

Effects of the Air Quality in Equine Stable Environments on the Respiratory Health and Allergy Response of Human Personnel: A Review

Maeve H Perrin, Christina J Keim

Many studies have evaluated the impact of poor stable air quality on equine respiratory health and performance, and found that poor air quality often leads to increased incidence of chronic respiratory illness in horses. Many factors can contribute to air quality conditions in the equine stable environment, including ventilation rates, humidity levels, presence of noxious gases, rate of fungal spore production, and level of airborne organic and inorganic dust particles. While the implications of poor air quality for equine health are well-documented, far less is known about air quality impacts on human stable personnel. This literature review seeks to evaluate the implications of poor stable air quality on the respiratory health and allergic response of human personnel and consider management strategies to mitigate the risks. Management practices showing efficacy at limiting the levels of respirable particles include the use of clean, low-dust bedding and hay, turning horses out of the stable for long periods of the day, and ensuring the stable is adequately ventilated. Findings suggest the most common cause of increased airborne respirable particles in stable air is the dispersion of settled dust during daily barn management and cleaning practices. Many of these practices are required to maintain an environment that meets equine health and husbandry needs, so further research is needed to determine ways of reducing workers' exposure during these activities.

Presenter: Maeve H Perrin

Presenter's Major: Equine Studies

Year at UNH: Senior

Adviser: Christina J Keim

Fungal Production of Enzymes, Melanin, and Metabolites in Artificial Soil

Olivia R Lachapelle, Serita D Frey

Globally, soils contain at least three times the amount of carbon as the atmosphere and four times the carbon present in all of Earth's vegetation. The fate of this carbon has important implications for climate change because stabilized carbon is protected from release to the atmosphere as carbon dioxide, the major greenhouse gas responsible for global warming. The production of enzymes and melanin by fungi may be factors affecting stabilized soil carbon. Determining the quantities of these compounds produced by different fungal species can aid in evaluating the effects of these fungal traits on stabilized soil carbon. In this study, ten fungal species were incubated in artificial, carbon-free soil to ensure that the compounds detected were produced by the target species. Colorimetric analyses were conducted to determine the melanin content and enzyme activities of each species. Species in the phylum Ascomycota were the greatest producers of hydrolytic enzymes, while Basidiomycota produced the greatest quantity of phenol-oxidizing enzymes. The data I collected will be used to explain the contributions of certain fungal species to stabilized soil carbon and will be utilized in a larger stabilized soil carbon study to analyze the relationship between fungal traits and stabilized carbon.

Presenter: Olivia R Lachapelle

Presenter's Major: Environmental Sciences

Year at UNH: Senior

Adviser: Serita D Frey

National Disparities in Food Security, Social Vulnerability and Health Conditions: Considerations for the COVID-19 Pandemic

Alexandra Marie Papadakis¹, Amy Taetzsch¹, Semra A Aytur², Jessica A Carson

¹Agriculture, Nutrition and Food Systems (ANFS), UNH Durham

²Health Management & Policy, UNH Durham

Food insecurity is a public health threat to the United States, particularly as the COVID-19 pandemic exacerbates food insecurity nationwide. The faces of the food insecure are not equal, with certain populations more vulnerable than others. Left unchecked, food insecurity increases the risk for chronic diseases like diabetes, heart disease, or obesity: conditions also associated with severe COVID-19 illness. Thus, this thesis' objectives are (1) to describe the association between social vulnerability and food insecurity, and (2) to examine the relationship between food insecurity and COVID-19 health determinants. We aggregated quantitative data using national, public datasets with the county as the unit of analysis. The Social Vulnerability Index themes (socioeconomic status, household composition & disability, minority status & language, and housing type & transportation) will be used in regression analysis to describe their association with food insecurity. The county prevalence of obesity, diabetes, and heart disease, as well as COVID-19 cases and deaths, will be used as COVID-19 health determinants in regression analyses to determine their relationship with food insecurity. Early results indicate the average food insecurity rate across counties (n=3142) was 13.2%, and the average county prevalence of obesity, diabetes, and heart disease was 35%, 13%, and 9%, respectively. During 2020, there were 6535±2787 and 113±87 COVID-19 cases and deaths, respectively, per 100,000 people. This thesis will characterize disparities amongst the food insecure and highlight consequences of persistent food insecurity, particularly during vulnerable events like the COVID-19 pandemic.

Presenter: Alexandra Marie Papadakis
Presenter's Major(s): Ecogastronomy, Nutrition
Year at UNH: Senior
Research Interest: Nutrition; Food Insecurity; Diet Patterns
Adviser: Semra A Aytur
Adviser: Jessica A Carson
Adviser: Amy Taetzsch

Effects of Hydrocarbon and NAPL Substances on Water Quality.

Robert Michael Lazo¹, Wilfred M Wollheim²

¹Natural Resources/Environmental Sciences , UNH Durham

²Water Systems Analysis Group, UNH Durham

Abstract: Underground fuel storage tanks are a major source of groundwater contamination as these fuel tanks are prone to leaks, which can degrade groundwater quality. After working with Capital Environmental, LLC for the past years, there have been numerous cases of groundwater contamination as a result of underground storage tank leaks. This project aims to highlight the commonly found compounds that infiltrate groundwater from these storage tank leaks, their effects, as well as remediation practices that are used to restore contaminant concentrations. In addition, data gathered from MassDEP will be used and analyzed to see how these hydrocarbon and NAPL substances behave in groundwater and their relative concentrations with respect to time at remediation sites.

Presenter: Robert Michael Lazo

Presenter's Major: Environmental Sciences

Year at UNH: Senior

Research Interest: Ground Water Contamination

Adviser: Wilfred M Wollheim

Regulation of Fibroblast Growth Factor 2 (FGF2) and Cellular Communication Network Factor 1 (CCN1) by Thyroid Hormone in the Mid-Cycle Bovine Corpus Luteum

Ian M Ayer, Paul C Tsang
MCBS, UNH Durham

The corpus luteum (CL) is a highly vascularized ovarian gland that produces progesterone, the hormone of pregnancy. The process by which this vasculature is built is called angiogenesis. A variety of chemical messengers orchestrates this angiogenic process, including Fibroblast Growth Factor 2 (FGF2) and Cellular Communication Network Factor 1 (CCN1). Previous studies have shown that disorders of the thyroid gland may lead to impaired ovarian hormone biosynthesis, and subsequently fertility. Interestingly, thyroid hormone (T4) increases FGF2 expression and also binds to the same cell surface receptor as CCN1. Whether or not T4, CCN1, and FGF2 interact to regulate angiogenesis in the CL unknown. Thus, the objective of the present study was to test the effects of T4 on CCN1 and FGF2 expression in cells obtained from the mid-cycle bovine CL. Mid-cycle CLs were collected from cows (n=3) during days 8-12 of their estrous cycles. The CLs were then dissociated with collagenase to obtain steroidogenic luteal cells, which were seeded in 6 well plates at 1×10^6 cells per well. Cells were maintained in Ham's F12 medium for 2 days before treating with T4 (from $10^{-6}M$ to $10^{-12}M$) for 2 and 24 hrs. CCN1 and FGF2 expression was determined using quantitative polymerase chain reaction (qPCR). At the present time T4 did not appear to affect FGF2 and CCN1 expression across all concentrations and time points. More replicates are needed to confirm these findings.

Presenter: Ian M Ayer
Presenter's Major: Biomedical Science
Year at UNH: Junior
Research Interest: Angiogenesis
Adviser: Paul C Tsang

Change in Oak Tree Vessel Size under Drought Conditions at Thompson Farm, NH

Stephanie N Petrovick, Heidi Asbjornsen

Global climate change is expected to increase the frequency of moderate-to-severe droughts in the northeastern U.S., which may result in conditions surpassing the threshold of moisture stress that native tree species are adapted to and can withstand. Consequently, future droughts could have a profound impact on altering forest composition and ecosystem processes. One potential adaptive response by trees to increasing moisture stress is to adjust their anatomical features, particularly the size of their vessels, the water-conducting cells, within trees. For example, when water is abundant, vessels will grow to be larger because they can transport more water, but these larger vessels are more vulnerable to the formation of catastrophic embolisms, especially if dry conditions emerge. My research tested the hypothesis that oak trees growing under simulated drought conditions would have smaller vessel diameters than control trees. Thin sections of droughted and control oak trees from the Thompson Farm DroughtNet experiment were compared under a light microscope. Vessel areas were run through a two factor ANOVA test. Results showed that while vessel size was significantly different between individuals, no significant treatment effect was detected. This could have occurred because of differences in environmental conditions at the plots. Further analyses incorporating other factors, such as the tree's age, size, and environmental conditions, may help clarify these results.

Presenter: Stephanie N Petrovick

Presenter's Major: Environmental Sciences

Year at UNH: Senior

Adviser: Heidi Asbjornsen

Postmortem and diagnostic findings in 38 Canada lynx (*Lynx canadensis*)

Joshua M Hall, David B Needle

From 2003-2017, 38 Canada lynx (*Lynx canadensis*, 21 males, 14 females, and 3 unknown sex) were submitted through the Maine Department of Inland Fisheries and Wildlife (MDIFW) to the New Hampshire Veterinary Diagnostic Laboratory (NHVDL) for postmortem examination. Thirty lynx had been struck by vehicles, 4 were shot or trapped, 2 died from natural causes, and 2 died from unknown causes. Diagnostic testing revealed three novel pathogens in lynx: *Oslerus osleri*, *Hepatozoon* spp., and *Lynx canadensis* gammaherpesvirus 1. Twenty-one lynx had lungworms. Six cases were most closely related to *Troglostrongylus wilsoni* and 3 to *Oslerus osleri*. Intramuscular protozoa were noted in two animals. Splenic samples from 14 animals were tested for most apicomplexan protozoa and 7 were found to have DNA from protozoa most closely related to *Hepatozoon* spp.. *Lynx canadensis* gammaherpesvirus 1 (LcaGHV1), a previously unidentified *Percavirus*, was also found in 12 of 33 animals tested.

Presenter: Joshua M Hall

Presenter's Major: Biomedical Science

Year at UNH: Senior

Adviser: David B Needle

An Examination of Oscillatory Power Modulation during Working Memory Updating

Mitchell Ryan Lachs, Robert S Ross
Psychology, UNH Durham

Working memory is our everyday ability to hold and manipulate information in our minds. The present study examined brain oscillatory responses between 4 and 30 Hz elicited during the performance of a visual working memory updating task with three increasingly cognitively demanding conditions in 27 adult volunteers. Brain oscillations are related to how effective the brain communicates within and across brain regions. The three conditions consisted of 0-back, 1-back, and 2-back working memory loads. The study provides information about how cognitive load during working memory is related to synchronization and desynchronization in different regions. I propose that the higher memory load (1-back and 2-back) conditions will exhibit increasingly greater synchronization across the theta and beta oscillatory bands, and accordingly increased desynchronization in the alpha band. This would indicate a shunting of cognitive resources to a more internally controlled information manipulation, which would require participants to shift their attention from a more behaviorally dominant target (stimulus at hand) to a more perceptually dominant, cognitively demanding target (previously encoded stimulus).

Presenter: Mitchell Ryan Lachs
Presenter's Major: Neuroscience and Behavior
Year at UNH: Senior
Research Interest: Cognitive Neuroscience
Adviser: Robert S Ross

Black-footed Cat (*Felis nigripes*) Husbandry: Improving Captive Experience via Enrichment

Sara Manzelli, Janet L. Anderson

Modern zoological parks strive to be centers of animal care, conservation, and education. Enrichment is the practice of providing opportunities for animals to exhibit natural behaviors, engaging species-specific behavioral choices. These opportunities enhance welfare and can be used as a behavioral management strategy to reduce stereotypical behavior, such as pacing. Enrichment is an essential component of husbandry and should be incorporated routinely into the captive experience. The Black-footed cat (*Felis nigripes*) is the smallest member of the African wild cats, its solitary nature and elusive behavior results in scarce knowledge about the species. The IUCN lists Black-footed cats as vulnerable; the captive population stronghold is in the United States. Lory Park Animal Sanctuary is one of the few internationally accredited facilities that houses the species within its endemic range, Southern Africa. This study looks at the baseline behavior of black-footed cats in captivity and any changes observed post-implementation of enrichment items. I will design a series of environmental enrichment with the goal to increase arboreal activity and thus, decrease pacing. Camera traps were positioned in black-footed cat enclosures, capturing activity continuously in 10-second clips over a 24-hours. Video footage will be analyzed using an ethogram, with specific attention to the amount of time spent exhibiting stereotypies and how long a cat is engaged in goal-directed behaviors.

Presenter: Sara Manzelli

Presenter's Major(s): Sustainability, Zoology

Year at UNH: Senior

Adviser: Janet L. Anderson

Bat-Associated *Streptomyces* Bacteria Encode Antiviral Peptides (Avps) That Target Clinically Relevant Viral Families

Griffin J. Nye, Cooper J. Park, PhD and Cheryl P. Andam, PhD

Many of the drugs used against infectious diseases and other medical disorders have been historically derived from molecules synthesized by environmental microbes, with the most notable belonging to the genus *Streptomyces* (phylum Actinobacteria). Most studies of *Streptomyces* have focused on those species that inhabit soil and form symbiotic association with insects. However, the recent COVID-19 pandemic has re-emphasized the importance of finding novel therapeutics for future pandemic-causing viruses. In this study, we aimed to investigate the diversity, phylogenetic distribution and viral targets of antiviral peptides (AVP) in *Streptomyces*. We studied the draft genomes of 73 *Streptomyces* isolates sampled from the skin (wing and tail membranes) and fur surfaces of bats collected in Arizona and New Mexico. Using the AVP database consisting of experimentally verified 2,683 AVPs, we show that the bat-associated *Streptomyces* harbor AVPs targeting five medically important viral families: Coronaviridae, Orthomyxoviridae, Herpesviridae, Retroviridae, and Filoviridae. The number of AVPs per genome ranged from 1-15. Viral targets of the detected AVPs include those associated with viral fusion, replication, entry and the spike protein. Our study therefore provides an initial assessment of the potential of bat-associated *Streptomyces* as a source of diverse AVPs that will be critical in fighting infectious diseases.

Presenter: Griffin Joel-Michael Nye

Presenter's Major: Biomedical Science

Year at UNH: Senior

Adviser: Cheryl Andam

Potential *Chenopodium ficifolium* Resistance to Glyphosate in New England Agriculture

Jonathan Walker Moehlmann, Thomas M Davis

In the proposed research project, *Chenopodium ficifolium* seedling populations will be generated from existing seed stocks and screened via exposure to glyphosate (an herbicide found in Round-Up) to identify resistant seedlings, and ultimately to produce a resistant population. Leaf tissue samples of resistant and untreated control plants will be collected, and DNA will be extracted for the purpose of isolating causative genetic changes conferring glyphosate resistance. If successful, the outcome will be to help illuminate the mechanisms by which glyphosate resistance occurs in *Chenopodium* and perhaps other plant species.

Presenter: Jonathan Walker Moehlmann

Presenter's Major: Biomedical Science

Year at UNH: Sophomore

Adviser: Thomas M Davis

Assessing the Potential Impacts of Invasive Japanese Knotweed on Brook Trout Prey in Stream Habitats in Northern New Hampshire

Andrew Julian Shapiro, Morgan L Kritzman, Nathaniel B Furey
Biological Sciences, UNH Durham

Japanese Knotweed (*Fallopia japonica*) is an invasive plant that is common around streams in New Hampshire. It can alter aspects of stream habitat such as sediment composition due to erosion, available light, and water level. These impacts to streams could have consequences for native fishes such as Brook trout (*Salvelinus fontinalis*) that are sensitive to environmental change and support recreational fisheries. The goal of the study was to determine the impact of Japanese knotweed on the availability of prey (stream macroinvertebrates) for brook trout, in Garland Brook (Lancaster), New Hampshire. Between August and October 2020, we measured stream characteristics and collected macroinvertebrates in habitats with and without knotweed present. A total of seven sites were assessed, measuring stream width and flow. A total of one surber and two drift net samples were collected to assess macroinvertebrates at each site every day they were sampled. Stream macroinvertebrates were counted, identified to Order, and size measured. We compared the macroinvertebrate composition, abundance, and size between seasons and between sites with and without knotweed. This continuing work will help determine the potential consequences of invasive non-aquatic plants on fish.

Presenter: Andrew Julian Shapiro

Presenter's Major: Marine, Estuarine and Freshwater Biology

Year at UNH: Senior

Research Interest: Fisheries Ecology

Presenter: Morgan L Kritzman

Presenter's Major: Marine, Estuarine and Freshwater Biology

Year at UNH: Senior

Research Interest: Fisheries Ecology

Adviser: Nathaniel B Furey

An Investigation of the Effect of COVID-19 on Engagement Methods in Community Planning

Polina A Pivak, Mary Adamo Friedman
Natural Resources and the Environment, UNH Durham

The purpose of this study is to examine and analyze the effect of the COVID-19 pandemic on community involvement and engagement in planning, mainly in the northeast region. Using standard definitions of engagement, the research will determine whether community engagement may have changed under the conditions of the pandemic. It is important to ensure that community engagement methods are inclusive and productive despite planning meetings following an online, hybrid, or other type of platform. The following research will attempt to describe current instances of community engagement and offer recommendations for equitable community engagement in the future.

Presenter: Polina A Pivak

Presenter's Major: Community and Environmental Planning

Year at UNH: Senior

Research Interest: Community Engagement Methods in Planning

Adviser: Mary Adamo Friedman

Linking Nest Timing Phenotypes to DNA Methylation of Circadian Rhythm Genes in Breeding Female Tidal Marsh Sparrows

Julia A Squillace, Adrienne I Kovach
Department of Natural Resources & the Environment, UNH Durham

Understanding the basis for organisms' adaptations to changing environments is a long-standing goal of evolutionary biology. Adaptations occur not only through changes in the DNA sequence of an organism, but also through epigenetic changes, which do not involve changes in the DNA sequence. One mechanism of epigenetic change is DNA methylation, which alters gene expression and resulting phenotypic traits. Changes in gene expression are triggered by environmental stress. The tidal marsh presents a harsh environment suited for studying this phenomenon. Tidal marsh sparrows are subject to tidal inundation of their habitat with saltwater, making their ground nests vulnerable to flooding. As an adaptation to the environment, successfully nesting sparrows time their nests according to the lunar, tidal cycle. However, variation exists among females in nest timing. I hypothesized that epigenetic regulation of circadian genes may explain this variation. To determine an epigenetic basis for these differences in nest timing phenotypes, I collected blood samples of 24 female saltmarsh and Nelson's sparrows, including early and late nest initiators. I conducted reduced representation bisulfite sequencing of sparrow DNA to allow for sequencing of methylated regions. Following bioinformatics to yield the sequences of interest, I used the Methylkit package in R to test for differential methylation in sequences associated with the two species and the phenotypic variation in nest timing.

Presenter: Julia A Squillace

Presenter's Major: Wildlife and Conservation Biology

Year at UNH: Senior

Adviser: Adrienne I Kovach

Using the Plasma AA Dose-Response Method to Compare the Methionine Bioavailability of Two Rumen Protected Encapsulated Supplements

Erica N Oliver, Nancy L Whitehouse

The plasma free AA dose-response technique is used to compare the methionine (Met) bioavailability of commercial rumen-protected methionine (**RP-Met**) products. The amino acid Met helps improve productive performance, reproductive efficiency, and aids in the production of proteins. The microbes of the rumen require and readily utilize amino acids first and that is why amino acids need to be protected. Our objective was to measure the Met bioavailability of a RP-Met supplement relative a reference RP-Met supplement. Six multiparous Holstein cows were fed a Lys adequate and Met deficient diet and used in a replicated 3 x 3 Latin square with 7-day experimental periods. The 3 treatments were: 1) negative control (**CON**); 2) CON plus 24 g/d Met from Smartamine® M (**SMM**; Adisseo; 75% Met with a Met bioavailability = 80%); and 3) CON plus 24 g/d Met from Kessent™ M (**KEM**; Kemin Industries, Inc.; 75% Met with an unknown Met bioavailability). Blood from the tail vein was collected on the last 3 d of each period at 2, 4, 6 and 8 h after the morning feeding (0500 h). Plasma Met and total sulfur AA (**TSAA**) concentrations (μM) were higher for cows fed SMM compared to CON or KEM with KEM being greater than CON. Slopes for RP-Met supplements expressed as %TAA-TSAA was greater for SMM compared to KEM. Relative to SMM, the Met bioavailability of KES was 86.0% [0.06794/0.07903] and a 51.5% metabolizable Met from the product. This confirmed Kessent M provided less metabolizable Met than Smartamine M even though compositional analysis of products was similar.

Presenter: Erica N Oliver

Presenter's Major: Biomedical Science

Year at UNH: Junior

Adviser: Nancy L Whitehouse

Ursolic Acid Blocks the NADPH Oxidase in Pathways of Neuroinflammation

Summer M Smith, Brian M Barth

Co-Authors: Emma Arsenault and Andrea Cote

Abstract:

Neuroinflammation is simply defined as inflammation of nervous tissue and can be linked to several neurodegenerative diseases such as Parkinson's disease, Alzheimer's disease, and dementia. Oxidative stress plays a significant role in the progression of neuroinflammation. Tumor necrosis factor-alpha, or TNF- α , has been found to cause such oxidative stress and the formation of ceramide, an important oxidative regulator in neural cells. Both ceramide and reactive oxygen species (ROS) are considered to be neurotoxic intermediates that contribute to aging and disease. NADPH oxidases (NOX) also contribute to such circumstances as they act to accelerate neurodegeneration by counteracting neuronal survival mechanisms [1]. Several beneficial factors such as anti-inflammatory, anti-oxidant, anti-apoptotic, and anti-carcinogenic effects have been found in the compound ursolic acid [2]. The experiments we ran in this lab tested the effectiveness of ursolic acid in being able to block NADPH oxidase pathways. We hypothesized that ursolic acid would block the NADPH oxidase, which would potentially benefit the treatment of neurodegenerative diseases.

Appendix:

[1] Barth, B. M., Gustafson, S. J., & Kuhn, T. B. (2012). Neutral sphingomyelinase activation precedes NADPH oxidase-dependent damage in neurons exposed to the proinflammatory cytokine tumor necrosis factor- α . *Journal of neuroscience research*, 90(1), 229–242.

[2] Seo, D. Y., Lee, S. R., Heo, J. W., No, M. H., Rhee, B. D., Ko, K. S., Kwak, H. B., & Han, J. (2018). Ursolic acid in health and disease. *The Korean journal of physiology & pharmacology : official journal of the Korean Physiological Society and the Korean Society of Pharmacology*, 22(3), 235–248.

Presenter: Summer M Smith

Presenter's Major: Biomedical Science

Year at UNH: Senior

Adviser: Brian M Barth

The Effects of Devil's Club (*Oplopanax horridus*) Root Extract Fractions in Acute Myeloid Leukemia

Emma Jane Arsenault, Joanna Rose Suber, Brian M Barth
MCBS, UNH Durham

Acute myeloid leukemia (AML) is a serious cancer affecting the blood and bone marrow wherein mature red and white blood cells are deficient due to incomplete hematopoiesis. Approximately 19,940 new cases of AML were predicted in the United States for 2020; it is one of the most common leukemias in adults. Despite advances in cancer research, 1 out of every 3 AML patients does not achieve remission with the currently available chemotherapies. These terrifying statistics demand the discovery of new treatments. One potential source of novel therapies is Devil's Club (*Oplopanax horridus*), a shrub used in traditional medicine by indigenous Alaskans. Devil's Club root extracts have previously demonstrated efficacy in treating AML and other cancers. However, it is unknown what specific chemical in the plant is causing this effect. Devil's Club root extract can be fractionated into 15 separate components. In this experiment, the 15 fractions found in Devil's Club were investigated *in vitro* by monitoring their effects on the gene encoding for growth differentiation factor 1 (GDF1), a ligand of the transforming growth factor beta receptor 1 (TGF β R1) which promotes hematopoiesis. It is hypothesized that an effective fraction of Devil's Club may exert an anticancer effect by promoting the upregulation of *GDF1*.

Presenter: Emma Jane Arsenault

Presenter's Major: Biochemistry, Molecular and Cellular Biology

Year at UNH: Senior

Presenter: Joanna Rose Suber

Presenter's Major: Genetics

Year at UNH: Sophomore

Adviser: Brian M Barth

Comparative *in silico* Analysis of Bromodomain-Containing Regulatory Complexes in Apicomplexan Parasites

Alyssa S Greig, Vicki Jeffers
MCBS, UNH Durham

Toxoplasma gondii is an Apicomplexan parasite that chronically infects an estimated 30-50% of the human population. Infection in healthy individuals causes a mild infection that quickly transitions to a dormant, chronic infection. Chronic disease is asymptomatic but in immunocompromised people, the parasite can revert to causing acute disease with severe and life-threatening symptoms.

Changes in gene expression drive this important process. One class of proteins, bromodomains, are epigenetic factors that enhance the transcription of target genes and are well conserved across Apicomplexan species. This project aims to examine the relationships between the essential *T. gondii* bromodomain protein one (TgBDP1) and its homologs in other Apicomplexan species to determine potential protein-protein interactions with TgBDP1.

Homology searches revealed that TgBDP1 homologs are expressed in many Apicomplexan species, including *Plasmodium falciparum* (PfBDP1). Published interactome data on PfBDP1 described a transcriptional regulatory complex that contains another bromodomain protein and DNA binding proteins. Comparing the published PfBDP1 complex with annotated proteins in *Toxoplasma*, identified many close homologs. This *in silico* analysis was then validated by co-immunoprecipitation of an epitope-tagged TgBDP1, indicating that TgBDP1 functions within a complex that is conserved across members of the Apicomplexa phylum. Ongoing research will identify which genes this complex regulates.

Presenter: Alyssa S Greig
Presenter's Major: Biomedical Science
Year at UNH: Senior
Research Interest: *Toxoplasma gondii* gene regulation
Adviser: Vicki Jeffers

Cyanotoxin Accumulation in Northeastern Seabird Tissues

Lillian M Delgado, James F Haney

The effects of cyanobacteria toxins on seabirds are poorly understood. Although several studies have investigated the role of these toxins in die-off events, few have compared toxin accumulation across tissue types, making it difficult to compare results among studies. Since there is an increasing presence of cyanobacterial blooms, many Northeastern seabirds are expected to be affected by exposure to the toxins produced by these bloom events. The aim of this study is to develop the relationships between toxins concentrations in different tissues and derive conversion factors based on that information, using results from this study and earlier research. Toxin concentrations were measured in tissue samples collected by the UNH Vet Diagnostic Center. Measured toxins include beta-methylamino-L-alanine (BMAA) and microcystins (MCs), both of which were measured using enzyme-linked immunosorbent assays (ELISAs). Toxin concentrations among tissue types will be compared using ANOVAs and linear regressions. Studying how these toxins accumulate in different tissue types through different seabird species will allow for a better understanding of the role of cyanobacteria in seabird die-off events.

Presenter: Lillian M Delgado

Presenter's Major: Marine, Estuarine and Freshwater Biology

Year at UNH: Senior

Research Interest: Cyanotoxins in Seabirds

Adviser: James F Haney

Cyanobacteria Communities under Opaque Ice: Analyzing Size and Pigment Changes with Depth

Justine Colombo Cassel, Katherine E Low, James F Haney
UNH Durham

Cyanobacteria are photosynthetic organisms that thrive in warm water (>25 C) conditions and few studies have investigated cyanobacteria abundance in wintering lakes and under ice cover. It is likely that ice cover influences cyanobacterial community structure because ice cover dictates which wavelengths of light can penetrate the water column, and therefore affects photosynthetic activity. Cyanobacteria use accessory pigments that absorb specific wavelengths of light and allow them to photosynthesize at lower light levels than most other phytoplankton; however, cyanobacteria species differ in their lower light tolerance. Therefore, cyanobacteria composition may change with changing light conditions. To investigate cyanobacteria community composition and abundance in winter lakes, I will be collecting water samples from under the ice in the Old Durham Reservoir, Durham, NH. I will analyze photosynthetic pigments at three community size fractions: Whole lake water (WLW), <50 um and bloom-forming cyanobacteria (BFCs). I postulate that dominant pigment will differ among cyanobacteria size classes. Much cyanobacteria research has focused on BFCs. Few studies have looked at <50 size fractions which contain picocyanobacteria, which also produce toxins. Pigment concentrations can represent biomass, which is related to toxicity. I'll compare my results to pigment data from other lakes to predict the toxicity of cyanobacteria at different size fractions in the Old Durham Reservoir.

Presenter: Justine Colombo Cassel

Presenter's Major(s): Marine, Estuarine and Freshwater Biology, Sustainability

Year at UNH: Junior

Research Interest: Sustainability

Adviser: James F Haney

Adviser: Katherine E Low

Investigating Erroneous Gene Duplication in Poison Frog, *Ranitomeya imitator*

Troy Matthew LaPolice, Matthew D MacManes
MCBS, UNH Durham

Modern sequencing technology allows researchers to study genetics more comprehensively than ever before. Amphibian genomes, however, are notoriously difficult to study because of their massive genome size and because their genomes are often filled with long repeated elements interspersed throughout the genome. For this project we examined the genome of the poison frog, *Ranitomeya imitator*. This genome assembly has many duplicated genes throughout its genome. ~23.2% of expected tetrapod genes are duplicated. We wanted to identify if these duplicated genes were biologically accurate or if they were an assembly artifact. We first determined how many copies of these duplicated genes were present. Next, we examined sequencing depth at the duplicated regions to determine if they were abnormal compared to the genomic regions surrounding each duplicate. Finally, we identified instances in the genome assembly where both alleles of a heterozygous gene were erroneously included in the assembly as a duplicated gene. Duplicated genes were typically present in two copies and had lower sequencing coverage than those that were single copy and duplicates. This suggests that the duplicated regions arose from erroneously including both copies of a heterozygous gene. This finding is important because it can help improve the quality of this specific genome that is being used for downstream analysis. We recommend detailed examinations of duplicated genes, especially in large or complex genomes.

Presenter: Troy Matthew LaPolice

Presenter's Major: Biology

Year at UNH: Senior

Research Interest: Genome Assembly

Adviser: Matthew D MacManes

Effect of Rosiglitazone on STAT3 Inhibition in Breast Cancer Cells

Samantha Emily Schultz, Sarah R Walker
MCBS, UNH Durham

Approximately 270,000 women and 2,620 men will be diagnosed with either invasive or non-invasive breast cancer this year (DeSantis *et al.* 2019). A major characteristic of over 50% of breast cancer cells is the overexpression and constitutively active (always turned on) form of the transcription factor (a protein that binds to DNA and affects the number of genes expressed); STAT3 (Wu *et al.* 2019). STAT3 is involved in an extensive signaling pathway that involves its activation by phosphorylation (adding a phosphate to the protein turns it on) and directly causes changes in the amounts of genes that control cell growth and prevent cell death. Importantly, constitutively active STAT3 (always on) in breast cancer cells has been linked to unmanageable cell division which eventually grows to form a tumor. A current antidiabetic and FDA approved drug called Rosiglitazone was identified as a potential STAT3 inhibitor through a computer based- screening program called Clue in the Walker lab. In this research, the effects of Rosiglitazone on breast and ovarian cancer cell lines were investigated through several experiments and techniques involving cell culture and viability tests to visualize how many living cells remain after being treated with Rosiglitazone compared to a control group that were not treated with this drug. Also, the gene expression levels were examined to determine if Rosiglitazone changed the activity of STAT3. Higher concentrations of Rosiglitazone showed decreased viability, and varying doses of Rosiglitazone had an effect on STAT3 target gene expression. Overall, the data suggests that Rosiglitazone could be useful for breast and ovarian cancer treatment.

Presenter: Samantha Emily Schultz

Presenter's Major: Genetics

Year at UNH: Junior

Research Interest: Cancer

Adviser: Sarah R Walker

Impacts of Obesity on Ceramide Treatment for Acute Myeloid Leukemia

Alexus Marie-Sheehan Day, Bert F Prince, Brian M Barth

Acute Myeloid Leukemia (AML) is a form of hematologic cancer that causes a buildup of immature white blood cells in the bone marrow. These immature cells fail to develop into the necessary mature cells for proper immune function therefore causing deficiencies. Studies have shown that these types of cancerous cells can arise from damage to the cellular regulation pathways. Although AML has classically been treated with chemotherapeutic agents, recent research has focused on the development of novel, efficacious, and non-toxic alternative therapies. One such alternative is the drug ceramide, a sphingolipid found in the membranes of cells, which has been identified as a potential therapeutic because of its known cellular regulation effects, namely cellular death. Although ceramide has been proven to be effective for the treatment of AML, it is unknown whether obesity plays a role in the efficacy of these therapeutics. Obesity has been associated with increased risk for AML and is thought to play a role in higher relapse rates and worse prognosis for patients with leukemia. This research focused on the effects of ceramide treatment on the proliferation of leukocytes in the blood of obese and non-obese leukemic mice. We tested the hypothesis that effects of ceramide treatment would be less efficacious in obese mice than normal-weight mice.

Presenter: Alexis Marie-Sheehan Day

Presenter's Major: Biomedical Science

Year at UNH: Junior

Presenter: Bert F Prince

Presenter's Major: Biochemistry, Molecular and Cellular Biology

Year at UNH: Senior

Adviser: Brian M Barth

Evaluating the Use and Accuracy of Unmanned Aerial Systems (UAS) for Forest Health and Individual Tree Measurements in New England Forest Communities

Jacob Douglas Dearborn, Russell G Congalton
Natural Resources and the Environment, UNH Durham

Since the summer of 2020, I have worked in the Basic and Applied Spatial Analysis Lab ran by Dr. Russell G. Congalton in the Department of Natural Resources and the Environment with the help of graduate students Benjamin Fraser and Heather Grybas. The major goal of the research was to create land cover and forest resource maps using remote sensing technologies and compare their accuracy to field data in order to analyze the efficacy of the maps. Positive results would show that these technologies save time and energy compared to field sampling methods. I was able to learn how to work with unmanned aerial systems (UAS or drone technology) and the imagery captured from UAS. The imagery and field data were collected from UNH woodland properties (College Woods and Kingman Farm) and local conservation areas like the Blue Hills Foundation lands. UAS was used to collect natural color imagery (as our eyes see) and imagery beyond visible wavelengths (near infrared) to create maps to compare to the field data. For field data, I measured parameters like size (diameter of tree at breast height) of large trees, trees per hectare, basal area, and forest health. After, I analyzed the accuracy of UAS technologies in assessing species composition, basal area, trees per hectare, forest health, and size of large trees based on canopy size. Results of this study can be used by land managers, researchers, and conservation agencies to improve their land cover and forest resource maps using UAS.

Presenter: Jacob Douglas Dearborn

Presenter's Major: Wildlife and Conservation Biology

Year at UNH: Senior

Adviser: Russell G Congalton

Review of Best Practices for Engaging Local Communities in Arctic Change Research

Carmen Grace Butler, Mark A Cummings, Ash Leighton Bustead, Collin Thomas Figler, Jessica G Ernakovich

Indigenous Arctic communities are facing the immediate impacts of climate change, threatening their way of life and unique existence in the coldest inhabited region on Earth. Permafrost thaw and shifts in local ecology due to warming have forced Arctic peoples into climigration, creating new issues for communities and local governing bodies alike. Arctic change has increased the need for collaborative efforts between Indigenous peoples and researchers. Case studies have shown that existing guidelines for engaging with indigenous communities may fail to forge equitable and reciprocal partnerships and should be reviewed.

The purpose of this review is to provide insight for researchers regarding how to effectively cultivate inclusive and respectful relations with local communities while undertaking studies in the Arctic. We conducted a literature review of studies relating to indigenous peoples to (1) highlight successful research practices and (2) address common challenges that hinder open communication, as identified by both communities and scientists. We reflect on a series of best practices commonly highlighted in existing research, emphasizing guidelines and concerns proposed by Arctic communities and how they may differ from assumptions made by scientists and organizations. By making adjustments in how we relate with Arctic communities, we create avenues for more open communication, benefitting both communities and researchers.

Presenter:	Carmen Grace Butler
Presenter's Major:	Environmental Conservation and Sustainability
Year at UNH:	Senior
Presenter:	Mark A Cummings
Presenter's Major:	Environmental Sciences
Year at UNH:	Senior
Presenter:	Ash Leighton Bustead
Presenter's Major:	Environmental Sciences
Year at UNH:	Senior
Presenter:	Collin Thomas Figler
Presenter's Major:	Environmental Sciences
Year at UNH:	Senior
Adviser:	Jessica G Ernakovich

Assessing Predator-Prey Interactions between Migrating Juvenile Sockeye Salmon Smolts and Bull Trout in British Columbia

Lok (Matt) Cheng, Sydney Jillen Mapley, Nathaniel B Furey
Biological Sciences, UNH Durham

Pacific salmon are anadromous, and thus spawn in freshwater, migrate to the ocean as juvenile salmon smolts, and return to their natal rivers to spawn, dying shortly after. During the migration from freshwater to the marine environment period, juvenile salmon smolts experience high rates of mortality, with predators exploiting the small migrant fish. For example, the downstream migration of sockeye salmon (*Oncorhynchus nerka*) smolts from Chilko Lake, British Columbia, Canada, is exploited by binge-feeding aggregations of bull trout (*Salvelinus confluentus*). The present study used Dual-frequency Identification Sonar (DIDSON) acoustic imaging videos to assess fine-scale predator-prey interactions between sockeye salmon smolts and bull trout. Specifically, we aimed to determine if the frequency of foraging behavior by bull trout is correlated with the number of smolts migrating from the lake, and determine how the size (length) of bull trout measured via DIDSON compared to field estimates. Over 10 days in 2015, we found that smolt densities were correlated with the number of predation events exhibited by bull trout at a specific location, a government-run counting fence that funnels smolts and facilitates bull trout feeding, but not elsewhere. Predatory behavior also densest at night, matching the timing of the smolt migration. Size comparisons via DIDSON and field estimates were similar, although the DIDSON did tend to observe a wider size range, with smaller fish measured. However, these smaller fish may be other species present in the system.

Presenter: Lok (Matt) Cheng

Presenter's Major: Marine, Estuarine and Freshwater Biology

Year at UNH: Senior

Presenter: Sydney Jillen Mapley

Presenter's Major: Biology

Year at UNH: Senior

Adviser: Nathaniel B Furey

Roles of non-*Frankia* bacteria in root nodule formation and function in *Alnus glutinosa*

Kelsey C Mercurio, Louis S Tisa
MCBS, UNH Durham

Actinorhizal plants play important roles in natural ecosystems, agroforestry, and land reclamation. These plants depend on a symbiotic association with nitrogen-fixing bacteria of the genus *Frankia*, which they house in root nodules. Similar nodules are formed by agriculturally important legume plants (*Fabaceae*) with their symbionts, the rhizobia. However, *Frankia* and rhizobia do not live alone in root nodules, and the other microbial residents may contribute to nodule formation and function. We collected root nodules from alder trees (*Alnus* sp.) in 2018 and 2019, then isolated DNA and individual bacterial strains to characterize the nodule microbial community. Of 90 isolates, several were identified via 16S amplicon sequencing, and we chose twelve isolates for whole genome sequencing. To test effects on the host plant, we used *Streptomyces*, *Thiospseudomonas*, and *Paenibacillus* strains to inoculate sterile *Alnus glutinosa* plants, both alone and in co-culture with *Frankia*. Nodule formation, nitrogen fixation, and plant growth were monitored under nitrogen-deficient conditions. We also tested ten isolates for plant-growth-promoting properties including auxin production, siderophore production, and phosphate solubilizing ability. Seven isolates produced the plant hormones indole butyric acid and/or indole-3-acetic acid. Putative pathways for siderophore synthesis were also identified in the *Streptomyces* and *Thiospseudomonas* genomes. Forthcoming results will provide further data, reveal whether any of the isolates impact nodule formation and nitrogen fixation, and allow us to suggest possible mechanisms, with implications for agriculture, ecology, bioremediation, and the biology of symbiosis.

Presenter:	Kelsey C Mercurio
Presenter's Major(s):	Biochemistry, Molecular and Cellular Biology, Sustainable Agriculture and Food Systems
Year at UNH:	Senior
Research Interest:	Plant-Microbe Interactions
Adviser:	Louis S Tisa

Fatal Salmonellosis in Four Guinea Pigs from Northern New England

Aidan R Buzard, Colleen F Monahan, David B Needle

Aidan Buzard; Anna Gates, Central Texas Veterinary Specialty and Emergency Hospital; Robert Gibson, NHVDL, UNH; Heather Grieser, Maine Health and Environmental Testing Laboratory; Rachael Fiske, Animal Health: Division of Animal and Plant Health, Maine Department of Agriculture, Conservation and Forestry; Michele Walsh, Animal Health: Division of Animal and Plant Health, Maine Department of Agriculture, Conservation and Forestry; Carolyn Hurwitz, Animal Health: Division of Animal and Plant Health, Maine Department of Agriculture, Conservation and Forestry; Stephen Combes, Maine Center for Disease Control and Prevention, University of Southern Maine; Colleen Monahan, NHVDL & MCBS, UNH; David Needle, NHVDL & MCBS, UNH

Salmonella is an important zoonotic bacterial pathogen associated with disease in humans and animals. Four guinea pigs originating from a single facility in Maine were submitted to the NHVDL between July 31 and October 15, 2020, having died naturally. Postmortem examination revealed necrotizing splenitis (guinea pigs 1, 2, 3), interstitial pneumonia (guinea pigs 1, 2), and peracute bacteremia (guinea pigs 2, 3). Tissues from guinea pig 4 were submitted for culture only. Pure cultures of *Salmonella sp.* bacteria were isolated from lung and liver cultures of each animal. In keeping with PULSENET protocols, the isolates were sent to the Maine CDC for whole genome sequencing (WGS), which indicated that all four belonged to the enteritidis serotype with no allelic differences among them. Using the WGS data, a phylogeny was assembled in RStudio to place these bacteria within the context of other enteritidis isolates and other temporally related isolates.

Presenter: Aidan R Buzard

Presenter's Major: Biomedical Science

Year at UNH: Senior

Adviser: Colleen F Monahan

Adviser: David B Needle

Anticoagulant Rodenticide, Canine Distemper Virus, and Necropsy Findings in Fisher, Gray Fox, and Red Fox from NH

Chiara J Antonioli, David B Needle

The carcasses of 11 red foxes (*Vulpes vulpes*), 9 gray foxes (*Urocyon cinereoargenteus*), and 15 fishers (*Pekania pennanti*) from the 2019-2020 winter season in New Hampshire were necropsied and examined for the presence of canine distemper virus and anticoagulant rodenticide. Testing methods included gross dissection and histopathology to look for evidence of canine distemper and anticoagulant rodenticide pathology, high-performance liquid chromatography to identify the accumulation of anticoagulant rodenticides, and PCR/sequencing for canine distemper virus and anticoagulant rodenticides. Canine distemper virus was identified in 4 out of 35 animals (3 gray foxes and 1 fisher). The identified canine distemper viruses all represented the wild type NH/VT clade, with one potentially novel strain in a gray fox. The dispersal of the canine distemper virus cases was within Grafton and Strafford counties. Anticoagulant rodenticides were identified in 34 out of 35 animals. The identified anticoagulant rodenticides included Brodifacoum, Bromadiolone, Chlorophacinone, Dicoumarol, Difethialone, and Diphacinone. Coumachlor, Coumafuryl, Difenacoum, Pindone, and Warfarin were not identified in any of the animals in this study. The anticoagulant rodenticide findings were widely dispersed throughout the state. These findings indicate that the anticoagulant rodenticides are dispersed throughout the state and canine distemper virus circulates in mesocarnivores in New Hampshire.

Presenter: Chiara J Antonioli

Presenter's Major: Biomedical Science

Year at UNH: Senior

Adviser: David B Needle

Determination of the Effects Maternal Colostrum Has on the Small Intestinal Development of Calves Evidenced by D-xylose Absorption

Jeanne M Cassidy, Peter Erickson, Tess Stahl

Within the first 12 hours of life, it is vital that dairy producers provide high quality colostrum (>50 g/L IgG) to calves (Morrill et al., 2012). The quality of the colostrum consumed by the neonate has lasting effects on their development past those initial 12 hours. The goal of this research is to look at the impact prepartum variation of the dietary cation anion difference (DCAD) and supplementation with nicotinic acid (NA) to the calf's dam would have on the development of the offspring's small intestine's as the result of consumption of the cow's colostrum. Previous research has demonstrated that the supplementation of NA can result in an increase in colostrum IgG concentration (Aragona et al., 2016) and yield (Aragona et al., 2020). Personal communication has indicated that changes to the DCAD may influence colostrum quantity. This study was a randomized complete block design which tested small intestinal development through glucose and D-xylose absorption. Calves were born on study to dam's fed one of four treatments in their prepartum diets (-80 DCAD +/- 24 g NA, -40 DCAD +/- 24 g NA, -80 DCAD without NA, and -40 DCAD without NA). Small intestine functionality was determined by the amount of glucose and xylose absorbed on d 5 of life. At that point each calf was challenge with 0.5 g/kg D-xylose following a 0 h venipuncture sampling. Blood samples were then taken at the 2, 4, 6, 8, and 12-h post xylose challenge during which the calf was fasted. Plasma was then analyzed for glucose and xylose concentrations. Currently analysis of the glucose has shown a variation ($P < 0.02$) between the calves fed colostrum from dam's fed the -80 DCAD + NA and -40 DCAD + NA diets. It is being noted that blood glucose concentration and therefore small intestine absorption of glucose is increased in calves from -80 DCAD + NA dams but is decreased in those from -40 DCAD + NA dams. Analysis for xylose is still being performed but it is expected to trend like the glucose.

Presenter: Jeanne M Cassidy

Presenter's Major: Biomedical Science

Year at UNH: Senior

Adviser: Peter Erickson

Adviser: Tess Stahl

Weight and Body Composition Fluctuations Among Male Collegiate Athletes across Multiple Seasons

Abigail J Laverriere, Tara E Willette, Kevin J. Pietro
ANFS, UNH Durham

Research on weight cycling prevalence in athletes, and more importantly, body composition (fat mass [FM] and fat-free mass [FFM]) fluctuations is limited. To address this gap, the primary aim was to examine the extent of weight and body composition fluctuation in collegiate male athletes. Through collaboration with UNH Athletics and the UNH sports dietitian, DI football, soccer, and basketball teams were invited to participate in body composition testing via air displacement plethysmography between October 2016-February 2020. A total of 20 athletes completed five separate tests across multiple competition seasons. While weight cycling (repeated cycles of weight loss and weight gain, defined as +/- 5% body weight) was only observed in 1 athlete across competition seasons, considerable weight and body composition fluctuations were observed in a number of athletes. Of the 20 athletes included in the study, 8 experienced body weight fluctuations of greater than 10-pounds. Of those athletes, 3 experienced a greater than 10-pound fluctuation in FFM, and 5 experienced a greater than 10-pound fluctuation in FM. Of the 12 athletes who did not experience that degree of weight fluctuation, 2 experienced a greater than 10-pound fluctuation in FFM, and 6 experienced a greater than 10-pound fluctuation in FM. Without measuring FFM and FM, assessing athletes' weight alone may hide dramatic body composition fluctuation, which may impact performance and potentially long-term health.

Presenter: Abigail J Laverriere

Presenter's Major: Nutrition

Year at UNH: Senior

Research Interest: Sports Nutrition

Presenter: Tara E Willette

Presenter's Major: Nutrition

Year at UNH: Senior

Research Interest: Sports Nutrition

Adviser: Kevin J. Pietro

Dietary Quality of Bhutanese Refugee Adults Eligible for the Supplemental Nutrition Assistance Program

Alexandra Marie Papadakis¹, Daniel R Winans², Sherman J Bigornia

¹Agriculture, Nutrition and Food Systems (ANFS), UNH Durham

²EcoGastronomy, UNH Durham

Objectives: To characterize nutrient intakes among Bhutanese refugee adults residing in New Hampshire eligible for SNAP.

Methods: In this convenience sample (n=54, mean age=47 y, 83% F), diet was estimated using three 24-hr recalls. Selected nutrients included vitamins C, D, E, and K, thiamin, riboflavin, niacin, B6, folate, B12, pantothenic acid, calcium, magnesium, sodium, and saturated fat. Participants were categorized based on meeting the Recommended Dietary Allowance (RDA) or Adequate Intake (AI) of selected nutrients. For sodium and saturated fat, recommendations were defined as consuming <2,300 mg/d and <10% of energy, respectively.

Results: More than half of participants (68%-90%) met recommendations for K, thiamin, niacin, folate, sodium, and saturated fat. However, a lower proportion (0% to 46%) consumed recommended amounts of C, D, E, riboflavin, B6, B12, pantothenic acid, calcium, and magnesium. Mixed legume dishes (e.g., lentils with tomato sauce) and vegetable curries were leading contributors to C (40%), E (33%), B6 (21%), pantothenic acid (18%), and magnesium (25%) intakes. Milk and yogurt were primary contributors to riboflavin (23%), B12 (40%), and calcium (31%) consumption, and parboiled rice for B6 (28%) and pantothenic acid (24%).

Conclusions: The prevalence of meeting recommendations was high for some nutrients but low for others. These shortfalls can inform dietary recommendations for this community.

Funding: The NH Agricultural Experiment Station

Presenter:	Alexandra Marie Papadakis
Presenter's Major(s):	Ecogastronomy, Nutrition
Year at UNH:	Senior
Research Interest:	Nutrition; Food Insecurity; Diet Patterns
Adviser:	Sherman J Bigornia
Adviser:	Daniel R Winans

Gene Editing in Actinobacteria

Lilly R Friedman, Louis S Tisa
MCBS, UNH Durham

The filamentous actinobacteria, *Frankia*, forms a nitrogen-fixing symbiotic association with eight families of angiosperms. These actinorhizal plants have positive environmental impacts by, for example, reclaiming salt-contaminated soils. A major obstacle in this field is the absence of genetic tools for *Frankia*. To overcome this obstacle, we attempted targeted mutagenesis in *Frankia* bacteria using CRISPR-Cas9 genome editing. The CRISPR-Cas9 system was used to edit hopanoid biosynthesis genes. Under aerobic conditions, *Frankia* produces hopanoid-enriched vesicles to protect nitrogenase from oxygen-inactivation. A *hpnC* gene deletion expected to cause hopanoid production deficiencies was generated and confirmed by molecular approaches. *HpnC* mutants produced smaller and less prevalent vesicles than those of the wildtype, demonstrating impaired hopanoid biosynthesis. The infectivity of the mutant on the actinorhizal host plant, *Casuarina*, was tested and resulted in aberrant nodule production. These results supported the generation of a *hpnC* mutation by the CRISPR-Cas9 system. These experiments are being repeated to confirm the results. The *hpnC* mutant genomes are being sequenced to eliminate nonspecific mutations and further support the existence of CRISPR-Cas9-induced mutations. Outcomes of this investigation have implications for the efficacy of future use of CRISPR-Cas9 genome editing for targeted mutagenesis in *Frankia* bacteria and other genetically-intractable bacteria. (Abstract Co-authors: Céline Pesce, Megan Worth, and Louis Tisa)

Presenter: Lilly R Friedman

Presenter's Major: Biomedical Science

Year at UNH: Senior

Adviser: Louis S Tisa

Assessing Salt Marsh Erosion Along Moody Point on New Hampshire's Great Bay Estuary

Natalie A White, Gregg E Moore
Department of Biological Sciences, UNH Durham

Salt marshes are incurring stress from several anthropogenic causes: sea level rise, invasive species, eutrophication, and increased intensity and frequency of storms. These stressors are causing marsh edges to erode and the vegetation to retreat landward. The residential community of Moody Point located along the shores of Great Bay in Newmarket, New Hampshire is particularly susceptible to these changes, and is already experiencing erosion of walking paths which will soon threaten infrastructure. To determine if Moody Point is a viable location for a coastal restoration project, the Landowner Technical Assistance Program, operated by NH DES and UNH Cooperative Extension, has assessed the property and begun a long-term study on this salt marsh. For this study, erosion pins (iron rebar rods) were installed horizontally into the marsh edge at 25 locations and were monitored over a 16-month period, still ongoing, to determine erosion rates. Other environmental parameters were monitored including vegetation (species composition, percent cover) and porewater (pH, salinity, redox potential, and sulfides). The first year of data shows a significant erosion rate of 0.384 inches per year averaged across the 25 erosion pins. No significant differences were found between percent cover or species richness in the vegetated plots over the one-year period. Salinity was the only porewater parameter to be significantly different one year after initial monitoring. Drought conditions in the 2020 monitoring season must be considered to put these data in context. Vegetation shift may occur with prolonged changes in porewater chemistry, yet this mechanism is not conducive to the time frame of the study and thus significant changes are not seen.

Presenter: Natalie A White

Presenter's Major: Environmental Sciences

Year at UNH: Junior

Research Interest: Coastal Resilience

Adviser: Gregg E Moore

Using the Plasma Dose Response Method to Determine If the Next Generation AjiPro-L is More Effective Than the Third Generation AjiPro-L

Alexia Gianoulis, Nancy L Whitehouse

The objective of this trial was to determine the bioavailability of rumen protected lysine supplements. Using the plasma amino acid dose response method, it was experimentally studied which generation of AjiPro-L, either the fourth generation or the third generation was more effective. Eight multiparous Holstein cows were used for the conclusion of this study and were equipped with ruminal cannulas (Bar Diamond, Parma, ID). Treatments were provided through varying amounts of digestible lysine fed in the diets of the cows and given through postruminal infusions. Cows were fed in the morning, noon and night each day of the trial. The design for this study was proposed to be an 8 x 8 Latin square with 7-d experimental periods. Sampling of blood and milk occurred for statistical analysis after the study. Blood samples from each cow were taken on the last 3 days of the covariate period and the last 3 days of the experimental periods. During the morning and afternoon milkings on the last 3 days of each experimental period, milk samples were taken from each cow. From data analysis, it was observed that there were outlier values in the plasma amino acid values that were collected throughout the study. In turn, those outlier data values were removed from the statistical analysis and results. The remaining data provided a positive linear relationship between the lysine infusions and plasma lysine content of AjiPro-L 3G and AjiPro-L 4G generation. There was a greater plasma lysine content and overall slope of AjiPro-L 4G generation compared to AjiPro-L 3G generation. In this study, the bioavailability of AjiPro-L 4G generation was more effective than that of the AjiPro-L 3G generation.

Presenter: Alexia Gianoulis
Presenter's Major: Biomedical Science
Year at UNH: Recent Graduate
Research Interest: Dairy Cow Nutrition
Adviser: Nancy L Whitehouse

Effects of Small Mammal Seed Predation on Seedling Establishment in Northern New Hampshire

Robyn B Parker, Ryan Bratz Stephens, Rebecca J Rowe

Across various ecosystems, small mammals can impact plant community composition by consuming seeds. In forested systems, most research has focused on what seeds different small mammal species prefer, however, there is limited knowledge to what extent this seed selection can shape forest composition. Selective seed removal by small mammals could impact habitat for other species and decrease the timber value of a forest. This project links small mammal abundance to seed removal and how it affects seedling establishment in northern New Hampshire. This was done by live-trapping small mammals, coupling seed fall baskets with small mammal foraging stations to assess seed removal, and tracking seedling establishment in plots where small mammals were excluded relative to controls in both the cuts and adjacent managed forest. Our analysis focuses on sugar maple (*Acer saccharum*), a common tree species at the site, as well as one of the most regionally profitable tree species. Our findings indicate a 35% reduction in viable sugar maple seeds in the foraging stations relative to the seed baskets. In addition, sugar maple regeneration in the patch cuts was significantly lower in control plots compared to exclosures, but similar between the control and exclosure in both the forest and edge plots. This suggests that small mammals remove a significant amount of seeds from the landscape which can affect the establishment of seeds in newly cut forests, ultimately leading to changes in forest composition.

Presenter: Robyn B Parker

Presenter's Major: Wildlife and Conservation Biology

Year at UNH: Senior

Adviser: Rebecca J Rowe

Adviser: Ryan Bratz Stephens

***Streptomyces hygrosopicus* in the Stellwagen Bank National Marine Sanctuary: Discovery of Biosynthetic Gene Clusters with Potential to Produce Chemotherapeutic Compounds**

Hannah Ruth Flaherty¹, John P Bucci², Semra A Aytur¹

¹Health Management & Policy, UNH Durham

²Marine Microbiology, UNH Durham

Sediment microbial communities may represent a biodiverse source of novel natural products with medicinal value. However, in the marine environment, there is a need to better understand biosynthetic gene clusters (BGCs) that encode secondary metabolites within bacterial genomes. The objective of this study was to characterize BGCs associated with chemotherapeutic compounds with antitumor properties. This project builds upon a Stellwagen Bank National Marine Sanctuary (SBNMS) metagenomics study that taxonomically described biodiversity. Samples collected from SBNMS during the summer of 2018 were analyzed using JMP software to quantify the abundance of *Streptomyces* species, which harbor a high percentage of biosynthetic gene clusters. Site 3 identified an estimated 8,202 hits of 858,043 total reads and 648 different types. The bioinformatics platform antiSMASH was then used to classify strain level BGCs that contain secondary metabolites associated with chemotherapeutic properties such as cytotoxicity. *Streptomyces hygrosopicus* was among the top ten species with a relatively high abundance of BGCs aligned with compounds that facilitate tumor cell toxicity, such as ferroptosis. The next steps include sequencing genomic regions of select *S. hygrosopicus* strains to further describe these preliminary results. This project highlights the importance to protect marine sanctuaries since they can provide insights into the role that marine microbes play in chemotherapy development.

Presenter: Hannah Ruth Flaherty

Presenter's Major: Biomedical Science

Year at UNH: Junior

Research Interest: Marine Metagenomics

Adviser: Semra A Aytur

Adviser: John P Bucci

Occurrence of Pulmonary Arteritis with Lungworm Infections in Gray Seals from Cape Cod, 2013-2020

Jillian R Broadhurst, Inga F Sidor

Gray seals (*Halichoerus grypus*) are a common pinniped species in New England coastal waters. Parasitic infection is an important cause of mortality for this species, and lungworm species are frequently implicated in cases of respiratory infection, especially in pups and weanling seals. The most common of these is *Otstrongylus circumlitus*, a large nematode found in the bronchi and bronchioles of affected seals. The full life cycle is unknown but its presence in lungs and sometimes pulmonary arteries suggests that migration via arterial circulation occurs. Signs and microscopic findings are widely variable; our cases included dyspnea, bloody mucoid oral and nasal discharge, eosinophilic bronchitis/bronchiolitis, suppurative pneumonia, and pulmonary congestion and emphysema. Recent evidence suggests a possible increase in *O. circumlitus* respiratory infection among gray seals that includes arterial vasculitis lesions with deposition of Splendore-Hoeppli tissue and infiltrates of eosinophils. We aim to describe and document the occurrence of this lesion in cases of *O. circumlitus* in the gray seal population on Cape Cod, MA. Necropsy results including gross and histologic examination of lung were compiled for 34 gray seals, with 11 of these being diagnosed with pulmonary nematodiasis. Eight of the diagnosed nematodiasis cases were found to have concurrent arteritis. Work is ongoing to evaluate the changes in both the pathology and prevalence of this pathogen over time.

Presenter: Jillian R Broadhurst

Presenter's Major: Biomedical Science

Year at UNH: Senior

Adviser: Inga F Sidor

The Impact of Water Withdrawals on Summer Low Flows in the Ipswich River Watershed, MA, USA

Julie Nicole Bobyock, Wilfred M Wollheim
Water Systems Analysis Group, UNH Durham

Water use management can significantly impact watershed water budgets and the ecosystem services provided by flowing waters. The Ipswich River watershed located in north eastern Massachusetts has a history of unsustainable withdrawals and severe low summer flows, to the extent that the Ipswich river was at one point named one of the most endangered rivers in the nation. Although water withdrawals began to decline more steeply since 2008 to address the critical condition of the river, no studies have yet determined how the hydrology of the watershed has responded to reduced summer withdrawals. The question guiding this research is: How have summer low flows changed in the Ipswich R. Watershed in response to water use management over the last 80 years? This research primarily focused on historical data analysis from the past eight decades for metrics such as discharge, runoff, precipitation, runoff coefficient and withdrawals from sources such as the United States Geological Survey (USGS), the National Center for Environmental Information, local Town Public Works Departments, and the Ipswich River Watershed Association. The mean runoff ratio for each water withdrawal period was calculated (1939-1950 with low withdrawals, 1951-1970 with large water withdrawals, 1971-2008 with slowly increasing withdrawals, and 2008-2019 with decreasing withdrawals. We found that the average runoff ratio slightly increased as withdrawals increased over the entire time period of high withdrawals (~ 22% per decade) but increased more rapidly (~ 50%) when withdrawals were decreased in the most recent decade. As summer withdrawals declined, the summer runoff ratio and discharge slightly increased (p = 0.08.)

Presenter: Julie Nicole Bobyock
Presenter's Major: Environmental Sciences
Year at UNH: Sophomore
Research Interest: Natural Resources
Adviser: Wilfred M Wollheim

Evaluating Regurgitated Pellets as Indicators of Microplastic Ingestion by NH-Breeding Seabirds

Cate Wardinski, Lauren Mary McDowell, Lok (Matt) Cheng¹, Aliya Everest Caldwell, Bonnie L Brown¹, Elizabeth C Craig²

¹Biological Sciences, UNH Durham

²Shoals Marine Lab, UNH Durham

Microplastics (MP) are distributed widely throughout marine ecosystems and research surrounding their environmental impacts is a burgeoning field. Previous studies have indicated that MP ingested by seabirds can be problematic and the effects of MP likely will be exacerbated as plastic pollution continues to increase in marine systems. Given the high trophic position of seabirds, understanding the extent of their MP exposure may provide insight about MP levels in their surrounding environments. Although MP research has increased over the past two decades, many species, including the Common Tern (*Sterna hirundo*), remain sparsely described. In addition, some dietary sample types remain unexplored in terns, e.g., regurgitated pellets. We therefore studied Common Tern pellet samples to assess their MP ingestion. Pellets were collected from a breeding colony on White and Seavey Islands (NH) throughout the 2020 breeding season. To isolate MP from the biogenic materials, pellets were chemically digested and filtered onto a 5µm PCTE filter. Samples were then stained with Nile Red dye which is absorbed onto plastic surfaces, causing them to fluoresce (excitation/emission 460/525 nm), allowing for a rapid-screening approach. The stained samples were screened for MP using a confocal microscope and final MP counts were obtained by automated analysis of the resulting images. Our results demonstrate that pellet analysis is a viable method to isolate MP that pass through the digestive tract, and we discuss the potential of this method to provide insight into MP ingestion processes in seabirds.

Presenter:	Cate Wardinski
Presenter's Major:	Marine, Estuarine and Freshwater Biology
Year at UNH:	Junior
Presenter:	Lauren Mary McDowell
Presenter's Major(s):	Marine, Estuarine and Freshwater Biology, Sustainability
Year at UNH:	Freshman
Presenter:	Lok (Matt) Cheng
Presenter's Major:	Marine, Estuarine and Freshwater Biology
Year at UNH:	Senior
Presenter:	Aliya Everest Caldwell
Presenter's Major:	Marine, Estuarine and Freshwater Biology
Year at UNH:	Recent Graduate
Adviser:	Bonnie L Brown
Adviser:	Elizabeth C Craig

Quantification and Evaluation of Oyster Larval Disease *Haplosporidium nelsoni* and *Perkinsus marinus* Throughout Summer Larval Spawning Months of Eastern Oysters in GBE

Declan D Pigeaud, Bonnie L Brown, Alyssa R Stasse
Biological Sciences, UNH Durham

The eastern oyster *Crassostrea virginica* is an abundant organism found throughout the East Coast of the United States and play critical roles in the management of intertidal habitats through filter feeding and acting as physical structure for smaller marine organisms to live in. In recent decades, the prevalence of disease in both organic and farmed oyster populations has seen significant increases which results in detrimental impacts to the intertidal ecosystem and economic losses for oyster farmers. Although the prevalence of disease causing organisms *Haplosporoidium nelsoni* (MSX) and *Perkinsus marinus* (Dermo) are not current quantified, this project seeks to use a qPCR assay developed by Brooks and Brown to quantify the abundance of these parasitic organisms during summer which are critical times for *C. virginica*'s reproduction cycle. Establishing a dataset to map out the parasite abundance will enable researchers to better understand both the broad patterns of disease incidence throughout eastern oyster populations and provide a starting point for future research.

Presenter: Declan D Pigeaud
Presenter's Major: Biomedical Science
Year at UNH: Senior
Research Interest: Infectious Disease, Virology
Adviser: Bonnie L Brown
Adviser: Alyssa R Stasse

Evaluating Seasonal Storage Technologies for the United States and UNH

Sam B Kitfield-Vernon, Clayton R Mitchell

Is it time for seasonal storage in U.S district energy systems? There are several district energy systems in the United States, but we lag behind Europe and other global regions in widespread adoption. An innovative development in these systems is the concept of seasonal storage. These system components maximize economic and emission benefits. This project describes existing technologies and how they benefit district energy systems as well as larger energy systems. We then provide a case study review of existing seasonal storage technologies deployed in the U.S and other areas of the world. Finally, we provide an initial framework for how existing district energy systems can begin to evaluate whether seasonal storage may be worth considering. We develop the framework using campus-based district energy systems in the U.S and focus on the UNH system as a candidate and extrapolate these findings to create the framework for evaluation.

Presenter: Sam B Kitfield-Vernon

Presenter's Major(s): Environmental Conservation and Sustainability

Year at UNH: Senior

Adviser: Clayton R Mitchell

Targeted Effect of Pacritinib, a Jak2/Flt-3 Inhibitor, on the Tumor Microenvironment in Waldenström Macroglobulinemia

Travis Fischer, Ava J Boutilier, Sherine F Elsawa

WM is a rare, indolent type of non-Hodgkin's lymphoma, characterized by the over-secretion of a monoclonal Immunoglobulin M (IgM) paraprotein and infiltration of the bone marrow (BM) by lymphoplasmacytic cells. The median survival rate of WM is 5-11 years, currently there is no cure for WM and there is only one FDA-approved treatment for WM using the Bruton's Tyrosine Kinase (BTK) inhibitor Ibrutinib. Therefore there is a need for the identification of new therapies to target WM. Pacritinib is an oral kinase inhibitor that shows specificity for IRAK1 and JAK2. Pacritinib completed Phase 3 clinical trials for use in myelofibrosis, a cancer of the BM that results in BM failure, and showed significant symptom improvement. Both IRAK1 and JAK2 signaling pathways are active in WM signaling. Therefore, investigating the role of Pacritinib in WM may provide insight into its effect on the malignancy. The role of the BM tumor microenvironment (TME) in WM is crucial for the progression of the cancer and its resistance to treatments. The pro-inflammatory cytokine interleukin-6 (IL-6) is an important survival protein that is secreted by stromal cells in the BM that activates the JAK/STAT signaling pathway in WM cells which in turn stimulates more IL-6 production creating a positive feedback loop between the TME and the cancer. Therefore, understanding the effects of Pacritinib on the stromal microenvironment is crucial to understanding the overall effects of the drug on the WM malignancy.

Presenter: Travis Fischer

Presenter's Major: Biochemistry, Molecular and Cellular Biology

Year at UNH: Senior

Presenter: Ava J Boutilier

Presenter's Major: Biomedical Science

Year at UNH: Recent Graduate

Adviser: Sherine F Elsawa

Investigating Sphingolipid Regulation of the Tumor Immune Microenvironment

Christopher Carmine Lenox, Brian M Barth
Molecular, Cellular, and Biomedical Sciences, UNH Durham

The progress involved with developing anti-toxic cancer therapies, and even cures, is dependent upon the understanding of underlying biological mechanisms. Sphingolipids are potent regulators for thousands of cell signaling pathways, and even slight deviations in their concentration can lead to drastic changes in the way that cells both communicate and behave. For example, ceramide and sphingosine-1-phosphate (S1P) are two classes of sphingolipids, yet their concentrations reflect whether a cell will die, or survive, respectively. These extensively studied lipids have been utilized in many cancer therapies. Commonly, these anticancer therapies target ceramide generation pathways in the cancer cells. However, the importance of another sphingolipid, dihydrosphingosine-1-phosphate (dhS1P), is just starting to be understood and utilized. With a chemical structure so similar to that of S1P, it is surprising that the mechanisms through which it operates cause drastic differences in the cell's response. Yet, these same mechanisms can have a profound role in future cancer treatments. Specifically, elevated dhS1P concentrations in the cell contribute to untapped anti-tumor effects. This study investigated the hypothesis that dhS1P can mediate systemic anti-tumor immunity, by suppressing the signaling of myeloid derived suppressor cells within the tumor microenvironment and effectively removing a blockade for lymphoid differentiation.

Presenter: Christopher Carmine Lenox

Presenter's Major: Biomedical Science

Year at UNH: Senior

Research Interest: Cancer Research

Adviser: Brian M Barth

The Effect of Pollen Source on Fruit Quality: An Investigation of the Xenia Effect in Kiwiberry (*Actinidia arguta*)

Khem Basnet, Iago L Hale

Kiwiberry (*Actinidia arguta*), a novel fruit of increasing global importance, has a long history of cultivation in the New England region. Native to eastern Asia, kiwiberry is well-adapted to the New England climate, making it a viable specialty crop for regional fruit growers. In 2013, a long-term breeding and research program was launched at the University of New Hampshire to develop the commercial potential of kiwiberry; and this proposed study has been designed to complement that program, specifically by investigating the role of pollen source on fruit quality. It is commonly thought that the fruit quality is solely determined by the genotype of female fruiting varieties. There is evidence in many fruits, however, including those of other species of larger kiwifruit family (*Actinidia* spp.), that pollen source can significantly influence fruit quality traits of importance to consumers, including berry color shape, size, taste and consistency in those traits. In the horticultural literature, the term used for immediate pollen effect on seeds and fruits is the “Xenia Effect”. If evidence of the Xenia Effect is demonstrated in kiwiberry, the development of superior male pollinating varieties will need to be integrated into the activities of the heretofore female-focused UNH breeding program. Such evidence may also present an opportunity to further improve fruit quality and uniformity facilitating the commercial success of prospective New England fruit producers.

Presenter: Khem Basnet

Presenter's Major: Sustainable Agriculture and Food Systems

Year at UNH: Senior

Adviser: Iago L Hale

How Does Streamflow Affect Specific Conductivity in Streams?

Paul S Rozenberg, Wilfred M Wollheim,
Water Systems Analysis Group, UNH Durham

Salt content can be a major indicator of the health of a stream as well as the presence of salt in the groundwater. Not much research has gone into the relationship of salt content in streams and groundwater and the introduction of stormwater. The problem being addressed involves the correlation between stream flow and the specific conductance reading during periods of increased flow. If a stream has increased flow due to a storm event, then the streams specific conductance will be higher also. This can be said during the non-winter months when salt is not being added to roads adjacent to streams as a de-icing agent. The results showed that as flow increased in The University of New Hampshire's College Brook due to precipitation events, the specific conductance decreased. The implications for this mean that the salt content found in the stream are due to groundwater and the salt content stored there.

Presenter: Paul S Rozenberg

Presenter's Major: Environmental Sciences

Year at UNH: Senior

Adviser: Wilfred M Wollheim

Biomagnification of BMAA in the Aquatic Food Web of Oyster River

Emily Anne Williams, James F Haney

Cyanobacteria produce toxins that can have adverse health effects known as cyanotoxins. Few studies have been done on the cyanotoxin transfer within stream food webs. This study aimed to compare concentrations of a neurotoxic cyanotoxin called beta-methylamino-L-alanine (BMAA) in macroinvertebrate suspension feeders and the water of the Oyster River, in southern New Hampshire. Macroinvertebrates were collected using a kick net method below the Oyster River dam. The invertebrate samples were stored in a fridge until analysis. Invertebrates were identified using light microscopy and separated into functional feeding groups. Water samples were collected from the surface of the stream at the same location to represent suspended cyanobacteria. BMAA concentrations were determined using an enzyme-linked immunosorbent assay (ELISA) and compared among sample types (water, functional feeding groups). BMAA concentrations are expected to increase between suspended cyanobacteria and macroinvertebrate consumers. These invertebrates spend their larvae form in the stream. When they reach adulthood, they connect the stream system to the surrounding terrestrial habitat. Potentially allowing the biomagnification of BMAA into macroinvertebrates species beyond the stream habitat.

Presenter: Emily Anne Williams

Presenter's Major: Biology

Year at UNH: Senior

Adviser: James F Haney

A Deposition Baseline for Microplastic Particle Distribution in an Estuary

Lok (Matt) Cheng, Bonnie L Brown
Biological Sciences, UNH Durham

Microplastics (MP) known to be ubiquitous in the plastisphere, have yet to be quantified within Great Bay Estuary (GBE) in the Gulf of Maine. Few studies have examined the natural dispersion and deposition of MPs in estuaries, nor do we have information on the deposition of MPs over space and time. Temporal concentrations of MPs in estuaries likely have changed as different types of plastics are introduced by society. Further, spatial concentrations of MPs likely are affected by the presence of oyster reefs and eelgrass beds where structure and filter-feeding can trap or slow the transport of particles. We extracted and analyzed MP in archived sediment cores obtained from representative transects across GBE. Results indicated that MP are distributed in GBE sediments 0-30 cm at an average occurrence of 100 ± 50 particles g^{-1} and that morphology varies by site and depth. Analysis by sediment depth and age class indicated that MP deposition increased over several decades but recently (5-10 years) has likely begun to decrease. Hydrodynamic and particle transport modeling indicated that bed characteristics are a more controlling factor in MP distribution than MP properties and that the highest deposition likely occurs in regions with weaker hydrodynamic flows and lower bed shear stress e.g., eelgrass meadows and along the fringes of the Bay. These results provide a baseline and predictive understanding of the occurrence, morphology, and sedimentation of MP in the estuary.

Presenter: Lok (Matt) Cheng

Presenter's Major: Marine, Estuarine and Freshwater Biology

Year at UNH: Senior

Adviser: Bonnie L Brown

Fact or Fiction? Identifying a Putative *Toxoplasma gondii* Transcriptional Complex

Julia M Paquette, Vicki Jeffers
MCBS, UNH Durham

Toxoplasma gondii is a prevalent protozoan parasite that is estimated to infect up to a third of the world's population, though there is no treatment for chronic infection and current treatments for acute infection may have serious side effects. Transcription is a tightly regulated process in *T. gondii*, allowing the parasite to successfully invade and replicate within host cells, and it is thus a promising avenue to study gene regulation and to investigate possible novel therapeutics. In previous research, a TFIID-like complex was identified and found to be associated with the parasite specific bromodomain protein BDP3. In all eukaryotes, the TFIID complex is composed of TAF proteins and is a highly conserved general transcription factor that has yet to be well characterized *T. gondii*. By comparing protein sequences and domain composition between *T. gondii* TAF proteins and other eukaryotic organisms, I identified two proteins that are most likely to be core components of this TFIID-like complex, TgTAF5 and TgTAF6. Ongoing experiments to endogenously epitope tag TgTAF6 will allow localization and proteomic analysis of TgTAF6 interactors to determine the composition of the primary TFIID complex in *T. gondii*.

Presenter: Julia M Paquette
Presenter's Major: Biomedical Science
Year at UNH: Senior
Research Interest: Molecular biology
Adviser: Vicki Jeffers

Identifying the Effects of Various Fractions of the Devil's Club Plant on SARS-CoV-2

Diya Mehr Anand, Brian M Barth

SARS-CoV-2 is a novel coronavirus that presents as a mild respiratory illness. There have been approximately 115 million diagnosed cases worldwide since January, 2020. Although most people infected with SARS-CoV-2 are able to recover at home, there is a large population of people considered high-risk, who are likely to experience more severe symptoms. There are currently very few treatments for SARS-CoV-2 besides medications for pain and fever relief. Having insight into possible treatments is vital for the benefit of the high-risk cases. One potential source of treatment is Devil's Club (*Oplopanax horridus*), a medicinal plant used by the indigenous people of Alaska to treat many different illnesses. The inner stem bark, stems and roots are used to treat respiratory ailments, pain and fevers. This project has helped to identify the role that the fractions of Devil's Club plays in the interference of viral protein binding to the human receptors. The project was completed by performing an ELISA specific to SARS-CoV-2 containing engineered fragments of the proteins, which are safe to use. It was hypothesized that one of the 15 different fractions may have a significant effect on inhibiting the spike protein binding to the receptor.

Presenter: Diya Mehr Anand

Presenter's Major: Biology

Year at UNH: Senior

Adviser: Brian M Barth

Mandibular Gland Volume Variation Across Jewel Wasp (*Nasonia* spp.) Species and Sex

Holly A Hoag, Istvan Miko

The jewel wasp's (*Nasonia* spp.) mandibular gland plays an important role in the insect's mating behavior, as it increases female receptivity via an aphrodisiacal pheromone. Males of different *Nasonia* species exhibit varying behavioral patterns — differing in number of head nods and mouthpart extrusions — in delivering the pheromone to the female antennae. The fine structure of the mandibular gland and possible phenotypic trait differences linked to behavior have never been described. We expect males to have larger mandibular glands than females and presume that gland size differs between species based on behavioral patterns. This study describes the ultrastructure of the mandibular gland in *Nasonia vitripennis* using SBF-SEM and explores size variation in three *Nasonia* species (*N. vitripennis*, *N. giraulti* and *N. longicornis*) using 3D data from synchrotron based micro CT. The gland is atrophied in females while size varies between species for males, with *N. giraulti* having the largest gland, followed by *N. longicornis*, then *N. vitripennis*. Our data suggest that a larger amount of pheromone is delivered with greater frequency of head nodding and mouthpart extrusion. The male mandibular gland in *Nasonia* species provide a new model system for analyzing quantitative trait loci and elucidate the evolution of insect exocrine glands. Overall, this study informs the relationship between morphology and courting behavior in insects and may be applied to other pheromone producing species.

Presenter: Holly A Hoag

Presenter's Major: Zoology

Year at UNH: Senior

Adviser: Istvan Miko

An Analysis of Signal Qualities of *Acheta domesticus* Calls Produced During Exposure to Noise Perceived via Different Sensory Pathways

Caridad A Reyes², Daniel R Howard¹

¹Department of Biological Sciences, UNH Durham

²Department of Biology, UNH Durham

Communication is critical for all organisms for the sake of their survival and chances of reproduction. Animals use many ways to communicate, including using airborne sound, substrate-borne vibration, chemical signals, and visual signals. Sensory systems to detect communication signals are complex, but there are chances that the critical messages in signals become obstructed or masked due to interference. Signal interference by noise can be caused by geophony, which is noise caused by nonliving sources, like wind or water rushing (Pijanowski et al., 2011). Signal interference can also occur due to anthropogenic noise, which is human caused noise that can influence animal behavior (Barber et al., 2010; Kight & Swaddle, 2011). The interference by noise can cause many problems to an organism's ability to communicate, whether it be in accessing food, seeking mates for reproduction, or avoiding predators. Noise can even influence habitat selection and space use (Barber et al., 2010), and can result in signal modification (Rabin & Greene, 2002). In some cases, populations of organisms exposed to chronic noise can become adapted to the noisescapes by a change in the frequency range that they hear, in order to match with the frequency of the sender and avoid the noise (Simmons et al., 2005). The cricket is an example of an organism that exhibits a easily measurable communication behavior with their sensory systems. This experiment will examine behavioral plasticity in response to noise by studying the calls of common house crickets, *Acheta domesticus*, that have been previously recorded in both quiet and noisy conditions to observe whether certain qualities of the male signal are alerted during periods of noise exposure.

Presenter: Caridad A Reyes

Presenter's Major: Neuroscience and Behavior

Year at UNH: Junior

Research Interest: Cricket adaptation to human made noise

Adviser: Daniel R Howard

Meta-Analytic Connectivity Modeling of Brain Regions Related to Deception

Savannah Rose Salvage, Donald A Robin, Sarah Katherine Meier

Neuroscientific research on deception has consisted of varying tasks and paradigms since it emerged twenty years ago. Such studies enhance our understanding of how individuals deceive others, carrying legal and philosophical implications. Activation likelihood estimation (ALE) and meta-analytic connectivity modelling (MACM) were conducted using BrainMap software and 46 fMRI brain activation studies with deception tasks. An ALE comparing activations during deceptive versus honest behavior revealed 7 significant activation clusters (left superior frontal gyrus, bilateral insula, bilateral supramarginal gyrus, and bilateral medial frontal gyrus). These 7 regions were found to compose an interconnected network via MACM, with both unidirectional and bidirectional connections. In tandem with subsequent paradigm class and behavioral domain analyses, our results indicate the supramarginal gyrus is a key component for deception.

Presenter: Savannah Rose Salvage

Presenter's Major: Neuroscience and Behavior

Year at UNH: Junior

Adviser: Sarah Katherine Meier

Adviser: Donald A Robin

Structural Studies of a Regulator of G-Protein Signaling

Ryan Zachary Puterbaugh², Krisztina Varga¹

¹Biomedical Molecular and Cellular Biology, UNH Durham

²Biomedical, Molecular, and Cellular, UNH Durham

G-protein coupled receptors (GPCRs) are involved in a host of cellular interactions and have been linked to cardiovascular, neurological, and visual disorders as well as many health risks such as diabetes and cancer. The regulators of G-protein signaling (RGSs) have become important targets for new therapeutic interventions, as the inhibition of these proteins could decelerate GTPase activity, affecting the termination of GPCR signaling within the cell. Thiadiazolidione (TDZD) analogues have been identified as inhibitors of RGS proteins, but the exact mechanism for how these small molecules bind to the RGS protein is not fully understood. The goal of the Varga research group is to characterize the ligand binding interface of RGS8 and experimentally characterize protein flexibility and dynamics utilizing nuclear magnetic resonance (NMR) spectroscopy.

Presenter: Ryan Zachary Puterbaugh

Presenter's Major: Biochemistry, Molecular and Cellular Biology

Year at UNH: Senior

Research Interest: Physical Biochemistry

Adviser: Krisztina Varga

Estimated Glomerular Filtration Rates and the Racial Multiplier: Clinical Implications and Current Attitudes

Brittney A Spooner, Juan U Rojo

Chronic kidney disease (CKD) is associated with high morbidity and mortality with increasing worldwide incidence. CKD is characterized by a reduced glomerular filtration rate (GFR), but GFR is difficult to measure directly, requiring the use of estimated glomerular filtration rate (eGFR) equations to approximate GFR based on serum creatinine levels. Some eGFR equations contain a racial multiplier that increases the eGFR of black patients, causing a spurious increase in reported kidney function. This study included a literature search that collected information on the rationale behind the multipliers usage and a survey that gathered information about healthcare professionals' opinion of its use. Use of the multiplier among healthcare systems in the US and globally was found to be inconsistent. Opinions vary among healthcare providers about its use. Applying the racial multiplier increases the eGFR of a patient by 16-21%, which may correspond to a less severe stage of CKD than is appropriate. Lack of consistency in the application of the racial multiplier, coupled with the understanding that race is primarily a social characteristic, contraindicates its inclusion in a diagnostic algorithm. Inappropriate application of the racial multiplier causes delay in necessary treatments for affected patients. The inability to sort people into discrete racial categories on biological lines and lack of studies definitively supporting the racial multiplier calls for reevaluation of its use.

Presenter: Brittney A Spooner

Presenter's Major: Biomedical Science

Year at UNH: Senior

Adviser: Juan U Rojo

Do the Phytoestrogens Daidzein and Equol Impact the Expression of Cellular Communication Network Factor 1 (CCN1) and Vascular Endothelial Growth Factor A (VEGFA) in the Young Bovine Corpus Luteum (CL)?

Donnelly Hutchings, Paul C Tsang

Soy is a rich source of phytoestrogens, chemicals that have beneficial health effects. These include daidzein and equol. Previous studies showed that phytoestrogens may have adverse effects on fertility by affecting the production of progesterone by the CL. The CL produces a variety of angiogenic factors, including CCN1 and VEGFA, but whether they are regulated by phytoestrogens or not is unknown. Thus, the objective of the present study is to determine the effects of daidzein and equol on the expression of CCN1 and VEGFA by the young bovine CL. Day 4 CLs were obtained from dairy cows and dissociated with collagenase. Steroidogenic luteal cells (5×10^5 or 1×10^6) were seeded into 6-well plates containing defined Ham's F12 medium. After 24 hours, medium was changed, and cells remained in culture for 48 hours. Cells were then treated in defined Ham's F12 medium containing luteinizing hormone (LH) in the presence or absence of daidzein (100, 10, 1, and 0.1 μ M) and equol (100, 10, 1, and 0.1 μ M) for 24 hours. Total RNA was extracted and CCN1 and VEGFA expression was determined by quantitative polymerase chain reaction (qPCR). Preliminary results showed that equol at all concentrations besides 100 μ M stimulated VEGFA expression ($p < 0.05$; $n = 2$), daidzein had no effect. Further, preliminary results showed daidzein had no effect on CCN1 expression, although the 0.1 μ M concentration tended to increase ($p = 0.058$; $n = 3$) CCN1. Additional replicates are needed to confirm these observations.

Presenter: Donnelly Hutchings

Presenter's Major: Biochemistry, Molecular and Cellular Biology

Year at UNH: Senior

Adviser: Paul C Tsang

Epidemiological Evaluation of Medical and Behavioral Illness at the Pope Memorial Humane Society

Elizabeth Anne Miller, Sarah E Proctor

Recent trends have shown the demographics of animals entering shelters has shifted from juvenile to senior-aged animals. This increase in the population of senior dogs and cats is believed to be due to a variety of reasons including the success of sterilization programs and recent advances in veterinary medicine (Hawes, 2018). Often when an animal is surrendered to a shelter it is because of owner-related concerns (Basel, 2020). Other major reasons are due to behavioral concerns and medical conditions. This paper aims to explore the frequency of animals entering The Pope Memorial Humane Society (PMHS) due to behavioral or medical illness, primarily focusing on behavioral disorders in dogs and medical conditions in cats. Shelter data from recent years will be analyzed for trends and patterns.

Presenter: Elizabeth Anne Miller

Presenter's Major: Animal Science

Year at UNH: Senior

Adviser: Sarah E Proctor

How Does Agricultural Management Affect the Distribution of Organic N Into Different Soil Pools?

Hayleigh S Hildebrand, Lauren C Breza, Stuart Grady

Anthropogenic nitrogen (N) has greatly altered the natural N cycle due to its widespread use in agriculture. Its overuse is incredibly damaging to many ecosystems and as a result it is important to understand how agriculture can be carried out to minimize these negative effects. The use of cover crops has become a widely known method to ameliorate this problem as their decomposing residues contribute toward amending the bioavailable N pool. This study examines how soil type (conventional or organic management) and isotopically labeled cover crop residues (rye or clover litter) affect the amount of N in different soil fractions and microbial biomass. We collected soils from the Kellogg Biological Station and conducted an incubation experiment where different cover crop residues were added to each soil. Soils were fractionated into particulate organic matter (POM) and mineral associated organic matter (MAOM) and analyzed on an Isotope Ratio Mass Spectrometer. We found that there was significantly more POM and MAOM-N in the organic soil than the conventional soil ($p = 0.002$). We also found a positive relationship between MAOM-N and microbial biomass ($p = 0.0001$, $r^2 = 0.38$). This indicates that microbial biomass may be contributing to the MAOM-N pool. The results of this study help us better understand how agricultural management affect soil N storage in agroecosystems and how management can be optimized to prevent the overuse of N in agriculture.

Presenter: Hayleigh S Hildebrand

Presenter's Major: Environmental Sciences, Russian

Year at UNH: Senior

Research Interest: Soil

Adviser: Lauren C Breza

Adviser: Stuart Grady

Evaluating Alternative Bait Ingredients for the Channeled Whelk Fishery

Mary K Munley, Megan M Molinari, Elizabeth A Fairchild

The channeled whelk (*Busycotypus canaliculatus*) is a large, predatory marine gastropod that supports an important commercial fishery in the United States. Channeled whelk are caught in baited traps. Although fishermen use their own unique blend of ingredients in these traps, the predominant attractant is the American horseshoe crab (*Limulus polyphemus*). Horseshoe crab blood is used in biomedical research to help develop vaccines, thus the crabs already are heavily exploited and an expensive bait ingredient in the channeled whelk fishery. To determine an effective alternative and more sustainable bait that does not require *Limulus* as the primary ingredient, a series of ingredients were tested as whelk attractants: 1) *Limulus* hemolymph (processing waste of the biomedical industry), 2) ground whole green crab (*Carcinus maenas*), 3) clam processing waste, 4) mix of *Limulus* hemolymph, green crab, and gelatin, 5) ground whole green crab with gelatin binder, 6) clam with gelatin binder, and 7) *Limulus* hemolymph with gelatin binder. A total of 64 trials were conducted in which whelk interactions with each ingredient were recorded over a period of 21 hours in seawater tanks during October-November 2020. Analyses included how quickly whelks responded to the bait and feeding duration. Final results will be shared during the Undergraduate Research Conference presentation.

Presenter: Mary K Munley

Presenter's Major: Marine, Estuarine and Freshwater Biology

Year at UNH: Senior

Presenter: Megan M Molinari

Presenter's Major(s): Marine, Estuarine and Freshwater Biology; Neuroscience and Behavior

Year at UNH: Senior

Adviser: Elizabeth A Fairchild

Genetic Variations of Coagulation Factor V Genes Across Populations and Species

Bryan T Landry, W. Kelley K Thomas
Genetics, UNH Durham

Factor V Leiden is a coagulation factor single point mutation on the Factor V gene. This mutation causes by a missense mutation where a single nucleotide is changed resulting in a codon swap coding for a different amino acid. In the case of Factor V the change occurs at nucleotide position 1691 causing the amino acid arginine at position 506 to be replaced with a glutamine resulting in a conformational change to the gene product. The effects of this would be the opposite of the bleeding disorder Hemophilia, which is a mutation occurring on the Factor VIII gene. The Factor V mutation causes a form of Activated Protein C (APC) resistance due to the resulting proteins conformational change ultimately leading to prolonged clotting and in some cases over clotting. What this study aims to do is identify missense mutations across twenty-six human populations acquired from the 1000 genome project, identify if these missense mutations are occurring at a higher frequency in specific populations or species, and if there is a pressure for selection on the genes. To determine pressure of selection the McDonald and Kreitman test will be used to further examine the potential presence of selection or adaptation across populations and species. The secondary aim of this study is to determine the mechanism of evolution for this gene by analyzing species with an ortholog to the human gene via computational analysis. The final aim of this study is to compare the factor V Leiden mutation with factor VIII mutations in order to better understand potential mutations within the two genes given the wild type of both share homology in the C-regions of the gene product which could suggest a potential duplication event.

Presenter: Bryan T Landry

Presenter's Major: Genetics

Year at UNH: Senior

Research Interest: Coagulation Factors, Gene regulation, and Physiology

Adviser: W. Kelley K Thomas

Exploring COVID-19 Effects on Level of Food Insecurity among College Students

Sarah Elizabeth Waleryszak, Laura E Lynch, Jesse Stabile Morrell,
Nutrition, UNH Durham

The coronavirus pandemic has caused financial hardship for many individuals across the United States. This study examines the effects of the COVID-19 pandemic on food security status among young adult college students (18-24 years old) at the University of New Hampshire Durham campus. Students (n=390) were recruited from an introductory nutrition course during the Fall 2020 & Spring 2021 semesters, amidst yellow and orange mode of campus operations, to participate in the continuous cross-sectional study, College Health and Nutrition Assessment Survey (CHANAS). Food insecurity data was collected through a self-reported wellness survey and responses were scaled using the USDA Food 6-Item Insecurity Questionnaire. These results were compared to those from Fall 2018-Spring 2020 (n=880) to see the impact that COVID-19 has had on the status of food insecurity on the UNH Durham campus. We found that 11% of participants experienced food insecurity between Fall 2020 & Spring 2021, with 7.1% with low security and 3.9% demonstrating very low food security. These rates are down from the previous semesters (Fall 2018-Spring 2020) where 18.6% experienced food insecurity with 13.2% having low food security and 5.5% being very low. Further investigation into class standing, on-campus housing participation, dining hall usage, and Pell Grant recipients will be completed in order to better understand the differences among food security status since the start of the COVID-19 pandemic.

Presenter:	Sarah Elizabeth Waleryszak
Presenter's Major:	Nutrition
Year at UNH:	Junior
Research Interest:	Food Insecurity and Covid-19
Presenter:	Laura E Lynch
Presenter's Major:	Nutrition
Year at UNH:	Senior
Research Interest:	Food Insecurity and Covid-19
Adviser:	Jesse Stabile Morrell

Benthic Cyanotoxin Transfer in the Oyster River Food Web

Joseph (Parker) P Philbrick, Katherine E Low, James F Haney

Cyanobacteria are among the oldest organisms on earth. While they are widely studied in limnetic settings, they are found in just about every environment. There are numerous cyanobacteria species, and many of them produce some form of toxin. Some cyanobacteria produce a group of hepatotoxins called Microcystins, and others produce a neurotoxin called beta-methylamino-L-alanine (BMAA). Cyanotoxins can often cause adverse effects in the organisms they accumulate in. Unlike in lake habitats, where cyanobacteria productivity is largely pelagic, stream cyanobacteria often occupy benthic habitats. The purpose of this study was to determine cyanotoxin concentrations in benthic stream cyanobacteria relate to concentrations in macroinvertebrates feeding in the stream benthos and on other invertebrates. Samples were collected from just below the UNH Reservoir dam on the Oyster River, in southern NH. Macroinvertebrates were sampled using a kick net method and benthic cyanobacteria were scrubbed from rocks for toxin analysis. We expect to find cyanotoxins in both periphyton (benthic cyanobacteria and algae assemblages) and stream invertebrates. Cyanotoxins have shown a bioaccumulation effect in other food webs, so we expect predatory invertebrates to have higher concentrations of toxins than benthic feeders. Because of their role in the food web, stream macroinvertebrates may play an important role in the transfer of cyanotoxins within and beyond stream habitats.

Presenter: Joseph (Parker) P Philbrick

Presenter's Major(s): Biology, Sustainability

Year at UNH: Senior

Adviser: James F Haney

Adviser: Katherine E Low

Examining Behavior of Lumpfish, *Cyclopterus lumpus*, Under Differing Light Levels

Jacqueline A Klombers, Joseph Brian Ledan, Elizabeth A Fairchild, Michael B Doherty
Ocean Engineering & Marine Sciences , UNH Durham

Lumpfish (*Cyclopterus lumpus*) are a species of cleanerfish used in the salmon farming industry to control parasitic sea lice infestations. However, little is known about lumpfish behavior in relation to photoperiod. The aim of this study was to determine if there is a correlation between lumpfish activity and light levels. To document lumpfish behavior in relation to light, 20 trials were conducted at the UNH Coastal Marine Laboratory in New Castle, NH, in which a single fish was filmed with time-lapse cameras every 30 seconds for 72 hours in a 400-liter, flow-through, seawater tank. The photoperiod was maintained at 14 hours light and: 10 hours dark. During the dark hours, overhead red lamps provided light for filming. New fish were used in each trial. From the videos, fish activity (swim speed) and position in the tank were scored every 30 minutes and mean values analyzed over time. Final results will be presented at the URC.

Presenter: Jacqueline A Klombers

Presenter's Major: Biology

Year at UNH: Senior

Research Interest: Marine Science

Presenter: Joseph Brian Ledan

Presenter's Major: Marine, Estuarine and Freshwater Biology

Year at UNH: Junior

Adviser: Elizabeth A Fairchild

Adviser: Michael B Doherty

Investigating the Substrate Specificity of Human Lactate Dehydrogenase Using Site-Directed Mutagenesis

Marisol Mendoza, Kaci Sierra Gilbert, Larissa M Fairweather, Rick H Cote, Laurie Fitzgerald Westover

Lactate dehydrogenase (LDH) is an important enzyme in energy metabolism and consists of two major forms that play different roles in aerobic (e.g., heart) and anaerobic (e.g., muscle) tissues in humans. LDH is responsible for the interconversion of pyruvate and lactate, depending on the energy status of the cell. Furthermore, LDH activity is elevated in cancer cells (where anaerobic metabolism predominates) and facilitates tumor progression. Inhibitors of LDH activity are thus promising candidates for cancer treatment, and a better understanding of the enzyme active site of human LDH is therefore important in designing drugs. To better understand the determinants of substrate specificity in human LDH, we relied on previous work with bacterial LDH showing that a single amino acid substitution from glutamine to arginine within the enzyme active site permitted bacterial LDH to prefer oxaloacetate (a substrate for malate dehydrogenase) over pyruvate as a substrate. To evaluate whether human LDH has similar substrate determinants, we constructed bacterial plasmids containing the human heart and muscle LDH sequences and expressed recombinant LDH in *E. coli*. We found that human heart LDH was expressed and purified in an active form, whereas human muscle LDH expression led to inactive protein. A glutamine-to arginine mutant of human heart LDH will be tested to advance our understanding of the binding specificity of human LDH and to aid the future design of novel LDH inhibitors.

Presenter:	Marisol Mendoza
Presenter's Major:	Biochemistry, Molecular and Cellular Biology
Year at UNH:	Senior
Presenter:	Kaci Sierra Gilbert
Presenter's Major:	Biochemistry, Molecular and Cellular Biology
Year at UNH:	Junior
Presenter:	Larissa M Fairweather
Presenter's Major(s):	Biochemistry, Molecular and Cellular Biology
Year at UNH:	Senior
Adviser:	Rick H Cote
Adviser:	Laurie Fitzgerald Westover

Assessing the Impacts of COVID-19 on Plastic Consumption and Recycling Behaviors on College Campuses

McKenna Leigh Wells, Patricia M Jarema
NREN, UNH Durham

For several years, members of the UNH community have been participating in research through a project called “Plastics Recycling Awareness and Assessment”; a survey conducted by professor Patricia Jarema and her biological statistics students. The survey attempts to reach a random sample of community members, including on-campus, off-campus, and commuter students, as well as faculty and staff at the University of New Hampshire (UNH) and Eastern Connecticut State University (ECSU). The survey questions address individuals’ recycling habits and related behaviors, varying from quizzing participants on their knowledge of proper recycling techniques, to assessing personal plastic use and motivation behind recycling. In 2020, the survey was updated to include additional questions regarding COVID-19 policies and impacts on plastic purchasing and recycling habits. Survey responses from 2019 and 2020 were analyzed to investigate the impacts of COVID-19 on plastic consumption and recycling habits between the two college campuses. Findings include a significant increase in some single use plastic items during the COVID-19 pandemic (2020), compared to the pre-pandemic responses (2019), as well as significantly incorrect recycling choices at both college campuses. These findings indicate how single use plastics consumption has not only increased due to the pandemic, but are also being improperly recycled across both college campuses.

Presenter: McKenna Leigh Wells

Presenter's Major: Environmental Sciences

Year at UNH: Senior

Research Interest: How has COVID-19 impacted plastic consumption and recycling behaviors on college campuses?

Adviser: Patricia M Jarema

The Impact of Sedges on Belowground Methane Concentration and Diffusion in a Temperate Peatland

Angelica Marie Dziurzynski¹, Ruth K Varner²

¹Department of Earth Sciences, UNH Durham

²Earth Science, UNH Durham

Increasing greenhouse gas emissions result in climate warming. Methane is a greenhouse gas with a global warming potential significantly greater than that of carbon dioxide. Wetlands are the largest natural source of methane to the atmosphere. Methane is emitted through three dominant transport pathways: diffusion, plant-mediated transport, and ebullition, or bubbling. Vascular plants found within wetlands are an important factor in methane emissions, since they can affect methane transport pathways as well as provide labile carbon for methane producing microbes. The objective of this project was to determine how the concentration gradient of methane in water belowground varies between vegetation communities at a local peatland, Sallie's Fen. Methane efflux measurements were made at 10 sites within the fen using static flux chambers, in addition to porewater and meteorological measurements. An aerial survey was also conducted and the results were used to create a vegetation map that allowed flux and porewater measurements to be scaled across the fen. It can be concluded that the sedge *Carex* spp. influenced the strength of the gradient of belowground dissolved methane. These results further our understanding of methane transport pathways in wetlands, as well as how vegetation impacts emissions.

Presenter: Angelica Marie Dziurzynski

Presenter's Major(s): Earth Sciences, Marine, Estuarine and Freshwater Biology

Year at UNH: Junior

Research Interest: Biogeochemistry

Adviser: Ruth K Varner

Comparison of Methods to Quantify Changes in Tree Productivity under Drought Conditions

Tanner R Frost, Matthew A Vadeboncoeur
NREN, UNH Durham

This project examines the effects of drought on two key northeastern forest timber species, American beech (*Fagus grandifolia*) and red maple (*Acer rubrum*). As CO₂ levels in the atmosphere continue to rise, temperatures have increased, and rainfall has become more variable. This increases the frequency and severity of droughts, possibly changing the rate at which northeastern forest species sequester carbon.

Using tree growth data collected from the DroughtNet experiment at Hubbard Brook in Woodstock, NH, I compared trees treated with artificial rainfall reduction against control trees. In the DroughtNet study, the treatment trees receive a rainfall reduction of 50% for three years and a 95% reduction for one year using throughfall exclusion structures to divert rainwater. My key questions were: 1) “What effects do severe drought conditions have on red maple and American beech” and 2) “How does the choice of measurement method affect the outcome of experiments similar to this?” To answer these questions, measurements were gathered using dendrometer bands which measure circumference growth around the tree and tree core samples which measure annual growth increment through growth ring thickness.

Results of statistical analysis showed that the treatment had no significant effect on tree growth in either measurement method. However, this may be due to the design limitations of the experiment. Future experiments might require longer precipitation reduction, larger aerial coverage, and minimization of overland water flow to detect significant growth effects on the droughted trees.

Presenter: Tanner R Frost

Presenter's Major: Forestry

Year at UNH: Senior

Research Interest: Climate Change

Adviser: Matthew A Vadeboncoeur

Phytoplankton Growth Response to Microplastics

Elizabeth A Nerney, Liz Lucas Harvey
Biological Sciences , UNH Durham

Microplastics are an increasing hazard in marine environments. Understanding the impacts of microplastics on marine organisms will allow us to better predict the effects of this ongoing pollutant. Of similar size to many microplastic particles are phytoplankton, single-cell algae that are pivotal organisms in the marine environment. They are the base of most marine food chains, produce oxygen, and cycle nutrients and carbon. The research presented here investigated how phytoplankton growth rates were affected by microplastics, when co-cultured together. Microbeads at a gradient of concentrations were cultured together with phytoplankton and changes in growth rate were observed via flow cytometry. Thus far, several species of phytoplankton have been tested, and no significant impact on growth rate has been observed relative to increased microbead concentration. Additional experiments continue with a range of phytoplankton species. These results highlight the importance of understanding how all members of the marine community may or may not be impacted by marine pollutants such as microplastics.

Presenter: Elizabeth A Nerney

Presenter's Major: Marine, Estuarine and Freshwater Biology

Year at UNH: Sophomore

Research Interest: Phytoplankton and Microplastics

Adviser: Liz Lucas Harvey