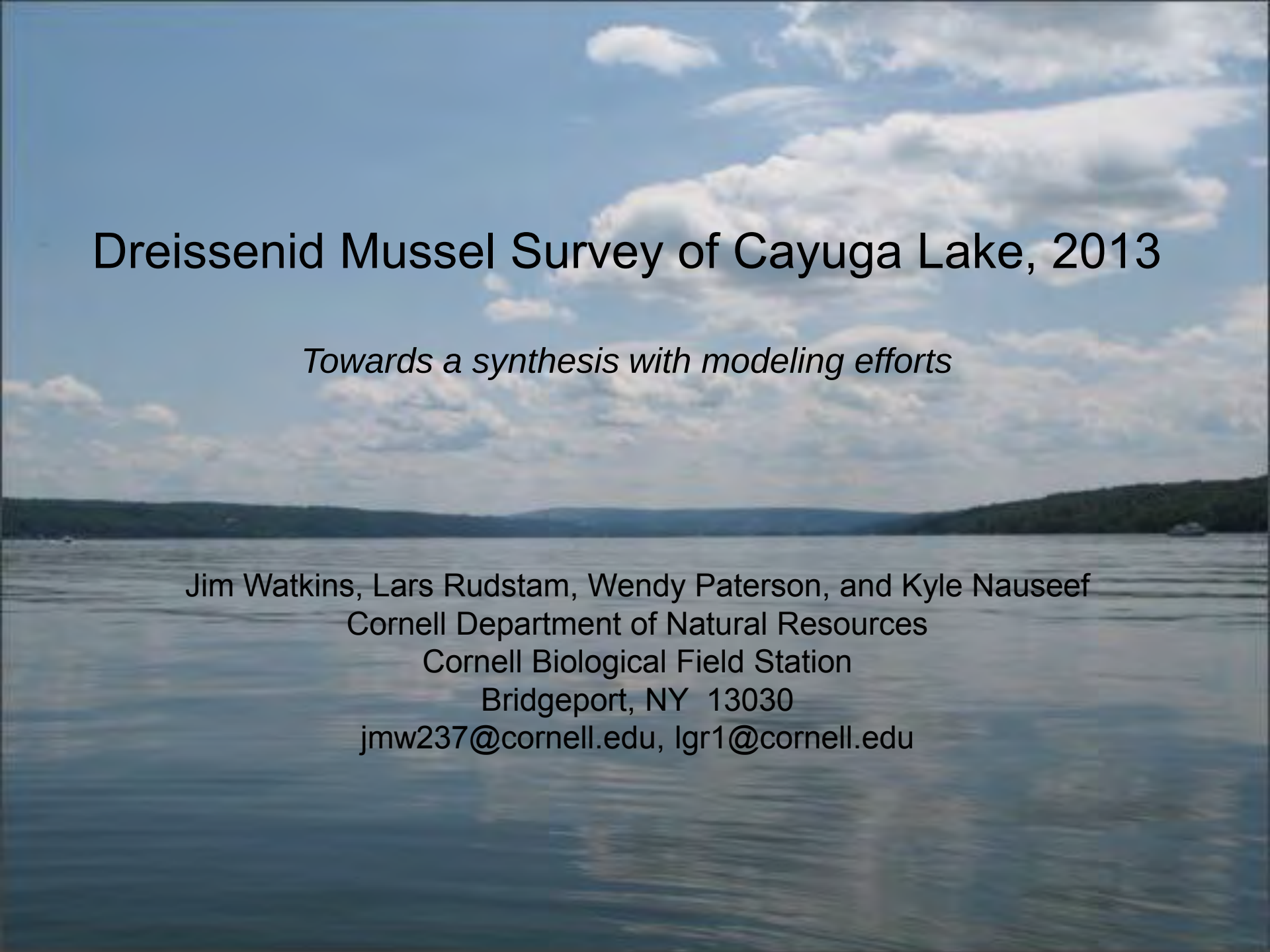

Dreissenid Mussel Survey of Cayuga Lake, 2013

Towards a synthesis with modeling efforts

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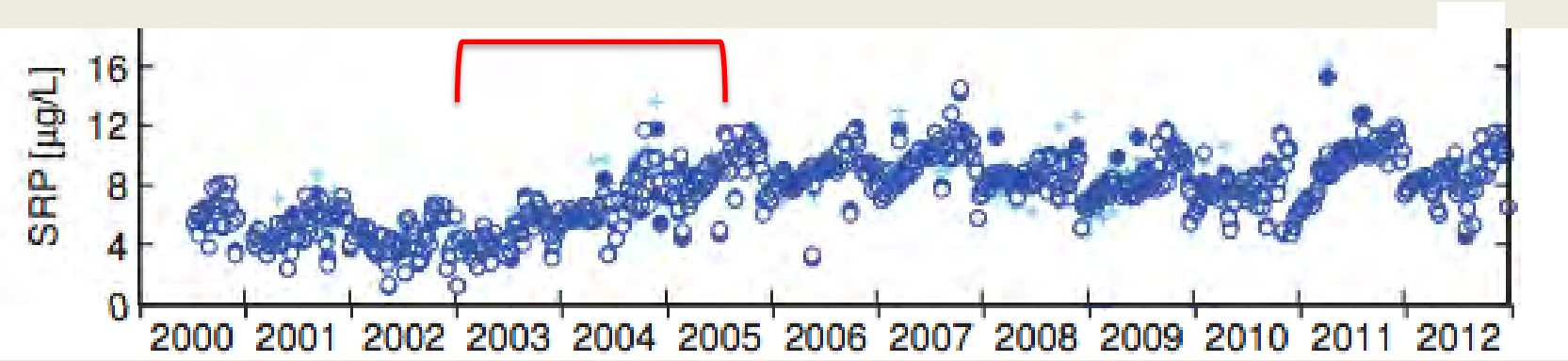
Question- Why did soluble reactive phosphorus increase in the hypolimnion?

Time Series of SRP at LSC Intake (78 m)



-rare hypolimnion SRP time series at weekly sampling resolution

-seasonal build-up during stratification and decrease at turnover

-increase in SRP from 2003 to 2005 a concern

Hypothesis- Expansion of dreissenid mussels played a role.

Dreissena polymorpha
(zebra)
1991
(north outlet)

Dreissena rostriformis bugensis
(quagga)
1994
(power plant intake)

Limited Benthic Surveys of Cayuga Lake prior to 2013

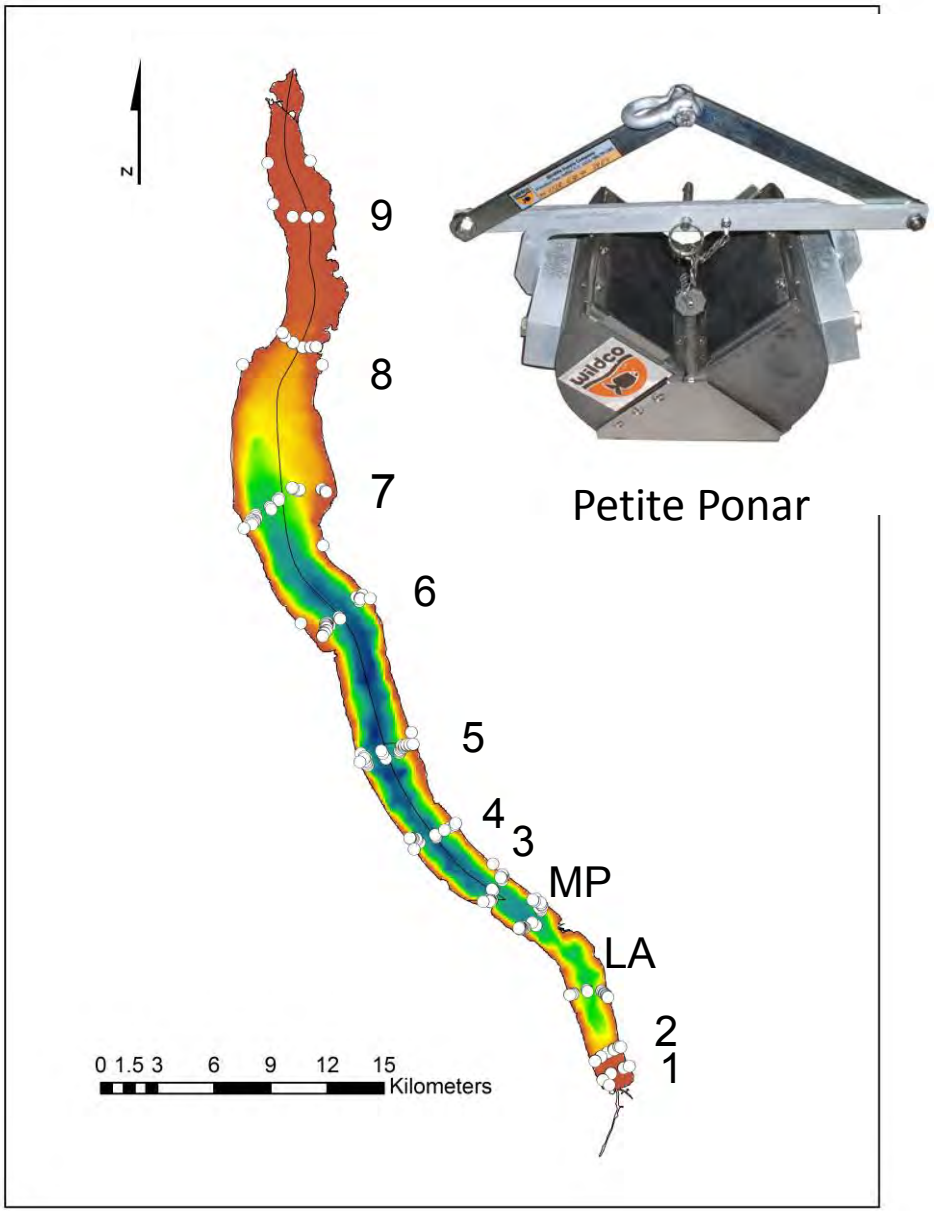
1994	Ed Mills	no mussels reported
2000/2001	Ed Mills	mussels not differentiated
2006-2010	Jim Watkins	primarily quagga mussels

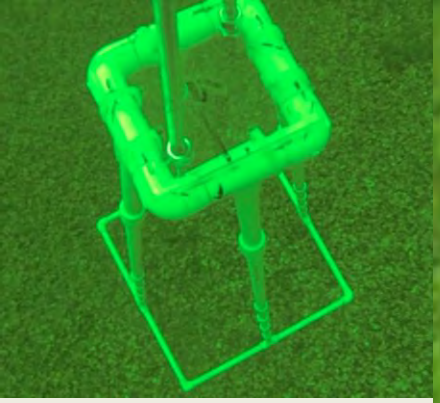
Cayuga Benthic Survey 2013

<u>Cross-Lake Transects</u>

9 (North End)
8 (Union Springs)
7 (Aurora)
6 (Long Point)
5 (Mid-lake)
4 (Power Plant)
3 (Taughannock)
MP (Myers Point)
LA (Lansing)
2 (Sailing Club)
1 (South End)

September and October 2013





GoPro Hero 3 Videos

0.25 m^2 Quadrat

Nearly complete coverage 10-20 m depth interval

OCEW020A
Quagas
11/20/13
4
3
2
1
CM
20 m Transect 6
West Side

Importance of Abundance Units

Density	count of live individuals	**issue**- high proportion of juveniles (< 5 mm)
Wet Weight	bulk weight	**issue**- includes shells
Dry Weight	compiled from individual lengths using length-weight regression- no shell	

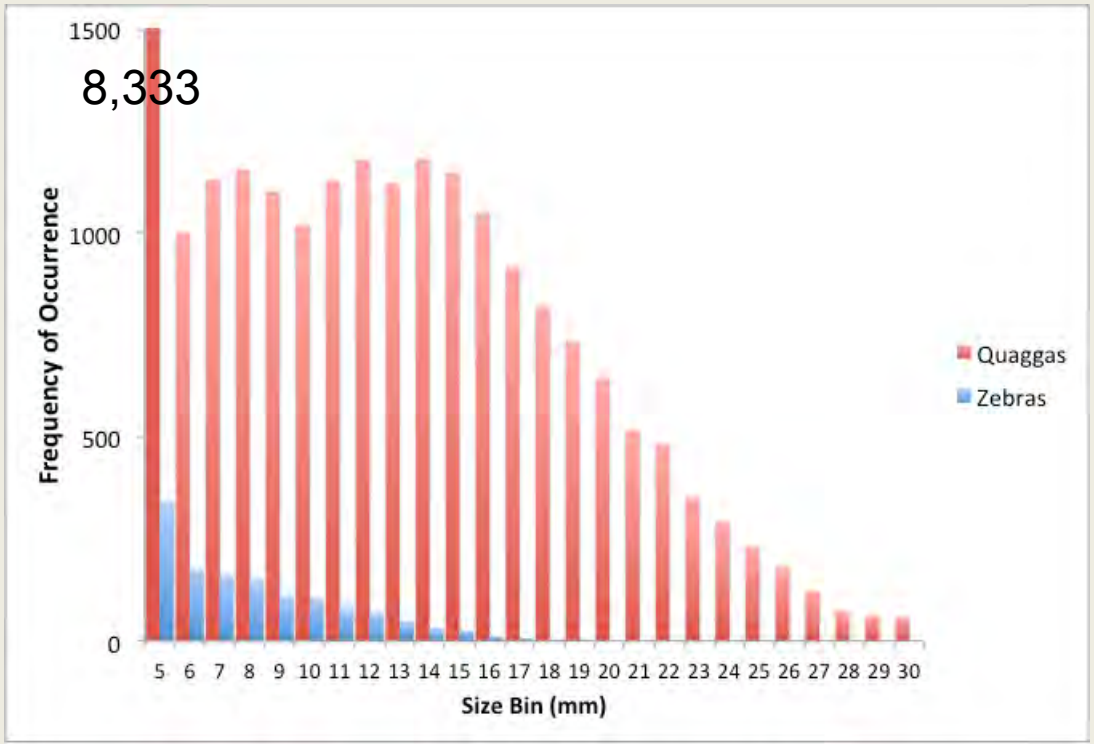
all are normalized to per m^2 basis (each grab 0.023 m^2)

Benthic Survey Totals

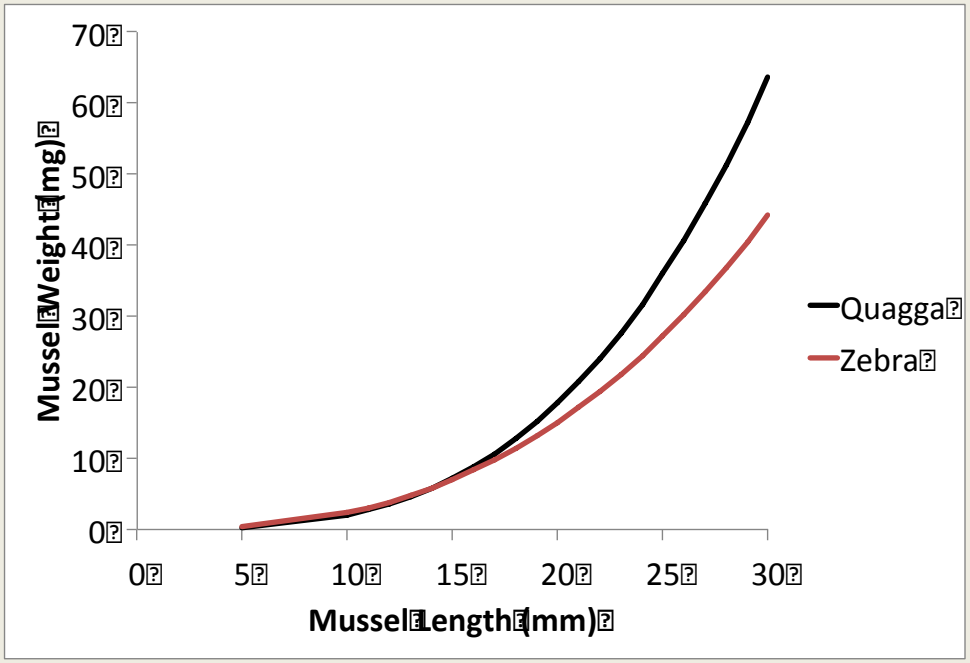
279 Samples Analyzed (98 stations)

Quaggas in 96.1% of samples, Zebras only in 24.4% of samples

26,117 Quagga mussels measured (31.9% less than 5 mm)
1,326 Zebra mussels measured (25.6% less than 5 mm)



Length-Weight Regression for Dreissenids



Nalepa et al. 2010

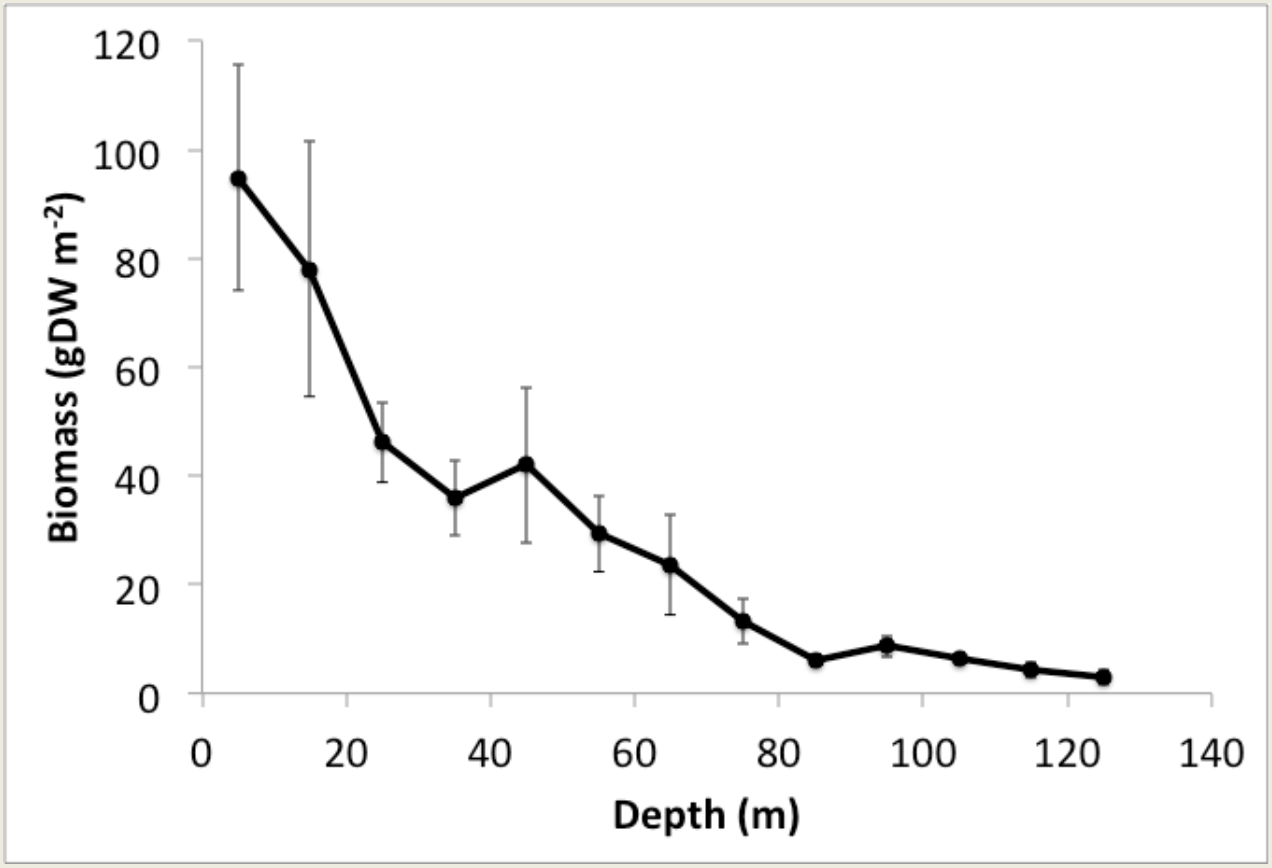
Matches Cayuga LW equation for 2007 quaggas (unpublished)

Length	Dry Weight
5 mm	0.2 mg
10 mm	2.0 mg
20 mm	17.8 mg
30 mm	63.7 mg

Biomass does not include shell weight

Useful for biological rates (grazing and excretion)

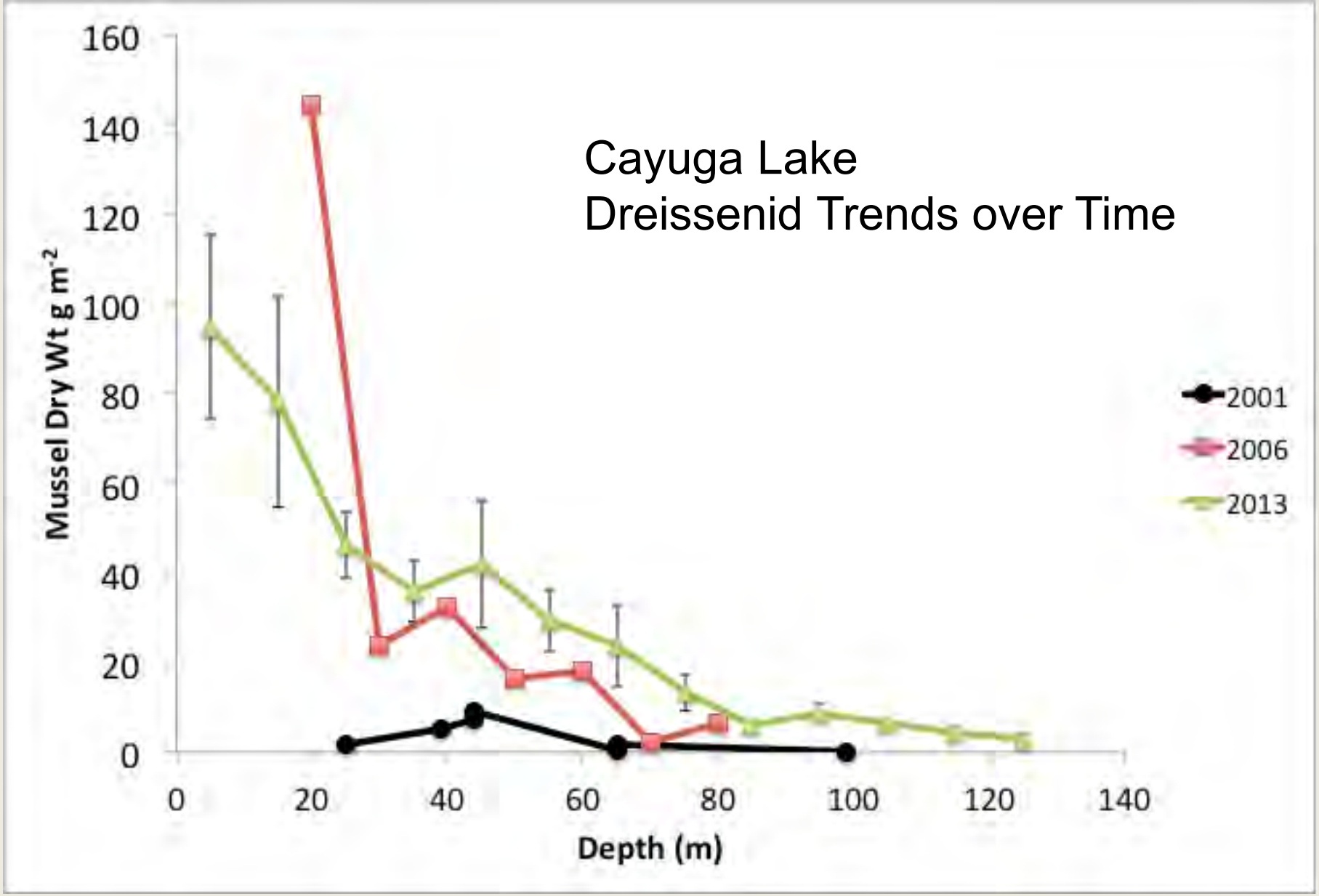
Shell-free dry weight biomass with depth



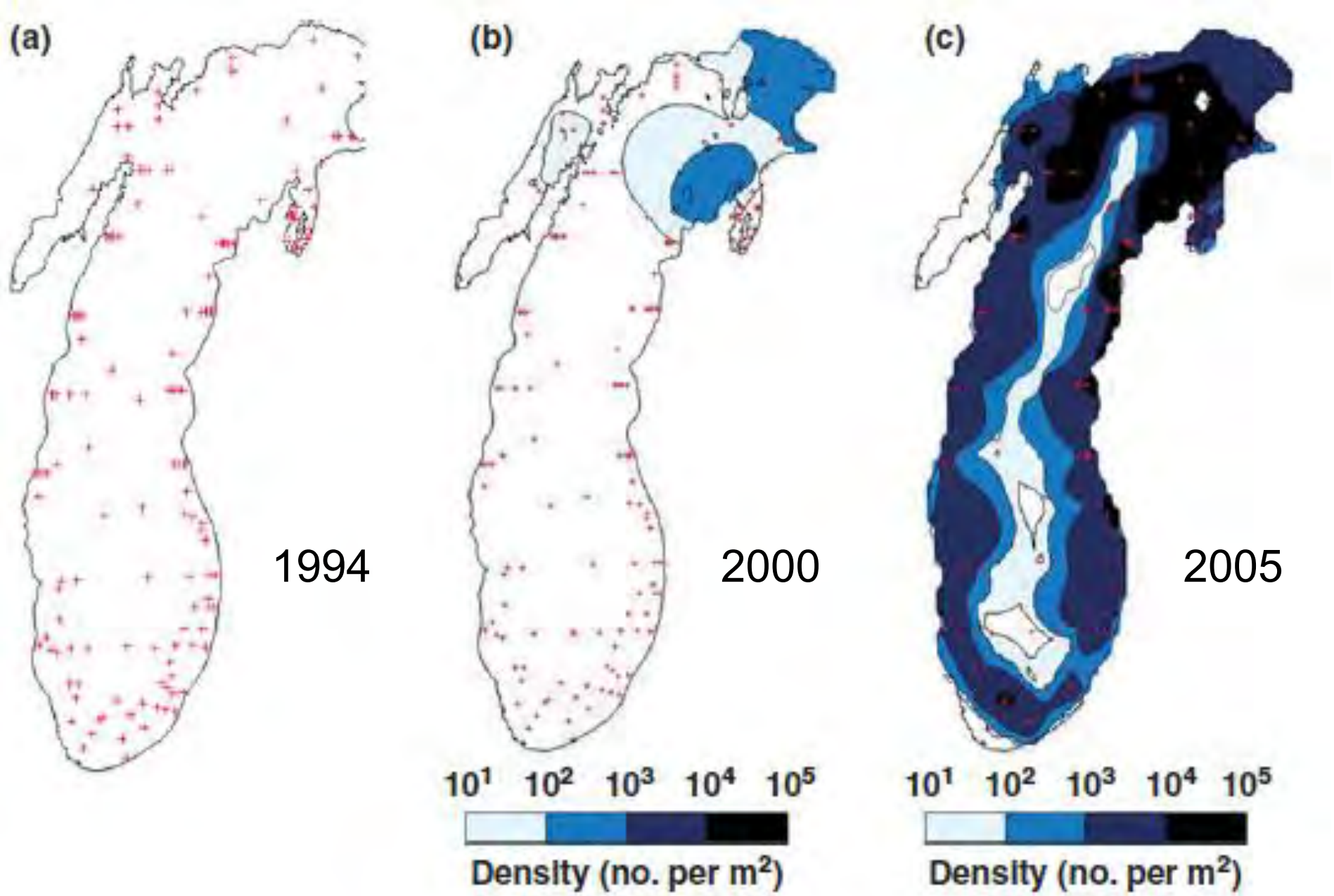
Quagga mussel biomass highest < 20 m, near 100 g m^{-2}, high variation.

Mussel biomass decreases with depth to 10 g m^{-2} below 80 m.

Mussel biomass 20-60 m is high relative to other deep lakes



2001 (density and wet weight)
2006 (density only)
2013 (density, wet weight, and dry weight)



Similar Quagga Mussel Expansion in Lake Michigan

Nalepa et al. 2010

Excretion Rate Study July 2014

-quaggas collected at three depths (25, 50, and 80 m)

- 5 treatments (three replicates and control)

Treatment	Source	Temperature
1	80 m	4°C
2	50 m	4°C
3	25 m	4°C
4	25 m	12°C
5	25 m	20°C

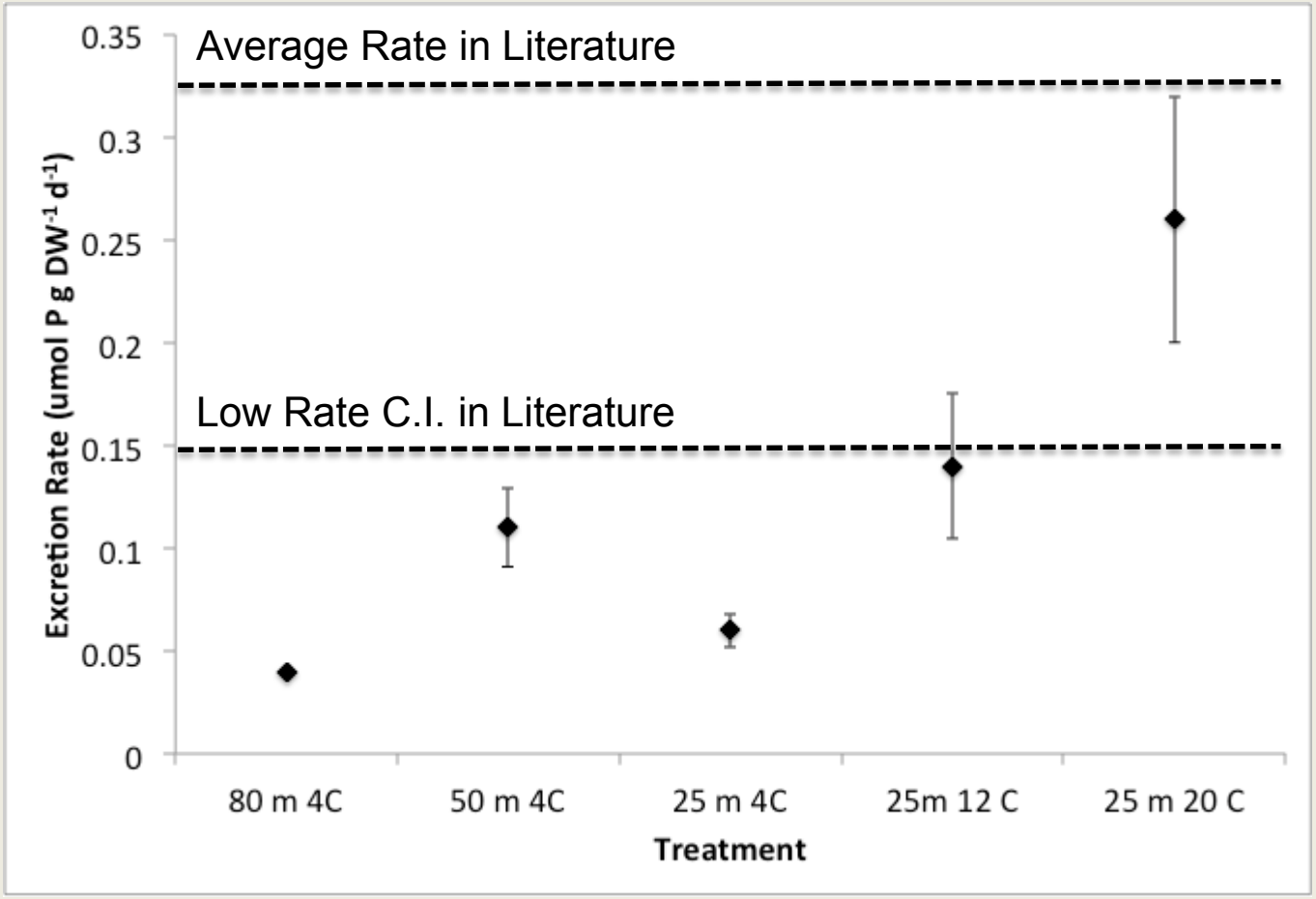
Source

Temperature

-20 individuals per treatment, ranging 10-27 mm length (average 17-19 mm)
Experiment started on the same day as collection.

-add to 300 ml filtered surface lake water for 10 hours, water filtered

-parameter- SRP increase (UFI analysis)
(Normalized to mussel biomass in treatment, water volume, and time)

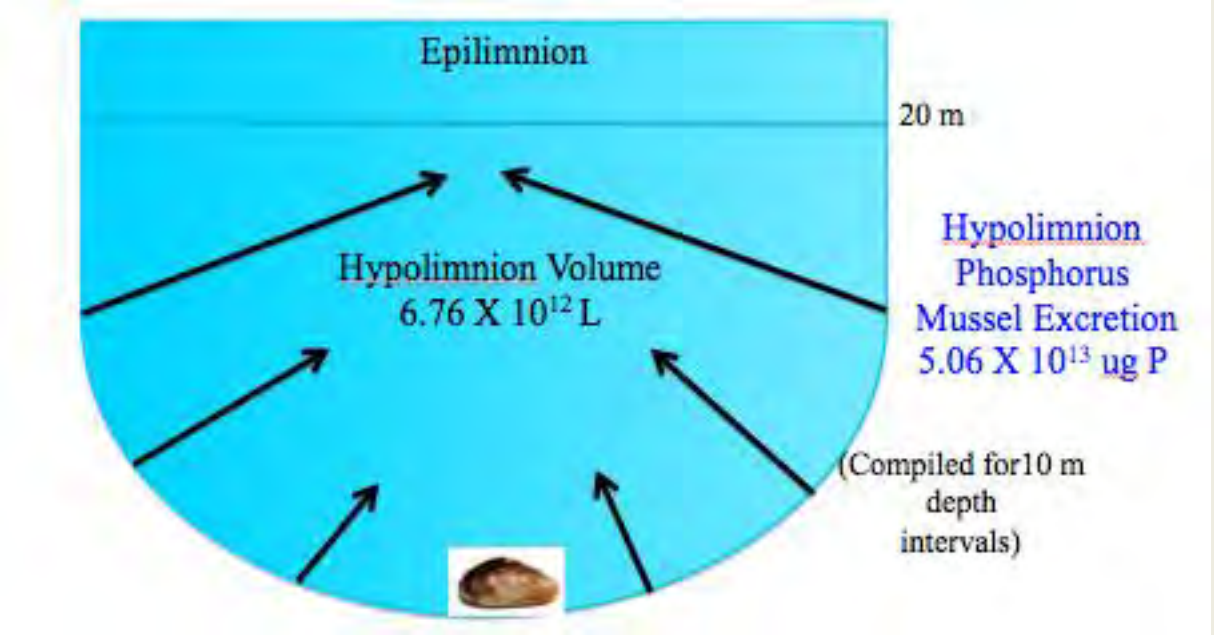


-Measurements at hypolimnion temperatures (4C) were low (0.04 to 0.11)

-Excretion rates increased with temperature from 0.06 to 0.26.

-High temperature treatment slightly lower than literature average (0.33)

Calculation- Is mussel excretion rate at a magnitude to affect hypolimnetic SRP?



Simplified model assuming complete stratification below 20 m for 100 days and no utilization

Includes mussel biomass and substrate area to estimate internal load from excretion

Literature Rate	0.33 µmol P gDW^{-1} m^{-2} day^{-1}	7.5 ug L^{-1} increase
Measured Rate	0.07 µmol P gDW^{-1} m^{-2} day^{-1}	1.6 ug L^{-1} increase
Measured (Temperature)	0.06 (4°C) to 0.26 (20°C)	2.1 ug L^{-1}increase

Observed increase was near 6 ug L^{-1}

Data Products Available

Relational Database (Microsoft Access)

Based on flat (text) files with

- >27,000 length measurements
- benthic sampling information (position, depth, subsample factor, analyst)
- length-weight coefficients (can add alternatives)
- wet weight measurements for each species

Database output queries yield Summary Tables for

- mussel density, wet weight, and dry weight biomass for each sample

- % mussels < 5 mm and average length of mussels > 5 mm

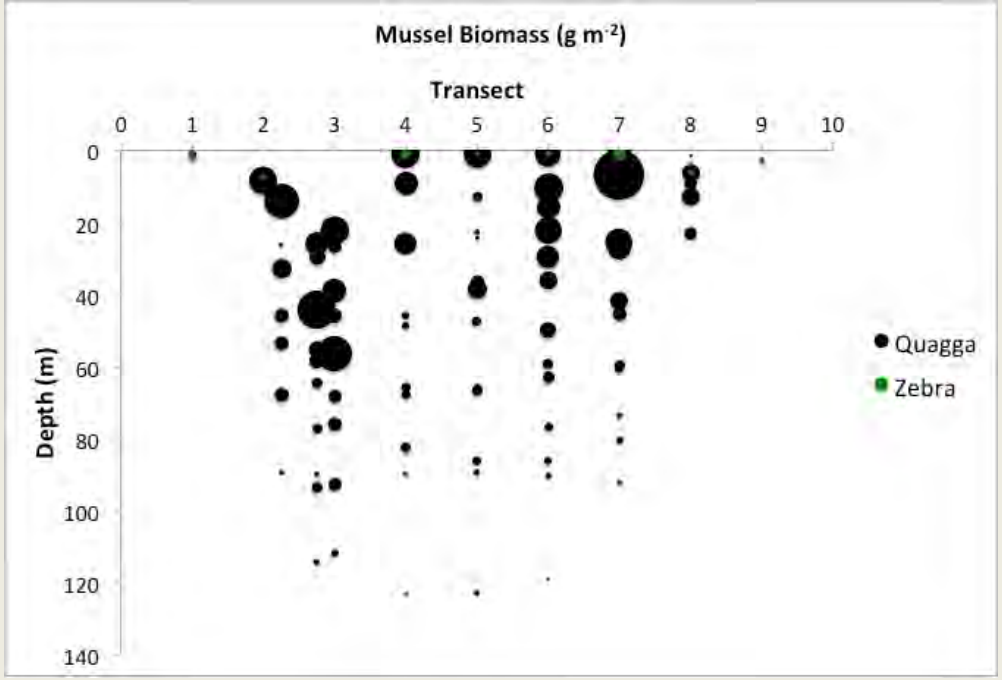
Other Planned Deliverables

Manuscripts submitted to peer-reviewed journals

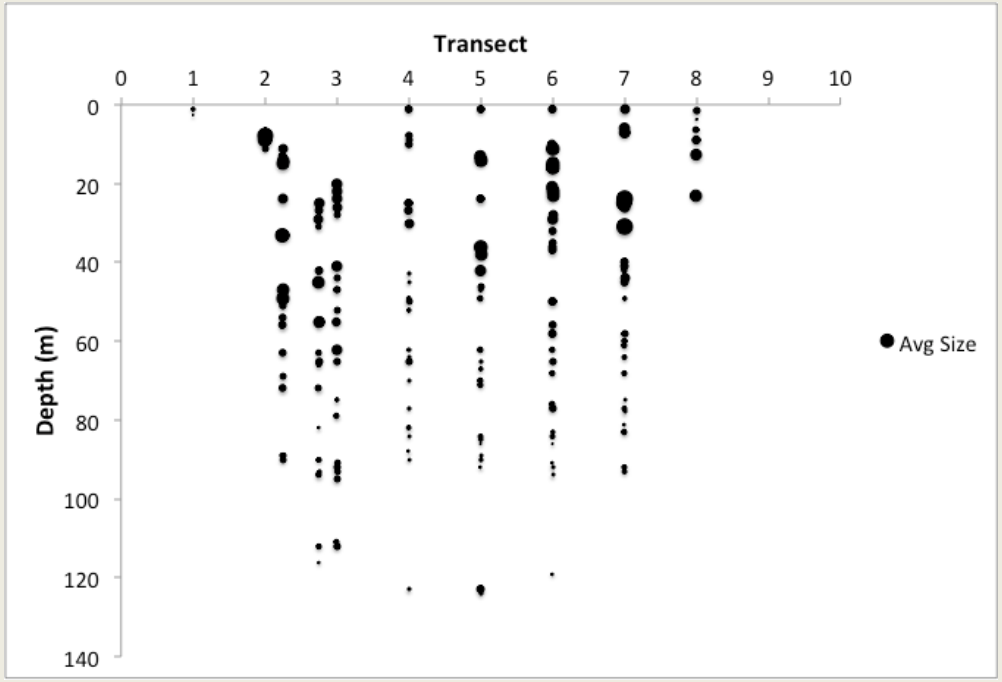
South

North

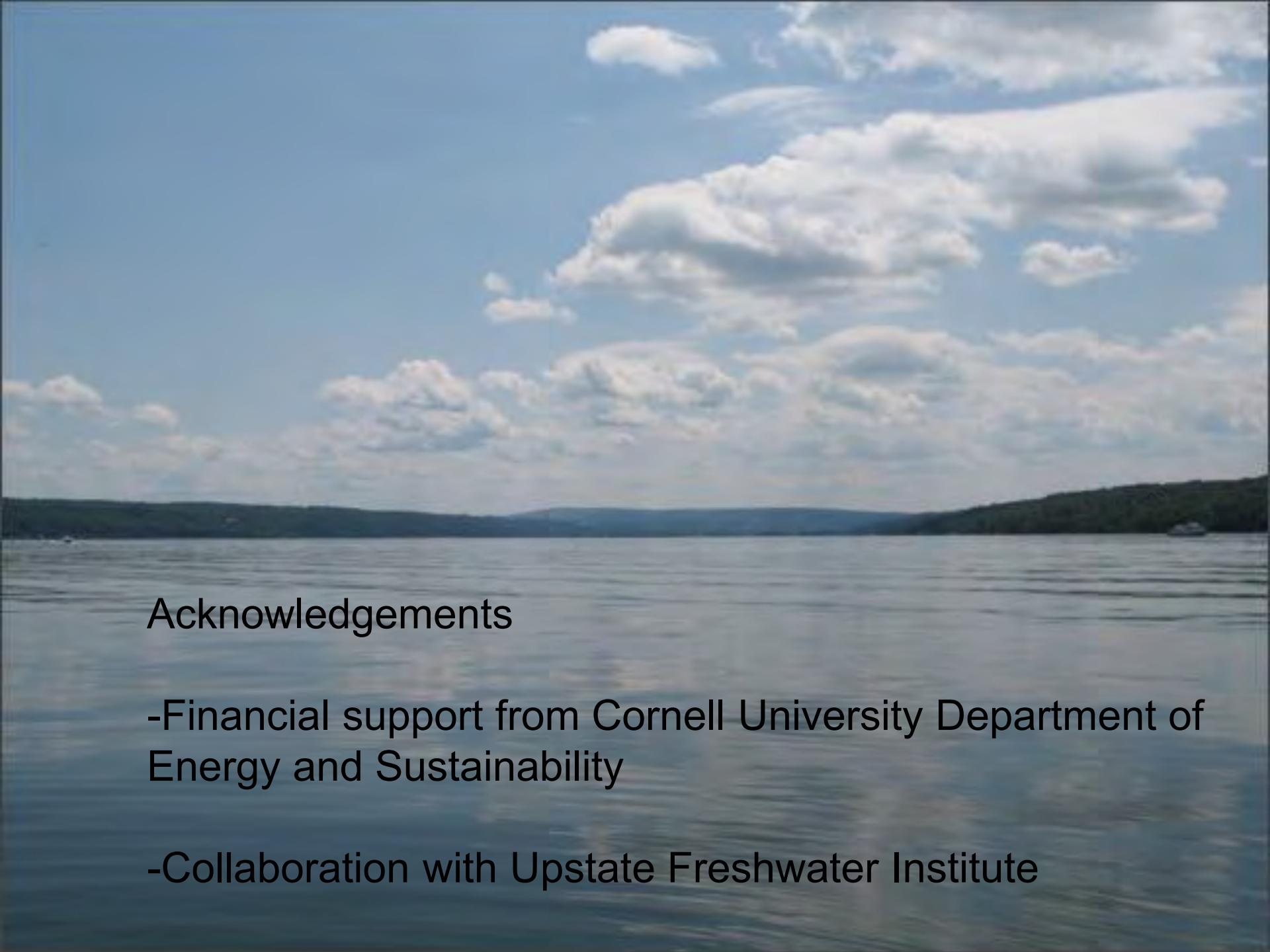
Latitudinal Gradients in Biomass and Size



Mussel Biomass (10-100 g m^{-2})



Quagga Avg Size 8 mm- 20 mm



Acknowledgements

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