27th ANNUAL COLSA UNDERGRADUATE RESEARCH CONFERENCE

Memorial Union Building
Granite State Room and Theatre II

April 21, 2018
7:45 am – 12:45 pm

University of New Hampshire

ORAL PRESENTATION ABSTRACTS

27th ANNUAL COLSA UNDERGRADUATE RESEARCH CONFERENCE

2

Epidemiology and prevalence of methicillin-resistant Staphylococcus species in veterinary animals

Sharlene Amador, Cheryl Marie P Andam, Robert E Gibson, David B Needle, Joshua T Smith
Molecular, Cellular, and Biomedical Sciences, UNH Durham

Transmission of infectious diseases between wildlife, livestock and humans presents major challenges to reducing the risk of disease outbreaks and the emergence of multidrug resistance. Microbial populations in animals can act as reservoirs of new strains with more virulent traits as well as antibiotic resistance (ABR) genes that can be transferred to clinical strains. *Staphylococcus* is known to cause serious skin and soft tissue infections, and drug resistant species such as methicillin-resistant *Staphylococcus aureus* (MRSA) has become a major pathogen in hospital and communities around the world. However, while the presence of these pathogens has been documented in animals, it is unclear how frequently they are found in different species of animals that humans are in contact with. The aim of this project is to determine the frequency and molecular epidemiology of various species of methicillin-resistant (MR) and methicillin-susceptible (MS) *Staphylococcus* species isolated from pets and livestock animals. In collaboration with the NH Veterinary Diagnostic Laboratory (NHVDL), we identified and cultured a total of ~200 bacterial isolates representing 12 *Staphylococcus* species from animal tissues collected from October 2017-March 2018. Species identification was done using MALDI-TOF and methicillin resistance was determined using standard cefoxitin and oxacillin discs. We present the distribution of different *Staphylococcus* species based on methicillin resistance, animal species, and geographic location. Output from this work will have a broad and significant impact in our understanding of the contributions of animals to the spread of ABR to human populations.

8

What is Forest Diversity?

Kaitlyn A Baillargeon, Scott V Ollinger

Biodiversity is an important characteristic of ecological communities that describes the species composition and variation in genetic material. There are also other diversity metrics that can be used in conjunction with biodiversity to describe the community. These metrics include the diversity of the community's structure, functions, phylogenetics or evolutionary history, and spectral properties. The choice of how a community is characterized depends on the type of research being conducted. While it is useful to know how diverse a community species population is, it is also important to understand the other ways in which a community can be diverse and how similar these metrics are to one another. To explore this, we looked at how a forest can be characterized by looking at the different metrics of diversity related to its most dominant species; trees. Using tree inventory data from over 400 30m by 30m plots at Bartlett Experimental Forest, we characterized each plot by its structural, spectral, functional, phylogenetic, and biodiversity. We tested for correlations between all diversity metrics to understand the similarities or the uniqueness of each metric. We discovered that only functional and biodiversity were moderately correlated. None of the other diversity metrics showed significant relationships with the other metrics. Therefore, we conclude that each diversity metric provides unique information about the forest that can be used in relevant applications.

4

Plasma Response of Histidine and Histidine Metabolites to Incremental Amounts of Abomasal Infusion of Histidine in Lactating Dairy Cows

Andre Fonseca De Brito, Bailey L Basiel, Nancy L Whitehouse

Supplementation of rumen-protected amino acids (AA) is often used to compensate blood deficiency of Methionine, Lysine and Histidine for optimal milk protein synthesis in dairy cows. The bioavailability of rumen protected (RP)-Methionine and -Lysine has been measured using the plasma free AA dose-response technique. However, the characteristic endogenous Histidine pool may increase uncertainty to apply the technique on RP-Histidine. Therefore, our objective was to determine the linearity in plasma Histidine by infusing Histidine abomasally. Five multiparous lactating Holstein cows (149 ± 92 days in milk) fitted with ruminal cannulas were used in a 5 × 5 Latin squares with 7-d experimental periods. All cows were fed a basal diet to provide adequate energy and metabolizable protein (NRC, 2001). Treatments were 0, 6, 12, 18, and 24 g/d of abomasally infused Histidine. Blood samples were collected at 2, 4, 6, and 8 h after the morning feeding on the last 3 d of each period and composited by day. Milk samples were also collected on the last 3 d of each period. Milk production and components data, and plasma metabolites were analyzed with the PROC MIXED procedure of SAS. Relationships between plasma Histidine and Histidine infused were described by the PROC REG procedure of SAS. Intake of dry matter was not affected by Histidine infused. Milk lactose concentration increased quadratically to the Histidine infusion. Milk yield and other milk components (fat and true protein) were not affected by treatment. Plasma Histidine concentration increased linearly with increasing amounts of His infused from 54.7 μ*M* at 0 g/d to 70.2 μ*M* at 24 g/d. Treatments had no effect on all other plasma AA, carnosine, and hemoglobin. Both plasma Histidine concentration (μ*M*) and the proportion of Histidine in total AA were highly related to the amounts of Histidine infused (r^2 = 0.93 and 0.97, respectively). We conclude that there is linear response of plasma Histidine to Histidine supplementation in this short-term study.

6

The Role of *Daphnia* in the Production of Aerosols

Emily J Ray[3], James F Haney[2], Patricia M Jarema[3], Hailey Carter[1]
[1]Biological Sciences , UNH Durham
[2]DBS, UNH Durham
[3]Department of Biological Sciences Center for Freshwater Biology, UNH Durham
[4]Department of Biological Sciences, UNH Durham

Aerosols emitted from lakes with toxin producing cyanobacteria pose a potentially serious threat to humans and wildlife. The physical and biological factors regulating the production of toxic lake aerosols have not yet been elucidated. Intensive grazing by zooplankton can reduce the concentration and alter the composition of the phytoplankton community. This study set out to examine the possible effects of zooplankton (*Daphnia*) grazers on aerosols. Our primary hypothesis is that *Daphnia* grazing will break up cells into smaller particles, thereby increasing the rate ogf aerosolization. The effect of *Daphnia magna* on the aerosolization of cells and particles was investigated by filling 6 flasks with a mixture of *Synechoccus* (cyanobacteria, 1-2 mm) and *Microcystis* (unicellular cyanobacteria, 6-7 mm). *Daphnia magna* were added to the flasks (0, 20, 40, 60, 80, and 100 *Daphnia*/Liter). Air was pumped out of the flasks and into a 20 mL milli Q trap for 24 h to capture any aerosolized particles. The experiment was repeated in flasks that contained only *Synechoccus* or *Microcystis*. The results were analyzed using cell flow cytometry to determine changes in sizes and abundance of aerosolized particles using scatter and fluorescence. ELISA were performed to test toxin (microcystin) levels in the trap and in the water.

5

Quantifying the Reproductive Success of a Declining Shrubland-Obligate Songbird, the Prairie Warbler (*Setophaga discolor*), Breeding in an Active Gravel Pit in Southeastern New Hampshire

Matthew David Tarr, Beau D Garcia
Natural Resource, UNH Durham

Shrubland habitats have been declining in New England since the mid 1950's and in response, many other shrubland obligate species such as prairie warblers have also been in decline. These species now rely on habitats with specific anthropogenic disturbances such as gravel pits, which were found to have the largest abundance of adult prairie warblers in southeastern New Hampshire. However, it is unclear if shrubland habitats in gravel pits can actually support viable breeding populations of these birds. To evaluate the habitat quality of my site, I quantified the abundance, age structure, territories of each breeding pair, reproductive success of each breeding pair and calculated the annual rate of increase (λ) for the population of prairie warblers breeding at my study site. The finite rate of increase (λ) for this habitat showed that mortality exceeded birth rates for this season. However, the large number of older birds (ASY) breeding here suggests this gravel pit has been a high-quality breeding ground in past years. The results of this study provide valuable information on understanding where these birds reproduce successfully which is critical to guiding management, conservation efforts and identifying where habitats exist.

3

Mapping sediment microbial community structure in the Stellwagen Bank National Marine Sanctuary to facilitate functional genomic studies

Semra A Aytur, Lina J Heinrichs, John P Bucci
School of Marine Science and Ocean Engineering, UNH Durham

The increase in antibiotic-resistant pathogens coupled with the prevalence of multi-resistant bacterial strains has necessitated a search for bioactive compounds within the marine habitat. The objective of this study was to characterize the sediment microbial community by quantifying the relative abundance and diversity of microbes sampled from the Stellwagen Bank National Marine Sanctuary. An important goal includes identifying sites with the highest potential for harboring bacterial strains (e.g., *Streptomyces*) that may produce novel biosynthetic gene clusters for natural products/drug discovery. Sediment was collected from 3 ocean sites during the summer-fall, 2016-17. Genomic DNA was extracted from 36 samples and libraries were prepared for molecular sequencing analysis. Metagenomic sequencing was employed to comprehensively delineate all bacteria present in each sample. Bioinformatics platforms, including metaSPAdes and BLASTn, were used for multiple read assembly and taxonomic identification. Biostatistical analysis was used to characterize relative bacteria abundance and biodiversity.

Preliminary results from 2017 identified *Streptomyces* to be 1.57% prevalent (N = 13315) in the summer samples compared to 1.22% prevalent (N = 18897) in the fall samples (seasonal difference: chi-square=486.38; $p < 0.0001$). Site 3 had the highest summer percentage (1.71%; N = 5420), and Site 1 had the highest fall percentage (1.35%; N = 4843). Comparative analysis of gene clusters of biomedical relevance was performed using PALADIN bioinformatics software. In addition to marine ecological implications, this methodological pipeline is a model that connects genomic, marine, and health sciences for novel gene bioprospecting.

7

Using Chemical Cross-linking and Mass Spectrometry to Identify the Binding Mechanism of PU-H71 on Heat Shock Protein 90 (HSP90) in Cancer Cells Using Mouse Embryonic Stem Cells As a Model

Feixia Chu, Hieu T Nguyen
MCBS, UNH Durham

Heat shock protein 90 (Hsp90) is a highly conserved molecular chaperone that regulates the activity, turnover, and trafficking of many proteins in cell signaling and adaptive stress responses. The protective function of Hsp90 for these proteins is often exploited by cancer cells to pathologically stabilize mutated and overexpressed oncoproteins; proteins that play an important role in the regulation and synthesis of proteins linked to tumorigenic cell growth. Hence, Hsp90 offers promising anti-tumor drug targets. Many potent inhibitors and their derivatives have been in clinical trials, two of which are PU-H71 and geldanamycin. Both geldanamycin and PU-H71 bind to the ATP-binding pocket of Hsp90 to elicit oncogene destabilization and tumor regression. However, detailed biochemical mechanisms in Hsp90 inhibition remain largely unknown, especially for PU-H71. In this experiment, we used embryonic stem cells as a model to study cancer cells due to their similarities in expressions. Using selective precipitation, we purified Hsp90 from embryonic stem cells that bound onto dynal beads, which were treated with drugs of interest, geldanamycin and PU-H71, and cross-linkers (DSS, disuccinimidyl suberate). The identification of cross-linked peptides was then carried out by mass spectrometer and the UCSF bioinformatics program Protein Prospector. Though we have identified some key cross-linked peptides that would shed light on the HSP90 conformation that is exploited in aiding cancer cell survival, further quantitative analysis and reasoning using homology models are needed for definitive results. High specificity of PU-H71 in cancer cells provides a critical step towards drug development to treat cancer.

1

Diversity and Antibiotic Activity of *Streptomyces* Bacteria: Searching for Super-Killer Bacterial Strains

Nicholas J Ritzo, Cheryl Marie P Andam, Taylor P Schwartz
MCBS, UNH Durham

The surge of antibiotic resistance and global spread of microbial infections, exacerbated by lagging drug discovery efforts, demands new approaches to this health threat. Environmental microbes have been shown as an important source of bioactive compounds with novel antibiotic properties, such as with the bacterial genus *Streptomyces* that has long been known as a major source of clinically relevant antibiotics. In this project, we aim to characterize the inhibitory characteristics of different *Streptomyces* strains collected from the gut of vertebrate hosts (horse and chicken). Our central hypothesis is that the gut of vertebrate animals harbor a diverse population of *Streptomyces* bacteria with variable ability to inhibit the growth of other bacteria. We collected a total of 72 *Streptomyces* isolates and tested their ability to inhibit the growth of other *Streptomyces* bacteria as well as *Escherichia coli*. Results indicate that a diverse population of *Streptomyces* collected from the two vertebrates displayed variable ability to inhibit the growth of other bacteria. A small subset of this bacterial population can be described as super-killers, or those with the ability to inhibit growth of at least three other isolates at an average zone of inhibition of at least 50mm. Future work will focus on determining the phylogenetic diversity of isolates and testing them against other bacterial pathogens. This work has important implications on using a targeted approach to drug discovery.

POSTER PRESENTATION ABSTRACTS

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43

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Transmission of infectious diseases between wildlife, livestock and humans presents major challenges to reducing the risk of disease outbreaks and the emergence of multidrug resistance. Microbial populations in animals can act as reservoirs of new strains with more virulent traits as well as antibiotic resistance (ABR) genes that can be transferred to clinical strains. *Staphylococcus* is known to cause serious skin and soft tissue infections, and drug resistant species such as methicillin-resistant *Staphylococcus aureus* (MRSA) has become a major pathogen in hospital and communities around the world. However, while the presence of these pathogens has been documented in animals, it is unclear how frequently they are found in different species of animals that humans are in contact with. The aim of this project is to determine the frequency and molecular epidemiology of various species of methicillin-resistant (MR) and methicillin-susceptible (MS) *Staphylococcus* species isolated from pets and livestock animals. In collaboration with the NH Veterinary Diagnostic Laboratory (NHVDL), we identified and cultured a total of ~200 bacterial isolates representing 12 *Staphylococcus* species from animal tissues collected from October 2017-March 2018. Species identification was done using MALDI-TOF and methicillin resistance was determined using standard cefoxitin and oxacillin discs. We present the distribution of different *Staphylococcus* species based on methicillin resistance, animal species, and geographic location. Output from this work will have a broad and significant impact in our understanding of the contributions of animals to the spread of ABR to human populations.

73

Optimizing DNA Yield from Commercial DNA Extraction Kits

Cassandra A Amarello[2], Adrienne I Kovach[1]
[1]NREN, UNH Durham
[2]Natural Resources, UNH Durham

Different DNA extraction kits utilize specialized protocols, lysis buffers, incubation and elution times to yield usable samples of DNA in a timely and efficient manner. Modifications of these specific parameters involved in DNA extraction and quantification will provide varying results in overall yields of samples. In this study, I compared the performance of three extraction kits using sixteen cod fin tissue samples, with elution time periods recommended by the manufacturer. After initial tests I conducted additional extractions and compared the resulting extracts from the unmodified and modified extraction protocols for the highest yield of genomic DNA concentrations with the smallest variation to indicate the best extraction method. I found that the ZyMo Quick-DNA Miniprep plus kit tissue extraction yielded the highest average concentration of gDNA when the elution period was increased to 24 hours, averaging 96.5 ng/uL and an average variation of 20.9ng/uL across all samples. E.Z.DNA kits analyzed with a modified elution period of 1 hour resulted in the lowest concentration average of 15.7ng/uL, also had the lowest average variation of 4.53 ng/uL between all samples. Tests on the Qiagen DNeasy Blood and Tissue Extraction Kit yielded inconsistent results under multiple elution time modifications. I conclude, based on various DNA extraction kit protocol modifications, that the ZYMO Quick-DNA Miniprep plus tissue kit had the highest success rate, with high measured individual concentrations of genomic DNA, a high average concentration rate, and a low amount of variation between all samples tested.

71

Metabarcoding Investigation of Extensive Dune Grass Die-Off in the Northeast

Marissa J Anderson, William K Thomas, Gregg E Moore
Hubbard Center for Genome Studies, UNH Durham

Occurrences of dune dieback, a rapidly spreading blight impacting coastal dunes, are becoming increasingly more common along the seacoasts of MA and NH. Believed to be caused by pathogenic nematode (*Meloidogyne* spp.), dieback results in death of American beachgrass (*Ammophila breviligulata*), which provides the primary, natural mechanism to stabilize dunes and protect coasts from the erosional effects of storm winds and surges. Despite evidence of *Meloidogyne* spp. in dieback events reported by others, it has not been found in dieback events in MA and NH. We hypothesize that dieback may be the result of multiple factors, including nematodes and other organisms that may exploit the tissue damage such organisms can cause. To resolve the organisms involved in dieback in our region, we are conducting a metagenomic analyses on the entire community of organisms in the rhizosphere of suspected dieback events and comparing them to reference sites nearby. This approach extracts DNA from all of the organisms on the root zone, allowing us to sequence that DNA and match results to a database of all the known sequences in the world, including putative parasites and diseases, and their vectors. Our analysis will look at the commonalities among the communities determining the most likely causes of dieback, including bacteria, fungi and other microbes linked to these events. The results will aid resource managers develop effective strategies to limit the spread of dieback in the future.

72

Testing DNA repair mechanisms of different hypersusceptible *Arabidopsis thaliana* mutant lines using *Pseudomonas syringae*

Lisa Arvidson

DNA double-strand breaks are highly damaging to cells and must be repaired to maintain chromosomal integrity. Interestingly, many pathogens induce DNA double-strand breaks (DSB) upon infection. Replication Protein A (RPA) is a large heterotrimeric subunit family involved in DNA damage repair mechanisms. In the model organism Arabidopsis thaliana, RPA1C and RPA1E are two of the five paralogs belonging to the large subunit that play a unique role in DNA repair and recombination. We propose that the RPA1C, and RPA1E subunits are important factors in pathogen-induced DNA double strand break repair. If this is the case, mutations in these genes would render the plant cells hypersusceptible to pathogen proliferation. To confirm this, we will determine how mutants of RPA1C and RPA1E respond to pathogen induced DNA damage employing a whole plant infiltration method and the model pathogen Pseudomonas syringae. Our current strategy tests hypersusceptibility of three mutant lines of Arabidopsis compared to WT; single mutants rpa1c, rpa1e and the double mutant rpa1c/rpa1e. Our results indicate that the rpa1c and rpa1e single mutant lines had higher levels of P. syringae versus WT or the positive control (brca2). Interestingly, the rpa1c/rpa1e double mutant displayed a decrease of susceptibility versus WT, and at lower levels than either of the single mutants, suggesting the double mutant is compromised in pathogen infection independently of DNA damage repair pathways.

107

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50

First Impressions: Dover

Tyler Q Smith, Mary Adamo Friedman, Jade M Long, Anna P Bannon, Monique S Duchesne, Madeline Susan Murphy, Benjamin D Touchette, Cathryn A. Hancock, Molly E Donovan
Community & Environmental Planning, EcoGastronomy, UNH Durham

New Hampshire First Impressions is program designed by UNH Cooperative Extension for evaluating the existing assets and needs of a community's downtown. It uses the ArcGIS Collector application to allow participants to make comments about certain features or aspects of the downtown. The pilot program was run in the summer of 2016 in the communities of Rochester and Littleton. The UNH Extension then identified interest in studying the thoughts of college students on downtowns. College students provide a unique view into how younger generations perceive downtown communities. The UNH Planning Student Organization completed the most recent project for the City of Dover over the past few months. Participants completed a pre-visit survey, the site visit, and a post-visit survey in October 2017.

The data set was analyzed with qualitative methods as team members identified common themes. Students came up with the assets and opportunities for each of the 13 characteristics. A key findings presentation was given to the Dover Planning Director and Assistant Planner on February 15, 2018. The First Impressions Team gave a professional presentation and handed over the final report to the City Council on March 21, 2018.

61

Investigating the Presence of Magnetoreception and Electroreception in the American Lobster (*Homarus americanus)*

Winsor H Watson, Cameron S Barnes
Biological Sciences, UNH Durham

Animals across many taxa are known to use magnetoreception as a navigational mechanism, with some migratory species even being able to geolocate with it. Similarly, many diverse species have also been shown to possess some degree of electroreception, which is commonly used in prey detection. Previous research has been done on the spiny lobster (*Panulirus argus*) to determine if they possess magnetoreception; however, little research has been done on the American lobster (*Homarus americanus)*. Likewise, electroreception has been researched in several vertebrate species, though accounts in invertebrates have been limited to two crayfish species, the Australian yabbie (*Cherax destructor)* and the redclaw crayfish (*Cherax quadricarinatus).* In this study, individual American lobsters were put into aquariums that had a simple shelter on one side, along with either an experimental or control object buried in the sand in varying locations. Depending on the trial, the experimental object was either a magnetic cap or a sealed plastic tube with an electrical device inside, while the control object was identical in every regard, except for the magnetic or electrical aspect. Time spent investigating, digging, and interacting with either object was then recorded. Initial results have suggested possession of these sensory modalities. This study will allow us to better understand an iconic and economically important marine species, and hopefully enable better management of the population overall.

55

How can the University of New Hampshire reduce its nitrogen footprint?

Kathryn A Bennett, John D Aber
Natural Resources, UNH Durham

The nitrogen footprint, a novel metric for campus sustainability, has been calculated at the University of New Hampshire since 2014. A nitrogen footprint measures the amount of reactive nitrogen generated and released into the environment from food, utilities, transportation, fertilizer, research animals, and agriculture. In fall 2017, the UNH Sustainability Institute launched a new integrated campus carbon and nitrogen footprint tool that is already being used by hundreds of campuses across the US. We are using this new tool, SIMAP (www.unhsimap.org), to assess management strategies for reducing UNH's carbon and nitrogen footprints together.

New scenario results for the nitrogen footprint considering food choice, food production systems, and energy consumption will be presented. These scenarios are the following: 1) Replacing 10% of meals with Flavor Forward meals, 2) Replacing 25% of beef purchases with chicken, 3) Vegetarian campus, 4) 100% organic food replacement, 5) 100% local food replacement, 6) 100% N-efficient food replacement, and 7) Achieving the 2050 80% C footprint reduction goal via different pathways. These scenarios will be analyzed with current campus initiatives and stakeholder meetings to recommend a feasible nitrogen footprint reduction goal and pathway for the University of New Hampshire.

99

The Significance of Particle-Associated *Vibrio parahaemolyticus* in Oyster Contamination

Audrey K Berenson, Stephen H Jones

Vibrio parahaemolyticus disease is becoming more prevalent during warm summer months in the northeastern United States due in part to climatic changes such as rising water temperature, although illnesses remain rare in New Hampshire. The main cause of *V. parahaemolyticus* induced gastroenteritis is through consumption of raw or undercooked seafood contaminated by the bacteria, particularly oysters. One suspected mechanism of how *V. parahaemolyticus* concentrations in oysters can be elevated is via filtration of suspended solids, as they are an ecological matrix where *V. parahaemolyticus* exists.

Oyster, water, total suspended solids (TSS), sediment, phytoplankton and zooplankton samples were collected bimonthly from two different sites in the Great Bay estuary, Nannie Island and Oyster River. These samples were processed using a Polymerase Chain Reaction/three-tube Most Probable Number assay to estimate *V. parahaemolyticus* concentrations. TSS samples were processed by filtering, drying, and combusting (with mass being measured throughout) to provide an estimate of suspended solids and the proportion of inorganic to organic solids in the water column at the time of collection. The mass of the TSS was then compared to concentrations of *V. parahaemolyticus* in oysters to determine if there was a relationship. Numerous relationships were found, providing information about the significance of suspended solids as a source of oyster contamination.

93

Testing the Sensory Ability of *Canis lupus familiaris* to Distinguish Between Human Identical Twins

Samantha M Bogdahn, Leslie J Curren
Biological Sciences , UNH Durham

Humans and dogs (*Canis lupus familiaris*) have coevolved for millenia to have a mutualistic relationship. Dogs that rely on humans benefit by receiving food, water, shelter, and medical care. People vary in their willingness to provide these benefits, suggesting selection on dogs to distinguish between individuals. Previous findings suggest that dogs identify people using visual and olfactory cues, both of which have strong genetic influences. But can dogs differentiate between identical twins, who share DNA but have minute differences in pheromones and facial features? Police dogs can distinguish between the scents of identical twins, but this ability is untested in non-working dogs, and it is unknown if dogs can make similar distinctions using visual cues. To test olfactory discrimination, I will conduct trials in which a dog will be positively reinforced for one twin's scent, then given a choice between both twins' scents. If the dog can detect pheromonal differences, it should prefer the familiar twin's scent. In visual discrimination trials, each dog will be presented with similar pictures of both twins and positively reinforced for one twin's photo. A novel set of photos of the twins will then be presented, and if the dog recognizes the unique features of the familiar twin's face, it should prefer that twin's image. This study will contribute to research on the mechanisms that allow dogs to have such complex sensory abilities.

83

Relationship between Binge Drinking Frequency and Diet among College Students

Jesse Stabile Morrell, Julia E Boisselle
Agriculture, Nutrition, and Food Systems, UNH Durham

The purpose of this project is to examine binge drinking habits among college students and its relationship to diet quality. It is hypothesized that greater binge drinking frequency is related to a lower diet score. Data were collected between 2005-15; students (n=6,353), ages 18-24, were recruited to participate in an ongoing, health survey. Binge drinking frequency, defined as consuming ≥ 4 or 5 drinks on occasion for women or men respectively, from the past month, was self-reported via online questionnaire. Three-day food records were used to evaluate nutrient intake and analyzed via online software (DietAnalysis Plus). Diet quality was quantified by scoring intakes of saturated fat, fiber, potassium, and calcium. Intakes were divided into quintiles and scored 1-5 with increasing intake; saturated fat was inversely scored. Higher diet scores (range 4-20) represented better diet quality. Among men (n=1,732), 32.7% reported weekly binge drinking, and 33.7% reported binge drinking more than once/week. Among women (n=4,621), 33.8% reported binge drinking weekly, and 16.8% reported binge drinking more than once/week. Findings support the current hypothesis and demonstrate a relationship between higher binge drinking frequency and lower diet quality among students at a northeastern university. As increased alcohol consumption and poor dietary quality are linked to weight gain and cardiovascular disease risk, findings hold importance to campus health professionals.

89

Storm Sediment Transport through the Parker and South Middleton Reservoirs to the Plum Island Estuary in Northeastern Massachusetts

Wilfred M Wollheim, Mason E Caceres

Coastal marshes in the US and around the world are susceptible to climate change induced sea level rise if sedimentation cannot keep up with increasing ocean levels. This is evident in the coastal marshes along the northeastern US, including those of the Plum Island Estuary (PIE). Sedimentation in the PIE marshes are a function of both incoming sediment from the ocean, internal processing (cycling) of sediment, and sediment exports from rivers draining into estuaries (Fagherazzi 2013). Sediment import from the ocean and internal cycling rates are well understood, but the estimates of sediment fluxes from watersheds have ignored sediment retention by small reservoirs. When a river is stilled behind a dam, the sediments it contains sink to the bottom of the reservoir (McCully 1996). Declines in fluvial suspended sediment concentrations (SSC) are significantly correlated with increasing water retention behind dams, indicating that human activities play a role in declining sediment delivery (Weston 2013). Storm events also influence the delivery of suspended sediment to the coast. Sediment fluxes during storm flows increase due to the rise in stage and velocity over a stream/river. Several reservoirs along the Parker and Ipswich Rivers that flow directly into the PIE may be influencing sediment delivery, but the difference in flux during storm flows will provide a better understanding of retention at reservoirs compared to average base flow conditions.

Suspended sediment concentrations (SSC) were measured at the inflows and outflows of the Parker and South Middleton Reservoirs to see how much sediment was retained during storm events. Results indicated that storm events could lessen the effects of sedimentation via increased discharge and less retention. The differences between SSC upstream and downstream of the reservoirs during storm flow conditions were smaller compared to base flow conditions. As climate change leads to more frequent and intense storm events, the delivery of sediment during these events may be able to keep up with the rising sea levels along the coast of Massachusetts.

91

Terning a New Leaf; The Influence of Plant Community Characteristic on Common and Roseate Tern Nesting Preference and Fledgling Success.

Gregg E Moore, Dylan T. Cairns, Robert J Lafreniere

The Isle of Shoals Seabird Restoration project began in 1997 with a mission to protect and manage the breeding populations of Roseate and Common terns to mitigate global declines in tern populations. The 2017 breeding season on Seavey Island was the most successful year on record with over 3,000 Common terns and over 100 federally endangered Roseate terns nesting on the island. Despite increased tern population size, vegetation characteristics remain a factor that influences nest preference and fledging success. The two dominant terrestrial plant habitats on Seavey Island are rocky barrens and maritime meadow (*i.e.*, "gull lawns"). Nests occur in both habitats but were most abundant in the gull lawns. In summer of 2017, we surveyed key plant community characteristics (*e.g.*, species composition, percent cover, and stature) within known nesting areas on the island to determine if vegetation parameters influence tern success. In cases where the canopy height was low (<55 cm) and percent cover was moderate (<70%), nesting density (13.5 nests/plot) and fledgling success were highest (0.44% fledgling success). Our results suggest that plant stature, species composition, and percent cover influence nest density and fledgling success. While the sample size is small, these data underscore the potential need to manage vegetation

29

Comparing populations of cortical activity while rats perform decision making tasks

Robert G Mair, Leah M Calderazzo, Miranda Jane Francoeur, Brett M Gibson
Psychology, UNH Durham

As the hub of executive functioning, Prefrontal Cortex (PFC) is responsible for organizing and executing complex cognitive behaviors. PFC has numerous connections to brain regions facilitating sensory, memory, and motor processes, giving rise to a wide variety of functions supporting adaptive decision-making. I am investigating how PFC neurons update when decision-making components of a task are removed. Electrophysiology activity was recorded from single- cells in PFC while rats performed a delayed non-match to position (DNMTP) task or a novel serial lever press (SLP) task. DNMTP task consist of a sequence of four retractable lever presses (start, sample, delay, choice) with reinforcement delivered on sample and choice. For each choice event, two levers were extended for the rat to choose from based on the placement of the previous levers in the trial. The locations were randomly assigned so the behavioral events were unpredictable for each trial. SLP was designed to remove the decision between two response options during the choice event. Comparisons of PFC activity were made from different rats performing either DNMTP or SLP, and from rats beginning on DNMTP or SLP and switching halfway through the session. Here, I performed population analyses to examine similar responses between the DNMTP and SLP tasks, and to compare responses when rats switched between the two tasks. Overall, there were fewer neurons collected when rats ran SLP. Response types associated with movement, delay, and initiation are seen in DNMTP and not SLP. When switching between the tasks, neurons were seen to respond selectively for one task or sustain their behaviorally correlated response for the whole session. The signals of response also change between the two tasks. Neural responses made during DNMTP have higher signal to noise properties compared to neurons firing during SLP. These findings show that neurons in PFC are dependent on task requirements. Cortical neurons adapt to reflect changes in task demands.

98

The Role of *Daphnia* in the Production of Aerosols

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Aerosols emitted from lakes with toxin producing cyanobacteria pose a potentially serious threat to humans and wildlife. The physical and biological factors regulating the production of toxic lake aerosols have not yet been elucidated. Intensive grazing by zooplankton can reduce the concentration and alter the composition of the phytoplankton community. This study set out to examine the possible effects of zooplankton (*Daphnia*) grazers on aerosols. Our primary hypothesis is that *Daphnia* grazing will break up cells into smaller particles, thereby increasing the rate of aerosolization. The effect of *Daphnia magna* on the aerosolization of cells and particles was investigated by filling 6 flasks with a mixture of *Synechoccus* (cyanobacteria, 1-2 mm) and *Microcystis* (unicellular cyanobacteria, 6-7 mm). *Daphnia magna* were added to the flasks (0, 20, 40, 60, 80, and 100 *Daphnia*/Liter). Air was pumped out of the flasks and into a 20 mL milli Q trap for 24 h to capture any aerosolized particles. The experiment was repeated in flasks that contained only *Synechoccus* or *Microcystis*. The results were analyzed using cell flow cytometry to determine changes in sizes and abundance of aerosolized particles using scatter and fluorescence. ELISA were performed to test toxin (microcystin) levels in the trap and in the water.

31

Comparison of Diet Quality among College Students with and without a Disability

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Objectives: Research suggests that having a disability is linked to increased risk of obesity and lower diet quality, however, little is known about the diet quality of college students with a disability compared to their peers without a disability.

Methods: Data were collected from an ongoing college health survey conducted at a mid-size, northeastern university between 2008-2015 [n=4242; 72.9% female]. Disability was self-reported via 1-item as part of an online questionnaire. Three-day food records were analyzed via nutrient analysis software (Diet Analysis Plus); intake of fiber, calcium, potassium, and saturated fat were utilized to assess diet quality. For each nutrient, students were given a score of 1-5 according to their quintile of intake (1= lowest intake for fiber, calcium, potassium; highest intake saturated fat) and scores were added together; scores ranged 5-20. Mean diet scores (±SE) were compared via ANCOVA for students with and without disabilities; sex, age, BMI, total kcalories, academic major, and academic semester served as covariates.

Results: Ten percent (10.1%) of students reported having a disability. Overweight ($BMI^3 25$) prevalence was higher among students with a disability (29.6 vs. 24.6%, $p<.05$). Diet scores for students with and without disability did not differ (12.00±.05 vs. 11.97±.15, $p=.83$).

Conclusions: Data did not show differences in diet scores between college students with and without disability once adjusted for potential confounding variables. Further research should examine additional factors that influence diet quality and food access among college students with disability.

94

The Effect of a High Calcium Diet on House Cricket (*Acheta domesticus*) Mobility

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House crickets (*Acheta domesticus*) are a common feed choice for insectivores in captivity, such as pet lizards and birds, but are lacking in calcium. Wild insectivores compensate by supplementing their diet with other calcium-rich food sources, but captive insectivores are unable to utilize these options. Crickets used for feed are therefore often "gut loaded," or fed a high-calcium diet, which causes calcium to accumulate in their intestines. Although research has shown how a gut loading diet can benefit the insectivore, its effect on the crickets are unknown. Calcium uptake in crickets has been shown to vary with age, so I will explore how gut loading might affect movement in different age classes of crickets. Juvenile and adult crickets will be fasted for 48 hours and then fed either a natural or gut loading diet. I will video each cricket for three hours at three separate points: during the initial fasting, one day after starting the diet, and seven days after starting the diet. I will split each video into five minute sections and record if the cricket moves during the first ten seconds of each section. I will then use a generalized mixed model to ask if age class or diet predict mobility at each of the three time points. If gut loading impacts mobility, it may affect other aspects of cricket behavior as well, and the ethicality of its use may come into question.

2

Predicting Stress Reactivity Using Ultrasonic Vocalizations: Neural Correlates of Innate Resilience

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For millions of individuals around the world, exposure to a significantly distressing event is associated with development of psychiatric illness, such as depression. For some individuals, resilience is "produced" by prior experiences and learned coping responses. Furthermore, there are individual differences in how an organism will respond to a stressor. Following exposure to an identical stressful experience, some individuals appear particularly susceptible to negative consequences, while others appear remarkably resilient and unaffected. The difference between susceptibility or resilience is likely an innate driven by key neurobiological changes. However, the current models of revealing stress vulnerability or resilience require substantial manipulation of the organism, which may mask key changes that occur during the initial stress exposure. Therefore, this project investigated the role of a critical stress-responsive brain region in a *predictive* model of stress resilience. Here we provide evidence for behavioral and neurobiological correlates in rats forecast as stress resilient.

59

Individual Difference in Stress Coping: Forecasting Innate Resilience Using Ultrasonic Vocalizations

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Depression is a severe mental illness that affects over 40 million adults, leaving them unable to function in their everyday lives. Unfortunately, 60% of these individuals do not respond to first-line drugs and so a new approach of treatment is needed. Development of the disorder is dependent upon individual risk factors, including vulnerability or resilience to stress, which affects the manifestation and the progression of the illness. Previous research has indicated that rats emitting 22 kHz ultrasonic vocalizations, thought to mimic coping responses in the rodent model, predict such individual differences. We analyzed coping strategies in uncontrollable situations, dividing animals into active and passive coping groups based on behavioral observation. We will be analyzing cell activity in the dorsal raphe nucleus, an area implicated in a critical coping neural circuit, to validate the predictive power of the vocalizations. The purpose of this research was to institute an animal model that predicts if rats emitting 22 kHz vocalizations will act more behaviorally resilient than rats who make no emissions.

17

Signals of cooperation; carcass burial by *Nicrophorus* burying beetles facilitated by stridulatory sound

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Burying beetles (Silphidae: *Nicrophorus)* are unique insects that contribute biparental care to the rearing of their young; both parents are known to engage in carcass burial, preparation, offspring feeding and nest defense. While emerging as a model system for studying parental care, little is known regarding how burying beetle parents communicate during cooperative reproductive behavior, nor how they partition labor during carcass burial. The purpose of this study was to describe cooperative burial behavior in *Nicrophorus marginatus*, and to understand how burying beetles use stridulatory sound to facilitate cooperation. We hypothesized that both sexes would contribute symmetrically to carcass burial, and that stridulatory sound would occur during both courtship and carcass burial. We predicted that a larger carcass resource (quail) would result in greater numbers of stridulations than would a smaller carcass (mouse), but that sound production related to courtship would not relate to carcass size. We collected video and audio recordings from ten breedings (quail = 5, mouse = 5), and created an ethogram of the burial process using BORIS software, comparing time spent in each behavioral state and overall sound production between the two resource size classes. We examined the behavioral occurrence of stridulatory events in five additional quail breedings using a sound-triggered high speed DSLR. We found a weak correlation between burial time and the number of stridulations (R^2=0.197) but observed that beetles took longer (P=0.005) and produced more stridulations when burying the larger carcass (P=0.024), and stridulated more often when actively cooperating (P=0.041). Despite the prevailing paradigm, the division of labor in carcass burial was not equal, with females exhibiting a greater share of the task. Cooperation in carcass burial appeared to be facilitated by stridulatory sound produced by the beetles, with the soundscape around the carcass indicating the degree of active cooperation between the parents.

36

Is Timing Everything? The Effect of Competition on Reproduction and Development in the Burying Beetle (*N. marginatus)*

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Organisms often optimize reproduction by altering investment in their young to enhance their fitness in stochastic environments. However, the degree to which individuals alter their strategy may be influenced by competition for limited resources. For the burying beetle (Coleoptera: Silphidae: *Nicrophorus* spp.), reproductive success is largely dependent on securing an ephemeral vertebrate carcass to initiate reproduction and feed developing young. Given vertebrate carcasses are rare in space and time, beetles within high density environments are required to defend the resource from potential usurpers. The burying beetle, *N. marginatus*, is known to adjust offspring number and size in response to resource availability and density. However, it is unknown how female *N. marginatus* may adjust oviposition rate in response to competition. We hypothesized that female *N. marginatus* would exhibit behavioral plasticity in response to conspecific density. Specifically, we predicted that beetles from high density environments would optimize reproductive success by increasing their duration of parental care. In addition, we also predicted that females in high-density environments would delay oviposition relative to low-density females, while exhibiting increased asynchrony in egg hatch rate. To investigate female reproductive strategy in response to density; we randomly assigned females to either low (1 female/container) or high (5 females/container) density. For each treatment, we recorded initial number of eggs, oviposition (i.e. first egg laid) and egg hatching (i.e. temporal distribution of egg hatching rate) rates and brood dynamics (i.e. number and size of offspring). In addition, the duration of parental care was also recorded.

75

Obesity Mediates Leukemia Progression Through Ceramide Kinase and the NADPH Oxidase

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Acute myeloid leukemia is heterogeneous leukemia that causes the cloning of hematopoietic progenitor cells in the blood, which creates an accumulation of immature myeloid cells. Studies have shown the possible risk factor of AML is obesity, therefore a topic of importance would be ceramide kinase activity. Ceramide kinase is an enzyme, and its activity produces ceramide-1-phosphate (C1P) which is a sphingolipid metabolite which is known to regulate inflammation. Ceramide and C1P both serve to activate the NADPH oxidase. NADPH oxidase's role in cancer cells is to promote proliferative and inflammatory signaling pathways through redox regulation. Excessive oxidation is a factor linked to AML progression, and is associated with enhanced redox signaling by the NADPH oxidase. These elements, ceramide kinase and NADPH oxidase, will be manipulated to investigate their effects on AML progression and to seek novel therapeutic modalities.

30

Comparing the effects of sodium butyrate and Monensin supplementation to post-weaned dairy calves on coccidian counts

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In the previous work completed at the University of New Hampshire (Rice M.S.Thesis, 2017), different concentrations of sodium butyrate (SB) were supplemented in the heifer's diet on a g/kg body weight amount. This was believed to be the first experiment to evaluate the supplementation of SB to post-weaned heifers. Results of this research indicated that as SB increased in the diet, dry matter intake was unchanged. However, overall weight gain and average daily gain increased with an increase in SB. While not statistically significant, the observations suggested that as SB increased in the diet, there was improvement in feed efficiency with no negative effects seen in the calves.

Because of the effects of SB on weight gain, average daily gain, feed efficiency, final weight and coccidian counts, it appears that SB is acting in the gut producing responses similar to those when monensin is fed to cattle. With the effort to decrease the use of antibiotics across the globe, possibly SB could be a replacement for the feed efficiency and growth promoting attributes often seen with ionophore feeding. The aim of this study is to see if SB is an effective replacement for monensin for aiding in nutrient absorption through altering the rumen environment and prevention of coccidiosis. While the focus of the study as a whole is to evaluate the growth of post weaned calves and apparent total tract nutrient digestibility of diets containing 0, 0.75 mg/kg SB, 1 mg/kg monensin or the combination, this report is focused specifically on evaluating the coccidian counts in the post weaned calves feed diets containing 0, 0.75 mg/kg SB, 1 mg/kg monensin or the combination.

Forty Holstein calves entered the study and were trained to Calan doors from week 12 to 13 age of life and began the study during week 14 of life. Pre-trail body measurements (weight and skeletal), DMI, blood concentrations of β-hydroxybutyrate (BHB), and glucose served as covariates. The design was a 2 X 2 factorial arrangement of treatments in a randomized complete block design. Calves remained on the study for 12 weeks. Daily DM intake was measured and calves was fed a haylage based diet at the same time daily. Total mixed ration samples were taken weekly and composited monthly for nutrient analyses. Orts samples were taken daily and composited by month for each calf. Feed ingredient samples were taken monthly for nutrient analyses. Blood samples for BHB and glucose analyses along with body weight and skeletal measurements were determined once weekly. Fecal samples were taken from each calf weekly beginning in the covariate period for determination of coccidia. Apparent total tract digestibility was determined twice during the experiment once during the third week and once during the ninth week. Chromium oxide (4 g/d) was dosed twice daily (12 h intervals) for 7 d, and fecal samples were taken over the last three days of the period to mimic a 24 h period.

The coccidian counts were determined using the Modified Wisconsin sugar float test. Sheather's solution was made by dissolving 75.6 grams of sugar into 59.2 milliliters of hot water. The

solution was covered and cooled to 38°F before use. To complete the sugar float test, 3 grams of fecal matter was mixed thoroughly in 10mL of Sheather's solution. The mixture was strained into a 15mL test tube and centrifuged at 1200rpm for 5minutes at 4°C. After centrifugation, the test tubes were slightly over-filled with Sheather's solution, until a meniscus formed at the top of the tube. A coverslip was then placed on the meniscus. After 10 minutes, the coverslip was placed a slide and viewed under light microscopy. Oocytes were counted at 10x over the entire area of the coverslip.

The study is ongoing and at this point, there is not enough data for an analysis.

1

Population Structure and Dispersal of Prairie Warblers in Southern Maine and New Hampshire

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Shrubland habitats and a suite of songbirds that depend upon them have been in decline throughout the northeastern United States. Ongoing habitat restoration efforts in southern Maine and New Hampshire aim to conserve shrubland habitats, but the effects these efforts have on the birds is unclear. Understanding the connectivity of local shrubland habitats from the standpoint of avian dispersal patterns is needed for informing the relevant geographic scale for management efforts. One shrubland-dependent species of management focus in the Northeast is the prairie warbler (*Setophaga discolor*). This strict habitat specialist relies on large plots of early successional habitat, which is highly fragmented in today's landscape in southern Maine and New Hampshire. In this study, we used genetic approaches to characterize population structure and dispersal of prairie warblers. During mistnetting efforts, we sampled 390 prairie warblers from 42 shrubland patches over a 80-km spatial extent from Concord, New Hampshire to Wells, Maine. We genotyped individuals at 14 microsatellite loci and calculated FST to characterize population level gene flow among sites. We used spatial autocorrelation to evaluate fine-scale relatedness and dispersal patterns. By identifying the connectivity of these local shrubland habitats this study provides information on the relevant geographic scale for conservation efforts.

28

Comparing Body Mass Index, Body Composition and Waist Circumference as Predictors of Health Risk in Male College Athletes

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The primary aim of this research study was to assess the validity of BMI in comparison to body composition and waist circumference as a predictor of health risk in collegiate male athletes.

A sample of 122 collegiate male athletes were invited to undergo body composition assessment in the BOD POD. Athletes followed BOD POD protocol in preparation for the assessment. Additional measurements of height, weight, and waist circumference (WC) were also obtained. Body mass index (BMI) and WC were classified according to the World Health Organization and National Institute of Health guidelines. Body composition was classified according to the BOD POD manual guidelines.

Based on BMI, 29 (23.8%) athletes were obese and 47 (38.5%) were overweight. According to body composition, 3 (2.5%) athletes were obese and 21 (17.2%) were overweight. Based on WC, 22 (18%) athletes, all of which were football players, were at risk. When broken down by sport, 6 (19.4%) soccer, 6 (40%) basketball, 15 (30.6%) football, and 28 (71.4%) hockey players were overweight according to BMI. For body composition, 1 (3.6%) hockey player and 20 (40.8%) football players were considered overweight. Additionally, 3 (6.1%) of football players were considered obese.

Using only BMI as a means to predict health risk in collegiate athletes may be inadequate. Due to athlete's having a large percent of fat-free mass, body composition may be a better predictor, in combination with WC, particularly in football players.

16

Gut *Streptomyces* Mediates the Generation of Anticancer Secondary Metabolites from Alaskan Botanicals

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Acute myeloid leukemia (AML) is the most common acute leukemia found in adults, affecting about 3-5 people out of every 100,000 people in the United States. Despite the many cancer therapeutics having been developed over the past decade, the rates of new AML cases have been rising 3.4% on average each year over the last 10 years with a 26.6% five year survival rate. In empirical drug discovery, compounds of interest undergo a screening process to determine if they exhibit remedial effects against a disease in a cellular (in vivo) and animal (in vitro) model. The bacterium Streptomyces, isolated from Alaskan bear feces, synthesizes various bioactive chemicals, or compounds that have an effect on living tissue, in order to protect itself from competitive and pathogenic species. The medicinal relevance of these bioactive compounds has been used in many drugs. Devil's Club, a medicinal plants used among the indigenous people of Southeast Alaska and the coastal Pacific Northwest, is innately united with the Streptomyces in the intestinal tract of an Alaskan bear. The Streptomyces, which is exposed to Devil's club as it travels through the bear's digestive system, is isolated from the Alaskan bear fecal samples, and then co-cultured with Bog Blueberries and Labrador Tea respectively. The metabolites from the cultures will then be chemically extracted and utilized to determine their anti-leukemic effects in vivo and in vitro.

44

Evaluating College Students and their Understanding of Antibiotics

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Even though professionals within the healthcare system understand that antibiotics are ineffective against viruses, often times patients do not understand this concept. This misunderstanding can lead to patients' asking their doctors to prescribe antibiotics—even when they are unnecessary. Although not always ethical, some doctors do admit to prescribing antibiotics in cases when not necessary (Butler). College-aged students make up a large population of patients who believe antibiotics "cure all" and treat them like over the counter pain relievers such as acetaminophen or ibuprofen (Hawking). The overuse and misuse of antibiotics contributes to the current antibiotic resistance crisis. From preliminary data collected at UNH, it was found that 47% of the students surveyed believed that antibiotics were effective for viral infections. This finding contributes to the previous research that stated there was a education gap between health-care providers and the general population. The research also demonstrated that students at UNH who were enrolled in the College of Life Science and Agriculture (COLSA) had the best understanding of appropriate antibiotic usage as only 17% of the students enrolled in COLSA who answered the survey responded "yes" to the question "Would you expect antibiotics for a viral infection?" Peter T. Paul College of Business and Economics had the greatest amount of students respond "yes," in belief that antibiotics can be used for viral infections at 70%.

56

Identifying Genetic Interactions of Protein Phosphatase 2A Genes in *Arabidopsis thaliana* Treated with Abscisic Acid

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Protein Phosphatase 2A (PP2A) is a highly-conserved eukaryotic holoenzyme that plays an essential role in many integral cellular processes, including metabolism, signal transduction, and cell cycle regulation. In *Arabidopsis thaliana*, the PP2A heterotrimer made of A, B, and C subunits has been shown to regulate root growth and development. Abscisic acid is a plant hormone known for its ability to regulate seed dormancy, root development, and stomatal movements in response to limited water conditions. SnRK2 protein kinases mediate many abscisic acid responses and PP2A has been found to be physically associated with SnRK2 kinases. Thus, it is possible that PP2A may also be involved in regulating abscisic acid responses. In this experiment, *Arabidopsis thaliana* seedlings with mutations in PP2A A and C subunits were grown in the presence or absence of 5 μM abscisic acid and root lengths were measured after 7 days of treatment. A and C subunit gene interactions that affect root length will be assessed using single and double mutant seedlings. Seedlings grown in the presence of 5 μM ABA appeared to be shorter than the same genotypes without ABA. Statistical tests are underway to determine the relationship between individual genes coding for the A and C subunits.

5

Analyzing Body Fat Percentage of Male Collegiate Athletes: Preseason, In-Season, and Off-Season Training.

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The intent of this research study is to assess how training season (preseason, in-season, or off-season) relates to body fat percentage (BFP) in male collegiate athletes. Moreover, how the relationship varies across different sports.

Male collegiate athletes at UNH (Basketball, Football, and Soccer) were invited to undergo body composition testing via the BOD POD. All athletes were instructed to follow the BOD POD specific protocol. A sample of 37 athletes have completed three tests, each categorized into preseason, in-season, or off-season training, in accordance with the NCAA Bylaws (Article 17). Changes in BFPs were analyzed by sport, within and between seasons.

When averaging the BFP of basketball, the test 1 preseason average was 8.1% (1.9-10.5%), the test 2 off-season average was 8.11% (4.2-12.7%), and test 3 off-season average was 8.88% (2-15%). For soccer, the test 1 off-season average was 7.65% (2.9-11.5%), test 2 off-season average was 8.11% (4.7-11.7%), and test 3 in-season average was 6.09% (1-10.1%). Football had a test 1 off-season average of 21.15% (10.3-32.8%), a test 2 off-season average of 21.09% (5.5-33.6%), and a test 3 off-season average of 20.64% (8.4-32%).

Based on the results, it is important to know where/how variations in BFP occurs within training seasons and among sports to aids in the creation of individualized diet and training plan for each athlete.

32

Comparison of the Effects of PDE Inhibitors on the Catalytic Domains of Human and *C. elegans* Phosphodiesterases

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Plant-parasitic nematodes cause substantial crop damage, and current nematicides are relatively nonspecific and toxic to other animals. Previous research indicates that cyclic nucleotide phosphodiesterases (PDEs) are promising targets for developing new, selective nematicides that disrupt cyclic nucleotide signaling pathways controlling nematode physiology. For example, the PDE4 enzyme family is present in all animals, and deletion of PDE4 in the nematode *C. elegans* disrupts locomotion. We hypothesize that differences in the inhibitor binding site of human and nematode PDEs may permit development of inhibitor compounds that selectively inhibit nematode PDEs without affecting vertebrate PDEs. To test this hypothesis, we recombinantly expressed the human and nematode PDE4 catalytic domains in *E. coli*. Whereas human PDE4 was easily prepared and purified, optimization was required for expression of recombinant *C. elegans* PDE4 catalytic domain to obtain catalytically active nematode PDE4. The catalytic activity of PDE4 was then measured in the absence or presence of PDE inhibitors known to inhibit human PDE4. Our data indicate that some compounds highly selective for human PDE4 do not bind as well to *C. elegans* PDE4. We conclude that differences in the inhibitor binding pocket of nematode and human PDE4 may permit future identification of selective PDE4 nematicides that disrupt normal physiological processes in parasitic nematodes.

4

The Diversity of Streptomyces in Common Earthworms (*Lumbricus rubellus*)

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Streptomyces (order Actinobacteria) is a gram-positive bacterium abundant in soil and marine environments. The bacteria is a major producer of bioactive secondary metabolites that are of pharmaceutical and medical importance. Due to the rapid emergence of antibiotic resistant infections, further exploration of novel antibiotics is even more imperative, and Streptomyces' prolificacy in the production of bioactive compounds can offset the slow rate of drug discovery.

We isolated actinobacteria from a species of the common earthworm (*L. rubellus*) using AIA and then cultured them in liquid broth for DNA extraction. We sequenced the rpoB gene of 180 isolates from three worms to construct the phylogenetic tree. Our results suggest that isolates are phylogenetically diverse despite coming from the same host. Secondary metabolite production were also observed from a third of the isolates, which will be tested against diverse bacterial pathogens.

60

Investigating of the Interplay between Angiogenic Regulators in the Developing Bovine Corpus Luteum

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Angiogenesis, the formation of new blood vessels, is a process that occurs in the ovarian gland called the corpus luteum (CL). The CL exhibits a high rate of angiogenesis during its early stage of development (1-4 days of age). This process requires several angiogenic regulators, growth factors, and matrix metalloproteinases (MMPs). We reported the expression of an angiogenic regulator Cysteine-rich 61-**C**onnective tissue growth factor-**N**ephroblastoma overexpressed (CCN1), in the bovine CL. However, the interplay between CCN1, basic fibroblast growth factor (FGF2) and MMPs in the developing bovine CL, is unknown. Therefore, the goals of the present study were 1. To determine the temporal regulation of CCN1 and FGF2; and 2. To determine the regulation of CCN1 and MMPs by FGF2, using cells from 4-day-old bovine CLs. For goal 1, luteal cells were treated with 10% fetal bovine serum (FBS), a known stimulator of CCN1, for 2, 4, 8, and 24 hours. For goal 2, luteal cells were treated for 2 hours with FGF2 (1 and 5 ng/mL). Afterward, CCN1 and FGF2 expression were determined by quantitative polymerase chain reaction (qPCR). Preliminary results showed that CCN1 was rapidly induced by FBS within 2 to 4 hours, while the FGF2 spike occurred between 4 and 8 hours. Further, both concentrations of FGF2 increased CCN1 expression by nearly two-fold, while MMP expression awaits analysis by gelatin zymography. Additional replicates will confirm these findings.

45

Evaluating Perceptions of Dietary Quality between Body Composition Measurements Using Air Displacement Plethysmography in Male Collegiate Athletes

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Objectives: The aim of this study is to determine if there is a direct correlation between perceived diet quality and changes in body composition.

Methods: Participants (n=89) underwent multiple body composition tests in the BOD POD. Between assessments, a questionnaire was administered to gather athletes' perceived diet quality since previous assessment, "Since the last BOD POD testing, I feel that my dietary habits have". Four options were provided to determine their perceived diet change. Authors examined which of the four answers athletes submitted in comparison to body composition changes, using a predicted thoracic gas volume.

Results: When comparing Tests, the mean body fat of the sample increased by 1.06%. Of the 89 athletes who responded to the questionnaire, 60.7% responded that their diet stayed the same or worsened. The groups having the smallest increase in body composition were groups that improved their diet or maintained the same. The greatest increase in body composition was the group that responded their diet worsened; this was an increase of 3.0% body fat.

Conclusion: Based on the results of the study, it is unclear if athletes purposefully modify their dietary quality due to previous BOD POD results. However, there appears correlation between perceived diet quality and increases in body fat percentage. In the future, it may be advantageous to question athletes about their dietary intake such as using a more specific questionnaire regarding food frequency.

41

Effects of the Mortalin Inhibitor MKT-077 on the Tumor Suppressor p53 in Neuroblastoma IMR-32 Cells

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The tumor suppressor protein, p53, is an important cell cycle regulator in humans. Over half of all human cancers involve disruption of p53 function. One way this is achieved is by tethering p53 to the mitochondrial 70 kilodalton heat shock protein (Hsp70), mortalin, in the cytoplasm, and preventing p53 from entering the nucleus. The mortalin inhibitor, MKT-077, binds competitively to the p53 binding site in mortalin, and disrupts the p53-mortalin complex in cancer cell lines, allowing p53 to enter the nucleus and promote apoptotic cell death. Previous research reported that cytoplasmic tethering of p53 occurs in certain human neuroblastomas. Thus, we have studied the effects of MKT-077 on the human neuroblastoma cell line, IMR-32, using viability assays to determine cell death following treatment with MKT-077 (0 μM to 10 μM), and using immunocytochemistry to localize p53 within the cell. There was a positive correlation between cell death and concentration of MKT-077. Treatment with MKT-077 increased cell death from 21% to 78% as the concentration increased from 2 μM to 10 μM. However, results from immunocytochemistry are currently inconclusive, as cell staining conditions need to be refined. Overall, the results so far suggest that the p53-mortalin complex may be present in IMR-32 cells, and that mortalin inhibitors may be an effective group of agents that selectively target cells with this complex.

15

Estimating the structures of cnidarian phototransduction proteins using homology mapping

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X-ray crystallography has revealed the 3D protein structures of thousands of protein molecules and is a vital tool in biochemistry. However, X-ray crystallography data are generally derived from only a handful of model organism species, which represent an exceedingly small fraction of biodiversity. The 3D structures of proteins from distantly related organisms like cnidarians (jellyfish, anemones, and the hydra) remain largely unexplored. Homology modeling facilitates the estimation of a 3D protein structure with the help of a known structure of a homologous protein ("Introduction to Homology Modeling"). This method leverages sequence alignment and known protein structures and could be used to determine the structures of proteins from distantly related organisms like cnidarians. Here we examine the utility of homology modeling to estimate the structures of selected cnidarian proteins that we have previously shown to be involved in mediating cnidarian photosensitivity. Our results show that homology modeling can provide rough estimates of protein structure for cnidarian phototransduction proteins and that some domain architectures are easier to accurately model than others. When compared to the original template structures, the cnidarian phototransduction proteins show numerous structural differences that could reflect unknown functional diversity.

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39

Effective Connectivity Post-Concussion

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Concussions may impact the brain through network activity alterations. Brain oscillations underlie how brain regions communicate with each other. Rule-switching requires engagement of cognitive control mechanisms, which are related to alpha (8-12 Hz) and beta (13-30 Hz) frequency bands. Therefore, concussions may impact rule-switching behavior through changes in effectivity connectivity in alpha and beta bands. The current study examined changes in effective connectivity in alpha and beta during a rule-switching task in participants that had suffered two or more concussions. Thirty-six participants, matched for age and gender, underwent EEG recording during a rule-switching task (n = 17 controls, n = 19 with concussion). Unique visual stimuli containing red or green, and circle or square dimensions were presented on every trial. A cue was given prior to each stimulus presentation informing participants which rule to use on the current trial. The rule changed after 3-5 trials which were named switch trials. The data was analyzed using MATLAB with the EEGLAB plugin groupSIFT. These preliminary results show that accuracy during switch trials is less for those with concussions compared to controls. Additionally, results suggest there may be an effective connectivity difference from left frontal superior cortex to right insula at 750 ms post-cue in the beta band in people with multiple concussions. There may also be effective connectivity differences between left insula to right postcentral cortex 650-900 ms post-cue in the alpha and beta band. These results may suggest that concussions change network activity in oscillatory bands associated with control.

87

Root Foraging Strategies of Maize and Four Common Agricultural Weeds

Richard G Smith, Benjamin M Fehr, Carolyn J Lowry

Nutrients are distributed within the soil heterogeneously. In agricultural systems, soil heterogeneity is unintentionally generated via the patchiness of incorporated decomposing organic matter (e.g. tilling in a preceding cover crop), or intentionally generated via banding of N fertilizers. 'Root foraging' encompasses the various traits exhibited by roots to find and acquire soil resources. Belowground competition for limited soil resources occurs early in a plants life and can influence later stages of growth. In an agricultural system, competition between the crop and various weeds would result in reduced yields. By understanding these root foraging traits, we can potentially select crops with traits that make it more competitive and hence more productive.

We examined root foraging traits of maize and four common agricultural weeds (Abutilon theophrasti, Echinocloa crus-galli, Setaria faberi, and Sinapis arvensis) within soil environments with both heterogeneously and homogenously distributed resources. We selected four maize recombinant inbred lines (M0063, M0167, M0005, and M0013) from the IBM population (B73 X Mo17) which previously had exhibited varying root plasticity in response to the heterogeneous distributions of soil resources. The experiment took place at UNH Macfarlane Greenhouses. The maize and weeds were grown in clear acryllic rhizo-boxes to facilitate the visualization and measurement of root foraging traits. A single species or cultivar was grown in a rhizo-box with either a homogeneous distribution of resources or a heterogeneous distribution of resources and the two treatments were then compared.
Both the maize and weed cultivars used in this experiment produced more shoot biomass when soil resources were distributed heterogeneously compared to the homogeneous distribution. This increase in shoot biomass was greater among the weed species than the maize. Increased root length and branching, measures of root proliferation, resulted in greater shoot responsiveness to soil heterogeneity. However, we found no differences between the weed species or maize genotypes in their ability to proliferate roots within resource patches. Selecting for greater root proliferation within resource patches may enhance crop productivity, and future work will examine how root proliferation within resource patches influences the outcome of belowground competition.

86

Role of GLI3 in Diffuse Large B Cell Lymphoma (DLBCL)

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The Hedgehog (Hh) signaling pathway, an active component of diffuse large B cell Lymphoma (DLBCL), is mediated by the GLI family of transcription factors. In previous research, it has been shown that inhibition of the HH signaling pathway reduces survival and growth of cells in DLBCL. In germinal center B cell DLBCL, GLI3 expression is increased, and when GLI3 is knocked down, cell growth is significantly reduced. My presentation will look at previous results regarding the role of GLI3 in DLBCL and outline my future plans to further to test the role of GLI3 in DLBCL.

76

Productivity and Calf Survival in New Hampshire Moose

Patrick H Fitzgibbons, Peter J Pekins

Over the past decade, moose populations in New England have been declining. This is due to high winter tick loads that cause high calf mortality. It is also suspected that these high tick loads cause lower productivity in the population. Yearling and adult cows; though rarely dying from winter ticks, realize reduced pregnancy rates, twinning and successive birth rates. The Productivity and survival of cow and calf moose have been monitored since 2014. In 2017 we continued to monitor 38 radio collared cow moose for their birthing rates and calf survival. The calving rate in 2017 was 74%, which was higher than in 2014-2016 (45-67%). Calf survival was similar in 2017 (70%) as in 2014-2016 (73-78%). This summer we also experienced 1 set of twins, the only identified in 4 years, and the successive birthing rate was 78% the highest in the study. The increased productivity measured in 2017 was believed to be related to the lowest tick loads measured in the study.

65

Localization Impacts of Eastern Broccoli Production

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Increasing transportation costs, demand for local and regional food that is sustainably produced and shipped, and water scarcity in mainstream supply regions are increasingly generating interest in greater localization of food supply chains. We develop a mathematical programming model for fresh broccoli that minimizes the costs of production and transportation to identify optimal flows and optimal locations for broccoli acreage expansion in New England and New York. Our results indicate that acreage expansion in the region considered may reduce total system costs and food miles, and generate modest reductions in broccoli prices. Localization impacts differ by supply chain segment, season, and region. Transport costs decrease enough to offset the slight increase in production costs. Seasonality of Eastern broccoli production limits the potential of reducing the distance of broccoli shipments in winter and spring.

79

Quantifying the Reproductive Success of a Declining Shrubland-Obligate Songbird, the Prairie Warbler (*Setophaga discolor*), Breeding in an Active Gravel Pit in Southeastern New Hampshire

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Shrubland habitats have been declining in New England since the mid 1950's and in response, many other shrubland obligate species such as prairie warblers have also been in decline. These species now rely on habitats with specific anthropogenic disturbances such as gravel pits, which were found to have the largest abundance of adult prairie warblers in southeastern New Hampshire. However, it is unclear if shrubland habitats in gravel pits can actually support viable breeding populations of these birds. To evaluate the habitat quality of my site, I quantified the abundance, age structure, territories of each breeding pair, reproductive success of each breeding pair and calculated the annual rate of increase (λ) for the population of prairie warblers breeding at my study site. The finite rate of increase (λ) for this habitat showed that mortality exceeded birth rates for this season. However, the large number of older birds (ASY) breeding here suggests this gravel pit has been a high-quality breeding ground in past years. The results of this study provide valuable information on understanding where these birds reproduce successfully which is critical to guiding management, conservation efforts and identifying where habitats exist.

47

Evaluation of B-cell Populations in Mice with Conditional GLI2 Knockout in B cells

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Conditional knockout of the GLI2 gene in mouse B-cells results in a decrease in both IgG and IgM secretion, as compared to WT mice with an intact GLI2 gene, indicating a regulatory role of GLI2 in the inflammatory process. By confirming knockdown of the GLI2 gene, its role in the regulation of IgG and IgM secretion can be further studied and classified.

70

Measuring Somatic Mutation Rates in the Model Organism, *Caenorhabditis elegans*, to Further Understand Cancers and Human Disorders

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The purpose of this research is to identify the stage during cellular division that somatic mutations occur by using the model, multicellular eukaryote, *Caenorhabditis elegans.* Although more research has been conducted in more recent years, somatic mutations are poorly understood due to the inability to measure de novo mutations. These somatic mutations are was underlie cancer and other human disorders, which makes them so important. *C. elegans* will be grown and lysed to obtain embryos that are in the early stages of development. Using a Sony™ microsorter and fluorescent dye that binds to DNA, embryos can be sorted based on their DNA size. The DNA size of these embryos will be directly proportional to the number of cells found inside each. The embryos that are selected for this study will contain eight or less cells, in order to mitigate external factors that could cause mutations and affect the results. In order to provide significant statistical data, a few hundred specimen that meet these conditions will be dispensed into microtiter wells and will have their genomes sequenced. By having knowledge of the complete genome sequence of this organism that can be used as reference, and a well characterized early embryonic development, a mutation percentage can be calculated. Using statistical analysis and bioinformatics, the baseline somatic mutation rate will be measured to infer when somatic mutations occur. The project will also look at the difference in rates of somatic mutation between the wild type and mutant strains.

6

Intelligence in Sled Dogs: Are Leaders Really the Top Dogs?

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Sled dogs (*Canis lupus familiaris*) have been used for over a millennium to transport people and supplies across frozen landscapes. At the front of these teams are the lead dogs, which take commands from the human driver. Leaders must also select the best part of the trail, ignore distractions, and guide the team away from potential dangers, such as oncoming teams. Given these challenges, do leaders exhibit higher levels of cognition than their non-leader counterparts ("team dogs")? My study seeks to address this question. I will administer tests that assess two key aspects of intelligence, problem-solving and memory, to leaders and team dogs at various sled dog kennels throughout New England. In the problem-solving test, I will place a towel over the dog's head and time how long it takes for the dog to remove it. In the short-term memory test, I will first have the dog watch me hide a treat under one of five cups. I will then distract the dog for 30 seconds and observe if the dog can subsequently find the treat. I hypothesize that leaders are more intelligent than team dogs and will therefore outperform team dogs on these tests. If leaders do in fact perform better, that would raise the question of whether they learned this intelligence through their experiences as a leader, or they are innately more intelligent. These tests could then be administered to sled dog puppies as a way to select future leaders.

10

Spatially Assessing the Status of Waste Disposal Infrastructure across UNH Academic Buildings

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The University of New Hampshire Durham campus has a decentralized approach to managing the recycling and waste stations across campus, and the lack of consistent indoor waste infrastructure and messaging creates confusion among the population about how and what to properly recycle. Recycling has become a hot topic on the UNH campus this year, with recent events both locally and globally—from UNH's highly-touted new "Platinum" status in the national STARS sustainability rankings, to upcoming negotiations for a new campus Waste, Recycling and Composting contract, to China's refusal to accept foreign recycling. Due to the effects on markets from China's new policy, stricter rules about the level of contamination waste vendors can accept are rapidly being implemented, making it essential that UNH reduce contamination levels to prevent our recycling being thrown in a landfill. In response, UNH aspires to increase the efficiency and comprehensiveness of recycling, in part by creating standardized signage and bin types. The Sustainability Institute, UNH Facilities, and Housekeeping are all concerned stakeholders in this issue, however none of these departments have been able to plan or implement standardization practices or protocols for bins and signage, due to a lack of essential data about the number, placement, and characteristics of existing indoor waste receptacles across campus. In order to better understand the nature of the existing infrastructure, as well as the most strategic options for a new, effective, standardized approach to deploying recycling stations across campus, spatial research was conducted, with the help of Campus Planning, to assess key variables of indoor waste stations in academic buildings across campus. Data was collected using ArcGIS Collector app on the size, shape, color, orientation, labeling, signage, and contamination of each recycling and trash receptacle in common spaces throughout select academic buildings. Data was then analyzed using ArcMap 10.5. The outcome shows a high diversity of bin type, placement and labeling, as well as inconsistent and insufficient messaging throughout. Spatial models were used to determine contamination "hot-spots" and show other recycling successes and failures. Using data attributes, the research team scored each building's recycling protocol from 1-10, and identified which locations have the most user-friendly and effective labeling and bin placement, making them ideal models upon which to develop rational recommendations for the University to update and standardize their bins, signage, and location of recycling stations in academic buildings across campus.

8

Examination of Phase-Amplitude Coupling During Working Memory Updating and Interactions with Goal-Directed Attention Ability

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Working memory updating ability may be related to attention. Working memory updating involves continuingly changing the contents of working memory. Oscillations in theta (4-8 Hz), alpha (9-14 Hz), and beta (15-25 Hz) ranges are associated with goal-directed attention and working memory. Interactions between alpha and beta bands supports working memory maintenance and is impacted by attention ability. However, it is unclear whether alpha and beta interact and/or theta and alpha interact during working memory updating. This study sought to identify how changes in phase-amplitude coupling (PAC), which measures how different oscillations interact, during working memory updating change with variations in goal-directed attention ability. Participants completed a Posner attention task where participants covertly shift attention to one side of a screen in anticipation of a stimulus. Reaction time was used to make high and low attention ability groups via a median split. After the Posner task, participants completed a 0-back, 1-back, and 2-back working memory updating task while undergoing EEG. PAC in the n-back tasks was analyzed using FieldTrip and compared across high and low attention groups using ANOVA. PAC between predefined regions in left and right frontal and left and right parietal regions showed that theta-alpha and alpha-beta PAC during working memory updating increased with load. Theta-alpha PAC between contralateral parietal regions during the 0-back task was greater for participants with higher goal-directed attention ability. No difference in alpha-beta PAC was seen based upon attention group. These results imply that goal-directed attention ability may not impact working memory updating ability.

58

Investigating concentrations of Microcystin and BMAA in various parts of locally and commercially grown Romaine lettuce

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Recent research has indicated crops such as lettuce that are exposed to microcystins (MC), a liver toxin produced by cyanobacteria, can accumulate these toxins in their tissues. Grocery stores and locally owned farms sell us their hard work in irrigated crops. The question is, are these crops contaminated with toxins in the irrigation water? Studies show that irrigated crops, like lettuce, are exposed to surface water contaminated with cyanobacterial blooms. Using ELISA analysis, we observed the varying concentrations of beta-Methylamino-L-alanine (BMAA) and MC in inner and outer leaves from Romaine lettuce that was locally and commercially grown. Based on previous studies, we expected to detect MC, but our neurotoxin concentration of BMAA was novel, due to lack of previous research. Similar studies testing toxin levels in various crops such as broccoli and mustard showed that more toxin is absorbed by, and accumulated in the roots. From this we expected to detect higher concentrations in the outer/oldest leaves of the lettuce, because its absorbance of toxin was not greatly reduced by rinsing. The implications of our findings to human health are discussed.

102

Understanding the Role of Polyamines in Rice Under Drought and Salt Stress

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Abiotic stresses are important constraints on crop productivity. Paddy-grown rice is particularly susceptible to drought and salt stress, which have negative effects on carbon and nitrogen intake thus limiting plant growth and grain yield. Polyamines (PAs), mainly putrescine, spermidine, and spermine, are important molecules in plant metabolism and have been implicated in abiotic stress responses, both as protectors of plants from stress and preparing the plant for tolerance of stress. This has led to genetic manipulation of PA metabolism aimed at improving drought and salt tolerance in rice and several other crops. Prior to overexpressing PA biosynthetic genes in order to produce a multiple-stress-tolerant plant, we have profiled the response of a commercial rice variety to drought and salt stress in terms of changes in growth and PA content. We found that PAs may be involved in recovery from stress, but levels during stress appear to fluctuate widely. To minimize sampling errors, we also studied differences in PA contents among different parts of the long, morphologically heterogeneous rice leaf. The PA levels were significantly higher in the leaf blade than the sheath, which may have affected our abiotic stress results. Together, the results will help us plan future strategies of transgenic rice plants with modified PA metabolism, which will ultimately increase scientific understanding of abiotic stress tolerance for plant improvement.

53

Greenhouse Gas Emissions from Headwater Stream Sediments

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Rivers and streams are often net sources of the greenhouse gases carbon dioxide, methane, and nitrous oxide to the atmosphere because of the biogeochemical activity within their sediments. Yet, little is known about how gas production varies along a headwater stream reach. Headwater streams often flow through a diverse array of habitats with varying flow conditions such as wetlands, beaver ponds, reservoirs, floodplains, or other impoundments. The primary research objective is to examine how greenhouse gas production varies between sediments in channelized segments of the stream and sediments underlying pooled segments of the stream. On average, pooled sediments were observed to be more productive than channel sediments. Additionally, gas production displayed positive, linear increases with percent organic matter content of the sediment. The results of this study suggest that pooled segments of rivers and streams must not be overlooked when scaling for entire reach or network greenhouse gas production.

14

Dissociating the Role of Anterior-/Posterior-Dorsomedial Caudate-Putamen in Associative Learning with Nicotine

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The Food and Drug Administration (FDA) reports tobacco use is the leading cause of preventable death and disease in the United States. In addition to the 480,000 lives claimed every year from cigarette smoking related health problems, the total cost of healthcare and lost work productivity due to smoking totals nearly $300 billion annually. The dominant addictive properties of tobacco are largely attributed to nicotine, an addictive stimulant and mild reinforcer. Previous studies demonstrate the role of dorsomedial caudate-putamen (dmCPu) in the associative learning processes between nicotine's interoceptive effects and other stimuli, as well as the expression of these associations. The current study sought to further investigate this relationship by examining how lesions to either anterior (a-) or posterior (p-) dmCPu in male rodents effects goal-tracking for sucrose after repeated pairings with intravenous infusions of nicotine. Overall, rats with lesions to p-dmCPu exhibited markedly lower levels of goal-tracking behavior for sucrose when compared to control groups. These findings indicate the involvement of p-dmCPu in associative learning with a nicotine stimulus. Although preliminary results revealed a trend, a replication of the experiment is required in order to gain significance.

80

Quantitative Discernment of the Genetic and Epigenetic Architecture of Coloration in the Poison Frog *Ranitomeya imitator* and its Morphological Variants throughout Development

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This work aims to understand genetic underpinnings of the specific colorations and coloration patterns found across the different morphologies of the Poison Frog *Ranitomeya imitator* through the identification of responsible genes and associated gene regulation schemes. Members of *R. imitator* and all congeneric aposematic species subject to the former's Müllerian mimicry were sourced from heterospecific clinal zones and assessed via differential gene expression analysis following RNA extraction. Whole transcriptomes were cross-compared both inter- and intraspecifically. Sampling and analysis are ongoing.

68

Mapping sediment microbial community structure in the Stellwagen Bank National Marine Sanctuary to facilitate functional genomic studies

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The increase in antibiotic-resistant pathogens coupled with the prevalence of multi-resistant bacterial strains has necessitated a search for bioactive compounds within the marine habitat. The objective of this study was to characterize the sediment microbial community by quantifying the relative abundance and diversity of microbes sampled from the Stellwagen Bank National Marine Sanctuary. An important goal includes identifying sites with the highest potential for harboring bacterial strains (e.g., *Streptomyces*) that may produce novel biosynthetic gene clusters for natural products/drug discovery. Sediment was collected from 3 ocean sites during the summer-fall, 2016-17. Genomic DNA was extracted from 36 samples and libraries were prepared for molecular sequencing analysis. Metagenomic sequencing was employed to comprehensively delineate all bacteria present in each sample. Bioinformatics platforms, including metaSPAdes and BLASTn, were used for multiple read assembly and taxonomic identification. Biostatistical analysis was used to characterize relative bacteria abundance and biodiversity.

Preliminary results from 2017 identified *Streptomyces* to be 1.57% prevalent (N = 13315) in the summer samples compared to 1.22% prevalent (N = 18897) in the fall samples (seasonal difference: chi-square=486.38; $p < 0.0001$). Site 3 had the highest summer percentage (1.71%; N = 5420), and Site 1 had the highest fall percentage (1.35%; N = 4843). Comparative analysis of gene clusters of biomedical relevance was performed using PALADIN bioinformatics software. In addition to marine ecological implications, this methodological pipeline is a model that connects genomic, marine, and health sciences for novel gene bioprospecting.

106

Weed community response to tillage and pesticide seed treatment

Hayleigh S Hildebrand, Richard G Smith, Nicholas D Warren

Pesticide Seed Treatments (PST) are insecticidal and fungicidal pesticides applied as seed coatings to some of the most commonly grown crops in the US. They are effective at protecting crops from soil pathogens and early-season insect pests, however, little is understood of their broader role in agroecosystems. Our previous work suggests that PST can influence weed community dynamics, possibly through indirect effects on "beneficial" organisms responsible for keeping weed pressure in check. We assessed the germinable weed seedbank of soils from a replicated field experiment where corn was grown under three tillage types (moldboard plow, strip tillage, or no tillage), with and without PST (six treatments total). Soil was collected from each treatment and grown in a greenhouse for 5 months, during which all emerging weeds were identified and counted. Weed seedling density varied considerably, from 1,500 to 15,000 individuals m^{-2}. After a single year of production, we did not see evidence for PST interactions with weed populations. Neither tillage nor PST had a significant effect on the total number of weeds, although tillage did affect the proportion of dicots to monocots found in each treatment. This shift is evident in a weed community ordination that suggests tillage is a strong driver of community structure across a range of seedling densities. These results suggest that despite an inconsistent effect on the total number of weeds, management filters can influence weed community structure. Community shifts between functional groupings could have implications for successful weed management in the future. Further study of the role of PST will help us understand the full extent to which these substances interact with an agroecosystem.

101

Transgenic Hydra: Editing Opsin with CRISPR

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Genetic engineering is an up and coming method of technology in the science community, effectively altering an organism's genome. Due to new technologies, like CRISPR (a gene editing tool), we are able to affectively alter DNA to prevent various genetic mutations. CRISPR is fairly new and has modernized the world of gene alteration with its simplicity and efficiency. Gene alteration is helpful for understanding gene expression because the genes can be manipulated to test when/if the protein is encoded. CRISPR can be used on a variety of organisms and this lab will develop transgenic Hydra. Hydra are model organisms that will be bred to allow for embryo microinjection of CRISPR. The tool utilizes a guide RNA that brings an endonuclease to a gene of interest in the DNA. The endonuclease cuts the strand of DNA and inserts a gene encoding a fluorescent protein (GFP). The gene of interest in this experiment is the opsin gene. Opsin are present in all animals, assisting with vision and are defined as light sensory proteins. If the embryo possesses transgenic tissue, then a fluorescent phenotype will be observed where opsin is expressed (turned on) in the tentacles of the Hydra. Once it is clear that CRISPR is successful in gene manipulation of hydra, it will be possible to place other florescent tags on various other genes to view their gene expression as well. This experiment will assist in providing insight to evolutionary change of vision in animals. The overall goal of this project is to insert GFP, which codes for a fluorescent phenotype, into the genome of a Hydra embryo, in order to produce transgenic animals.

Keywords: Hydra, opsin, CRISPR, GFP, genetic engineering

77

Pathological Etiologies in EMS Demographics Relevant to Current Literature

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Emergency Medical Services provide a wide variety of services to a large community and varying demographics. The traditional model for EMS providers is the "Golden Hour," however recent evidence related to etiological evidence in certain chronic pathologies suggests a more varied model depending on the acuity of the factors involved. This current metric is designed for a variety of calls, ranging from the most acute (Motor Vehicle Collisions, trauma, etc.) to the somewhat more chronic (COPD, cardiac events, etc.), with different implied call times. Using McGregor Memorial EMS call data; demographics, notably town of residence and preference in hospital, for both general pathologies, and trauma, will be analyzed for, and compared against current literature. In the case of acute myocardial infarction events, relevant call time measured by a biochemical marker map, established in the hospital setting. As well as a specific corollary analysis of demographic data for UNH and the surrounding college town of Durham, and more spread out areas such as the towns of Lee and Madbury. The relevance of these demographics to long and short term patient health effects, may be used to increase efficiency of EMS logistics and planning, possibly improving patient outcomes in the future.

82

Regulation of the Angiogenic Inducer, CCN1, by Heat-Inactivated Serum, in Human Tumor Granulosa Cells

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Cysteine rich 61-Connective tissue growth factor-Nephroblastoma overexpressed 1 (CCN1) is a protein that plays a role in angiogenesis, the growth of new blood vessels. Using fetal bovine serum (FBS), a component of cell growth media, we have shown that it increases expression of CCN1 in ovarian cells, e.g., granulosa cells. Although it remains undefined, analysis of FBS revealed that it comprises a variety of proteins, hormones, vitamins and enzymes. In order to determine which component(s) of FBS may regulate expression of CCN1, the objective of the present study was to assess the response of the human tumor granulosa cell line, KGN, to heat-inactivated FBS. The FBS was heat inactivated at 56C for 30 minutes. The KGN cells were grown in DMEM and Ham's F12 (1:1 ratio), 10% FBS and gentamycin. For experiments, 200,000 cells were seeded into 6-well plates. After 24 hours, the KGN cells were serum-starved for 2 hours before they were treated with heat-inactivated serum for 2 hours. The presence or absence of 10% FBS served as the positive and negative controls, respectively. Afterwards, quantitative polymerase chain reaction (qPCR) was performed. The preliminary results indicate that CCN1 expression in KGN cells was reduced by approximately 50% with heat-inactivated FBS, compared to the positive control. Currently, experiments are underway to treat KGN cells with FBS that have been heat-inactivated at higher temperatures to determine the effects on CCN1 expression.

88

Sleep Quality's Effect on EEG Activity Underlying Information Processing during Motor Control

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Only 9% of the poor sleep population attributes their sleep difficulties to having a diagnosed sleep disorder, yet a majority of people suffer from poor sleep quality. Sleep quality impacts cognitive processing and it is currently unclear how sleep quality impacts motor control. The N1 visual sensory component and the P300 attention and cognitive processing component during motor control may be impacted by sleep quality. The objective of this experiment was to determine if tasks with increasing motor-control requirements altered N1 and P300 latency and amplitude. EEG data were collected during a simple reaction task (SRT), a choice reaction time task (CRT), and a CRT-Dual Task (CRT-Dual). In the SRT, participants were instructed to hit a button after a cue, in the CRT they were instructed to hit different buttons based on varying color cues, and in the CRT-Dual they performed the CRT while counting backwards. Both amplitude and latency of N1 and P300 were compared across all three conditions and in poor (N=8) and good sleep (N=5) quality groups for electrodes Pz and O2 located over parietal and occipital scalp regions using two 2x3 ANOVAs. Preliminary results indicated a main effect of condition for P300 latency, where latencies increased with task complexity. Results also suggested a trend towards a significant main effect of group for P300 amplitude, where amplitude may be increased in the poor sleep quality group across all conditions. Results suggest sleep quality may impact attention, leading to changes in information processing during reaction-time tasks.

84

Relationship between Multivitamin/Mineral Supplement Use and Presence of Metabolic Syndrome Biomarkers among College Students

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Objectives: The purpose of this cross-sectional study is to examine the relationship between frequency of multivitamin/mineral supplement (MVM) usage and presence of biomarkers for metabolic syndrome (MetS) among college students.

Methods: Data were collected between 2012-2015 via ongoing college health survey at a mid-size, northeastern university. Demographic information and MVM use by college students 18-24 years of age (n=1,926) was reported via online survey; MetS biomarkers (elevated blood pressure, abdominal obesity, low HDL-cholesterol, elevated glucose, and elevated triglycerides) were collected via physical assessment in the fasted state. Proportional differences between men and women were evaluated via chi-square analyses; mean differences were evaluated via ANCOVA with sex, age, measured BMI, year of data collection, semester, academic major, and average daily kcalories serving as covariates.

Results: Mean age of students was 18.8±1.0 years; 69% were female. Overall, 54% of students reported no MVM usage, 22% reported usage 1-5 per week, and 24% reported daily [6+ times/week] usage. Females were more likely than males to report more daily usage of MVM (26 vs. 20%, $p<.05$). More than half (51.2%) of students had no biomarkers for MetS, 34.6% had 1 biomarker of MetS, 11.2% had 2 biomarkers, and 3.0 % had ³ 3 biomarkers of MetS. Men were more likely than women to have 2 or more MetS biomarkers (19.1 vs. and 12.3%, $p<.01$). Mean number of MetS biomarkers was 0.68±0.8; no significant differences in number of MetS biomarkers were observed according to the frequency of MVM usage.

Conclusions: No relationship between the use of MVM and presence of biomarkers for MetS among college students was observed. These findings do not support the use of MVM to reduce cardiovascular disease risk among young adults.

13

CRISPR/Cas9 Aided Gene Editing of *Hydra magnipapillata*

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The CRISPR/Cas9 complex is derived from bacterial immune defense, and has been domesticated to become a powerful tool for genome editing and biotechnology. In previous studies, CRISPR/Cas9 has been utilized in model organisms like fruit flies, nematodes and zebrafish to induce mutations and to facilitate the insertion of novel genomic elements. Our study examines the feasibility of CRISPR/Cas9 for the production of transgenic individuals of the freshwater polyp, *Hydra magnipapillata*. Hydra are cnidarian animals closely related to sea anemones and jellyfish. Using the whole genome sequence of *H. magnipapillata*, we designed guide RNAs for targeted double strand breaks and synthetic DNA constructs for homologous recombination. Our construct contains fluorescent markers to be inserted at the amino terminus of genes encoding visual opsins and chemosensory taste receptors. Marking these genes with Green Fluorescent Protein (GFP) will allow us to observe their expression patterns in living organisms and will allow the neurons that express them to be examined using electrophysiology. Preliminary results from *in vitro* demonstrate that our reagents induce double strand cuts at specific loci efficiently. Ongoing efforts apply these reagents to the production of transgenic hydra using microinjection of hydra embryos.

63

Investigation of Histone Modifications on Preadipocyte 3t3 Cells

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Our project looks to investigate a preadipocyte cell line (3t3) that is derived from mice. Through our investigation we looked at histone modification of the undifferentiated preadipocytes as well as the differentiated adipocyte species. We did this by harvesting undifferentiated samples, inducing differentiation, and then harvesting the differentiated samples. We also used a HAT inhibitor called mg149 that stopped the differentiation process. We tested the drug in three different conditions, first we only treated the cells with the drug the initial day. Second we treated the cells the initial day and then three days after. The third sample the cells were treated throughout the incubation (One week). Each of these samples were then analyzed by an oil red assay and compared to each other as well as to the undifferentiated and differentiated samples. Samples were then harvested and an acid extraction was preformed, an SDS page gel was run with the histone samples from acid extraction. An ingel digestion was then preformed. All samples were analyzed by a mass spectrometer, the data was collected and individual inspected to find a correct assignment of peptides as well as the correct charge state and modifications. The samples were broken up into 2 histone categories, histone H4 and Histone H3. XIC was conducted on each peptide and a percentage was calculated for the peptides. The percent acetylation was one of the major modifications that was paid attention to for all samples. The percentages for each histone on all samples were then used to compare the modifications seen between the differentiation and undifferentiated conditions.

92

Testing the Effectiveness of Therapeutic Agents on Neuronal Primary Cilia

Amanda M Kabel, Xuanmao Chen

Primary cilia are non-motile, centriole-derived organelles found on neurons and many other vertebrate cells. Many G protein-coupled receptors (GPCRs) have been identified in neuronal cilia, such as odorant receptors, type 3 somatostatin receptors and type 6 serotonin receptors. This connection between GPCRs and primary cilia suggests that cilia depend on metabotropic receptors and their signals to influence neuronal functions. Type 3 adenylyl cyclase (AC3) is expressed in neuronal primary cilia and olfactory sensory cilia. An ablation of AC3 in mice causes phenotypes such as anosmia, obesity, depression-like behaviors, and more. Additionally, there is human genetic evidence to suggest that AC3 is involved with obesity, major depressive disorder (MDD), inflammatory bowel disease, and infertility. Due to the multitude of phenotypes associated with AC3, it is important to study the functionality of AC3. However, it is currently unknown how AC3 in neuronal primary cilia regulates neuronal functions, and how primary cilia modulates the signal pathways. I have worked with a graduate student in the Chen Laboratory and partook in other research projects to study the roles of AC3 in neuronal primary cilia. Here we show that there are some therapeutic agents that can affect primary cilia morphology.

81

Can we achieve hydrolysis-acidification for the anaerobic digestion of aquaculture waste?

Todd C Guerdat, Danielle M Kalmbach

The fish waste produced from a recirculating aquaculture system (RAS) can be transformed into a fertilizer to be ideally used for plant production. In order to achieve this, the effluent from the system must go through an anaerobic digester to solubilize the nutrients necessary in the development of an effective fertilizer. Under anaerobic conditions, denitrification occurs followed by fermentative processes producing volatile fatty acids (VFAs). An accumulation of VFAs effectively reduces the pH of the digester volume. This means that the waste has reached the hydrolysis-acidification step and it allows for many of the nutrients to solubilize in the solution. The reactions that occur in the digester to effectively reduce the pH in the digester are largely driven by the carbon:nitrogen ratio. This means that there needs to be enough carbon in the system to achieve fermentative conditions and ultimately accumulate VFAs. For this project, we developed a simplified means for determining the C:N ratio. This simplified method was then used to predict the potential for a waste stream to supply all the nutrients (e.g. carbon) to achieve the hydrolysis-acidification stage and effectively dissolve the mineral nutrients. The simplified relationship was based on the carbonaceous biological oxygen demand (cBOD) and the amount of available nitrate-nitrogen (cBOD:NO3-N). This ratio will then be used to determine whether additional carbon sources are required for the reactor to function properly. At the same time as the cBOD testing, effluent samples with three different ratios developed and treated using anaerobic digestion to the extent of impact on the solution pH. As a result of this study, we developed a relationship between the rate of hydrolysis-acidification as a function of the cBOD:nitrate ratio.

25

Boldness and Natural Behaviors in the African Lion (*Panthera leo*): How Are They Related?

Andrew B Conroy, Courtney Marie Kamyk

The African lion (*Panthera leo*) population is diminishing rapidly, approximately 43% since 1993 (Bauer et al., 2016. The species is currently listed as vulnerable by the IUCN (Bauer et al., 2016). With numerous threats to current populations including human conflict, prey depletion and habitat loss the African lion is in danger of becoming endangered or even critically endangered in the near future. Ex-situ conservation is a proposed method of restoring populations. The current study focuses on correlations of boldness with natural behaviors and sociality to further understand individual personality in hopes of connecting it with success after reintroduction. Six playbacks were used to assess boldness personality traits of the 12 individuals of the Dambwa pride. Social interactions and daily activity budgets were also recorded. Spearman's correlations were conducted in order to examine correlations between boldness sociality, and average daily activity.

96

The Effects of Pollen Composition on Growth and Development in the Native Bee, *Ceratina calcarata*

Kiley B Kennedy, Sandra M Rehan, Sarah P Lawson

As native bee populations decrease there is a need to better understand their nutritional requirements to sustain pollinator populations. Very little is presently known about the nutritional needs of native bees. A common native bee to eastern North America is *Ceratina calcarata*. Females of this species forage and create a pollen ball for each individual offspring that contains all of the nutrients needed to develop from an egg to an adult. Previous studies have shown that the primary pollen sources for *C. calcarata* are clover and rose. The aim of this study was to compare how pollen composition impacts body size, development, and survival. Pollen diets were created using different ratios of clover and rose pollen. Data revealed that higher ratios of clover in pollen balls produced larger individuals with better survival rates and longer development. The macronutrient profiles of the clover and rose were examined for protein, fatty acid, amino acid, and sugar content. Results from these profiles indicated that rose pollen has a greater sugar content, while clover pollen contained more protein. Interestingly, clover has higher concentrations of essential amino acids and this might explain the increased survivorship observed on high clover diet treatments. These results indicate that clover pollen provides a superior diet for larvae development and increased clover availability may help increase immature bee survival in the wild.

67

Lying behaviors in Holstein and Jersey breeds of cow

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Rest is an activity that all species require for energy conservation and physical restoration. Rest for production animals can reduce stress and risk of injury from extended periods of standing time. For dairy cows, resting can increase milk production and indicate comfort level. Previous work demonstrated that Holstein cows prefer to lie on their left side more often than their right. This preference is strongest in cows further along in pregnancy, possibly because the uterus is on the right side of the abdomen, making the right side more uncomfortable as the fetus grows. Although Jersey and Holstein cows are anatomically similar, it is unknown if they exhibit similar lying preferences, and identifying breed differences may provide insight into factors affecting comfort in each breed. I predict that like Holstein cows, Jersey cows will show a left-side preference that intensifies as pregnancy progresses. Furthermore, because cows that have had more calves are typically larger, each subsequent fetus takes up less room in the abdominal region; I therefore predict that in both breeds, left-side preferences will weaken as a cow has had more calves. To investigate this, I will observe 50 cows of each breed, recording resting side preferences for 14 days and using a generalized linear mixed model to predict side preference. Understanding lying behaviors allows farmers to provide their cows with a comfortable environment, which can increase productivity and extend a cow's lifespan.

52

Genetic Tools in *Frankia*

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An actinorhizal tree known as *Casuarina* is able to form a mutualistic relationship with *Frankia,* a nitrogen-fixing actinobacteria. Through this relationship, *Casuarina* is able to grow in harsh environmental conditions where many other plants cannot, such as soil with a high salt concentration. It is very beneficial to grow these plants and reclaim degraded land due to the alarming global increase in soil salinity. Currently little is known about the molecular mechanism behind the salt tolerance of *Frankia* and its plant host and there are no concrete genetic tools to manipulate *Frankia*. These protocols were improved for the introduction of plasmids into *Frankia*. Transfer of a candidate gene from a salt-tolerant strain into a salt-sensitive strain was performed in order to better understand how *Frankia* assists the growth of *Casuarina* in salt-affected soil. In the future, the transformants will be characterized through their ability to grow in the presence of high salt. This research greatly contributes to the understanding of the genetics of *Frankia* and its symbiotic relationship with *Casuarina*.

85

Relationship between Reported Sleep and Physical Fitness among College Students

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Objectives: As limited research has explored the role of sleep deprivation and physical fitness among college students, we examined the relationship between reported hours of sleep, daily activity, and measured physical fitness among a cohort of college students, 18-24 years of age. **Methods:** Data were collected from an ongoing, cross-sectional health survey at a midsize, northeastern university between 2011-15 (n=2643; 70% female and 63% first year students). Students self-reported sleep and physical activity via online questionnaire; daily activity was measured via pedometer (7-day step average) and fitness (VO2max) was determined via 1-mile Rockport walk test. Mean differences (±SE) were evaluated via ANCOVA; sex, age, year of data collection, health major, semester, and BMI served as covariates. **Results:** More than half (56%) of students reported 6-7. 5 hours of sleep/day while 36. 8% reported 8 – 9. 5 hours of sleep/day. Forty percent (40%) of students reported participating in physical activity ≥ 5 times/week; 44% of students exceeded 10,000 steps/day. Students who reported sleeping less than 8 hours/day had a higher number of steps as compared to those that reported sleeping more than 8 hours (10118±92 vs. 9731±113, p<. 01) however, measured fitness levels did not differ (41. 7±. 1 vs. 41. 6±. 1 VO2max, p=. 60). **Conclusions:** Findings indicate that college students who report less sleep may have modestly higher amounts of daily activity, however, the difference may not increase physical fitness in young adults.

37

Eavesdropping on grassland ecosystems; investigating disturbance effects on bat distributions across a mixed-use tallgrass prairie

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Bats play a critical ecological role as pollinators and insectivores in grassland food webs. We examined the presence/absence and distribution of bats at The Nature Conservancy's Tallgrass Prairie Preserve using acoustic recordings obtained from a study investigating prescribed burning effects on grassland acoustic communities, and related these findings to the known spatial distributions of night-flying insect biomass and biodiversity at the study site. In addition to forage availability and diversity, we examined how habitat disturbance from prescribed burns influenced bat distributions, and found no difference in the abundance of bat biosonar signals recorded in burned vs unburned grassland settings. We also report on patterns of bat distribution with respect to anthropogenic noise produced by oil pumps, air traffic and automobiles, and examined how grazing regimes influence bat site occupancy. Results from this preliminary research will guide future investigations focused on identifying bat species composition, habitat preferences, and phenological patterns at the site, which represents one of the largest tract of tallgrass prairie remaining in North America.

105

Using qPCR to evaluate the toxicity of lake aerosols

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Cyanobacteria are prokaryotic, photosynthetic organisms that can produce a wide range of toxic secondary metabolites. Important toxins found in cyanobacteria are microcystins, cylindrospermopsin, anatoxins, and saxitoxins (analogs of red-tide toxins). Often cyanobacteria in freshwater bodies produce toxic blooms, posing a health risk for aquatic organisms, wildlife and humans. Such blooms also release cyanobacteria and toxins into the air as aerosols. This study examines the possible application of real time PCR as a method for the detection of toxigenic genes (microcystins/nodularin, cylindrospermosin (liver toxins)) and anatoxin a and saxitoxin (neurotoxins) in cyanobacteria in lake-generated aerosols. By utilizing qPCR we are able to detect the presence of toxic genes, even before the toxins are detectable. Aerosol samples were conducted *in vitro*, and then analyzed using the qPCR method, combined with 16s rRNA sequencing to detect presence of cyanobacteria. Use these two qPCR tests could allow for identification of cyanobacteria and their toxigenic genes, providing early aerosol toxin warnings through one simple test.

46

Evaluating the Effect of Baiting on White-tailed Deer Harvest in New Hampshire

Emily R Landry, Peter J Pekins, Daniel Bergeron

New Hampshire's white-tailed deer (*Odocoileus virginianus*) population is managed by the New Hampshire Fish and Game Department using a controlled harvest. The deer population in New Hampshire is low-moderate density and ecological/economic conflicts are uncommon. Harvest methods are similar among New England states, except in New Hampshire which allows baiting (with permit) for a portion of its hunting season. Baiting introduces multiple ethical and biological arguments, including the concept of fair chase and disease transmission. We analyzed harvest and baiting data (2014-2016) to assess possible effects on the deer harvest. The overall harvest success rate of bait permit holders was 3-4x higher than that of all hunters in 2014-2016: 43% of baiters were successful versus 12% of all hunters. Although the success rate of permit holders was high (> 40% on average), only 8% reported harvesting a deer directly over bait. In the three years combined, the proportion of bucks harvested by hunters with (64%) and without baiting permits (66%) was similar. The harvest rate of trophy bucks (>150 lbs and $\geq$ 8 points) by all hunters compared to permit holders was similar (8%); interestingly, harvest rate of trophy bucks directly over bait was 50% lower. The substantial differences in reported harvest success over bait, compared to the similarities between permit holders and all hunters, suggest the possibility that permit holders underreport harvest over bait.

95

The Effects of Feeding an Organic-Certified Milk Replacer to Dairy Calves on Body Weight and Growth

Courtney A LeCuyer, Andre Fonseca De Brito

Calf management is a critical aspect of dairy farming and proper nutrition in the preweaning phase of life is essential to produce healthy and productive cows. In the first few weeks of life calves depend entirely on milk or milk replacer (**MR**) to meet their nutritional requirements. Milk replacer provides several benefits to dairy producers including improved biosecurity, calf performance, and economics. Organic dairies typically do not feed MR to their calves because there was no organic-certified MR available for purchase until recently. The objective of this study was to compare whole milk (**WM**) vs. MR (Organi-Calf^{TM}; MilkSpecialties Global, MN) on body weight and growth of organic dairy calves. Eight Jersey calves were fed 4 L of either WM or MR from birth until weaning (8 weeks of age). Water and starter grain were offered ad libitum throughout the study. Body weight and skeletal measurements were taken weekly. Data were analyzed using the MIXED procedure of SAS. The average body weight of calves fed WM was 5.7 kg greater ($P < 0.001$) than that of calves fed MR. Similarly, the average daily weight gain was greater ($P = 0.01$) in WM- vs. MR-calves. Average hip height did not differ significantly between treatments. In contrast, average heart girth increased ($P < 0.01$) and average body length and wither height tended ($P = 0.06$) to increase with feeding WM vs. MR to dairy calves. It can be concluded from these preliminary results that MR is not recommended for organic dairy calves due to decreased body weight and skeletal growth as compared with WM.

54

How Do Female-Biased Sex Ratios Influence Male Resource Defense Behavior in Hissing Cockroaches?

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Sexual selection theory predicts that competition will occur between males for access to females. However, the idea of economic defendability suggests that extreme low and high levels of resources are less valuable than moderate levels. Gains received by low levels of resources may not be worth the effort to exclude other individuals, and, high levels of resources may not be worth protecting because not all resources can be utilized. Male Madagascar hissing cockroaches (*Gromphadorhina portentosa*) are known to engage in intrasexual competition in the presence of females, but it is unknown if this behavior follows the pattern of economic defendability. In this study, we will observe how male aggressive behavior is altered when the sex ratio is biased towards females. We will expose individual resident males to each of three male-female sex ratios: low (1:1), intermediate (1:3), and high (1:6). We will then introduce a male intruder and quantify the frequency and duration of intrasexual aggression the resident male directs toward the intruder, comparing the treatments with ANOVAs. We hypothesize that male cockroaches adhere to the principle of economic defendability, and will therefore display more aggression in the intermediate treatment than in either the high or low treatments. Our study will bring further understanding to how the values and levels of resources influence defensive behaviors based on the theory of economic defendability.

78

Phylogenetic diversity of *Streptomyces* bacteria in the gut of the earthworm *Lumbricus terrestris*

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New antibiotics are critically needed as resistance to our existing arsenal of drugs is growing. An important source of drugs or drug precursors with broad pharmaceutical application, including serving as the most effective antibiotics, are natural products produced by environmental microbes. *Streptomyces* (phylum Actinobacteria) have long been known as prolific producers of antibiotics and other clinically useful compounds (such as antiviral, antitumor, antihelminths, immunosuppressants). For the past several decades, majority of antibiotics used in the clinic have been derived from *Streptomyces*. In this project, we aim to determine the genetic diversity of *Streptomyces* in the gut of the earthworm *Lumbricus terrestris*. Our approach involves culturing and enrichment of *Streptomyces* isolates in agar and broth media, DNA extraction and *rpoB* sequencing. We obtained approximately 60 phylogenetically diverse isolates from a single earthworm alone. This project demonstrates the potential of earthworms and other invertebrates as important sources of these bacteria. Future work will focus on testing the ability of different *Streptomyces* isolates to inhibit the growth of other bacteria, including pathogens.

57

Improving Assembly Completeness with *Shmlast*

Matthew D MacManes, Kaelina Dee Lombardo

Optimization of transcriptome assembly, the building of a set of transcript sequences without the use of a genome reference, has been an ongoing project in the MacManes Lab. While the actual assembly is just one step of this process, final results can vary depending on the assembler used. Currently, numerous assembly programs exist, varying in both specific technical functionality and popularity. This project aimed to improve assembly completeness by creating a program to ensure that all of the genes found among a variety of differently-assembled transcriptomes were indeed included in a composite transcriptome and to append any that might be missing.

To begin to tackle this, a Python program was written to use Shmlast, a program written by Camille Scott and collaborators. Shmlast finds orthologs between a transcriptome and protein database based off of the Conditional Best Hits algorithm. The program written for this project uses Shmlast to first make a master list of every unique gene found between any number of differently assembled transcriptomes. Then, a similar list is produced for the composite transcriptome, and the two are compared. Anything missing from the composite assembly can either be added to a new file or appended to the composite assembly, depending on the user's needs. Currently, basic functionality is in place and data is being collected on which genes were missing from each composite assembly. This program is still in development, and more user-defined-parameter features are being added. Future work includes in-depth analysis of final transcriptome quality and patterns in gene ontology of recovered genes.

35

Do Lobsters Have Extraocular Photoreceptors?

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The American lobster, Homarus americanus, tends to be most active at night and this pattern of activity is driven, in part, by an endogenous circadian clock. Furthermore, like most circadian rhythms, these clocks are sensitive to natural light:dark (LD) cycles, so that most animals have daily rhythms that are synchronized to the ambient LD cycle.

The goal of this research was to determine if lobsters have extraocular photoreceptors that help them synchronize their daily rhythms to the imposed LD cycle. In the first set of experiments the locomotion of juvenile American lobsters was measured during a normal 24 hour light:dark cycle and the majority of them were most active at night, as expected. Then their eyes were covered and the experiment was repeated, both in a LD cycle and in constant dark conditions. We found that some of the animals were able to keep their daily rhythms synchronized to the LD cycle, indicating they have photoreceptors other than their eyes for this purpose. To further test this hypothesis, a cardiac assay was used to determine if adult lobsters could perceive light while their eyes were covered. When lights were turned on, or off, their heart rates changed and they moved, indicating that they could, in fact, detect light using extraocular photoreceptors. Studies are currently underway to try and localize these receptors using antibodies directed against photosensitive proteins such as opsins and cryptochromes.

26

Using Leaf Traits to Estimate Photosynthetic Capacity

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Forests are a major part of the global carbon cycle, as they are the largest terrestrial carbon sink in the world. Understanding how a forest uses and stores carbon is important in studying the carbon cycle, as well the effects of climate change. The best way to measure the production of a forest is by measuring carbon dioxide fluxes using a gas exchange system at a forest level, or at a leaf level. While this method is accurate, it is also time consuming, and expensive. Collecting foliage from trees in the forest is significantly easier. This project collected gas exchange data at the leaf level, as well as different leaf properties such as leaf mass per area(LMA), leaf nitrogen content, and leaf chlorophyll concentration with the goal of creating a model using the leaf properties that were measured to estimate photosynthetic properties. If a model is successfully created, it would allow for the collection of photosynthetic data on a much larger scale than before, which would help in the future research of carbon cycling. Further analysis is needed to find the perfect combination of leaf properties to enter into the model.

22

Acrolein Toxicity in Humans and Plants

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Acrolein is an aldehyde produced though both lipid oxidation and polyamine catabolism, and it has highly toxic effects in both humans and plants. In stroke patients, acrolein has been found to cause cell apoptosis at the site of infarction. N-acetyl cysteine compounds have been found to be effective in reducing the toxic effects of acrolein in in-vitro studies. Acrolein has also been found to related to abiotic stress plant cell damage. The effect of polyamine level manipulation, with genetically engineered Arabidopsis thaliana, on acrolein production was tested.

21

Abiotic Factors Affecting Collection Efficiency of Microcystin Aerosols

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Cyanobacteria are photosynthetic bacteria that flourish in many aquatic environments. Rapid growth normally results in cyanobacterial blooms. These blooms produce many toxins that are released into both water and air. The cyanobacterial toxin Microcystin (MC) has been found to be dangerous to humans. Recent studies have suggested that aerosolized MC entering the body can be up to 10 times more toxic than if ingested orally. A 2015 study discovered a possible link between amyotrophic lateral sclerosis (ALS) in people living around a New Hampshire lake and MC. Few studies have been done on the collection efficiency or on the formation of MC aerosols. The goal of this experiment is to measure which abiotic factors cause a change in the rates of aerosolization of MC. For this experiment, both temperature and surface disturbance in the form of bubbles were tested as well as a control group, n = 12. Each sample consists of 600 mL of 20 μg of MC per L of well water, a filter collecting aerosolized MC, a 20 mL Milli q water trap and a vacuum to pull air through. The collection runs for 24 hours. Samples will then be frozen, sonicated, and analyzed using an ELISA test. We expect a decrease in the temperature will lower the production of MC aerosols, while the bubbling will increase the production of aerosols.

38

Effect of Estradiol on Polyamine Levels in *Arabidopsis thaliana*

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Polyamines such as putrescine, spermidine and spermine perform essential functions in all living cells such as cell growth, survival and proliferation. Some hormones like estradiol have been introduced to see if it induces a change in that plant, more specifically the polyamine levels. To see if estradiol induced a change in the polyamine levels, biomass from types SPDS 1A, 1B, and 1C of *Arabidposis thaliana* were submerged in a 5µm concentration of estradiol and controls with just Arabidopsis growth media as a control. Samples were collected at 0, 24, and 48 hours, and dansylation was done to prepare samples for HPLC analysis. Results of putrescine, spermidine, and spermine levels were calculated per gram of fresh weight and a T-test was run between averaged values at 24 and 48 hours for each seed type to test for significance. Three seeds showed a change when estradiol was added compared to just the growth media. Those plants were then introduced to two different concentrations of proline and arginine to see if either one of those could induce a bigger change in the polyamine levels at 24 and 48 hours.

62

Investigating the effects of BMAA exposure of the Northern Gannet (*Morus bassanus*) and the Great Shearwater (*Puffinus gravis*)

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Along the coast of the northeastern United States, seabird populations have declined. Large numbers of Northern Gannet (Morus bassanus) and Great Shearwater (Puffinus gravis) populations have been found dead and dying along the New England coast, but there has been investigation of the possible causes. As apex predators, both the health and population shift of the Northern Gannet and Great Shearwater species could adversely affect ecosystems and result in a possible trophic cascade resulting in changes at unanticipated changes at lower trophic levels. A possible explanation for the illness of these bird species could be the bioaccumulation of biotoxins released by cyanobacteria. The cyanobacteria toxin beta-methylamino-L-alanine (BMAA), known to produce neurological disorders, was extracted from the livers, brains, lungs, and blood of both seabird species. Toxin extraction analysis was conducted on all the tissue and blood samples and BMAA concentration was determined using ELISA antibody tests to compare the toxin levels in the dead/dying birds to levels of bird that presumably died accident deaths (bycaught). Data was analyzed for correlations corresponding with the existing premortal health conditions of the birds. These health conditions were categorized by birds that were healthy enough to hunt and died as bycatch or ill birds that were dead or dying when collected. Results of this study are discussed relative to the possible sources of BMAA in the food web and broader implications of the seabird population decline.

27

Characterization of a Protein S-Acyltransferase Mutant, *pat3*, from *Arabidopsis thaliana*

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Protein palmitoylation or S-acylation is the reversible, covalent, post-translational lipid modification of cysteine residues with the 16-carbon fatty acid palmitic acid. Protein S-acyl transferases (PATs) catalyze this reaction. PATs are integral membrane proteins with four to six transmembrane domains and a cytoplasmic DHHC motif that is essential for enzymatic activity. Palmitoylation promotes membrane association of cytosolic proteins, regulates protein activity, or impacts protein stability. S-acylation influences cell size, growth, and polarity within eukaryotic cells; however, knowledge of the roles of S-acylation in plant cells is limited in comparison to other organisms. We use the model plant *Arabidopsis thaliana* to study the role of S-acylation in plants. *Arabidopsis* has 24 *PAT* genes. I am studying *PAT3* using homozygous *pat3-2* and *pat3-3* mutants. T-DNA mapping by PCR showed a deletion in the cytosolic tail after the fourth transmembrane domain. This area contains several regions that are conserved across all PAT proteins and thus may affect enzyme activity. To detect transcript from the *pat3-2* and *pat3-3* mutants, I am using reverse transcriptase PCR. Finally, the *GUS* reporter gene system is being used to determine where and when *PAT3* is expressed in *Arabidopsis.* Once the quality of the *pat3-2* and *pat3-3* mutants is determined, the search for *pat3* mutant phenotypes will begin with the ultimate goal of determining the normal function of PAT3 in this plant.

9

The Effects of Mediodorsal Thalamic Lesions on mPFC Activity During a Delayed Non-matching to Position Task

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Although previous research has demonstrated that the mediodorsal thalamic nucleus (MD) is involved in high level cognition, such as memory and learning, the role it plays is not fully understood. It has been shown that MD projects to medial prefrontal cortex (mPFC) to support goal-directed behavior, but it is not understood what information is sent or how this alters prefrontal activity. Previously, we have found individual neurons in mPFC that encode information about actions, outcomes, and spatial context needed for successful performance in a decision-making task. Neurons in MD also encode task relevant information that are similar in form to responses observed in mPFC. The goal of the present study was to understand how lesion to MD effects mPFC activity and spatial learning during Delayed Non-matching to Position Task (DNMTP) in rats. Three rats received a unilateral NMDA lesion to MD prior to learning, and electrophysical recordings were taken from both hemispheres of mPFC during DNMTP task. Understanding the role that thalamus plays in learning could inform novel treatment for people with learning impairments.

69

Masking Effect of Anthropogenic Noise in Predatory Detection

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As human society continues to expand into wildlife habitats, anthropogenic noise has an increasing effect on animals. Anthropogenic noise affects a variety of behaviors, including anti-predatory behavior. Several studies have demonstrated that anthropogenic noise can hinder an animal's ability to avoid predation, but most of these studies were conducted on birds and marine wildlife. Here, I asked if traffic noise has negative effects on a terrestrial mammal, the elk (*Cervus canadensis*). I hypothesized that if anthropogenic noise masks other sounds, it could reduce the auditory detection of, and consequent vigilance for, predators. To test this, I observed vigilance in semi-domesticated elks under various noise conditions. These conditions were combinations of the presence or absence of road noise and predatory cues, and I used ANOVAs to compare vigilance among the treatments. As predicted, the elks were less vigilant in response to predatory cues when played with traffic noise than when the traffic noise was absent. These results supported the masking effect hypothesis: the traffic noise may have inhibited the elks' ability to hear and react to potential predatory threats. This study highlighted the possible consequences of anthropogenic noise on prey's ability to effectively avoid predation. In addition to direct disturbances from habitat fragmentation, human expansion may be indirectly disturbing predator-prey interactions.

23

Analysis of Whelk, *Busycotypus canaliculatus,* Circadian Rhythms of Locomotion

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My overall goal was to test the hypothesis that the channeled whelk (*Busycotypus canaliculatus*) has an endogenous circadian rhythm of locomotion. For this study, 25 channeled whelks were transported to the Coastal Marine Laboratory (CML), in New Castle NH, from off the coast of Martha's Vineyard. The first goal of this study was to determine if channeled whelks will express a daily rhythm of locomotion by monitoring whelk movement for a week under a 12:12 light/dark cycle. Their activity was recorded with an accelerometer attached to their shells, and the data obtained were calibrated by comparing the output of the accelerometers with time lapse digital videos of the same animals. The second goal of this study was to determine if the channeled whelk has an endogenous circadian rhythm by monitoring whelk activity for a week in constant darkness. If the channeled whelks have an endogenous clock they should maintain their daily rhythm under constant darkness conditions. My results so far suggest that channeled whelks do, in fact, have an endogenous circadian rhythm and they are predominantly nocturnal. This is based on the more regular movement of the whelks between the hours of 7pm and 7 am, during both the 12:12 light/dark cycle and constant darkness trials. During the final phase of this study I plan to try and localize their circadian clocks using antibodies directed against known clock proteins. Ultimately, I hope this work will be useful in investigating circadian clocks at the level of individual, identifiable neurons.

7

Comparing Bird Communities in Transmission Line Rights-of-Way Dominated by Native Shrubs or by a Mixture of Native and Non-Native Shrubs in Maine and New Hampshire: Preliminary Results from 2017

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Throughout the Northeastern U.S., shrubby transmission line rights-of-way (ROW) provide important habitat for a variety of songbirds that nest either in shrublands or in mature forest habitats. The vegetation composition within a ROW has an important influence on the specific species of birds that will use it as habitat. Many ROW in the region are mowed with a forestry mower every 3-5 years to keep trees from contacting the transmission lines. This regular disturbance is important for keeping the ROW in a shrubby condition, but it can make them susceptible to invasion by non-native shrubs (e.g., autumn olive, glossy buckthorn, honeysuckle spp., multiflora rose). When non-native shrubs comprise a large proportion of the plant community within a shrubland they can have both positive and negative effects on habitat structure, vulnerability to nest predation, and food resources (e.g., fruits and insects) for birds. As part of a larger study we initiated in 2017 to investigate songbird use of shrubby ROW in ME and NH, we used constant-effort mist netting to compare the bird community between three ROW dominated by native shrubs and three ROW dominated by a mixture of native and invasive shrubs. We surveyed each ROW six times between May-Aug and caught a total of 1189 shrubland-dependent birds of 26 species and 168 mature-forest birds of 18 species. There was no difference in bird species richness or diversity among ROW types, but the generalist shrubland birds (common yellowthroats, gray catbirds, and song sparrows) were the most abundant species at ROW composed of a large proportion of invasive shrubs. By the end of 2018 we will have surveyed a total of 24 ROW to further improve understanding for how differences in native/non-native shrub composition in ROW influence the role of ROW as habitat for a variety of songbirds.

104

Using Chemical Cross-linking and Mass Spectrometry to Identify the Binding Mechanism of PU-H71 on Heat Shock Protein 90 (HSP90) in Cancer Cells Using Mouse Embryonic Stem Cells As a Model

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Heat shock protein 90 (Hsp90) is a highly conserved molecular chaperone that regulates the activity, turnover, and trafficking of many proteins in cell signaling and adaptive stress responses. The protective function of Hsp90 for these proteins is often exploited by cancer cells to pathologically stabilize mutated and overexpressed oncoproteins; proteins that play an important role in the regulation and synthesis of proteins linked to tumorigenic cell growth. Hence, Hsp90 offers promising anti-tumor drug targets. Many potent inhibitors and their derivatives have been in clinical trials, two of which are PU-H71 and geldanamycin. Both geldanamycin and PU-H71 bind to the ATP-binding pocket of Hsp90 to elicit oncogene destabilization and tumor regression. However, detailed biochemical mechanisms in Hsp90 inhibition remain largely unknown, especially for PU-H71. In this experiment, we used embryonic stem cells as a model to study cancer cells due to their similarities in expressions. Using selective precipitation, we purified Hsp90 from embryonic stem cells that bound onto dynal beads, which were treated with drugs of interest, geldanamycin and PU-H71, and cross-linkers (DSS, disuccinimidyl suberate). The identification of cross-linked peptides was then carried out by mass spectrometer and the UCSF bioinformatics program Protein Prospector. Though we have identified some key cross-linked peptides that would shed light on the HSP90 conformation that is exploited in aiding cancer cell survival, further quantitative analysis and reasoning using homology models are needed for definitive results. High specificity of PU-H71 in cancer cells provides a critical step towards drug development to treat cancer.

100

The effect of ground conditions on the emergence, establishment, and mortality of the invasive shrub, glossy buckthorn (*Frangula alnus*)

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The non-native shrub glossy buckthorn (*Frangula alnus*) is invasive in recently disturbed areas in the eastern USA, and has been known to inhibit the growth of economically important tree species. There is little knowledge on control of glossy buckthorn establishment. We hypothesized that soil compaction, grass turf, and oak litter would reduce buckthorn establishment, while pine litter would enhance establishment. During the fall of 2016 at the UNH Kingman Farm, we applied these substrate conditions and a control treatment to 1 m^2 plots (six replicates per treatment), and later seeded these plots with buckthorn. We collected data from June to October of 2017. Each week, we measured the newly emerged, newly dead, and total living buckthorn. Partway through August, we began to measure these variables biweekly. Compared to controls, buckthorn emergence was reduced significantly only by the pine litter treatment (78%). Yet, by the end of the growing season, the number of remaining living buckthorn was significantly different from controls in both pine litter (78%) and grass turf (81%) treatments. Interestingly, despite relatively high emergence in grass turf (48% of control), this treatment also saw a high mortality rate (59%). All other treatments saw low mortality rates. This suggests that grass turf and pine litter can help reduce buckthorn establishment after disturbance.

12

To Bend, or Not to Bend? Hinged Teeth in the Goosefish (*Lophius americanus*) Have Multiple Functions and Two Distinct Lever Systems

Jessica A Ohrenberger, Jessica A Bolker, Stacy Farina

Lingually hinged teeth are useful for ambush predators, such as the goosefish (*Lophius americanus*). They bend inward to allow prey to be easily pulled into the mouth, but their limited forward bending prevents prey from escaping. In this study, we use illustrations, photographs, and tooth measurements to document the hinging mechanism in *Lophius americanus*. The hinged teeth are not ankylosed to the jaw, and the base of the tooth sits on a semicircular tooth pedestal protruding from the jaw bone. Points of occlusion between the tooth and this pedestal act as the fulcrum of the tooth lever system, although the position of the fulcrum is different in backward and forward bending. In lingual bending, the tooth can be pushed back on the lingual fulcrum with very little effort. In labial bending, the pedestal and tooth have interlocking grooves for stability at the labial fulcrum point, and an inelastic ligament prevents labial bending past this occlusal surface. These morphological features form a "locking" mechanism, which requires substantial force to overcome. Additionally, some *Lophius* teeth are ankylosed to the jaw, allowing for comparisons of both hinged and unhinged tooth types within the same individuals. We found that ankylosed teeth are smaller and less variable in size compared to the hinged teeth. We are also applying techniques such as micro-CT, mechanical testing, and histological sectioning to add to our understanding of the anatomy and function of these teeth.

90

Temporal Regulation of an Angiogenic Inducer in Human and Bovine Ovarian Cells

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The building of a new blood vessel network, otherwise known as angiogenesis, is regulated by a variety of factors, including Cysteine rich 61-Connective tissue growth factor-Nephroblastoma overexpressed 1 (CCN1). We have shown that serum induction of CCN1 occurs by two hours in human and bovine ovarian cells. But it is unknown whether induction occurs earlier in these ovarian cells. Thus, for the present study, we asked- Is CCN1 expression induced earlier than two hours, and if so, how much earlier? Immortalized human ovarian granulosa (HGrC1) cells and primary bovine luteal cells were cultured in six T_{25} flasks until approximately 80% confluency. Then, ovarian cells were treated with fetal bovine serum (10%) for 15 and 30 minutes. Following extraction of RNA and generation of cDNA, quantitative polymerase chain reactions (qPCR) were performed. In HGrC1 cells (n=4) preliminary results showed that CCN1 expression was induced at the15-minute and 30-minute time points. Similarly, in bovine luteal cells (n=2), the same trend was observed, but additional replicates are needed to confirm this observation. Future studies will focus on identifying signaling molecules that regulate CCN1 expression in these ovarian cells.

18

The Effects of White Nose Syndrome (*Pseudogymnoascus destructans*) on the Health of *Myotis lucifugus* in Summer Colonies in the Northeast

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The spread of white nose syndrome (WNS) in North America has caused a precipitous decline in populations of little brown bats (*Myotis lucifugus*) since 2006 (Frick et al 2010). This is reason for concern, considering the importance of the ecosystem services provided by these bats to their ecological communities and to human health and agriculture. Current research into the disease has largely focused on the impacts of this cold-loving fungus on bats during the winter. I am interested in WNS prevalence during the summer, the birthing season. Bats develop wing damage from WNS over the winter, and may feel these effects during this critical part of the lifecycle lacks research. Over the summer of 2017, I worked alongside Katherine Ineson in the field (PhD student under Dr. Jeff Foster) collecting capture-mark-recapture data. Using a harp trap, we captured and sampled bats at seven known colonies in New England. Each bat was marked with a unique, metal band with hopes for recapture, assessed for evidence of WNS (independent variable) and massed (dependent variable). My hypothesis is: in the early summer (May), a high prevalence of WNS on adult female bats will correlate with a lower mass.

40

Effects of Equine Musculoskeletal Conformation on Athletic Performance

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An individual horse's athletic potential is largely determined by its musculoskeletal conformation. In order to succeed at the most elite level in any equestrian discipline, a horse must exhibit qualities and proportions that support the type of performance and impact it requires; be it speed, power, flexibility, grace or endurance. Certain breeds exhibit a combination of specific musculoskeletal traits that predispose the animal to succeed in different athletic endeavors. At the University of New Hampshire, the Equine Program employs a herd of school horses of varying breeds and musculoskeletal conformations. These animals serve as teachers for students from an array of riding backgrounds. While this specific herd does not perform at an elite level, they are subject to a repetitive, low-impact stress of jumping and dressage in their career as a school horse. The unique traits in each of these animals can present challenges when their conformation amplifies strain or inhibits their ability to perform at a greater level. This case study analyzes the conformational variety among the UNH herd. It also examines how each unique animal would measure up to elite performance or breed standards and possible challenges such work would present to these individuals.

42

Environmental and Genomic Analyses of Lyme Disease Prevalence in Stafford County, NH

Tasya Rakasiwi, Brian Andrew Stevens, Christopher Benton

The prevalence of tickborne diseases in New Hampshire have increased over time. The increased prevalence of tickborne disease have been contributed to changes in landscapes and changes in population of ticks and its host and predator. In this study, the prevalence of Lyme disease was also correlated with forestation coverage, deer population, and possum population. We also questioned if the increasing prevalence of tickborne diseases is due to a presence of antibiotic resistance in prokaryotic genome of tick microflora. To address this question, tick samples collected in Stafford County in the years of 2000, 2001, 2002, 2003 and 2011 were analyzed. Genomic DNA was extracted from each tick sample. The extracted DNA samples were analyzed through TaqMan PCR for the detection and quantitation of *Borrelia burgdorferi*. Tick samples, that tested positive for *B. burgdorferi* in qPCR, were then sequenced via Illumina sequencing for the presence of any antibiotic resistance.

108

Determining the Nutrient Production Rate of Rainbow Trout (*Oncorhynchus mykiss*) Grown in Recirculating Aquaculture Systems

Ashutosh Rao, Alex Sitek

Rainbow trout (Oncorhynchus mykiss) is a coldwater fish species originally native to drainages west of the Rockies, from Mexico to Alaska. Due to its popularity as a game fish, it is now found in all continents except for Antarctica. It is a prime candidate for aquaculture due to its high growth rate and FRC (food conversion ratio). Rainbow trout are grown in a variety of systems including net pens, ponds, flow-through (raceway), and closed recirculating systems. Flow-through (raceway) systems account for around 90% of trout production currently. Although raceways are ubiquitous and can produce many fish with relatively low water usage, they discharge a high volume of waste directly into the environment. The purpose of this study is to determine the nutrient production rate (daily vs. weekly vs. year) from rainbow trout in recirculating aquaculture systems in terms of plant-available nutrients. Specifically, a mass balance analysis was conducted to determine the amount of nitrogen in system water, wastewater, and fish tissue in relation to the inputs (feed, well water, and chemicals for water quality (NaHCO3)).

34

Diversity and Antibiotic Activity of *Streptomyces* Bacteria: Searching for Super-Killer Bacterial Strains

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The surge of antibiotic resistance and global spread of microbial infections, exacerbated by lagging drug discovery efforts, demands new approaches to this health threat. Environmental microbes have been shown as an important source of bioactive compounds with novel antibiotic properties, such as with the bacterial genus *Streptomyces* that has long been known as a major source of clinically relevant antibiotics. In this project, we aim to characterize the inhibitory characteristics of different *Streptomyces* strains collected from the gut of vertebrate hosts (horse and chicken). Our central hypothesis is that the gut of vertebrate animals harbor a diverse population of *Streptomyces* bacteria with variable ability to inhibit the growth of other bacteria. We collected a total of 72 *Streptomyces* isolates and tested their ability to inhibit the growth of other *Streptomyces* bacteria as well as *Escherichia coli*. Results indicate that a diverse population of *Streptomyces* collected from the two vertebrates displayed variable ability to inhibit the growth of other bacteria. A small subset of this bacterial population can be described as super-killers, or those with the ability to inhibit growth of at least three other isolates at an average zone of inhibition of at least 50mm. Future work will focus on determining the phylogenetic diversity of isolates and testing them against other bacterial pathogens. This work has important implications on using a targeted approach to drug discovery.

19

A Comparative Analysis on Various Feed Types on the Reproductive Success of Ornamental Clownfish

Athena M Ryan, Michael D Chambers

The ocean ecosystems have been facing many problems that are caused by human disturbances. One of the main problems is overfishing. Overfishing happens not only for the food industry but also for the ornamental industry. The demand for exotic fish has been on the rise and every day more fish are taken out of their natural habitat to fill these tanks. The aim of this study is to lessen the strain that humans are putting on wild clownfish populations. This will be done by breeding fish in the lab, therefore there will be no effect on the environment. This study will specifically consider what feeds will yield the highest performing breeding pair of clownfish. There will be three different feeds that will be given to the clownfish: Fertility Frenzy, Brine Shrimp, and White Worms. The prediction for this study is that the white worms will yield the most amount of eggs that will also have the highest survival rate. The white worms are easy to culture and can be fed a wide variety of diets to pack them with the most nutrients for conditioning and breeding clownfish. This study will provide a better understanding on how to condition and spawn clownfish fish in an aquaculture setting. By knowing this, many more systems can be put in place until eventually there are no fish being taken from the wild to fill ornamental tanks.

20

A Preliminary Nutritional Analysis of Food Menus in Local Older Adult Assisted Living Facilities

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Nutrition is important in all the life stages, especially in the later years with older adults (those 65 years of age and older). Beyond having a tendency not to consume as many calories overall, the quality of their diets can also be hindered due to physical disabilities, monotony of their food choices, or the foods they have access to. This last point is notably pertinent for older adults in assisted living facilities, where most of the meals are provided to the residents. The purpose of this study was to analyze the food offerings from local assisted living facilities. This was done via collecting weekly food menus from various locations. The meal plans were then assessed on a nutritional level based on the 2015-2020 Dietary Guidelines for Americans in the domains of food groups, food variety, and avoidance of excess fats, sugars, and salt. The results of this study revealed the complexity in analyzing food menus across facilities and also highlighted the need for more whole fruits, among other things, to be included in assisted living facility meal plans. Findings from this research are important because they can provide insight into how well older adults are being fed in these institutions after they no longer wish to or cannot provide food for themselves. This study also serves as a preliminary model for any future researchers looking to analyze food menus in such a way.

74

Molecular Diet Analysis of Hawaiian Birds

Alissa C Scinto, Jeffrey Foster

The aim of this project is to utilize high-throughput molecular methods to investigate the diets of three non-native and one native Hawaiian bird species. Next generation sequencing has made it possible to produce thousands of reads in a relatively short amount of time. This technology has been used to identify the insects in the diets of other species, including bees and bats. Samples underwent genomic sequencing using a targeted approach of the cytochrome oxidase I (COI) gene, a region that is present in all insects. DNA was extracted from bird feces and stomach contents using protocols designed for fecal material and amplified using universal COI primers on a thermocycler using polymerase chain reaction. The resulting amplified sequences will be compared to an online reference database for taxonomic identification. The success of this experiment will be measured by the comparison of the identified sequences between this project and the identifications made on these same samples a decade prior by microscope dissection.

64

Isoform Swapping: Can Members of a Gene Family be Functionally Interchanged?

Brennan S Senecal, Estelle M Hrabak

Protein phosphatase 2A (PP2A) is an enzyme that participates in signal transduction pathways by removing phosphate groups from proteins. PP2A is involved in the regulation of key enzymes of primary metabolism and in the responses to light and several hormones, . PP2A has 3 subunits – A (structural), B (regulatory), and C (catalytic). The *Arabidopsis thaliana* genome encodes five isoforms of the C subunit of PP2A. The C3 and C4 subunits are the most similar –only differing by six amino acids out of 313 – and have very similar expression patterns. Despite their similarity, *c3* and *c4* mutants respond differently to salt stress conditions – *c3* mutant roots are straight and *c4* mutant roots are twisted. Because the C3 and C4 subunits are so similar, we asked whether the reason for the phenotypic difference was due to subtle variations in gene expression. To address this, we are constructing hybrid genes in which the promoter of one gene drives expression of the other gene (i.e., *C3::C4* vs *C4::C3*). Hybrid constructs will be made by Gibson assembly and transformed into *c3* or *c4* mutant plants. Transformed plants will be analyzed for their root phenotype under salt stress conditions. A *C4::C3* construct has been assembled and transformed into Arabidopsis. The *C3::C4* construct is currently in progress.

66

Lying Times, Feed Particle Size, and Rumination Correlated with Milk Production in Dairy Cattle

Jessica R Sexton, Peter S Erickson

Data used from 3 weeks of data collection, observing behavior of lactating dairy cows three times a day at Fairchild Dairy's tie-stall barn to make correlations between lying times, and rumination with milk production and the effects of feed particle size on rumination (data is not completely compiled yet in final form, results are not yet reportable). Preliminary results are show that early lactation animals have a slight positive correlation between lying times and milk production, while late lactation animals have a slight negative correlation with milk production attributed to decreased rumination due to decreased dry matter intake. In all cows, it is expected that rumination has a strong positive correlation with milk production and that an increase in particle size, increases rumination. If the study were to be done again, a sampling method with less variables should be used, such as 24 hour camera observation, since there is a lot of random chance in behavior especially when cows can see people. This should result in stronger correlations between lying times and milk production.

48

Evaluation of the After-School Program "Healthy Me, Healthy Earth"

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The “Healthy Me, Healthy Earth” program was an eight week after-school program located in Dover, NH. The program utilized a food-systems based curriculum to evaluate the knowledge and health literacy of the students who attended this after-school program. Objectives relating to nutrition, environment, agriculture, sustainability, and behavior were measured throughout the duration of this program. It was found that there was a noted improvement in student willingness to try new foods and ability to identify the nutritional quality of their favorite foods. There was also a greater desire to learn more about environmental related information. The project faced various challenges relating to student behavior, program management, school closures, and program duration.

33

Degradation of Dioxin-Like Compounds by *Frankia*

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Bioremediation efforts are needed to eliminate toxic, organic pollutants from soils such as biphenyl (a dioxin-like compound). A promising candidate for bioremediation is the nitrogen-fixing actinobacteria *Frankia*, due to the beneficial plant-microbe symbiosis it forms with actinorhizal plants. Previous studies have demonstrated the *bph* operon in *Frankia* strains EuI1c and EUN1f have been upregulated in the presence of biphenyl. Therefore these strains could potentially be used in bioremediation of areas contaminated with dioxin-like compounds. Due to the potential metabolism of biphenyl and PCBs from the *bph* operon of *Frankia*, it is beneficial to see if the effects of the *bph* operon can be replicated into other strains of *Frankia*. This experiment transferred the *bph* operon from strain EuI1c to strain CcI3 of *Frankia*. The transformants will be characterized through their ability to metabolize biphenyl and PBCs. This research contributes to the understanding of the genetics of *Frankia* and its bioremediation uses with actinorhizal plants.

49

Exploring Toxin Production in picocyanobacteria: An Investigation of Lab Culture and Natural Systems

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Bloom forming cyanobacteria (BFC, >50 mm) have recently been in the forefront of aquatic science due to their toxicity and an increase in bloom occurrence and size. Bloom forming species are chiefly studied due to their ability to produce secondary metabolites, cyanotoxins, that have been linked to clusters of ALS, dementia, and other neurodegenerative disorders.

Picocyanobacteria (Pcb) are species separate from their bloom forming counterparts. Pcb's are the smallest photosynthetic organisms on Earth (0.2 – 2.0 mm), and rarely form surface blooms and thus are generally unknown by the public. Little research has been conducted on Pcb's due their small size, and general belief that BFC's are more important to study due to their perceived larger impact on the ecosystem. Pcb's can likewise produce cyanotoxins and are readily consumed by zooplankton grazers unlike BFC's, thereby introducing toxins into the aquatic food web.

In this study, we examined the presence of cyanobacteria in natural samples using fluorometry to indicate the presence of phycocyanin and phycoerythrin; both accessory pigments largely exclusive to cyanobacteria. Fluorometric instruments were calibrated using known concentrations of lab cultured *Synnechcoccus,* a common single celled picocyanobacterium. Natural samples were then fractionated and the Pcb fraction tested for the cyanotoxins microcystin (MC) and beta-Methylamino-L-alanine (BMAA) using the ELISA technique.

3

Gdf1 Regulates Sphingolipid Metabolism and Stem Cell Biology in Acute Myeloid Leukemia

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Acute myeloid leukemia (AML) is a heterogeneous disease defined by rapid expansion of immature myeloid cells in the bone marrow and blood that hinders the growth and activity of essential mature blood cells. There is a poor clinical outlook for AML patients and a lack of therapies. Epigenetic regulation of sphingolipid metabolism may be responsible for the ability of AML to survive and proliferate. Ceramide, an omnipresent bioactive sphingolipid in eukaryotic cells, plays a large role in governing cell proliferation and apoptosis, and pathways to neutralize ceramide are upregulated in AML, promoting cancer cell survival. Growth differentiation factor-1 (Gdf1) is part of the TGFβ superfamily of proteins which are associated with stem cell regulation. Our studies show that splicing of the bicistronic transcript for ceramide synthase 1 isoform 1 (*Cers1*) and *Gdf1* may be under epigenetic control, and that treatment with recombinant Gdf1 downregulates ceramide metabolism. We hypothesize that dysfunctional *Gdf1* expression may play a role in the development of AML and in dysfunctional sphingolipid metabolism. We aim to further explore these roles of Gdf1 in AML by treating AML cell lines and transgenic mice with recombinant Gdf1, using RT-qPCR and flow cytometry to analyze the results.

24

Assessing the Quality of the Oyster River Protocol for Transcriptome Assembly

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The goal of this research project was to determine the most effective set of methods for assembling transcriptomes. A transcriptome is the set of messenger RNA molecules expressed from the tissues of an organism. Therefore, this set of data determine which proteins the organism will produce. To begin, assemblies were made using three different transcriptome assemblers, Trinity, SPAdes, and Shannon. Once assembled, these were combined using Orthofuse. BUSCO and TransRate scores were recorded at each step. These scores evaluate the completeness of the assemblies and aid in determining which transcriptome is best. This work demonstrated that merging the assemblies resulted in better scores overall.

97

The Interspecific Interactions and Habitat Preferences of Harbor Seals (*Phoca vitulina concolor*) and Gray Seals (*Halichoerus grypus*) on Duck Island and Ledges, ME

Kadianne Keira Tommasi, Lisa Sette, Andrea Bogomolni, Nadine Lysiak

The number of pinnipeds in the Gulf of Maine have been increasing since the Marine Mammal Protection Act (MMPA) went into effect in 1972, making it illegal to hunt and kill all marine mammals in the United States. Both species inhabit the Northwest Atlantic and have been observed to haul out on the same sites, which can lead to aggressive interactions among the two species. Previous studies have shown that harbor seals prefer to haul out on large landing areas that are accessible to them at both high tide and low tide, while gray seals prefer rocky ledges only accessible at low tide. Between 20 and 30 shipboard photographic surveys were conducted each year at low tides during the summers of 2011-2017 at Duck Island and its surrounding ledges. We counted the number of harbor seals and gray seals per ledge for all surveys. Gray seals have their preferred habitats to haul-out and so do the harbor seals, however, there have been shifts in ledge preference between the two species. Increasing gray seal numbers appear to be having an effect on harbor seal haul-out patterns and this is something that needs to be monitored further.

103

Use of Transmission Line Rights-of-Way Managed by Mechanical Mowing or Selective Herbicide Treatment by Shrubland-Dependent and Mature-Forest-Dependent Songbirds in Maine and New Hampshire: Preliminary Results from 2017

Kathleen P Wadiak, Matthew David Tarr

In the northeastern U.S., thousands of miles of shrub-dominated transmission line rights-of-way (ROW) extend across the landscape and provide some of the largest and most stable shrubland habitats in the region. These ROW are used as nesting and post-fledging habitat by the region's entire community of shrubland-dependent songbirds, but evidence for how ROW are used by songbirds that require mature forest for nesting is lacking. Mist-netting surveys conducted in regenerating clearcuts indicate that adult and fledgling mature-forest songbirds comprise a large proportion of the bird community in clearcuts during the post-fledging portion of the breeding season, a time when juvenile birds and molting adults require dense cover to avoid predators and abundant food resources to prepare for migration. In 2017, we began the first comprehensive mist-netting survey ever conducted in shrubby ROW in southern Maine and New Hampshire to inventory the entire community of songbirds using ROW during the nesting and post-fledging periods. In this preliminary year of our study, we investigated whether differences in the height, density, and species composition of plants between three ROW maintained by mowing and three ROW maintained with selective herbicide treatment resulted in differences in the community of shrubland-dependent or mature-forest dependent songbirds. We conducted six mist net surveys in each ROW from late May-late August and we caught a total of 83 adult and 49 fledging mature-forest birds and 520 adult and 340 fledging shrubland-dependent birds. There was no difference in the number or diversity of shrubland-dependent or mature-forest birds between the different ROW types. Certain mature-forest birds (e.g., scarlet tanager, ovenbird, wood thrush) were caught regularly in ROW throughout the breeding season. By the end of 2018 we will have surveyed a total of 24 ROW to further improve understanding for how ROW function as habitat for a variety of songbirds.

11

Designing a Biofilter for Ammonia Removal at a Commercial-Scale Compost Facility

Nicole A Williamson, John D Aber, Allison M Leach

Composting provides an environmentally friendly alternative for processing organic waste material compared to landfills. Aerated static pile composting is a method of composting that pulls air through the compost to promote microbial activity. This limits some environmental losses, but it still produces exhaust vapors with pollutants like carbon dioxide (greenhouse gas), ammonia (local air quality pollutant) and methane (greenhouse gas). One potential solution to this problem is a simple woodchip and finished compost biofilter. These biofilters are cost efficient and easily installed. Biofilters work by removing NH3 as the exhaust vapors pass through it. Current literature explores biofilters in lab-scale settings with low concentrations and does not consider commercial-scale facilities and higher gas concentrations. More research is needed to address the efficiency of biofilters at high concentrations, and the ideal ratio and size for effective NH3 removal.

The presentation will address construction, sampling methods, and preliminary results of a woodchip-compost biofilter. The biofilter is located at the UNH heat recovery compost facility at the UNH organic dairy farm. Because a study like this has not been done before, most of the work done to date has been focused on construction and developing methods for sampling. NH3 removal results of the current woodchip-only biofilter, collected last summer, will be presented.

51

GLI3 Mediated Inflammation in Human and Mouse Cells

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GLI3 is an effector of the hedgehog signaling pathway, which is involved in embryonic development and malignant transformation. Through its repressor domain, it negatively regulates hedgehog signaling. However, similar to GLI1 and GLI2 family members, it also consists of an activation domain, suggesting a potential role for GLI3 as a transcriptional activator. Our preliminary data suggests GLI3 may positively mediate TLR4 signaling. The goal of my project is to investigate the regulation of TLR4-induced inflammation by GLI3 using human and mouse cells.