

# Developing Monitoring Guidelines and Criteria for Judging the Performance of Oyster Restoration Projects

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## Overview

### Background

- Oyster reefs are the most imperiled marine habitat on Earth (Beck et al. 2011), with declines of 88% in the US over the last 120 years (zu Ermgassen et al. 2012)
- In addition to fisheries, there is increasing recognition of the valuable ecosystem services provided by oysters (water quality improvement, habitat enhancement, shoreline stabilization, etc.)

### Issue

- Post-construction monitoring is often inconsistent and not performed to an extent that will allow for:
  - Determination of whether or not ecosystem-based restoration goals have been successfully achieved
  - Adaptive management based on the initial monitoring efforts
  - Comparison of projects

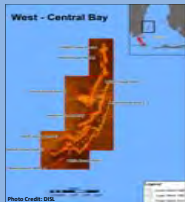
### Solution

- Project team - a broad group of restoration practitioners led by members of the NOAA Restoration Center, The Nature Conservancy, the University of South Alabama and Florida Atlantic University
- Develop performance criteria and monitoring guidelines for:
  - Universal metrics to be monitored for all oyster restoration projects
  - Metrics specific to the various restoration goals and ecosystem services associated with oyster reefs.
- Will allow for the assessment of basic performance of restored oyster habitats and the comparison of performance within and across regions, tidal location, and construction type, and will provide information towards adaptive management of restored and constructed reefs
- Manual
  - In progress, but a draft is available for download at: <http://www.oyster-restoration.org/>

## The Universal Metrics and Environmental Variables

### Universal Metrics

- A universal metric is one that we recommend monitoring for all oyster restoration projects, regardless of the restoration goal(s) of that project
- We propose the following universal metrics:
  - Reef Areal Dimension**
    - Consists of two separate measurements:
      - Project Footprint** = the maximum areal extent of the footprint of the reef
      - Reef Area** = the actual area (summed) of patches of living and non-living oyster shell (or reef substrate) within the project footprint
  - Reef Height (*Crassostrea virginica* only)**
    - Average height of a reef off the bottom substrate
  - Emergent Reef Structure (*Ostrea lurida* only)**
    - Consists of three separate measurements
      - Shell thickness = Average height of bed off the bottom substrate
      - Percent cover = Visual estimation of percentage of substrate covered by shell
      - Emergent shell volume = Volume of emergent shell present on bed



- Oyster Density**
  - Number of live oysters per m<sup>2</sup> (includes adult oysters, juvenile oysters, and spat)



- Oyster Size-Frequency Distribution**
  - The various sizes of oysters present on the reef



### Environmental Variables

- Descriptive or physical parameters that should be reported or monitored for every oyster restoration project, regardless of the restoration goal(s) of that project.
- We propose that the following be monitored:
  - Water Temperature
  - Salinity
  - Dissolved Oxygen (subtidal reefs only)
  - Disease Prevalence and Intensity
  - Presence of Predatory or Competitive Species (optional)



## Restoration Goal-Based Metrics: Brood Stock and Oyster Population Enhancement

- To determine if oyster restoration efforts are contributing to local oyster stocks, we propose two metrics:
  - Off-Reef Oyster Density and Size-Frequency Distribution
  - Off-Reef Large Oyster Abundance



## Restoration Goal-Based Metrics: Habitat Enhancement for Resident and Transient Species

- Many invertebrates and vertebrates, some of which are commercially or recreationally important, utilize oyster habitat for shelter and feeding grounds.
- To assess habitat enhancement, we propose one metric and suggested methodologies for various organisms:
  - Density of Two Target Species**
    - Epifaunal Sessile Invertebrates.
    - Infaunal Invertebrates
    - Non-Oyster Filter Feeders or Encrusting Species
    - Small Resident Mobile Fish and Invertebrates
    - Transient Crustaceans and Juvenile Fish
    - Transient Adult Fish
    - Waterbirds



## Restoration Goal-Based Metrics: Water Quality Improvement

- Oyster habitats improve water quality by removing seston from the water column, thus increasing water clarity.
- We propose two metrics to monitor the effects of a constructed oyster reef on local water quality.
  - Oyster Biomass for Determination of Filtration Rates
  - Oyster Condition Index



## Restoration Goal-Based Metrics: Enhancement of Adjacent Habitats

- Oyster habitat can stabilize adjacent shorelines by mitigating the erosive action of both natural waves and those propagated by vessels.
- May also promote sediment accumulation inshore of the reef.
- We propose two metrics to monitor the effects of a constructed reef on the adjacent shoreline.
  - Shoreline Loss/Gain
  - Shoreline Profile/Elevation Change
  - Density of Marsh/Mangrove Plants (if applicable)



## 2011 Oyster Restoration Performance Metrics Workshop Participants

- Lesley Baggett, Sean Powers (USA/DISL)
- Rob Brumbaugh, Jenn Greene, Boze Hancock (TNC)
- Bryan DeAngelis, Kay McGraw, Summer Morlock, Stephanie Westby (NOAA)
- Loren Coen (FAU)
- Brian Allen (Puget Sound Restoration Fund)
- Denise Breitburg (SERC)
- Dave Bushek (Rutgers University)
- Jon Grabowski (Northeastern University)
- Ray Grizzle (UNH)
- Ted Grasholz (UC - Davis)
- Megan La Peyre (USGS)
- Mark Luckenbach (VIMS)
- Mike Piehler (UNC - Chapel Hill)
- Philine zu Ermgassen (University of Cambridge)

