Nutrients and Harmful Algal Blooms—the Lake Erie Experience

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Southernmost

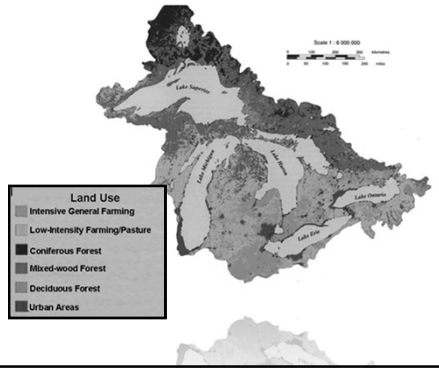
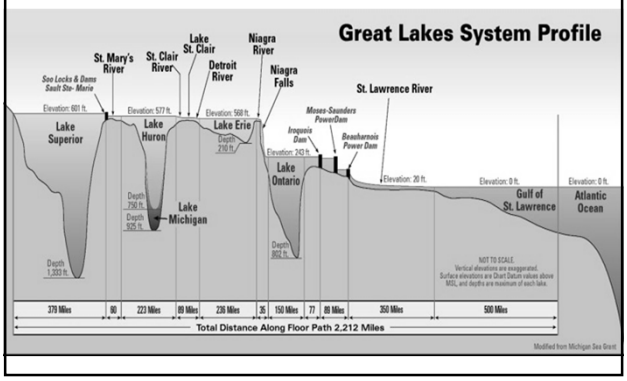


Image: Ohio Sea Grant

Shallowest and Warmest



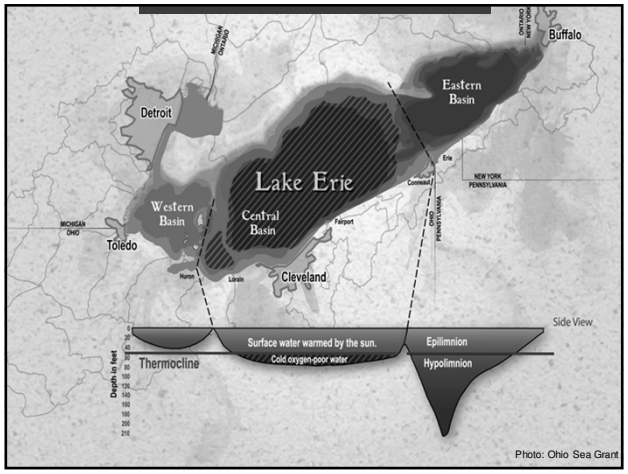
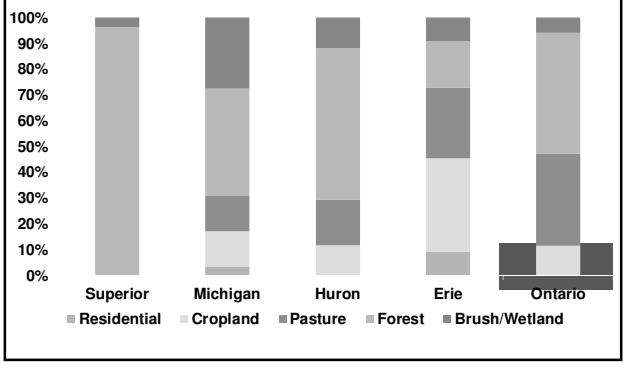


Photo: Ohio Sea Grant

80:10:10 Rule

- 80% of water from upper lakes
- 10% direct precipitation
- 10% from Lake Erie tributaries
  - Maumee
    - Largest tributary to Great Lakes
      - Drains 4.5 million acres of ag land
    - 3% of flow into Lake Erie

Major Land Uses in The Great Lakes

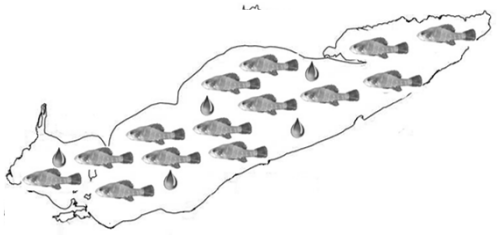


Because of Land Use, Lake Erie Gets:

- More sediment
- More nutrients (fertilizers and sewage)
- More pesticides
- (The above 3 items are exacerbated by storms, which will be more frequent and severe due to climate change.)
- And Lake Erie is still biologically the most productive of the Great Lakes—And always will be!!

50:2 Rule

(Not exact, but instructive)



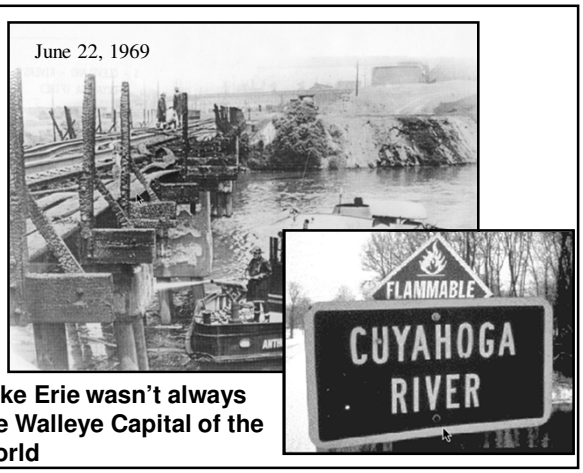
Lake Superior:
20% of the water and 50% of the fish

Lake Erie Stats

- Drinking water for 11 million people
- Over 20 power plants
- Power production is greatest water use
- 300 marinas in Ohio alone
- Walleye Capital of the World
- 40% of all Great Lakes charter boats
- Ohio's charter boat industry is one of the largest in North America
- $1.5 billion sport fishery
- One of top 10 sport fishing locations in the world
- Most valuable freshwater commercial fishery in the world
- Coastal county tourism value is over $11.5 billion and 117,000 jobs

Lake Erie: One of the Most Important Lakes in the World

- Dead lake image of 60s and 70s.
- Poster child for pollution problems in this country.
- But, most heavily utilized of any of the Great Lakes.
- Shared by 5 states, a province, and 2 countries.
- Best example of ecosystem recovery in world.



Lake Erie wasn't always the Walleye Capital of the World

Impact of Ecosystem Recovery (rebirth)

- Ohio walleye harvest 112,000 in 1976 to over 5 million by mid-80s
- 34 charter fishing businesses in 1975 to over 1200 by mid-80s and almost 800 today
- 207 coastal businesses to over 425 today

What brought about the rebirth (dead lake to Walleye Capital)?

- Phosphorus reductions from point sources (29,000 metric tons to 11,000); and agriculture helped!

Why did we target phosphorus?

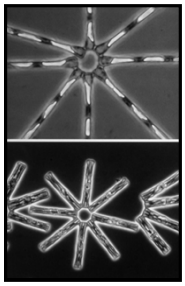
- Normally limiting nutrient in freshwater systems
- P reduction is best strategy ecologically and economically
- Reducing both P and N would help

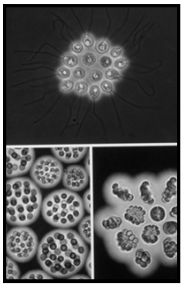
Algae are tiny plant-like organisms that live in water

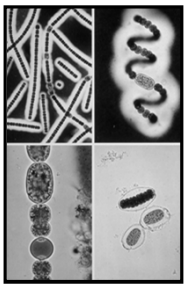
There are hundreds of species of algae in Lake Erie. Most are beneficial.

- Source: Tom Bridgeman, UT

Major groups/kinds in Lake Erie







Diatoms Greens Blue-greens (Cyanobacteria)

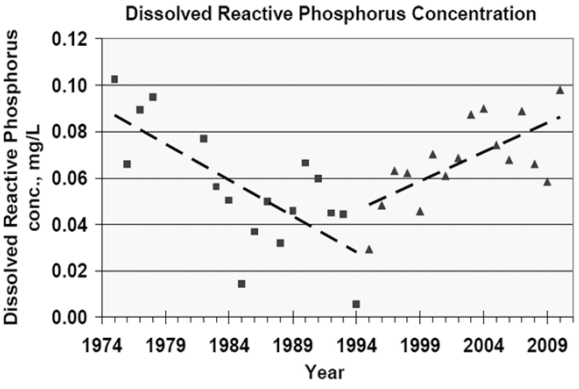
- Source: Tom Bridgeman, UT

Impacts of Increased Phosphorus Concentrations

- HABs—If P concentrations are high (regardless of the source, Ag, sewage, etc.) and water is warm, we will have a HAB (nitrogen concentration will likely determine which of the ~10 species bloom)
- Nuisance Algae Blooms
  - Cladophora—Whole lake problem. An attached form.
  - Winter algal blooms
- Dead Zone in Central Basin

Blue-green Algae Bloom circa 1971, Lake Erie

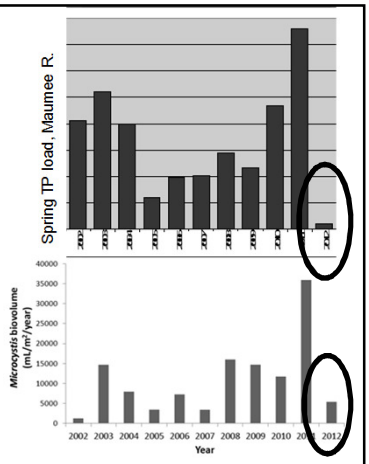
Photo: Forsythe and Reutter



2012

TP loading during March-June 2012 was one of the lowest on record, resulting in a much smaller algal bloom.

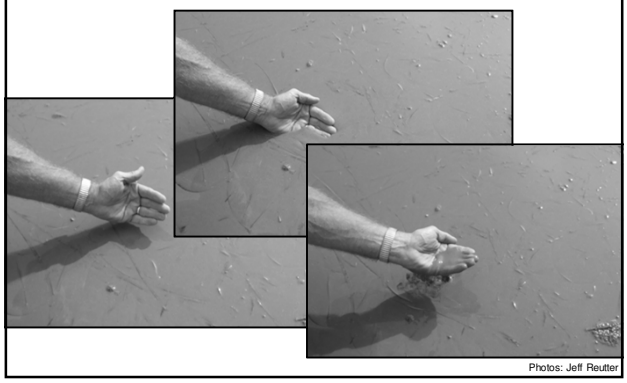
Source: Tom Bridgeman, UT



Lake Erie's 7 Biggest Problems/Issues (see *Twine Line*, Spring/Summer, 2012)

- Sedimentation
- Phosphorus and nutrient loading
  - Harmful algal blooms
  - Western, Central, and Eastern Basin Differences
  - Different problems in different lakes (possibly more difficult than Lake Erie)
- Aquatic invasive species
- Dead Zone—exacerbated by nutrients
- Climate Change—Makes the others worse
- Coastal Economic Development

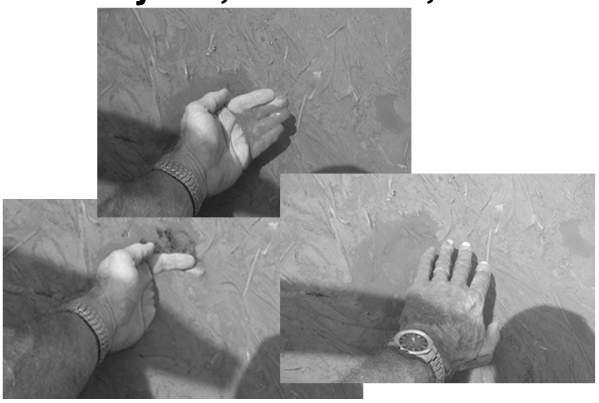
Microcystis, Stone Lab, 8/10/10



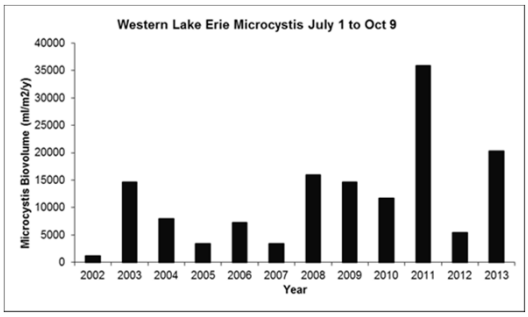
Photos: Jeff Reutter

Microcystis near Marblehead

Microcystis, Stone Lab, 9/20/13



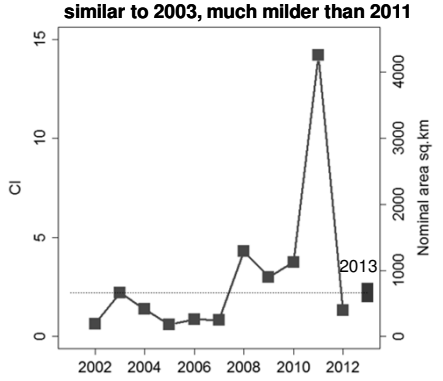
2013 *Microcystis* open water bloom



2013 open water bloom was second only to 2011 over last 12 years. Source: Tom Bridgeman, UT.

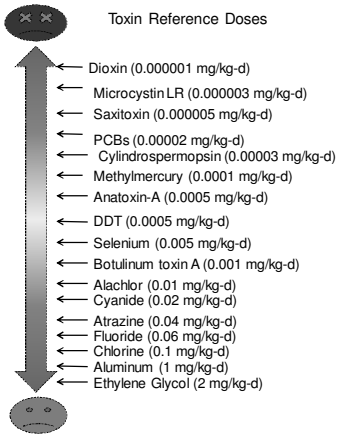
2013 Forecast: Significant bloom.

similar to 2003, much milder than 2011



Toxicity of Algal Toxins Relative to Other Toxic Compounds found in Water

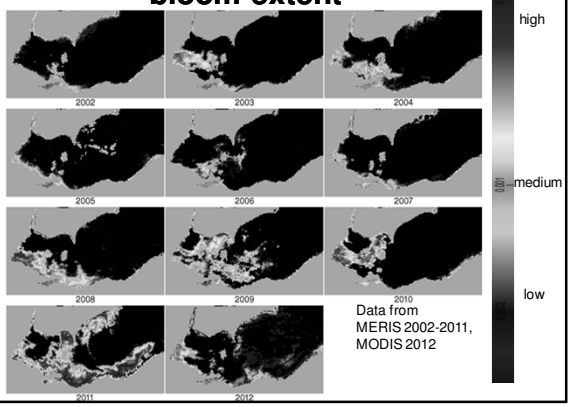
- Reference Dose = amount that can be ingested orally by a person, above which a toxic effect may occur, on a milligram per kilogram body weight per day basis.



Microcystin Concentrations

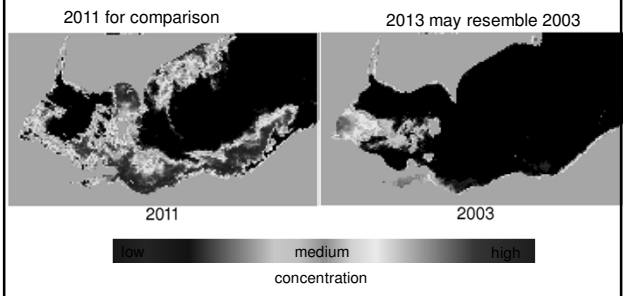
- **1 ppb WHO drinking water limit**
- **20 ppb WHO swimming limit**
- **60 ppb highest level for Lake Erie till 2011**
- **84 ppb highest level for Grand Lake St. Marys till 2010**
- **2000+ Grand Lake St. Marys 2010**
- **1200 Lake Erie Maumee Bay area 2011**

11 years of satellite data provide bloom extent



Data from MERIS 2002-2011, MODIS 2012

2013 prediction for western Lake Erie: similar to 2003, <1/5 of 2011, 2X 2012



9/14/13

October 12, 2013

Figure 2. MODIS Cyanobacterial Index from 12 October 2013.

R. Stumpf, NOAA National Center for Coastal Ocean Science

2013

- Only blooms in 2011 and 2013 extended well into October.
- Toxins appeared in treated drinking water in 2013.
- Meris vs. Modis Limitations
- Greater recognition of of their role by agriculture community, but clearly not enough action.
  - When nutrients leave fields they are pollutants.

Are HABs only a Lake Erie and Ohio Problem?

- Serious problem in US and Canada
- 21 states and Canada in 2012
- Global problem
- Chaired Loadings and Targets Subcommittee for Ohio P Task Force
- Now US Co-Chair of the Loadings and Targets Task Team of Annex 4 (nutrients) Subcommittee of GLWQA
- Weather can determine how we experience a bloom

Target Loads to Solve Problem

- Leading subcommittee of the Ohio Phosphorus Task Force to identify both spring and annual target loads of both total P and DRP to prevent or greatly reduce HABs
- Target is 40% reduction

Nutrient Loading: Expect improvement

- Scotts P removal from over the counter fertilizer bags
- CSO's moving in right direction (too slow?)
- Detroit sewage—hopefully in compliance—but bankrupt
- Frequency of severe storms continues to go up
- Ag—expect improvement
  - Farm Bureau is supporting efforts to reduce P
  - Majority of farmers now accept responsibility
  - Certification programs being developed
  - 4R Program
  - Recommendations
    - Don't apply more fertilizer than needed
    - Don't apply on frozen or snow covered ground
    - Don't broadcast, incorporate into soil
    - Don't apply before when rain in immediate forecast

What Can I Do?

- To stop HABs we have to either make it colder or put in less nutrients.
  - Reduce your carbon footprint (use less energy and sustainable sources of energy)
  - Reduce phosphorus input by 40%
    - Reduce flow to sewage treatment plant (Low-flow toilets and showerheads)
    - Reduce stormwater leaving property (rain barrels and rain gardens)
    - Make sure septic tank is working
    - Encourage sewage treatment plant to eliminate CSO's and be willing to pay more for changes
    - Use "0" P lawn fertilizer
    - Use low P cleaning products

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