North Carolina Aquaculture Gear Management and Storm Preparedness Resource Guide

Quick Reference Guide

The following document is meant to serve as a guide to the resources shared in the North Carolina Aquaculture Gear Management and Storm Preparedness Workshop to help prevent aquaculture debris and help shellfish growers prepare their farms for storm events. The workshop was put together by multiple partners with the goal of bringing together the shellfish aquaculture community to improve aquaculture gear management and storm preparedness on shellfish leases throughout coastal North Carolina.

National Weather Service Resources

Access to accurate forecasts in the days and weeks ahead of a tropical storm, hurricane, or other severe weather event can be critical in making decisions about preparing a shellfish aquaculture operation for storm impacts. The National Weather Service provides both short and long-term forecasts for specific geographic areas. An extremely detailed hourly forecast (out to 48 hrs), combined with a comprehensive 7-day forecast, and additional coverage of incoming storms can be valuable resources for shellfish growers to optimize their storm preparations.

https://weather.gov/moreheadcity

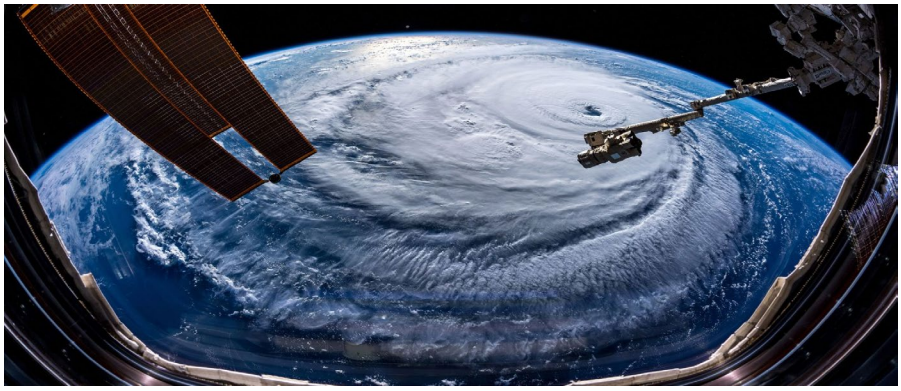
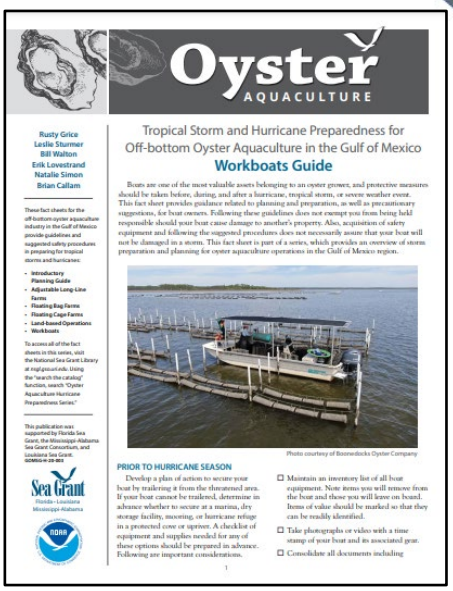


Figure 1. International Space Station view of Hurricane Florence.
Photo courtesy of The European Space Agency

Hurricane Preparedness Guide

Hurricanes are an ever-present threat to shellfish aquaculture operations. Knowing how to plan for storm impacts is a critical part of running a successful operation. This series of fact sheets was developed by shellfish extension specialists at the University of Florida/Institute of Food and Agricultural Sciences, Auburn University Shellfish Lab, and Louisiana State University in collaboration with the Florida, Mississippi-Alabama, and Louisiana Sea Grant Programs as a guide to help shellfish growers prepare for hurricane and storm impacts.


Oyster
AQUACULTURE
Rusty Grice
Leslie Sturmer
Bill Walton
Erik Lovestrand
Natalie Simon
Brian Callam
Tropical Storm and Hurricane Preparedness for Off-bottom Oyster Aquaculture in the Gulf of Mexico
Workboats Guide
PRIOR TO HURRICANE SEASON
Sea Grant

[Storm And Hurricane Preparedness For Off-bottom Oyster Aquaculture In The Gulf Of Mexico]

Best Management Practices - Templates

Best Management Practices (BMPs) are a guideline for how to safely and responsibly manage a shellfish aquaculture operation. Derelict shellfish aquaculture gear presents a hazard to wildlife and recreational users of public waterways and can result in negative public perception of the shellfish aquaculture industry in North Carolina. While the current set of BMPs for North Carolina are voluntary, shellfish growers are strongly encouraged to adopt a farm level BMP document. The suggested practices in these documents will not only help to prevent avoidable damage and production of marine debris, but ensure that farms are running smoothly and efficiently, which is an essential part of maximizing production and profits. It's not a matter of if, but when, and planning and preparing for severe weather can mitigate economic damage to growers' gear and product. Not only will routinely inspecting, adjusting and replacing worn/compromised farm gear minimize losses, it will reduce the labor and time required to prepare a shellfish farm for a severe storm in the critical days prior to impact. The following fact sheets and websites contain information regarding BMPs and resources that can be used to help create a farm level management plan.

[The East Coast Shellfish Growers Association Best Management Manual]

This BMP manual from the East Coast Shellfish Growers Association is a broad guide to help farmers develop their own farm level BMP document. It covers many different aspects of shellfish aquaculture with example BMP's for each and contains a farm level BMP template.

[Prevention Of Marine Debris From Shellfish Mariculture: Best Management Practices For North Carolina Producers]

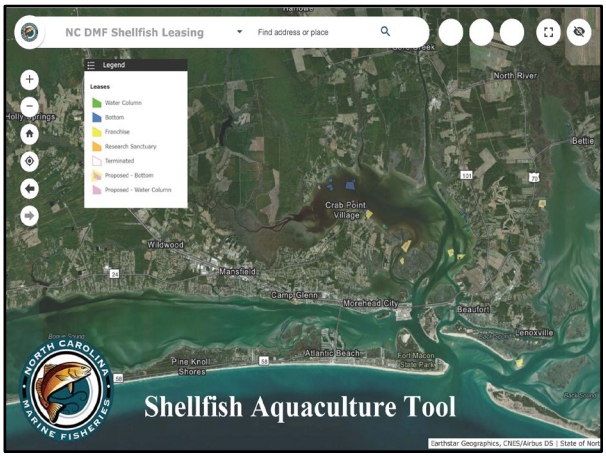
Produced by the NC Coastal Federation, in conjunction with NC Sea Grant, National Oceanic and Atmospheric Administration, NC Division of Marine Fisheries, and industry partners, this guide is meant to help shellfish

growers prevent avoidable damage to gear and the production of marine debris by responsibly managing aquaculture gear placed in the marine environment.

Figure 2. Floating shellfish bags post-storm. Photo courtesy of Bryan Snyder

Florida Department of Agriculture and Consumer Services Shellfish Aquaculture Best Management Practices
The reference sheets on this website help culturists in Florida navigate the regulatory BMP landscape in their state. Many of these practices have been adopted by shellfish aquaculture operations in North Carolina voluntarily and help minimize any negative impacts the industry may have on the natural environment.

Shellfish Lease Siting Tools



Produced to help prospective shellfish growers find suitable shellfish lease sites and promote transparency in the leasing process, these interactive mapping tools are useful when investigating new shellfish lease sites.

NC DMF Interactive Shellfish Aquaculture Tool

UNCW Shellfish Lease Siting Tool

Local and Regional Shellfish Growers Associations

Joining local and regional Shellfish Growers Associations is a good way to stay up to date on changes in the industry, as well as stay in communication with other growers.

The North Carolina Shellfish Growers Association

The East Coast Shellfish Growers Association

NCSGA
North Carolina Shellfish Growers Association

EAST COAST
SHELLFISH GROWERS
ASSOCIATION

Permanent Gear Tags - Suppliers

Permanent gear tags are a great low-cost solution to help identify aquaculture gear after storms for retrieval and to reduce theft. Permanent gear tags are used by shellfish growers in many states and are well worth the investment. Tag information may include lease number and lease holder name and telephone number… for example.

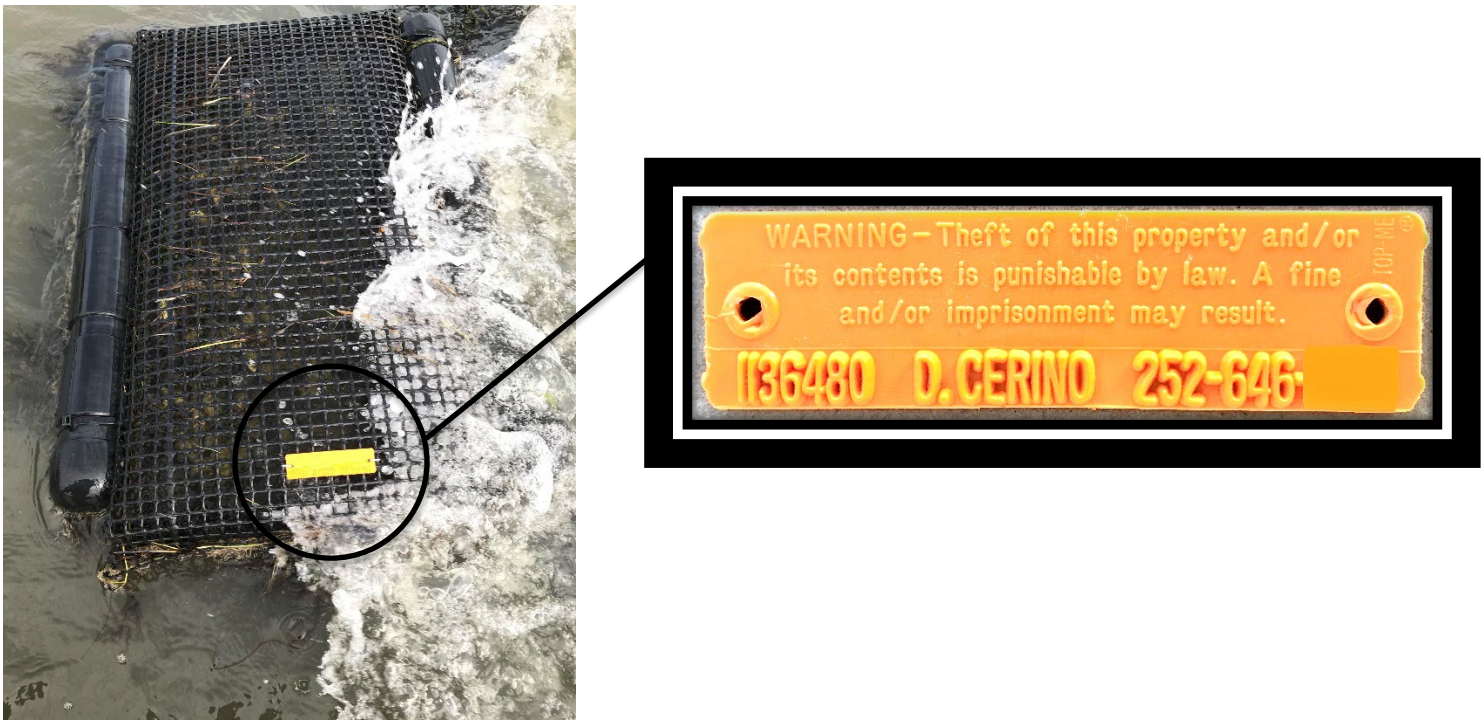


Figure 3. Floating shellfish bag with a permanent gear tag. Photo courtesy of Eric Herbst, NC Sea Grant.

This handout produced by Florida Sea Grant gives a description and contact information for several companies that produce permanent or semi-permanent gear tags.

https://shellfish.ifas.ufl.edu/wp-content/uploads/Marker-Tag-Flyer_2020.pdf

Storm Preparedness and Gear Management Best Practices

NC Shellfish Lease and Aquaculture Program
Adapted from FDACS and UF Resource Guides

*Relocating gear and product off lease into public waters is illegal and will result in product confiscation, permit revocations, and fines.

*Relocating gear or product to another lease outside of the growing area requires resubmergence for 21 days and proper resubmergence tagging (please refer to SS1/SS2 for guidance). The receiving lease must be permitted properly to accommodate any additional gear.

*Relocating shellfish greater than seed size (clams 12mm in length, oysters 25mm in length) to another lease in a different growing area requires resubmergence for 21 days, proper resubmergence tagging, and recording of resubmergence activities in a logbook (please refer to proclamations SS-1/SS-2)

*When relocating gear to another lease, the receiving lease must be permitted properly to accommodate any additional gear.

*Moving product to a land-based cold or wet storage is only allowed by prior approval and permitting by Shellfish Sanitation as a certified shellfish dealer with wet storage permit (as applicable).

Assessing Risks

A farm's vulnerability to risks, such as wind, storm surge, and flooding, can be assessed by reviewing previous storm trends near the farm's location. The NOAA National Hurricane Center, www.nhc.noaa. gov, has storm information (wind speed and direction, pressure, landfall) archived since 1900, which can be used to determine prevailing patterns for different growing locations. By reviewing characteristics of previous storms that have made landfall near the farm, growers can consider what they would have done to prepare in those cases, and what should be included in their plan.

Preserving Business Information

Important information that must be safeguarded should be identified in the plan. A list of insurance policies and financial documents should be kept current along with locations where these documents are stored. Most of this information can be stored electronically; however, hard copies of important documents may be useful in the event of power outages. It may be prudent to duplicate some documents and keep them in different locations.

Maintaining Farm Records

Farm information, such as coordinates, maps, and diagrams of layout and gear, should be included in the plan and available immediately after the storm. Timely inventory records (number of culture units and estimated quantity, age, and sizes of oysters) should also be included. Maintaining a spreadsheet with this information is important for record-keeping required by insurance policies, business loans, or crop disaster assistance programs, such as the U.S. Department of Agriculture (USDA), Farm Service Agency's Noninsured Crop Disaster Assistance Program (NAP). Oyster inventory apps, such as Blue Trace or SmartOysters, are available and recommended. Inventory records should also include vehicles, boats, and motors, as well as equipment used on farms (tumblers, pressure washers, cranes or winches, etc.), at shore-based seed facilities (tanks, pumps, filtration systems, etc.), or at shellfish processing plants (forklifts, refrigerated units, etc.). Photographs and videos with time stamps of both water and land-based operations can provide timely and critical documentation.

Farm Employees

The plan should have information available for farm employees, such as an operational plan identifying essential personnel, services, and equipment, re-opening protocols, records storage, and agreements with suppliers and contractors. Information on evacuation routes, reentry requirements, shelter-in-place plans, and alternative reporting locations could be included. It is important to know how many people will be needed to implement the storm plan and who will help as a storm is approaching. Farm employees should be able to implement the storm plan themselves and be cross-trained in tasks outside their normal job duties to assist with securing gear.

Maintaining Communication

An emergency contact list (electronic and hard copies) for key personnel and businesses providing services to the farm and its customers should be developed and phone numbers kept current. Phone numbers for employees to call for information should also be included. Another communication component could be developed for the media, customers, or public with predetermined messages and messaging platforms.

Maintain Insurance Policies

The time to review insurance policies for the business is prior to the hurricane season to ensure there is adequate coverage for flood, wind, fire, theft, general liability, catastrophic loss, loss of income, and product liability. Insurance agents should be contacted to review coverage.

Figure 4. Floating shellfish bags installed on long lines. Photo courtesy of North Carolina Division of Marine Fisheries

Items in blue boxes apply to floating bags, items in green boxes apply to floating cages.
Items in white apply to all intensive gear types.

Installation

During installation of the farm, there are several important considerations.

1. Assess the site's exposure to storms as a primary factor in site selection.

2. Orient main lines parallel to prevailing winds and waves.

3. Choose an anchoring system suitable to the bottom type.

4. Install substantial, durable anchors (buried to at least 5 feet depth) that will hold in the farm's bottom substrate in the strongest storms.

5. Bury anchors (typically helical metal screw anchors) fully in the sediment to reduce projection above the sea floor, corrosion, and tangling hazard.

6. Invest in durable main line that meets the supplier's recommendation with some protection from chafing at friction points (e.g., anchor attachment).

7. Allow sufficient spacing between lines to ensure bags do not collide in bad weather.

Figure 5. (Top) Shellfish bottom cage filled with oysters. Photo courtesy of Karen Hudson.
Figure 6. (Bottom) North Carolina Shellfish lease with floating gear. Photo courtesy of North Carolina Division of Marine Fisheries.

8. Use a system that will reinforce the bag to reduce chafing at friction points.

9. If floats have removable caps, invest in and practice with a system, such as a mechanical davit or an air compressor to fill floats with air (with a back-up system in place), that allows for safe and efficient sinking and re-floating of bags.

10. Invest in and practice with a system, such as a mechanical davit or a compressor to fill the floats with air (with a back-up system in place), that allows for safe and efficient sinking and re-floating of cages.

11. Place identifying tags on each bag.

Figure 7. Two types of anchors for lines supporting floating aquaculture equipment, sand screw anchor (left), and arrowhead anchors (right). Photos courtesy of Auburn University Shellfish Lab.

Prior to Hurricane Season

Prior to the onset of hurricane season, oyster farmers should take these steps to reduce the risk of losses.

1. Check stocking densities and reduce as necessary (though some farmers have had success by overstocking bags to achieve neutral buoyancy just prior to a storm).

2. Check biofouling and control on a routine basis.

3. Check all lines for chafing (especially near the clips) and repair as needed.

4. Check all bag clips are secured and in good condition at attachment points.

5. Have crew conduct timed practices to gauge time needed per line to prepare for a storm.

6. For shoreside operations, pick up loose pieces of equipment and secure bags to reduce loss from flooding and wind.

7. Review storm plan with crew and family so they can account for personal preparations alongside farm preparations.

8. Maintain appropriate stocking densities so that cages are not crowded and heavy.

9. Air dry cages to control biofouling on a routine basis.

10. Make it a habit to check bridles and lines when flipping to ensure lines do not get tangled.

11. Check all door closures to ensure that the attachments are secure and not worn.

12. Have extra pontoon float caps on hand in workboat.

13. Remove empty cages from the line, as these are prone to come off the line in bad weather.

During Hurricane Season

A tiered approach to preparation, which has been adopted in each fact sheet, allows growers to stage tasks based on the storm or hurricane's track forecast. The authors developed the following color codes to address increasing levels of concern and actions.

Code Yellow

Once a hurricane or tropical storm is projected to impact North Carolina, it is time to begin preparations according to the farm's plan. Note that the timeline is fluid and will depend on the storm's speed and track.

1. Re-check stocking densities and reduce as necessary. If opting to overstock bags to achieve slightly negative buoyancy, ensure stocking is appropriate.

2. Farmers opting to sink their bags below the surface but still float off the bottom by overstocking bags should consider taking this step now.

3. Re-check all lines for chafing (especially near the clips) and repair as needed.

4. Ensure all bag clips are secured and in good condition.

5. Secure any empty bags on shore or on lines.

6. Document the condition of the farm with dated photographs and notes.

7. Document the numbers of various sizes of oysters. (Conduct a product inventory)

8. Review workboat(s) plan.

9. Re-check that all bridles and pucks are in good condition.

10. Re-check that all bag and cage closures are in good condition.

11. Consider consolidating all small seed (e.g., seed held in 2 mm bags) to one section of cages so that you can re-float those cages first once the threat has passed.

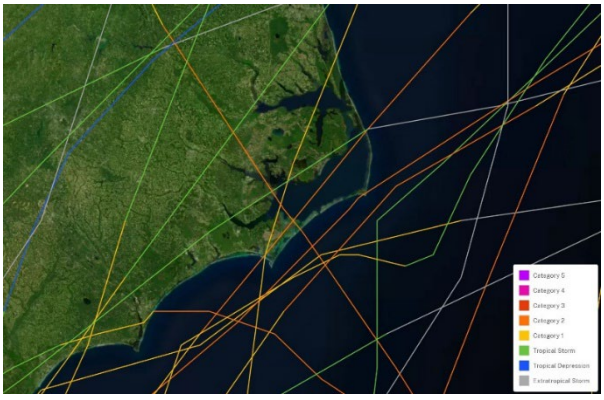


Figure 8. Historical hurricanes of North Carolina, 2005 – 2022. Photo courtesy of NOAA Historical Hurricane Tracks

Code Orange

Once a hurricane or tropical storm watch has been issued, final preparations should begin. In the case of a fast-moving storm, proceed with tasks associated with final stages of preparation.

1. Sell product as market allows.

2. Track the storm's progress frequently and carefully. When assessing whether to sink bags, keep in mind the amount of time necessary to carry out the sinking operation. Farmers should also weigh the risks of bags and oysters being buried in the substrate.

3. Remember that the day before the storm is to make landfall, farmers should not plan to be on the water. They will need that day for other preparations and the weather will likely not allow for it.

4. If weather conditions do not warrant sinking bags, consider adding slack to anchor lines to allow for storm surge. Alternatively, some farmers opt to tighten their mainlines to pull bags under the water surface.

5. If weather conditions warrant sinking bags, remove both floats from bags and allow them to rest on the bottom or remove one float or alternate floats to partially or completely submerge the bags to keep them just above the bottom. Store floats safely onshore.

6. For systems that have floats with caps, remove caps from floats or alternate floats and ensure all air from floats is removed when sinking.

7. Allow time for replacing caps on floats (once all air is removed) to prevent sediment from filling the floats

8. Prepare to implement workboat(s) plan

9. Ensure all air from floats is removed when sinking and walk or dive over the cages to be sure the pontoons are down, with adjustments made as needed.

***Reminder- it is illegal to relocate gear and product outside the boundaries of your shellfish lease unless they are being relocated to another, properly permitted shellfish lease**

Code Red

When a hurricane or tropical storm warning has been issued and there is a high probability of being in the path of the storm, farmers must conclude final preparations if and only if they can be accomplished safely. Farmers will make a series of personal risk assessments.

1. Conduct last check of farm.

2. Implement workboat(s) plan.

3. Get to safety.

Post-Storm Recovery

Oyster growers and their employees must be ready to take care of the needs of the farm as soon as it is safe and reasonable to do so. After a storm has passed, the following tasks should be considered.

1. Assess risk of returning to farm and proceed only when safe.

2. Patrol the area upstream and downstream of the farm for significant debris that could entangle or dislodge gear once it is raised and remove or secure debris.

3. Document the condition of the farm with dated photographs and notes.

4. For shellfish product that has been transported off the lease as a result of the storm, please contact Division staff for guidance.

5. Refloat bags as soon as practically possible by adding flotation and/or reducing stocking densities.

6. If caps were removed from floats, use systems designed for this task, with bags lifted from reinforced points, allowing water to drain out the end caps and being careful to work any bags out of the sea floor if necessary.

7. If necessary, use an on-board washdown hose to rinse sediment off the bags or out of floats and recap once washed down.

8. Assess and document oyster survival, gear condition, and losses.

9. Once mortality risk has passed, resume normal biofouling regimen.

10. Communicate with public agencies about closures and effects of the storm.

11. Communicate with buyers and suppliers to provide situation and outlook reports.

Figure 9. Floating aquaculture gear washed ashore following Hurricane Michael. Photo courtesy of Auburn University Shellfish Lab.

Other Shellfish Aquaculture Resources

Contacts:

North Carolina Division of Marine Fisheries
Shellfish Lease and Aquaculture Program Coordinator
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Email: echerbst@ncsu.edu

Shellfish Lease and Aquaculture Program Assistant
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Email: Marla.Chuffo@ncdenr.gov

Aquaculture Permits Coordinator
Zach Harrison
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Email: Zach.Harrison@ncdenr.gov

Resource Links:

North Carolina Sea Grant

Provides valuable assistance in helping determine capital investment, shellfish lease size, grow-out methods, seed sources, and many other important items that will help aquaculture ventures succeed: https://ncseagrant.ncsu.edu/aquaculture/

Carteret Community College

Offers an Aquaculture Technology Certificate and Associate's Degree programs that provide technical knowledge about aquaculture, operating a business, and finance management: https://carteret.edu/programs/aquaculture-technology/

NOAA: Marine Cadastre National Mapper and Viewer

Offers specific data for vessel traffic density https://marinecadastre.gov/ais/ (*Note this does not apply to personal watercraft) and generalized summaries in the Marine Cadastre viewer: https://marinecadastre.gov/nationalviewer/

North Carolina Division of Marine Fisheries

Administers the Shellfish Lease and Aquaculture Program for the purposes of shellfish cultivation, aquaculture and mariculture within the State of North Carolina: https://deq.nc.gov/about/divisions/marine-fisheries/licenses-permits-and-leases/shellfish-lease-and-franchise

North Carolina Marine Fisheries

Sea Grant North Carolina

National Oceanic and Atmospheric Administration · NOAA · U.S. Department of Commerce

North Carolina Coastal Federation
Working Together for a Healthy Coast