Poster Session B

Pre-Function Lobbies (Concurrent Session Level)
2:30 pm – 3:30 pm

0376
P

Calibration of the Biological Condition Gradient (BCG) for Fish Community Assemblages in Connecticut and Southern New England

Michael Beauchene[1], Christopher Bellucci[1], Jereon Gerritsen[2] and Jen Stamp[3]

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The BCG is a scientific model that evaluates alteration to biological structure and function in a number of levels relative to an anchor or baseline of "minimally disturbed" conditions. The US EPA and state entities in New England have partnered to develop a common assessment system based on the Biological Condition Gradient (BCG) for several fish community assemblages of Connecticut streams. This is achieved via a collective exercise among regional biologists to develop consensus on the membership of an assemblage to one of the BCG tiers. Through discussion of tier assignment rationale for each fish community sample and description of biologist's *gestalt* we have developed a set of quantitative decision criteria rules for assigning fish community samples to BCG levels. The tools developed from this exercise will augment existing multi-metric indices as well as bolstering best-professional judgment. This process will not only be applicable to Connecticut, but also to neighboring states as well.

0553
P

Calibration of Biological Condition Gradient (BCG) Models for Fish Assemblages in Minnesota, Michigan and Wisconsin

Jeroen Gerritsen and Jen Stamp

Tetra Tech, Inc., Owings Mills, Md., USA

The Biological Condition Gradient (BCG) is a consistent way to assess aquatic biological data, independent of sampling protocols and compatible with accepted ecological theory. The US EPA and state and tribal entities in Minnesota, Michigan and Wisconsin have partnered to develop a common assessment system based on the Biological Condition Gradient (BCG) for fish and macroinvertebrate assemblages in streams (warm, cool, and cold) of the region. The final product is a quantitative set of decision criteria rules for assigning samples to BCG levels, based on expert elicitation. We summarize the decision criteria rules for the fish assemblage and stream type, the process we went through to derive them, and the challenges, in particular with classification, which we faced when developing them.

0354
P

Assessment of Water Quality and Biota in Korean Reservoirs

Bomchul Kim[1], Yunkoung Lee[1], Jai-ku Kim[1], Jaeyong Lee[1], Myoung-sun Shin[1], Changwon Jang[1], Mansig Jun[2] and Yukong Jung[1]

[1]Kangwon National Univ., Chuncheon, Republic of Korea,[2]Research Institute for Gangwon, Chuncheon, Republic of Korea

The goal of aquatic habitat management is being changed from water quality management to the improvement of ecological integrity in lakes and reservoirs in Korea. Korean Ministry of Environment recently launched projects to develop assessment systems of ecological health in lentic habitats. Because there are few natural lakes in Korea, most of study is focused on reservoirs. By analyzing data of more than 500 reservoirs, the lake water quality index (LQI) representing Korean reservoirs was developed. The LQI developed by artificial reservoirs was better adapted to Korean reservoirs than trophic state indices developed for natural lakes. In order to develop quantitative indices of biological integrity in reservoirs, biotic and abiotic habitat surveys are being conducted; phytoplankton, zooplankton, benthos, fish, littoral vegetation, and morphological characteristics. As the first step to normalize survey methods, sampling methods and gears are compared for fish, macrophytes, and benthic macroinvertebrates. To compare sampling efficiency of various methods, comprehensive monitoring of water quality and biota were condedted. Multimetric system

adapted for Korean lakes and reservoirs were developed for biotic assessment. Final goal of this project is to make an integrated index representing ecological health condition of lentic ecosystems in Korea

0141

Comparison of Two Adjacent Watersheds Using Multi-metric Macroinvertebrate Indices to Assess Biological Conditions in the Kansas City, Missouri Metropolitan Area, 2007 to 2011

Eric Christensen and Heather Krempa

US Geological Survey, Missouri Water Science Center, Lee's Summit, Mo., USA

Macroinvertebrate samples were collected in separate urban stormwater studies in adjacent basins in the Kansas City, Missouri metropolitan area: the Blue River Basin (2002 to 2010; 7 sites) and the Little Blue River Basin (2007 to 2011; 10 sites including Rock Creek which drains directly to the Missouri River). Two rural sites representative of the area's ecoregions (Central Dissected Till Plains and Osage Plains) were included for comparison. Consistent procedures between the studies allowed for statistical comparisons. Both basins are substantially urban; however, differences exist that may affect macroinvertebrate communities. The Blue River has no flood control reservoirs and receives wastewater effluent and stormflow from a combined sewer system. The Little Blue River has flood control reservoirs, receives no licit effluent, and has a separate stormwater sewer system.

Multidimensional scaling (MDS) plots based on metrics, indices, and environmental factors will be used to visually analyze similarities/dissimilarities in the data. Taxa abundance, tolerance, and abundance of functional feeding groups will be used to assess differences among stream basins, differences among samples, and measures of urban intensity and selected environmental factors.

The Missouri Stream Condition Index (SCI), a 4-metric index, will be used to evaluate the aquatic-life status of the streams. SCI scores can indicate differences among the Blue River Basin, Little Blue River Basin, and rural sites. Unique multi-metric indices (MMIs) will be calculated from a list of candidate metrics using step regression to a simple urban intensity index. Comparisons among calculated MMIs and MMIs from local and national studies will be made to determine the response to the urban gradient. Scores typically decrease with increasing urbanization.

0393
P

The Extent of Fishing and Fish Consumption in the Los Angeles and San Gabriel Rivers Watersheds, California

Andrew Tsiu, Laura Quintero and Kristy Morris

Council for Watershed Health, Los Angeles, Calif., USA

Despite the popularity of fishing in the freshwater lakes and streams in the Los Angeles and San Gabriel River watersheds, little is known about the extent of fishing and fish consumption amongst fishermen. One of the objectives of the Council for Watershed Health's watershed-wide monitoring programs is to provide information on whether locally caught fish are safe to eat. As a preliminary step, a survey was developed and conducted to ascertain trends on the extent of fishing and fish consumption and provide vital information of demographics of fishermen including gender, age, ethnic background and annual income.

Surveys commenced in June 2010 and were ongoing through August 2011. During this period, 87% of fishermen that were approached agreed to participate in the survey. A total of 254 fishermen were surveyed, with 111 in the Los Angeles River watershed and 143 in the San Gabriel River watershed. In the Los Angeles River watershed approximately 56% of fishermen interviewed were self-identified as Latino/Hispanic, while in the San Gabriel River watershed 48% self-identified as Latino/Hispanic and 26% of White/Non-Hispanic origin.

The survey results identified catfish and bluegill as the most frequently consumed fish in both the Los Angeles and San Gabriel Rivers watersheds. Fisherman typically ate the fish whole and gutted, and frying was the most popular method for preparing the fish.

The results from this monitoring survey have already provided valuable information on fish consumption on both regional and sub-watershed scales. Continuation of the surveys is recommended in order to maintain and provide data to agencies tasked with promoting and educating local fisherman about fish consumption advisories, as well as to ensure that dissemination of information is relevant and appropriate to those populations who are at high risk of suffering health consequences as a result of watershed fish consumption.

0108
P

The Influence of Reducing Full Macroinvertebrate Sample Data to a Common Fixed 300 Individual Count on Assessments of Stream Quality

Jean Sifneos and Alan Herlihy

Oregon State Univ., Corvallis, Oreg., USA

Much research has been done on determining the optimal number of macroinvertebrate individuals to use when calculating metrics to describe stream quality. Often, however, the number of individuals counted in the laboratory for each sample varies from the predetermined count in the study plan. As taxa richness is highly dependent on sample counting effort, this usually requires that all samples in the dataset be reduced to a common fixed number of individuals for data analysis. Typically, the fixed count is set so that most of the samples have the required number of individuals and a random subsample of this number of individuals is taken from the full laboratory count of each sample. The bioassessment measures are then calculated from this random subsample. How different would the bioassessments be if a different random subsample of individuals had been chosen? To address this question, we analyzed the full laboratory macroinvertebrate count data from 2469 samples collected during EPA's National Wadeable Streams Assessment (WSA). We took 1000 random subsamples of 300 individuals from each full sample and examined the variability of four bioassessment measures; predictive model observed/expected taxa ratio (O/E), total taxa richness, EPT richness and the WSA multimetric index (MMI). For the 1000 random subsamples of macroinvertebrates the coefficient of variation for all bioassessment measures increased as the number of individuals in the site increased and then tended to level off. Total taxa richness was the least variable metric and EPT Richness was the most variable. The median coefficient of variation for all sites for MMI was 7.27 and was 6.84 for O/E. The median standard deviation for all sites for MMI was 3.39 and was 0.06 for O/E. The coefficient of variation and the standard deviations of MMI and O/E were different for different aggregated ecoregions and different quality sites (Good, Fair, Poor) but not vastly so. We hope that investigating the relationship between the variability of the metrics and the number of individuals counted in a site enables researchers to make more informed decisions about the precision of the metrics under different situations and regions.

0448
P

Water Quality Dynamics and Phycocyanin Detection as a Biomass Indicator in Upper Klamath Lake, Oregon, 2011

Blake Eldridge[1], Liam Schenk[1], Sara Eldridge[1], Tamara Wood[2] and S. Wherry

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Seasonal growth and decomposition of phytoplankton blooms dominated by the cyanobacterium Aphanizomenon flos-aquae in hypereutrophic Upper Klamath Lake, Oregon, cause extreme water-quality conditions characterized by high pH, extremely low dissolved-oxygen concentrations, and high levels of un-ionized ammonia, which have historically contributed to the overall decline in populations of endangered Lost River (Deltistes luxatus) and shortnose (Chasmistes brevirostris) suckers. In addition, previous work by the U.S. Geological Survey and others has shown the presence of microcystins in the lake at concentrations that may also be detrimental to juvenile sucker health. From May to October, 2011, continuous water-quality monitors were deployed at four sites in the lake to record pH, dissolved oxygen concentrations, water temperature, specific conductance, and phycocyanin (a photosynthetic pigment specific to cyanobacteria, measured at two sites). Water column samples were also collected weekly and analyzed for concentrations of chlorophyll a, total and dissolved nutrients, dissolved and particulate microcystins, and total particulate nutrients. Twice during the season, additional water samples were collected at 3-hour intervals over a 24-hour period at one site in the deepest part of the lake. In addition, vertical profiles were collected with a phycocyanin sensor weekly at monitoring sites to quantify the spatial variability of phytoplankton throughout the lake and to describe the distribution of buoyant colonies in the water column.

Chlorophyll a has been historically used as a biomass indicator in Upper Klamath Lake and phosphorus concentration provides a means to calculate internal loading and downstream export, but both quantities are only collected on a weekly basis during the summer months. In an effort to acquire denser temporal information about both quantities in a cost-effective way, the use of the continuously deployed phycocyanin, dissolved oxygen, pH, and temperature sensors to develop a surrogate for biomass and phosphorus was investigated. Six multi-variate regression models were created for two sites to calculate depth-integrated cyanobacteria cell counts, chlorophyll a concentration, and total phosphorus concentration, as a function of data collected by continuous sensors deployed at two locations in the water column. The models returned adjusted R2 values between .92and .72, indicating that they could be used successfully to interpolate chlorophyll a and total phosphorus concentration values between weekly physical sample values.

0447

Surrogate Bed Load Measurement Using Impact Sensors on the Elwha River During and After Dam Removal

Robert Hilldale[1], Brian Carpenter[2], James Chambers[2], Bradley Goodwiller[2], Timothy Randle[1] and Daniel Kleinert[2]

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Bed load on the Elwha River will be monitored during and after removal of the Glines Canyon and Elwha dams using a series of instrumented steel plates which monitor the vibration from gravel impact. There are 72 steel plates, each instrumented with either a geophone or an accelerometer, spanning a diversion weir downstream of both dams. Previous to the installation, laboratory flume research was performed to produce algorithms to correlate the bed load data to the signals generated by both types of sensors which were mounted to the underside of the steel plates. With this prediction information, a 72 channel data acquisition system was designed and installed to capture, analyze and store the bed load data. Preliminary tests to determine the minimum gravel detection size have indicated that plates instrumented with accelerometers are capable of detecting a geometric mean particle size of approximately 6 mm, while the plates with geophones were only able to detect particles with a geometric mean particle size of 25 mm. Plans are in place to calibrate the bed load measured by the steel plates with field measurements using a pressure difference sampler taken at the same cross section on the Elwha River. This paper will document progress to this point and discuss future plans.

0095
P

Status Network Water Quality Sampling within the St. Johns River Water Management District: Annual Sampling Cycles 2009 to 2010

Aisa Ceric[1], Steve Winkler[1], Gail Sloane[2] and Thomas Seal[2]

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Since 1996, the Florida Department of Environmental Protection (FDEP) has been working together with regional water management districts, local governments, and other entities to establish an Integrated Water Resources Monitoring (IWRM) Program. The IWRM program combines surface and ground water monitoring efforts, which consist of water chemistry, biological, and sediment assessments. There are three levels of monitoring design: (1) a Status Network monitoring program that allows statistical inferences about state waters, (2) more intensive basin monitoring used to identify and confirm impaired waterbodies, and (3) site-specific regulatory compliance monitoring.

The Status Network is based on a probabilistic monitoring design to assess the state's surface and ground water quality. Probabilistic design allows the characterization of water resources quality with a known statistical confidence. Although the probabilistic design provides information about resources type quality, it provides very little information about individual lakes, rivers, or streams. Florida's waters are divided into six resource types. The four surface water types are small lakes, large lakes, rivers and streams, while the two ground water types are unconfined and confined aquifers. Since 2009, the Status Network divides the state into six zones, each zone is sampled annually; the entire SJRWMD area is in one zone. Approximately 10 samples are collected twice from each resource type in a given zone. Consequently, in each zone, approximately 120 samples are collected for the surface and ground water resources types in addition to quality assurance samples. The resource types are sampled during a so-called "index period", which is established as a time of the year with high biological activity. Thus, the Status Network would potentially indicate the "worst-case scenario" for the selected indicator of each resource type.

This poster presents results from the three most recent annual cycles (2009-2010). In general, the Status Network is useful for: 1) characterizing regional and basin water resource conditions, 2) determining percentages of each resource type that meet/exceed state standards within each zone with known confidence limits using core indicators, 3) comparing resource conditions within the zone and the state as a whole, and 4) comparing resource types with each other.

0124
P

What's New with the National Hydrography Dataset Plus (NHDPlus) Version 2?

Tommy Dewald[1] and Cindy McKay[2]

[1]US Environmental Protection Agency / Office of Water, Washington, D.C., USA, [2]Horizon Systems Corporation, Herndon, Va., USA

The National Hydrography Dataset Plus (NHDPlus) is a suite of geospatial products that build upon and extend the capabilities of the NHD by integrating it with the National Elevation Dataset and the Watershed Boundary Dataset. Interest in estimating NHD stream flow volume and velocity to support pollutant fate-and-transport modeling was the driver behind the joint US Environmental Protection Agency and US Geological Survey effort to develop NHDPlus. NHDPlus has been used in a wide variety of applications since its initial release in the fall of 2006. This widespread positive response prompted the multi-agency NHDPlus team to design an enhanced NHDPlus Version 2 that is currently under production and scheduled for completion during 2012. This presentation will provide an overview of NHDPlus status and plans.

0499
P

Update on the US EPA Integrated Reporting Activities Charles Kovatch, Shera

Reems, Wendy Reid and Jamie Fowler

US Environmental Protection Agency, Washington, D.C., USA

In 2012, states and the US Environmental Protection Agency (EPA) will be preparing for the biennial Integrated Report (IR). Under Clean Water Act Section 305(b), states make assessments of their waters to determine whether their waters support their designated uses, and under Section 303(d), states list the waters that are impaired or threatened by a pollutant and needing a Total Maximum Daily Load (TMDL). EPA guidance recommends that these two reporting efforts are combined to form an Integrated Report that meets the requirements of both assessment and impairment decisions

The purpose of this presentation is to provide an update on EPA's activities related to the Integrated Reporting Program. The presentation will provide a summary of the 2010 IR cycle and a status on new activities related to the EPA's interest to improve reporting timeliness and reduce reporting burden. The activities covered in this presentation will include a geospatial pilot to evaluate the types of geospatial information collected and reported to EPA within the IR, a review of the core IR data elements with an intention to establish a data standard, and an evaluation of the IR review and approval process to determine where efficiencies can be gained.

0419
P

The Freshwater Biological Traits Database

Jen Stamp[1], Liejun Wu[2], Jeffrey White[2], Anna Hamilton[3] and Britta Bierwagen[4]

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The Freshwater Biological Traits Database currently contains traits data for 3857 North American macroinvertebrate taxa, and includes habitat, life history, mobility, morphology and ecological trait data. These data were compiled for a project on climate change effects on river and stream ecosystems that was conducted by the EPA Global Change Impacts and Adaptation Group. Data gathering efforts focused on data that were published or otherwise well- documented by trustworthy sources, accessible, appropriate for the regions being studied, in a standardized format that could be analyzed or easily converted to a format that could be analyzed, and ecologically relevant to the gradients being considered. We have made an experimental version of this database accessible online to facilitate further research. This is intended to be a 'living' database, and we encourage you to contribute data and provide suggestions or feedback on how we can expand and improve on it in the future.

0265
P

Integration of Routinely Collected Municipal Monitoring Data Sets to Supplement a Regional Dissolved Oxygen Total Maximum Daily Load (TMDL) Model

Jeremy Hanlon[1,2], Mary Kay Camarillo[3], Ashley Stubblefield[1] and William Stringfellow[1,2]

[1]Ecological Engineering Research Program, Univ. of the Pacific, Stockton, Calif., USA, [2]Earth Sciences Division, Lawrence Berkeley National Laboratory, Berkeley, Calif., USA, [3]Civil Engineering Dept., Univ. of the Pacific, Stockton, Calif., USA

Water quality data was collected by the Ecological Engineering Research Program (EERP) at the University of the Pacific for calibration of a Watershed Analysis and Risk Management Framework (WARMF) model. The WARMF model is being used to support the creation of a total maximum daily load (TMDL) for oxygen depleting materials in the San Joaquin River. The SJR is located in the intensively farmed Central Valley of California and is included on the federal 303d list of endangered waterways for lack of dissolved oxygen. In this project, water quality sampling was expanded from the riverine portion of the river to include 17 sites in the estuary region of the SJR. Sampling was conducted on a weekly basis during the summer and fall months of one calendar year. All EERP sample collection and analysis was performed according to a Quality Assurance Project Plan (QAPP), compatible with the California state Surface Water Ambient Monitoring Program (SWAMP). Field measurements were made with a handheld multi-parameter water quality instrument and grab samples were taken for phytoplankton enumeration and classification, measurements of algal toxin production, and water quality parameters such as nutrients and organic carbon. Efforts were also made to locate and obtain data collected by other agencies. The City of Stockton (COS) performs water quality testing on a weekly basis as part of routine regulatory monitoring but on different days and not at exactly the same locations as EERP. A comparison with the COS data set was completed to determine if the two data sets were comparable and whether or not the COS data could be used to extend our study spatially and temporally. Comparison of the two data sets indicated consistent results in seasonal trends; however, a few outlier results made it difficult to completely rely on COS data for inclusion in the study. The WARMF model proved useful in identifying potential outliers in both data sets. Correlation of each data set to the WARMF model output was used to help justify inclusion or exclusion of external data points.

0128
P

Using the Lower Colorado River Water Quality Database to Share and Exchange Data between Agencies and Researchers along the Lower Colorado River

Warren Turkett and Todd Tietjen

Southern Nevada Water Authority, Las Vegas, Nev., USA

The Southern Nevada Water Authority maintains the Lower Colorado River Water Quality Database (Database). This database is used to submit and exchange data between governmental agencies and researchers. In the past sharing data between agencies was primarily accomplished through data requests to the agency that collected the data. This method was time consuming, since the data had to be prepared and emailed. If a researcher required all the data collected in a particular location data requests to multiple agencies were required to get a complete data set. This method of data dissemination was slow and inefficient. The Southern Nevada Water Authority developed an online Database that would permit agencies to submit, archive, and exchange data online. Initially the Database was developed for agencies in Southern Nevada to share data that was collected on Lake Mead and the surrounding tributaries. Additional organizations became involved which expanded the area of sampling. Currently 11 agencies/ organizations submit data to the Database. The Database contains over 2 million water quality records from along the Lower Colorado River. Users of the Database can create project descriptions and sampling locations which are displayed using a Google Earth feature. Data that is submitted has to be approved by the submitting agency to prevent data errors. Data can be searched by project, station, and parameter. The data can be viewed and exported for further analysis. The Database can serve as a model for how regional and local agencies can work together to develop a system for more efficient data sharing and exchange.

0071

Diel Biogeochemical Processes and Their Effects on Sample Design and Trend Analysis: A Study Looking at Diurnal Arsenic Cycling in a NJ Stream

Pamela Reilly and Julia Barringer

US Geological Survey - NJ WSC, West Trenton, N.J., USA

Many biogeochemical processes affecting streams occur on a diel cycle (Nimick et al., 2010). These processes can cyclically affect the concentrations of certain characteristics and constituents, such as pH, temperature, dissolved oxygen, arsenic, metals, nutrients, pH, temperature, and dissolved organic carbon. Diel cycles must be taken into consideration when defining research objectives and designing surface-water sampling plans for any of the above constituents. If the surface-water sampling strategy does not account for the occurrence of cyclic maxima and means the sampling event may not capture the peak or mean concentrations of toxic constituents.

The NJ Water Science Center used both automatic samplers and manual sampling to help determine the diel variations of total and dissolved arsenic and metal concentrations of the Wallkill River in northwestern NJ. Understanding diel processes that cause variability in arsenic concentrations is critical for the NJ Department of Environmental Protection (NJDEP) to develop and implement EPA mandated TMDLs on NJ rivers. We found that cycles of arsenic concentrations varied diurnally in a wetlands reach;

concentrations appeared to increase during late afternoon as pH increased. It was also found that concentrations of particulate Fe, Mn, and Zn increased during the night, and peaked in the early morning (Barringer and others, 2007). These data show that for studies of surface- water geochemistry we need to take into account the diel biogeochemical processes of the stream or our interpretation of data for trends analysis may be compromised by temporally random samples.

0097
P

A Multipronged Approach to Identifying Potential Risks to Drinking Water

Kathleen McCarthy[1], David Donahue[2], Valerie Kelly[1] and David Alvarez[3]

[1]US Geological Survey, Portland, Oreg., USA, [2]Eugene Water and Electric Board, Eugene, Oreg., USA, [3]US Geological Survey, Columbia, Mo., USA

A growing number of anthropogenic chemicals are being detected in the environment. Although the risks posed by many of these compounds are currently unknown, it is reasonable to assume that some may pose risks to drinking water, especially if they are ubiquitous and chronic. We are using a combination of conventional discrete sampling, time-integrated passive sampling, and the yeast estrogen screen (YES) to identify potential concerns in the McKenzie River system, the drinking water source for nearly 200,000 water consumers in the vicinity of Eugene OR. Conventional water samples are being used to measure point-in-time concentrations and understand how those concentrations change as flow conditions change. Passive samplers – both semipermeable membrane devices (SPMDs) and polar organic chemical integrative samplers (POCIS) – are being used to detect chemicals that are present at concentrations below the detection limits of conventional sampling and analysis techniques and to detect chemicals that are present only during episodic events that may be missed by point-in-time sampling. YES is being used to provide one measure of the synergistic effects of the full mixture of individual chemicals present, whether or not those chemicals are included as specific targets in the analytical methods. By using this multipronged approach at a number of locations associated with different land uses, we are developing a rich data set that will support a robust understanding of the potential risks to drinking water posed by forestry, agricultural, and urban land-use practices in this basin.

0487
P

Can the Addition of a Polymer During Drinking Water Treatment Improve Finished Water Quality?

April Nabors, Patty Barron and Jeff Cochran

Birmingham Water Works Board, Birmingham, Ala., USA

In preparation for the United States Environmental Protection Agency's (USEPA) upcoming Stage 2 Disinfection/Disinfectant By-Product Rule (DBPR) the Birmingham Water Works Board (BWWB) developed the following study. Through the use of a mobile Pilot Plant, containing two identical small scale treatment trains, the addition of a polymer to the current treatment process was evaluated to see if it could improve total organic carbon (TOC) removal. TOC is a precursor for DBPs so if the polymer is effective at lowering the TOC then one would expect to produce less DBPs in the distribution system. The Pilot Plant contains two identical small scale treatment trains that are essential for the validation of data. One treatment train is set to mimic current procedures at the plant while the second treatment train is manipulated to assess alternative treatment options. The facility contains all water quality monitoring instrumentation that is required at full scale treatment plants including turbidimeters, pH probes, streaming current monitors, particle counters and a spectrophotometer.

0200
P

Development of a US EPA Method for the Analysis of Selected CCL 3 Drinking Water Contaminants by Solid Phase Extraction and LC/MS/MS

Daniel Tettenhorst and Jody Shoemaker

US Environmental Protection Agency, Cincinnati, Oh., USA

The 1996 amendments to the Safe Drinking Water Act (SDWA) required the US Environmental Protection Agency (USEPA) to establish a Drinking Water Contaminant Candidate List (CCL) of chemicals and microbes that the Agency will consider for future regulation. The first CCL was published in 1998 and is updated every five years. CCL 3 was published in October 2009 and contains 104 chemicals or chemical groups. One of the key pieces of information that must be available in order to make a regulatory

determination is nationwide occurrence data for the contaminants under consideration. Historically, EPA's Office of Ground Water and Drinking Water (OGWDW) has collected the necessary occurrence data under its Unregulated Contaminant Monitoring Regulations (UCMRs). Thus, analytical methodology suitable for gathering occurrence data for these CCL 3 analytes in drinking water is needed.

A group of 15 potential drinking water contaminants (12 CCL 3 chemicals and 3 CCL 3 degradates) are being evaluated for inclusion in a drinking water method that utilizes solid phase extraction (SPE) to isolate the analytes and liquid chromatography/tandem mass spectrometry (LC/MS/MS) for quantitation. With the exception of the industrial chemical 4,4'-methylenedianiline, the contaminants being evaluated are primarily pesticides or pesticide degradates. Preliminary studies of sorbents and preservatives show most promise using Oasis HLB SPE in combination with 2-choroacetamide as an antimicrobial, Trizma as a pH regulator, and ascorbic acid as a dechlorinating agent. Preliminary results of fortified reagent water replicates yield mean recoveries of 80-107%, with precision of <3.6% RSD. Additional precision and accuracy data for tap water, stability studies of primary dilution standards, solvent elution studies, and results of preliminary aqueous and extract holding time studies will be presented. Results comparing manual SPE extractions and automated SPE extractions will also be discussed.

0180

The Hydraulic Fracturing (HF) Process: Real Concern or Misdirected Focus Concerning Threats to Drinking Water Supplies (DWS)

Peter Penoyer

National Park Service, Natural Resource Stewardship and Science Directorate, Fort Collins, Colo., USA

Hydraulic fracturing has been used by the oil and gas industry in vertical wells to stimulate low permeability, conventional sandstone/carbonate reservoirs since 1949. Multi-stage hydraulic fracturing coupled with horizontal drilling began in the 1990s Barnett shale play (Texas) to enhance production from "tight" gas-bearing shale. Massive development of unconventional shale gas reservoirs then ensued establishing significant new reserves through continued efficiency improvements in these two technologies. Industry maintains that the process of hydraulic fracturing so critical to new reserve growth poses little threat to potable aquifers. Opponents argue that risk of contamination to drinking water supplies by the escape of fluids during the hydraulic fracturing process or from subsequent migration of frack fluids that remain underground is very real because only 10% to 30% of injected frack fluid is actually recovered as flowback. The hydraulic fracturing debate is high stakes for us all pitting the perceived long-term viability of drinking water supplies against development of significant new domestic oil and gas reserves. Monetary infusions to local economies, domestic job creation and minimization of our reliance on foreign energy supplies hang in the balance subject to an objective analysis of this contentious topic. The author's 2-year investigation of this issue for the NPS Water Resources Division, suggests that as hydraulic fracturing takes place at shallower depths in closer proximity to drinking water supplies, risks will increase and additional types of monitoring should be required. Furthermore, many valid concerns exist associated with the sheer scale and rural industrialization from shale gas development. However, the concern over the "process" of hydraulic fracturing and threats it may pose when conducted at deeper depths may be misdirected. A pathway analysis indicates "stray" gas migration due in part to methane's high mobility and concentration is facilitated by inadequate well design standards, well construction and cementing programs that may become manifest under some geologic conditions. Longer term cumulative effects of methane gas migration via uncemented borehole annuli exacerbated by the scale (*e.g.*, expansiveness, well density etc.) of unconventional resource plays will pose the greatest threat to potable aquifers (DWS) unless anticipated and managed adequately through stringent well designs.

0417
P

Analytical Approaches and Challenges to Measuring Pharmaceuticals and Endocrine Disrupting Compounds in the Environment

Mark Benotti

Battelle, Duxbury, Mass., USA

The occurrence, fate and transport of wastewater-derived pharmaceuticals and endocrine disrupting compounds (EDCs) in the environment have received a significant amount of attention in recent years. This talk will summarize methods for measuring trace-level concentrations of these compounds as well as provide a brief discussion of their concentrations in environmental waters and drinking waters. Most commonly, these compounds are measured by liquid chromatography tandem mass spectrometry (LC-MS/MS) using electrospray ionization. One of the major challenges of this approach, particularly when working out of matrix-rich samples (*e.g.*, wastewater, surface water with high levels of organic matter, etc.) is ionization suppression. Examples of the effects of ionization suppression will be presented. Additionally, strategies for monitoring for and mitigating suppression will also be discussed.

Most of these compounds are fairly hydrophilic, and their removal during water treatment is most commonly tied to solids retention time (for wastewater) or chemical oxidation (for drinking water). While it is tempting to discuss how effectively a particular compound is removed, it is important to highlight the potential for forming as-of-yet unknown transformation products, particularly with chemical or photolytic oxidation processes. The application of quadrupole time-of-flight mass spectrometry (QToF-MS) to screen for transformation products will also be discussed. Examples of the transformation of selected pharmaceuticals will be presented to highlight how researchers might use this tool to identify transformation pathways and degradation products.

0472

An Overview of Oregon DEQ's Toxics Monitoring Efforts and Their Relevance to the Agency's Toxics Reduction Strategies

James Coyle, Kevin Masterson, Lori Pillsbury and Aaron Borisenko

Oregon DEQ, Portland, Oreg., USA

As part of its broader toxics reduction strategy the Oregon Department of Environmental Quality (ODEQ) has implemented a range of monitoring and assessment efforts. These include establishment of a long-term state-wide ambient surface water and aquatic biota toxics monitoring program, an on-going watershed-scale surface water pesticide assessments (Pesticide Stewardship Partnerships) and a survey of the final treated effluents of 53 of the state's largest wastewater treatment plants for a defined spectrum of toxic, persistent and bioaccumulative pollutants. (Senate Bill 737). While each of these toxics monitoring efforts addressed specific issues at varying spatial/temporal scales, they all measured a common sub-set of analytical targets, including contaminants of emerging concerns (i.e.</i>, select pesticides, pharmaceuticals, personal care products, steroids). Sampling design drivers, implementation schedules, analytical targets and an overview of results from these complementary monitoring efforts will be presented. Where available, measured concentrations of toxic pollutants will be compared to existing water quality criteria and/or biological effects benchmarks. The implication and relevance of recent monitoring findings to ODEQ's toxics reduction strategy will be discussed.

0030
P

iSTREEM™ – An Internet-Based National Watershed Scale Model Capable of Determining Where and When to Monitor for Chemicals from Consumer Products

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In recent years, attention to anthropogenic chemicals in the environment has expanded beyond conventional industrial chemicals and pesticides to include those used in everyday consumer products such as pharmaceuticals, cosmetics and cleaning products. As an area of emerging scientific interest, researchers have less familiarity of the use patterns of consumer product ingredients and therefore have more difficulty estimating potential impacts to aquatic environments.

The American Cleaning Institute has developed and is sharing publicly (at no cost) a national-scale, Internet-based wastewater and river chemical concentration estimation model called iSTREEM™ (http://www.aciscience.org/EnvironmentalHealth/iSTREEM.aspx). This model predicts the concentration of a chemical used in 'down-the-drain' consumer products in the effluent and mixing zone of more than 9,000 wastewater treatment plants in the USA by treatment type and location. In addition, the model predicts concentrations in 28,000 river reaches covering over 200,000 river miles and at downstream drinking water intakes throughout the coterminous USA.

The model can be used to help identify freshwater environments potentially experiencing higher chemical exposures and as a forecasting tool for the development of public policy with minimal data inputs required. For example, candidate sites for effluent or receiving stream monitoring are easily identifiable. In addition, the tool can be used by water quality managers to rapidly assess whether a particular chemical constituent is likely to be present in a water- body of interest at concentrations of concern, permitting identification of target chemicals and establishment of threshold levels of concern. As an example, we will illustrate how simulations for consumer product chemicals compare to target values developed by the Oregon Department of Environmental Quality and monitoring data for 52 wastewater treatment facilities studied under their Priority Persistent Pollutant program, and demonstrate the value of such a tool for policy makers, the regulated community and other stakeholders.

This low-cost screening tool can accelerate decision-making while allowing more efficient use of ever dwindling resources for water quality monitoring campaigns.

0256
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Emerging Contaminants in Bottom Sediments from the Lower Boise River and Its Tributaries near Boise, Idaho

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The US Geological Survey has conducted water-quality and biological monitoring in the lower Boise River basin since 1994. The watershed is impacted by urban and agricultural land uses, and ongoing monitoring has shown declines in native fish and invertebrate species as a result of poor water quality. Evaluating land use change in conjunction with environmentally persistent compounds from known sources may inform decisions about land management and implementation of best management practices. Starting in Water Year 2009, the US Geological Survey collected samples from bottom sediments in the lower Boise River and its tributaries. Bottom sediment samples were analyzed for a suite of emerging contaminants including many associated with urban and household wastewater, as well as several associated with industrial and agricultural impacts to stream quality. Samples are collected at one site in the main stem of the Boise River each year and at as many as three sites located within a selected tributary each year. Sample sites are selected to represent conditions throughout different land use settings. Detected compounds found in each sample have been grouped into four categories including urban, industrial, steroids, and personal care products (PCPs). Thus far, agricultural pesticides included in the analytical suite have not been detected in samples. Results are shown spatially with land use coverage information. Land use change will be evaluated with samples collected at the same sites on a three- to six-year cycle.

0100

Preliminary Assessment of the Effects of Treated Wastewater Effluent on Water-Quality, Sediment-Quality, and Biological Conditions in Spirit Creek, Fort Gordon, Georgia: 2010 – 2011

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Fort Gordon is a US Department of the Army (Army) facility located in east-central Georgia, near Augusta, where it currently operates a wastewater treatment plant on Spirit Creek. The treatment plant is scheduled to be closed prior to 2012. The US Geological Survey, in cooperation with the Fort Gordon's Environmental and Natural Resources Management Office, has been conducting a two-phase study to assess the water quality, sediment quality, and biological conditions of Spirit Creek at sites upstream and downstream from the wastewater treatment plant outfall prior to (phase 1) and after (phase 2) closure of the plant. Specifically, concentrations of major ions, trace elements, nutrients, and contaminants of emerging concern (for example, fragrances, detergent agents, pharmaceuticals, and hormones) in water and sediment and benthic macroinvertebrate community structure are being assessed and compared among sites and between phases.

This paper presents preliminary findings from phase 1. Several types of contaminants of emerging concern were detected in water and sediment at sites downstream from the treated effluent outfall, including detergent agents, flame retardants, fragrances, and hormones. Many of the detected contaminants also are known endocrine disruptors. However, the frequency of detection and concentrations varied between the sediment and water. In the water column of Spirit Creek, total nitrogen and phosphorus concentrations increased by more than an order of magnitude downstream from the wastewater effluent discharge. Inorganic constituents, including metals and major ions, also demonstrated higher concentrations in water at downstream sites relative to the upstream site. Benthic macroinvertebrate richness and diversity metrics were determined at the upstream and one downstream site. The computed metrics demonstrated reduced richness and diversity at the downstream site, which indicated a cumulative negative effect on the biological community by environmental stressors at the downstream site.

0009
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A Survey of Trace Metals and Organic Chemicals in Effluent from Oregon's Major Municipal Treatment Facilities

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Oregon's Senate Bill 737, enacted in 2007, required the state's 52 largest municipal wastewater treatment plants (WWTP) and water pollution control facilities (WPCF) to collect effluent samples in 2010 and analyze them for persistent organic pollutants. These facilities are located state-wide and represent a variety of treatment types, service population sizes, geographic areas, and flow conditions. Although this survey was constrained by legislative directives and operational practicalities to only two samples at each

facility within the same year, it nonetheless represents a unique effort to examine effluent from all of the major municipal treatment facilities within a state's regulatory jurisdiction for over 400 chemical contaminants. Of the chemicals ultimately analyzed, 114 were detected above the level of quantification (LOQ) in at least one sample. Few persistent pollutants were found possibly because of their diminished environmental presence, their diversion from effluent via sorption to sludge (solids phase), or high LOQs for certain chemicals. For several classes of contaminants, most notably the now ubiquitous PBDEs and polycyclic aromatic hydrocarbons (PAHs), as well as phthalate esters, certain pharmaceuticals, and common consumer products, our findings are consistent with those of others. Conversely, we report the presence of several commercial and consumer pesticides, as well as of benzene and phenol degradation products, not previously reported in municipal effluent. Ten polychlorinated biphenyls (PCB) congeners were present at low concentrations in £ 10 samples, while polychlorinated naphthalenes and dioxins/furans were not detected at all. Twenty-one polybrominated diphenyl ether (PBDE) congeners were found, nine of which have been reported in Osprey eggs in Oregon and Washington. Methylmercury was present in 65% of samples, with average and maximum concentrations of 0.18 and 1.36 ng/L, respectively. Although they are generally assumed to be innocuous by- products of sewage treatment, additional research is needed on potential impacts to aquatic ecosystems from high loadings of coprostanol and cholesterol. These results suggest that effluent, rather than just receiving waters, should itself be analyzed for a wide range of contaminants in order to understand how upstream sources, conveyed through WWTPs and WPCFs, could be impacting aquatic ecosystems.

0269
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Assessment of Perfluorinated Compounds in Fish from US Rivers

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EPA's Office of Water and Office of Research and Development are collaborating to conduct assessments of US river contaminants that are of emerging concern for human health. These assessments include analysis of fish tissue from about 150 urban river locations (≥ 5th order based on 1:100,000-scale Strahler order) throughout the lower 48 states for the presence of perfluorinated compounds (PFCs). This national-scale urban river study is EPA's first broad assessment of CECs in fish using a statistically-based sampling design. It is being conducted under the framework of EPA's National Rivers and Streams Assessment (NRSA), a probability-based survey designed to assess the condition of the Nation's streams and rivers. Samples were collected for the study in 2008 and 2009 during June through October sampling seasons. Field teams across the country applied consistent methods to collect one fish composite sample at every sampling location. Each composite sample consisted of five similarly-sized adult fish of the same species, and the field teams targeted species that are commonly consumed by humans. Largemouth and smallmouth bass were the primary species collected for the study, accounting for 34% and 24% of all fish composites, respectively. Fillets from fish composite samples were analyzed for 13 PFCs, including perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS). PFCs, and PFOA and PFOS in particular, are heat stable chemicals that repel water and oil, and are commonly used in stain repellants, non-stick cookware, and a variety of other industrial and commercial applications. They are very persistent in the environment and they bind to blood proteins. Analytical results from this study of US urban rivers indicated that 6 of the 13 target PFCs were detected in fish fillet composites. Frequency of occurrence was dominated by PFOS, which was detected in 76% of all samples.

0423
P

Geospatial Assessment of the Impacts of Changing Agricultural Landscape in Louisiana

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Agriculture is an integral part of the economy, environment and life activities of the people of Louisiana. For decades it has provided jobs and numerous benefits to the sector and the state. At the same time, good agricultural practices and conservation measures in place contribute to effective environmental management of the agricultural land base. However, in the last several years, notwithstanding these benefits, farming activities have been associated with the changing agricultural landscape and the river environments in the area. While very little work exists in the literature on the trends in Louisiana. Available regional statistics point to recurrent changes in the area of farmland, cropland, and host of other variables. While other trends in the area involve, the intense use of agrochemicals and pesticides to boost productivity. Their impacts on the built environment and natural systems continue to amplify

with threats to watersheds, water quality, and the surrounding ecology. Considering the severity of the problems and the risks posed to ecological health of river systems, there is a need for a GIS analysis of the impacts of the changing agricultural landscape in Louisiana. Using GIS to track these trends spatially strengths the readiness of land managers to plan and protect vulnerable areas. Accordingly, the paper will bridge the gap in the literature by assessing the occurrence of change in the study area. The emphasis are on the issues, trends, factors fuelling the problems, environmental analysis, efforts to deal with the problems and future lines of action. In terms of methods the paper adopts a mix scale approach involving GIS connected to descriptive statistics and primary census data. Preliminary results point to the occurrence of change and a gradual diffusion of environmental stressors across space.

0115

Linked Micromaps: Statistical Summaries in a Spatial Context

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Communicating summaries of spatial data to decision makers and the public is challenging. We present a graphical method that provides both a geographic context and a statistical summary for such spatial data. Monitoring programs have a need for such geographical summaries. For example, the National Aquatic Resource Surveys (NARS), generate large volumes of geospatial data. Linked micromap plots (LMplots) provide a way to simultaneously present geographic context and statistical summaries of data from such surveys. LMplots were named and described in 1998, but then, as now, plot production convenience is a bottleneck to the process of creating and using such plots. While some limited methods exist to make LMplots, such as at: http://gis.cancer.gov/tools/micromaps/, we take advantage of the open-source software R, specifically the R package ggplot2, to overcome this bottleneck so that environmental scientists can readily produce LMplots. Some issues to be solved prior to producing LM plots include dealing with highly detailed polygon boundaries that can lead to slow graphics production and correctly filling 'island' polygons in complex spatial features. To deal with slow graphics, plotting polygons need to be thinned or generalized. The boundaries of the micromaps in LMplots only need to convey region identity and neighbor relationships. In order to deal with 'island' polygons, plotting methods need to correctly over-plot the 'island' polygons. LMplots also require structuring the geographical and statistical data such that both sets of data share a unique identifying variable that links the geographical data of the polygon with the statistical display for that polygon. LMplots provide a way to display such geographically indexed statistical summaries in a spatial context and can be applied to summaries from spatial surveys of streams in watersheds. These plots can also be applied to summaries for administrative units, such as counties and states. Our examples of LMplots summarize estimates over ecoregions and watersheds.

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0522
P

A GIS-Based Approach to Evaluating Riparian Integrity along Montana's Large Rivers

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The large river valleys of the West have been magnets for development since European settlement, often to the detriment of hydrological and ecological integrity. Our goal was to develop a method for carrying out a comprehensive, statewide characterization of the condition of Montana's rivers, using readily available, high- resolution imagery and a Geographic Information System (GIS). We began by using digital elevation models, topographic maps and 1-meter aerial imagery from the National Agricultural Imagery Program (NAIP) to complete heads-up digitizing of valley bottoms. We then used image segmentation software (eCognition) and the RandomForests™ machine learning technique to classify seven land cover types (Open Forest, Closed Forest, Riparian Emergent, Shrub-Scrub, Upland Emergent, Sandbar, and Russian Olive) and open water within river valleys from 2009 NAIP imagery. We drew from Montana Spatial Data Infrastructure GIS layers (transportation and structures) and Department of Revenue land use classifications to create a human alteration layer. Reach polygons were created based on geomorphology, hydrology, and length to serve as analysis and reporting units, and reach characteristics (channel length, sinuosity, valley width and area) were calculated. From these GIS layers, we developed both disturbance and condition metrics (*e.g.*, % irrigated agriculture, structure density, road density, average patch size, density of natural vegetation mosaics, etc.), correlating specific condition metrics with disturbance factors. This analysis was carried out on all large rivers in Montana. Classification accuracy was field checked over a two year period, while literature reviews and best professional judgment formed the basis for metric selection. When classification and analysis was complete, we created statewide maps of riparian condition for these rivers.

0346
P

Understanding Peatland Mercury Cycles under Elevated Carbon Dioxide and Soil Warming: Introduction of the SPRUCE Experiment

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Scientists at the Oak Ridge National Laboratory and the USDA Forest Service are developing a large-scale ecosystem study in which temperature and carbon dioxide will be experimentally increased to quantify effects of climatic forcing on ecological, hydrological, and biogeochemical processes in a northern peatland. Here we provide an overview of the mercury research directions within the Spruce and Peatland Responses Under Climate and Environmental change (SPRUCE) Experiment that will occur at the Marcell Experiment Forest in northern Minnesota, USA. We plan on heating peatland soils up to 9°C down to 3 m depth and elevate CO_2 up to 900 ppm in 12-m diameter chambers on a black spruce - *Sphagnum* bog. Each chamber will have a nest of piezometers, runoff collector, and a pair of sippers to measure routine chemistry as well as total Hg (THg) and methyl Hg (MeHg). Piezometer nests will include samples from near the soil surface to near the peat-mineral interface at depth. A belowground corral is planned to isolate the chamber from outside influences of hydrology and allow us to sample surface and near-surface runoff events. In addition, we will insert a pair of Teflon sippers in each chamber to sample distinct soil water zones focusing on samples just above and below the water table. We anticipate that the soil warming treatments alone or in combination with elevated CO_2 will increase primary productivity and lower water tables as a result of more uptake and higher evaporation. We hypothesize that lowering of water tables will result in a decline of THg and MeHg in soil pore water as deeper organic soils with lower mercury burdens contribute to pore water chemistry. However, when we have a significant event such as major storm or snowmelt, we hypothesize that treatments with lower initial water tables will have more Hg available for methylation and thus higher THg and MeHg concentrations, especially under heated conditions. These responses will be also controlled by how water table variation and heating influence carbon and sulfate cycles. We seek interaction with the scientific community on the design and hypotheses of the SPRUCE experiment.

0387
P

Techniques for Winter Stormwater Monitoring in Minnesota

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Capitol Region Watershed District (CRWD), located in St. Paul, Minnesota, is completely urbanized, with 42% coverage by impervious surfaces and is drained almost solely by underground storm sewers. CRWD began its water quality monitoring program in 2005 with 8 stormwater water quality monitoring stations and has grown to 20 stations in 2011. In 2009 CRWD began collecting continuous real-time flow data at five of these sites through the winter months. Real-time conductivity data is collected at three of these sites. Winter baseflow samples are collected monthly and analyzed for nutrients, solids and metals. Snowmelt samples are also collected. This data helps capture the extent of pollutant loading through winter and into the spring snowmelt period. Average normal daily temperatures range from 9 to 26 degrees Fahrenheit, adding additional challenges to the data collection process. Stormwater monitoring methods will be discussed with an emphasis on techniques used to overcome difficulties associated with winter conditions. Subjects include power management, data collection frequency, safety concerns, troubleshooting, and preliminary results.

0262
P

Developing a Monitoring Strategy for Tracking Environmental Impacts of Co-Digested Feedstocks in an Anaerobic Biomass Energy Project

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A full-scale biomass energy system located at a dairy in California was studied to determine the feasibility of utilizing wastes from off-site of the dairy for biogas and electricity production while maintaining control of nutrients and protecting groundwater. Bio-methane production is significantly increased when imported agricultural wastes are co-digested with manure. Of particular interest to environmental regulators is the effect of importing off-site agricultural waste streams on previously well-established dairy nutrient and salt balances. Characterizing the impact imported agricultural and process wastes will have on salt and nutrient balances is important before long term sustainability of such systems can be determined. Monitoring the performance and environmental impacts of these systems is challenging, in part because biomass energy facilities are being integrated into the existing dairy and irrigated crop operations. This integration results in a complex network of liquid, solid, and air process streams that must be characterized to track the mass flow of organic material, salts, and nutrients. An appropriate monitoring plan was developed to sample and analyze liquid, slurry, and solid samples collected at various points within the biomass energy system. A combination of data collected using continuous online sensors and data from laboratory analyses of grab samples was used for system characterization. Baseline data was collected on the anaerobic digester system for eighteen months while the digester was being operated with only onsite waste streams and a salt mass- balance was developed. Monitoring continues while offsite wastes from pasta processing, tomato canning and grease traps are now being added. For the future of biomass energy systems, the development of a sensible monitoring approach and characterization co-digested feedstocks will provide the scientific basis for enhanced system management and reduced environmental impacts.

0144
P

Snap Shot Monitoring of the Niangua River Watershed – Part I, Organizing a Large-Scale Monitoring Effort

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The Lakes of Missouri Volunteer Program organized a one day monitoring effort within the Niangua River watershed (2650 km^2). The river is a major tributary to Lake of the Ozarks, one of Missouri's largest and economically most important reservoirs. The three goals of the effort were to 1) identify spatial trends in water quality, 2) educate the public about the relationship between watershed and lake water quality, and 3) highlight the effectiveness of volunteer monitoring. This poster will focus on the planning and organization of this large-scale monitoring event, with an emphasis on the hurdles (anticipated as well as unexpected) to success. Results of this monitoring effort will be the focus of a second presentation.

0120
P

Everglades Depth Estimation Network (EDEN): Integrating Real-time Networks to Provide Hydrologic Data for the Restoration of the Everglades

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Successful restoration of the Everglades depends on restoring or approximating the former natural volume, timing, and distribution of wetland sheetflow and the corresponding response of the natural system to these changes. The Everglades Depth Estimation Network (EDEN) is a network of over 280 real-time water-level gages maintained by multiple State and Federal agencies including the South Florida Water Management District, the US Geological Survey (USGS), Everglades National Park, and Big Cypress National Preserve. The real-time water-level data is integrated with ground-elevation and real-time water-surface modeling results and provides scientists and managers with current (2000-present), on-line water-depth information for the entire freshwater portion of the greater Everglades. Presented on a 400-square-meter grid spacing, EDEN offers a consistent and documented dataset that can be used by scientists and managers to guide large-scale field operations, integrate hydrologic and ecological responses, and support biological and ecological assessments that measure ecosystem responses to the implementation of the Comprehensive Everglades Restoration Plan.

Data from the multiple agencies are combined in the USGS National Water Information System (NWIS) database and then served real-time by NWISweb to scientists, managers, and the general public. The water-level surfaces are posted on the EDENweb (http://sofia.usgs.gov/eden). By combining the daily water-level surfaces with the ground- elevation model and using the EDEN applications, a full suite of hydrologic data is made available to scientists and others including: water depth, hydroperiod (computation of days since last dry), water-surface slope, surface animations of water elevation and water depth over time, and transects of water depth animated over time. EDEN's computations of these important ecological drivers provide biologists and ecologists with the data necessary to examine landscape and trophic-level responses to hydrodynamic changes in the Everglades. In

addition, the EDENweb serves as a portal to NWISweb for all the EDEN gages. Challenges in establishing, prototyping, and maintaining the EDEN network will be presented.

0266
P

Quantifying Effects of Temperature, Concentration, and Particles on *In situ* Measurement of DOC Concentration Using Fluorescence Based Sensors

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Commercially available field deployable fluorometers designed to measure dissolved organic matter fluorescence *continuously in situ* are of considerable interest as a proxy for continuous dissolved organic matter (DOC) measurements. However, the ability to make continuous DOC fluorescence measurements that are comparable across sites, over time and under different hydrologic conditions and reliably relate them to DOC concentration, requires a clearer understanding of how instrument characteristics and environmental conditions affect measurements of DOC fluorescence. In particular, the effects of water temperature and interferences from particle attenuation and high DOC concentration are significant when deploying these instruments in rivers and streams.

We evaluated the performance of four commercial DOC fluorescence sensors in laboratory studies over a range of sample temperatures as well as particle and DOC concentrations using standard reference materials. Our results demonstrate that measured fluorescence values were strongly influenced by temperature, turbidity and DOC concentration in matrix conditions similar to those observed in many of rivers and streams. Correction of fluorescence values measured *in situ* for the effects of temperature, particle and DOC concentration appears to be fairly straightforward over the wide range of turbidities and DOC concentrations found in most rivers and streams. However, in order to construct suitable correction factors for these effects, concurrent measurements of temperature and turbidity are necessary as well as information about the relationship between DOC concentration and fluorescence for the specific instrument used, most simply determined as absorbance.

0301

Continuous Monitoring of Suspended-Sediment Transport from Headwater Basins in Northeast Kansas

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Relatively little information exists nationally on sediment transport from small watersheds. Rapidly changing streamflow and sediment transport conditions can preclude accurate estimation of sediment concentrations and loads because of difficulty collecting representative samples and lack of adequate temporal resolution to accurately characterize flashy runoff in small basins. Three headwater (4 to 10 square miles) watersheds with varied agricultural practices in northeast Kansas were monitored for streamflow and turbidity data, which were collected continuously at 15-minute increments. These data were coupled with data from periodic suspended-sediment sampling to develop regression models for computing continuous suspended-sediment concentrations, loads, and yields. Despite differences among the basins with regard to the extent of crop cultivation and land management practices, regulation of streamflow and sediment transport by small watershed impoundments was likely the predominant factor affecting sediment yields. To further test this hypothesis, continuous streamflow and turbidity data were collected upstream and downstream from three small impoundments-one in the reference watershed and two in an agriculture dominated watershed. An assessment of the sediment trapping efficiency of these structures in relation to total watershed sediment yield will be presented.

0334
P

Time Integrative Continuous Sampling Finally Made Quantitative for both Total and Dissolved Trace Organics

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Trace organics in the water column are often extremely low. In the past, estimations of concentrations in the water column were obtained from indicator organism tissue residue studies, or passive samplers using equilibrium partitioning calculations. These studies were time consuming and supplied qualitative data at best of the dissolved water fraction. The results were dependent on temperature, bio-fouling, water flow, partition coefficients and motility, and provided no data on particulate droplet or pelagic

contaminate laden sediments in the water.

Using a time integrative extraction device to provide both quatitation and total and dissolved values, in a small form factor this submersible extractive device uses SPE (Solid Phase Extraction) media to sequester pesticides, herbicides, PAHs, TPH, and other CECs from water. The device actively draws water in a submersed state through a SPE disk that has special lofted pre-filtration filters, and draws water slowly through the filter disk at under 80 ml/min. This reduces media clogging allowing for a pre-extracted quantitative continuous extraction event of hours to days, and up to one hundred liters of water, providing ultra low detection of target analytes.

In order to separate the pelagic sediments and oil droplets from the dissolved fraction, a two stage Luer-lock disk system was developed. The first stage disk uses lofted glass depth filtration to quantitatively retain pelagic sediments and oil droplets, for extraction and analysis. The second stage disk sequesters the filtrate containing the dissolved trace organics of interest with solid phase extraction media.

GC/MS/ LVI results from two studies will be presented using this submersible extraction system: An ultra low level study for total and dissolved PAHs in a large volume extraction event of 50 to 100 liters of sediment laden water and a study of the water column off Dauphine Island, Alabama, which was continuously monitored for PAHs in the PPT level during the Horizon spill event. This provided three months of monitoring before and during the event which will also be presented.

0437
P

Deployment of Data Sondes from Fishing Piers to Monitor Nearshore Hypoxia in Long Bay, South Carolina

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In July 2004, reports of unusual fish catches led to the discovery of hypoxic conditions in the nearshore waters of Long Bay, a coastal embayment that borders the sandy beaches of the Grand Strand in northeastern South Carolina. This area is a focal point for beach-based tourism, hosting 14 million visitors a year. Hypoxic conditions in Long Bay were unexpected given the shallow water depths and lack of nearby rivers. Since no routine DO concentration measurements had ever been made in Long Bay, several state agencies partnered to establish continuous monitoring platforms on the seaward ends of two fishing piers in water depths that range from 5 to 7 m. These sites were operational by 2006 and featured measurements of salinity, DO and temperature, collected every 15 minutes in the surface and bottom waters using YSI and Hydrolab datasondes. Continuous deployment so near the surf zone required innovative strategies, including counter-weighted surface flotation, a zipline to avoid use of standpipes, and antifouling controls. QC procedures include manual collection of vertical profiles which has enabled a robust estimate of *in situ* performance.

Data from the deployment site still in operation are provided at: http://www.ysieconet.com/public/WebUI/Default.aspx?hidCustomerID=131. These data are being used to support research efforts investigating the causes of low DO in Long Bay and in public outreach efforts associated with local stormwater management programs, as discharges of polluted runoff into the coastal waters are a concern given the tourism-based economy.

Since 2006, low DO has been observed primarily during June through September. In 2009, anoxic conditions were present for several days in August and September. Offshore grab sampling data suggest that low DO waters are restricted to a narrow band paralleling the shoreline. The nearshore waters of Long Bay are also prone to contraventions of water quality standards for fecal bacteria. Hence generalized concern exists over managing terrestrial flows into Long Bay, with monitoring needed to evaluate the success of these strategies. In recognition, the local communities are developing a cooperative strategy for expanding the pier-based monitoring to cover three locations that bracket the middle, northern and southern limits of Long Bay.

0531
P

A Novel Application of Dithizone in an Evanescent Wave Sensor for Rapid Detection of Acidic Gases and Ammonia

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Dithizone (diphenylthiocarbazone), a water insoluble organo-sulfur compound has been widely used as a chromogenic reagent for extraction and colorimetric analysis of heavy metals like lead, mercury, zinc, copper, etc. Chloroform and Carbon tetrachloride have

been widely used as the extraction solvent of metal-dithizone complexes.

We report here another application of dithizone, which has not been previously reported to the best of our knowledge. We have observed that dissolution of dithizone in dimethylsulfoxide (DMSO) yields a product that is sensitive to pH. This product is deep-green in color and changes to royal blue under low pH condition. Consequently, a clad-modified evanescent wave optical fiber (CMEOF) sensor has been fabricated to exploit this phenomenon for detection of acidic gases in air and aqueous media.

The CMEOF sensor was fabricated by etching the cladding of a 5 cm mid-section of a plastic optical fiber to expose the bare core using a 2:1 mixture of tetrahydrofuran and deionized water. Immobilization of the sensing material on the bare core was achieved by dipping the de-clad portion in a solution of 0.01 g of dithizone in 25 ml DMSO, using a motorized translation stage. After five minutes, a thin film of the dithizone-based sensing material was found to have been immobilized on the de-cladded portion. A thermal treatment process was exercised to enhance the adsorption of the dithizone film on the core.

The coated section of the fiber was protected from moisture by encapsulating within a gas-permeable PDMS layer, via a dip-coating process using a motorized translation stage. The gas-permeable PDMS layer also ensures that only gases such as acid fumes can interact with the dithizone-based sensing reagent.

Experiment with nitric acid fumes showed the sensor was capable of detecting acidic gases in air and water, and the response was reversible.

0344
P

Computing Time-Series Concentrations and Loads from In-Stream Sensors and Streamflow Data

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Over the last decade, the use of in-stream, continuous water-quality sensors to compute water-quality constituent concentrations and loads have become more prevalent. These sensors record a time series of measurements, including turbidity, specific conductance and other water-quality characteristics which are often related to time- varying, in-stream concentrations. Loads are computed by multiplying these computed concentrations and streamflow. The uncertainty for instantaneous concentrations and loads are computed using regression model statistics. Depending on the characteristics of the measurement site, this method is often more reliable and more accurate means for computing concentrations and loads than traditional computation methods using streamflow.

Guidelines and procedures for computing time series of suspended-sediment concentration and loading as a function of turbidity and streamflow data have been published in 2009 (USGS Techniques and Methods report, book 3, chapter C4). USGS is drafting further guidelines for the use of in-stream sensors to compute concentrations of additional constituents of interest. The concepts, statistical procedures, and techniques used to maintain a multiyear time series and to prepare data for public dissemination are described. Specific examples of the method will be presented.

0175
P

Long-Term Deployment Module: Promising New Anti-Fouling Technology

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The single largest obstacle in continuous water quality data collection is fouling. Site visits required to clean fouling from sensors contribute greatly to the overall cost of water quality projects. Additionally, fouling can degrade the quality of the data produced at a monitoring site. Because of this, various strategies to reduce or eliminate fouling have been developed by the greater water quality monitoring community. One such stratagem is the Long-term Deployment Module (LDM) by Hydrotech ZS Consulting, a promising new anti-fouling technology. It works by enclosing the sonde’s sensors in a water-tight sampling chamber that fills with water before each measurement. The sample chamber is first filled using hydrostatic pressure. The sonde takes a measurement and then the sample chamber is pumped out. The sensors remain hydrated in the dark sample chamber until the next measurement. By limiting the time the sensors are immersed in the water, the LDM dramatically reduces fouling. It works with a variety of vendors sondes and can be

controlled externally using a SDI-12 compliant data logger. Testing indicates that the LDM can extend field visits for maintenance to every four week cycle and may reduce the calibration drift caused by sensor fouling most notably the pH sensor.

0326

Combination of Monitoring Approaches Provides Comprehensive Assessment of Changing Stream Conditions in Urbanizing Watersheds of Northeastern Kansas

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Many factors contribute to impairments in urban streams, leading to challenges in accurately characterizing stream conditions and identifying causes of degradation. Multiple monitoring approaches that include chemical, biological, and physical aspects of stream quality are being used to assess current and changing conditions in the complex, urbanizing watersheds of Johnson County, Kansas. Since 2002, the US Geological Survey, in cooperation with the Johnson County Stormwater Management Program, has been collecting data to characterize the quality of county streams. The ongoing monitoring program includes: 1) broad scale water and streambed-sediment sampling to describe watershed characteristics and identify contaminant sources, 2) continuous water-quality monitoring in conjunction with regression models to estimate real-time chemical concentrations and loads and describe variability during storm runoff, 3) macroinvertebrate, periphyton, and habitat surveys to describe biological conditions and evaluate relations with environmental factors, and 4) focused studies to improve understanding of specific stream issues such as sediment transport and effects of wastewater effluent on receiving streams. Monitoring approaches have incorporated new technologies, adaptive sampling, use of GIS and aerial imagery, and innovative data analysis.

The information is being used to document and monitor changes in stream conditions, develop effective water- quality protection plans that minimize the effects of point source discharges and nonpoint source stormwater runoff, and assist in targeting efforts to implement stream management practices. The stream monitoring program is critical as urbanizing areas strive to meet local stream protection objectives, National Pollutant Discharge Elimination System requirements, and total maximum daily load goals.

0480
P

Use of High-Frequency Dissolved Oxygen and Water Temperature Data to Infer the Relative Importance of Components of a Stream Dissolved Oxygen Budget

Stewart Rounds

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The semi-continuous monitoring of stream water quality provides rich datasets to assess aquatic health, quantify water-quality variations that occur at several important time scales (daily, weekly, seasonally), assess trends, determine loads of important constituents, and better understand processes and factors that affect water quality. The deployment of continuous water-quality monitors has increased substantially in the last 20 years, from dozens to hundreds and even thousands of monitors today. Even as such datasets are becoming more common, however, scientists are challenged to find ways to analyze the data to better understand the systems being monitored. In many systems it can be important to understand the various factors and processes influencing a stream's dissolved oxygen budget, but it can be difficult and time-consuming to quantify the important processes affecting that budget.

In this study, data from five characteristically different streams in the Pacific Northwest of the United States are used to illustrate a method that can be used to quickly identify many aspects of a stream's oxygen budget. Using hourly or more frequent paired measurements of water temperature and dissolved oxygen concentration, and plotting the latter against the former along with contour lines of constant dissolved oxygen percent saturation, it is possible to infer much about the dissolved oxygen budget of a stream. The degree of reaeration, the relative importance of photosynthesis and its source from periphyton or phytoplankton or macrophytes, the magnitude of oxygen demands from respiration or organic-matter decomposition, and important seasonal cycles all can be determined from this type of plot. Data from these sites show widely different patterns in the oxygen/temperature plots, and knowledge of the characteristics of those streams is easily connected to patterns in the data. It is hypothesized that such plots might be used to determine certain aspects of a stream's characteristics and dissolved oxygen budget when more detailed rate and process-related information is lacking.

0246
P

Lateral Variability of Water Quality Refugia Created by Near Shore Aquatic Macrophytes During Periods of Prolonged Hypoxia in the Klamath River

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Survival and recovery of federally listed Endangered shortnose (Chasmistes brevirostris) and Lost River (Deltistes luxatus) suckers may be negatively impacted in the Lake Ewauna to Keno reach of the Klamath River in Oregon, due to low dissolved oxygen (DO) levels. Summer water quality in this reach of the Klamath River is extremely poor, with heavy algae growth, low dissolved oxygen concentration, and high pH and water temperature. The observed low DO levels are caused by both a natural, as well as human, induced process called eutrophication. This typically occurs when excess nutrients promote cyanobacteria (Aphanizomenon flos-aquae,i>) blooms. Seasonal cyanobacteria bloom and die-off events, and the associated organic matter decomposition, consume DO and create localities with low DO levels. Through a collaborative Bureau of Reclamation and Oregon Institute of Technology student project, repeated lateral variability DO data was collected during the summer of 2011 in an effort to determine if near shore aquatic macrophyte growth is creating improved DO conditions compared to the thalwag of the river. Dissolved oxygen data was gathered across the width of the Klamath River every mile from Keno to the Klamath Straits Drain (KSD), and every other mile between KSD and Lake Ewauna. It was hypothesized that near shore aquatic vegetation was providing refugia for fish by raising the DO content of the water through photosynthesis during times of hypoxia. Data analysis showed, however, that daytime near-shore dissolved oxygen levels were sometimes lower than that of the River's thalwag. This result may be due to the fact that the level of hypoxia observed during the summer of 2011, in this reach of the Klamath River, was less intense than observed in previous years.

0152

Preliminary Results from the North Dakota Intensification of the National Wetland Condition Assessment

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An intensification of the Environmental Protection Agency's (EPA's) National Wetland Condition Assessment (NWCA) is being conducted in North Dakota. Besides gathering the data needed for the NWCA, the intensification included increasing North Dakota's overall sample size to over 50 wetland sites. Specific studies conducted as part of the North Dakota NWCA Intensification include comparing the NWCA techniques with regionally developed wetland assessment methods; modeling carbon, nitrogen, and phosphorus cycling under different wetland conditions; and sampling for mercury content at each site. Based upon EPA recommendations, the original probabilistic sample size of 11 was increased to a total of 53 randomly selected wetland points located throughout North Dakota to meet sample size adequacy not only for the state, but the wetland rich Prairie Pothole Region as well. The NWCA protocol for the characterization of a wetland point was completed at each site, and the three tiered assessment methods developed in North Dakota for wetland assessment were also completed for comparison. The protocol utilized during the 2011 field season ended up providing detailed data on plant species composition, water quality, soil profile descriptions, soil chemistry, rapid assessment variables, buffer condition, landscape variables, hydrology, and land-use/stressors. Additionally, above ground plant biomass and soil samples were collected within different landscape positions (upland and wetland) at each site to be tested for carbon, nitrogen, and phosphorus content. These data will be utilized in modeling the cycles of these elements in various wetland conditions. Samples were also collected at the different landscape positions and analyzed for mercury content. The probabilistic approach utilized in the NWCA happened upon a variety of North Dakota wetland types, which included depressional, riparian, slope, and lacustrine wetlands found in both prairie and wooded environments. These wetlands were found under varying types and levels of land disturbance found within the wetland or its catchment which included cropping, grazing (native prairie and pasture), haying, Conservation Reserve Program, and idle. The preliminary results of these sites indicate a diversity of wetland conditions, both physically and biologically, representing the majority of North Dakota's ecoregions.

0134
P

Fish Taxonomy Proficiency in the National Rivers and Streams Assessment

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During 2008 and 2009, EPA initiated the National Rivers and Streams Assessment (NRSA). Monitoring of the fish assemblage is an integral component of the NRSA. Fish were collected from standardized stream reaches in wadeable and non-wadeable streams by electrofishing from approximately 2,031 locations over a two year period within a seasonal index period of May through September. Sampling locations were re-sampled at a rate of 10% and fish voucher collections were also sampled at approximately 10% of the sites. Voucher samples were both field identified by the field team and a second QC identification was completed by a second expert taxonomist. Percent similarity of the two analyses were calculated for each crew and compiled by state and nationally. Voucher collections were submitted for taxonomic QC from a total of 262 sites (12.9% of all sampled sites). Field teams made a total of 25,425 unique identifications (defined as each unique species at each sampled site) during the two field seasons. Of these unique identifications, 3,153 (12.4%) were submitted as vouchers for re-identification by a second independent taxonomist. Sans unknown and missing collections, the overall QC level was 10.9% of all unique identifications. The comparison of voucher identifications revealed that 86.9% of all specimens were identified correctly to species, 96.6% were correctly identified to genus, and 99.9 percent were correctly identified to family. Taxonomy accuracy varied by state with the percent of specimens accurately identified to species ranging from 33% to 100%.

QC taxonomists identified a total of 349 species during the study. Species with five or more occurrences in the voucher collections that were most commonly mis-identified were pearl dace, black buffalo and long-head darter. Species with ten or more occurrences in the collections that were most commonly misidentified were hybrid sunfish, rosy faced shiner and spotted sunfish. Of the species with 25 or more occurrences in the voucher collections, the most commonly misidentified species were shorthead redhorse, spotfin shiner and central stoneroller. Differences were largely explained by misidentification, poorly preserved or photographed specimens, name changes (common and scientific) and taxonomic proficiency.

0383
P

Quality Water for Wildlife: Developing a Comprehensive and Integrated Water Quality Monitoring Effort for the National Wildlife Refuge System

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The National Wildlife Refuge System (NWRS) comprises a network of 554 refuges covering over 150 million acres, with a wildlife and habitat conservation mission that is unique among federal land management agencies. With a particular emphasis on managed and unmanaged wetland and riverine habitats, the Refuge System depends on the maintenance of reliable supplies of clean, fresh water to successfully complete this mission. The NWRS has recently initiated a System-wide inventory and monitoring effort and has identified water quality monitoring as one of the national priorities. In developing this monitoring effort, emphasis has been placed on ensuring both scalability and integration. Scalability refers to the selection of a small number of core parameters that are measured universally across the Refuge System, with additional monitoring tailored to the specific needs of an individual refuge. Integration refers to ensuring that monitoring data collection and management are consistent, comparable, and rigorous for use within the Refuge System, and within a larger landscape scale in partnership with the monitoring activities of other federal and non-federal entities. Thus, Refuge System water quality monitoring can simultaneously help to inform management decisions on individual refuges, and contribute to broader monitoring networks that track trends at the watershed level and beyond.

0212
XX

Retrospective Analysis of Daily Mean Suspended-Sediment Data in the United States

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The US Geological Survey has started a national synthesis of existing suspended sediment data to, among other things, assess the spatial and temporal distribution of daily sediment data and to document, where possible, trends in sediment concentrations and yields and to define where additional data is need to define these trends. Much of the historical and ongoing suspended-sediment data collected by the USGS is in the form of mean daily values of concentration and load. As part of this initial assessment, a nationwide retrieval of the instantaneous and mean daily suspended-sediment concentrations and loads was made from the USGS National Water Information System database. The primary planned product of this effort is a web-accessible, interactive, map-interface for sediment and sediment-associated data, including interpreted information on suspended-sediment loads, yields, and trends. This data base, which will contain both instantaneous and daily sediment data, will be of immense benefit to modelers and to individuals and

organizations concern with the development of assessment methods.

This presentation will show the current status of sediment monitoring in the US by displaying the distribution of daily sites by decades and length of record and estimated long term sediment yields by region and decades.

0360
P

Monitoring Water Quality in the Mississippi River Basin – An Integrated and Interagency Approach

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Anthropogenic activities in the Mississippi River Basin have altered river dynamics, land use and inputs into the Mississippi River. There is great interest in both tracking water quality in the River as well as establishing cause and effect relationships between land management and the water quality. The enormity of this task requires a integrated approach with many partners to even approach the goals of understanding water quality in the Basin.

There is a need to establish a comprehensive and integrated multi-tiered, science-based, monitoring system for the Mississippi River Basin to address questions about water quality. The proposed monitoring framework is intended to guide USDA, and its partners' contributions in the establishment of an integrated water quality monitoring system. This framework will allow efficient, credible monitoring of water quality conditions and responses to conservation activities. While this framework proposes an interagency approach that will require substantial scientific input and stakeholder engagement, it recommends near-term actions that USDA should undertake as part of its charge leading the Mississippi River Basin Healthy Watersheds Initiative.

The framework will provide a robust and rigorous water quality monitoring system providing the foundation to address compelling questions on the impacts of nutrients and sediments to the Mississippi River Basin and Gulf of Mexico. This system would quantify current water quality conditions and detect improved conditions that result from conservation implementation.

0209

Condition of Indiana Streams and Rivers using a Probabilistic Monitoring Program

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The objective of the Probabilistic Monitoring Program within Indiana's Department of Environmental Management is to provide a comprehensive, unbiased assessment of all Indiana streams for their ability to support aquatic life and recreational uses. This is accomplished by sampling randomly generated sites in major hydrologic units on a rotating basin schedule to assess and characterize overall water quality and biological integrity. Data collected at these sites (approximately 950 from 1996-2010) include ambient E. coli concentrations, water chemistry and chlorophyll a, fish and macroinvertebrate assemblage data, as well as habitat evaluations. These data are used to identify waterbodies not meeting their designated uses and provide statistically valid estimations of the percent of stream miles impaired in the basin(s) of interest.

All water quality and biological data and subsequent assessments serve as integral components of the Integrated Water Quality Monitoring and Assessment Report which satisfies reporting requirements to US EPA; however, the data have some limitations (*i.e.*, random sites are not revisited in following years, data are not collected year round, and not enough data collected to determine extent, cause, or source of impairments). The biological assemblage data have been used to predict the status of endangered or special concern species in Indiana, update species list and distribution patterns throughout watersheds, validate an Index of Biotic Integrity (IBI) for coolwater streams, refine the macroinvertebrate IBI to lowest taxonomic level, explore nutrient criteria thresholds through biological response signatures, and compare water quality and biological integrity within and between basin(s) over time.

0400
P

Urban Waters Monitoring: Monitoring and Assessment of Biological, Chemical, Habitat and Watershed Influences on Kansas City Streams and Lakes

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US Environmental Protection Agency, Kansas City, Kans., USA

The US Environmental Protection Agency in Kansas City has established urban stream and lake monitoring networks in the Kansas City urban area. The stream monitoring network consists of 36 sites on twelve urban streams. An array of biological, chemical and physical data have been monitored and assessed annually from 2006 to 2011. Monitoring efforts include sampling bacteria, algal, macroinvertebrates and fish, and the assessment of stream habitat and watershed characteristics such as land use and impervious surface. Water column and sediment samples have been analyzed for waste indicators, pharmaceutical and personal care products (PPCP), plasticizers, flame retardants, nutrients, metals, pesticides, herbicides and polycyclic aromatic hydrocarbons (PAHs). Results have indicated a gradient of effects on macroinvertebrate and fish communities associated with water column and sediment contaminants and varying urban land use watershed conditions.

The urban lake monitoring network consists of over 30 public lakes across the Kansas City metropolitan area. The lake monitoring consists of nutrients, bacteria, microcystin and fish tissue samples which have been taken from 2009 to 2011. Both stream and lake networks provide the public and decision maker's data and information as to the condition and trends of urban waters in the greater Kansas City area. All urban stream and lake network data is made available to the public along with other federal, state and volunteer data, on our website at KCWaters.org.

0409
P

Monitoring Nutrient Concentrations to the Lower Missouri and Upper Mississippi Rivers

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Nutrients originating in the upper Mississippi and lower Missouri watersheds have been recognized as sources contributing to hypoxia in the Gulf of Mexico. To help identify relative contributions of nutrients, samples have been collected on over 30 major tributaries discharging into the lower Missouri and upper Mississippi Rivers. Monitoring site locations are located near USGS gauging stations and on tributaries that represent more than three quarters of the flow that enters each of the two rivers from watersheds in the region. Nine rounds of sampling have been conducted (spring, summer and fall of 2009, 2010 and 2011). Samples have been analyzed of total nitrogen, total phosphorus and chlorophyll a along with basic *in situ* parameters. Preliminary results show the relative contributions of nutrients (total nitrogen and total phosphorus) from tributaries to the main stems of the Missouri and Mississippi Rivers, and will assist the Agency and its partners as they move forward to address gulf hypoxia.

0411
P

Dynamic Modeling of Nitrogen Flux in the Potomac Watershed Using Spatially References Regressions

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SPARROW models describe the average relations between contaminant sources and stream conditions based on long-term hydrologic data, standardized water quality monitoring data, and spatially-referenced explanatory information. Empirically derived results provide useful insights to the long-term steady state factors that affect fate and transport. However, many watershed management issues stem from temporal changes in contaminant sources or environmental conditions which cause a temporary imbalance among inputs, hydrology, and stream water quality.

A dynamically calibrated SPARROW model of total nitrogen flux in the Potomac River Watershed is being constructed. The model will be calibrated using seasonal water quality and watershed characteristics over the period 2001 to 2008 for 16,000 stream reaches. The model formulation allows for the evaluation of separate storage compartments of nonpoint sources including fertilized cropland, pasture, urban land, and atmospheric deposition. Nitrogen removal from storage to stream channels and to "permanent" storage (deep groundwater and the atmosphere) will be specified as parallel first-order processes. Enhanced Vegetation Index (EVI) and gross primary productivity data from the Aqua Satellite-borne MODIS sensor will be tested and evaluated to parameterize seasonal uptake and release of nitrogen. Conceptually, mass balance considerations imply that under constant nitrogen inputs and changing temperature and precipitation, flux will gradually change as temporary basin stores of nitrogen either grow or shrink and rates of removal to the atmosphere and release to streams change.

0488

Influence of Land Use on Phosphorus Concentrations in Southeastern US Piedmont Headwater Streams

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We monitored total dissolved phosphorus (TDP), dissolved soluble reactive phosphorus (SRP) and dissolved organic phosphorus (DOP) concentrations on a monthly basis over a two-year period (2008-2009) in 15 Georgia Piedmont headwater streams. The headwater streams are part of the South Fork Broad River watershed, which is a mosaic of areas with intensive animal agriculture, forestry, and rapidly increasing residential development. The studied headwater watersheds span a range of land covers, ranging from > 75 % forested to > 80 % pasture. Linear regression techniques were used to evaluate the relationship between land cover and dissolved P concentrations. Dissolved P concentrations were positively correlated with pasture land cover, which was generally the best independent variable. The best models for two-year mean TDP and SRP concentrations had % pasture land cover in the watershed and % open water in the stream buffer zone (90 m on each side of the stream) as independent variables and had adj r^2 of 0.82 ($p < 0.0001$) and 0.75 ($p = 0.0001$), respectively. The best model for two-year mean DOP had watershed pasture land cover as the independent variable and adj r^2 of 0.31 ($p = 0.019$). We observed substantial variation in two-year mean P concentrations among the streams; TDP: 17 to 72 mgP/L, SRP: 8 to 57 mgP/L, and DOP: 9 to 25 mgP/L. P concentrations were substantially elevated in all of the streams in August and September of 2008 and dramatically elevated in the streams with extensive pasture land cover in January 2009. The high P concentrations in January 2009 likely reflect stormflow-associated flushing of P from pasture soils that had been fertilized with P-rich broiler litter and grazed by cattle. The elevated P concentrations in summer 2008 were associated with low streamflow, high temperatures, and generally low dissolved oxygen concentrations. One mechanism that may contribute to the summer elevated P concentrations is dissolution of P- containing iron oxides associated with iron redox cycling processes that likely occur in the oxygen-depleted stream sediments.

0471
P

Validation of a Green Chemistry Method for the Determination of Total Nitrogen and Total Phosphorus Levels in Pulp and Paper Mill Wastewaters: NCASI Method TNTP W10900 Comparative Study

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Many states already have or are developing nutrient criteria based on total nitrogen (TN) and total phosphorus (TP) measurements. The current approach for determining TN is to measure total Kjeldahl nitrogen (TKN) and nitrate/nitrate and add them to obtain TN. To provide a “green chemistry” approach that will improve accuracy, precision, and sensitivity when assessing TN and TP in pulp and paper mill wastewaters, concentrations and QA/QC results obtained using NCASI TNTP-W10900 (an alkaline to acidic persulfate digestion) were compared to EPA monitoring methods (EPA 365.1 and 365.4 for TP; EPA 351.2 for TN). In contrast to TKN methods, this digestion is conducted in sealed vials, no fumes are released, lower method detection limits are obtained, waste is non-hazardous, simultaneous digestion for TP and TN occurs, and costs are reduced.

TP and TN concentrations obtained using NCASI TNTP-W10900 are comparable to EPA’s monitoring methods. Reproducibility for the TP methods yielded relative percent differences (RPDs) for replicate samples ranging from <0.01 to 14.3% except for EPA 365.4 using copper sulfate ($CuSO_4$) (44 and 50% RPDs). Precision for matrix spikes and matrix spike duplicates ranged from < 0.1 to 18.6% RPD for all TP methods with the exception of two samples analyzed using EPA 365.4 ($CuSO_4$) that yielded 47.1 and 96.1% RPDs. TN assessments of precision yielded RPDs ranging from 0.20 to 15.3% except for one sample in which EPA 351.2 ($CuSO_4$) yielded 32.4% RPD. NCASI TNTP-W10900 matrix spike recoveries for TP and TN were within EPA standardized acceptance criteria. Similar results were observed for continuing and independent calibration verifications and independent recovery (digestion) spikes in the TP and TN methods.

NCASI Method TNTP-W10900 provided results comparable to EPA methods for TP and TN in 16 matrices and QA/QC results indicated better accuracy and precision than the reference methods, thus providing a method for simultaneous digestion of TN and TP in pulp and paper mill wastewaters that reduces costs, eliminates hazardous waste, provides greater sensitivity for TN measurements, and exhibits excellent precision and accuracy.

0130
P

Algal Community Response to Nitrogen and Phosphorus Concentrations in Ozark Streams, Southern Missouri, 1993-95 and 2006-07

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To develop a Nutrient Criteria for the State of Missouri, an analysis of the relation between algae community structure and nutrient concentrations in the Ozark region of Southern Missouri was conducted. Nutrient and algae data were collected in the 1990s and 2000s by the US Geological Survey for the National Water-Quality Assessment program in the Ozark Highlands, southern Missouri. These data were collected at sites of differing drainage area, land use, nutrient concentrations, and physiography. All samples were collected at sites with a riffle/pool structure and cobble/gravel bed material. A total of 60 samples from 45 sites were analyzed. Water samples collected for this study had total nitrogen concentrations ranging from 0.07 to 4.41 milligram per liter (mg/L) with a median of 0.26 mg/L, and total phosphorus concentrations ranging from 0.003 to 0.78 mg/L with a median of 0.007 mg/L. These nutrient concentrations were transformed into nutrient categories consisting of varying percentiles of data. Algal community data were entered into the US Geological Survey's Algae Data Analysis System for the computation of more than 250 metrics. These metrics were correlated with nutrient categories, and four metrics with the strongest relation with the nutrient data were selected. These metrics were Organic Nitrogen tolerance, Oxygen Tolerance, Bahls Pollution Class, and the Saprobien index with the 25th and 80th percentile nutrient categories. These data indicate that near the 80th percentile (Total Nitrogen = 1.05 mg/L, Total Phosphorus = 0.035 mg/L) the algae communities significantly changed from nitrogen-fixing species dominance to those species more tolerant of eutrophic conditions.

0550
P

Tracing Sources of Nitrate, Organic Matter, and Water in the Willamette River Basin, from the Headwaters to Portland, Using Stable Isotopic Techniques

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The Willamette River Basin contains more than 70% of Oregon's population and is under increasing pressure from continued urbanization. To better understand the sources of nutrients, organic matter, and water to the Willamette River and how these sources are linked to land uses, our team conducted two synoptic samplings of the Willamette River and its major tributaries, one under summer baseflow conditions in August 2006 and one under winter baseflow conditions in January 2007. We collected (1) mid-river grab-samples from the entire length of the Willamette River (> 275 km), at sites selected to represent both uniform geographic coverage and different sources of nitrate, including feedlot operations, urban sewer and septic drainage, industrial effluent, and crop agriculture; and (2) near-shore grab-samples from all major tributaries near their confluence with the Willamette River, from the mouths of minor tributaries to the Willamette River that had largely urban or agricultural land use, and from major sub-tributaries, reservoirs, or other sites of local hydrologic interest. About 100 samples were collected during each synoptic; most samples were analyzed for nitrate, ammonium, DOC concentration, conductivity, and water- $\delta^{18}O$ and $\delta^{2}H$. Selected summer samples were also analyzed for nitrate-$\delta^{15}N$ and $\delta^{18}O$; the nitrate isotope analyses of selected winter samples are in progress.

During summer baseflow conditions, nitrate-$\delta^{15}N$ values indicate a range of nitrate sources to tributaries. Nitrate concentrations in the mainstem increase downstream but the nitrate-$\delta^{15}N$ remains relatively constant. In contrast, both the nitrate concentrations and $\delta^{15}N$ of tributary-mouth samples increase downstream, probably indicating increased contributions of nitrate derived from nitrification of human/animal waste downstream. Unlike in other large river basins, the nitrate isotope data show little evidence of denitrification. The downstream oscillations in nitrate-$\delta^{18}O$ in both mainstem and tributary-mouth samples probably reflect differences in water-$\delta^{18}O$ in the sub-basins where nitrification occurred. The spatial changes in water-$\delta^{18}O$ in tributary-mouth and mainstem sites can be explained by the elevations of the contributing sub-basins. This dataset provides a fundamental assessment of the potential usefulness of isotopic techniques for identifying spatial and temporal changes in nitrate and water sources in the Willamette Basin during contrasting hydrological conditions.

0253
P

Evaluating Sediment and Nutrient Loading into Texas Bays and Estuaries from Riverine Systems

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The US Geological Survey (USGS), in cooperation with the Texas Water Development Board and the Galveston Bay Estuary Program, is evaluating the variability of sediment and nutrient loads entering Texas coastal ecosystems.

Discharge, sediment concentration, and nutrient concentration data can be used to gain a better understanding of the hydrologic and water-quality characteristics and can serve as input to hydrodynamic and water-quality models that contribute to the overall understanding of the coastal ecosystem. At present, these type of data are not well known for many Texas estuaries, particularly during peak inflow periods, when large pulses of nutrients and sediments have the potential to significantly affect bay health and resources.

Initially, this study evaluated the lower reaches of the Trinity River during a variety of hydrologic conditions and aimed to help characterize the sediment and nutrient load transported into Galveston Bay. An extension of this study adds focus on the lower reaches of the Colorado River entering into the Matagorda Bay estuary and the lower reaches of the San Jacinto River entering into the Galveston Bay estuary.

0414
P

A Method for Economic Valuation of Nutrient Monitoring

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One of the potential economic *benefits* of monitoring is a reduction in pollution control costs stemming from greater certainty over the predicted effects of pollution controls in improving water quality. Increased monitoring leads to measurably smaller errors in water quality model predictions which, in turn, reduce the amount of “over design” required for a pollution control program to achieve an acceptable level of water quality improvement with a desired level of reliability. In this modeling study, we attempt to quantify this benefit by comparing the marginal cost of USGS water quality monitoring with the estimated marginal cost of pollution controls required to reduce the flux of reactive nitrogen to US coastal waters with specified performance and reliability levels. We conducted repeated calibrations of a national-scale SPARROW model of fluvial total nitrogen (TN) using data from a varying number of monitoring stations randomly chosen from a 425-station database. Model accuracy of each calibrated model was then assessed through “bootstrapping” methods. The results show a positive relation between number of stations used in the calibration and model accuracy. Each of the calibrated models was used to develop an economically efficient nutrient control plan designed to reduce the flux of TN to US coastal waters by specific “design” percentages. Economically efficient control plans represent the least-cost combination of control technologies which, when applied to the individual nitrogen sources in the SPARROW water quality model, are expected to achieve the design level of coastal nitrogen reduction. The estimated probability that each plan would *actually* achieve a level of nitrogen reduction equal to, or greater than, a specified “acceptable” level of reduction (less than the design level) increased with increasing accuracy of the model used to design the control plan. The difference between the “design” and “acceptable” levels is the required amount of “over design”. The probability that an “acceptable” level of nitrogen reduction would be achieved also increased with the size and cost of the control plan. Comparing the slopes of the relationships of accuracy (*i.e.*, monitoring cost) and pollution control cost to reliability provides a meaningful measure of the value of monitoring.

0476
P

Clay Minerals as Important Inorganic Constituents Controlling Uptake and Bioavailability of Phosphorous Retained in Bottom Sediments of Klamath Lake, Oregon

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Sediments in lakes, reservoirs and streams are known to retain nutrients and contaminants that affect water quality and aquatic

ecosystems long after anthropogenic processes on the land have introduced substances to the environment. Clay minerals, especially smectites, are important mineral constituents of lacustrine deposits that increase retention of phosphorus in sediments in and around Klamath Lake, Oregon. Sediments rich with smectite contain more phosphorus, whereas sediments with less smectite are lower in phosphorus.

Core samples from the bottom of Klamath Lake, as well as outcrop specimens from the Sycan River near the mouth of upper Klamath Lake, were analyzed for crystalline mineralogy and cryptocrystalline clay minerals by X-ray diffraction (XRD) after sequential particle size separations from whole sample to < 0.03 µm size fractions. Chemical analyses of these bracketed size separates have shown that phosphorus content increases with decreasing particle size of the sediment. The dominant clay species in 0.1-0.03 µm and <0.03 µm grain sizes of the sediment is an aluminous dioctahedral smectite similar to montmorillonite. These finer grain sizes enriched with smectite contain 78% of the total phosphorus analyzed in 5 bracketed size fractions separated from Klamath Lake sediment. Size fractions of the sediment larger than 0.1 µm contain only 22% of the phosphorus, and are dominated by quartz, feldspars and amorphous silica. The portions of the sediment with coarser crystalline resistate minerals have less exchange capacity when compared to highly colloidal smectite-rich clay separates.

Ultrafine particles of smectite suspended in the water column or deposited in the bottom sediment of Klamath Lake may be a source of phosphorus for microorganisms. Studies are currently being conducted to determine the bioavailability of phosphorus in the interlayer exchange sites of the smectite crystal structure. Smectite from natural sediment and commercial bentonites are being used to culture bacteria that attempt to access phosphorus held by interlayer exchange sites.

0446

Analysis of Monitoring Data from Multiple Small Watersheds to Identify Drivers of Agrochemical Runoff from Corn and Sorghum Agriculture

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Over 150 site years of herbicide concentration data have been collected from 2nd / 3rd order streams draining from >65 small Midwest watersheds that represent corn and sorghum agriculture with a high potential for agrochemical runoff. To complement these monitoring data, very detailed assessments of watershed soils, slopes and cropping have been developed using GIS tools. These data have been analyzed using a combination of statistical approaches including logistic regression, discriminant analysis and principal components analysis, among other multivariate techniques, in order to identify key drivers of runoff that differentiate between sites with varied vulnerability characteristics. Automated analyses were conducted across many variables and, after simplification, a three factor model was found to successfully distinguish between classes of vulnerable sites. One key factor is the fraction of the watershed where cropped lands have shallow depths to restrictive soil layers co-occurring with slopes and this offers potential for field-scale application.

0433
P

Improved Characterization of the Temporal and Spatial Variability of Potential Surface Water Drinking Water Exposure by Using Environmental and Historic Monitoring Databases

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The extensive atrazine surface water monitoring database totals over 300,000 samples including ~120,000 drinking water samples from high frequency seasonal monitoring programs covering more than 15 years and >210 Community Water Systems (CWS). This wealth of frequent monitoring data sampled across a wide range of years and sites allows for robust conclusions to be drawn with very high statistical certainty regarding the highest centiles of potential atrazine exposures. To complement the monitoring data, site-specific details have also been accumulated on CWS watersheds, source waters and water handling procedures; this information has been used to better understand the expected temporal concentration patterns at individual CWS. We will outline how these and related data (*e.g.*, daily flow and chemical monitoring data from Heidelberg University) have been used to examine approaches for optimizing sampling strategies for assessing potential drinking water concentrations in surface water.

0501
P

Water Quality Implications from Wildfire in Northern Oregon

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In August 2011, lightning ignited the Dollar Lake Fire in the Mount Hood National Forest near the Bull Run watershed. The fire burned over 6,000 acres just outside the eastern boundary of the watershed; the fire threatened to enter the watershed for several days until weather conditions changed bringing cooler temperatures and rain. The Bull Run watershed is the primary water source for the Portland Water Bureau (PWB), which provides drinking water to over 900,000 Oregonians. A fire in the Bull Run watershed would be especially problematic for PWB, as the Bull Run water supply is an unfiltered system, one of the few remaining large unfiltered systems in the U.S.

The potential water quality issues due to wildfire include both short and long term impacts. In the short term, ash deposition could cause an increase in pH and alkalinity. Some metals, organic carbon, and nutrient concentrations could also increase. Increased erosion resulting in elevated turbidities for an extended period would also be likely after a large fire. Other fire related activities that could impact water quality were also assessed. Primary among those included the use of fire retardants and the introduction of Forest Service equipment into Bull Run Lake (in case the water source was needed to fight the fire).

To more fully understand potential impacts to the water quality of the water supply in the event that the Dollar Fire did progress into the Bull Run watershed, a sampling protocol was developed. The sampling plan involved collecting samples at various locations within the watershed including the primary intake, tributaries, and reservoirs. These samples were taken both during the incident and again during the first rain event to capture first flush conditions. Sampling included the utilization of field probes as well as laboratory analyses. This data was then compared with baseline data taken from the same areas prior to the fire. This information was prepared to inform concerned customers as well as internal stakeholders. However, due to the unplanned and sporadic occurrence of wildfires, it will also be invaluable should another fire threaten the watershed in the future.

0386
P

State of the San Gabriel River Watershed (California) 2005 to 2009: Ambient Stream Condition, Unique Habitats, Swimming Safety & Fish Consumption Safety

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The San Gabriel (California) River Regional Monitoring Program (SGRRMP) is the first ongoing watershed-wide monitoring effort initiated in California. Stakeholders designed the monitoring program around five key monitoring questions: What is the ambient condition of streams?; Are conditions at unique habitats changing over time?; What are water quality conditions near major discharges?; Is it safe to swim?; and, Is it safe to eat fish? Sampling for these programs has included six annual summer surveys that began in 2005. During that time field crews have collected samples at 80 probabilistic sites, nearly 100 samples at unique habitat sites, 800 samples for FIB and measured contaminants in the tissues of over 200 fish.

The overall condition of streams in the watershed is based on a probabilistic monitoring design using a triad of indicators that includes water quality, toxicity, bioassessment, and physical habitat conditions. Combinations of these indicators were also used to assess changes in habitat condition at unique sites over time. The water quality conditions in receiving waters near seven major NPDES discharges was assessed by comparing monitoring data against state and federal standards. Fecal indicator bacteria (FIB) were collected during summer months at popular lake and river recreation areas to determine the safety of swimming. Fish consumption safety was assessed by measuring tissue concentrations of mercury, selenium, DDT and PCB from composites of fish collected at popular angling sites.

Results to date illustrate clear patterns in stream condition that distinguish the upper (un-developed) portions and lower (developed) portions of the watershed in terms of water quality and habitat condition stressors. There have been few exceedances of water quality standards in receiving waters near NPDES discharges during the period. Public swimming areas have had few exceedances of FIB standards. Contaminant concentrations in fish tissues have helped identify species that exceed state consumption thresholds and will be used by the state to determine where fish advisory postings might be needed. These results have been presented to watershed managers, regulators, the public, politicians and the media through a State of the Watershed report and symposium, annual summary reports and a web based data portal.

0045
P

Can an Urban Stream that Has Been Diverted Into a Series of Pipes underneath the City of Portland Ultimately Contribute to Improving Salmonid Habitat in the Willamette River?

Marc Peters and Frank Wildensee

City of Portland, BES, Portland, Oreg., USA

Over 100 years ago, Tanner Creek flowed naturally from its headwaters in Portland's West Hills down to the shallow basin of Couch Lake that extended south of the Steel Bridge to the Fremont Bridge in what is now downtown NW Portland. As the population of the city grew in the late 19th century, Tanner Creek was rerouted underground through a system of pipes to the Willamette River. Couch Lake and the surrounding wetlands were filled in to make way for urban development and what eventually became transformed into the Pearl District.

Historically, many of the pipes in the Tanner Creek conveyance system were a combination of both stormwater runoff and wastewater that would often result in combined sewer overflows (CSOs) at the outfall to the Willamette River. The six-phase Tanner Creek Stream Diversion Project (1994-2007) was one of many efforts by the city to better manage CSOs to the Willamette River. The primary purpose of the project was to construct a separated storm- only pipe system to convey runoff from undeveloped areas and treated stormwater from impervious areas to the river, ultimately removing about 165 million gallons of stormwater annually from the combined system. As a result of directing the combined flow to the Westside tunnel (a.k.a. big pipe) CSOs from the Tanner Creek basin have been eliminated. Tanner Creek is now a separated storm-only drainage system and is considered part of the city's Municipal Separate Storm Sewer System (MS4) that delivers clean, cold water directly to the Willamette River.

In 2011, the City of Portland released the Tanner Creek Water Quality Characterization Report. This work provides a summary of current and historical water quality, flow, and temperature monitoring and analysis of Tanner Creek from 2002 through 2010. Although the water quality in Tanner Creek is somewhat typical of other impacted urban waterways, the cool, relatively clean water that now makes its way to the Willamette River gives the area around the outfall potential to provide off-channel aquatic habitat and the opportunity to create an important cold water refugia for migrating salmonids.

0295
P

Trophic Level Interactions in Lake Havasu, AZ-CA: Comparison with Other Colorado River Reservoirs

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Lake Havasu, AZ-CA was formed in the 1930s to provide water to Los Angeles and central and southern Arizona. A robust sport fishery developed in the reservoir but steadily declined until a habitat improvement program, which included installing artificial reef habitats, was instituted in 1992 and resulted in significant increases in sport fish. Unlike larger reservoirs on the Colorado River, Lake Havasu is relatively shallow, has a short hydraulic residence time, minimal variation in lake elevation, lacks significant submerged geologic formations, and has a broad, sandy littoral zone.

Quagga mussels were discovered in the reservoir in January 2007 at approximately the same time this invasive species was confirmed upstream. Significant increases in water clarity were noted after quagga mussel establishment in Lake Havasu. Similarly, a comparison of current chlorophyll and total phosphorus concentrations with historic values suggests that plankton productivity is markedly lower than the early 1980s. Current zooplankton production in Lake Havasu is extremely limited with an almost complete lack of *Daphnia*, the major zooplankton biomass component of other Colorado River reservoirs (Lakes Mead and Powell). Zooplankton biomass is estimated to be about 30% that of the Lake Mead and Lake Powell ecosystems. Overall zooplankton biomass was dominated by small-bodied cladocerans, primarily *Bosmina longirostris*. Significant primary production in Lake Havasu likely occurs in the periphyton community. Planktivore gut analyses indicates the majority of forage and sport fish utilize invertebrates associated with artificial habitats and the benthos, including quagga mussels, rather than zooplankton. Food web relationships in Lake Havasu will be compared with other reservoirs of the Colorado River.

0556
P

Analysis of Water Quality Trends and Evaluation of Climate Change Effects in a Rocky-Mountain Reservoir: A Case Study

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A surface water quality assessment was performed for Deer Creek Reservoir in Utah. Temporal trends for this study included water quality data collected from 1980 through 2007 from three different sampling sites. These sampling sites represent the three main zones (lotic, transitional and lentic) of a typical reservoir. Spatial water quality data collection also included measurements at three different depths along the water column (surface, mid-water, and bottom) from each sampling site. These depths were measured using multi-parameter water quality sondes and laboratory methods. Hydro-climatological, physicochemical and biological data were collected and used for the water quality assessment and development of a statistical model. Our water quality analysis included a period of dam reconstruction that created extremely low reservoir levels as well as normal operational levels. We performed analyses of variance (ANOVA) to determine the statistical significance of temporal and spatial variations in the data. The best statistical model for each sampling site was predicted and used to evaluate Deer Creek's water quality induced by different climatic and land use changes. Chlorophyll a concentrations were used as water quality indicator to assess the in-reservoir effects of climate and land used variation produced by meteorological, hydrological and nutrient enrichment changes. We compared the results obtained from our statistical model with previous results from a computational two-dimensional-hydrodynamic and water quality model. Our results from the statistical model showed similar patterns of chlorophyll a than the computational model. These results suggest that chlorophyll a concentrations for Deer Creek were more sensitive to nutrient changes than climatic changes.

0031
P

Integrated Water Quality Trend Analysis: A Standardized Non-Parametric Characterization of Water Quality at the Watershed Scale

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A newly developed "Integrated Water Quality" (IWQ) methodology is being used to track temporal changes in key water quality parameters. Using the IWQ approach, we are able to integrate data from numerous sites, collecting organizations, projects, and testing laboratories to evaluate water quality trends within pre-defined geographic areas. We have introduced a scoring system similar to an Index of Biological Integrity (IBI) to summarize and quantify annual water quality distributions so that regional trends can be calculated and compared. We also present a comparison between our watershed-based IWQ results and formal Kendall Trend Analysis results for individual sites. Watershed scale IWQ maps illustrate areas of improving as well as declining conditions to help focus water quality managers' priorities toward restoration.

0570

XX

Making a Difference on the Ground: The US Forest Service-TNC Partnership for Monitoring and Managing Groundwater Resources

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Groundwater is an important source of freshwater to both people and the environment, sustaining surface and subsurface biodiversity and providing ecological services to humans. However, rapidly growing demand for groundwater, coupled with declining availability and quality, has pushed groundwater management to a crossroads. Ensuring a sustainable future for this resource requires that decisions about its allocation and protection fully integrate the needs of both human and ecological communities. Recognizing the need for better data and tools for accomplishing this goal, the Forest Service and the Nature Conservancy formed a partnership to inventory, monitor, and manage groundwater resources and the ecosystems that depend on groundwater for their health and viability. In 2009, the Pacific NW Region of the Forest Service and the Oregon program of the Conservancy developed a Memorandum of Understanding (MOU).

Implementation of this MOU is intended to: 1) advance understanding of groundwater and groundwater-dependent ecosystems (GDEs) in the Pacific NW; 2) promote the gathering and sharing of scientific data and information; 3) evaluate the effects of existing and proposed management on the physical, chemical, and biological diversity of groundwater resources; 4) develop and implement strategies to protect or restore the integrity of groundwater resources and GDEs that consider current and future human needs for water. The partnership and MOU have allowed the Forest Service and the Conservancy to coordinate programs, resources and knowledge for managing groundwater resources. For the past two years, seven National Forests across Oregon have been inventorying GDEs using the draft National Protocols developed by the Forest Service and the Conservancy. These protocols include data on location, GDE type, soils, geology, water quality, water quantity, vegetation, aquatic biota, and disturbance. Additionally, the Conservancy has been developing tools and methods for identifying and mapping GDEs to fill data gaps on National Forest land. The mapping, inventory and monitoring data are being used by the Forest Service to inform management decisions for range allotment management plans, forest plan revision, aquatic restoration plans, and watershed condition assessment.

0231

Communication, Consistency & Quality: Keys to Volunteer Data Incorporation California

Annie Gillespie and Ann Kitajima

Morro Bay National Estuary Program, Morro Bay, Calif., USA

Morro Bay, California was incorporated into the National Estuary Program in an effort largely fueled by local volunteers. The strong spirit of volunteerism in the community continues to drive the Estuary Program's current Volunteer Monitoring Program, which has grown steadily in numbers and scope since 2002. Personal communication between Program staff and resource managers across multiple regulatory levels has generated strong interest and a growing reliance on volunteer data to inform environmental management decisions.

Estuary Program staff frequently communicate with contacts at County, Regional and State levels to ensure that data collection efforts are consistent with data needs. Significant effort is dedicated to reviewing data quality, updating field and lab procedures, and researching and integrating more consistent methods and accurate equipment. An emphasis on careful data management and documented data quality procedures allows for rapid sharing of results as raw values, summaries, and annual reports. Frequent communication with agency contacts and quick turnaround with data products has resulted in the incorporation of volunteer collected data for statewide research projects, regional 303d listings and TMDL monitoring, and local BMP effectiveness reports and aquaculture water quality management.

0165
P

Supporting Volunteer Water Quality Monitoring Efforts Throughout the USA

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The USDA NIFA Cooperative Extension-based Volunteer Monitoring Water Resource Project began in 2000. We have created a comprehensive support system for volunteer water quality monitoring & citizen science efforts across the country. We developed the "*Guide for Growing Volunteer Water Quality Monitoring Programs*" as the centerpiece for our efforts, which can be found on-line at http://www.usawaterquality.org/volunteer. This Guide provides succinct, comprehensive and timely information distilled from successful programs across the country, packaged as a suite of factsheet learning modules, which can be accompanied by workshops. Modules exist to help programs get started, design a monitoring strategy, train effectively, build and maintain credibility, manage volunteers, plan a data management system, make effective presentations, fund-raise and evaluate their efforts. Designed for "one-stop-shopping", the modules highlight techniques of successful programs and link to a multitude of available resources. This poster will provide an overview of the Project emphasizing recent outputs, the Guide for Growing Programs, the Extension Volunteer Monitoring Network, and additional resources on our virtual hub.

0514
P

Investigating the Feasibility of Using Biological and Habitat Metrics to Determine the Effectiveness of TMDLs: A Case Study

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The Deschutes River in western Washington and some of its tributaries are on the 2008 federal Clean Water Act Section 303(d) list for the following parameters: temperature, fecal coliform bacteria, dissolved oxygen, fine sediment, or pH. In 2008, the Washington State Department of Ecology (Ecology), in cooperation with the Squaxin Island Tribe, Thurston County, the City of Olympia, and others, conducted a Total Maximum Daily Load (TMDL) study. Loading target limits for temperature, dissolved oxygen, fecal coliform and pH were established for the Deschutes River.

In 2009, Ecology developed a Quality Assurance (QA) Project Plan describing a technical study that uses macroinvertebrates, periphyton, and related habitat indicators to evaluate the effectiveness of the 2008 TMDL or water cleanup plan in improving water quality in the Deschutes River. The goals of this study are to: (1) summarize and link watershed-based cleanup efforts to changes in biological communities (macroinvertebrates and periphyton), and (2) distinguish between natural and anthropogenic (human-caused) variables that affect changes in biological communities over time. This project explores the feasibility of using biological measures to determine the effectiveness of TMDL implementation activities.

Currently, Ecology is using multi-year macroinvertebrate and periphyton assessments on the Deschutes River for establishing baseline conditions. Biological indices will be chosen and used as benchmarks for demonstrating improvement during future monitoring efforts. Key indices as well as assemblage measures related to the impairment will be compared to measure TMDL effectiveness. These measurements will be used as a supplement to routine chemical parameters currently used for monitoring TMDL effectiveness.

0353
P

Use of NAIP Imagery to Characterize Riparian Vegetation Health for TMDL and Land Management Purposes

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With numerous streams in Nevada included on the 303(d) List for temperature, the Nevada Division of Environmental Protection (NDEP) has been interested in identifying TMDL-development methods that were better aligned with its limited resources and its desire for more appropriate TMDLs. Given significant concerns about the appropriateness of the temperature water quality standards that led to the listings, NDEP sought an approach that relied on a surrogate for stream temperature. Research showed that both Idaho and Oregon have successfully used riparian vegetation health as a surrogate target for their temperature TMDLs. Building off of examples from Idaho and Oregon, NDEP developed a similar approach that took advantage of BLM riparian vegetation survey results.

For over 25 years, BLM has been characterizing riparian vegetation health (including bank cover) on Nevada public lands. A key element of this TMDL project was to test the ability to develop a predictive relationship between characteristics derived from the 2006 NAIP imagery and the BLM bank cover ratings. To test the ability to use NAIP imagery for assessing vegetation conditions, a series of information was extracted from the NAIP images for selected BLM survey sites in northeastern Nevada. While BLM has performed over 700 surveys, only 46 were considered appropriate for seeking a relationship between the NAIP imagery and the habitat survey data (specifically bank cover) for purposes of this TMDL. The primary reasons for selecting these sites were: 1) BLM surveys were performed at these sites within one year of 2006 NAIP imagery acquisition (2005-07); and 2) these BLM survey sites had not experienced wildfires between the time of imagery acquisition and bank cover surveys.

The analyses showed that “percent woody vegetation” and “percent healthy riparian vegetation” within a riparian buffer were good predictors of bank cover conditions, with a regression coefficient of determination (R^2) of 0.94. This relationship was then successfully used to characterize existing conditions and to set target conditions for an EPA-approved temperature TMDL.

0174

Fanno and Tryon WatershedsWater Quality Monitoring – 1998 – 2011

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Monitoring environmental conditions and project effectiveness are important components of the watershed approach and the Portland Watershed Management Plan. By gathering ambient data, BES tracks trends in environmental conditions in Portland's watersheds. BES will be able to determine if overall watershed health is improving and if the City is moving toward meeting watershed health goals as described in the Portland Watershed Management Plan. The Bureau of Environmental Services' Fanno Creek and Tryon Creek watershed water quality monitoring program is a key component in the Bureau's TMDL implementation program and the Portland Watershed Management Plan.

BES' Water Pollution Control Lab provides sample collection, laboratory analyses, and flow monitoring services. The water quality monitoring program has five basic objectives:

Determination of recent/current water quality conditions to evaluate compliance with water quality standards, criteria, and support of beneficial uses;

- Determination of general temporal trends in water quality conditions;
- Evaluation of the effectiveness of management activities and initiatives (BMPs, for example);
- Identification of high pollutant load sources and the relationship between land uses and water quality; and
- Compliance with regulatory requirements for monitoring and reporting.

Key elements of the BES monitoring program for Fanno Creek and Tryon Creek watersheds are described below:

Fixed-Station Water Quality Monitoring: BES has been monitoring the water quality of Fanno Creek and its tributaries since 1989 and in Tryon Creek since 1997. A total of 11 sites were monitored until 2010. Sampling at a number of sites was discontinued due to budgetary constraints and need to focus sampling efforts in other areas. All sites were/are monitored monthly and three of the sites weekly during the TMDL compliance period from May to October. Water quality analyses include fifteen field and lab parameters. Water depth and velocity along with weather conditions are also recorded during field sampling. A sufficient baseline has been established to draw logical conclusions.

0526
P

The Stream Temperature Project: Expanding the Use of Volunteer Data

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The stream temperature project tries to leverage several of the lessons learned in communicating science to the public. The project requires citizen involvement in data collection and it daylights their data along with quality control data and data from other stream temperature projects in the region on a web portal. The stream monitoring is focused on one parameter, temperature, which makes the data and science very accessible, but the science communicated is broad, reaching from watershed awareness, to thermal load as a pollutant, to the importance of temperature to the life-cycle of aquatic organisms, to insights into relationships between our individual and community actions and stream temperature.

Accurate and affordable continuously recording equipment is used. Participation is open to anyone - individuals, schools, clubs, watershed groups - and the project seeks to foster partnerships between local municipalities that have an interest in public outreach, as well as a need to expand their temperature monitoring networks. *in situ* ations where a monitoring network in a given watershed is meeting programmatic needs, perhaps the impact of a specific feature on stream temperature, students and other participants are empowered to be involved in the collection of real data that may affect policy decisions.