Session F7: Monitoring and Modeling Cyanobacteria Blooms, Session 1

Room C124
1:30 – 3:00 pm

0340
F7-1

A Comparison of Modeling Approaches to Predict Taste-and-Odor Occurrences in Cheney Reservoir, Kansas

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Cheney Reservoir, a primary drinking-water supply for the city of Wichita, Kansas, has historically had cyanobacterial-related occurrences of the taste-and-odor compound geosmin. Since 2001, the US Geological Survey, in cooperation with the city of Wichita, has routinely collected water-quality data (approximately bi-weekly to monthly) to evaluate the environmental factors affecting the occurrence of cyanobacterial nuisance compounds in Cheney Reservoir. A model was developed in 2003 to predict geosmin concentrations from continuously monitored, real-time environmental variables (temperature, pH, specific conductance, turbidity, dissolved oxygen, and chlorophyll). A multiple regression model was developed between geosmin and the variables turbidity and specific conductance ($r^2 = 0.71$, $p < 0.01$, $n = 18$) to provide a continuous estimate of geosmin concentrations in real-time. The model is conservative, and within model limits geosmin concentrations are more likely to be overestimated than underestimated. Other studies have found that geosmin also can be predicted in reservoirs using water-quality variables that cannot easily be measured continuously, such as phosphorus concentration and total algal biovolume. Since 2003, a larger data set of discrete water quality data (bi-weekly to monthly) and continuous data has been collected at Cheney Reservoir. For Cheney Reservoir, the increase in the size of the dataset and the inclusion of other water-quality variables may lead to a better predictive model with artificial neural networking. Artificial neural networks are used to create predictive models in complex systems with complicated interactions between a large number of variables. In this study, geosmin data were modeled using both continuous and discrete water-quality parameters in an artificial neural network. The network model is compared to other modeling techniques (i.e., linear, nonlinear, and logistic regression). The models are assessed for accuracy using multiple years of data to analyze the variance under different environmental conditions. In addition to models based on yearly data, seasonal models also are compared to the neural networks and regression models.

0343
F7-2

History of Cylindrospermopsis in a Large Flood-Control, Hydroelectric, and Water-Supply Reservoir in Northwestern Arkansas

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The US Geological Survey, in cooperation with Beaver Water District, a regional water utility, has monitored water quality, including phytoplankton community composition in Beaver Lake, Arkansas since 2002. Beaver Lake is a large headwater reservoir of a chain of three flood-control and hydroelectric reservoirs on the White River, spanning across northern Arkansas and southern Missouri. These reservoirs also serve as industrial and potable water sources and support fisheries and wildlife habitat and recreational activities. Water-quality samples have been collected at five sites along the mainstem of the White River in Beaver Lake since 2002. Analysis includes measurements of physical and chemical characteristics and phytoplankton identification and enumeration. Two additional sample sites have since been established, one in 2007 in the War Eagle Creek arm and the other in 2008 in the White River mainstem integrating the White River and War Eagle Creek contributions. Samples were collected at least six-times annually during 2002-2010 with the exception of the 2008 White River site, which was sampled monthly. In all, 317 phytoplankton samples were analyzed and 113 unique taxa have been identified. Cylindrospermopsis, a toxin- producing cyanobacteria of major concern, was identified for the first time at three mid-reservoir sites in September, 2004. Since 2004, Cylindrospermopsis biomass has increase by about three times in the most dense samples. In 2008, Cylindrospermopsis was found in all seven sites. Cylindrospermopsis biomass was greatest when water temperatures were between 25 and 32 degrees Celsius, total phosphorus around 0.02 mg/L, and total nitrogen around 0.3 mg/L. Preliminary results indicate that the smaller of the two major tributaries (War Eagle Creek) may be producing more Cylindrospermopsis than the larger White River mainstem. Therefore, War Eagle Creek may be feeding the White River mainstem at the upper end of the reservoir, with the residuals surviving and being transported downstream. This site of origin (War Eagle Creek arm), the major contributor of Cylindrospermopsis, may lend itself to potential mitigation in limiting the growth and accumulation of Cylindrospermopsis in the reservoir.

0290
F7-3

Phytoplankton Communities of Productive Ohio Reservoirs: Importance of Cyanobacteria and Ecoregion

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We analyzed 35 phytoplankton samples collected from 13 Ohio reservoirs located within three distinct ecoregions corresponding to heavily forested land (Western Allegheny Plateau), intermediate forestation and intermediate agricultural land use (Erie/Ontario Lake Plain), and intense agricultural land use (Eastern Corn Belt Plain) between May and October in 2008, 2009, and 2010. Phytoplankton community structure was affected by both ecoregion and water quality variables. Spring phytoplankton populations were composed primarily of diatoms and chlorophytes. Cyanobacteria populations peaked in late summer months and were dominated by nitrogen-fixing taxa in all three ecoregions. The nitrogen-fixing cyanobacteria commonly encountered in productive Ohio reservoirs during the summer included *Anabaena*, *Anabaenopsis*, *Aphanizomenon*, and *Cylindrospermopsis*. During summer stratification, reservoirs located in the more forested southeastern portion of the state were generally phosphorus-limited (high TN:TP ratio) and less productive than the more nitrogen-limited (low TN:TP ratio) reservoirs located in agricultural areas of central and western Ohio. Similarly, total phosphorus increased and Secchi disk transparency decreased from east to west. The importance of summer cyanobacteria absolute biovolume as well as percentage contribution to total phytoplankton biovolume also increased from east to west. Although the timing of cyanobacteria population peaks was the same in reservoirs of all three ecoregions, the mean amplitude was an order of magnitude higher in reservoirs associated with agricultural watersheds. Our limited data indicate that the shift to an increased proportion of cyanobacteria in reservoirs located in agricultural influenced watersheds during summer months was accompanied by a reduction in the mean TN:TP ratio and a decrease in mean Secchi disk transparency, suggesting both light availability and nitrogen limitation may be factors influencing the qualitative and quantitative characteristics of phytoplankton populations in these Ohio reservoirs. The impact of land use patterns and thermal regimes of the reservoirs on phytoplankton community structure will be discussed.

0331
F7-4

Creating Cost-effective Regional Algal Bloom Monitoring Networks

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Algal blooms pose serious threats to the health of aquatic and terrestrial ecosystems, local economies, and humans. Understanding patterns in the distribution, intensity, and frequency, as well as the effects, of algal blooms requires consistent water-quality monitoring. Although fundamentally important, such projects are difficult to implement because of the high costs for travel and staff needed to collect and process samples. We propose a new approach for effective and efficient regional water-quality monitoring that integrates academics, state and federal scientists, and industry researchers with complementary needs and capabilities. In 2008-2010, we leveraged existing monitoring efforts of several agencies into a prototype collaborative algal bloom monitoring network. This resulted in the sampling and analysis of hundreds of samples from AL, GA, FL, TN, and KY with limited additional funds. Data generated from this project were used to develop the first water-quality models used to predict blooms of freshwater phytoplankton, cyanobacteria, and toxic cyanobacteria for the southeastern US We are now starting a new project to enhance our existing dataset and models. More information about this project is available on the web at: http://wilsonlab.com/bloom_network/. We will provide resources and information gleaned from our past experiences to aid in establishment of similar algal bloom monitoring networks elsewhere in the US In the future, the union of these monitoring networks could provide analytical and intellectual infrastructure needed to improve existing water- quality policies and management strategies.