The 19th Annual Environmental Chemistry and Microbiology Student Symposium

April 8th – 9th, 2016

The Pennsylvania State University

University Park, PA

The 19th Annual Environmental Chemistry and Microbiology Student Symposium (ECMSS) at the Pennsylvania State University is proudly presented by the Student Association of Environmental Science and Enigeering (SAEAE), and is supported by the Penn State Institutes of Energy and the Environment (PSIEE), Environment and Natural Resources Institute (ENRI), the Engineering Energy and Environment Institute (E^3I), and Materials Research Institute (MRI). SAESE is also grateful for the support of various departments across campus.

Cover Photo: Coastal Erosion. Providencia is a little-known island in the western Caribbean. Although its coasts are protected against waves erosion by one of the largest coral reefs in the Americas, fluvial erosion is still a process reshaping the landscape in a gradual process that takes over the coastline retreat. In this high exposure photography, eroded volcanic rocks are depicted immersed in the water always in motion.

Hannier Pulido, First Place Photo Contest Winner

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Welcome

The organizing committee of the 2016 Environmental Chemistry and Microbiology Student Symposium (ECMSS) welcomes to Penn State's main campus in University Park, PA. ECMSS, now in its 19th year, is a long standing tradition at Penn State that brings together graduate and undergraduate students, post-doctoral researchers, and faculty members engaged in environmentally relevant research. The Student Association of Environmental Science and Engineering (SAESE) organizes ECMSS, with an interdisciplinary graduate student committee whose members have worked to provide a unique, enriching opportunity to the environmental science and engineering community at and around Penn State.

This year, the ECMSS organizing committee is honored to host three keynote speakers, including Dr. Marc Edwards (Virginia Tech), Dr. Paula Mouser (Ohio State University), and Dr. John Kelmelis (The Pennsylvania State University). Additionally, we are proudly hosting over 50 student presenters from Penn State as well as several regional universities. Our Penn State participants include students from the Departments of Ecosystem Science and Management, Plant Pathology and Environmental Microbiology, and Animal Science in the College of Agricultural Sciences; the Departments of Meteorology, Geosciences, and Materials Science and Engineering in the College of Earth and Mineral Sciences; the Departments of Agricultural and Biological Engineering, Civil and Environmental Engineering, and Chemical Engineering in the College of Engineering; the Departments of Chemistry, Biochemistry and Molecular Biology, and Biology in the Eberly College of Science. We are also pleased to welcome students from Cornell University, Susquehanna University and Duquesne University.

The ECMSS organizing committee has spent months preparing for this year's event, which would not be possible without the generous support of our sponsors. We would like to recognize and thank the Penn State Institutes of Energy and the Environment (PSIEE), the Environment and Natural Resources Institute (ENRI), the Engineering Energy and Environment Institute (E^3I) of the College of Engineering, the Graduate and Professional Student Association (GPSA), and the University Park Allocation Committee (UPAC). Funding for monetary awards was generously donated by the Departments of Civil and Environmental Engineering, Plant Science, Plant Pathology & Environmental Microbiology, Chemistry, Geosciences, and Ecosystem Science & Management.

We thank you for joining us for this year's ECMSS, and encourage you to enjoy the keynote addresses as well as the student poster and oral presentation sessions. Additionally, we hope you will take the opportunity to forge new connections and gain new insights into other disciplines by communicating with your fellow environmental scientists and engineers. We appreciate your participation this year, and invite you to continue to be a part of the Environmental Chemistry and Microbiology Student Symposium for years to come.

Regards,

The 2016 ECMSS Graduate Student Organizing Committee

The 19th Annual ECMSS Keynote Speakers

Dr. Paula Mouser

Assistant Professor of Civil, Environment and Geodetic Engineering,
Ohio State University

Keynote Address: Friday 4:00 pm

Biography

Paula Mouser is an Assistant Professor at The Ohio State University in the Department of Civil, Environmental and Geodetic Engineering. Dr. Mouser obtained a B.S. degree in Environmental Engineering from Utah State University, after which she worked for the City of Logan in the Permits and Compliance Division. Dr. Mouser went on to obtain her M.S. and Ph.D. from the University of Vermont, where she studied under Prof. Donna Rizzo. Currently, Dr. Mouser specializes in biotechnology, as applied to microbial-environmental interactions in the sub-surface. Notably, the Mouser lab studies the microbial degradation of hydraulic fracturing fluids

Diving into Deep Shale – Microbial Travels and Persistence in the Hydraulic Fracturing Ecosystem

Microorganisms have the potential to influence energy recovery from unconventional shale formations, yet little is known of their functional diversity in this engineered system. Methanogenic populations, for example, can enhance the total volume of recovered hydrocarbons through the production of biogenic methane within the formation. Conversely, other microorganisms may degrade used additives, lowering the chemical's efficacy in situ, and consequently producing agents that foul the formation or corrode installed equipment. This talk presents new molecular information supporting the presence of microorganisms indigenous to pristine shale before it is tapped for natural gas. Metagenomic data is then used to characterize the trajectory of microbial communities through time in samples produced from shale wells after hydraulic fracturing. Finally, HPLC-high-resolution mass spectrometry and 1H NMR in conjunction with gene information from isolate genomes and reconstructed metagenomes are used to confirm metabolic pathways for in situ compound degradation, providing new insight into why certain taxa persist in these engineered systems, with important implications for the industry.

Photo Credit: http;//ceg.osu.edu/

Dr. Marc Edwards

Charles P. Lunsford Professor of Environmental and Water Resources Engineering, Virginia Tech

Keynote Address: Saturday 11:40 am

Biography

Marc Edwards is the Charles P. Lunsford Professor of Civil and Environmental Engineering at Virginia Tech. With M.S. and Ph.D. degrees from the University of Washington, he has been part of the Environmental and Water Resources Engineering group at VT since 1997. Dr. Edwards has worked extensively in the field of corrosion in pipes, improving the safety of drinking water in Washington DC and exposing deficiencies in the water distribution system. He is an expert in applied aquatic chemistry, specializing in water quality research. Recently, Dr. Edwards and his team investigated the lead levels in drinking water in Flint, Michigan, where an emergency has been declared due to lead poisoning.

How Jonathan Baldwin Turner Saved Flint, Mich.: Public-inspired Science and the Modern Land-Grant University

Jonathan Baldwin Turner lost the academic job he loved, because his anti-slavery and anti-predestination views, offended large donors to his university employer. His friends abandoned him, and his farm was burned. Undeterred, Mr. Turner then launched a 12 year crusade to form a "people's University," that culminated in the Morrill Act, which led to the founding of the land grant college system which successfully met the academic needs of the industrial class. Our relief effort to save Flint MI, partly drew on the strength and courage of Mr. Turner's life story--in the process we (re)discovered the power of public inspired science.

Photo Credit: Marc Edwards

Dr. John Kelmelis
Professor of International Affairs,
Pennsylvania State University

Keynote Address: Saturday 4:15 pm

Biography

Professor John A. Kelmelis joined the School of International Affairs faculty in September 2008 as a scholar of national and international geography. He brings to Penn State more than thirty years of distinguished government service and leadership, during which time he has provided scientific advice on U.S. foreign policy, regional resource management, disaster response, and information infrastructure.

Five Things You Should Know about Science and Policy

Scientific information moves through our society in complex ways and it often does not have the impact on policy that scientists might expect. There are a number of reasons for this. Here we will look at five issues related to science and policy. First, what is that route? Does the mere fact that scientific information travels affect its acceptance? Then I will discuss some of the things that affect the general public's view of scientific information and how that has changed over time. Third, I ask what are some differences between the scientific and policy cultures? What are the goals and the reward structures for the scientific community and the policy community? What are the differences and do they make a difference? Those are important to the acceptance of scientific information both in the policy realm and by the general public. Fourth, interpretation of the same information varies from place to place and by a socio economic considerations. This, in-turn, feeds back across societal lines to increase the haze of acceptance. Finally, we will ask the question of whether it is possible to help facts travel well, that is, with integrity and fruitfully.

Photo Credit: http://www.sia.psu.edu/

Symposium Itinerary

Friday, April 8th

2:00 – 4:00 pm Registration, Presentation Upload, & Poster Setup

4:00 – 5:00 pm Opening Keynote Address: **Dr. Paula Mouser**

"Diving into Deep Shale – Microbial Travels and Persistence in the Hydraulic Fracturing Ecosystem"

5:00 – 6:15 pm Oral Presentations, Session I

Time slot	Presenter	Title
5:00 – 5:15	Christopher Smyth	Sink Drains to Sea Turtle Eggs: Unraveling the Ecology and Epidemiology of Infectious *Fusaria* in Humans and Animals
5:15 – 5:30	Jessie Larios-Valencia	CysB-regulated Genes of *Vibrio fischeri* are Heterogeneously Expressed within the Squid Light Organ
5:30 – 5:45	Freddy Magdama	The Importance of Endophytes in Developing Molecular Detection Methods: The Case for Race 4 of *Fusarium oxysporum f. sp. Cubense* Causing Panama Disease on Bananas
5:45 – 6:00	Maliheh Safari	Evolution of a Persistent Virus in Different Pepper Cultivars
6:00 – 6:15	Rebecca Johnson	Use of a Transgenic Virus to Modulate microRNA and Protein Levels in the Malaria Vector *Anopheles gambiae*

6:15 – 7:15 pm Poster Presentation Session I (with catered dinner)

Saturday, April 9th

8:00 – 9:00 am Registration (Catered Breakfast)

9:00 – 9:10 am Opening Remarks

9:10 – 10:10 am Poster Presentations, Session II

10:10 – 11:30 am Oral Presentations: Session II

Time slot	Presenter	Title
10:10 – 10:25	Alison Franklin	Water Conservation through Wastewater Reuse at Penn State's Living Filter: Are We Eating and Drinking our Prescription Drugs?
10:25 – 10:40	Kyra Murrell	GCxGC-TOFMS Comparison of Extraction Techniques for the Determination of Emerging Contaminants in Wastewater
10:40 – 10:55	Garrett Morrison	Detection of Volatile Organic Compounds Associated with *Trichoderma aggressivum* Infestation within *Agaricus bisporus* Compost Substrate
10:55 – 11:10	Emma Clement	Feasible Mixing Times for a Water-purifying *Moringa Oleifera* – Functionalized Sand (*f-sand*) Filter
11:10 – 11:25	Michael Shreve	Removal of Trace Organic Contaminants in Six Full-scale Integrated Fixed-film Activated Sludge (IFAS) Wastewater Treatment Plants

11:30 – 11:40 am Break

11:40 – 12:40 pm Featured Keynote Address: **Dr. Marc Edwards**

"How Jonathan Baldwin Turner Saved Flint, Mich.: Public-inspired Science and the Modern Land-Grant University"

12:40 – 1:20 pm Catered Lunch

1:20 – 2:40 pm Oral Presentations, Session III

Time slot	Presenter	Title
1:20 – 1:35	Ozgul Calicioglu	Improvement of Bioenergy Yields Obtained from Duckweed by Sequential Ethanol Fermentation and Anaerobic Digestion
1:35 – 1:50	Andrew Heon	Abiotic Analysis of Gas Diffusion and Aqueous Cathodes for Microbial Electrolysis Cells
1:50 – 2:05	Wulin Yang	Immobilization of Fe-N-C Co-catalyst on Activated Carbon with Enhanced Cathode Performance in Microbial Fuel Cells
2:05 – 2:20	Yaoli Ye	Wastewater Treatment Using a Novel Aerated and Fluidized Bed Membrane Bioreactor
2:20 – 2:35	Mohammad Rahimi	Copper Removal from Wastewater Using Thermally Regenerative Electrodeposition Battery

2:40 – 2:50 pm Break

2:50 – 3:55 pm Oral Presentations Session IV

Time slot	Presenter	Title
2:50 – 3:05	Gulten Izmirilioglu	Optimization of Growth Conditions for Simultaneous Saccharification and Fermentation of Ethanol by *Aspergillus niger* and *Saccharomyces cerevisiae* in Biofilm Reactors
3:05 – 3:20	Hang Wen	Understanding the Dependence of Magnesite Dissolution Rates on Spatial Heterogeneity
3:20 – 3:35	Xin Gu	How Tree Roots Affect Shale Weathering at Shale Hills CZO
3:35 – 3:50	Allison Karp	Grassland Expansion in the Miocene: A Fire Biomarker Comparison between Two Records of Ecological Change

3:55 – 4:10 pm Coffee Break

4:15 – 5:15 pm Closing Keynote Address: **Dr. John Kelmelis**

"Five Things You Should Know about Science and Policy"

5:15 – 5:45 pm Awards Ceremony and Concluding Remarks

5:45 – 6:00 pm Poster Removal

Overview of Poster Presentations

Poster Session I (Friday 6:30-7:30 pm)		
Poster #	**Presenter**	**Presentation Title**
1	Flor Acevedo	Beyond Strengthening the Leaf Surface – Silicon Enhances Herbivore-induced Plant Defense Responses
2	Moses Ajemigbitse	A Novel Process for Reclaiming Marketable Raw Materials from Hydraulic Fracturing Wastes
3	Anita Behari	Stopping the Cereal Killer: Exploring Biological Control to Mitigate *Fusarium* Head Blight of Wheat
4	Juan Callejas	Electrocatalytic and Photocatalytic Hydrogen Evolution Using Iron Phosphide Nanoparticles
5	Luis Castillo	Impact of Shale Gas Wastewater Disposal on Conemaugh River Lake Sediments
6	Weile Chen	Identity of Host Tree Species May Not Control the Community Composition of Ecto- and Arbuscular Mycorrhizal Fungi
7	Sarah Cronk	Role of Iron Minerals in Preserving Organic Carbon during Aerobic Degradation
8	Dinakaran Elango	Improving Anthracnose Disease Resistance through Phytoalexins in Sorghum (*Sorghum bicolor* (L.) Moench)by Genome Wide Association Studies
9	Carly Hawkins	New Antibiotic Development: Cloning and Expression of Novel Mannose-binding Lectin from Rainforest Soil
10	Jennifer Estrada	Effect of Brine Evolution on Ca-isotope Composition in the Salar de Atacama, N. Chile
11	Alexandra Everhart	Data Analysis of Emerging Contaminants in Surface Runoff
12	Carlos Fernandez Pulido	Using *Lemna minor* (duckweed) Grown in Contaminated Waters as a Sustainable Soil Amendment: Recycling Nutrients to Reduce Environmental Pollution and Grow Food Sustainably
13	Melissa Finley	Examining the Relationship of Nutritional Auxotrophy and Pathogenicity in *Erwinia amylovora* via Tn5 Mutagenesis
14	Alison Franklin	Presence of Three Antibiotics in Wheat Plants and Groundwater at the Living Filter: A Water Reuse Site
15	Maridel Fredericksen	New Insights into a Behavior-controlling Fungus
16	Emily Grandinette and Andrew Murtha	Characterization of Novel Symbiotic *Vibrio fischeri* Strains EMG003 and ANM004
17	Rob Harvey	Assessment of *Calonectria pseudonaviculata* Microsclerotia Survival in Compost over Varying times and Temperatures
18	Gulten Izmirlioglu	Ethanol Fermentation by *Saccharomyces cerevisiae* from Potato Waste Hydrolysate in Biofilm Reactors

Poster Session II (Saturday 9:10 – 10:10 am)		
Poster #	**Presenter**	**Title**
1	Elnaz Kermani	Simulation of Seepage through Porous Media Using Smoothed Particle Hydrodynamics Method
2	Faith Kibuye	Impact of Land Use and Drinking Water Treatment Processes on the Occurrence of Pharmeceuticals and Personal Care Products (PPCPs) in the Susquehanna River Basin
3	Shelby Lyons	Ocean Redox Change during the Paleocene-Eocene Thermal Maximum: Insight from Organic Geochemical Proxies
4	Aleia Mouchref and Emma Schwendeman	Analysis of Novel *V. fischeri* Strains ABM004 and EBS004
5	Aria Parangi	Detection of Pb(II) in Aqueous Samples Using a Turn-on Ratiometric Chemosensor Coupled with a Hand-held Portable Fluorometer
6	Shane Pusey	Taxonomic Description of *Fusarium solani* Species Complex Phylogenetic Species 12 (FSSC 12), A Fungal Pathogen of Marine Animals
7	Benjamin Roman	Maximizing the Yield of High-protein Duckweed Grown on Domestic Wastewater for Beneficial Reuse as Aquaponics Feedstock
8	Jacob Romeiser	*Beauveria bassiana* Biopesticide Sporulation and Bed Bug Mortality on Tapes and Adhesive-bound Textiles
9	Shelia Saia	Factors Influencing Phosphorous Cycling in Biogeochemical 'Hot Spots'
10	Kevin Smeltz	Genetic Characterization of Bacterial Canker in Tomato
11	Caroline Steingard	Investigation of Polyclonal *Vibrio fischeri* Infections within the Squid Light Organ
12	Sydney Stewart	Determining Redox Properties of Fe(II) and Geothite to Predict Reactivity with Environmental Contaminants
13	Miranda Stockton	Potential Role of Polyphosphate-accumulating Organisms in Regulating Phosphorus Mobility in Sand Environments Subject to Aerobic/anaerobic Cycles
14	Hunter Swisher	Exploring the Potential Mycorrhizal Interaction between *Morchella* and Associated tree Species in Central Pennsylvania
15	Xiaoyu Wang	iTRAQ-based Quantitative Proteomic Analysis Reveals New Metabolic Pathways Responding to Chilling Stress in Maize Seedlings
16	Allena Wilson	Field Measurements of Wet and Dry Deposition
17	Boya Xiong	The Impact of Slickwater Fracturing Fluid Composition and Shale Interactions on Membrane Fouling of Flowback Water
18	Juanli Zhu	Land Use and Hydrologic Drivers of Atrazine Presence in Drinking Water Sources

Poster Abstracts

Photo Description: Steam rising from natural hot springs in Yellowstone National Park, one of the most geothermally active locations in the world.

Sydney Stewart, Second Place Photo Contest Winner

Beyond Strengthening the Leaf Surface - Silicon Enhances Herbivore-induced Plant Defense Responses

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Abstract:

Insect herbivory induces the production of defensive plant compounds that can poison or reduce the growth of their attackers. Previous studies have shown that plants supplemented with silicon (Si) have increased tolerance to both abiotic and biotic stresses including herbivores. This tolerance has been mainly associated with the accumulation of Si bodies in plant tissues, but the effect of Si on other plant resistant mechanisms has been explored in only a few systems. This study tested the effect of Si supplementation on herbivore-induced defense responses in tomato and corn plants. Si-supplemented plants and their respective controls (without Si) were exposed to herbivory by the fall armyworm (FAW) larvae Spodoptera frugiperda. The plant defense response was tested by counting the density of trichomes and by measuring the activity of two defensive proteins, polyphenol oxidase (PPO) and trypsin proteinase inhibitor (trypsin PI). Our results show that tomato plants supplemented with Si had higher number of glandular trichomes and higher PPO activity when fed upon by the FAW larvae compared with non-supplemented controls. In corn, Si-treated plants also had higher activity of trypsin PI upon FAW feeding but the density of trichomes did not change. We conclude that Si boosts defenses upon insect herbivory in both Si-accumulators and non Si-accumulator plants. Si supplementation may be a promising practice to reduce the use of pesticides in agricultural systems. This research was funded by the Northeast Sustainable Agriculture, Research and Education program (NESARE).

A Novel Process for Reclaiming Marketable Raw Materials from Hydraulic Fracturing Wastes

Ajemigbitse Moses[a*] and **Fred Cannon[a]**
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Abstract:

The handling and treatment of hydraulic fracturing (fracking) waste is a challenging problem**.** Much of the research is focused on surface water effects, organic transformation and treatment. Little research is being carried out on reclamation of raw materials, such as sand and clay, found in the waste. Sand plays a prominent role in the fracking process and fractures can require as much as 200,000 lbs. of sand. Clay is also an important component of the drilling process. The sand and clay are therefore valuable resources that should be of interest for conservation and management. This project potentially offers in a new direction for solid waste management on two fronts: reducing what goes to landfill while recovering raw material and reducing associated costs with generating new material.This research puts forward a novel approach to reclaiming sand and clay from fracking waste using hydroacoustic cavitation and advanced oxidation (HAC-AO). As an outcome, we are investigating the treatment of the wastewater for radium removal using the recovered clay to create a radium free brine. We also are investigating the reuse of the recovered clay as clay source for drilling mud in lieu of fresh/new bentonite clay. We hypothesize that HAC-AO can do this in three ways: i) HAC-AO separates and discretizes fine material (clay mineral) from large grain material (sand), ii) HAC-AO increases the cation exchange capacity of the clay minerals (activates the clay), and iii) the activated clay minerals can be used to treat the brine for the removal of radium.

Stopping the Cereal Killer: Exploring Biological Control to Mitigate *Fusarium* Head Blight of Wheat

Behari, Anita[a] and **Gretchen Kuldau**[a*]

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Abstract:

Fusarium head blight (FHB) of wheat is a devastating fungal disease impacting wheat production globally. Exacerbating the impact of disease is the *in planta* production of the toxic fungal secondary metabolite, deoxynivalenol (DON). DON is an inhibitor of the eukaryotic ribosome thereby blocking protein translation, and in toxicological studies has been found to affect the gastrointestinal, immune, and endocrine systems of humans and animals. Preventing DON accumulation in grain ultimately begins with preventing infection by FHB causing *Fusarium* species. Current mitigation strategies to combat FHB include the use of fungicides, moderately resistant varieties of wheat, and crop rotations, but even in conjunction these strategies provide only minimal to moderate control when environmental conditions are conducive to disease. This research aims to identify and characterize biological control agents for mitigation of FHB through screening samples from different production systems and geographic locations for *Fusarium graminearum* inhibiting and DON degrading microbes. Exploring multiple sources including various soils, plant material, silage, and haylage will allow for a diverse range of microbes exhibiting these capabilities to be studied for their specific mechanisms, and potential common genetic basis.

Electrocatalytic and Photocatalytic Hydrogen Evolution Using Iron Phosphide Nanoparticles

Callejas, Juan[a], **J. McEnaney**[a], **C. Read**[a], **J. Crompton**[b], **A. Biacchi**[a], **E. Popczun**[a], **T. Gordon**[a], **N. Lewis**[b], and **R. Schaak**[a]

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[b] Division of Chemistry and Chemical Engineering, California Institute of Technology, Pasadena, CA

Abstract:

The clean and efficient production of molecular hydrogen is central to the development of several clean energy technologies. Hydrogen is a particularly attractive candidate to replace hydrocarbon fuels due to its high energy density but more importantly due to the absence of pollutants upon combustion in air. Currently, most commercial hydrogen is produced through steam-methane reforming, which requires large amounts of fossil fuels. A potentially green alternative to steam-methane reforming is the splitting of water into molecular oxygen and hydrogen. Platinum is a highly active and acid stable electrocatalyst for the hydrogen evolution reaction (HER). Nonetheless, its high cost and scarcity limits its utility in clean energy systems on a large scale. Nanoparticles of transition metal phosphides have recently emerged as Earth-abundant alternatives for the catalytic production of molecular hydrogen from acidic aqueous solutions. Iron phosphide (FeP) nanoparticles have been synthesized and evaluated to be highly efficient catalysts and titania-supported photocatalysts for the hydrogen evolution reaction.

Impact of Shale Gas Wastewater Disposal on Conemaugh River Lake Sediments

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Abstract:

Combining horizontal drilling with high volume hydraulic fracturing has increased the extraction of hydrocarbons from low-permeability oil and gas (O&G) formations across the US. This increase in O&G production has been accompanied by an increase in wastewater production. In 2009-2010, more than 50% of the Marcellus Shale wastewater generated in Pennsylvania was treated by centralized waste treatment plants (CWTs) and 42% of these CWTs had permission to discharge to surface water. Surface water discharge of O&G wastewater poses risks to aquatic and human health from contaminants in the water column and sediments. Lake sediments in areas of O&G wastewater disposal provide an opportunity to develop tools for environmental forensics. Using a Vibracore sampling package to drive 20 ft sections of Al pipe into the sediments, we collected sediment cores from the Conemaugh River Lake of western Pennsylvania. Cores were flash frozen, transported to Penn State, sectioned, thawed, and analyzed. We found Conemaugh River Lake sediments to contain elevated concentrations of radium, barium, strontium, bromide and specialty organics. O&G wastewater from two large CWTs has been discharged into the Blacklick Creek upstream of the Conemaugh River Lake. Using a preliminary sediment age model based on 228Ra and 210Pb we found that the peak concentration of many of these contaminants corresponded to 2007 – 2011 when the highest volumes of O&G wastewater were discharged into the watershed. In this case, surface water disposal of O&G wastewater impacted sediments 10 km downstream of the CWT plants.

Identity of Host Tree Species May Not Control the Community Composition of Ecto- and Arbuscular Mycorrhizal Fungi

Chen, Weile[a], Roger Koide[b], and **David Eissenstat[a]***

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[b] Department of Biology, Brigham Young University, Provo, UT
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Abstract:

Mycorrhizal fungi form associations with most land plants and benefit plants in nutrient acquisition. These mycorrhizal nutritional benefits may depend largely on the fungal identities and their community structures and thus can vary among host plants. However, to what extent host species identity determines mycorrhizal fungal community is still largely unknown. Local environmental conditions may also select for certain groups of mycorrhizal fungi. This study collected root samples from arbuscular mycorrhizal (AM) trees (e.g. maple, tulip poplar) and ectomycorrhizal (EM) trees (e.g. oak, pine) growing together at two nearby sites of different soil properties in central Pennsylvania, U.S.A. One site was derived from limestone and the other derived from shale. Mycorrhizal fungal DNA was extracted from roots and Next-Gen sequencing techniques (Illumina Miseq) were applied to identify the mycorrhizal fungal species and their community composition of each plant host from the two sites. Mycorrhizal fungal composition differed among host plants, but the difference between sites was even stronger, for both AM and EM fungi. Many of the same fungal operational taxonomic unites (OTUs) were shared among different host species from the same site. In contrast, the overlap of fungal OTUs was small for the same host species from different sites. These results indicated that host specificity was relatively low for mycorrhizal fungi associated with the co-occurring temperate trees. Local fungal species pool that was filtered by habitat conditions may be a key driver shaping the mycorrhizal fungal community composition for both AM and EM trees.

Role of Iron Minerals in Preserving Organic Carbon during Aerobic Degradation

Cronk, S. Sarah[a]* and **Christopher A. Gorski[a]**
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Abstract:

Soil organic carbon in peatlands is an important terrestrial carbon pool that stores 15-30% of the world's soil carbon. Peatlands are typically considered carbon sinks because they maintain anaerobic conditions that impede microbial mineralization of CO_2. In the face of climate change, environmental changes may induce peatlands into more aerobic conditions. Predictions estimate that such events would lead to a rapid and large release of CO_2 into the atmosphere, equivalent to 34-46% of current atmospheric carbon. Recent work has shown that minerals, particularly those with redox-active metals, may impede this process by protecting organic carbon from biodegradation. Here, we focused on quantifying the extent to which iron minerals inhibit organic carbon degradation under aerobic conditions. To do so, we isolated dissolved organic carbon from a bog in an old-growth boreal forest. We exposed this carbon to the native microbial population from the bog and measured CO_2 and dissolved organic carbon concentrations over time in aerobic conditions with different amendments of iron oxides. These experiments provide insights into how iron minerals may inhibit microbial carbon oxidation in aerobic conditions. To better simulate natural environments, we intend to further study this process under reducing conditions and over multiple redox cycles.

Improving Anthracnose Disease Resistance through Phytoalexins in Sorghum (*Sorghum bicolor* (L.) Moench) by Genome Wide Association Studies

Elango, Dinakaran[a*], I. Gaffoor[a], W. Xue[a], G.W. Roth[a] and **S. Chopra[a]**
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Abstract:

Sorghum is an important cereal crop and staple food for 500 million people who live in the semi-arid regions of the world. Anthracnose is a major fungal disease caused by *Colletotrichum sublineolum* with heavy yield losses up to 45% under favorable environmental conditions. Sorghum fights back to fungal attacks by producing anti-fungal compounds known as phytoalexins. These phytoalexins in sorghum are 3-deoxyanthocyanidins (3-DA's) belonging to flavonoids class of secondary metabolites. Our objective is to screen the global sorghum diversity collections for their ability to synthesize 3-DA's and map the potential candidate genes through genome wide association approach. The induction of 3-DA's were quantified in 550 sorghum accessions by infecting with *C. sublineolum* at 10^{-6} spores per ml concentration through detached leaf assay using field grown plants and seedling assay using greenhouse grown plants. Results show significant variation among genotypes for 3-DA accumulation. Further, top 3-DA producing lines in sorghum association panel as well as in sorghum mini-core panel were identified. In a second experiment, parental lines of nested association mapping (NAM) RIL (recombinant inbred line) panels are being used to develop QTLs. The phenotypic data of 2014 and 2015 will be used to predict potential candidate gene associations for 3-DA accumulation by using 45,000 SNP's available across sorghum diversity panel through genome wide association approach. Genes and their marker identification will allow plant breeders to enhance their breeding program. Moreover the identified resistant lines will be used in our breeding program to develop anthracnose disease resistant sorghum cultivars for wider adaptation.

Effect of Brine Evolution on Ca-isotope Composition in the Salar de Atacama, N. Chile

Estrada, Jennifer[a*], M. Fantle[b], T. Russo[ab], and **S. Hynek[ab]**
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Abstract:

Calcium (Ca) isotopic compositions offer discrete signatures for biological, chemical, and climatic processes due to calcium's chemical versatility, ubiquity in biological and inorganic systems, and abundance and range of stable isotopes (Gussone et al., 2003). Laboratory studies have investigated abiotic precipitation of gypsum and revealed preferential uptake of isotopically light Ca into the crystal lattice; however, how this abiotic fractionation occurs in natural systems is not well understood (Harouaka et al., 2014). This study investigates changes in Ca-isotope composition in water and rock samples from the Salar de Atacama (SdA) in Northern Chile. The SdA is a hyperarid region heavily influenced by evaporation dynamics that yield significant mineral precipitation (i.e. calcite, gypsum, and halite) and demonstrates properties of variable density hydrologic flow (Tejeda et al., 2003). Given the dynamic properties of the basin groundwater with brine evolution, this research aims to provide a means of understanding how large-scale hydrological processes may influence Ca-isotope compositions via active precipitation processes.Surface water and groundwater samples were collected alongside sediment cores and analyzed for major cations using ICP-AES and for anions using an ion chromatography (IC) system. All samples were separated using a sequence of IC columns to isolate Ca in solution; Ca-isotope data was measured via a MC-ICP-MS. Resulting Ca-isotope data suggests variability throughout the basin according to: (1) sample type and (2) region. Furthermore, the data provide a means of further refining the geochemical component of regional reactive transport hydrological models to better determine how subsurface brine interacts with freshwater.

Data Analysis of Emerging Contaminants in Surface Runoff

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Abstract:

With recent increases in the number of concentrated animal feeding operations in the United States, manure management has become an increasing environmental concern. While the land-application of animal wastes can provide many agronomic benefits, concerns exist regarding the subsequent transport of hormones and the potential endocrine disrupting effects on aquatic ecosystems. This research examined the presence of estrogens in surface runoff from 12 plots at the Rock Springs Research Farm near Penn State's University Park campus. The twelve 50' by 90' plots had dairy manure applied on the surface or applied through shallow disk injection (6 plots of each application practice). The surface runoff was recorded very five minutes over the nine-month study period (October 2014 – June 2015), and one water sample was collected from each plot during each of 10 runoff events. I created graphs and tables so that the data collected from the 12 plots was more easily understood. I also evaluated the precipitation data during the eight-week experiment time interval and linked the recorded levels of pollutants to the levels of precipitation. Over the study period, a total of 90 samples were collected. The results showed that detectable levels of estrogens were present in 70% of samples collected from the surface broadcast plots, with concentrations ranging over four orders of magnitude (0.63 – 6400 ng/L). For the shallow disk injection plots, a total of 45% of the samples collected had detectable estrogen concentrations, with concentrations ranging from 0.45 to 6.42 ng/L. Samples were detected during spring snowmelt and rainfall events, several months after the October 2, 2014 manure applications, and therefore we have evidence that hormones are preserved in the soil profile over the winter months for both application types. This has important implications for aquatic ecosystems, as the presence of excess estrogens in surface water bodies can negatively impact sensitive fish populations, particularly during the spring months shortly after eggs hatch. However, overall, our results showed that the estrogen loads leaving the plots that received manure via shallow disk injection were on average two orders of magnitude smaller compared to the plots that received surface broadcast applications. Therefore, the results suggest that shallow disk injection, which is not currently a common practice in the Eastern United States, has the potential to reduce estrogen fate and transport in surface runoff.

Using *Lemna minor* (duckweed) Grown in Contaminated Waters as a Sustainable Soil Amendment: Recycling Nutrients to Reduce Environmental Pollution and Grow Food Sustainably

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Abstract:

Eutrophication is caused by excessive nutrients released into the environment from different activities, such as agricultural and domestic wastewater discharges, often generating irreparable damage to aquatic ecosystems. An aquatic plant, duckweed, can be used to sustainably treat polluted water, accumulate nutrients, and generate a by-product capable of replacing or supplementing commercial fertilizers. Its structure allows it to be used as a slow-release soil amendment that minimizes nutrient runoff. Experiments were performed to evaluate the effectivity of duckweed as a soil amendment in comparison with commercial fertilizer. Leaching and superficial runoff of compounds such as ammonia, nitrite, nitrate and phosphate were collected and analyzed along with pH, electrical conductivity and ORP to determine which amendment contributed less to runoff. Common root, leaf, and fruit vegetables (beet, kale, tomato) were tested in the greenhouse, while the draught-resistant grain, sorghum, was tested in both the greenhouse and the field. Relative to fertilizer in all cases, duckweed leached between 40 to 60 % less ammonia, and also provided comparable plant yield in all the experiences except for the greenhouse sorghum in which duckweed provided 10% more yield than commercial fertilizer. Duckweed proved to be an alternative to commercial fertilizer from an environmental and agricultural perspective.

Examining the Relationship of Nutritional Auxotrophy and Pathogenicity in *Erwinia amylovora* via Tn*5* Mutagenesis

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Abstract:

Fire blight, caused by the bacterium *Erwinia amylovora*, is a destructive disease affecting apples and pears. This study seeks to elucidate the ability of auxotrophic *E. amylovora* mutants, which are unable to synthesize one or more of the biological molecules required for growth, to effectively induce disease, in comparison to the prototrophic wild type, which is fully capable of synthesizing all of the molecules required for growth. This comparison will reveal more about the parasitic relationship of *E. amylovora* to its host, specifically what types of biological molecules the bacteria are capable of scavenging from host tissues. In this work, over 5000 mutants were obtained via Tn*5* mutagenesis of a Pennsylvania wild type strain, 6P1, and tested for auxotrophy on M9 minimal media plates and confirmed as auxotrophs in a secondary liquid media assay. Of the 5000 tested, approximately 115 were auxotrophic. Confirmed auxotrophic mutants were then inoculated in immature 'Gala' apple fruits and monitored for fire blight symptom development. DNA was then isolated from each mutant in order to analyze the segments bearing the Tn*5* mutated gene sequence and deduce the affected genes and their products. Future work will include inoculation of selected pathogenic auxotrophic mutants in 2 year old apple trees to compare disease development to that which occurs in immature fruits. This study will contribute to the understanding of *E. amylovora* parasitic nutrient acquisition by comparing biosynthetic pathways affected in pathogenic and non-pathogenic mutants, which should identify host molecules needed for bacterial growth and disease development.

Presence of Three Antibiotics in Wheat Plants and Groundwater at the Living Filter: A Wastewater Reuse Site

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Abstract:

With rising demands on water supplies, wastewater treatment plant (WWTP) effluent is often reused to irrigate agricultural lands. Emerging contaminants, like antibiotics and other pharmaceuticals, are frequently found in WWTP effluent, and concern has arisen about their environmental fate. The aim of this study was to analyze the presence of three antibiotics, sulfamethoxazole, trimethoprim, and ofloxacin, in wheat plants (*Triticum aestivum*) and groundwater at The Living Filter, an agricultural site where WWTP effluent is reused for spray irrigation. Water samples were collected throughout the year. Wheat was collected prior to and during harvest and divided into grain and straw. Plant and water samples were analyzed by solid phase extraction and liquid chromatography – tandem mass spectrometry. Sulfamethoxazole and ofloxacin were quantifiable in groundwater samples with concentrations that varied spatially and temporally (0.14 – 660 ng L^{-1}), while trimethoprim was typically only detectable. Residues of each compound were present on most plant surfaces and in certain plant parts (0.09 – 10.2 ng g^{-1}). Ofloxacin was found throughout the plant in the straw and grain. Trimethoprim was found only on grain and straw surfaces, while sulfamethoxazole was concentrated within the grain. These findings demonstrate that antibiotics can be taken up into plant tissue, adhere to plant surfaces, and be found in groundwater when WWTP effluent is spray irrigated. These low levels of antibiotics found in groundwater and in the tissues or on the surfaces of plants used as food sources raise questions about potential health risks for humans and animals.

New Insights into a Behavior-controlling Fungus

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Abstract:

Some parasitic microorganisms manipulate the behavior of their hosts, but the mechanisms by which they accomplish this remain a mystery, especially given the parasites' small size in relation to their hosts. One way parasites could overcome this size discrepancy is by coordinating their behavior. Fungi from the species complex *Ophiocordyceps unilateralis* infect ants of the tribe *Camponotini*, inducing aberrant host behaviors that precisely place host cadavers in areas suited for parasite dispersal. Fungi are thought to enter the host as individual cells, which proliferate in the hemocoel for two to three weeks. This implies that the timing of host manipulation depends on the parasite reaching an optimal stage of development and distribution within the host. In this study, we examine the distribution of the fungus and its interaction with ant tissues at the time of manipulation. *O. unilateralis* fungi were visualized inside manipulated *Camponotus castaneus* ants using serial block-face scanning electron microscopy (SBFSEM) and confocal laser scanning microscopy (CLSM). SBFSEM images and 3D reconstructions of head and leg muscle tissue reveal that this parasite exhibits coordinated behavior by forming fungal networks through cell-cell fusions. CLSM images of the brain suggest that the fungus surrounds the brain but does not enter it while the host is still alive.Besides this laboratory study I am also examining the diversity of the parasite's infection strategy in the field. I am comparing host biting location and timing of fungal spore release for several *O. unilateralis* species from the Brazilian Amazon.

Characterization of Novel Symbiotic *Vibrio fischeri* Strains EMG003 and ANM004

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Abstract:

Vibrio fischeri is a bacterium that forms a symbiosis with the Hawaiian bobtail squid *Euprymna scolopes*. The bioluminescence produced by *V. fischeri* masks the shadow of the squid swimming in the ocean. The diversity of *V. fischeri* strains that are capable of colonizing the squid provides valuable insight into the bacterial traits that promote this symbiosis. This study aimed to characterize two strains directly isolated from the light organ of a wild-caught *E. scolopes* individual. Each isolate, designated as EMG003 and ANM004, displayed luminescence levels that were greater than that of the type strain ES114 – EMG003 with a 17-fold difference and ANM004 with a 43-fold difference in the presence of the signaling molecule that induces luminescence in *V. fischeri* (3-oxo-c6 HSL). Both strains also had slower motility rates when compared to the type strain. The statistically significant differences in the luminescence values and motility rates between EMG003 and ANM004 also demonstrate that EMG003 and ANM004 are unique strains. Demonstrating these strains as novel isolates supports previous reports of strain diversity within the light organ, and it also suggests that no one trait appears to determine successful host colonization.

Assessment of *Calonectria pseudonaviculata* Microsclerotia Survival in Compost over Varying Times and Temperatures

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Abstract:

Boxwood blight is an emerging threat to the Pennsylvania nursery industry, although does not seem to be widespread in Pennsylvania despite repeated introductions. The causal agent behind boxwood blight in the United States *Calonectria pseudonaviculata* (*Cap*), with a second species *C. henricotiae* found in Europe. *Cap* forms fungal resting structured called microsclerotia, which are known to be very resistant to environmental conditions. Due to this, there is concern that if infected plants are composted, the microsclerotia could survive the process, allowing for further spread. To elucidate this threat, a composting bioreactor was constructed at the Mushroom Research Center at Penn State University. Discrete lab grown microsclerotia were subjecting to 24, 48, and 72 hours of composting at 40, 50, and 60 °C. Results initially indicated pathogen survival, however further replication indicated that this was not true, composting at 40 °C for over 24 hours should be sufficient for eradication. Further replication of these experiment will be performed to confirm these results, as well as confirmation that microsclerotia in infected plant material will follow the same eradication timeline.

New Antibiotic Development: Cloning and Expression of a Novel Mannose-Binding Lectin from Rainforest Soil

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Abstract:

Lectins bind to a soluble carbohydrate or carbohydrate moiety that is part of a glycoprotein or glycolipid. Glycolipids are important components of cellular membranes and/or extracellular matrix, affecting interactions between cells and their external environment. As a result of this binding and associated effects, lectins manifest activities including antitumor, immunomodulatory, antifungal, anti-viral, and anti-insect activities, which often find practical applications. Existing commercial uses include applications in biotechnology (e.g. glycomics, wherein lectin arrays provide high-throughput screening of many samples containing glycans) and biomedicine (blood typing, flow cytometry). Since modifications in content, distribution, and accessibility of cellular and extracellular glycoconjugates are often associated with pathological processes, much effort is invested in screening lectins for their potential as diagnostic reagents in clinical situations. We have obtained root transcriptomes from size species of tropical trees and therein discovered a large number of putative lectins containing a variety of lectin domains, but less than 60% amino acid to any genes in the Genbank NR database. We suspect that these come from unculturable root-associated fungi. For one of these chosen as a test case, we have synthesized the oligonucleotide corresponding to the coding region of this gene, cloned it into a vector containing a poly-histidine tag for purification, and induced expression of the protein in bacteria after large-scale fermentation. From that protocol we have produced substantial quantities (mg) of purified protein ready for testing and application. This method can fairly readily be adapted to production of g quantities.

Ethanol Fermentation by *Saccharomyces cerevisiae* from Potato Waste Hydrolysate in Biofilm Reactors

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Abstract:

Bioethanol is a renewable energy source as an alternative to fossil fuels. Bioethanol is produced from starchy biomass in the U.S. such as corn. However, a cheaper non-food value source is needed. In this context, wastes of industrial potato processing plant were utilized as carbon source for ethanol production. On the other hand, to reduce the cost of ethanol and improve the effectiveness of the process, cell immobilization was employed. Plastic composite supports (PCS) are solid supports that were used to stimulate biofilm formation in bioreactor (a.k.a. biofilm reactor) during microbial production of value-added products. Therefore, in this study, PCS were employed to promote the cell population and biofilm formation in the reactor. Response surface methodology was used to evaluate the various growth conditions, pH, temperature, and agitation, for enhanced ethanol production in biofilm reactors. The optimum conditions were found to be 4.2 pH, 34 °C, and 100 rpm agitation. An optimum ethanol concentration of 37.05 g/L ethanol yield, giving a 92.08% theoretical yield was achieved. The results indicated that biofilm reactors can enhance the ethanol fermentation from industrial potato wastes.

Simulation of Seepage Through Porous Media Using Smoothed Particle Hydrodynamics Method

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Abstract:

Seepage, which is essentially flow of water through soil medium, may lead to erosion of earth dams and their foundations and eventually can result in instability and failure. Thus, understanding of flow of water through porous media and accurately modeling this phenomenon are of great importance in geotechnical engineering. In this study, a 2D model based on the Smoothed Particle Hydrodynamics (SPH) method is developed to simulate a pressure-driven vertical flow through non-deformable porous media. In the developed model, the spatially averaged Navier-Stokes equations are implemented into SPH formulations to model fluid motion. The characteristics of porous media including heterogeneity and anisotropy of pore space are introduced in the model using local porosity values imported from granular samples created using the discrete element method (DEM). The fluid-solid coupling is modeled using readily-available, semi-empirical equations. To remediate fluid pressure oscillations, a density diffusion term is implemented in the model. The SPH model is developed using one-way coupling method, as the first step toward developing the fully coupled fluid-soil model. The developed model is validated against published simulation results and a series of seepage tests. The results show that the developed model is capable of simulating discharge velocities and pressure distribution along a porous medium under varied differential fluid pressures.

Impact of Land Use and Drinking Water Treatment Processes on the Occurrence of Pharmaceuticals and Personal Care Products (PPCPs) in the Susquehanna River Basin

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Abstract:

Occurrence of pharmaceuticals and personal care products (PPCPs) in aquatic systems is a global concern due to PPCPs persistence in the environment and their potential impacts on human and environmental health at trace concentrations. Removal of PPCPs through conventional wastewater treatment is known to be inadequate; however, the efficiency of different drinking water treatment technologies on PPCPs has received limited investigative attention. The goal of this research project is assessing the natural (hydro-climatic) and anthropogenic (land use) controls influencing selected PPCPs occurrence in identified drinking water sources within the Susquehanna River Basin, tracking their step-by-step removal efficiency through six drinking water treatment plants (DWTPs), and assessing their potential persistence in drinking water distribution systems.

Three main sample collection phases are proposed: In Phase 1, the temporal variability of PPCPs in DWTPs source waters will be evaluated through daily and bi-monthly, post storm and post spring rainfall sampling. In Phase 2, removal efficiencies of each DWTPs treatment technologies will be assessed and Phase 3 will investigate the occurrence of PPCPs at points of use within each of the DWTP's distribution networks. The PPCPs of interest are: acetaminophen, ampicillin, caffeine, metformin, naproxen, ofloxacin, sulfamethoxazole, triclosan, and trimethoprim. Sample analysis will be performed through a Thermo Scientific Q Exactive Orbitrap Liquid Chromatography-Mass Spectrometry (LC-MS/MS) System.

Ocean Redox Change During the Paleocene-Eocene Thermal Maximum: Insight from Organic Geochemical Proxies

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Abstract:

The Paleocene-Eocene Thermal Maximum (PETM) involved a rapid injection of isotopically light carbon into Earth's ocean-atmosphere system, resulting in a carbon isotope excursion of 3-5 ‰ and a warming of 5-9 ^{o}C globally. To define the biogeochemical effects of the PETM on shallow water sites, sediment cores from the Atlantic Coastal Plain were taken to elucidate water column chemistry changes during the climatic event. While less work on the PETM has been done in shallow water records, previous deepsea studies have recorded ocean acidification, eutrophication, and anoxia. To better understand the geochemical and biological effects of global warming and carbon pulses into the ocean-atmosphere system, it is necessary to define the change in marine redox conditions and proposed water column stratification during the climate event.

To determine the biogeochemical effects of the PETM on the Atlantic Coastal Plain, organic biomarker proxies were analyzed to better understand chemical and biological changes on the shelf. While organic biomarkers have been utilized extensively in petroleum studies, organic proxies were implemented in this study on immature sediments. Through the study of organic biomarkers during the PETM, changes in provenance, maturity, and redox conditions in shallow water sites were analyzed. Ultimately, the PETM is often studied as an analogue for modern anthropogenic climate change, thus understanding the scope of effects of the PETM can provide a better understanding of the geologic event, as well as an example for the potential effects of modern climate change.

Analysis of Novel *V. fischeri* Strains ABM004 and EBS004

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Abstract:

The bioluminescent bacterium *Vibrio fischeri* forms a mutualistic symbiosis with the Hawaiian Bobtail squid *Euprymna scolopes*. This mutualism is established within the squid's light organ. Previous work has shown that wild-caught animals harbor polyclonal infections. How these polyclonal infections become established within squid is poorly understood. The goal of our research project was to use standard microbiological assays to characterize two strains, ABM004 and EBS004, which were isolated directly from the light organ of a wild-caught squid. Relative to the type strain ES114, ABM004 displays a 22-fold higher bioluminescent response to *N*-3-oxohexanoyl-homoserine lactone (3-oxo-C6 HSL), which is the signaling molecule that induces bioluminescence in *V. fischeri*. Conversely, ABM004 is 0.81-fold slower than ES114 in soft-agar motility plates. EBS004, is 80-fold brighter than ES114 but displays similar rates of motility to ES114. Together, these results show that ABM004 and EBS004 are distinct symbiotic strains of *V. fischeri* and provide a platform for investigating the establishment polyclonal infections in *E. scolopes*.

Detection of Pb(II) in Aqueous Samples Using a Turn-on Ratiometric Chemosensor Coupled with a Hand-held Portable Fluorometer

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Abstract:

Lead is a serious environmental pollutant which can be dispersed between various media in nature. Recent studies by the Centers for Disease Control have found correlations between low levels of lead blood concentrations, <10 µg/dL, and a decrease in IQ levels as well as an increase in behavioral issues such as ADHD and ADD. Currently the methods for detection of lead in aqueous samples involve expensive and non-portable equipment, which require time-consuming sample preparation and have limitations on their limit of detection. However, a recently developed fluorophore, Leadglow™, is a ratiometric turn-on chemosensor which is able to measure lead(II) down to 10 ppb. Aqueous samples were analyzed by using a portable fluorometer designed by Dr. Theodore Corcovilos with the next step being implementation in the field.

Taxonomic Description of *Fusarium solani* Species Complex Phylogenetic Species 12 (FSSC 12), A Fungal Pathogen of Marine Animals

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Abstract:

Fusarium is a diverse genus, containing ~300 known phylogenetic species distributed in 20 phylogenetic species complexes. Members of this genus also play a wide range of ecological roles, including as disease-causing agents in plants and animals. The *Fusarium solani* species complex (FSSC) contains two-thirds of all human and animal pathogenic fusaria. The approximately 50 species within the FSSC cannot be differentiated with traditional morphological techniques, but rather requires the use of multiple genetic markers in a technique called multilocus sequence typing. Most of the isolates that fall into clade 12 of the FSSC (FSSC 12), via a 3-locus molecular phylogeny, either played a role in marine animal infections or were found in marine environments. Infections by the FSSC 12 can be severe, sometimes causing mass mortalities. For example, in 2012, Salter et al. reported a fusarial mycosis epizootic that killed 152 lined seahorses (*Hippocampus erectus*) shipped to a public aquarium. Other marine animals reported with FSSC 12 infections include prawn, shrimp, sea turtles, sharks, etc. Here we describe FSSC 12 as a novel species and characterize the physiological characteristics that may give it the ability to infect marine animals, as well as survive and reproduce in aquaria and other marine environments.

Maximizing the Yield of High-protein Duckweed Grown on Domestic Wastewater for Beneficial Reuse as Aquaponics Feedstock

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Abstract:

Aquaponics (combining fish farming with hydroponic crop production) is becoming an area of interest due to the release of concentrated nutrients from conventional aquaculture and agriculture. Aquaponics creates a symbiotic relationship between fish and plants by cycling nutrients from the fish waste to the plants, thus removing the need for synthetic fertilizers. However, the feedstock used to support the growth of fish in aquaponics is generally derived from wild, ocean-caught fish, with a feed to product ratio of around 6:1 (six pounds of ocean caught fish are required to produce each pound of farmed fish). This feeding practice raises concerns due to collapsing ocean fish populations. Therefore, the evaluation of alternative feedstocks generated from plant biomass is critical to finding sustainable nutritional supplements for fish.Duckweed is a floating aquatic plant that can recover nutrients from wastewater and be harvested as a protein-rich feed supplement for livestock. In this study, duckweed was grown on a continuous stream of primary wastewater effluent in aquariums equipped with warm fluorescent lights in the Kappe Lab of the Penn State Wastewater Treatment Plant. The hydraulic residence time of wastewater and the harvesting frequency of duckweed were optimized to produce the fastest growing duckweed with the highest protein content. The removal efficiency of nitrogen species, phosphorous, suspended solids, and chemical oxygen demand were also determined. This experiment is the first step in upgrading the existing Penn State Eco-Machine™ into a self-sustaining system that can simultaneously treat wastewater using ecological techniques and produce food using aquaponics.

Beauveria bassiana Biopesticide Sporulation and Bed Bug Mortality on Tapes and Adhesive-Bound Textiles.

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Abstract:

Aprehend™ is a novel fungal biopesticide for the control and prevention of bed bugs (*Cimex lectularius)*, developed by the Penn State Department of Entomology. Bed bugs become infected with the fungal disease (*Beauveria bassiana)* following contact with the spray residue, and spread the disease on return to their harborages. Aprehend™ had been demonstrated to remain viable and effective on most surfaces for up to 3 months, but long term efficacy on raw wood, such as that found on the undersides of furniture and head boards is limited due to poor spore viability and reduced spore transfer to bed bugs. Since these surfaces are frequently colonized by bed bugs in infestation situations, methods for improving efficacy on raw wood surfaces were sought. This investigation explores the potential for using self-adhesive tapes or glued fabrics to extend spore viability and increase spore transfer in comparison to raw wood. Glue compatibility with the Aprehend™ formulation was used as the preliminary screening criteria, followed by weekly spore viability checks and monthly bed bug bioassays to evaluate efficacy of spore transfer over a three-month evaluation period. Results from this investigation will help in the development of application strategies to maximize the long-term efficacy of Aprehend™ in commercial use.

Factors Influencing Phosphorous Cycling in Biogeochemical 'Hot Spots'

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Abstract:

Anthropogenic alteration of the phosphorus (P) cycle has led to subsequent soil and water quality issues. For example, P build up in soils due to historic fertilizer application may become biologically available and exacerbate eutrophication and anoxia in nearby water bodies. In the humid Northeastern United States, storm runoff transports P and also stimulates biogeochemical processes, these locations are termed biogeochemical 'hot spots'. Many studies have looked at nitrogen and carbon cycling in biogeochemical hot spots but few have focused on P. We hypothesize the periodic wetting and drying of biogeochemical hot spots promotes a combination of abiotic and biotic processes that influence the mobility of P. To test this hypothesis, we took monthly soil samples (5 cm deep) from May to October in forest, pasture, and cropped land near Ithaca, NY. In-situ measurements taken with each sample included volumetric soil moisture and soil temperature. We also analyzed samples for 'runoff generated' phosphate, nitrate, and sulfate (from 0.01 M CaCl2 extraction), Fe(II), percent organic matter, pH, as well as oxalate extractable and total P, Al, and Fe. We used linear mixed effects models to test how runoff generated phosphate concentrations vary with soil moisture and whether other environmental factors strengthen/weaken this relationship. The knowledge gained from this study will improve our understanding of P cycling in biogeochemical hot spots and can be used to improve the effectiveness of agricultural management practices in the Northeastern United States.

Genetic Characterization of Bacterial Canker in Tomato

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Abstract:

The tomato (*Solanum lycopersicum*) is one of the most important horticultural crops in the world. The bacterial pathogen *Clavibacter michiganensis* subsp. *michiganensis* (*Cmm*) causes bacterial canker disease, which devastates fields of tomatoes yearly. There are currently no cultivars resistant to *Cmm.* It was previously discovered that certain accessions of the wild tomato species *Solanum pimpinellifolium* are resistant to *Cmm.* In previous work, *S. pimpinellifolium* was bred with the domestic tomato cultivar "Red Defender" to produce 170 recombinant inbred lines (RILs). The current research project tested whether the trait responsible for resistance to *Cmm* in the wild species *S. pimpinellifolium* segregated normally. In this study, 100 of the RIL's were selected and two tomatoes per RIL were inoculated with *Cmm* culture. This process was replicated one time. These RILs were then observed for diagnostic *Cmm* symptoms under controlled conditions in a growth chamber. Roughly 50% of the RILs exhibited at least intermediate resistance, which supports the hypothesis that the trait for *Cmm* resistance is indeed heritable. We are repeating this experiment in a greenhouse to confirm the phenotypic designations for each RIL, and to verify the resistance trait under more representative, practical conditions. The end goal for this experiment is to provide confident *Cmm*-resistant plant matter to map the genome, and pinpoint the exact gene responsible for providing resistance. In the future, breeders can use the results from this research to breed a high-yielding, *Cmm*-resistant cultivar.

Investigation of Polyclonal *Vibrio fischeri* Infections within the Squid Light Organ

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Abstract:

The light organ of wild-caught *Euprymna scolopes* (the Hawaiian Bobtail Squid) houses genetically distinct *Vibrio fischeri* strains in exchange for bioluminescence that serves as camouflage from predators. How such polyclonal V. fischeri infections are established within E. scolopes is poorly understood. To study this process, we isolated three strains of *V. fischeri* from the light organ of a wild-caught *E. scolopes*. These Light-Organ (LO) strains were characterized though microbiological assays including bioluminescence, motility, and host colonization. Relative to the type strain ES114, LO-1 showed similar bioluminescence levels but was significantly less motile and colonized fewer hosts. LO-2 was significantly brighter and swam slower than ES114, but colonized comparable host numbers. The final strain LO-3 was significantly less luminescent, less motile, and colonized significantly fewer animals than ES114. A phylogenetic analysis using four genetic loci demonstrated that natural isolates are genetically different from each other and ES114. Together, our results demonstrate that these strains, which have a common host, display phenotypic and genetic differences, thereby providing a foundation for future investigations into the establishment of polyclonal *V. fischeri* infections within *E. scolopes* squid.

Determining Redox Properties of Fe(II) and Goethite to Predict Reactivity with Environmental Contaminants

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Abstract:

Ferrous iron (Fe(II)) adsorbed to iron (oxyhydr)oxides has been shown to provide an important pathway for reductive degradation of many contaminants in groundwater. Predicting the rates of these redox reactions has proven to be difficult, due in part to the lack of thermodynamic data for interfacial aqueous Fe(II)–iron oxide redox couples. Recently, our lab demonstrated that mediated potentiometry can be used to perform these measurements. The goal of the proposed work is to determine if measured reduction potential values for Fe(II)–goethite redox couples can be used to accurately predict reduction rates of nitrobenzene, a nitroaromatic compound that serves as a model contaminant. The rate of nitrobenzene transformation will be analyzed over time using high performance liquid chromatography (HPLC) to measure nitrobenzene and its reduction product at specific time points. The effects of pH, goethite concentration and Fe(II) concentration will be examined to evaluate how each of these parameters, as well as the reduction potentials of nitrobenzene and the Fe(II)-goethite couple, relate to the overall reaction rate. Understanding the correlation between these parameters and reaction rates could greatly improve predictive models for redox reactions between iron oxides and contaminants in the environment.

Potential Role of Polyphosphate-accumulating Organisms in Regulating Phosphorus Mobility in Sand Environments Subject to Aerobic/anaerobic Cycles

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Abstract:

Polyphosphate-accumulating organisms (PAOs) are known to accumulate and release phosphorous depending on aerobic/anaerobic conditions in a wastewater treatment plant (WWTP) using enhanced biological phosphorous removal (EBPR). Under anaerobic conditions, intracellular polyphosphate (poly-P) bodies are hydrolyzed releasing phosphate, while under aerobic conditions the phosphate is taken up and poly-P inclusions are reformed. Most work on PAOs has focused on their roles in a WWTP, and less is known about their potential roles and presence in natural environments. Other environments that mimic the cyclic anaerobic/aerobic environments encountered in a WWTP are benthic biofilms and soils subjected to periods of saturation and dryness. If PAOs from a WWTP can be successfully enriched and shown to perform their phosphorous metabolism in an engineered system, it can be hypothesized that PAOs could be exhibiting the same behavior in the natural environment. PAOs utilizing their phosphate uptake and release metabolism in the environment influence phosphorous availability and transport into water bodies. Sand columns, with a less complex matrix than soil, are being subjected to cycles of saturation and unsaturation to mimic conditions in a WWTP. Pore water and solid sand samples will be collected during periods of saturation and unsaturation. Pore water samples will be used to monitor changes in soluble reactive phosphorous concentrations, and solid particles of sand will be subjected to FISH and DAPI staining to visualize PAOs using probes developed for PAOs in EBPR processes and to determine if changes in intracellular poly-P are detectable between the two cycles.

Exploring the Potential Mycorrhizal Interaction between *Morchella* and Associated Tree Species in Central Pennsylvania

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Abstract:

Among the many edible fungi foraged for human consumption, members in the genus *Morchella* tend to be the most sought after. In Pennsylvania it is common to repeatedly find morels fruiting in similar ecological environments, especially in relation to specific tree species. Due to the short fruiting period in the spring, understanding the potential mycorrhizal relationships that could exist between certain *Morchella* and tree species will help predict fruiting patterns as well as offer more evidence for mycologists attempting to understand the life cycle. Here we present two approaches, one documenting ascocarp fruiting patterns and one using a controlled environment setting. In the first part, we aim to identify ascocarp production patterns in relation to specific tree species, with a focus on those in the genera *Fraxinus* and *Ulmus*. By collecting morel fruit bodies and measuring their exact location relative to nearby trees at multiple sites for multiple years, we constructed maps that allow a visual analysis of some local sites. We determined the species identity of the collected *Morchella* ascocarps by sequencing the ITS region of the rDNA, and by visual examination of morphological characters. We are also working to assess whether mycorrhizal associations exist between *Morchella* and local trees by conducting inoculation experiments under controlled conditions using local seeds, soil, and *Morchella* isolates. The data that has been compiled from exploring these two aspects of this research will be presented.

iTRAQ-based Quantitative Proteomic Analysis Reveals New Metabolic Pathways Responding to Chilling Stress in Maize Seedlings

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Abstract:

Chilling stress is one of the major threats to plant growth, spatial distribution, agricultural productivity and crop of yield. In this study, we conducted an iTRAQ-based quantitative proteomics analysis to compare the abundance of proteins in maize seedlings under normal conditions and chilling stress. A total of 88 up-regulated and 77 down-regulated proteins were identified under chilling stress. This result demonstrates the remarkable metabolic flexibility of maize leaves, which may contribute to the survival of plants under chilling stress. The adaptive response of maize leaves to chilling stress might include the following aspects: (a) the induction of stress-responsive proteins; (b) the improvement of the overall ability to scavenge ROS, including detoxifying enzymes and compatible solutes; (c) the up-regulation of the expression of all protein synthesis/assembly-related proteins; and (d) posttranscriptional and posttranslational modifications. This approach identified new proteins involved in signal transduction, RNA metabolism, protein metabolism and other biological processes that were not previously known to be associated with chilling stress responses. Our results revealed complex changes at the proteomics level in maize leaves under chilling stress conditions and provided new information concerning the plant response to chilling stress. Additional studies are essential to improve the chilling stress tolerance of maize.

Field Measurements of Wet and Dry Deposition

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Abstract:

In this study, dry and wet deposition samples were collected using an automated sampler equipped with a rain sensor in order to study the removal of trace gases and particles from the atmosphere. In particular, a comparison between the magnitude of dry and wet deposition for individual species in this region was of interest. Samples were taken for approximately four months with 4 or 7 day sampling periods. Wet deposition samples were collected whenever rain occurred during a sample period while dry deposition samples were collected at all other times. After collection the pH of each sample was measured, then analyzed by ion chromatography to measure the concentrations of specific anions (chloride, sulfate, nitrate, and phosphate), cations (sodium, ammonium, potassium, magnesium, and calcium), and organic acids (acetate and formate). These concentrations were converted to total deposited mass for easy comparison between wet and dry deposition. In addition, the flux (mg/cm2/s) of each species was calculated to further evaluate deposition between wet and dry samples. It has been noticed that wet samples have a greater flux than dry samples for all measured ions. In particular there are three samples that have significantly higher flux values than any other samples, which may be due to large rain events. Correlations between the different anions, cations, and organic acids were determined and used for further understanding of the sources of the deposited compounds.

The Impact of Slickwater Fracturing Fluid Composition and Shale Interactions on Membrane Fouling of Flowback Water

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Abstract:

Although there is broad interest in the development of membrane systems for treatment of flowback water from natural gas production, there is currently little information on the critical components governing the fouling behavior of these complex fluids. Synthetic flowback water was generated by subjecting mixtures containing friction reducer (polyacrylamide – PAM), breaker (ammonium persulfate), and surfactants (etoxylated alcohol) to the high pressures and temperatures in typical fracking operations, using a Parr reactor that contained pulverized shale outcrops. Dead-end filtration experiments were performed using 0.2 µm PVDF microfiltration membranes to evaluate the impact of fluid composition on the fouling characteristics. Polyacrylamide-based friction reducer wasthe most significant membrane foulant. Size exclusion chromatography results suggested that the addition of ammonium persulfate reduced the peak molecular weight of PAM from 6 million Da to 3.5 kDa after reaction at a fracking temperature of 80℃, resulting in a significant reduction in fouling. However, the addition of surfactants led to increased particle size in flowback water, which enhanced the fouling. The interactions between fluid and shale formation reduced fouling of MF by adsorbing organics and lowering PAM concentration in flowback water. The greatest removal of organic matter by shale was obtained with friction reducer alone (70% TOC reduction); nevertheless, this solution caused the greatest fouling due to the large particle size. These results demonstrate that there are significant interactions between the components used in hydraulic fracturing operations, providing valuable insights for the development of efficient membrane-based strategies for treatment of flowback waters.

Land Use and Hydrologic Drivers of Atrazine Presence in Drinking Water Sources

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Abstract:

Atrazine, a widely used pesticide in both agricultural and residential applications, can pose problems for drinking water treatment plants if it is present in source waters at high concentrations. We examined the presence of atrazine in drinking water sources for 14 drinking water treatment plants (DWTPs) in the Mississippi River Basin in Illinois. Data reported to the Environmental Protection Agency (EPA) by the DWTPs from 2004 – 2009 were used to assess the frequency at which the drinking water standard (3 ppb) was exceeded and the ranges of concentrations observed over the study period at each site. We used ArGIS to delineate the watersheds for each site and to determine the land use percentages within each watershed. Our goal was to identify possible relationships between the frequency at which drinking water standards were exceeded and the ranges of atrazine concentrations and the percentage of agricultural and residential land use in each watershed. Additionally, we used precipitation data from NOAA's National Climatic Data Center to identify possible links between rainfall events and high concentrations of atrazine. Our analysis showed that the percentage of agricultural land in the watersheds for 11 of the 14 drinking water sources is over 50%. Additionally, the highest atrazine concentrations were nearly always in May, June, and July, and were associated with high rainfall amounts, suggesting transport in surface runoff from agricultural sources. Additionally, high concentrations in the spring and early summer months pose potential concerns for aquatic species, as atrazine is a known endocrine disrupting compound.

Oral Presentation Abstracts

Photo Description: Dragonflies are some of nature's flashiest insects. Here, a bright blue dragonfly lands for a quick respite from flying on a bright green lilypad. Taken in Assateague Island, MD.

Emma Clement, Third Place Photo Contest Winner

Improvement of Bioenergy Yields Obtained from Duckweed by Sequential Ethanol Fermentation and Anaerobic Digestion

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Abstract:

Utilization of duckweed, a fast-growing, simple, floating aquatic plant, as a resource for bioethanol production has been proven to be a promising alternative compared to other bioenergy crops. However, management of the waste streams associated with duckweed bioethanol production has not been previously addressed. In this respect, coupling ethanol fermentation and anaerobic digestion processes can be a feasible approach for increasing the overall energetic and environmental performance of the system. The potential for improving bioenergy yields obtained from duckweed was evaluated using three methods: (1) determining the optimum substrate-to-inoculum (S/I) ratio for anaerobic digestion (i.e., duckweed to microorganism ratio); (2) low-temperature thermal treatment prior to anaerobic digestion; and (3) subjecting duckweed sequentially to ethanol fermentation and then anaerobic digestion, after evaporation of ethanol from the fermentation broth. Bioethanol yields of (0.41 ± 0.03) g/g and (0.50 ± 0.01) g/g (glucose) were achieved for duckweed harvested from the Penn State Living-Filter and Eco-Machine™, respectively. The highest biomethane yield was (390 ± 0.05) mL CH_4/g VS_{added} in a reactor containing fermented duckweed from the Living-Filter at an S/I = 1.0. This value was 51.2 % higher than the biomethane yield of a replicate reactor with untreated (non-fermented) duckweed. The combined bioethanol-biomethane process yielded 87.2 % more bioenergy from duckweed, than if anaerobic digestion had been run alone.Results of this study reveal that coupling fermentation and anaerobic digestion processes can improve the applicability of large scale duckweed biorefineries, providing a more robust system in terms of energy and the environment.

Feasible Mixing Times for a Water-Purifying *Moringa Oleifera*-Functionalized Sand (*f*-Sand) Filter

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Abstract:

Low-technology water purification methods are desirable for the millions of people who need it most. One option is the Moringa *f*-sand filter. F-sand is created by selectively adsorbing an antimicrobial cationic protein found in the seeds of the *moringa oleifera* tree to sand. Microbes flowing through an f-sand filter will "stick" to the f-sand and be removed from the water. Although our current process for creating f-sand requires only sand, seeds and water, it requires three hours of mixing. Here we will present a simple microscopic test that allows us to determine the effectiveness of the f-sand. We use this technique to reduce the mixing time to 10 minutes. This technique will also help us test the effectiveness of various types of seeds. These results have helped to create a new culturally and feasibly appropriate filter model that can be implemented in developing areas around the world.

Water Conservation Through Wastewater Reuse at Penn State's Living Filter: Are We Eating and Drinking our Prescription Drugs?

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Abstract:

With rising demands on water supplies, wastewater treatment plant (WWTP) effluent is often reused to irrigate agricultural lands. Emerging contaminants, like pharmaceuticals and personal care products (PPCPs), are frequently found in WWTP effluent, and concern has arisen about their environmental fate. This study's aim was to analyze the presence of three antibiotics, sulfamethoxazole, trimethoprim, and ofloxacin, in wheat plants (*Triticum aestivum*) and groundwater at The Living Filter, an agricultural site where WWTP effluent is reused for spray irrigation. Water samples were collected throughout the year. Wheat was collected prior to and during harvest and divided into grain and straw. Plant and water samples were analyzed by solid phase extraction and liquid chromatography – tandem mass spectrometry. Sulfamethoxazole and ofloxacin were quantifiable in groundwater samples with concentrations that varied spatially and temporally (0.14 – 660 ng L^{-1}), while trimethoprim was typically only detectable. Residues of each compound were present on most plant surfaces and in certain plant parts (0.09 – 10.2 ng g^{-1}). Ofloxacin was found throughout the plant with higher concentrations in the straw and lower concentrations in the grain. Trimethoprim was found only on surfaces, while sulfamethoxazole was concentrated within the grain. These findings demonstrate that PPCPs, specifically antibiotics, can be taken up into plant tissue, adhere to plant surfaces, and be found in groundwater when WWTP effluent is spray irrigated. The presence of PPCPs in groundwater and in the tissue or on the surfaces of plants used as food sources raises the question of potential health risks for humans and animals.

How Tree Roots Affect Shale Weathering at Shale Hills CZO

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Abstract:

Plants help drive atmospheric and land-surface water and carbon fluxes, but also play a key role in weathering the regolith/bedrock. In this study, we try to test the specific contributions of biota with respect to porosity formation and chemical weathering in the forested watershed near Susquehanna/Shale Hills Critical Zone Observatory (SSHCZO) underlain by the Rose Hill shale. We quantified the depth and distribution of roots and their effect on regolith geochemistry in soil and shale along a planar slope transect. Neutron scattering techniques were used to qualitatively analyze the pore structure in the shale chips and its relationship to weathering by root action. We strategically measured shale chip porosity around rooting and non-rooting zone to determine whether rooting depth and distribution influences shale porosity. At the ridge top, where soils are thin (~ 20 cm) and weathering is fast, the density of roots is higher in the fractured bedrock below the augerable regolith. Conversely, in the toe-slope, where soils are thick (> 70 cm) and weathering is slow, the density of roots are low in the bedrock fractures. Clay material associated with roots on rock fragments in weathered bedrock zone shows geochemical signal like clay observed in regolith. We did see higher porosity above 5 meters. We did not see higher porosity on rocks surrounded by roots. We attribute the increase in porosity above 5 m to fracturing of the rock, perhaps driven by periglacial conditions during Last Glacial Maximum (LGM), not due to plants or roots.

Abiotic Analysis of Gas Diffusion and Aqueous Cathodes for use in Microbial Electrolysis Cells

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Abstract:

Microbial Electrolysis Cells (MECs) utilize an applied voltage to cause electrons from organic matter in the anolyte and protons from water to undergo the hydrogen evolution reaction (HER) on the surface of the cathode. Gas diffusion cathodes are designed to keep evolved hydrogen in the gaseous phase, unlike the more well-studied aqueous cathodes, which are designed to have hydrogen bubbles form on the cathode surface and rise up into the headspace of the catholyte. The development of a gas diffusion layer that allows for an efficient HER is of great interest as it could increase the cathodic efficiency in MECs by reducing hydrogen cross over into the anolyte liquid and increasing the active surface area of the cathode. Gas diffusion cathodes that were examined here were made from SS mesh with a catalyst layer containing carbon black (CB), platinum, and a poly(dimethylsiloxane) (PDMS) binder. The gas diffusion layer, containing activated carbon (AC) and a poly(1,1-difluoroethylene) (PVDF) binder, was soaked in ethanol to wet the hydrophobic binder. The gas diffusion cathode averaged a 76% cathodic efficiency, which was high for a gas diffusion cathode, but lower than the 92% cathodic efficiency for the aqueous cathode (constant applied current density of -5.7A/m^2). Further testing of the gas diffusion cathode at a higher applied current density of -8.6 A/m^2 produced an improved 86% cathodic efficiency, but with greater variance in results. Once additional tests are completed to reduce variance among tests, experiments will be conducted using biotic MECs.

Optimization of Growth Conditions for Simultaneous Saccharification and Fermentation of Ethanol by *Asprgillus niger* and *Saccharomyces cerevisiae* in Biofilm Reactors

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Abstract:

Bioethanol is one of the renewable energy sources that is highly on demand due to increasing environmental concerns. In this study, ethanol production from industrial potato waste was studied for an improved production of ethanol by employing co-cultures of *Aspergillus niger* and *Saccharomyces cerevisiae* in biofilm reactors. Biofilm is a natural cell immobilization that is used to reduce the cost and improve the effectiveness of the fermentation process. Plastic composite supports (PCS) are solid supports that are used to stimulate biofilm formation in bioreactor during microbial production. The PCS, which was composed of polypropylene, soybean hull, soybean flour, yeast extract, and salts were selected based on the biofilm formation. Growth conditions, pH, temperature, and aeration, were optimized using a three-factor Box-Behnken design of response surface method. Optimum conditions were found to be 35 °C, pH 5.8 with no aeration (0 vvm). This study showed that ethanol production can be produced from industrial wastes by simultaneous saccharification and fermentation with application of biofilm reactors.

Use of a Transgenic Virus to Modulate microRNA and Protein Levels in the Malaria Vector *Anopheles gambiae*

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Abstract:

In recent years, the role of endogenous microRNAs (miRNAs) has become a major area of interest. miRNAs are short (~22 nucleotide) segments of noncoding RNA that have been found to modulate gene expression levels through post-transcriptional regulation processes known as RNA activation and RNA interference. Several studies have identified miRNAs in key mosquito vectors that exhibit altered expression during important processes such as malaria infection, egg development, and sugar absorption. Manipulation of specific miRNAs in the malaria vector *Anopheles gambiae* may lead to the development of novel control strategies and deepen our understanding of gene regulation processes within the mosquito. The use of a genetically modified viral agent such as *An. gambiae* densovirus (AgDNV) has the potential to stably alter *An. gambiae* miRNA levels *in vivo*. AgDNV is species specific and has been shown to have nominal effects on the *An. gambiae* transcriptome. We have developed an AgDNV co-transfection system to positively or negatively manipulate *An. gambiae* miRNA levels by expressing endogenous pre-miRNA sequences from a created viral intronic region. *In vitro* expression of mature *An. gambiae* miR-375 has been validated via qPCR, indicating proper pre-miRNA recognition and processing. AgDNV-based expression of miR-375 *in vitro* led to a decrease in mRNA transcripts encoding REL1, an important mosquito immune gene and a predicted target of miR-375. This AgDNV system represents a novel molecular tool with which the role of *An. gambiae* miRNAs in mosquito biology and immunology can be studied. Future studies using AgDNV may lead to innovative vector control methods and aid in basic *An. gambiae* miRNA function investigations.

Grassland Expansion in the Miocene: A Fire Biomarker Comparison Between Two Records of Ecological Change

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Abstract:

C4 grassland expansion (5-8 Ma) was one of the largest ecological shifts of the Cenozoic. This event was not globally synchronous, with ~2 Myr offsets between expansion events in Africa, Asia and the Americas. This discordant timing implies that a regional, rather than global, mechanism drove grassland transition. One hypothesis is that changes in local-scale fire dynamics cleared forested areas, providing grassland habitats with a competitive advantage. However, the relationships between fire and C4 vegetation shifts in deep time remain largely unconstrained. Here, we analyze combustion biomarkers in two types of sedimentary records from the Late Miocene. Our first site is DSDP core 94 from the Gulf of Mexico, a record representative of the North American C4 shift. Our second site is a series of paleosols from the well-characterized Neogene Siwalik group, a record representative of local Indian subcontinent C4 expansion. We compared a suite of polycyclic aromatic hydrocarbons (PAHs) in both of these records. We address the questions 1) Are there distinct fire patterns associated with C4 transition events on different scales? and 2) Do forest ecosystems directly transition to C4 grassland or is there a forest-C3 grassland-C4 grassland shift?

Molecular weight ratios indicate that there were more high intensity fires in the North American continental record than the Siwalik record. Pyrene values suggest a peak in fire combustion at the onset of C4 transition in both records. Retene, a PAH which signifies high conifer input, shows that plant communities in the Siwaliks shift directly from conifer forests to C4 grasslands.

CysB-regulated Genes of *Vibrio fischeri* are Heterogeneously Expressed within the Squid Light Organ

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Abstract:

Bacterial infections impact basic human health and physiology. The symbiosis established between, *Euprymna scolopes*, and the bioluminescent bacterium, *Vibrio fischeri* provides researchers with a powerful tool to study host-microbe interactions. *E. scolopes* houses *V. fischeri* within a specialized light organ, where the host provides nutrients in exchange for light production. Previous work has demonstrated that cysteine auxotrophs of *V. fischeri* were accommodated within the squid light organ to 5% percent of wild-type levels. We hypothesize that cysteine biosynthesis promotes full colonization of the light organ. To address this hypothesis, we used reporter plasmids and confocal microscopy to quantify gene expression. We found that CysB activates *cysD* and *fliY* in the absence of cysteine. Specifically, cells grown in sulfate exhibited 28-fold and 24-fold higher levels of *cysD* and *fliY* expression, respectively, than in the presence of 1mM cysteine. We also made the surprising discovery that CysB-regulated genes were heterogeneously expressed across the *V. fischeri* populations within the three distinct crypt spaces on each side of the light organ. Our results demonstrate that CysB regulates cysteine biosynthetic genes in *V. fischeri* cells within the host. In addition, our results suggest that cysteine-containing peptides are being provided in crypt I at higher quantities than crypt 1 and 2. Because crypt I is developmentally more mature than non-crypt I spaces, our work supports a model where nutrient provision is influenced by host development. Such examples of development impacting infections are likely to occur in more complex interactions, such as those involving the human microbiota.

The Importance of Endophytes in Developing Molecular Detection Methods: The Case for Race 4 of *Fusarium oxysporum* f. sp. *cubense* Causing Panama Disease on Bananas

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Abstract:

Panama disease is caused by the fungus *Fusarium oxysporum* f. sp. *cubense* (*Foc*) and is currently considered the main threat for banana production in the world. A new variant of *Foc*, known as tropical race 4 (TR4), has emerged that causes disease on 'Cavendish', the main cultivar used for export purposes. In addition, 80% of all banana varieties are susceptible to TR4 and its incursion in developing countries will put at risk the livelihood and food security of millions. Prevention is the best strategy available for combating this disease. In this regard, early detection of TR4 outbreaks can help to quickly adopt quarantine procedures to avoid the further dispersal of the pathogen. However, the current detection methods were developed only considering pathogenic isolates, without considering the diversity of *F. oxysporum* found in the roots of banana plants. We hypothesized that the accuracy of these technologies may be compromised if tested with non-pathogenic, endophytic isolates. This work incorporated the analysis of 280 pathogenic and non-pathogenic isolates of *F. oxysporum* obtained from banana based on a PCR approach, using four sets of specific primers for detection of race 4 (TR4 and SubTR4). Isolates with positive amplification for TR4 were further tested for pathogenicity to banana. Phylogenetic analysis of two housekeeping genes (TEF and MtSSU) and the intergenic spacer region of the ribosomal RNA (IGS) were considered for elucidating the genetic relationships of pathogenic and endophytic lineages of *F. oxysporum*. Our results show that some *F.oxysporum* endophytes share the same genomic regions exploited for the development of current *Foc* detection methods and generate false positive amplifications. The possibility of obtaining false positives in the molecular identification of TR4 has very important implications regarding quarantine procedures and contingency plans.

Detection of Volatile Organic Compounds Associated with *Trichoderma aggressivum* Infestation within *Agaricus bisporus* Compost Substrate

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Abstract:

Preparation of high-yielding *Agaricus bisporus* mushroom substrate is a proven science and art. Experienced members of the mushroom industry are able to recognize off-odors throughout the composting and growing process, such as anaerobic conditions or green mold disease. Current technologies (i.e. tunnels, bunkers) distance the compost producers from the process and inhibit this sensory mechanism that has been a proven source of assessing compost quality. *Trichoderma aggressivum,* the causal agent of green mold disease, remains one of the greatest challenges to the industry despite our advanced composting and sanitation practices. Early identification of the organism will provide a mechanism for quality control and determine the source of inoculum. Headspace air sampling and analysis using gas chromatography-mass spectrometry is capable of identifying even trace amounts of volatile organic compounds (VOCs) associated with competitor molds and pathogens. My research seeks to associate *T. aggressivum* infestation of phase III compost with the presence of unique VOCs. Phase II compost inoculated with *A. bisporus* grain spawn and *T. aggressivum* infested grain was placed into a miniature phase II/III tunnel, or bioreactor. Volatiles were collected on to solid-phase microextraction (SPME) fibers allowed for VOC monitoring throughout a 14day spawn run. The results from these analyses will be used in the calibration of a portable-MS. Once completed, a portable-MS will then be capable of detecting the presence of green mold in phase II or phase III compost prior to filling houses and identifying disease development earlier in the cropping process.

GCxGC-TOFMS Comparison of Extraction Techniques for the Determination of Emerging Contaminants in Wastewater

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Abstract:

A topic of growing importance to environmental scientists is the presence of emerging contaminants in municipal wastewater treatment facilities and the possibility of them remaining in the water after treatment. Many of the treatment methods used today are not effective at removing these contaminants. Compounds from personal care products, industrial processes, and pharmaceuticals contribute to these contaminants and are analyzed in this study. Water samples from the pre-treatment influent and post-treatment effluent from the Penn State Wastewater Treatment Facility were extracted and analyzed by multidimensional gas chromatography (GCxGC) coupled to time of flight mass spectrometry (TOFMS). Liquid-liquid extraction (LLE) and stir bar sorptive extraction (SBSE) were compared for their extraction efficiency, “greenness”, and ease of process. The preliminary data from this project shows contaminants present in the influent and effluent, signifying that many are not being removed during the treatment process. Both extraction methods were effective, LLE extracts a more broad range of compounds but SBSE is more sensitive. SBSE is a much “greener” and easier approach to extraction than LLE. GCxGC TOFMS is a very useful technique for the separation of these complex mixtures and to identify compounds of interest in wastewater samples.

Copper Removal from Wastewater Using Thermally Regenerative Electrodeposition Battery

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Abstract:

A thermally regenerative ammonia battery (TRAB) recently developed for electricity generation using waste heat was adapted and used here as a treatment process for wastewaters containing high concentrations of copper ions. Copper removal reached a maximum of 77% at an initial copper concentration (C_i) of 0.05 M, with a maximum power density (P) of 31 W/m^2-membrane. Lowering the initial copper concentration decreased the percentage of copper removal from 51% (C_i=0.01 M, P=13 W/m^2) to 2% (C_i=0.002 M, P=2 W/m^2). Although the final wastewater may require additional treatment, the adapted TRAB process removed much of the copper while producing electrical power that could be used in later treatment stages. These results show that the adapted TRAB can be a promising technology for removing copper ions and producing electricity from wastewater by using waste heat as a highly available and free source of energy at many industrial sites.

Evolution of a Persistent Virus in Different Pepper Cultivars

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Abstract:

They are many plant viruses that are maintained in a persistent lifestyle in their hosts. Plant persistent viruses are widespread in both commercially important crops and wild plants, replicating in their hosts for many generations. These viruses have been ignored because they are asymptomatic and do not cause any disease. Movement between plant cells and transmission through grafting has not been observed in them. They are distributed to all host cells through host cell division, and vertically transmitted via the gametes at rates close to 100%. The biology of plant persistent viruses has not been studied thoroughly, but their very long-term relationships with their hosts, and their high level of vertical transmission imply beneficial interactions. So far, *Endornaviridae* is the only family of plant persistent viruses with a single-stranded RNA genome, and, in addition to plants, members infect fungi and oomycetes. *Bell pepper endornavirus* (BPEV) has been reported from peppers (*Capsicum* spp.). Peppers are perennial plants, native to South America, and as domesticated plants human selection accelerated their evolution. Studies on plant acute viruses showed high genetic diversity in their population, and the level of variation may change over time and in different hosts. Plant persistent viruses remain in their host for a long time; so, they may have different evolutionary patterns. To investigate the evolution of BPEV in peppers, dsRNA was extracted from over one hundred peppers leaves, including different cultivars of *Capsicum annuum*, *C. chacoense*, *C.chinense*, and *C.bacccutum*. The presence of BPEV was assessed by RT-PCR using the specific primers for the RNA dependent RNA polymerase and helicase domains, which amplified fragments of 1,144 bp and 1,162 bp respectively. The nucleotide sequences of the RT-PCR products were determined and the phylogeny of these two domains in different peppers has been analyzed.

Removal of Trace Organic Contaminants in Six Full-scale Integrated Fixed-film Activated Sludge (IFAS) Wastewater Treatment Plants

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Abstract:

Trace Organic Contaminants (TrOCs) often pass through conventional activated sludge wastewater treatment plants (CAS-WWTPs) and are discharged into surface waters, threatening aquatic ecosystems. The integrated fixed-film activated sludge (IFAS) process is a cost-effective means of upgrading CAS-WWTPs by adding free-floating media, which promotes biofilm formation in the well-mixed suspended growth reactors and provides a niche for slow-growing microorganisms. IFAS upgrades reliably enhance nutrient removal; however, limited data indicate that TrOC removal is also improved. Slow-growing fungi may be enriched in the biofilm and could contribute to TrOC removal. In this study, six full-scale IFAS-WWTPs were surveyed to quantify TrOC and estrogenic activity removal and to compare fungal diversity within the biofilm and suspended growth. Twenty-four-hour composite samples of secondary influent and effluent (pre-disinfection) were collected from each IFAS-WWTP during September/October 2015 and were analyzed for total suspended solids (TSS), chemical oxygen demand (COD), ammonia, estrogenic activity, and 98 TrOCs. Grab samples of AS and IFAS media were stored at -80 °C for later DNA extraction. The biomass distribution between AS and IFAS media was also assessed. All IFAS-WWTPs efficiently removed TSS, COD, and ammonia. Total solids per liter of wetted reactor volume ranged from 2.5-7.6 g, with 40-60% attached to media. TrOCs with no detection (34) and those with consistently high removal (27, ≥99% average removal) were observed. Other TrOCs had highly variable removal rates, but qualitative assessment shows higher removals for acesulfame-k, atenolol, diclofenac, and TCPP, when compared to CAS-WWTPs. Estrogenic activity and fungal diversity analyses remain in progress.

Sink Drains to Sea Turtle Eggs: Unraveling the Ecology and Epidemiology of Infectious *Fusaria* in Humans and Animals

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Abstract:

Emerging fungal diseases of wildlife are increasingly common, with devastating consequences for biodiversity and ecosystem health. White nose syndrome, snake fungal disease and chytridiomycosis of amphibians are all examples of fungal diseases that have taken, and continue to take, a major toll on populations of bats, snakes, and frogs, respectively. *Fusarium keratoplasticum* (Fk) and *Fusarium falciforme* (Ff) have been implicated in mass mortalities in the nests of endangered sea turtles. These are common, cosmopolitan species of filamentous fungi that are known opportunistic pathogens of immunosuppressed, and sometimes healthy, humans. Ff is an ubiquitous soil-associated species, while Fk occurs more frequently in areas under high anthropogenic influence, particularly in sink drains and in human infections. Unravelling their genetic diversity and population structure is integral to elucidating the ecology and epidemiology of the fusaria implicated in both clinical and sea turtle egg diseases. Both species show high levels of genetic diversity, and known anthropogenic isolates of Fk are dominated by an expanding clone complex. Fusarium isolated from sea turtle eggs may offer a key to understanding the global population biology of these two species. The results from this research will allow for inferences to be made regarding the epidemiology of *Fusarium* infections in sea turtle eggs and humans, as well as the impact of anthropogenic versus natural environments on population structure.

Understanding the Dependence of Magnesite Dissolution Rates on Spatial Heterogeneity

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Abstract:

Mineral dissolution plays a critical role in many chemical and physical phenomena in earth and environmental sciences. It affects the chemistry of surface and ground water, changes the reservoir structures and energy productions, and influents global climate. Mineral dissolution rates measured in field studies have been reported to be orders of magnitude lower than those measured under well-mixed batch reactors. Our column experiments have shown that the effectively-dissolving mineral surface area (effective surface area, A_e) varies in different spatial patterns of magnesite, therefore contributing to the rate discrepancy. To extend our experimental work, here we applied reactive transport modeling to understand the dependence of magnesite dissolution rates on spatial heterogeneity in porous media. Multiple realizations of heterogeneous permeability distributions were generated using the Gaussian sequential simulation method. These realizations differ in permeability variance and correlation length. We found that large variance and correlation length trends to result in small A_e and dissolution rates but with large uncertainty. The A_e provides a good linear relation with dissolution rates and varies by more than 1 order of magnitude. The local residence time distribution in the magnesite zones and its relevant mean (reactive residence time, τ_r) determines the A_e value. From the output of 240 simulations with different characteristics of spatial heterogeneity, we derived a general equation that quantifies the rates in heterogeneous media as a function of A_e through τ_r. This work reveals the critical role of water-mineral contact time in the dependence of dissolution rates on spatial heterogeneous fields and provides a possible approach predicting dissolution rates.

Immobilization of Fe-N-C Co-catalyst on Activated Carbon with Enhanced Cathode Performance in Microbial Fuel Cells

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Abstract:

The broader application of microbial fuel cell (MFC) is limited by the low power density mainly due to poor cathode performance. Here, activated carbon was immobilized with Fe-N-C co-catalyst and the oxygen reduction reaction pathway was altered from two-electron to a quasi-four-electron pathway. A maximum power density of 4.7 ± 0.2 W m^{-2} was achieved in MFCs using the Fe-N-C/AC catalyst in 200 mM PBS, which was 38% higher than the untreated AC. The Fe-N-C co-catalyst loaded AC cathode also obtained a maximum power density of 0.8 ± 0.03 W m^{-2} in wastewater and was 100% higher than 0.4 ± 0.03 W m^{-2} of typical Pt/C cathode, suggesting the effectiveness in harvesting more electricity from wastewater. Compared to typical nitrogen doping where the mass of nitrogen precursor was usually several times of that of activated carbon, only one sixth of mass of nitrogen dopant was consumed in this study, suggesting a more economical way of modification. With the same amount of nitrogen precursor consumed, activated carbon immobilized with Fe-N-C co-catalyst showed 19% higher mass current density compared to just nitrogen doped activated carbon. Iron doping onto activated carbon was not able to boost the ORR activity or increase current generation. Adoption of this Fe-N-C immobilized activated carbon as cathode catalyst would enable higher power production and broader applications of MFCs.

Wastewater Treatment Using a Novel Aerated and Fluidized Bed Membrane Bioreactor

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Abstract:

Anaerobic fluidized bed membrane bioreactors (AFMBRs) use granular activated carbon (GAC) particles suspended by recirculation to effectively treat low strength wastewaters (~100-200 mg/L COD), but the effluent can contain high concentration of dissolved methane. An aerobic fluidized bed membrane bioreactor (AOFMBR) was developed to avoid methane production and the need for wastewater recirculation by using rising air bubbles to suspend GAC particles. The performance of the AOFMBR was compared to an AFMBR and a conventional aerobic membrane bioreactor (MBR) for domestic wastewater treatment over 130 d at ambient temperatures. The total COD of AOFMBR effluent was averaged to be 26 mg/L, compared to 38 mg/L for the MBR and 51 mg/L for the AFMBR, with an effluent turbidity of <0.2 NTU, for influent CODs of 150, 200, and 300 mg/L (hydraulic retention time of 1.3 h). The membrane TMP of the AOFMBR increased at 0.04 kPa d^{-1}, which was 20% less than the MBR and 57% less than the AFMBR, at low influent COD conditions (150 and 200 mg/L), in the absence of backwashing or chemical cleaning. Scanning electron microscopy (SEM) analysis confirmed that addition of GAC in AOFMBR can remove cake layer deposition, and it did not show any evidence of membrane damage. DNA sequencing analysis showed that the dominant phyla in the AOFMBR was consistent with conventional activated sludge treatment. High similarity was found between communities in the suspended biomass in AOFMBR and MBR. Communities on the GAC and suspended sludge in the AOFMBR were dissimilar, while the GAC and solution in AFMBR clustered together.

Published works from previous ECMSS presenters

Ambler, J. R., & Logan, B. E. (2011). Evaluation of stainless steel cathodes and a bicarbonate buffer for hydrogen production in microbial electrolysis cells using a new method for measuring gas production. International Journal of Hydrogen Energy, 36(1), 160-166.

Baier, B.C. , W. H. Brune, B. Lefer, D. Miller, D. Martins, 2015: Direct ozone production rate measurements and their use in assessing ozone source and receptor regions for Houston in 2013, Atmos. Environ., (114), 83-91, doi:10.1016/j.atmosenv. 2015.05.033.

Brown, J. F., Jones, D. S., Mills, D. B., Macalady, J. L., & Burgos, W. D. (2011). Application of a depositional facies model to an acid mine drainage site. Applied and Environmental Microbiology, 77(2), 545-554.

Burgos, W. D., Borch, T., Troyer, L. D., Luan, F., Larson, L. N., Brown, J. F., Shimizu, M. (2012). Schwertmannite and Fe oxides formed by biological low-pH Fe(II) oxidation versus abiotic neutralization: Impact on trace metal sequestration. Geochimica et Cosmochimica Acta, 76(0), 29-44. doi: http://dx.doi.org/10.1016/j.gca.2011.10.015

Chacon-Madrid, H., & Donahue, N. (2011). Fragmentation vs. functionalization: chemical aging and organic aerosol formation. Atmos. Chem. Phys, 11(10), 553.

Cheng, K.-C., Demirci, A., Catchmark, J. M., & Puri, V. M. (2010). Modeling of pullulan fermentation by using a color variant strain of *Aureobasidium pullulans*. Journal of Food Engineering, 98(3), 353-359.

Cusick, R. D., & Logan, B. E. (2012). Phosphate recovery as struvite within a single chamber microbial electrolysis cell. Bioresource technology, 107(0), 110-115. doi: http://dx.doi.org/10.1016/j.biortech.2011.12.038

Davis, R. E., Normile, C. P., Sitka, L., Hondula, D. M., Knight, D. B., Gawtry, S. P., & Stenger, P. J. (2010). A comparison of trajectory and air mass approaches to examine ozone variability. Atmospheric Environment, 44(1), 64-74.

Dere, A. L., & Stehouwer, R. C. (2011). Labile and Stable Nitrogen and Carbon in Mine Soil Reclaimed with Manure-Based Amendments. Soil Science Society of America Journal, 75(3), 890-897.

Dere, A. L., Stehouwer, R. C., Aboukila, E., & McDonald, K. E. (2012). Nutrient Leaching and Soil Retention in Mined Land Reclaimed with Stabilized Manure. Journal of environmental quality, 41(6), 2001-2008.

Dere, A. L., Stehouwer, R. C., & McDonald, K. E. (2011). Nutrient leaching and switchgrass growth in mine soil columns amended with poultry manure. Soil Science, 176(2), 84.

Dere, A. L., White, T. S., April, R. H., Reynolds, B., Miller, T. E., Knapp, E. P., Brantley, S. L. (2013). Climate dependence of feldspar weathering in shale soils along a latitudinal gradient. Geochimica et Cosmochimica Acta, 122, 101-126.

Domagal-Goldman, S., Paul, K., Sparks, D., & Kubicki, J. (2009). Quantum chemical study of the Fe (III)-desferrioxamine B siderophore complex—Electronic structure, vibrational frequencies, and equilibrium Fe-isotope fractionation. Geochimica et Cosmochimica Acta, 73(1), 1-12.

Dominguez, V. C., McDonald, C. R., Johnson, M., Schunk, D., Kreuter, R., Sykes, D., Chohan, B. S. (2010). The characterization of a custom-built coulometric Karl Fischer titration apparatus. Journal of Chemical Education, 87(9), 987-991.

Doughty, D., Fuentes, J. D., Sakai, R., Hu, X.-M., & Sanchez, K. (2013). Nocturnal isoprene declines in a semi-urban environment. Journal of Atmospheric Chemistry, 1-20.

Garner, G. G., & Thompson, A. M. (2012). The Value of Air Quality Forecasting in the Mid-Atlantic Region. Weather, Climate, and Society, 4(1), 69-79. 66

Goebel, M., Hobbie, S. E., Bulaj, B., Zadworny, M., Archibald, D. D., Oleksyn, J., Eissenstat, D. M. (2011). Decomposition of the finest root branching orders: linking belowground dynamics to fine-root function and structure. Ecological Monographs, 81(1), 89-102.

Golanoski, K. S., Fang, S., Del Vecchio, R., & Blough, N. V. (2012). Investigating the Mechanism of Phenol Photooxidation by Humic Substances. Environmental Science & Technology, 46(7), 3912-3920.

Hatzell, M. C., Kim, Y., & Logan, B. E. (2013). Powering microbial electrolysis cells by capacitor circuits charged using microbial fuel cell. Journal of Power Sources, 229(0), 198-202. doi: http://dx.doi.org/10.1016/j.jpowsour.2012.12.006

Hatzell, M. C., & Logan, B. E. (2013). Evaluation of flow fields on bubble removal and system performance in an ammonium bicarbonate reverse electrodialysis stack. Journal of Membrane Science, 446, 449-455.

Herndon, E. M., & Brantley, S. L. (2011). Movement of manganese contamination through the Critical Zone. Applied Geochemistry, 26, S40-S43.

Herndon, E. M., Jin, L., & Brantley, S. L. (2010). Soils reveal widespread manganese enrichment from industrial inputs. Environmental Science & Technology, 45(1), 241-247.

Iyer, P. R., Catchmark, J., Brown, N. R., & Tien, M. (2011). Biochemical localization of a protein involved in synthesis of *Gluconacetobacter hansenii* cellulose. Cellulose, 18(3), 739-747.

Izadi, G., & Elsworth, D. (2011). Influence of Energy Release In Fracture Networks On Reservoir Evolution And Triggered Seismicity In EGS Reservoirs. Paper presented at the 45th US Rock Mechanics/Geomechanics Symposium.

Jensen, A. A., Thompson, A. M., & Schmidlin, F. (2012). Classification of Ascension Island and Natal ozonesondes using self-organizing maps. Journal of Geophysical Research, 117(D4), D04302.

Kariyat, R. R., Mauck, K. E., De Moraes, C. M., Stephenson, A. G., & Mescher, M. C. (2012). Inbreeding alters volatile signaling phenotypes and influences tri-trophic interactions in horsenettle (*Solanum carolinense* L.). Ecology letters, 15(4), 301-309. doi: 10.1111/j.1461-0248.2011.01738.x

Kariyat, R. R., Scanlon, S. R., Mescher, M. C., De Moraes, C. M., & Stephenson, A. G. (2011). Inbreeding depression in *Solanum carolinense* (Solanaceae) under field conditions and implications for mating system evolution. PloS one, 6(12), e28459.

Lashaway, A. R., & Carrick, H. J. (2010). Effects of light, temperature and habitat quality on meroplanktonic diatom rejuvenation in Lake Erie: implications for seasonal hypoxia. Journal of Plankton Research, 32(4), 479-490.

Lupton, M. K., Rojas, C., Drohan, P., & Bruns, M. A. (2012). Vegetation and Soil Development in Compost-Amended Iron Oxide Precipitates at a 50-Year-Old Acid Mine Drainage Barrens. Restoration Ecology, 9999(9999), n/a-n/a. doi: 10.1111/j.1526-100X.2012.00902.x

Morrow, C. P., Nangia, S., & Garrison, B. J. (2009). Ab initio investigation of dissolution mechanisms in aluminosilicate minerals. The Journal of Physical Chemistry A, 113(7), 1343-1352.

Mullaney, E. G. (2009). Carib Territory: Indigenous Access to Land in the Commonwealth of Dominica. Journal of Latin American Geography, 8(2), 71-96.

Rader, G. K., & Logan, B. E. (2010). Multi-electrode continuous flow microbial electrolysis cell for biogas production from acetate. international journal of hydrogen energy, 35(17), 8848-8854.

Reed, Andra J., Michael E. Mann, Kerry A. Emanuel, Ning Lin, Benjamin P. Horton, Andrew C. Kemp, and Jeffrey P. Donnelly. (2015.) Increased threat of tropical cyclones and coastal flooding to New York City during the anthropogenic era. PNAS 112 (41) 12610-12615.

Ren, L., Tokash, J. C., Regan, J. M., & Logan, B. E. (2012). Current generation in microbial electrolysis cells with addition of amorphous ferric hydroxide, Tween 80, or DNA. International Journal of Hydrogen Energy, 37(22), 16943-16950. doi: http://dx.doi.org/10.1016/j.ijhydene.2012.08.119

Salesky, S., & Chamecki, M. (2012). A Similarity Model of Subfilter-Scale Energy for Large-Eddy Simulations of the Atmospheric Boundary Layer. Boundary-Layer Meteorology, 145(1), 69-91. doi: 10.1007/s10546-011-9618-0

Smyth, C., S. Schlesinger, B. E. Overton, and C. Butchkoski. 2013. The Alternative Host Hypothesis and Potential Virulence Genes in *Geomyces destructans*. Bat Research News, 54:17–24.

Stauffer, R. M., Thompson, A. M., Martins, D. K., Clark, R. D., Goldberg, D. L., Loughner, C. P., Tzortziou, M. A. (2012). Bay breeze influence on surface ozone at Edgewood, MD during July 2011. Journal of Atmospheric Chemistry, 1-19. 67

Stockwell, W. R., Lawson, C. V., Saunders, E., & Goliff, W. S. (2011). A Review of Tropospheric Atmospheric Chemistry and Gas-Phase Chemical Mechanisms for Air Quality Modeling. Atmosphere, 3(1), 1-32.

Tai, Y.-L., & Dempsey, B. A. (2009). Nitrite reduction with hydrous ferric oxide and Fe (II): stoichiometry, rate, and mechanism. Water Research, 43(2), 546-552.

Wagner, R. C., Porter-Gill, S., & Logan, B. E. (2012). Immobilization of anode-attached microbes in a microbial fuel cell. AMB Express, 2(1), 1-6.

Wagner, R. C., Regan, J. M., Oh, S.-E., Zuo, Y., & Logan, B. E. (2009). Hydrogen and methane production from swine wastewater using microbial electrolysis cells. Water Research, 43(5), 1480-1488.

Watson, V. J., & Logan, B. E. (2010). Power production in MFCs inoculated with Shewanella oneidensis MR-1 or mixed cultures. Biotechnology and Bioengineering, 105(3), 489-498.

Wei, B., Tokash, J. C., Zhang, F., Kim, Y., & Logan, B. E. (2013). Electrochemical analysis of separators used in single-chamber, air-cathode microbial fuel cells. Electrochimica Acta, 89(0), 45-51. doi: http://dx.doi.org/10.1016/j.electacta.2012.11.004

Weitzman, J.N., Forshay, K.J., Kaye, J.P., Mayer, P.M., Koval, J.C., & Walter, R.C. (2014). Potential nitrogen and carbon processing in a landscape rich in milldam legacy sediments. *Biogeochemistry*, *120*(1-3), 337-357.

Yang, F., Ren, L., Pu, Y., & Logan, B. E. (2013). Electricity generation from fermented primary sludge using single-chamber air-cathode microbial fuel cells. Bioresource Technology, 128(0), 784-787. doi: http://dx.doi.org/10.1016/j.biortech.2012.10.021

Zhang, F., Chen, G., Hickner, M. A., & Logan, B. E. (2012). Novel anti-flooding poly(dimethylsiloxane) (PDMS) catalyst binder for microbial fuel cell cathodes. Journal of Power Sources, 218(0), 100-105. doi: http://dx.doi.org/10.1016/j.jpowsour.2012.06.088

Zhang, F., Pant, D., & Logan, B. E. (2011). Long-term performance of activated carbon air cathodes with different diffusion layer porosities in microbial fuel cells. Biosensors and Bioelectronics, 30(1), 49-55.

Zhang, F., Saito, T., Cheng, S., Hickner, M. A., & Logan, B. E. (2010). Microbial fuel cell cathodes with poly (dimethylsiloxane) diffusion layers constructed around stainless steel mesh current collectors. Environmental Science & Technology, 44(4), 1490-1495.

Zuroff, T. R., Xiques, S. B., & Curtis, W. R. (2013). Consortia-mediated bioprocessing of cellulose to ethanol with a symbiotic Clostridium phytofermentans/yeast co-culture. Biotechnology for Biofuels, 6(1), 59.

Acknowledgements

This student symposium has been made possible by the strong support of various individuals and organizations at Penn State. We would like to acknowledge them for their effort, guidance, and sponsorship.

We express our gratitude to the Student Association of Environmental Science and Engineering and its executive committee for their generous support and invaluable advice. Director Dr. John Regan is to be applauded for his unwavering support of ECMSS 2016.

The symposium is funded in part by the Environment and Natural Resources Institute (ENRI, a part of the College of Agricultural Sciences), the Penn State Institutes of Energy and the Environment (PSIEE), and the Engineering Energy and Environment Institute (E^3I) of the College of Engineering, the Graduate and Professional Student Association (GPSA), Materials Research Institute (MRI), Huck Institute of the Life Sciences, and the University Park Allocation Committee (UPAC). The following departments have generously provided funds to support this year's monetary awards for outstanding presentations.

Department of Chemistry
Department of Civil and Environmental Engineering
Department Ecosystem Science and Management
Department of Plant Science
Department of Plant Pathology and Environmental Microbiology
Department of Geosciences

The chairs and the student organizing committee wish to thank Debra Lambert for administrative assistance – she has answered countless questions and has made the organization of this symposium immeasurably easier.

We are grateful to the many individuals that are participating in the symposium as judges. Their service adds professionalism to our efforts to provide a competitive forum to encourage excellence in environmental scientific research.

We would like to acknowledge our keynote speakers, Dr. Paula Mouser, Dr. Marc Edwards, and Dr. John Kelmelis, for sharing their experiences in the field of environmental research.

The diversity of research presented at ECMSS is its greatest strength, and the symposium would not be a success without the outstanding contributions of the student participants. We appreciate the participation from Penn Staters as well as the many students and faculty who have traveled from around the region to join us.

Finally, the symposium co-chairs wish to thank all of the dedicated student volunteers that have served on the organizing committee. Their dedication to this meeting has allowed for the continuation of a great tradition, and their desire to innovate has fostered its growth.

Lillian Hill – *Secretary*

Jessie Ward – *Abstract Book, Publication list*

Shauna-Kay Rainford – *Audio/Visual, Judging*

Janet Ellsworth – *Judging*

Kyra Murrell – *Photo and T-shirt Contest*

Christopher Smyth – *Publicity*

Michael Shreve – *Webdesign and Maintenance*

Miranda Stockton – *Off-campus Outreach*

Ozgul Calicioglu – *Hospitality/Event Setup/Food*

Margaret Kennedy – *Undergraduate Outreach*

Shelby Lyons – *Undergraduate Outreach*

Sincerely,

Paulina Piotrowski and Prachi Joshi

Co-chairs, 2016 ECMSS Organizing Committee

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