OYSTER REEFS 101: AN ENGINEERS PERSPECTIVE

Restore America’s Estuaries, Tampa FL
October 2012

Dr. Jon D. Risinger, Ph.D.
Lead Coastal Engineer
MWH Global, Inc.
THE EASTERN OYSTER
CRASSOSTREA VIRGINICA

• Sessile
• Gregarious
• Fecund
• Amorphoditic

Oyster Life Cycle (after Berrigan et. al 1991)
COASTAL BIO-BREAKWATERS

- Detached
- Intertidal/Submerged
- Segmented
- Modular
- High Relief (3-D)

OysterBreak™ Armor Units

ORA Estuaries, 2011
BIO-ENGINEERED OYSTER REEFS

DETAIL 1
OYSTERBREAK ARMOR UNIT
TOP UNIT ShOWN (BOTTOM UNIT SIMILAR)

DETAIL 2
OYSTERBREAK ARMOR UNIT - TOP UNIT

DETAIL 3
OYSTERBREAK ARMOR UNIT - BOTTOM UNIT

DETAIL 4
OYSTERBREAK ARMOR UNITS - REINFORCEMENT

DETAIL 5
OYSTERBREAK ARMOR UNIT - TOP UNIT REINFORCEMENT

DETAIL 6
OYSTERBREAK ARMOR UNIT - BOTTOM UNIT REINFORCEMENT

DETAIL 7
OYSTERBREAK BREAKWATER CONFIGURATION

DETAIL 8
OYSTERBREAK BREAKWATER END
BIO-BREAKWATER ALTERNATIVES

Reef Balls

Reef BLKS

Eco Disks
When the breakwater is long and/or located close to shore, conditions favor **TOMBOLO** formation. Dally and Pope (1986) recommend:

\[
\frac{L_s}{Y} > 1.5-2 \text{ for single breakwater} \\
\frac{L_s}{Y} = 1.5 \text{ for segmented breakwater (} L < L_g < L_s) \\
\]

- **L**-wavelength at the structure
- **Y**-Distance of breakwater from nourished shoreline
- **Ls**-Length of breakwater structure
- **Lg**-Gap distance between adjacent breakwater segments

Short breakwaters at greater distance from shore favor **SALIENT** formation. Dally and Pope (1986) recommend:

\[
\frac{L_s}{Y} > 0.5-0.67 \text{ for single & segmented breakwater} \\
\]
ROCKEFELLER WILDLIFE REFUGE DEMONSTRATION PROJECTS
• Oyster shell height measurements of 50 mm were recorded after 6 months growth
• Oyster counts exceeding 500 per m^2 on the artificial concrete modular units
SPAT PLATES
MONITORING OYSTER SETTLEMENT

Spat Plates

Temperature

Salinity
‘SPATFALL’ ANALYSIS
OYSTER LARVAE SETTLEMENT

Spat plate data exceeded 10,000 spat/m^2 in some locations.
‘BIOFOULING’

- Oysters
- Barnacles
- Bryozoans
- Algae
‘CULTCH’ PLATES
SPAT SETTLEMENT & OYSTER RECRUITMENT
ENGINEERING ANALYSIS: GEOMETRY, WEIGHT, & FORCES

Stress

Strain

Displacement
CONCRETE COMPRESSIVE STRENGTH

No significant difference in material strength using lightweight aggregates
FLEXURAL MATERIAL STRENGTH

![Graph showing load vs. time for control, 6 Months, and 2 Years samples. The graph indicates a significant increase in load bearing capacity over time.](image-url)
SEDIMENT ACCRETION

Pilot scale breakwater emplacements dominated by biological growth accumulated nearly 4 cubic meters of leeward sediment over 4 years.

Heavy emplacements installed for less than one year accreted 1.6 cubic meters of sediment.

Light emplacements accreted 0.37 cubic meters of sediment.
Oysters were once valued primarily as a fishery resource, but today increasing attention is being focused on other ecosystem services that oysters and the reefs provide in coastal bays and estuaries (Brumbaugh & Coen, 2009).
CASE STUDIES:
BIO-ENGINEERED OYSTER REEF DEMONSTRATION PROJECTS

Vermillion Bay
(Low Energy)

Rockefeller Refuge
(High Energy)
FUTURE RESEARCH

- Living Shorelines
- Clemson Reef
- Oyster Reef Sills
- Vegetative Plantings
ACKNOWLEDGEMENTS

• MWH Global, Inc.
• ORA Estuaries, LLC
• Wayfarer Environmental Technologies, LLC
• Louisiana State University (LSU), LSU AgCenter
• Clemson University BioSystems Engineering Group
• LDWF, Rockefeller State Wildlife Refuge
• Louisiana Transportation Research Center (LTRC)
QUESTIONS