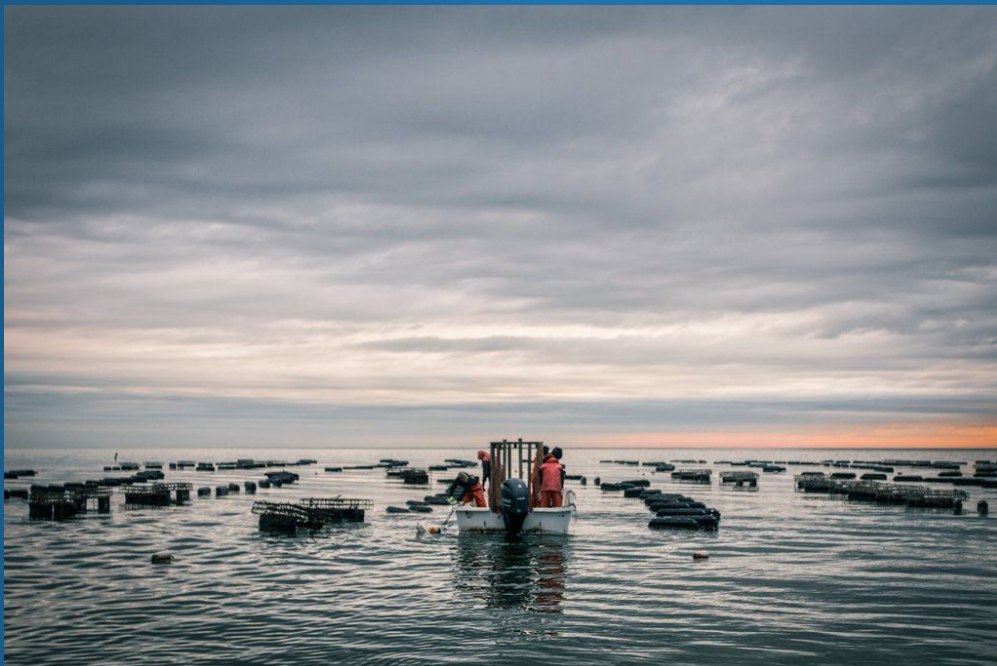


North Carolina Aquaculture Gear Management and Storm Preparedness Workshop: April 8, 2021

-Framing the Issue in North Carolina: A Historical Perspective-

Eric Herbst

Coastal Aquaculture Specialist



North Carolina Shellfish Aquaculture Products

Eastern Oyster (*Crassostrea virginica*)



Hard Clams (*Mercenaria mercenaria*)

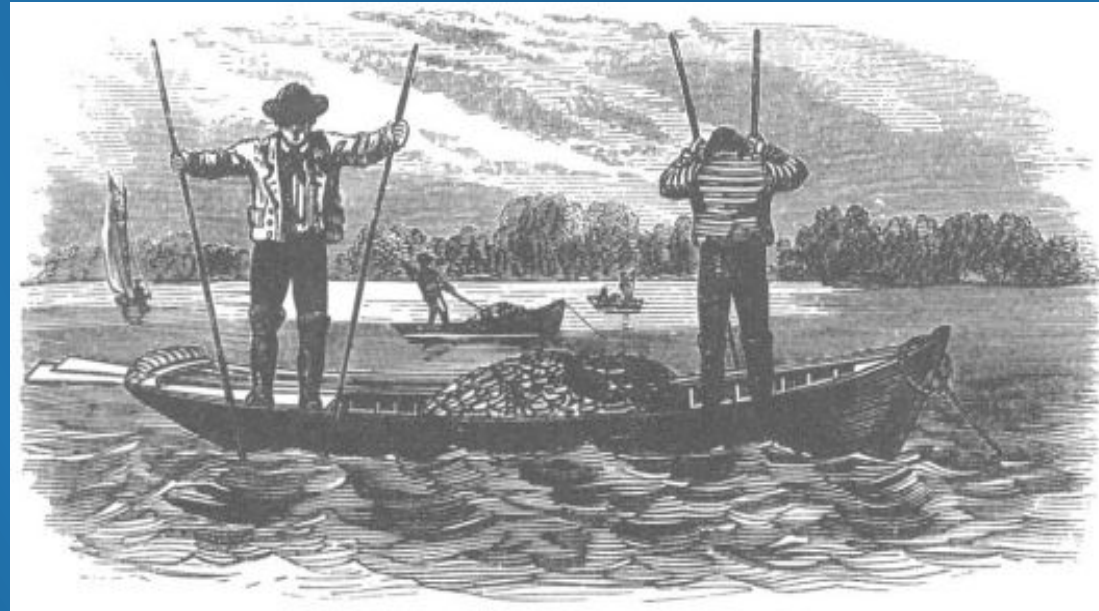


Soft Crabs (*Callinectes sapidus*)



North Carolina Shellfish Aquaculture History

- North Carolina has provided for the private use of public trust waters for shellfish cultivation for over 150 years



Deep-Rooted History of Cultural and Economic Importance for NC Coastal Communities

North Carolina Oyster Leases

- 1989 legislation expanded that role to include shellfish water column leases above existing shellfish bottom leases



Bottom Oyster Lease



Water Column Oyster Lease



Increase in Use of Containerized Gear for Half-Shell Market = Potential Marine Debris

Clam Leases



From Dale Levitt: Applied Shellfish Farming

Clam Netting

Protects Clam Beds from Predators

Same Day Stock Shipment, Custom Fabrication, Worldwide Service

INDUSTRIAL NETTING
www.industrialnetting.com

Clam Leases: Netting Used to Protect Clams from Predators

North Carolina Clam Leases



Clam Leases: Plastic Netting, Sand Bags and Rebar = Potential Marine Debris

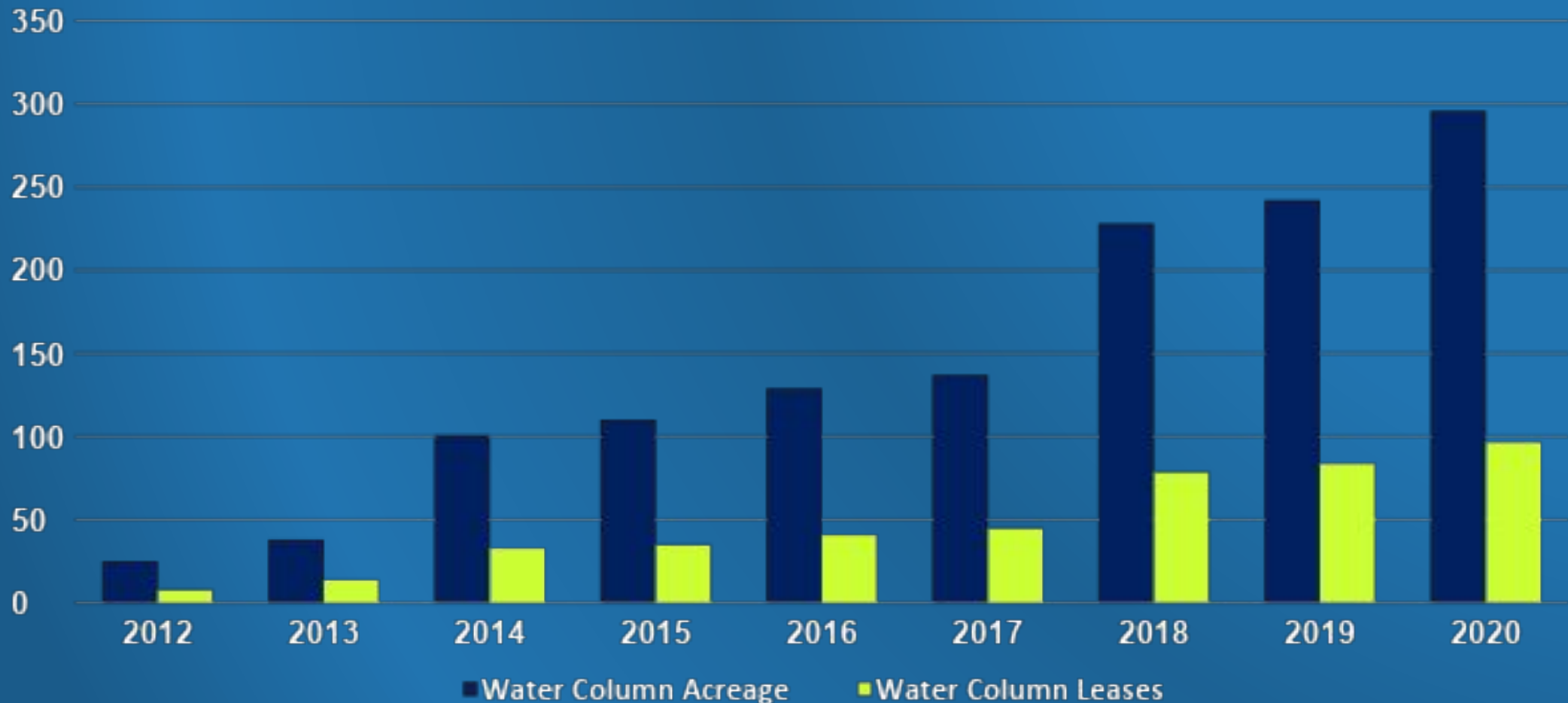
2020 North Carolina Shellfish Lease Applications

2020 Shellfish Lease Applications			
County	Lease Applications	Count of Approved Leases	Acres Approved
Beaufort	0	3	9.48
Carteret	2	14	57.68
Dare	7	2	12.64
Hyde	6	3	8.16
New Hanover	9	0	0.00
Onslow	2	4	19.07
Pamlico	14	2	9.72
Pender	14	5	13.47
Unknown	4		0.00
Grand Total	58	33*	130.23

***Some 2020 approved leases were applied for in 2018 & 2019 Some 2020 applications are still in approval process**

2020 Leases: 58 applications, 33 and a corresponding 130 acres approved

North Carolina Water Column Shellfish Leases



2020 Water Column Leases: # 97 (+ 15% from 2019); Acres 296 (+ 22% from 2019)

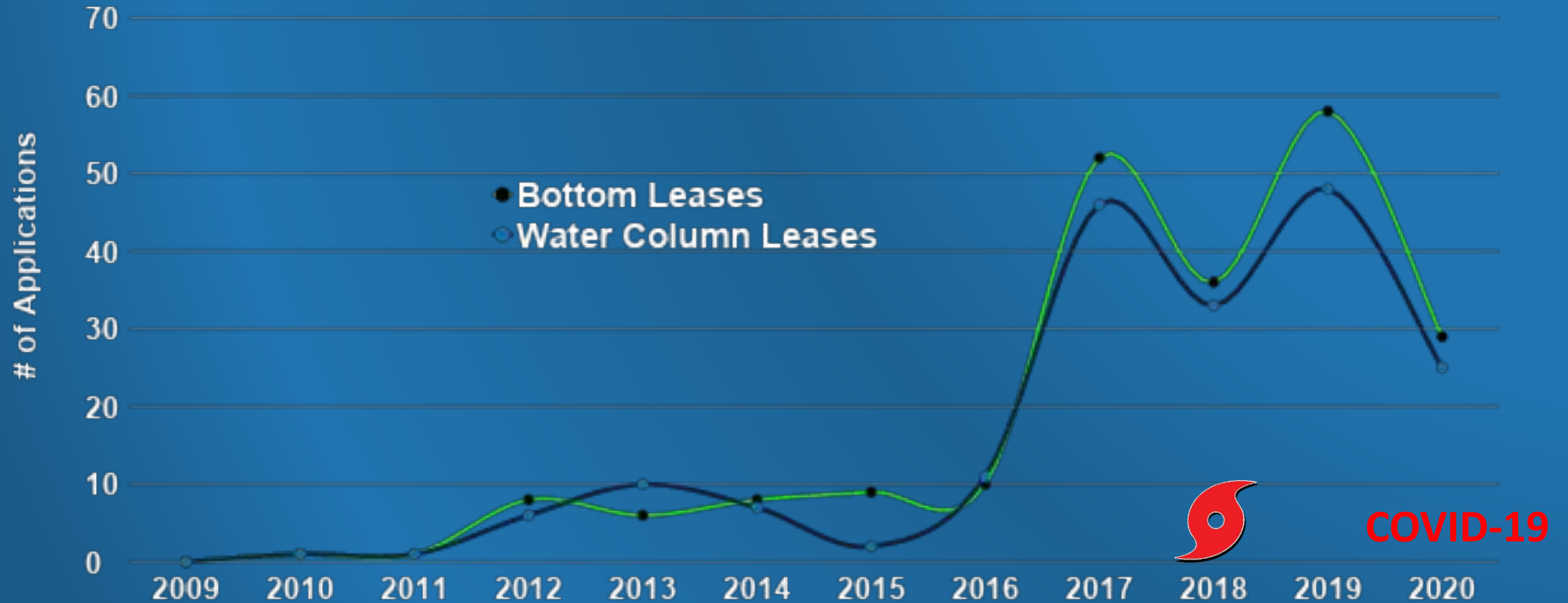
2020 North Carolina Shellfish Leases (Growing Capacity)

2020 NC Shellfish Leases		
Type	Number	Total Acreage
Bottom	232	1,240.87
Water Column	97	295.77
Franchise	48	512.89
Research	4	23.58
Total	381	2,073.11



2020 Shellfish Leases: 381 Leases Totaling 2,073 acres

North Carolina Shellfish Lease Applications

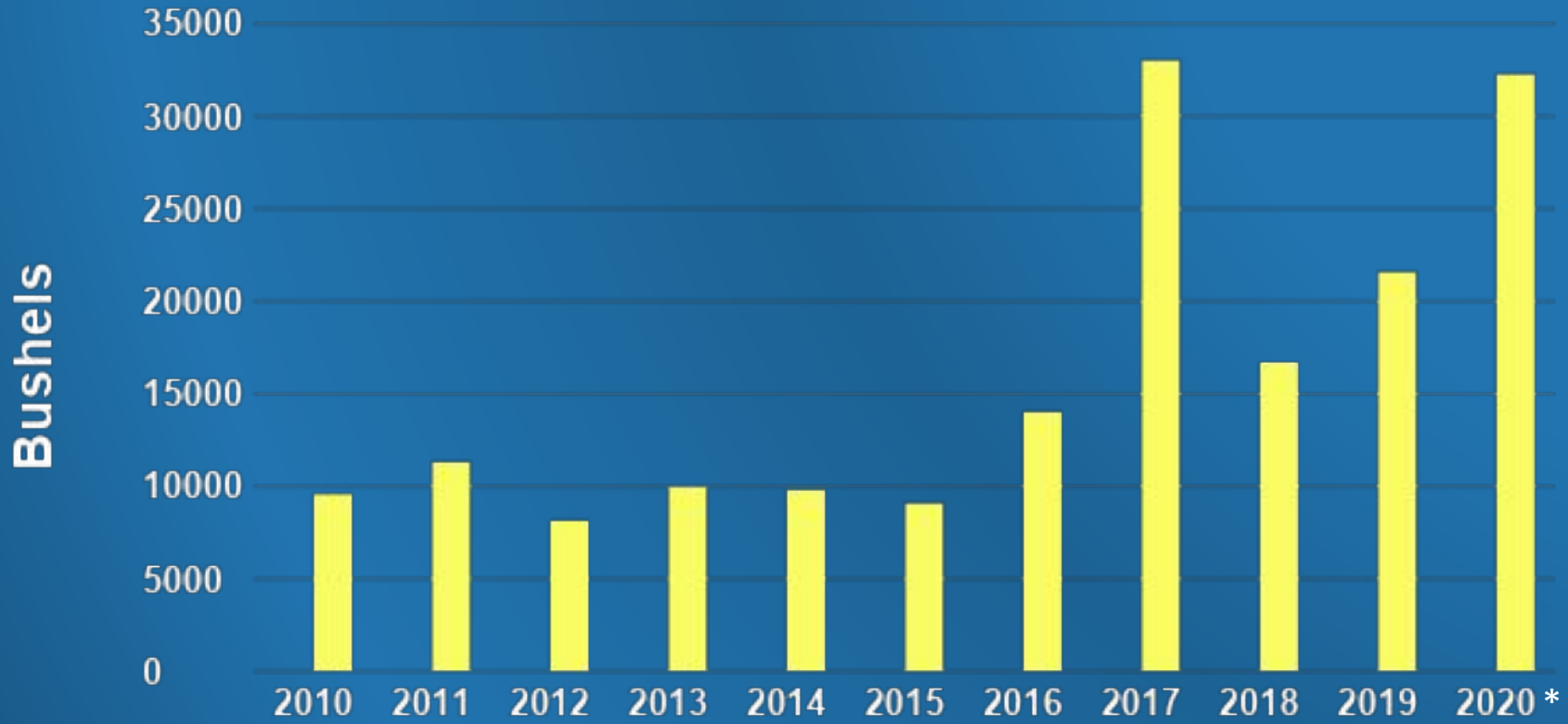


2020 Lease Applications: Water Column =25 (- 48% from 2019); Bottom =29 (- 50% from 2019)

North Carolina Farmed Oyster Production



North Carolina Farmed Oyster Production

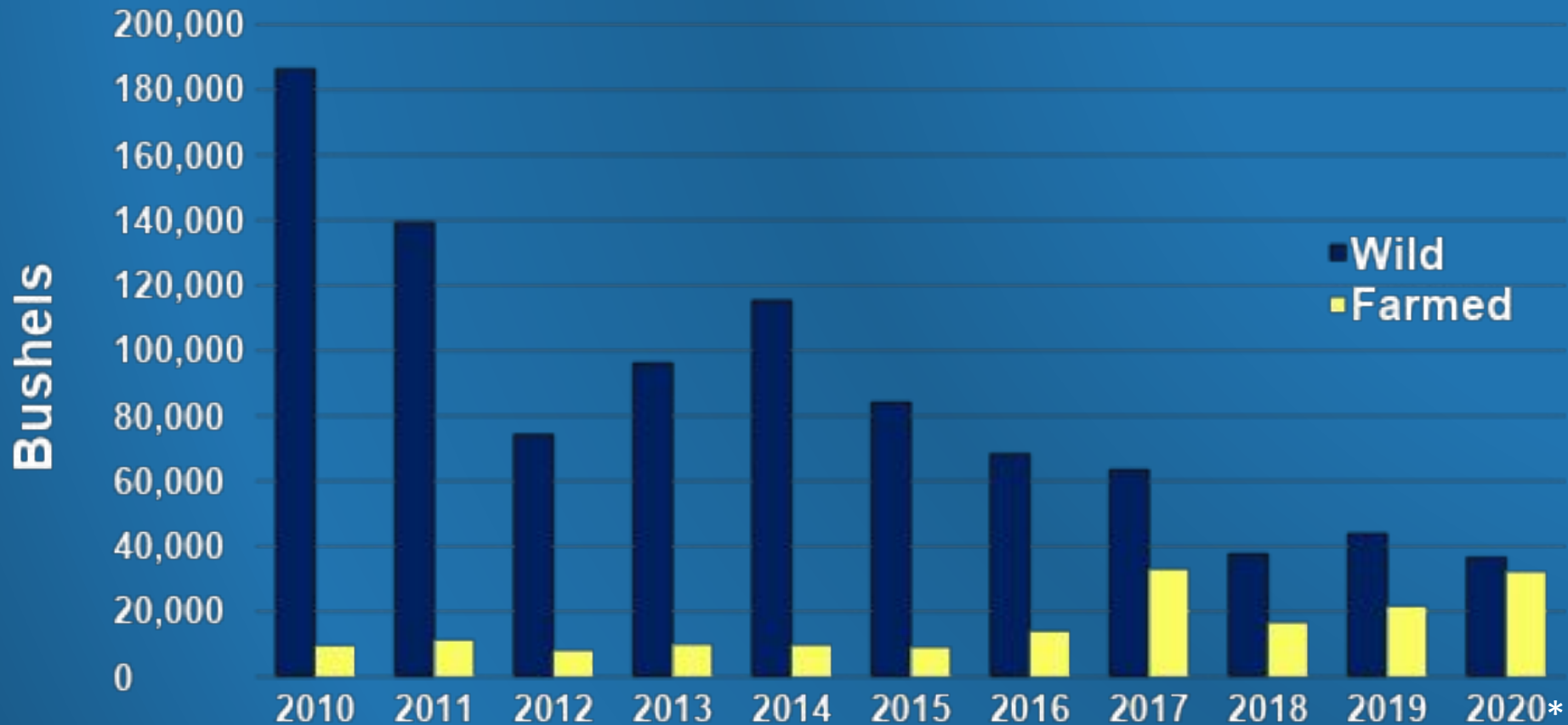


*2020 Data is preliminary

2020 Farmed Oysters: 32,307 Bushels (+ 49% from 2019)

2nd Highest, Slightly < 2017

North Carolina Oyster Production

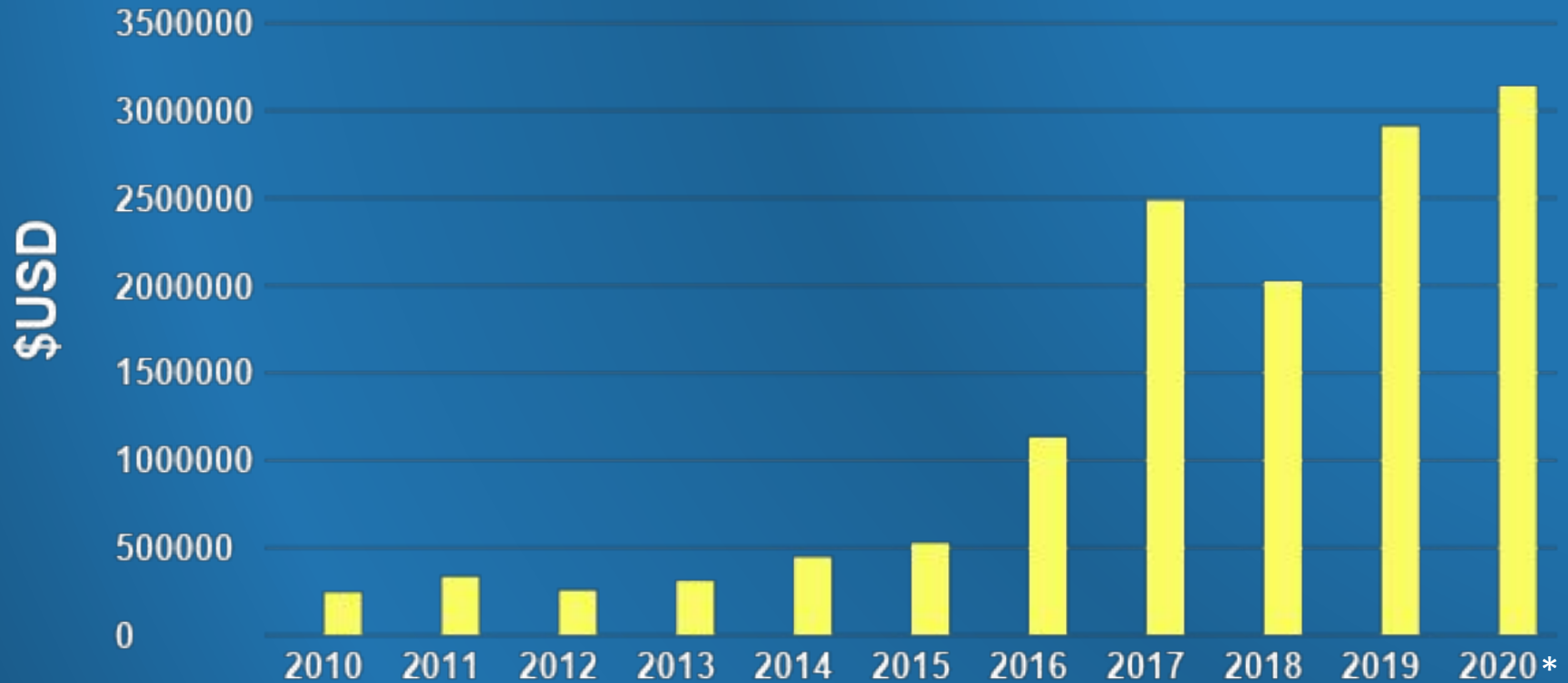


*2020 Data is preliminary

Farmed Oysters Increasing

Wild Harvest Decreasing

North Carolina Farmed Oyster Production

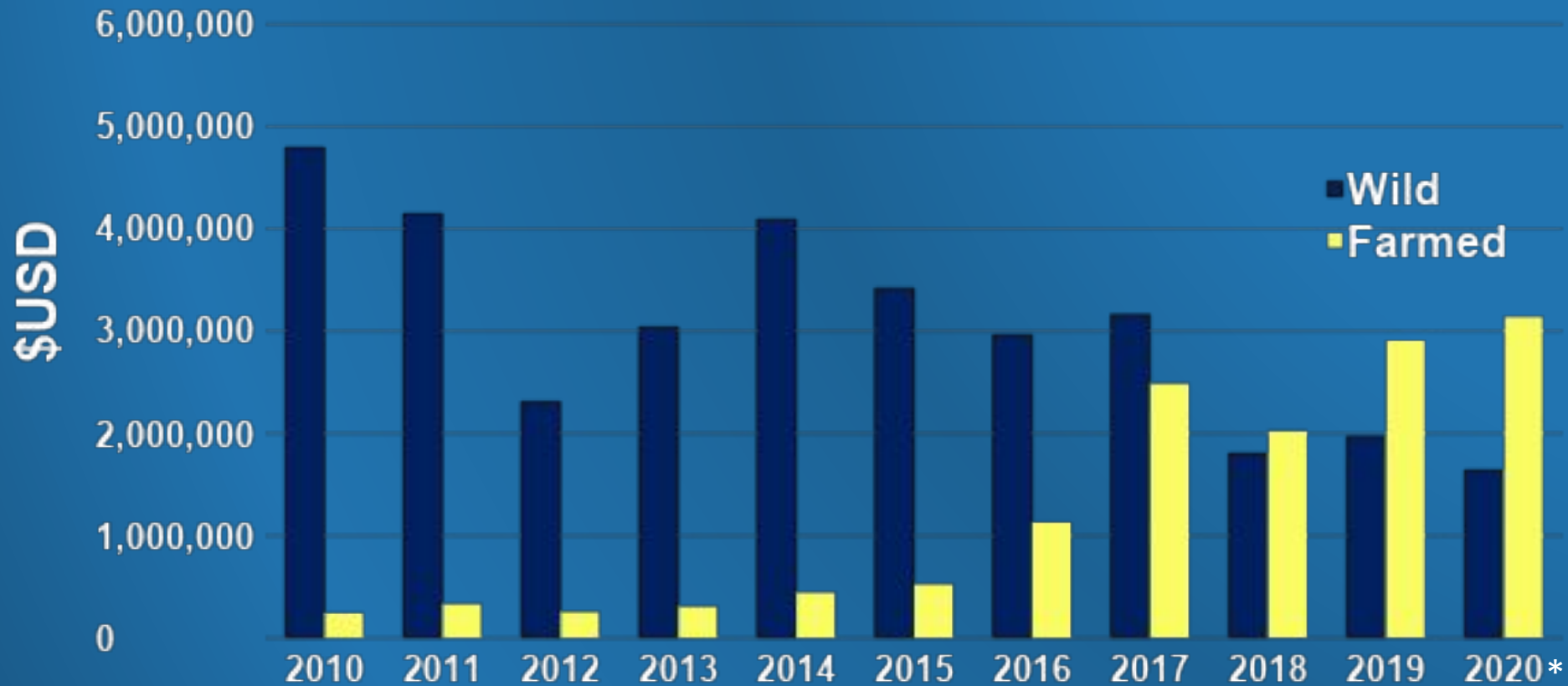


*2020 Data is preliminary

2020 Farmed Oysters: \$3.14M (+ 8% from 2019)

Highest Ever

North Carolina Oyster Production



*2020 Data is preliminary

2020 Farmed Oysters Highest \$ Value Ever

Wild Harvest Lowest \$ Value in Last

10vrs

North Carolina Shellfish Aquaculture: The 2020 Story

COVID-19

**Spring / Summer
Mortality (oysters)**



Isaias

Eastern Oyster (*Crassostrea virginica*)



\$USD ↑

Hard Clams (*Mercenaria mercenaria*)



\$USD ↓

Soft Crabs (*Callinectes sapidus*)



\$USD ↓

What Would Have Happened if No COVID-19 or Summer Mortality in Oysters?

North Carolina Shellfish Aquaculture: Future Growth

NORTH CAROLINA STRATEGIC PLAN FOR SHELLFISH MARICULTURE: A VISION TO 2030



FINAL REPORT TO THE NORTH CAROLINA
GENERAL ASSEMBLY

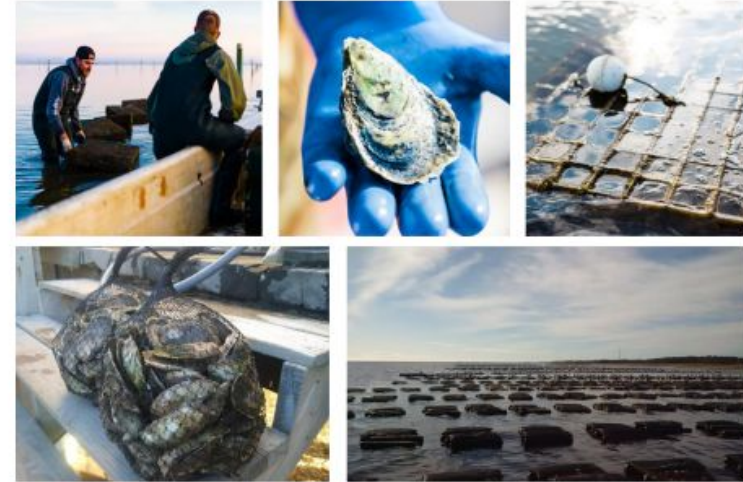


Photo credit clockwise from top left: Suspended oyster culture by Bax Miller; Single oyster by Bax Miller; Suspended oyster cage with buoy by Bax Miller; Floating bags on a water column lease by Chuck Weirich; Sacks of single oyster by Chuck Weirich.

Cover photos: Shucked raw oyster by Paul Manley

Prepared by: Drs. Joel Fodrie, Charles Peterson, Christine Voss, and Christopher Baillie on behalf of the North Carolina Shellfish Mariculture Advisory Committee

Submitted to the North Carolina General Assembly and the North Carolina Policy Collaboratory on December 30, 2018.



**December
2018**

Goal of \$33M Farm Gate Value By 2030

North Carolina Shellfish Aquaculture: Future Growth?



We Will Likely See Continued Expansion of Coastal Aquaculture Footprint & Containerized Gear

North Carolina Storm / Hurricane History

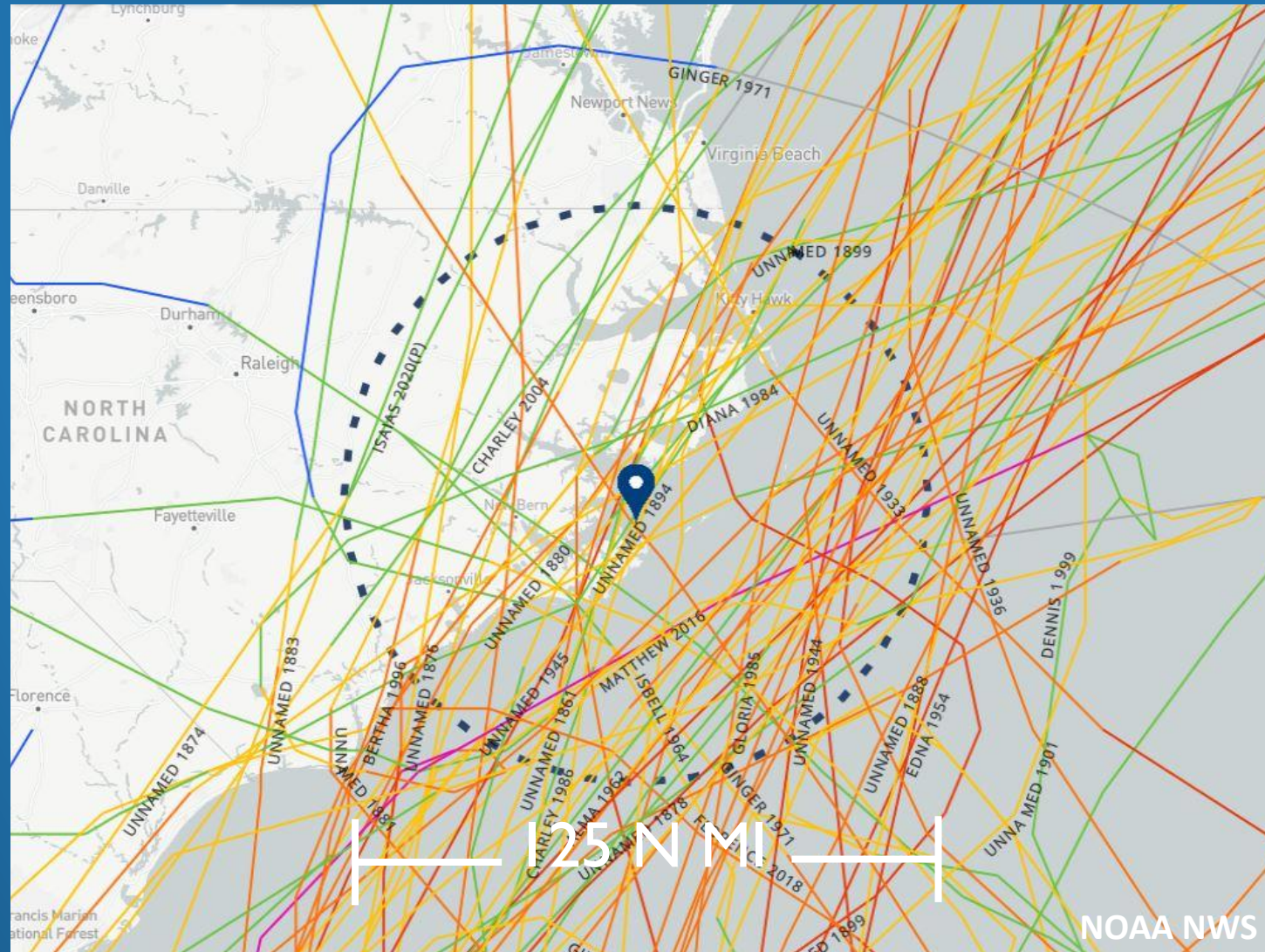


- **First recorded Hurricane: 1851**
- **Hurricane Florence 2018**
- **Hurricane Dorian 2019**
- **Hurricane Isaias 2020**



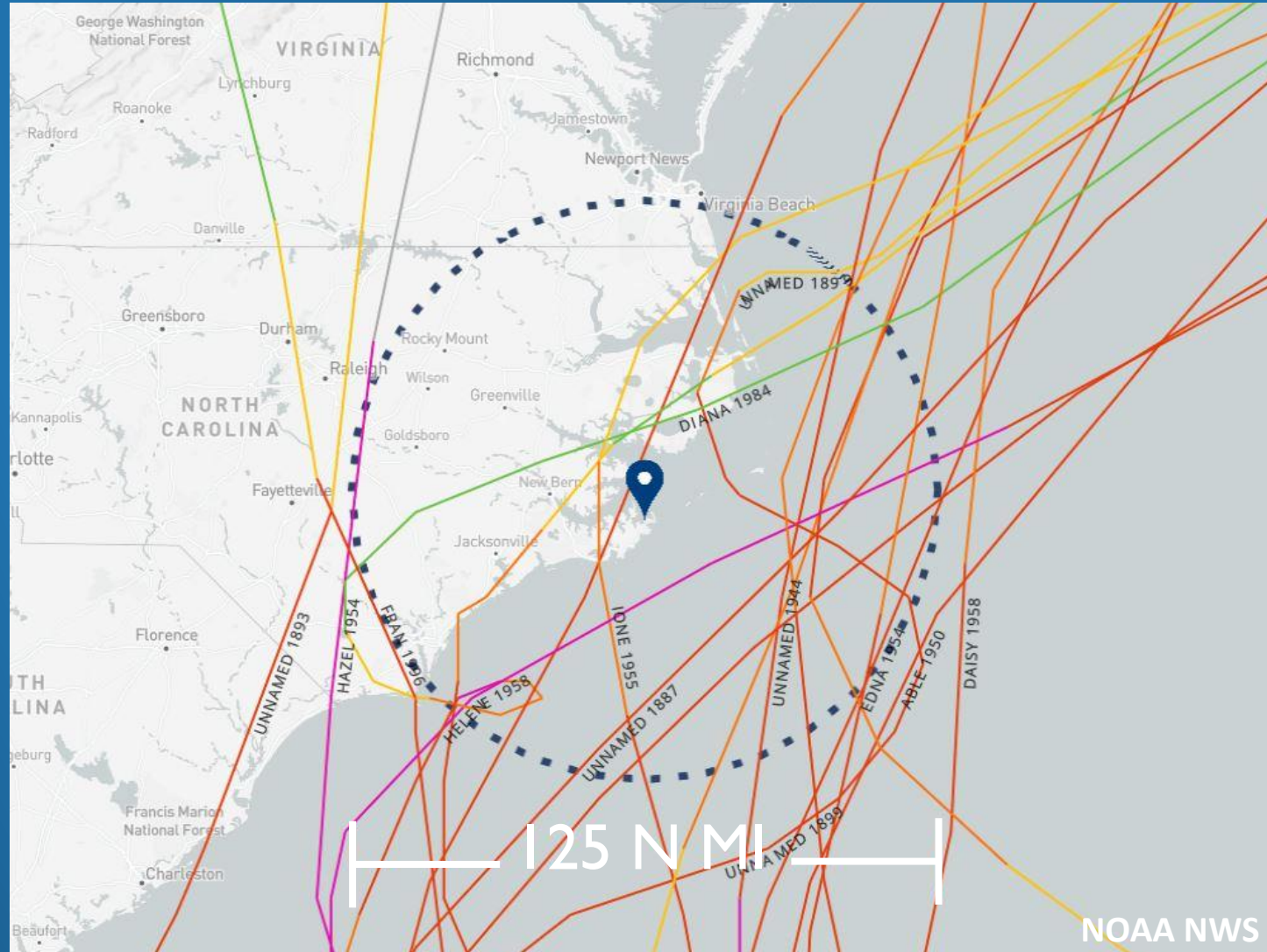
Eastern North Carolina: Three Hurricanes in The Last Three Years

North Carolina Hurricanes: Since 1851



Eastern North Carolina: 73 Hurricanes

North Carolina Major Hurricanes: Since 1851



Eastern North Carolina: 19 Major Hurricanes

Hurricane Florence: September 13-17, 2018



Hurricane Florence: Slow Moving and Heavy Rains (5 days affecting NC)

North Carolina Hurricane Florence



Hurricane Florence: Many Shellfish Farms Completely Destroyed

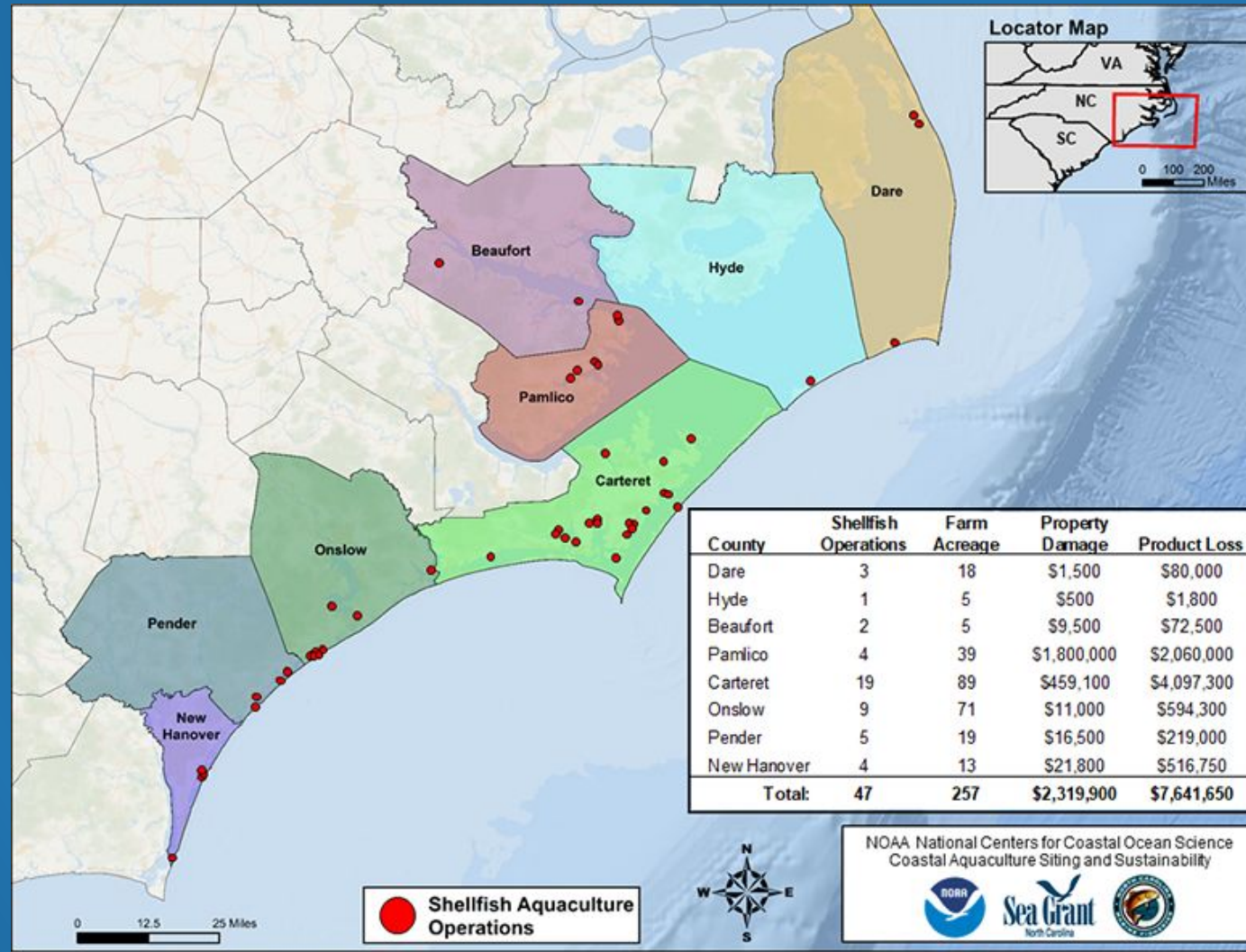
North Carolina Hurricane Florence



Hurricane Florence: Many Shellfish Farms Completely Destroyed

North Carolina Storm / Hurricane Economic Impacts -Aquaculture-

North Carolina Sea Grant collaborated with partners from NOAA and the N.C. Division of Marine Fisheries and N.C. Department of Agriculture and Consumer Services to tally damage from hurricanes Florence and Michael in 2018.



2018 NC Hurricanes: \$2.3M in Property Damage; \$7.6M in Crop Losses

North Carolina Storm / Hurricane Frequency

North Carolina Tropical Cyclone Statistics (1851 - 2020)

Statistic	Direct Landfalling Storms in NC	Non-landfalling Storms Affecting NC Within 150 Miles	Total Storms Affecting NC
Number of Storms	84	303	387
Percentage of Storms	4.37%	15.76%	20.12%
Average Years Between Storms	2.02	0.56	0.44
Average Storms Per Year	0.49	1.78	2.28

Direct
Landfalling
Storms
in NC

Storms
That Have
Affected
NC

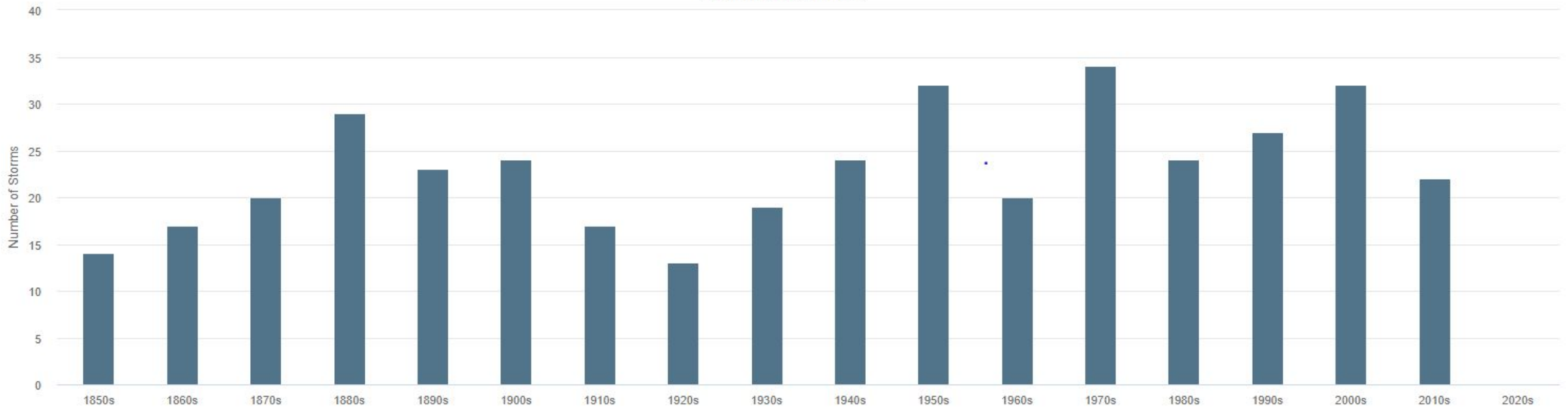
<https://products.climate.ncsu.edu/>

On Average: North Carolina is Affected by 2.28 Tropical Storms Per Year

North Carolina Storm / Hurricane Future?

The graph above shows the total number of days that North Carolina has been impacted by tropical cyclones on a weekly basis.

Total Storms Affecting North Carolina by Decade
Within 150 Miles (1851-2020)



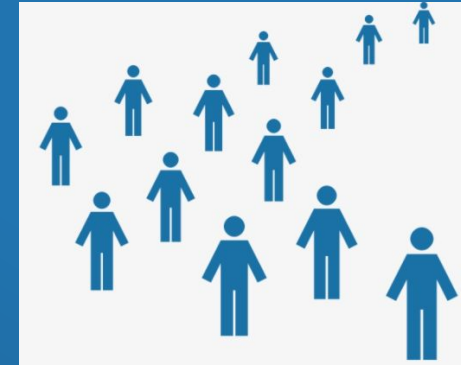
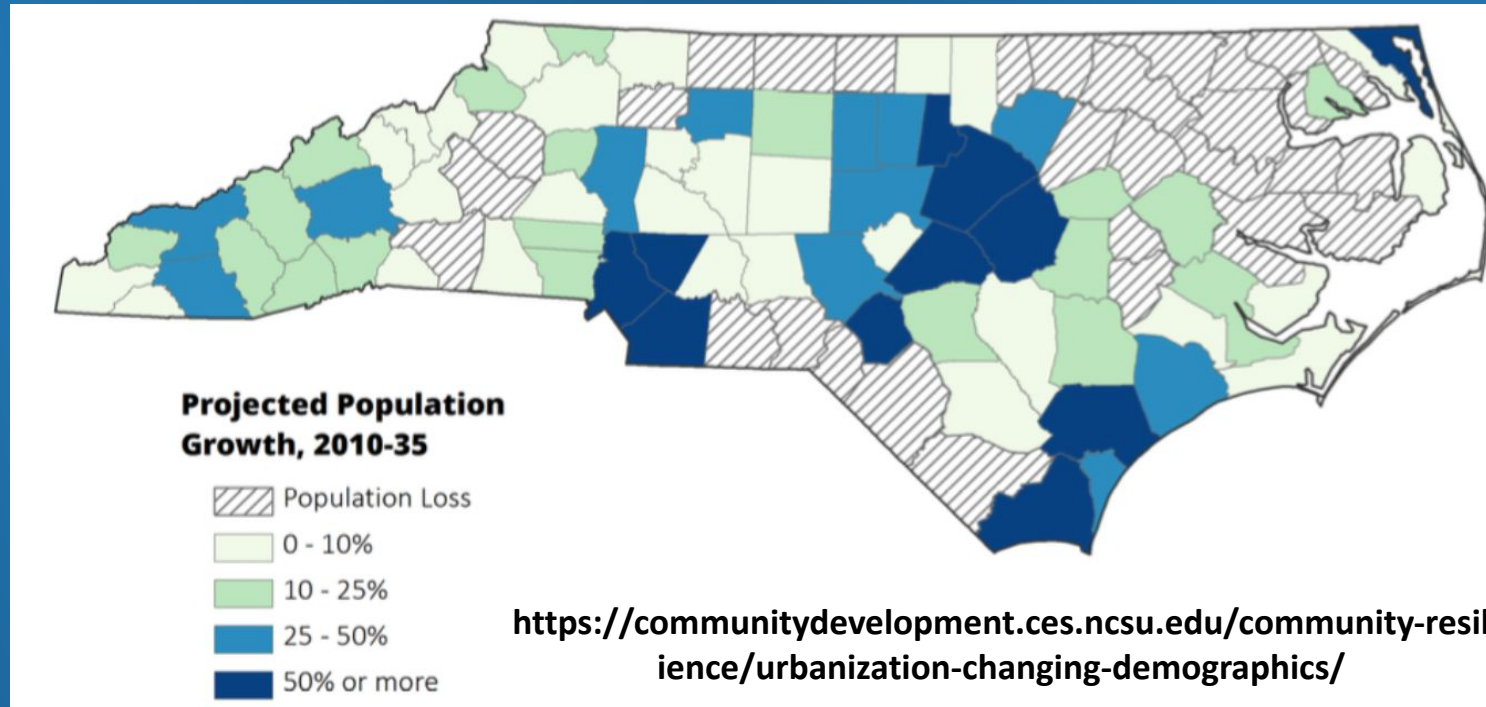
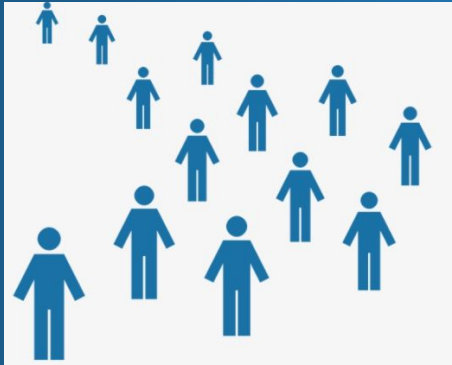
The graph above shows the total number of tropical cyclones affecting North Carolina by decade.

<https://products.climate.ncsu.edu/>

North Carolina Has Been Affected by Severe Weather Events Since Time Immemorial

North Carolina Coast & Changing Demography

NC has 322 miles of ocean shoreline and the second largest estuarine system (bays, sounds and wetlands) in the country, which amounts to almost 12,009 miles of estuarine coastline.



-Population 10.6 Million 2020

-10th fastest growing state population

-9th most populous state in the Nation

-Growth rate of 1% (2X national average)

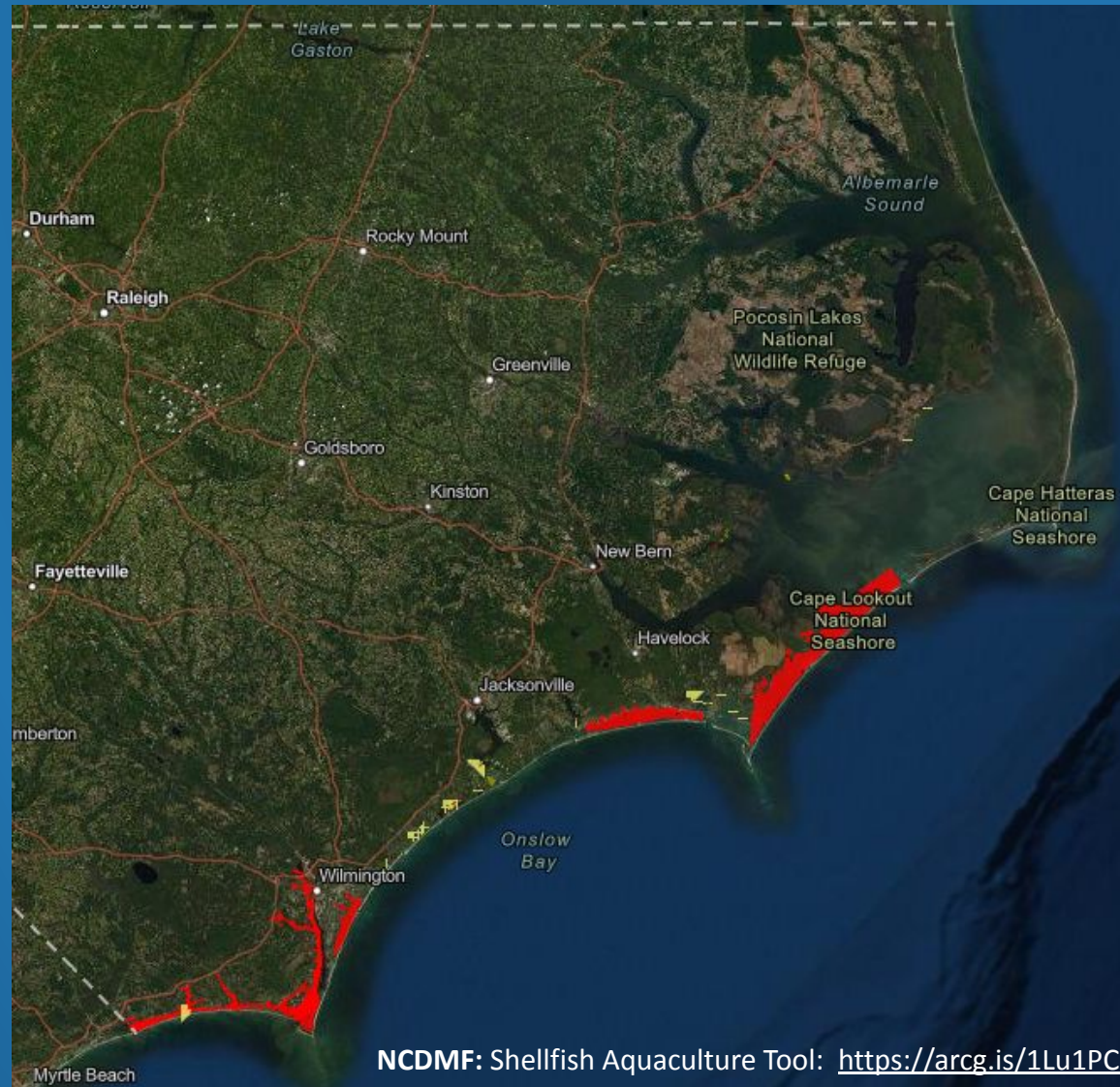
-4th largest population Increase since 2018 Many coastal counties will grow 25-50% by 2035

North Carolina Shellfish Aquaculture in Public Trust Waters



Multiple Interests in Use of Public Trust Water = Potential Conflict

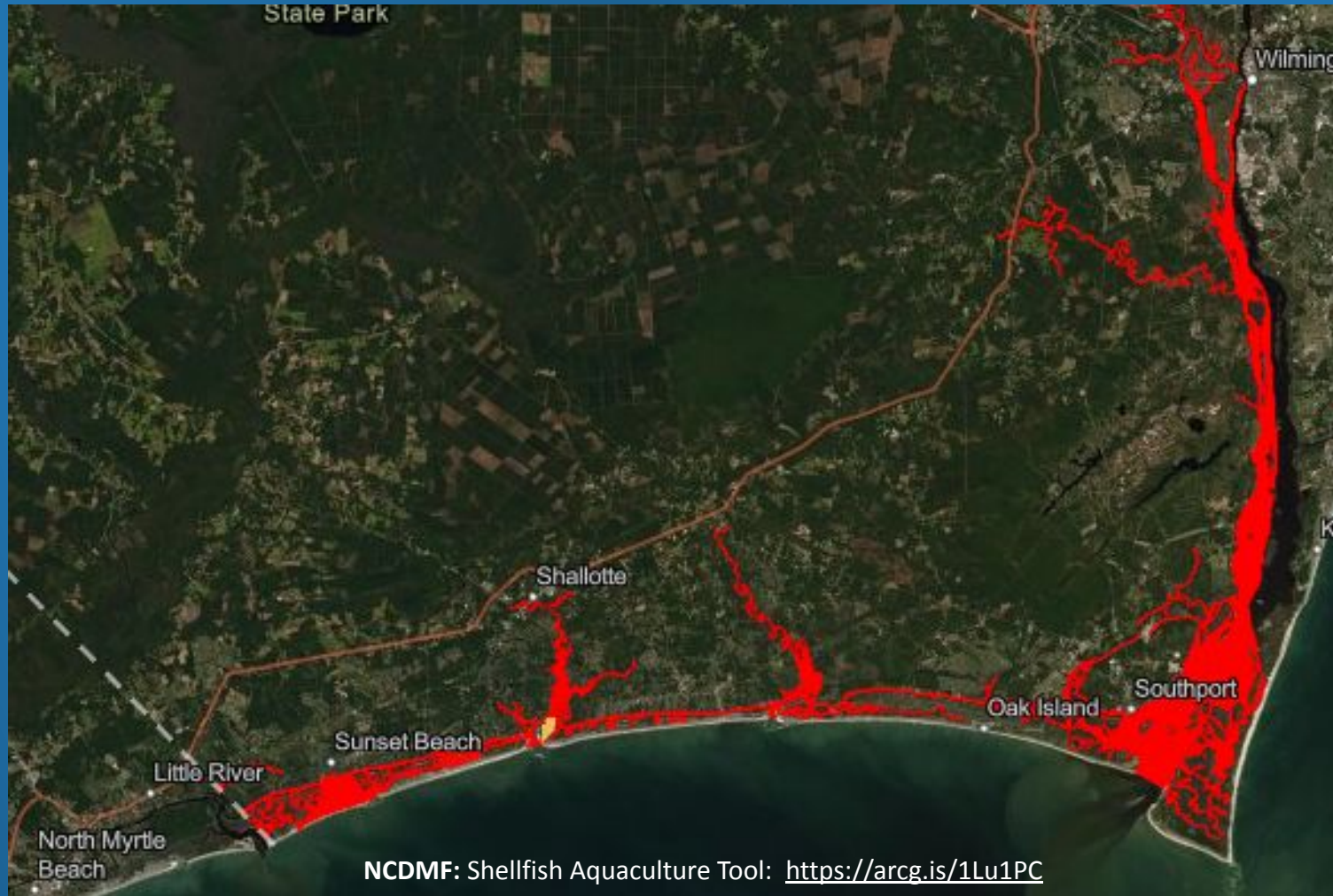
Multiple Interests in Same Resource = Potential Conflict



Currently There are Four Shellfish Aquaculture Moratoriums in North Carolina

North Carolina Shellfish Aquaculture Moratoriums

- Already limited area for Public Shellfishing
- Violates Public Trust Doctrine



Brunswick County -North Carolina House Bill 317 (1949) -Permanent Moratorium

North Carolina Shellfish Aquaculture Moratoriums

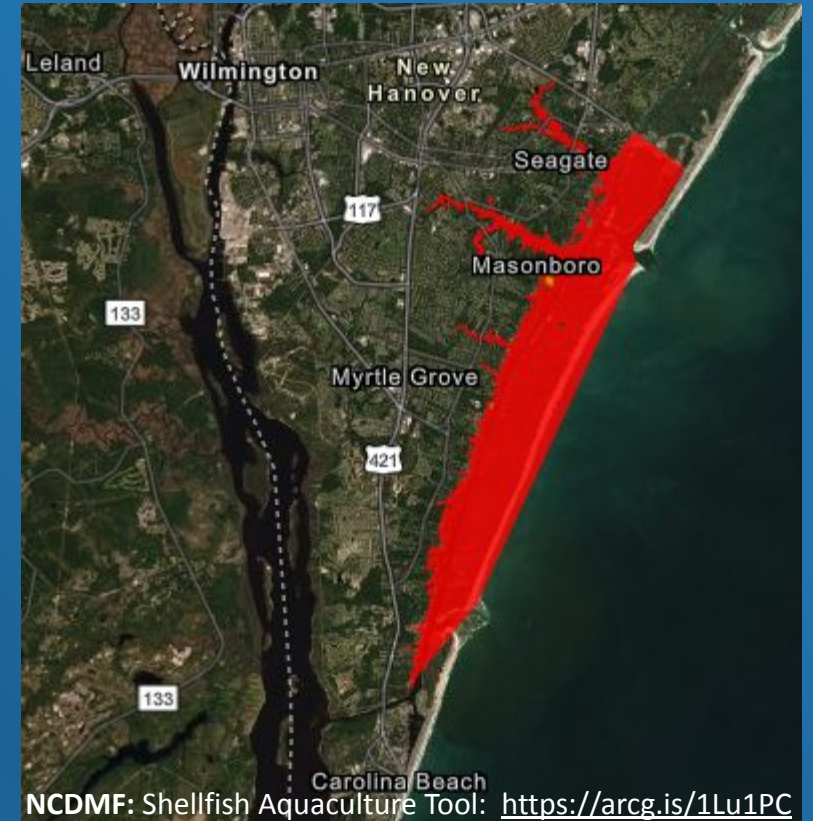
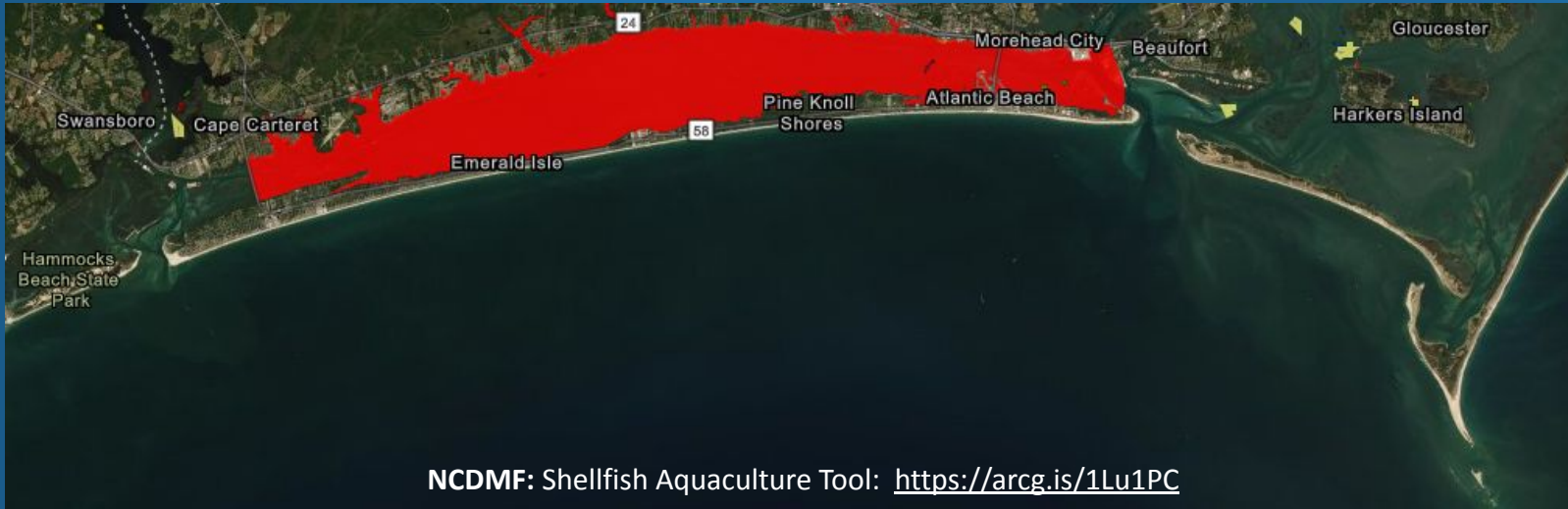
- Private Shellfish Leases Interfere with Fishing and Recreation



Core Sound Moratorium -1993 to 1995; 1996 (East side) and 2003 -Permanent Moratorium on New Leases

North Carolina Shellfish Aquaculture Moratoriums

- Substantial Increase in User Conflicts



Bogue Sound and New Hanover County Area Moratoriums -July 1 2019 to July 1 2021

North Carolina is Experiencing a Greater Convergence of a Growing Shellfish Aquaculture Industry, Increase in Competing Interests in Public Trust Water Use, and The Ever-Present Threat of Storms



Need for Increased Awareness of Aquaculture Gear Management & Storm Preparedness

Many Thanks To:



Jacob Boyd
Owen Mulvey-McFerron
Teri Dane
Amanda Tong
Alan Bianchi



Chuck Weirich



Frank López
Bryan Snyder



David Glenn



Ken Riley

North Carolina Case Study: Abandoned Clam Farm Cleanup

Bree Charron



North Carolina
Coastal Federation

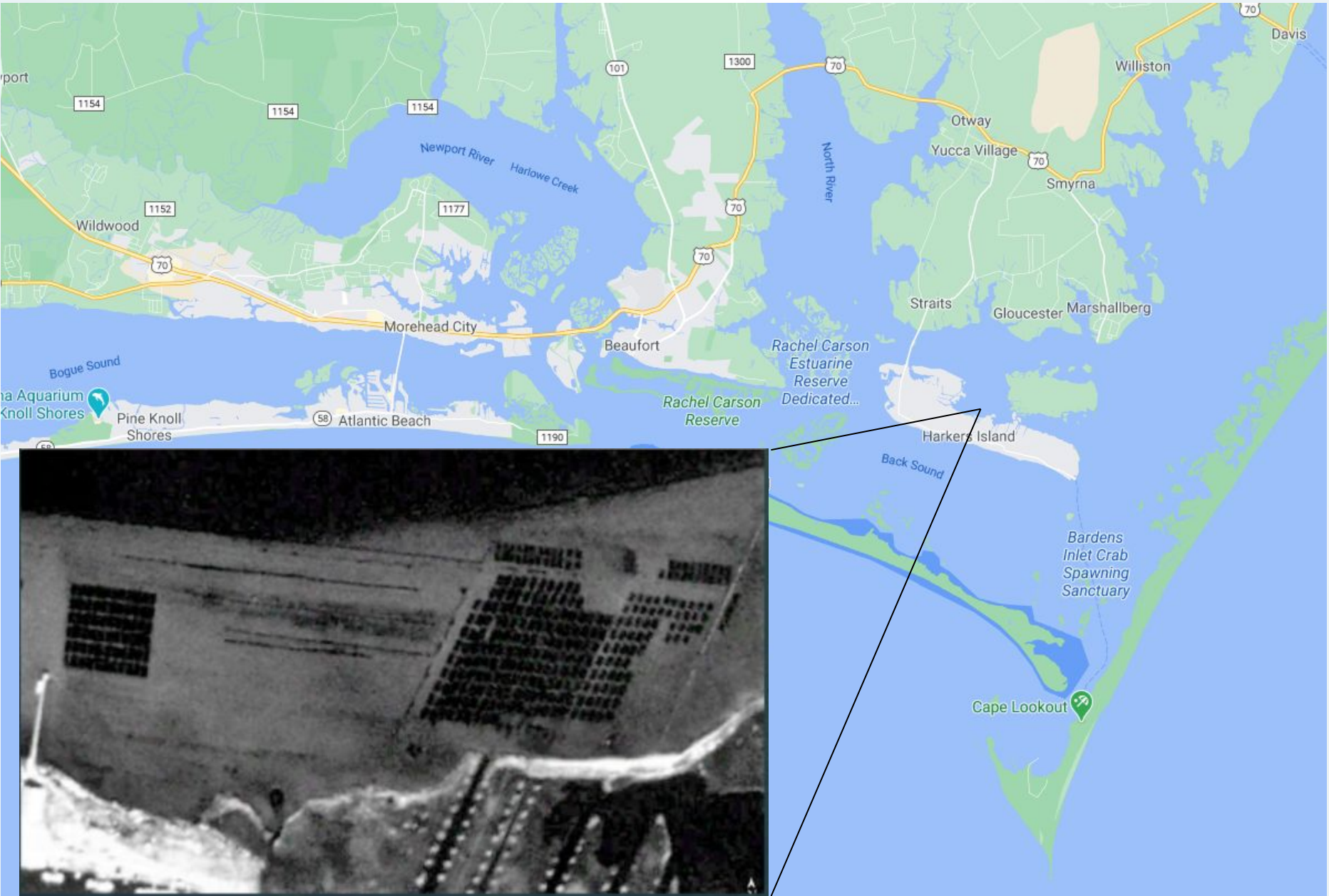


NOAA Marine Debris Project

Project Goals

1. Clean-up a derelict clam farm in Carteret County.
2. Evaluate the use of drone technology for assessment of marine debris.
3. Develop BMPs for NC growers to reduce threat of marine debris from the industry.





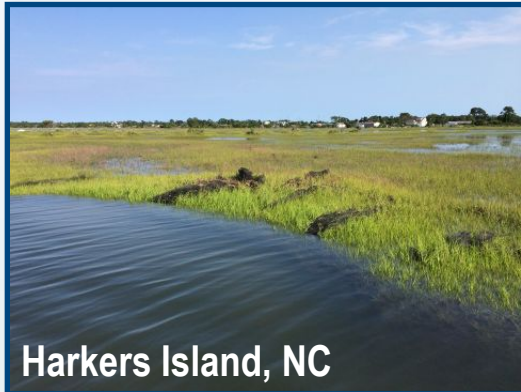
UAV Debris Identification

The screenshot displays a flight planning interface with a satellite map of a coastal area. A mission area is outlined in white, containing a grid and flight path. A status box shows: 0 m/ATO, 0 m/AMSL, 0:00, Idle, Ready to take off. The map coordinates are 34.7092669°N 76.5750831°W 2 m/AMSL (-36 m/WGS84). The right panel shows mission parameters: Camera model: DJI,ELPH RGB; Mapping and mission parameters: Mission area: Polygonal; Camera: DJI,ELPH RGB; Ground resolution: 2.5 cm/px; Desired altitude: 81.2 m/ATO; Lateral overlap: 60%; Longitudinal overlap: 75%; Advanced parameters: Starting waypoint: 1; Wind estimate: 0 m/s; Max flight time: 40 min; Resulting flight characteristics: Number of flights: 1; Flight time: 00:21:21; Total flight distance: 15.1 km; Total ground coverage: 15.5 ha; Number of flight lines: 6+18; Flight lines spacing: 46.1 m; Mean flight lines altitude above elevation data: 81 m (2.5 cm/px); Max flight lines altitude above elevation data: 81 m (2.5 cm/px).

Fixed Wing Platform



Multicopter Platform



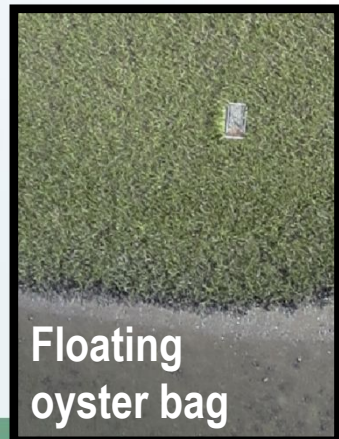
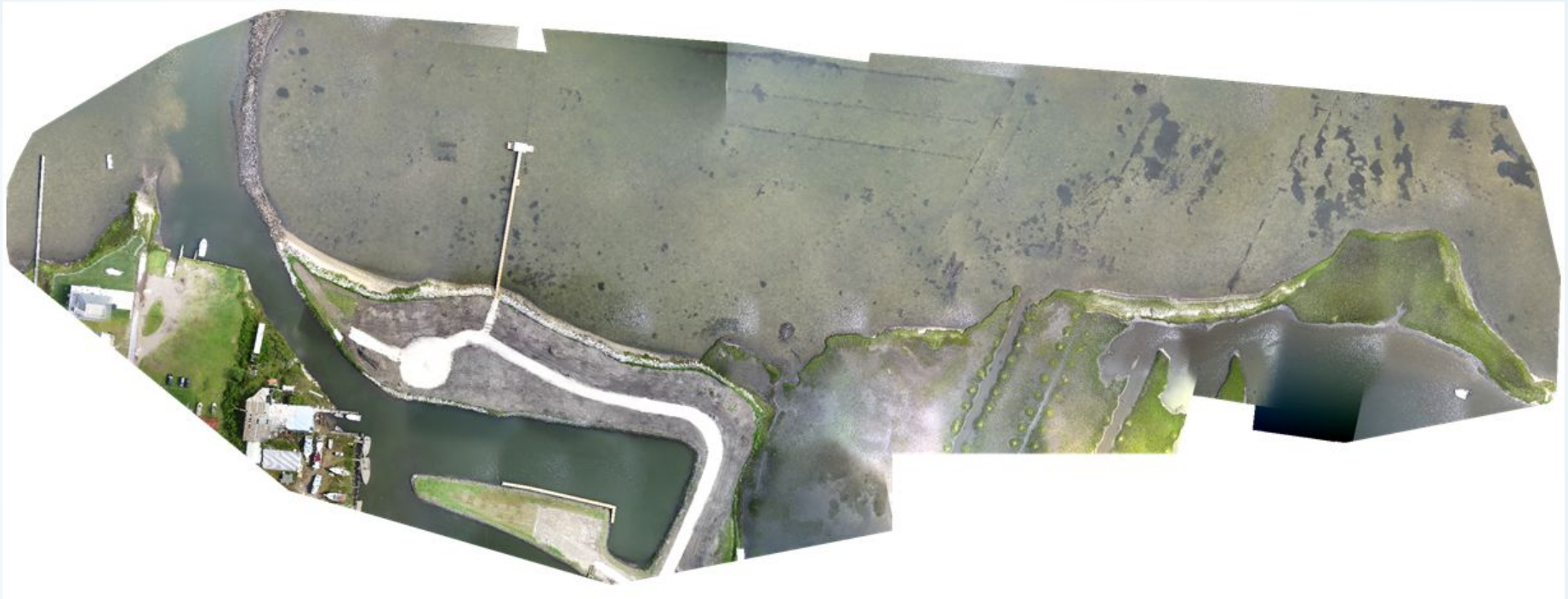
Harkers Island, NC



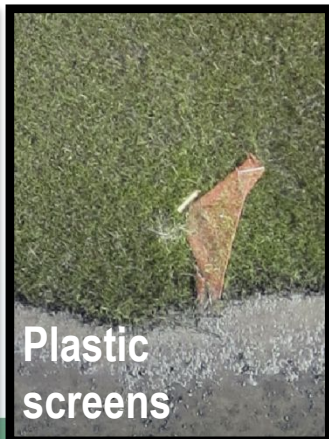
Benefits

- Survey up to 12 sq. km
- High resolution (2.5 cm/pixel)
- Photogrammetry and lidar
- Digital terrain modeling
- Topographic maps
- FAA Permitted

Aerial Survey – 25 acre site



Floating oyster bag



Plastic screens



Plastic screens



Bottom cages



Fabric sandbags

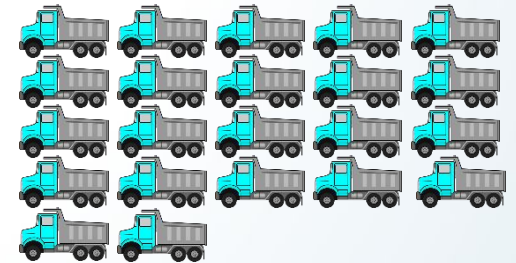
Removal



- November 2017
- 22 Marines = 3000 lbs by hand

Removal

- Winter 2017-2018
- 600,000 lbs by machine





November 2017



November 2017



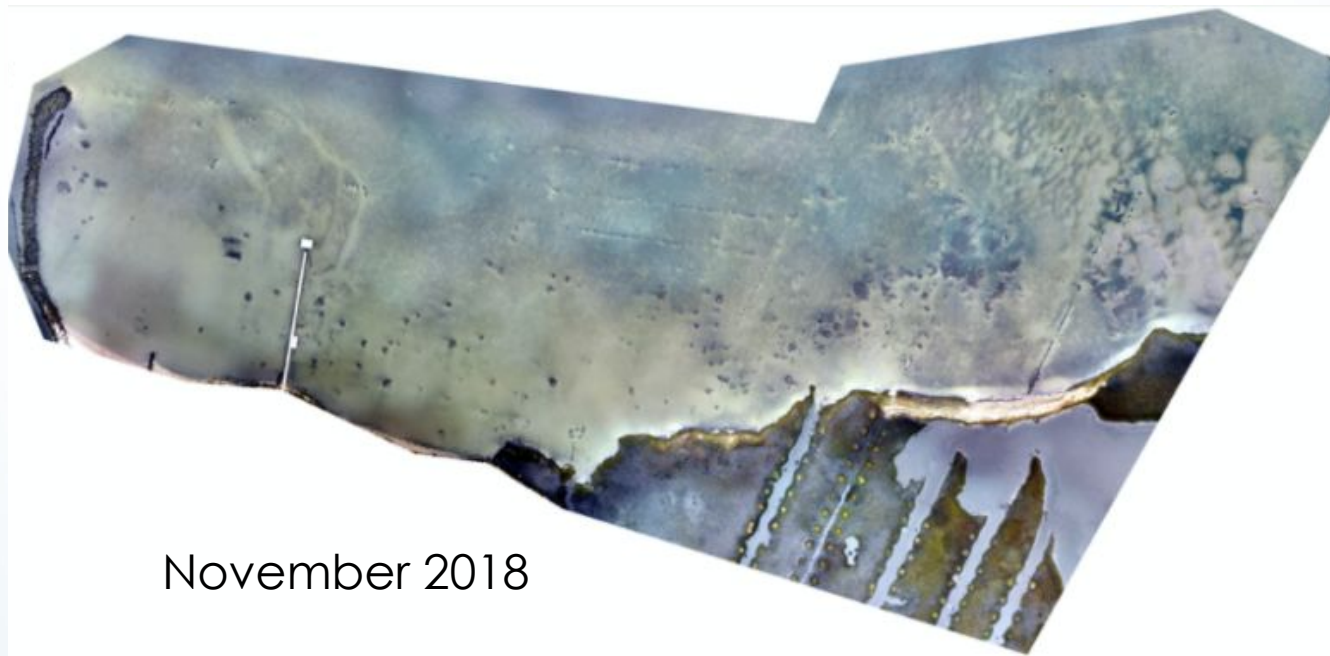
November 2017



November 2018



November 2017



November 2018

Best Management Practices

Core Partners

- NOAA Coastal Aquaculture Siting and Sustainability (NOAA National Ocean Service, Beaufort Lab)
- NC Sea Grant Marine Aquaculture Specialist
- Work group of growers
- North Carolina Shellfish Mariculture Advisory Committee



Best Management Practices

SITING

FARM DESIGN

FARM OPERATION

COMMUNITY
ENGAGEMENT



Best Management Practices

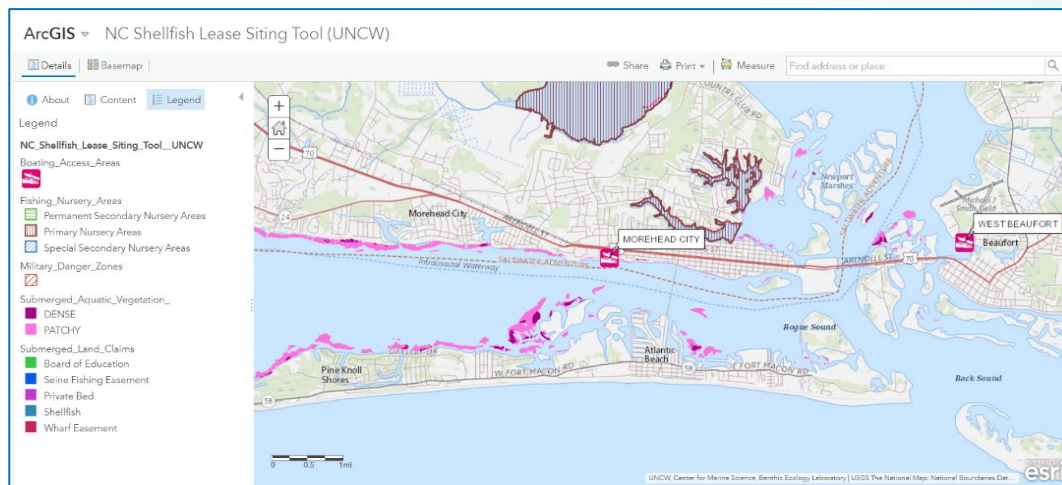
SITING

FARM DESIGN

FARM OPERATION

COMMUNITY ENGAGEMENT

- Choose sites with viable waters for shellfish growth.
- Consider channels, inlets, fetch, tidal range.
- Communicate with riparian landowners.
- Scope area for other potential debris sources



Best Management Practices

SITING

FARM DESIGN

FARM OPERATION

COMMUNITY
ENGAGEMENT

- Start small and scale up.
- Design for hurricanes.
- Maintain a well-organized farm.
- Mark lease and gear to fullest extent.



Best Management Practices

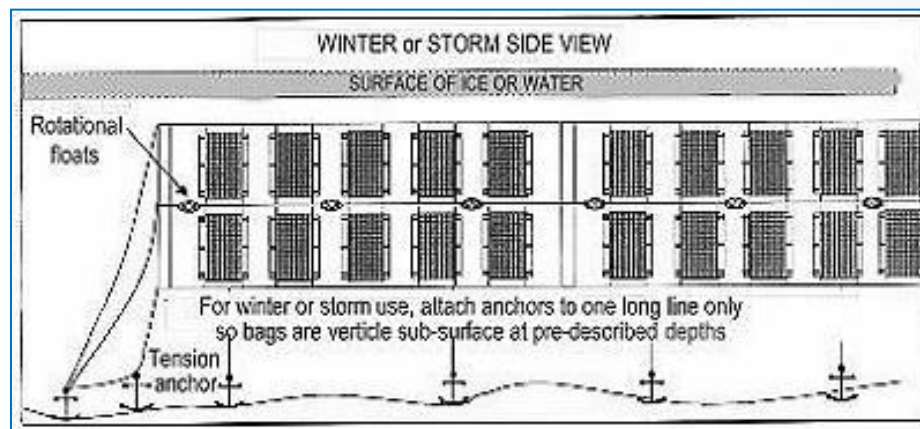
SITING

FARM DESIGN

FARM OPERATION

COMMUNITY
ENGAGEMENT

- Daily operations should not produce debris.
- Keep lines taut and gear neat.
- Dispose or recycle gear once it is no longer usable.
- Create storm preparation plans.



Best Management Practices

SITING

FARM DESIGN

FARM OPERATION

COMMUNITY
ENGAGEMENT

- Open channels of communication with riparian neighbors
- Join or organize local cleanup efforts
- Be proactive in recovering lost gear
- Every farmer can become the face of the industry



Oyster Entrepreneurs

Greater Wilmington Business Journal - Jun 20, 2017

Local oyster farmer Tim Holbrook works with researchers looking into the industry's growth potential in southeastern **North Carolina**. (Photo by Chris ... Holbrook is one of many oyster entrepreneurs across the state and area investing in a more intensive form of **shellfish aquaculture**. Local officials think ...



Tons of junk the target of Harkers Island clean-up project

News & Observer - Jul 25, 2017

The **North Carolina** Coastal Federation will match funding from the National Oceanic and Atmospheric Administration to pay for the \$129,000 project. Debris – including cages, netting, and plastic – is tainting salt marshes, and seagrass and **oyster** beds, and storms have deposited tons of the material in ...



Masonboro residents oppose more oyster farms

StarNewsOnline.com - Feb 8, 2018

Dr. Goudarzi wants the state to pull the permit for **oyster** farms in Masonboro Sound that he says are a safety hazard and aesthetically ugly. heard this called a problem, an **aquaculture** problem, and to a lot of you it may well be, but a lot of us enjoy oysters and that is a demand of **North Carolina**," he said.

Prevention of Marine Debris from Shellfish Mariculture

Best Management Practices for North Carolina Producers

The shellfish mariculture industry relies heavily on synthetic materials for oyster growout within the estuarine system. If these materials are lost from the farm, they become marine debris which can be detrimental to habitat, aquatic species and the people who work and play on the water. The North Carolina Coastal Federation worked with partners and shellfish growers to produce voluntary best management practices for the prevention of marine debris from shellfish leases.

SITING

The first step to establishing a successful shellfish farm is proper siting. There are many aspects that contribute to a farm's viability including frequency of closures, survivability of oysters, salinity, wave energy, other physical factors and public use conflicts.

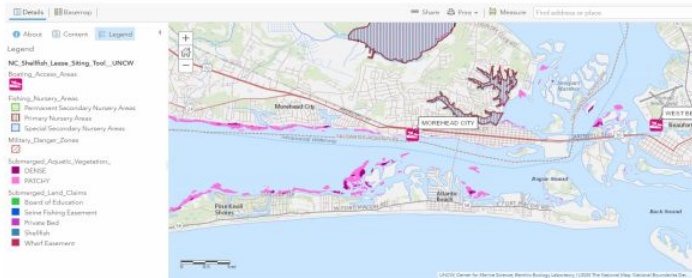


QUICK SITING TIPS

- Choose sites away from navigational channels and inlets.
- Always consider wave energy.
- Scope potential areas of debris spread that might come from your farm or from neighbors (docks, other farms, etc.)
- Be a good neighbor and communicate with adjacent riparian landowners.
- Be aware of tidal range and strong tidal currents.

NC SHELLFISH SITING TOOL

Researchers at the University of North Carolina Wilmington have produced an interactive siting tool for shellfish mariculture that provides invaluable data for growers to scope the feasibility of a potential lease site. The tool includes continuously updated data on salinity, submerged aquatic vegetation, depth, utilized channels and much more. Find the tool at: uncw.edu/benthic/sitingtool



QUICK DESIGN TIPS

- Seek advice from established farmers and mariculture professionals when designing.
- Start small and scale up.
- Design for hurricanes.
- Maintain a well-organized and tidy farm.
- Consult design strength of gear from manufacturer.
- Clearly demarcate lease site to prevent vessel collisions.
- Mark gear units to aid in recovery.

FARM DESIGN

After locating and properly identifying the lease site, thoughtful development of the farm layout and design is a critical step toward developing a successful operation. Organization, gear selection and lease marking are important components of the design stage.



FARM OPERATION

Once the farm is established, daily operations should be set in place that reduce the risk of marine debris generation. Good inspections, materials management, storm readiness and community outreach programs are key to preventing marine debris associated with shellfish farming operations.

QUICK OPERATION TIPS

- Keep lines taut and keep gear neat and orderly.
- Regularly inspect gear and replace items that are worn.
- Keep lines full, so it is obvious when gear is missing.
- Dispose of or recycle used gear once it is no longer usable.
- Prepare the farm for forecasted storms.
- Obtain federal crop insurance.
- Keep lines and materials as deep as possible.
- Pick up loose gear as soon as possible.



For more information, visit nccoast.org/bmps.



nccoast.org/bmps



North Carolina
Coastal Federation
Working Together for a Healthy Coast



North Carolina
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