Plenary

Mariana Cains - Unintended Consequences: Perspectives on Synthetic Biology Risk Assessment
Technological advancements often outpace regulations, and synthetic biology is no different. Traditionally, the EPA conducts risk assessments to determine the magnitude of human health and ecological risks posed by chemical and non-chemical stressors (e.g. habitat alteration). However, there are currently no regulatory guidelines that specify environmental risk assessment methods for synthetic biology products or applications. So, what do regulators and risk assessors do / need to consider when the stressor in question is a synthetic gene drive designed to produce daughterless populations of invasive or non-native species? Last month, the Environmental Laboratory of the US Army Corps of Engineers' Engineering and Development Research Center hosted the Synthetic Biology Environmental Risk Assessment Workshop in an effort to answer questions like this and more. The workshop served as an opportunity for government, academia, and industry attendees to provide constructive criticism of the USACE's proposed synthetic biology risk assessment methodology. This presentation will discuss the outcomes of the workshop (e.g. novel hazards associated with synthetic biology and risk perception of synthetic biology) and the proposed next steps forward. Given the interdisciplinary, cross-sector application and significance of synthetic biology, commentary from the audience is most welcome.

Joe Shaw - How the struggle for survival reveals molecular pathways of toxicity

Platforms

Overview of the USACE Water Quality Program Including work on New Technologies. J. Young, U.S. Army Corps of Engineers

Modeling Microbial Growth in Carpet Dust at Varying Relative Humidity Levels using the "Time-of-Wetness" Model. Haines, S.R. * 1,2,3, Dannemiller, K. 1,3; 1 Department of Civil, Environmental & Geodetic Engineering, College of Engineering, Ohio State University, Columbus, Ohio, 2 Environmental Science Graduate Program, Ohio State University, Columbus, Ohio, 3 Division of Environmental Health Sciences, College of Public Health, Ohio State University, Columbus, Ohio. People spend 90% of their time indoors where they can be exposed to microbes from dust resuspension. Microbes are known to grow in carpet dust under conditions of elevated moisture, but it is unknown how diurnal changes in relative humidity effect this growth. This study aims to use the "time-of-wetness" (TOW) concept for microbial growth in drywall to model microbial growth in carpet dust. Carpet and dust was collected from homes across Ohio, cut into squares, embedded with dust from the same site and incubated at varying equilibrium relative humidity (ERH) conditions for 5, 10 or 14 days to simulate diurnal variation in ERH. After incubation, the dust was vacuumed, and DNA extractions were performed. A growth rate was determined using the results of quantitative polymerase chain reaction. Around 10uL of each DNA extraction underwent 16S/ITS DNA sequencing on an Illumina MiSeq and were analyzed using QIIME. Results demonstrated that our model fits the activation limited growth curve from the original TOW concept. Pearson correlation coefficients were calculated to be 0.898 for 85% ERH TOW and 0.958 for 100% ERH TOW, showing a strong correlation between the relative growth rate and the TOW. The taxonomic analysis from sequencing of fungal samples showed that Aspergillus and Penicillium were among the most abundant taxa when moisture level was increased. This study will be useful in future epidemiological studies to develop a more realistic model for fungal growth in carpet.

Immunotoxicity of PFOA in zebrafish embryos – a potential model for ecological and human health risk assessment? Pecquet, A.M.*[1], Yadav, J.[1], Maier, A.[1], Sumanas, S[2]. 1. University of Cincinnati, Cincinnati, OH; 2. Cincinnati Children's Hospital Medical Center, Cincinnati, OH. Perfluorooctanoic

acid (PFOA) is ubiquitous and persistent in the environment and can be found in public drinking water supplies. PFOA is detectable in nearly all human serum and environmental media, and is expected to persist given the relatively long half-life of 2-8 years in serum and 41-92 years in water. PFOA has been classified as PBT and was recently labeled “presumed to be an immune hazard to humans” by the NTP. This hazard classification was based on alterations to the immune system in both experimental animals and humans. However, the exact immunotoxicity mechanisms for PFOA have yet to be fully elucidated, and current regulatory paradigms do not include standardized testing for immune effects for environmental or human health hazards. Additionally, there is very little information investigating immune effects during early development windows of susceptibility, or on the ecological impacts of immune modulation. Therefore, the overall goal of this project is to investigate the immunomodulatory mechanisms of PFOA using zebrafish embryos (ZFE) as a model for both ecological and human health risk assessment. Use of a single model (considered invertebrate in early life stages) contributes to the 3Rs aimed at reducing animal testing. The following aims were investigated: 1) explore the lethal and sublethal effects of PFOA on ZFEs; 2) identify overt immunotoxicological effects of PFOA on innate immunity (ZFE model validation); and 3) (in progress) evaluate the mechanistic and genetic pathway modulation in the adverse outcome pathway related to overt immune effects. Ultimately, these identified effects and adverse outcome pathways in ZFEs can be used to read across to human adverse outcome pathways given the homology of embryonic development and homology between immune systems. These data can be used in the human and ecological

Scaling to organisms: modeling dynamic exposure in streams. Harrigan, K.M. 1,2, Weighman, K.K. 1, Moore, P.A. 1,2; 1 Bowling Green State University, Bowling Green, OH, 2 University of Michigan Biological Station, Pellston, MI. For organisms in flowing environments, the dynamic nature of chemical exposure is determined by both flow regime and geomorphology. Stream characteristics cause spatial and temporal variations in exposure at organismal scales. Using an Epsilon electrochemical recording system to extract proxies for the frequency, magnitude, and duration of exposure in artificial stream systems, we can gain insight into how toxicant “hot spots” form in different stream environments. From these measurements, geographic information systems and inverse distance weight interpolation can be used to predict chemical distribution throughout habitats. Utilizing these methods, Previous work has successfully demonstrated that exposure dynamics at the scale of macroinvertebrates are influenced by habitat (riffle, pool, run, bend, woody debris), substrate (sand or gravel), and specific location within a habitat. The aim of current work is to explore patterning of toxicant “hot spots” in streams of different flow velocities, with both mode of toxicant introduction and position in the water column being taken into consideration. Variation in the structure of chemical exposure will be used to construct three-dimensional toxicant “hot-spot” maps, accounting for the spatial and temporal fluctuations of fine scale exposure. To realistically appraise the impacts of chemical pollution, experimental systems must be designed to account for temporal and spatial variability in chemical concentrations at scales relevant to organisms of interest.

How to define exposure: Contribution of exposure paradigm characteristics to impairment of aquatic organisms. Steele, A.N.* 1, Moore, P.A. 1; 1 Bowling Green State University, Bowling Green, OH. In recent years, the field of aquatic ecotoxicology has undergone vast growth in the understanding and modeling of the movement and transport of contaminants in different natural habitats. With this knowledge comes an increased comprehension of the spatially and temporally dynamic nature of toxicants in fluvial aquatic systems. However, classically laboratory toxicity tests used to determine environmental management decisions have utilized static exposure paradigms. Therefore, experimental results are tied to a specific set of highly controlled lab conditions. Thus, defining toxicity and exposure in static systems creates a disparity between toxicity test environments and conditions experienced in natural systems. The structure of contaminant plumes in flowing systems vary across both space and time as a result of the hydrodynamic characteristics of the environment. Temporally and spatially variant exposure paradigms can be described using the characteristics concentration, frequency, and duration. Current research has yet to address the evaluation of effects caused by all three exposure paradigm

characteristics and determining which characteristic or combination of characteristics causes the most detriment to organisms. The goal of this current work is to elucidate the relative contribution of these characteristics of exposure paradigms (concentration, duration, and frequency) to negative effects on organisms. Through the use of artificial flow-through streams and an electrochemical detection system, dynamic exposure characteristics can be measured in real-time and compared to organismal response. This research may lead to a more comprehensive environmental risk-assessment concept and appropriately applied regulatory standards for water quality.

Incorporating Diet into In Vitro Methods to Improve Prediction of Lead Bioavailability in Wildlife.

Zearley, A.Z.* 1, Gonzalez-Serrano, M.S.2, Basta, N.T. 1, Beyer, N.W. 3; 1 Ohio State University, Columbus, OH, 2 University of Puerto Rico, Mayaguez, PR, 3 United States Geological Survey, Beltsville, MD. Bioavailability data for human health risk assessment is commonly assessed using in vitro methods, and there is interest in using these methods in ecological risk assessment to improve accuracy and potentially reduce cleanup costs. However, current in vitro methods do not consider the impact of diet on soil metal bioavailability. Previous studies have shown that diet can reduce bioavailability of lead (Pb), and different diets can have varying impacts on uptake. This study sought to determine if including diet directly into an in vitro method could accurately predict soil Pb bioavailability in birds and if in vitros could demonstrate the impacts of a variety of diets on soil Pb bioavailability. Six lead-contaminated soils from a previous quail (Courtnix japonica feeding study) were evaluated. Six soils blended with the feeding study diet were assessed for bioavailability using 2 human in vitros (USEPA 1340 and OSU-IVG) and a new method designed to simulate avian digestion (AOSU-IVG). With the addition of diet, AOSU-IVG was predictive of bioavailability ($p=0.002$), while USEPA 1340 and OSU-IVG were not. The impact of the feeding study diet was relatively constant across soils, with an average 73% decrease in bioaccessibility. To assess the impact of different food items, six diets were added to a single Pb-contaminated soil and assessed with all three methods. Soil lead bioaccessibility reductions varied from 49-84%. These results suggest that including diet into in vitro methods can improve bioavailability prediction in fed animals and that diet composition may have a strong impact on soil Pb bioavailability

Extrapolating the effects of food and silver nanoparticle stress on individuals to populations of Daphnia: an empirical and theoretical approach.

Stevenson, L.M.*1,2, Krattenmaker, K.E. 1, McCauley, E. 1,3, Nisbet, R.M. 1; 1 University of California, Santa Barbara, Santa Barbara, CA, 2 Bowling Green State University, Bowling Green, OH, 3 University of Calgary, Alberta, Canada. Ecological Risk Assessment (ERA) is charged with evaluating the potential effect of a stressor on the environment, however the data used in the ERA framework is collected at the individual level. Since environmental concerns relate to how contaminants affect daphnid populations, not individual Daphnia, there is a great need to understand the link between individual- and population-level effects of toxicants. Further, most data used in ERA come from standardized toxicity tests that require that the Daphnia are fed unrealistically high algal food levels. Except during algal blooms, natural Daphnia populations experience food levels as low as 1% of those used in toxicity tests. Therefore, it is important to analyze the effects of a toxicant on Daphnia fed environmentally relevant concentrations of algal food at the individual level to quantify the interactions between ecological stressors (food and toxicant stress) at multiple levels of biological organization. We conducted a suite of experiments investigating the effect of silver nanoparticles (AgNPs) on individuals and populations of Daphnia.We measured the direct effect of AgNPs on daphnid survival, growth and reproduction using food levels similar to those found in natural populations. We followed the dynamics of populations experiencing the same food and AgNP environments for 60 days. The most interesting result was that a concentration that was lethal to individual Daphnia such that few individuals reached adulthood and even fewer reproduced had no significant effect on daphnid populations. To understand the differences observed between AgNPs exposed to individuals or daphnid populations, we simulated daphnid populations with population models parameterized using the individual-level data. We found that an individual-based population model

including feedback between the daphnid population and its algal food explains the observed pattern of population persistence. This study emphasizes the
importance of feedbacks when extrapolating individual-level effects to whole populations experiencing multiple stressors.

Application of Adverse Outcome Pathways to Non-Chemical Stressors: Assessing Effects of Sea Lamprey Parasitism and Warmed Winter Water Temperatures Firkus, T.J. *1,2, Murphy, C.A. 1; 1 Department of Fisheries and Wildlife, Michigan State University, East Lansing MI, 2 Institute for Integrative Toxicology, Michigan State University, East Lansing MI. The adverse outcome pathway (AOP) concept is designed to describe a mechanistic-based progression from a molecular initiating event to an adverse outcome based on perturbation from a chemical stressor. Though the AOP framework has gained considerable traction amongst toxicologists, its acceptance and use is currently limited. The inclusion of non-chemical stressors into the AOP framework has potential to create a unified system through which interactions between toxicology-based and ecology-based stressors can be assessed. This integrated system can improve robustness of AOP networks and add credibility to adverse outcome pathway-based regulatory decision making and risk assessment. Non-chemical stressor based AOP development will require several small changes to the AOP framework such as allowing for initiating events at higher levels of biological organization. The potential for AOP development based on non-chemical stressors is illustrated using two examples highlighting two diverse non-chemical stressors. The first describes how epithelium loss from sea lamprey (Petromyzon marinus) parasitism leads to decreased sperm quantity and quality. The second describes how warmed winter water temperatures initiate early reproductive development leading to reproductive dysfunction during the normal spawning period. Expanding the AOP framework to include non-chemical stressors will improve AOP network development, contribute to quantitative AOP development, and promote the involvement in, and application of the AOP framework to other fields.

Nutrient mass balance for selected Ohio watersheds. White, D.A.* 1; Griffin, J.E. 1; 1 Ohio Environmental Protection Agency, Columbus, OH. A nutrient mass balance was completed for nine large watersheds in Ohio covering over 66 percent of the state's land area. The watersheds studied were in both the Lake Erie and Ohio River drainages with a computation of total phosphorus and nitrogen load for water year's 2013-2017. Comparison of relative proportions of point and nonpoint sources is made with attention to the computation of wastewater and residential septic system effluent. The study highlights differences between the watersheds both as total loads and relative contributions from different sources in the watersheds. Opportunities are identified for data collection and new approaches that can refine future analysis on a biennial basis.

Using Mass Spectrometry to vet Microcystin Concentrations by Enzyme-Linked Immunosorbent Assay. Westrick, J.A.* 1, Birbeck, J. A. 1, Citriglia, M.E. 2, Agrawal S.G. 3, Schordock, D.C. 3, Thees, A.M. 4, Huntley, J.F. 4, Szlag, D.C. 5; 1 Wayne State University, Detroit, MI, 2 6329 Indian Point Rd., Painesville, OH 3 Northeast Ohio Regional Sewer District Laboratory, Cleveland, OH, 4 University of Toledo, Toledo, OH, 5 Oakland University, Rochester, MI. Some of the most hazardous chemicals are natural toxins such the cyanotoxin, microcystin (MC). Microcystin is a cyclic heptapeptide hepatotoxin produced by several species of cyanobacteria. Anthropogenic actions have increased the number and intensity of freshwater toxic cyanobacteria blooms increasing the exposure risk through drinking water and recreational waters. US EPA has released a drinking water health advisory at 0.3 ppb MC for pre-school aged children and a draft recreational health advisory at 4.0 ppb MC. With over 150 MCs and only 13 congeners commercially available as standards; quantitation by ELISA is recommended by US EPA. Therefore, the goal of our research was to develop targeted and untargeted MC MS workflows to vet the ELISA method. Thirty four of 168 samples analyzed by ELISA and LC/MS/MS with pre-concentration met the > 30% criteria. Eight samples had a similar untargeted MC. The untargeted MC was detected by PDA and a shift in chromatography. Based on the PDA (assuming a similar absorptivity constant as MC),

the untargeted MC concentration was 250 ppt. Preliminary nominal mass data suggests that the untargeted MC is isobaric to D-Asp^3 MC LR. Further investigation includes identification of the untargeted MC by LC/IT/HRMS. Several freshwater bacteria strains degrade MC. Bench experiments were designed to mimic natural waters biodegradation. Initial the experiments were analyzed by ELISA and no microbial degradation was reported. However, analyses by LC/MS/MS showed decreased concentrations of MC-LR. Two of the nominal mass byproducts were identified by LC/IT/HRMS, 615 m/z and 1013 m/z as the tetramer and linearized MC, respectively. Samples were fractionated by HPLC/PDA. The fractions were analyzed by ELISA and LC/MS/MS and fractions with 615 m/z tetramer and 1013 m/z linear MC tested MC positive by ELISA. The presence of these biodegradation by-products will cause the MC concentration to be artificially inflated.

Quantifying and Modeling Microcystin Concentrations Across a Gradient of Michigan Inland Lakes D. C. Szlag*, J. A. Westrick, and H. A. Ansari, Oakland University, Rochester, MI
The threat of cyanobacteria blooms to drinking water sources and recreational waters is increasing across the globe and is being driven by climate warming and eutrophication. The goal of this work was to develop a local/regional model to predict cyanotoxin concentration and aid the state of Michigan in prioritizing lake monitoring. In this paper the key objectives included identifying drivers or predictor variables for microcystin concentration and practical statistical frameworks for analyzing data. We measured cyanotoxin concentrations once a month in July, August, September, and October of 2016 across 31 Michigan inland lakes extending from N41 to N46 degrees. Physical / chemical measurements included 12 microcystins, nodularin, anatoxin-a, 16S RNA, cell counts, nutrients, pH, conductivity, DO, continuous temperature, zebra mussels, chlorophyll-a, and phycocyanin. Physiographic variables included lake-shed area, land-use, ecoregion, Julian date, maximum depth, lake area, and precipitation. Stepwise regression, principle component analysis, and regression tree analysis were used to generate models to predict microcystin concentrations. The best and most useful physical/chemical models included ortho-phosphorous and a surrogate for cyanobacteria concentration such as turbidity, phycocyanin, or the number of copies of the cyanobacteria 16S RNA gene. We describe these models and show how the model based on ortho-phosphorous and turbidity is particularly useful since those data are collected by citizen scientists with the MiCorps program.

Posters

Fungi and bacteria in different aerosol particle size fractions on the International Space Station (ISS). Bope, A.*1, Haines, S.R. 1, Meyer, M. 2, Dannemiller, K. 1; 1 Ohio State University, Columbus, OH, 2 NASA Glenn Research Center, Cleveland, OH. On earth, humans are exposed to microbes indoors from many sources, including occupants, outdoor air, pets, tracked in soil, and ventilation. Aboard the International Space Station (ISS) exposure is limited to only a few sources of microbes. Additionally, the airborne particle size distribution is different in microgravity due to the lack of gravitational settling. This study aims to characterize particle distribution of bioaerosols on the ISS to reduce and identify potential microbial exposures on the ISS. Dust from a filter element screen on the ISS was collected using a portable vacuum cleaner and sieved creating five different particle size fractions. A separate aerosol tape sample was retrieved from a Passive Aerosol Sampler (PAS) on the ISS which collected airborne particles, including some bioaerosols. DNA extractions were performed on ~50 mg aliquots of the filter dust samples and tape aerosol sample. Quantitative polymerase chain reaction was then used to measure the concentration of microbes in the samples. Samples were then sequenced on an Illumina MiSeq and analyzed using QIIME. Particle size was associated with different microbial communities and the aerosol tape sample was most closely related to the largest particle size fraction of the vacuum bag material. Abundant bacterial genera were Staphylococcus and Corynebacterium, while abundant fungal genera were Penicillium, Rhodotorula, and Aspergillus. Some identified microbes may originate from food

sources. This study will help determine potential microbial exposures associated with different sized bioaerosols present within a spacecraft cabin environment.

Extraction and analysis of perfluoroalkyl substances from water using specialized organosilica adsorbents. Edmiston P.L.* Nguyen, H.K., Lawrence, M.G. The College of Wooster, Department of Chemistry, 943 College Mall, Wooster, OH 44691 Perfluoroalkyl substances (PFASs) are highly fluorinated alkyl chemicals where one or more H substituents have been replaced by F. Surfactants and polymers comprised of PFASs have been used in industrial and commercial applications such as fire fighting foams. Analysis of PFASs is important for environmental monitoring. Microporous organosilica materials are being developed to adsorb a broad range of PFASs including PFOA and PFOS, but also fluorinated substances with cationic and zwitterionic groups. The approach is to use self-assembly of alkoxysilane precursors to create pore structures possessing mixed mode surface chemistry including fluoroalkyl groups. Application of these materials for solid-phase extraction, passive sampling, and downstream analysis by LC-MS/MS will be discussed.

Quantifying Ecosystem Responses to Anthropogenic Stress: An Environmental DNA (eDNA) Approach. Feller, J.D.* 1, Swab, R.M. 2, Spear, S.F. 2, Lanno, R.P. 1; 1 The Ohio State University, Columbus, OH, 2 The Wilds Conservation Center, Cumberland, OH. To better understand ecosystem responses to anthropogenic stress, new biomonitoring methods are needed that assess biodiversity in a quick and cost-efficient manner. The emerging field of environmental DNA (eDNA) offers such an approach, as it can provide rapid, low-cost identification of the species in an area. To test the effectiveness of this new technology, eDNA will be collected from lakes along an acid-mine drainage (AMD) gradient within The Wilds Conservation Center. The lake ecosystem here consists of one large headwater lake that filters down to several smaller lakes, all within ~1 mile of each other. We previously observed fish recolonization of ponds downstream of the mine, and plan to use eDNA sampling to quantify biodiversity in fish, amphibians, and benthic invertebrate communities along this gradient. The goal of this proof-of-principle study is to estimate biodiversity and community structure at each lake using eDNA sampling and then compare these results with traditional ecological assessment methods (e.g., netting, electrofishing, invertebrate sampling). Our working hypothesis is AMD will reduce biodiversity and simplify community structure at lakes closest to the AMD source and that eDNA will successfully detect these ecosystem changes. Results from this study will provide a wealth of species information beyond what is typically considered for remediation efforts. The extensive species data along a pollution gradient will allow for construction of site specific species sensitivity distributions (SSDs) for pH, metals, and other AMD characteristics. Knowing which levels of AMD correspond to desired community structures can help create AMD benchmark levels for any future attempts to restore affected lakes at the Wilds.

Microcystin treatment by chemisorption to a thiol and amine functionalized organosilica: Comparison to powder activated carbon Graham A.L.* Carter, K.A. Edmiston, P.L. The College of Wooster, Department of Chemistry, 943 College Mall, Wooster, OH 44691 Microcystins are cyclic heptapeptide toxins produced by cyanobacteria that are frequently detected in surface waters during seasonal blooms. Chemisorption of microcystin through covalent bond formation to the acryloyl group common to all congeners was hypothesized to be a high affinity adsorption mechanism. Sol-gel derived organosilica materials were synthesized as sorbents that could potentially facilitate a Michael addition reaction between an immobilized thiol group on the adsorbent and the acryloyl group of microcystin. Amine groups were also added to the organosilica to catalyze the thiol addition reaction at neutral pH. Adsorption isotherms of microcystin-LR, -LA, –RR, and nodularin were measured for sol-gel derived sorbents and compared to adsorption by wood-based powdered activated carbon, which has been demonstrated to be an effective adsorbent for microcystin. The amine/thiol containing organosilica demonstrated a broad specificity to remove all three congeners from water. Adsorption capacities for MC-LR from natural water were reduced compared to deionized water, especially for the thiol-amine

organosilica media. Overall, the reaction of microcystin with a surface thiol appeared to be promoted by an initial physical adsorption event and thiol deprotonation by the amines to create a better nucleophile for the Michael addition reaction.

Habitat Alteration from Land Use: Stono River Estuary. R. Havill. School of Public and Environmental Affairs, Indiana University. The research performed for this poster investigated how the wetlands in the Stono River Watershed are projected to be altered by increases in urban and industrial land use. The research employed a regional risk assessment method to compare land use in three regions of the Stono River Watershed. The data for the research came from the USDA and EPA in the form of GIS raster and shapefiles for land use in the Stono River Watershed. The base data was from measurements at 2010 and the projections used in this research extended to 2060 and 2100. GIS and Excel were used to tabulate the change in land use data. The relative risk ratings for each region were based on percent change of wetland area as well urban and industrial from 2010 to 2060 and 2010 to 2100. The relative risk model employed in this research can be applied to other regions in the future as well as further research could illuminate how this change in land use directly effects ecosystem dynamics and ecosystem services of the Stono River Watershed.

Total microcystin values do not reflect Ohio HAB toxicity. Hipsher, C.H., Lanno, R.P, Barker, J.D., MacKay, A.A. Byrd Polar and Climate Research Center. The Ohio State University. Although Ohio has experienced severe harmful algal bloom for years, little is known about their lethal toxicity to aquatic organisms. Ohio authorities have primarily used enzyme-linked immunosorbent assays to determine total microcystin content in surface waters which may or may not represent actual lethal toxicity to aquatic organisms. This study aims to determine if the lethal toxicity to the cetacean Thamnocephalus platyurus of Ohio blooms are correlated to total microcystin values. Phytoplankton samples from five sites in Ohio were collected monthly from May to October 2017. One site served as a control, two sites represented lakes dominated by Planktothrix cyanobacteria, and two sites were on Lake Erie, which is dominated by Microcystis cyanobacteria. Planktothrix dominated blooms peaked earlier in the season, between June and July, compared to Microcystis dominated blooms, which peaked in September. Total microcystin was measured by enzyme-linked immunosorbent assay and lethal toxicity to Thamnocephalus platyurus (LC_{50}) using Thamnotoxkit-F for each site. LC_{50} values did not correlated with total microcystin levels suggesting that microcystin concentration may not reflect bloom toxicity to aquatic organisms. Further, the type of bloom in a waterbody should be taken into consideration before implementing corrective action because peak toxicity to aquatic organisms occurs at different times depending on whether the lake is dominated by Planktothrix or Microcystis cyanobacteria.

Relative Risk Assessment of Mercury Contaminated Fish Consumption M. Howell, M. Cains, D. Henshel. Indiana University. Mercury is a legacy pollutant that, in certain forms, is a known neurological toxicant. Mercury is released into the environment through environmental and anthropogenic processes. The presented research examines the health impacts associated with chronic exposure to fish consumption by recreational fishers along the Cooper River, SC. Using geo-referenced data (e.g. EPA Toxic Release Inventory, land use, fishing advisory), an environmental risk assessment is being conducted using the Relative Risk Model and ArcGIS.

Determining the effects of water hardness and sub-lethal levels of calcium- and magnesium-based deicing agents to the toxicity of sodium chloride using the aquatic amphipod Hyalella azteca. Kidd, K.A.* 1, Bood, L.E. 1, Trimble, A.J. 1; 1 Ashland University, Ashland, OH. Many products used to melt ice in winter are formulations of highly water-soluble salts that readily dissolve in rainwater and snowmelt. Runoff from suburban neighborhoods, highways, and other sources could discharge complex mixtures of salts into natural surface waters, which could result in unpredictable toxic effects to aquatic organisms. The most commonly used saline deicing agent is sodium chloride (NaCl), though calcium

chloride ($CaCl_2$) and magnesium chloride ($MgCl_2$) are also used. Some aquatic invertebrates, like the amphipod Hyalella azteca, prefer hard water to soft water and have a higher tolerance to calcium and magnesium than to sodium. Therefore, they might benefit from the presence of less toxic ions in NaCl contaminated water. The objective of the present study was to determine the effects of water hardness and sub-lethal levels of $CaCl_2$ and $MgCl_2$ to NaCl toxicity. Specifically, 96-h water-only toxicity tests were conducted using H. azteca exposed to NaCl in both soft and hard water. Separate NaCl toxicity tests were conducted that contained either $CaCl_2$ or $MgCl_2$ at levels corresponding to their approximate 1% lethal concentrations. A preliminary water hardness test resulted in a substantially higher (less toxic) NaCl 50% lethal concentration (LC50) in hard versus soft water (4413 mg/L versus 546 mg/L, respectively). When sub-lethal levels of $CaCl_2$ are present, there is a significant decrease in NaCl toxicity based on non-overlapping 95% fiducial limits. This effect was not observed with $MgCl_2$. These results will help water quality managers more accurately predict risk to aquatic organisms from these contaminants.

Impacts of Microplastics on Benthic Invertebrate Feeding Ecology and Nutrition. W.M., King., J.E. Bauer. Department of Evolution, Ecology, and Organismal Biology. The Ohio State University. Microplastics have been established as a major environmental concern in recent years and are now recognized as ubiquitous contaminants across terrestrial and aquatic systems. To date, aquatic studies have mainly focused on marine systems with lower but growing emphasis on freshwater systems. Microplastics are known to enter freshwater systems through a variety of routes and they have been quantified and characterized in a number of these systems. However, studies on the effects of microplastics on aquatic ecological processes are so far relatively rare. It is therefore important to evaluate the impacts of microplastics on freshwater biota and their associated activities. Freshwater mussels play an important functional role within ecosystems through their filter feeding process. With a majority of freshwater mussels being classified as threatened or endangered, an evaluation of microplastic effects is critical for determining the effects these contaminants have on mussel feeding and nutrition, which in turn may impact population survival and population abundances. This study aims to determine how microplastic concentrations and chemical composition impact freshwater mussel filter-feeding activities, ingestion of aquatic food sources and nutritional well-being. The results of this study will advance our understanding of filter feeder responses to microplastics and aid in management and conservation efforts for this imperiled group.

Quantifying aqueous phase PAH degradation during ultrasound remediation Kohan, D.* 1, Weavers, L. The objective of this study is application of ultrasound to reduce the health risks from Polycyclic Aromatic Hydrocarbons (PAHs) bound in sediment. PAHs have a possible or probable carcinogen classification and are often found in sediments of sites historically contaminated by wood treating facilities. PAHs contaminated sediment samples were collected from Marion, OH, a designated U.S. EPA Superfund site. Ultrasound treatment (US) has been shown to be capable of degrading PAHs in the aqueous phase. It has been suggested that exhaustive extraction techniques to determine PAH levels may overestimate risk, since solvent have the capability to quantify levels higher than the concentration actually accessible for organism uptake. It has also been observed that for PAHs to be degraded by US, they must first be bioaccessible. US application can increase this bioaccessiblity and subsequent degradation, resulting in significant PAH removal from contaminated sediment. In this study, solid phase micro extraction (SPME) is used to measure the bioaccessible fraction by quantifying aqueous phase PAHs. Deploying SPME fiber during ultrasound can measure the change in the bioaccessible fraction over time. Ultrasound experiments were performed using contaminated sediment in a glass reactor and high frequency sound (>20kHz) was delivered though a horn-type sonicator. SPME fiber with a 30μm polydimethylsiloxane (PDMS) coating was deployed through a port in the Teflon cuff seal between the reactor and sonicator. The implications of this work include reframing PAH contamination by identifying

the aqueous concentration and observing the ability of ultrasound technology to remediate this fraction, which can lead to the creation of a more meaningful assessment.

Destruction and Detoxification of Microcystins (Cyanotoxins) by UV/Chlorine Process. M. Kong* 1, X. Duan 1, A. A. de la Cruz 2, D. D. Dionysiou 1; 1 Environmental Engineering and Science Program, Department of Chemical and Environmental Engineering (ChEE), University of Cincinnati, Cincinnati, Ohio, USA, 2 Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio. Abstract: Harmful algal blooms (HABs) occurred severely and intensively in recent years. Consequently, microcystins (MCs), the most common toxins produced by cyanobacterial, were frequently detected in water resources, posing a significant threat to human health due to their high toxicity and limited removal efficiency in conventional water treatment processes. In this study, UV/chlorine process was evaluated as a potentially practical and effective process for the destruction and detoxification of MCs in water supplies. Therefore, degradation kinetics and mechanisms as well as the detoxification effect of MCs by chlorination and UV/chlorine process were investigated. The UV/chlorine process showed a significant synergistic effect on the degradation of all studied MCs as shown by the magnitude of degradation kinetics. The changes of cytotoxicity during UV/chorine process were tested by HepaRG human liver cell line. The results of MC-LR detoxification indicated cytotoxicity decreased though the UV/chlorine process and UV/chlorine process enhanced detoxification compared with chlorination or UV irradiation applied separately.

Toxicological Effects by Cadmium In Prochilodus magdalenae. Sierra-Marquez, L.* University of Cartagena, School of Pharmaceutical Sciences, Environmental and Computational Chemistry Group, Cartagena, Colombia, 2 University of Cordoba, Faculty of Veterinary Medicine and Animal Science, Department of Aquaculture Sciences, Institute of Fishculture Research - CINPIC,Monteria, Colombia. Heavy metal cadmium (Cd) is a well-studied toxic known to cause a wide range of adverse environmental effects. In aquatic ecosystems, exposure to this metal can damage reproduction and fertilization rates in organisms, such as fish. In Colombia, one of the most important fish species for riparian communities is the species Prochilodus magdalenae, which is present in many rivers of the territory. The objective of this study was to determine the toxic effects of cadmium chloride (0, 0.003, 0.03, 0.3, 3 and 30 ppm) in larvae and sperm of P. magdalenae. The results indicated that cadmium-induced a dose-dependent effect on the lethality of the exposed larvae that depends on its development stage. The heavy metal also altered sperm quality by decreasing total motility and speed of rapid and medium swimming spermatozoa. The heavy metal also impaired sperm curvilinear and straight-line velocities in a concentration-response dose. Fertilization and hatching was also affected. The results showed that exposure to cadmium produces effects in the early stages of the development of P. magdalenae, which probably reduces the rate of fertility of this vulnerable species. UniCartagena (2016-2017), Colciencias, 647-2014.1, Lozano-Guerrero, M. 1, Espinosa-Araujo, J. 2, Atencio-Garcia, V. 2, Olivero-Verbel, J. 1; 1

Predicting the toxicity of mixtures of choride-based deicing agents to Hyalella azteca using mathematical models. Vidmar, J.N.* 1, Nininger, H.B. 1, Kidd, K.A. 1, Trimble, A.J. 1; 1 Ashland University, Ashland, OH. Commercially available deicing agents often contain various ratios of several highly water soluble chloride salts that readily dissolve in rainwater and snowmelt. Runoff from residential areas, parking lots, highways, and other non-point sources could potentially discharge highly concentrated complex mixtures of these salts into surface water in the environment, which can result in unpredictable toxic effects to aquatic organisms. The objectives of this research were to examine the effects of mixtures of the common saline deicing agents sodium chloride (NaCl), calcium chloride ($CaCl_2$), and magnesium chloride ($MgCl_2$) to the aquatic amphipod Hyalella azteca and to compare the experimental results to those predicted by commonly-utilized mathematical mixture models. Specifically, 96-h water-only toxicity tests were conducted with these saline toxicants as single compounds and in binary and tertiary mixtures. The concentration addition (CA) and independent action (IA) models were

used to determine deviations from additivity and to assess the overall predictive abilities of the models. The binary mixture toxicity test median lethal concentrations (LC50s) were 7707 mg/L, 6639 mg/L, and 5646 mg/L for the $NaCl/CaCl_2$, $CaCl_2/MgCl_2$, and $NaCl/MgCl_2$ mixtures, respectively. The LC50 for a tertiary mixture of all three salts was 8317 mg/L. Model comparisons showed that there is a significant antagonistic effect at the LC50 level in all of the mixtures with both models predicting toxicity to within a factor of two. Overall, the CA model provided better predictions at lower, more environmentally-relevant concentrations, while the IA model performed better at median and high concentrations.

Meta-analysis of nanoparticle toxicity. Wheeler. R.M.1*, Lower, S.K.1 1 Ohio State University, Columbus, OH. Since the first studies on nanoparticle toxicity emerged a decade ago, little consensus has been reached on the magnitude or mechanism of toxicity. The lack of agreement can in part be attributed to researchers trying to compare data using units of g/L which may be of little use when comparing particles of different bulk chemistry, size, and surface coating. Instead, units of particles/L or Surface Area/L may be better measures of nanoparticle toxicity and point to a mechanism of action. To test this hypothesis, a meta-analysis has been conducted with the Nano-E-Tox database, which contains data from over 200 papers comprising 1500 individual toxicity measurements. To be included in the meta-analysis, a record in the database had to meet the following criteria: examine metallic particles, report EC50 values for mortality, and provide estimates of error for the toxic concentration and particle size. The results of the meta-analysis show that particles/L is unlikely to be the best model and provides some support to Surface Area/L being a better model than g/L. The meta-analysis also revealed there is a need for better data reporting practices, as only 100 of the records met the standards to be included in the final analysis.

Methods Development for the Characterization of Carbonyl Compounds in Rainwater and the Evaluation of Their Multiphase Reactions to Form Brown Carbon. Wokosin, K.A.*, Miller, K.A., Faust, J.A.; The College of Wooster, Wooster, OH. Brown carbon, a collective term for light-absorbing organic compounds in the atmosphere, impacts climate, air quality, and health. Atmospheric reactions of carbonyls and amines represent a known brown carbon formation pathway. Characterizing atmospherically relevant carbonyl compounds in rainwater and investigating their multiphase reactions with amines will ultimately improve the accuracy of climate models. Carbonyl species in collected rainwater samples were analyzed with stir bar sorptive extraction and gas chromatography-mass spectrometry, but low extraction efficiency limited carbonyl characterization. Additionally, a flow reactor was coupled with attenuated total reflection (ATR) infrared spectroscopy to monitor multiphase reactions of glyoxal (CHOCHO) films with gas-phase amines. Non-reactive adsorption of gas-phase triethylamine and corresponding desorption of the solid glyoxal film was observed in ATR flow reactor experiments. The experimentally observed rates of adsorption/desorption were 1-2 orders of magnitude faster than corresponding rates from glyoxal-only and triethylamine-only control experiments, indicating competitive surface interactions between the two molecules. The ATR flow reactor represents a promising model for future experiments involving more reactive amines and enhanced control of vapor pressure, relative concentrations, and gas flow rates.

Human Health Risk Assessment of water pollution in swimming area of Charleston Harbor Watershed in South Carolina J. Zhang, M. Cains, Henshel, D. Indiana University. Charleston Harbor Watershed in South Carolina is important for residents and tourists because they do various water-related recreational activity there. Charleston Waterkeeper conducts a weekly water quality test which shows that several swimming areas have a high amount of enterococcus bacteria. This project assesses the human health risk of these swimming areas. Through calculation and comparison, we find that water in these swimming areas is harmful to adults' skin health. We suggest related department to improve the management of the water quality to prevent residents and tourists to have skin illness after swimming.

Investigating the possible TFM-resistance of sea lampreys with a history of TFM exposure. R. Zhang, Sepulveda, S.M., Martinez, A., Christie. M., Guffey, S. Purdue University. Invasions of organisms have resulted in catastrophic influence on aquatic ecosystems, both ecologically and economically. Sea lamprey (Petromyzon marinus) is a typical invader in freshwater lakes of North America and significantly changed the structure of the fish community there. For the sea lamprey in Great Lakes, 3-trifluoromethyl-4-nitrophenol (TFM**)** has been the main pesticide used to control the populations of sea lamprey for more than 50 years. TFM can not be detoxified by sea lamprey, which could lead death to this organism by interfering with the production of ATP. In order to study if the sea lamprey evolved resistance to TFM, we investigated the sea lampreys exposed to TFM for different periods from Lake Michigan (LM, 57 year TFM exposure), Lake Champlain (LC, 30 year exposure) and Connecticut (CT, 0 year exposure). We exposed larval sea lampreys to various concentrations of TFM (0, 1, 2, 3, 4 ppm) for 12 h and measured the glycogen level of the liver, brain and gill of sea lamprey. Compared to the CT group, the glycogen levels of LM and LC groups decreased significantly in all the three organs. This indicates there is no detectable resistance in sea lampreys from LM and LC.