Oyster Best Management Practices: What Does It Mean For Growers?

Suzanne Bricker and Matt Parker

43rd East Coast Commercial Fishermen’s & Aquaculture Trade Exposition
Roland E. Powell Convention Center
Ocean City, Maryland
January 14, 2017
Chesapeake Bay Program Partnership
Water Quality Assurance Process

**Water Quality Assessment**
2010 Chesapeake Bay did not meet nitrogen, phosphorus, and sediment water quality standards

**ChesBay TMDL / Model**
A plan was developed to reduce nitrogen, phosphorus, and sediment loads.

**Watershed Implementation Plan**
States and local partners develop plans to achieve pollutant reductions

**Best Management Practices**
CBP-approved practices or technologies are approved for credit toward achieving WIP commitments

**End Goal:**
Meet Water Quality Standards
Nutrients cause water quality degradation:
Too much of a good thing

- Potomac River, MD
- Florida Bay, FL
- Caloosahatchee Bay, FL
- Corsica River, MD

Excessive algal blooms

Qiangdao, China

Low dissolved oxygen → fish kills

Harmful Algal Blooms

Florida Bay, FL

Loss of seagrasses due to loss of light penetration

Caloosahatchee Bay, FL
What is a Best Management Practice?

BMPs are practices or technologies used by the Chesapeake Bay Partnership to reduce nutrient pollution to help meet water quality goals.

- **Structural BMP**: runoff diversions, silt fence, stream buffers, groundcover vegetation, and **oysters**!

- **Non-structural / programmatic BMP**: pre-harvest planning/nutrient application management, manure transport, stormwater management.

Approved BMPS are given ‘credits’ for the amount of nutrients they remove.
Why should a grower be interested in BMPs?

65% of US estuaries have moderate to high level degradation from nutrients.
Why should a grower be interested in BMPs?

- Biological removal of nutrients directly from the water through filtration by shellfish, removes algae and particulates – improves water quality

Source: Screenshots from Chesapeake Bay Foundation time-lapsed video of a reef

Eastern Oyster, *Crassostrea virginica*
The Stars of our Show: The Mighty Bivalve

- Eastern Oyster, *Crassostrea virginica*
- Northern Quahog, *Mercenaria mercenaria*
- Blue Mussel, *Mytilus edulis*
- Geoduck clam, *Panopea generosa*
- Ribbed Mussel, *Geukensia demissa*
Using bivalve shellfish to improve water quality

LONG ISLAND SOUND STUDY
A PARTNERSHIP TO RESTORE AND PROTECT THE SOUND

Ribbed Mussel Pilot Study in the Bronx River, New York City

OVERVIEW
The New York State Office of the Attorney General, through the Bronx River Watershed Initiative, has funded Carter Novell, a commercial shellfish farmer, and Rocking the Boat, a local youth organization, to incorporate ribbed mussels into their shells and release them into the Bronx River. These mussels will filter out nitrogen and other substances from the water, improving water quality.

Nutrient Bioextraction Workshop
International Workshop on Bioextractive Technologies for Nutrient Remediation
Sponsored by LISS, NOAA, NEIWPCC, and UCONN

Improving Marine Water Quality by Mussel Farming: A Profitable Solution for Swedish Society

Eutrophication of coastal waters is a serious environmental problem with high costs for society globally. In the Baltic region, reduction of nutrient inputs through the use of filter-feeding organisms such as mussels is a promising solution. Off the coast of Sweden, Norrström is starting a pilot project to test nutrient removal using mussels. The project aims to evaluate the cost-effectiveness and scalability of this approach.

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Estuarine, Coastal and Shelf Science

Invited feature
Use of oysters to mitigate eutrophication in coastal waters
M. Lisa Kellogg a, Ashley R. Smyth a, Mark W. Luckenbach a, Ruth H. Carmichael b, Bonnie L. Brown d, Jeffrey C. Cornwell e, Michael F. Piehler f, Michael S. Owens e, D. Joseph Dalrymple c, Colleen B. Higgins b

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d U.S. Environmental Protection Agency, National Laboratory, Woods Hole, MA, USA
University of Virginia, Marine Biological Laboratory, Woods Hole, MA, USA
f University of California, San Diego, California, USA

Eutrophication of coastal waters is a serious environmental problem with high costs for society globally. In eastern Skagerrak, reductions in eutrophication are planned through the use of filter-feeding organisms such as mussels, which remove nitrogen while providing food for the mussels. Off the coast of Sweden, Norrström is starting a pilot project to test nutrient removal using mussels. The project aims to evaluate the cost-effectiveness and scalability of this approach.

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Requests to Chesapeake Bay Partnership to Consider Oysters as BMP to Improve Water Quality

Workshop to evaluate use of Shellfish for Nutrient Reduction in the Chesapeake Bay (2013)

A proposed practice is evaluated by a BMP Expert Panel following the Chesapeake Bay Program Partnership’s BMP Review Protocol to determine BMP reduction effectiveness.
Chesapeake Bay Partnership Program convened Oyster BMP Expert Panel in 2015

- **Water Quality Assessment**
  - 2010 Chesapeake Bay did not meet nitrogen, phosphorus, and sediment water quality standards

- **Oyster BMP Expert Panel**
  - Evaluates reduction effectiveness of proposed BMPs following the CBP BMP Review Protocol

- **ChesBay TMDL / Model**
  - A plan was developed to reduce nitrogen, phosphorus, and sediment loads.

- **Watershed Implementation Plan**
  - States and local partners develop plans to achieve pollutant reductions

- **Best Management Practices**
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- **End Goal:** Meet Water Quality Standards
Oyster BMP Expert Panel Overall Goals

1. Evaluate existing science to reach consensus on nutrient (nitrogen and phosphorus) and suspended sediment removal that oysters provide (aquaculture, restoration).

2. Determine a methodology to update estimates when new science becomes available.

3. Establish guidelines for the Chesapeake Bay Partnership to:
   • use in crediting oyster nutrient and sediment removal for the TMDL
   • verify that removal is actually taking place.
Oyster nutrient and sediment removal processes under evaluation

1. **Tissue and shell nutrient content**
2. Denitrification rates associated with oyster reefs
3. Burial in sediment

- First focus was nutrients removed via tissue of oysters harvested from private oyster aquaculture practices.
- Panel reviewed existing studies and data to determine tissue nitrogen and phosphorus content.
- Panel review continues.
Sampling on Chesapeake MD oyster farms providing water quality data and oysters

Map of oyster aquaculture study sites in Maryland

Ongoing (Parker and Bricker) and previous study results support Oyster BMP Panel evaluation
Research to help determine oyster related nutrient removal at local scale

Models for a single oyster farm estimate production and nutrient removal

(Ferreira et al., 2007)
Research to determine impact of oyster nutrient removal at waterbody scale

Simulations to determine potential impact of oyster reef and aquaculture removal of nutrients in the entire waterbody

Shows feasibility and potential for using oysters as BMP
Oyster BMP Expert Panel First Recommendations released December 19, 2016

• Decision framework illustrating the process by which nutrient and sediment removal recommendations will be generated.

• Recommended amounts of nutrient and sediment removal to be credited by the Chesapeake Bay Program for oyster tissue:
  • Off-bottom private oyster aquaculture using hatchery-produced oysters
  • On-bottom private oyster aquaculture using hatchery-produced oysters
  • On-bottom private oyster aquaculture using substrate addition
Panel Recommended Nutrient Removal in Harvested Oyster Tissue

1. Default estimates for recommended practices regardless of location and applied to diploid and triploid oysters based on tissue dry weight where:

   Average % Nitrogen Content in Oyster Tissue = 8.2%
   Average % Phosphorus Content in Oyster Tissue = 0.9%

2. Site-specific estimates are possible but need to be coordinated among growers, the state, and Chesapeake Bay Program Partnership using methods recommended by the panel.
Derived from oyster growth data from Chesapeake Bay locations.
Determined five size class ranges based on shell height.

<table>
<thead>
<tr>
<th>BMP Name</th>
<th>Lbs N Reduced/million Oysters Harvested</th>
<th>Lbs P Reduced/million Oysters Harvested</th>
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<tbody>
<tr>
<td>Diploid Oyster Aquaculture 2.25 Inch</td>
<td>110</td>
<td>22</td>
</tr>
<tr>
<td>Diploid Oyster Aquaculture 3.0 Inch</td>
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<tr>
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<td>970</td>
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</tr>
<tr>
<td>Triploid Oyster Aquaculture ≥ 5.5 Inch</td>
<td>1,477</td>
<td>154</td>
</tr>
</tbody>
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Triploid oysters have greater nutrient tissue content than diploid oysters of same shell height because they have greater tissue biomass.
Application Options — Offers Scientifically-Defensible Flexibility to BMP Calculation

<table>
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<tr>
<th>Minimum Default Estimate</th>
<th>Likely underestimates reduction due to conservative approach</th>
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</thead>
<tbody>
<tr>
<td>Default Estimates</td>
<td>Most representative of the actual reduction</td>
</tr>
<tr>
<td>Site-Specific Estimates</td>
<td></td>
</tr>
</tbody>
</table>

**Minimum Default Estimate**
Use reporting States’ minimum legal harvest size and corresponding diploid default estimate if missing ploidy and size class info.

**Default Estimates**
Use ploidy and size class verification measurements to apply the corresponding estimate from table above.

**Site-Specific Estimates**
Use recommended method to establish site-specific estimates for the practice.
What does this mean to you?

- States can now pursue nitrogen and phosphorus removed in oyster tissue from aquaculture farms as a BMP in Watershed Implementation Plans and trading programs.
- Potential for additional income stream for growers.
- Price and potential impact on farm profitability yet to be determined (Parker, ongoing).
- Potential positive impacts for marketing to generate higher prices or more sales depending on market or customer base.
Acknowledgements – Thank You!!

- Don Webster and organizers of Watermen’s Trade Show seminar
- Chesapeake Bay Partnership
- Oyster Recovery Partnership – Julie Reichert and Ward Slacum
- Jeffrey Cornwell and other Oyster BMP Panel Members
- Julie Rose, NOAA NMFS Milford Lab
- Oyster growers contributing to our project