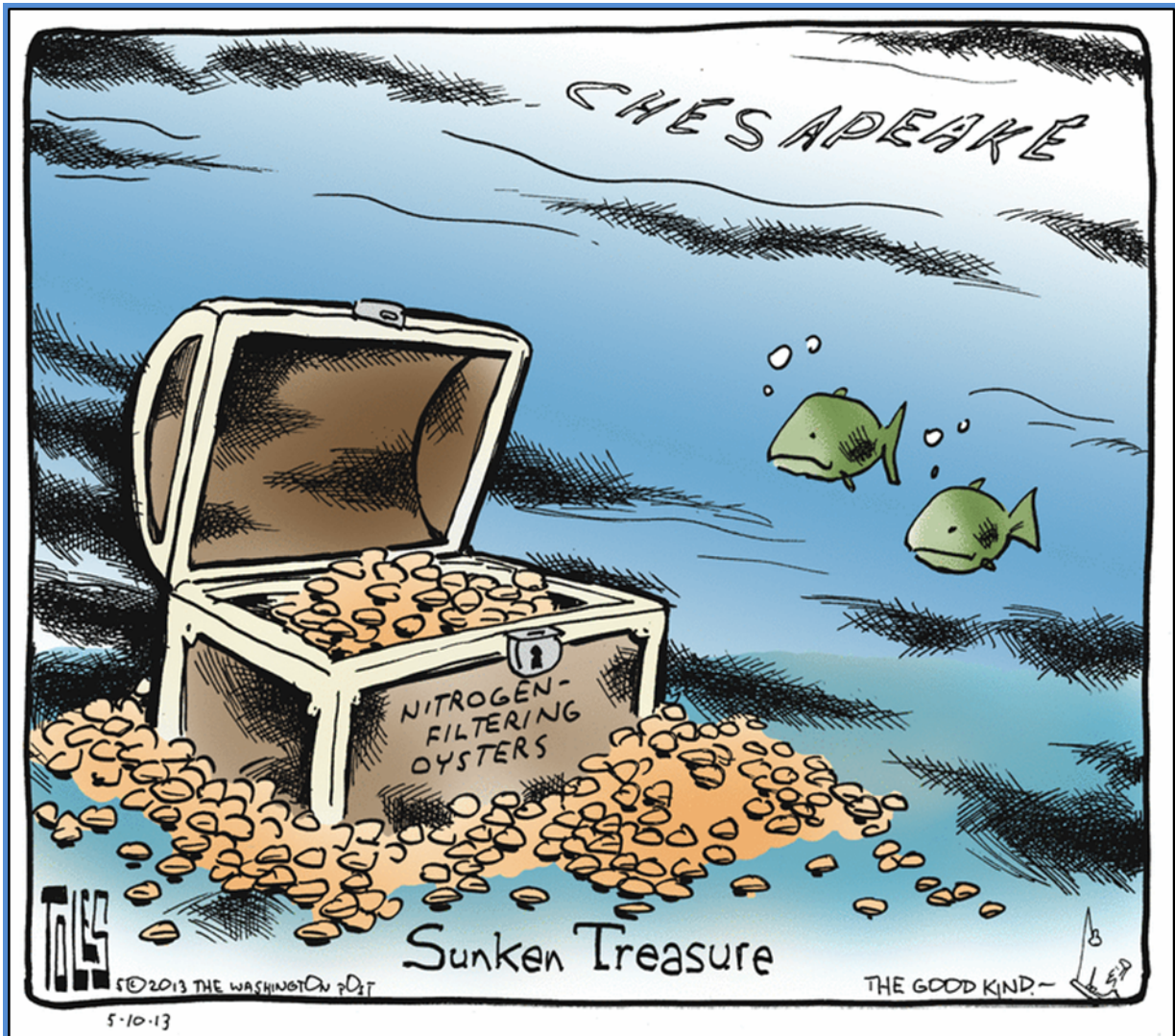


Bivalve BMP's - Adapting Proposed Tidal BMP's (Oysters) to Flowing Waters (Mussels)?

Jeffrey Cornwell



Thanks to Lisa Kellogg, Mike Owens,
Julie Reichardt-Nguyen and the
whole oyster BMP panel



Source: Tom Toles (2013) The Washington Post

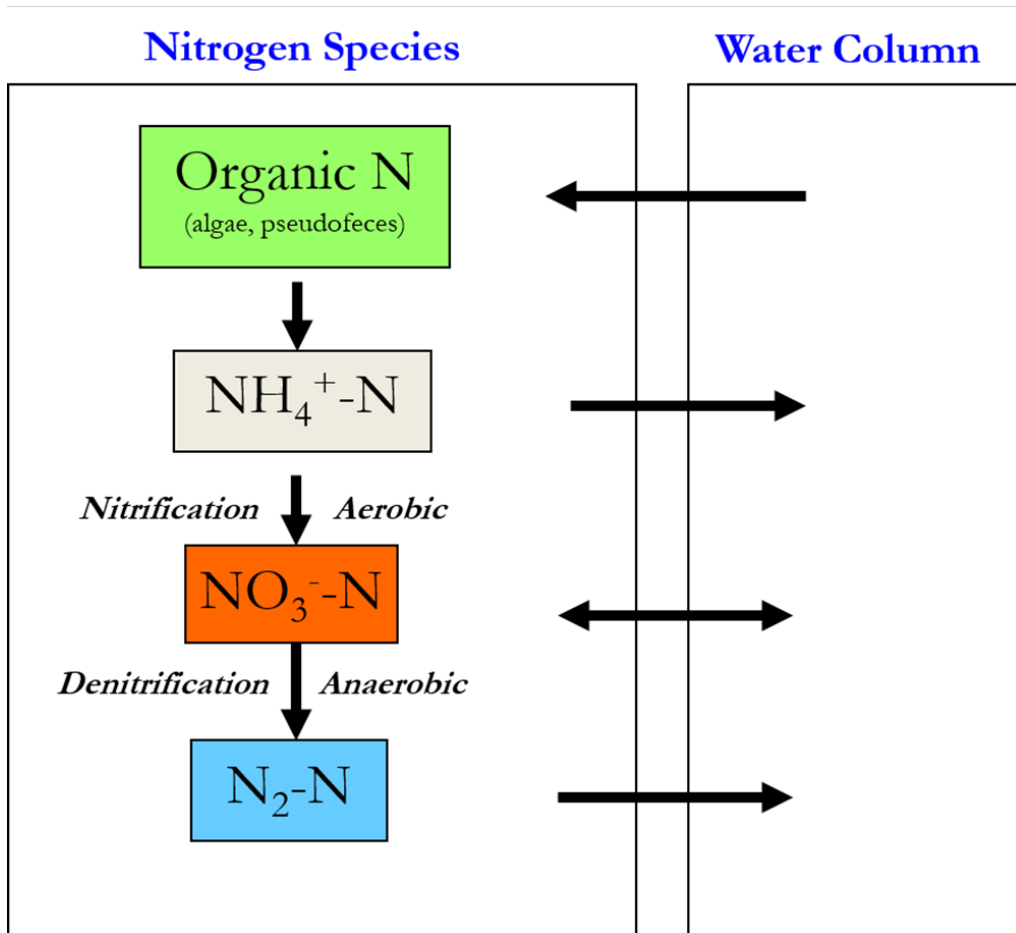
Kellogg, M. L., J. C. Cornwell, M. S. Owens and K. T. Paynter. 2013. Denitrification and nutrient assimilation on a restored oyster reef. *Marine Ecology Progress Series*, 480:1-19.

Oyster BMP Expert Panel Charge

- **Panel convened on September 22, 2015; charged with:**
 - Establishing a nutrient and suspended sediment reduction effectiveness determination decision framework for oyster BMPs.
 - Determining the nutrient and suspended sediment reduction effectiveness of oyster practices using available science.



Denitrification



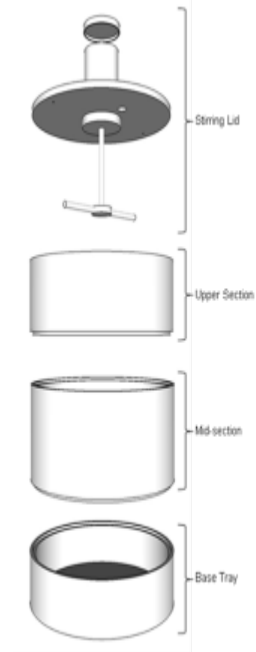
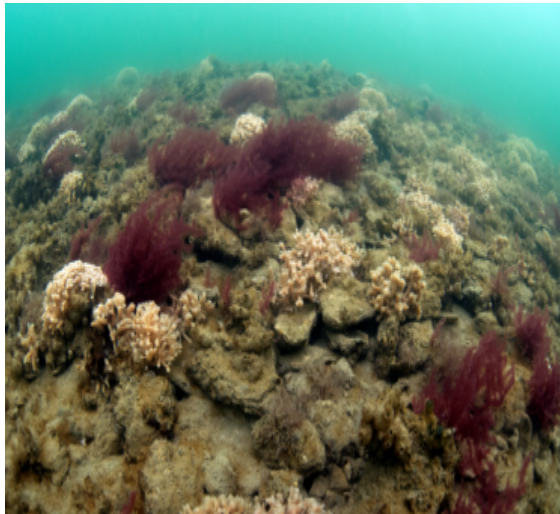
Other Nutrient Ecosystem Services:

- Burial of N & P from enhanced deposition in reefs?
- Removal of N and P from oyster harvest!
- Buildup of N and P in restoration reefs (living component)

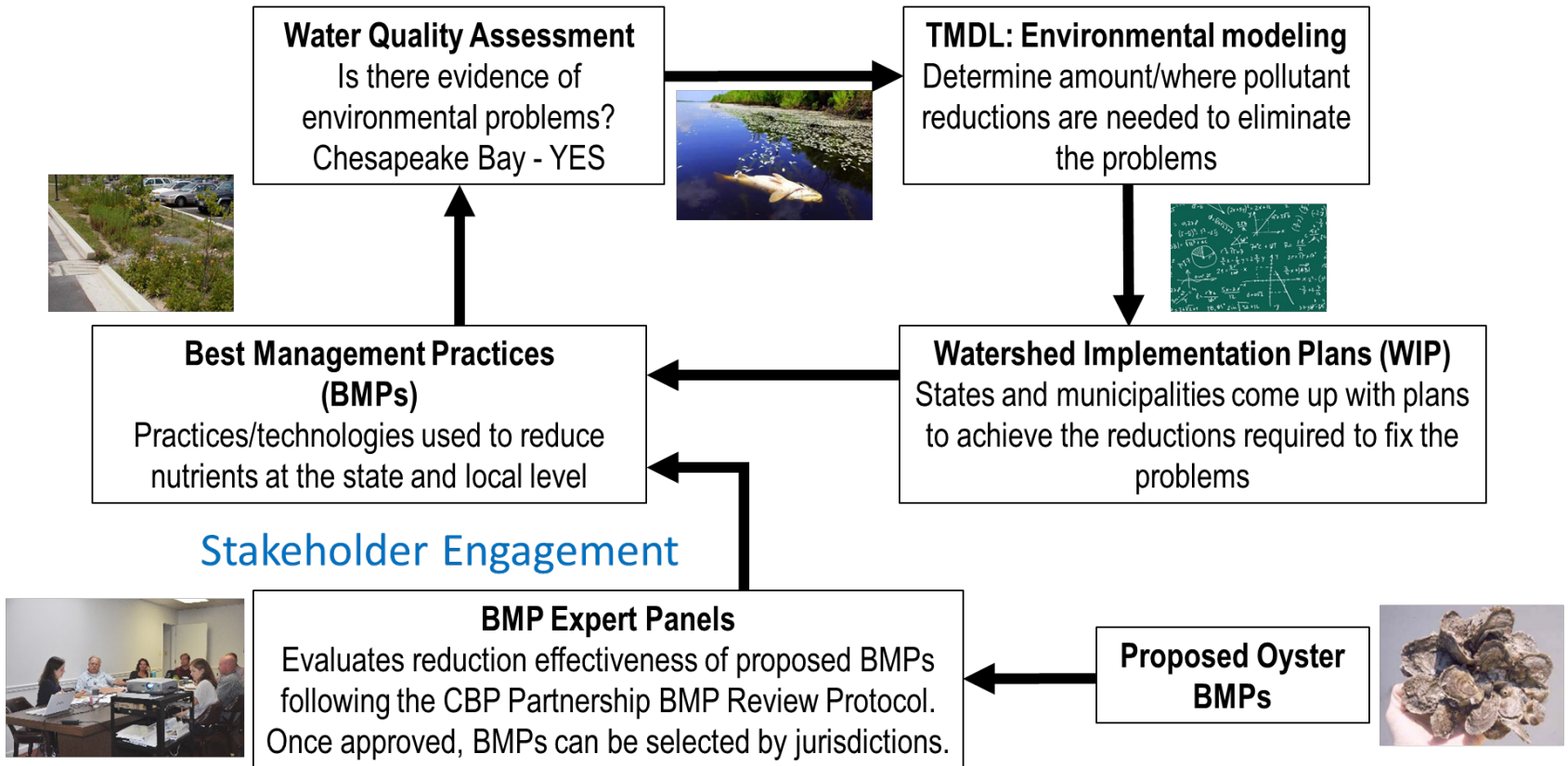
Enhanced Denitrification Protocol

Goal:

Provide defensible, verifiable estimates of N reduction from enhanced denitrification associated with oyster reefs



Chesapeake Bay Program (CBP) Partnership— Using science to inform policy following a consensus-based approach



Site-Specific Best Management Practice – Oyster Reef Restoration

- Indexed to oyster biomass. Must stay relatively constant or increase to keep BMP
- BMP (*in final development*) is prescriptive, as much as possible, regarding approaches for assessment
- Implementation will not be simple, but we believe for medium to large restoration projects it could enhance the rationale for restoration
- Key need: sufficient oyster biomass data sets
- Key need: affordable assessment of denitrification

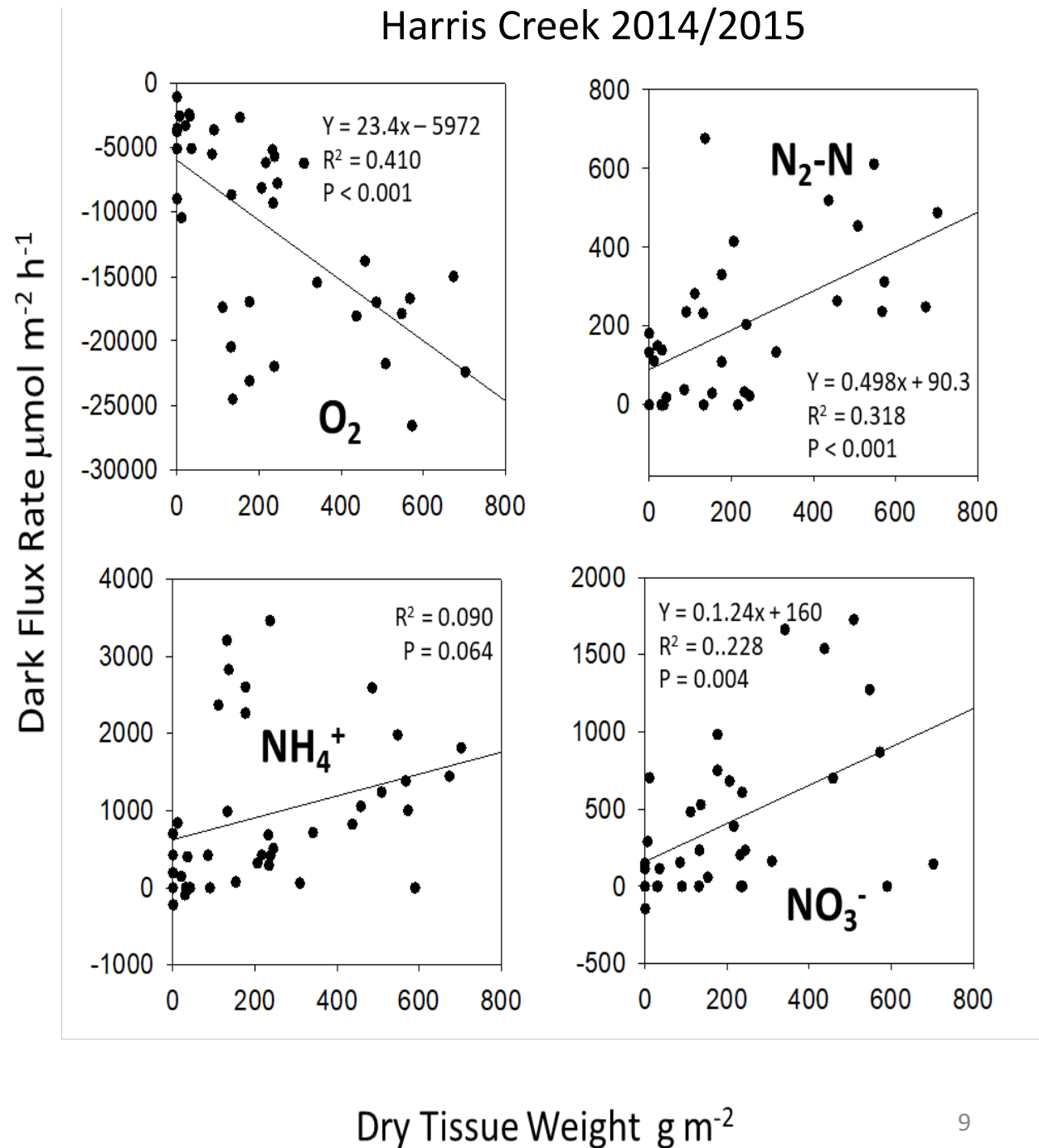
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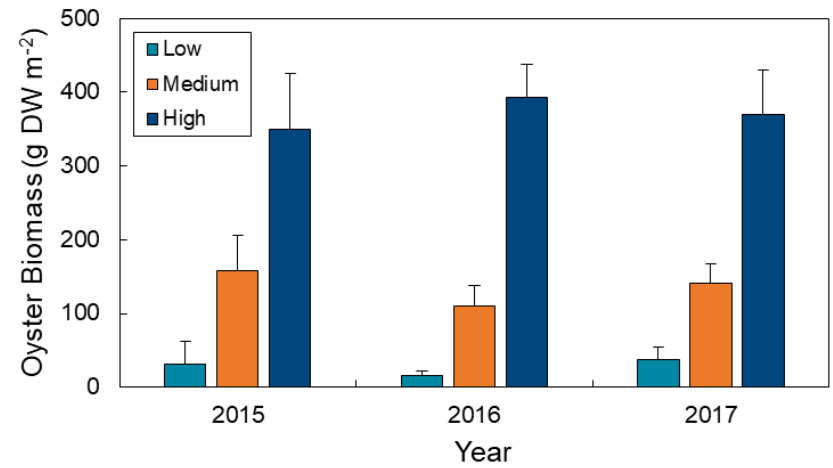
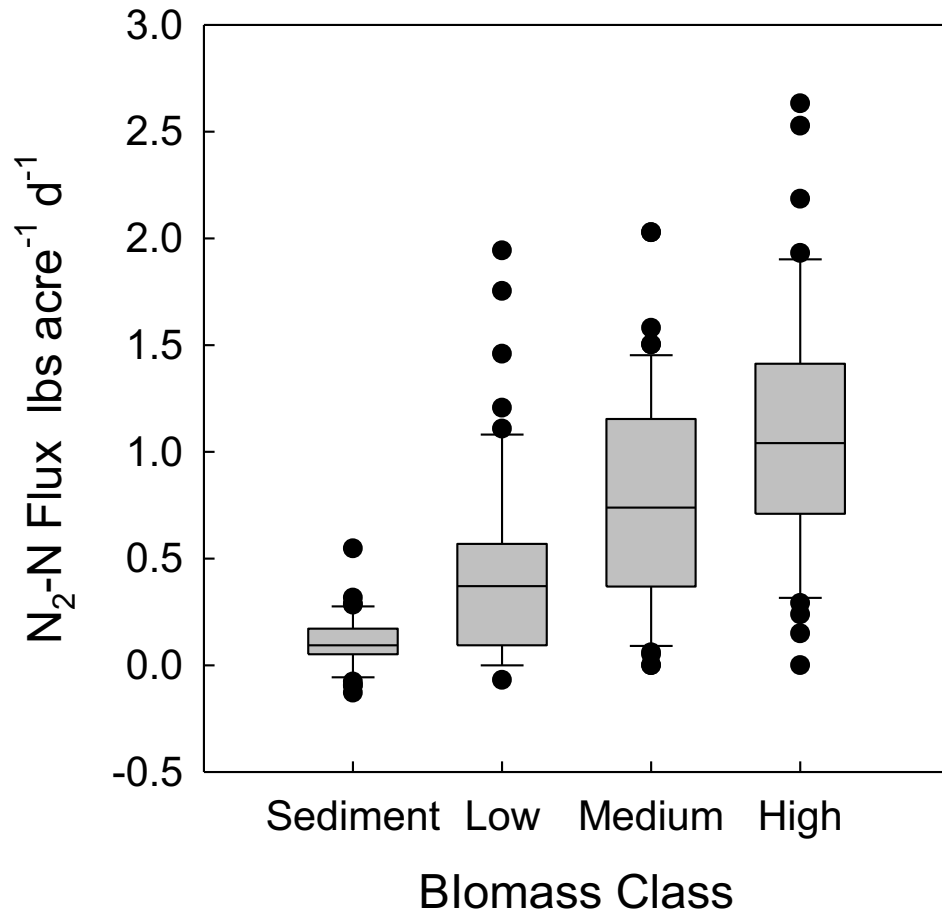
Importance of Biomass

Harris Creek 2015-2018



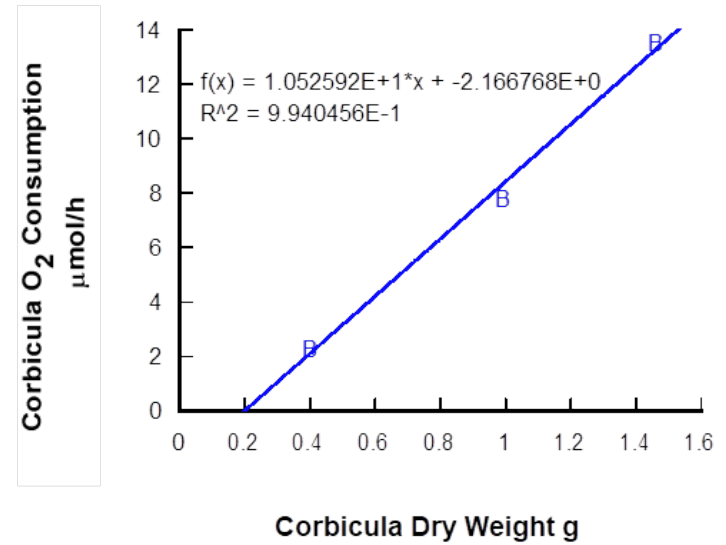
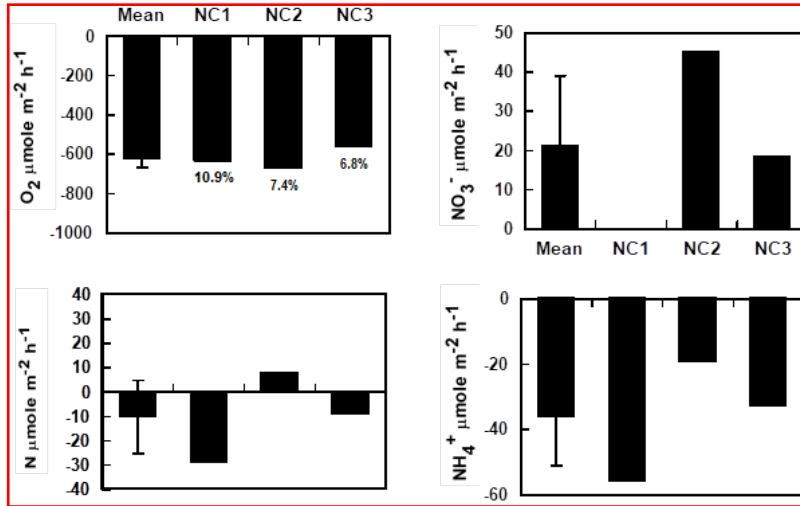
Warm Season Denitrification --Indexed to biomass--

A

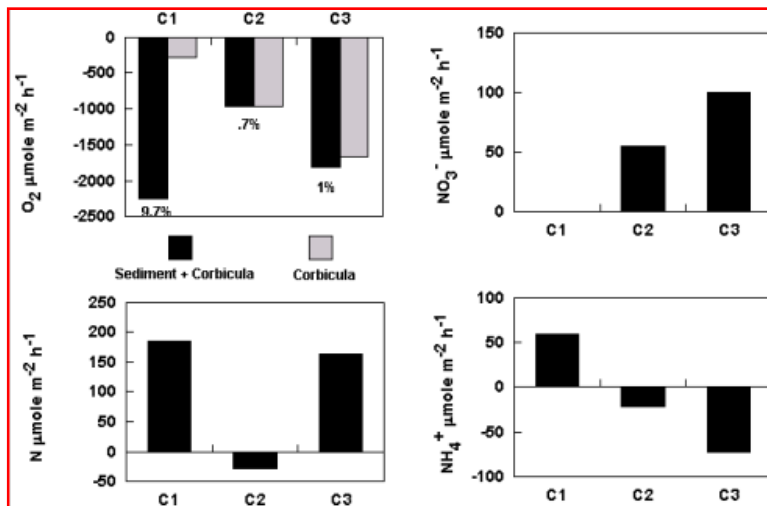


Delaware River Shallow Sediment Fluxes

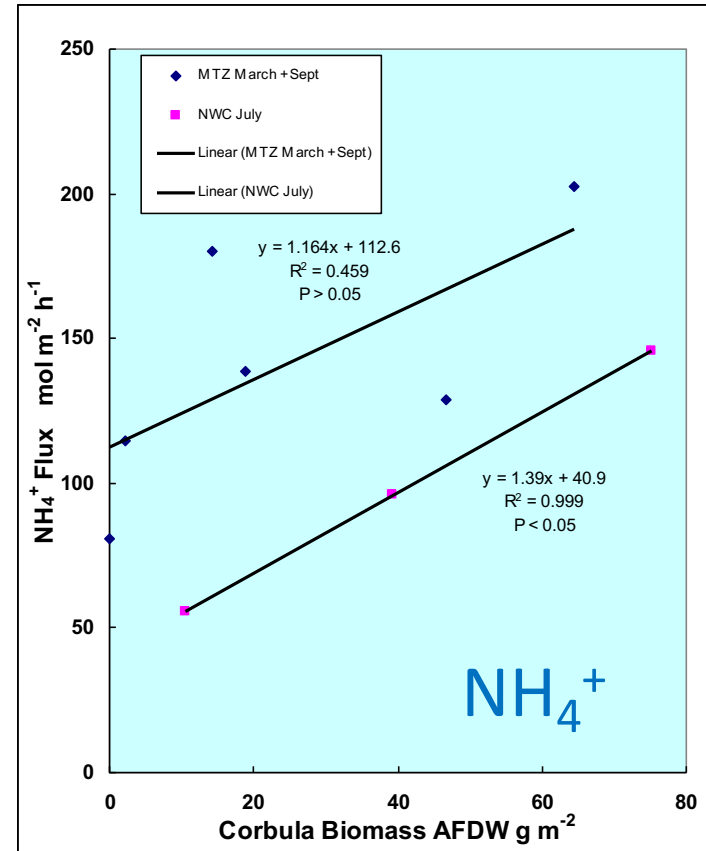
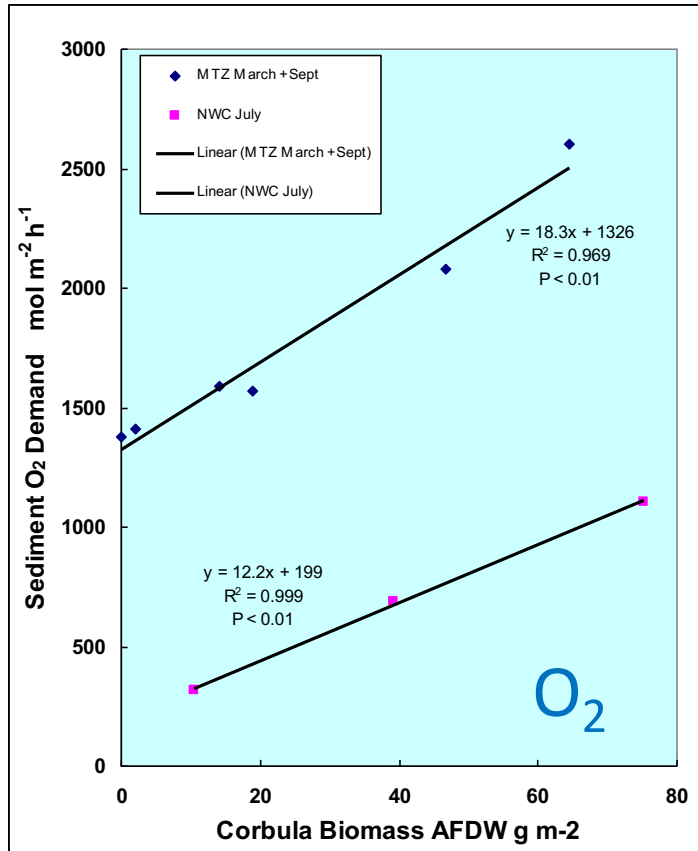
No Animals



Bivalves

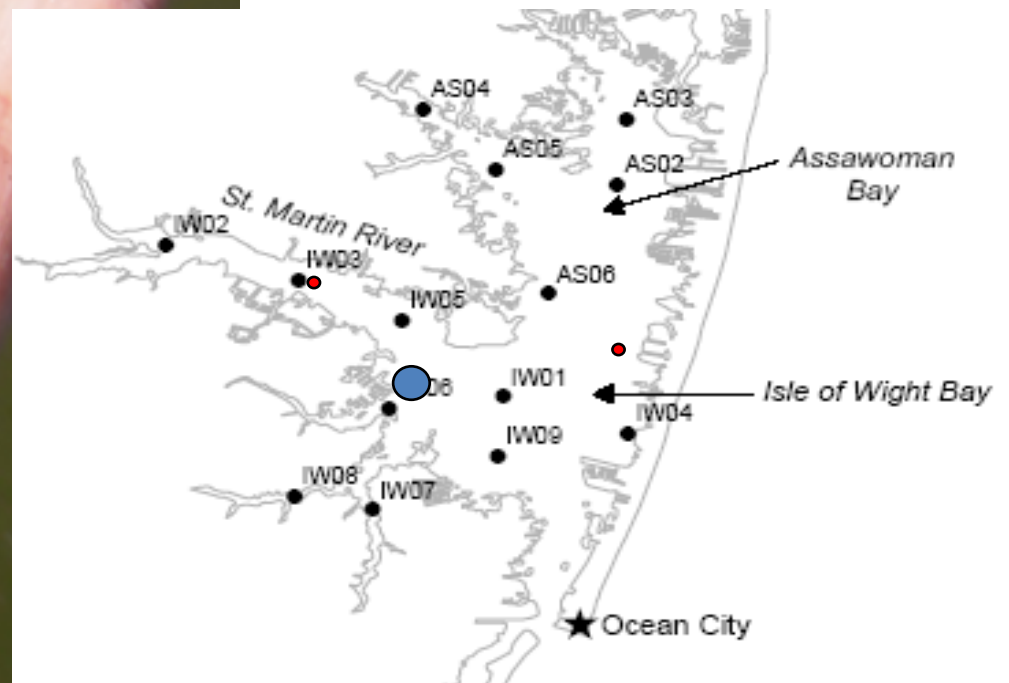


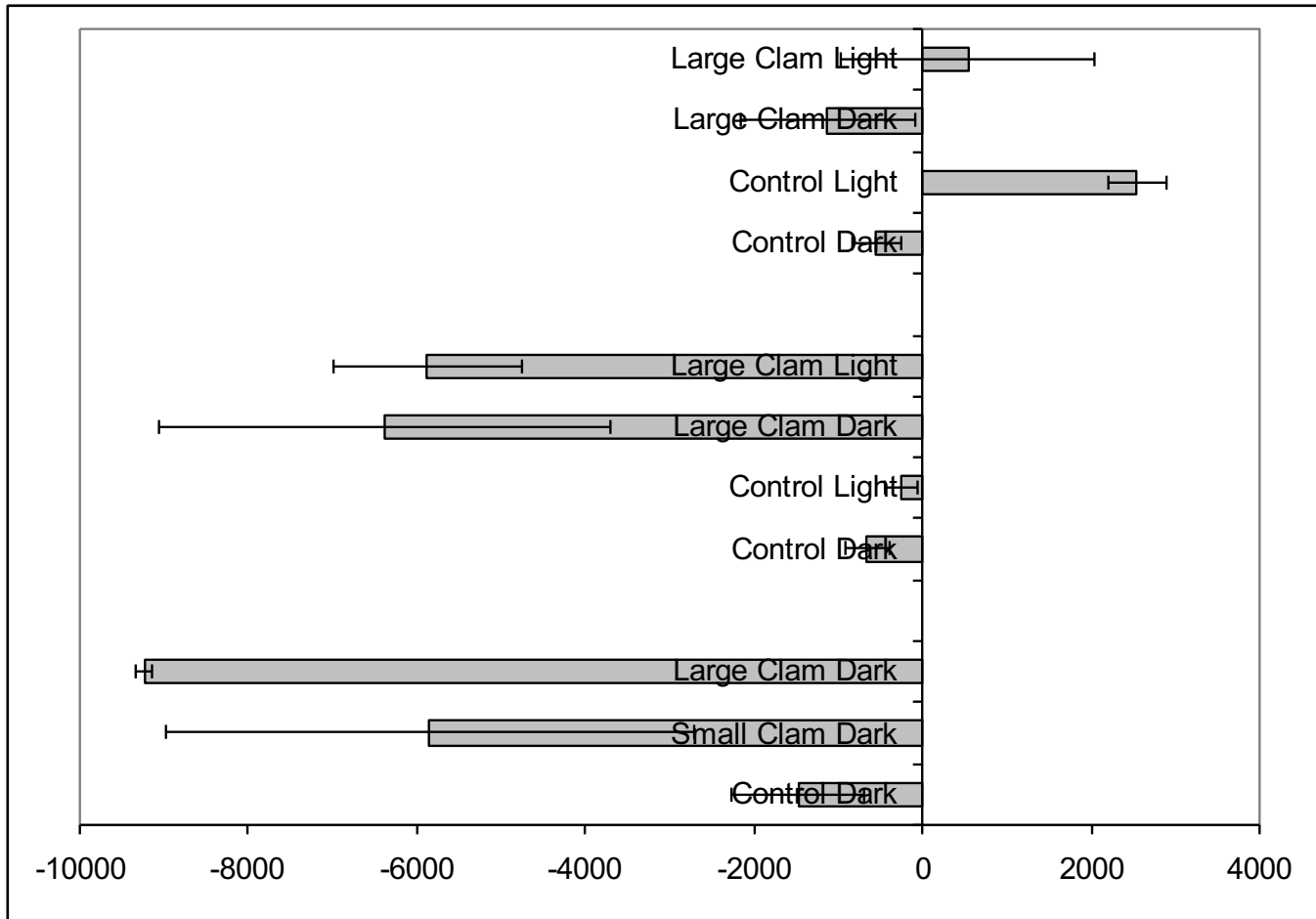
Corbula- San Francisco Bay Delta



Oxygen uptake linearly correlated to *Corbula* biomass. Ammonium fluxes are correlated with biomass in the peaty sediments at Naval Weapons Channel but not at Montezuma Slough. Based on literature values, the NH₄⁺ yield is low for the observed clam biomass.

Clam Aquaculture – Maryland Coastal Bay Study *Mercenaria mercenaria*



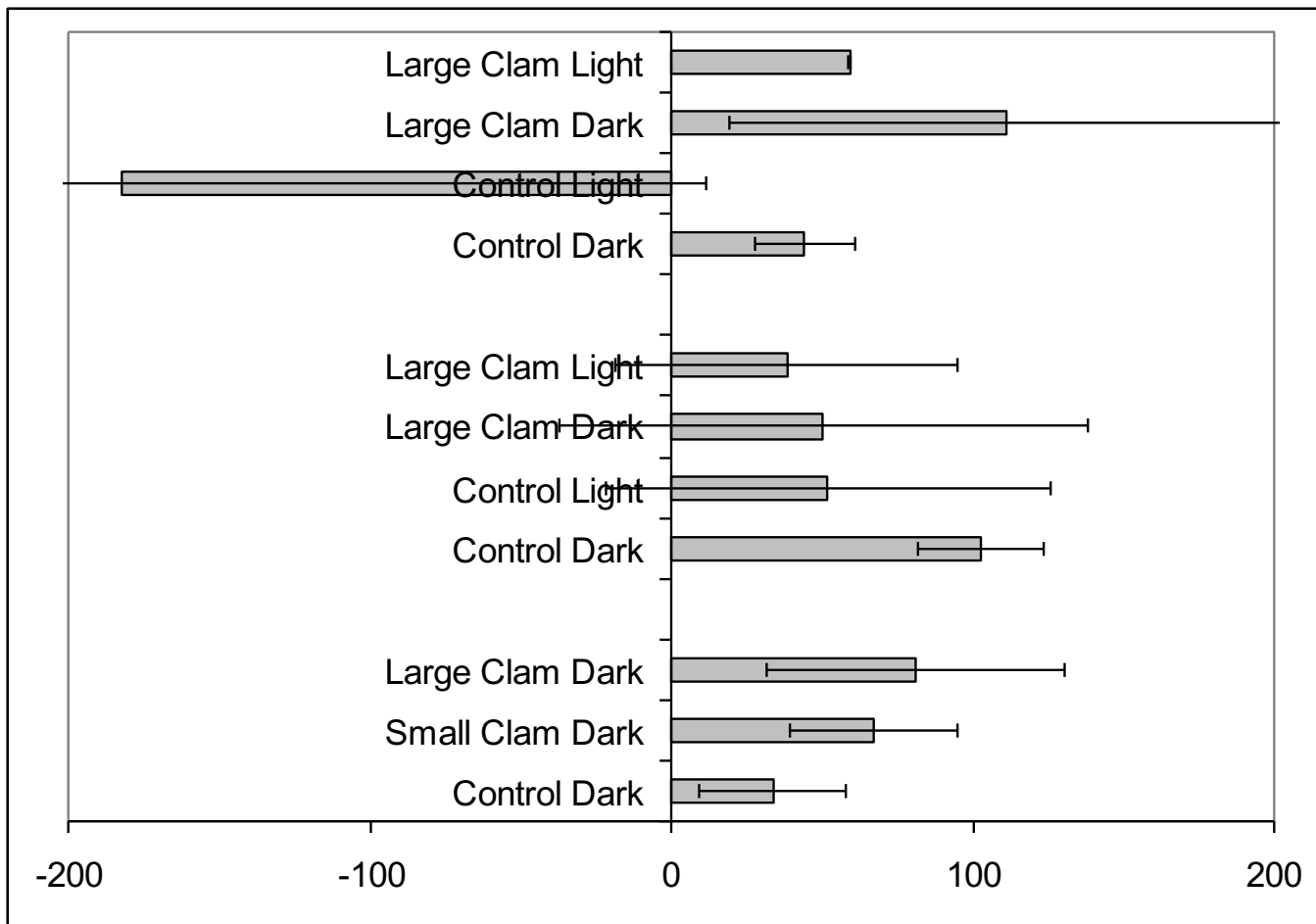


November

September

June

O₂ Flux μmol m⁻² h⁻¹



November

September

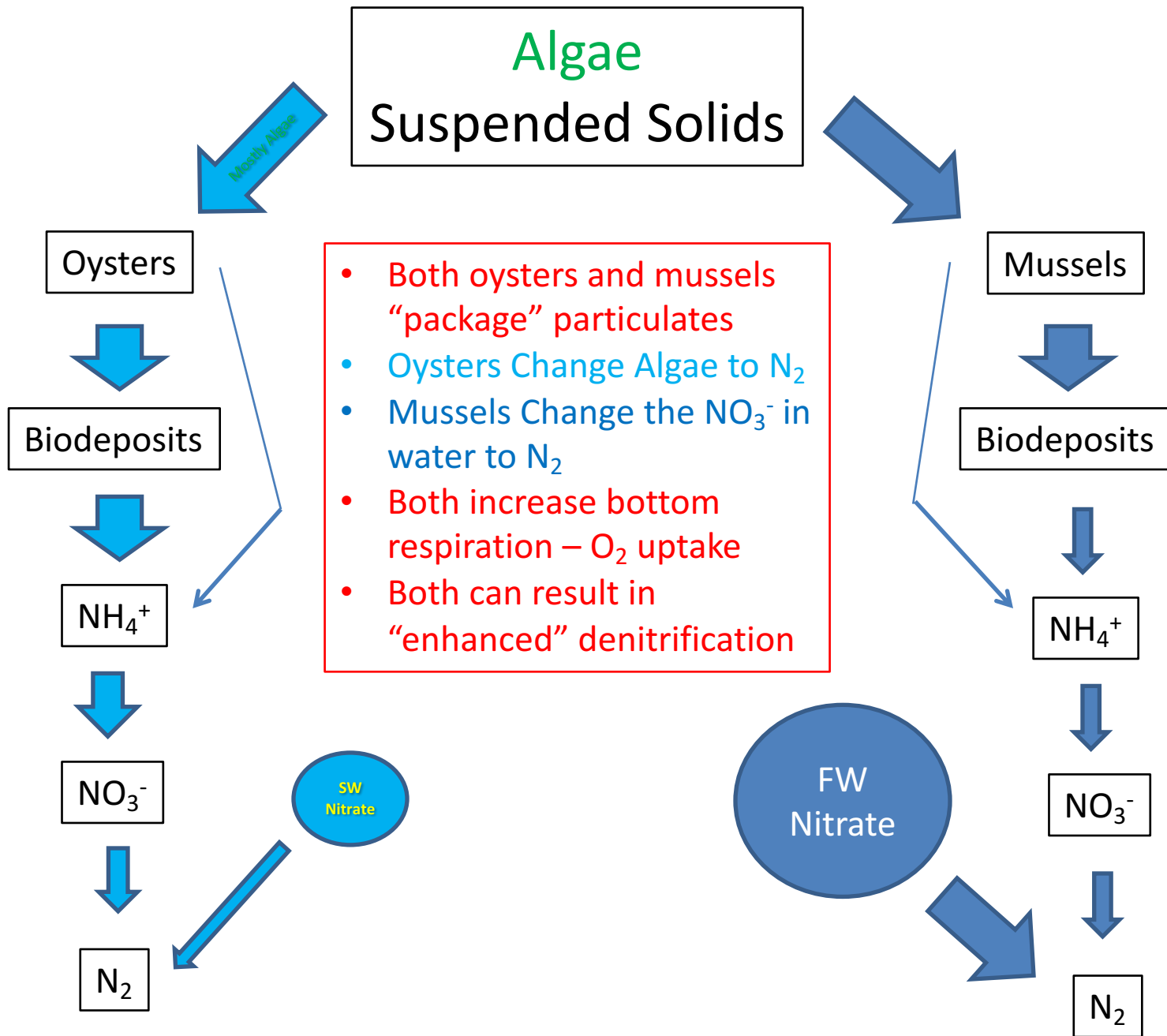
June

N_2-N Flux $\mu\text{mol m}^{-2} \text{h}^{-1}$

Freshwater Mussels

- Environmental Setting Can Be Very Different – Considerably Higher NO_x^- concentrations
- In high NO_x^- environments, the rate of N_2 -N production can be limited by organic matter – i.e. deep oxygen penetration depths limit downward diffusion
- If biodeposits increase oxygen uptake and decrease oxygen penetration, N_2 -N production from NO_x^- can be enhanced

Coupled Nitrification/Denitrification



Denitrification From Water Column Nitrate

Missing Pieces

- Rate of generation of biodeposits
- Fate of biodeposits –
resuspension/dispersion?
- Is the biogeochemistry, including N_2 -N production, dominated by hot spots where biodeposits are retained, or focused?

Final Thoughts/Questions: Mussels as BMP?

- Data – sufficient scientific evidence to warrant putting together a panel?
- Nutrients are not the only ecosystem service endpoints! (but perhaps the most similar to other BMP's)
- Any unintended consequences? N_2O , CH_4 ...