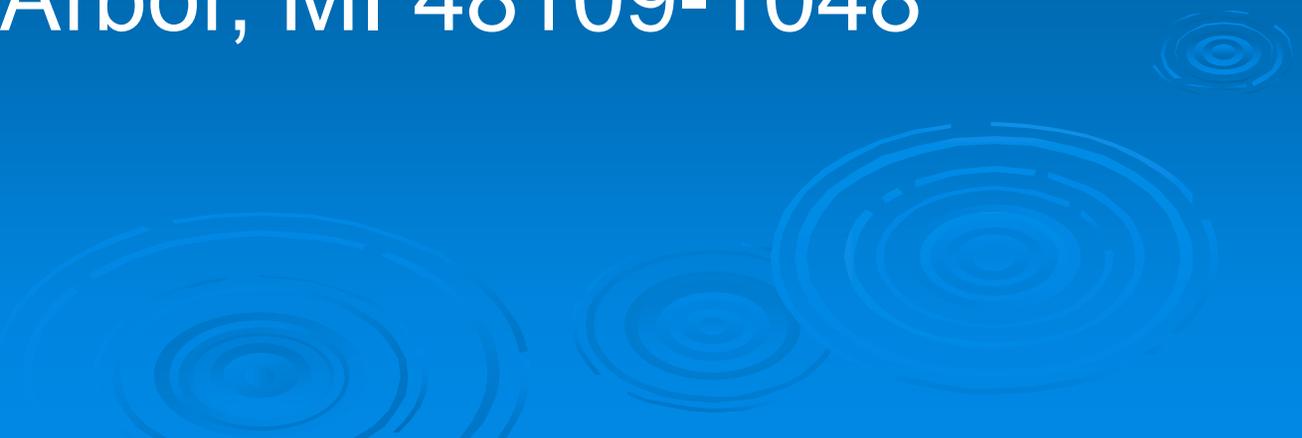


River Phosphorus and Lawn Fertilizer: Case Study of Ann Arbor, Michigan and the Huron River

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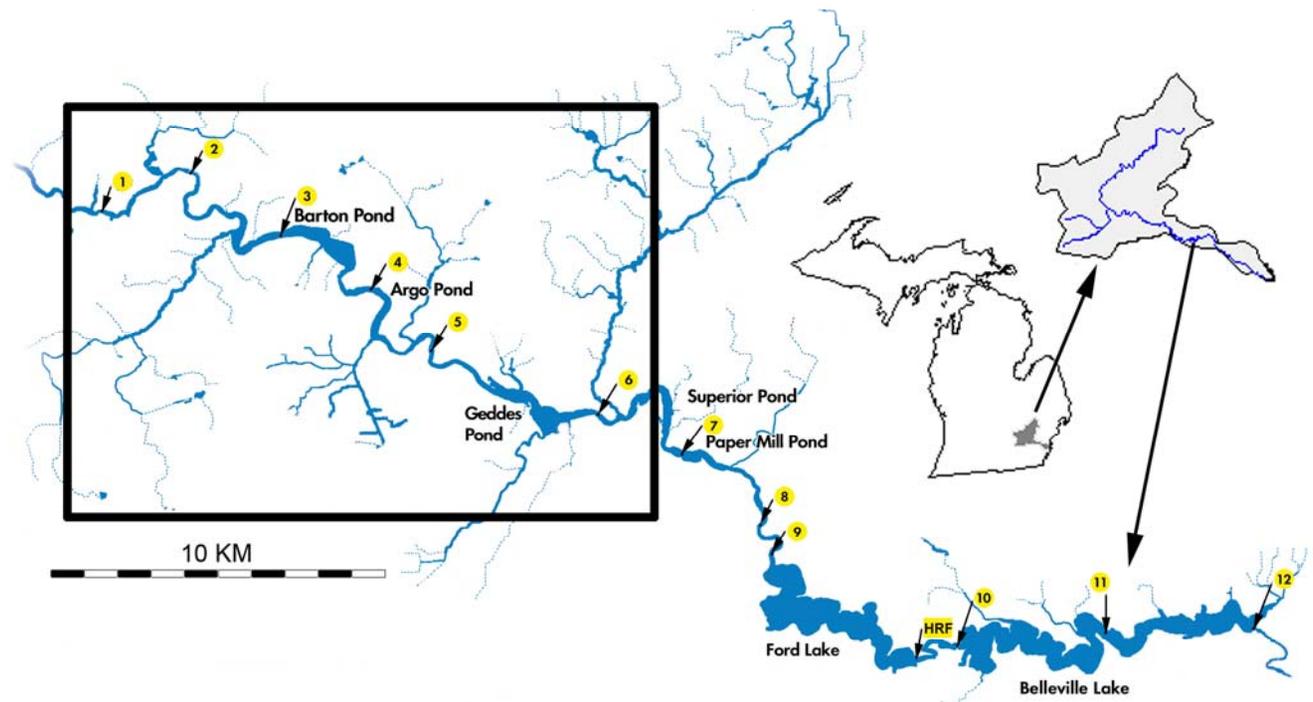
The environmental problem:

Nuisance and harmful algal blooms in area lakes (Ford and Belleville)



The regulatory problem:

Reduce point source and non-point source P loading to the Huron River above the lakes (TMDL)



Experiment:

Ann Arbor restricts the use of lawn fertilizer containing phosphate.

A watershed model predicts full compliance could reduce river P by 22%.

If real, can a change of such magnitude be detected? How hard will it be to detect?

The bottom right portion of the slide features a decorative graphic of several concentric, light blue circles that resemble ripples on water, set against the dark blue background.

A baseline data set existed for the Huron River, 2003-2005 (pre-ordinance)

Baseline data included multiple sites weekly or twice weekly.

Phosphorus as well as other variables were measured.

Individual measurements had precision of 5% or less.



Theory:

A 25% change in Huron River TP should be detectable within one or two years by taking weekly samples from May to September.

(Ferris and Lehman 2008, *Lake and Reservoir Management*, Vol. 24: 273-281).



Theory:

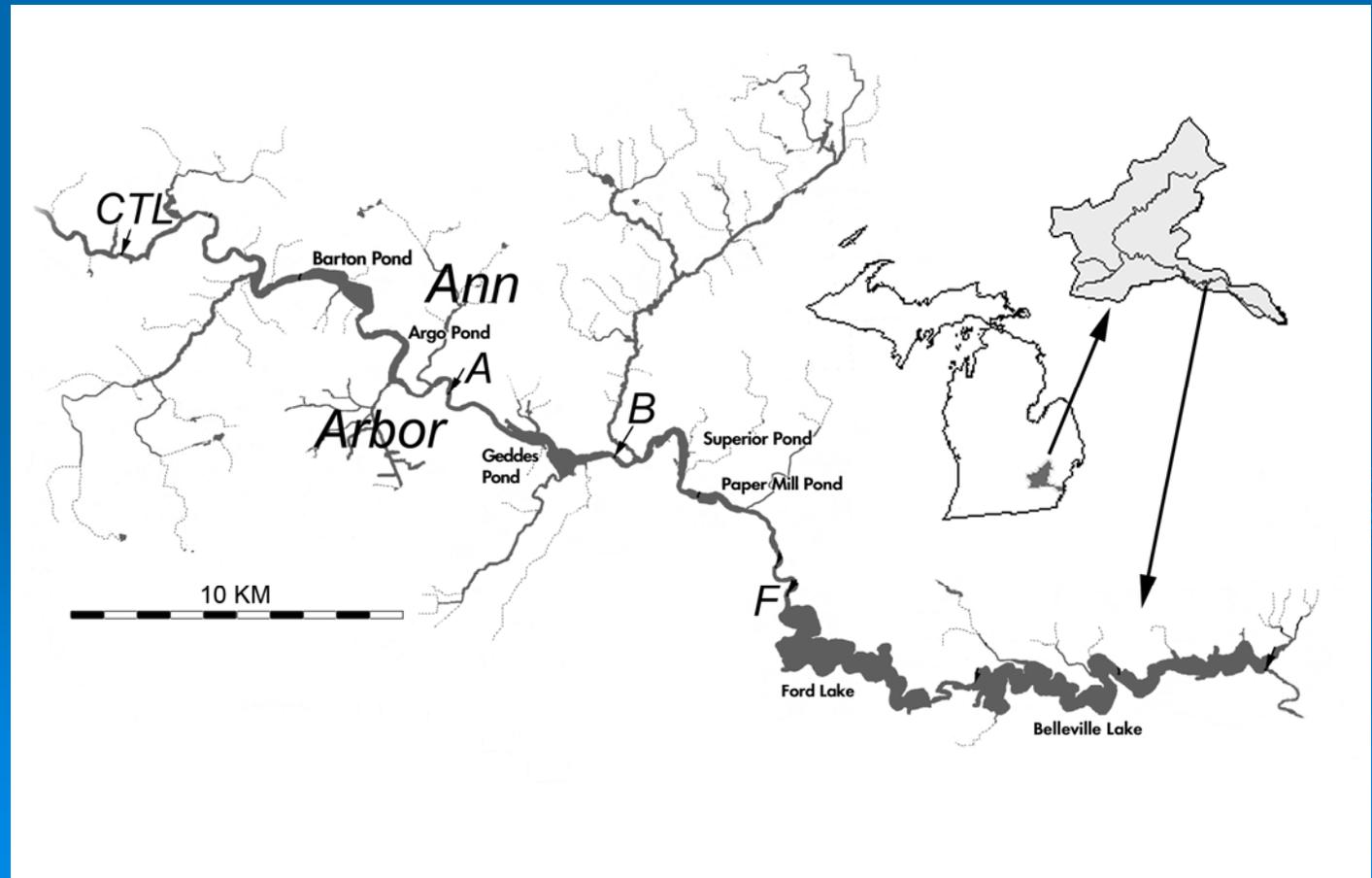
Pre-experiment 'natural variability' in the Huron River makes it easier to detect changes in Total P (TP) and Total Dissolved P (DP) than soluble reactive P (SRP).

That is, SRP is more variable than DP or TP in this system.



Test:

Design the study. Select sampling sites, target variables, and non-target variables.



Sampling Sites:

CTL- 'control' site upstream of Ann Arbor jurisdiction

A- first experimental site with 29 km² of drainage attributable to Ann Arbor

B- second experimental site with 94 km² of drainage attributable to Ann Arbor

F- downstream of AAWWTP outfall

Target Variables (the *a priori* expectation is that these should decrease):

TP- Total P, both particulate and dissolved.

DP- Dissolved P, both organic and inorganic.

SRP- mainly dissolved or colloidal inorganic P.

Non-Target Variables (no *a priori* expectation for change):

Nitrate- a mineral nutrient.

CDOM- colored dissolved organic matter, mainly organic nitrogen and carbon.

SRSi- silica, a mineral nutrient for some algae.



**Experimental Years = May to Sep
2008 and 2009**

Sample weekly

**Laboratory analytical error- less than
5%**

**Statistical tests- by month, 2008-2009
versus 2003-2005**

Results-

No systematic changes in non-target variables.

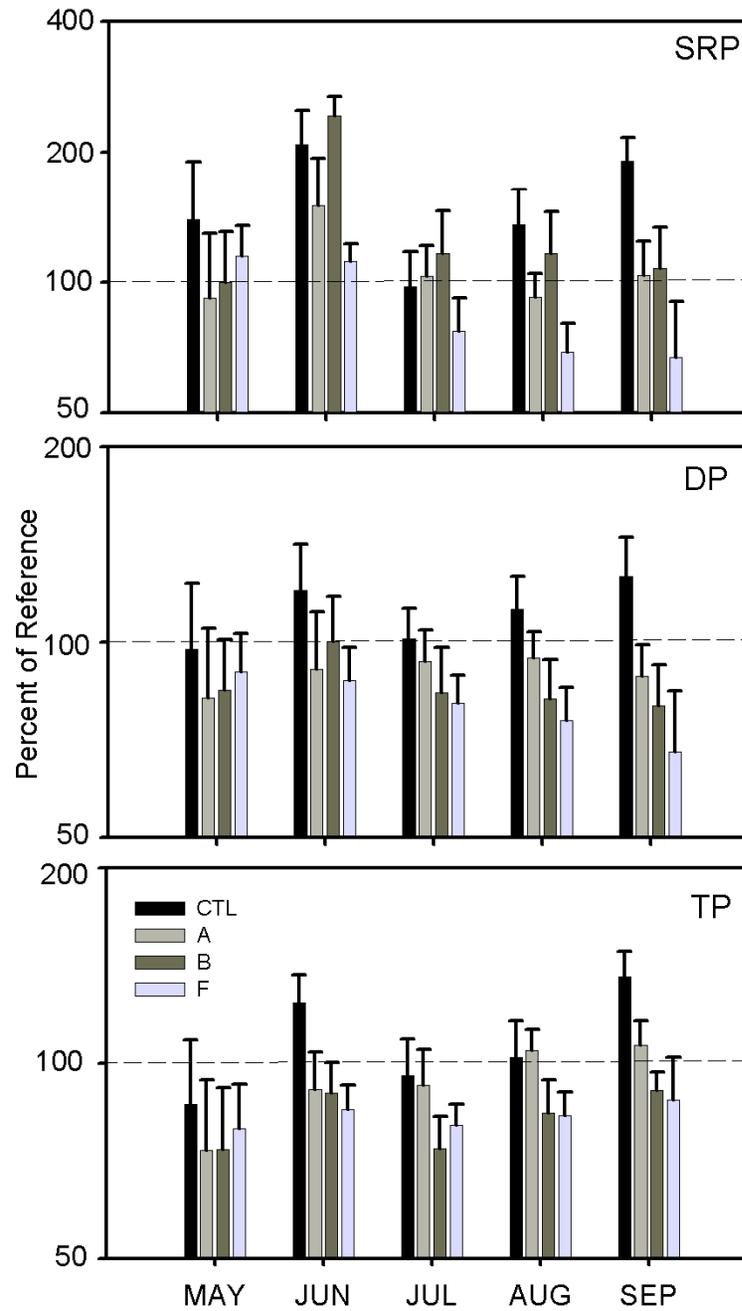
No decreases in P at CTL site.

No decreases in point source P effluent from AAWWTP.

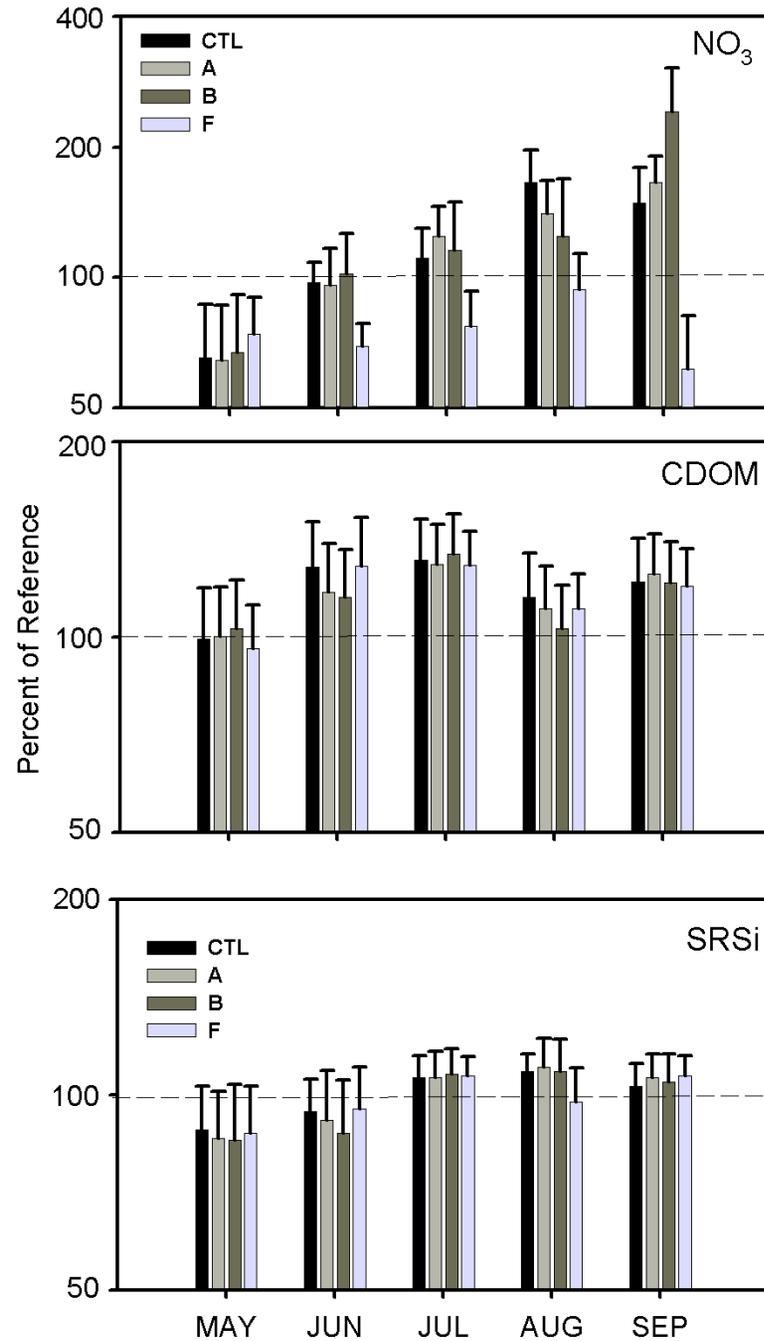
Yes- decreases in TP and DP at experimental sites.



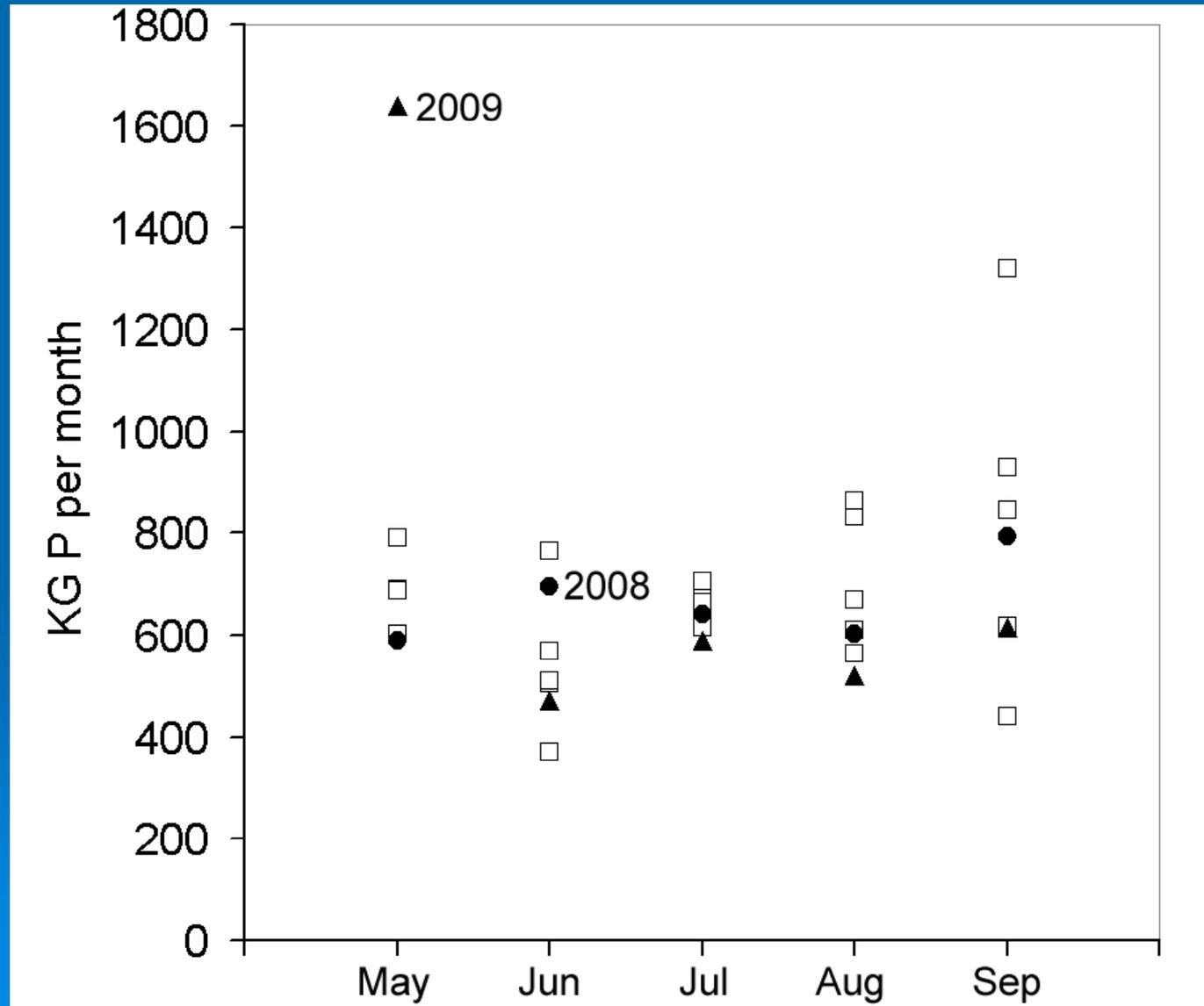
Results- P variables



Results- Non-target variables



Reductions at Station F cannot be attributed to WWTP effluent



Conclusion

- River TP decreased on average 17% (prediction = 22%).
- Causal inference is not clean- fertilizer ordinance was just one of several non-point source management efforts
- To duplicate this study elsewhere you need a good baseline or reference data set to document pre-existing condition

For more information and the data themselves, visit

<http://www.umich.edu/~hrstudy>



For comparison with other sites:

From May-Sept of 2003-2005, 94 km² drainage area exported P to the Huron River at the following average rates:

SRP 0.12 g/ha/d

DP 0.38 g/ha/d

TP 1.41 g/ha/d

This is equivalent to 0.5 kg TP/ha/yr