

The Role of Agricultural Activities in Re-occurrence of *Microcystis* Blooms in Lake Erie: Why Should I Care?

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

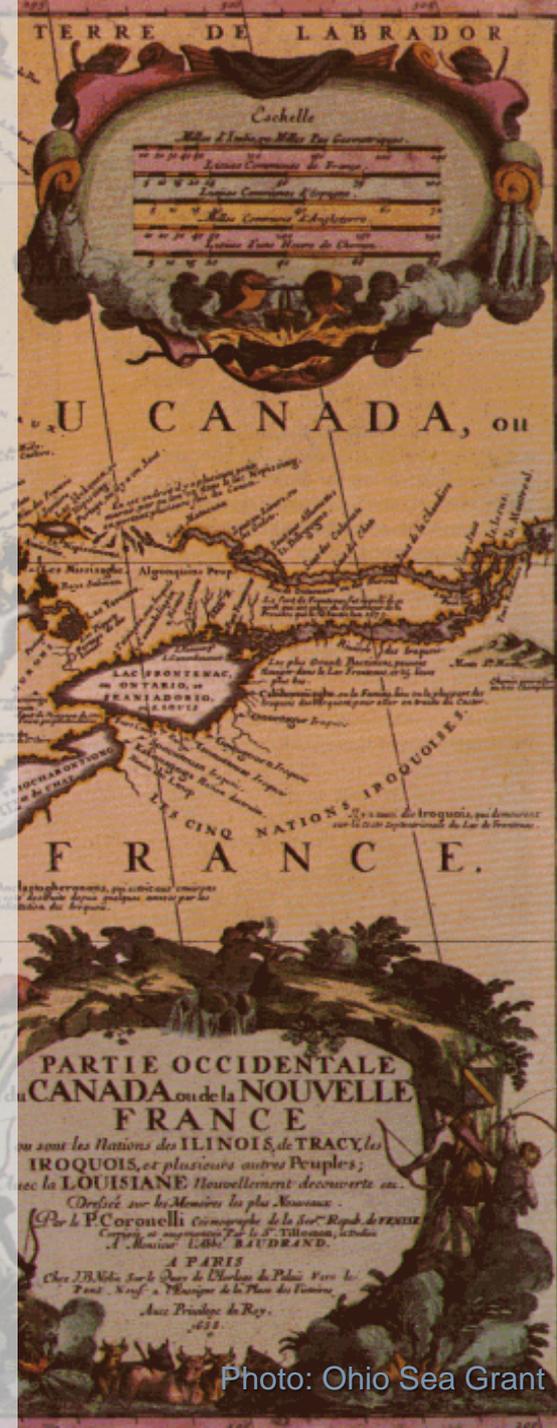
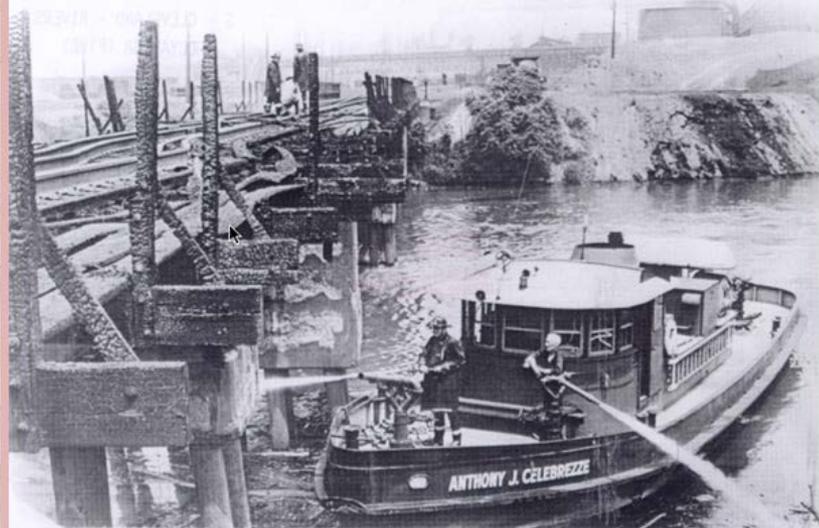
- Poster child for pollution problems in this country.
 - “Dead lake” image of 60s and 70s.
 - *“They’ll walk on their fins and get woefully weary in search of some water that isn’t so smeary. **I hear things are just as bad in Lake Erie.**”*
 - From *The Lorax*, Dr. Seuss (1971)
 - Best example of ecosystem recovery in world.
- But, most heavily utilized of any of the Great Lakes.
 - Shared by 4 states and 2 countries.
 - Drinking water for 11 million people
 - Over 20 power plants
 - 300 marinas in Ohio alone
 - Walleye Capital of the World – \$1.5 billion sport fishery
 - 40% of all Great Lakes charter boats
 - Ohio’s charter boat industry is largest in North America
 - The most valuable freshwater commercial fishery in the world
 - Coastal county tourism value is over \$10 billion

Historical Trends: The Lake Erie Ecosystem

- 1970: Lake Erie declared “dead lake”
 - 1969—Cuyahoga River burns
 - Hypoxia in Central Basin
 - Major blue-green algal blooms

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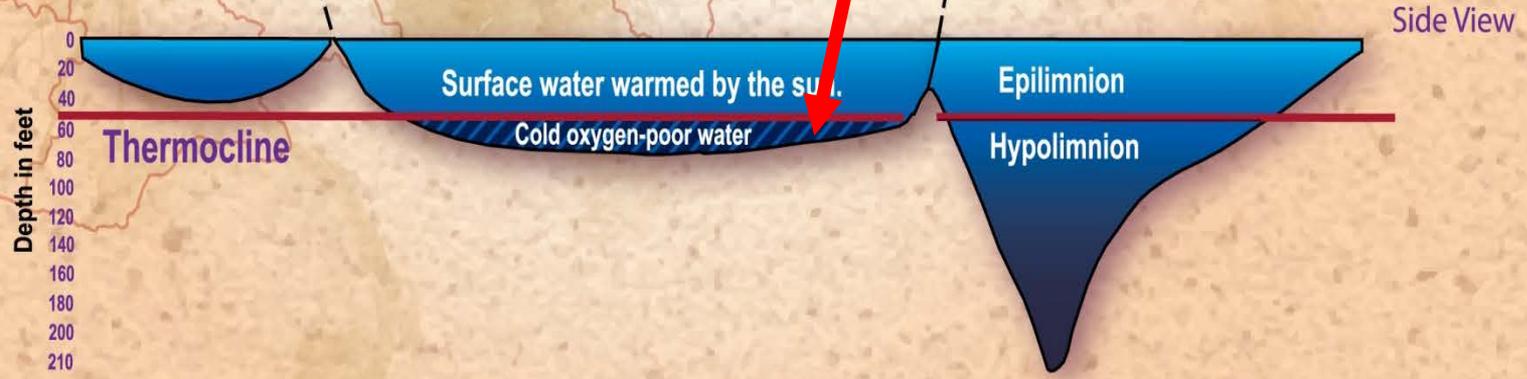
June 22, 1969



Serious Nuisance and Harmful Algal Blooms



Annual Hypoxia



Blue-green Algae Bloom circa 1971, Lake Erie



Photo: Forsythe and Reutter

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- 1970 – 1985: Enormous binational effort to address eutrophication problem
 - Confirm excess phosphorus is cause
 - Reduce point and nonpoint source phosphorus loads to achieve IJC targets established by whole-lake models
- ~1985-95: Stable
- 1995 – present: Getting worse
 - Re-occurrence of Blue-green algal blooms
 - Worsening of Central Basin hypoxia

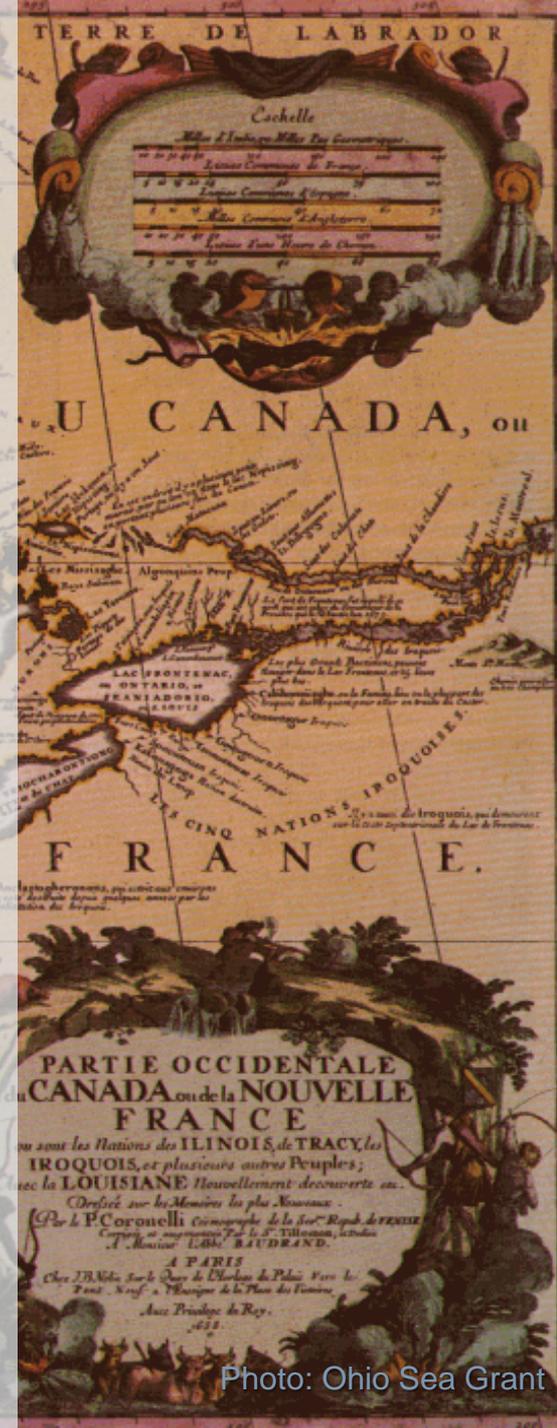
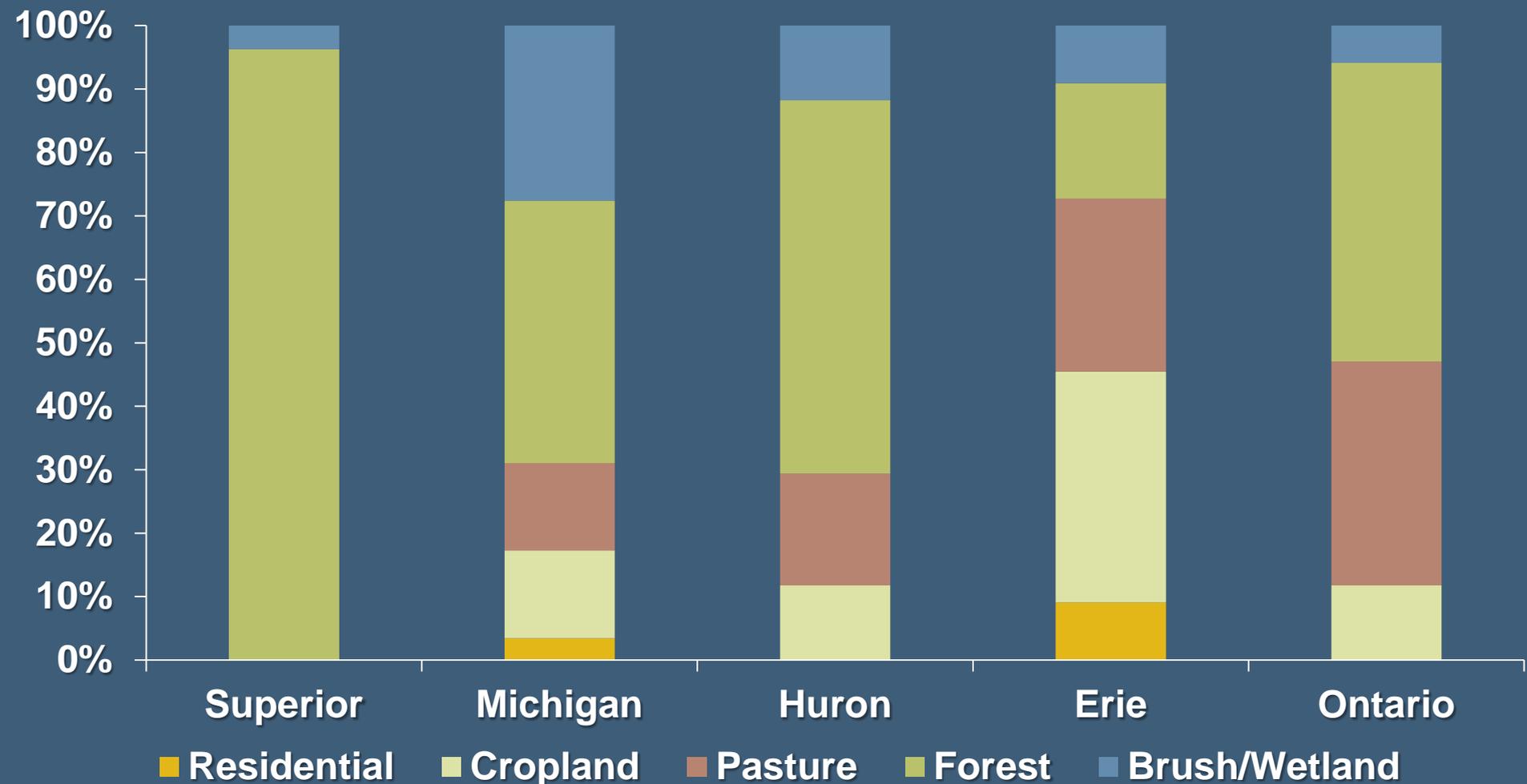


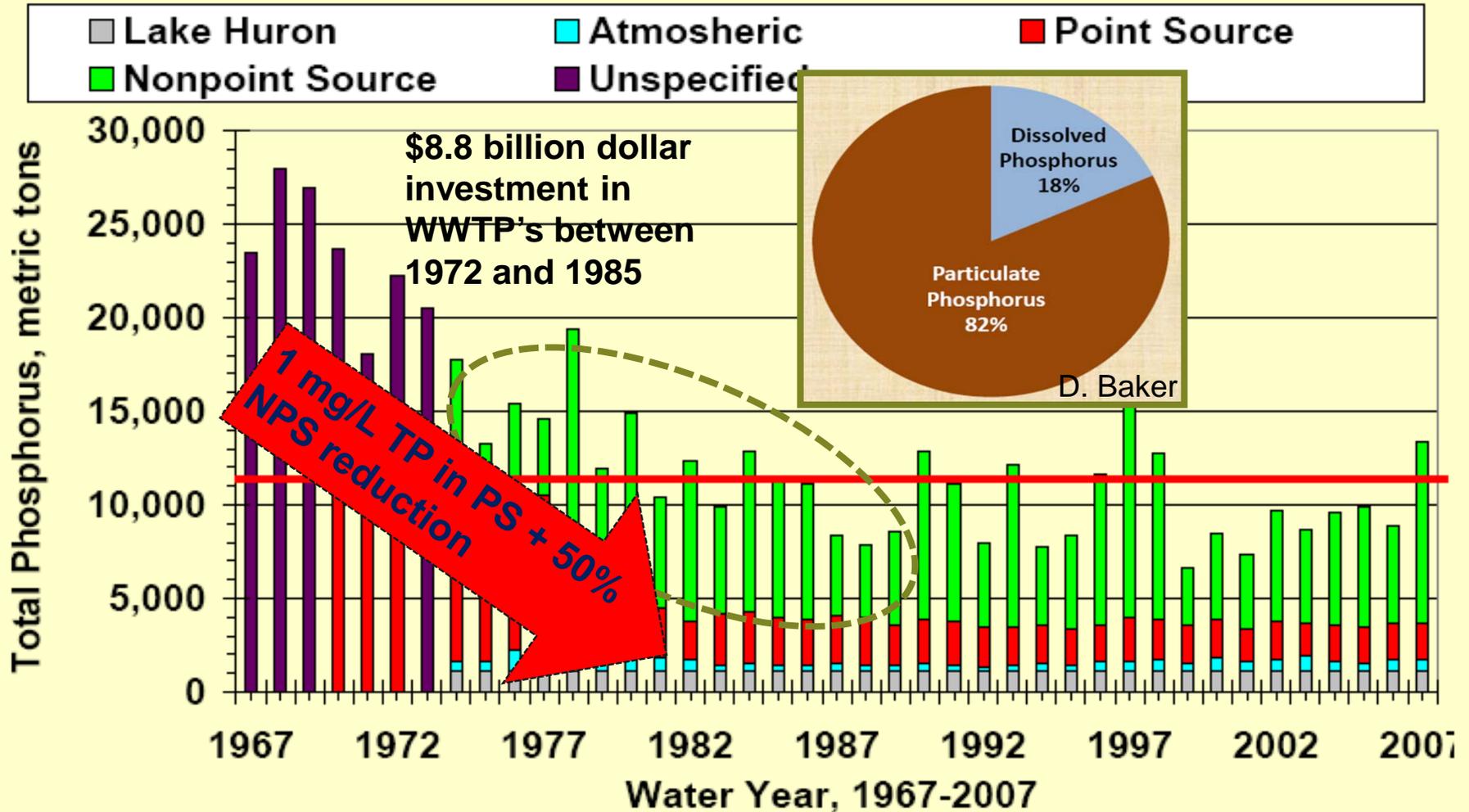
Photo: Ohio Sea Grant

Land Uses in the Great Lakes



An overview of phosphorus loading to Lake Erie

Lake Erie Total Phosphorus Loading by Major Source

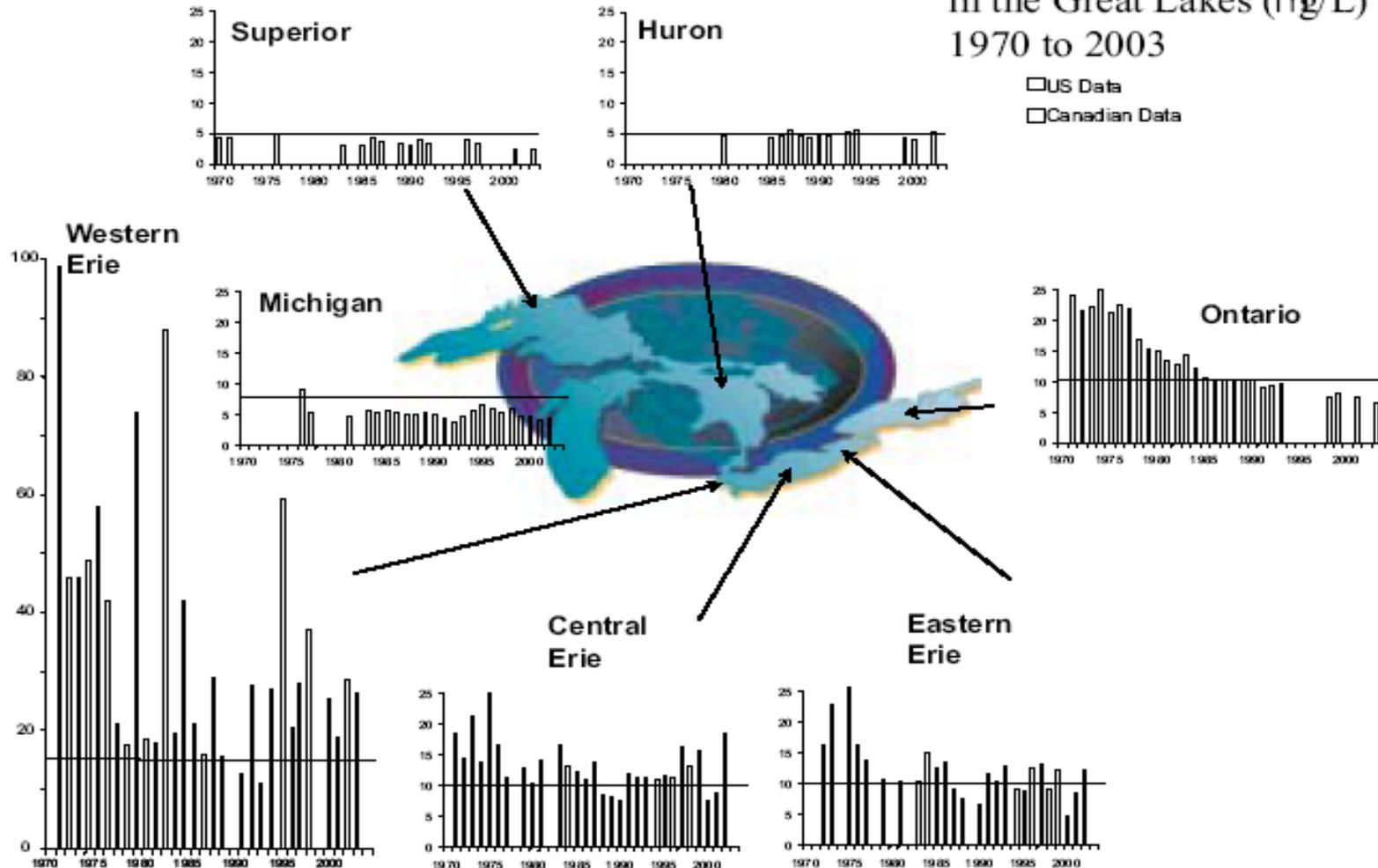


Data from Rockwell and Dolan

Response of TP to Load Reductions (SOLEC 2004)

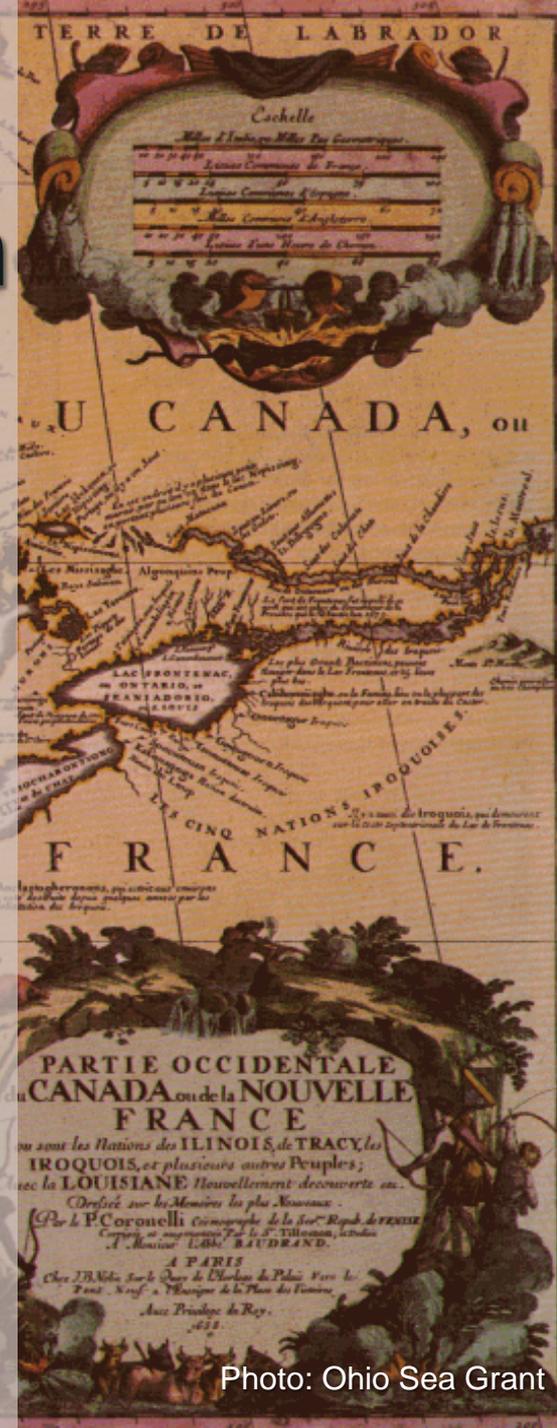
Total Phosphorus Trends
in the Great Lakes (mg/L)
1970 to 2003

□ US Data
□ Canadian Data



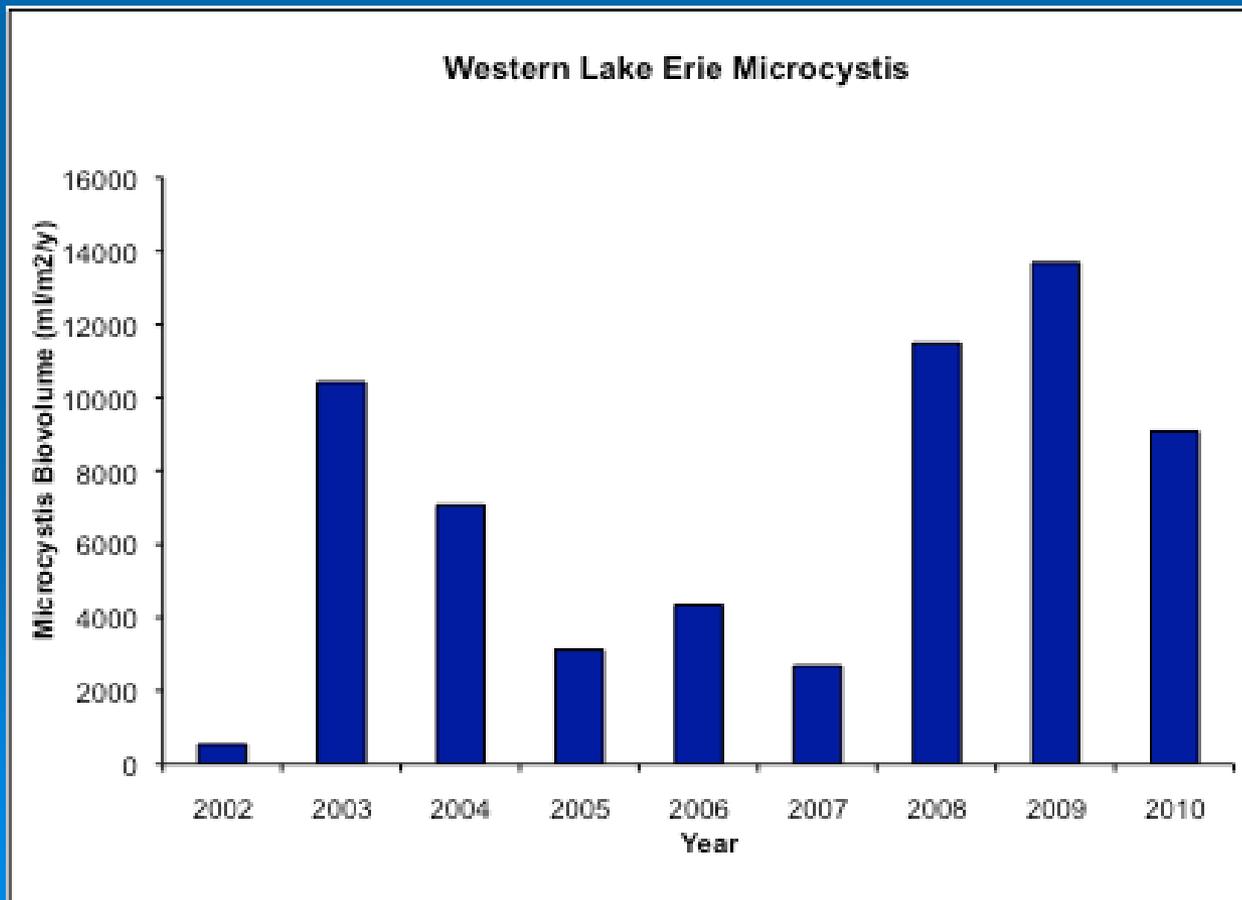
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Microcystis in Lake Erie Western Basin

- The *Microcystis-Anabaena* bloom of 2009 was the largest in recent years in our sampling region
- ...until 2011



2011

T. Bridgeman

Microcystis Bloom of 2011



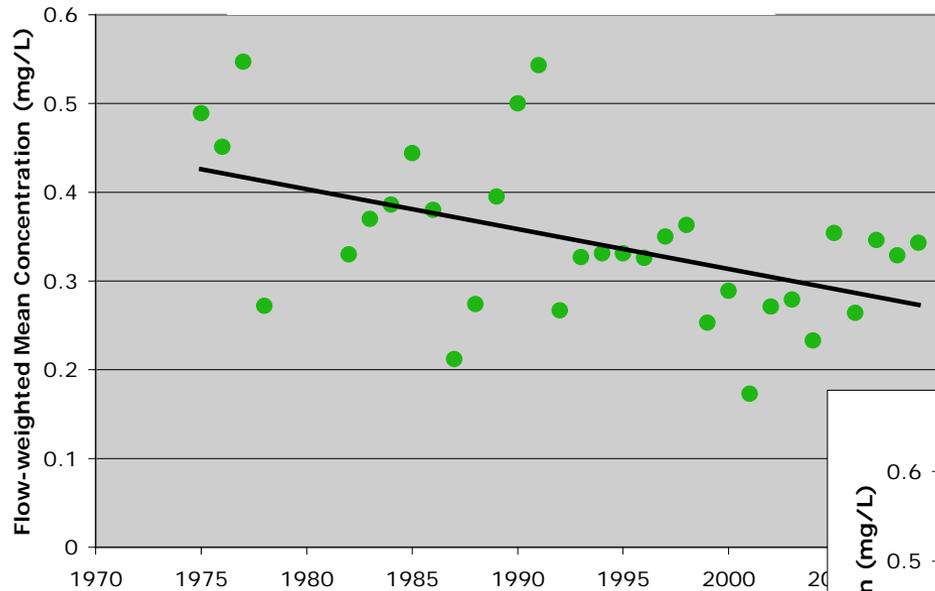
Lyngbya wollei, a new nuisance cyanobacterium in Lake Erie



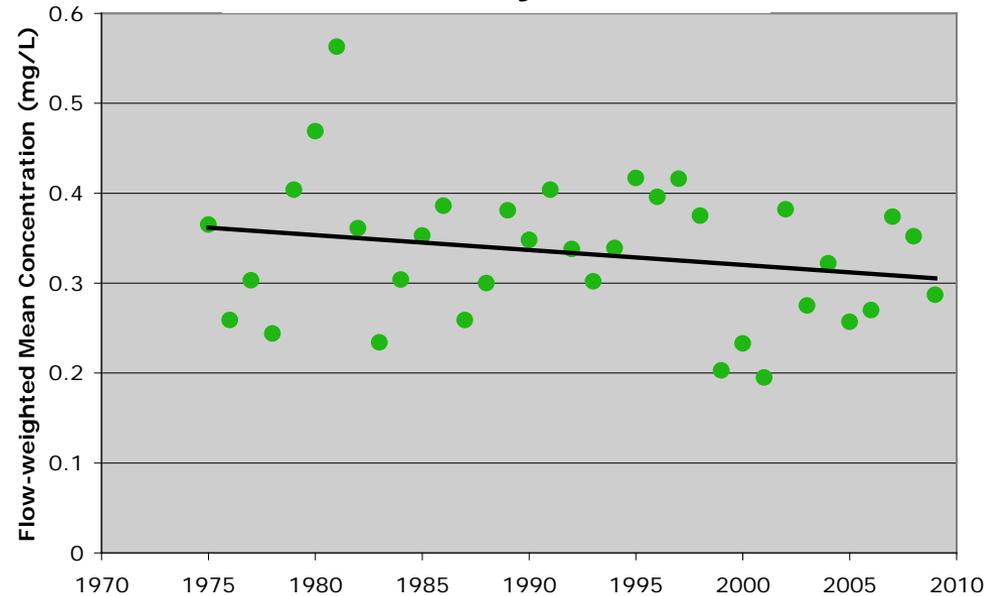
First became
evident in 2006

The Trends Particulate Phosphorus

Maumee River



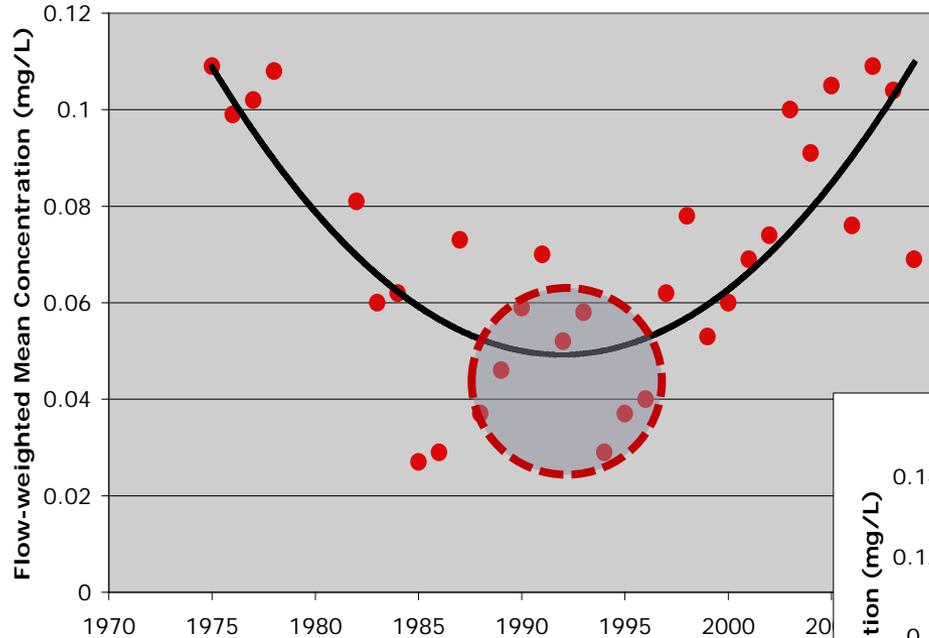
Sandusky River



**P. Richards,
Heidelberg University**

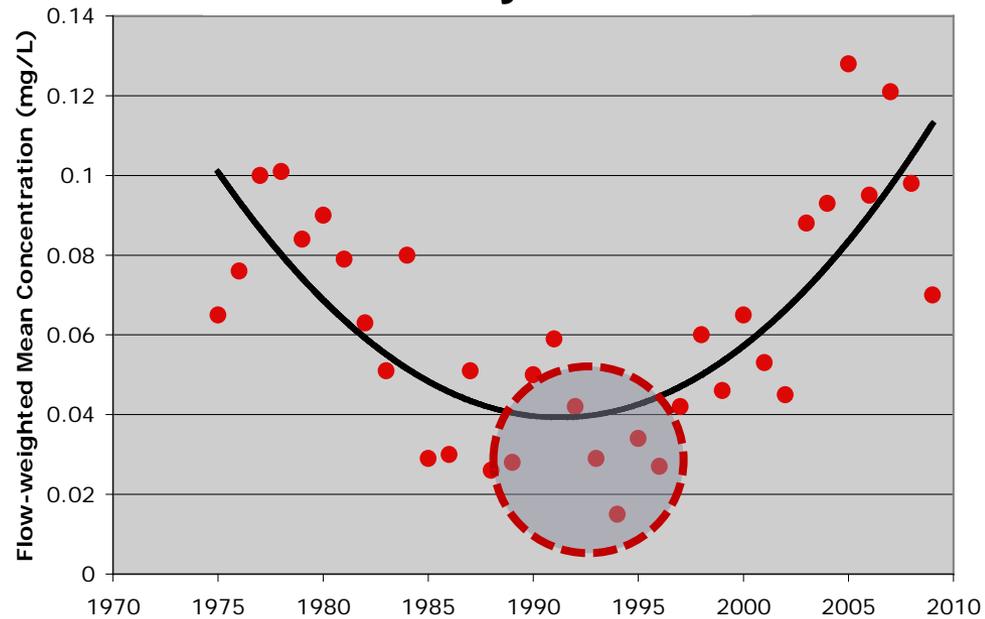
The Trends in Dissolved Reactive P

Maumee River



>80% agricultural land use
in both watersheds.

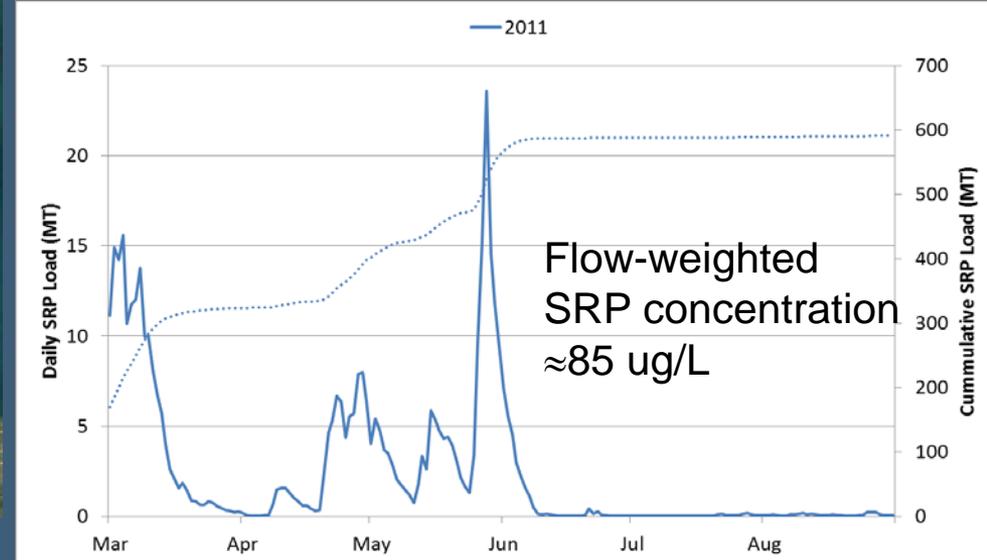
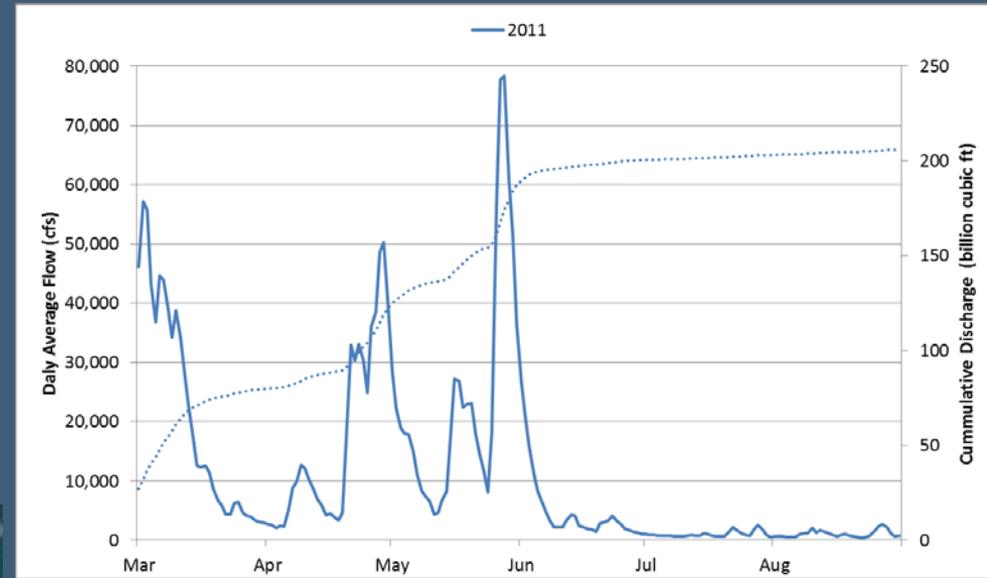
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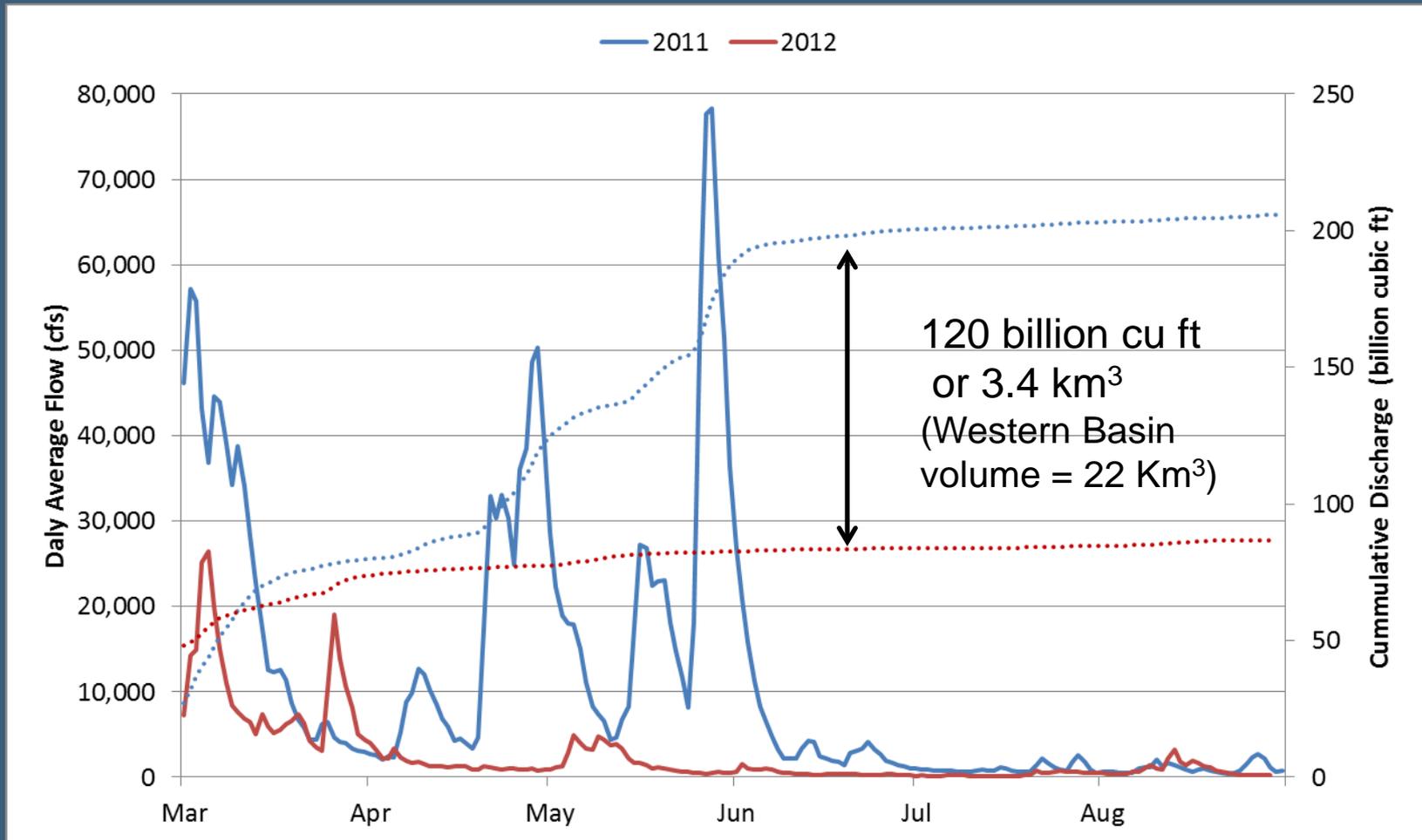
P. Richards, Heidelberg
University

Maumee phosphorus load fueled 2011 bloom

Several large events from March – May, followed by very low flows for rest of the summer. Very little Detroit River dilution; main plume moved to Central Basin north of Pelee Island.

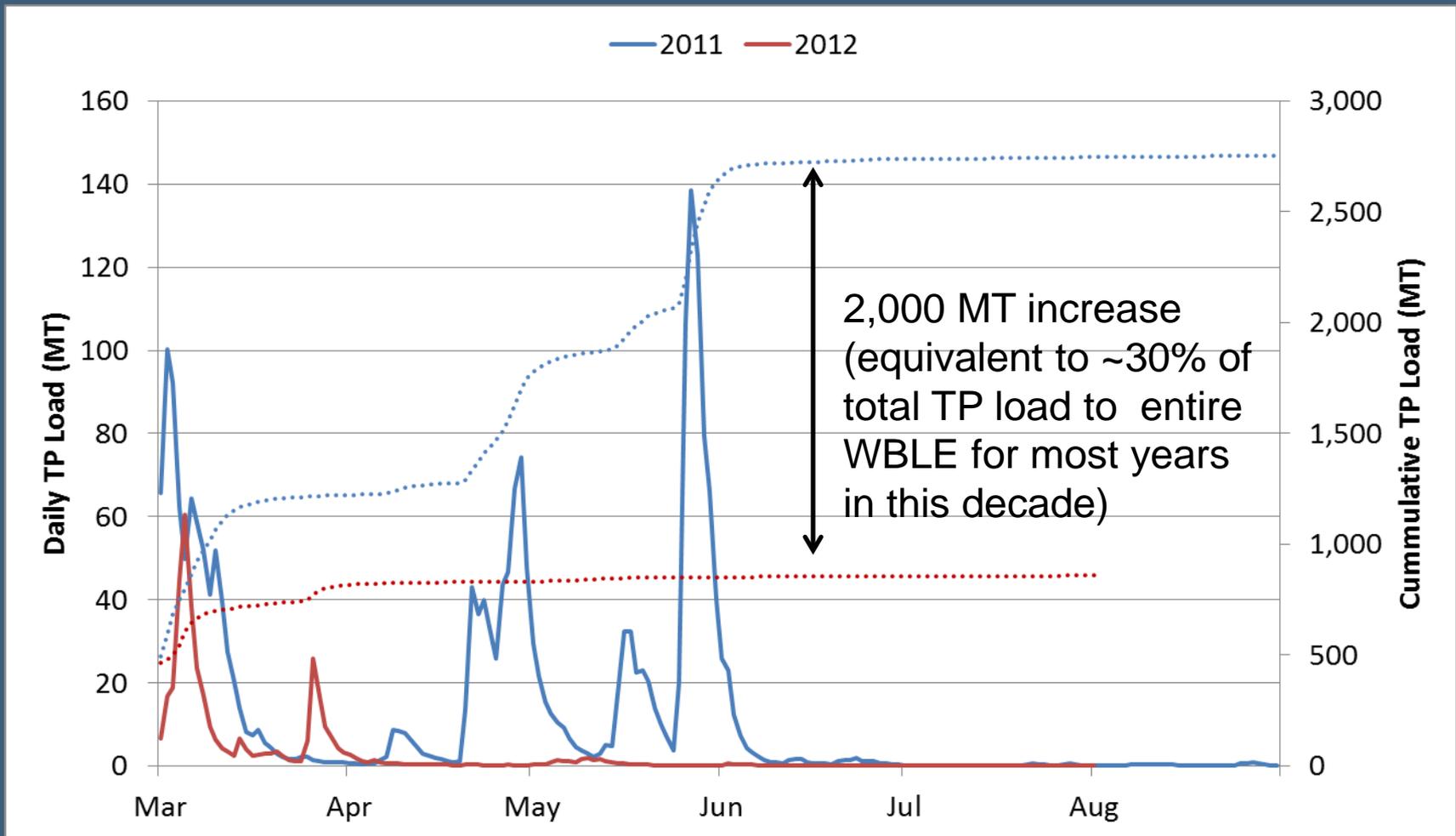


Maumee River Discharge



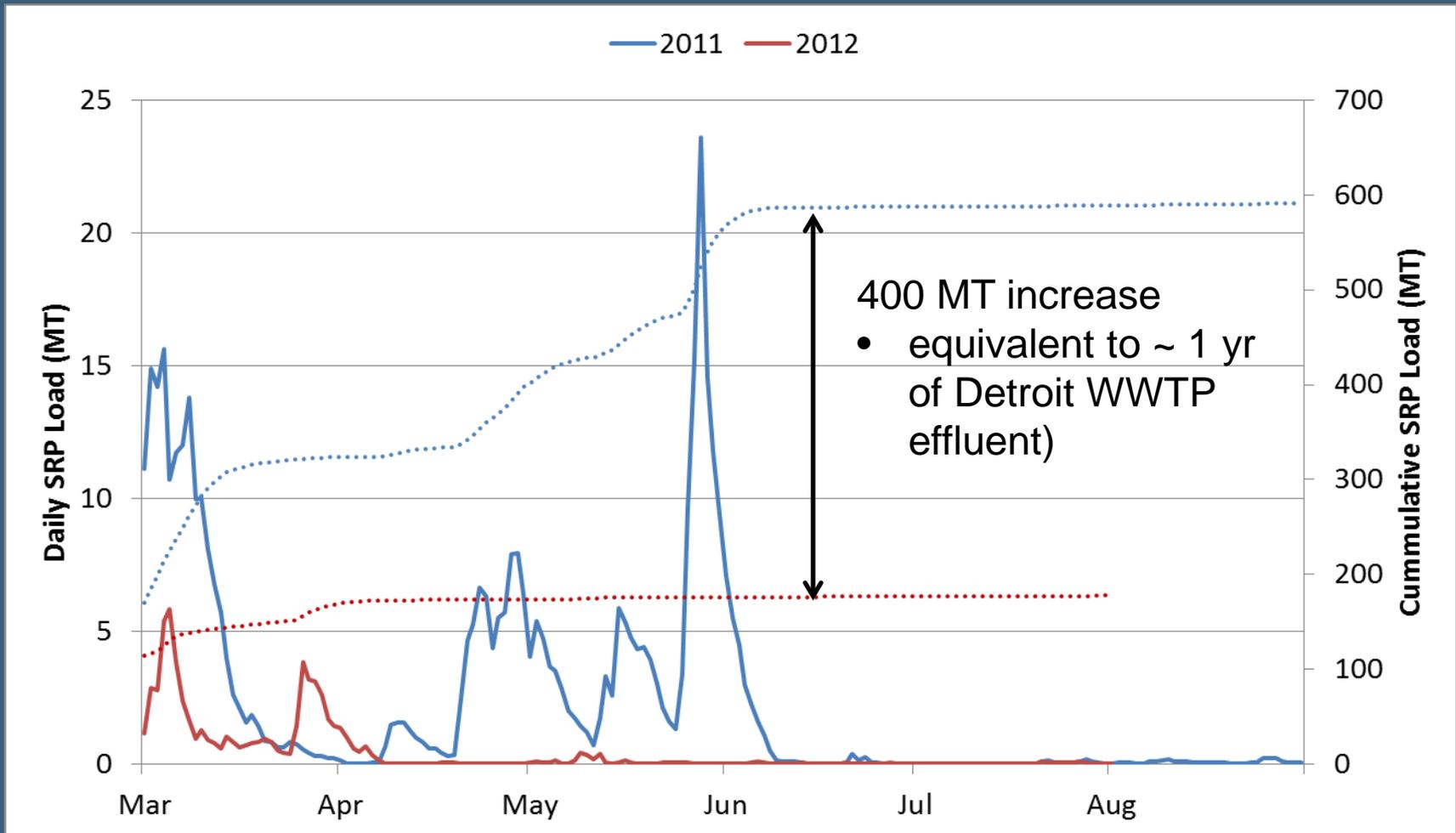
Data obtain from USGS gage at Waterville, OH

Maumee River TP Load



Data obtain from Heidelberg College

Maumee River SRP Load

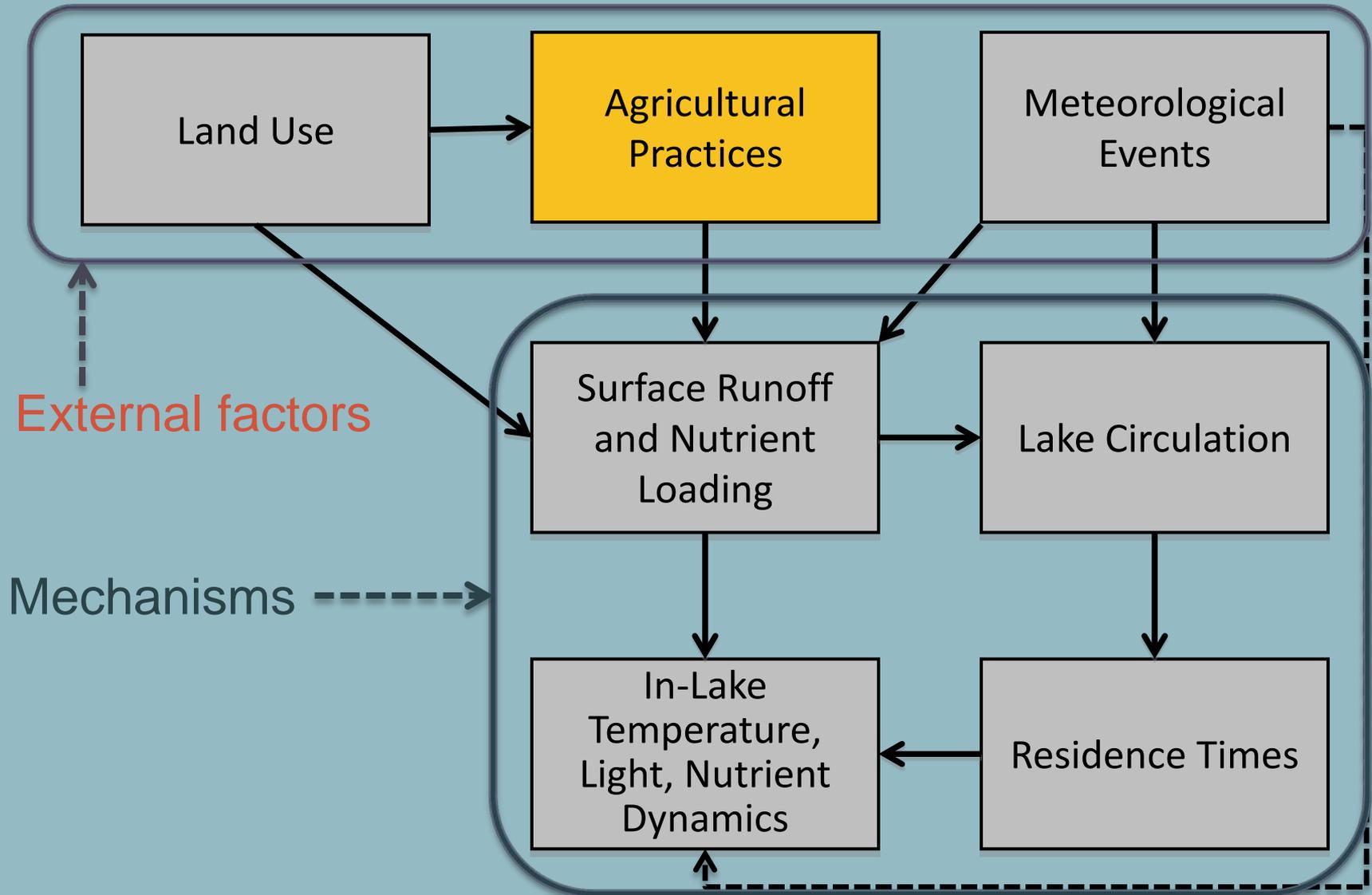


Data obtain from Heidelberg College



2012

Conceptual Model of Potential Causes



Agricultural Practices

Risk Factor	Trend	Impact	Basis of knowledge
Fertilizer amounts used	- then +, minor	++	Documented
Fall fertilizer application	+	++	Anecdotal
Application before precip.	o	++	Documented
Fertilizer broadcast on surface	+	++	Trend anecdotal, Impact documented
Conservation tillage	+ pre-2000	+	Documented
Stratification of P in soil	+	++	Presence documented, Trend inferred.
Extent and efficiency of tile drainage	+	+	Documented (?)
Excessive fertilizer sales	o	+	Documented
Consolidation of farms	+	+	Documented
Animal numbers	+	+	Documented
Soil phosphorus concentrations	-	-	Documented

Several trends in agricultural practices exacerbated susceptibility to nutrient loading

Source: Modified from Pete Richards (Heidelberg U.)

Questions?
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Roger Knight



Jim Piper



Jim Piper