



Introduction to the next edition of the Blueprint

Erin Fleckenstein, NC Coastal Federation

NC Oyster Restoration Efforts

>1915: NC DMF started cultch plantings

- 1915-2020 ~22 million bushels of cultch material planted
- >1947: Shellfish Rehabilitation Program began
- >1995: Blue Ribbon Advisory Council on Oysters
- >1996: Oyster sanctuary program initiated
- >1997: Fisheries Reform Act
- ➤ 2001: Oyster Fishery Management Plan
- 2003: NGOs & research institutions ramp up efforts
- ➤ 2004: Coastal Habitat Protection Plan



Oyster Restoration and Protection Plan for North Carolina: A Blueprint For Action

➤ 2003 Oyster Forum yielded compilation of suggested actions

Incorporated recommendations from:

- Blue Ribbon Advisory Council on Oysters
- Fisheries Reform Act
- Oyster Fishery Management Plan
- Coastal Habitat Protection Plan
- Basinwide Water Quality Plans

Drafted into comprehensive, concerted & bold effort to take place over five years

2003-2008; 2008-2012; 2015-2020

Steering Committee and Regional Workgroups engaged



Oyster Restoration and Protection Plan for North Carolina: A Blueprint for Action **Three Editions** OVSTER RESTORATION



Oyster Restoration and

Protection Plan for North Carolina:

Prepared by: N.C. Coastal Federation

Oyster Restoration and Protection Plan for North Carolina: A Blueprint **For Action - Second Edition** 2008 - 2012

A Blueprint for Actio

2003-2008

Partnerships and Collaborations are Key to Success



Major Accomplishments 2003-2013

- Government, private agencies and other shellfish stakeholders coordinated habitat, water quality and fisheries management activities.
- Funding for oyster related programs increased by a factor of ten from 2003-2013.
- Nearly 200 acres of oyster habitat were enhanced and restored, annual oyster harvests increased during this time, and a greater number of watershed restoration projects were implemented along the coast.



Major Accomplishments 2015-2020

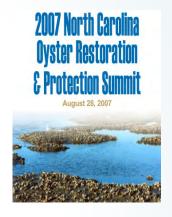


- Oyster Restoration and Growing are good for both the economy and environment
- North Carolina joined NOAA's National Shellfish Initiative
- **Developed Strategic Mariculture Plan**
- Shellfish aquaculture grew from \$1 million to nearly \$5 million industry
- Built ~50 acres of reef through oyster sanctuaries, living shorelines and patch reefs
- Built ~200 acres of harvestable reef
- Water quality degradation continues to be a concern but some localized improvements were observed
- Researchers developed and refined tools to guide restoration, growing and enhancement efforts



Blueprint Summits, Roasts & Forums

- >2003 Oyster Forum, Ocean
- >2004 Encore for Oysters Summit, Morehead City
- ➤ 2005 Oyster Summit & Legislative Reception, Raleigh
- 2006 Regional Public Oyster Forums, Wilmington, Beaufort & Manteo
- 2006 Legislative Oyster Roast, Raleigh
- ➢ 2007 Legislative Oyster Roast, Raleigh
- >2007 Oyster Summit, Pine Knoll Shores
- >2014 Oyster Restoration Workshop, Beaufort
- >2015 Oyster Summit & Legislative Reception, Raleigh
- ➢ 2017 Oyster Summit & Legislative Reception, Raleigh
- >2019 Oyster Summit & Legislative Reception, Raleigh





Wednesday, May 24, 2006 12 noon to 2 pm Halifax Mall in Downtown Raleigh



Annual State of the Oyster Report



STATE OF THE OYSTER: 2015 Progress Report on the oyster restoration and protection plan for North Carolina Progred by the Worth Carolina Coasted Federation



STATE OF THE OYSTER: 2016 Progress Report on the oyster restoration and protection plan for progress of the pr



STATE OF THE OYSTER: 2017 Progress Report on the oyster restoration and protection plan for North Carolina

Prepared by the North Carolina Coastal Federation



STATE OF THE OYSTER: Progress Report on the oyster restoration and protection plan for North Carolina

Prepared by the North Carolina Coastal Federation Published September 2019

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WHO WE ARE ABOUT OYSTERS THE BLUEPRINT NEWS & RESOURCES PROGRESS EVENTS Q



Since 2003, a diverse group of stakeholders involved in growing, harvesting, studying, educating, managing and eating oysters have voluntarily and productively worked together to protect and restore North Carolina's oyster habitats and fisheries. This website links their efforts to present a holistic approach to advancing the vision of North Carolina becoming "the Napa Valley of Oysters."

NCOysters.org is North Carolina's clearinghouse for oyster habitat restoration, planning, education/outreach and research. It is designed to:

News Grower Profile: Ryan Bethea Grower Profile: Katherine McGlade Senate Mulls Fisheries, Shellfish Overhauls | Coastal Review Online Genetic impacts of a commercial aquaculture lease 2019 Oyster Summit Held in Raleigh

SUBSCRIBE FOR UPDATES HERE



@NcOysters@NorthCarolinaOysterswww.ncoysters.org

Blueprint Focus Areas

- Education and Outreach
- Research
- Fishery & ShellfishAquaculture Development
- Oyster Habitat Protection & Restoration
- Water Quality Protection & Restoration



















Vision for 4th Edition of the Oyster Blueprint

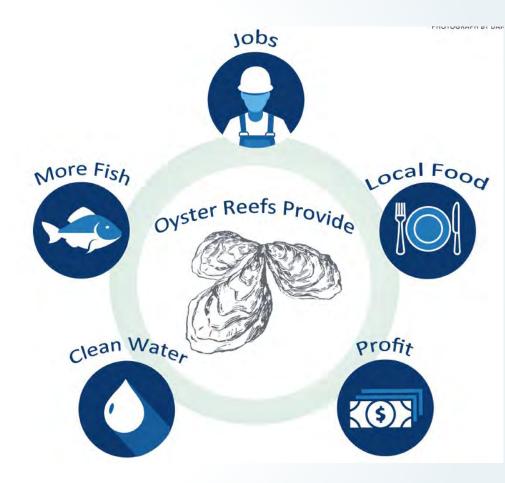


The vision of the Blueprint is to foster collaboration among partners, ensuring oysters in N.C. perpetuate a healthy and robust environment and economy.

Ecosystem Services

Ecosystem Services defined as Benefits people gain from thriving coastal habitats and clean waters.

Setting goals based on Ecosystem Services.



Stakeholder Survey



o Benefits

o Threats

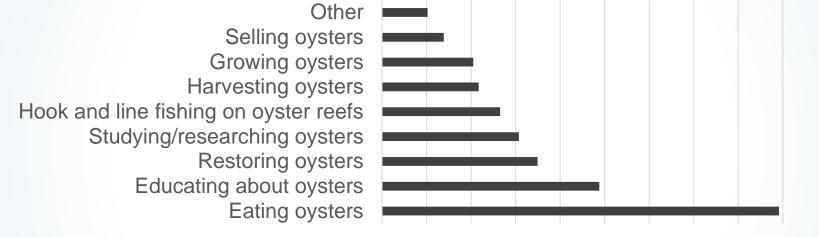
o Actions

Results of Stakeholder Survey

Professional Affiliation of Survey Respondents

| | Recreational fisher | State gov't agen | | Academic institution | |
|-------|-------------------------|------------------|--|---------------------------|--|
| | | | Local gov't staff | Commer cial fisher | |
| Other | Non-profit organization | Oyster grower | Seafood wholesaler/d istributor/r… | Federal gov't Elect | |

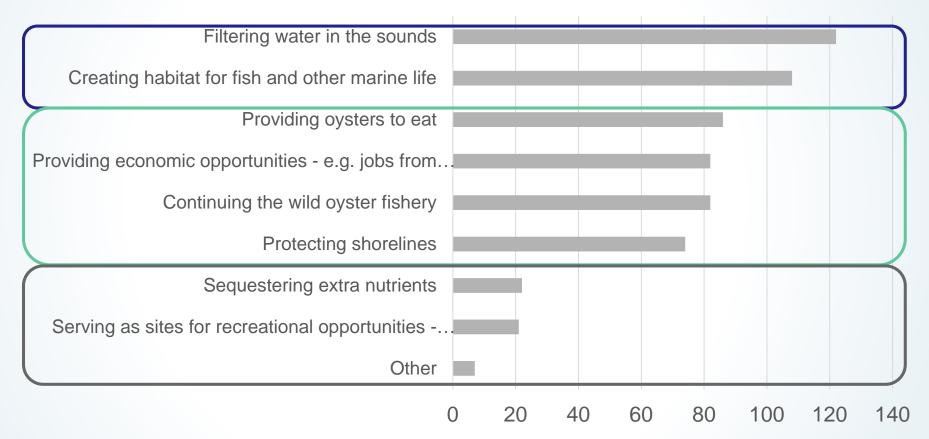
Survey Respondents' Oyster Related Activities



0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Survey respondents' participation in oyster related activities as a percent of all respondents

Survey Respondents Selected the Benefits of Oysters that were Most Important to Them



Number of Times an Oyster Benefit was Selected by Survey Respondents

Direct Threats to Oysters Most to Least Concerning

Physical Destruction to Reefs from Human Related Activities

(other than harvest)

Overharvest of Resource

Siltation/Burying of Reefs

Incompatible Fishing Practices (e.g. dredging)

Low Dissolved Oxygen

Lack of Spawning due to Low Oyster Population

Shellfish Diseases

Salinity Changes (too high/too low)

Lack of Settlement due to Low Substrate Availability

Introduced Invasive Species

Ocean Acidification

Physical Destruction to Reefs from Storms or Natural Causes

Predation

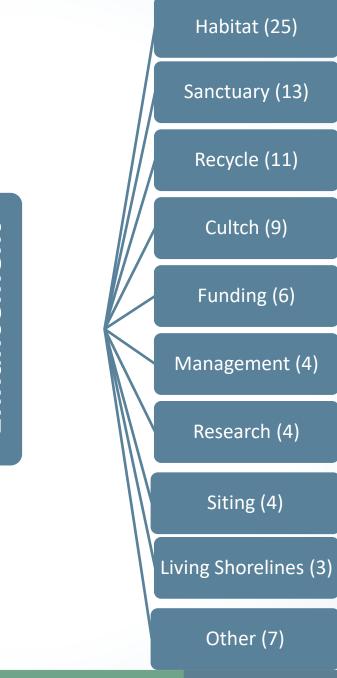
Lack of Sufficient Food for Oysters

What do you consider to be the single greatest threat to oysters in North Carolina in the next 5-10 years and why?

| Threat | # of Times |
|--------------------------------|------------|
| | Selected |
| Water Quality | 11 |
| Incompatible Fishing Practices | 8 |
| Overharvest of Resource | 5 |
| Land-based Development | 4 |
| Storms | 4 |
| Ocean Acidification | 3 |
| Shellfish Diseases | 3 |
| Physical Destruction to Reefs | 3 |
| Management | 3 |
| Lack of Spawning | 2 |
| Lack of Substrate | 2 |
| Siltation | 2 |
| Swings in Salinity | 1 |
| Lack of Awareness | 1 |
| Multiple Threats/Interactions | 66 |

Respondents provided 241 actions to be considered for Oysters

| Action Related to: | Number of Times Made |
|----------------------------|----------------------|
| Habitat Enhancement | 85 |
| Water Quality Improvements | 52 |
| Shellfish Aquaculture | 52 |
| Fisheries Management | 38 |
| Education/Awareness | 6 |
| Other | 8 |



Habitat Enhancement

SANCTUARIES





www.ncoysters.org/2020blueprintupdate



Oyster Sanctuary Strategy

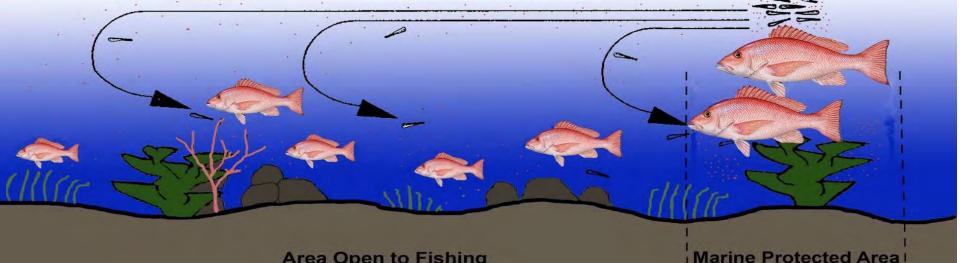
Brandon Puckett, NC Coastal Reserve and National Estuarine Research Reserve Jason Peters, NC Division of Marine Fisheries



Sanctuaries: a response to habitat loss & overharvest



Egg and Larval Dispersal

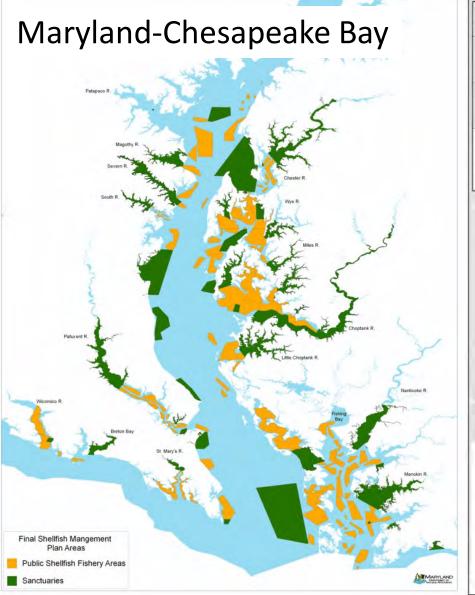


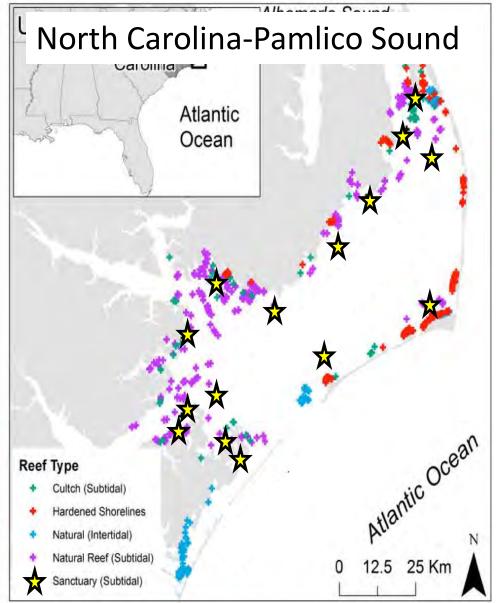
Area Open to Fishing

Bohnsack 1990

Oyster sanctuaries in a national context

Theuerkauf et al. (in prep)

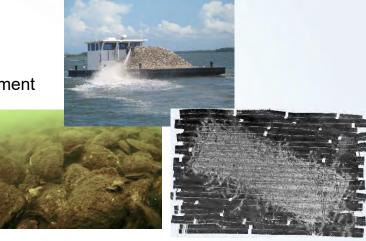




North Carolina Oyster Rehabilitation Strategy

Two part approach: cultch planting + sanctuaries

- Cultch Reefs (since 1915)
 Primary objective: restore available hard substrate for settlement
 Low habitat complexity
- Open harvest
- Inexpensive to build: \$13,304 per acre to build
- Strategy more acreage, more sites (40-50 ac/yr)
- Short term investment

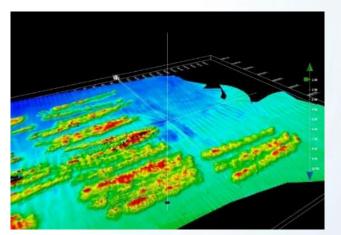


Oyster Sanctuaries (since 1996)

- Primary objective: function as broodstock reserves, supply larvae system wide
- High habitat complexity
- Closed harvest
- Quite expensive to build: \$162,338 per acre
- Long term investment







Sanctuaries in NC: what do they look like?

Sanctuaries

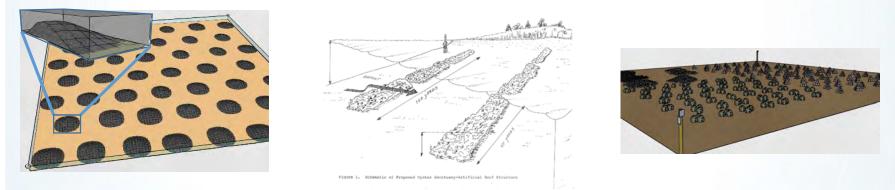
General design:

Large areas - ~40 acres each High relief habitat – 2-6' high Ridges, mounds, patches Large aggregate rock (5-12") or other large materials

Material types:

Limestone marl, crushed concrete, granite, basalt, ERUs (engineered reef units), recycled concrete pipe, precast concrete



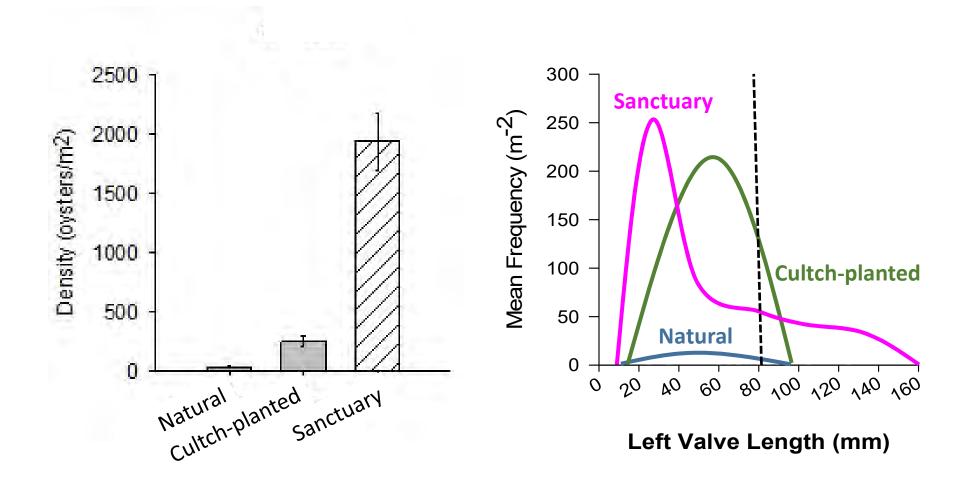


15 oyster sanctuaries | 395.44 protected ac | 357.76 developed ac | 97.22 footprint ac

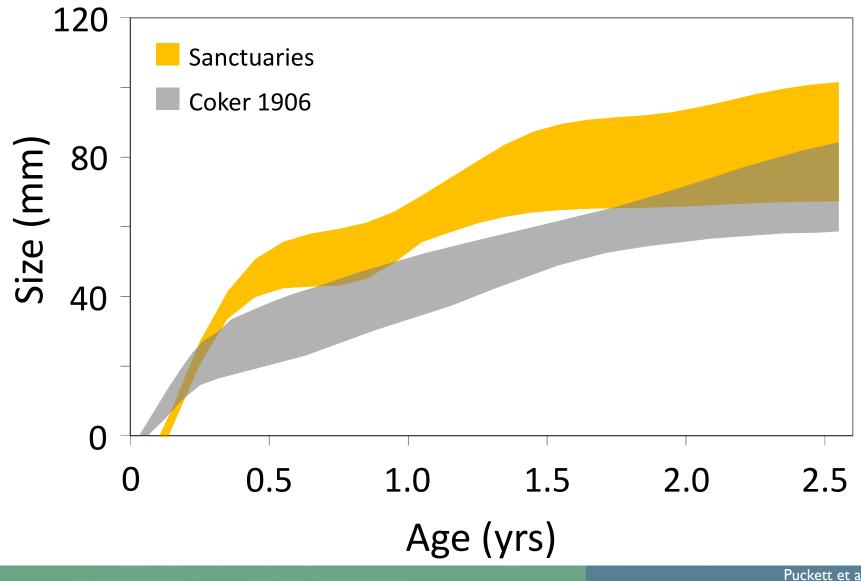
Research & Monitoring



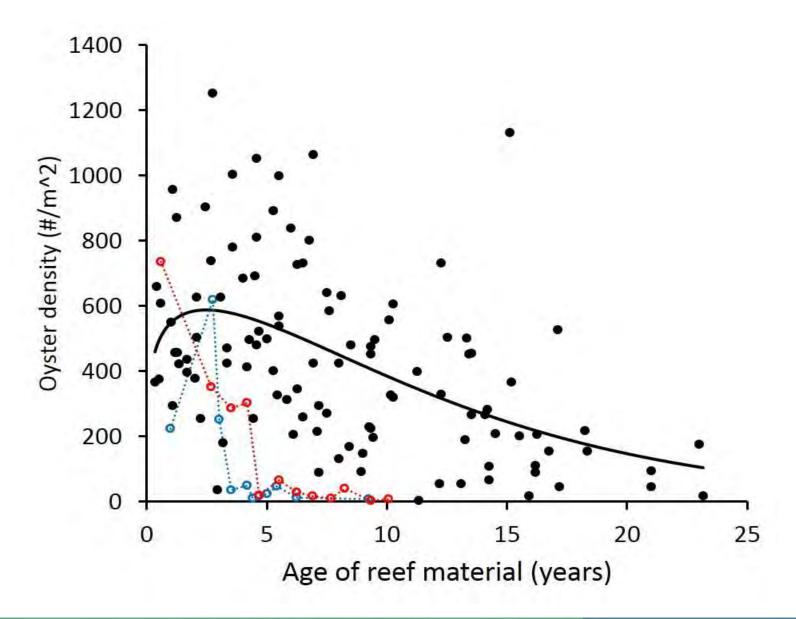
Sanctuaries improve oyster demographics



Sanctuaries improve oyster demographics

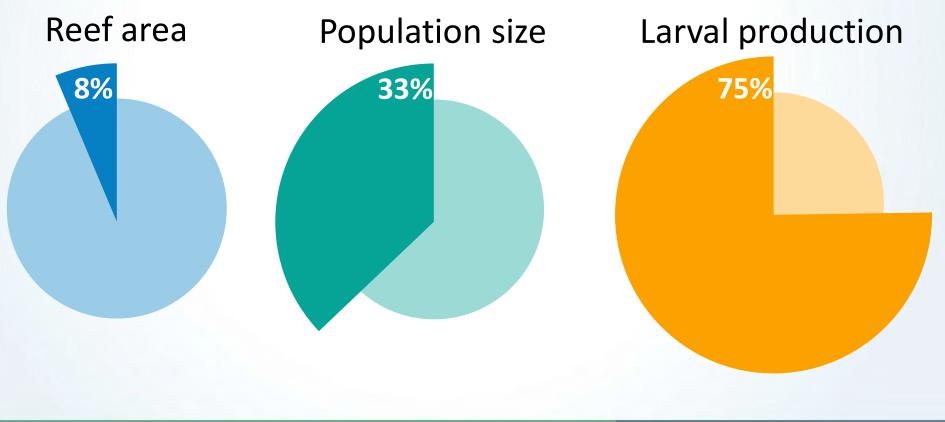


Demographic benefits long-lasting

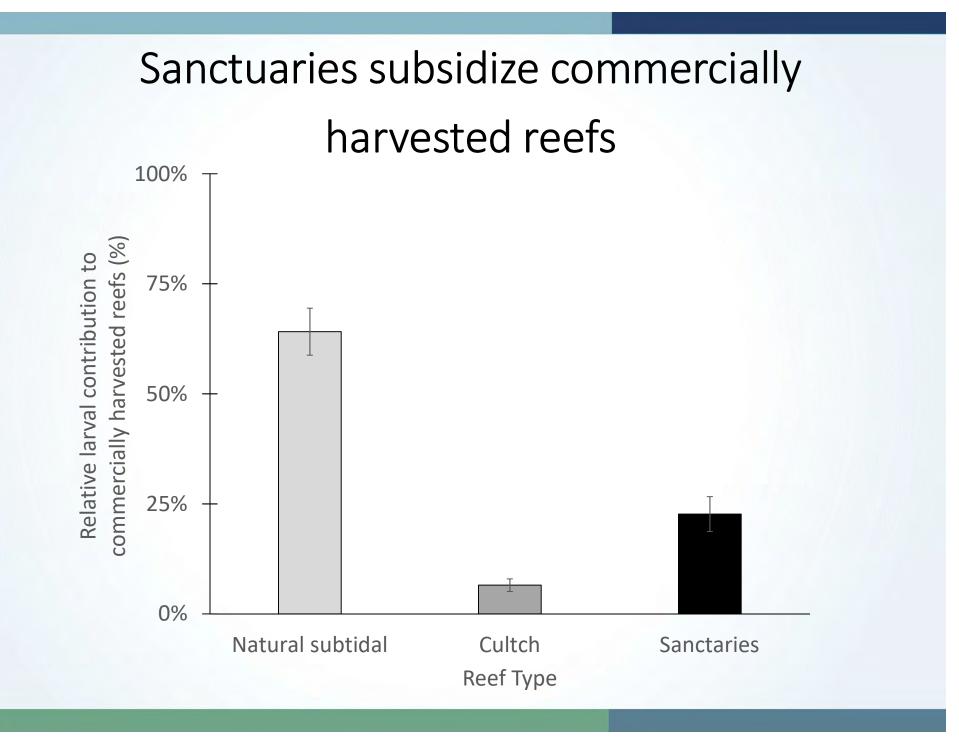


Puckett et al. (2018), DMF unpubl. 2019

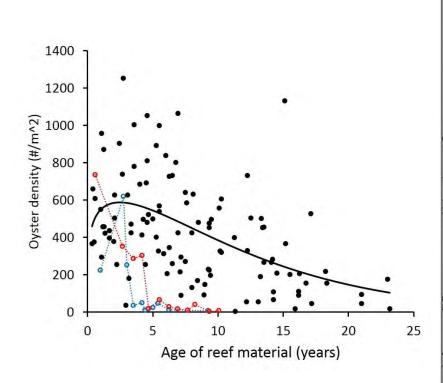
Sanctuaries contribute disproportionately to reproductive output

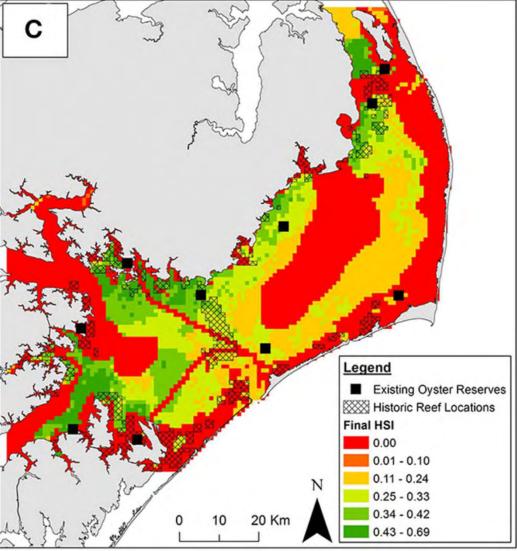


Puckett et al. (2016), Peters et al. (2017), Theuerkauf et al. (in prep)



Siting critical to sanctuary success





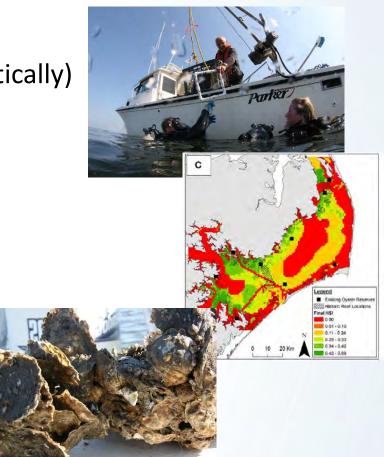
Puckett et al. (2018)

Best Practices



Reef Making Guidance

- Decisions to make:
 - Where to build (geographically)
 - How to build (physically and logistically)
 - What materials to use
- DMF decisions guided by:
 - Peer reviewed literature
 - DMF lessons learned
 - Oystermen
 - NGO advocates
 - Marine fisheries commission
 - State legislature
 - State and federal permits
 - Logistical feasibility



Best Practices

SITING TOOLS

~HSI (NCSU) ~

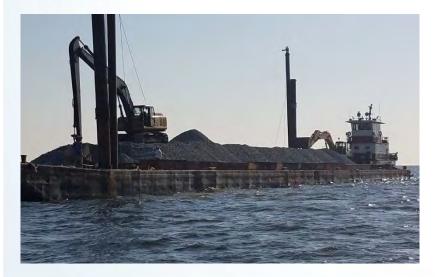
~ Long-term reef monitoring ~

Side scan length frequency population data water quality monitoring marine pest data

~ Lease program maps ~

~ DMF habitat maps ~

~ Winslow/Ballance maps ~





Key Considerations

- Careful balance of biology and logistics
 - 10 ac of EXCELLENT habitat for \$1m or 100 ac of GOOD habitat for \$1m?
- Real-time application of lessons learned
 - Material successes
 - Location successes
 - Acknowledge failures, learn, and move on!

Looking Ahead...

Our focus:

- Not all reef-building materials are suited for all locations. Where to use what; how to be cost effective?
- Not all locations are receptive to restoration. Can we successfully build in high salinity or low settlement areas?
- Oyster populations at sanctuaries typically start high, but decline over time.
 Can these areas be successfully reinvigorated? Can we improve the trajectory?

It is crucial to:

- Maintain strong relationships with university researchers
- Apply emerging research to planning
- Remain flexible and open-minded while planning future research projects



Draft Recommendations



Oyster Blueprint 2021-2025 Oyster Sanctuary Workgroup Members

- Jimmy Johnson, APNEP
- Daniel Brinn, Hyde County
- Dr. Dave Eggleston, NC State CMAST
- Jason Peters, NC DMF
- Dr. Brandon Puckett, NCNERR

- Simon Rich, Stevens Towing
- Dr. Niels Lindquist, UNC IMS
- Dr. Brian Boutin, TNC
- Erin Fleckenstein, Todd Miller, Ted Wilgis, NC Coastal Federation

Oyster Blueprint 2021-2025 Oyster Sanctuary Major Recommendations

As we're reviewing these recommendations, consider

1) Are they important and achievable in 5 years?

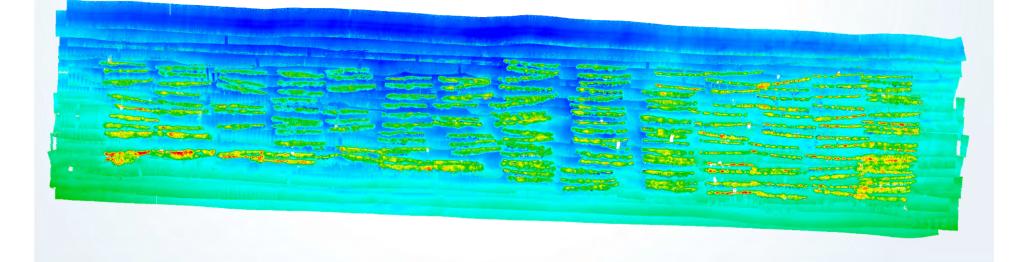
2) What did we miss?

Oyster Blueprint 2021-2025 Oyster Sanctuary Major Recommendations

- 1. Build 100 acres of Oyster Sanctuary in Pamlico Sound.
- 2. Monitor and use the best science available to inform restoration activities.
- 3. Make restoration of oyster habitat a state mandated activity, building off the State Shellfish Initiative.
- 4. Plan for future work: Permit sanctuaries in 3-5 year batches for ease of construction/fund raising.
- 5. Report out and publicize the results of the sanctuary program in the annual State of the Oyster report.
- 6. Continue to refine and improve the oyster sanctuary acreage goal through the next five-year Blueprint period.
- 7. Determine the Feasibility of an Oyster Sanctuary and/or Shellfish Management Area Designation in Southern Waters.

Build 100 acres of Oyster Sanctuary in Pamlico Sound.

- Secure funding and staff to build 100 acres of sanctuary reef.
- Determine best method to allow the Division to contract over multiple fiscal years.



Monitor and use the best science available to inform restoration activities.

- Location of sanctuaries
- Selection of appropriate substrate material (not all materials are suitable in all locations).
- Appropriate design including size, architecture and amount of relief of reefs.
- Determine the metrics of success that would allow sanctuaries to sustain a positive return on investment
- Monitor reefs for success and practice adaptive management of sanctuaries as needed.

Make restoration of oyster habitat a state mandated activity, building off the State Shellfish Initiative.



Plan for future work: permit sanctuaries in 3-5 year batches for ease of construction/fund raising.

- Maximize use of existing permitted sanctuaries, where appropriate.
- Prioritize new sanctuary locations to maximize larval output and long-term persistence.

Report out and publicize the results of the sanctuary program in the annual State of the Oyster report. Include:

- acres created
- the success of the program, understanding that the success of the reefs (how many oysters and the size of the oysters) changes over time
- estimated fish production
- estimated water filtration improvements
- economic impact (number of people employed in the reef construction)

Continue to refine and improve the oyster sanctuary acreage goal through the next five-year Blueprint period.

- Determine the highest priority ecosystem service that more oyster reefs would achieve.
- Based on the priority ecosystem services of the sanctuary network, determine how many sanctuaries are needed to achieve this goal.
- Communicate sanctuary accomplishments, additional needs and goals through a coordinated outreach strategy.
- Develop recommendations for sampling methods and survey design for a statewide oyster stock assessment of subtidal and intertidal populations.

Determine the Feasibility of an Oyster Sanctuary and/or Shellfish Management Area Designation in Southern Waters.

- When considering this option:
- Define need/intent of this management action (ecosystem service based/larval connectivity/coastal resiliency).
- Determine the best- most appropriate designation of protected/created reef.
- Enact rule change and/or legislation to allow new designation as needed.
- Research/Modeling to inform location/material/architecture of reefs based on intent.
- Use existing science to inform success of proposed reefs.
- Establish plan for future reefs.



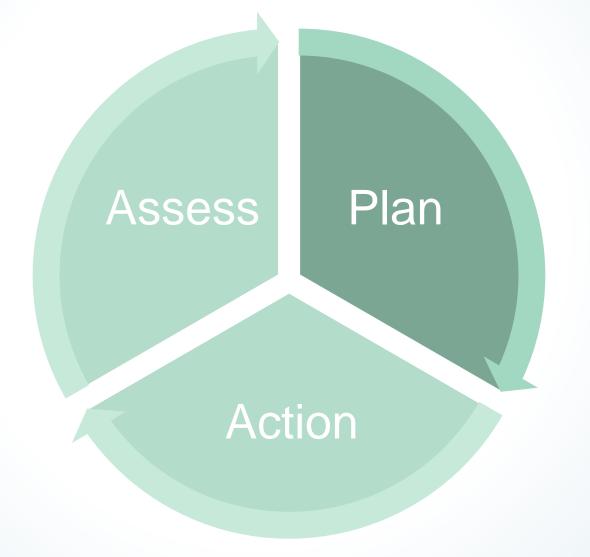




Wrap up and Next Steps

Erin Fleckenstein, NC Coastal Federation

Process of Updating the Blueprint



Assessing

Blueprint Accomplishments Stakeholder Survey Strategy Workgroup Recommendations

Planning

Public Review of Draft Plan

Oyster Steering Committee

Review

Virtual Meeting Input

Workgroup Recommendations



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