What we know about
Phosphorus Loading to
Lake Erie

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What was wrong with Lake Erie?

Hypoxia

Western Basin Algae Problems

HABs

Hypoxia

Microcystis
Some basic things we know

• Excessive algae reflect excess nutrients
• When an essential nutrient (N, P) gets used up, algal growth stops
• HABs can be reduced or eliminated by controlling phosphorus (P)
• In the 1970s, most of the P came from sewage treatment plants
• At present, most of the P entering the Western Basin comes from the landscape - non-point source origin

Remediation

• Make phosphorus the limiting nutrient
• Reduce phosphorus inputs
  • Detergent phosphorus ban
  • Sewage Treatment Plant upgrades
  • Nonpoint source management
    • Fertilizer and manure management
    • Erosion prevention
      - Conservation tillage
      - Buffer strips
Lake Erie Total Phosphorus Loading, 1967-2008

TP target load 11,000 metric tons

Western Basin Total Phosphorus Loading

2003, Total Western Basin load 4615 metric tons
2007, total Western Basin load 7238 metric tons

Data from Dave Dolan, UWGB
Forms of P

(Total) Dissolved P
- 90% of it is Dissolved Reactive P (DRP)
- "Reactive" because...

Particulate P (PP)

Importance of DRP

(Total) Dissolved P
- 90% of it is Dissolved Reactive P (DRP)
- DRP is 100% bioavailable

Particulate P (PP)
- ~30% bioavailable
- Tends to settle to bottom
Tributary P trends 1975-1995

Discharge, $10^6$ meters$^3$/day

Total Phosphorus, tonnes/day

Particulate Phosphorus, tonnes/day

Diss. React. Phosphorus, tonnes/day

Shift in lake response

$y = -0.0015x + 58.122$

$R^2 = 0.0798$

$p=0.0003$

$y = 0.0009x - 17.622$

$R^2 = 0.0745$

$p<0.0001$

In-lake TP

WHY?
Importance of DRP

Dissolved P
- 90% DRP
- DRP is 100% bioavailable for algal growth

Particulate P
- ~30% bioavailable
- Tends to settle to bottom

Maumee River, Bioavailable Phosphorus Loading

Discharge, 10^6 meters^3/day
Total Phosphorus, tonnes/day
Particulate Phosphorus, tonnes/day
Diss. React. Phosphorus, tonnes/day

Tributary P trends 1975-2012
Maumee Annual Discharge

2011 and 2012 sort of medium, not too different

Annual TP Load

2011 high medium, 2012 low medium
Annual DRP Load

Dissolved Reactive Phosphorus Load

2011 and 2012 very comparable, sort of medium

Seasonal Loading

• P loading drives algal growth
• HABS occur in late summer
• Perhaps P loads in some seasons are more important than loads in others
• Several lines of research point to spring loading as most important
Spring Discharge (April-June)

2011 and 2012 are the extremes - 2012 is 8.2% of 2011!

Spring TP Load

2011 and 2012 are the extremes - 2012 is 2.5% of 2011!
2011 and 2012 are the extremes - 2012 is 2.6% of 2011!

Prediction, anyone?!!!
Stay tuned for next talk....