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# Influences of Physical Chemistry on the Abundance of Phytoplankton in Different Slackwater Habitats

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## Objectives

This study focuses on influences of physical-chemical factors on phytoplankton abundance in different slackwater habitats of the Upper Mississippi River to:

- Define correlations between physical-chemical measures and phytoplankton chlorophyll concentrations; and
- Determine which measures show significant relationships to phytoplankton chlorophyll concentration.

## Methods

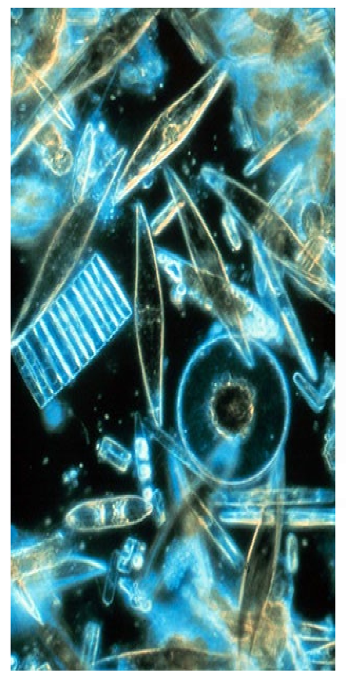
Study Area

The study area consisted of multiple slackwater habitats along the Mississippi River between La Crosse and Alma, WI. Habitats were generally heavily vegetated with aquatic macrophytes and shoreline vegetation. The Upper Mississippi River is characterized by large floodplains and a regular spring flood pulse that advances and retreats over the floodplain, creating temporary connections with slackwaters. This area provides ecosystem habitats for a wide variety of fish and wildlife species.

Sample Methods

- Conductivity, pH, and temperature were measured using appropriate probes.
- Turbidity was measured using a spectrophotometric turbidity meter.
- A Secchi disk was used to measure light penetration.
- Phytoplankton samples were collected in 1-L bottles at each site and processed in the laboratory by pouring water through a 1-µm glass fiber filter. Filters were ground up to break cells walls of phytoplankton. The samples were centrifuged then chlorophyll concentrations were determined using a spectrophotometer.

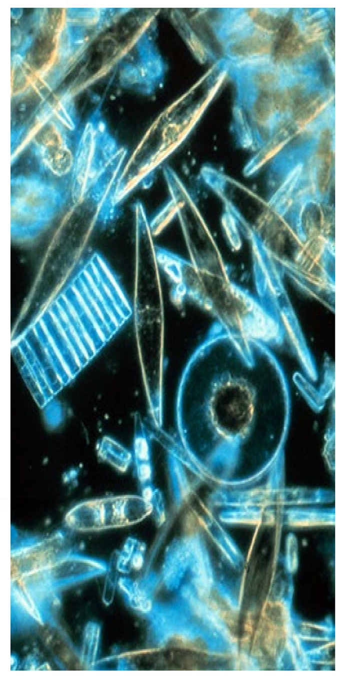
## Typical Slackwater Habitat



Pearson Correlation Coefficients
Prob > |r| under H0: Rho=0
Number of Observations

| | Conduct | pH | DO | Turbid | Temp | Secchi |
|---|---|---|---|---|---|---|
| Chloro | 0.11870 | -0.36618 | -0.02934 | 0.43552 | -0.10001 | -0.17669 |
| | 0.5106 | **0.0305** | 0.8671 | **0.0089** | 0.5676 | 0.3175 |

Table 1. r (top row) and p (lower row) from partial correlation analysis of physical-chemical measures vs phytoplankton chlorophyll concentration of slackwater habitats of the Upper Mississippi River during summer 2012. Bold values were significant.



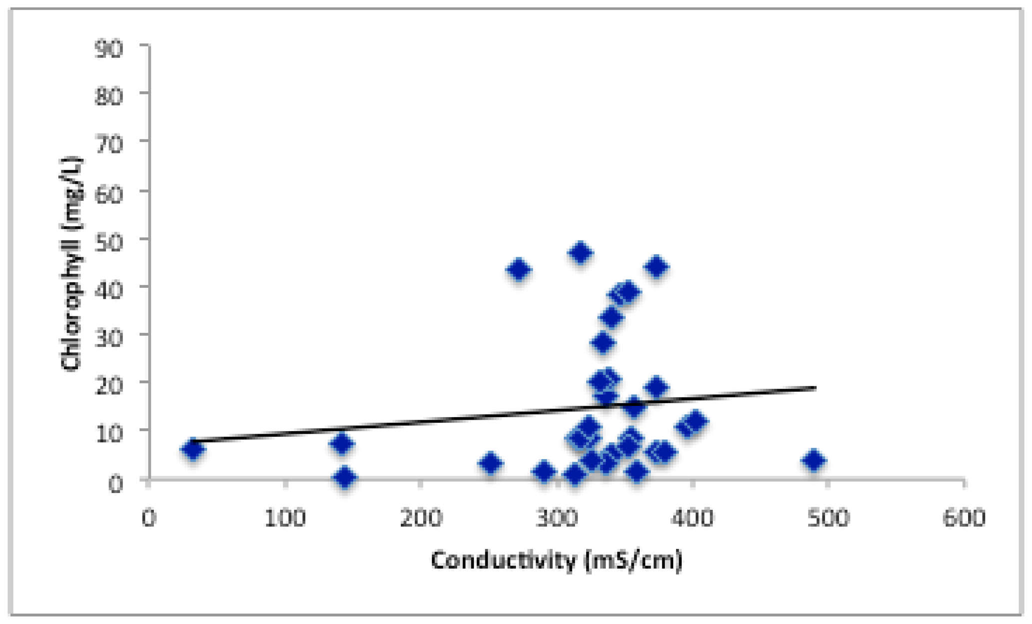



Figure 1. Conductivity vs chlorophyll concentration in Upper Mississippi River slackwaters during summer 2012. No significant correlation existed.

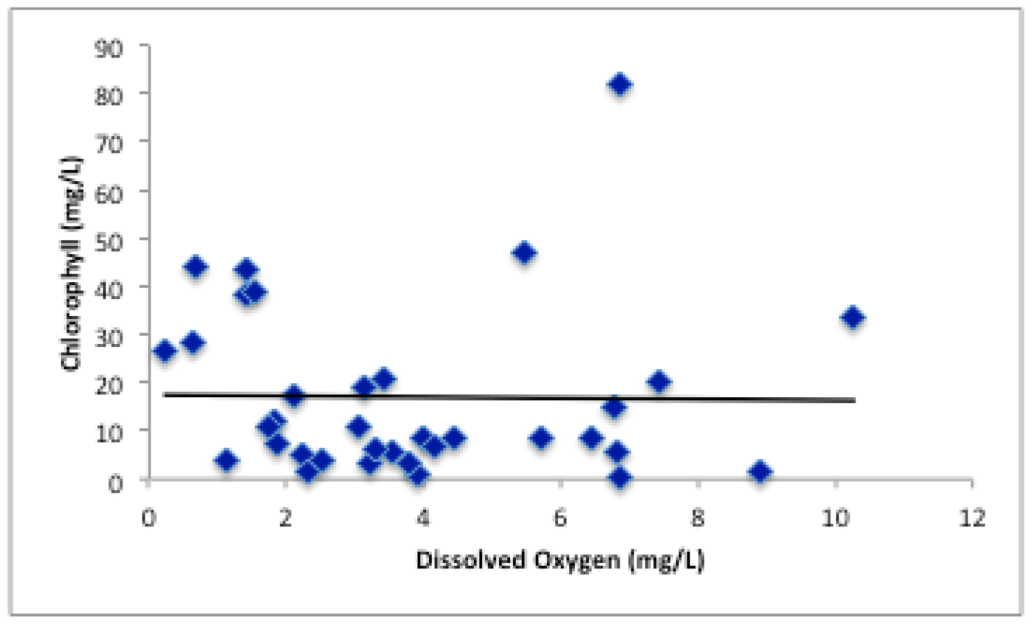



Figure 2. Dissolved oxygen concentration vs chlorophyll concentration in Upper Mississippi River slackwaters during summer 2012. No significant relationship existed.

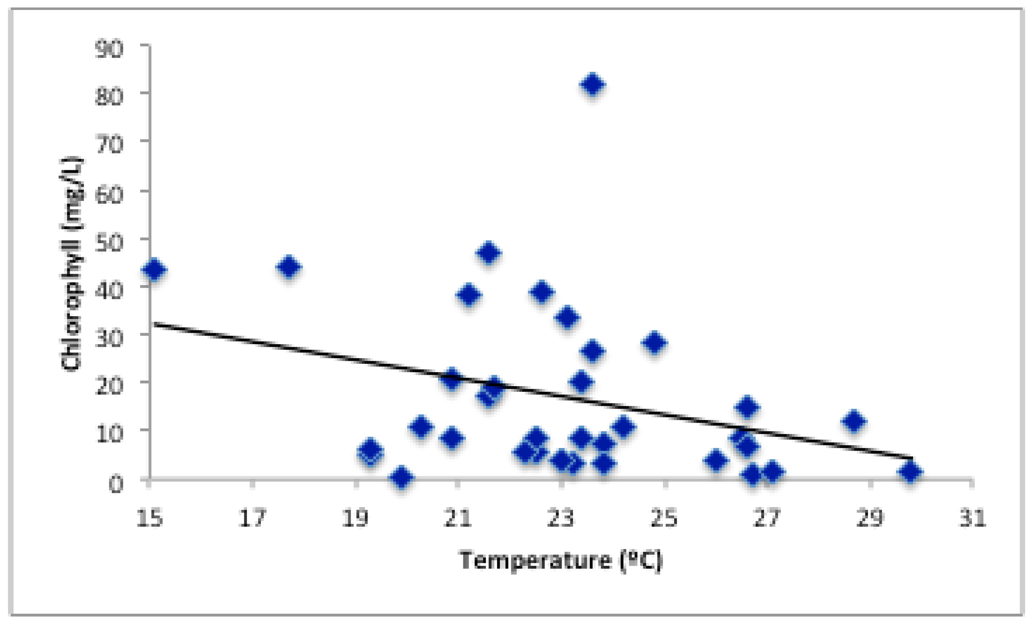



Figure 3. Temperature vs chlorophyll concentration in Upper Mississippi River slackwaters during summer 2012. No significant relationship existed.

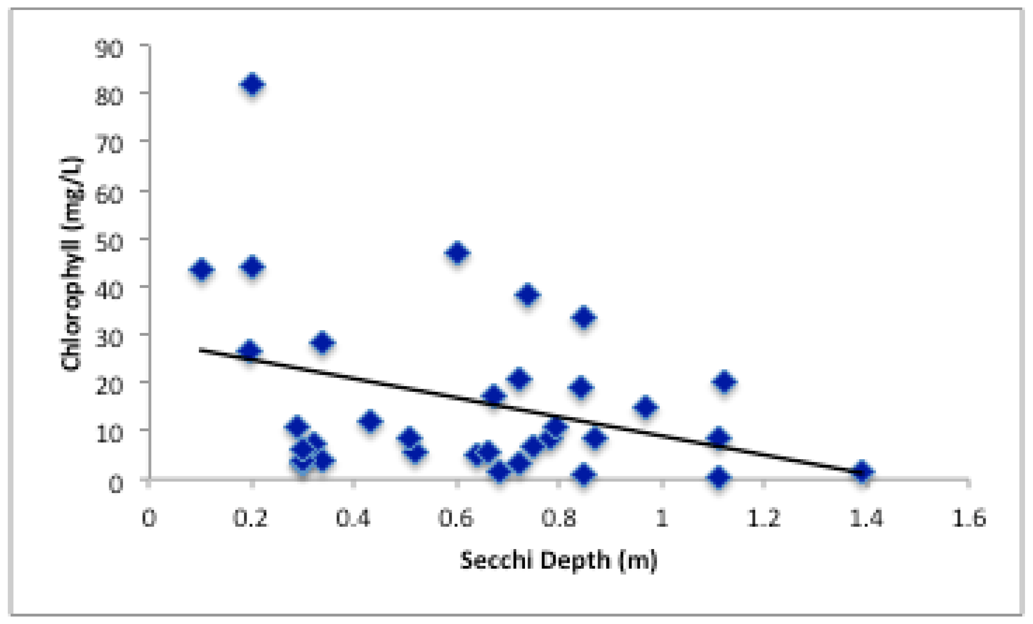



Figure 4. Secchi depth vs chlorophyll concentration in Upper Mississippi River slackwaters during summer 2012. No significant relationship existed.

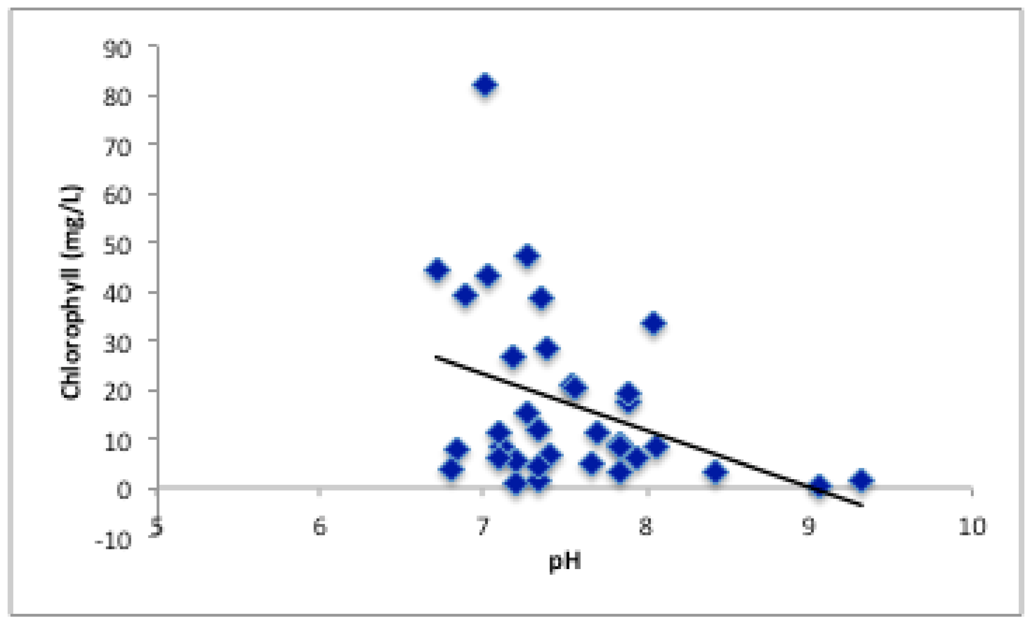



Figure 5. pH vs chlorophyll concentration in Upper Mississippi River slackwaters during summer 2012. A significant correlation was detected (p = 0.031).

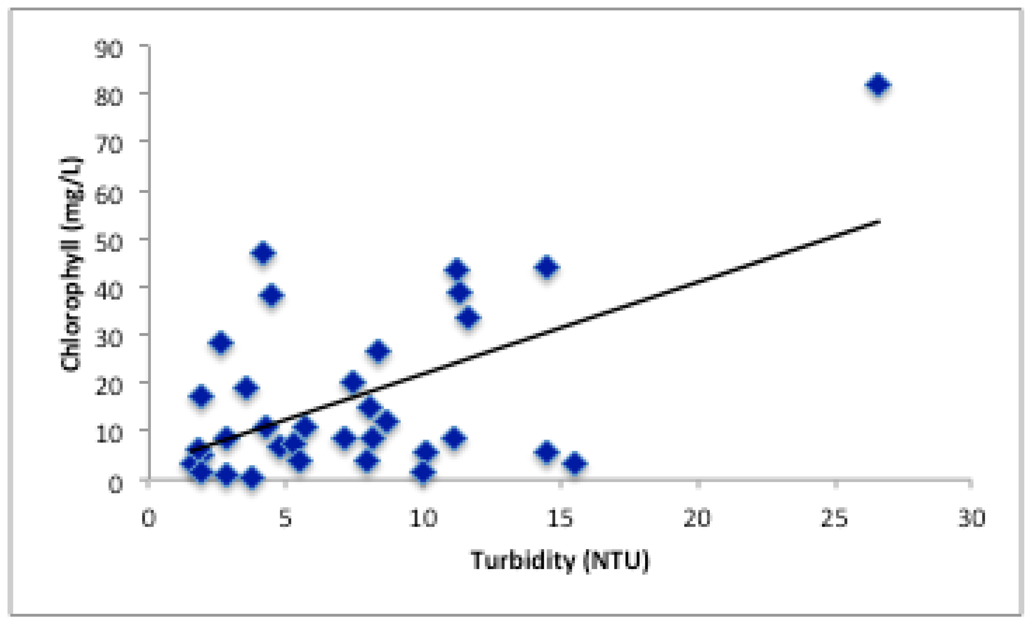



Figure 6. Turbidity vs chlorophyll concentration in Upper Mississippi River slackwaters during summer 2012. A significant correlation was detected (p = 0.009).

## Results

- Conductivity, dissolved oxygen concentration, temperature, and Secchi depth were not correlated with phytoplankton chlorophyll concentration (Table 1; Figures 1 - 4).
- There was a significant negative relationship between pH and phytoplankton chlorophyll concentration (Table 1; Figure 5).
- There was a significant positive correlation between turbidity and phytoplankton (Table 1; Figure 6).

## Conclusions

- Conductivity exhibited little variability across habitats which would account for the absence of an influence on phytoplankton chlorophyll concentration.
- Dissolved oxygen concentrations were highly variable but did not influence pattern exhibited by phytoplankton chlorophyll over the summer.
- Temperature and Secchi depth varied over the course of the study and associated weakly with chlorophyll concentrations, but the linkages were not significant.
- Phytoplankton chlorophyll concentrations were highest when pH was closer to neutral then decreased as water became more basic. This may be related to release of chemicals from the soils during inundation.
- The positive correlation of phytoplankton chlorophyll concentration and turbidity is contradictory to expected patterns. Three possibilities exist to create this relationship in slackwaters:
  - Zooplankton were less abundant in habitats with high turbidity, which would reduce grazing pressure.
  - Higher turbidity may correlate with greater nutrient inputs, minimizing nutrient limitations on phytoplankton reproduction.
  - High turbidity may actually be an increase in organic turbidity caused by phytoplankton abundance. This may account for lack of a correlation with Secchi depth.

## Acknowledgements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