Improved Site-Specific Methods for Quantifying Oyster-Related Denitrification

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Crediting Oyster N Removal

- Harvest the N in tissue (aquaculture) – credited at harvest
- Build up N in restored reef – one time during initial reef growth (proposed)
- Removal as N_2 gas – denitrification, a microbial process

Step 1
Assessment

1) Science

Observations of enhanced denitrification and nutrient removal associated with aquaculture and restoration, preferably leading to a default rate applicable to specific gear and circumstances.

2) Science Into Policy

Development of an new BMP or inclusion into an existing BMP

3) Implementation

Maryland & Virginia develop protocols/policies for crediting – indexed to biomass or ?

Step 4
Why?

4) Crediting

- Local government Watershed Implementation Plans
- Market for Approved Water Quality Trading Credits?

What Do We Know/Not know About Oyster-Related Denitrification

- We know it occurs at high rates in subtidal, restored oyster reef (e.g. Harris Creek)
- Data, largely outside the Chesapeake, suggests on-bottom aquaculture has high rates
- The data from suspended aquaculture suggests minimal benefit in the sediment "footprint". We have no rates from within the cages
- Data from engineered surfaces with attached oysters suggests high rates (oyster castle, reef balls)

Purpose

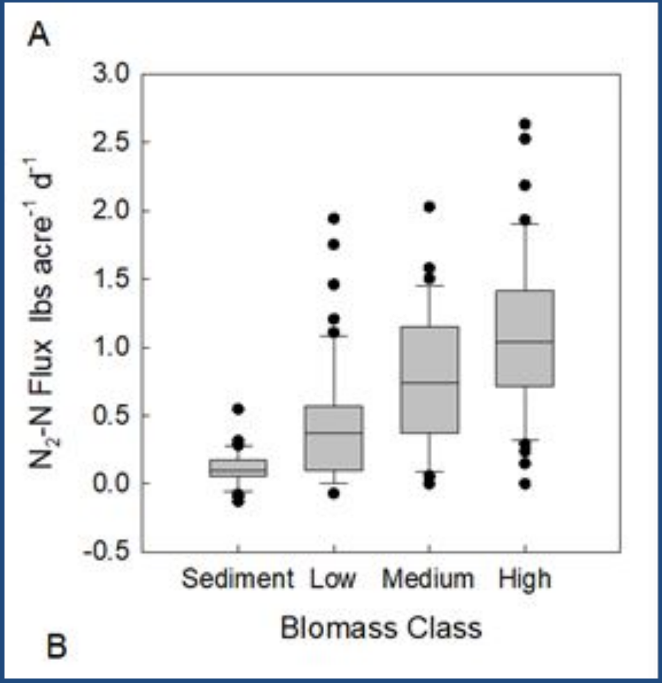
Our goal is to develop an *in situ* chamber approach to decrease the field and incubation personnel effort 3-4 fold and make the measurement of denitrification affordable for management purposes.

We are developing and testing a measurement system that is lowered to the bottom, does not require divers, and in which two individuals can operate two chambers simultaneously.

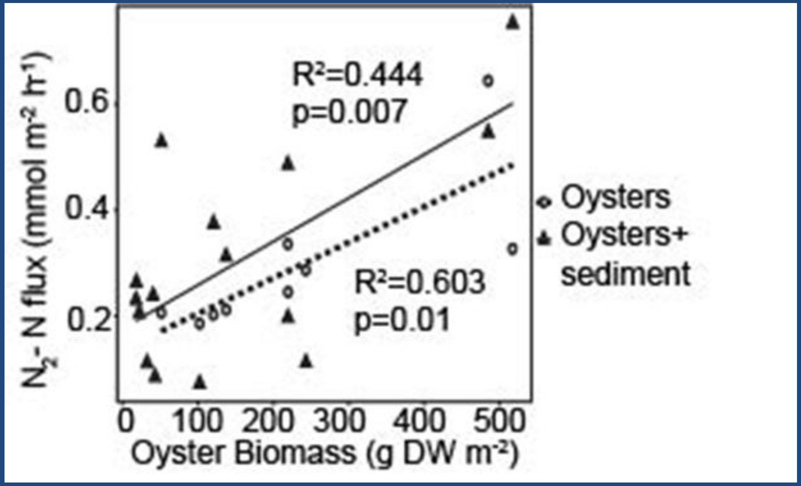
Harris Creek, MD

Incubations

(*Recent*) Observations I



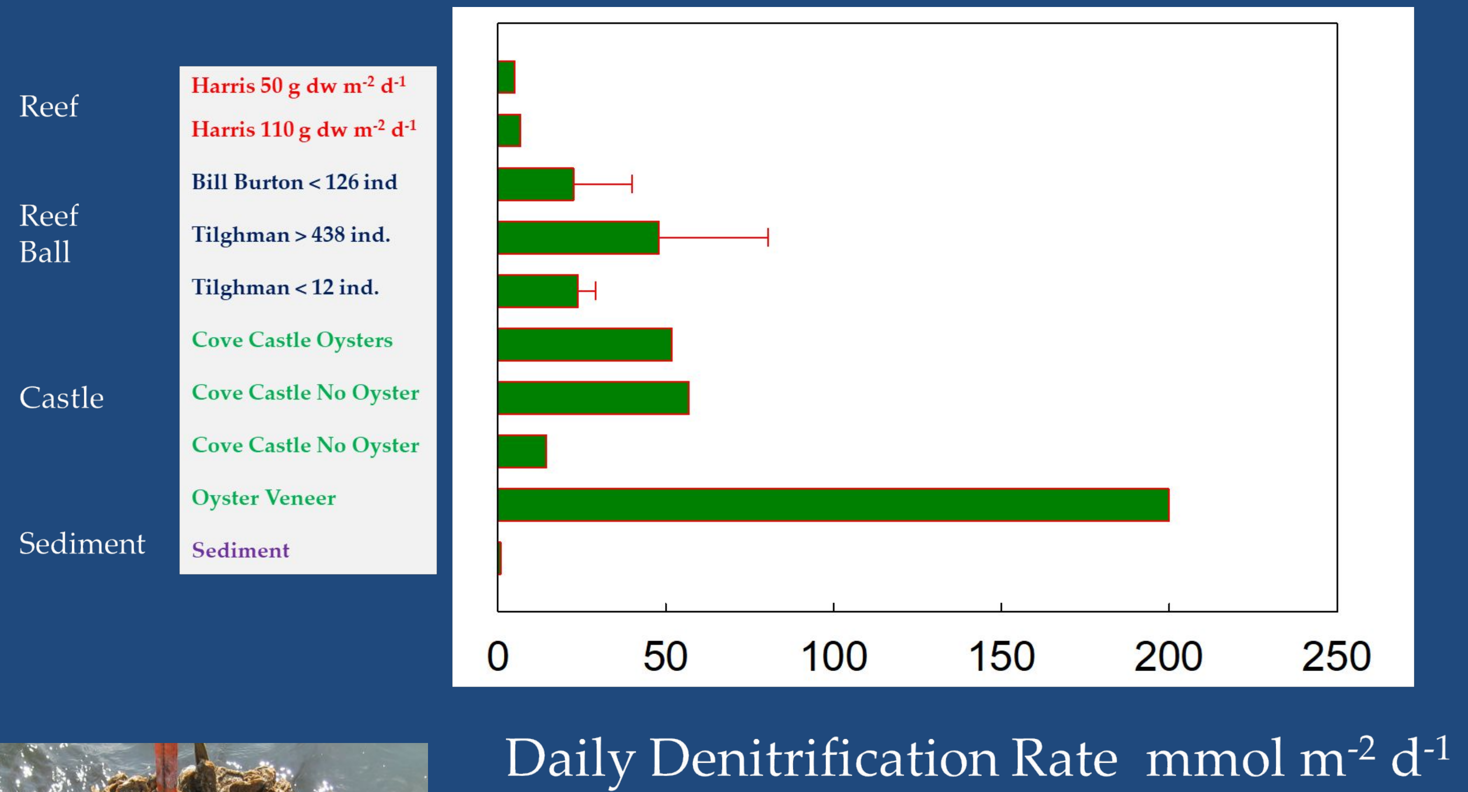
Harris Creek –
Biomass is key



Much of the denitrification is not in the sediment (Jackson et al. 2018)

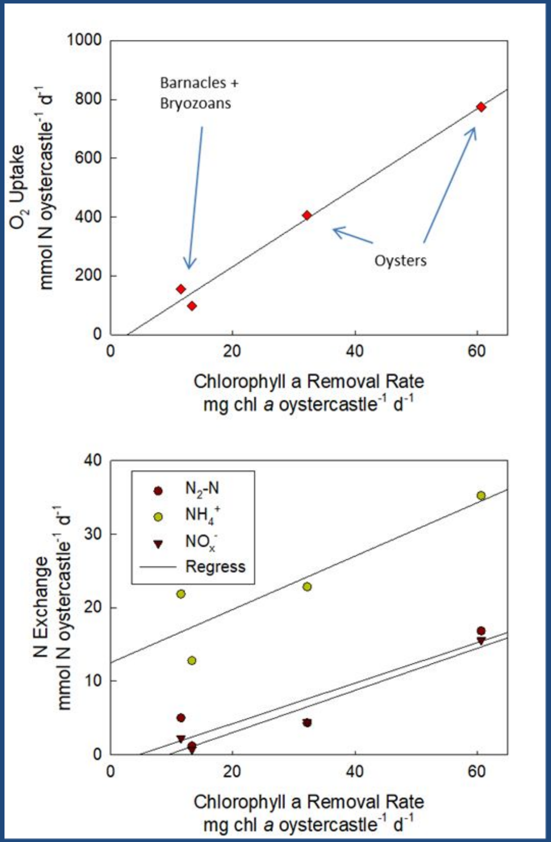
Recent Observations II

Engineered Surfaces

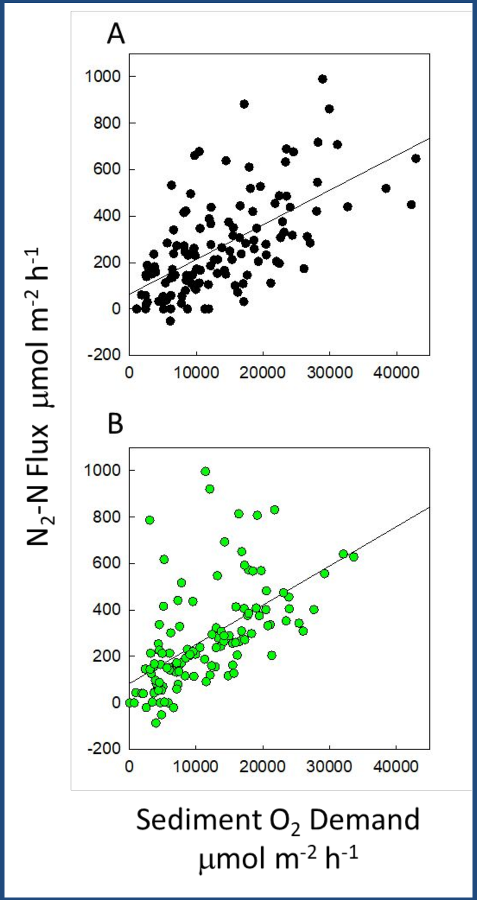


Recent Observations III

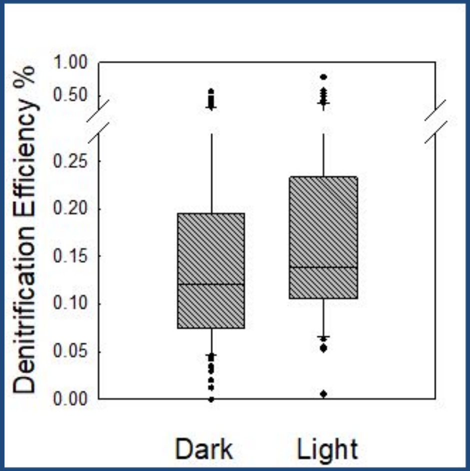
Correlates May Be Useful



With oyster castles, filtration is a good predictor of N cycling



Oxygen demand is a good predictor of N cycling (Harris Creek)



The process of denitrification is ~10-15% efficient

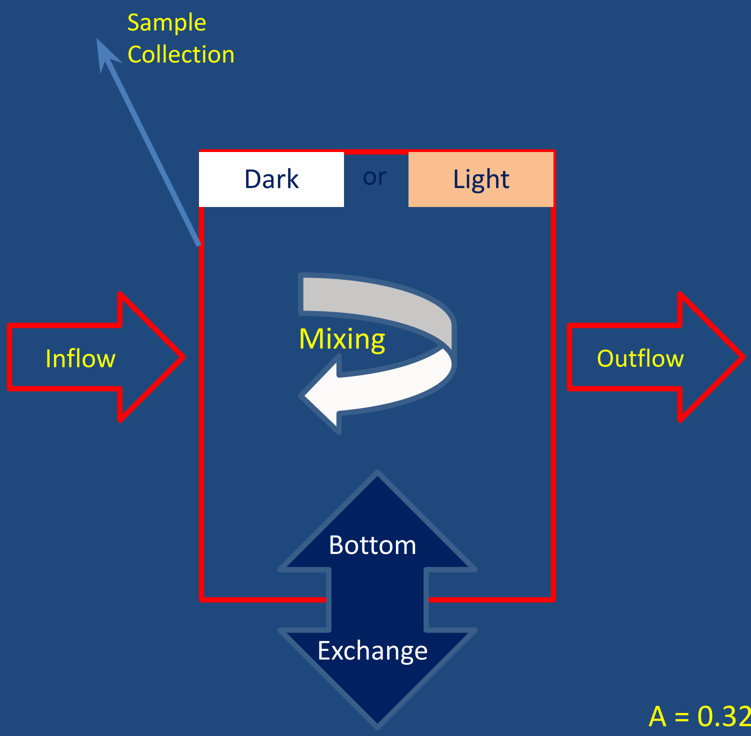
N_2 Flux Measurement

Current Kellogg/Cornwell

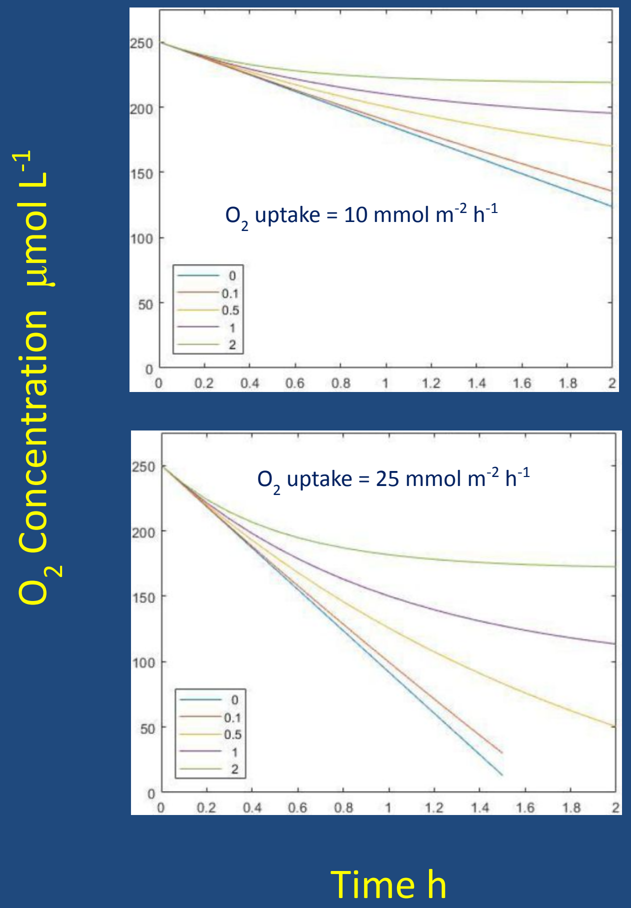
- Trays are deployed by divers and sediments + oyster are inserted.
- After > 4 weeks, trays are retrieved and incubated in the laboratory using a time course
- Manpower: ~3 person days per rate (2 in field, 1 in lab)
- Advantage: we know exactly what we have incubated
- Disadvantage: potential change in biomass by divers working (almost) blind

New Approach

- Develop a lander that can be dropped onto a reef, 2 at a time.
- Compensate for "leakage" through use of tracers
- Manpower: ~ 0.5 person days per rate
- Advantage: less disturbance
- Disadvantage: less information on bottom characteristics



$A = 0.32\ m^{-2}$
$H = 0.15\ m$



With known leakage, data is fit to a solved differential equation

Key Benefits

- Lower personnel numbers per measurement
- Lower cost
- Less sediment disruption
- No need for a temperature-controlled incubation tank facility
- More readily transferred technology

This project will be successful in 1) the lander approach proves reliable, 2) measurements are manageable with a small number of personnel, and 3) provides a large cost benefit relative to current approaches that include the whole oyster community.