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2018 Student Spotlight on Research Proceedings

SUNY College of Environmental Science and Forestry

Student Spotlight on Research Proceedings

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Gateway Center

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College of Environmental Science and Forestry

Members of the Ad Hoc Committee for the Student Spotlight on Research:

The Spotlight is organized by the Ad-Hoc Committee for Spotlight on Student Research, a sub-committee of the Academic Governance Committee on Research (COR). The Committee would like to thank the Office of Research Programs for sponsoring the refreshments during the poster session.

We would also like to express our gratitude to the graduate students, undergraduates, and faculty for contributing to this event. Without your work there would be no event!

GRADUATE RESEARCH

Authors: Coleman, S. and Mirowsky, J., Department of Chemistry

Title: Efficiency of Industrial Noise-Canceling Headphones for Reducing Traffic Noise

Abstract: Particulate matter (PM) air pollution and noise have both been shown to cause an increase in stress levels in humans, which can lead to increased risk for cardiovascular disease (CVD). Many studies exist to support the relationship between high levels of PM and high rates of CVD; however, limited studies exist that examine the relationship between noise and CVD, even though high levels of PM and noise often exist simultaneously. In the first step of a larger-scale epidemiological study aimed at separating the health effects of PM and noise, this study assessed the efficiency of three different noise canceling headphones (Tronsmart passive and active noise-canceling, 3M Optime 98, 3M Optime 105). The headphones were tested in a lab environment when exposed to pre-recorded traffic noise. The headphones' efficiency was measured by calculating the percent of sound reduction compared to a control. Of the three headphones tested, the 3M Optime 98 headphones were most effective at reducing the sound levels on six out of eight soundtracks. These headphones reduced the sound level by an average of 33.1 dBA, which was a 23% reduction from baseline levels. As we realize most people don't use industrial headphones, future work will expand our study to include testing the noise canceling efficiency of popular brands of headphones used by consumers. Results from this study will be used in future work aimed at minimizing people's exposure to ambient noise using noise-canceling headphones to determine if reduced stress levels are observed.

Level of research: Graduate - Ph.D.

Department: Chemistry

Faculty advisor: Jaime Mirowsky

Authors: Derminio, D.S. and Boyer, G.L., Department of Chemistry

Title: Light Intensity Effects on *Microcystis aeruginosa* Pigments, Cell Migration, and Toxin Levels

Abstract: Cyanobacterial harmful algal blooms (cHABS) are a common occurrence in many lakes across New York State. Cyanobacteria gather light energy for growth within photosystem II using a phycobilisome. Phycobilisomes contain two major pigment-proteins complexes in their light-gathering antenna complex: phycocyanin (PC) and phycoerythrin (PE). To understand how this antenna changes with light intensity, an 18-hour experiment was conducted on a natural toxic cHABs in Lake Neatahwanta (Fulton, NY, USA). Light intensity, cyanobacteria biomass as both cell number and pigment fluorescence, and toxicity were measured at 2-hr intervals at four depths between the hours of 4:00 am and 10:00 pm. Toxicity per liter did not significantly change with time of day or depth. In contrast, pigments (chl-a and PC) did vary with time of day and depth. Microcystis cell numbers were significantly different between depths ($p = 0.02$), but not time of day. There was a significant difference in PC to PE

ratio based on fluorescence measurements over the course of the day. This study will improve the fundamental understanding of how *Microcystis* pigment composition responds to an ever-changing light field and has important implications for the use of fluorescent techniques in monitoring cyanoHABs.

Level of research: Graduate - Ph.D.

Department: Chemistry

Faculty advisor: Gregory Boyer

Authors: Liu, X. and Gitsov, I., Department of Chemistry

Title: Amphiphilic Linear Dendritic Poly(ether ester)-Polystyrene Block Copolymers as Giant Nonionic Surfactants: Synthesis and Solution Self-Assembly

Abstract: Polymers that can change their size and shape by an external stimulus are of great practical importance for diverse areas such as sustained drug delivery, smart coatings, “green” catalysis and even biomimicry. In this presentation we report the synthesis and solution self-assembly of a new family of amphiphilic linear dendritic block copolymers (LDBCs), namely LGn-PSt Mn, which are able to undergo such transitions. They are composed of hydrophilic dendritic poly(ether-ester), PEE block based on 2,2-bis(hydroxymethyl)propionic acid, bis-MPA, and hydrophobic linear poly(styrene) block with various molecular weight (LG is the type of PEE dendron, n denotes the generation of the dendron and Mn represents the molecular weight of LDBC). The synthesis is based on Dendron-initiated atom transfer radical polymerization (ATRP) of styrene, followed by deprotection of hydroxyl groups on dendron’s periphery. The solution self-assembly of the LDBCs is investigated by slowly adding water to the polymer in THF as a common solvent for both blocks of LDBCs. The morphologies of the micelles formed are preserved either by diluting the aggregates dispersion with excess of water or by THF evaporation. It is found that the micellar morphology (sphere, wormlike and vesicle) depends on the hydrophilic block fraction (FPEE) and dendron generation. The poly(styrene) chains are stretched in the micelles of the first- and second generation LDBCs, while assume a more relaxed arrangement in the third generation LDBCs. The vesicle to wormlike or sphere transition is found by switching common solvent to DMF. Interestingly, LG2-PSt 18k forms bicontinuous sponge phase like aggregates using acetone as common solvent.

Level of research: Graduate - Ph.D.

Department: Chemistry

Faculty advisor: Ivan Gitsov

Authors: Scheibel, D. and Gitsov, I., Department of Chemistry

Title: Lipase-Laccase Domino-Type Cascade Reaction for the Synthesis of Unique Alternating Copolymers

Abstract: This study focuses on the "green" synthesis of polymers with biomedical application potential. The synthetic strategy involves a one-pot domino-type cascade reaction catalyzed by immobilized laccase from *Trametes versicolor* and lipase from *Burkholderia cepacia* to afford an alternating copolymer of catechol and m-xylene diamine. Laccase immobilized in a linear-dendritic block copolymer is the first enzyme to catalyze for the oxidation of catechol to 1,2-orthoquinone. This product then participates in the lipase-mediated Michael addition of m-xylene diamine to form the repeating polymer unit. The two-enzyme cascade reaction investigated proceeds at a much faster rate than when either of the two enzyme are omitted (0% relative reaction rate when laccase is omitted and 85.8% relative reaction rate when lipase is omitted). Future work will focus on the effect the lipase catalyst has on the molecular weight of the synthesized polymer. Additional lipases and immobilizing agents will also be investigated.

Level of research: Graduate - Ph.D.

Department: Chemistry

Faculty advisor: Ivan Gitsov

Authors: Wei, B. and Boyer, G., Department of Chemistry

Title: The Relationship Between Nutrients and Cyanobacteria Toxins in Lake Neatahwanta, Oswego County, NY

Abstract: Cyanobacteria, also known as blue-green algae, are prominent in freshwater systems around the world. In recent years, excessive anthropogenic nutrient loading in Lake Neatahwanta has promoted the growth of harmful cyanobacterial blooms. Blooms of algae can cause damage to aquatic environments by blocking sunlight and depleting oxygen required by other aquatic organisms, restricting their growth and survival. Some types of cyanobacteria, can produce potent toxins like microcystin that can cause adverse health effects to wildlife and humans, such as damage to the liver and nervous system. Lake Neatahwanta has experienced multiple blooms of cyanobacteria since 2010. Water samples were collected from the end of pier in Lake Neatahwanta weekly from May to October and analyzed for nutrient level and the presence of microcystin. Microcystin were present in Lake Neatahwanta over the course of the study. But the peak concentration varied a lot among different years. Maximum microcystin concentrations were >50 ?g/L in 2011 and 14.83 ?g/L in 2017. Total phosphorus, total dissolved phosphorus, soluble reactive phosphorus, total nitrogen, nitrate and nitrite concentration were measured for each samples. Statistical comparisons of lake chemistry demonstrate relationships between toxin concentrations and nutrient levels within the water column. The N:P ratio changed during the bloom which suggests nitrogen availability is important for toxin production.

Level of research: Graduate - Ph.D.

Department: Chemistry

Faculty advisor: Gregory Boyer

Authors: Kua, Z. X.[1], Stella, J. C.[1,2], and Farrell, J. M.[1] , Department of Environmental and Forest Biology[1] and Department of Forest Research Management[2]

Title: Water Regulation Effects on Aquatic Community Associations in the St. Lawrence River

Abstract: Hydrologic management affects wetland communities by altering habitat availability and biological interactions. The construction of the Robert-Moses-Saunders Power Dam in 1958 decreased hydrologic fluctuations in the St. Lawrence River, altering the surrounding wetland community structure, and is thought to have led to increased expansion of invasive cattails (*Typha x glauca* and *Typha angustifolia*), decrease in muskrat (*Ondatra zibethicus*) populations, and decline in habitat heterogeneity. The recent implementation of Plan 2014 sought to restore natural hydrology in the St. Lawrence River, however, the actual effects of the strategy still needs to be evaluated. The success of *Typha* has led to its expansive dominance in emergent plant communities of coastal wetlands, further decreasing habitat heterogeneity and connectivity. As muskrats are known to positively affect wetland habitat heterogeneity by consuming herbaceous emergent plants and constructing structures, we examined the potential enhancement of local fish habitat by muskrat disturbances. We compared the community differences in selected wetlands in the Thousand Islands region by manipulating seasonal water levels, focusing on *Typha* percent cover, muskrat house density, and local fish diversity and abundance. This study will help us better understand the effects of Plan 2014 on the wetland community interactions in the St. Lawrence River.

Level of research: Graduate - M.S.

Department: EFB

Faculty advisor: John Stella

Authors: Nasta, J.V. and Green, H.C., Department of Environmental and Forest Biology

Title: Adaptive Response of *Escherichia coli* to Zinc Oxide Nanoparticles Across a Spatiotemporal Gradient

Abstract: In the soil environment, bacteria must adapt to gradients of selection pressure. One potential stressor is nanoparticulate Zinc Oxide (npZnO), a compound utilized for its antimicrobial, anticorrosive, antifungal and UV-blocking properties. npZnO is found in many products such as sunscreens, cereals and biosensors. Our aim is to investigate the adaptive response of Escherichia coli to an increasing gradient of npZnO over approximately a two week period using a Microbial Evolutionary Growth Arena (MEGA plate). Towards this aim, we have two goals: 1) construct and optimize the design of a MEGA plate using

the stressor ciprofloxacin, a common antibiotic that was used previously to demonstrate MEGA plate utility and 2) determine the effective range of npZnO concentrations that permit adaptation. Preliminary results show that *E.coli* evolved resistance to 500 ug/ml ciprofloxacin (1000X known minimum inhibitory concentration) in about 16 days. “Evolved” isolates were collected and stored for future testing.To determine an effective range of npZnO to use on the MEGA plate, we monitored the growth of *E. coli* in liquid LB media supplemented with 0-6.14mM of npZnO. npZnO concentrations below 1.23mM showed no measurable effect on growth, while concentrations above 3.69mM significantly lengthened lag phase and decreased growth rate. When complete, this work could demonstrate a) the ability of npZnO to alter evolutionary trajectories of bacteria, b) a potential adaptive route of bacteria to npZnO at the molecular level, and c) the utility of the MEGA plate system as a tool to study evolution under various selection pressures.

Level of research: Graduate - M.S.

Department: EFB

Faculty advisor: Hyatt Green

Author: Xue, D., Department of Environmental and Forest Biology

Title: Evaluating the Interpretation System for Dujiangyan Irrigation National Park

Abstract: The World Heritage Site of the Dujiangyan Irrigation System in China is a famous weir conservation site blessed with natural resources and human resources, also an excellent place for outdoor environmental education. With the development of interpretation in China, many parks, scenic areas, and World Heritage Sites have started to emphasize environmental education rather than tourism only. This emphasis on environmental education creates a need for the development of an interpretive plan for the scenic sites. Through the effective interpretation, visitors would know more about the environment and shape their own environmental perspectives gradually. Nowadays, World Heritage Sites in China are faced with double impacts of environmental issues and tourism industry, so the challenge is to enable visitors to be conscious of both natural and cultural environments through interpretation. Interpretation for the World Heritage sites is a part of nonformal environmental education, which is a necessary supplement for formal environmental education at local schools. Through professional interpretive programs based on the goal of environmental education, tourists are able to have real experiences within the natural and cultural environment. At present, the World Heritage Site of the Dujiangyan irrigation system calls for the development of interpretation to optimize the traditional tourism sector and speed up the development of environmental education while promoting sustainability.

Level of research: Graduate - Ph.D.

Department: EFB

Faculty advisor: Melissa Fierke

Authors: Bhatti, S.J. and Kroll, C.N., Department of Environmental Resource Engineering

Title: Probability Distributions for Low Flow Series in the U.S.

Abstract: Low streamflow series (LSS) and statistics are required for understanding streamflow regimes, water quality management, issuing and renewing discharge permits, planning hydropower, water supplies, cooling and irrigation systems, and to assess the impacts of prolonged droughts on the ecosystem. The aim of this study was to identify appropriate probability distributions for describing low streamflow series in the conterminous US. We employed a historic daily streamflow records from 740 unregulated basins which are part of the USGS'S Hydro-Climatic Data Network-2009 (HCDN-2009), and used theoretical L-moment ratio diagrams for different probability distribution to assess the fit of different probability distributions to LSS. We also examined whether probability distribution may better fit to the inverse of these series,, and to see if we can improve distributional fit by fitting a lower percentage of the data set using censored L-moment diagrams. The low flow series examined included 1-day, 3-day, 7-day, and 30-day annual minimums, and the quantiles with a 90%, 95%, and 99% exceedance probability from annuals flow duration curves. The NSE and bias of the at-site L-kurtosis theoretical L-kurtosis were used to assess the goodness of fit for the series to the probability distributions. Results indicate that GEV and LN3 were the closest fit low flow series (original and inverse).

Level of research: Graduate - M.S.

Department: Environmental Science

Faculty advisor: Charles N. Kroll

Authors: Healey, C., Department of Environmental Science

Title: Optimizing Biofiltration Drainage Media to Target Specific Stormwater Pollutants

Abstract: Biofiltration stormwater management practices rely upon combinations of engineered drainage media to manage stormwater runoff. The drainage media, comprised of sand, silt, clay, and organic matter must be designed in such a way to maintain porosity for stormwater handling, provide storage for a designated volume of stormwater, and maintain percolation throughout the media. Currently, the New York State Stormwater Design Manual defines a single drainage media for biofiltration facilities; however, the failure of several biofiltration installations within NYS highlights the need for further investigation into the ideal biofiltration drainage media. This study evaluates the effectiveness of different biofiltration media comprised of varying sand fraction mixes, silt, organic matter, and three types of clays (kaolinite, illite, and montmorillionite) in maintaining proper functioning

of a biofiltration facility. Utilizing the UMS Ksat Benchtop Saturated Hydraulic Conductivity Instrument, the hydraulic conductivities (Ksat) of five sand fractions, seven unique sand fraction mixtures, and twenty-one biofiltration media mixtures were determined for both the falling head and constant head tests. The resultant data followed expected trends in that higher Ksat values corresponded to mixes with larger sand fraction grains (in both volume and proportion), and lover Ksat values corresponded to mixes with smaller sand fraction grains (in both volume and proportion). Similarly, biofiltration mixtures followed the same trends as the sand fraction mixes in addition to having Ksat values corresponding to the swelling potential of the respective additive clay type. Overall, the biofiltration media mixture chosen to best facilitate the functioning of biofiltration facilities in NYS was comprised of illite clay and exhibited a Ksat value of 2.4 in/hr.

Level of research: Graduate - M.S.

Department: Environmental Science

Faculty advisor: Tim Toland

Authors: Slodysko, K.N., Graduate Program in Environmental Science, and Boyer, G.L., Department of Chemistry

Title: Cyano Harmful Algal Blooms in New York's Finger Lakes – A Harbinger of Change to Come?

Abstract: The eleven Finger Lakes are the crown jewel of central New York and serve as important resources for drinking water, recreation, and tourism. While the lakes share a similar geological origin they vary in hydrology, land use, and trophic status. Canandaigua and Skaneateles Lakes are historically oligotrophic (TP<12), whereas Honeoye and Otisco Lakes are eutrophic (TP>20). In 2016, Owasco Lake suffered a severe cHAB with microcystin concentrations in the water reaching 2500 ug/L. Detectable levels of toxins were found in the City of Auburn's finished drinking water. In 2017, all 11 Finger Lakes developed cHABs for the first time on record. Peak microcystin concentrations reached 200 ug/L in oligotrophic Skaneateles Lake, 400 ug/L in meso-oligotrophic Seneca Lake, and 1,800 ug/L in mesotrophic Owasco Lake. Nine of the eleven lakes had toxin levels exceeding the drinking water standard set by the New York Department of Environmental Conservation. Historical data indicates that bloom frequency and toxicity may be increasing in the Finger Lakes, however more research is needed in this area. In the future, routine monitoring will be necessary to protect these valuable resources and human health.

Level of research: Graduate - M.S.

Department: Environmental Science

Faculty advisor: Gregory Boyer

Authors: Sullivan, B.M. (Department of Environmental Science), Fortier M.P., Malmsheimer R.W. (Department of Forest and Natural Resources Management)

Title: Geographically Specific Life Cycle Assessment of Electricity from Tidal Turbines in the United States

Abstract: Life cycle assessment (LCA) can be used to determine whether electricity from ocean energy sources has a lower climate change impact than electricity from fossil energy sources. Previous LCAs on tidal turbines have not evaluated how their climate change impacts vary across multiple locations. A mathematical model was developed to calculate the GHG emissions of electricity from a standard tidal turbine across its life cycle processes from cradle to grave. LCA scenarios from 23 hotspot sites were modeled to incorporate differences in potential power generation across sites. The functional unit is 1 kWh. Daily peak tidal velocities were obtained at each site from NOAA and used to determine electricity generated over the turbine's lifetime, adapted to the cyclical patterns of the tides. The life cycle climate change impact of electricity from tidal turbines varied significantly across deployment sites. For example, electricity from a tidal turbine in the East River in NY showed a carbon footprint that is 11,373% lower than that of a tidal turbine in the Sitkinak Strait in AK. This study shows that even in some "hotspot" sites, electricity from tidal turbines can have higher life cycle GHG emissions than electricity form natural gas and coal power plants due to low electricity generation over the turbine lifetime relative to the emissions arising from the production of the infrastructure and materials. This highlights the need to model site-specific parameters in LCAs of ocean energy technologies and depicts the utility of LCA in optimizing sustainable siting decisions for tidal turbines.

Level of research: Graduate - M.S.

Department: Environmental Science

Faculty advisor: Marie-Odile Fortier

Authors: Garcia-Polo, J., Stewart A.W. Diemont, Department of Environmental and Forest Biology

Title: Mayan Traditional Ecological Knowledge and Wetland Restoration in Lake Atitlan, Guatemala

Abstract: Lake Atitlan, Guatemala, a formerly pristine volcanic lake with a long history of Mayan traditional use, is now heavily impacted by land management that results in cultural and environmental degradation. Littoral wetlands are important areas for fish spawning, waterfowl nesting, and for erosion control and nutrient cycling. Wetland losses have diminished livelihoods of local peoples of the Lake Atitlan region. Mayan traditional ecological knowledge (TEK) influences fishing, crabs and snail collection, and harvesting wetland plants Typha domingensis (cattail) and Schenoplectus californicus (sedge). These plants, together called tul, are traditionally used to weave crafts, such as sleeping mats. Interviews and focus groups with harvesters, fishers and artisans were conducted in three Tzutujil-speaking communities: Santiago Atitlan, San Juan La Laguna and San Pablo La Laguna. Interview results were categorized into uses, environmental impacts, and restoration of tul. Findings will inform a more

holistic vision for Lake Atitlan restoration. A framework that links TEK with science, management, and policy is vital for Mesoamerica and elsewhere where indigenous and local groups have a history of environmental management.

Level of research: Graduate - Ph.D.

Department: Environmental Science

Faculty advisor: Stewart Diemont

Authors: Lin, J. and Kroll, C.N., Graduate Program in Environmental Science

Title: Ecosystem Service Based Sensitivity Analyses of i-Tree Eco

Abstract: i-Tree Eco is a USDA Forest Service software product that quantifies the ecosystem services and benefits of urban forests. Here we perform a sensitivity analysis (SA) analyzing the relative impact of different model inputs on model outputs for three submodules of i-Tree Eco: biogenic volatile organic compounds (BVOCs) emissions isoprene and monoterpenes, carbon storage and sequestration, and dry deposition of NO2, SO2, and O3. The SA methods included a Morris one-at-a-time method and a variance-based decomposition method which integrates Monte Carlo simulation with Latin hypercube sampling and Iman Conover analysis. A case study was performed in New York City with field plot data collected in 2010. The results show that (1) genus plays a dominate role in determining BVOC emissions while leaf biomass, temperature and photosynthetically active radiation (PAR) are also important. There is a strong interaction between these variables and BVOC emissions; (2) for carbon storage and sequestration, diameter at breast height plays a dominate role while height and land use has negligible effects; crown light exposure and tree condition play moderate roles for carbon sequestration; and (3) dry deposition velocity is most sensitive to leaf area index and relative humidity in a nearly linear way while sensitive to temperature and PAR in a non-linear manner. Wind speed and pressure have minimal effects on dry deposition velocity. The results have important implications for future field campaigns, model development, uncertainty assessment of model outputs, and urban forest management.

Level of research: Graduate - Ph.D.

Department: Environmental Science

Faculty advisor: Charles N. Kroll

Authors: Shruti Mokashi

Co-authors: Mokashi, S. and Diemont, S., Department of Environmental Science

Title: Forest Gods and Forest Conservation: Local Perceptions and Management of Village Sacred Forests in the Bhimashankar Region, Western India

Abstract: Sacred forests or sacred groves are patches of forest vegetation which are traditionally protected by local communities because of their religious or cultural significance. They are also ecologically important, as they are biodiverse and provide numerous ecosystem services. They are therefore receiving increasing international attention from conservation biologists and resource managers. Numerous ecological studies have been conducted, but few have focused on the social and cultural complexity of these sacred forests. My research addresses this knowledge gap. I am investigating local peoples' attitudes towards their sacred forests and how they manage these sacred forests. I explore the meanings and belief systems attached to these groves to determine what could drive their continued protection. I examine how these sociocultural systems differ across age groups. I conducted my study in and around the Bhimashankar Wildlife sanctuary in the Western Ghats region of Maharashtra state, India. I conducted in depth-interviews, with people from five villages, where each village had at least one village-level sacred forest. My findings indicate that each village has an established and a similar system of rules and taboos based on their belief systems. Older villagers use a religious narrative to describe sacred forests while the younger generations use a conservation narrative. The primary reasons expressed for grove conservation are religious and aesthetic. Secondary reasons are social and political. This research indicates that for continued sacred grove conservation in India the conservation policies designed should have site-specific understanding of belief systems in order for conservation efforts to be successful.

Level of research: Graduate - Ph.D.

Department: Environmental Science

Faculty advisor: Stewart Diemont

Authors: Nyelele, C. and Kroll, C.N. Departments of Environmental Science and Environmental Resources Engineering

Title: Present and Future Ecosystem Services of NYC trees

Abstract: Trees provide ecosystem services such as air pollution removal, carbon storage and sequestration, urban heat island reduction and storm water improvements among other socio-economic benefits. With large-scale plantings being undertaken in many cities to increase tree canopy coverage as well as the health, economic and environmental benefits that come with trees, there is need to assess the extent to which trees provide ecosystem services, where services are realized and most importantly to improve methods of determining future planting locations. This study uses ecosystem service models and mapping tools to estimate the current and future ecosystem benefits of New York City's recent planting initiative in the Bronx, NY for 2010 and two 2030 tree cover scenarios (assuming no tree mortality and 8% annual mortality). Land cover and tree canopy estimates for 2010 are derived from a high-resolution land cover dataset of the borough. A grow-out scenario based on urban tree database information and allometric equations is used to predict future canopy estimates. i-Tree (www.itreetools.org) tools are used to determine the benefits of trees in each census block group for

each analysis period. Change analysis is carried out at the census block group level to determine the magnitude and direction of change for each ecosystem service over time. The ecosystem benefits of trees in the Bronx in 2010 are estimated to be $18 million, and these benefits are estimated to range from $19.1 million to $20.4 million in 2030 if the current canopy is maintained and newly planted trees grow to maturity.

Level of research: Graduate - Ph.D.

Department: Environmental Science

Faculty advisor: Charles N. Kroll

Authors: Petroni, M., Hill, D., Collins, M., Department of Environmental Science

Title: UpStream, New York: Discover Toxics in Your Neighborhood

Abstract: Does targeted risk information affect a citizen's perceptions of industrial pollution risk and mitigation decision making? Can source reduction decision making by manufacturers be influenced by similar-actor comparisons and targeted information sharing? These are some of the research questions that UpStream and our project address. UpStream New York is an interactive data viewer and reporting database developed as part of the US Environmental Protection Agency's (EPA) 2017 Toxics Release Inventory (TRI) University Challenge by PhD researchers and faculty at SUNY College of Environmental Science and Forestry in Syracuse, NY. UpStream provides targeted, actionable information and insights from TRI chemical risk data to serve citizens, manufacturers, community groups and EPA activities under the Emergency Planning and Community Right to Know Act of 1986 and the 1990 Pollution Prevention Act. For citizens, we provide address specific potential toxic pollution risk profiles through an online map viewer and home report generated based on TRI data for potential risk. These profiles contain targeted information on the manufacturer and chemical posing the most potential risk to that location. For manufacturers, we provide targeted pollution control alternatives for chemical releases utilizing source reduction actions reported by similar facilities. We also highlight manufacturers displaying source reduction success with State, Industry Class, and National Pollution Prevention Awards.

Level of research: Graduate - Ph.D.

Department: Environmental Science

Faculty advisor: Mary Collins

Authors: Mussehl, M. and Shaw, S.

Title: How Fast Does the River Run Dry? Exploring a New Parameter for Drought Management

Abstract: This project focused on the exploration of a new low flow forecasting tool that may be used by water managers, particularly those dependent on 'run of the river' water systems. Essentially, this project assessed how quickly drainage basins might transition from wet to dry conditions. This was done by selecting 55 basins in the Mid-Atlantic states that has USGS daily flow data exceeding 20 years. Watersheds were selected to ensure that reservoirs and dams did not significantly impact the natural hydrologic regime. This data was then analyzed to determine the 'dry down time' given a set of thresholds. Thresholds were determined based on percentiles of the daily flow data, making them unique to each watershed. Three threshold sets were used in this analysis: 0.5 per. -0.25 perc. , 0.4 perc -0.1 perc. , and 0.3 perc. -0.1 perc.. The mean dry down times for the threshold sets were found to be 21.25 days, 19.72 days and 27.08 days respectively. The 20th percentile of the 0.3-0.1 threshold set was 16.77 days, meaning that in extreme cases, watersheds may transition from the 30th percentile of streamflows to the 10th in just short of two weeks. A multivariate regression attributed watershed variability in dry down times to differences in precipitation seasonality and hydrologic landscape region. Given the temporal and spatial limitations of current drought forecasting tools and indices, the development of the dry down time statistic will allow water managers to make informed decisions regarding drought risk management.

Level of research: Graduate - M.S.

Department: ERE

Faculty advisor: Stephen Shaw

Authors: Sabitov, T.

Title: Hydrologic Modeling of the Glaciated Watershed in Central Asia Under Current and Future Climate Scenarios

Abstract: This work utilizes four hydrologic models based on simple water balance and SCS runoff curve number methods to analyze watershed characteristics for the Pskem River watershed, a major tributary of Syr-Darya River, which flows into the upper part of the Aral Sea. We collected comprehensive information about streamflow, temperature, and precipitation for the Pskem watershed and determined land cover features affecting streamflow conditions such as glaciers and analyzed climatic characteristics in the watershed. We compared four increasingly complex hydrologic models to estimate streamflow for water years 2013–2015 and to determine if the increased complexity provided accuracy or computational advantages. The coefficients of determination of the final hydrologic models for monthly streamflow were 0.84, 0.77, 0.93 and 0.85, suggesting that there are moderate requirements for model adjustment. Parameters used for streamflow modeling were estimated using extensive calibration and remote sensing techniques and could also have use for other watersheds having similar characteristics. We also compared mean annual streamflow in the Pskem River during two periods of observations (1965–1990 and 1991–2015) using student's t-test and performed a Mann-Kendall seasonal trend test to determine if there were monthly trends in the observations. The

comparison of average values between the two time periods revealed no significant difference in streamflow. However, the trend test suggested that there are downward trends of flow in August, October, and November. This trend may be due to change in climatic factors such as early snowmelt and decrease in the meltwater input from glaciers due to degradation.

Level of research: Graduate - M.S.

Department: ERE

Faculty advisor: Cornelius B. Murphy Jr., Lindi J. Quackenbush

Authors: DeMarco, M., Endreny, T. (Department of Environmental Resources Engineering, SUNY College of Environmental Science and Forestry), Nowak, D. (USGS Forest Service, Northern Research Station)

Title: Potential Benefits of Shade Trees on Three Story Buildings

Abstract: Shade trees reduce carbon dioxide (CO2) emissions by reducing building cooling loads, and this has only been analyzed for one and two story buildings. Given the cooling of three story buildings also contributes to CO2 emissions, can shade trees reduce the solar heat gain of a three story building in a magnitude comparable to one and two story buildings. To quantify the tree shade area on a wall based on tree, wall, and solar geometry, a modification of SHTREE, a mechanistic tree-shading model, was coded into Python. The model was run for a variety of factorial treatments; cylindrical tree height at 7.3m, 11m, and 15.2m, tree setback distance at 5m, 10m, and 15m, day of year on June 15, July 15, and August 15, wall azimuth at due East, South, and West, and latitude of site at 25, 35, and 45 degrees North. The model summed total daily shaded area cast on each story. Results from Kruskal-Wallis nonparametric tests show that the third story received comparable shade as the first and second stories when tree height is tall (average normalized shade on 1st story = 2.8, 2nd story = 2.9, 3rd story = 2.6), but is not comparable when tree height is small (average normalized shade on 1st story = 1.8, 2nd story = 1.2, 3rd story = 0.2) and medium (average normalized shade on 1st story = 2.5, 2nd story = 2.2, 3rd story = 1.7). Not all shading is equal and it is possible that top story shading would have the biggest impact on reducing solar heat gain; this will be a follow on study.

Level of research: Graduate - Ph.D.

Department: ERE

Faculty advisor: Theodore Endreny

Authors: Siqi Li

Co-authors: Li, S. and Quackenbush, L.J. (Department of Environmental Resources Engineering, SUNY College of Environmental Science and Forestry)

Title: Integrating Airborne Lidar and Landsat for the Estimation of Forest Aboveground Biomass in Different Forest Types and Biomass Ranges

Abstract: Quantifying forest aboveground biomass (AGB) is crucial for understanding the role of forests in the global carbon cycle. Light detection and ranging (lidar) data provides accurate measurement of forest structure in the vertical plane; however, current airborne lidar datasets are often practically limited in terms of spatial coverage. This limitation can be compensated by supplementing lidar data with the extensively distributed Landsat imagery. We compared the performance of Landsat, lidar, integration of Landsat and lidar data for the estimation of AGB in Huntington Wildlife Forest, a managed property in Central New York State. Our approach trained regression models to estimate AGB from Landsat and lidar derived variables based on field inventory data. We found that lidar was effective in quantifying AGB compared to Landsat. Integration of Landsat and lidar often performed better than the lidar model, but it is not consistent on different site conditions. Landsat performed better for hardwood forest compared to softwood forest, which was in contrary to the lidar data. All models exhibited better performance at estimating more extreme (small or large) AGB values rather than the whole data range. This study has demonstrated the ability of regression models for AGB estimation using Landsat, lidar and data integration in boreal forest at different site conditions.

Level of research: Graduate - Ph.D.

Department: ERE

Faculty advisor: Lindi Quackenbush

Authors: Pu, G. and Quackenbush, L.

Title: Using Remote Sensing and GIS to Monitor Riparian Buffer Spatial-Temporal Variations

Abstract: Riparian buffers play a significant role in filtering contamination and maintaining water quality. Under stress from climate change, agricultural practices and urbanization, the extent of buffers in many areas are decreasing. In order to protect existing buffers, we need to know the current conditions of various environmental attributes within the riparian corridors. Traditional field-based approaches to assess the ecological attributes of buffers have high financial and other resource cost. Because of this, there is still no widely available dataset documenting the current state of riparian buffers. However, with recent innovations in remote sensing and spatial analysis, new technologies can now be incorporated into buffer mapping and assessment. This project incorporated a wide array of technologies, including cloud computing, BigData, spatial statistics, and machine learning. The project goal was to rapidly transform our past approaches to riparian buffer mapping and assessment. With the developed approach, buffer stakeholders and managers can conveniently map the extent of buffer vegetation across multiple years at high spatial resolution. This enables them to perform rapid spatial analysis to identify local hotspots of vegetation removal to target restoration efforts.

Level of research: Graduate - Ph.D.

Department: ERE

Faculty advisor: Lindi Quackenbush

Authors: Xu, J., Quackenbush, L.J. (Department of Environmental Resources Engineering, SUNY College of Environmental Science and Forestry)

Title: A Review of Forest and Crop Leaf Area Index Estimation Using Remote Sensing

Abstract: Leaf area index (LAI) is a significant vegetation leaf structure parameter in forest and agricultural ecosystems because of the relationship to mass exchange (e.g., CO2 and water) primary production, energy exchange, and other physiological functions. LAI combines with other biophysical and biochemical parameters to play a significant role in monitoring plant nutritional and health status and serves as an indicator of stress and insect damage. The development of remote sensing techniques provides an effective way to acquire LAI measurements. Remote sensors are typically labeled as passive or active detection systems, each with ground-based, airborne, and satellite platforms. This study reviews the application of remote sensing-based approaches across different system configurations that are used to estimate forest and crop LAI. A comparison of the difference in LAI estimation for forest and agricultural applications given the different structure of forest and agriculture ecosystems was presented, particularly as this relates to scale. Finally, the literature review summarized the challenges faced in forest and crop LAI estimation and the potential for future developments.

Level of research: Graduate - Ph.D.

Department: ERE

Faculty advisor: Lindi Quackenbush

Authors: Dillon, G.A, Young, A.R., Campbell, J.L., Green, M.B., Yanai, R.D.

Title: Measurement Error in Forest Inventory and Analysis (FIA) Plots in the Northern Region

Abstract: Responsible reporting of forest inventory requires accounting for uncertainty in tree measurements. In the US Forest Service, following Forest Inventory and Analysis (FIA) protocols, field checks of production crews are routinely made by quality control crews, which provides a means to ensure that uncertainties are within acceptable bounds. The difference between the measurements made by these two crews is a rich source of data on measurement uncertainty that has yet to be reported to the scientific community; Previous studies focused on a narrow subset of measurement variables specific to estimating stem volume. Here we report the magnitude of measurement uncertainty in the FIA data collected for 60 variables across 24 states in the northeastern and north central USA. Tree diameter measurements (averaging 0.14 cm or 1% of tree diameter) had better agreement between the two crews than did tree height (1.0 m or 7% of tree height). Errors in tree

species identification averaging 1.6% showed that hardwoods, especially *Quercus* and *Juglandaceae*, were more difficult to identify than conifers. Categorical measurements showed higher error rates especially with estimations involving the cause of tree death (19%), tree grading (21%), decay stages (41%), crown light exposure (50%), and foliage transparency (69%). Small errors in measurements can have large consequences for timber and carbon stock volume predictions. Understanding all sources of uncertainty is important to making decisions to improve the design of forest monitoring systems.

Level of research: Graduate - M.S.

Department: FNRM

Faculty advisor: Ruth D. Yanai

Authors: Frank, J., Brown, T., Volk, T., Heavey, J., Malmsheimer, B.

Title: A Stochastic Techno-Economic Analysis of Shrub Willow Production Using EcoWillow 3.0S

Abstract: EcoWillow 3.0S is a techno-economic analysis (TEA) tool that calculates realistic willow biomass production costs using data from field trials of willow production in New York State. The model represents the input parameters for diesel fuel price, wood price, and willow yield as data-derived probability distributions rather than as single values. This study uses EcoWillow 3.0S with Oracle Crystal Ball to perform a stochastic TEA of shrub willow production in the Northeastern United States. Two outputs obtained from this model are a 24-year net present value (NPV) and minimum selling price (MSP) of shrub willow production under price and yield uncertainty. The MSP for dry willow ranges within a 95% confidence interval from $59-$102/Mg. The NPV, also within a 95% confidence interval, ranges from -$153,819 to $207,129 for 40 ha of willow harvested seven times over 24 years. The relevance of this study is to utilize the TEA methodology to assess the financial feasibility of shrub willow production as a bioenergy feedstock. The results of this analysis provide the bioenergy field with NPV and MSP probability distributions on shrub willow production that have previously been absent from the refereed literature. Using data collected from field operations over a number of years, EcoWillow 3.0S captures some of the key inputs that influence the variation in the delivered cost of willow biomass crops.

Level of research: Graduate - M.S.

Department: FNRM

Faculty advisor: Tristan Brown

Authors: O'Keefe, M. E., Bevilacqua, E. (Department of Forest and Natural Resource Management, SUNY College of Environmental Science and Forestry), Volk, T. (Department of Forest and Natural Resource Management, SUNY College of Environmental Science and Forestry), Quackenbush, L. (Department of Environmental Resources Engineering, SUNY College of Environmental Science and Forestry)

Title: Unmanned Aerial Systems for Estimating Canopy Structure and Assessing Vegetation Health in Willow Crops

Abstract: Off-the-shelf, low cost small Unmanned Aerial Systems (sUASs) have been increasingly applied for conservation and management of natural resources. Using sUASs to monitor vegetation health and estimate canopy structure in willow crops would provide an avenue for rapid, quality data collection, similar to applications in precision agriculture. Multispectral imagery was collected at two altitudes over 3 willow sites in Upstate New York in October 2017. Individual bands were calibrated to account for minor variations in weather conditions during acquisition, stitched into orthomosaics and used to calculate Normalized Difference Vegetation Index (NDVI). Field measurements including canopy depth, Leaf Area Index (LAI), and location were collected in summer 2017. Regression analysis showed significant positive, linear relationships between sUAS NDVI values around each plot location and field measurements of LAI. An analysis determining differences in computed NDVI values using calibrated and uncalibrated imagery was also performed.

Level of research: Graduate - M.S.

Department: FNRM

Faculty advisor: Eddie Bevilacqua

Authors: Thomas, S.

Title: Energy Modeling using BIM for a Net Zero Energy School

Abstract: The K.W.S Bear Road Elementary school, located in the northern region of Syracuse, New York, built in 1958 and renovated in the 1960's is a single-story school that currently contains 36 classrooms and educates roughly 600 children from grades K-4. The school is in dire need of a renovation with its crumbling walls, mismatched replacement tiles, poles in auditorium that block the view of the stage and 50's style learning experience. The U.S. Department of Energy (DOE) Race to Zero Student Design Competition (Race to Zero) has a commercial project category to design a Net zero energy elementary school. This competition presents a unique opportunity to create a feasible design that can be used in a real application while providing the community with a sustainable, energy efficient, net zero school building. By taking up this project for developing a BIM model, I will be able to understand the building in depth, with envelope details and energy analysis. The values obtained in BIM can be compared to the calculated values used for the competition. I even plan to do a comparison of

the existing Bear Road elementary school model with the proposed Net Zero energy school model. I plan to understand how to achieve Net zero energy building with the support of 3D BIM design tools.

Level of research: Graduate - M.S.

Department: FNRM

Faculty advisor: Mohamed Elzomor

UNDERGRADUATE RESEARCH

Authors: Allison, C.M., Sarwar, S., and Nomura, C.T., Department of Chemistry

Title: Biochemical Characterization of the Enhancer-Binding Protein DdaR of *Pseudomonas aeruginosa*

Abstract: *Pseudomonas aeruginosa* is a bacterium that forms biofilms in the lungs of individuals with cystic fibrosis. Biofilm formation is regulated by nitric oxide synthase, which is known to produce nitric oxide from the substrate L-arginine. Pathogenic bacteria are released from biofilms in the presence of nitric oxide. A product of methylarginine metabolism in *P. aeruginosa* is NG,NG-dimethyl-L-arginine (ADMA), which inhibits nitric oxide synthase and prevents the formation of nitric oxide. The PA1195 (ddaH) gene of *P. aeruginosa* encodes a dimethylarginine dimethylaminohydrolase (DdaH) enzyme for methylarginine metabolism. The protein DdaR may act as an enhancer-binding protein (EBP) and regulate the activation of ?54-dependent transcription for this gene. In this study we heterologously expressed the DdaR protein as an N-terminal Maltose Binding Protein (MBP) fusion protein in Escherichia coli BL21 cells, and subsequently purified the MBP-DdaR fusion-protein using amylose affinity chromatography. Polymerase chain reaction (PCR) was used to replicate the DNA probes ZS458 and ZS406. The ZS458 probe contains the PA1195 promoter sequence and is the expected target promoter of DdaR. The ZS406 probe contains the gcvH2 promoter. DdaR is not expected to bind to this probe and hence it will serve as a negative control probe. The ZS406 and ZS458 probes were purified at a concentration of 9.1 ng/µL and 8.2 ng/µL, respectively. Future research will focus on utilizing the purified DdaR protein and ZS458 and ZS406 probes in electrophoretic mobility shift assays (EMSAs) to determine if DdaR binds to the promoter region of the ddaH gene in *P. aeruginosa*.

Level of research: Undergraduate

Department: Chemistry

Faculty advisor: Christopher Nomura

Authors: Seth Beadle

Co-authors: Beadle, S. and Giner, J., Department of Chemistry

Title: Synthesis of Petuniasterone D, an Insecticidal GABA-A Antagonist

Abstract: Petuniasterone D is a naturally occurring steroidal insecticide found in petunias. This steroid's side chain contains a [3.2.1]-bicyclic orthoester in the natural (22R,24R)-configuration. The orthoester was synthesized by a biomimetic acid-catalyzed epoxy ester-ortho ester rearrangement. Aside from its unique arrangement, this orthoester is appealing because it is found to be an antagonist of the GABAa cyclodiene receptor. GABA (gamma-amino butyric acid) is the main CNS inhibitory neurotransmitter of animals and insects. Antagonism of the GABAa cyclodiene receptor results in a decrease in GABA inhibitory response in neurons. This can be toxic, especially to insects, thus giving petunias a reason to synthesize such a compound. These qualities make Petuniasterone D a possible candidate for a natural insecticide, along with a useful tool for doing studies related to GABA receptors. The synthesis of Petuniasterone D from commercially available stigmasterol, a very common plant cholesterol, can be done in 12 steps. This 12-step route is the shortest but presents a few problems with yield and unreliability of certain reactions. Thus a few alternative routes are presented in this synthesis that circumvent some of these issues. The alternative routes do add more steps but improve the synthesis as a whole.

Level of research: Undergraduate

Department: Chemistry

Faculty advisor: Jose Giner

Authors: Chambers, C.R., Chen, L., and Kieber, D.J., Department of Chemistry

Title: Synthesis of dimethylsulfoxonium propionate (DMSOP)

Abstract: Dimethylsulfoniopropionate (DMSP) and the product of its enzymatic cleavage, dimethylsulfide (DMS), are significant in the global sulfur cycle and as a source of cloud condensation nuclei. However, the physiological function of these species in marine phytoplankton is still uncertain. DMSP acts as an osmolyte in the cell, but previous work showed that intracellular concentrations of DMSP adapt slowly following changes in salinity, suggesting this may not be its main role. One proposed function for DMSP and its breakdown products (DMS, dimethylsulfoxide (DMSO), acrylate, and methane sulfinic acid) is as an antioxidant system. Previous work has shown these compounds are produced in response to oxidative stress and are capable of scavenging hydroxyl radicals at rates comparable to well-established anitoxidants (glutathione and ascorbate). An unknown product has been observed from the

oxidation of DMSP by the hydroxyl radical. It has been proposed that this is dimethylsulfoxonium propionate (DMSOP), resulting from the oxidation of the sulfonium center. In order to determine this, a standard of DMSOP must be prepared for comparison. DMSP was first synthesized from DMS and acrylic acid using a well-known method. Then, DMSP was oxidized in an aqueous solution by sodium hypochlorite using a ruthenium catalyst. A product has been obtained from this reaction, and its identity and purity will be determined using 13C and 1H NMR. A standard of DMSOP would allow it to be identified during the oxidation of DMSP, which will allow a greater understanding of the behavior of DMSP and its related compounds.

Level of research: Undergraduate

Department: Chemistry

Faculty advisor: David Kieber

Authors: Fusi, A. D., Scheel, R. A., and Nomura, C. T. (Department of Chemistry)

Title: The Use of Lignocellulosic Waste as an Alternative Feedstock to Produce and Increase the Yield of Poly(hydroxyalkanoates) in Recombinant *Escherichia coli*

Abstract: Petroleum-based plastics constitute a major problem to environmental health. To address the hazards resulting from the production and disposal of these materials, the thermoplastic class of polymers known as poly(hydroxyalkanoates) (PHA) have been investigated in depth due to their biodegradable and biocompatible properties. Given the limited market of PHAs and the amount of waste generated from various industrial processes, we are presenting an approach focused on re-purposing lignocellulosic waste products and on increasing the production of these thermoplastics through a combination of genetic engineering and use of novel feedstocks. In this study, we integrated the plasmids pTrcGK and pBBR-STQKAB into several strains of *E. coli* and grew the cultures with sugars hydrolyzed from cardboard waste fines over a period of 48 hours. The cultures were then harvested and the polymer contents were analyzed. A significant increase in PHA yield (g/L) was observed across all strains when comparing hydrolysate to pure sugar feedstocks. In trials utilizing pTrcGK, there was no significant difference in the percentage of medium chain length (MCL) monomers incorporated into polymer between the trials that contained hydrolysate or pure sugars. Preliminary results indicate that there is a low polydispersity index for all polymer samples, and a small decrease in the molecular weight of polymers produced from hydrolysate. Overall, the results indicate that this cardboard waste hydrolysate can be used as a substrate for PHA biosynthesis, and represents a potentially valuable product from a currently undesirable waste stream.

Level of research: Undergraduate

Department: Chemistry

Faculty advisor: Christopher Nomura

Authors: Iacono, G. and Teece, M., Department of Chemistry

Title: Characterization and Composition of Sterols in Four Caribbean Scleractinian Coral Species

Abstract: Scleractinian corals are comprised of an animal host and algal symbionts (zooxanthellae). Corals can obtain energy and nutrients through either autotrophy by translocation from their algal symbionts, or heterotrophy by consuming zooplankton or dissolved and particulate organic carbon. Sterols are important nutrients for corals and must be obtained through either their zooxanthellae or diet, since they cannot be synthesized by the corals themselves. Since sterols are specific to their source, the sterol composition of coral species can be used as a marker for feeding strategies. Variation in sterol composition among coral species could aid our understanding of coral response to environmentally stressful conditions. The sterols of the Caribbean corals, *Montastraea faveolata*, *M. cavernosa, Porites asteroides*, and *P. porites*, were extracted and analyzed with GC-MS to determine their individual sterol compositions. The results showed that the four coral species each have their own composition of sterols that is different from that of other species. Corals also have the same sterol composition as their respective zooxanthellae. Some species contain similar concentrations of some sterols. Four sterols were found in one species only, *P. porites*, the only finger coral among the other (mounding) species studied. This suggests that *P. porites* structure may allow for the uptake of more nutrients, an advantageous feeding strategy that may be useful during environmental stress.

Level of research: Undergraduate

Department: Chemistry

Faculty advisors: Mark Teece and John Hasset

Authors: Kilbourn, E., Department of Chemistry

Title: Short-term Photoacclimation of *Microcystis aeruginosa*

Abstract: Cyanobacteria harmful algal blooms are an important public health hazard because of their potential to produce toxins. One of the primary bloom forming species is *Microcystis aeruginosa*. Due to density of these blooms, the cells are often self-shaded and must adapt to acquiring light under lower light conditions. Cyanobacteria have three pigments: chlorophyll-a, phycocyanin (PC), and phycoerythrin (PE), that form the bulk of their photosystems. PC and PE make up the antenna system for photosystem II and play a primary role in this adaptation to changing light conditions. The objective of this study is to determine how quickly *M. aeruginosa* can adapt to changing light conditions. *Microcystis* was grown under fluorescent light (12 µmol m-2 –s-1) until in exponential stage, then transferred to four different

light levels (0, 3, 9 and 12 (control) µmol m-2 –s-1). Cultures were sampled every four hours over a 24-hour period. Photosynthetic efficiency was measured on the Walz PhytoPAM. Total and cyanobacteria specific chlorophyll were measured using the bbe FluoroProbe. Cultures were also filtered at each time point onto polycarbonate filters for later measurements of extracted PC and PE. The changes in these pigments over the 24 hour period will be presented. These studies intend to improve our ability to use individual pigments as a monitoring tool for cyanobacteria in natural environments.

Level of research: Undergraduate

Department: Chemistry

Faculty advisor: Gregory Boyer

Authors: Kirschner, A., Lundgren,B.R, and Nomura C.T., Department of Chemistry

Title: Growth of 3-Deoxy-D-arabinoheptulosonate 7-phosphate Synthases Null *Pseudomonas aeruginosa* in Supplemented Minimal Media

Abstract: Enzymes called 3-Deoxy-D-arabinoheptulosonate 7-phosphate synthases (DAHP) catalyze the rate limiting step in the biosynthesis of aromatic compounds in bacteria. The biosynthesis of aromatic amino acids, aromatic vitamins and some secondary metabolites such as phenazines are dependent on DAHP synthases. In this study, we determined the requirements of DAHP synthases PA1750 and PA2943 in the growth of *Pseudomonas aeruginosa* PAO1. Specifically, the growth rates for wild-type *P. aeruginosa* PAO1 and its DAHP synthase mutants (DPA1750, DPA2943 and DPA1750 DPA2943) were determined for cells grown in rich media and minimal media that was supplemented with various sugars and aromatic amino acids. The lag and doubling times for the mutants DPA1750 and DPA2943 were not significantly different compared to wild-type cells for all media types tested. In contrast, the doubling and lag time for the DPA1750 DPA2943 mutant was significantly higher compared to wild-type cells for all media tested. This time difference suggests that DAHP synthases PA1750 or PA2943 are essential for normal growth of *Pseudomonas aeruginosa* PAO1 in the absence of aromatic compounds.

Level of research: Undergraduate

Department: Chemistry

Faculty advisor: Benjamin R. Lundgren

Author: Klaczko, M. E., Department of Chemistry

Title: Evaluation of Stainless Steel FeCr/Ni Particle Synthesis and the Susceptibility of the Particles to Oxidation

Abstract: Stainless nanoparticle synthesis encompasses the processes used to develop corrosion resistant nanoparticles. Syntheses within labs have been successful, however at the large scale these processes have been hindered by low yields as a result of byproduct formation and oxidation loss. This study addresses these problems by introducing a new precursor to synthesize the Fe core of FeCr/Ni stainless core/shell particles. Traditionally iron pentacarbonyl (Fe(CO)5) is used, but this study uses iron acetylacetonate (Fe(acac)3) as a substitute. Although the degradation of Fe(CO)5 is more commonly used and understood, Fe(acac)3 is safer and less costly. Properly synthesized particles show high crystallinity and have immense magnetic capabilities. In this work, a comparison between the two precursors is completed and a study of the oxidation of these particles is done. The ability for Fe0 particles to act as a core for stainless particles and the effects of shells on the cores is also tested. Analysis of the particles was done using thermogravimetric analysis (TGA), Laser Ablation Induced Coupled Plasma Mass Spectrometry (LA-ICP-MS), Physical Property Measurement System (PPMS), and x-ray diffraction (XRD). These analysis methods allow for the approximate composition and oxidation of the particles to be determined. Results of the study show that Fe(acac)3 had similar or lower yields and more oxidation than Fe(CO)5, therefore supporting that Fe(acac)3 is not an effective substitute for Fe(CO)5. This shows that further research needs to be completed in order to find a potential substitute or create a new route for the successful creation of stainless nanoparticles.

Level of research: Undergraduate

Department: Chemistry

Faculty advisor: Mathew Maye

Authors: Leinoff, W.V. and Boyer, G., Department of Chemistry

Title: bbe Algae Torch: A Cost-Effective Instrument to Monitor for Cyanobacteria Blooms

Abstract: Due to the danger of toxins that have been attributed to certain phytoplankton there is an increasing need to identify algae in water samples quickly to determine their hazard level. A new instrument on the market is the bbe AlgaeTorch which gives real time quantitative analysis of total chlorophyll-a contributed by cyanobacteria *in situ*. Characteristic fluorescence of algae taxa has been identified and manipulated to determine concentrations of chlorophyll-a. Testing environments in which the bbe AlgaeTorch is effective will help identify potentially toxic waters in need of further testing as well as separating those which do not cause harm. This exciting tool is easy to transport and simple to use which will allow implementation of cost-efficient appraisal for identifying toxic algal blooms. Experiments with the bbe AlgaeTorch yield data comparable to analytical laboratory methods set for total chlorophyll-a and cyanobacteria chlorophyll-a concentration. Comparing total chlorophyll-a readings in situ with the bbe AlgaeTorch to fluorometric concentration of chlorophyll-a extractions following the EPA method yields linearly correlated results with a slope of ~1.5. Readings for cyanobacteria and green algae between two fluorescence detecting instruments agree with one another particularly closely at concentrations below 20 ?g/mL. Citizen scientists and researchers could easily use

the bbe AlgaeTorch in the field for determining safety of recreational waters and water sheds effectively alleviating some of the expensive and time-consuming lab-work necessary for screening water for harmful algae.

Level of research: Undergraduate

Department: Chemistry

Faculty advisor: Gregory Boyer

Author: Natwora, K., Department of Chemistry

Title: The Production of the Siderophore Schizokinen in *Anabaena* SP 27898

Abstract: The production of the hydroxamate siderophore, schizokinen in *Anabaena* sp ATCC 27898 is investigated. Siderophores are small, high affinity complexing molecules that cyanobacteria use to acquire or reduce ferric iron to provide iron that is otherwise not bio-available . In this experiment, *Anabaena* sp will be cultured and grown in iron-limited environments to induce siderophore production. Siderophore production will then be detected by two bioassays, CAS and Csáky, and a structural assay, High Performance Liquid Chromatography (HPLC) with a photodiode array absorbance (PDA) detector. Both bio-assays are colorimetric changes that can be measured for absorbance by a plate reader . For the structural assay, the siderophore is isolated by HPLC on a prp-1 column, then enters the PDA for dectection . Siderophore presence will be indicated by an absorbance spectrum with a peak at 425nm at a retention time of approximately 20 minutes. For proof of concept, *Bacillus megaterium* ATCC 19213 which is known to produce schizokinen will be used to provide a positive control for iron-limitation methods and detection methods. In iron-replete cultures (0.5mmol/L ferric chloride), the methods did not detect the siderophore schizokinen. In iron-limited cultures, schizokinen was detected by all three methods. The presence of siderophore production is significant because it is hypothesized that iron-limitation plays a role in algal bloom formation.

Level of research: Undergraduate

Department: Chemistry

Faculty advisor: Gregory Boyer

Authors: Pitt, J. (Department of Chemistry, SUNY College of Environmental Science and Forestry), Kozal, J.S., Massarsky A., Trevisan R., Di Giulio R.T. (Nicholas School of the Environment, Duke University) Jayasundara, N. (Nicholas School of the Environment, Duke University and School of Marine Sciences, University of Maine), Geitner N., Wiesner M. (Department of Civil and Environmental Engineering and the Center for the Environmental Implications of Nanoechnology), and Levin E.D. (Department of Psychiatry and Behavioral Sciences, Duke University)

Title: Developmental Distribution and Toxicity of Polystyrene Nanoparticles in Zebrafish (*Danio rerio*)

Abstract: Plastics are a ubiquitous anthropogenic contaminants, including macro, micro, and nano-scale (less than 100 nm in at least one dimension) particles that are a growing concern in aquatic environments. The hazard of macro-plastics is well documented, but nano-plastics remain relatively understudied. The current study examines the uptake, developmental toxicity, and tissue distribution of polystyrene nanoparticles (PS NPs) in zebrafish (*Danio rerio*). The developmental distribution and toxicity were examined by exposing zebrafish embryos to PS NPs (0.1, 1, or 10 ppm) from 6 hours post-fertilization (hpf) until 120 hpf with observations continuing until 144 hpf. The PS NPs were found to penetrate the chorion, initially accumulate in the yolk sac, and migrate to the gall bladder, liver, gastrointestinal tract, head, pericardium, and pancreas of the larvae throughout larval development. The study found that exposure to PS NPs did not induce any significant mortality, deformities, or changes to mitochondrial bioenergetics. Further, the PS NP exposed larvae exhibited bradycardia and hypoactive locomotor activity, a toxicity pattern predicted by the particle localization in the heart and brain. The capability of the PS NPs to affect the physiology and behavior indicates that they may reduce organismal fitness in affected aquatic ecosystems.

Level of research: Undergraduate

Department: Chemistry

Faculty advisor: John Hassett

Authors: Lillian Zemba

Co-authors: Zemba, L., Zhu, Y. and Kieber, D.J., Department of Chemistry

Title: Superoxide Concentration and Disproportion Rate in Water

Abstract: Dimethylsulfoniopropionate (DMSP) is a compound occurs in high concentration in many marine algae. DMSP and its breakdown products serve as an antioxidant system for reactive oxygen species (ROS) including the superoxide radical (O2-). Superoxide is the most frequently generated ROS in the cell. It is unknown whether DMSP scavenges O2- in the cell. In order to determine whether DMSP reacts with superoxide, first it was necessary to study the kinetics of O2- in solution. O2- is in equilibrium with HO2, and it also disproportionates to H2O2 and O2. The absorbance was measured at 240, 250 and 270 nm using UV-Vis spectroscopy to determine concentrations of O2-, H2O2, and HO2 during the first hour after a solution of O2- was prepared. Disproportionation rates for 5 mM O2- were measured at pH 9, 10, 11, 12, and 13. and the disproportionation rate constant was independent of pH. However, the amount of O2- present 10 min after the mixing was directly proportional to pH. Additionally, disproportionation rates of 2.5, 3.5, 4.5 and 5 mM O2- were measured at pH 13. The average rate constant at pH 13 was 9.25 M-1 s-1. Once the pH study is completed the next step in the project is to add DMSP to the reaction mixture along with catalase (to remove any hydrogen peroxide

that may form, and examime the kinetics and products formed from the reaction of DMSP and superoxide.

Level of research: Undergraduate

Department: Chemistry

Faculty advisor: David Kieber

Authors: Barkley, M.A., Kirkpatrick, S.M., Yanai, R.D., Miller, W.R., and Young, A.R., Department of Environmental and Forest Biology

Title: Tardigrade Community Response to Nitrogen and Phosphorus Addition

Abstract: Tardigrades prey on microbial communities that are likely limited by nutrient availability. However, no studies to date have examined the effect of nutrient manipulations on tardigrade communities. Here, we assess the response of tardigrade communities to fertilization with nitrogen and phosphorus across nine northern hardwood forest stands of three age classes: young, mid-aged, and mature. In August 2017, we collected 108 samples of moss from rock surfaces in the Bartlett Experimental Forest in the White Mountains of New Hampshire, USA, where research plots had been fertilized annually since 2011 with 30 kg N/ha/yr as NH4NO3, 10 kg P/ha/yr as NaH2PO4, a combined N+P treatment at the same rates, and a control with no fertilizer added. Tardigrade abundance increased in both N and NP treated plots ($p = 0.05$) and had marginally different community composition ($p = 0.07$). Additionally, moss in these N-treated plots had 28% more tardigrades compared to plots not amended with N. Tardigrade communities may respond to nutrient additions due to changes in their food source or changes in other factors affecting their population dynamics, such as migration, fecundity, longevity, or mortality. This impact on tardigrade abundance may have cascading effects throughout forest ecosystem food webs.

Level of research: Undergraduate

Department: EFB

Faculty advisor: Ruth Yanai

Authors: Emma Buckardt

Co-authors: Buckardt, E., Department of Environmental and Forest Biology

Title: Weather-Associated Triggers of Nesting Activity of Blanding's Turtles (*Emydoidea blandingii*) in Northeastern Illinois

Abstract: Environmental triggers of nesting activities in turtles are poorly known, but important for guiding species protection efforts. Blanding's turtle (*Emydoidea blandingii*) is a species of concern throughout much of its range and considered more likely to nest on wet warm nights, a pattern not yet evaluated. Weather conditions were analyzed during the 2013-2017 nesting seasons of a Blanding's turtle population located in the lake plain region of northeastern Illinois to identity climate conditions most associated with nesting activity. Peak nesting dates each year were associated with warmer mean temperature in the preceding months of March, April, and May such that on warmer years the majority of turtles nested earlier. Within a given nesting season, nights in which nesting activity occurred had higher maximum (x?=27.6 C), mean (x?=21.9 C), and minimum temperatures (x?=15.9 C) than nights without nesting behavior. No pattern between nesting activity and precipitation was evident. Average barometric pressure was lower on nights with nesting activity (p=0.03). When the moon was in its brightest stages (Waxing Gibbous to Last Quarter), nesting behavior was more likely (p=0.0016). Nights when nesting occurred tended to have winds from the south (p=<0.001), which are generally associated with warmer temperatures and lower average air pressure in the study region. In conclusion, warmer nights with lower barometric pressure, brighter moon phase, and winds from the south appear to be drivers of nesting activity in Blanding's turtles. These readily measured environmental triggers provide a useful guide to biologists to time efforts for finding and protecting nests and nesting females.

Level of research: Undergraduate

Department: EFB

Faculty advisor: James Gibbs

Authors: Cromwell, S.R., Romano, J.A., Holroyd, D.E., Hong, D.S., and Yanai, R.D., Department of Environmental and Forest Biology

Title: Leaf Resorption and Characteristics of Three Northeastern Hardwood Species in Response to Nutrient Additions

Abstract: Whether nitrogen or phosphorus is more limiting to northeastern hardwood forests is currently in dispute. This study looks at the effect of N and P addition on specific leaf area, resorption efficiency and proficiency of American beech (*Fagus grandifolia*), pin cherry (*Prunus pensylvanica*), and white birch (*Betula papyrifera*) in a young stand in Bartlett Experimental Forest, New Hampshire, which was treated annually with P, N, N and P, and one-time application of calcium, or nothing. Ca was included as its concentration often increases in senescing leaves opposed to other nutrients the tree saves. Three trees of each species were chosen in each treatment plot (n=3). The trees were then classified in terms of their specific leaf area (SLA) as well as their resorption proficiency and efficiency of P and Ca. It was hypothesized that though both N and P additions would have increased in SLA compared to the control, the largest increase would be seen in the combined NP plot. In terms of resorption, it is expected that plots containing P additions will see a decrease in P resorption, but N

additions will have no effect. Furthermore, resorption of P is expected to increase in the Ca plot because of increased ion strength.

Level of research: Undergraduate

Department: EFB

Faculty advisor: Ruth Yanai

Authors: Czarnecki, C., Parry, D. and Manderino, R., Department of Environmental and Forest Biology

Title: Ultraviolet Reflectance and Relative Bird Predation Rates on Plasticine Caterpillar Dummies

Abstract: The caterpillars of moths and butterflies (*Lepidoptera*) reflect UV wavelengths to varying degrees. Insectivorous birds have photoreceptors that can detect UV-reflectance. How this influences birds' prey selection preference or ability to detect caterpillars remains largely unknown. In this study, we used plasticine 'dummy' caterpillars modeled after Polyphemus moth (*Antheraea polyphemus*) caterpillars, a known UV-reflecting species, to test the effects of UV-reflectance on relative avian predation rates in forests. We hypothesized that attack rates would be greater for UV-fluorescent dummies, as they would present an additional visual cue. We made 240 plasticine dummies and painted 80 of them with UV-reflective paint in patterns exhibited by live caterpillars. The dummies were deployed for 6 days across 16 sites that represented a hardwood forest gradient in the Adirondacks, NY, after which they were collected and assessed for damage from avian predators. Differences in predation between paint treatments were compared across sites. Bird strikes were recorded on 26 dummies, with 22 on unpainted and 4 on painted dummies. Proportion of dummies struck was greater for unpainted (0.14 ± 0.03) than it was for painted dummies (0.05 ± 0.02). A paired t-test showed statistical significance between the paint treatment and the proportion of strikes across sites ($t = -2.61$, $p = 0.014$, $n = 16$). The lower attack rate on UV-reflecting dummies indicates that the UV patterns on caterpillars protect against predation. Ongoing research will investigate if these patterns enhance caterpillar crypsis, or present warning cues to avian predators.

Level of research: Undergraduate

Department: EFB

Faculty advisor: Dylan Parry

Authors: Deutschman-Ruiz, G. and McNulty, S., Department of Environmental and Forest Biology

Title: Common Loon Vocalization Activity on Undeveloped Adirondack Lakes: Lake Size Matters

Abstract: Vocalization is a means of transmitting a message from one individual to another individual of the same or different species; species can change their call strategy to adapt to local conditions. Yet,

increasing urbanization has influenced the soundscape of many northeastern lakes and affected animal behavior and biophony. The acoustic adaptation hypothesis (AAH) states that more vocalizations will occur in more densely vegetated/packed areas. *Gavia immer* (Common Loon) is an iconic species known for a variety of low frequency vocalizations such as wails, tremolos, yodels, and hoots. We hypothesized post-nesting Loon call activity would decrease with increasing lake size and show a diurnal pattern. We placed sound recorders at four undeveloped Adirondack lakes (area 0.46 - 2.17 km2) for six nights. Total vocalizations were negatively related to lake size (R2 = 0.94). Our result concurs with the AAH, given smaller lakes have more densely packed shoreline vegetation and a larger perimeter to area ratio. Our study supports the idea that Loon vocalizations, and by extension, soundscapes, may be influenced by geography. However, mechanisms behind Loon vocalization activity remain complex and relate to breeding status, age, predation risk, time of year and other factors. As one of the most charismatic species in the Northeast, an understanding of Loon behavior is useful for wildlife conservation. Loon vocalization activity and lake use patterns suggests attention to shoreline development is needed for land use policy.

Level of research: Undergraduate

Department: EFB

Faculty advisor: Stacy McNulty

Authors: Devlin, M., McMullin, J., Caltabiano, S., Martini, S., Abuqube N., and Newman L., Department of Environmental and Forest Biology

Title: Understanding Plant Metabolic Pathways for Trichloroethylene Degradation

Abstract: Trichloroethylene (TCE) is one of the most common organic groundwater contaminates. It was widely used as an industrial degreaser until the 1970's when it was suspected to be a human carcinogen as well as causing other health problems. Humans can break down TCE using the liver enzyme P450-2E1, and the pathway is well studied. Plants can break down TCE producing similar metabolites, but the mechanisms of plant degradation are not well understood. P450-2E2 homologs have been found in yeast and bacteria, and the sequences of the reactive sites have been identified. Using BLAST analysis of the model organism *Arabidopsis thaliana*, five P450 genes that the same amino acid motif have been identified. In previous experiments with mutant *Arabidopsis* strains, two of the genes showed promise to be involved with TCE degradation. The genes, AT5G24960 and AT4G37430 are currently being isolated from *Arabidopsis* and will be transformed into the model plant *Nicotiana tabacum* using *E.coli* and *Agrobacterium* overexpression vectors. The transformed *Nicotiana tabacum* will be exposed to TCE and a metabolite profile will be conducted. Copy numbers of the gene as well as the expression pattern will be determined using q-PCR to compare to the metabolite profile. Identifying genes used for TCE degradation in plants would lead to better identifying the potential of other plants to remediate TCE contaminated sites.

Level of research: Undergraduate

Department: EFB

Faculty advisor: Lee Newman

Authors: Grant, D., Cohen, J., Stantial, M., and Linhart, R., Department of Environmental and Forest Biology

Title: Substrate-level Nest Site Selection of Piping Plovers (*Charadrius melodus*) and American Oystercatchers (*Haematopus palliates*) on the Holgate Unit of Edwin B. Forsythe National Wildlife Refuge, New Jersey, USA

Abstract: Piping Plovers (*Charadrius melodus*) and American Oystercatchers (*Haematopus palliates*) are two shorebirds of conservation concern that can be found nesting along the Atlantic coast of the United States during the late spring through the early and mid-summer. They occupy beaches that have been under increasing pressure from human development and activity. Mutual aggression has been increasingly observed between these species, which use similar areas for nesting. Breeding success depends on survival of their nests which are camouflaged against the sand; therefore, habitat selection for nesting is an important component of fitness. We studied nest site selection on the Holgate Unit of Edwin B. Forsythe National Wildlife Refuge in southern New Jersey. Understanding interspecific differences in habitat selection could provide a means for managing the two species while reducing agonistic interactions between them. We compared nest sites with paired random sites based on median proportions of substrate cover in categories of rock, shell, wrack, plant, and other items ("other", including dead, woody debris, peat, and plastic litter) within a 1 m quadrat. Both American Oystercatchers (n = 37) and Piping Plovers (n = 42) selected some substrate features out of proportion to their availability and there were interspecific differences. Locations near wrack appear to be selected by American Oystercatchers for nesting, while Piping Plovers used areas with greater proportion of shells, particularly medium fragments (2 mm - 64 mm). Our results indicate that substrate management may be effective in creating ecological separation where these species coexist.

Level of research: Undergraduate

Department: EFB

Faculty advisor: Jonathan Cohen

Authors: Kirkpatrick, S.M., Young, A., and Yanai, R., Department of Environmental and Forest Biology

Title: Soil Nutrient Amendments Affect Foliar Chemistry at Different Heights within *Acer saccharum* Trees

Abstract: Information regarding the effect of nutrient amendments at different heights within the tree is limited by the difficulty of sampling leaves in forest trees. The foliar chemistry response of *A. saccharum* to light attenuation within the canopy and three nutrient amendments was tested in Bartlett Experimental Forest, NH. This study examines three mature stands that have four treatment plots within each stand (N, P, NP, Control) for a total of twelve trees. Treatments involved seven annual additions of 30 kg/ha of nitrogen and 10 kg/ha of phosphorus. Leaf samples were collected every two meters from the top of the canopy down to the lowest available foliage. The leaf samples were microwave digested and then analyzed with inductively coupled plasma optical emission spectroscopy (ICP-OES). Magnesium, manganese, and calcium were examined as they are indicators of *A. saccharum* health and growth (Long et al., 2009). Foliar concentrations of manganese ($p=0.008$), magnesium ($p=0.001$) and calcium ($p=0.002$) were higher in plots treated with nitrogen. The concentration of magnesium ($p=0.0008$) and calcium ($p=0.005$) decreased toward the top of the tree. Manganese was not affected by canopy position.

Level of research: Undergraduate

Department: EFB

Faculty advisor: Ruth Yanai

Authors: Mahon, H.J., Jones, M.I., and Fierke, M.K. (Department of Environmental and Forest Biology, SUNY College of Environmental Science and Forestry) and Crook, D.J. (USDA APHIS)

Title: Evaluation of Trap Color for Recovery of Emerald Ash Borer Parasitoids

Abstract: Three hymenopteran parasitoids, *Tetrasticus planipennisi*, *Spathius galinae*, and *Oobius agrili* have been released within the Syracuse area for biological control of emerald ash borer (EAB), *Agrilus plannipennis* (Coleoptera: Buprestidae). Previous research revealed adult parasitoids were attracted to yellow colors; therefore, yellow pan traps have been used to detect parasitoid establishment and dispersal. Sunshine yellow has been effective for detecting *T. planipennisi* and somewhat effective for *O. agrili*; however, *S. galinae* have rarely been recovered. To investigate these low recovery rates, retinal sensitivity analysis was carried out to determine the wavelength of color eliciting the highest response from S. galinae. Based on retinogram results, 68 pan traps representing four color treatments were placed on 17 ash trees (*Fraxinus* sp.) near two parasitoid release points in East Syracuse. Trap color treatments were sun porch, sunshine yellow, yellow finch, and a control (a commercially purchased plastic bowl, yellow sunshine 09). Traps were established for 8 weeks (Aug–Oct) and sampled weekly. During the same period, three releases of ~250 *S. galinae* were conducted (the other parasitoid species were released in 2015/16 and were established). In congruence with retinogram results, sun porch traps caught more than other colors (7 *S. galinae* and 6 *T. planipennisi*) indicating it is likely a better color choice for EAB parasitoid recovery. Further investigations on a larger scale, for all parasitoids, are needed to demonstrate effectiveness of this new pan trap color, compared to the control color (yellow sunshine) as recommended in USDA APHIS parasitoid monitoring protocols.

Level of research: Undergraduate

Department: EFB

Faculty advisor: Melissa Fierke

Authors: Mensah, S., Sarwaar, Z., Department of Environmental and Forest Biology and Nomura, C.

Title: Making Labelled Probes To Investigate The Binfing of FhpR to The Promoter Sequence of The Flavoemglobin Gene in *Pseudomonas aeruginosa*.

Abstract: The protein complex flavohemoglobin detoxifies nitric oxide in *Pseudomonas aeruginosa*. The ability to detoxify nitric oxide is crucial to the ability of *P. aeruginosa* to infect humans and other animals because nitric oxide is often produced by host immune system to combat *P. aeruginosa* infection. The enhancer binding protein FhpR has been shown to be one of several proteins that regulate the transcription of the flavohemoglobin gene, fhp, of *Pseudomonas aeruginosa* in the presence of reactive nitrogen species. FhpR is one of the key transcriptional regulators of fhp, and this study aimed to optimize the production of DNA probes to be used for further studies on binding of FhpR to the promoter region of the fhp gene, Pfhp. PCR was used to make Cy5 labeled probes using the pZS404 plasmid as a template and BRL456 Cy5 labeled oligonucleotides as primers. The pZS404 plasmid contained a 250-base pair sequence that contains the promoter region of fhp. The segment of DNA containing this sequence was isolated using gel electrophoresis. The concentrations of this DNA segment isolated and purified were 10.7 ng/mL and 11.1 ng/mL. These probes will be used for EMSA reactions with isolated and purified FhpR proteins.

Level of research: Undergraduate

Department: EFB

Faculty advisor: Lee Newman

Authors: Morley, M.S. (Department of Environmental and Forest Biology, SUNY College of Environmental Science and Forestry), Walsh, G.E. (Department of Chemical and Environmental Engineering, Yale University), and Yanai, R.D. (Department of Forest and Natural Resources Management, SUNY College of Environmental Science and Forestry)

Title: Overachieve and Retain the Leaves: Nutrients Affect Fall Leaf Retention in Northern Hardwood Tree Species

Abstract: In deciduous trees, autumn leaf abscission signals the end of seasonal photosynthesis. This study examines the effect of nitrogen and phosphorus additions on leaf retention in *Fagus grandifolia*, *Acer saccharum, Acer rubrum, Betula papyerifera, Betula alleghaniensis*, and *Prunus pensylvanica* in four

stands in Bartlett Experimental Forest, New Hampshire, USA. These stands are part of a project on Multiple Element Limitation in Northern Hardwood Ecosystems (MELNHE), which contains plots that are either unfertilized or treated with nitrogen (N), phosphorus (P), or both N + P. Leaf litter was gathered and sorted four times in fall of 2016 and again in spring 2017. At each collection, the proportions of leaves retained among treatments were analyzed with a randomized complete block design analysis of variance. Fertilization caused sugar maple trees to retain their leaves longer. By the second collection date (October 18 - 19), sugar maple trees in P plots had 34% more leaf mass still in the canopy than those in the controls, while those in N and N + P plots retained 29 and 22% more leaf mass than those in the controls ($p < 0.005$). Red maple trees in the N plots had dropped 31% more leaves than red maples in the N + P plots ($p = 0.05$). These observations are consistent with a reduced dependence on nutrient resorption from leaves with the addition of limiting nutrients, allowing trees to extend their growing season. This evidence suggests that increased nitrogen deposition could be contributing to increased carbon fixation in deciduous forests.

Level of research: Undergraduate

Department: EFB

Faculty advisor: Ruth Yanai

Authors: Morrissey, P., Kenyon, A., Newman, L., Department of Environmental and Forest Biology

Title: Production of Pharmaceutical Compounds in Plants

Abstract: The use of injectable vaccines and pharmaceuticals pose logistical problems around the world. This problem has previously been investigated using plants to produce pharmaceuticals, which would eliminate the problem of injection sterility. Concentration determination in the harvested plants still pose a critical problem. For medicines that might be cytotoxic, there is another problem that production in the living plant tissues could kill the plant before they could produce enough compound to be economically viable. The solution proposed by this project focused on the use of the promotor for a 58kD protein in Capsicum to target pharmaceutical production in ripened fruit of the red pepper plant. This avoids the cytotoxicity issue as the promotor drives protein synthesis only in final ripening states of the fruit, that can be harvested when ripened, thus preventing plant death. These peppers can be ground and dried, providing a sample that can be tested for concentration and uniformly allocated into capsules. The protein has been isolated from the chromoplast of the Capsicum fruit with a sucrose gradient centrifugation using a modified method for isolations. The next step is the isolation of mRNA and genomic DNA to search for the promoter regions using a cDNA clone for the protein. Once the promoter regions are identified a DNA cassette can be produced containing a marker gene and inserted into fruit bearing plants to determine which fruits produce the highest level of the marker, and the marker timing. The final goal would be the insertion of a pharmaceutically relevant gene into the cassette and creation transgenic plants that produce the desired compound.

Level of research: Undergraduate

Department: EFB

Faculty advisor: Lee Newman

Author: Palmer, C.T., Department of Environmental Forest Biology

Title: A Comparative Study of the Benthic Macroinvertebrate Assemblage of Two Central Adirondack Streams

Abstract: *Bacillus thuringiensis var. israelensis* (Bti) is a bacterium that occurs naturally in soils, and the crystalline protein produced during sporulation is approved for use as an insecticide by the EPA to target black fly (*Simuliidae*) and mosquito (*Culicidae*) larvae in waterbodies. In the 1980s, SUNY ESF graduate student Jonathan Kennen examined the potential impacts of Bti on the assemblage structure of benthic macroinvertebrates in Big Sucker Brook and Little Sucker Brook in the Adirondacks. Using his data from August of 1987 as a baseline, this study made comparisons of the stream invertebrate assemblages to explore whether there were any changes in the 30 years since. Macroinvertebrates were collected with a standard Surber sampler and identified to order or genus using a stereoscopic dissecting microscope and taxonomic keys. Analysis of functional feeding groups and ecological indices showed no significant spatial or temporal differences in the benthic macroinvertebrates between Little Sucker Brook and Big Sucker Brook.

Level of research: Undergraduate

Department: EFB

Faculty advisor: Kim Schulz

Authors: Roden, H.E., Horton, T.R., Powell, W.A., Department of Environmental and Forest Biology

Title: Effects of Oxalate Oxidase Transgene Expression on Mycorrhizal Colonization in American Chestnuts

Abstract: The mycorrhizal network increases plant root volume, enhancing water and nutrient uptake and creating a communication network between individual plants. The American chestnut (*Castanea dentata*) is symbiotic with ectomycorrhizal fungi, a fungus that does not penetrate the cell wall of the plant host, instead forming an intercellular interface (Dulmer, LeDuc, and Horton, 2015; Palmer, Lindner, and Volk, 2008). American chestnuts have been genetically engineered to express an oxalate oxidase gene isolated from wheat, which allows the plants to degrade oxalic acid, the virulence factor produced by *Cryphonectria parasitica*, the pathogenic fungus that causes the fatal chestnut blight. In this study, we investigated the effect of oxalate oxidase gene expression on mycorrhizal colonization rates. Six-

month-old transgenic and wildtype plantlets were placed in a soil inoculant and cultured in a greenhouse for 7 months, then root tips were visually assessed to estimate how many were colonized (expressed as a percentage). Three genotypes were used: ELLIS 1 trees were a cloned wildtype, and Darling 54 and Darling 58 were ELLIS 1 genotypes transformed with the oxalate oxidase gene, differing only in where the gene construct was inserted into the genome. Of surviving trees, 100% of both ELLIS 1 and Darling 58 trees were >95% colonized. Ninety percent of Darling 54 were >95% colonized, and 10% were 90-95% colonized. A Fisher's exact test of independence was used to reach the conclusion that expression of the oxalate oxidase gene has no effect on mycorrhizal colonization, a result consistent with similar studies.

Level of research: Undergraduate

Department: EFB

Faculty advisor: Thomas Horton and William Powell

Authors: Sinopoli, D.A., Stewart, D., Palumbo, J., Clifford, K., Department of Environmental and Forest Biology, and Wright, J., New York State Museum, Albany, NY.

Title: Morphological Variation Among Bowfin (*Amia*) Populations from the Mississippi River Basin: Taxonomic and Conservation Implications

Abstract: The genus *Amia* has been considered monotypic since 1896, when 12 nominal species were synonymized with *A. calva* without analysis or rationale. To further test that monotypy hypothesis, we analyzed morphological variation among museum materials and freshly-collected population samples of Bowfins from Louisiana (type locality of *A. marmorata*, the fourth described species, *A. viridis*, and *A. subcoerulea*) and Walbash R., Illinois (type locality of *A. reticulata*); other nominal taxa for the Mississippi drainage with uncertain localities are *A. piquotti* and *A. ornata*. Multivariate analyses (PCA's) were applied to data for 38 morphometric characters; 8 meristic characters were evaluated with univariate statistics. We also examined all available type materials for Amia spp. We find that there appear to be multiple morphotypes within each region [lower and upper Mississippi], and furthermore, those from LA are morphologically distinct from IL specimens. This suggests a pattern of "drainage allopatry", where lowland and upstream fishes from the same drainage are distinct, but further sampling is needed from intermediate areas. We reject the 122-year-old monotypy hypothesis. We are continuing to evaluate the taxonomic and conservation implications of these findings, including comparisons with South Carolina fishes (type locality of *A. calva*) and Lake Huron (type localities for *A. ocellicauda* and *A. occidentalis*, 2nd and 3rd described species). Discovery of Bowfin diversity within the Mississippi basin raises conservation concerns, given the developing Bowfin caviar fishery.

Level of research: Undergraduate

Department: EFB

Faculty advisor: Donald Stewart

Authors: Windstein, K.Z., Teale, S.A., Horton, T.R. and Preminger, M.Z.

Title: The Influence of Heart-Rot Fungi on Beech Bark Disease Pathosystems in Central New York

Abstract: Beech bark disease (BBD) is an important ecological and economic problem in the Northeastern United States. It is caused by a complex of interacting fungi (*Neonectria faginata* and *N. dittisima*) and insects (*Cryptococcus fagisuga* and *Xylococulus betulae*) on a host tree (*Fagus grandifolia*). A previous study revealed an association between low levels of one phenol (catechin) with the presence of C. fagisuga and N. faginata, while low levels of another phenol (isorhamnetin) are associated with the presence of *X. betulae* and *N. ditissima* in beech hosts of long-affected forests in New York. There is also evidence that beech simultaneously affected by BBD and specific heart-rot fungi are virtually free of C. fagisuga, but *X. betulae* is not affected by the presence of heart-rot fungi. We hypothesized that BBD lesions on heart-rot infected trees are caused by *N. ditissima*, not *N. faginata*. Bark discs (n=101) were sampled from trees (n=46) exhibiting signs of Neonectria infection (control trees), heart-rot fungi or both. Fungi from discs were cultured on sterile PDA so the *Neonectria* species, if any, could be identified. *Neonectria faginata* was isolated from both control and case trees possessing heart-rot. *Neonectria ditissima* was not found on any tree. Thus, our hypothesis is rejected. These results suggest that heart-rot fungi do not exhibit an interaction with *N. faginata*, and that insect feeding alone is insufficient to predict *Neonectria* species infection pathways. Absence of *N. ditissima* can be explained by previous studies that have shown *N. faginata* to dominate the BBD complex in long affected stands.

Level of research: Undergraduate

Department: EFB

Faculty advisor: Stephen Teale

Authors: Baronian, M. and Stella, J. C., Department of Environmental Science

Title: Climate and Stream Network Influences on Seasonal Conductivity in an Urban Stream (Meadowbrook Creek, Syracuse, New York)

Abstract: Meadowbrook Creek is a first order urban stream in Syracuse, NY, making it susceptible to road salt infiltration due to runoff from impervious surfaces. Road salt leads to more saline conditions, giving organisms insufficient time to cope with environmental changes, which can be estimated through fluxes in chloride concentrations. The upstream portion of Meadowbrook Creek is highly urbanized, while the downstream portion is connected to its floodplains through a vegetated riparian zone. Three stream gauges were installed, measuring electrical conductivity (EC) as a proxy for chloride concentrations. This study used R to analyze relationships between precipitation and stream EC

concentrations, its seasonal differences, and how that is impacted by degree of relative urbanization and stream network position. It was expected that in the summer, baseflow EC levels would be higher downstream and upstream, yet higher upstream than downstream in the winter. It was also expected that there would be a negative correlation between EC and summer precipitation, and a positive correlation between EC and winter snowmelt events. Baseflow conditions in EC were found to be highest downstream in the summer, and highest upstream in the winter. In the winter, the upstream stream gauge was found to be more sensitive to precipitation events, yet in the summer, the stream gauge furthest downstream was found to be most sensitive to precipitation events. As no strong correlations were found between EC and precipitation per season, further understanding on the relationship between snowmelt, dilution, and stream discharge on electrical conductivity needs to be evaluated.

Level of research: Undergraduate

Department: Environmental Science

Faculty advisor: John Stella

Authors: Becker, E. and Butler, D. (Department of Environmental Science, SUNY College of Environmental Science and Forestry; Department of Plant Sciences, University of Tennessee)

Title: Using Intercropping as a Land Management Strategy for the Vaca Forest Reserve

Abstract: Pressures on protected lands have risen as the need for agricultural land has increased. The Vaca Forest Reserve (VFR), located in Cayo, Belize, has had an increase in both legal and illegal farming activity within its borders. Current management of the VFR is focusing on utilizing sustainable agricultural practices as a bridge between the needs of the people and conservation efforts focused on preserving the land. Initial cropping systems evaluations in the VFR indicate that there are existing practices used by multiple farmers which could improve sustainability if used by more farmers over a larger percentage of cropped land. For example, it is likely that intermixed annual and perennial systems would be more beneficial to the farming system and provide more ecosystem services than annual herbaceous crop production systems, as bare ground was generally lower than annual systems (18% versus 31% bare ground), while annual crop ground cover was similar among systems. Intermixed annual and perennial systems also maintained relatively high tree canopy cover (53%) compared to perennial production systems (84% canopy cover). These results indicate that an appropriate land management strategy for the VFR may be intercropping agricultural fields in order to decrease the need for excess land.

Level of research: Undergraduate

Department: Environmental Science

Faculty advisor: David Butler

Authors: Lawrence, C. and Mao, H.

Title: Factors Affecting Atmospheric Methane in the North American Arctic Region

Abstract: Methane plays a critical role in Earth's atmosphere, responsible for about 20% of the Earth's warming since the pre-industrial era. However, our understanding remains incomplete for budgets and distributions of atmospheric methane as well as the factors controlling them, especially in Polar Regions which have been under the great impacts of anthropogenic influence and climate change. This study focused on two Polar locations, Barrow, Alaska (71.323, -156.611) and Alert, Canada (82.451, -62.507). Potential causes of differences in concentrations between these two Arctic sites and their long-term variations were investigated over the period of 1986 to 2014. The potential causes investigated included wetland release linked to permafrost melt, atmospheric transport, and anthropogenic influence. Preliminary results suggested a complicated relationship between temperature and methane concentrations, with the strongest correlations in the months of November and October. Analysis of atmospheric transport using teleconnections such as the El Nino Southern Oscillation (ENSO) and North Atlantic Oscillation (NAO) suggested very little contribution. Contributions from anthropogenic sources, permafrost thawing, and atmospheric oxidation were estimated.

Level of research: Undergraduate

Department: Environmental Science

Faculty advisor: Dr. Huiting Mao

Authors: Schreiber, G. N. and Stella, J. C.

Title: Influence of Sacramento River Processes on Growth Rate of *Populus fremontii*

Abstract: The Sacramento River riparian ecosystem has been heavily impacted by land conversion and flow alteration from Shasta Dam. The Middle Reach of the river still has a large proportion of forested riparian area that contains an abundance of *Populus fremontii*, Fremont cottonwood. Tree inventory data and tree-ring increment cores were collected from riparian sites along 100 miles of river as part of a previous study. The purpose of this study was to utilize the tree-ring data to understand if riparian tree growth responds to climate drivers similarly to upland trees and to determine what factors can best predict riparian tree growth. Preliminary results reveal that riparian trees do not respond to climatic factors such as temperature and precipitation. Using multiple regression models that account for growth influences of tree age, we found that depth of fine sediment and river mile are the best predictors of cottonwood radial growth along the Middle Reach of the Sacramento.

Level of research: Undergraduate

Department: Environmental Science

Faculty advisor: John Stella

Authors: Anderson, G.J.

Title: Implementing a Self-Sustaining Compost Program in Syracuse City Schools: A Feasibility Study

Abstract: Nottingham High School (NHS) in the Syracuse City School District (SCSD) produces a large amount of food waste by offering breakfast and lunch for over 1,300 students five days a week. The school would save money and reduce its environmental impact by implementing food waste collection in the cafeteria to send to Onondaga County Resource Recovery Agency (OCRRA)'s industrial composting facility in Jamesville, NY. This would also provide educational benefits to students in selected programs at the school through involvement in the waste analysis and reduction process. An investigation supported by OCRRA was conducted to assess the feasibility and impacts of collecting food waste from SCSD schools to send to their two composting facilities in Onondaga County due to the more environmental friendly nature of compost. This project had three deliverables to meet its primary objectives: recommendations to pitch a self-sustaining compost program to SCSD using NHS as a case study; a report with economic and environmental impact analyses on composting and other related sustainability initiatives in the school; and procedures for the students' involvement in the waste characterization and other educational materials be included in the Natural Resources curriculum. The results of this project support the implementation of a food waste collection program at Nottingham High School to be sent to OCRRA's composting facility in Jamesville, NY. The environmental impact of Nottingham High School would be reduced, and expenses would decrease.

Level of research: Undergraduate

Department: ERE

Faculty advisor: Douglas Daley

Authors: Carris, D., Murphy, C., Claeys, J. and Kruegler, J.

Title: Non-Point Source Pollutant Preliminary Study of Skaneateles Lake Tributaries

Abstract: During the summers of 2016 and 2017 a study of nutrient and sediment pollution to Skaneateles Lake was completed to address concerns over watershed management and potential threats to Skaneateles Lake water quality. Four tributaries were selected based upon the compositions of land uses within their subwatersheds for water quality analysis under dry and wet weather conditions. Water quality parameters including Total Suspended Solids, Orthophosphate, Nitrate, and Ammonia concentrations were tested for and compared across watersheds based on land use type and flow conditions. Observations were also taken of potential water quality concerns during field sampling, and through resident interviews. Finally, a literature review was completed to identify best management practices currently applied in the watershed, and management practices that could be promoted to farmers. This preliminary study was intended to acquire data within a large scope with minimal depth of analysis. Data acquired through this project are intended to identify areas of concern in the watershed

and encourage more specific research efforts toward watershed management and water quality improvement.

Level of research: Undergraduate

Department: ERE

Faculty advisor: Douglas Daley

Authors: Jermyn, C.D., Kroll, C.N.

Title: An Analysis of Runoff Ratios Across Urbanizing Gradients

Abstract: This study examines precipitation and streamflow patterns in watersheds in the Bronx, New York and Baltimore, Maryland to analyze runoff ratios, the ratio of runoff to precipitation, across varying levels of urbanization. i-Tree Hydro was also utilized to assess its effectiveness at modeling urban hydrology. NEXRAD precipitation data and USGS streamflow measurements were used to calculate monthly average runoff ratios for five watersheds of varying land cover characteristics. This data, supplemented by weather station data from BWI Airport, was also used to run the i-Tree Hydro model. Streamflow predictions from this model were used to calculate average monthly runoff ratios for comparison to the above estimates. Accuracy of the NEXRAD data was a limiting factor in drawing broad conclusions, as it appeared to consistently overestimate precipitation amounts. Despite this, differences were shown between the runoff ratios of the watersheds with the greatest and least percentages of tree cover during summer months, indicating the importance of tree cover as a valuable resource for reducing runoff during high warmer months when evapotranspiration is high. This could be particularly valuable in cities susceptible to heavy precipitation in the summer months, such as Baltimore. At these sites, the i-Tree Hydro model was shown to take into account land cover, while underestimating the effect of seasonal changes on ET and subsequent runoff ratios.

Level of research: Undergraduate

Department: ERE

Faculty advisor: Charles Kroll

Authors: Taylor, B.S.

Title: Developing a Localized Predictive Model for Sugar Maple Sap Production Season Termination

Abstract: For thousands of years, humans have been extracting the sap of the sugar maple tree for use in many areas of life. The ability to predict the key events, like the change in the flavor of maple sap, can be critical for the success and profitability for modern maple syrup production. Four models are developed to correlate the accumulation of heating and cooling over specified periods of time with the

change in maple sap flavor at a maple operation in Attica, NY. Growing degree days and cooling degree days are used to simulate this heating and cooling accumulation. After testing the four models with varying date ranges, threshold/base temperatures, cooling accumulation thresholds, and heating start dates, the data suggests there is no significant correlation between heating and cooling accumulation and the flavor change of maple sap at this location.

Level of research: Undergraduate

Department: ERE

Faculty advisor: Christopher Somerlot

Authors: Christensen, F.

Title: Caryatids and Stones: The Unnoticed Battles for Environmental Quality and Justice

Abstract: My research efforts focus on several contemporary environmental issues being downplayed or ignored by mainstream media. Some examples include the Deepwater Horizon oil spill remediation effort's deleterious health effects on both cleanup workers and Gulf coast residents; commonplace toxic practices widely used in industrial agriculture; risks – to health, life and limb – of environmental advocacy; the ongoing struggle for control of the water in California's San Bernardino National Forest, and its parallels in other, similar situations going on across the world. I examine what elements combined to produce the conditions of each problem and what, if anything, is being done to fix it. My goal is to bring increased attention to these issues, in the hope more people will become actively involved in resolving them.

Level of research: Undergraduate

Department: Environmental Studies

Faculty advisor: David Sonnenfeld

Authors: Gier, J. and Quaresma, J.

Title: Cornell Cooperative Internship

Abstract: In January 2018, I was hired through a grant as a STEM Extension Educator in the Natural Resources Department of Onondaga County Cornell Cooperative Extension. Lockheed Martin provided this grant for the Career Pathways Program, which is facilitated by Cornell Cooperative Extension. The primary objective of this STEM program is to provide community programming to 300 students, specifically targeting young women of minority background. This internship is intended to provide mentorship and training, a better understanding of the intersection of public and private partnerships and grant writing, as well as provide environmental education. Through this grant, I visited multiple

schools throughout Syracuse for the purpose of delivering 12 inquiry-based STEM programming lessons to K-12 students. After meeting the goal of providing STEM education to 300 students, the remainder of my semester will be spent performing duties that are of career development interest to me. So far, I am in the process of coordinating a garden for 4-H Homeschoolers Club behind Meals on Wheels. I have been instructed to take the lead on design and implementation. There are two garden plots 20 feet by 4 feet. One garden is planned to be a three-sisters garden, and the other will be an herb garden. I will also be running a mushroom cultivation lesson featuring wine-cap mushrooms rolled in cardboard that can easily be incorporated in any garden in the 5b zone.

Level of research: Undergraduate

Department: Environmental Studies

Faculty advisor: David Sonnenfeld

Authors: Gilbert, C., Boyer, G., Green, H.

Title: Microbial Source-Tracking for Fecal Contaminants in Sodus Bay, Lake Ontario

Abstract: Fecal contamination of water bodies can pose major threats to water quality as well as human health. Wastewater discharges and agricultural runoff to fresh waters as well as costal seawaters are thought to be the major sources of fecal pollution. Exposure to pathogens in these pollutants is a major contributor to water-borne diseases globally. Additionally, excess nutrients entering aquatic systems through fecal contamination aids in the growth of algal blooms. Harmful Algal Blooms (HABs) in New York State are an increasing threat; in 2017 over 100 beaches in NYS were closed due to HAB outbreaks. Monitoring for specific sources of contaminants needs to be done in order to inform the proper mitigation strategy. This study attempts to monitor possible fecal pollution of Sodus Bay in Lake Ontario using microbial source-tracking (MST) tools. Water samples were taken from three sites within the bay over a 29-week time span and filtered. DNA extracts from filters were analyzed with well-established MST assays targeting human, ruminant, and avian sources. Although work is ongoing, results indicate sparse contamination from human fecal sources indicating that sewage or septic waste is a concern in this waterbody.

Level of research: Undergraduate

Department: Environmental Studies

Faculty advisor: Hyatt Green

Authors: Kaplan, I.

Title: Supporting Roots: The Role of the Forestry Sector in Increasing Women's Participation

Abstract: Local women's participation within Nepal's Forestry Sector is essential for it to operate as a form of sustainable development as women in Nepal are often the connecting bridge between family, economy and the local economy. When women are involved in local government, there has been increase in equality of distributions of benefits among the community, as well as higher economic and ecological success. The participation of women is exceptionally important in Community Forest User Groups (CFUG). Nepal's government manages the forestry sector through a polycentric or a multi-stakeholder paradigm. The Ministry of Forestry and Soil Conservation partners with a variety of government departments, local communities, and non-Government agencies to create and implement sustainable, economically efficient and socially just policies. Through this network, many policies, laws, and training programs have been designed to increase women's participation. Although this broad range of tactics has led to an increase in women's participation, the numbers are still small. In many places, these national level policies, laws, and training programs have not met their full potential. The difficulties do not lie within inefficiency or lack of policy, but rather the social-economic barriers that prevent women from attending such programs. This paper examines how this polycentric forestry system is trying to increase women's participation in Chitwan, Nepal. Interviews with a broad range of local and national Government agencies and Quasi NGOs were conducted to gain information on the laws, policies, and trainings that are currently being implemented to increase women's participation in Chitwan.

Level of research: Undergraduate

Department: Environmental Studies

Faculty advisor: Diane Kuehn

Authors: Ochocki, S.

Title: Interning with the Allegheny National Forest

Abstract: In the summer of 2017, I began my internship with Allegheny National Forest, Marienville Ranger District. I worked mainly as a forestry technician marking timber to be harvested. I learned tree identification along with how to measure trees and determine the products that could be harvested, such as pulpwood or saw logs. I learned about sustainable timber harvesting and how cutting the trees would actually promote regeneration and renewal in the forest ecosystem. While working, I also had a lot of hands-on experience with different departments within the Forest Service, such as biology, NEPA, and archaeology. It was through those interactions that I learned just how interdependent all of the different departments are. A task cannot be completed unless all of the above listed departments have conducted their research and deemed it a minimal enough risk. Through these interactions I learned about the hostility the different departments feel toward each other, though each department is only doing their job and not intentionally making tasks difficult. I learned that there is a lot of miscommunication throughout our ranger district which has led to animosity and grudges. These poor communication skills need to be addressed in order for the district to operate efficiently.

Level of research: Undergraduate

Department: Environmental Studies

Faculty advisor: David Sonnenfeld

Authors: Oran, K.

Title: Inner-city Highways: Driving Change in American Cities

Abstract: There is a documented history of urban planners using zoning and redlining in the 1930s to disenfranchise urban communities of color. This practice continued with the urban renewal programs stemming from the 1949 Housing Act that sought to segregate poor and minority residents into predetermined areas. Numerous studies have since shown that cities around America used the Interstate Highway Act of 1956 alongside the 1949 Housing Act for federal funding that racially segregated and "renewed" neighborhoods via the construction of inner-city highways. The construction of highway overpasses and access ramps through inner-city neighborhoods created vast amounts of unusable space that altered the urban landscape across the country. This paper assesses the viability of removing inner-city highways as a new and just form of urban renewal through an evaluation of case studies in San Francisco, CA; Milwaukee, WI; Boston, MA; New Haven, CT; and Syracuse, NY.

Level of research: Undergraduate

Department: Environmental Studies

Faculty advisor: David Sonnenfeld

Authors: Oswald, K.

Title: Young Naturalists: Connecting Youth to their Local Environment

Abstract: Today's youth are spending less time outside in their local environment, and the Izaak Walton League of America (IWLA) made it their goal to get more youth involved in the outdoors. The Central New York chapter of the IWLA created the Young Naturalists program with the mission to teach and engage the youth of Central New York with their local environment. With the Young Naturalists, I became the Program Coordinator to design and implement different activities to connect youth to the environment. With this internship, I gained invaluable skills in the field of environmental interpretation, communication, and community outreach. Through different activities, lesson plans, posters and discussions, participants became connected to their local environment. This internship demonstrated how important it is to create engaging and hands-on activities to teach children about the environment to instill a passion and awe to create future stewards of the Earth.

Level of research: Undergraduate

Department: Environmental Studies

Faculty advisor: T'Shari White

Authors: Shanahan, K.

Title: Envisioning a Beautiful Future: The Function of Visual Art in the Advancement of Sustainability

Abstract: Art is integrated into our daily lives, and it shapes the way we see the world around us. Visual art can cultivate empathy, aid in learning, facilitate collaboration, and show the beauty and passion in an idea. These functions of visual art have the power to facilitate the advancement of sustainability. For this research, I have decided to narrow my focus to the influences of visual art on advancing sustainable practices. All research conducted is secondary research, primarily using academic databases. Most of the information on this subject is qualitative, however a few quantitative studies have been conducted on the effects of visual art on environmental learning and behavior. Art and sustainability share similar modes of thinking, including systems thinking and empathy. Art facilitates collaboration and interdisciplinary work by providing new ways of looking at ideas, stimulates creative thinking, and improves cohesiveness of group dynamics. Collaboration is essential to moving toward a sustainable future. Art can assist the integration scientific findings into our societies. Art can aid in enhancing the grasp of difficult concepts, memory retention, extending attention spans, increasing concentration, and enjoyment of learning. Additionally, art is a powerful form on non-violent activism, and can serve as a non-threatening platform for people to express their political opinions about the future. Art has a unique ability to create important connections within exploring environmental solutions and working together toward a sustainable future.

Level of research: Undergraduate

Department: Environmental Studies

Faculty advisor: Bennette Whitmore

Authors: Smalley, H., (SUNY ESF), Cudak, K. (Providence Colleg), Kissui, B., (The School for Field Studies) and Michaelson-Kelly, M., (Muhlenberg College)

Title: Attitudes, Awareness, and Adoption of Conservation Agriculture Techniques by Farmers in the Karatu Highlands

Abstract: Rising temperatures and varying rainfall, as results of anthropogenic climate change, are threatening the livelihoods and food security of small-scale agro-pastoralists throughout East Africa. However, the use of conservation agriculture (CA) techniques as climate change mitigation strategies remains largely unexplored in this region. This study interviewed 101 participants using questionnaires to examine the awareness, challenges, and uses of different CA techniques in the rural village of

Kilimatembo in the Karatu highlands of Tanzania. While the use of CA techniques, such as terracing (69.13%), intercropping (82.18%), and cover cropping (46.35%) is prevalent in the area, awareness of climatic changes varies greatly, and knowledge of the use of CA techniques as climate change mitigation strategies is relatively nonexistent. CA techniques could provide necessary relief from the negative impacts of climate change; however, challenges such as cost (31.68%), labor (24.75%), and neighbor conflicts (17.82%) still prevent many farmers from implementing these strategies. Increased soil fertility (68.32%), increased crop yield (73.27%), and reduced soil erosion (80.20%) were the three benefits of CA implementation most often answered by interview respondents. A majority of farmers in Kilimatembo village stated themselves as very likely (91.09%) to continue implementing CA techniques or implement CA techniques in the future. However, the extension of educational opportunities and monetary support to local small-scale agro-pastoralists is needed before the use of CA can be fully realized in the region.

Level of research: Undergraduate

Department: Environmental Studies

Faculty advisor: Andrea Feldpausch-Parker

Authors: Mahoney, M.J., Lemanis, V., Desrochers, M.L., Giambona, B., Johnston, M.T, Yanai, R.D, and Dillon, G.A. (Department of Forest and Natural Resources Management, SUNY College of Environmental Science and Forestry)

Title: Impacts of Fertilization on Causal Organisms of Beech Bark Disease

Abstract: Although beech bark disease (BBD) was first detected in North America almost 130 years ago, little is known about this stand-restructuring patho-system. Two phloem-feeding beech scale insects, *Cryptococcus fagisuga*, an invasive species and *Xylococcus betulae*, a native species, may predispose American beech (*Fagus grandifolia*) to infection by *Neonectria ditissima* and *N. faginata*, fungal pathogens believed to be a cause of beech decline. While it is known that high bark N:P predisposes trees to BBD (Cale et al. 2015), it is unknown whether N or P affects which causal organisms are involved. Research on these nutritional aspects is taking place within the Bartlett Experimental Forest of Bartlett, New Hampshire, using six existing experimental plots of three age classes variously maintained as controls or fertilized with nitrogen, phosphorous, a combination of the two, or calcium. Photographic analysis is being used to quantify scale insect densities on trees exposed to varying treatments, while microscopy and PCR analysis are being used to quantify the abundance of the two *Neonectria* species across different treatments. Higher scale densities are expected within the nitrogen and nitrogen-phosphorous plots, and *N. faginata* is expected to be more dominant in older stands, as well as those treated with nitrogen. Preliminary results suggest *N. faginata* is the dominant fungal species throughout the experimental forest, with *N. ditissimia* only being found in one stand, while results on scale quantification have been inconclusive. Improving our understanding of the nutritional aspects of BBD may allow for better disease mitigation techniques in aftermath zones.

Level of research: Undergraduate

Department: FNRM

Faculty advisor: Ruth Yanai

Authors: Mahoney, M.J., Zevin, R., and Stella, J.C.

Title: Impacts of Beaver on Forest Structure and Composition of the Adirondacks

Abstract: Once nearly extirpated from North America, American beaver (*Castor canadensis*) populations have begun to rebound due to reintroductions and decreases in trapping. Alongside this rebound has come an increase in impacts of beaver activities on forest structure and composition. Beavers are known ecosystem engineers, whose dam-building and foraging habits have the ability to restructure the forests they inhabit. While some work has been done within the Huntington Wildlife Forest (HWF) to understand exactly how Adirondack forest structure and composition shifts due to beaver impacts, it is unclear if the patterns observed within this research forest will hold true across entire Adirondack Park. This work aims to clarify that by examining beaver impacts across a representative sample of forest types throughout the Adirondacks. ArcGIS will be used to identify bodies of water likely to have active beaver colonies. These bodies of water will then be surveyed for beaver presence, with data on beaver activity, forest structure and composition collected along three transects established at each identified dam. These datasets will then be used to model beaver harvesting selectivity with increasing distance from the water, as well as the changes in forest structure and composition with distance from shore. This research will be further compared to models generated from data gathered in the HWF, in order to determine if the HWF models are applicable to the greater Adirondacks.

Level of research: Undergraduate

Department: FNRM

Faculty advisor: John Stella

Authors: Onwumelu, A. (Department of Environmental and Forest Biology) and Drake, J.E. (Department of Forest and Natural Resources Management)

Title: Evaluation of Photosynthetic and Respiratory Capacity of Transgenic and Wild Type American Chestnut Plants Growing in a High-light Growth Chamber

Abstract: Chestnut blight is a fungal disease that devastated American chestnut trees in the early 20th century. The American Chestnut Restoration Project has created blight-resistant American chestnuts by inserting a transgene (the OxO gene) that produces oxalate oxidase, which detoxifies the fungal infection. The OxO gene was inserted in three events: with a constitutive promoter for lines 54 and 58,

and an inducible promoter triggered by fungal infection for line WX. Five plants per each transgenic and non-transgenic, wild type (Ellis) treatment were placed in a high-light growth chamber. Our first hypothesis proposed that plants with constitutive OxO insertion possess a greater respiratory burden and reduced net photosynthesis (Anet) compared to wild type plants. Our second hypothesis proposed that plants with inducible OxO insertion have a similar respiratory burden and Anet compared to wild type plants. Light response (A~Q) curves were measured on an average of four plants per treatment, and leaf respiration rates in the light (Rlight) and in the dark (Rdark) were estimated using the Kok method. Contrary to both hypotheses, all taxa had equivalent rates of Rlight and Rdark. Consistent with both hypotheses, however, Anet was reduced 33% by constitutive OxO insertion relative to wild type and inducible OxO insertion, suggesting constitutive OxO insertion may reduce net photosynthetic carbon gain by a mechanism not directly related to respiratory metabolism. The effects of transgene insertion on photosynthesis and tree growth warrant future research attention, given the potential implications for tree reforestation and forest carbon balance.

Level of research: Undergraduate

Department: FNRM

Faculty advisor: John Drake

Authors: Morris, A.B.

Title: Pedestrian Movement Tendencies and Statistics Under Varying Spatial Conditions Within the Old and New Towns of Edinburgh, Scotland

Abstract: This project stems from a study abroad project located in Edinburgh, Scotland on the topics of non-vehicular transport and urban planning. The question that this study aims to answer is: Where will pedestrians statistically walk along a sidewalk under different spatial conditions? This is a two part study in which the first part analyzes seven sites throughout the city with different spatial layouts that allow for comparison between one another. The hypothesis, which was proven, was that similar patterns would be observed regardless of site layout. The second part studies one particular site in more depth. It studies the reaction of one side of pedestrian traffic to another. Results were gathered from 4,000 data points cumulatively between the sites. A summary of results is that overall, pedestrians stay in the middle of the sidewalk, on their right, and away from the road.

Level of research: Undergraduate

Department: LA

Faculty advisor: Tom Hughes