay. Of the \$24.57 million, the state of Maryland spent \$19.4 million, the U.S. Army Corps of Engineers spent \$1.8 million, the National Oceanic and Atmospheric Administration spent \$890,000, and CSX railroad donated \$2.47 million in transportation. States such as Mississippi, Louisiana and Texas are currently investing tens, if not hundreds, of millions into oyster restoration through appropriations and grant funding.

In addition to sufficient restoration funds, states like Louisiana, Mississippi, Maryland and Virginia have attributed some success to rotationally managing oyster harvest areas. These rotational areas are opened and closed in a manner to allow harvest while protecting the resource to ensure sustainability and future harvest. In Virginia, a rotational harvest system was implemented in the Rappahannock River during 2007. Over the following three years, the oyster production in the Rappahannock River increased more than 14 times, from 1,600 bushels in 2007 to 23,000 in 2010. Due to increased restoration funding, improved management strategies, rotational harvest, and emphasis on aquaculture, Virginia's total oyster harvest increased from an all-time low of 23,000 bushels, worth \$575,000, in 1999, to 659,000 bushels, worth \$33.8 million, in 2014.

To make North Carolina's restoration efforts competitive with other states, the division has participated for the past decade with a group of stakeholders (federal, state and local government agencies, universities, non-governmental organizations and fishermen) to develop comprehensive strategic plans for oyster restoration. This plan, updated every five years, is called the N.C. Oyster Restoration and Protection Plan: Blueprint for Action. A steering committee and work groups of stakeholders are currently supporting an existing plan that covers 2015 – 2020. However, funding to implement and reach goals within the Blueprint for Action has not been sufficient. The recommendations set forth in this report are consistent with the Blueprint and are supported by the steering committee. Construction of new oyster habitats, improving oyster restoration technology and methods and reducing adverse impacts of harvest to existing oyster habitat are cited in the Albemarle-Pamlico National Estuary Program's Comprehensive Conservation and Management Plan, as well as the N.C. Department of Environmental Quality's Coastal Habitat Protection Plan.

Shellfish Leases

As of September 2015, there were 292 shellfish leases in North Carolina, covering 1,931 acres. Out of 292 total leases, 236 are bottom leases covering 1,931 acres, and 36 have water column leases covering 111 acres. The Shellfish Lease Program has no dedicated staff to support shellfish lease holders and administer shellfish leases. Further, the Shellfish Lease Program operates with an annual budget of \$4,526, which is often insufficient to cover the cost of postage for statutorily required public notices for new leases. The lack of funding and dedicated staff significantly inhibits the program's administrative support for lease holders and drastically increases the time to acquire a lease.

In comparison, Virginia has 5,400 leases covering 122,000 acres, and this expanding program is credited with the state's rapid increase in oyster landings.

Virginia's lease program is staffed by eight dedicated employees, including two managers, one mapper and draftsman, one clerical worker and four surveyors. Currently, Virginia has 300 pending applications, and their staff has the capability to process approximately 100 applications per year. Virginia management estimates it will take up to 10 years to work through the 300-application backlog due to the new lease applications and contested cases.

Further, expansion of the North Carolina shellfish aquaculture industry has been hindered by the absence of a reliable source for seed. In 2015, the division received several inquiries from shellfish growers, interested in purchasing millions of seed. The division was contacted by hatcheries in Virginia and Maryland about importation of seed, noting that they did not have the capacity to fulfill all of the North Carolina orders.

Recommendations:

1. Location and delineation of oyster sanctuaries.

NCGA Requirements: The plan should include locations for sanctuary components that minimize the impact on commercial trawling. The location of sanctuaries shall take into account connectivity to existing oyster sanctuaries and proposed oyster enhancement sites. New oyster sanctuaries shall be designed to provide hook-and-line fishing while allowing the development of complex fish habitat and brood-stock oysters that will enhance recruitment in the surrounding reefs. The plan should outline a 10-year development project to accomplish the expansion.

The division identified five zones within the Pamlico Sound for the construction of oyster sanctuaries, zones 1-5 (Figure 1). These zones were delineated by combining oyster growing areas into regional areas and taking into account access from major oystering ports. Within these zones, the division works with commercial and recreational fishermen, scientists, universities, and non-governmental organizations to determine the location and delineation of existing and new oyster sanctuary sites.

North Carolina Oyster Restoration Regions

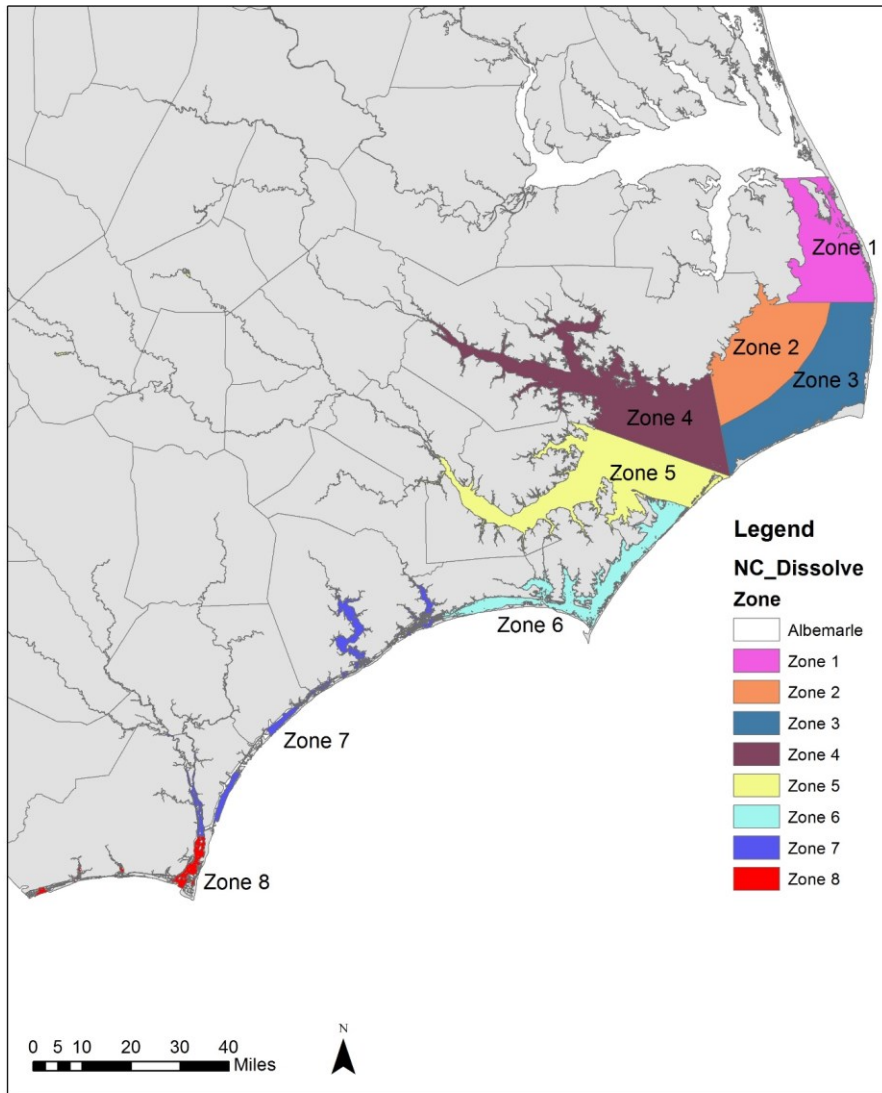


Figure 1: North Carolina Oyster Restoration Regions

Existing Sanctuary Sites

For the past 21 years, the objective of the Oyster Sanctuary Program has been to establish a network of protected oyster beds to provide increased larval production and settlement to other reefs throughout Pamlico Sound, including the Neuse River. As of 2016, 15 planned sites, including 14 completed or under development and two in design, are under the direct management of the Sanctuary Program in Pamlico

Sound. Table 1 outlines the current and planned oyster sanctuaries in North Carolina. Figure 2 depicts the locations of all sanctuaries in coastal North Carolina.

Table 1: Current and Planned Oyster Sanctuaries in Pamlico Sound

Sanctuary	Year Established	Permitted Acres	Developed Acres	Material
Croatan Sound	1996	7.7	5.4	1,800 tons limestone marl riprap, Pallet Reef Balls (added 2013)
Crab Hole	2003	30.5	30.5	38,076 tons limestone marl riprap
Gibbs Shoal	2009	30	30	16,075 tons limestone marl riprap, 2,674 Ultra Reef Balls; reef cube
Deep Bay	1996	17.2	5.7	1,300 tons limestone marl riprap, 290 Bay Reef Balls (added 2014)
West Bluff	2005	19.9	9.1	8,400 tons limestone marl riprap, 10 Ultra Reef Balls, 75 Pallet Reef Balls and 125 Bay Reef Balls
Clam Shoal	1996	58.2	31.4	38,359 tons limestone marl riprap
Middle Bay	2004	4.6	0.4	900 tons limestone marl riprap
Ocracoke	2004	76	25.4	11,347 tons limestone marl riprap, Reef Balls, precast concrete, processed recycled concrete, three 65'–130' vessels
Neuse River	2005	5.7	5.3	7,500 tons limestone marl riprap
West Bay	1996	6.7	2.2	2,000 tons limestone marl riprap, 100 Mini Bay Reef Balls (added 2014)
Long Shoal	2013	10	6.6	880 Ultra Reef Balls
Raccoon Island	2013	10	7	1,169 Ultra Reef Balls, 150 tons precast concrete, 157 tons processed recycled concrete
Little Creek	2016	20.7	9.8	Limestone marl riprap, Reef Balls, precast concrete, processed recycled concrete, concrete blocks, granite riprap; basalt riprap
Pea Island	2015	32	12.4	360 Ultra Reef Balls, 900 tons precast concrete, 1,800 tons processed recycled concrete
U.S. Army Corps of Engineers Mitigation (funded, proposed, but not finalized)	2016-2020	82.8	42	Granite riprap covered with processed, recycled concrete (proposed)

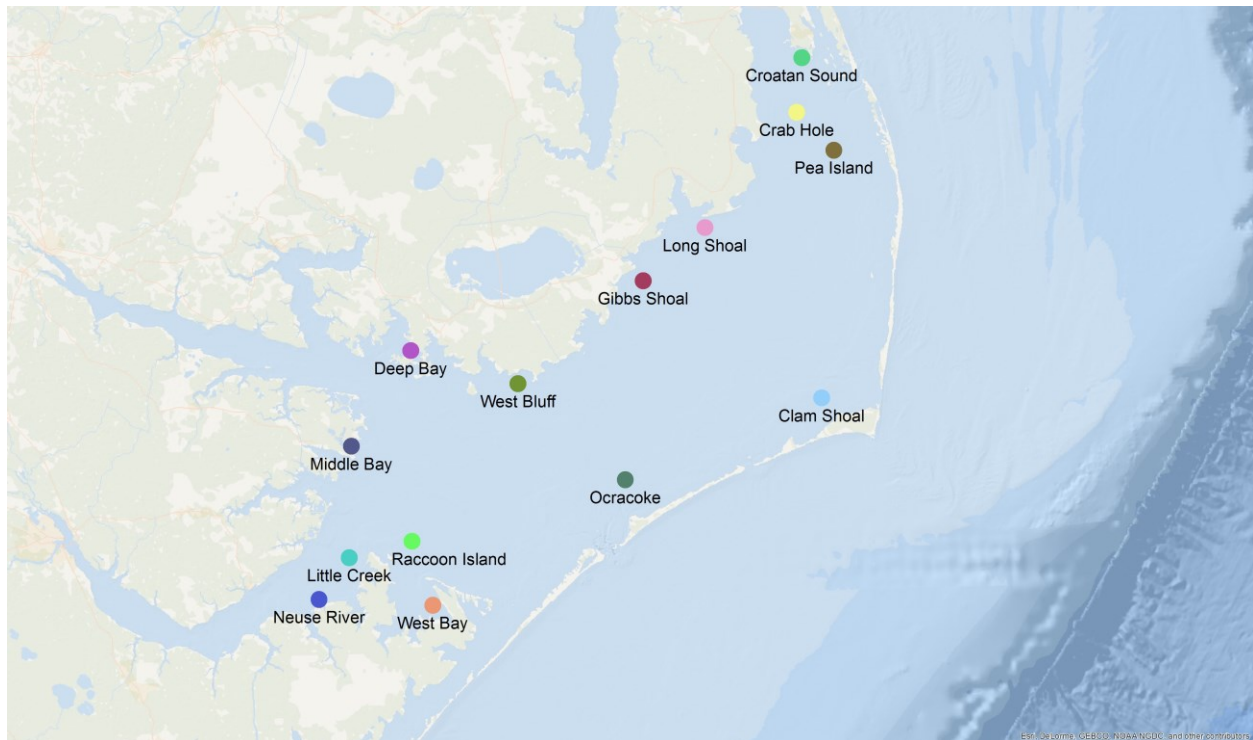


Figure 2: Location of existing and planned oyster sanctuaries in North Carolina.

On-going evaluation and future siting of sanctuaries

The goal for the system is to complete the construction of approximately 500 acres of sanctuaries in the next 10 years. So far the division has received permits to construct 328.5 acres of sanctuaries, and 171.5 acres of the system have been constructed. On-going research and monitoring has indicated a need to concentrate large scale sanctuary development in Zones 1,2,4 and 5 and this will require some modification and adjustments to existing permits as well as the siting of additional locations for sanctuaries to meet the 500-acre goal.

The division will work with existing stakeholders to hold bi-annual meetings with scientists, universities, non-governmental organizations and fishermen to evaluate existing progress in developing the sanctuary system and to gather information and develop a list of target areas within each zone for future adjustments to the plan. The division has determined that the existing salinity in Albemarle Sound is too low to support sustained oyster growth and survival. The division will work with N.C. State University's Center for Marine Sciences and Technology to maintain and use an oyster sanctuary site-suitability model. This model will incorporate information such as commercial trawling areas, larval connectivity among existing cultch planting sites and oyster sanctuary sites and accessibility by recreational fishermen. The division will use these data, in concert with monitoring data, to guide future decisions on reef construction materials and designs. Once target areas and construction plans have been identified, the division will schedule regional public meetings so that individual fishermen, non-governmental organizations and the general public can provide comments.

2. Enhancement of oyster habitat restoration.

NCGA Requirements: The NCGA found that the lack of a reliable State-based supply of oyster seed and inadequate funding for cultch planting are limitations to the expansion of oyster harvesting and the restoration of wild oyster habitat in North Carolina. Therefore, it requested the following:

- a) Provisions and recommendations to facilitate the availability of oyster seed produced in North Carolina for wild oyster habitat restoration projects as well as oyster aquaculture and to reduce potential negative impacts from importation of nonnative oyster seed.*
- b) Plans, where feasible, for public-private partnerships for State-based production of viable oyster seed through the creation of one or more production hatcheries and recommendations for increased support of 10 the existing research hatchery at UNC-Wilmington.*
- c) Plans and cost estimates for an expansion of cultch planting in suitable areas of the State's coastal waters in order to expand areas suitable for development of wild oyster habitat.*

Provisions and recommendations to facilitate the availability of oyster seed

In 2005, Senate Bill 550 and budget appropriations in Fiscal Year 2005/2006, led to the N.C. Oyster Hatchery Program and a 2007 report recommending a production hatchery to provide seed to the industry and for restoration projects; an educational and training hatchery and a research hatchery. In 2008, \$4.3 million was provided to construct the University of North Carolina at Wilmington Shellfish Research Hatchery. It began operations in 2010 with a focus on developing techniques for rehabilitating and farming the state's shellfish species, particularly oysters.

The division is contracting with the university with funds provided in the 2015 state budget to enhance their oyster broodstock development program. The focus will be on developing stocks genetically suited for the salinity and habitat regimes found within coastal North Carolina. This effort will ensure that hatchery broodstock oysters are available and optimized for grow out and are available to commercial hatcheries in North Carolina. Continued recurring funding in the amount of \$500,000 is necessary to maintain the broodstock program with the university.

Plans for public-private partnerships for state-based production of viable oyster seed

The division does not have the facilities or expertise to operate a production hatchery. It does own property in Cedar Island, N.C. that can be developed into a state hatchery or provide the site for a public-private partnership for a hatchery. A partnership such as this could be simply structured as a traditional lease. In an alternative, mutually beneficial partnership scenario, the division could lease the site to an individual or group at a reduced cost or in exchange for diploid (reproductive) seed product to support restoration projects. Under this scenario, seed would facilitate the division's investigation of remote setting practices as a restoration measure (spat-on-shell). Remote setting might be beneficial in areas where natural larval supply is low, but water quality is suited for growth and survival of marketable shellfish. Supplementing these areas with hatchery-seeded shell has potential to jumpstart an oyster restoration site by skipping the phase of the cycle where larvae settles onto the shell known as recruitment.

Plans and cost estimates for an expansion of cultch planting

The Shellfish Rehabilitation Program has been operational in North Carolina since 1915 through various agencies and divisions. Between 1915 and 2013, an estimated 20 million bushels of cultch material was

planted in coastal North Carolina. Cultch material provides hardened structures to facilitate oyster larvae settlement and growth. Oyster larvae settle on a hard surface and grow into spat, eventually growing into adult oysters of harvestable size. In addition to the commercial opportunity associated with the oyster harvest, oyster reefs provide numerous ecosystem services, including essential habitat for commercially and recreationally targeted fish and crustaceans.

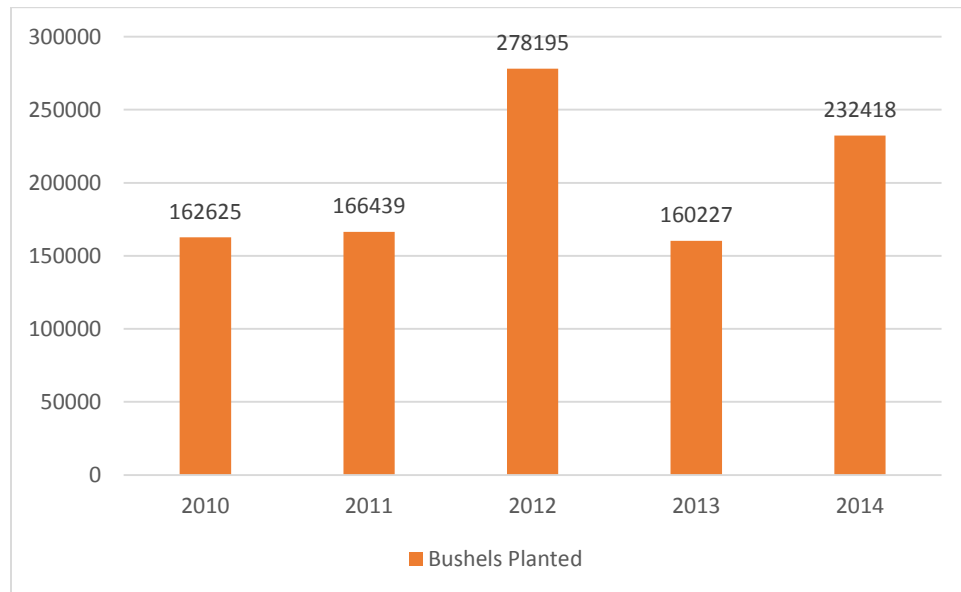


Figure3. Bushels of Cultch Material Planted, 2010–2014

The estimated acreage for oyster cultch planting (Table 2) ranged from 50 acres in 2009 to 39 acres in 2014, with a high of more than 81 acres in 2010, resulting from a partnership with the North Carolina Coastal Federation. The cumulative total planted was 309 acres.

Table 2. Number of Bushels and Acreage of Cultch Planted per Year

Year Planted	Year Benefits Begin to Accrue	Bushels Planted	Acreage
2009	2010	206,364	49.59 ^a
2010	2011	208,309	81.36 ^b
2011	2012	166,439	30.12 ^b
2012	2013	276,370	69.47 ^b
2013	2014	157,677	39.43 ^b
2014	2015	232,418	39.08 ^b

^a Denotes estimated acreage from using the average bushels per acre from total bushels planted divided by the total acres during 2010 through 2015.

^b Denotes actual acreage developed from known coordinates.

Cultch is deployed in spring and summer months at prime shellfish-growing areas to enhance the existing oyster fishery. The prime areas are designated by the division through consultation with various stakeholders, including commercial fishermen, the general public and research partners. The division hosts eight public meetings per year in coastal areas to facilitate input. There are no additional harvest restrictions for commercial or recreational fishing at cultch planting sites. Oysters and reef-associated organisms can be removed from the cultch planting sites in accordance with their specific regulations, such as size limit and season.

The division has identified eight zones for the construction of harvestable cultch planting sites that provide harvestable reefs on public bottom (Figure 1, Zones 1-8). Like the zones for oyster sanctuaries in the Pamlico Sound, areas were delineated by combining oyster growing areas into regional areas and taking into account access from major oystering ports. Three additional zones (Zones 6, 7, and 8) were added for restoration outside of the Pamlico Sound. Zone 6 covers the Core, Back, and Bogue sounds in Carteret County. Zone 7 covers the waters open to shellfishing from the N.C. 58 Bridge in Emerald Isle, south to Snows Cut in Carolina Beach and a portion of the Cape Fear River. Zone 8 covers the southern Cape Fear River south to the South Carolina state line.

Through existing and future funds, the division will use two approaches to increase its cultch planting program. With current appropriated funds, cultch planting operations will be increased using division vessels and staff in all restoration zones 1-8 (Figure 1). These plantings will mainly target hand harvest areas within shallower waters. Existing appropriations will enable the division to place cultch material on approximately 80 to 100 acres each year. With additional appropriations, the division will use private contractors to develop larger scale cultch planting sites (greater than five acres) within deeper areas of the Pamlico Sound. With the funds requested, approximately 80 acres will be planted by contractors each year.

Zones 1, 2, 4, and 5 (Figure 1) are the target areas for large scale restoration, two of which will be targeted each year. By targeting two each year it will reduce operation cost for contractors and the division by reducing mobilization and staging costs. Zone 3 (Figure 1) is not targeted for large scale restoration due to the salinity ranges, submerged aquatic vegetation presence, and oyster predation and pests. However, small-scale restoration projects will continue in areas of Zone 3 that are suitable for restoration. The division has concluded that because of low salinity there are no areas suitable for cultch planting in the Albemarle Sound. Additionally, the Albemarle Sound is not sampled by the Shellfish Sanitation Program due to funding cuts and because the water quality does not support commercial quantities of shellfish.

Larger sites will be strategically located to ensure access by fishermen, and they will be large enough to be managed in a rotational harvest. With rotational harvest, a selected area or areas are opened for a specified length of time to allow for commercial harvest, while others are closed. Then the areas open or closed to harvesting are rotated to prevent depletion of material. This strategy will help sustain long-term benefits to commercial oystermen. Through this 10-year plan, the division's goal is to develop enough acreage of cultch plantings to keep at least one rotational harvest area open at all times during the mechanical oyster harvest season in zones 1, 2, 4, and 5 (Figure 1). Rotational harvest management will require additional monitoring effort.

The division will hold bi-annual meetings with scientists, universities and non-governmental organizations to gather information and develop a list of target areas in each zone for cultch planting construction. The division will work with the Center for Marine Sciences and Technology to develop a cultch planting site-selection model and to determine the necessary funding needed to update the model

periodically. This spatial model will consider location of commercial trawling areas, connectivity to existing cultch planting sites and oyster sanctuary sites, and accessibility by recreational fishermen. Once target areas for cultch planting construction have been identified, the division will schedule public meetings so that individual fishermen, organizations, and the general public can comment on the proposed locations and materials selected.

3. Economic Relief

NCGA Requirements: The plan should consider a waiver of application fees and yearly rental fees for new shellfish leases for an established period of time to further promote and support shellfish aquaculture in North Carolina. The new leasing fee waiver program should include measures to discourage speculation and target persons with a genuine interest in starting a shellfish aquaculture business, such as a requirement that the lease be nontransferable for a five-year period.

To promote commercial production of shellfish seed and nursery of seed product, the division recommends allowing commercial shellfish hatcheries to apply for and obtain up to a three-acre water column lease, rent free for the first five years of the lease (this would save the hatcheries up to \$1,500). Additionally, the division recommends waiving bottom lease rental fees for individuals who complete a course of study in shellfish aquaculture from a community college. This would apply to a rental term of up to 10 years and a maximum of 10 acres (this would save leasers up to \$1,000). Reducing start-up costs for recent graduates will help them to become established, while promoting the shellfish aquaculture industry as a whole. Thus becoming productive and providing benefits to the local and state economy as well as the resource. Lease production requirements would still apply for discounted leases.

The division will work with the oyster steering committee stakeholders to encourage the Natural Resources Conservation Service of the U.S. Department of Agriculture to include oyster restoration as part of its conservation plan for North Carolina. This will enable the Natural Resources Conservation Service to provide cost-share funds to assist oyster growers with operations. The Natural Resources Conservation Service is providing such cost-share funds in other states already.

4. Outreach

NCGA Requirements: The plan should include outreach and education that promotes, whenever possible, public-private partnerships utilizing the Sea Grant College Program, local colleges, and other nongovernmental organizations to:

- (i) encourage shellfish aquaculture and provide technical assistance to broaden cost-effective technologies available to leaseholders;*
- (ii) encourage best management practices to leaseholders; and*
- (iii) inform fishermen and the public on the benefits provided by the Senator Jean Preston Oyster Sanctuary Network.*

To expand the shellfish lease program, the division must have dedicated staff and funding, coupled with strong outreach and extension provided by an appropriate agency such as N.C. Sea Grant. Recommendations to accomplish this support are outlined in the aquaculture recommendations report that is also being submitted to the General Assembly.

Shellfish aquaculture can be promoted and enhanced by funding dedicated programs to provide outreach to the industry and those interested in pursuing shellfish leases. A significant number of shellfish lease

holders currently and historically do not meet annual production requirements, which often results in termination of the lease. Reasons vary from lack of formal training and business planning, to families trying to hold on to once productive leases that have been passed down through generations but are no longer cultivated. Extension services such as demonstration leases, aquaculture training and business planning is needed to increase the success rate of shellfish growers and reduce the chronic high non-compliance rate with shellfish lease requirements.

The division will work with the oyster steering committee and seek to partner with publications such as N.C. Sea Grant's Coastwatch and the North Carolina Coastal Federation's Coastal Review Online to inform and educate the public on enhancement efforts and the shellfish aquaculture industry. The division will work with the steering committee to organize working committees to assist in implementing this plan and participate in public conferences held every two years by the steering committee to help publicize progress made in carrying out the plan.

5. Monitoring

NCGA Requirements: The plan should include a monitoring plan designed to (i) determine the success of oyster reef construction and (ii) evaluate the cost benefit of the oyster sanctuary network and harvestable enhancement sites.

The division will work with stakeholders and the university community to continue to develop and refine oyster sanctuary and cultch planting areas, monitoring protocols, and success criteria. Through this sampling, it will determine material suitability based on oyster population density, fish assemblage, water quality, material stability and durability as well as a cost-benefit analysis. To the extent practical, it will work to align these protocols with national monitoring standards so that North Carolina restoration efforts can be compared favorably with similar efforts in other states and be used to leverage additional private and federal funding. Information generated from this sampling will allow the division to determine biological communities associated with each material and reef within salinity regimes. Oyster density and size structure will be a focus of this monitoring protocol, which are indicators of potential reproductive (larval) output.

In addition, for cultch planting sites, the division will develop a new sampling program to determine the long-term viability of sites as it relates to salinity regime, oyster density, material type, harvest gear type, and construction methods. Through this sampling the division will be able to determine the length of time rotational harvest areas should remain opened and closed and if supplemental cultch material is needed for long term production. It will allow the division to refine its construction and site selection criteria to provide the maximum benefit to the commercial fishermen and environment.

The division will consider a range of success for cultch planted reefs. The minimum threshold for success will be a mean density of 15 oysters per square meter, containing at least two year classes and covering at least 30 percent of the reef area after three years. However the division's target is 50 oysters per square meter, containing at least two year classes and covering at least 30 percent of the reef area after three years. Each is higher than the 10 oysters per square meter threshold set forth by Powers (2009).

In 2014, the division was allocated additional funds that purchased a state-of-the-art side-scan sonar system with the capability to identify subtidal hard substrate. This system will allow the division to actively map and monitor oyster rocks within the Pamlico Sound and other areas to determine the amount of suitable natural substrate. The division will design a monitoring plan to map and designate natural rocks for management purposes. Repeated monitoring should allow the division to determine the shell budget, which is the relationship between shell removal and shell replacement. A shell budget, a deficit

has greater shell removal than replacement, and conversely, a shell budget surplus has greater shell replacement than removal. Ultimately, a balanced or surplus shell budget is required for sustainable oyster populations, and a surplus shell budget is required to expand oyster populations, as oysters are substrate dependent. Due to high harvest pressure in the early to mid-20th century and inconsistent restoration effort to replace shell compared to harvest, North Carolina is most likely experiencing a shell budget deficit. Determining the shell budget will assist the division in management and restoration decisions.

6. Funding

NCGA Requirements: The plan should include a request for appropriations sufficient to for division staff to expand oyster restoration and monitoring activities for 10 years. The plan should provide that, whenever possible, public-private partnerships are employed to meet the construction, seeding, and outreach requirements of the plan.

To expand these programs, the division will need a minimum total annual funding increase of \$5,035,928 (Table 1). At this time the Division does not request any funding for the recommendations outlined in the FY 16-17 budget. Estimated fiscal impacts are included for informational purposes only. These funds cover capital improvements, oyster sanctuary construction, oyster sanctuary siting models, cultch planting construction, cultch planting siting models, Marine Patrol operational budget, and full time equivalency position funding. Funds will need to be flexible as the division will need to make capital purchases for Marine Patrol equipment, purchase shell stockpile sites and build a new vessel to ensure the programs' success now and in the future. The flexibility of funds will allow the division to partner with non-governmental organizations to leverage funds for oyster restoration. Partnering with non-governmental organizations will allow them to use appropriated funds as leverage to secure state, federal, and other grants to expand oyster restoration. The anticipated budget breakdown and expenses are itemized in Table 1.

Oyster Sanctuaries

The division currently has 171.5 acres of Oyster Sanctuaries constructed and designated throughout the Pamlico Sound. There are 9.8 acres funded and under construction as well as other projects in the works. Once all current projects are complete it is expected that approximately 200 acres will be constructed. In contrast, the N.C. Oyster Restoration and Protection Plan: Blue Print for Action 2015 – 2020 (N.C. Coastal Federation 2015) calls for 500 acres of oyster sanctuaries to be constructed by 2020. It is unlikely the 500-acre goal will be met in the foreseeable future without additional state appropriated funding.

The construction capability of the division is limited; therefore, funding will be required to increase the scale of development through hired contractors and additional purchased materials. The division will continue to construct oyster sanctuaries to reach the 500-acre goal through small-scale (10-acre) projects. Small reefs of this nature, distributed throughout the state, are an important insurance policy to protect against catastrophic events.

In 2009 and 2010, the division worked with the North Carolina Coastal Federation to receive federal funds to construct approximately 47 acres of sanctuaries at two locations in Pamlico Sound in 10 months by using private contractors. The cost of constructing this acreage was approximately \$4 million, and included division staff time, Coastal Federation staff time, as well as all contractor and material costs. In current dollars, the division estimates that it will cost approximately \$1 million to construct 10 acres of

reef, and thus it will cost approximately \$30 million over 10 years to build the additional 300 acres of sanctuaries in Pamlico Sound. There are numerous federal sources of funds that may be secured to help build these reefs, as well as additional funding sources, such as the Marine Resources Fund (Coastal Recreational Fishing License grants) and the North Carolina Clean Water Management Trust Fund.

New reef siting is extremely important for the success of the Senator Jean Preston Marine Oyster Sanctuary Program. Every three years, up to \$75,000 of the funds for oyster sanctuaries may be used to contract with universities for updating site modeling tools.

To reach the 500-acre goal for sanctuaries over this 10-year plan, it is estimated that the oyster sanctuary program will need:

1. \$1.5 million in recurring state appropriations each year to pay for construction.
2. Work with non-governmental organizations to secure at least \$1.5 million in non-appropriated state funds, at a one-to-one ratio, each year using the state appropriation to leverage additional funding.
3. Develop public-private partnerships with non-governmental organizations that enable the use of state appropriations to serve as matching funding to secure non-state appropriated funding as well as to assist in securing and managing private contractors.
4. When appropriate, combine the construction of sanctuaries by contractors with the construction by contractors of deep water cultch sites to reduce mobilization costs and increase the scale and duration of construction activities so as to realize economy of scale cost savings.

Cultch Planting

Until fiscal year 2015-2016, annual funding was limited to approximately \$300,000 to purchase and transport cultch material for harvestable oyster reefs. This funding allowed for annual development of approximately 40 acres of harvestable reef sites. In fiscal year 2015-2016, funds for cultch planting were increased to approximately \$600,000, with another increase to a total of approximately \$900,000 in fiscal year 2016-2017. With the higher budget, the cultch planting program will increase annual plantings to approximately 80-100 acres of harvestable reefs by fiscal year 2016-2017.

To support a growing oyster industry and provide harvest opportunities on a scale similar to neighboring states, additional state-appropriated funding increases will be necessary for the cultch planting program (Table 1). Through these funds, over time, the state will try to move any shell or cultch deficit to a surplus, which will provide the basis for growth of oyster stocks.

Every year, in addition to the 80-100 acres constructed by the division, contractors will be used to construct 80 acres of harvestable oyster reefs. Reefs constructed under contract will focus on areas in deeper portions of the Pamlico Sound, where division vessels cannot easily work. Over the 10-year period, the division, with contractors, plans to create 800 acres of harvestable oyster reefs. Zones 1, 2, 4, and 5 (Figure 1) will each contain 200 acres. Once these sites are constructed, they will be managed in a rotational harvest scheme to maximize harvest and prevent material and resource depletion. Following the 10-year period, the division will be able to maintain the sites with recurring money at a much lower annual cost than construction cost.

Every three years up to \$75,000 of the funds for cultch planting will be used to contract with universities for updating modeling to improve reef siting and the ultimate success of the Cultch Planting Program.

Currently, the Shellfish Rehabilitation Program which includes the Oyster Sanctuary Program, Cultch Planting Program and several other small programs, has several vehicles, boats and major pieces of equipment to maintain; however, the program only has one mechanic. To ensure proper maintenance and expand the rehabilitation programs, the division will need a Maintenance Mechanic IV position to support the Marine Mechanic Supervisor.

The Cultch Planting Program is in need of a Marine Fisheries Biologist II and Marine Fisheries Technician II position to support cultch planting operations, provide assistance to fishermen, conduct sampling and oversee the new monitoring programs.

To increase cultch planting in North Carolina, the division needs to maintain current dedicated cultch planting funds of \$900,000, as well as additional funds to contract with private contractors. To develop an additional 80 acres of harvestable oyster reefs through contractors in the deeper areas of Pamlico Sound, the division will need \$3 million of additional funding annually. This will bring the total dedicated cultch planting budget to \$3.9 million per year.

In addition to this level of funding, the cultch planting program will:

1. Work with non-governmental organizations to secure non-appropriated state funds each year using the state appropriation as leverage.
2. Develop public-private partnerships with non-governmental organizations that enable the use of state appropriations to serve as matching funding to secure non-state appropriated funding, as well as to assist in securing and managing private contractors.
3. When appropriate, combine the construction of cultch reefs by contractors with the construction by contractors of nearby sanctuaries sites to reduce mobilization costs and increase the scale and duration of construction activities so as to realize economy of scale cost savings.

The division currently purchases oyster shell and other shell products such as scallop shell, surf clam shell, etc. as cultch material. Fossil rock or marl is also purchased to supplement supplies of shell. Shell purchases for cultch material fall under a special delegation for oyster shells. Any increase in the price of shell, loading or transport must be approved under this delegation. In the past this has led to shortages of shell because it is sold to other states or even non-governmental organizations. The division needs the flexibility to purchase, load and transport shell at market prices to allow expedient delivery for seasonal cultch planting activities.

Shellfish Leases

To staff the N.C. Shellfish Lease Program and ensure that North Carolina can expand its shellfish aquaculture industry, the program will need increased staff and funding as recommended in the Aquaculture Recommendation Study, submitted by the division. Through this increased staff and funding, the division will reduce the length of time it takes to process a lease application and sample the site. In addition, the division will be able to work with the applicant to find a suitable lease site.

Capital Improvements

Dockage and Stock Pile Sites

To ensure the longevity of division restoration activities, the state of North Carolina will need to either purchase property, secure long-term leases for vessel dockage and stockpile locations or develop

alternative methods for supplying shell and materials for cultch sites, such as using larger vessels as floating stockpiles.

Currently, the division owns two vessel dockage and stockpile sites, both of which are in Carteret County. One is in Cedar Island and the other is in the South River community near Beaufort. These two sites enable the division to plant cultch in the Core Sound and Pamlico Sound portions of Carteret County. The South River site serves as a base of operations for oyster sanctuary and artificial reef development in the Neuse River and southern reaches of the Pamlico Sound. Some operations are also conducted from several other state-owned properties, though those sites are not owned by the division. These ancillary sites are generally very small and have restrictive use agreements which prevent long-term planning.

In Wanchese, the division rents a small lot for vessel dockage and shell storage from the Wanchese Marine Industrial Park under the N.C. Department of Commerce. This site is only large enough for cultch planting and not oyster sanctuary or artificial reef development. Long-term planning at this site is difficult, as it is a short-term agreement, requiring annual renewal, at a cost of approximately \$11,000.

In Swan Quarter, the division uses a small space at the N.C. Division of Transportation's ferry terminal. This site is provided free of charge; however, we do not have a long-term commitment from the N.C. Ferry Division. This site allows the division to plant cultch in the waters adjacent to the southern portion of mainland Hyde County. It also allows for oyster sanctuary and artificial reef development in the waters off Hyde County, the Pamlico River and southern Pamlico Sound.

In Jacksonville, the division uses a vessel dockage and stockpiling facility owned by Marine Corps Air Station New River free of charge. However, this facility may not always be available and access fluctuates depending on base activity and security levels. This site allows the division to plant cultch in the New River. This facility is large enough to use for cultch planting, oyster sanctuary and artificial reef development.

In Holly Ridge, the division uses a barge loading and stockpile facility owned by the North Carolina Coastal Federation free of charge. This facility was purchased using a Clean Water Management Trust Fund grant and the dock was built with funding from an Environmental Enhancement grant. The site will remain available to the division and provide a model for how to partner with non-governmental organizations to develop stockpile sites that also provide for public access, as well as water quality protection.

Due to limited dockage and stockpile sites, the northern portion of Hyde County, New Hanover County, Pender County and Brunswick County are underserved for oyster restoration. In the southern coastal area of the state (Onslow, New Hanover, Pender and Brunswick counties) contains 5.7 percent of the total area open to shellfish harvest, but produce, on average, approximately 47 percent of the state's landings.

To ensure continued cultch planting, oyster sanctuary, and artificial reef development within the state, the division will need to secure long term access at or near current non-division sites, as well as purchase or lease vessel dockage and stockpile sites in the aforementioned underserved areas. In fiscal year 2016-2017, the division will work with stakeholders to explore possible purchases, strategically located vessel dockage and stockpile sites using funds described in Table 1 for capital improvements. In addition, the division will investigate the use of rental barges and tugs to provide for mobile stockpile locations that can be positioned close to where cultch planting work is occurring. Such use of barges will increase the speed at which material can be deployed by decreasing the time it takes to transport materials from stockpile sites.

Vessel Upgrades

The division's primary oyster sanctuary development, artificial reef development and large scale cultch planting vessel is the M/V West Bay. The West Bay is a 1600-class steel hulled landing craft utility vessel which was constructed in 1976. It is 135 feet long with a 30-foot beam. The vessel was purchased in 2003 on surplus from the federal government but has had several repairs, totaling approximately \$750,000, since 2006. In past years, the division has worked with the N.C. Ferry Division to procure the West Bay's annual maintenance. However, the Ferry Division informed the division earlier this year that they can no longer assist with this maintenance due to budget and staff reductions, and required U.S. Coast Guard maintenance for passenger vessels. This will require the use of private shipyards and will considerably increase the maintenance cost of the West Bay.

The division recommends replacing the West Bay with a slightly smaller, self-propelled barge. The barge will be approximately 120-foot-by-30-foot. It will be lighter and less complex than military designs, but functionally equivalent. It will have near the same capacity as the M/V West Bay. This lighter and less complex design will allow the division to haul it locally, in the Morehead City, area and will greatly reduce operational and maintenance costs over time. It is expected that this vessel will have a life expectancy of 30 years or more. Most of the division's small, self-propelled barges have been in service since the early 1980s and 1990s. The estimated cost for the replacement barge is \$1,200,000. It will be purchased in fiscal year 2016-2017.

Outreach

The Aquaculture Recommendation Study submitted by the division specifies annual funding needs for outreach, which include provisions for division partners to provide outreach, hold workshops, buy demonstration lease gear, conduct demonstrations and hire an outreach assistant.

Marine Patrol

The division's Marine Patrol is in need of four additional officers to increase patrols on oyster harvest grounds and leases. These positions will be stationed in the Pamlico Sound area, where a large number of oyster sanctuaries, leases, rotational harvest areas and hand harvest areas, are located to decrease poaching and increase compliance. Protecting the oyster resource and ensuring sustainability is pivotal to the success of oyster restoration. In year-one, vehicles, vessels, communication equipment and other equipment will be purchased to outfit the officers. Thus, the first year's operational cost will be significantly higher than subsequent years (Table 1).

Shellfish Sanitation

The Division recommends re-establishing a northern regional shellfish sanitation laboratory and laboratory technician as outlined in the Aquaculture Recommendation Study submitted by the division.

7. Recommendations

Poaching from Oyster Sanctuaries and Shellfish Management Areas

To deter poaching at oyster sanctuaries and shellfish management areas and to ensure their continued effectiveness, stricter penalties and fines will need to be imposed.

North Carolina faces a severe poaching problem, exacerbated by low fines, minimum penalties, and insufficient law enforcement to observe oyster harvest areas. Poaching is occurring within oyster sanctuaries, on shellfish leases, and in hand harvest areas. Dredge fishermen have been observed poaching in oyster sanctuaries and in hand harvest areas. Further, the shellfish aquaculture industry, including the Shellfish Growers Association, has repeatedly expressed concerns about theft from leases, pointing to both recreational and commercial poachers. While poaching on any lease has negative effects on the lease holder, losses can be much more significant on water column leases. Aside from the high value of the oysters themselves, water column leaseholders must also invest a considerable amount of money in culture equipment, which is often lost due to theft and poaching. Producers have estimated that water column gear can approach \$40,000 for bottom cages and \$56,000 or more for floating bags to culture one million oysters. Seed costs range from \$15,000 to \$30,000 for one million seed.

Enforcement of oyster harvest regulations has been extremely difficult, contributing to the increase in poaching. Leases are typically located away from shorelines, in remote locations, and are difficult to observe. Since fiscal year 2009-2010, Marine Patrol's budget has been reduced by \$1,237,481, which has limited Marine Patrol's ability to enforce rules and regulations in some circumstances. On the rare occasion an individual is actually caught poaching on a lease, the court system has seldom imposed high fines. The average fine levied for citations under G.S. 113-208 from 1994-2014 was \$24.72, despite an allowed maximum penalty of \$5,000.

The poaching issue is not unique to North Carolina. Other states have taken action to combat the problem. A new Virginia law went into effect on July 1, 2015, giving the Virginia Marine Resources Commission authority to revoke a commercial and/or recreational fishing licenses for up to five years and levy a fine of up to \$10,000 for convicted poachers. The Virginia Marine Resources Commission may also place a lien on the poacher's vehicle or vessel if levied fines are not paid.

Contract Provisions

Purchasing large volumes of material and contracting large scale projects, which may take six-months to a year to complete, requires a new provision which will allow monies to be carried over to the next fiscal year. Without this provision, it will be difficult, if not impossible, to work with contractors to complete large-scale projects without reverting funds at the end of the fiscal year.

Cultch Planting

The division is currently exempt from the N.C. Division of Coastal Management's regulations for the use of natural shell material and marine limestone marl (#4 Marl) in cultch planting operations. However, the division is not exempt from Coastal Management's regulations for the use of processed, recycled concrete less than 4-inches in size. To expand cultch planting operations, it will be pivotal for the division to be exempt from Coastal Management's regulations and permit process for the use of processed, recycled concrete less than 4-inches in size.

Outreach

To promote outreach and allow universities, government or non-governmental organizations to have demonstration or research aquaculture development projects the statutory changes recommended in the Aquaculture Recommendation Study submitted by the division will be needed.

Shellfish Leases

To protect shellfish leases rights and aquaculture operations, fines levied under G.S. 113-208 and 113-269 will need to be increased. The average fine of \$24.72 for convictions under G.S. 113-208 has not been sufficient to deter theft off of shellfish leases.

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

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

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

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

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

- (a) The definitions established in G.S. 106-758 are incorporated by reference into this section. ~~For the purposes of this section, a shellfish lease issued pursuant to G.S. 113-202 is defined as an aquaculture facility only when it has been amended pursuant to G.S. 113-202.1 to authorize use of the water column and when it is or has been regularly posted and identified in accordance with the rules of the Marine Fisheries Commission.~~
- (b) It is unlawful for any person without the authority of the owner of an aquaculture facility to take fish or aquatic species being cultivated or reared by the owner from an aquaculture facility.
- (c) It is unlawful for any person to receive or possess fish or aquatic species stolen from an aquaculture facility while knowing or having reasonable grounds to believe that the fish or aquatic species are stolen.
- (d) It is unlawful for any person to willfully destroy or injure an aquaculture facility or aquatic species being reared in an aquaculture facility.
- (e) Violation of subsections (b) or (c) for fish or aquatic species valued at more than ~~four hundred dollars (\$400.00)~~ one thousand dollars (\$1,000.00) is punishable under G.S. 14-72. Violation of subsections (b) or (c) for fish or aquatic species valued at ~~four hundred dollars (\$400.00)~~ one thousand (\$1,000.00) or less is a Class ~~4~~ A1 misdemeanor punishable by a fine of not less than five

hundred dollars (\$500.00) nor more than five thousand dollars (\$5,000.00). Any second or subsequent violations of this section within three years after the date of a prior violation is guilty of a Class A1 misdemeanor punishable by a fine of not less than one thousand dollars (\$1,000.00) nor more than five thousand dollars (\$5,000.00).

- (f) Violation of subsection (d) is a Class ~~A1~~ misdemeanor punishable by a fine of not less than five hundred dollars (\$500.00) nor more than five thousand dollars (\$5,000.00). Any second or subsequent violations of this section within three years after the date of a prior violation is guilty of a Class A1 misdemeanor punishable by a fine of not less than one thousand dollars (\$1,000.00) nor more than five thousand dollars (\$5,000.00).
- (g) In deciding to impose any sentence other than an active prison sentence, the sentencing judge shall consider and may require, in accordance with G.S. 15A-1343, restitution to the victim for the amount of damage to the aquaculture facility or aquatic species or for the value of the stolen fish or aquatic species.
- (h) The district attorney shall dismiss any case brought pursuant to subsections (b) and (c) if defendant produces a notarized written authorization for taking fish or aquatic species from the aquaculture facility or if the fish or aquatic species taken from a shellfish lease aquaculture facility was not a shellfish authorized for cultivation on the lease. (1989, c. 281, s. 1; 1993, c. 539, ss. 850, 851; 1994, Ex. Sess., c. 24, s. 14(c).)

Table 3. Proposed operational bud get expansion to accomplish goals put forth within this plan.

Fiscal Year	Capital Improvements	Oyster Sanctuary Construction	Cultch Planting Construction	Operating Budget Marine Patrol	FTE Staff Salaries and Fringe
2016/2017	\$2,000,000	\$1,500,000	\$1,500,000	\$688,660	\$340,004
2017/2018	\$100,000	\$1,500,000	\$3,000,000	\$95,924	\$340,004
2018/2019	\$100,000	\$1,500,000	\$3,000,000	\$95,924	\$340,004
2019/2020	\$100,000	\$1,500,000	\$3,000,000	\$95,924	\$340,004
2020/2021	\$100,000	\$1,500,000	\$3,000,000	\$95,924	\$340,004
2021/2022	\$100,000	\$1,500,000	\$3,000,000	\$95,924	\$340,004
2022/2023	\$100,000	\$1,500,000	\$3,000,000	\$95,924	\$340,004
2023/2024	\$100,000	\$1,500,000	\$3,000,000	\$95,924	\$340,004
2024/2025	\$100,000	\$1,500,000	\$3,000,000	\$95,924	\$340,004
2025/2026	\$100,000	\$1,500,000	\$3,000,000	\$95,924	\$340,004