Role of dreissenid mussels and sediment nutrient flux in phosphorus availability

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Phosphorus: Why are we studying it?

Nutrients (primarily phosphorus) were repeatedly identified as an area of concern at the first stakeholders meeting.

Nutrients are tied to:

- MUCK
- HABs
- e-coli/pathogens

This priority was confirmed by DEQ managers associated with our project

Are P targets being met ?

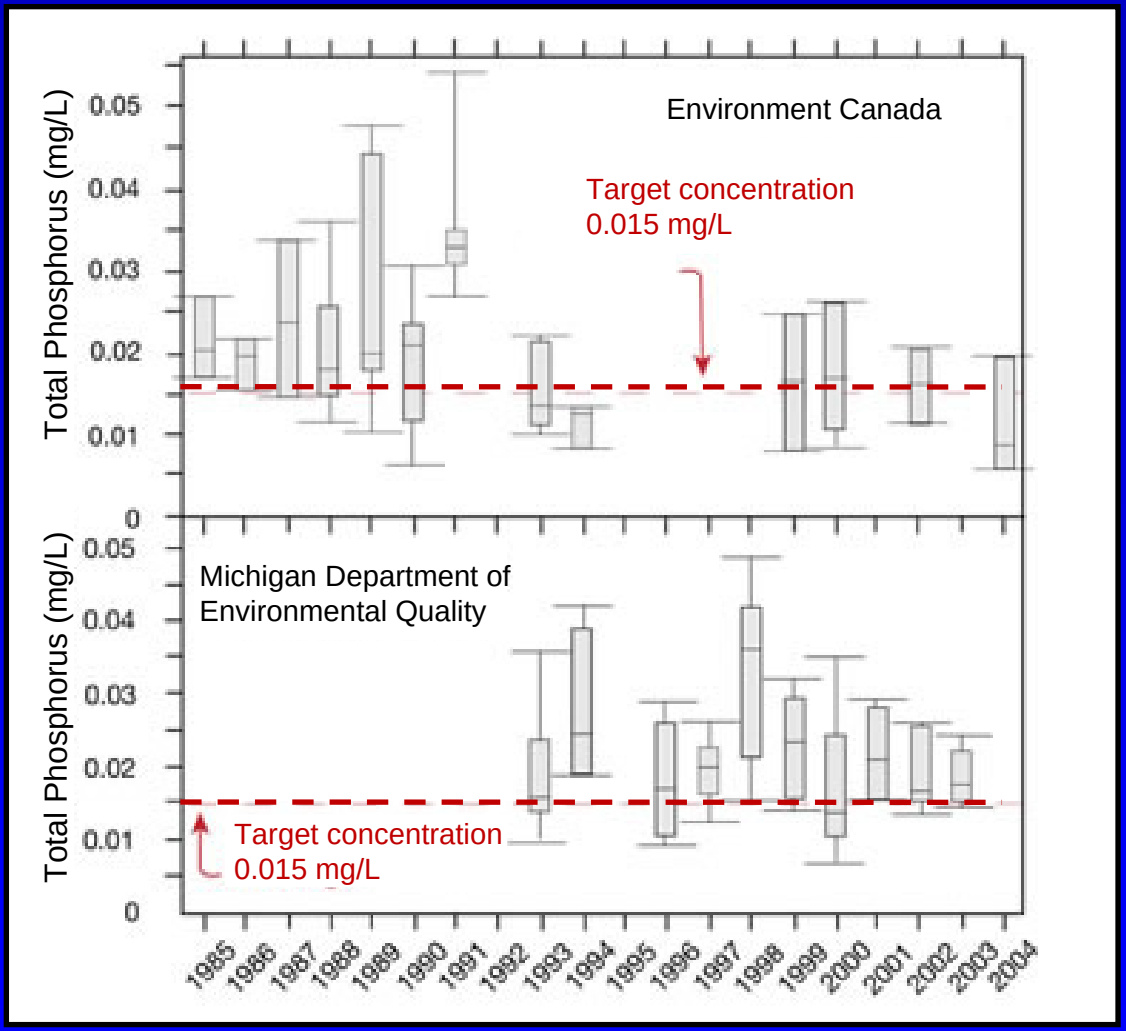


Image from: Phosphorus in Saginaw Bay, have we met the target? Lake Huron Binational Partnership. Fact Sheet. February 2006.

Nutrient (phosphorus) project component goals

- Collect parameters and data <u>needed for models</u> to describe phosphorus budget and nutrient loading

- <u>Inform managers</u>: Collect data to describe and predict phosphorus levels (forecasting)

Photo credit: Bay City Times

2009 Objectives:

Where is the phosphorus? What is available?

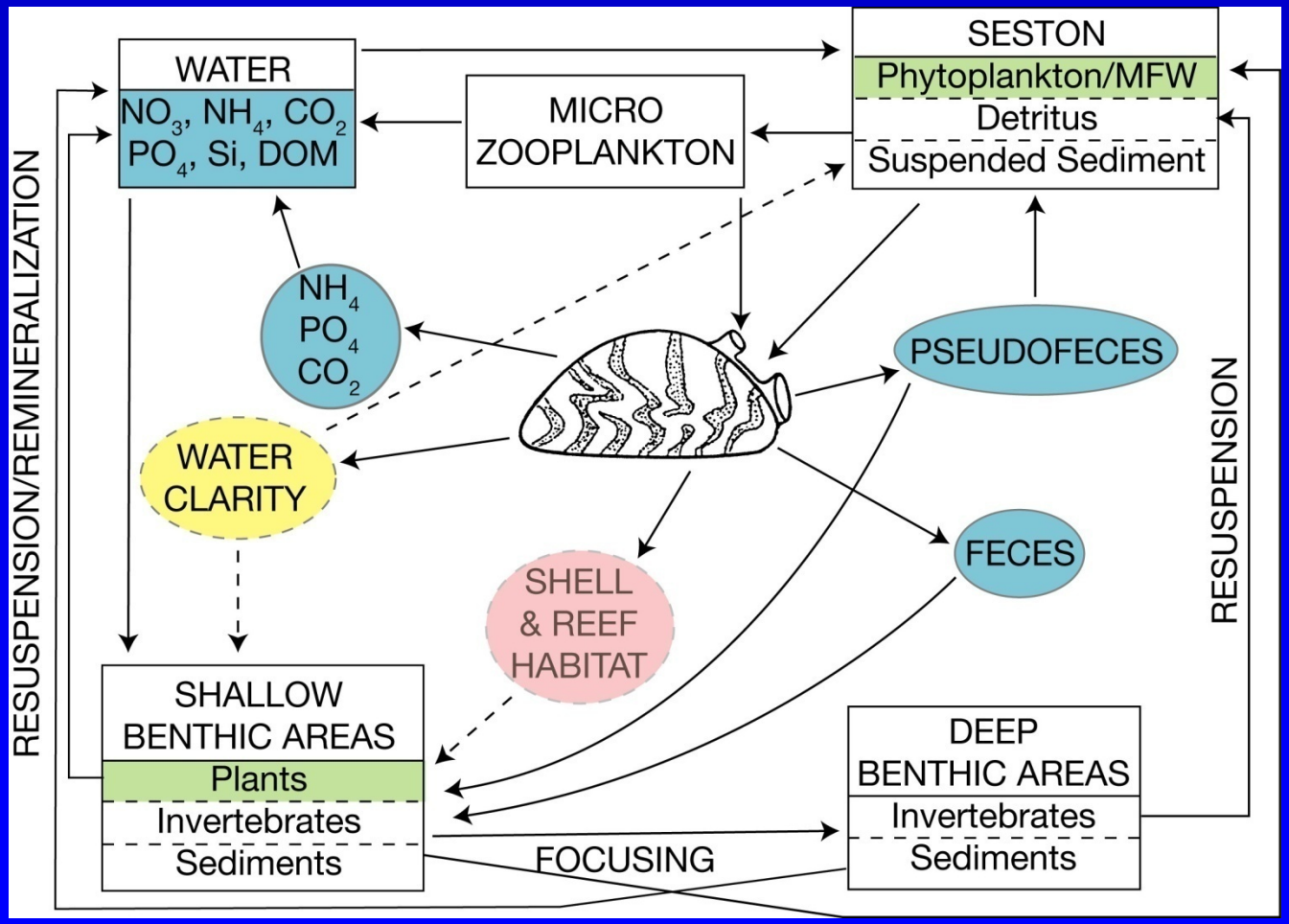
- Determine the role of Dreissenid mussels in nutrient cycling and availability

- Determine role of sediment flux in phosphorus availability

  -- Resuspension in sediment cores

  -- Sediment traps

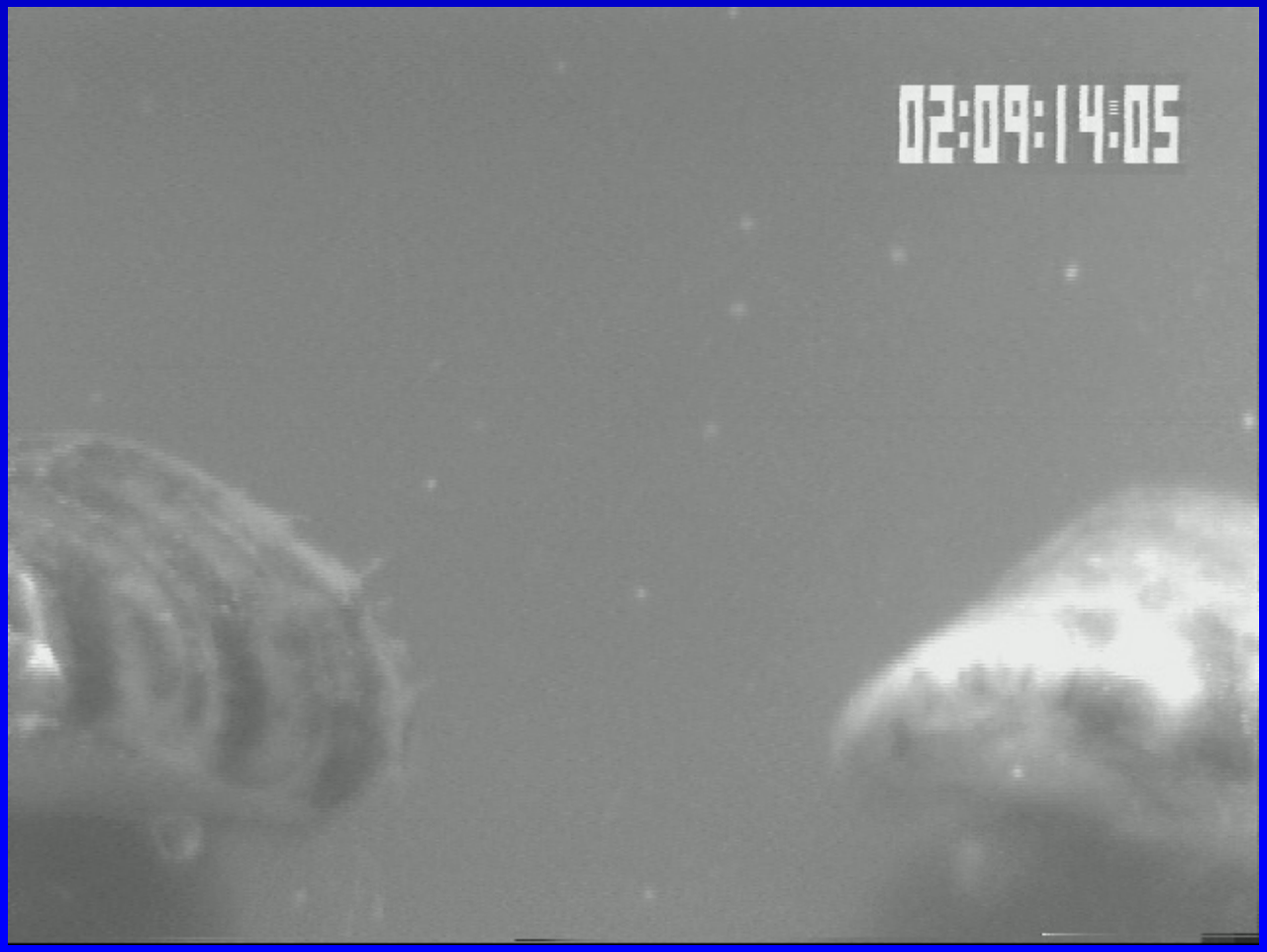
What mussels do



Nutrient recycling goals: Dreissenid Mussels

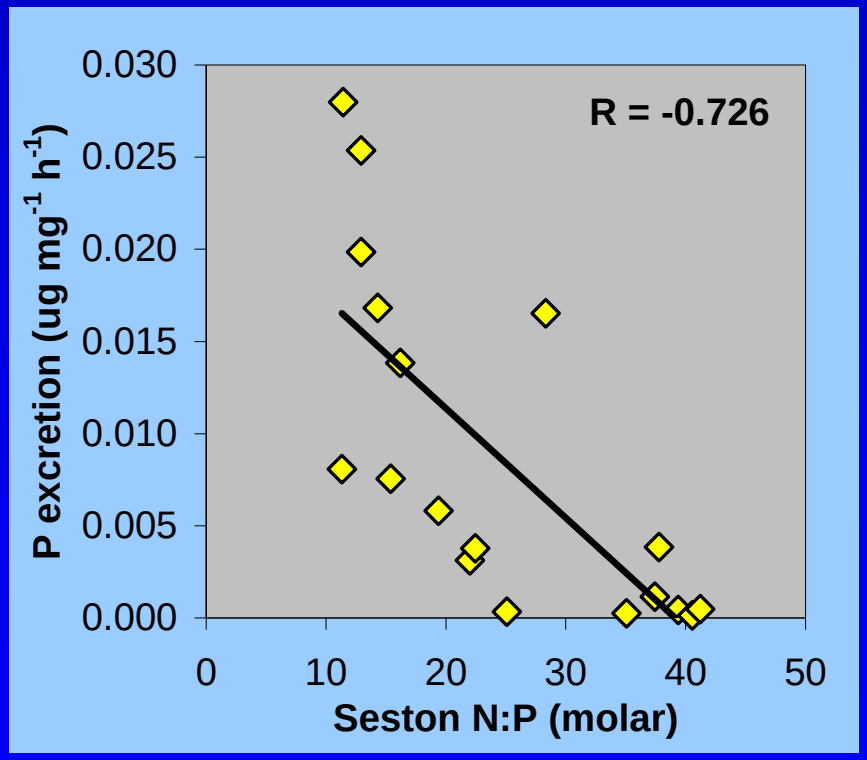
- Determine amount of P sequestered by dreissenid tissue and shells.
- Determine phosphate and ammonia excretion rates by dreissenids as a function of seston composition and feeding rate
- Estimate the amount of P and N that dreissenids deposit each in feces and in pseudofeces as a function of seston composition and feeding rate (little info)
- Evaluate the availability of the P in feces and pseudofeces to benthic plant growth (no info)

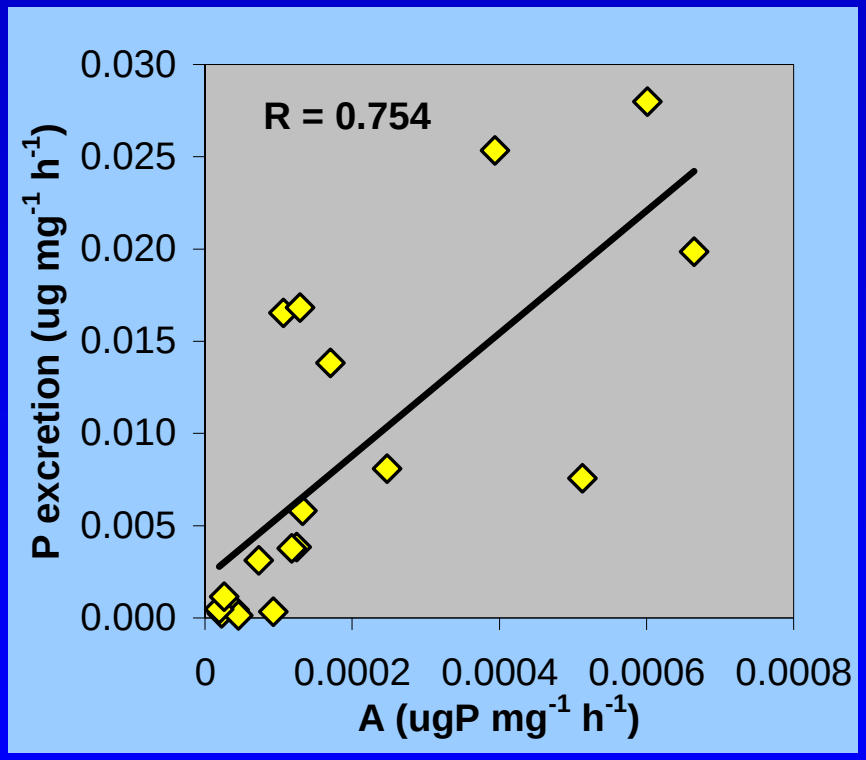
Mussels and seston from Lake Erie near Maumee Bay, September 2004



What are biological and physical-biological coupling implications?

Mussel P Excretion is Sensitive to Seston N:P Ratio and P Ingested (A)

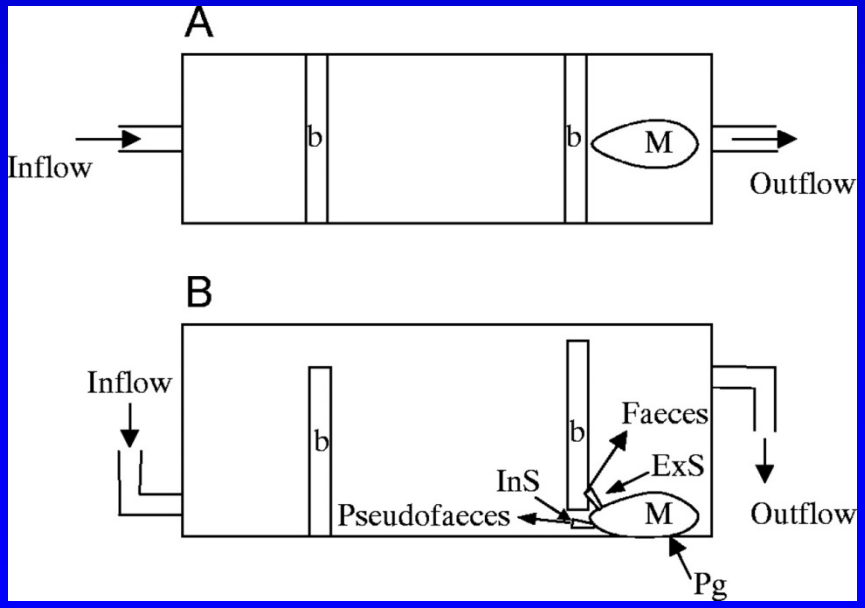




Results from experimentally manipulated mesocosms on Gull Lake

Nutrient recycling goals: Dreissenid Mussels
Brief Methodology

P in biodeposits and availability



- Collect feces and pseudofeces
- Determine P, C, and N content
- Visually determine biodeposit breakdown rate
- Determine P availability by chemical means

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- Determine role of sediment flux in phosphorus availability

  -- Resuspension in sediment cores

  -- Sediment traps

Role of sediment flux in phosphorus availability

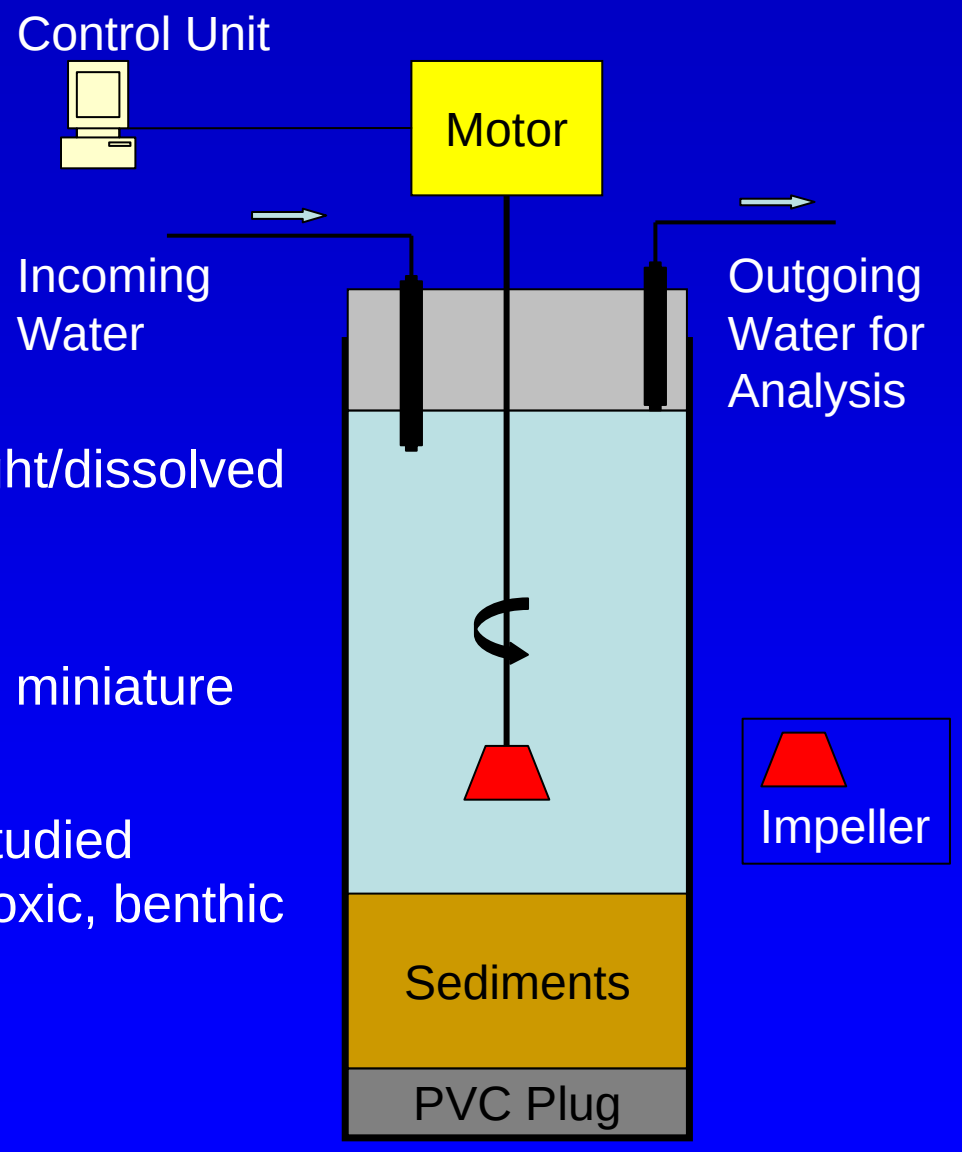
Sediments are a significant component in nutrient cycling

Sediments can act as either a sink or source depending on conditions

(i.e. pH, oxygen penetration, mineral content, surface area and temperature)

Resuspension in sediment cores

Sediment flux: Nutrient availability



- Highly controllable (temperature/light/dissolved gases/pH/etc.)
- Reproduce resuspension events in miniature
- Allows for multiple regimes to be studied simultaneously (i.e. anoxic vs. hypoxic, benthic algae, dreissenid mussels)

Sediment flux: nutrient availability Brief Methodology

Cores will be incubated at ambient temperatures with filter sterilized ambient water added back to the core at a known volume.

The overlying water will be bubbled with either air or helium to maintain aerobic or anaerobic conditions and keep the water column mixed.

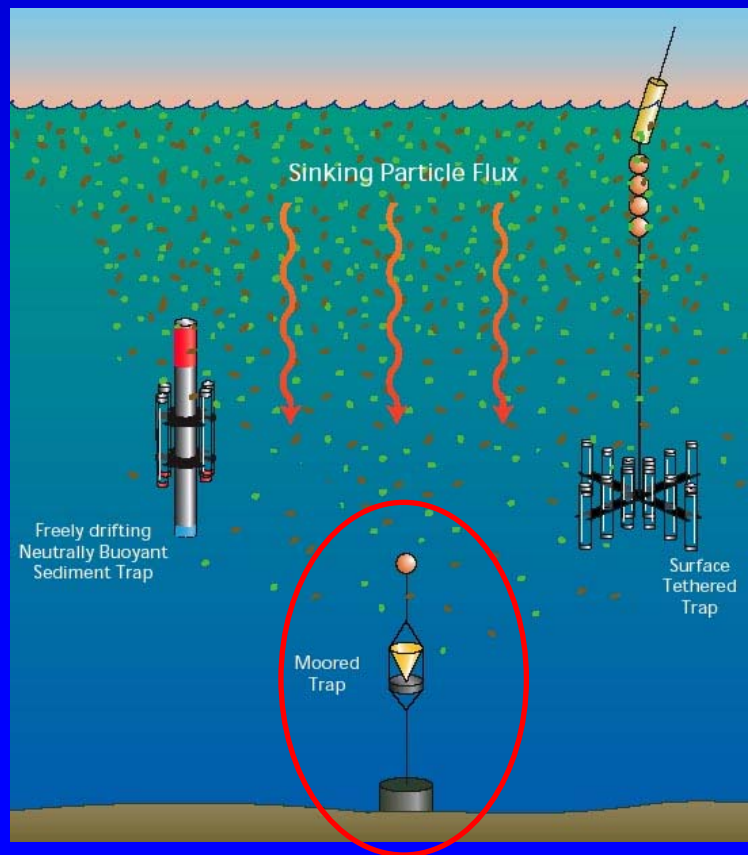
Sub-samples will be drawn off on a daily basis for approximately one week and analyzed for dissolved ammonia, phosphorus and silica.

Role of sediment flux in phosphorus availability

Determine how much sediment was kicked up/settling and recycled in specific locations.

Measure phosphorus loads in sediments based over a given period of time.

Sediment traps



Work 2010

- P-labeled seston to determine cycling of P from biodeposits to incorporation in benthic plants
- Determine stimulatory effect of both soluble and particulate nutrients on benthic plant growth.
- Sample vertically (multi-channel piezometers) through the sediment column and within the water column, in areas <u>with and without dense algal beds</u> to determine if dreissenids increase P availability.
- *In situ* nutrient flux experiments with plexiglass chambers.