Fishing leads to investigation of environmental changes in waterways

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Undergraduate research students, Josh Price (left) and Zach Weagly (right) at lake preparing to collect water samples for chemical and microbiological testing. Downstream from swimming area at Blue Marsh Reservoir. Credit: Melissa Buchter, Penn State

A fisherman's curiosity led to identification of the correlation between microbial communities in recreational freshwater locales and seasonal environmental changes, according to a team of researchers from Penn

State.

Zachary Weagly, a 2018 graduate of Penn State Berks and an avid fisherman, noticed that the quality of the water where he fished changed with the local environment. He asked Tami Mysilwiec, associate professor of biology and one of his teachers, if he could use some of her laboratory's Biolog Ecoplates to test the water and a three-site, multiyear project to test freshwater in the Blue Marsh watershed in Pennsylvania began.

"Zach came to me because he is an avid fisherman and our campus abuts a tributary of the Schuylkill River, Tulpehocken Creek," said Mysilwiec. "When he went fishing he noticed changes in the water and the fish at various times.

Biolog Ecoplates are commercially available and contain three sets of identical wells that test for 31 different forms of carbon-containing chemicals. Bacterial communities have identifiable reaction patterns on these plates and researchers can characterize the communities and track changes in them through time and environmental change.

The first site tested is on a creek that receives runoff from agricultural land. The second site is a lake with an artificial dam that is unusual because water empties from the lake from below rather than falling over a spillway. The third site is downstream in an area with industrial complexes, a hospital and an airport.

Tuplehocken creek sampling site (upstream site). Credit: Zach Weagly, Penn State

"The three sites are in three different environmental areas," said Mysilwiec. "The water quality changes on a seasonal basis, which leads to the question of what happens to potential pathogens."

The testing plates can provide an idea of what the microbes in the water like to eat, and from that, a profile of the bacteria is possible. Some of the chemicals tested are antibiotics, nutrients, growth factors and other metabolites.

The researchers, including Jill M. Felker, research technologist at Penn State Berks and graduate student at Antioch New England, and Katherine H. Baker, associate professor emerita in the School of Science, Engineering and Technology at Penn State Harrisburg, looked at E. coli and Enterococci bacterial counts, because those are the two bacteria the U.S. Environmental Protection Agency uses to decide if recreational waterways are safe.

"We found that the lake near the survey was over the acceptable amounts 93% of the time," said Felker. "We also found that depending on the season, E. coli could be 36 percent higher than previously measured and Enterococci could be 86 percent higher than previously measured.

Blue Marsh Reservoir, near public-use swimming area (lake site). Credit: Zach Weagly, Penn State

"We do not know why this happens," she continued. The researchers wonder if it is phosphates and nitrates in runoff from agriculture from livestock or fertilizer.

The researchers also used 16S ribosomal sequencing to capture a snapshot of the pathogenic bacteria in the samples. The 16S rRNA gene is present in all bacteria and differences in this gene can identify the bacterial types.The researchers report today (Aug. 14) at the annual meeting of the Ecological Society of America in Louisville, Kentucky, that there were seasonal differences at all three sites and between the three sites. Levels of nitrate and phosphate increased in late fall and mid-spring. They found that microbial populations varied among the three sites, with numbers of colonies increasing in warmer months and peaking when human waterway use was highest.

Signs of human use were the levels of chemicals used in personal care products and agricultural practices.

The researchers noted that "common human practices can potentially change a waterway's chemistry, leading to the preferential selection of pathogenic microbial communities."

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