Leesville Lake Water Quality Newsletter

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Lynchburg College Water Quality Center

In 2010, Lynchburg College partnered with Leesville Lake Association to join the water quality-monitoring program. The program ensures the continued health of the lake by monitoring nutrient and bacteria levels, which the Federal Energy Regulatory Commission deemed primary water quality issues. Because nutrient and bacteria levels come from shoreline development and watershed development, these levels are subject to change and are important to analyze and report for the health and safety of those using the lake and the native wildlife. Figure 1 shows the 8 sites LC samples at along the 17-mile stretch of Leesville Lake starting at the Dam and periodically stopping along the way until the tail waters. The data collected from the lacustrine section at the Dam is compared to the transition section at MM6 and to the riverine section at Toler Bridge. Parameters measured at the sampling sites with a hydrolab include temperature, conductivity, dissolved Oxygen, pH, Oxygen-Reduction Potential (ORP), turbidity, and secchi depth. Hydrolabs are instruments that have a probe attached that measures all the different parameters and can be lowered to different depths of the lake. Water samples are taken

Dr. Thomas Shahady sampling on the lake

Water quality sampling

from the sites for further testing at LC to determine *E. coli* levels and Total Phosphorus. If any bacterial concerns arise, then LLA would be notified. Instruments such as a new hydrolab and adding onto the existing water quality program allow LC to invest in maintaining the idyllic nature of this Blue Jewel. Additionally, analysis of the data compiled since LC first partnered with LLA can show any trends or changes throughout the years. Long-term analysis can help connect any problematic shifts in nutrient and bacteria levels to changes in the surrounding communities. The long-term data set is currently used by Dr. Thomas Shahady and students from Lynchburg College to research the effects of the power generation system of Leesville Lake on water quality. The LC water quality-monitoring program has an internship position available to students that provides an opportunity to apply classroom learning and experience fieldwork.

The water quality intern assists in sampling Leesville Lake and sample analysis. As the current intern, I can say that I've gained a whole lot of knowledge about water quality and this opportunity has allowed me to explore fields I'm interested in! Check out what else the LC water quality-monitoring program is up to! https://www.lynchburg.edu/academics/academic-community-centers/center-for-water-quality/

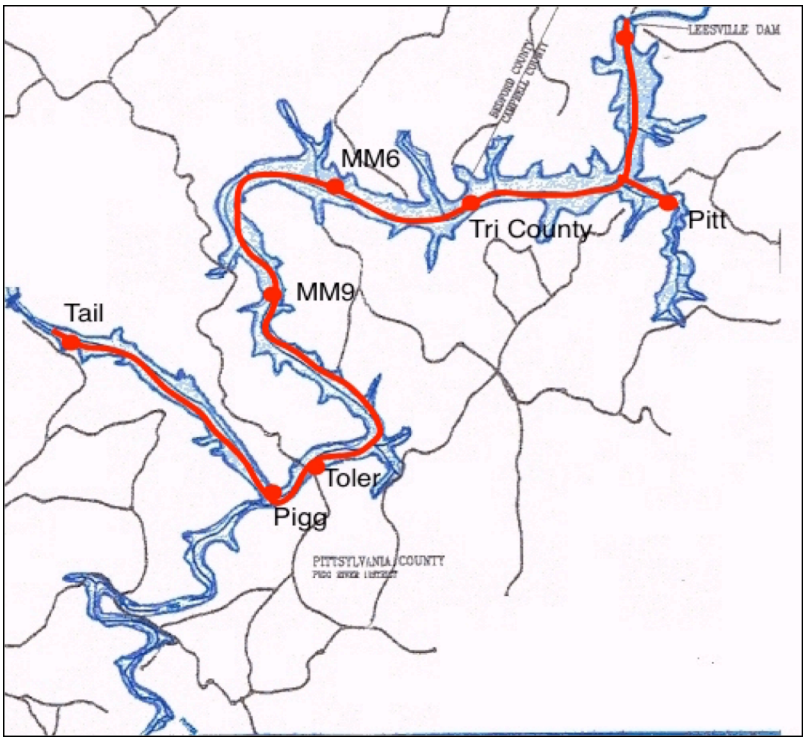


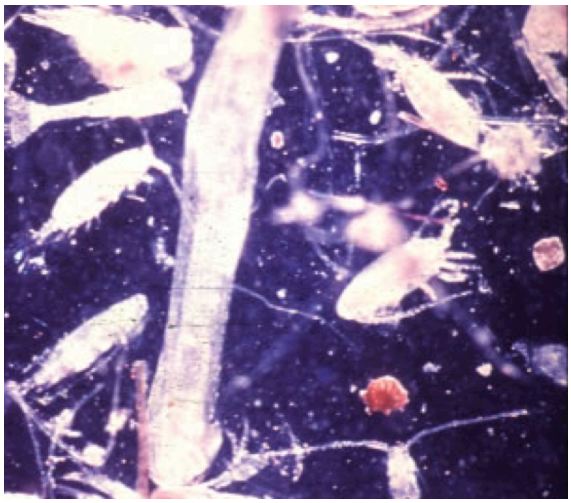
Figure 1 –The 8 Leesville Lake sampling sites

Zooplankton

Plankton are small organisms with weak swimming capacity typically found at the surface level of bodies of water drifting in the current. There are two different types of plankton: phytoplankton and zooplankton. Phytoplankton consist of plantlike organisms and are mostly consumed by zooplankton. Zooplankton consume Phytoplankton and therefore their numbers are dependent upon the Phytoplankton population, which usually increases during the spring as there is an increase is sunlight. Zooplankton help keep algae levels under control through predation.

Daphnia, a larger Zooplankton, are especially effective in this regard and can be used to increase water quality by limiting the accumulation of algae. Algae can be detrimental to lake health by causing oxygen depletion, which in turn harms organisms like fish that need oxygen to survive. The process of purposefully encouraging the increase in *Daphnia* to limit algal growth is called biomanipulation. Typically, after an increase in *Daphnia* in the spring, their numbers will dip as most of their food sources will have been consumed at that point.

Zooplankton, which are tiny animals ranging in size from 2 micrometers to 200 millimeters, are vital to marine ecosystems as they are a food source for fish. Zooplankton alternate between staying in the dark deep portions of the lake in the daytime and returning to the surface at night. This process is known as diurnal migration and allows zooplankton to avoid their predators and feed at the surface in safety. Zooplankton have also adapted to avoid predators by having transparent bodies or red coloring that would be easily absorbed at greater depths, making them blend into the dark light deficient surrounding. Zooplankton are indicators of changes in the environment due to their sensitivity to their surroundings. Zooplankton are highly sensitive to changes in nutrient levels (higher levels of phosphorus and nitrogen will be detrimental to the population), temperature, pollution, and predation intensity. Due to their high sensitivity, Zooplankton levels are often analyzed with relation to the overall health of the ecosystem.



A collection of different zooplankton –photo from University of Charleston

Monthly Water Quality Report

Lake Turnover and Seasonal Changes

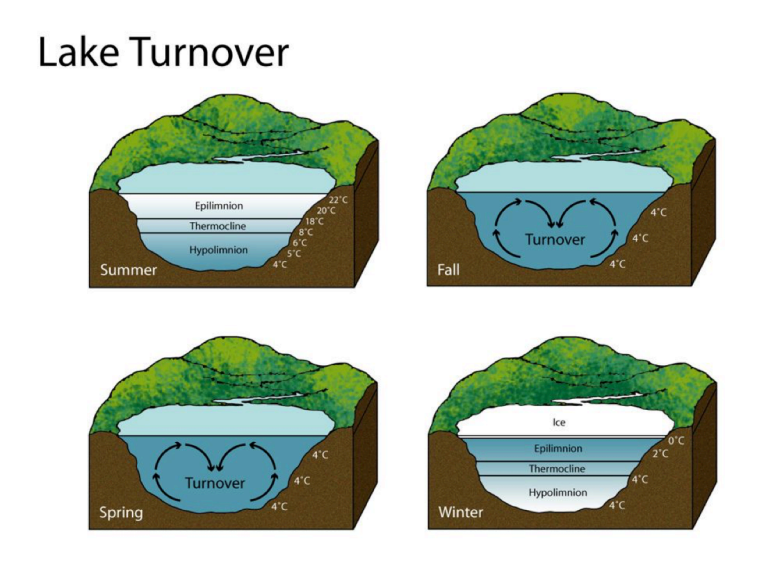
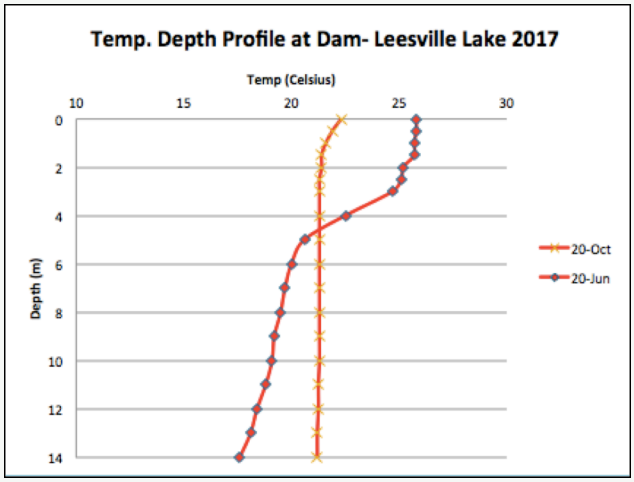
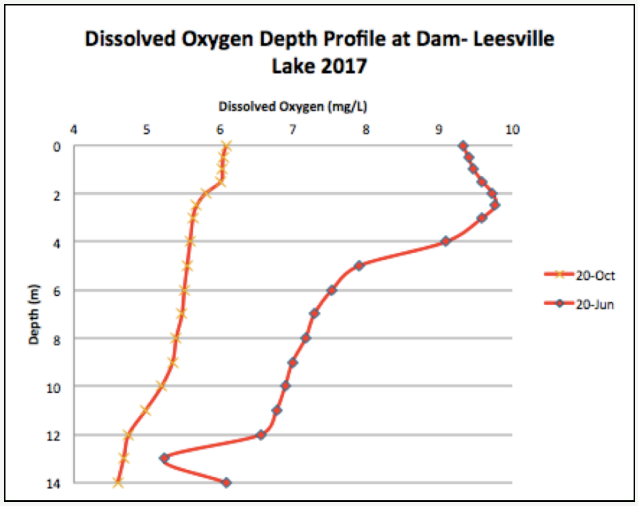


Figure 2 – Dimictic seasonal turnover

Lake turnover is a process where the surface layer of water sinks to the bottom and mixes with the different layers of the lake and often happens when there is a shift in temperature. There are three different layers of a lake: the epilimnion, metalimnion, and hypolimnion. The epilimnion is the topmost layer of the lake. It is the warmest layer during the summer months as it receives the most sunlight and has a higher pH and dissolved oxygen content due to the presence of aquatic vegetation such as the phytoplankton that zooplankton consume. The metalimnion is the smallest layer of the lake just under the epilimnion and is also referred to as the thermocline. In this layer, the dissolved oxygen levels and the temperature of the water significantly decrease. As the water gets colder in the thermocline, it increases in density and sinks to the hypolimnion. Water hits peak density at 4 °C (39 °F). The hypolimnion is the bottom layer of the lake and is the densest. This division of the lake based off temperature is called thermal stratification. In Leesville Lake, this stratification is periodic as reservoirs have some different characteristics than lakes. Thermal stratification becomes more pronounced as the depth of a lake increases and because Leesville Lake is moderately shallow, stratification is relatively minimal.

The depth of a lake also affects how often it turns over every year. A Monomictic lake has one turnover per year and occurs when lakes are either mostly cold or mostly warm for the majority of the year, but experience one brief change in temperature that sparks the turnover. Monomictic lakes are in arctic or high altitude regions or in lower temperate regions. A dimictic lake has two turnovers per year, one in the spring and one in the fall, and most commonly occurs in temperate regions. Polymictic lakes, what our Leesville Lake is, experience multiple turnovers per year. These lakes can turn over due to mixing





by strong winds, heavy rainfall events, or seasonal temperature changes and are only stratified for periods ranging from days to weeks.

In late September to early October, Leesville Lake begins the fall turnover. The decrease in sunlight and colder nightly temperatures that occur in the fall cools the water in the epilimnion. As the water cools, it becomes denser and the thermal stratification distinction between layers dissipates. The fall to winter months have warmer water in the hypolimnion below the colder water of the epilimnion, which is the opposite of what occurs in the spring to summer months. This leads to a mixing between the different depths of the lake and an even distribution of plant matter, oxygenated water, and nutrients. In fall turnover, the nutrient rich water that once was at the bottom rises to the top and can make the water look murky and decrease the dissolved oxygen. The decomposing plant matter that rises from the bottom can cause distinct odor changes as well.

The artificial movement of water between Smith Mountain Lake and Leesville Lake to generate power intensifies the amount of mixing throughout Leesville Lake. Leesville Lake alternates between 600ft to 613ft above sea level, meaning there is a significant difference in depth depending whether power generation is in operation. When water has been pumped back into SML and Leesville Lake is at a lower level, the thermal stratification becomes limited. We can expect another seasonal turnover from Leesville Lake as we get warmer weather towards the end of May.

Water Quality Research Members

Dr. Thomas Shahady has been conducting water quality research at Leesville Lake since 2006. He is an Environmental Science professor at Lynchburg College, and teaches a variety of freshwater ecology courses. He received his BS in Biology at Guilford College, MSP.H. in Environmental Biology at UNC School of Public Health, and PhD in Zoology at North Carolina State University. He has had experience with the EPA and North Carolina Departments of Environmental and Natural Resources. His research interests are in aquatic ecology, lake management, and environmental compliance.

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Wrenn Cleary is a new member to the Water Quality Project. She is a sophomore at Lynchburg College, majoring in Environmental Science. She will be the Water Quality Intern for Dr. Shahady 2018 academic year. She will be managing the water quality newsletter for the year, hoping to bring some basic understanding of what the research purpose is, and discussing the monthly findings. Please feel free to email her with any questions, concerns, or suggestions!

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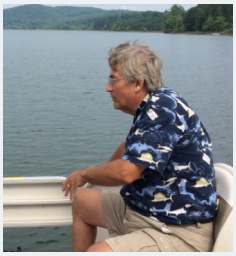
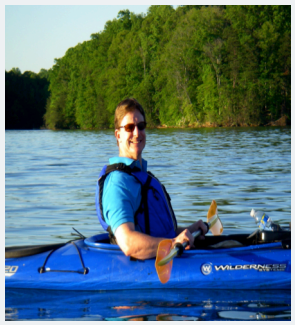
Anthony Capuco, aka Tony, has lived at Leesville Lake for 3 years. After receiving his BA in Biology from Hobart College, he went forward to pursue a PhD in Mammalian Physiology from Cornell University. He then had a 30-year career as a research scientist with the USDA- Agricultural Research Service as a lactation and cell biologist. He has been a member of the water quality committee for 3 years. Tony likes spending time woodworking, swimming, golfing, and time with family and friends.

Dave Waterman is a member to both Leesville Lake, moving here a little over a year ago, and the water quality project. Before joining the Leesville Lake community Dave received his BS in Economics at Northeastern University, which led to his career working for an electric company called National Grid. He recently began engaging in the water quality project volunteering with the TLAC Environmental Committee. During his off time he is a voracious reader, enjoys swimming and boating, and daily walks and hikes.





Mike Gooden is a member of the Leesville Lake Water Quality Committee. Before settling into the cabin his wife, Margy, and himself built in 2010, he received his Bachelor's degree in Chemistry of the University of Maryland at Baltimore County. He then worked at the National Institute of Standards and Technology from July 2007 to June 2016, acting as a liaison between the technical staff and the contracting office to generate contacts that met mission requirements. During his time off he enjoys hiking, running, kayaking, photography, reading, and helping others.