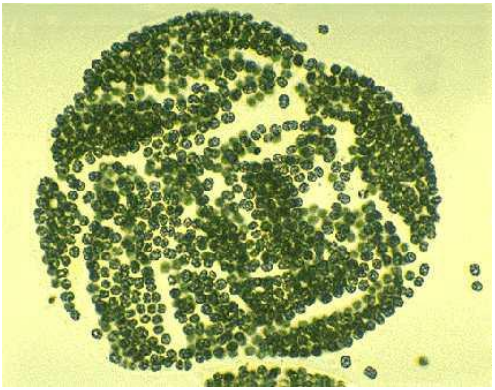
MONITORING, MECHANISMS, AND MACRONUTRIENTS: *MICROCYSTIS* IN THE MAUMEE AND SANDUSKY SYSTEMS



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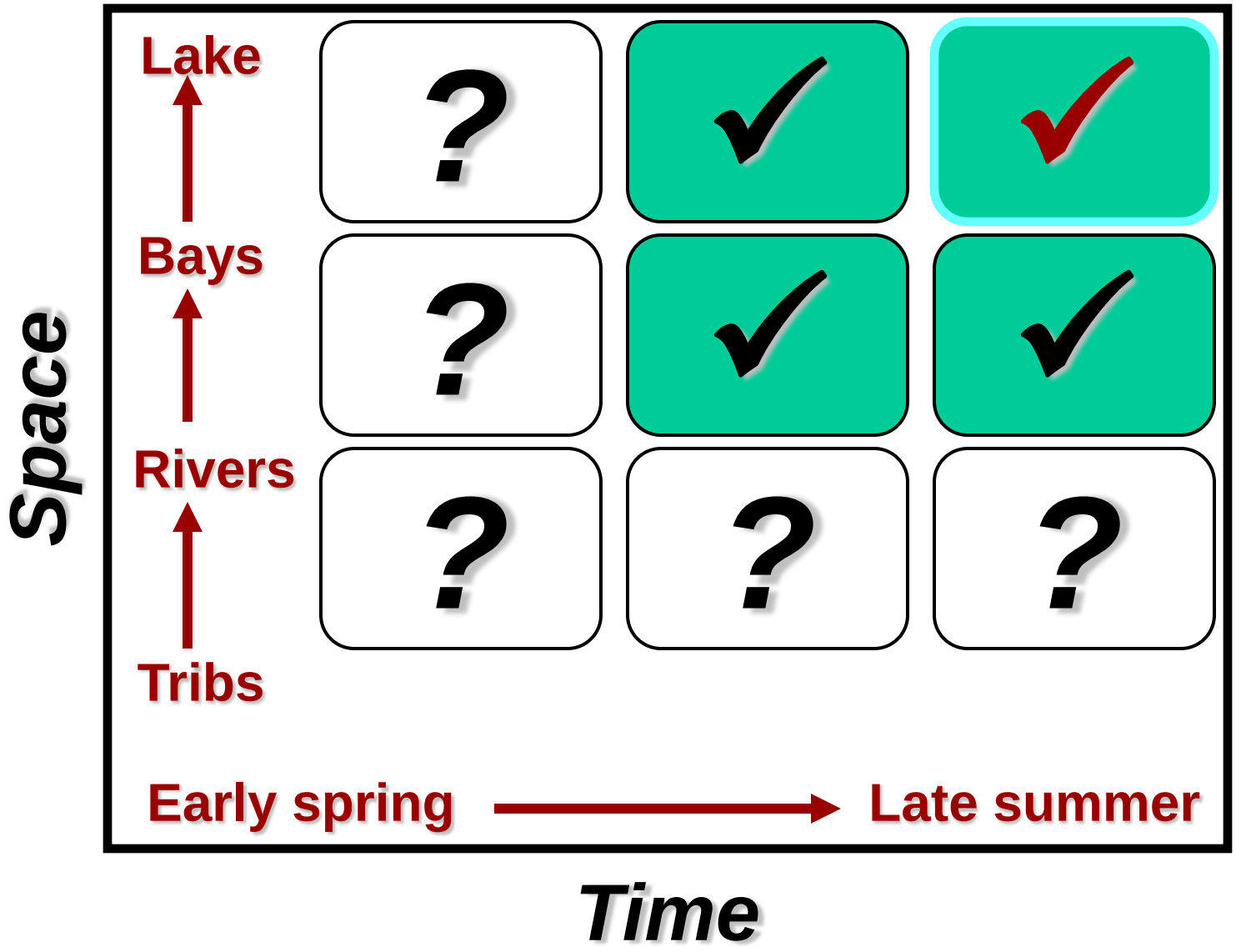
Roadmap

- Part I: Determining bloom trigger points
  - » Measuring pools and process
  - » Quantifying *Microcystis* abundance

- Part II: How should we monitor and measure *Microcystis*?

Problem: *Where & When do blooms start?*

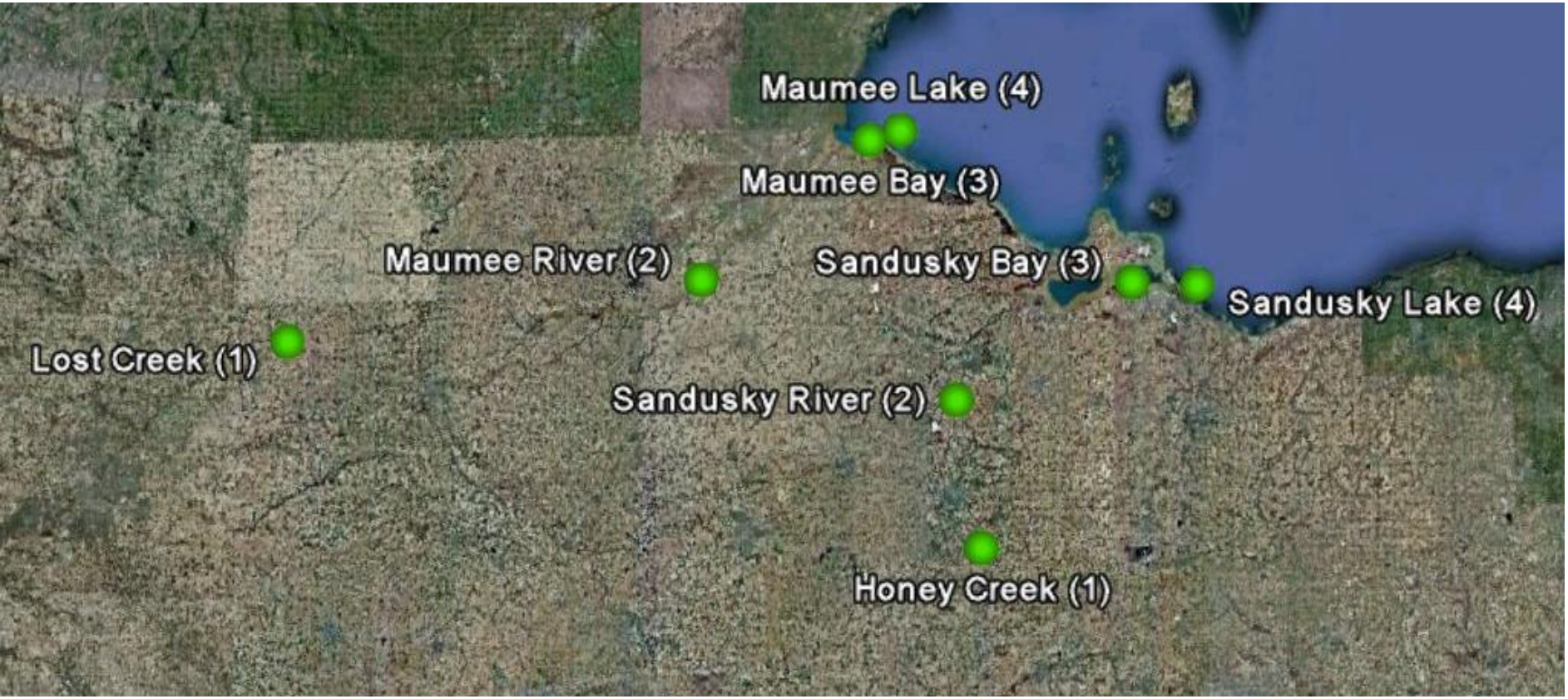


Methods: Data Collection

Field Sampling

Laboratory Analysis

Methods: Sampling locations



Roadmap

- Part I: Determining bloom trigger points
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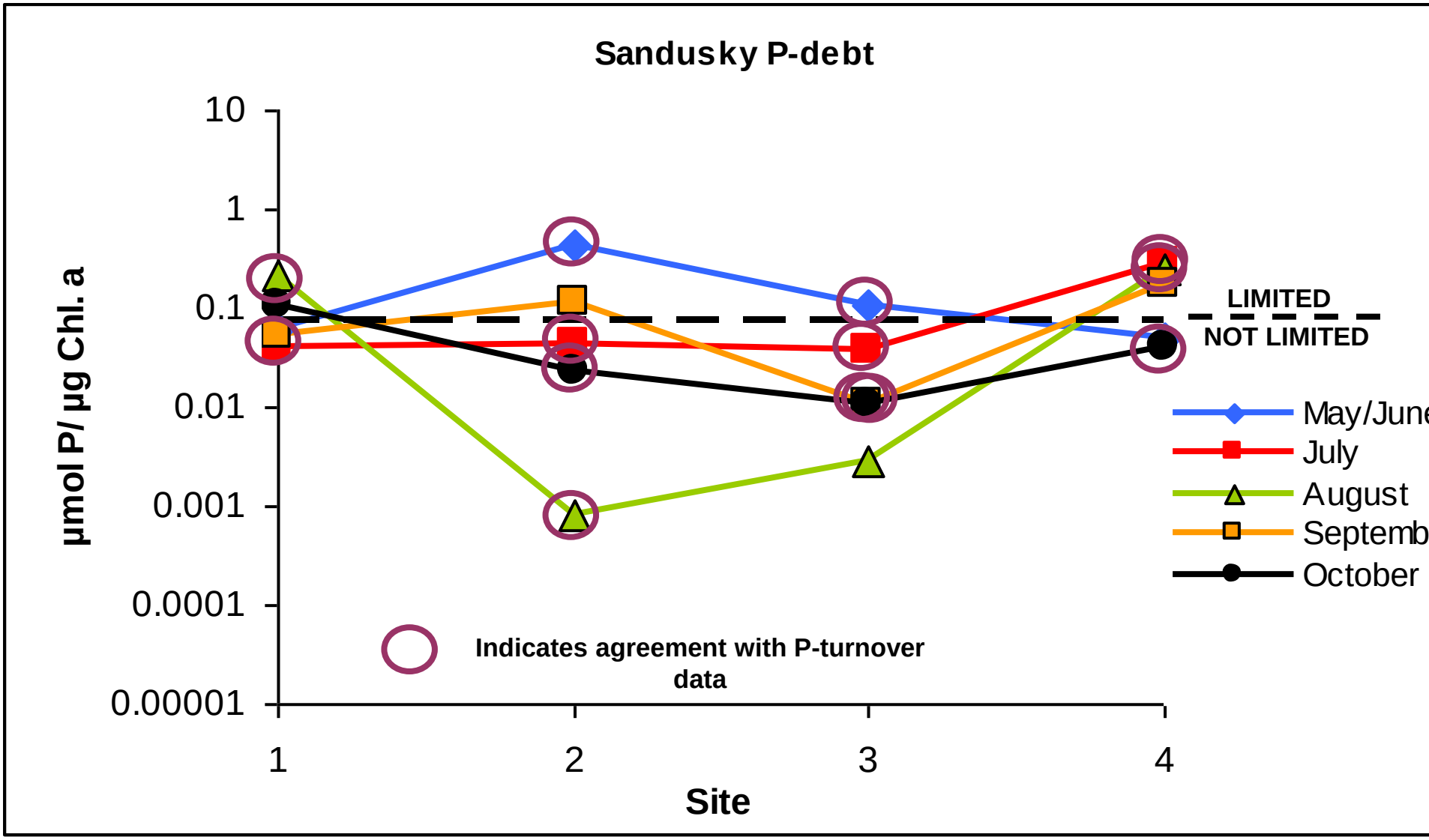
- Part II: How should we monitor and measure *Microcystis*?

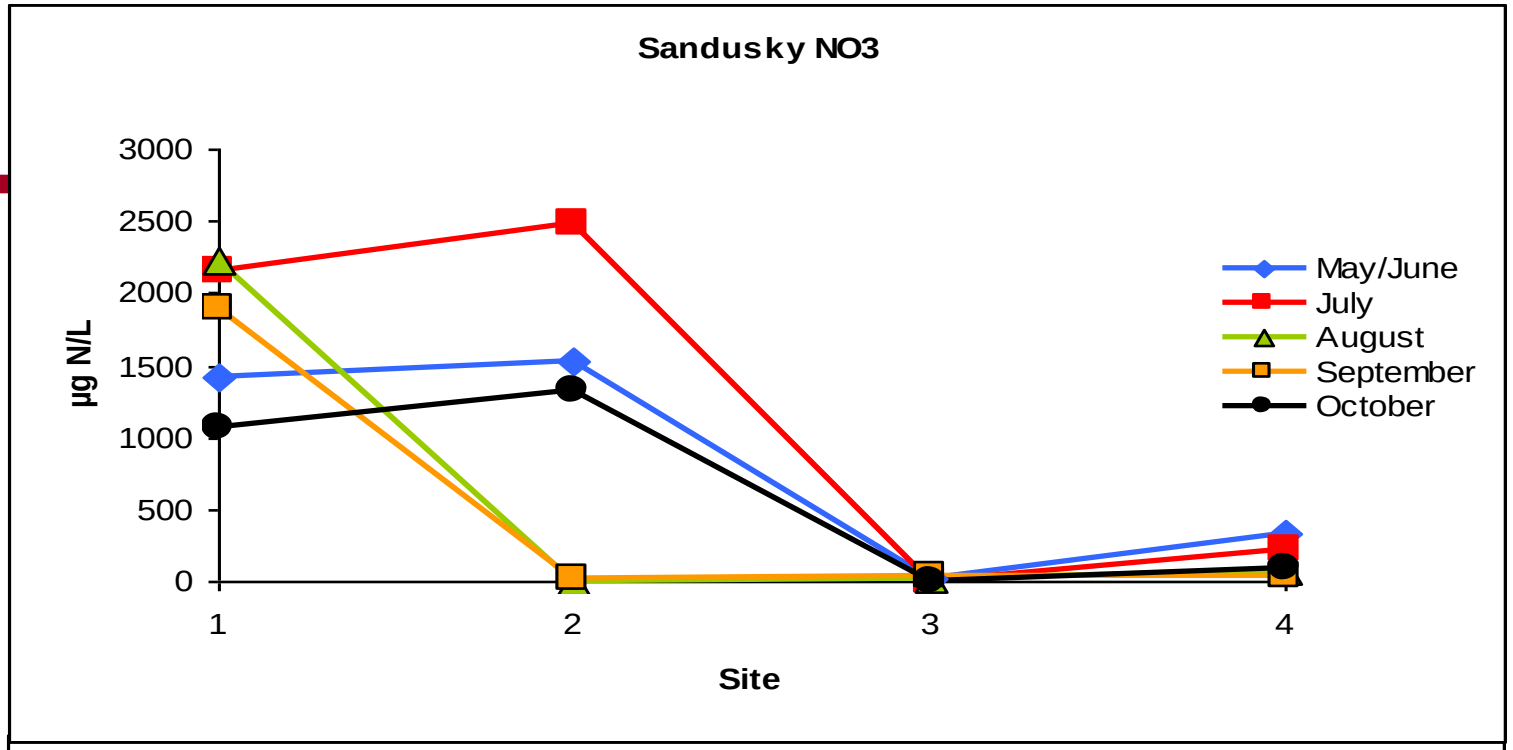
Methods

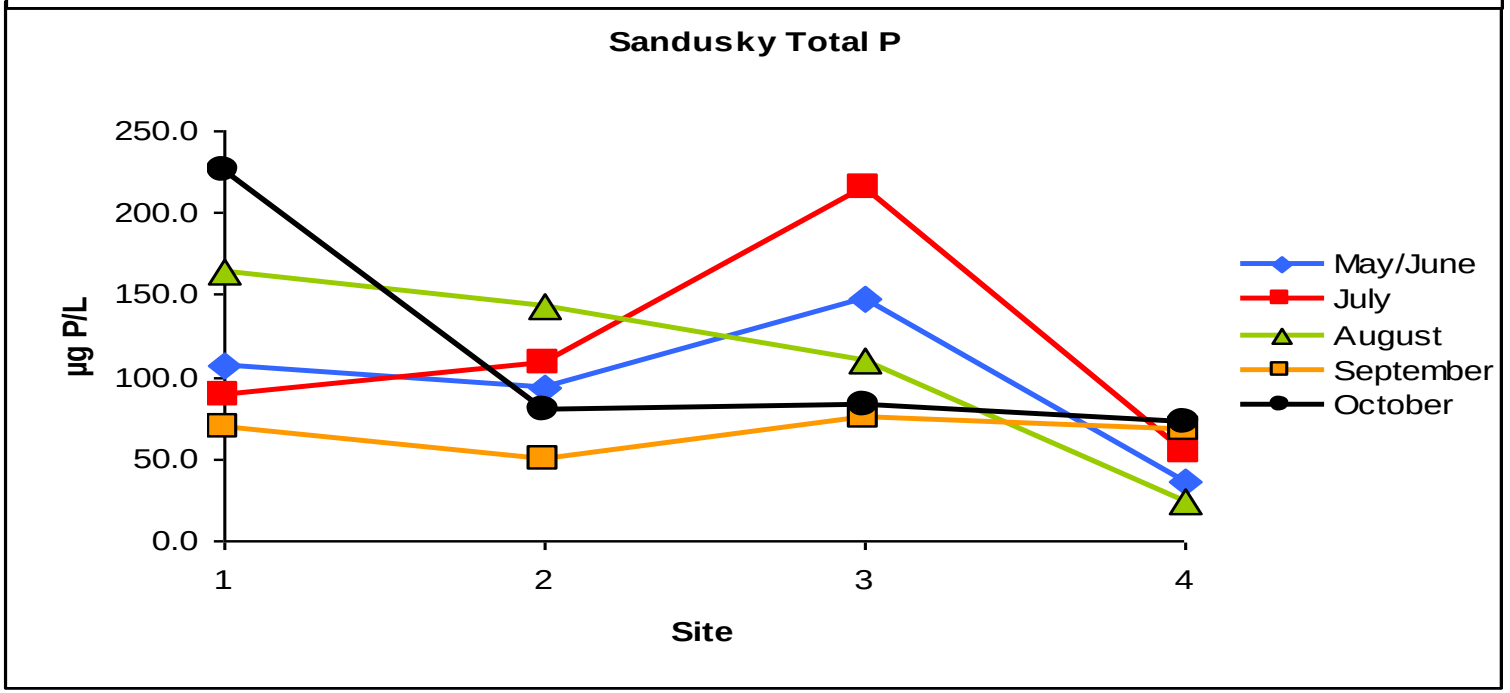
- **Algal Phosphorus Debt (P-debt):**
  - Amount of phosphate incorporated in 24 hours in dark
  - The more “phosphate starved” algae are the more phosphate is taken up
  - Scaled to algal biomass
  - Values above 0.075 µmol P/ µg chl are considered P limited
- **Phosphate Turnover Time (P-turnover):**
  - Fast turnover times (less than 60 minutes) indicate P-limitation
  - Fast turnover times could be caused by a small phosphate pool or high demand by algae

Healey & Hendzel 1979
Heath, R.T. 1986

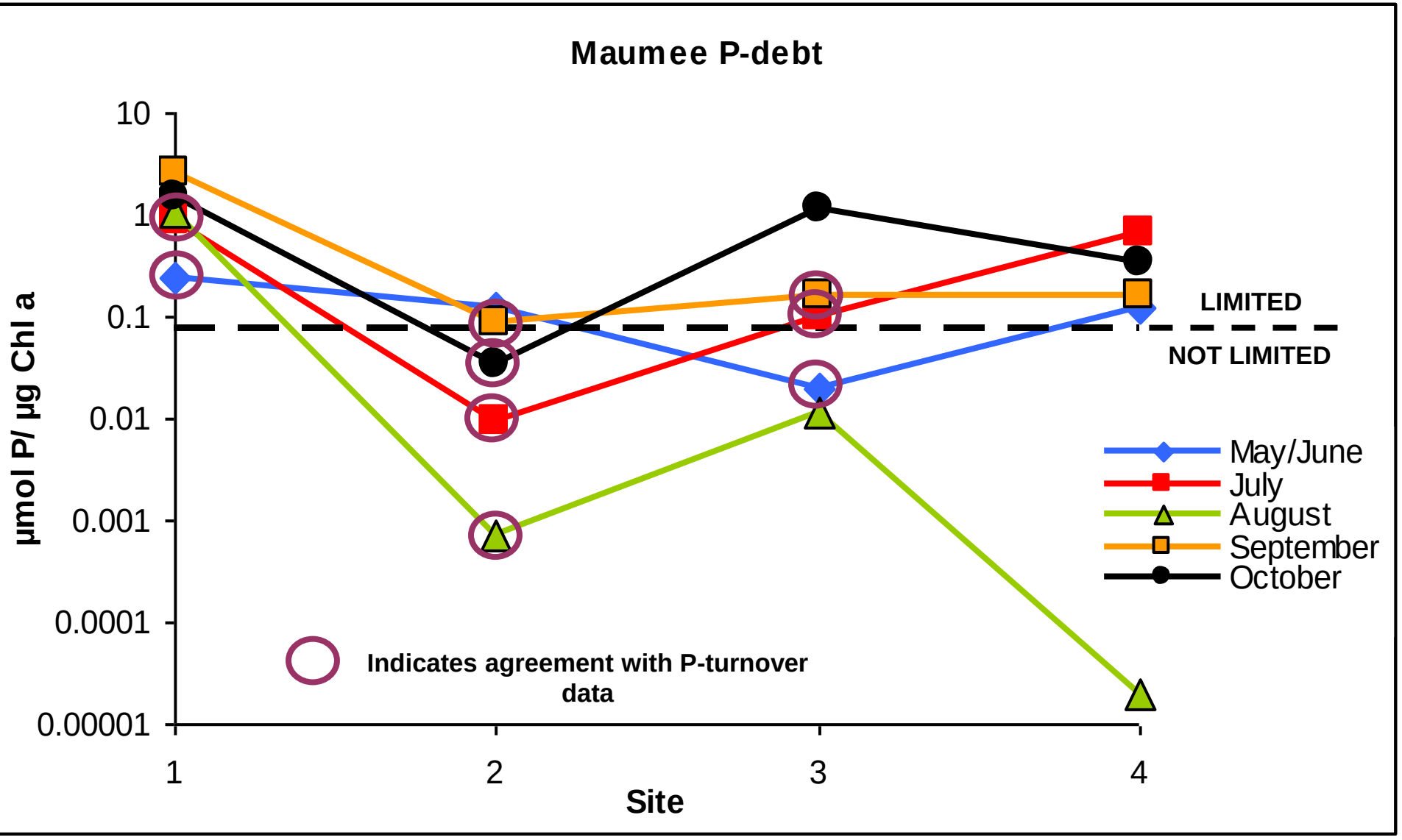
Sandusky System Results

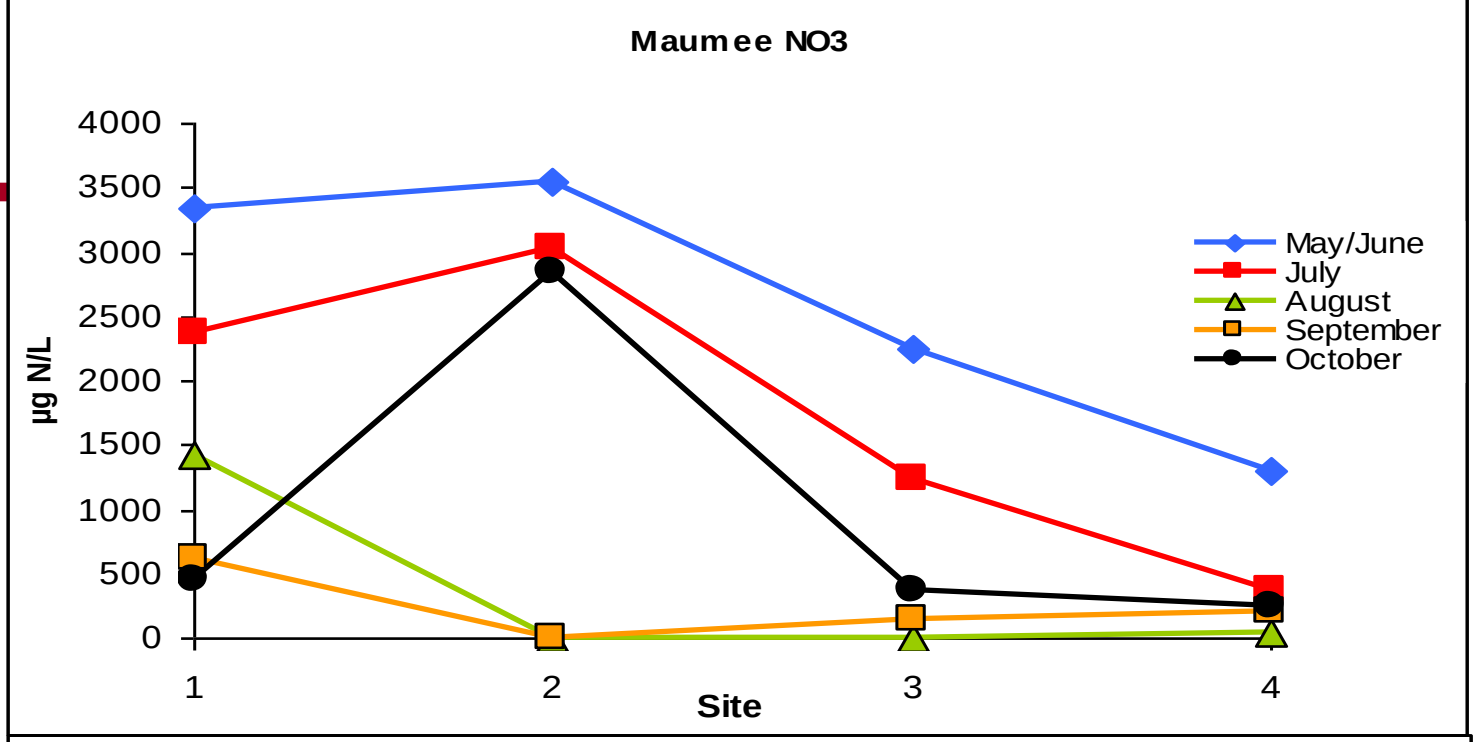


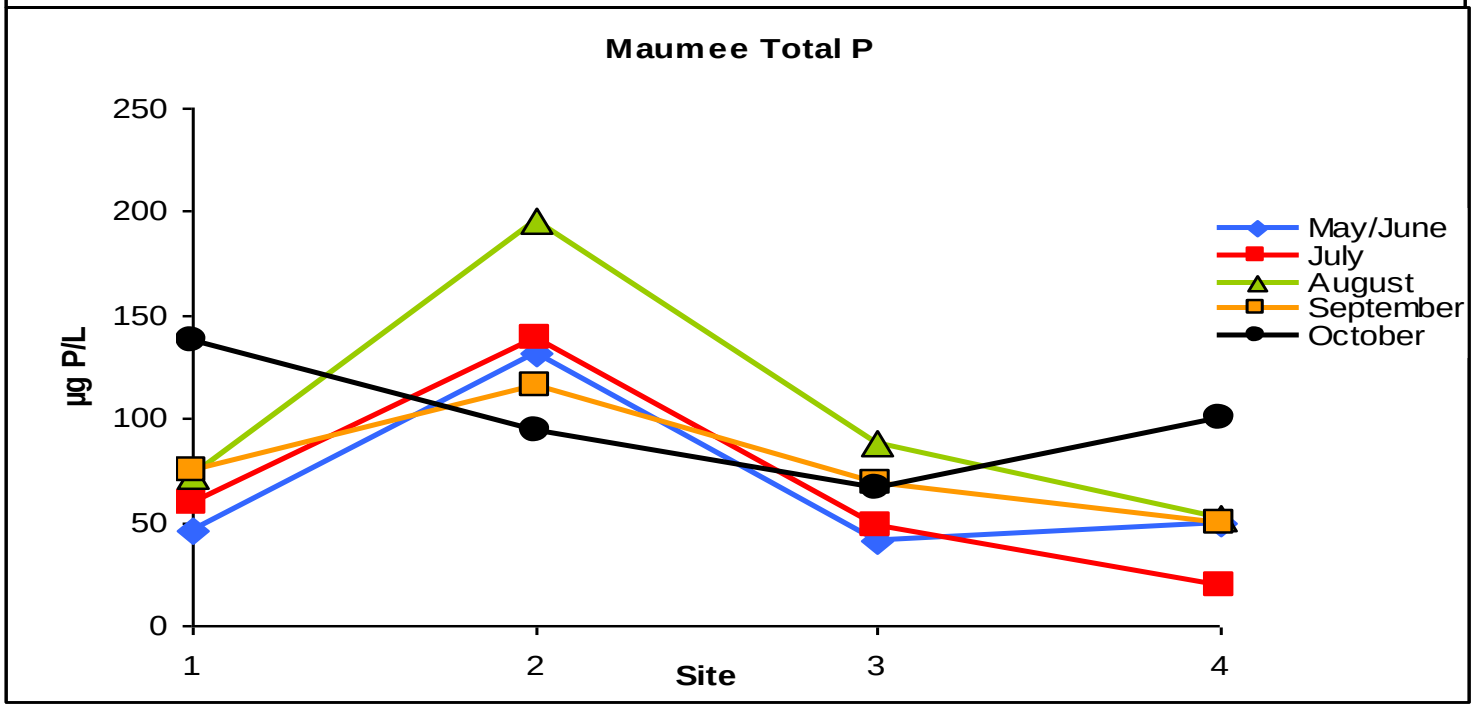

Sandusky NO3
3000
2500
2000
1500
1000
500
0
µg N/L
1
2
3
4
Site
May/June
July
August
September
October


Sandusky Total P
250.0
200.0
150.0
100.0
50.0
0.0
µg P/L
1
2
3
4
Site
May/June
July
August
September
October

Maumee System Results




Maumee NO3
4000
3500
3000
2500
2000
1500
1000
500
0
µg N/L
1
2
3
4
Site
May/June
July
August
September
October


Maumee Total P
250
200
150
100
50
0
µg P/L
1
2
3
4
Site
May/June
July
August
September
October

Nutrient Summary

- Sandusky system P-limited in 40% of the samples
- Maumee system P-limited in 70% of the samples
- Lake and tributary sites variable
- Sandusky Bay generally not P-limited
- Maumee River generally not P-limited

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Results: *Microcystis* biomass

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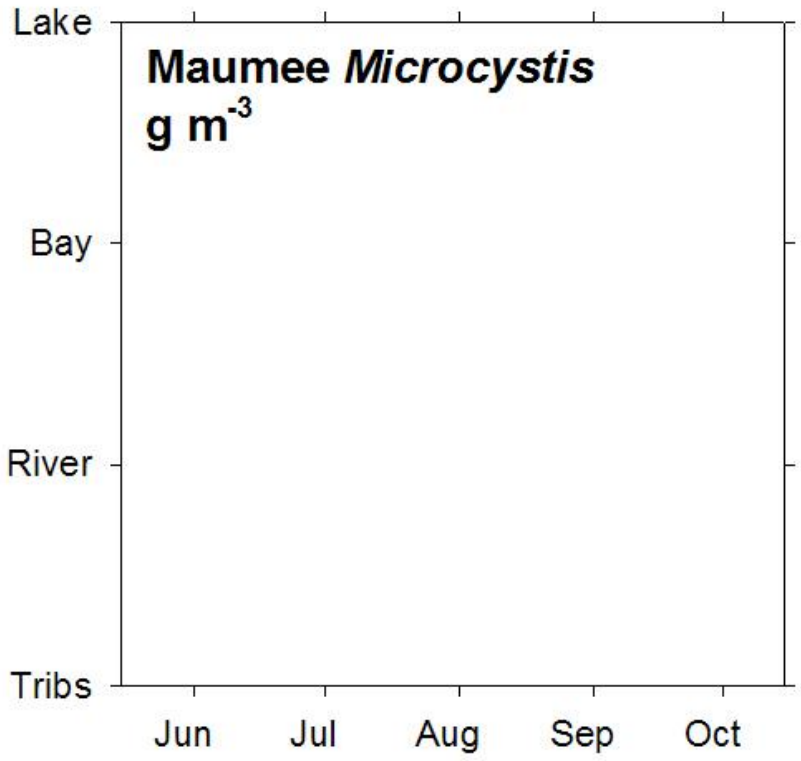
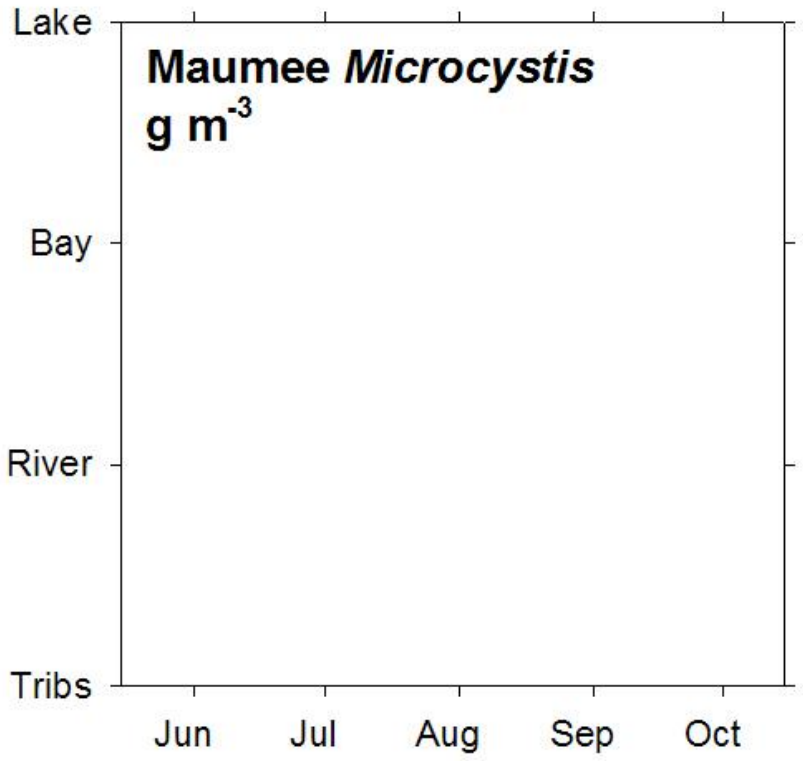
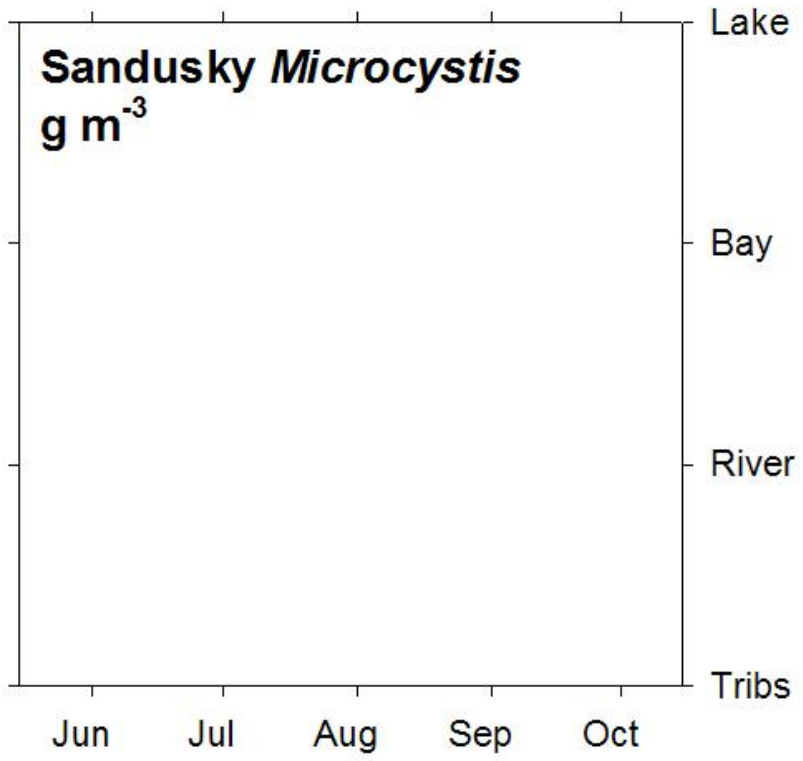


Results: *Microcystis* biomass





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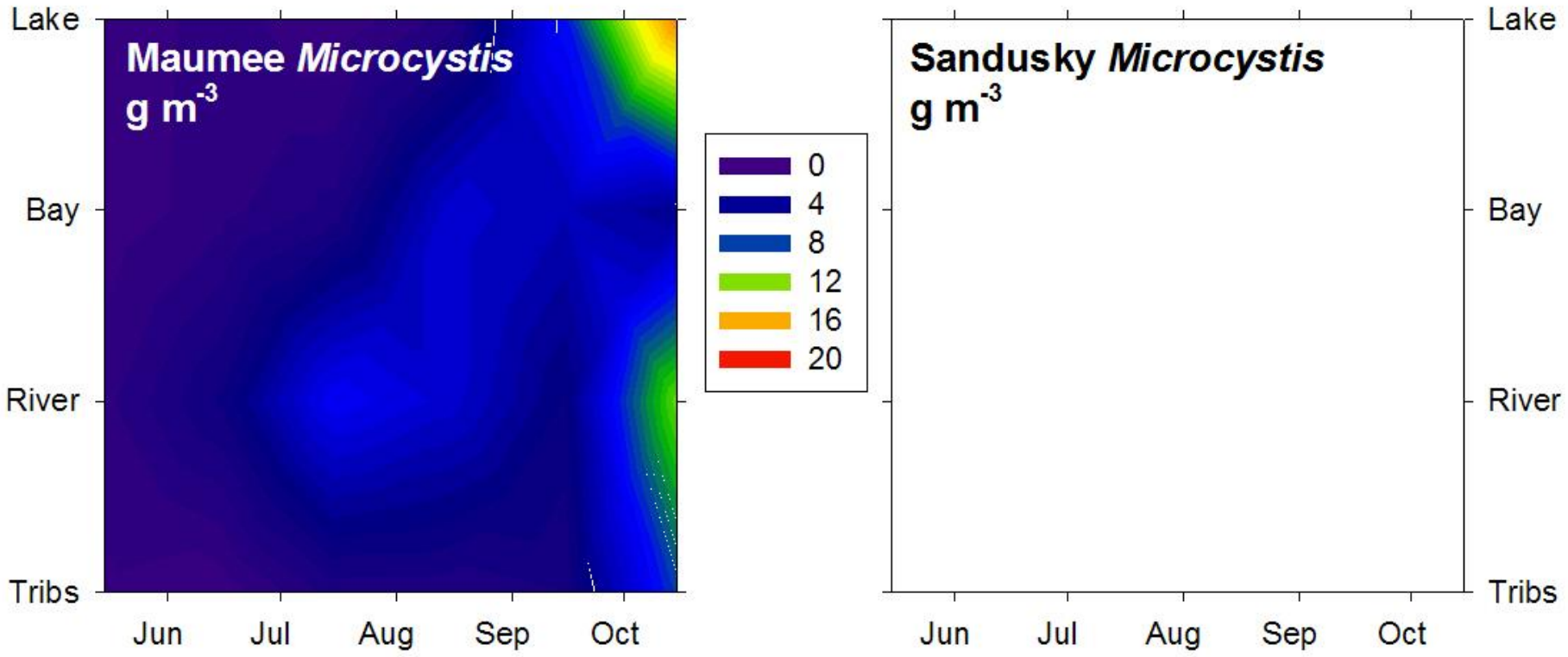
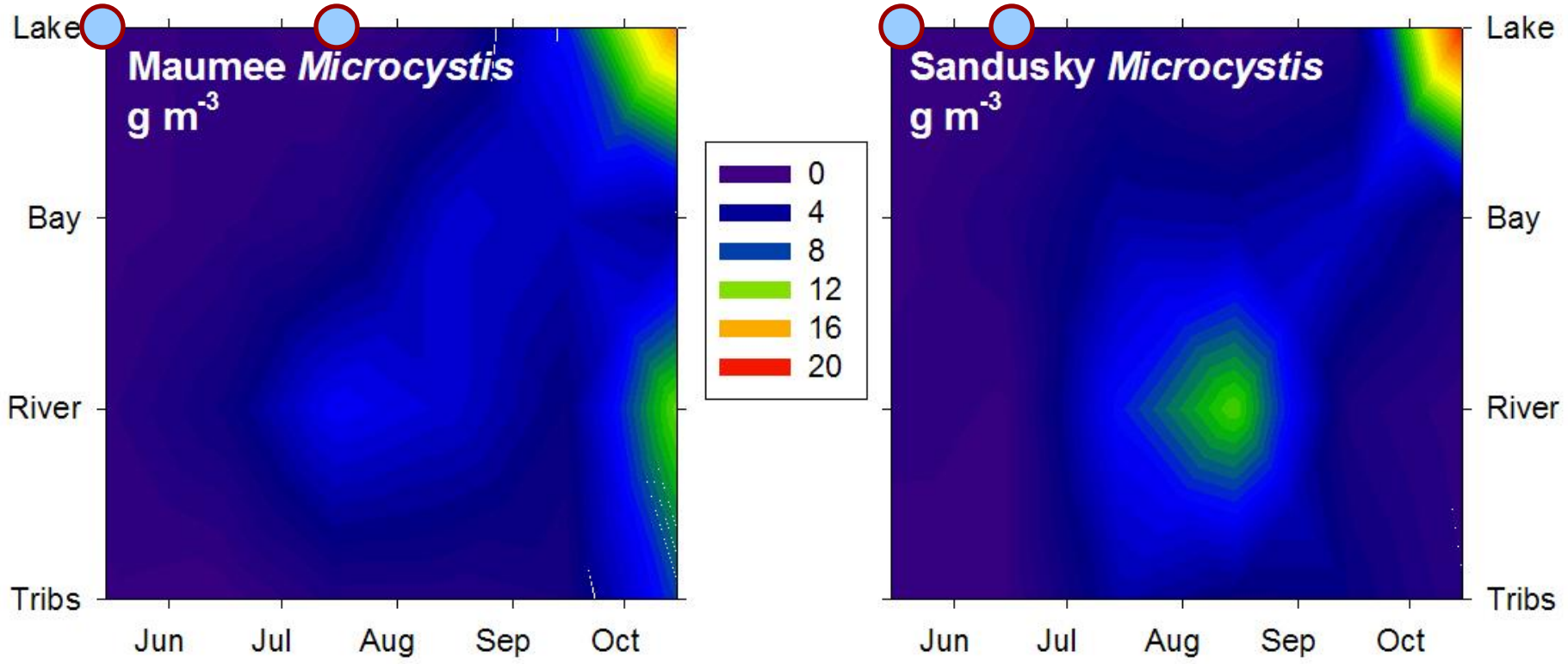


Results: *Microcystis* biomass

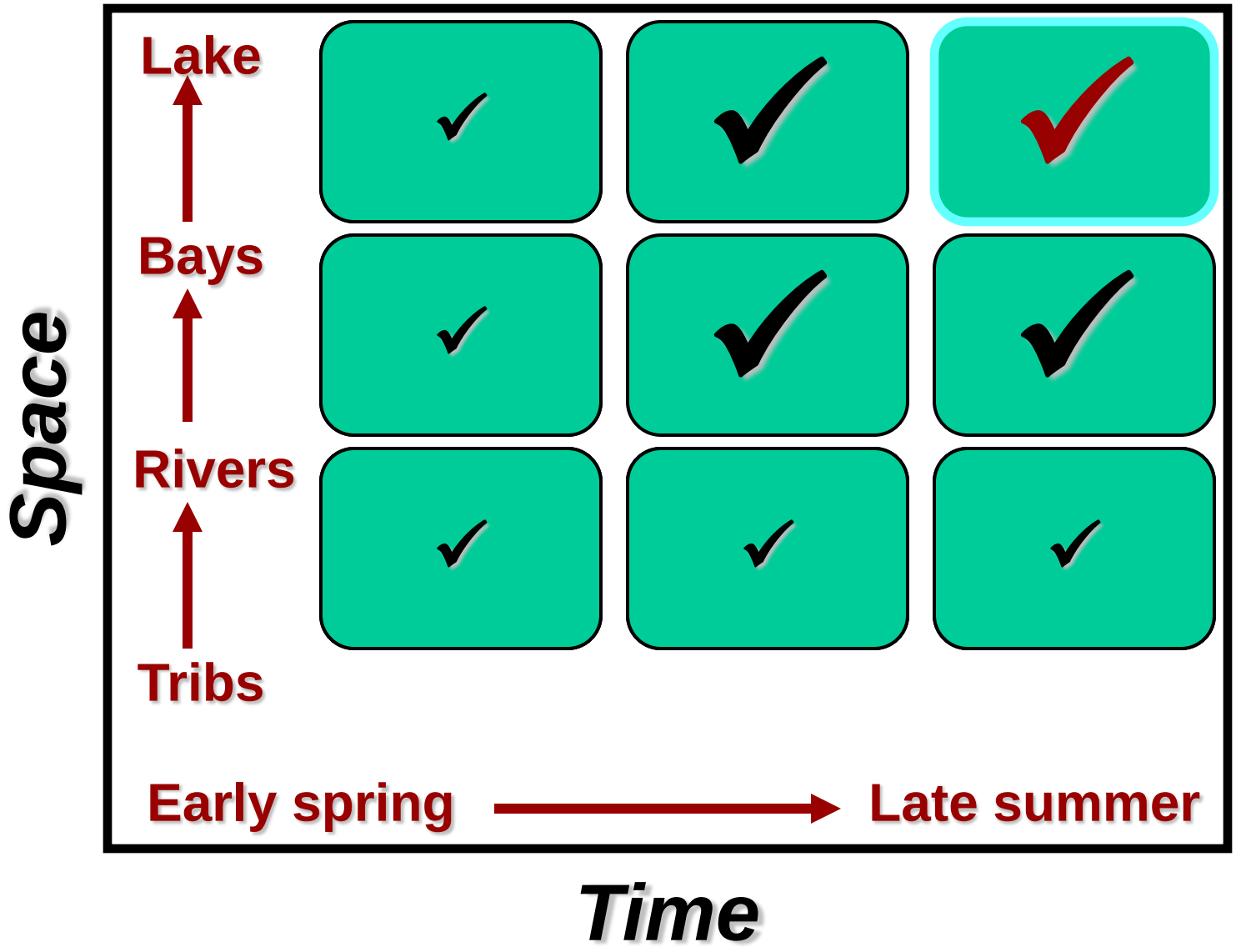


- 1970 Cyanobacteria biomass = 1 g m^{-3}
- April tributary *Microcystis* biomass = 0.00–0.85 g m^{-3}
- Only four samples without *Microcystis*!

Where & When do blooms start?

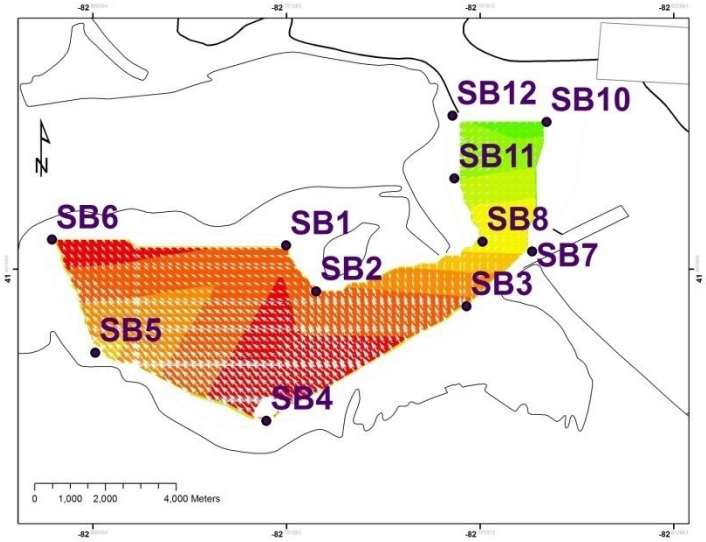
- *Microcystis* present in 0.3-m deep, 1st-order streams
  - » Biomass ⬆ in main-stem rivers, bays, and the open lake
- *Microcystis* occurs by late April
- *Microcystis* abundant through October
- Current *Microcystis* biomass = 1970's Cyanobacteria

Where & When do blooms start?



Future Directions

- Physical Transport Modeling



- Genetic Analysis of *Microcystis*

Roadmap

- Part I: Determining bloom trigger points
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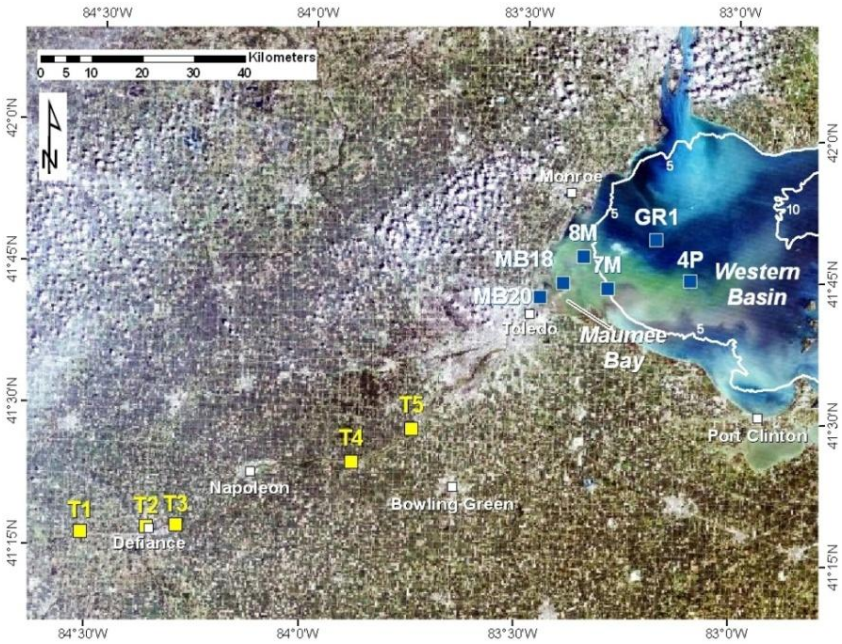
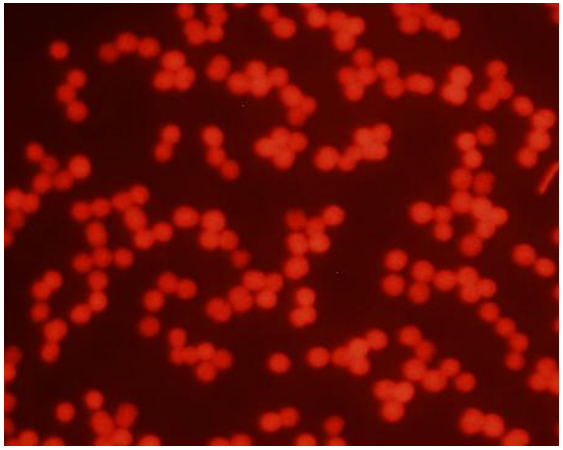
- **Part II: How should we monitor and measure *Microcystis*?**

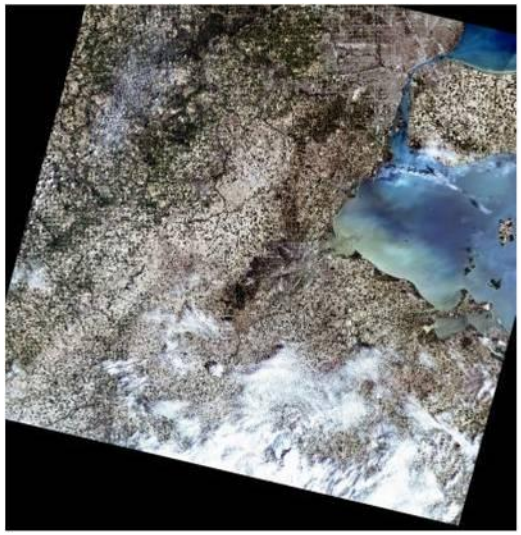
Problem: How should we monitor and measure *Microcystis*?

- Remote Sensing
- Fluoroprobe
- Utermöhl Microscopy
- Epifluorescence Microscopy
- Other

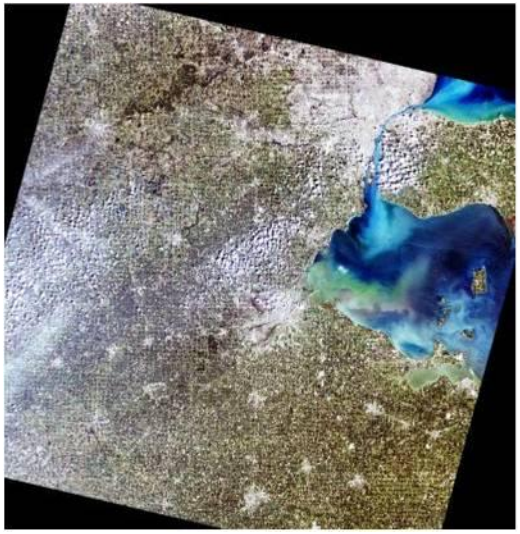




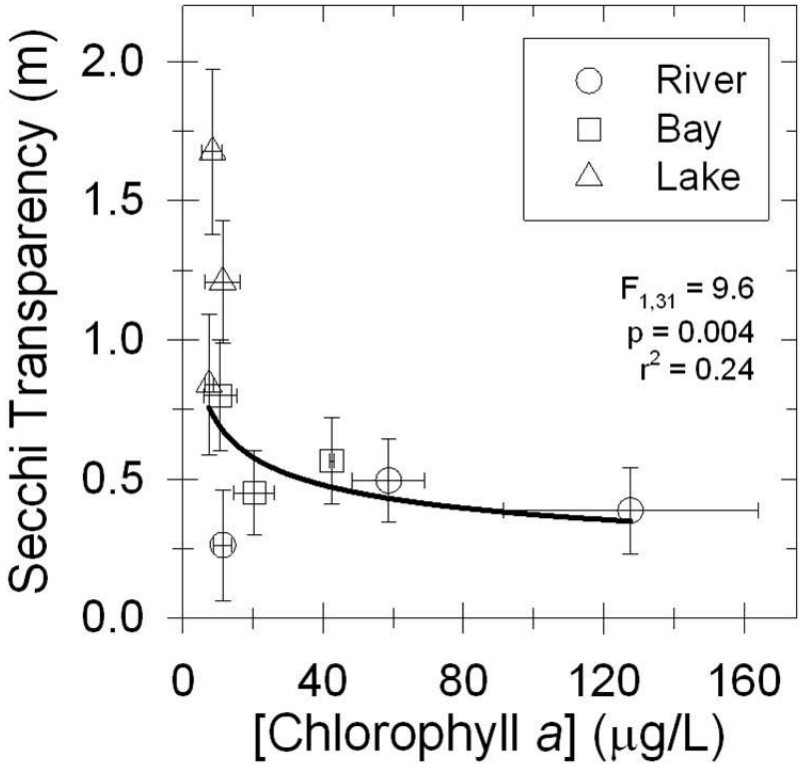
Remote Sensing (multiple types)



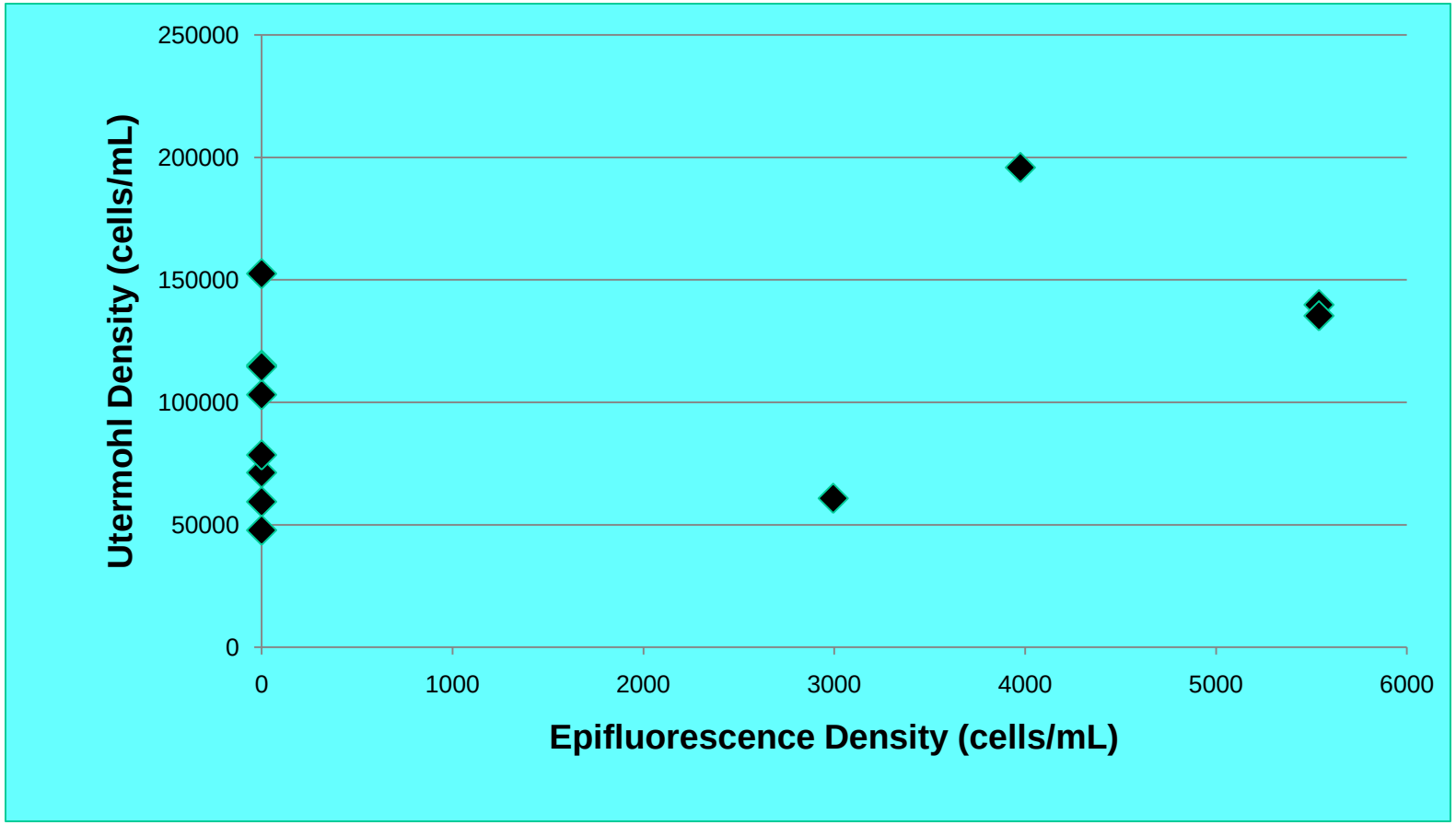
June 2003-OhioLink



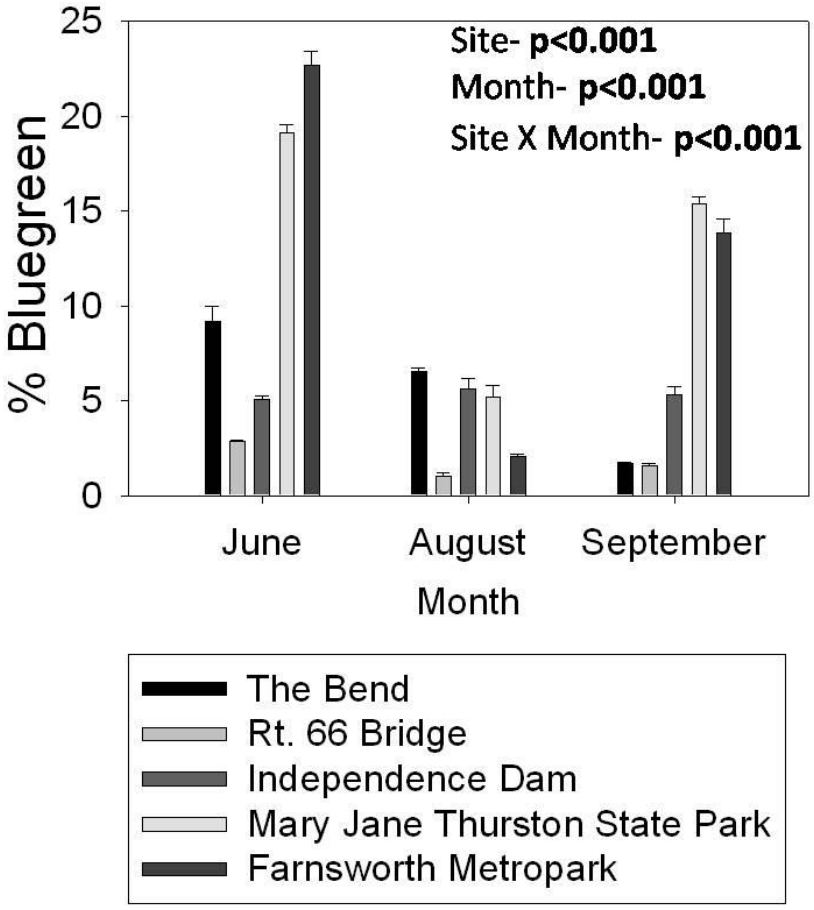
August 2003-OhioLink

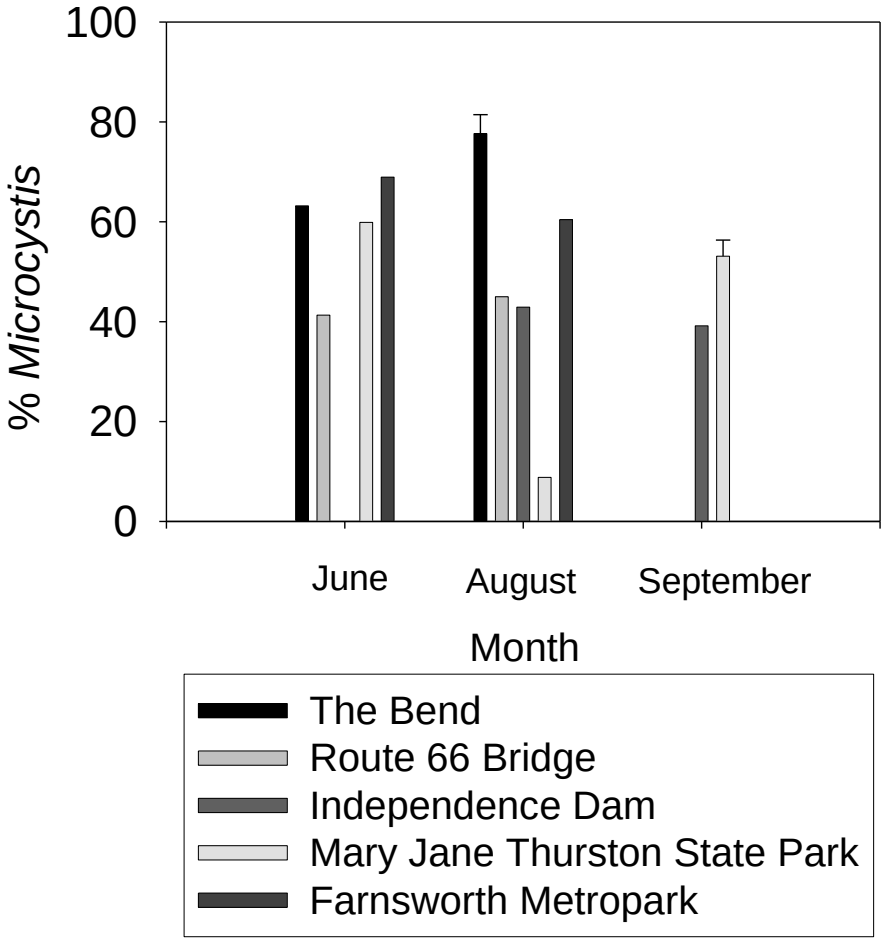


Utermöhl vs. Epifluorescence Microscopy



Fluoroprobe vs. Utermöhl Microscopy





Acknowledgements

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Questions?