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Relationship Between Phytoplankton Chlorophyll Concentration and Fish Community Structure in Slackwaters of a Large River

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Objective

This study examined phytoplankton chlorophyll concentrations in various slackwater patches of the Upper Mississippi River to determine if abundance of phytoplankton, based on chlorophyll concentration, influenced fish community structure.

Methods

Study Area

The study was conducted in slackwater patches of the Upper Mississippi River between Brownsville, MN and Alma, WI. Ten sites were selected from various floodplain lakes and backwaters. Backwaters of the Upper Mississippi River are areas of water which branch off of a channel and have no flow. Floodplain lakes are only hydrological connected to channels during flood pulses. Samples were taken on three different dates between 11 June and ending 26 August 2012, ranging from low to high periods of hydrological connection.

Sample Methods

- Three, One-liter water samples were collected at each site to measure chlorophyll concentrations. Each sample was filtered and analyzed using the monochromatic method.
- Fish were collected monthly during the study using fyke nets, seines, and electrofishing.
- Fish were collected then identified and counted.
- Chlorophyll concentration was determined using the monochromatic method.

Scenes from the Study

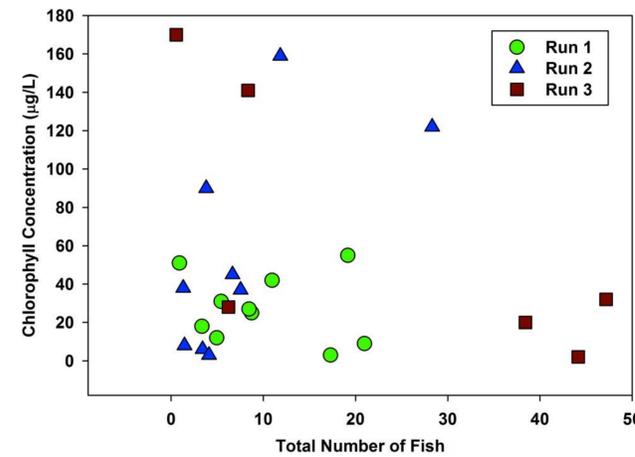


Figure 1. Relationship between total number of fish and phytoplankton chlorophyll concentration over three periods covering June – August 2012. Samples were taken from slackwater habitats of the Upper Mississippi River between Brownsville, MN and Alma, WI.

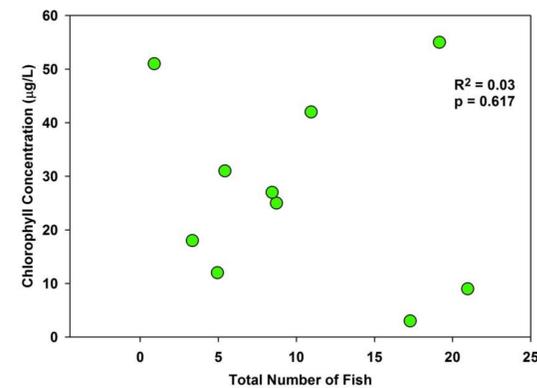


Figure 2. Relationship between total number of fish and phytoplankton chlorophyll concentration during connecting phase of a flood pulse June 2012. Samples were taken from slackwater habitats of the Upper Mississippi River between Brownsville, MN and Alma, WI.

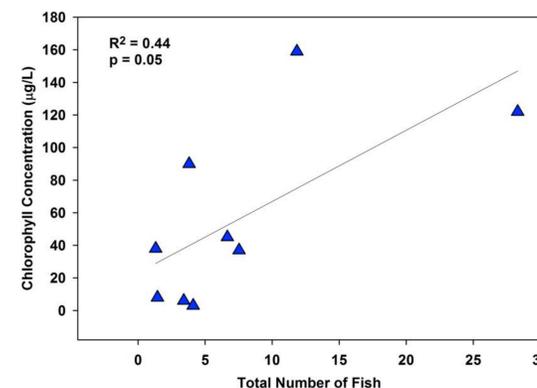


Figure 3. Significant linear relationship between total number of fish and phytoplankton chlorophyll concentration during connected phase of a flood pulse, July 2012. Samples were taken from slackwater habitats of the Upper Mississippi River between Brownsville, MN and Alma, WI.

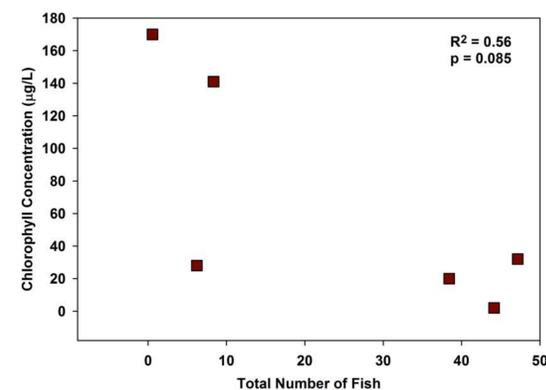


Figure 4. Relationship between total number of fish and phytoplankton chlorophyll concentration during disconnecting phase of a flood pulse August 2012. Samples were taken from slackwater habitats of the Upper Mississippi River between Brownsville, MN and Alma, WI.

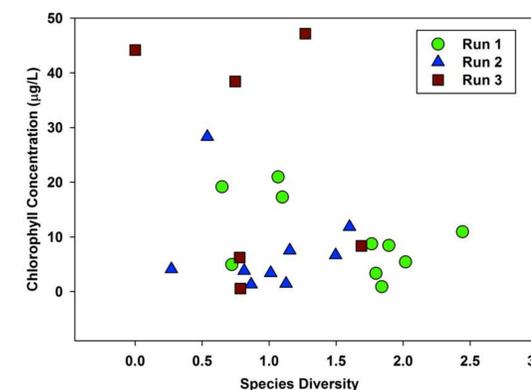


Figure 5. Relationship between fish species diversity and phytoplankton chlorophyll concentration over three periods covering June – August 2012. Samples were taken from slackwater habitats of the Upper Mississippi River between Brownsville, MN and Alma, WI.

Results

- There was no significant relationship between phytoplankton chlorophyll concentration and total number of fish when examined across all three sample periods (Figure 1).
- Separate analysis of each sample period revealed a significant linear relationship between total number of fish and chlorophyll concentration during the connected phase (Run 2) but not the during the connecting or disconnected phases (Figures 2 - 4).
- No significant relationship was evident between fish species diversity and phytoplankton chlorophyll concentration (Figure 5).
- No strong correlation noted between individual fish species and phytoplankton chlorophyll concentration.

Conclusions

- Differences in the relationship between the total numbers of fish and phytoplankton chlorophyll concentration as a function of timing during connection may be due to variation in the levels of hydrological connectivity. The most significant relationship occurred during a transitional period, when most of the patches were still connected to the river, while other sites were starting to disconnect or had become disconnected.
- It appears that phytoplankton abundance has little or no impact on fish species diversity. This could be because some physical conditions more strongly impact fish community structure and diversity, such as hydrology, depth, turbidity, and geomorphology (Halyk and Balon, 1983; Rodriguez and Lewis, 1997; Feyrer et al., 2004).
- Another possible explanation for the lack of a relationship is that other basal resources, such as detritus, are more important drivers of community organization or that, if biotic processes are important, that top-down forces are responsible.

Literature Cited

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