2019 Belmont Undergraduate Research Symposium

Biology I/ Biochemistry & Molecular Biology/ Environmental Science

Moderator: Matthew Heard, Ph.D.

April 11, 2019, 6:15-7:15 p.m.
McWhorter 429

6:15 – 6:30 p.m.

Elucidating the effects of statins and hormone receptor status in the prevention of breast cancer

Hayley Baker
Faculty Advisors: Edgar Diaz-Cruz, Ph.D., Rachel Rigsby, Ph.D.

Breast cancer is the most commonly diagnosed cancer among women in the United States and is second to lung cancer in cancer related deaths. Finding new treatments and preventative techniques for breast cancer is a high priority. Clinical studies indicate that statins play a role in reducing breast cancer incidence, recurrence, and mortality in. Of particular interest is the possibility of using statins in the prevention of breast cancers. Studies have shown that women taking lipophilic statins had a decreased incidence of late-stage estrogen receptor positive breast cancer. It is expected that treating two cell lines, MCF-7, a hormone receptor-positive breast cancer model, and MDA-MB-231, a hormone receptor-negative breast cancer cell model, with lovastatin will result in decreased proliferation and increased cellular death. Cell proliferation assays were conducted to determine the viability of cells after treatment with lovastatin. Upon seeing decreased proliferation in both cases, western blots and gene expression assays were conducted to determine the mechanism behind these observations. Pathways essential to cell proliferation, including the ERK1/2 (MAPK) and PI3K-Akt pathways, and expression of tumor suppressors and apoptotic proteins were analyzed. Effects on MCF-7 cells after treatment with lovastatin were seen in the ERK1/2 and PI3K-Akt pathways in a time-dependent manner. MDA-MB-231 showed decline in activity of the PI3K-Akt pathway after a shorter period of time and displayed higher levels of apoptosis, indicating that hormone receptor status plays a significant role in response to statin treatment.

6:30 p.m. - 6:45 p.m.

A Study on the Effective Use of Shelby Bottoms Greenway and Nature Center Trail Systems by Urban Mammalian Wildlife

Kerra Gaona
Faculty Advisor: Darlene Panvini, Ph.D.

Land fragmentation is an increasing disturbance for wildlife. Fragmentation results in patchy habitats that are difficult for non-avian wildlife to maneuver. Greenways can help mitigate this problem by providing connectivity to patches that may contain crucial resources. However,

the effective use of patchy environments, like greenways, by wildlife may be greatly influenced by size and spatial connectivity, relative distance to natural resources such as water, and structure of the path (paved or unpaved). An observational study at Shelby Bottoms Greenway and Natural Area in Nashville, Tennessee assessed trail use by mammalian wildlife. Wildlife cameras were used for five weeks during September through October, 2018, to determine mammalian traffic on trails and assess which type of trail was most commonly used: paved, primitive, and/or located near a water source. Trails that were paved near a water source yielded more species diversity while trails that were primitive near a water source yielded more species abundance. These findings did not support the original hypothesis. During this study, the discovery of *Lynx rufus* was found to be present in the area, which was not previously recorded or reported.

6:45 p.m. - 7:00 p.m.

The Effects of Steroid Estradiol on Growth and Development of *Danio rerio*

Mallory Arstikaitis
Faculty Advisor: Lori McGrew, Ph.D

Non-point source pollution can be defined as pollution that comes from many diffuse sources whereas point source pollution is any single identifiable source of pollution. Non-point source pollutants include pharmaceuticals such as antibiotics and steroid hormones which are found in many waterways as well as sources for drinking water. Steroid hormones have been shown to have a negative impact on growth and development of many organisms including fish and amphibians. *Danio rerio* (zebrafish) are a model organism that has been used in many toxicology studies. In addition to allowing accurate identification of hazardous chemicals, *Danios* can also be tested throughout their entire life cycles to look for developmental effects. Finally, zebrafish are a marine organism with significant homology to humans meaning that results of studies that utilize zebrafish are relevant to both human and marine toxicology. The purpose of this study was to determine at which concentration estradiol poses a negative effect on the growth and development of *Danio rerio,* starting with concentrations present in today's water ways. It was found in this study that β-Estradiol had no significant effect at the embryonic stage on the growth or development of *Danio rerio* in comparison to the control. Future studies could look at the chronic effects of long-term exposure to β-Estradiol as an endocrine disruptor, male v. female sex ratio, mortality, and behavioral or anxiety abnormalities in treated v. control groups.

7:00 p.m. – 7:15 p.m.

Effects of sub-lethal levels of antibiotics on the growth of freshwater algae

Asia Gladney
Faculty Advisor: Matthew Heard, Ph.D.

Urban rivers have seen an increase in the introduction of antibiotics to their waters over time. While this is of growing concern because of the potential to impact freshwater species, there has been limited research done to date to examine the impacts of these pharmaceutical introductions. In this study, we examined how three common pharmaceuticals: penicillin, erythromycin, and tetracycline influenced the growth and survival of two common groups of freshwater algae:

Chlorella spp. and *Euglena spp.* In our study, we found that antibiotics significantly affected the growth and survival of both types of algae. However, we found no consistent trends between antibiotics and for our two algae species. Collectively, our findings indicate that antibiotics have the potential to impact the growth and survival of freshwater biodiversity in urban rivers. However, they also suggest that more work is needed to fully understand this issue.

2019 Belmont Undergraduate Research Symposium

Biology II

Moderator: Jennifer T. Thomas, Ph.D.

April 11, 2019, 6:15-7:15 p.m.
Ayers 1045

6:15 p.m. – 6:30 p.m.

Growth of *Andropogon gerardii (*Big Bluestem) with NPK 10-10-10 Fertilizer

Daniel Campos
Faculty Advisor: Darlene Panvini, Ph.D.

Grasslands that contain *Andropogan gerardii*, big bluestem, have enough plant tissue to provide adequate habitats and nutrition for wildlife. Tall grasses specifically serve as good model organisms to study growth trends. Over fertilizing is a world-wide problem that harms the environment. Excessive nitrogen absorbs into the ground and goes into bodies of water, causing pollution. The damage caused by the fertilizer run-off creates issues by attracting unwanted pests, disrupting wildlife, and altering the oxygen concentration in the water. The N-P-K (nitrogen, phosphate, and potassium) ratio of 10-10-10 is a combination that benefits most plant types without causing fertilizer burn and is suggested to be a safe fertilizer to enhance soil nutrition. Given the cost and labor of applying fertilizer to maximize yield, can less fertilizer with a safe nutrient concentration generate better growth results? This study examined the relationship between the growth of *Andropogan gerardii* and the addition of NPK 10-10-10 fertilizer. The plants were grown for 48 days with different amounts of fertilizer: 0.00g, 1.75g, 3.5g, and 5.25g. Plants were measured for growth throughout the study, and leaf length and biomass at the end. Results suggest that no strong correlation exists between fertilizer amount and growth in length, mass, or rate. Furthermore, the results indicate that over-fertilizing *Andropogan gerardii* will not yield more growth. Therefore, it is not beneficial to add large amounts of fertilizer. Future experiments can explore cost-efficiency, such as how the growth rate within a one-month period can be dependent on the dose of fertilizer.

6:30 p.m. – 6:45 p.m.

The effect of nutrient growth media on microbial diversity cultured from *Desmognathus fuscus* skin

Tori Hongo
Faculty Advisor: John Niedzwiecki, Ph.D.

The microbiota of amphibians has been implicated in the health of amphibian populations. Research in this area has spiked in response to the global amphibian crisis of the past 50 years, suggesting that a healthy and natural microbiome may help fend off potentially pathogenic microbes. Therefore, understanding the normal microbiome is important for conservation. Characterizing the microbiome of wildlife is challenging. The conditions in which samples are processed and cultured may affect the number and types of bacteria and fungi isolated from a

particular organism in a lab setting. In this study, *Desmognathus fuscus* salamanders were sampled from Beaman Park in Nashville, Tennessee in order to attempt to characterize the microbiome of the salamander skin. In particular, the characteristics of the microbiome were being compared when cultured on three nutrient media types, to see if the microbes from each are redundant, yield significantly different patterns, or if each contributes to a better picture of the microbiome. The results suggest that all of the media types selectively favor gram negative bacteria and that the diversity of bacteria vary significantly from each media type. By using three different media types to culture the cutaneous microbes in lab, there is a better understanding of the diversity of the microbiota of this population of *D. fuscus*. This study provides an efficient technique to characterize the microbiota of additional populations or different species.

6:45 p.m. – 7:00 p.m.

Use of DNA Barcoding as an Effective Tool in Earthworm Identification and Diversity Analysis in Native and Exotic Plant Plots

Erin Laubacher
Faculty Advisor: Darlene Panvini, Ph.D. and Chris Barton, Ph.D.

Soil dwelling organisms play a major role in supporting ecosystems by creating biomolecules necessary for life, and assessment of their diversity can indicate the health of ecosystems. There are over 6000 species of earthworms, many of which are still unknown. Earthworms have a high cryptic diversity and differentiating morphological characteristics arise only after sexual maturity, thus presenting a challenge in identifying juvenile individuals. In this study, DNA barcoding was used to identify earthworms in both adult and juvenile stages. Earthworms were collected from plots dominated by both native and exotic plants. DNA was isolated, sequenced, and compared to a database of gene sequences for species identification. DNA barcoding can be an effective tool for juvenile species identification and used in conjunction with some morphological characteristics for future identification purposes. Non-native earthworm species was observed in the exotic plants plot.

7:00 p.m. - 7:15 p.m.

The Effects of Caffeine on Anxiety in *Danio rerio*

Nardeen Fayik
Faculty Advisor: Lori McGrew, Ph.D

This study used *Danio rerio* (zebrafish) as a model organism and focused on assessment of anxiety in the fish. While these fish have long been used by developmental biologists, their utility for neuroscientists has only recently become apparent. Zebrafish are easily maintained and have the ability to absorb substances through their gills, eliminating any stress induced by the traditional method of injections. Zebrafish, as vertebrates, have complexity that is useful for behavioral models. Their social structure and conditioned behaviors are being carefully characterized. Relevant to these studies, the *Danios'* behavior in a novel dive tank has been demonstrated to correspond to their anxiety. (Anxious fish spend more time near the bottom of the tank while control fish spend more time near the surface.) Using this behavioral assay, fish were treated with increasing concentrations of caffeine prior to placement in the novel tank. The

treated fish were less anxious at lower doses but more anxious at higher doses compared to untreated control fish. Future studies should test male and female fish separately to determine the effects of gender as a variable for response to caffeine.

2019 Belmont Undergraduate Research Symposium

Biology III

Moderator: Chris Barton, Ph.D.

April 11, 2019, 8-9:30 p.m.
Ayers 1045

8:00 p.m. – 8:15 p.m.

Stressor Interactions of Acid and Radiation in Native and Invasive *Lonicera*

Alexander Wharton
Faculty Advisor: Darlene Panvini, Ph.D.

Higher concentrations of UV-B radiation and frequent occurrences of acid rain are plant stressors: the result of human activities dating to the mid-20th century and the mass release of chlorofluorocarbons and sulfur dioxide. The intricacies of photosynthetic processes in plants are largely affected by changes in these two variables, radiation and acidity. Specifically, the effects of these pressures on carbon dioxide assimilation of Tennessee-native *Lonicera sempervirens* and the invasive *Lonicera japonica* are unknown. The purpose of this research was to observe the impact of these stressors on the net CO_2 assimilation rates of the two species of honeysuckle and the resulting stressor interaction when combined. Each species was exposed to various stresses under the constant conditions of a growth chamber. Net CO_2 assimilation rate was measured with a LICOR 6400XT. The results showed significant variation between the two species of honeysuckle overall but not when treatment groups were distinguished. Individually, acid treatments showed no significant difference from the control, but radiation treatments resulted in an increased CO_2 assimilation rate. Subjects exposed to both stressors simultaneously demonstrated an intermediary difference between the values of the stresses alone. In conclusion, anthropogenic UV-B radiation has a significant impact on the net CO_2 assimilation rate of two common honeysuckle species in Tennessee. These two stressors can now be classified as demonstrating a positive antagonistic interaction. These findings broaden the understanding of the effect of ultraviolet radiation and acid rain on plants found in the Southeastern United States and add to information regarding stressor interactions.

8:15 p.m. – 8:30 p.m.

The Effect of Acidity on Kairomone Detection in the Antipredator Response of the Aquatic Snail, *Elimia lauqueta*.

Tanner Augello
Faculty Advisor: John Niedzwiecki, Ph.D.

The purpose of this experiment was to ascertain if the acidity of an aquatic environment has a measurable effect on the population's ability to detect and respond to predators. Previous research established the use of kairomones (chemical signals) by aquatic snails in antipredator responses. Since acidity may affect the shape of either signal chemicals or receptor proteins, we

hypothesized that small changes in pH may inhibit ability to detect predators. We used the local aquatic snail, *Elimia laqueta* as well as their natural predator, an *Orconectes* crayfish. Atntipredtor defensive behavior, was assessed using water from Beaman creek, in control water, with pH lowered by one point using HCl . The snails were then added and left to acclimate to their new environment for 48 hours before tests predator cues were added to some tanks. Results showed that there was a significant antipredator behavior in control tanks but the levels returned to "no predator" levels in acidic conditions. A two-way ANOVA, revealed a significant interaction of predator and Acidity treatments. The decrease in defensive behavior indicates that acidity of an environment impacts the ability of this particular species to detect predators and change the predator prey balance in this ecosystem.

8:30 p.m. – 8:45 p.m.

Varying 10-10-10 Fertilizer Concentration for the Optimal Growth of Kentucky Fescue (Lolium arundinaceum)

Nicholas Alexander
Faculty Advisor: Darlene Panvini, Ph.D.

Elk have been reintroduced into Tennessee and Kentucky in hopes of establishing new healthy herds. A main concern is if there are enough natural resources available to sustain a new population. Elk have been known to favor Kentucky fescue, *Lolium arundinaceum*, in all seasons as a nutritional source. Kentucky fescue is a grass that grows well in Tennessee regions, but little is known about how the plant responds to growth in varying concentrations of 10% Nitrogen-10% Phosphorous-10% Potassium fertilizer (10N-10P-10K) concentrations. In this experiment, Kentucky fescue was exposed to 0.00g, 1.75g, 3.5g, and 5.25g of 10N-10P-10K fertilizer in an attempt to see which concentration promoted optimal growth. Dry weight and length showed a significant difference at all fertilization levels from the control of 0g. Therefore, it is possible for *Lolium arundinaceum* to increase in mass and length by 10N-10P-10K fertilizer applications.

8:45 p.m. – 9:00 p.m.

Investigating the possible correlation between microplastic abundance and the presence of *Escherichia coli* in the Cumberland River

Chandler Phelps
Faculty Advisor: Matthew Heard, Ph.D.

Recent research has suggested that microplastic pollution can facilitate the growth of bacteria. However, little work been done to examine if this is occurring in ecosystems that are polluted with microplastics. To examine this, we conducted an observational study in the Cumberland River in Nashville, TN to determine if microplastic abundance was correlated with the abundance of a common bacteria - *Escherichia coli*. We also conducted an experimental study to examine how the abundance of microplastics influenced the growth of *Escherichia coli* colonies collected from the river. For the observational study, we found no significant correlations between microplastic and bacteria abundance. However, using the experimental approach, we determined that there was a significant positive correlation between microplastic abundance and

bacterial growth. Our findings indicate that increasing levels of microplastics could increase the abundance of bacteria. However, more work is needed to fully understand this issue.

9:00 p.m. – 9:15 p.m.

The Use of Green Roofs by Avian Species and Their Preference in Green Roof Characteristics

Paige Ulrich
Faculty Advisor: Darlene Panvini, Ph.D.

Green roofs in urbanized settings such as large cities have become increasingly popular over the years due to their abundant benefits for humans and the nature that surrounds them. Birds are one of the few urban wildlife vertebrates that show interest in using green roofs. The purpose of this experiment is to determine the characteristics birds prefer in green roofs. The green roofs of Belmont University were observed through in-person observations. The frequencies of birds that visited each green roof were recorded as well as the species or classification of the birds. The average populations were then compared to one another on a basis of the frequencies of behavior versus the green roof's characteristics. The final results were then analyzed through one-way ANOVA. Concluding from the collected results, the hypothesis was supported in stating that green roofs with larger square footage and higher percentiles of vegetation diversity attract larger populations of birds.

9:15 p.m. – 9:30 p.m.

The Efficacy of Bait-Trap Methods in Butterfly Monitoring in an Urban Park in Nashville, TN

Marcie Bulla
Faculty Advisor: Darlene Panvini, Ph.D.

As urbanization expands, monitoring populations of indicator species in and around cities is increasingly important to assess the impact that civilization has on the environment of remaining green spaces. As a pollinator with particular sensitivity to environmental disturbances, butterflies are one potential indicator species. However, most standardized butterfly baiting protocols are written for tropical and neotropical regions to attract fruit-feeding butterflies and do not offer direct guidance for bait-trapping methods in other regions of the world. This study assessed the efficacy of banana and nectar bait trap protocols in wooded and open field areas in Shelby Bottoms Natural Area in Nashville, Tennessee to determine if bait-trapping is a viable method for butterfly monitoring in this region. Results indicated that banana baited traps can be used as a baiting method for the family *Nymphalidae* only, and that future studies must maximize the diversity of habitats studied. Commercial nectar traps were found to be ineffective in attracting all types of butterflies. These results could serve as a guide for improving butterfly baiting methods in temperate regions of North America in order to facilitate the analysis of butterfly populations in other cities throughout the region, although further research is needed to determine if a trapping method exists for families outside of *Nymphalidae*.

2019 Belmont Undergraduate Research Symposium

Biology IV

Moderator: Darlene Panvini, Ph.D.

April 11, 2019, 8-9:30 p.m.
Ayers 1044

8:00 p.m. – 8:15 p.m.

Antimicrobial Properties of Soil Microorganisms Underneath Exotic and Native Plant Species in Nashville, Tennessee

Britney Sams
Faculty Advisor: Darlene Panvini, Ph.D. and Jennifer T. Thomas, Ph.D.

Within the last century, humans have discovered antibiotics, exploited their properties, and have now entered into a period where their efficacy is waning. Many pharmaceutical companies have ceased their efforts in antibiotic research due to the high adaptability that bacterial species have to become resistant to medications and the high costs associated with antibiotic research and development. This project adapts principles and procedures established by the Small World Initiative to explore soil bacteria in Nashville, Tennessee for potential antimicrobial characteristics. The introduction of exotic plants into areas can be a conduit for novel bacteria to grow and thrive in new environments. Therefore, a group of thirty bacterial unknowns were collected from soil found beneath a native and an exotic plant species and assessed for antibiotic properties against two gram-positive bacteria, *Bacillus subtilis* and *Staphylococcus epidermidis*, and two gram-negative bacteria, *Escherichia coli* and *Enterobacter aerogenes*. Three of thirty bacterial unknowns were found to exhibit zones of inhibition when cultured on bacterial lawns of *Staphylococcus epidermidis*. The use of sterile disks to test for antagonistic properties of soil bacteria is an easily used biological technique that can be utilized in future antibiotic research and development projects.

8:15 p.m. – 8:30 p.m.

Examining the presence of antibiotic resistant *Escherichia coli* in Nashville, TN's Cumberland River

Rachel Hongo
Faculty Advisor: Matthew Heard, Ph.D.

The introduction of antibiotics to urban rivers is driving the emergence of antibiotic resistant bacteria. This emergence is of concern because urban rivers are home to diverse assemblages of organisms and rivers can provide drinking water and places for recreation for urban residents. Assessing the scope of this problem is challenging because we often lack information on how commonly we find antibiotic resistant bacteria in many rivers. Here, we examined the prevalence of resistant bacteria in the Cumberland River, in Nashville, TN, which is home to numerous aquatic species and is the source of drinking water for Nashville residents.

To do this, we collected water and sediment samples over a two-month period in summer 2018 and looked for signs of resistance to eight different types of antibiotics in a common bacteria species – *Escherichia coli*. We found that antibiotic resistance was common in *E. coli* collected from both the water and the sediment samples. In addition, when we found *E. coli*, it always showed resistance to multiple antibiotics. Our findings indicate that the emergence of antibiotic resistance is occurring in the Cumberland River and could be of potential concern to both wildlife and human health in the future.

8:30 p.m. – 8:45 p.m.

The Effects of Native and Non-Native Plant Species on CO_2 Soil Flux Levels in Relation to Bacterial Community Diversity

George Bukenya
Faculty Advisor: Darlene Panvini, Ph.D.

Soil carbon dioxide flux can be a major contributor to atmospheric carbon. Carbon dioxide in the atmosphere has negative effects on the climate. Excess carbon dioxide can increase the acidity of water in the ocean and increase the atmospheric temperature. Preventive measures have been utilized in an attempt to lower the emission of the greenhouse gas. Various factors such as the species of plants, the bacterial community and soil quality can influence the amount of CO_2 flux released. The purpose of this project was to determine the amount of CO_2 released from the soil in the presence of native and non-native plant species. The Li-COR 8100A machine was used for weekly CO_2 measurements. A probe that measured soil moisture and temperature was used for weekly measurements. The area of study was an urban forest in Nashville, TN which was utilized for three months. BioLog Ecoplates were used take monthly measurements of microbial diversity around the native and non-native plant. The study found no significant differences between soil CO_2 flux levels or microbial communities in the presence of native versus exotic plants.

8:45 p.m. - 9:00 p.m.

The Effects of Dopamine Modulators on *Danio rerio*

Unique Ellis
Faculty Advisor: Lori McGrew, Ph.D

Danio rerio, aka zebrafish are excellent model organisms in that seventy percent of genes found in humans have a counterpart in zebrafish including receptors for the neurotransmitter, dopamine. Dopamine neurotransmission has been implicated in addiction in addition to other neuromodulatory effects. In this project, the influence of dopamine on the central nervous system of zebrafish was examined. Apomorphine, a dopamine agonist, was utilized along with haloperidol, a dopamine antagonist, to treat the fish. Apomorphine treatments were administered to the fish chronically to mimic the effects of drugs of abuse. Subsequently, anxiety and movement in the zebrafish were measured using a novel dive tank. Following apomorphine withdrawal, the Danios demonstrated higher levels of anxiety along with increased movement; both of these effects were blocked by treatment with haloperidol. These results suggest that

haloperidol could be effective in managing the symptoms associated with the withdrawal process following drug addiction.

9:00 p.m. – 9:15 p.m.

The Effects of Native and Non-Native Plant Species on CO_2 Flux Levels in Relation to Bacterial Community Diversity

Samantha Rodriguez
Faculty Advisor: Darlene Panvini, Ph.D.

Soil CO_2flux is a major contributor to atmospheric carbon. While various factors can affect CO_2 flux, the species of plants in the immediate area and the bacterial community can greatly determine carbon exchange between the soil and the atmosphere. The purpose of this project was to determine the levels of CO_2 released from the soil in the presence of native and non-native plant species. The Li-COR 8100A machine was used for weekly CO_2, soil temperature, and soil moisture measurements in an urban deciduous forest in Nashville, TN. from September to December. BioLog Ecoplates were used monthly to determine microbial community diversity in the soil at the same location as the CO_2 flux measurements. The relationship between microbial diversity, presence/absence of exotic plant species, and CO_2 flux levels was determined. Results from this study showed that there was no significant difference between CO_2 levels released in the presence of native and non-native plant species. The study also showed that there was no significant difference in the microbial community diversity
between native and non-native plant species.

9:15 p.m. – 9:30 p.m.

Comparison of Antibacterial Properties in Selected Plant Parts of *Spigelia marilandica*

Sarah E. Crossan
Faculty Advisor: Darlene Panvini, Ph.D. and Jennifer Thomas, Ph.D.

Spigelia marilandica, a Missouri native and Tennessee residing perennial, has been used by Native American tribes for hundreds of years for the plants presumed antibacterial, anti-inflammatory, and antihelmintic properties. Few studies have been conducted in order to scientifically support these medicinal benefits. This study tested the hypothesis that extracts from the roots, stems, and leaves of *Spigelia marilandica* would show antibacterial properties. Two gram positive bacteria, *Bacillus subtilis* and *Staphylococcus epidermidis*, and two gram negative bacteria, *Escherichia coli* and *Enterobacter aerogenes*, were chosen because of their frequency in previous herbological literature, with the gram positive bacteria expected to be more greatly inhibited. Ampicillin was used as a control to put any inhibition into perspective of established prescription grade potency. In this study, the root of *Spigelia marilandica* showed inhibition against both the gram positive and gram negative bacteria in one hundred percent of replicas, while neither the stem nor leaves showed any inhibition. This study lays essential groundwork in establishing the medicinal potential of this ancient herbal remedy.

2019 Belmont Undergraduate Research Symposium

Biology V

Moderator: Lori McGrew, Ph.D.

April 11, 2019, 8-9:30 p.m.
Ayers 2140

8:00 p.m. – 8:15 p.m.

Use of DNA Barcoding as an Effective Tool in Earthworm Identification and Diversity Analysis in Native and Exotic Plant Plots

Bailee Powell
Faculty Advisor: Darlene Panvini, Ph.D. and Chris Barton, Ph.D.

Soil dwelling organisms play a major role in supporting ecosystems by creating biomolecules necessary for life. Assessing their diversity can indicate the health of ecosystems. There are over 6000 species of earthworms, many of which are still unknown. Earthworms have high cryptic diversity; differentiating morphological characteristics arise only after sexual maturity, thus presenting a challenge in identifying juvenile individuals. This study had two objectives: 1) assess the diversity of earthworms in plots dominated by native and exotic plant species, and 2) determine the effectiveness of DNA barcoding as a tool in species identification of earthworms in adult and juvenile stages. It was hypothesized that 1) exotic plots would have greater earthworm diversity and 2) DNA barcoding would be successful in the identification of both adult and juvenile earthworms. Earthworms were collected from plots dominated by either native or exotic plants using vermifuge techniques at Belle Forest Cave Property in Nashville, Tennessee in September to November 2018. Using taxonomy books, the adult worms were identified to species for comparison to identification through barcoding. For each worm, DNA was isolated, sequenced, and compared to a database of gene sequences for species identification. DNA barcoding proved to be an effective tool for juvenile species identification and provided more accurate results for the adults than identification based solely on morphological characteristics. The biodiversity among the native and exotic plant plots was determined by comparing the number of different earthworm species identified. The native plant plots contained more earthworm diversity than the exotic plant plots.

8:15 p.m. – 8:30 p.m.

Elevation, Climate Change and Epiphyte Diversity in the Costa Rican Cloud Forest

Caitlin Barnes
Faculty Advisor: John Niedzwiecki, Ph.D.

Climate change is lifting the cloud base on tropical mountains, thus raising the elevation of the mist gradient; subsequent changes have become apparent in many tropical montane forests. Recent studies have shown altitudinal migration within avian and mammalian populations, but

these trends are more difficult to note in plants due to their lack of locomotion. The following study analyzes the diversity, abundance, and richness of epiphytic plants along an elevational mist gradient from 1540 m to 1800 m above sea level in the Monteverde Cloud Forest. The range is divided into three groups for analysis based on a difference in abiotic factors across the gradient. Epiphytes were inventoried from fallen branches of a standard size (20cm – 40cm circumference; 0.5m length). Percent bryophyte and lichen cover was determined for each branch using photo analysis. Epiphyte abundance, richness and diversity show a significant difference across the categories with the highest diversity, abundance and richness observed in the category of highest elevation. Bryophyte cover is highest at the top of the mountain, where lichens were lowest. Increase in bryophyte cover was coupled with an increase in epiphyte richness, abundance, and diversity, all linked to differences in abiotic factors across the range. These changes with elevation show that epiphyte communities at lower elevations, hence lower mist frequency, are simpler and less abundant. As mist frequency continues to decline with the lifting cloudbank, this will lead to the loss in bryophytes and epiphyte abundance, richness, and diversity.

8:30 p.m. – 8:45 p.m.

Comparing Carbon Dioxide Soil Flux Between a Green Roof and a Community Garden in Nashville, Tennessee

David Gustitus
Faculty Advisor: Darlene Panvini, Ph.D.

The exchange of carbon dioxide (CO_2) between soil and the atmosphere affects the atmospheric carbon balance and is thus an essential factor influencing climate change. In an era when climate change is becoming more perceptible, measuring soil flux of specific regions indicates how that region contributes to the overall carbon balance. Large cities are prevalent contributors to the carbon balance of the world, but what is their role in influencing atmospheric CO_2? The increase in the number of green roofs in urban environments, combined with the decrease in undisturbed urban soils, serves as a great opportunity to find other methods of measuring soil CO. The purpose of this study is to measure and compare the CO_2 flux on a green roof and a community garden located in Nashville, Tennessee for eight weeks with the LI-COR 8100A. Preliminary results suggest there is no significant difference between CO_2 flux between the green roof and community garden.

8:45 p.m. – 9:00 p.m.

Examining the presence and abundance of microplastics in the Cumberland River in Nashville, TN

Lina Said
Faculty Advisor: Matthew Heard, Ph.D.

Urban rivers are facing a growing threat from microplastic pollution. However, there has been little research done in most rivers to examine how the presence and abundance of microplastics varies over time: Here, we examined how microplastic pollution levels varied over a two-month period in the Cumberland River in Nashville, TN. In addition, we examined whether sites

upstream and downstream of wastewater treatment plants, which have been listed as sources of microplastics had different levels of pollution. We found that every water sample we collected across our sites had microplastics present. In addition, we found significantly higher levels of microplastics downstream of wastewater treatment plants. These findings indicate that microplastics are a threat in the Cumberland River. This finding is concerning because the Cumberland is a diverse ecosystem and because it provides drinking for the city of Nashville, TN.

9:00 p.m. – 9:15 p.m.

Characterization of Novel *Clostridium difficile* Virulence Targets: A Structural Biology Approach

Isria Jarrett
Faculty Advisor: Darlene Panvini, Ph.D. (Belmont University), Heather K. Kroh and D. Borden Lacy (Vanderbilt University)

Clostridium difficile is a gram-positive bacterium associated with the nosocomial disease *C. difficile* infection (CDI) which causes inflammation in response to sporulation and toxin secretion. Because incidence and recurrence of CDI have increased dramatically in immunocompromised and elderly patients, these toxins have been studied for antibody-based therapies. However, proteins on the surface of and within *C. difficile* could also provide new, more efficient targets for prevention of disease. This study examined the uncharacterized *C. difficile* protein C9YJI8 using structural biology methods to identify its structure and potential functions. The objective was to recombinantly express, adequately purify via chromatographic methods, and obtain refined protein crystals for X-ray diffraction analysis. Protein crystallization is a critical step in identifying protein structure and requires varying factors for optimal protein crystal formation. It was hypothesized that isolated, refined crystals would grow in conditions that have a pH of 5-6, at temperatures below 18°C, and at lower protein concentrations. The protein crystallized well in select monovalent salts, polyethylene glycol of a low molecular weight, and between a pH of 5.5-6.5. The storage of crystal optimization trays at 4°C resulted in protein precipitation, suggesting that colder temperatures were unfavorable for crystal growth to occur. Under certain reservoir conditions, C9YJI8 at lower concentrations formed less isolated crystals. Further studies of this structural approach will aid in understanding the protein's potential role in bacterial survival or virulence, provide new information about the mechanisms involved in the virulence of *C. difficile*, and guide new therapeutic treatments for CDI.

9:15 p.m. – 9:30 p.m.

Antimicrobial Properties of Soil Microorganisms Under Exotic and Native Plant Species in Nashville, TN

Adria Payne
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Within the last century, the human population discovered antibiotics, exploited their properties and entered into a period where their efficacy is waning. Due to the high adaptability of bacterial species to become resistant to antibiotics and the high costs associated with research and

development, many pharmaceutical companies have ceased their production efforts. The purpose of this experiment is to discover bacterial species that contain antagonistic properties and compare microorganisms found under exotic and native plant species. This project adapts principles and procedures established by the Small World Initiative, as well as the disk diffusion protocol, to explore soil bacterial populations for potential antimicrobial characteristics. Thirty bacterial unknowns found under exotic and native plants were isolated, cultured and assessed for antagonistic properties against two gram-positive bacteria, *Bacillus subtilis* and *Staphylococcus epidermidis,* and two gram-negative bacteria, *Escherichia coli* and *Enterobacter aerogenes.* In conclusion, three bacterial unknowns from the native plant soil exhibited zones of inhibition when plated on lawns of *Staphylococcus epidermidis.*