

# North Carolina Intertidal Reefs

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# N.C. Intertidal Reef Restoration

- Research on reef restoration - Factors affecting restoration and habitat function
  - Reefs as habitat (Meyer; Alphin/Posey)
  - Interactive effects of reefs and marsh shoreline (Meyer)
  - Materials and oyster recruitment (Meyer)
  - Surface and edge complexity effects on habitat function (Posey and Alphin)
  - Water quality effects of created reefs (Alphin and Posey)
- Restoration efforts
  - USACE (Wilson)
  - NC Coastal Federation
  - NC State efforts

## Reefs as Habitat

- Faunal colonization and utilization of created intertidal oyster reefs (3 NC sites)
- Created reefs supported reef associated faunas at  $\geq$  densities than nearby natural oyster reefs.
  - Including: *C. virginica*, *B. amphitrite*, *B. exustus*, *G. demissa*, *P. herbstii* and *E. depressus*
- After 2 yr, harvestable sized *C. virginica* (~75mm) and clusters were present in the created reefs



Meyer and Townsend 2000.

# Reef/Marsh interactions

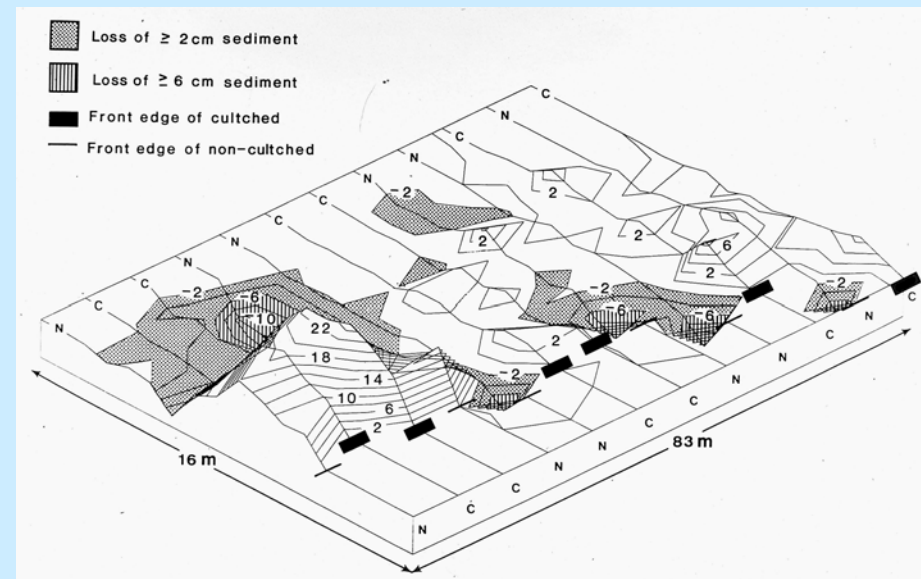
- Examined the influence of an intertidal oyster cultch fringe on nekton use of salt marsh
- Addition of an oyster cultch fringe increased abundance of resident marsh nekton with an affinity for oyster substrate compared to non-cultched salt marsh
  - including *Fundulus heteroclitus*, *Gobionellus boleosoma*, *Gobiosoma bosc*, and *Palaemonetes* spp.
- Cultch may have served as a barrier to juveniles of some nekton species which tend to move onto the marsh early in the tidal cycle
  - e.g. *Leiostomus xanthurus* and *Callinectes sapidus*



Meyer et al. 1996.

# Reef/Marsh interactions

- Examined the influence of an intertidal oyster cultch fringe on marsh edge stabilization
- Significant differences were observed for marsh edge vegetation change between cultched (-0.02 m) and non-cultched (-0.83 m) plots during storm events.
- Significant differences were observed for marsh sediment stabilization, with net erosion observed within non-cultched plots and accretion within cultched plots due to storm wave and boat wake activities



Meyer et al. 1997.

# Materials and Oyster recruitment

- Examined the potential use of geotextile fabric as a substrate for oyster settlement and a foundation for intertidal oyster reef restoration (NC and Chesapeake Bay).
- After 16 months harvestable sized oysters (~75mm) were present. In both NC and Chesapeake Bay oyster recruitment was greatest on black compared to white geotextile and on shaded versus full sunlight treatments.



Panel after 48 months  
Meyer et al. 1997

## Reef Landscape – complexity and fragmentation effects

- Compare nekton, epifauna, oyster populations and adjacent infauna among created reefs, natural reefs, and tideflat
- Examine main and interactive effects of edge and vertical complexity on selected habitat and ecosystem factors
- Examine influences of fragmentation on reef use



**Posey and Alphin - ongoing**

# Approach

- Experimental Reefs
  - Low vertical / low edge complexity
  - Low vertical / high edge complexity
  - High vertical / low edge complexity
  - High vertical / high edge complexity
  - Small fragmented reefs with high vertical complexity (reef system size constant)
  - Large fragmented reefs with high vertical complexity (reef area constant)
  - Natural reefs
  - Sand flat habitat
- Natural Reefs in 2 systems
  - Varying surface complexity
  - Fragmented, non fragmented



# Response Variables – on reef

- Epifauna – experimental and natural reefs
  - Quadrat sampling and excavations
  - Seasonally, among treatments and in controls
- Nekton – experimental and natural reefs
  - Seasonally, among treatments and in controls
  - Breder traps; gill nets; lift nets; direct observation
- Oysters – experimental and natural reefs
  - Comparison among treatments and natural reefs
  - Settlement; growth; survival; size distribution

# Response Variables – reef/sandflat connections

- Infauna – experimental reefs
  - Core sampling seasonally
  - In reef, at varying distances from reefs, and in control areas
- Benthic microalgae – experimental reefs
  - Core sampling seasonally
  - In reef, at varying distances from reefs, and in control areas
- Pore water N and P – experimental reefs
  - Wells, taken seasonally
  - In reef, at varying distances from reefs, and in control areas

# Summary



- Difference aspects of reef morphology appear to affect different fauna groups
  - Recruitment of oysters greater with lower vertical complexity – possible indirect effects?
  - Certain epifauna (e.g. rock crabs) positively associated with increased vertical complexity; others show no significant relationship
  - Nekton show variable patterns, but fragmentation and surface complexity associated with most responses
  - Infauna show variable responses, but proximity to reefs and convolutions related to abundances of several taxa
  - Small-scale sediment, sediment chlorophyll and N affects adjacent to convoluted edge reefs; possible interactions with infaunal distributions

## Filtration Effects

- Examine influence of created and natural oyster reefs on removal of particulates and chlorophyll a
- Significant effects on particulates and chlorophyll for created reefs placed in tidal channels
- Significant effects on chlorophyll for bar reefs



# Restoration Efforts

- North Carolina Division of Marine Fisheries
- North Carolina Coastal Federation
- U.S. Army Corps of Engineers –  
Wilmington District
  - Morehead ARC Project
  - Festival Park Project

# Morehead ARC Mitigation Site

- Estuarine habitat was constructed at a historic dredged material disposal site.
- Oyster cultch were placed on tidal flats in the constructed marsh ecosystem in 1995
- These efforts produced sustainable oyster reefs



Summer  
1995



Winter  
2004



**US Army Corps  
of Engineers  
Wilmington District**



US Army Corps  
of Engineers  
Wilmington District

# Morehead ARC Mitigation Site



## Good Spat Set

- 12.23 Spat/Cultch 1996
- 2.86 Spat/Cultch 1997
- 0.30 Spat/Cultch 1998

## Healthy and Productive

- 21% at least 2.5 inches in 1996
- Average length 2.7 inches 1997
- Length ranges from 1.5- 3.9 by 1998

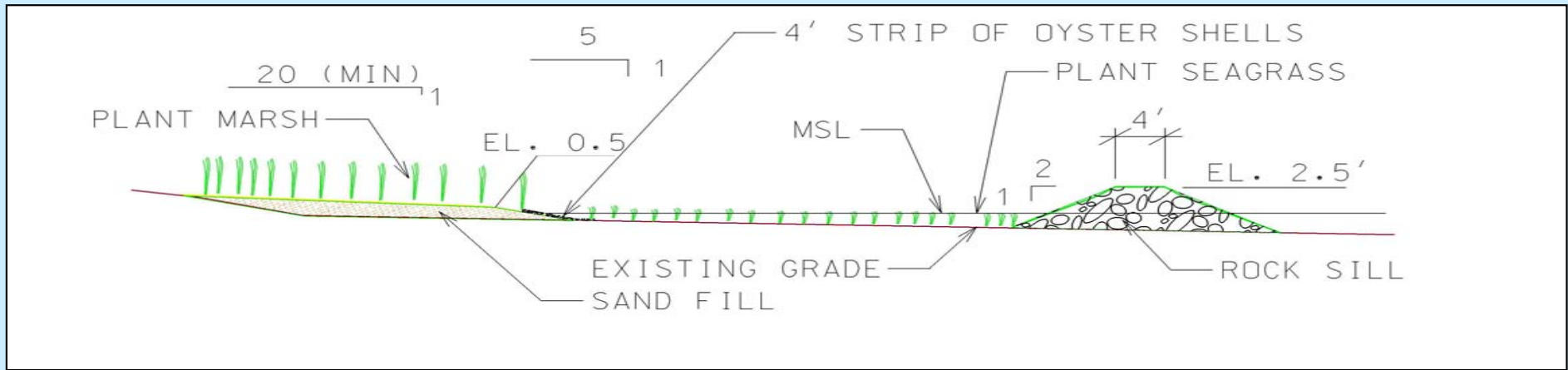
Three Year Monitoring: Spat set and oyster length were assessed based on inspection of 30 random pieces of cultch. Fall seining and spring trawling were conducted as a part of the red drum and juvenile recruitment sampling efforts by the State.



# Festival Park Ecosystem Restoration

US Army Corps  
of Engineers  
Wilmington District

## Typical Section



This project restores or protects 5 acres of maritime forest and shallow estuarine habitat, including marsh, sea grass, and oysters. It includes a rock sill that increases diversity by providing attachment substrate and protects the habitat and adjacent public facilities from future erosion.





# Festival Park Ecosystem Restoration

US Army Corps  
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Wilmington District



10,000 Bushels of cultch funded by the State and the NC Coastal Federation were placed offshore of the rock sill by the NCDMF in May 2003.

The constructed subtidal oyster reef provides about 1 acre of improved estuarine habitat.





# Festival Park Ecosystem Restoration

US Army Corps  
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Wilmington District



In 2004, the NCDMF will seed about 1,000 bushels of shells to assure high spat set. Seeded cultch will be transferred to the reef for growth.

Proposed Monitoring: Spat set and oyster length will be assessed based on inspection of 30 random pieces of cultch.

