NEWSLETZER OF THE LAKES OF MISSOURI VOLUNTEER PROGRAM



LMVP in Finland

LMVP coordinators were in Finland this August to present Missouri lake data. The event was the 29th Congress of the International Association of Theoretical and Applied Limnology. The conference meets every three years and is truly an international affair, with attendees from over 65 countries taking part in the Congress. Tony's talk was entitled *Bacterial Abundance in Missouri Reservoirs in Relation to Trophic State*, Dan presented *Response in the James River Arm of Table Rock Lake to Point Source Phos-*

his issue of The Water Line focuses on the current

projects of the University of Missouri Limnology

Laboratory. For instance, you can read about some

of the results from our Table Rock Monitoring project on

pages 6 to 7. Another project is the Statewide Lake As-

sessment, which has monitored Missouri's lakes since

1978. This project is highlighted on pages 2 to 3. A short

term project we're working on we call the "Daily Sampling"

and it involves sampling 3 reservoirs every day for 100 days. The goal is to see how precipitation influences our

regularly measured parameters and you can read about it

phorus Reductions. Dr. Jack Jones, program manager for all of the projects coordinated by the limnology laboratory at the University of Missouri (including the LMVP), presented Monsoon influences on the limnology of Juam Lake, South Korea. All of the presentations will appear as articles published in the 29th Congressional Proceedings.



ter's thesis work, which deals with the numbers of bacteria in Missouri lakes and their relation to phosphorus and algae. Essentially, as the phosphorus increases in the water, both algae and bacteria increase. Note that these bacteria aren't the kind associated with sewage that can make you sick. The bacteria in question are just run-of-the-mill bacteria that grow everywhere. In general, bacteria consume organic matter. If there's plenty of organic matter, the number of bacteria increases. These bacteria serve as food for the smaller animals that can be seen under a microscope. These smaller animals then become food for slightly larger (but still quite small) animals, and so

on. In some cases, bacteria can be more important than algae as a food source in a lake's food web. This work was part of the Statewide Lake Assessment Project and was funded by the Missouri Department of Natural Resources.

Dan's presentation is summarized on pages 6 and 7 in *Changes in the James River Basin.*

Tony Thorpe

Tony presented his Mas-

on pages 4 to 5.

Dan Obrecht presents data (including LMVP data!) to an international audience

We have more projects running than we have the space to describe! Some of the other projects are:

- a long term study of Lake of the Ozarks
- an once-weekly (for 52 weeks) monitoring of 16 northwestern Missouri lakes
- a study monitoring the distribution and causes of toxic algae blooms
- a study of chlorine by-products in drinking water

We'll highlight our other projects in future Water Line articles. Until then, keep an eye out for us on Missouri's lakes. You just might see us out there!



Missouri has a wealth of lakes available for public recreation that range from small community lakes that can be enjoyed best by canoe, to large impound-



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quarter of the lakes had average Secchi readings less than 28 inches while clearest 25% of the lakes had readings greater than 70 inches.

ments that would take a life-time to explore. With all of these waterbodies available to us, the sad truth is most of us spend all of our time on one or two lakes. While most of us are limited in the lakes we explore, this was not the case for Kurt and Joe. Kurt and Joe work in the limnology laboratory at MU and were the field crew for the Statewide Lake Assessment Project during 2004. They spent their summer traveling around Missouri sampling 61 different lakes.

Statewide assessments began in 1978, and have occurred every year since 1989. During this time over 150 lakes have been monitored, with most of these lakes having been monitored for at least 6 years and the key lakes within the state being monitored for over 20 years. This has resulted in what may be the most complete, long-term study of lakes within an individual state. Through this effort we have gained a better understanding of lake water quality and the factors that influence it, as well as how water quality varies in the short (within summer) and long terms (year to year). The data generated through the Statewide Assessment helps the state meet Clean Water Act requirements for monitoring lake water quality, but more importantly, the knowledge helps agencies (DNR, MDC, local governments, etc.) identify problems and manage our lakes.

During this past summer, Kurt and Joe took 244 Secchi transparency readings (each lake was visited on 4 occasions). The results reflect how variable lake water quality can be within the state. The overall average Secchi reading for the 61 lakes was 45 inches with individual lakes ranging from a low of 16 ½ inches to a high of 254 inches (21 feet!) of water clarity. One Past data have indicated regional differences in water clarity, and the 2004 data support this observation. The Osage Plains had an overall average Secchi of 26 inches, while the Ozark Highlands had an average of 67 inches. The Glacial Plains and Ozark Border regions were intermediate with averages of 37 and 48 inches, respectively. Regional differences are due to differences in geology (deep nutrient rich soils vs. thin rocky soils), topography (the steepness of the landscape influences the lake's volume), and land cover within the lake's watersheds (agricultural vs. forest).

Readers familiar with the Lakes of Missouri Volunteer Program might wonder if there will be a need for

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Using the hotel room as a laboratory is a requirement when sampling for the Statewide Lake Assessment Project. Pictured: Joe

(Continued from page 2)

Kurt and Joe in the future as the LMVP continues to grow. While both programs generate similar data (Secchi, total phosphorus, total nitrogen, chlorophyll, and suspended solids) there are some important differences. The Statewide Assessment is able to equip the field crew with a temperature/dissolved oxygen meter that allows for a vertical profile of each lake. This information shows us how the lakes are stratified or layered during the summer. The field crew also has gear for taking water samples from different depths. Currently, equipment cost limits the volunteers to just sampling at the surface of the lake. Another difference between the programs is that the Statewide Assessment crew can and do take other measurements and samples while on the lakes (total number of parameters measured varies from year to year as different questions about lake ecology are addressed).

In the past, supplemental monitoring has included: processing of various chlorophyll filters to investigate the size structure of the algal population, dissolved nutrient analyses to monitor the phosphorus and nitrogen available for plant uptake, zooplankton sampling to describe community structure and monitor invasive species, comparison of Secchi readings with and withOver 25 years worth of Missouri lake data have been collected by a single project coordinated by the University of Missouri's limnology laboratory



The filtering process is identical to that used by the Lakes of Missouri Volunteer Program.

Pictured: Kurt

out a view scope, bacteria sampling to gauge trophic state relations, testing of new field equipment, algal samples to determine community structure, light readings to explore the influences of turbidity, and a survey of algal toxins in our lakes. These supplemental samples have improved our understanding of Missouri's complex lakes. While volunteers collect quality data, it would be impossible to equip and train them to do all of this supplemental sampling.

As the volunteer program continues to grow, it will contribute more and more to the data we use to gauge current conditions and long-term changes in our lakes. But if we, as a state, are going to continue to expand our understanding of lake ecology as well as monitor for new water quality problems, we will need to have people like Kurt and Joe in the future. And my guess is they will be happy to spend their summer visiting lakes across the state.

As an LMVP volunteer , you diligently sample every three weeks. Haven't you ever wondered HOW'S THE WATER QUALITY ON THE OTHER 20 DAYS?

In this issue of the *Water Line* we're featuring some of the projects coordinated by staff at the University of Missouri's Limnology Laboratory. One such project is our "Daily Sampling". This is a project where 3 lakes were sampled for 100 consecutive days this summer by the lab. These lakes were monitored for Secchi, phosphorus, nitrogen, chlorophyll, suspended sediments, turbidity and color. The goal of this project is to track how parameters vary on a day to day basis in relation to rainfall. When you collect a sample every 3 weeks you can get a pretty good idea of what the average conditions are for the season. However, in order to determine how long sediments remain suspended following a storm you have to sample a little more intensively.

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One of the lakes sampled for the Daily project was Little Dixie. Little Dixie also happens to be sampled by a volunteer in the Lakes of Missouri Volunteer Program. This provided an excellent opportunity to compare some numbers. Another way to look at the data is to see how well the sampling interval (e.g. every 3 weeks) captures



the lake's "character", or average condition. The table shows some statistics for each project's observations. The Daily project features 100 Secchi values, one for each day, while the LMVP has only 5 Secchi values, or one approximately every 3 weeks. While the LMVP sampler didn't witness the day with the greatest clarity (50") or the day with the lowest clarity (13"), the average value recorded by the volunteer is only three inches less than the average of 100 days. That means that LMVP volunteers are doing a pretty good job of estimating summer conditions on their lakes by visiting once every 3 weeks.

If you look at Figure 1, you'll notice how the volunteer's measurements follow the University staff's Sec-(Continued on page 5)

collected values. We compared the volunteer Secchi values and the MUcollected Secchi values for corresponding dates. The difference was only two inches on 3 of the 4 days that both projects sampled Little Dixie. On one day, though, the difference in Secchi values was eight inches. That eight inch difference could have been caused by cloud cover moving in, increased wave activity or even the presence of sunglasses.



One way to examine these numbers is to see how the volunteer's values compared to that of the University



(Continued from page 4) chi values rather well. It was not uncommon for the clarity to shift up to



10 inches from one day to the next. Further evaluation of the chlorophyll and suspended solids data (after analyses are completed) will hopefully help us to explain these shifts.

Finally, it's worth noting that by going out every 3 weeks, volunteers aren't simply choosing the nicest, sunniest days to sample. Imagine how the data might differ if this particular volunteer only sampled when the sun was shining, or if he only sampled after rainstorms. By sampling at regular intervals, we ensure that we don't "skew", or bias, the data so it represents one lake condition more than another. It's also impor-

orld Water Monitoring Day is back again for its third year. Last year there were 4,842 sites registered in the US and 433 sites registered internationally. Missouri had 116 registered sites last year, with 40 of those being LVMP sites. Iowa had the most sites monitored with 643. Florida had the most participants

with a whopping *14,635*, compared to 352 in Missouri.

World Water Monitoring Day is somewhat different from the Secchi Dip-In, with the biggest difference being that the World Water Monitoring Day is, as you would expect, worldwide.

The "officially" monitored parameters include temperature, pH, turbidity, and dissolved oxygen. Test kits cost \$19.95



	MU Collected Secchi	LMVP Collected Secchi
Number of Observations	100	5
Minimum	13"	25"
Maximum	50"	33"
Average	31"	28"
Table 1. Summary statistics comparing University Secchi observations with LMVP volunteer Secchi observations		

tant to get as close to 8 samples as possible over the course of the summer. When the regular sampling intervals are combined with consistent sampling, we can be quite sure we have accurately represented that lake's summertime conditions. Plus, sampling is another excuse to get out on a lake on a summer day. Tony Thorpe

(including shipping), but aren't required. If you are a LMVP volunteer, you can use the thermometer and Secchi disk you already have to measure temperature and turbidity.

Though the official day is October 18, samples may be collected between September 18 and October 18.

> Most LMVP volunteers will be collecting their last sample of the year between these dates, so the effort required to participate is actually very minimal. If you wish to participate, visit the World Water Monitoring Day website at

worldwatermonitoringday.com

From the website you can register your site and enter your data. If you don't want to enter your own data, we can do it for you. Just turn over your data sheets like normal and Tony will be happy to enter your numbers. A sk anyone who has lived on Table Rock Lake for a few decades

Changes in the James River Basin

and they will tell you the lake has changed. This clear gem of the Ozarks has, over time, become a little more clouded. This is *especially* true for the James River Arm of the lake. However, efforts to halt the loss of clarity and reverse the trend of decreasing water quality may be paying off according to a review of data made by MU.

Brief History

The declining water quality in Table Rock Lake really came to the state's attention in the mid 1990's. Longterm MU data had identified a trend of decreasing water clarity at the dam. This, along with algal blooms, a fish kill and an increasingly loud voice of concern from the public motivated the state to take action. One result of the public and state's concern about Table Rock Lake was the adoption of a regulation to limit the amount of phosphorus being released from sewage treatment plants in the Missouri portion of the watershed. The Missouri Clean Water Commission passed a regulation in 1999 to limit the phosphorus concentration in treatment plant effluent to <0.5 mg/L. The City of Springfield was scheduled to meet standards by November 2003, but moved forward with plant upgrades and was able to reduce phosphorus concentrations in the effluent to regulated levels by March of 2001. Monitoring within the basin allows us to compare water quality in the James River Arm of the lake for both before and after Springfield started to meet the new standards. Results of the comparisons have been submitted for publication in the Proceedings of the International Society of Limnology 29th Congress. The information was also presented at the congress in Finland this past summer.

Findings

This review of data focused solely on the James River Basin. Sites ranged from a stream site located just below the Southwest Treatment Plant in Finley Creek to a lake site at Oswald Bluff, located 2 miles above the confluence of the James River Arm with the main lake (see **Figure 1** for site locations). The United States Geologic Survey monitored Sites 1 and 3 year-round. Site 2 was sampled through the University's Table Rock Lake Long-Term Monitoring (TRM) effort and was also sampled year-round. Sites 4 and 6 were sampled during the summer by the Lakes of Missouri Volunteer Program (LMVP). Site 7 was sampled yearround through the TRM project, while Site 5 data is combined summertime information from both TRM and LMVP.

Between July 1992 and February 2001 the treatment plant released between 4,170 to 68,570 pounds of phosphorus into the James River Basin per month, with a median value (middle) of 27,340 pounds. After the plant started meeting the new regulations, the amount of phosphorus released into the basin dropped by approximately 90%, to a median of 2,683 pounds with a range of 1,757 to 5,421 pounds per month. This decrease was mimicked in both Finley Creek and the James River (Sites 1-3) where phosphorus concentrations decreased by 69%-87%.

Within the lake (Sites 4-7) the summertime phosphorus values dropped by 33-50%, with the actual decreases ranging from a high of 49 μ g/L at Site 4, to a low of 5 μ g/L at Site 7 (See **Figure 1**). Statistically, the decreases in phosphorus throughout the basin were significant.

Algal chlorophyll within the lake (Sites 4-7) responded in a predictable fashion to the decreases in phosphorus. (Continued on page 7)



tions before and after treatment plant upgrades

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Actual shifts in chlorophyll during the summer ranged from no-change at Site 5 to a 17% decrease at Site 6. Generally speaking, as phosphorus decreased the algae became a little more efficient at using what was available. This is why the algal chlorophyll levels did not decrease in direct proportion to the phosphorus. Currently, the chlorophyll-phosphorus relation suggests that future decreases in phosphorus at these sites will lead to a greater change in algal chlorophyll.

The decreases that did occur in algal chlorophyll results in predictable changes in Secchi water clarity readings (**Figure 2**). In the upper James River Arm (Site 4) the clarity improved by only 5 inches, but this was a consistent improvement that was considered to be statistically significant. Given where this site is located on the hyperbolic curve of the chlorophyll-Secchi relationship, we would not expect very much increase in clarity with decreases in algal biomass. Secchi readings at Site 6 improved by 15 inches while Site 7 improved by 21 inches. We would expect noticeable changes in water clarity with decreases in algal chlorophyll at those sites, given their position on the Chlorophyll-Secchi curve (**Figure 2**).

Responses within the lake to decreases in phosphorus released from the Southwest Treatment Plant may not be a large as some would think. It must be pointed out that the data we have covered so far is from the summertime. During this period of the year the James River actually plunges underneath the surface waters of the lake due to differences in density (**Figure 3**). This means that the surface water samples that we are looking at were not directly influenced by the nutrient rich inflows. During the winter, when the lake is mixing, the inflows from the river directly impact the surface waters of the lake.

Samples collected at Site 7 during the winter indicate a greater response to decreased phosphorus than the samples collected during summer. Actual decreases in phosphorus concentrations were greater in the winter (11 vs. 5 μ g/L during the summer), as were decreases in algal chlorophyll (5.2 vs. 0.4 μ g/L) and increases in water clarity (57 vs. 21 inches). It is reasonable to assume that the rest of the James River Arm of the lake displayed greater response to decreased phosphorus during the winter months.



Regulation of the point sources within the Missouri portion of the watershed seems to be having the desired impact on lake water quality in the James River Arm of Table Rock Lake. Future monitoring will allow for better quantification of the actual impacts of management. Future monitoring will also be necessary to continue to gauge the impact of nonpoint source pollution from the watershed. As population, tourism, and agriculture grows in the lake's watershed, so will nonpoint source pollution threats. Some of the impacts are coming from Arkansas, which holds about 54% of the lake's watershed. Continuous monitoring is the best way to identify problems as they arise and protect the gains that we have made.

