Fall Newsletter

November 2021

Announcements

14-18th November: SETAC North America 42nd Annual Meeting: SETAC SciCon4

Cover Photo: Bluestone River National Scenic River (Contributed by Jennifer Flippin)

Inside this issue

Photo: East Fork Greenbrier River, WV (Contributed by Jennifer Flippin)

Mission Statement

Serving the Chesapeake-Potomac Region (Maryland, DC, Virginia, and West Virginia), our chapter of SETAC North America (SNA) provides a professional forum for individuals from private industry, academia, and government agencies who are engaged in the study, analysis and solutions for environmental problems, management, and regulation of natural resources, and/or research and development. We facilitate networking and educational opportunities for scientific professionals, mentoring and career guidance for students, and environmental education and outreach for the public.

Keep in touch with CPRC SETAC

CPRC Leadership and Committees

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Assistant Editors	Michael Quinn, Andrew East, Nathalie Lombard	

President's Podium

Autumn is finally here! As many are preparing for the autumn festivities and the upcoming 42nd SETAC North America meeting (SciCon4), Covid-19 still persists and social distancing remains the norm. CPRC continues to adapt to keep members connected!

This year, we hosted our second virtual meeting on April 21-22, 2021, using CPRC's Zoom account for the first time. This meeting featured a series of outstanding talks from a variety of speakers. I hope you also had a chance to chat during the coffee breaks with colleagues from Virginia, West Virginia, Maryland and DC from the comfort of your home. Maybe you were able to participate in the game night during the happy hour or learn more about career options during the mentoring activities. If you were not able to attend, more information on the CPRC Spring meeting 2021 can be found here.

This year also marked CPRC's first virtual Fall dinner, with guest speaker Dr. Millner from USDA-ARS-Beltsville Agricultural Research Center, who gave a wonderful talk on the microbiological risks and technology involved to get fresh produce safe to eat from Farm-to-Table. There was also a virtual course conducted by Nathan Sell on the Toxic Substance Control Act (TSCA) and changes to expect in TSCA under the new administration.

As the vaccination rate increased in Maryland (>60% people fully vaccinated at the end of July 2021) and many of us longed to reconnect in person, CPRC Events Planning Committee organized a happy hour last August at the Guinness Brewery (MD). A Zoom link was made available for members who could not join in person but still wanted to participate. Learn more about this event here.

In accordance with members' feedback on gathering preference from our August 2021 survey, you will see more hybrid events in the future. Not only will this allow members across our chapter to stay connected while living hundreds of miles away, but this will also provide an opportunity to connect with people from across the world. SETAC members move a lot. Among CPRC members, some might be from other SETAC NA regions. Others (including myself) traveled across oceans before joining CPRC. This new way of communication will allow us to continue our exchange wherever we might go next.

President's Podium

Don't miss the future events coming up. The next SETAC NA annual meeting is right around the corner. If you are presenting at SciCon4, do not forget to complete the online form to promote your work, learn about the research performed within the CPRC chapter, and find common interests with fellow CPRC members. Unfortunately, there will be no chapter mixer this year at SETAC NA but stay tuned for an upcoming CPRC business meeting. We are still considering a joint meeting with the Hudson Delaware Chapter in April 2022 and will keep you updated.

If you want to be more involved with CPRC SETAC, nominations for Officers and Boards of directors will soon open. You can also volunteer in any committee of your interest: Events Planning, Communications, Memberships, Inclusive Diversity (learn more here). You can also donate and specify how you want it contributed. We also welcome any suggestions or ideas! Feel free to reach out at president.cprc.setac@gmail.com.

I look forward seeing you all at SETAC NA. Stay safe, happy, and healthy.

Nathalie Lombard

Nathalie Lombard, Ph.D.
CPRC President 2021-2022

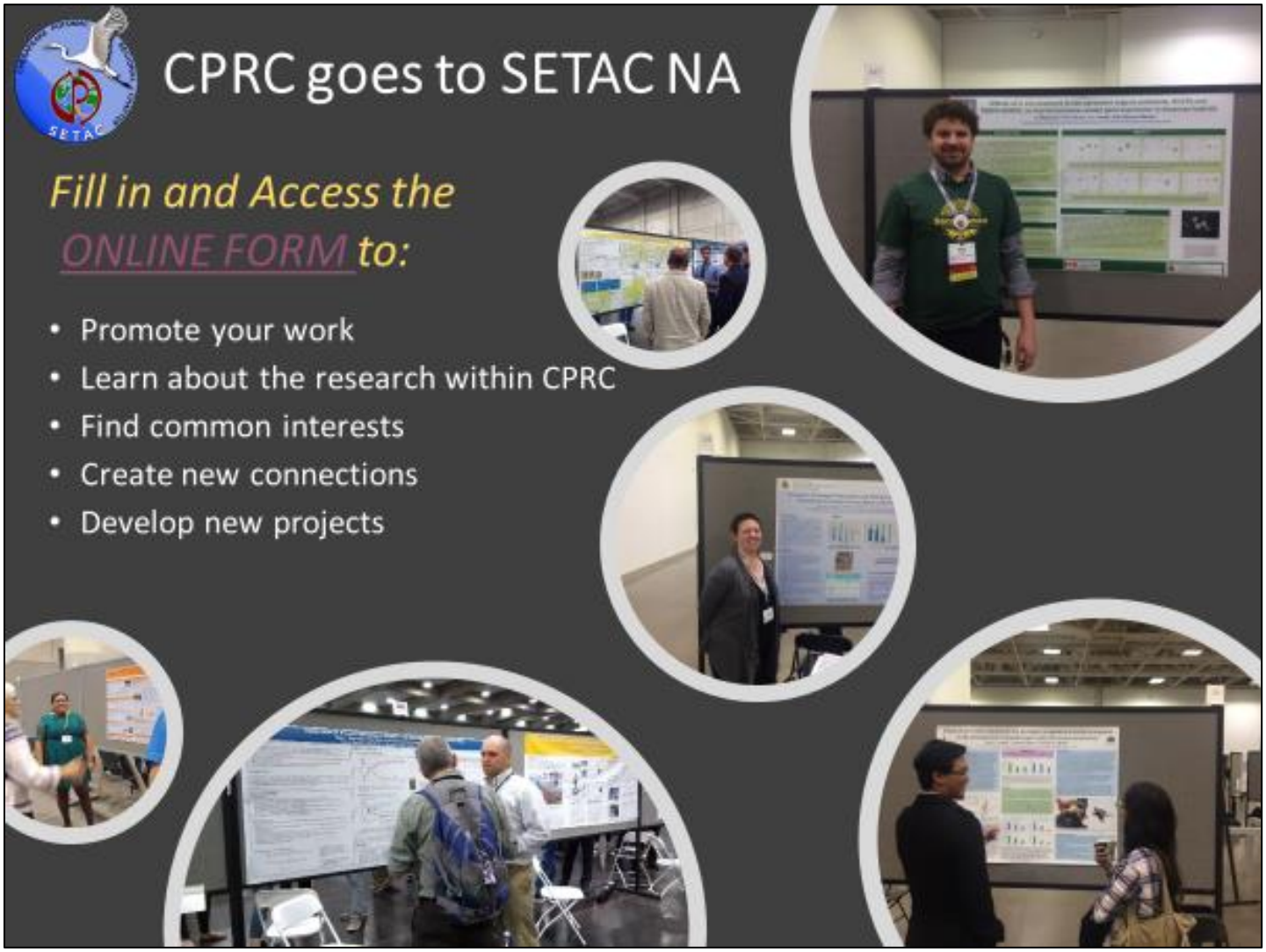
New CPRC Student Representative

JADA DAMOND

University of Maryland, Baltimore County

Jada Damond is a 2nd year Ph.D. student in Environmental Engineering at the University of Maryland Baltimore County (UMBC). Her current research focuses on the development of an equilibrium-based polymeric passive sampling device for the measurement of methylmercury in aquatic systems. She had been involved in research as a Chemical Engineering undergraduate student at UMBC, working to measure black and activated carbon in sediment samples. Jada has been involved with the regional and continental chapters of SETAC since she was an undergrad, serving as the SETAC North America Student Advisory Committee (NASAC) Outreach Blog Chair since February 2020 and serving on the CPRC event planning committee since March 2021.

CPRC SETAC at SETAC NA 2021: Share your research



(Click on the image to access the online form)

CPRC SETAC Annual Spring Meeting 2021

Nathalie Lombard
President, CPRC SETAC

The CPRC Events Planning Committee prepared the 2021 program to emphasize SETAC North America's theme **"Solutions with Respect for our Community and Environment"** and we hoped to illustrate this with a photo of the Anacostia River Bladensburg Waterfront Park chosen for our 2021 flyer (see **Box** for more info).

This year's meeting went virtual, using for the first time. Instead of a previous year's weekly lunch series, we tried out a new half day format, which was well received by participants who responded to our live survey during the event.

The Annual Spring Meeting was made up of live presentations, a student's presentation contest, and a happy hour/ game night. Other activities that were held include the following:

- **Late breaking science session** for members to share their latest science updates.
- **Coffee breaks** to allow for discussion and networking
- **Mentoring activity** to support students and early career professionals
- **Live survey** to collect preferences on the next series of virtual events
- **Raffle** for the spring meeting participants.

The Committee selected a series of presentations discussing ongoing and emerging regional issues, as well as solutions to improve our environment. The Virtual meeting opened with Dr. Charles Menzie, the former Global Executive Director of SETAC, who provided updates

on SETAC activities around the world. JoEllen Santulli, Communication Director at Friends of the Rappahannock, gave a keynote address "Restoring Oyster Reefs Through Partnerships" on how they engaged industries, local farmers, schools and individuals in their oyster program to improve water quality of the river. Several talks this year focused on stormwater water runoff and how it impacts water quality of downstream waterbodies, bioretention treatments, processes within wastewater treatment plants and water sustainability, monitoring of pollutant levels (heavy metals, PFAS), and treatment solutions (bioremediation of PCBs, PAHs, removal of heavy metals). The meeting program with abstract and participants email addresses is available on the CPRC website. Feel free to consult it and contact the presenters for more information about their work.

Box: The Anacostia River was neglected for several decades during which it was subjected to industrial activity, increased pollution, and erosion that led to loss of wetlands, presence of raw sewage, heavy metals, PCBs, and pesticides into the river exposing residents and communities. For several years, efforts have been under way to restore the river (see video featured at Scicon2) with the objective of being fishable and swimmable by 2032. Total maximum daily loads (TMDLs) are now in place for trash, PCBs, bacteria, sediment, and other materials. An underground tunnel to redirect sewer overflow into Blue Plains WWTP is under construction. In 2020, the Anacostia River Sediment Project released an Interim Record of Decision outlining the findings of existing Anacostia River contamination and early actions that the District will be taking to clean up the contamination. Several studies are ongoing, including a freshwater mussel restoration project by Anacostia Watershed Society. The residents are now returning to activities on the river: the first kayak rental opened in 2013, now more boating, kayaking and paddling locations are opening. New docks were installed to facilitate public access to the river and the Anacostia River Trail, a 20-mile-long route, opened in 2016 and is enjoyed by cyclists, runners, and walkers.

Please congratulate this year's winner of the student contest for best presentation: Erica Loudermilk 1st, Xiaojue Chen 2nd, and best poster: Wayne Omagamre 1st, Catherine Crowell 2nd, Idrissa Soumaoro 3rd. Raffle Prizes were won by Jada Damond (CPRC mask), Vanessa Wuerthner (mug), Ben Buruss (mug).

If you have any comments on how to improve the meeting, recommendations for keynote speakers that you would like featured, or suggestions of new activities, feel free to share it at vice.president.cprc@gmail.com. We welcome any feedback and can include you in the CPRC Events Planning Committee to help organizing the next Spring meeting.

We hope to see you at the 2022 Annual Spring Meeting. Meanwhile, please find below some pictures to remember from the 2021 meeting!


CPRC Spring Meeting 2021
Brian Wartell
Guangbin Li
Nathalie Lombard (inc. CPRC Pres., UMBC)
charles menzie
Jada Damond - UMBC
Ben Burruss (TRS SafeBridge)
Eguono Omagamre
Jim Laurenson
Mandar Bokare
Ilana Herold
Rebecca Lazaurs (USEPA)
Songjing yan
Erica Loudermilk
Catherine Crowell
Vanessa Wuerthner
Sarah Lanasa (Towson University)
Susan Thomas
Meghann Niesen
Paula Henry
Idrissa

Award Winners: CPRC SETAC Annual Spring Meeting 2021

Name: Erica Loudermilk
University: University of Virginia
Department:
Type of Degree:
Award: 1st Place Platform ($100)
Email: eml5ys@virginia.edu

Title: Fate of Nosocomial Resistant *Klebsiella pneumoniae* producing *Enterobacterales* in a Wastewater Treatment Plant and Receiving Waters.

Erica *is currently a fourth-year Ph.D. student of Environmental Engineering at the University of Virginia in Dr. Lisa Colosi Peterson's research lab. Her research focuses on antibiotic resistance in wastewater treatment systems and their fate in the natural environment. She is currently working on a project aimed at investigating the impacts of chlorination and ultraviolet radiation disinfection technologies on the fate and dissemination potential of antibiotic resistant bacteria and their corresponding genes.*

Abstract: Antibiotic resistance has been recognized as one of the largest challenges facing human health by the World Health Organization. Wastewater treatment plants (WWTP) serve as important reservoirs of antibiotic resistance and, thus, are an important engineering link to containing the spread of antibiotic resistance into the environment. Klebsiella pneumoniae producing Enterobacterales (KPCE) are a serious concern in hospital settings because of their ability to cause life-threatening human infections. KPCE also have the ability to thrive in wastewater and environmental settings, which causes concern for human acquisition from the environment. In our study, we investigated the fate and concentrations of viable KPCE and the corresponding gene, blaKPC, from a hospital into, through, and out of a WWTP as well as in upstream and downstream surface water and sediment samples. The results show that KPCE are present in the hospital effluent and throughout each compartment of the WWTP, except for the UV-disinfected final effluent. A Klebsiella oxytoca strain was also isolated in a surface water sample downstream of the WWTP, which is an identical match to strains found in patients in the nearby hospital. This demonstrates conclusive linkage between hospital discharges of antibiotic resistant bacteria and their ultimate presence in the environment. These results show that constituents of hospital wastewaters that are capable of eliciting antibiotic resistance are present in the downstream receiving water. It is not yet known to what extent the presence of these agents elicits antibiotic resistance in downstream microbial communities.

Award Winners: CPRC SETAC Annual Spring Meeting 2021

Name: Xiaojue Chen
University: University of Maryland, College Park
Department: Department of Civil and Environmental Engineering
Type of Degree: PhD
Award: 2nd Place Platform ($75)
Email: xiaojuec@terpmail.umd.edu

Title: Inhibition of Azole Compounds on Biological Nitrogen Removal in Wastewater Treatment Processes.

Xiaojue *is a third-year Ph.D. candidate in Environmental Engineering at the University of Maryland. His research focuses on the toxicity of azoles on the biological nitrogen removal (BNR) processes in wastewater treatment plants and the potential adaptation or acclimation of bacteria to the azole inhibition. Besides, Xiaojue is also trying to develop strategies for the BNR bacteria to resist the inhibition of azoles. Xiaojue is now working in the NES lab and will keep working on his topic in the future.*

Abstract: Over the decades, various biological nitrogen (N) removal processes including nitrification, denitrification, and anaerobic ammonium oxidation (anammox) have been successfully applied for removing N in the wastewater treatment plants (WWTP). Azoles, classified as emerging organic contaminants (EOCs), are a group of man-made chemicals that have been widely applied in aircraft de-icing agents, semiconductor manufacturing, and household dishwashing detergents. The object of this study is to investigate the inhibition effects of different azole compounds to biological N-removing processes, including nitrification, denitrification, and anammox processes with experiment-based lab research and literature review. 10 azole compounds were selected as model compounds to represent azoles structures with different physiochemical properties in this study. Serious activity inhibition (> 50% inhibition) was observed in the nitrification process when exposed to pyrazole and 1,2,4- triazoles at 2.69 mg L-1 and 3.53 mg L-1, respectively. 1H-Benzotriazole and 5-Methyl-1H-benzotriazole could cause serious inhibition of the anammox process at approximately 20 mg L-1. Azoles with less solubility, such as ketoconazole and climbazole, exhibited mild (< 25% inhibition) or no inhibition effect on the nitrification and anammox process at up to 10 mg L-1. One hypothesis is that the azoles may chelate with enzyme-bound copper and thus inactivate the function of ammonia monooxygenase, which is supported by the results of a higher inhibition to the nitrification process compared with anammox. In addition, the azoles with functional groups that could impede the complexation presented less inhibition to the nitrification process, such as 1-methylpyrazole and 3,5-dimethylpyrazole. Results of the study provided a comprehensive analysis of the potential risk of azoles to biological N-removing processes and improved the understanding of the inhibition mechanisms. The presence and/or potential accumulation of azoles within WWTP may impact the stability and performance of biological N removing processes. Further studies will focus on the inhibition of azoles to the denitrification process, as well as the potential of N-removing bacteria to adapt and/or biodegrade azoles.

Award Winners: CPRC SETAC Annual Spring Meeting 2021

Name: Eguono Wayne Omagamre
University: University of Maryland Eastern Shore
Department: Department of Natural Sciences
Type of Degree: PhD
Award: 1st Place Poster ($100)
Email: ewomagamre@umes.edu

Title: Study of the modulatory impact of perfluorobutanoic acid (PFBA) on the growth and development of soybean (Glycine max (L.)) and cherry tomato (Solanum lycopersicum var. cerasiforme) plants.

Wayne *is a 4th year doctoral candididate in environmental toxicology investigating the impact of perfluoroalkyl substances on plant-insect ecology. Specifically, he is investigating the physiologic, biochemical and molecular impacts of short chain PFAS on plant and insect herbivore model systems. Data from his research recently attracted a $600k US Department of Agriculture Capacity Building Grant.*

Abstract: Per and polyfluoroalkyl substances (PFAS) are a class of chemical contaminants of emerging concern that are widely distributed in the environment. Translocation studies suggest that plants uptake and accumulate perfluorobutanoic acid (PFBA) much more than other short chain PFAS (4-6 carbon chains) with carboxylate and sulfonate functional groups. However, the phytotoxicity impact on plant exposure to PFBA at environmental concentrations are not fully known. In this study, soybean (Glycine max L.) and cherry Tomato (Solanum lycopersicum var. cerasiforme) plants were used to investigate the impact of perfluorobutanoic acid (PFBA) on some key plant growth and development indices. Soybean and cherry tomato seeds were surface-sterilized and sown in polypropylene pots containing approximately 70 g of wet sterilized soil. Sown seeds were irrigated as 7-treatment groups with PFBA-spiked solutions at concentrations ranging from 10 ng/L to 1 mg/L. Impact evaluation was carried out on the soybean plants after growing for 4 weeks while the tomato plants were allowed to grow until they bore fruits. Plant development patterns suggested a non-monotonic impact of PFBA on chlorophyll content, growth height, flowering and fruit bearing. The 100 ng/L treatment group showed the most stimulation of the studied growth and development indices, with 17%, 28%, and 150% stimulation over the controls respectively for leaf chlorophyll content, plant height and total number of produced fruits. Groups treated with less than 100 ng/L PFBA produced less flowers and fruits compared to the controls. Plant flowering data suggests that the 1 mg/L group were stressed as they produced a significantly higher number of flowers than the controls and the other treatment groups but failed to develop fruits. The overall data suggests that PFBA modulated some growth and development pathways in the studied plants at environmentally relevant exposure levels.

Award Winners: CPRC SETAC Annual Spring Meeting 2021

Name: Catherine Crowell
University: University of Mary Washington
Department: Department of Earth and Environmental Sciences
Type of Degree: B.S.
Award: 2nd Place Poster ($75)
Email: ccrowell@mail.umw.edu

Title: The presence, distribution, and concentration of trace metals in the James River near a coal-burning repository.

Catherine *is a senior at the University of Mary Washington. Her research focuses on assessing the impacts of trace metals from coal ash on water quality and on a freshwater snail species. Catherine is passionate about water quality and the impacts of pollutants on aquatic organisms and human health. She plans to pursue her Master's of Science (M.S.) in Toxicology in Fall 2022.*

Abstract: The Chesapeake Bay, one of the largest estuary systems on the east coast of the United States, has numerous coal-burning power stations located along its waterways. Coal ash, or fly ash, is a form of industrial waste that is mainly produced by coal-burning power stations and is known to be enriched with trace metals that are at high risk for leaching into waterways, resulting in the presence of these contaminants within aquatic environments. Few studies have examined the distribution of trace metals in the James River watershed, a tributary of the Chesapeake Bay, and the implication of a coal-burning power station located in its upper reaches. Thus, the goal of this study was to evaluate the spatial and temporal distribution of trace metals in both water and sediments within the James River in the vicinity of the Chesterfield power station (Richmond, VA). Water and sediment samples (grab and core) were collected upstream, midstream, and downstream from the Chesterfield power station. The samples were analyzed using ICP-OES (a spectrometer used for analyzing environmental samples for trace metals) for the concentration of twelve trace metals including Al, As, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Se, and Zn. The preliminary results of water and grab samples show high concentrations of trace metals downstream as well as behind the power station near Dutch Gap Conservation Area. Cadmium concentrations in the water (0.005-0.017 ppm) exceeded the EPA's MCL's for drinking water. Complete water and sediment cores samples analyses will provide a clearer picture of trace metals spatial as well as temporal variability and loading at the study site. This study will provide vital information regarding the potential impacts of coal-burning repositories on the presence and mobilization of trace contaminants within aquatic ecosystems and their future impacts on terrestrial and aquatic organisms.

Award Winners: CPRC SETAC Annual Spring Meeting 2021

Name: Idrissa Soumaoro
University: University of Lomé
Department: Geoscience and Environment
Type of Degree: Doctorate
Award: 3rd Place Poster ($50)
Email: idrissou2020@gmail.com

Title: Heavy Metals Removal in Drinking Water using Moringa Oleifera Seeds and their Accumulation on Broiler Chickens and Health Risk Assessment.

Idrissa *graduated with a Doctorate in Ecosystems Pollution and Ecotoxicology, Option: Avian Science at University of Lomé-Togo.*

Abstract: Heavy metals are persistent in the environment and can cause bioaccumulation in the food chain. Drinking water contamination by heavy metals can pose a risk to poultry performances and to human health thereby causing enormous toxic health effects. The need for affordable, reliable and effective methods of water treatment has led to the use of plant materials, including coagulants such as Moringa oleifera seeds in order to make poultry products safe for consumers. The aim of this study was to investigate the effects of drinking water treatment by Moringa oleifera seed on the concentration and distribution of metals such as arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), nickel (Ni), lead (Pb) in different parts of broilers chickens and theirs effects on consumers' health. A total number of 264 chickens (Cobb-500) one-day old were assigned to three treatments, having twenty-two birds for each treatments and replicated four times: untreated well water (UW), well water treated with Moringa oleifera seeds filtered (MOF) and well water treated with Moringa oleifera seeds not filtered (MOT). Thirty birds were randomly chosen in different treatments and slaughtered at the 45 day of the experiment and samples of livers, kidneys, gizzards and breasts were obtained and analysed for toxic metals concentrations using spectrophotometer atomic adsorption. The results indicated that the bioaccumulation of heavy metals were lower in MOF than those in UW and MOT. The target hazard quotient (THQ) for individual metal was below acceptable limits except for As and Pb in UW and MOT. The carcinogenic risk (TR) were estimated for each metal due to consumption of different types of chicken. Moringa oleifera seeds is an environmentally-friendly natural coagulant and removes water containing undesirable heavy metal concentrations and keeps poultry meat safe for consumers.

CPRC SETAC Member Spotlight

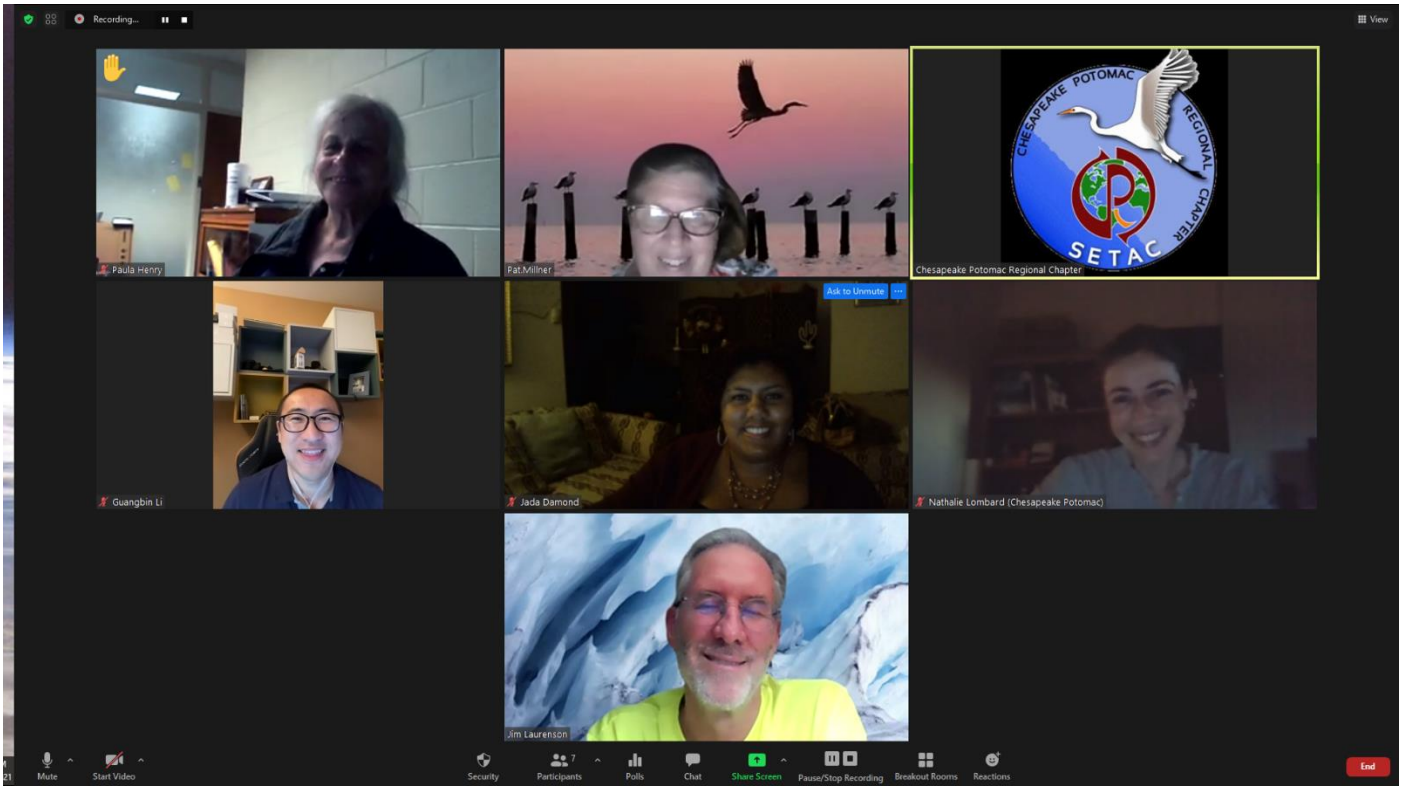
Each year, SETAC recognizes the best student papers published across its journals, *Environmental Toxicology and Chemistry (ET&C)* and *Integrated Environmental Assessment and Management (IEAM)*. Recognition is given to innovative or creative papers, which contain transparent, reproducible, rigorous and relevant science, while also considering the quality and clarity of the presentation and the potential impact of the paper on its field.

For 2020, **CPRC SETAC Secretary, James Sanders (US EPA),** was awarded the **"SETAC Best Student Paper Award"** for his paper on *"Development of a novel equilibrium passive sampling device for methylmercury in sediment and soil porewaters"* which was published in ET&C (DOI: 10.1002/etc.4631). Additionally, this paper was also selected as one of the **"Exceptional Papers"** in ET&C for 2020.

CPRC SETAC congratulates James Sanders for these recognitions. Read more about James' achievements at Accolades for and Summaries of the SETAC Best Papers and ET&C Best Student Paper of 2020.

CPRC SETAC Events in 2021

CPRC SETAC Events in 2021



CPRC SETAC Events in 2021

August 2021 Happy Hour

Student Research Highlight

Towson Tigers Team Up!

Abbi Brown, Megan Gaessar
Towson University

Complied by Andrew East

About the authors: *Abbi is currently a second-year graduate student pursuing a master's degree in Environmental Science at Towson University. Her current thesis work aims to generate an improved understanding of the bioaccumulation of Per- and Polyfluoroalkyl substances (PFAS) in freshwater fish by better characterizing temporal variability of PFAS in surface water and sediment. In her free time, Abbi enjoys hiking, mountaineering, and photography.*

Megan is a first-year graduate student working towards her master's degree in Environmental Science at Towson University. Her current research, funded by the Chesapeake Bay Trust, utilizes field monitoring and in-situ experiments to understand the effects of iron on the biota of streams. In her free time, Megan enjoys reading, hiking, and baking.

While generating discussion about Student Research Highlights for the Chesapeake-Potomac Regional Chapter Newsletter with Abbi Brown and Megan Gaesser, we stumbled upon a classic science networking and collaborating phenomenon. Why weren't they collecting concurrent samples?! They work in the same lab for crying out loud! The lightbulb has been lit, connections made, and science is happening—in my experience, that's a critical moment for early-career scientists. Partially the actual details—how exactly are Abbi and Megan going to connect PFAS and iron contamination to improve management of stream health in the Chesapeake-Potomac watershed? - but also the sense of community, contribution, and common goals among scientists. The triangle of SETAC (academia, industry, and government) is founded on engagement and solving environmental problems with objective science. Exactly what we're highlighting here today in two outstanding Tigers. What a fortuitous moment for CPRC to facilitate!

Abbi's team's samples were collected from the Recreational Pond at Naval Air Station Joint Reserve Base Willow Grove, Pennsylvania and Piscataway Creek at Joint Base Andrews, Maryland. They obtained biota

and environmental samples at multiple locations within each site several times per week in fall, winter, and summer, followed by an ongoing analysis of PFAS concentrations in fish liver, muscle, stomach contents, and gonad tissue as well as surface water and sediment samples. Preliminary findings for samples collected from the Recreational Pond at Willow Grove suggest that concentrations of several PFAS including PFHxS and PFOA are variable in surface water and sedimenton a multi-day scale. Further, they observed relatively high concentrations of PFOS (>7,000 ng/g) and several other PFAS in fish tissue despite relatively low concentrations in water and sediment, suggesting high bioaccumulation of these compounds.

Abbi's ongoing field work and chemical analysis will yield additional insights regarding bioaccumulation and temporal/spatial variability of PFAS in freshwater fish and environmental media. This research is critically important to better our understanding of the temporal and seasonal variability of PFAS in environmental media to inform ecological risk assessments and better predict PFAS bioaccumulation in aquatic ecosystems.

To explore the issue of iron in streams, Megan's team intends to deploy several field experiments and monitor the water chemistry of 8 Regenerative Stormwater/Streamwater Conveyance (RSC) restored streams and 7 reference streams across Anne Arundel County. Water quality is measured monthly with a YSI and water samples are collected for further analysis, such as ion chromatography, dissolved organic carbon and total nitrogen determinations, and flame atomic absorption spectrophotometry (to measure iron). They also measure chloride and conductivity as these are known stress factors for biota in many Maryland streams. So far, a year of sampling average iron concentrations across all study sites (restored and reference) yields results: dissolved iron (1.5 mg/L) and total iron (2.91 mg/L) both exceed the EPAs Criterion Continuous Concentration (CCC) for iron (1.0 mg/L).[2]

Megan's team has also built in-situ enclosures similar to those developed in DeNicola and Stapleton (2002).[4] After seven days the Trichoptera (*Hydropsychidae*) housed in experimental PVC and mesh enclosures were observed for survivorship and then preserved. While this method was indeed successful, they did not observe strong effects of iron under the in-situ conditions or with the test species. Additional field experiments will involve leaf pack decomposition rates and periphyton density at various levels of iron. Megan hypothesizes that leaf pack decomposition rates will be lower in the streams with high iron compared to reference sites[5] and periphyton density will be higher in high iron streams than reference sites.[4] This research will enhance our understanding of the impacts that dissolved and precipitate iron have on local stream biota and may help inform future restoration goals and method.

Student Research Highlight

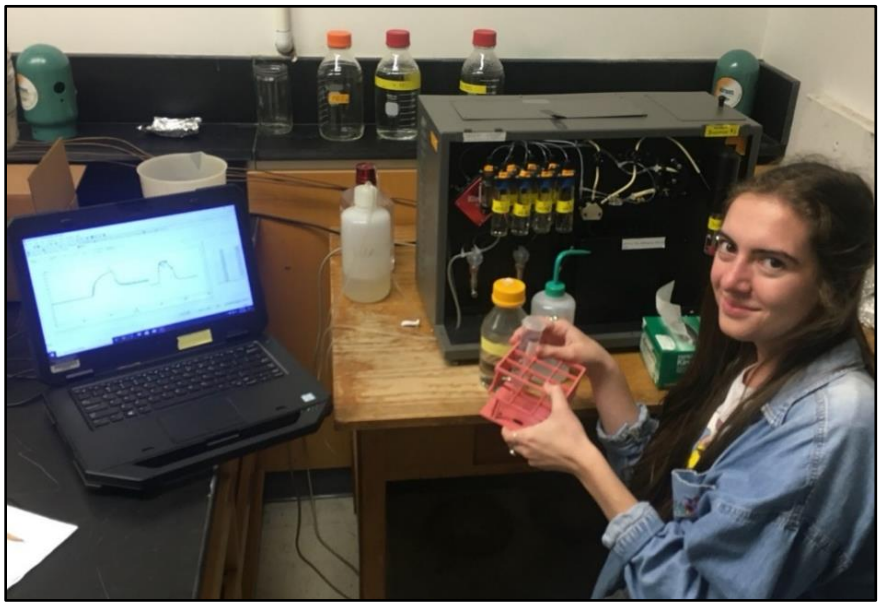
Near Real-Time Measurement of PAHs in Sediment Porewater and Oyster Interstitial Fluid Using Antibody-Based Biosensor Technology

Kristen Prossner
Virginia Institute of Marine Sciences (VIMS)

About the author: *Kristen Prossner is a 5th year PhD candidate at the Virginia Institute of Marine Science (VIMS) in Gloucester Point, Virginia advised by Dr. Michael Unger. She earned her B.S. in biology at the College of William & Mary in 2016 where she also minored in marine science. Her research focuses on using novel antibody-based biosensor technology to measure PAH levels in individual oysters in near real-time. She conducts extensive field work in the Elizabeth River in southeast Virginia, a Chesapeake Bay tributary known for its elevated PAH levels in sediment due to decades of historic contamination. Kristen currently serves in a science advisory role as member of the State of the River and Watershed Action Plan Steering Committee. This committee is tasked with assessing the current health of the Elizabeth River and determining future remediation goals for the watershed– a state-funded effort led by a local non-profit, The Elizabeth River Project. Having grown up in the area, Kristen feels a personal connection to the real-world impact of her research and is excited to have a hand in cleaning up her own backyard. You can contact Kristen Prossner at kmprossner@vims.edu.*

Polycyclic aromatic hydrocarbons (PAHs) are a class of persistent organic pollutants known to have carcinogenic and toxic effects. Important anthropogenic sources of PAHs to the aquatic environment include oil spills and creosote pollution among others. As hydrophobic molecules, PAHs accumulate in sediment; however, a small fraction is freely dissolved in water and available for uptake by organisms. Over time, steady state is reached between phases, and an unknown concentration of PAHs in one phase is proportional to a known concentration in another phase based on the partitioning coefficient for the two phases.

Over the past few decades, the Unger Lab at VIMS has developed a monoclonal antibody using mice that has a strong, yet uniform affinity for 3-5 ring PAH compounds, both parent and alkylated compounds. Coupling our fluorescently tagged antibody with the KinExA Inline Sensor, an instrument with highly sensitive fluorescence detection capabilities, biosensor technology allows us to measure total PAH concentrations in low (1-2mL) volume aqueous samples in near real-time (8 minutes) with a sub-ppb detection limit. Concentrations measured via biosensor strongly correlate to those by established methods such as gas chromatography-mass spectrometry (GC-MS). Additionally, with almost no sample preparation required, analysis via biosensor is inexpensive on a per sample basis. The biosensor can address PAH fate and distribution questions within a fine spatiotemporal scope, beyond the capabilities of most analytical methods currently available. Our lab has explored several different applications of this technology: monitoring run-off during a storm event, guiding contaminated sediment remediation, measuring sediment toxicity, and even using it as an oil detector during a simulated spill event. My research aims to exploit the features of biosensor technology to elucidate PAH partitioning mechanisms within biota and explore its use a rapid quantitative screening tool for PAH-contaminated seafood.



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With limited capacity to metabolize PAHs, bivalves such as oysters are highly sensitive to PAH bioaccumulation during spill events. During such events, rapid turnaround time for accurate, quantitative data on the status of seafood safety is critical for stakeholders. Following the Deepwater Horizon oil spill, slow time-to-data led to extended closures of harvesting areas during which the Gulf of Mexico seafood industry lost billions of dollars. Established screening methods such as sensory analysis (i.e. sniff testing) are non-quantitative and unreliable. More reliable PAH quantification methods such as GC-MS are laborious and expensive. Fast, cost-effective, yet reliable screening methods to measure PAH in seafood are necessary.

To fill this gap in contaminated seafood detection methods, I explored the biosensor's potential to serve as a rapid screening tool. Since the biosensor requires an aqueous sample for analysis, the concentrations measured by biosensor in the aqueous phase of the oyster (i.e. oyster interstitial fluid) needed to somehow translate to PAH concentration in tissue, a more meaningful measurement for potential seafood consumption health risks. Oyster interstitial fluid is defined as the fluid surrounding the soft tissue upon opening of the oyster shell. My hypothesis was that the equilibrium partitioning theory which describes the fate and distribution of contaminants in the environment also explains contaminant distribution within an individual oyster.

To test this, oysters were collected throughout the Elizabeth River, heavily impacted by legacy PAH contamination due to wood treatment and creosote-related industries. In a regression analysis comparing the biosensor-measured concentrations in the oyster interstitial fluid to GC-MS-measured tissue concentrations, a strong positive correlation in the results from these two methods was observed, suggesting that equilibrium partitioning drives PAH distribution in an oyster. The slope of the linear

regression serves as the partition coefficient. Based on the regression-derived partition coefficient and PAH concentration of the oyster interstitial fluid, oyster tissue concentrations can be reliably estimated under the equilibrium partitioning assumption. Calibration of the regression model to different subsets of PAH compounds used in previous seafood consumption advisory guidelines showed that the strong positive correlation still held.

Oyster collection sites in the Elizabeth River were evaluated under previous regulatory limits defined in the advisory guidelines to demonstrate the realistic utility of the biosensor as a screening tool. To further demonstrate the real-world application of this method, rapid data acquisition and low-cost per sample allowed for mapping of oyster concentrations throughout the entire Elizabeth River watershed. A streamlined approach to assess oyster concentrations at a watershed-wide level is highly valuable for oil spill response or guiding future remediation efforts.

For time-sensitive scenarios like oil spill response, the biosensor method shows promise as a tool to rapidly screen for total PAH levels in oysters. Due to low volume requirement and high sensitivity of the biosensor, concentrations in individual oysters were measured–data currently unattainable with GC-MS since composite samples are required for adequate detection limits. The biosensor method establishes a protocol for rapid screening of other important seafood products including other valuable bivalve species. The novel use of equilibrium partitioning to describe PAH distribution within biota advances the application of this theory conventionally used in contaminated sediment evaluations. In cases where rapid data is less important, but cost-effective analyses are required, biosensor technology can serve as tool to triage samples for further analysis as well as determine baseline contaminant levels. The biosensor method has been used in an Elizabeth River watershed-wide survey of PAH in oysters as part of state-funded evaluation of remediation efforts throughout the river–the 2020 State of the Elizabeth River Scorecard. Based on this report, a long-term monitoring program has been established to assess the changes in PAH concentration in oysters on an annual basis.

Currently, I am running laboratory crude oil exposure experiments with oysters to assess the biosensor's ability to operate outside of the steady state regime and track changes in PAH concentration over time, further evaluating its potential to serve as an oil spill detector. I will be giving a platform presentation at the SETAC North America 42nd Annual Meeting on this work. The title of my talk is "Near Real-Time Prediction of PAH Bioaccumulation in Individual Oil Exposed Oysters Using Antibody-Based Biosensor Technology" in the session "Current Advances in Bioaccumulation Assessment and Predictive Tools for Nonionic/Nonpolar Organic Chemicals"

Chesapeake Bay Update

Analysis Reveals that Maryland's Industrial Stormwater Dischargers May Disproportionately Harm Overburdened Communities

Darya Minovi, MPH
Center for Progressive Reform
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The last week of September was Maryland Stormwater Week, when advocates in the state called on the Maryland Department of Environment (MDE) to protect communities from the harms of stormwater pollution. MDE is currently in the process of updating its general permit for discharges of stormwater, which covers approximately 1,200 industrial facilities across the state, including auto salvage yards, metal recyclers, and landfills. The permit aims to limit the type and amount of pollutants that these facilities can discharge into waterways via runoff from rain or snow. This permit does not cover air emissions, therefore regulating stormwater discharges is one of the only tools the state has to control pollution from these types of facilities.

Earlier this year, a group of advocates from the Chesapeake Accountability Project reviewed MDE's proposed revisions to the permit and identified several deficiencies. The full comments can be found here, but one of our major concerns is that the revised permit fails to adequately control contaminants that threaten public health and safety, and does not require permit holders or MDE to comprehensively assess the cumulative impacts of existing environmental and social stressors in affected communities.

Stormwater discharges from industrial polluters contribute heavy metals, organic compounds, and other chemicals to Maryland's waterways. According to the state-federal Chesapeake Bay Program, the Anacostia and Patapsco Rivers are the only two waterways in the 64,000 square mile watershed that are impaired by heavy metals, polychlorinated biphenyls (PCBs), and toxic organic compounds. Mercury has been detected at hazardous levels in freshwater fish of the Chesapeake Bay watershed, particularly in the Potomac and Susquehanna rivers. And the Gunpowder and Bird Rivers continue to have fish consumption advisories due to elevated concentrations of PCBs.

In urban areas where impervious surfaces dominate the landscape, contaminated runoff from rainfall or snowmelt can be particularly harmful to nearby communities. In 2016, for example, stormwater runoff from Baltimore Scrap, a metal recycling facility, was found to have excess levels of heavy metals. And this is to say nothing about the air quality impacts for communities living adjacent to these facilities.

The public health burden of toxic industrial stormwater runoff and other fugitive emissions is not equally distributed. A 2017 report by The Center for Progressive Reform and Environmental Integrity Project's found that many of the industrial facilities covered under the industrial stormwater permit are clustered in and around low-income neighborhoods. This includes areas such as eastern and south Baltimore, northern Anne Arundel County, Prince George's County bordering the District of Columbia, and Salisbury

on the Eastern Shore. These same communities are plagued by a variety of polluting industries, according to EPA data, and are also where most of the state's public drinking water violations occur.

To more comprehensively assess who is impacted by pollution from facilities covered by Maryland's industrial stormwater permit, we used a **statewide environmental justice screening tool** developed by researchers at the Maryland Institute for Applied Environmental Health at the University of Maryland School of Public Health. The tool combines data on 22 environmental pollution and demographic indicators and assigns a cumulative score to each census tract in the state. It ranges 0 to 1, with a higher score representing a greater "environmental justice burden" compared to all tracts in the state. For the purposes of our analysis, and in alignment with other screening tools like CalEnviroScreen, we classified census tracts in the top quartile (score greater than 0.75) as "overburdened."

Our analysis focuses on Baltimore City and County, where a large concentration of permit holders are located. Of the 300 facilities in our assessment, we found that 41 percent are in overburdened tracts, meaning they have a cumulative environmental justice score greater than at least three-quarters of census tracts in the state. More than 100,000 Marylanders live in these tracts. The percentage is even higher in Baltimore City, where nearly 70% of facilities are in overburdened tracts.

We also found that facilities are clustered in low-income communities of color. For example, there were two tracts in Baltimore City – among the most overburdened in the state – that **each** have 24 industrial stormwater permit holders. One of these tracts, which encompasses parts of Curtis Bay (approximately 4,200 residents) has two facilities – Curtis Bay Energy and Quarantine Road Municipal Landfill – that are on record for failing to comply with their permits multiple times.

Notably, we found that the census tracts with the greatest number of facilities were the same tracts where permit violations most frequently occurred. Permit violations can include not adequately controlling or monitoring emissions. To add insult to injury, violators aren't under a great deal of pressure to clean up their acts. Of the nearly 2,000 facility inspections between 2017 to 2020, the MDE took formal enforcement actions against **only six** permit holders.

Our analysis reveals that industrial stormwater discharges are disproportionately concentrated in communities already burdened by other environmental and social stressors, and the resulting impacts are only made worse by lack of compliance with permits and poor enforcement by MDE. Furthermore, heavy rains and flooding driven by climate change will exacerbate these effects over time.

The Chesapeake Accountability Project and many other advocates are working to strengthen MDE's stormwater pollution controls, particularly in the face of worsening climate impacts. You can help us by urging MDE to stand up for polluted runoff protections for the health of all Marylanders and our waterways. Sign the petition and help us spread the word.

Improving Inclusion and Diversity: Be an Ally

Jennifer Flippin

Our chapter is committed to the acknowledgement of past and present inequalities for members of underrepresented or marginalized groups and aspires to move forward in a manner that improves inclusion and diversity. Earlier this year, CPRC joined with the SETAC North America Inclusive Diversity Committee to formally commit to this effort.

The SETAC World Council poignantly notes that *There is no magic policy or quick fix to the deep systemic issues that so many environmental professionals have faced in the field, their schools, labs and institutions, at meetings, and in their efforts to be published, recognized for their achievements and invited to contribute their expertise.* Dialogue around these topics can be uncomfortable, frustrating, and overwhelming for both the individuals experiencing inequality and people in a majority group who are unable to recognize and perhaps unwilling to acknowledge the issue. Overall, it can be difficult to find a place to start or understand how you can make a difference.

The key is to start. Start small in your office, classroom, organization, or event. Everyone can develop a practice of being an ally. And calling it a *practice* is deliberate word choice because dissolving deep systemic issues takes constant work and the recognition that we will not always get it right on the first try. The more we engage and learn, the better we can rapidly adapt our strategies, and help to empower those around us.

An ally is any person who empowers, stands up for, or otherwise supports an individual or group of underrepresented people. Members of an underrepresented group can also be allies to people in different underrepresented groups. Thus, there is in an opportunity for anyone to recognize a situation where they have power and use it for the good of another person who does not have the same privilege. Below are some ideas to kick start your work as an ally, but we encourage you to do your own research as this list is not comprehensive.

- **Educate yourself.** Seek reputable information that helps you understand the history, current status, and experiences of underrepresented groups. Remember that inequality is not merely an abstract concept that is occurring somewhere else. Whether intentional or not, biases are almost certainly lurking in your own organization and affecting people you know.
- **Listen.** Believe people when they talk about their experiences with inequitable treatment. Listen and ask questions when someone speaks about an experience, and remember that it is probably not the right time for you to share your story. Do not automatically assume that inequality does not occur just because you cannot personally relate to a situation. Pay close attention when co-workers from an underrepresent group talk about their experience in your organization.
- **Amplify.** Give credit where credit is due. Invite members of underrepresented groups to directly present their work in high-visibility situations like staff meetings, work groups, conferences, and

newsletters. Repeat good ideas giving credit to the appropriate person and encourage them to be the center of the conversation.

- **Advocate.** Look at invitation lists for meetings, strategic events, and networking opportunities, and speak up when you identify members of underrepresented groups who should have been invited. Share high profile opportunities with underrepresented individuals. There is always space for one more co-author/collaborator or time for one more introduction to an influential colleague in your network. Point out expertise you see in other people and recommend them for learning opportunities, promotions, increased pay, and engaging assignments.
- **Stand up and speak up.** Call attention to behavior or communication that is offensive, dismissive, abusive, or unwelcome, and speak up for the people who are not there. Call out jokes that make light of an underrepresented group and let people know that their humor is not funny or acceptable. Clearly state your stance and expectations for the culture of your organization. If you witness someone being subjected to unprofessional conduct, step in and redirect the conversation and determine if further action is needed.
- **Be patient with one another.** Improving inclusion and diversity is an ongoing process, and even well-intentioned words or actions will miss the intended mark sometimes. Learn from mistakes, accept criticism, and move forward with better knowledge. No one person is completely responsible or able to fix this complex issue. Encourage others to find ways to be an ally and embrace principles that improve diversity, equity, and inclusion.

Our Inclusive Diversity Committee is currently part of our Membership Committee and we are excited to welcome volunteers and suggestions for how we can improve our chapter! For more information, please reach out to CPRC Inclusive Diversity Representative Jennifer Flippin (jennifer_flippin@nps.gov) or Membership Committee Chair Nathan Sell (treasurer.cprc.setac@gmail.com).

Tune in to a conversation on diversity inclusion at SETAC SciCon4

Career Corner

Toxicology opportunities at the Army Public Health Center

The U.S. Army Public Health Center is a matrixed organization founded and dedicated to ensuring the health of people, communities, animals and the environment located at Aberdeen Proving Ground, Maryland. Our mission is to enhance Army readiness by identifying and assessing current and emerging health threats, developing and communicating public health solutions, and assuring the quality and effectiveness of the Army's Public Health Enterprise. The Toxicology Directorate, in collaboration with a host of DoD, government, private, and international entities, provides data about the toxicity of military-unique and military-relevant compounds and the risks they pose to Soldiers, civilians and the environment. The Toxicology Directorate is looking for candidates to join their workforce in several positions to include Biologist/Toxicologist (GS-11-13), Biological Technician (GS-7-8), and Veterinary Histopathogist (GS-13-14). Those interested in any of those career tracks are welcomed to contact Dr. Michael Quinn at michael.j.quinn104.civ@mail.mil or call at 410-404-7705. More information on APHC and the Toxicology Directorate can be found at: https://phc.amedd.army.mil/Pages/default.aspx

Environmental Cleanup Project Manager (Natural Resource Specialist 3) at Oregon DEQ

Application Deadline: 11/29/2021

For additional information on this opportunity, please visit:
https://oregon.wd5.myworkdayjobs.com/en-US/SOR_External_Career_Site/job/Portland--DEQ--Multnomah-Street/Environmental-Cleanup-Project-Manager--Natural-Resource-Specialist-3_REQ-79504

Please visit the CPRC SETAC website to keep updated with latest job postings:

https://cprcsetac.wordpress.com/job-opportunities/

Summer Fun

CPRC SETAC Secretary, James Sanders, teaching his son how to sling rocks at Sligo Creek, MD (Contributed by James Sanders)

Summer Fun

Top left: Sunflower Field in Jarrettsville, MD

Top and bottom right: Maryland State Fair, Timonium, MD
(Contributed by Mandar Bokare, picture credits: Christen Hooks)

Summer Fun

CPRC President, Nathalie Lombard, shares highlights of her bike trip through the Great Allegheny Passage (Contributed by Nathalie Lombard)

Unusual Pandemic Pets: Toads

Michael J. Quinn

I know many people who adopted or purchased pets during the beginning of the pandemic. Pet shelters were emptying as house-bound people sought animal companionship to help get them through the uncertainty and monotony of the "new normal" - and my family of four was no different. We had just rescued a deaf and half-blind Louisiana Catahoula leopard dog, Pineapple, right around Thanksgiving of 2019. With our 19 year old terrier mix passing on early in Spring of 2020, we felt that it might be a good idea to get another dog to help Pineapple adjust and maybe help act as a guide-dog to assist with her diminished senses. We found one about 2 months into the pandemic – another Catahoula that we broke our "P"-food naming streak (Pineapple, Pickles, Punkin' Pie with by naming him Charlie. Charlie had one of those 'broken glass' eyes – brown with bright streaks of blue bursting from the pupil. We were drawn to him because his eyes look very similar to my oldest daughter's heterochromia, where one eye is dark brown and the other is bright blue. And although he is still a 75 pound bull in a China shop, he does make a great guide dog for Pineapple. She keeps her one good eye on him at all times and takes cues from him constantly. And then our adventure with birds began. This story is about toads, so I'll spare you the details of how we got seven parakeets in the short order of about two and a half months. I also won't bother to name them for you because I'm sure I can remember only (maybe) five of the seven?? Much like Star Trek's hive mind of the Borg, I see our birds more as a collective flock than individuals. So you still might be wondering, where do the toads fit in?

In between all of the adapting to telework life, searching for toilet paper, teaching older family members how to use Zoom, Face-Time, and Teams (and learning how to do it all ourselves), a new project that sought to improve the understanding of the bioavailability, bioaccumulation, and biomagnification of PFAS got funded. This is where the toads come into the story. Although I've worked with finches to falcons, shrews to salamanders, rabbits to rats (I'm running out of alliterative examples here), I've never used toads in any of my studies before. So why start now? We partnered with the U.S. Army Combat Capabilities Development Command who have a long history with invertebrate work. They wanted to see how PFAS would transfer from worms grown in contaminated soil to the next trophic level. And when I tried to figure out what would eat worms but be relatively manageable in a lab setting, toads seemed like the clear winner.

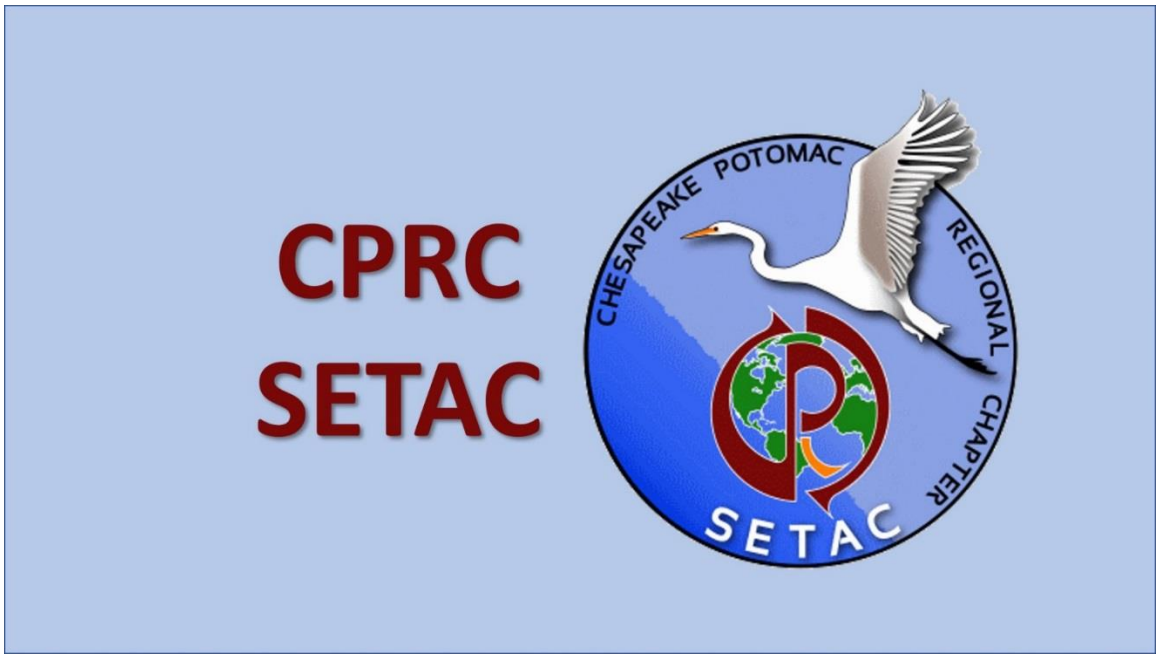
But with labs being closed, as many of you have likely experienced, work was getting delayed. Before we ever got to the point of beginning the study, veterinary and animal care staff would need to establish husbandry protocols for this new species. They couldn't readily do that in the Spring and Summer of 2020, but I thought, maybe I could. At the same time, I was also scouring the internet to find educational games and opportunities to keep my girls' brains stimulated as the onset of homeschooling began to show its true potential. Heck, I thought – I have a whole animal care staff in my house. Sure, they're (very) junior level technicians (4 and 7 years old at the time) and have a lot to learn, but maybe if they learn enough, they could help inform our institution's senior staff about the proper care and maintenance of the American toad.

So, after a quick call to Carolina Biological, three toads arrived at our house in a week and a half. Back at the lab, I figured that we would use mouse cages as housing during the study, but mouse cages were lacking at Casa de Quinn. A quick masked trip to the local Walmart produced three small plastic storage boxes. With some easy drill work, the tops were adequately perforated in no time. Some mulch was borrowed from our gardens as substrate, and three petri dishes served as a place for the toads to soak and drink. But what to feed them? Online resources said they liked crickets. Pet stores in our area had a ton of them, but my daughters loved digging up grubs and searching the thick grass for their own crickets. My animal care staff made sure they had plenty of invertebrates, kept the petri dishes clean, and nailed down animal handling techniques that any member of our Center's animal care staff could follow.

For the study back at the lab, we decided that we would have to orally gavage the toads with an earthworm homogenate to ensure consistent dosing among individuals. DEVCOM would be supplying us with the earthworm species *Eisenia fetida*. The specific name of this worm means "foul-smelling," and when handled roughly, it exudes a pungent liquid that is presumably an antipredator adaptation. We weren't sure how palatable the earthworm mixture would be for our toads, so my stay at home staff and I had a new dosing Standard Operating Procedure to develop. I picked up a sample of *E. fetida* from DEVCOM a few days later and worked on our oral exposure methods. With someone holding the toad firmly, their mouths were fairly easy to open with the thin, yet not sharp, end of a nail trimmer. We started with placing a small segment of worm in back of a toad's tongue. A swallow reflex was triggered, and the section of worm disappeared down the amphibian's throat. We monitored each individual every five minutes following the oral dosing, then every half-hour, then hourly. We dosed of all of the toads again successfully for the following two days, and declared our mini-experiment in methodology a success!

Currently, it is September 2021, and we are a few weeks away from the start of the actual study. We added toads to our Center's training protocol and (thankfully) found the husbandry and oral exposure methods my tiny crew developed last year to be adaptable to our facility. The methods we worked on during the Summer of 2020 might not be *ET&C*-worthy, but it gave me a chance to show my kids a little about what I do for work, gave them a chance for some hands-on learning during a time when most of their education was done remotely, and made for some special memories during what was otherwise a confusing, and somewhat stressful time.

CPRC Face Masks



Clockwise from top left: Scott Lynn, Jada Damond, Nathalie Lombard and James Laurenson with CPRC SETAC Face masks!

CPRC SETAC Membership

SETAC: The Society of Environmental Toxicology and Chemistry is an independent, nonprofit professional society that provides a forum for individuals and institutions engaged in the study of environmental issues, management and conservation of natural resources, environmental education, and environmental research and development.

CPRC: The Chesapeake and Potomac Regional Chapter of SETAC is a non-profit organization started in the year 1983. CPRC's mission is to promote the exchange of information among environmental scientists in the Mid-Atlantic States.

Note: you do not have to be a SETAC member to be a member of CPRC.

There are three ways to join/renew:

1) Preferred Method: SETAC North America (SNA) (**LINK**). SNA will send us your contact information so we can add you to our chapter mailing list. You do not have to be an SNA member to use this option.

2) PayPal CPRC (**LINK**): Credit cards accepted, no PayPal account needed. Enter appropriate fee amount ($5 student, $15 professional). Please note that it is easier for us to track your membership when you join via the SNA site (option1 above).

3) Snail Mail: Check and money orders accepted. Please include your name, affiliation and address with your payment.

SETAC-CPRC P.O. Box 2728

Brooklyn, MD 21225

Attn: Meredith Bohannon, Treasurer

Membership renewals occur every December. If you have any difficulty with your membership application or payment, please contact Meredith Bohannon (treasurer.cprc.setac@gmail.com).

CPRC SETAC Sponsorship Opportunities

STEP THREE: PAYMENT INFORMATION

Please submit a completed copy of this form and a check (payable to "CPRC SETAC") to the following address:

CPRC SETAC Treasurer
PO Box 2728
Brooklyn, MD 21225
Attn: Meredith Bohannon

If you have any difficulty with your sponsorship payment, or have any questions, please contact CPRC Treasurer Meredith Bohannon (treasurer.cprc.setac@gmail.com) or (cprc.setac@gmail.com).

CPRC SETAC Sponsorship Form

ADDITIONAL SPONSORSHIP BENEFITS BY TIER[A]

Benefit	Primary Producer ($250/year) [A]	Secondary Producer ($500/year) [A]	Keystone Sponsor ($1000+/year) [A]
Complimentary Spring Meeting Registration(s)[B]		1	2
Table and poster display space at a CPRC annual meeting (if requested)			✓
Logo appears in CPRC newsletter and meeting documents. Logo and link posted on CPRC website[C]	2 years[C]	3 years[C]	5 years[C]
Advertising in newsletter	Half Page	Full Page	Full Page
Advertising in Spring Meeting Program		Half Page	Full Page

[A] Sponsorship Tier is determined by the total amount given on an annual basis from **STEP TWO**.

[B] Complimentary Spring Meeting Registrations are granted on an annual basis according to the sponsorship tier with the recommendation that they are to be used within a year.

[C] Length of time during which the logo appears in the newsletter, meeting documents, and website is a benefit only and does NOT represent a commitment to provide sponsorship money on an annual basis.

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- Senior-level Ecological Risk Assessor
- Junior- and Mid-level Ecological Risk Assessors
- Mid-, Senior-, and Principal-level Engineers
- Mid- and Senior-level Geologists
- Mid-, Senior-, and Principal-level Hydrogeologists

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Every day, our staff is involved in a diverse range of projects for a variety of clients—applying skills and making recommendations th lead to positive change.

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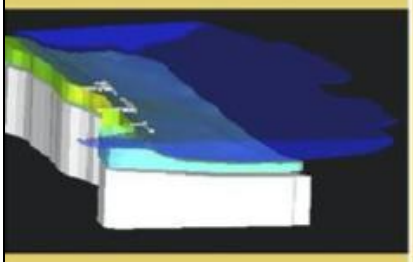

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