

Observations

Microcystis blooms have formed
in 4 of the past 5 years

2002 - No bloom

2003 - Large bloom (August)

2004 - Medium bloom (July)

2005 - small bloom (July)

2006 - Medium bloom (August)

Questions

1. What determines the occurrence and size of blooms?

Observations

Blooms form near Maumee Bay



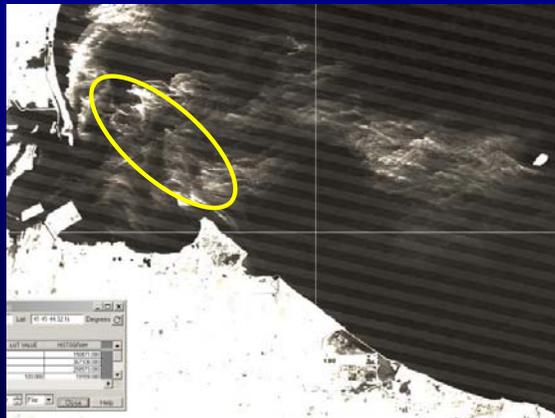
Questions

1. What determines the occurrence and size of blooms?

2. What is the influence of the Maumee River on blooms?

Observations

Blooms initiate in the same region each year



Questions

1. What determines the occurrence and size of blooms?
2. What is the influence of the Maumee River on blooms?
3. What triggers blooms to form just outside of Maumee Bay?

Questions

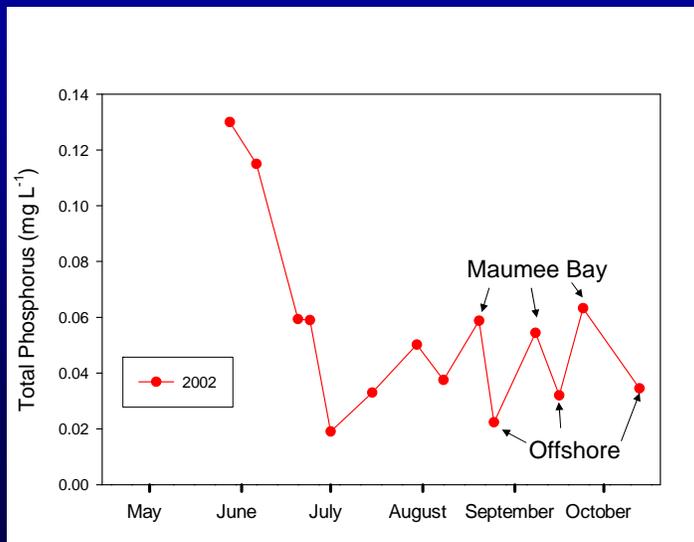
1. What determines the occurrence and size of blooms?

Examine Total Phosphorus 2002-2006

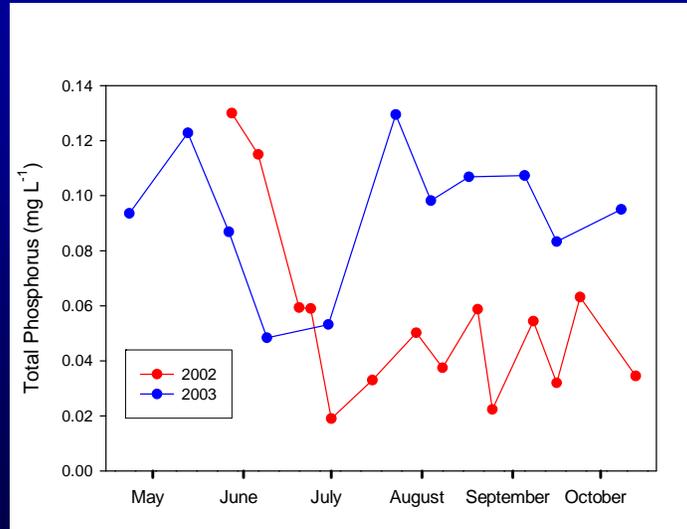
Western Lake Erie sampling locations



Total Phosphorus: 2002

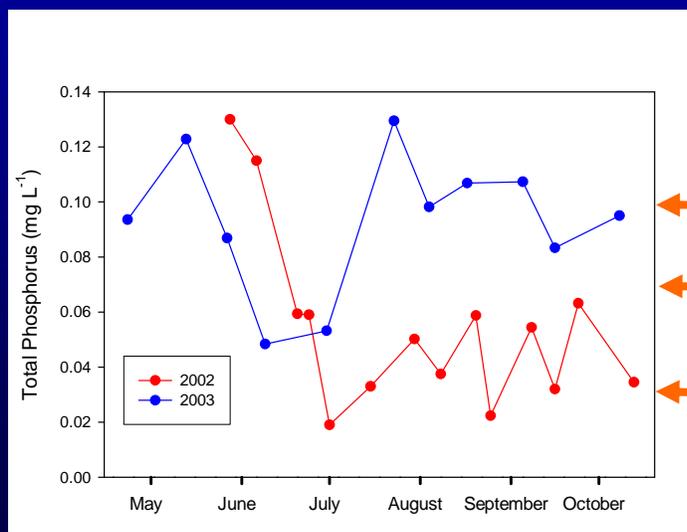


Total Phosphorus: 2002-03

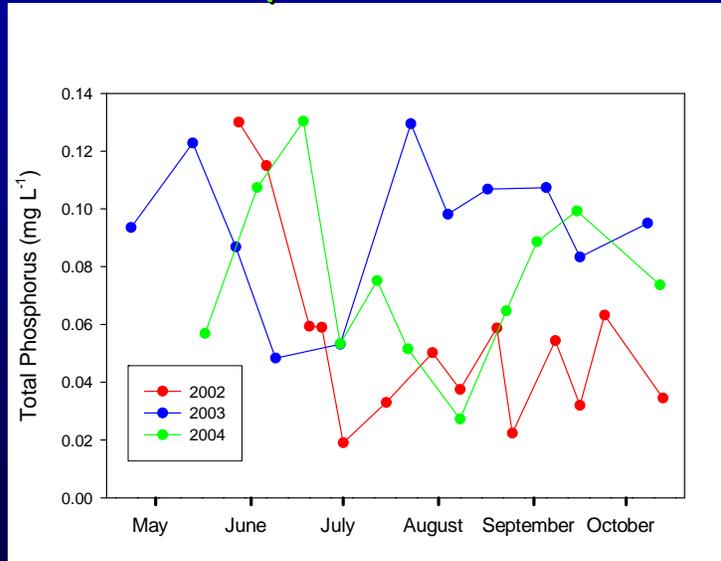


Risk of cyanobacteria dominance

(Downing, et al. 2001)



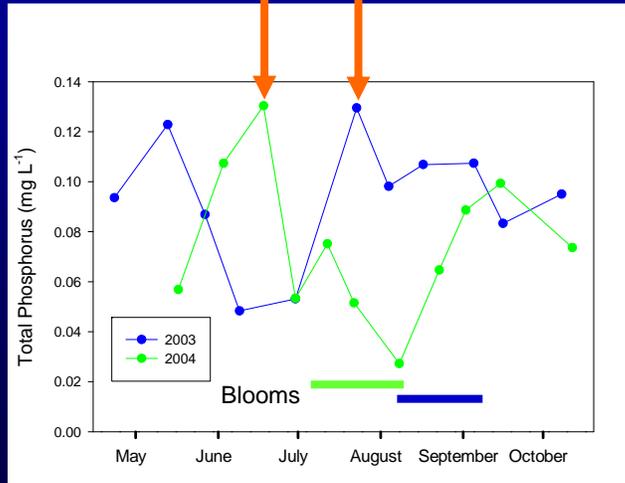
Total Phosphorus: 2002-04



Timing of phosphorus may be important

2004: TP maximum in June

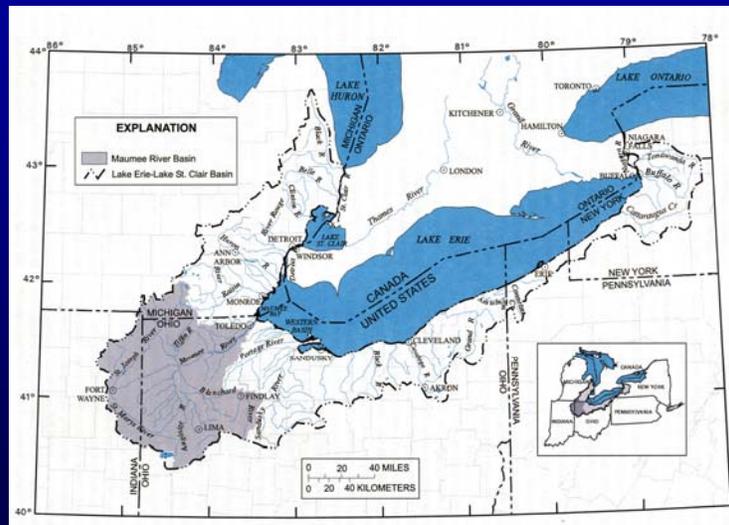
2003: TP maximum in July



Questions

2. What is the influence of the Maumee River on blooms?

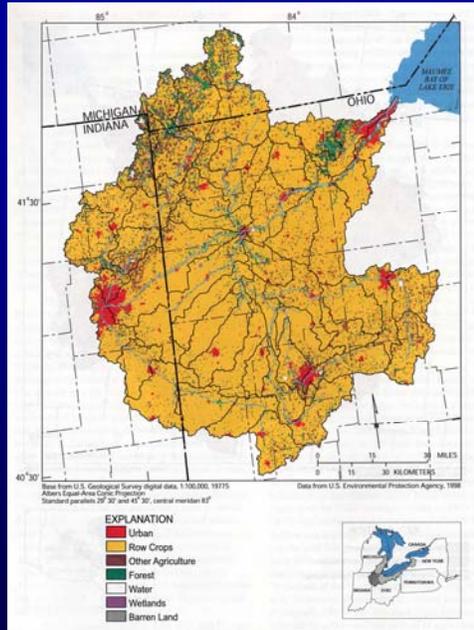
Maumee River Watershed



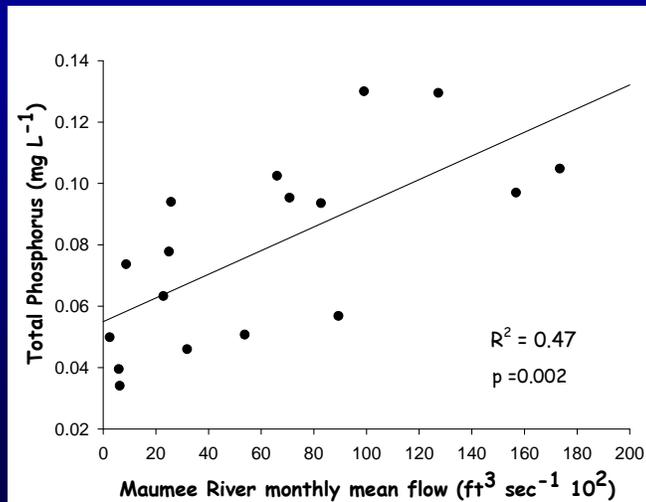
USGS

Maumee River Watershed

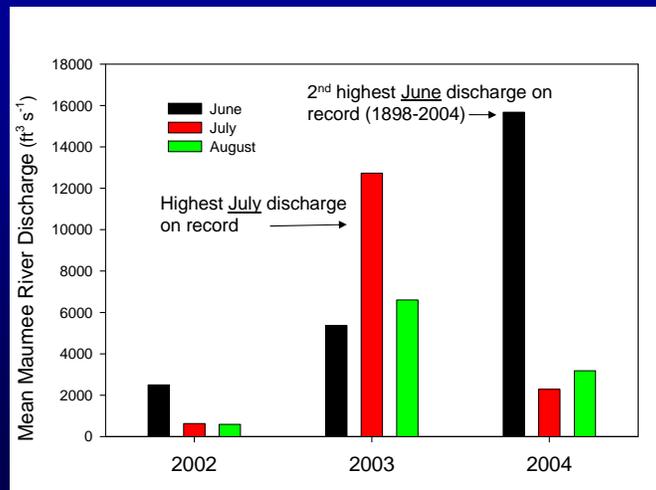
Land Use



USGS

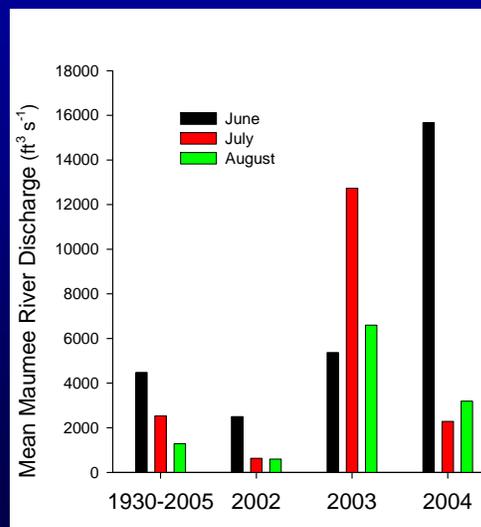


Maumee River summer discharge

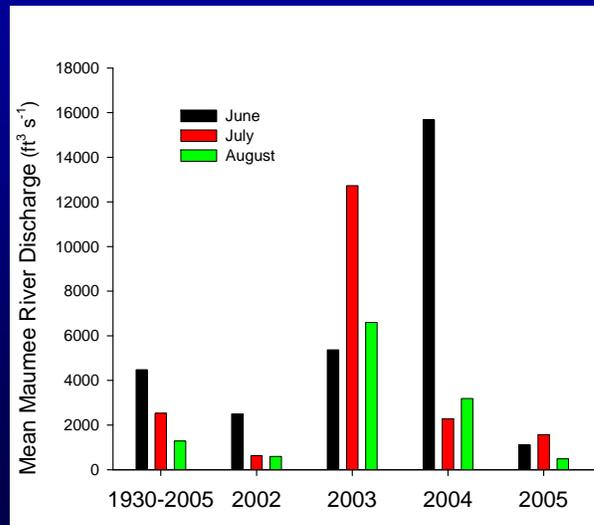


(Source data: USGS)

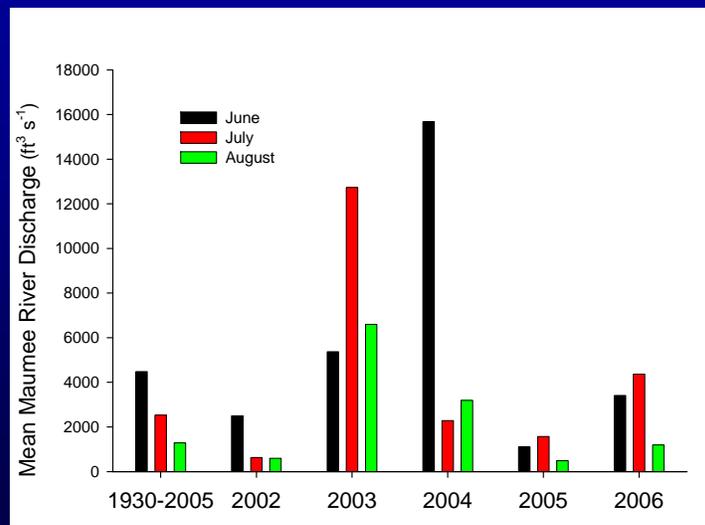
Maumee River summer discharge

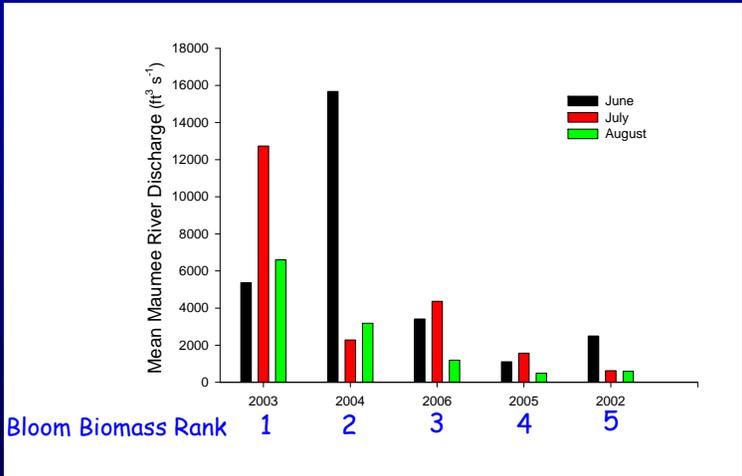
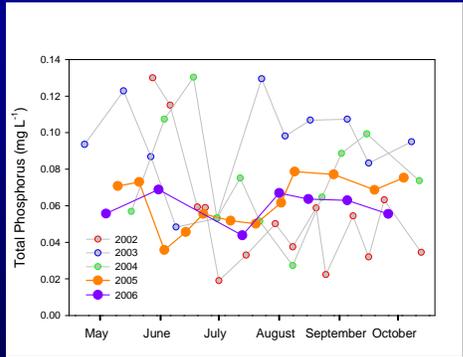
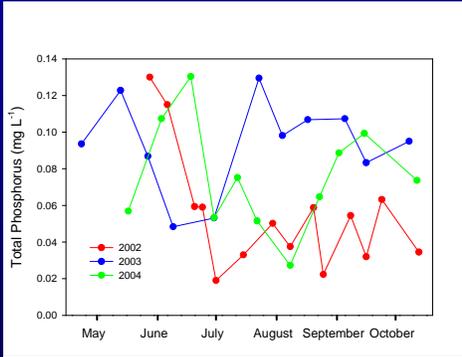


Maumee River summer discharge



Maumee River summer discharge





Observations (Part 1)

1. *Microcystis* blooms form in years with high TP concentrations.
2. High TP concentrations are associated with high Maumee River flow.
3. Seasonal timing of blooms may be associated with timing of river flow (July vs. August).

Questions

1. What determines the occurrence and size of blooms?
2. What is the influence of the Maumee River on blooms?
3. What triggers blooms to form just outside of Maumee Bay?

Or

What is it about this location that allows *Microcystis* to out-compete other algae?



Aphanizomenon prevails
under conditions of:

Nitrogen-limitation

no mixing

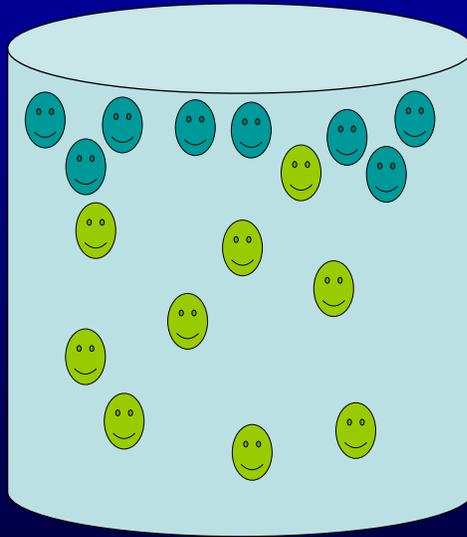


Microcystis prevails under
conditions of:

No nitrogen-limitation

Moderate mixing

Microcystis has superior buoyancy



 = *Microcystis*

 = Aphanizomenon
and green algae

Microcystis has superior buoyancy



Mixed plankton

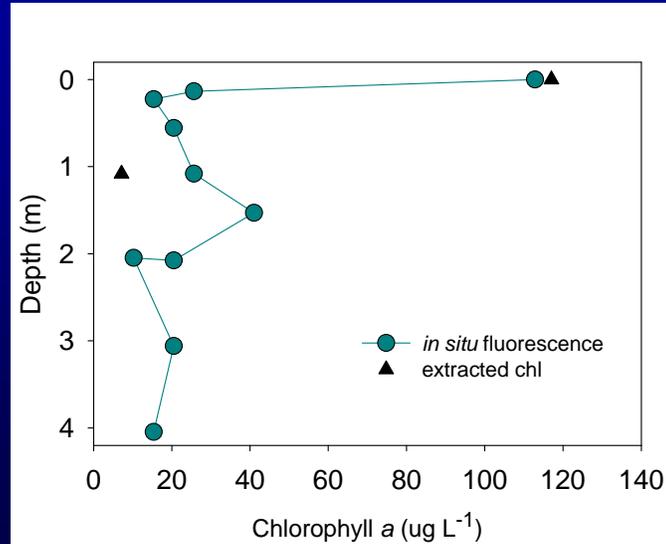


After 1 Hour



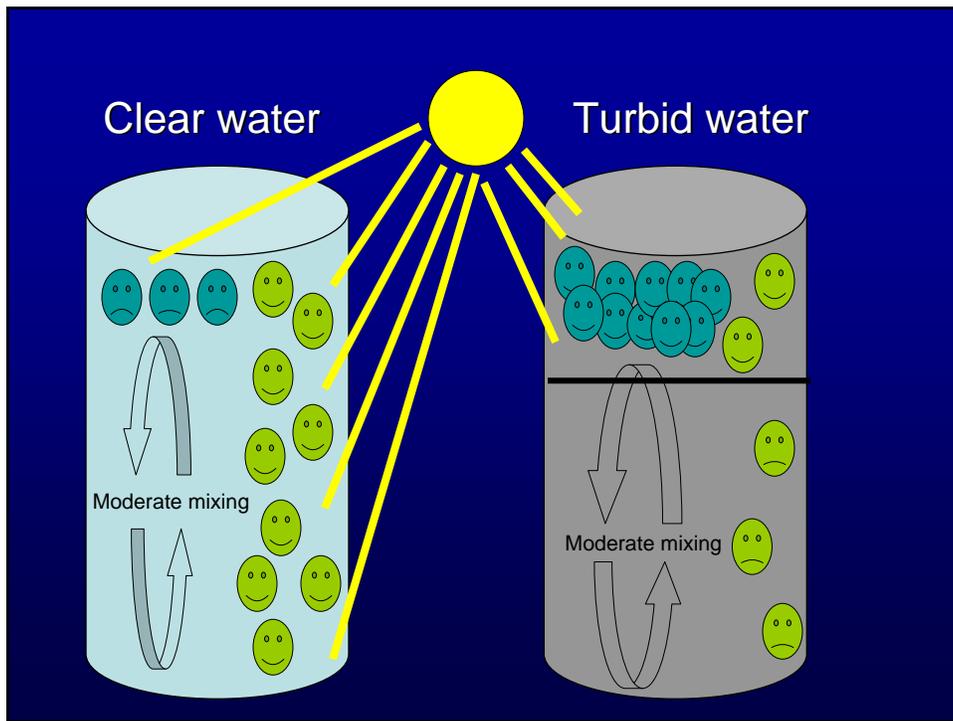
After 1 Day

Chlorophyll depth profile

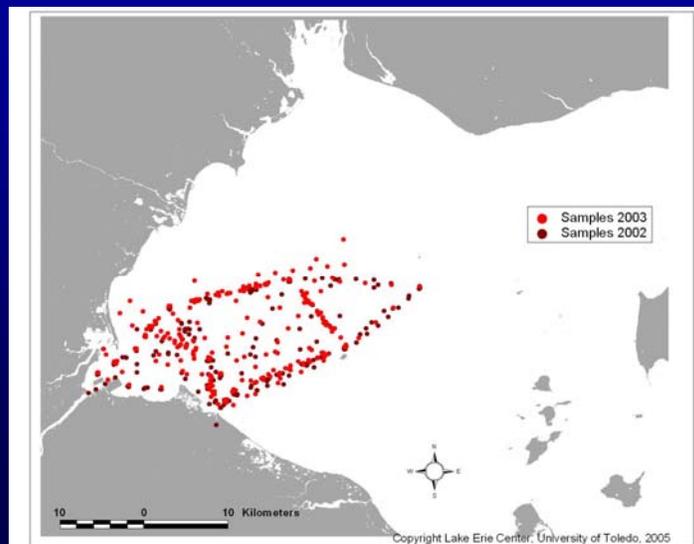


Hypothesis: High turbidity (suspended sediments) in the Maumee River plume gives *Microcystis* an advantage over other green and blue-green algae





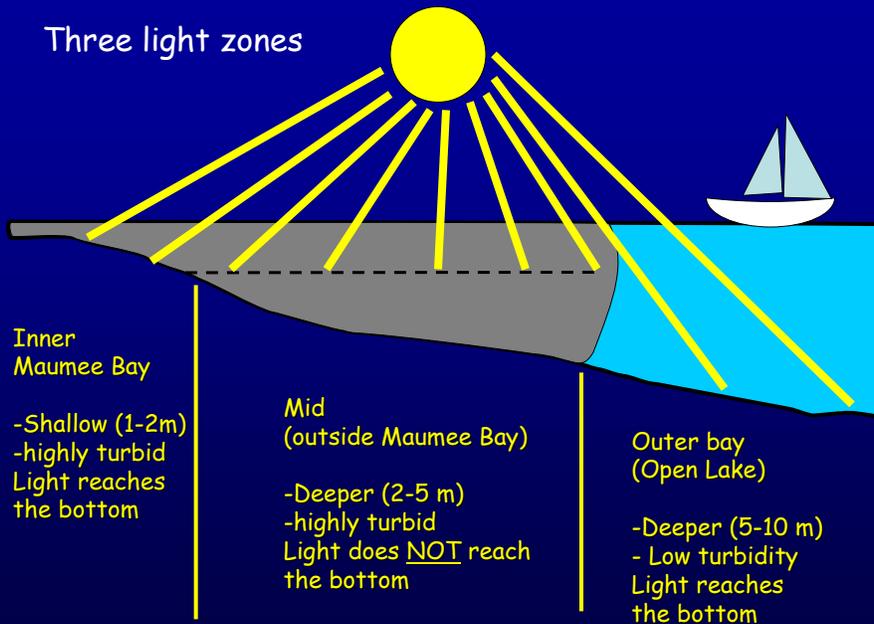
Light measurements (2002-04)



Maumee Bay light zones



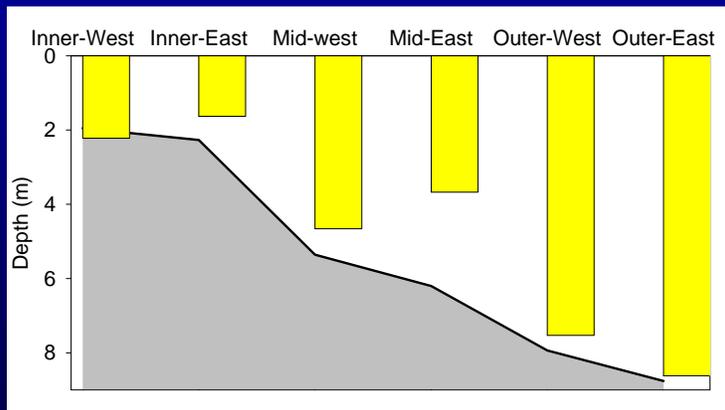
Three light zones



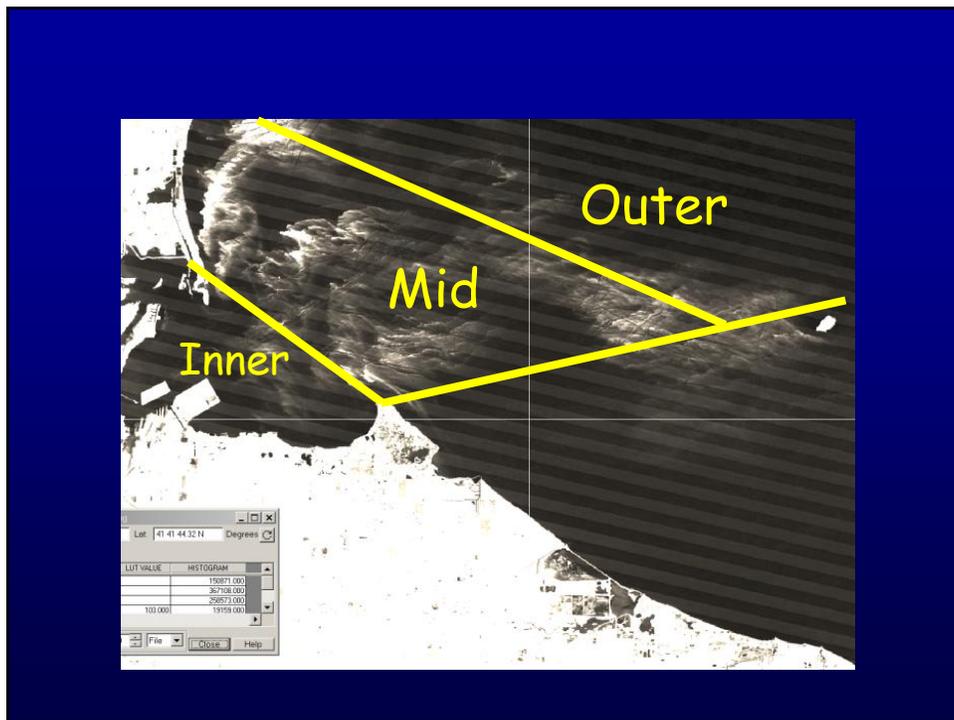
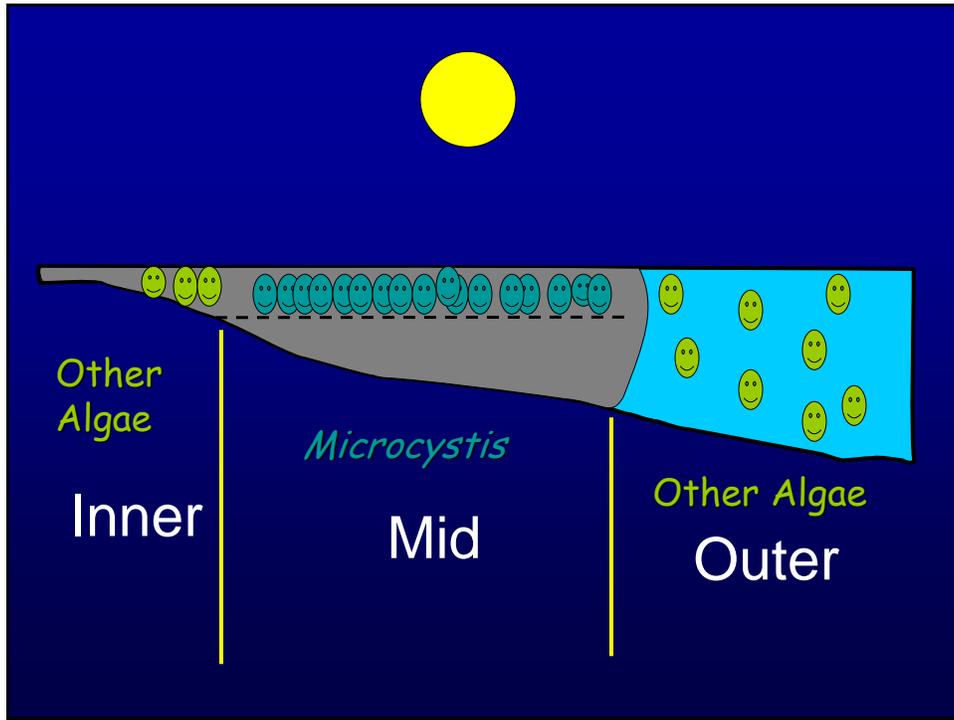
Maumee Bay light zones



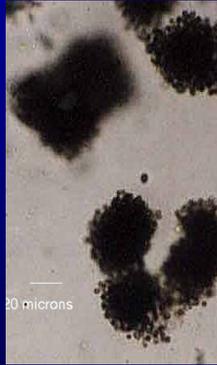
Average Depth of Light Penetration (1%) July-Aug, 2002-04



n Kpar = 99
n Secchi = 292



Post-Bloom Transition

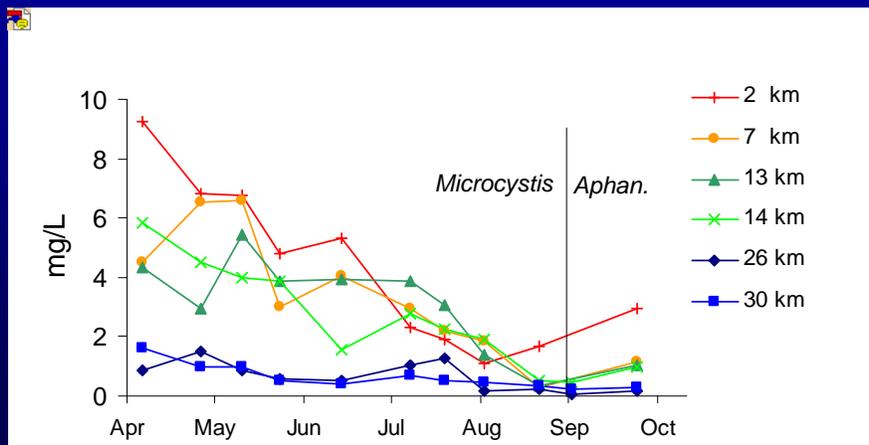


Microcystis



Aphanizomenon

Nitrate (2003)



Observations (Part 2)

1. Maumee Bay has distinct light climates based on turbidity and depth.
2. In 2002-2006, *Microcystis* first appeared in areas with greatest potential for light-limitation.
3. Seasonal decline in available nitrogen leads to a transition from *Microcystis* to *Aphanizomenon*.

September 2006

A new cyanobacteria bloom in Maumee Bay

Lyngbya wollei



Acknowledgements



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