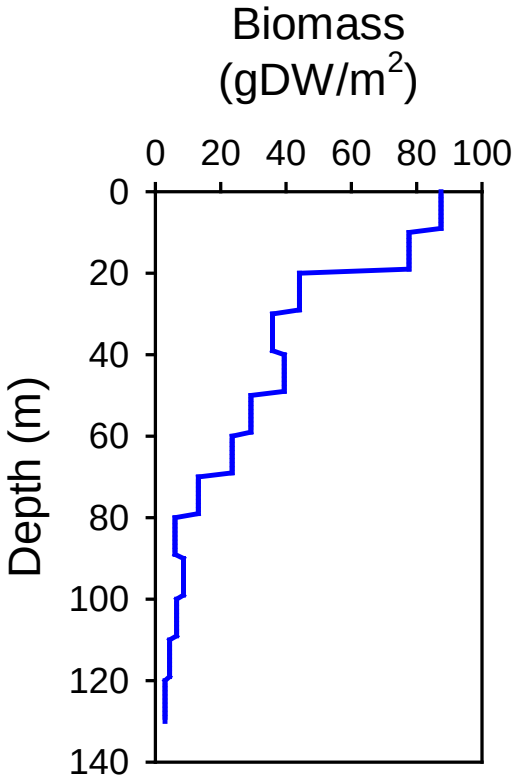
Preliminary Thoughts on Quagga Mussels and SRP Cycling

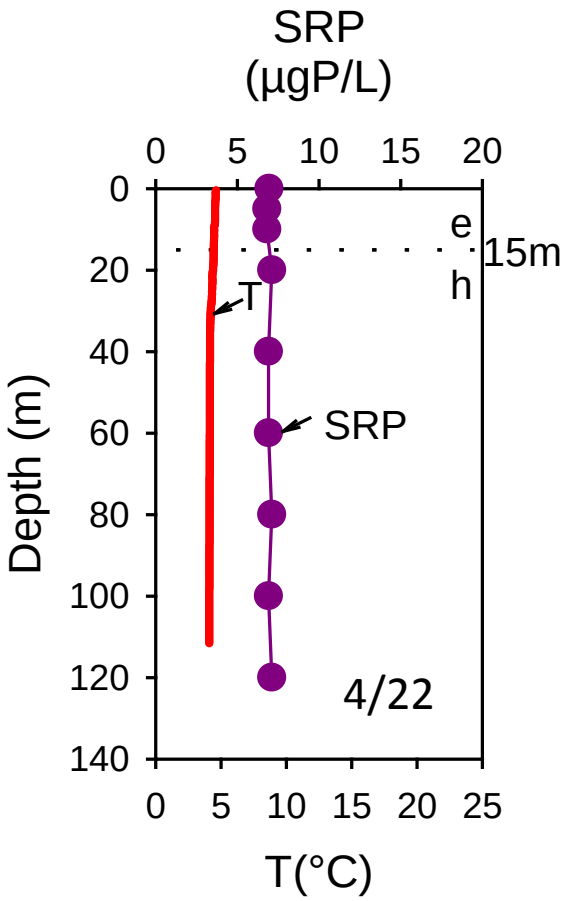
Steven W. Effler

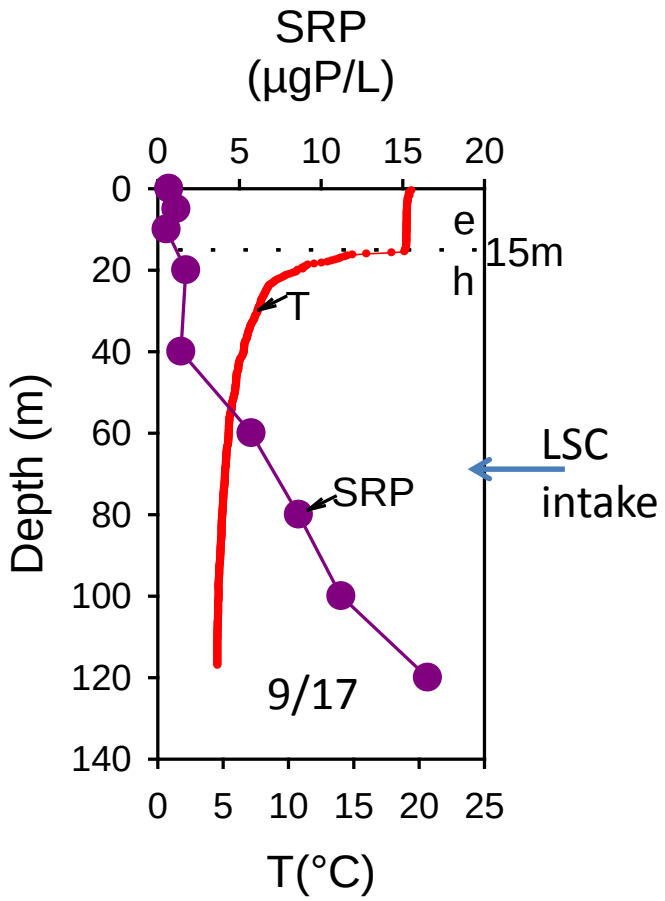
Upstate Freshwater Institute, Syracuse

Technical Briefing (CLTAC)
Cayuga Lake Modeling Project
May 19, 2014
Albany, NY

Limnological Context of Quagga Mussel Metabolism: Potential Signatures, Vertical

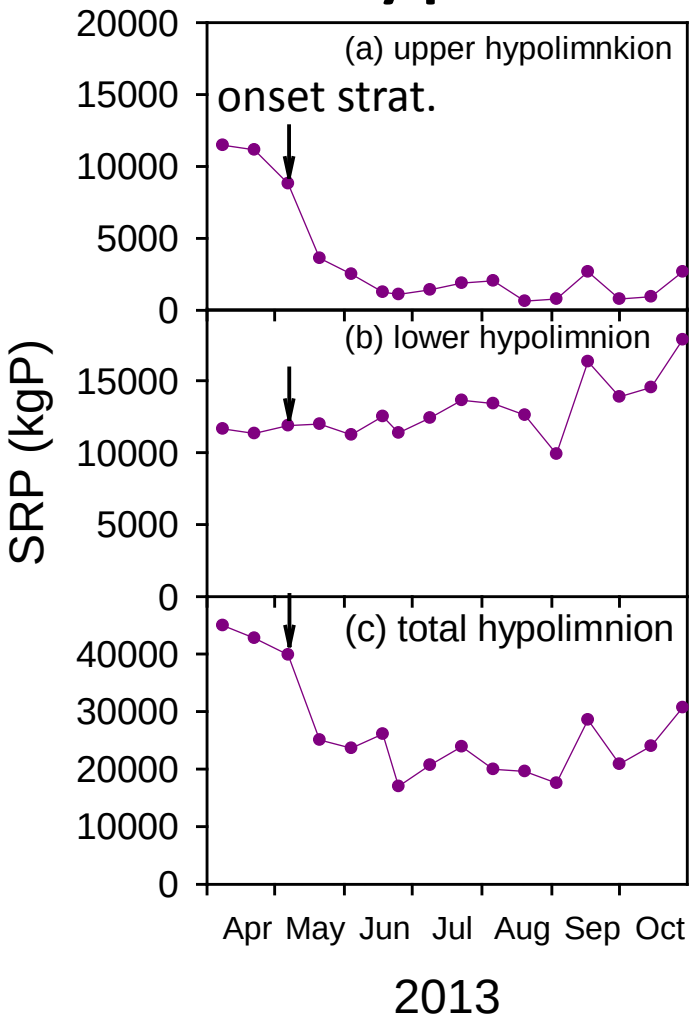






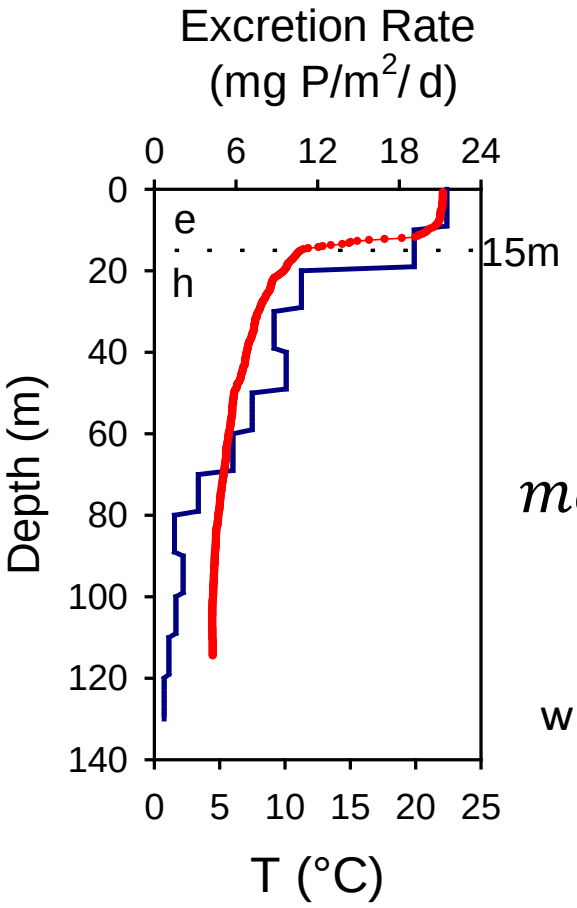
- depletion of SRP in epilimnion, metalimnion and upper hypolimnion
- increases in deep hypolimnion of SRP – suggestive of bottom release
- overall SRP profile signature consistent with transport from hypolimnion to epilimnion

Limnological Context of Quagga Mussel Metabolism: Dynamics of Hypolimnion SRP Content



- upper hypolimnion
  - loss after onset of stratification
  - consistent with loss to epilimnion
- lower hypolimnion
  - gain after onset of stratification
  - consistent with bottom source
  - only modest change in overall mass of hypolimnion after late May

Quagga Mussel Metabolism: Estimates of SRP Dynamics of Excretion

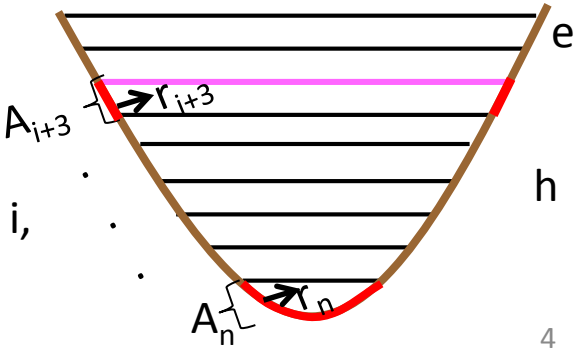


- stratification interval, Jun – October
- excretion rate (Cornell, Shackelton Point)
  - units of mg/m^2/d
- mass SRP excreted = excret. rate x area x duration stratification

$$mass_{SRP,h} = \sum_{i=1}^{n} r_i \cdot A_i$$

where

A_i = the bottom area for layer i,
r_i = the rate for layer I, and
n = number of layers



Sources of Variability in Excretion

- multiple regulating factors
  - temperature
  - mussle size
  - food quantity
  - food quality
  - reproductive stages
  - dissolved oxygen concentration
  - substrate type
- unexplained temporal differences
- influence of experimental conditions

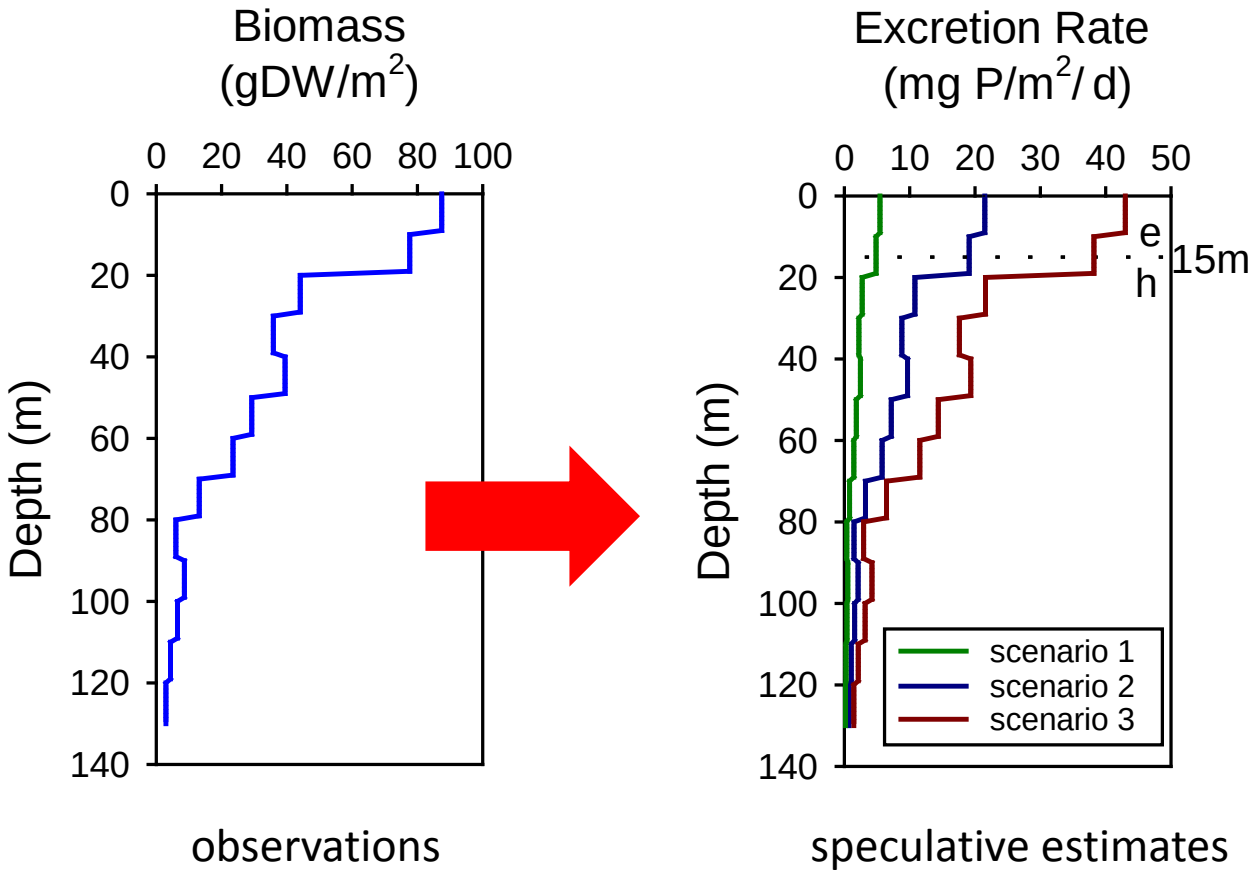
Quagga Mussels
(*Dreissenia rostriformis bugensis)*

Zebra Mussel
(*Dreissena polymorpha*)

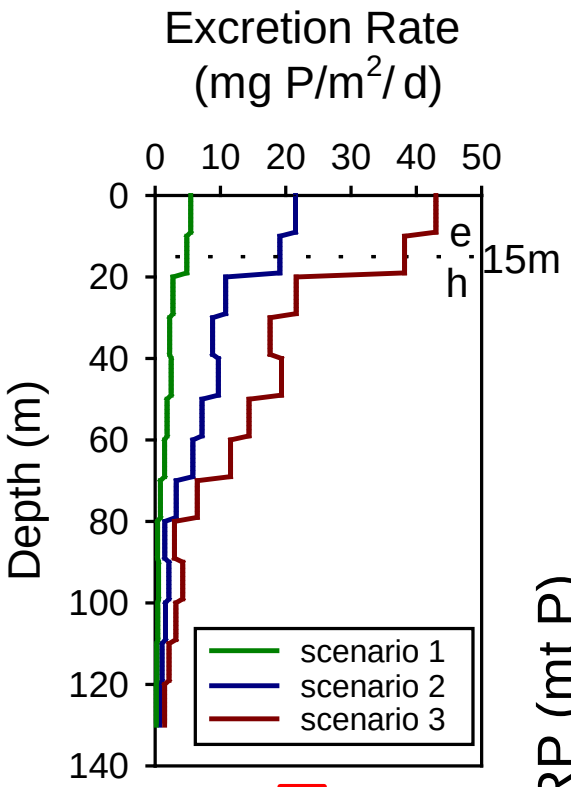
Bootsma and Liao. 2014. Nutrient Cycling by Dreissenid Mussels, Controlling Factors and Ecosystem Response. p. 555-574. Quagga and Zebra Mussels. CRC Press, New York, NY

Excretion Rate Scenarios Considered

- scenario 1 = 0.084µmol/gDW/hr (Orzersky *et al.*, 2009)
- scenario 2 = 0.33 µmol/gDW/hr (Nalepa and Schloesser, 2014)
- scenario 3 = 0.66 µmol/gDW/hr (Bootsman *et al.*, unpublished)



Conservative Assumption Calculations With Excretion to Provide Context

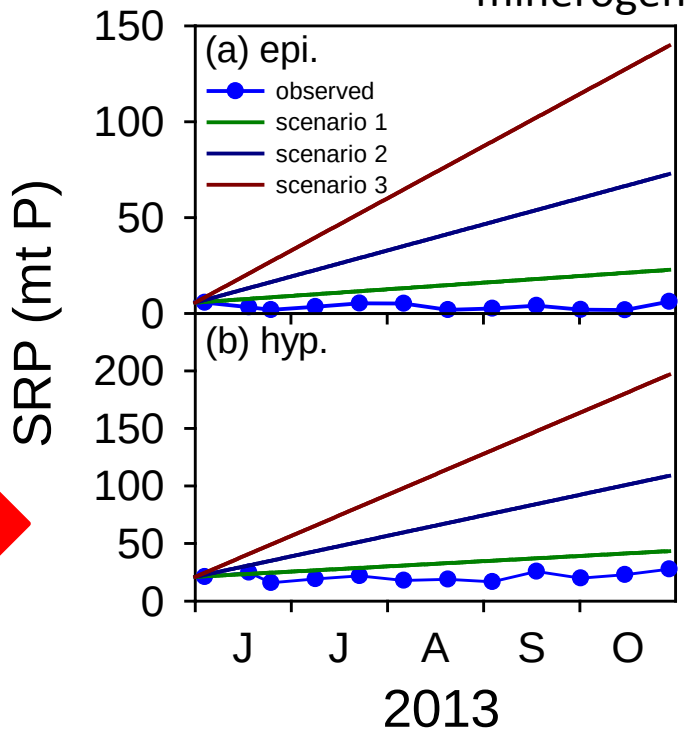


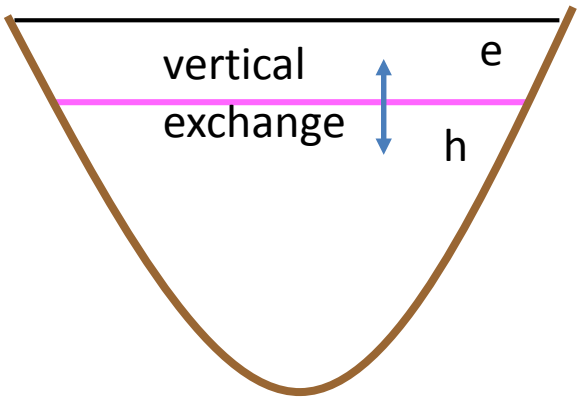
epi.

- sink(s), algae and ?
  - near-shore (shunt/collar effect)
  - pelagic

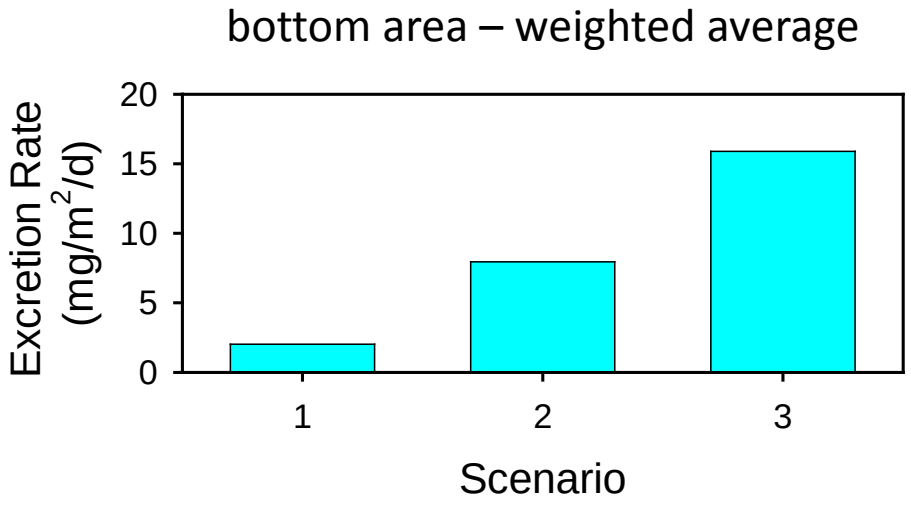
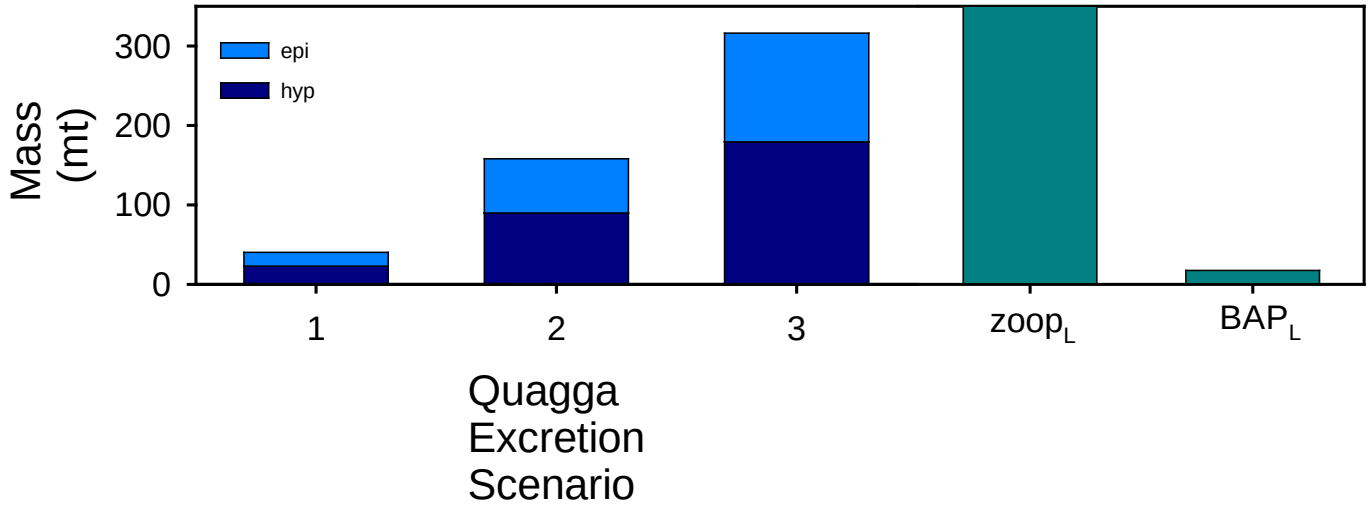
hyp.

- sink(s)
  - vertical transport to epilimnion, lake-wide algae
  - other processes: e.g., sorption to minerogenic particles and bottom sediment





Estimated Mass Excreted, According to Excretion Rate Scenarios



- large quantities of SRP
- raises issues concerning representativeness of excretion rates, and the fate
  - deserves careful consideration
  - great uncertainty
  - potential for compensating sink processes
  - quagga excretion literature presently limited