Advection and nutrients regulate phytoplankton dynamics in Tainter Lake, Wisconsin

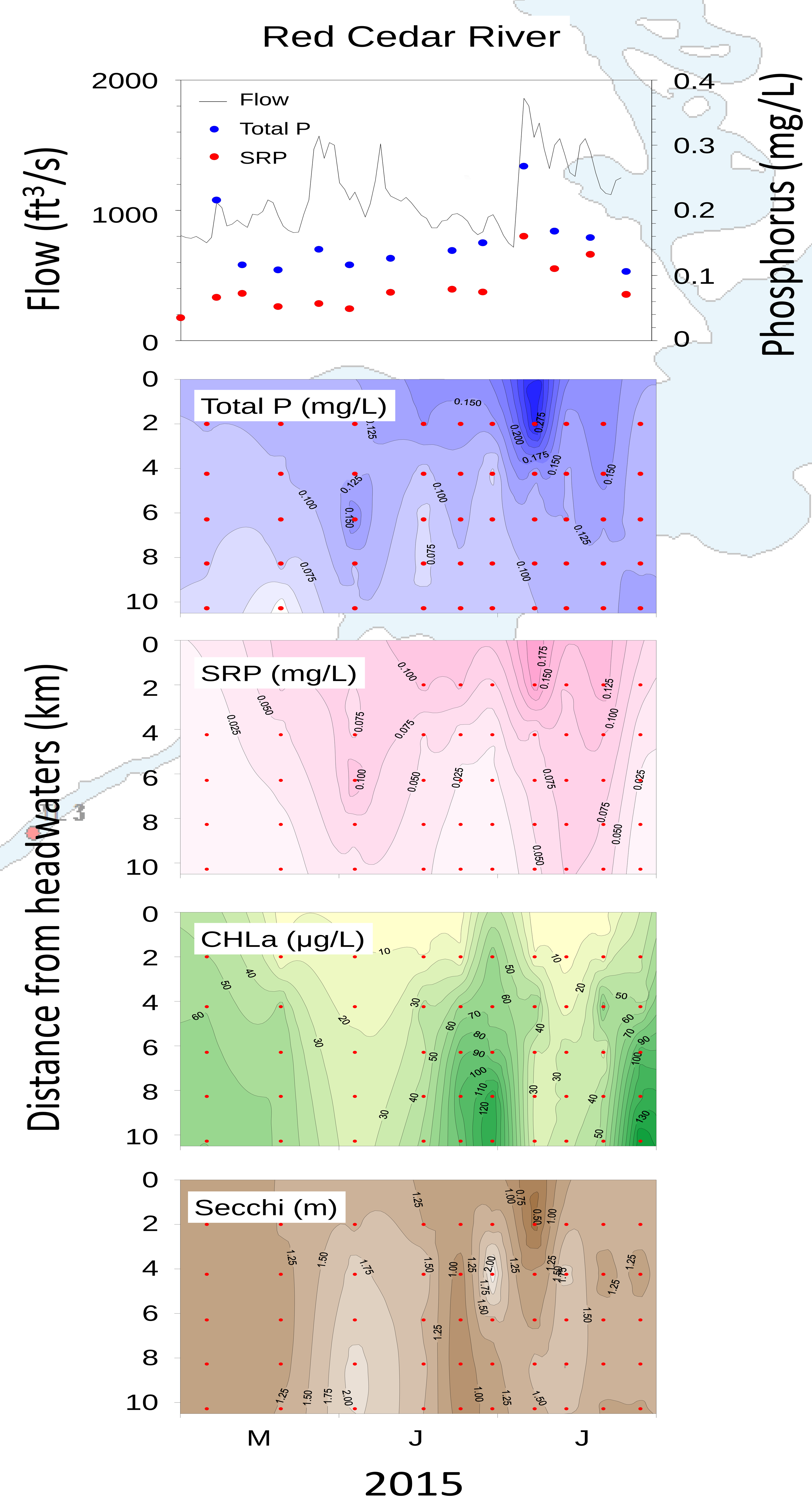
Lanna Anderson, Bennett College, William F. James, University of Wisconsin-Stout

Introduction

- Phosphorus largely limits phytoplankton growth in freshwater systems.
- Excessive P loading into lakes and reservoirs can lead to cyanobacteria blooms and potential toxicity.
- Reservoirs are impoundments of large rivers that drain extensive watersheds, therefore advective flow, flushing rate, and residence time can also regulate phytoplankton dynamics.
- For instance, during storm runoff and elevated flow, residence time can decrease to less than a week, while flushing rate increases.
- Rapid flushing that exceeds the algal growth rate can lead to anomalously low chlorophyll in the reservoir due to washout of the algal blooms.
- During lower flow, residence time increases while flushing rate decreases.
- P loads assimilated by phytoplankton during these periods can result in bloom development because algal doubling rate exceeds the flushing rate.

Hypothesis

- We hypothesized that although P concentrations would increase in Tainter Lake during periods of high flow, chlorophyll would be abnormally low due to the high flushing rate. Conversely, as flow and P loading subsided and residence time increased, high P availability would lead to phytoplankton blooms and chlorophyll increases if algal doubling rate exceeded the flushing rate.



Objective

- The objective was to measure seasonal variations in phosphorus and chlorophyll concentrations and Secchi transparency in relation to hydrodynamics and nutrient (primarily phosphorus) availability in Tainter Lake, Wisconsin.

Results

High flow periods (late May, early June, mid-July)

- Total P and SRP increase in the headwaters.
- Longitudinal gradients of decreasing TP and SRP concentration toward dam.
- SRP is very high and available for algal uptake.
- Residence time is low, resulting in washout of the phytoplankton community.

Low flow periods (late June, late July)

- Total P and SRP decrease
- SRP declines tremendously near the dam in conjunction with massive chlorophyll increases signifying uptake for growth.
- Residence time is much higher and phytoplankton doubling exceeds flushing rate.

Conclusion

- Algal growth can be limited by advection and transport in rapidly flushed reservoirs like Tainter Lake even though phosphorus concentrations are high and available for phytoplankton uptake.

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