2019 ANNUAL ENVIRONMENTAL SCIENCE AND DESIGN SYMPOSIUM

March 20-21, 2019

KIVA/KENT STUDENT CENTER

"COMPLEXITY OF ENVIRONMENTAL LEGACIES"

"6TH ANNUAL KENT STATE ENVIRONMENTAL SCIENCE AND DESIGN RESEARCH SYMPOSIUM"

KENT STATE UNIVERSITY

Environmental Science and Design Research Initiative

INTRODUCTION

The Environmental Science and Design Symposium, formerly the Land and Water Symposium, is a multidisciplinary forum that promotes the exchange of ideas related to the resiliency of natural and built systems. This year's theme, "Complexity of Environmental Legacies", reflects the challenges of developing sustainable systems in landscapes transformed by decades of modification and contamination. Speakers from a wide range of disciplines (fashion, geology, geography, architecture, and ecology) will address topics related to urban, sustainability, restoration, and the integration of design with biological systems.

Table of Contents

1) Remote Sensing of Cyanobacterial and Harmful Algal Blooms in Lake Okeechobee and Biscayne Bay, Florida

Dulcinea Avouris, Department of Geology, Kent State University (davouris@kent.edu)
Scarlett Henson, Department of Geology, Kent State University
Joseph Ortiz, Department of Geology, Kent State University

Cyanobacterial and Harmful Algal Blooms (CyanoHABs) have become a major topic of concern for homeowners and environmental groups in Florida, with blooms occurring in both Lake Okeechobee and Biscayne Bay in prior years. While Biscayne Bay and Lake Okeechobee are distinct water bodies, with different manifestations of the blooms, in both environments CyanoHABs can contain toxins that are harmful to humans and animals, can lead to fish and wildlife kills, as well as disrupt ecosystems.
Furthermore, recreational and economic use of the waters of Biscayne Bay and Lake Okeechobee are negatively impacted by these blooms. Monitoring and assessment of the CyanoHABs in both water bodies is a vital aspect of understanding the drivers and impacts of CyanoHAB growth in Florida.
Spectral decomposition of satellite remote sensing images of Lake Erie has been shown to be effective at discriminating between in-water constituents, both those related to CyanoHABs, and those that are non-HAB forming. Here we show that the KSU spectral decomposition method is also successful in identifying in-water constituents in Florida waters using images from the Sentinel 3A- Ocean and Land Color Instrument, acquired on 16 July 2017 and 28 July 2018. We identify the CyanoHAB signal in Lake Okeechobee on both days, as well as the sediment and algal signal in Biscayne Bay.

---

2) How does elevation and/or substrate affect the composition of biocrusts?

Lauren M. Baldarelli, Department of Biological Sciences, Kent State University (lbaldare@kent.edu)
David Ward, Department of Biological Sciences, Kent State University
Heather Throop, School of Life Sciences, Arizona State University

Biological soil crusts ('biocrusts') are conglomerations of a variety of organisms including bacteria, lichens and mosses that dominate soil surfaces in arid environments. Biocrusts are important in drylands due to their ability to perform several ecological functions such as soil stabilization and increasing pools of available nitrogen. Higher elevations are typically associated with more precipitation and, consequently, higher vascular plant densities, either outcompeting biocrusts or providing optimal conditions for later successional biocrust communities (lichens and mosses). However, the relationship between the abundance of biocrust and elevation may be obscured by soil type and its effects on nutrient cycling. We tested whether there was a relationship between biocrusts and elevation, and whether differences among biocrust communities were affected by soil type and enzymatic activity (a proxy for nutrient cycling). Biocrust samples were collected from a variety of sites along an elevational gradient between Phoenix (300 m) and Flagstaff (2,100 m) in Arizona while targeting different soil types. We measured % cover of biocrusts and the activity of three enzymes associated with carbon, nitrogen and phosphorus cycles. We found a significant effect of elevation on biocrusts. Lichens and mosses were significantly affected by elevation, while cyanobacteria were not. No significant substrate results were observed, except for the avoidance of granitic soils by mosses and avoidance of basalt by lichens. These results indicate that elevation affects the community composition of biocrusts, but perhaps greater sampling efforts are needed to make more general conclusions about the effects of substrate on biocrust composition.

---

3) Influence of iron (oxyhydr)oxide crystallinity on phosphate bioavailability in contrasting redox and hydrological conditions

Maximilian R. Barczok, Department of Geology, Kent State University (mbarczok@kent.edu)
Elizabeth M. Herndon, Department of Geology, Kent State University
Chelsea E. Smith, Department of Biological Sciences, Kent State University
Lauren E. Kinsman-Costello, Department of Biological Sciences, Kent State University

Hydrological shifts can change redox regimes in soils and can form poorly crystalline iron (Fe) oxides that have the potential to adsorb the limiting nutrient phosphate. The crystallinity and mineralogy of the Fe oxides that form as a function of redox fluctuations remain unknown. Phosphate bioavailability may decrease as hydrological changes drive the precipitation of Fe oxides, potentially limiting plant growth. To investigate these complex interactions, an in situ incubation experiment was conducted. Mesh bags filled with Fe-oxides of different crystallinity (ferrihydrite, goethite and hematite) were buried in and around a vernal pond in northeast Ohio. Fe-oxides were either phosphate-free or had high concentrations of sorbed phosphate. Lowland soils in vernal ponds were flooded during spring months but progressively dried out over the summer, while upland soils remained unsaturated, providing us with contrasting redox conditions. Bags were removed at two times intervals to capture flooded and dried conditions in the lowland soils. Redox conditions in the lowland soils shifted from anoxic to oxic as the pond above dried out. Fe-oxide crystallinity, analyzed using x-ray absorption fine structure spectroscopy, decreased over time for oxides incubated in the pond. Phosphate loss from phosphate-added treatments generally followed trends in Fe loss, indicating phosphate was released from dissolving iron oxides. Phosphate-free treatments in the lowlands gained phosphate over time despite losing Fe-oxides, indicating enhanced ability of small amounts of freshly precipitated Fe-oxides to adsorb phosphate. Results from this study will provide insight into the effect of Fe-oxide crystallinity on phosphate bioavailability.

---

4) Quantifying the rate of denitrification in different stream components of a 4th order stream

Sohini Bhattacharyya, Department of Biological Sciences, Kent State University (sbhatta6@kent.edu)
Laura Gunn Leff, Department of Biological Sciences, Kent State University
Paul Ayayee, University of Wyoming

Nitrogen is an important macroelement essential for life. Denitrification is an important step in the nitrogen cycle which microbially converts nitrate to nitrous oxide (incomplete denitrification) or di-nitrogen gas (complete denitrification). Denitrification is ecologically significant in streams as it can help in mitigating the amount of nitrate transport downstream. In this study, conducted in summer 2018, we examined the rate of denitrification in various stream components (sediment, water and macroinvertebrates). Freshwater macroinvertebrate guts have been shown to be a site for denitrification in prior research works. For the purpose of the study two sites in the West Branch of the Mahoning River (in Jennings Woods) were chosen. Macro-invertebrates that were sampled include crayfish, mayfly, caddisfly and members of Athericidae. Rate of denitrification was measured with and without acetylene block treatment. Each component (sample) was replicated thrice per treatment except caddisfly and mayfly samples due to lack of sufficient individuals that could be obtained from the respective sites. Caddisfly and mayfly samples were used only for the study with acetylene block treatment. Rate of denitrification was statistically significant among samples in both the sites and between the two different treatments. Sample, site, interaction between sample and site and the interaction between sample, site and treatment were also statistically significant. The future goal is to

study the functional genes associated with denitrification in the various stream components and perform 16S gene sequencing to gain insight regarding the microbial community present in the various stream components.

---

5) Improving Vertical Axis Wind Turbine Feasibility: Predicting Turbine Airfoil Performance Via Wind Tunnel Experimentation

Sydney E. Bihn, College of Aeronautics and Engineering, Kent State University (sbihn1@kent.edu)
Adam J. Fertig, College of Aeronautics and Engineering, Kent State University
D. Blake Stringer, College of Aeronautics and Engineering, Kent State University

Vertical-axis wind turbines have a unique advantage over traditional horizontal-axis wind turbines, because they can operate at lower wind speeds. These wind speeds are typically encountered during a majority of days in the Midwest region of the United States, as well as other locations in the world.

Vertical-axis wind turbine configurations have some significant advantages over horizontal-axis wind turbines. One major advantage is their size, they are small enough that they can be used in a more densely populated urban area; however, performance challenges prevent these vertical configurations from being widely integrated. One possible design solution is a spherical vertical axis turbine, employing a sequence of airfoils on the struts comprising the sphere. The objective of this research is to measure and assess the aerodynamic properties of different airfoils and predict their performance through one complete rotation. Kent State University's subsonic wind tunnel was utilized to collect the airfoil data on two airfoil shapes: the NACA 0012 and NACA 2412, at two low-speed Reynolds-numbers: 50,000 and 100,000.

Conventional correction factors and curve-fitting techniques are applied to the experimental data. Using the resulting data, the optimal airfoil placements can be predicted to create a working model for further testing and implications. It is expected that the results of these experiments will assist in improving the performance of vertical-axis wind turbine configurations over a wide range of wind speeds, thus expanding the operational feasibility envelope of wind turbines as important sources of renewable energy.

---

6) Evidence for net nitrogen gas production in Lake Erie surface waters

Christopher T. Boehler, Department of Biological Sciences, Kent State University (cboehler@kent.edu)
Darren L. Bade, Department of Biological Sciences, Kent State University

Two methods are commonly employed to quantify rates of N_2-fixation in surface waters. Acetylene reduction assays (ARA) are an indirect measure of N_2-fixation, relying on the conversion of acetylene to ethylene at a known mole ratio with respect to dissolved nitrogen gas. An alternative method, membrane-inlet-mass-spectrometry (MIMS), can directly quantify dissolved N_2 gas concentrations in water. Here, surface sample grabs (0.5m depth) were collected at 6 sites in Sandusky Bay on 4 dates (N=24) and bioassays were performed using both techniques. Significant levels of N_2-fixation were detected with ARA in 83% of samples, whereas net N_2-fixation was not detected in any samples (0%) by analysis via MIMS. In contrasts, significant levels of N_2-production were observed in 40% of the samples. N_2-production is not possible to detect with ARA and would have been missed had MIMS not been employed. Notably, 36% of the samples yielded significant rates of N_2-fixation via ARA and also net N_2-production via MIMS. In order

for analysis via MIMS to show significant increases in concentrations of dissolved N_2, the rates of N_2-production must exceed the rates of N_2-fixation in those samples. It is well documented that members of the cyanobacterial order Nostocales produce specialized cells (heterocyst) that can fix nitrogen, converting inert gaseous N_2 into ammonium ion (NH_4^+). Thus, detecting N_2-fixation in Sandusky Bay is not atypical. However, N_2-production is known to occur via two pathways within the microbial nitrogen cycle (i.e., anaerobic ammonium oxidation and denitrification). Currently, neither of these N_2-production pathways are known to be associated with oxygenated surface waters, but rather anoxic lake sediments (denitrification) or groundwater (anaerobic ammonium oxidation). Additional research is needed to resolve the net N_2-production observed by the methods employed in this study.

---

7) A tale of two communities; The characterization of an urban neighborhood for community issues and urban forests in East Cleveland from two different stakeholders.

Chad Allen Boston, College of Architecture and Environmental Design, Kent State University (cboston2@kent.edu)
Maci T. Nelson, College of Architecture and Environmental Design, Kent State University

Geospatial narrative was developed as a qualitative GIS approach to extend current GIS data capture capabilities. This method allows the integration of narrative interpretation with GIS to understand ephemeral and physical qualities of a location. This methodology can help assess the quality of a community and identify issues. The issues monitored by stakeholders can include failing infrastructure, vacancy, and crime for the community and disease, poor maintenance, and vandalism for urban forests. With geospatial narrative these issues can be mapped and analyzed. This project will study two geospatial narratives, from urban forestry and community stakeholders, in East Cleveland. A correlation will be determined from the data collected from the two narratives by extracting a set of keywords from each narrative. This data will assess the quality of a neighborhood and the urban forest. The project will determine whether geospatial narratives are reliable alternatives available to use for site analysis. Mapping the data from the narrative will identify a relationship with the quality of a neighborhood and the existing urban forest. This project will consult primary sources that have previously used geospatial narrative to understand methodology and results. This data offers a more considerate analysis for planning and design. Converting the stakeholder's assessment and input into mapped data, allows for a more holistic and complete analysis of the site, which can increase the overall success of the design.

---

8) How pore geometry affects the transition of non-Fickian to Fickian solute transport over various length scales

Jacob M. Bradley, Department of Geology, Kent State University (jbradl19@kent.edu)
Kuldeep Chaudhary, Department of Geology, Kent State University

Pore scale solute transport is known to exhibit non-Fickian solute transport characteristics related to pronounced tailing during asymptotic times. The tailing behavior is likely associated with large variability in pore fluid velocity, which is caused by diverging-converging pore channel geometry, and which further is magnified during inertial flows, as eddies or 'recirculation zones' form and grow in the dead-end part of pore channels. In this study we, at first, design a series of pore channel geometries and define them with a non-dimensional pore geometry parameter 'γ'. We use these geometries to solve Navier-Stokes and

Advection-Diffusion (ADE) equations and obtain 'break through curves'. These curves are used to fit analytical solution to ADE and determine the degree of non-Fickian to Fickian transport characteristics for various range of Reynolds number (Re) flows. Finally, pore channels are systematically extended in the direction of flow to 'length scales' where the non-Fickian transport becomes Fickian transport. The relationships between 'γ', Re, and length scales for Fickian transport will be presented during the conference meeting.

---

9) Using Crowdsourced Data to Analyze Patterns in Odonate Phenology

Christian M. Bullion, Department of Biological Sciences, Kent State University (cbullion@kent.edu)
Christie A. Bahlai, Department of Biological Sciences, Kent State University

The influence of long-term climate change on phenology for insects of the order Odonata (dragonflies and damselflies) has been well documented in several parts of the world, showing a negative correlation between emergence date and temperature. Likewise, previous studies have shown that spring-emerging species, with an overwintering diapause, are more susceptible to climate change than those species emerging later in the summer. This study analyzed the responsiveness of local odonates by utilizing data gathered from a recently established, ongoing biodiversity inventory of Odonata residing on the campus of UVA-Wise in Wise, VA. Odonates collected in Spring 2015 experienced a much colder winter than the specimens collected in 2017 which allowed for the testing of links between any earlier emergences and warmer temperatures. If winter temperatures increased, then it would be expected that adult odonate emergences will occur earlier in the year. First capture dates for 24 species of spring-emerging odonates were compared for 2015 and 2017 and these first capture dates served as a proxy for emergence dates. The statistical analyses revealed that the 2017 first capture dates are significantly earlier than the 2015 dates ($p = 0.036$) for just the damselflies. This link observed here between temperatures and earlier emergences for damselflies, but not with dragonflies, is for a very limited scope and time frame, but is consistent with other research linking the effects of climate to larger-scale patterns specifically just for damselflies.

---

10) Innovative Reuse of Alum-Water Treatment Residuals (WTR)

George J. Carleton, Department of Civil Engineering, University of Akron (gjc28@zips.uakron.edu)
Michael P. Spade, Department of Civil Engineering, University of Akron

Excess phosphorus levels in water ways can lead to eutrophication. A low-cost measure to reduce P levels may be to use Water Treatment Residuals (WTRs), which are otherwise shipped to a landfill or stockpiled in a drying field for blending and future land application. Two WTRs were selected for this study: an alum-based WTR and an alum-based WTR augmented with powdered activated carbon (PAC). Additionally, a study is being performed to investigate if baking the WTR will reactivate surface sites, leading to a greater PO_4 uptake. Batch isotherm and column experiments were performed to assess the specific adsorptive capacities. Numerous isotherm trials were planned to compare potential P adsorption within differing conditions. Variables may include different isotherm temperatures, static vs. dynamic desorption, and distilled vs. raw water desorption. The adsorption capacity will then be used to determine the variety of WTR best suited for P sequestration, identifying the amount that would be necessary to run a trial in a tributary flowing into original receiving source waters of the WTR material. Decreasing the P concentration entering the reservoir would aid in the prevention of harmful algal blooms.

11) Evidence of colloidal pyrite transport in soils developing on historic coal mine spoils

Md Abu Raihan Chowdhury, Department of Geology, Kent State University (mchowdh7@kent.edu)
David Singer, Department of Geology, Kent State University
Elizabeth Herndon, Department of Geology, Kent State University

Historic coal mines are one of the major generators of Acid Mine Drainage (AMD) in the United States. Past coal mining activities in Huff Run, Ohio generated large mine spoils and oxidation of these mine spoils led to a serious AMD generation in the Huff Run watershed. A remediation project conducted in the Huff Run watershed costing over $590,000 failed to resolve AMD generation. The persistent AMD generation could be associated with the possible formation, transportation and oxidation of colloidal pyrite from mine spoils. To investigate the transport of colloidal pyrite through unsaturated soil in Huff Run subwatershed HR#25, eight lysimeters were installed and pore water samples were collected during summer of 2018. Initial studies have indicated the presence of colloidal pyrites in the porewater. The scanning electron microscopy-energy dispersive spectrometer (SEM-EDS) analysis of the colloidal particles isolated from pore water samples revealed the presence of iron (Fe), sulfur (S) and oxygen (O) bearing phases in the colloids which are consistent with pyrite (FeS_2) and the oxidation product Fe oxides. The x-ray diffraction (XRD) analysis of the colloidal samples confirmed the presence of multiple phases of sulfide bearing minerals (FeS_2, $FeAsS_2$, $CuFeS_2$). Both SEM-EDS and XRD detected the presence of Fe oxides associated with colloidal pyrite which can have a significant environmental impact in terms of colloidal pyrite oxidation, AMD generation and trace metals adsorption.

12) Pyrite Morphology, Texture, and Trace Metals Across a Weathering Profile (from Parent Rock to Soil) of Ohio Coal Shales

Kortney A. Cole, Department of Geology, Kent State University (kjohns15@kent.edu)
David Singer, Department of Geology, Kent State University

Acid mine drainage (AMD) refers to the acidic outflow of water from a mining site caused by the weathering of pyrite (FeS_2) present in coal. Oxidation of pyrite, within underground mine work and surface waste, releases sulfuric acid and metals, including nickel, cobalt, arsenic, and lead into surface and subsurface waters. AMD negatively impacts water quality, wildlife, and human health. The aim of this study was to determine changes in pyrite particle size, morphology, texture, and composition during the weathering of the parent coal-shale rock. This was accomplished by collecting scanning electron microscopy (SEM) images and energy dispersive spectroscopy (EDS) element maps of pyrite in the following materials: (1) the parent coal-shale rock; (2) rock powder before and after simulated weathering; and (3) soils developing on historic mine waste. Shale samples were crushed to 63, 250, and 2000 µm and subjected to an artificial weathering process over several months to observe if particle size impacted the degree of weathering and its effect on mineral morphology. Soils were collected at various depths and prepared as thin sections. The commonest morphologies seen were framboids and octahedra. Oxidation rim and replacement textures were observed repeatedly, especially in the soils. Iron and sulfur oxide concentrations were universally observed over the range of crushed particle sizes and various surface topographies. Oxidation rim textures are most abundant on small particles consistent with prolonged weathering, resulting in greater degrees of oxidation. Preliminary results suggest AMD production

increases with greater variability of surface topography and decreasing particle size. Understanding how the release of AMD will progress in an impacted system, controlled by the degree of weathering of parent rock, is important to assessing its environmental impact. Characterization of mine spoil is instrumental to proper planning and implementation of treatment systems.

---

13) Ecotone effects on flying invertebrate communities in a temperate hardwood forest

Colleen R. Cosgrove, Department of Biological Sciences, Kent State University (ccosgro1@kent.edu)
Christopher B. Blackwood, Department of Biological Sciences, Kent State University
Mark W. Kershner, Department of Biological Sciences, Kent State University

Transitional areas between ecosystems, called ecotones, are areas of biotic and abiotic change often leading to differences in plant communities and soil conditions. Invertebrate communities taking advantage of surrounding plant and soil conditions are likely to structure their own communities around favored resources. Flying invertebrates have the unique advantage of avoiding ground obstacles giving them a larger range to gather and utilize resources. As a result, flying invertebrate communities should be less strictly structured based on surrounding plant communities or abiotic factors. To test this, we conducted a survey of the flying invertebrate communities to compare to existing tree and soil surveys. We used baited traps to collect invertebrates during 4 separate collection time points, preserved samples in ethanol, and then sight-identified to lowest practical taxonomic level. This study was conducted in Jennings Woods, a temperate hardwood forest in NE Ohio comprised of unique ecosystems – riparian, upland, and bottomland forests – separated by elevational gradients, each with its own particular soil parameters. We found that, in general, the flying invertebrate community is not structured around the tree community nor the soil, as expected. However, community structure did show a relation to ecosystem type. We also found that diversity and richness were significantly different between ecosystems and dates. This suggests that there are ecosystem and time differences structuring flying invertebrate communities, but they are not limited by the surrounding soil and tree communities.

---

14) An Investigative Deconstruction of a Solid Oxide Fuel Cell (SOFC)

Angela M. Deibel, College of Aeronautics and Engineering, KSU Clean Energy and Sustainability Lab (adeibel4@kent.edu)

In the US and around the globe, over 60% of our electricity is from burning fossil fuels. Fuel cells can be twice as efficient and have the potential to dramatically change the way electricity is generated. When hydrogen and oxygen meet on the electrolyte plate, a catalyst spurs a reaction that creates H_2O and electricity, without greenhouse emissions. Emissions can be generated through obtaining hydrogen, but with significantly less greenhouse gases and higher fuel-energy conversion. There is a unique opportunity to study a large commercial fuel cell, a 150 Kilowatt Fuel Cell Module (FCM). This FCM was donated by a company represented by the letter B*, per a Non-Disclosure Agreement. The FCM weighs 720 pounds and works with 9 other units to create one megawatt of power.

---

15) Eutrophication: can we reverse the process with Algae?

Qunxing Ding, Department of Biological Sciences, Kent State University at East Liverpool (qding@kent.edu)
Haiyan Zhu, Department of Biological Sciences, Kent State University at East Liverpool

Eutrophication is hallmarked by excessive algal growth due to the increased availability of inorganic and organic compounds in the water. Pollution is usually one of the major reasons that induces eutrophication. In addition, polluted water is one of the leading factors that induce a wide range of diseases, especially in children. Currently about 45% of U.S. streams, 40% of America's rivers, 47% of lakes, and 32% of bays are polluted, which are not suitable for drinking, swimming, fishing nor aquatic lives. To ensure the quality, residential water is usually suppled after treatment, and the water treatment also induces toxic components, for example, trichloroacetic acid (TCA) and bromodichloromethane, which both are cancer inducers. The national average concentration of these compounds in tap water are 4.92 ppb (part per billion) and 4.31 ppb respectively. In groundwater, the nitric components are one of the major contaminants, which significantly promote the growth of green algae, leading to eutrophication. Single cell algae Chlorella is one of the common algae that involves in eutrophication, and our recent study indicated it also can help reduce the concentration of some contaminants, including TCA, iron, and nitric oxide. This support our hypothesis that green algae can absorb the pollutants and reduce their concentration in the water to reverse the eutrophication.

---

16) Do different green roof substrates, plant communities, and mycorrhizal fungi impact water runoff quality and quantity?

Anna G. Droz, Department of Biological Sciences, Kent State University (adroz1@kent.edu)
Taylor Fulton, Department of Biological Sciences, Kent State University
Reid Coffman, College of Architecture and Environmental Design, Kent State University
Chris B. Blackwood, Department of Biological Sciences, Kent State University

A major goal of green infrastructure is the reduction of stormwater in the urban and suburban landscape, which is accomplished by the design—particularly the growing substrate and plants within it. Engineered growth substrate is often used because it is a known quantity that can hold specific volumes of water while still being lightweight. Natural growth substrate (soil) is a more unknown quantity but has the benefit of being able to support more plant species and introduce native soil organisms into the system. The interactions between growth substrate, plant, and soil biota have the potential to be able to bring additional benefits to the urban environment besides just stormwater reduction, such as air and water purification, and providing biological habitat. This study aims to examine how different types of substrate, plants, and the addition of soil organisms called mycorrhizal fungi impact the quality and quantity of stormwater. Located at the Cleveland Industrial Innovation Center, 39 different square meter plots were built on a low height roof. Three different substrate types: a bioretention grade soil, a worm casting compost, and a conventional engineered media (RoofliteTM) were used in combination with two separate plant communities, a native prairie and a designed community. Half of these were inoculated with symbiotic mycorrhizal fungi and the other half were left uninoculated. Water runoff was collected bi-monthly over the course of a year and total N and P content were measured. Preliminary analyses show that substrate type had a very significant effect on the volume of water runoff, while plant communities significantly impacted the amount of nitrogen runoff. All the treatments showed high amounts of phosphorus runoff, which could potentially impact

downstream water quality if not addressed. However, further analyses on the plants, substrate, and soil biota are still in progress and the information may help improve green roof health and functioning.

---

17) Comparative analysis of treatment efficiency of PPCPs in wastewater and drinking water plant in Northeastern Ohio

Sayoni Dutta, Department of Biological Sciences, Kent State University, (sdutta2@kent.edu)
Kai Wang, Department of Biological Sciences, Kent State University
Jen Mou, Department of Biological Sciences, Kent State University

Pharmaceuticals and personal care products (PPCPs) are one group of Contaminants of Emerging Concern (CECs) that have the potential to impact water quality and human health. Currently, PPCP monitoring and reporting is not mandatory according to state or federal laws, and more often water treatment plants are not directed to remove PPCPs This study monitored and compared treatment efficiencies of separate drinking water and wastewater treatment plants (DWTP and WWTP) in Northeastern Ohio, focusing on their ability to remove PPCPs. This study also examined if environmental variables have a role in altering PPCP concentrations in water treatment plants. Samples were collected from the Sandusky Water Treatment Facility and Kent wastewater reclamation plant in the summer of 2018. PPCPs were determined using High-Performance Liquid Chromatography-Mass Spectrometry (HPLC-MS). Screening for antibiotic-resistant bacteria from source water was also conducted using LB agar plates. The concentration of nutrients and environmental variables, including soluble reactive phosphate (SRP), nitrate, ammonia, total nitrogen, dissolved organic carbon (DOC), and chlorophyll-a, were measured using standard methods. Chlorophyll-a and nitrate concentrations were comparatively higher at the point of discharge in the Kent WWTP compared to the source water at the DWTP in Sandusky. Future work will involve monitoring PPCP concentrations in water treatment plants with different treatment processes (e.g., UV, biofiltration, ozone) to better understand the efficacy of filtration techniques in successful removal of these contaminants from water systems.

---

18) Predicting Lake Erie Algal Blooms based on Alternate Ecosystem States Theory: Early Warning Signals of an Impending Bloom

Allison Ruth Erf, Geological and Environmental Sciences, Youngstown State University (arerf@student.ysu.edu)
Darren L. Bade, Department of Biological Sciences, Kent State University

Algal blooms have become a yearly occurrence in Lake Erie for some time now. These blooms are not only a nuisance but can also pose a risk to human health. Theoretically, early warning signals will exist prior to a shift in ecosystem state, i.e. an algal bloom. Indicators, such as increasing variance and rising autocorrelation close to 1, have been associated with transitions to alternate ecosystem states. These early warning signals have been observed in some whole-ecosystem experiments using quickest detection (QD) methods. The goal of this study was to determine if these early warning signals were detected in chlorophyll data prior to an algal bloom in a real-life ecosystem, Lake Erie. The QD method for detecting early warning signals associated with shifts in ecosystem states was used. In Lake Erie, the shift from a mixed phytoplankton state to a cyanobacterial dominated state was considered a transition to an alternate ecosystem state. Results showed that increasing variance before an algal bloom was not always detected,

and therefore early warning signals of an impending algal bloom were not seen. The research suggests that examining phycocyanin, a pigment specific to blue-green algae, may provide more promising results in the future. If successful, this research could be used to provide warnings of impeding algal blooms to water treatment managers, allowing them to be prepared for the situation.

---

19) More than One Way to Limit Algae: Trace Metal-Nutrient Colimitation of Algal Production

Andi Fitzgibbon, Department of Biological Sciences, Kent State University (afitzgib@kent.edu)
David Costello, Department of Biological Sciences, Kent State University

Algae use diverse mechanisms to acquire and sequester nutrients to support metabolism and growth. Some mechanisms include the use of trace metals as enzyme cofactors to support electron transfer proteins, for photosynthesis and respiration, or to produce enzymes that allow for use of less common organic nutrient sources. Much of what is understood about stream nutrient limitation focuses on just N and P, although trace metals support several underlying metabolic pathways that may also cause apparent nutrient limitation. We present data from streams in the Great Lakes basin that span a gradient of pristine to urban and low to high inorganic nutrient concentrations. We used trace metal nutrient diffusing substrates (tNDS) with different combinations of elements to identify trace metal-nutrient co-limitation of algae. Metal-nutrient co-limitation was observed in streams with low dissolved inorganic nutrients. Chlorophyll a concentrations showed that 80% of streams with low inorganic P were Zn-P co-limited. Net primary production estimates showed that streams with low inorganic N were Ni-N co-limited. We suggest that while a stream may appear N or P limited, the metabolic mechanism underlying this result may be due to trace metal co-limitation.

---

20) Impact of Deer and Soil Chemistry on Plant Mutualists in Forest Soil

Kyra A. Flauhaus, Department of Biological Sciences, Kent State University
Jean H. Burns, Department of Biology, Case Western Reserve University
Sarah R. Carrino-Kyker, Research Department, The Holden Arboretum
David J. Burke, Research Department, The Holden Arboretum

In temperate forests, understory herbaceous plants are often affected by the abundance of white-tailed deer, both directly through herbivory and indirectly through soil compaction. Soil chemistry, particularly soil pH, also has a large effect on the soil microbial communities that influence plant growth and survival. The objective of this study was to study the interactive effects of deer herbivory and soil chemistry on plant mutualists in forest soil using Jack-in-the-Pulpit plants. Jack-in-the-Pulpit are common understory herbs in temperate forests that deer will eat but are not preferred. In Bole Woods at the Holden Arboretum, 760 Jack-in-the-Pulpit plants were planted into 19 plots (both deer exclosures and un-fenced controls), each containing 4 subplots, 3 where soil chemistry had been altered and a control. Soil samples were collected from each subplot to be used for DNA analysis. Using PCR-terminal restriction fragment length polymorphism, we determined community structure of the fungal and bacterial communities. Our results showed that across communities of general fungal, AM fungi and bacteria, there were taxonomic differences present with soil chemistry alteration. Subplots that were amended with limestone and calcium

had similar communities compared to subplots that were amended with triple superphosphate or the control. These differences reflected changes in soil pH that we had seen previously.

---

21) The Impact of the Bokashi Composting Method on Soil Fungal Community Structure and Function

Matt D. Gacura, Department of Biological Sciences, Kent State University (mdgacura@gmail.com)
Andrew C. Eagar, Department of Biological Sciences, Kent State University
Anna Droz, Department of Biological Sciences, Kent State University
Oscar J. Rocha, Department of Biological Sciences, Kent State University
Laura G. Leff, Department of Biological Sciences, Kent State University
Christopher B. Blackwood, Department of Biological Sciences, Kent State University

Conversion from traditional farming practices to more sustainable, organic methods is becoming increasingly popular. While widely practiced, little research has been performed on how many of these methods influence overall plant health and their impact on soil microbial communities. In Costa Rica, for instance, many local farms utilize an organic farming technique known as the Bokashi method. This method is an anaerobic composting technique that utilizes the fermentation of organic matter and waste as a means of adding nutrients to soil to increase crop productivity. This is method is not only cost effective, but it is also not as work intensive as traditional composting techniques. However, while this method has great potential and is widely used, the impact that it has on soil microbial community structure and function is still a mystery. In this study, we analyzed whether Bokashi treatments have an impact on fungal community structure within several Costa Rican fields. We sampled soil from cilantro and/or cabbage farms representing a chronosequence of the Bokashi organic farming method, which ranged in age of implementation from 1 – 18 years. After sampling, we utilized next-generation Illumina sequencing to examine fungal taxonomic community structure. Overall, samples were found to contain a diverse array of fungi with dominance of phyla belonging to Ascomycota and to a lesser extent Basidiomycota. We found that the length of time a farm has been organically managed has a marginally significant effect on soil fungal community composition. However, sampling site and crop type had a more significant effect, which may show the importance of surrounding plant cover and dispersal limitation in determining community composition. While our findings suggest a small potential effect of organic farming on community composition, further analysis will be performed on how it influences the distribution of fungal functional groups.

---

22) Geodesic Filter

Douglas E. Gallucci, Center for Architecture and Environmental Design (dgalluc3@gmail.com)

This geodesic Dome has vegetation built with the structure. It has microclimate greenhouses on the exterior. The vegetation on the exterior of the building and inside of the microclimates are plants specifically chosen because of their ability to clean the air and create more oxygen. The interior is a research center that focuses on creating more microclimates as well as filtering water pollution with Plants. The parts of the Center is open to the public to educate them like a botanical garden. I am researching what microclimates can survive in Cleveland greenhouses and what they need to function.

---

23) Epidemiology of Staphylococci collected from Boston-area wild rodents

Gracen Renee Gerbig, Department of Biological Sciences, Kent State University (ggerbig@kent.edu)

As *Staphylococcus aureus* strains evolve and gain resistance to antibiotics, the risk of bidirectional transmission of resistant strains between humans and animals increases. The objective of this study was to identify and type *S. aureus* among wild rodents in Boston, Massachusetts, to examine their genetic relationship to common human and animal isolates. A total of 168 bacterial isolates collected from 45 Brown rats (Rattus norvegicus) in Boston proper were analyzed. Polymerase chain reaction was used to detect the mecA and PVL genes. All *S. aureus* isolates were spa typed. A subset of isolates was characterized via multi-locus sequence typing (MLST). All *S. aureus* isolates were tested for antibiotic susceptibility. Overall prevalence of *S. aureus* was 11.9% (20/168). Of all *S. aureus*, 5.0% (1/20) were MRSA (based on detection of the mecA gene which encodes methicillin-resistance) and 95.0% (19/20) were methicillin-susceptible *S. aureus* (MSSA). All isolates tested resistant to benzylpenicillin. Two isolates were resistant to erythromycin and one isolate was resistant to four antibiotics, including oxacillin. Of the 20 isolates, 75.0% (15/20) were spa type t933. MLST results to date show that these are sequence type (ST) 1094. Additional molecular testing is ongoing. Our results indicate that wild rats from Boston, MA are carriers of *S. aureus*. Additional study is needed to examine the distribution of t933/ST1094, an uncommon strain previously found in ewes in Tunisia. Further research is warranted to identify and characterize lineages of *S. aureus* strains in order to minimize the risk of Staphylococcal infection from city rodents.

---

24) In-stream decomposition and macroinvertebrate community dynamics: a comparison between invasive Glossy Buckthorn and native Silky Dogwood leaf litter

EmmaLeigh K. Given, Department of Biological Sciences, Kent State University (egiven1@kent.edu)
William D. Haas, Department of Biological Sciences, Kent State University
Jared E. Dyer, Department of Biological Sciences, Kent State University
Oscar J. Rocha, Department of Biological Sciences, Kent State University
Ferenc de Szalay, Department of Biological Sciences, Kent State University

Invasive species are a major threat to the biodiversity of an ecosystem. Their ability to establish and thrive in foreign habitats and often outcompete natives have led to changes in ecosystem dynamics in both terrestrial and aquatic habitats. However, the influence of riparian invasive plants on adjacent aquatic insect communities is understudied. This is important because riparian zones provide essential leaf litter resources for aquatic communities. To test this question, we studied how aquatic invertebrate communities varied between leaves of invasive *Rhamus frangula* and *Cornus amomum*. Leaf litter bags with either leaf type were constructed and deployed into Swine creek allowing aquatic invertebrates to colonize for over three months. No differences in macroinvertebrate community composition between *Rhamus frangula* and *Cornus amomum* leaves were observed, however, there were differences in the rate leaf litter decomposition and the numbers of shredders and predators present on the leaf material. The mechanisms behind these differences in decay and invertebrate preference are still not completely understood, however it can be said that with the increased invasion of glossy buckthorn into swine creek's riparian zone, changes to ecosystem dynamics and potentially the food web may be observed.

---

25) What are the effects of nutrient addition and competition on the growth of *Juniperus virginiana*?

Samia Hamati, Department of Biological Sciences, Kent State University (mhossai3@kent.edu)
David Ward, Department of Biological Sciences, Kent State University

The eastern redcedar *Juniperus virginiana* is the most widespread conifer in the eastern United States. *J. virginiana* is a range-expanding (encroaching) species that is native to the United States. This species contributes to the decline of grassland biodiversity because it competes with native species for nutrients, resources and changes the landscape of the areas where it encroaches. In Ohio, *J. virginiana* is particularly abundant on limestone-derived substrates, either because this species prefers to grow on limestone or due to the absence of competition with other species. We are interested in investigating the factors that are most important in facilitating the encroachment of *J. virginiana* into new areas. We tested the effects of nutrient content, high pH, and interspecific competition with a common invasive grass (*Bromus inermis*) and a native tree (*Quercus stellata*) on the growth and survival of *J. virginiana* seedlings. We recorded *J. virginiana* and *Q. stellata* height and trunk diameter weekly as an estimate of seedling quality and performance. We found that *J. virginiana* seedlings competing with the invasive grass *B. inermis* grew more slowly than *J. virginiana* growing without *B. inermis* or *J. virginiana* seedlings with the post oak *Q. stellata*. In addition, there was a negative effect of limestone addition on J. virginiana growth rate. Our results suggest that *J. virginiana* does not prefer high pH soil, but rather it thrives in these soils to minimize competition. Future efforts will determine if competition is the main factor affecting the encroachment of *J. virginiana* into new habitats and areas, which in turn will assist efforts to control woody encroachment into grasslands.

---

26) Bacterial colonization on different microplastics in a local stream in Northeast Ohio

M. Rumman Hossain, Department of Biological Sciences, Kent State University (mhossai3@kent.edu)
Laura G. Leff, Department of Biological Sciences, Kent State University

Research was performed to understand bacterial colonization on different types of microplastics in a local stream in Northeast Ohio. Disks were placed in bags constructed mesh fabric with 1000 µm diameter. Sampling was done at various intervals to determine early and late colonizers within bacterial communities on microplastics in freshwater. Microplastics (diameters <5 mm) are a global concern in environmental sciences and are readily colonized by bacteria in the environment. The term "plastisphere" has been used to describe bacterial communities residing on microplastics. The composition of the communities inside the plastisphere has been affected by the physicochemical properties of different microplastic types. Plastics have variations in physicochemical properties based on their intended applications. For example, polyethylene (PE) has a net negative charge while polypropylene (PP) has a net neutral charge at the pH of seawater. Subsequently, DNA was extracted from microbes adhering to disks and the plastisphere community composition will be determined from the V6 hypervariable region of 16S rDNA using 16S MiSeq 250 sequencing. Sampled disks will also be analyzed for differences in surface roughness, buoyancy, and weight after bacterial colonization. As the study progressed, microplastic disks broke down and had increased surface roughness.

---

27) Differentiation of Harmful Algal Bloom Signatures in the Indian River Lagoon by Remote Sensing

Taylor J. Judice, Department of Geology, Kent State University (tjudice@kent.edu)
Warren Falls, Ocean Research & Conservation Association
Edith A. Widder, Ocean Research & Conservation Association
Joseph D. Ortiz, Department of Geology, Kent State University
Dulcinea M. Avouris, Department of Geology, Kent State University
Dominic Cristiano, Department of Biological Sciences, Kent State University

Located along the east coast of Florida, the Indian River Lagoon (IRL) is a shallow-marine estuary that extends along 240 km of coastline. Historically, freshwater flowing into the IRL has transported high concentrations of nitrogen and phosphorus runoff from agricultural fertilizers and septic systems. As a result, eutrophic waters have driven the growth of various types of harmful algal blooms (HABs). Previous remote sensing research has focused on monitoring water quality by identifying the spectral characteristics of color producing agents (CPAs) associated with HABs through the use of ocean color chlorophyll-a algorithms. The ability to reliably distinguish CPAs of HABs, color dissolved organic matter (CDOM), and suspended sediment within water bodies through remote sensing techniques has become critically important for monitoring regional water quality. Recent statistical techniques for processing Landsat 8 and Sentinel 3 imagery have expanded retrievals beyond chlorophyll-a and corrected for atmospheric interferences. The Kent State spectral decomposition method, a type of Varimax-rotated Principal Component Analysis (VPCA), is used to process visible reflectance spectra (400-700nm) from multispectral and hyperspectral imaging systems. The VPCA decomposition describes the total percentage of variability of CPAs mixed in the water column and determines the leading spectral components of the satellite image that contribute to the overall signal. We identify these leading spectral components obtained from this analysis with lab measured reflectance spectra, such as brown tide cultures, *A. lagunensis*, to qualitatively assess areas of the IRL which have relatively high or low proportions of CPAs over time. Results using the VPCA method have identified *A. lagunensis* constituents within the Banana River region of the IRL and have since been validated with in-situ biovolume and water quality measurements.

---

28) Taxonomical and Functional Heterogeneity of Microcystin-Degrading Bacteria in Lake Erie

Anjali Krishnan, Department of Biological Sciences, Kent State University (akrishn5@kent.edu)
Xiaozhen Mou, Department of Biological Sciences, Kent State University

Microcystins (MCs) are one among the predominant cyanotoxin in the freshwater environment which are primarily degraded by heterotrophic bacteria. Nevertheless, our knowledge about the taxonomic diversity of MC degrading (MC+) bacteria from Lake Erie is very limited. In the current study we look at forty MC-degrading bacterial isolates screened from numerous bacterial cultures from Lake Erie. These isolates were characterized based on their MC-degradation rates at different pH, temperature and addition of organic carbon. A mixed culture MC-degradation was also performed to further characterize MC-degradation rate for isolates which were taxonomically close. The MC-degrading isolates were primarily gram positive in nature and exhibited an array in terms of color, shape and morphology. Taxonomically they belonged to *Alphaproteobacteria*, *Gammaproteobacteria* and *Firmicutes* phyla. MC degradation rate of the isolates were impacted by temperature and also pH, but remain unchanged with the addition of organic carbon. The

MC-degradation rate were also observed to show an increase for some of the isolates primarily belonging to the *Pseudomonas* spp. in the mixed culture degradation process. These MC+ isolates identified were also found to possess other degradation properties and biological uses according to previous literature.

---

29) Ruptured stream anticline pools as Portage Escarpment habitat features

Roy Larick, Bluestone Heights (roylarick@gmail.com)

Introduction

On Cleveland's urbanized Portage Escarpment, small Lake Erie tributary ravines show degraded anthropogenic aquatic habitats. Escarpment ravines also have small geological features called stream anticlines which, when naturally ruptured, produce channel pools that tend to improve habitat.

Problem

At the base of deep ravines within the local Devonian shale sedimentary sequence, small, non-tectonic stream anticlines are notable upwarp deformation features. As exposed anticline crests naturally rupture and erode, aquatic pools form within the resident stream channel. Watershed scientists assess such pools as healthy habitat features but do not link them with discreet geological process. Synthesizing from both sciences, a significant Portage Escarpment habitat feature type is proposed.

Results

In the escarpment ravines of Cleveland's urban Heights, flashy stream flows reduce aquatic habitat to scoured bedrock channels and isolated gravel bars. Nevertheless, where ruptured stream anticlines produce channel pools, habitat assessments (HHEI, QHEI) show higher than expected scores. Ruptured anticline features are herein identified for Devonian sedimentary units within the Doan Brook-Frontal Lake Erie administrative watershed. Significant pool habitat features are enumerated.

Conclusion

In Portage Escarpment ravines, ruptured stream anticline channel pools are underappreciated aquatic habitat features. When appearing in scoured bedrock channels typical of local urban hydrology, such pools can enhance habitat health. With the systematics of anticline pools in hand, escarpment ravine habitat restorations can better build upon local natural conditions. In any event, ruptured anticline pools should be preserved as natural components in aquatic habitat health.

---

30) Manganese dissolution kinetics and uptake rates by red maple trees in soils

Sydney A. Laubscher, Department of Geology, Kent State University (slaubsch@kent.edu)
Elizabeth M. Herndon, Department of Geology, Kent State University

Manganese, an essential nutrient critical for photosynthesis and a toxic element in excess, impacts forest metabolism, carbon storage, and ecosystem productivity. Given the significant role Mn can play, it is important to understand how soil geochemistry controls Mn uptake. We conducted a greenhouse pot experiment to quantify Mn uptake by plants based on controlled geochemical constraints. Specifically, we investigated whether Mn uptake was limited by the supply of Mn to soil solution or by biological controls within the plants. Tree pots containing soil-only or soil and red maple saplings were supplied with either

dissolved Mn, Mn-oxides, or crushed shale containing Mn-bearing pyrite. We predict that Mn uptake would be higher in systems with dissolved Mn because it is not limited by mineral weathering, and that Mn uptake would be higher when the system is supplied with fast-weathering substrates (pyrite in the shale) than slow-weathering substrates (Mn-oxides). We analyzed the chemical composition of leaf tissue to quantify Mn uptake and soil leachate to quantify Mn losses. Leaf chemistry varied on orders of magnitude, with Mn uptake being the highest in the dissolved Mn treatment and lower in the Mn-oxide and shale treatments. Conductivity data indicates major solute loss in leached water from the dissolved Mn and shale treatment groups. The leached water from the shale group was extremely acidic, suggesting rapid dissolution of pyrite. Leachate chemistry indicates that Mn loss in the dissolved Mn treatment groups was two to 10 times higher than the other treatment groups. We conclude that vegetation stored Mn and reduced leaching rates in all treatments, and that Mn dissolution rates influenced plant uptake. Ongoing analyses include constructing mass balance models to quantify Mn uptake and leaching, microscale imaging techniques to examine root-soil associations and mineral transformation, and community analysis of Mn-oxidizing or reducing microorganisms.

---

31) The Changing Frequency of Spatiotemporally-Relative Weather Types across North America

Cameron C. Lee, Department of Geography, Kent State University (cclee@kent.edu)
Scott C. Sheridan, Department of Geography, Kent State University

Most climate change research is focused on the trends in different metrics (means, maximums, minimums, extremes, etc.) of temperature and/or precipitation. Beyond this, however, trends in other variables have been noted, including absolute moisture metrics, relative humidity, sea-level pressure and many other atmospheric variables and phenomena. This multivariate nature of the weather at any given location naturally underlies the concept of an air mass or weather type – a category of weather that defines the holistic atmospheric situation at a particular time. Thus, since temperature and precipitation trends over the last few decades are well-researched, but a changing climate can manifest itself in myriad ways, the simple aim of this research is to examine the changes in GWTC weather type (WT) frequency over North America since 1979. Generally, warm WTs (Humid Warm, Warm, Dry Warm) are increasing in frequency at the expense of the cool WTs (Humid Cool, Cool, Dry Cool), and the effects of Arctic Amplification are apparent. Humid Cool weather is significantly increasing in northwestern North America and transitional (frontal) weather types are increasing in the US and decreasing in Canada. The magnitude of changes is greater than we expected (+/- 30 to 40 days in some regions). We postulate that noting the extreme magnitude of the WT frequency changes found herein might be a more efficacious means (than explaining importance of a 2-3 °C change) of communicating longer-term climate change trends to policymakers and the general public.

---

32) Understanding biodiversity services in urban and analogous natural systems: the case of green roofs

Katherine McNamara Manning, Department of Biological Sciences, Kent State University (kmanni12@kent.edu)

Green roofs provide urban environments and the humans within them with many services, including stormwater management, reduced energy consumption and habitat for organisms. However, due to the physical constraints of many green roof environments, green roof habitats are typically characterized by thin soils experiencing drought, flood, and intense wind and solar radiation. Natural habitats with these characteristics are relatively rare, however, some intact thin soil environments occur in the Great Lakes basin. Our research examines the plant and insect communities arising around these natural and built thin-soil environments, to gain insight into how these habitats contribute service and function to the greater landscape. Insect communities are key contributors to several ecosystem services, including pollination, pest control, and decomposition. Improving our understanding of how insects in these habitats function is important to guide efforts to design structurally-analogous elements intended to deliver services in urban environments. We will sample three functional groups of insects (pollinators, natural enemies and decomposers) in green roofs and natural areas that are similar to green roof structure, while characterizing the plants and other physical attributes of each site. Once identified, we will compare communities between and within built and natural systems of various characteristics, and the functional ecology can be described. Our work will inform design of green roofs to improve biodiversity service delivery in urban environments.

---

33) Using VPCA Analysis to Determine Impact of Main Contaminants in Euclid Creek

Nicholas Manning, Department of Geology, Kent State University (nmannin4@kent.edu)

Villa Angela beach in Northeast Ohio has been closed multiple times over the past decade due to high influxes of *E. Coli* bacteria. Problems often arise after large rain storms due to the flooding of multiple combined sewer overflow systems feeding into the streams of the Euclid Creek watershed and being deposited off the shore of the beach. This project is an attempt to use discharge data to assess times of high flow and assess the content and contamination influx of these dates using specific remote sensing techniques. Landsat-8 images were combined with the KSU spectral decomposition method of image analysis, which employs varimax-rotated principal component analysis (VPCA) to determine the main contributors to the water's overall content and their interaction with the aquatic systems in the lake and around the mouth of the creek. This more cost- and time-effective method can reduce potential biases in traditional remote sensing techniques by separating individual components based on their respective spectral fingerprints and comparing against a known library of spectra.

---

34) Getting to the root of soil carbon sequestration: tracking fine root carbon losses and soil carbon gains

Anthony J. Minerovic, Department of Biological Sciences, Kent State University (aminero1@kent.edu)
Oscar J. Valverde-Barrantes, Florida International University
Christopher B. Blackwood, Department of Biological Sciences, Kent State University

Fine roots of woody plants are the greatest terrestrial source of carbon (C) to soils, hence represent a major flux of C out of the atmosphere. While the decomposition rates of many tree species' roots have been measured in other experiments, such information doesn't address how much root C is ultimately incorporated into microbial biomass, respired, leached to dissolved organic C pools, or stabilized as soil particulate organic matter (POM). We explored two different pathways by which plant litter becomes stabilized in soil: a physical pathway, where root fragments are protected from decomposition by

microorganisms in soil aggregates, and a biochemical pathway, where labile plant tissues are utilized by microorganisms that, in turn, bond with minerals to form stable soil C. In two two-year long decomposition experiments with four tree species' roots that had contrasting chemical and morphological properties, we monitored losses of root C and gains of C in various soil C pools. Preliminary results suggest that root morphology strongly affects which decomposition pathway predominates. Roots with smaller diameter and specific root length lose more C to fragmentation, becoming occluded in POM, while thicker roots contribute more C to microbial and dissolved organic pools, which have faster C turnover rates. Overall, more root C was stabilized in soil from roots with thin, highly-branched roots. Understanding which plant traits affect a tree's potential as a C sink is important for improving our accounting of carbon in forests in a changing climate.

---

35) Landuse/Landcover (LULC) change modeling of Old Woman Creek (OWC) Watershed using Remote Sensing and GIS

Israel A. Olaoye, Department of Geology, Kent State University (iolaoye@kent.edu)
Joseph D. Ortiz, Department of Geology, Kent State University
Anne Jefferson, Department of Geology, Kent State University
Abdul Shakoor, Department of Geology, Kent State University
Rem Confessor, Water Quality, Heidelberg University

This study employs Markov chain model and Cellular Automation analysis to analyze the land use/land cover change of Old Woman Creek watershed in Ohio from 1992 to 2018 and to predict same for 2022 and 2026. Supervised classification was carried out on preprocessed 1992, 2003, 2013 and 2018 Landsat images to produce four main LULC categories namely; Agriculture, Urban, Forest/wetland and Water. Different GIS layers needed as input for Markov chain were produced with the same scale and spatial resolution. Data analysis showed that road is a major driver of urbanization in OWC watershed with farthest distances from road being about 1470m. Change detection analysis was conducted between two different time periods, namely 1992-2003 and 2003- 2013, to study the rate and pattern of urban growth. Urban growth rate was found to be less than 1% of the watershed per annum in both time periods. Transition probability matrix was generated to show the rate of conversion of one LULC class to another after a period. Initial simulation was validated with 2103 and 2018 LULC map with the accuracy ranging from 95% to 99% for all the LULC classes. LULC will be simulated for 2022 and 2026 and the projected area and percentage change in each of the LULC classes will be discussed with emphasis to loss and growth. This study provides a good strategy for LULC monitoring for management practices and assesses the efficacy of the modeling method.

---

36) Holocene changes in algal abundance and dissolved oxygen discovered in Sluice Pond, MA through spectroscopy and analysis of a sediment core

Olivia A. Ols, Department of Geology, Kent State University (ools@kent.edu)
Bradford J. Hubeny, Department of Geological Sciences, Salem State University
Renee V. Knudstrup, Department of Geological Sciences, Salem State University
Joseph D. Ortiz, Department of Geology, Kent State University

Throughout the Holocene, Sluice Pond (Lynn, MA, USA), has experienced fluctuations in algal communities and dissolved oxygen (DO) content based on measurements from a sediment core raised from its anoxic central basin. The variability in the core's composition can be mapped with Visible Derivative Spectroscopy based on varimax-rotated, principal component analysis (VPCA) through wavelet analysis and by plotting this information against an AMS 14C constrained age model. The temporal history yields a better understanding of the lake's changing environment and provides insight into the extent of preserved natural and human events. Thirteen separate constituents were present in the core, as mixtures of six different orthogonal (or independent) VPCA components that account for 97.1% of the variance in the data set. Six components were extracted overall, but a detailed look at two is presented in this project. Through the data collected in 6VPCA1 and in 6VPCA6, algal blooms and lake turbidity can be mapped out and referenced against the age model to show changes in relative concentration. The data shows anoxic conditions through the increase or decrease of DO indicators. The first component oscillates on a period of 4 ka, and the second has a 6 ka oscillation. Major climate events such as the Younger Dryas and the 8.2-kiloyear event are represented in the data by a large drop in algal concentrations and an increase in DO during both extreme cold events. Within the last 200 years, fluctuations in algal blooms, turbidity, and DO have increased dramatically in both frequency and extent. Through the data and methods used in this project, we are given a representation of the natural variance over the Holocene and can start to understand how humans may have impacted Sluice Pond. This new information allows for a better understanding of the conditions Sluice Pond has experienced in the past and can inform us on steps that need to be taken for the overall health of the lake.

---

37) Fostering a people's forest: using Citizen Science-driven biodiversity monitoring to understand restoration processes

Cheyan K. Pace, Department of Biological Sciences, Kent State University (cspace8@kent.edu)
Christie A. Bahlai, Department of Biological Sciences, Kent State University

Ecosystem restoration takes place over a longer time scale than the typical ecological study, particularly when the ecosystem includes slow-growing taxa, such as trees. Yet, humans take strong interest in ecosystem restoration- both as a process to participate in (i.e. contributing to tree planting and Citizen Science), and as a process to measure (i.e. asking "is our restoration activity working?"). This project examines both of these facets through restoration activities within former surface mine sites at Cuyahoga Valley National Park. We use the lens of beetle communities observed through participatory models of data collection to examine how functional groups of organisms can give information on how an ecosystem is operating. With the help of community members, we will conduct "bio-blitzes" and systematic sampling to document Coleoptera communities within 5 sites undergoing restoration, and their surrounding forest at CVNP. We will then use these communities to describe the functional 'health' of their surrounding landscape. This project will also examine how effectively citizen scientists contribute to ecological research within a national park and what implications this may have on future ecological research. We will combine these data with observations from public databases (iNaturalist) and use these data to effectively map the 'health' of mature and restored forest within CVNP– with respect to beetle community composition - providing a means to assess the effectiveness of Citizen Science on supporting ecological research.

---

38) Oak tree differentiation of defense and reallocation strategies in response to herbivore pressure

Cindy L. Perkovich, Department of Biological Sciences, Kent State University (cthoma16@kent.edu)
David L. Ward, Department of Biological Sciences, Kent State University

Plant strategies against herbivory may involve defending themselves by producing plant secondary metabolites (PSM), regrowing to negate injuries from tissue loss (tolerance), or reallocating resources to better defend or protect themselves from further damage. We investigated the strategies of oak plants to minimize herbivory by investment in tannins and reallocation of non-structural carbohydrates. Oak species may differentially invest in defenses and reallocation depending on the intensity and location of herbivore feeding. We simulated the effects of herbivory by removing 25% or 75% of oak tissue, removing either the apical or lateral meristems. The investment in defenses may act as a selective pressure driving herbivore diversity and behavior. Using 12 oak species from different parts of a well-supported phylogeny, we applied five treatments of simulated herbivory, varying in intensity and location. The 12 species were chosen to represent a broad array of geographical and phylogenetic diversity. Using an untransformed statistical analysis, we found that oak species invest differentially in defensive mechanisms. We will also present a more thorough phylogenetic comparative analysis of the data to determine if differences in defense and reallocation strategies are a result of adaptation to herbivory or if defense and reallocation strategies are associated with particular oak lineages.

---

39) Comparing Stream Nitrate Concentrations in Baseflow and Stormflow Conditions across Urban Watersheds

Mary Plauche, Department of Geology, Kent State University (mplauche@kent.edu)
Anne Jefferson, Department of Geology, Kent State University

Degraded water quality is common in urban streams due to increased impervious surface cover, which can input stormwater runoff directly into the stream. Nitrate, which enters streams from sewage inputs or runoff from fertilizer and atmospheric deposition, is a common contaminant in urban watersheds. Nitrate concentrations can vary throughout a stream network due to land cover and urban infrastructure influences including proximity to sewer lines and stream burial. Three urban watersheds (5-15 km^2) in Summit County, Ohio with similar impervious surface cover, but spatially variable land cover metrics to understand urbanization on nitrate concentrations. Biweekly sampling of 26 sites between October 2017 and October 2018 was accompanied by 5-minute conductivity and water level data, as well as storm event sampling in August and September 2018. Baseflow concentrations showed that nitrate has higher concentrations and more variation between sampling locations in the summer (2-9 mg/L), with little variation in the winter (<2 mg/L). During storm events, nitrate concentrations changed in response to water level, with generally lower concentrations at high water level due to dilution. Nitrate concentrations varied at baseflow and stormflow between watersheds, possibly due to differences in land cover metrics. Understanding water quality response to discharge provides greater insight into the mechanisms affecting urban water quality, allowing managers to better predict impairment and target land use and stormwater actions that will improve water quality.

---

40) Living architecture: an anthropocentric and biocentric review

Rajab K. Hajar, College of Architecture and Design, Kent State University (hrajab@kent.edu)

In the event of the environmental urgency, the necessity for ecologically friendly architecture was the driving impetus behind the emergence of living architecture. The perplexity overarching this notion bars architects from embracing and implementing it into their designs. This paper is an attempt to define living architecture; what are the similarities and differences with other trajectories of green architecture approaches, also, what it represents for both human and the environment, removing the ambiguity that overshadows it. Built on the philosophical and historical literature reflected on a range of world known case studies, it demonstrates what living architecture entails from an anthropocentric and biocentric approaches. It is believed that a clear understanding of the living architecture role and importance will result in proper implementation by designers whether we build for human or nature. Living architecture is a relatively new and thriving concept; yet, it lacks coherence due to the complexity of its components which mandates the architectural community for continuous research.

---

41) The FoSTER (Forest Soils and Trees Ecosystem Restoration) Project: Reforesting Cuyahoga Valley National Park and setting the stage for long-term ecological study

Thomas A. Ruggles, Department of Biology, Kent State University (truggle2@kent.edu)
Christopher B. Blackwood, Department of Biological Sciences, Kent State University
Anne Jefferson, Department of Geology, Kent State University
Christopher A. Davis, National Park Service
Catherine T. Ruhm, Department of Geology, Kent State University
Christine A. Bahlai, Department of Biological Sciences, Kent State University

The FoSTER (Forest Soils and Trees Ecosystem Restoration) Project is a collaborative effort between Cuyahoga Valley National Park (CVNP) staff and Kent State University faculty to reforest disturbed habitats inside the park. These disturbed sites consist of five former surface mines, which have previously undergone reclamation with unsatisfactory results. The sites have fallen victim to exotic plant invasion and have made minimal progress returning to their naturally forested state, even after 35 years in some cases. To accelerate afforestation, the deep ripping method is being used. Deep ripping involves tearing 1.2 m deep grooves into the soil in a checkerboard pattern, which helps to alleviate soil compaction, accelerate soil weathering, and allow tree root penetration. Large-scale tree planting events follow deep ripping. To date, this has been done with the aid of hundreds of citizen volunteers. Trees are planted in a plot-based design, allowing for long-term study of the response of soil properties, tree species, and mycorrhizal fungi type to deep ripping. Surveys conducted in fall of 2018 show 84% survivorship of the nearly 1,500 trees planted between fall of 2017 and spring of 2018. In addition to reforestation, the FoSTER Project aims to educate managers on best management practices for deep ripping, increase public interest in environmental issues faced by CVNP, and promote participation in citizen science.

---

42) The Effects of Deep-Ripping Reclamation on Abandoned Non-Coal Surface Mine Soils in Cuyahoga Valley National Park, Ohio

Catherine T. Ruhm, Department of Geology, Kent State University (cruhm1@kent.edu)
Anne Jefferson, Department of Geology, Kent State University
Christopher A. Davis, Resource Management, Cuyahoga Valley National Park

Thomas A. Ruggles, Department of Biological Sciences, Kent State University
Anthony J. Minerovic, Department of Biological Sciences, Kent State University
Christie A. Bahlai, Department of Biological Sciences, Kent State University
Christopher B. Blackwood, Department of Biological Sciences, Kent State University

Since 2016, with the help of Kent State faculty and students, staff at Cuyahoga Valley National Park have been studying the effects of deep-ripping reclamation on abandoned non-coal mine sites within the park. The ultimate goal of this study and deep-ripping reclamation is to reforest the sites which otherwise have failed to support native tree growth post-abandonment. At 5 mine sites and 4 forested reference areas we have collected 205 soil bulk density samples and 289 soil probe samples for grain size distribution analysis and have performed 66 infiltration rate measurements to determine Ksat. Soil textures encompass silt loams, loams, and sandy loams. Bulk density of the top 5 cm of soil is significantly higher in the mined sites than the forest areas, though values are not high enough to restrict root penetration. However, bulk density at depth exceed root restriction values. Mine sites also have significantly slower Ksat values than reference areas. Deep-ripping reclamation was conducted at one site in September 2017. Near-surface bulk density samples and Ksat measurements were collected post-ripping. Deep-ripping did not appear to significantly alter bulk density or Ksat. Deep-ripping reclamation was conducted at a second site in September 2018. Prior to deep-ripping we installed soil moisture sensors at two locations of different slope within the site: on a slope of 20.51% and a slope of 6.00%. Two sensors were installed at each location at depths of 20 and 50 cm to collect baseline soil moisture data for four months before they were removed for the deep-ripping. Post-ripping, three sensors were installed on the sloped portion of the site at a depth of 10 cm in rips running parallel and perpendicular to the slope and in a cross-rip. Two sensors were installed to a depth of 10 cm on the flat portion of the site: one in a cross-rip and one not in a rip. All five sensors continue to collect data and analyses of changes in moisture regimes are currently underway.

---

43) Short-term sea-level fluctuations along the eastern seaboard of the US and their atmospheric connections

Scott C. Sheridan, Department of Geography, Kent State University (ssherid1@kent.edu)
Cameron C. Lee, Department of Geography, Kent State University

In this research, we assess the impact of short-term events, combined with sea-level rise, through synoptic climatological analysis, exploring whether circulation pattern identification can be used to enhance probabilistic forecasts of flood likelihood. Self-organizing maps (SOMs) were created for two discrete atmospheric variables: 700-hPa geopotential height (700z) and sea-level pressure (SLP). For each variable, a SOM array of patterns was created based on data spanning 25°-50°N and 60°-90°W for the period 1979-2014. Sea-level values were derived from tidal gauges between Cape May, New Jersey and Charleston, South Carolina, along the mid-Atlantic coast of the US. Both anomalous sea-level values, as well as nuisance flood occurrence (defined using the local gauge threshold), were assessed. Results show the impacts of both the inverted barometer effect as well as surface wind forcing on sea levels. With SLP, higher sea levels are associated with either patterns that were indicative of on-shore flow or cyclones. At 700z, ridges situated along the east coast are associated with higher sea levels. As the SOM matrix arranges atmospheric patterns in a continuum, the nodes of each SOM show a clear spatial pattern in terms of anomalous sea level, including some significant sea-level anomalies associated with relatively ambiguous

pressure patterns. Further, multi-day transitions are also analyzed, showing rapidly deepening cyclones, or persistent onshore flow, can be associated with the greatest likelihood of nuisance floods.

---

44) A parametric study of impact of Neighborhood Morphology on air pollution dispersion patterns due to unplanned building demolition

Samata Shrestha, Architecture and Environmental Design, Kent State University (sshrest4@kent.edu)
Adil Sharag-Eldin, Architecture and Environmental Design, Kent State University

An unplanned demolition of a building can be a result of either natural, e.g. earthquake, or human-made disaster, e.g. terrorist attack and wars. It generates considerable amount of coarse, fine and ultrafine Particulate Matter, which are significantly associated with chronic and acute adverse health effects. Literature study attributed to few studies about the impact of planned demolition on local air quality, while the short-term bursts of pollutants and public exposure to this high pollution levels during an unplanned demolition were widely overlooked. Meanwhile, the existing research has also pointed out that the characteristics of the pollutant dispersion are highly dependent on the urban morphology. The primary objective of this research is to investigate the pattern and characteristics of pollution dispersion due to unplanned building demolition in a compact high-rise/ low rise and open high-rise/ low rise neighborhood. CFD-based microscale air quality model "ENVI-met" was used to simulate the pollution dispersion in the selected morphologies. The pollution concentration was measured at the various horizontal and vertical distance at various times and wind directions (0 and 315 deg). Thirty-six different measurement from horizontal dispersion and forty-eight different measurements from vertical dispersion for PM concentration and wind speed were measured and tabulated. LEONARDO was used to visualize the output in ENVI_met binary files and Microsoft Excel was used to plot the graphs showing a summary of relationship between the tested parameters. The results indicated that the pollution dispersion pattern depended on its neighborhood morphology which is represented by its street canyon and building height, wind flow and vegetations. These findings are followed by the design recommendations based on the observation of pollution dispersion pattern in different morphologies while suggesting a need of air quality standards for short term high pollution levels.

---

45) Food Web Structure in a Constructed Wetland

Kaitlin Shvach, Department of Biological Sciences, Kent State University (kshvach@kent.edu)
Mark Kershner, Department of Biological Sciences, Kent State University

Wetlands are globally important ecosystems known for strong interactions among aquatic and terrestrial animals and plants. While natural wetlands are known for their complex food webs, constructed wetlands are often simpler, containing reduced levels of biodiversity. However, these systems generally reflect similar inter- and intra-specific interactions, with the advantage of having replicate sites. This project assessed food web interactions of macrofauna in ten wetland cells during an 8-week summer period in constructed wetlands at Kent State University. In each wetland cell, fish and amphibian (tadpoles/adults) assemblages were sampled twice/week using modified minnow traps to gain insight into population size and fish/amphibian size distributions. Next, to assess mammal and bird activity and their potential interactions in these wetlands, game cameras were strategically placed around each of the wetlands. Finally, odonates (i.e., dragonflies and damselflies) were also identified and counted in each wetland. Overall,

species richness was relatively low, with only two fish species and two frog species captured from the minnow traps. In contrast, multiple mammal, bird, and odonate species were detected at the site in other sampling. Analyses of food web structure suggest a strong, negative relationship between sunfish abundance and frog/tadpole abundance and level of development, likely as a result of predation. The distribution of beavers, green herons, and great blue herons also appeared to be associated with food availability (woody vegetation for beavers, fish/frogs for herons). In summary, while simple, the food web in these constructed wetlands was structured similarly to what we see in natural wetlands.

---

46) Analysis of Cold Air Outbreaks Across the Globe

Erik Tyler Smith, Department of Geography, Kent State University (esmit149@kent.edu)
Scott C. Sheridan, Department of Geography, Kent State University

Periods of anomalously cold temperatures impact regions of the globe every winter. Depending on the magnitude and duration of the occurrence, extremely cold periods may be deemed cold air outbreaks (CAOs), which can be detrimental to the agricultural industry and human health. A systematic CAO classification was developed from gridded NCEP/NCAR reanalysis data, from 1948 through 2017, based on a set of criteria concerning magnitude, duration, and spatial extent. Statistical analyses of the data were used to determine the overall trends in CAOs for different regions across the globe. This research will be used to further understand the large-scale atmospheric mechanisms that precede these CAOs and how the specific mechanisms impact the location of CAOs.

---

47) Understanding how microorganisms influence the bioavailability of iron-bound phosphate under shifting redox regimes in nutrient poor soils

Chelsea E. Smith, Department of Biological Sciences, Kent State University (csmit287@kent.edu)
Maximilian R. Barczok, Department of Geology, Kent State University
Elizabeth M. Herndon, Department of Geology, Kent State University
Lauren E. Kinsman-Costello, Department of Biological Sciences, Kent State University

Plants remove carbon dioxide (CO_2) from the atmosphere and can mitigate climate change but require nutrients like phosphorus (P) to increase primary productivity and build biomass. P can become limiting to plant growth as changes in the water table alter soil redox conditions. These anoxic-oxic changes can influence geochemical sorption of phosphate (PO_4^{3-}) to iron (oxyhydr)oxides, modifying P bioavailability. Vernal ponds are one such system that experience seasonal hydrologic changes that result in redox fluctuations.

Release of iron-bound phosphorus through microbial mechanisms could increase P bioavailability for plants to grow and in turn take up more CO_2. To assess how microbes affect the availability of P in iron-bound PO_4^{3-}, we examined P uptake by the microbial community in vernal pond soils in Northeast Ohio. Mesh bags were filled with organic material and three types of synthetic iron oxides (ferrihydrite, goethite, and hematite). Iron oxides were either saturated in a PO_4^{3-} solution or not sorbed with PO_4^{3-}. Bags were incubated in both lowland (pond) and adjacent upland environments and removed during flooded conditions and after the pond had dried. Preliminary results show that bags in both environments that contained iron-bound PO_4^{3-} had higher mass following incubation than those without PO_4^{3-}, suggesting biomass

accumulation. Release of iron-bound PO_4^{3-} could supply plants with vital nutrients needed to grow, resulting in greater uptake of atmospheric CO_2.

---

48) Large woody debris (LWD) as biomimetic inspiration for Lake Erie coastal infrastructure

Elena M. Stachew, Department of Civil Engineering & Biology, University of Akron (ems191@zips.uakron.edu)

The Ohio Lake Erie shoreline is 75% hardened with rock, steel and concrete and is the most modified shoreline of all the Great Lakes. While shoreline armoring effectively reduces erosion from wave action for coastal properties, this modification disrupts the land-water interface and diversity of nearshore habitat. Historically, natural LWD input from frequent, small-scale windthrows provided structural complexity in habitat and positively affected local hydrodynamic conditions in streams, rivers and lakes, among other ecological benefits. For this reason, large woody debris (LWD) is often used as a natural element for both stream stabilization and habitat creation in stream restoration projects. This project uses the biomimicry process to understand local context and mimic the LWD form of a rootwad for potential use as a structural element in freshwater coastal stabilization and restoration projects. Rootwad structures are 3D printed in ABS and PLA and tested in a recirculating wave flume simulating wave conditions on Lake Erie. Wave attenuation and downstream velocity reduction along the centerline are measured as well as downstream sediment deposition regions roughly characterized. The hope is to assist in the development of a resilient Lake Erie shoreline transformed by modification through coupled natural-built coastal protection structures using the biomimicry process.

---

49) Baseline biodiversity measures for vegetative roofs

Lama Yasmin Tawk, Landscape Architecture, Kent State University (ltawk@kent.edu)
Reid Coffman, College of Architecture and Environmental Design, Kent State University
Christine Bahlai, Department of Biological Sciences, Kent State University
John E. Reinier, Wetland Ecology, Cleveland Metroparks
Julia Perrone, Department of Biological Sciences, Kent State University

Vegetative roofs can be designed to extend local habitat or replace, in part, the functionality of regional plant and wildlife communities lost in urban development. In creating living architecture habitat, it is important to understand the characteristics that are transferable from the local ecosystems to a roof environment. Commonly referred to as a 'habitat template' approach (Lundholm, 2006), roof systems can be designed as speculative habitat which incorporates local ecological wildlife community insight and biodiversity provisioning. To improve the understanding of speculative roof habitat, we investigate novel ecosystems and system attributes (soils, plants, and insect species) in Northeastern Ohio, USA. Novel ecosystems harbor species compositions and relative abundances that have not previously occurred in a given biome (Hobbs, 2006). New and unique species combinations arise frequently in impacted habitats that possess both historic and uncommon associations which refer to as 'eco-types' for this study's descriptive purpose. We use our observations for informing a design process conducted in partnership with the Cleveland Metro Parks, and highlight the importance of partnerships between institutional and public

organizations. Reported here are the locations and primary descriptions of 5 eco-types across 19 sites in the Cleveland, Ohio area.

---

50) Small scale (<10,000 km^2) isoscapes reveal spatially variable water sources for northeastern Ohio precipitation, surface water, and groundwater

Jeffrey S. Timmons, Department of Geology, Kent State University (jtimmon4@kent.edu)
Anne Jefferson, Department of Geology, Kent State University

Water isotopes are a long-standing environmental tracer in hydrogeology, but many studies focus on their variations in time rather than space. Isoscapes are an emerging tool to visualize and analyze the variation of water isotopes at large regional scales. Here we hypothesize that varying influences of different air mass source areas, plus lake effects, have the potential to impart variation in water isotopes at much smaller scales. We test this hypothesis in a 10,000 km^2, low relief study area in northeastern Ohio, which receives moisture from Pacific, Arctic, Gulf of Mexico, and Great Lakes source areas. Across the study area, mean annual precipitation ranges from 900-1100 mm and winter snowfall varies from 800 to 2500 mm. Precipitation was collected at two locations separated by 0.5 degrees latitude: one in the area receiving lake effect precipitation and high snowfall (the "snow belt"). Lake, river, and groundwater samples collected from 120 locations seasonally, and 12 locations sampled biweekly. Water samples were analyzed with the Picarro L2130-I analyzer, and precipitation source areas were calculated using HYSPLIT. Precipitation samples have high inter-storm isotopic variability associated with different moisture source areas, as well as seasonal variability. There is also a difference between the precipitation isotopes at the two locations, up to +/- 6 ‰ for δ18O in the winter. At lentic locations, water isotopes are generally more negative in the snow belt, but evaporative effects create additional spatial and temporal variability to the surface water isoscape. Biweekly river samples show both seasonal and spatial variability, with δ18O ranging from -11.6 to -2 ‰. Rivers in the snow belt have a more negative isotopic ratio than rivers to the south. Groundwater samples show little seasonal variability but there is a gradational variance towards less negative isotopic ratios towards the south of the research area.

---

51) Temporal patterns and Interactions of Bacteria, Algae, and Zooplankton following a Freshwater Reservoir Cyanobacterial Bloom

Kai Wang, Department of Biological Sciences, Kent State University (kwang12@kent.edu)
Mandy Razzano, Division of Surface Water, Ohio Environmental Protection Agency
Xiaozhen Mou, Department of Biological Sciences, Kent State University

The frequency and severity of cyanobacterial bloom are at risk of increasing as a consequence of eutrophication and increased water temperature. The elevated cyanobacterial biovolume can have substantial impacts on water ecosystem function by producing toxic secondary metabolites and subsequent induction of hypoxia affecting microbial community structure and biogeochemical cycles. Here we combined 16S rRNA gene sequencing and microscopic cell counting to explore the seasonality and co-occurrence patterns of bacteria, algae, and zooplankton following a reservoir cyanobacterial bloom. During the sampling period, 22 distinct cyanobacteria genus were identified, and the dominant ones were *Chroococcus*, *Planktolyngbya*, *Aphanizomenon*, *Pseudanabaena*, and *Cylindrospermopsis*. Our results showed that the bloom event significantly altered the bacterial community composition without affecting

the alpha diversity. Time-lag analysis found that the similarities of microbial communities significantly declined with the increase in time-lag. Regression modeling showed that environmental variables strongly affect the distribution of functional profiles, but weakly influence taxonomic composition within individual functional groups. Neutral community modeling revealed that stochastic processes also strongly affected bacterial community assembly, and the fit of the model varied over the sampling period and was the lowest during the bloom. Co-occurrence network analysis showed that correlations between bacterial taxa were predominantly positive, suggesting cooperation interactions might contribute to the stability of the microbial community during cyanobacterial succession. Overall, we concluded that changes in the structure of bacterioplankton are associated with the changes in the abundance and composition of freshwater cyanobacteria.

---

52) Road Salt Runoff in Freshwater Constructed Wetlands: A Year in the Life

Riley M. Weatherholt, Department of Biological Sciences, Kent State University (rweather@kent.edu)
Lauren E. Kinsman-Costello, Department of Biological Sciences, Kent State University

Road salts, brines, and other de-icers are used to melt snow and ice on roads and sidewalks. The runoff resulting from this process is high in salt ions such as sodium, chloride, calcium, magnesium, and potassium. These ions end up in our waterways, and contribute to the problem of increasing salinity in freshwater ecosystems. In this study, two constructed freshwater wetlands near Kent State University were monitored for one year by measuring conductivity with in situ conductivity probes, concentration of road salt ions in surface water samples, and salt content in plant tissue. This data set allowed us to assess seasonal trends in road salt runoff as well as to estimate a mass balance for road salt ions in these systems. We found that the wetlands were a considerable sink for road salt ions over the course of the year. Moreover, the degree to which each wetland retained the ions was not the same. The wetland with continuous flow and comparatively less pore space retained less of the ions than the intermittently flowing, deeper wetland. This notable imbalance in the salt budget of these wetlands, despite their differences in flow regime, is symptomatic of unsustainable road salt practices in these and similar watersheds. Should this pattern continue, there could reach a point where the wetlands could no longer store the influx of salt ions each year, resulting in a large release of saline water into downstream freshwater ecosystems. Long term studies like this are critical to addressing these issues, and these findings can be used to inform management decisions not only in Kent, Ohio, but also in any city to better balance ecosystem function with public safety.

---

53) Metal Speciation and Transport in a Stream Impacted by Coal Mine Drainage

Lindsey D. Yazbek, Department of Geology, Kent State University (lyazbek@kent.edu)
David Singer, Department of Geology, Kent State University
Elizabeth M. Herndon, Department of Geology, Kent State University

Acid mine drainage (AMD) is acidic, metal-rich water produced from the oxidative dissolution of sulfide minerals exposed to air and water during mining. AMD can continue to contaminate water resources years after mining ends, damaging affected ecosystems and requiring costly reclamation. AMD-derived metals can be transported through water as dissolved ions, nanoparticles, and larger suspended particles. Although these species differ in toxicity and mobility, most AMD studies either do not include or do not differentiate

between certain phases. The objectives of this study were to examine metal speciation and transformation in an AMD-contaminated stream and determine the unique concentration-discharge behaviors (C-Q) of different metal species. Here, we examined metal speciation along the length of a stream that mixed with AMD contaminated groundwater and treated, alkaline water from an AMD-treatment system. Dissolved and nanoparticulate Fe concentrations spiked where AMD-contaminated groundwater upwelled into the stream, but decreased downstream as nanoparticulate aggregates of Fe-oxides and other Fe-containing minerals settled out of the water column. Streambed sediments contained high concentrations of Fe-oxides, pyrite, and Fe-sulfates. At the watershed outlet, nanoparticulate Fe concentrations decreased relative to dissolved Fe at times of higher discharge, indicating unique C-Q behaviors depending on metal speciation. Our results indicate that geochemical processes, such Fe-oxide precipitation, along the stream help sequester most contaminant Fe in the watershed. This work will help address a knowledge gap regarding the understanding of metal transport though streams and has implications for policy regarding the effectiveness of AMD treatment systems.