Abstracts

Thursday, May 1

Session L5: Multiple Stressors and Water Quality Impairments

1:30 – 3:00 pm | Room

Software for Analysis of Chemical Mixtures: Composition, Occurrence, Distribution, and Possible Toxicity

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Abstract
The composition, occurrence, distribution, and possible toxicity of chemical mixtures in the environment are research concerns of the U.S. Geological Survey and others. The presence of specific chemical mixtures may serve as indicators of natural phenomena or human-caused events. Chemical mixtures may also have ecological, industrial, geochemical, or toxicological effects. Chemical-mixture occurrences vary by analyte composition and concentration. Four related computer programs have been developed by the National Water-Quality Assessment Program of the U.S. Geological Survey for research of chemical-mixture compositions, occurrences, distributions, and possible toxicities. The compositions and occurrences are identified for the user-supplied data, and therefore the resultant counts are constrained by the user's choices for the selection of chemicals, reporting limits for the analytical methods, spatial coverage, and time span for the data supplied. The distribution of chemical mixtures may be spatial, temporal, and (or) related to some other variable, such as chemical usage. Possible toxicities can be optionally estimated from user-supplied benchmark data.

The software for the analysis of chemical mixtures described in this presentation is designed to work with chemical-analysis data files retrieved from the U.S. Geological Survey National Water Information System but can also be used with appropriately formatted data from other sources. Use and functionalities of the mixture software will be presented. This software was designed to function with minimal changes on a variety of computer-operating systems. To obtain the software presented here and other U.S. Geological Survey software, visit http://water.usgs.gov/software/.

Headwaters Stressor Identification Study for the Central Great Plains Ecoregion of Kansas and Nebraska

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Abstract
The purpose of this study was to identify potential pollutants contributing to biological impairment in headwater streams of the Central Great Plains Ecoregion by targeting 16 waterbodies in northern Kansas and southern Nebraska. Four of the 16 waterbodies were listed as impaired and identified by EPA. Using the available GIS layers, the remaining 12 waterbodies were selected to provide a reference condition where there is minimal human disturbance. Locating sites with minimal human disturbance was challenging due to widespread agricultural land use and difficulty obtaining landowner permission for access to many streams. Waterbodies were sampled for ambient water quality, biology, and habitat in both the spring and fall seasons. However, severe drought conditions throughout the study area prevented sampling the full number of stations selected. In total, only eight of the 16 waterbodies were sampled, but additional samples within these waterbodies were taken to improve their characterization

We applied EPA's CADDIS framework to identify potential stressors in the reference and impaired streams and analyzed the data using a range of statistical approaches from simple descriptive statistics and box plots to complex Bayesian models. Datasets with low sample size tend to violate the assumptions of parametric statistical

methods. For example, the data are unlikely to be normally distributed or have homogeneous variances. For this reason, we used simple data exploration methods and non-parametric statistical methods to evaluate the distribution of the data and to make comparisons between the reference and impaired condition and among land use types. Likewise, we applied Bayesian approaches because they are able to handle small or incomplete datasets and incorporate data from a variety of sources to inform modeled relationships. In consultation with the EPA and our external partners, we revised our technical approach to enhance the primary monitoring data with state-collected data and leverage similar data sets for parameter relationships. We also conducted a literature review on the effect of drought and water use on stream base flow, and the biological recovery of streams after droughts. The approaches explored in this study provide a methodology that could be applied if more data were to become available.

Drowning in Data: Leveraging Multi-Parameter Datasets to Inform Adaptive Management-Based Restoration in the Long Creek Watershed, a Small Urban-Impaired Freshwater Stream in Coastal Cumberland County, Maine

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Abstract
Long Creek is a small urban-impaired stream in a commercial/retail district in the greater Portland, Maine area. Anthropogenic disturbances within the watershed have resulted in degraded water quality, habitat loss, and sedimentation. Long Creek fails state water quality standards due to elevated concentrations of metals, chloride, phosphorus, nitrogen, PAHs, and low dissolved oxygen. Altered hydrological conditions and increased water temperatures further contribute to stream impairment. These stressors manifest themselves differently throughout the watershed and may not impact stream reaches equally. Understanding how stressors collectively impact the overall system is critical when considering policy and best management practices to restore streams.

In 2009 the United States Environmental Protection Agency exercised its Residual Designation Authority (RDA) in the Long Creek Watershed. This precedent-setting use of RDA led to the establishment of the Long Creek Watershed Management District (LCWMD), which implements stormwater permit requirements for 70% of the watershed's impervious cover using the Long Creek Watershed Management Plan. The plan includes pollution prevention practices, stormwater retrofits, riparian corridor restoration, and a monitoring assessment program. The Plan relies on an adaptive management approach utilizing structural and nonstructural best management practices to attain water quality classification standards by 2020.

The Long Creek project is approaching the end of its first 5-year permit cycle. Prior to negotiating the next 5-year permit, LCWMD is reviewing progress of restoration efforts using water chemistry, stream flow, and channel geomorphology data collected since 2010. This presentation will provide an overview of the Long Creek monitoring program and describe how adaptive management has yielded a comprehensive program integrating GIS, chemical, meteorological, riparian corridor, macroinvertebrate, hydraulic, and hydrologic datasets to inform permit negotiations. This dataset has led LCWMD to consider stressor identification and management as a model for urban stream restoration rather than the criteria-based model that is common to point-source discharges or the TMDL model that is being implemented in other watersheds in the region. By using this model, LCWMD will attempt to identify the highest priority (or most challenging) stressors within the watershed, and focus limited resources on solutions that are more likely to yield improvements to water quality.