Sediment Trapping and Inflow/Outflow Phosphorus Turnover

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Field Research

If you have ever been swimming in Lake Eau Claire you know exactly what everyone else on the lake is also thinking, why is there all this algae everywhere. Lake Eau Claire annually has a very large abundance of algae growth every year making it very troublesome sometimes during the summer when water recreation is at its high. The main reason for the growth is the introduction of phosphorus into the lake which helps the algae bloom. Phosphorus is not only introduced through its following tributaries: Hay Creek, Muskrat Creek, and the Eau Claire River, but it is also settled in the lake which is recycled and kicked up by natural events. This can be tested not only through water samples but by the sediment that is being kicked up and settling in other places. The main focus this project is to monitor and record the phosphorus coming in and leaving the lake and also monitor the settling of lake sediment in different spots of the lake to be able to tell the natural phosphorous/nutrient loads and settling sediment patterns of the lake.

Hay Creek is one the few large tributaries of Lake Eau Claire. The creek starts north of Boyd, Wisconsin and runs 27 miles south before entering Lake Eau Claire. It flows through some intense agricultural areas and wetlands that are heavily pastured or surrounded by agriculture (upper 3.2 miles). The surrounding areas are comprised of 30% agriculture, 68% forest, and a few other tiny percentages of things including urban, wetland, prairie, and barren.

Muskrat Creek is another tributary that flows south 18 miles to Lake Eau Claire. Most of the creek is surrounded by county forest, but headwaters are affected by sources of polluted runoff. One site indicated a significant amount of organic loading affecting the macroinvertebrate population, probably caused by surrounding wetland.

The North Fork of the River begins in Taylor county. There is habitat degradation due to streambank pasturing, as well as low dissolved oxygen levels (particularly during low flow conditions). The water at the mouth of the river during high flow is brown and quite turbid. Due to such low dissolved oxygen (DO) the Lublin Wastewater Treatment Plant discharges to a dry run tributary, which is only authorized during spring and fall. The surrounding land use is 60% agriculture, 36% forest, 1.5% wetland, and a small percentages of others including barren, and urban.

Lake Eau Claire is known for a history of heavy algal blooms during times of warm weather. It also has a significant sedimentation near the inlets of tributary streams, which is being monitored, and the river. Sedimentation is causing navigational problems for some riparian residents.

External Loading. The Eau Claire River dominated annual and seasonal loading of suspended seston, particulate organic matter, total nitrogen, and total phosphorus to the lake in 1998, contributing over 90% of the material income. The reservoir was also a sink for total phosphorus on an annual basis, but net retention was affected by export of phosphorus during the summer as an apparent result of high internal phosphorus loading. Annual and daily loading by various external sources were estimated using the computer model Flux. Loading were estimated via either weighting concentrations with respect to flow or via a regression algorithm. (William F. James, John W. Barko, and Harry L. Eakin)

Past summer data that has been collected are as follows. External phosphorus loading via the Eau Claire River, Hay, and Muskrat Creeks incrementally increased and decreased under 1998 summer flow conditions to examine effects of changes in phosphorus loading on chlorophyll concentrations in the reservoir. Both total phosphorus and chlorophyll varied linearly as a function of changes in phosphorus loading, while

Secchi transparency responded positively primarily as a function of phosphorus loading reduction. With 50% phosphorus loading reduction, chlorophyll concentrations were reduced only by 30% while Secchi transparency increased by only 20%, over 1998 nominal levels. These modest responses to external phosphorus loading reduction were attributed to the important role that internal phosphorus loading plays in sustaining algal blooms in the reservoir, even when external phosphorus loading is diminished. In contrast, increasing external phosphorus loading100% over 1998 levels via, for example changing land use patterns (increasing agricultural land use urbanization coupled with declining forested lands, wetlands, and buffer strips), resulted in a near doubling of estimated summer chlorophyll levels over 1998 conditions to nearly 80 mg/m^3. (William F. James, John W. Barko, and Harry L. Eakin)

In late July (1998) through early August, concentrations again increased dramatically at all stations, exceeding 80mg/m^3 in the surface waters. Disruption of thermal stratification in August, and the occurrence of small storm-related inflows, was accompanied by a decline in viable chlorophyll concentrations at all stations by mid to late August. With the onset of autumnal overturn in September through October. These observations coincided with overturn and establishment of isothermal conditions starting first at the shallow station 3 in early September and progressing down reservoir to station 1 by October.(William F. James, John W. Barko, and Harry L. Eakin) Let me remind you that high levels of chlorophyll is directly related to the levels of phosphorus in the water.

The goal of this research is primarily interest in the topic of the lake environment. I took a summer science class in which we monitored the lake, and I was quite interested and had some fun. I then wanted to take another step forward and with the help of Paul Tweed, I was able to come up with a good project that would show you some interesting information on why Lake Eau Claire is what it is. We set it up to find the following: sediment settling at different points of the lake, finding the inflow, outflow, and residence time of the lake by finding the volume and calculating flow, and testing the amount of phosphorus going into the lake at different points at different times of the year.

My hypothesis for the sediment, without really looking to deep into it, was probably an average thought of many people. I believed that most sediment will collect around the mouth of the tributaries entering the lake, along the channel, and around the dam. When we set the traps out during the fall, we set three at 3 different locations. One was by the boat landing, along the channel. Another was toward the beginning of the channel of the river at the other side of the lake, and the third was set between the islands in the middle of the lake. In the spring they will be collected and taken back to the lab to be tested.

The sediment traps were homemade and easily at that. They are comprised of a long skinny pipe, which was the base, three PVC pipes cut into sections that are about a foot long, corked by a rubber cork, and hose clamps to hold the pipe onto the pipe. These pipes were then threaded with a rope that held a milk jug on one end, and a weight on the other so that it would stand vertically strait up and down. When they are collected they will be tested by emptying the contents into three container and then weighed with the contents. They will be then set out to dry the additional water and moisture out, and then weighed again. This will show the amount of sediment that was caught at each of the three different levels. After this is collected and recorded, then I will calculate the amount of sediment that settles over area of the lake with the knowledge of the size, volume, and sediment that was collected in the general area.

Testing for phosphorus is a different story altogether, it is much easier. There are three points in which are inflow, and one that is an outflow. I go to each point and I test the flow with a tool that hooks into a graphing calculator called a flow-o-meter. This is a plastic tube with a propeller on the end and according to how fast the propeller is moving that is how fast the current is. Then I fill three bottles with samples from the creek. Actually the experiment for testing for phosphorus is a rigorous one, and has to be followed very carefully. It is just a time tedious one and can be found in the "Hach: Phosphorous, Test 'n Tube Procedures.

The experiments and evaluations are completed, and the results are in. The lake inflow of phosphorus are considerable higher than the outflow over the course of the fall, winter, and spring. The lowest time for both was of course the winter, with all of the tributaries being almost entirely frozen due to their slow flow and shallow depth. The outflow was almost more at this time because of the size of the river that it flows out of, and the speed it flowed. The highest time was during the spring, in which the water raised quite a lot as did the speed. This shows that there is a lot of phosphorus settling in the lake, and that could be determined with the sediment traps. The sediment traps would tell how much sediment was kicked up and recycled around to different parts of the lake, clueing in on the natural cycle of the lake. The sediment trap experiment was never finished due to time constraints, but could be further evaluated with the information and data that was collected. The graphs that are attached on the back will show the raw data of the experiment that were accomplished.

As time goes along I hope to be able to get out and get quite a few more samples before its time to hang it up and start the "finale" of my project and make the slide show. Not to long after the ice breaks up and dissipates, it will be time to cruise around the lake in the boat to pick up the samples. I'm quite curious to seem how much sediment could accumulate and where the most did accumulate in the period of time. I know that there are two channels that flow east to west on the north side of the lake and south side of the lake but I wonder where the sediment will end up. There are still a bunch of questions that need to be answered that I hope I will have a chance to. I also will be able to see soon the difference between phosphorus inflow and outflow of fall to winter to spring and time goes on. I will be curious to see things winde down and things to change, and I will hope I will be able to come up with an answer for the changing.