Effects of Oyster Biodeposit Resuspension on Phytoplankton Community Structure

Sabrina Tolbert

Mentors: Elka T Porter; Richard Lacouture
Background – Oyster Biodeposits

- Oysters are filter feeders
  - Adult oysters can filter 50 gal daily
- Biodeposits are nutrient rich
  - Transfer nutrients to the sediment
- Oysters have been considered as a method to reduce phytoplankton biomass
Background - Phytoplankton

• Microscopic plants Primary producers
• Populations are influenced by nutrients
  • Nitrite, nitrate, ammonium, phosphate
• Dominant phytoplankton in the Chesapeake Bay Estuary include: Diatoms, Dinoflagellates, Phytoflagellates, and Cyanobacteria
Background – STURM System

• STURM (Shear Turbulence Resuspension Mesocosm)
• Gives a more realistic model of shallow water ecosystem
  • Accurate shear bottom turbulence and water column mixing
• Allows for data collection involving:
  • Nutrient cycling, particle suspension, plankton communities
Hypotheses

Phytoplankton samples from 2018 were analyzed to draw further conclusions

❖ Resuspension tanks were found to be water column dominated
❖ Chlorophyll a data showed no significant difference between tanks

• Higher levels of nitrate, nitrite, and dissolved inorganic nitrogen in resuspension tanks will have impacts on phytoplankton community structures
  • Increased nutrient levels will cause an increase in phytoplankton biomass
  • Resuspension tanks will be diatom dominant

• Tanks with increased phytoplankton biomass will also have increased zooplankton biomass
Methods – Mesocosm Set-up

- **6 tanks total** – 3 STURM (R) and 3 Non-Resuspension (NR)
- **All tanks received:**
  - 1000L seawater, 10cm sediment, mixing paddles (paddles differ between R and NR tanks)
- **Daily Procedures:**
  - 10% water exchange, biodeposits added, water quality measurements
- **Twice Weekly:**
  - Water sampling, plankton sampling, light profile
Methods - Phytoplankton

• Microscopy Techniques:
  • Utermohl settling technique – uses an inverted microscope
  • 500x magnification used
  • Min of 100 cells counted per sample
  • Min 10, Max 50 fields looked at per sample

• Species ID and carbon conversion to calculate biomass

• Phytoplankton biomass compared to zooplankton and nutrients
Methods – Phytoplankton ID
Results – Phytoplankton Biomass

$P = 0.0728$
Results – Population Compositions as Biomass

% Species in Resuspension Tank Populations

% Species in Nonresuspension Tank Populations
Results – Diatom Biomass

$P = 0.0481$
Results – Diatom Biomass in R tanks

STURM Paddle
Results - Diatom Biomass in NR tanks

There is a sudden jump in diatom biomass in the NR tanks in the last days of the experiment.
Results – Diatom Biomass in NR tanks

\[ \text{NH}_4^+ (\mu \text{mol l}^{-1}) \]

- **R**
- **NR**

\[ p = 0.0164 \]

Day of Experiment
Synthesis NR vs R with Biodeposit Additions

NR

\[ \text{DIN} \]

O₂

\[ \text{NH}_4^+ \]

O₂

R

\[ \text{DIN} \]

O₂

\[ u_* \]
Results - Zooplankton

Total Biomass in Resuspension VS Nonresuspension for Zooplankton

p=0.846621
Discussion

• Biomass was not different between tanks, but population structure did vary
  • Diatom biomass was higher in the resuspension tanks (R)

• There was bottom up population control impacting the phytoplankton populations
  • Nutrient levels were controlling populations as opposed to zooplankton

❖ Research attempts to complete the picture when discussing oyster restoration to control nutrient overloads
Acknowledgments

Elka T. Porter – Mentor
Erin and Habibah - Peers working on the STURM project

Richard Lacouture – Mentor
University of Baltimore and PEARL