ABSTRACTS FOR

ORAL PRESENTATIONS

(in order of presentation)

CHANGE IN RELATIVE POPULATION ABUNDANCE AND DISTRIBUTION OF HOCHSTETTER'S FROG (*LEIOPELMA HOCHSTETTERI*) IN MAUNGATAUTARI ECOLOGICAL ISLAND, NEW ZEALAND

Heidi Giguere and Ria Brejaart
Department of Natural Resources & the Environment, UNH

Native New Zealand frogs (*Leiopelma* spp.) have suffered extinctions since human settlement brought introduced mammalian pests to the country. Since the discovery in 2004 of a population of Hochstetter's frog (*Leiopelma hochstetteri*) in Maungatautari Ecological Island, a pest-proof fence has been established and all mammalian predators have been eradicated. Mammalian pests are known to prey on native frog species, and can also create habitat instability which has been linked to population declines. With pest eradication, habitat suitability and quality has significantly improved, benefiting the health of the frog population. Results have shown an increase in relative abundance of Hochstetter's frogs, an increase in the proportion of juveniles in the populations, and an increase in spatial distribution within the enclosure. These results suggest that the eradication of pests has had a significant positive effect on this frog population.

IN SITU OCEANOGRAPHIC LIDAR AS A TOOL FOR RETRIEVING AND CHARACTERIZING PARTICLE DISTRIBUTIONS IN THE OCEAN

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An *in situ* LiDAR system (*i*LiDAR) was deployed from a surface vessel on a cruise in the Chesapeake Bay in June 2015, and the profiles retrieved were compared with other water column optical properties measured *in situ*. An *i*LiDAR offers several advantages when compared to airborne or satellite based LiDAR. Examples include the cost effectiveness of use on a cruise, the ability to make other measurements simultaneously, increased spatial coverage, and a shorter time frame of data collection. The system attenuation values (K_{sys}) retrieved from the *i*LiDAR profiles were compared to a variety of optical properties measured on station. A linear regression modeling the relationship between diffuse attenuation (K_d) and the *i*LiDAR system attenuation yielded a near 1:1 relationship ($m=0.9903$, $R^2=0.8144$, $p<0.05$). The *i*LiDAR can provide a reasonable estimate of diffuse attenuation within the water column, which can be used to estimate chlorophyll and primary production. The depolarization ratio of the backscattered *i*LiDAR signal was compared to the backscatter ratio in an attempt to better understand the distribution of particles throughout the water column. The results of this analysis were not conclusive, but the potential for the *i*LiDAR to detect changes in types of particles in the water column is described.

THE EFFECT OF THE EARTH'S MAGNETIC FIELD ON THE RESTING POSITION OF *CANIS FAMILIARIS*

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With dogs (*Canis familiaris*) in over 43 million households in the U.S., learning more about their behavior can enrich our relationship with them. Although much research has been done on certain sensory modalities in dogs, magnetoreception has received relatively little attention in this species. Hart et al. (2013) found that dogs use the Earth's magnetic field to preferentially defecate on a north/south (N/S) axis. If the magnetic field affects a dog's defecation alignment, might it also impact a dog's resting alignment? Pilot data I have collected suggest that dogs do use the Earth's magnetic field to orient themselves when lying down. Here, I follow up on this preliminary work. Based on Hart et al.'s findings regarding defecation, I first hypothesize that dogs will show a similar preference when lying down and show a collective preference for the N/S axis. Alternatively, dogs may exhibit individual preferences for a magnetic axis when lying down; this predicts that dogs will show within-individual consistency regarding their resting alignment, but no universal patterns across individuals. To test these predictions, I will use a compass to record the directional alignment of a dog's thoracic spine when it lies down. I will make 20 observations per dog for each of 60 dogs. This research will not only enhance our understanding of dog behavior, but more broadly, it may also contribute to our knowledge of how animals use the Earth's magnetic field to make behavioral decisions.

THE EFFECT OF OCEAN ACIDIFICATION ON THE FEEDING BEHAVIOR OF THE AMERICAN LOBSTER (*HOMARUS AMERICANUS*)

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The American lobster (*Homarus americanus*) fishery is one of the most lucrative fisheries in New England. Lobsters are attracted to traps by the odor of the bait, which they detect with a variety of chemical receptors. Recent studies in other laboratories indicate that changes in pH might interfere with the ability of odorants to bind to these chemoreceptors. Therefore, the working hypothesis for this project was that climate change induced ocean acidification would impair the responses of lobsters to bait. Typically, in normal seawater, lobsters responded to the presence of bait by increasing activity and moving towards the bait. However, when the pH of the seawater was reduced, by bubbling CO_2, the overall activity of the lobsters was reduced and lobsters did not respond as quickly or clearly to the bait. These data suggest that ocean acidification could have a significant impact on the lobster fishery.

CHARACTERIZATION OF ROD AND CONE Pγ AFFINITY FOR PDE6 CATALYTIC DIMER AND EFFICIENCY OF ACTIVATION BY TRANSDUCIN

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The ability to see is a result of a complex biochemical cascade, triggered by the visual pigments in the eye. The vertebrate retina contains two distinct photoreceptor cells: rods and cones. Rods mediate night vision, while cones mediate day vision. Phototransduction in these two cells is regulated by phosphodiesterase (PDE6), an enzyme that degrades the intracellular messenger, cGMP. PDE6 is composed of an alpha and beta subunit, and two identical inhibitory gamma subunits (Pγ). A secondary protein, transducin (Tα), can bind the Pγ subunits and relieve the inhibition from PDE6. Differences between the rod Pγ and cone Pγ amino acid sequences may result in different affinities for the PDE6 catalytic dimer or the efficiency of activation by transducin. We hypothesize that the transducin α-subunit has a greater binding affinity to rod Pγ than the cone. We have expressed recombinant rod Pγ and cone Pγ, and tested their ability to inhibit the purified catalytic dimer. Results show that cone Pγ has a lower affinity to bind to and inhibit rod Pαβ. We are currently testing the ability of Tα to activate purified PDE6 containing rod and cone Pγ subunits. This work provides a biochemical basis for the physiological differences between rod and cone phototransduction pathways.

AN EXAMINATION OF THE FACTORS THAT CONTROL NITRATE RETENTION IN MAN-MADE RESERVOIRS

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In this study, we examined eight reservoirs located in four different coastal watersheds in New England, USA, to analyze the role that characteristics such as depth, surface area, and flow conditions play in regards retention of nitrate. At the inflows and outflow of each reservoir, we measured conductivity, dissolved oxygen, total suspended solids, chlorophyll, and nutrients. Using conductivity and watershed area, we created a mass balance for each reservoir. In most cases the conductivity mass balance indicated that hydrologic inputs and outputs were at equilibrium during sampling, allowing us to assess the alteration of non-conservative material fluxes. Nitrate removal was found to decrease with increasing hydrologic load, and TDN removal was similar to values described in the literature. Chlorophyll a concentrations decreased with increasing hydraulic load, suggesting that biotic assimilation plays a key role in nitrate removal at low hydraulic loads. DON production increased with nitrate removal in the smallest reservoirs, suggesting that nitrate transformation to DON is occurring. With nutrient loading from anthropogenic sources, and increased push for small dam removal, this study provides useful information regarding the benefits of low head dams, and the impact that their removal may have on nitrogen export from river networks.

A COMPARATIVE ANALYSIS OF THE NEST STRUCTURE OF SALTMARSH, NELSON'S, AND SALTMARSH-NELSON'S HYBRID SPARROWS

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Few species are able to inhabit the harsh environment provided by salt marshes. Saltmarsh sparrows (*Ammodramus caudacutus*), Nelson's sparrows (*Ammodramus nelsoni*), and their hybrids are ground nesting birds that are adapted to this hostile habitat. Monthly flood tides inundate the marsh and often cause their nests to fail by washing the eggs and nestlings out. Some features of nest structure, however, may contribute to reproductive success by decreasing flooding impacts. We hypothesized that Saltmarsh sparrows, a species that is restricted to salt marsh habitat, would build nests with characteristics that make them more resistant to flooding than Nelson's sparrows, which are not salt marsh obligates. We also hypothesized that females of any species would change their nest structure following a failure due to flooding. We collected nest structure measurements, including nest height and location, presence of a woven dome, percent of the nest visible from above, and the composition and average height of vegetation around the nest from the two sparrow species and their hybrids at four study sites in Maine, New Hampshire, and Massachusetts. Nest structure data were compared across groups as well as across repeat nesting events of individual females. Our results will provide a deeper understanding of the nesting ecology of these species and the impacts of hybridization and sea level rise that will allow the creation of effective conservation strategies for these threatened birds.

ABSTRACTS FOR

POSTER PRESENTATIONS

ASSESSING HUNGER ISSUES AMONG UNIVERSITY OF NEW HAMPSHIRE STUDENTS

Alana Davidson and Jesse Morrell
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In 2014, 7.9 million children lived in households where both children and adults were food insecure. As college students are excluded from national surveillance data, it is difficult to characterize the prevalence of food insecurity among this population. The purpose of this study was to determine the prevalence of food insecurity among college students and contributing factors. A 31-item online survey was developed by combining the USDA 6-item Short Form U.S. Household Food Security Survey, the USDA Child Food Security Survey, and UNH-specific questions related to food access. The online survey was sent to students in fall 2015 (n=946, 79% female). Survey results indicate that, during the past year, 4.1% of students (>18 years) reported experiencing very low food security, 19.9% reported low food security and 10.5% reported marginal food security. During their childhood, 6.3% of students reported very low food security, 12.7% low food security and 9.5% reported marginal food security. In elementary, middle, and high school, 16.6% of students surveyed qualified for free and reduced-priced school breakfast/lunch. Students were most likely to rank educational expenses as the highest priority, food was second leading highest priority (56% vs. 36%, $p<.01$). This research shows that food insecurity impacts a significant number of UNH students. Further research is warranted to assess the prevalence on other college campuses and identify sustainable solutions.

THE EFFECT OF ELECTROSTATIC CHARGE ON DNA OLIGONUCLEOTIDE INTERACTIONS

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The electrostatic charge of nucleic acid polymers (DNA and RNA) is linked inextricably to their structure. However, there is little experimental data to determine what the charge/structure relationship is. Membrane confined electrophoresis (MCE) has been used to measure the charge on DNA oligonucleotides. These data are needed to test various models, including the Debye-Hückel-Henry, counterion condensation, and a Grand Canonical Monte Carlo simulation that provide estimates of DNA charge. Previously, data were gathered on short oligonucleotides in a solvent consisting of 100 mM KCl, 10 mM Tris, pH 8. However, it is known that DNA interacts strongly with Mg^{2+}, but only weakly with Ca^{2+}. Accordingly, experiments have been undertaken to determine the effect of 3 mM on the charge and shape of the DNA.

DIET AND NUTRITION OF LONG-DISTANCE HIKERS ON THE APPALACHIAN TRAIL: A CROSS-SECTIONAL STUDY

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Long-distance hikers (LDH) often subsist on limited food items due to weight and food preparation restrictions. Thus, understanding their nutritional status is crucial. Due to the lack of existing data, the aim of this study was to characterize the nutritional status, dietary behaviors, and basic nutrition knowledge and concerns of LDH trekking the Appalachian Trail (AT). Between Aug–Nov 2014 LDH (n=39) were recruited on the AT and asked to complete an initial survey (IS) of their diet and nutrition knowledge. Participants were invited to complete a 24h diet recall (n=21) and a follow-up email survey (FS) (n=15). While 69% felt nutrition was very important to their success on the AT, only 10% felt they consistently met their nutritional needs; 67% failed to eat any vegetables (0 svgs/day) and 46% failed to eat any fruit (0 svgs/day). 24h data showed most hikers met or exceeded recommended intakes for 18 of 22 micronutrients. However, 67% and 76% consumed <90% of the AI for potassium and the RDA for vitamin D, respectively; 71% consumed <90% of the RDA for vitamins A, C, and K; and 95% surpassed the UL for sodium. Eighty percent of LDH who responded to the FS reported losing weight (mean loss=26lbs). FS data indicated that the majority (86%) of LDH worried about having enough food; 29% ran out of food at some point during their trek. Elucidating shortcomings in the LDH diet will provide areas for further nutrition education and methods for improving LDH health and performance.

THE EFFECTS OF INTERMITTENT SWIM STRESS ON MORPHINE-INDUCED CONDITIONED PLACE PREFERENCE

Jacqueline Watts and Robert Drugan
Department of Psychology, UNH

Stress induced anxiety disorders are prevalent throughout society and are often coupled with substance abuse. Patients often find current treatments inadequate and resort to self-medication with drugs of abuse. However, some individuals exposed to traumatic events seem to be resilient, while others are more vulnerable and develop disorders like PTSD. Further research is essential, as these disorders are linked to the increase in addiction. The current study investigated a link between stress and the potentiation of morphine conditioned place preference in two experiments. In exp. 1, subjects explored both sides of the chamber for 20 minutes on day 1 and experienced the stress (ISS) on day 2. Day 3 and 4 consisted of morphine (3 mg/kg SC) and saline conditioning. The CPP test occurred on day 5. The results of exp. 1 showed a drug conditioning effect, but no stress effect. Exp. 2 was conducted to see if conditioning pre-ISS showed a stress effect on morphine CPP. Conditioning was done on days 2 and 3 and ISS was administered on day 4. The results of exp. 2 were the same as exp. 1. Subjects demonstrated a conditioning effect to morphine, but stress had no increased effect on morphine potentiation. Subjects that underwent ISS compared to home cage groups did not show an increased conditioning effect. This investigation was done to better understand how stress affects the rewarding properties of a drug and how resilient individuals may be able to innately cope with stress.

PREDICTING THE ABUNDANCE OF SHRUBLAND-DEPENDENT SONGBIRDS IN MANAGED SHRUBLANDS IN SOUTHEASTERN NEW HAMPSHIRE

Erica Holm, Jennifer Kerr, and Matthew Tarr
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Shrubland habitat and wildlife species, such as birds and cottontails, have been declining throughout most of New England since the 1950s. Many songbirds that have been declining at a rate of 4 to 7 percent per year in New England, require large openings to breed. Large shrubland openings are uncommon and today's birds rely primarily on humans to create and maintain their required habitats. As that is a costly venture, ensuring the specific size and structural needs of each bird species are met is beneficial. Our study focused on prairie warblers and field sparrows, as these species cover each end of the summer breeding season and all shrubland habitat types. We determined presence/absence and abundance of these birds in 40 shrubland habitats in Grafton County, New Hampshire of four types: recent clearcuts, powerline rights-of-way, regenerating old fields and gravel pits by mist netting, male bird song playback, banding, and binoculars. Additionally, we measured vegetation density, height and percent cover to determine if these site characteristics could be used to predict the presence/absence and abundance of these birds. Most of the birds we captured and/or resighted were in powerlines (44.8%) and gravel pits (37.6%). Both of these sites had the least percent cover and shortest grasses ($p<0.0001$; $p<0.0001$) and forbs ($p=0.005$; $p=0.003$) and the highest percent cover of bare ground ($p<0.0001$) with the lowest density ($p<0.001$).

SKELETAL INJURIES IN SMALL MAMMALS: A MULTI-SPECIES ASSESSMENT OF INJURY TYPE AND PREVALENCE

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Skeletal injuries in wild animals can impact survival, reducing an individual's ability to avoid predation and compete for resources. Recent studies of skeletal injuries in small mammals are limited to an individual or a single species. Our study takes a comparative perspective, looking across a suite of small mammal species to determine whether certain traits such as eating behavior and locomotion type, as well as age can affect the occurrence of skeletal injuries. A total of 2884 skeletons of seven representative small mammal species collected at Bartlett Experimental Forest, New Hampshire were inspected for injuries and aged. These species were binned together based on trait groups and compared across groups to determine significant differences in occurrence of injuries using a chi-square goodness of fit test. Skeletal injuries in the forelimbs, skull, pelvis, and fibula showed significant differences across trait groups. These bones can affect survival of a species differently based on their traits, whereas injuries in bones that affect all species similarly (ribs, tails) did not show significance across trait groups. This suggests that traits such as eating behavior and locomotion type do impact the occurrence of injuries. Age showed a significant difference, with older animals amassing more injuries; evidence that injuries are acquired throughout a life time, not associated with a certain age.

THE ABILITY OF HORSESHOE CRABS (*LIMULUS POLYPHEMUS*) TO DETECT CHANGES IN TEMPERATURE

Vilma Vaattovaara[1] and Winsor Watson[2]
[1]Department of Molecular, Cellular, & Biomedical Sciences, UNH
[2]Department of Biological Sciences, UNH

Each spring horseshoe crabs (*Limulus polyphemus*) migrate up into estuaries and bays and spawn. The available data suggest that during these migrations they are seeking the warmest water possible. However, it is not known if they can sense water temperature. In this study a cardiac assay was used to determine if horseshoe crabs can detect changes in water temperature. Horseshoe crabs were placed in a light-tight chamber that was constantly perfused with 12°C seawater. Their heart rate was monitored using impedance converters connected to Powerlab data acquisition system. In addition, both the horseshoe crabs' internal temperature and the temperature of the water in the chamber were continuously recorded. After giving the animal at least 3 hours to adjust to the chamber, warm seawater was added and a change in heart rate was considered to be an indication that they sensed the change in water temperature. Control trials involved the same procedure, but no change in water temperature. It was concluded that horseshoe crabs can sense changes in water temperature. Now were are trying to determine how small a change in temperature they can detect and where the temperature receptors are located.

CHANGE IN RELATIVE POPULATION ABUNDANCE AND DISTRIBUTION OF HOCHSTETTER'S FROG (*LEIOPELMA HOCHSTETTERI*) IN MAUNGATAUTARI ECOLOGICAL ISLAND, NEW ZEALAND

Heidi Giguere and Ria Brejaart
Department of Natural Resources & the Environment, UNH

Native New Zealand frogs (*Leiopelma* spp.) have suffered extinctions since human settlement brought introduced mammalian pests to the country. Since the discovery in 2004 of a population of Hochstetter's frog (*Leiopelma hochstetteri*) in Maungatautari Ecological Island, a pest-proof fence has been established and all mammalian predators have been eradicated. Mammalian pests are known to prey on native frog species, and can also create habitat instability which has been linked to population declines. With pest eradication, habitat suitability and quality has significantly improved, benefiting the health of the frog population. Results have shown an increase in relative abundance of Hochstetter's frogs, an increase in the proportion of juveniles in the populations, and an increase in spatial distribution within the enclosure. These results suggest that the eradication of pests has had a significant positive effect on this frog population.

REGIONAL PATTERNS OF WHITE-NOSE SYNDROME PRESENCE IN BIG BROWN BATS

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White-Nose Syndrome (WNS), a fungal disease impacting bat populations in North America, is among the most devastating wildlife diseases ever recorded. The causative agent, *Pseudogymnoascus destructans*, has been detected on bat species hibernating in caves but little is known from bats in man-made sites. Sampling of bats at a bunker at Odiorne Point in Rye, New Hampshire failed to detect *P. destructans*. Moreover, despite past diversity of bat species at this site, only one species, the big brown bat (*Eptesicus fuscus*), was present. Consequently, we were interested why no *P. destructans* was present, and to what degree *P. destructans* was impacting big brown bats. From sampling across 23 states, I found that the percent of bats infected with *P. destructans* and the average load had substantially decreased in the Northeast, while the Midwest indicated a slow increase. Comparing the trends seen here to the emergence of WNS may predict that the highest prevalence and load of *P. destructans* is during periods when the fungus first appears in that region, followed by progressive decline in infection and load. Thus, it is possible that the decline seen in the Northeast region could help predict the future of WNS in big brown bats and other bats throughout North America.

THE EFFECTS OF HISTONE DEACETYLASE INHIBITOR TREATMENT ON EXECUTIVE FUNCTION AND PREFRONTAL CORTEX IN ADOLESCENT RATS

Gwyneth Welch[1] and Jill McGaughy[2]
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In preclinical models, histone deacetylase inhibitors (HDACi) have been proposed as a potential class of cognitive enhancers for neuropsychiatric diseases associated with deficits in learning and memory. The effects of these potential cognitive enhancers on executive function, specifically selective attention, during normal neurodevelopment remain unknown. Work from our lab show high densities of norepinephrine transporters in prefrontal cortices during adolescence leads to immaturities in attentional set shifting that are mitigated by administration of selective norepinephrine reuptake inhibitors. HDACi increase transcription of norepinephrine transport (NET) protein, which is hypothesized to further decrease extracellular norepinephrine and increase cognitive rigidity in adolescent rats. We investigated the effects of HDACi on the performance of adolescent rats in an attentional set shifting task (ASST). Adolescent animals treated with sodium butryrate (0.0, 0.3 or 0.6 g/kg/ml) showed differential effects on performance that varied based on cognitive demands. Western blotting assessed HDAC inhibition in prefrontal subregions critical to executive function as well as the effect of this drug on adolescent cortical NET levels. These data will provide information regarding the use of HDACi as cognitive enhancers during a key developmental period and will provide additional information on the role of specific subregions of the prefrontal cortices in moderating these effects.

DO DISSOLVED MICROCYSTINS AEROSOLIZE IN FRESHWATER LAKES?

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Cyanobacteria are ubiquitous microorganisms found in both marine and terrestrial environments. In aqueous environments, a high nutrient load can result in blooms where cyanobacteria (A.K.A. blue-green algae) are visible as blue/green carpets across freshwater surfaces. Adverse effects arise when cyanobacteria die and lyse, releasing dissolved forms of toxins into the water. Even in the absence of cyanobacteria blooms, dissolved microcystin has been detected in fresh water systems. The most abundant of these is a hepatotoxin called microcystin. This toxin bioaccumulates in aquatic animals and enters human bodies through ingestion and inhalation. The cellular form of microcystin found in cyanobacteria and its effects from aerosolization have been studied, but little research has been done on the effects of microcystin in the free and dissolved forms. Our study tests the hypothesis that dissolved microcystins aerosolize and thus contribute to the overall toxin amount in the air. We have developed a method to capture aerosolized toxins on a glass fiber filter (GFF). Two different methodologies were tested to determine whether a methanol or water extraction from the filters would result in the highest yield of microcystin. After collection of aerosols, the toxins were extracted from the filters and analyzed using the enzyme-linked immunosorbent assay (ELISA). The implications to possible human risk from dissolved microcystin exposure are discussed.

IN SITU OCEANOGRAPHIC LIDAR AS A TOOL FOR RETRIEVING AND CHARACTERIZING PARTICLE DISTRIBUTIONS IN THE OCEAN

Adrien Flouros[1] and Richard Zimmerman[2]
[1]Department of Natural Resources & the Environment, UNH
[2]Department of Ocean, Earth, and Atmospheric Sciences, Old Dominion University

An *in situ* LiDAR system (*i*LiDAR) was deployed from a surface vessel on a cruise in the Chesapeake Bay in June 2015, and the profiles retrieved were compared with other water column optical properties measured *in situ*. An *i*LiDAR offers several advantages when compared to airborne or satellite based LiDAR. Examples include the cost effectiveness of use on a cruise, the ability to make other measurements simultaneously, increased spatial coverage, and a shorter time frame of data collection. The system attenuation values (K_{sys}) retrieved from the *i*LiDAR profiles were compared to a variety of optical properties measured on station. A linear regression modeling the relationship between diffuse attenuation (K_d) and the *i*LiDAR system attenuation yielded a near 1:1 relationship ($m=0.9903$, $R^2=0.8144$, $p<0.05$). The *i*LiDAR can provide a reasonable estimate of diffuse attenuation within the water column, which can be used to estimate chlorophyll and primary production. The depolarization ratio of the backscattered *i*LiDAR signal was compared to the backscatter ratio in an attempt to better understand the distribution of particles throughout the water column. The results of this analysis were not conclusive, but the potential for the *i*LiDAR to detect changes in types of particles in the water column is described.

CONTOURING THE GENOMIC TRANSFORMATION IN *ARABIDOPSIS THALIANA* FOR MUTATION ACCUMULATION LINES FOR DNA DAMAGE RESPONSE GENES

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The objective of this study is to increase our understanding of mutation accumulation in multicellular genomes with deficiencies in the DNA damage response regulators employing the model organism *Arabidopsis thaliana*. We compare and quantify genomic mutations between wild-type cells and cells defective in global regulator ATR of the DNA damage response mechanism. We have established mutation accumulation (MA) lines for whole genome mutation analysis. Assembly and analysis of the MA line genomes show a spectrum of genome rearrangements as compared to point mutations. Defects in ATR and related repair pathways generate a unique spectrum of mutational events that can be used to predict similar genomic deficiencies in other organisms. A combination of bioinformatics, genomic analysis and a model organism that tolerates mutation accumulation of DNA damage response genes sheds light on how global regulators of the DNA damage response affect overall genomic stability and how defects in these genes contribute to genomic instability. Understanding how global regulators of the DNA damage response affect genomic stability in healthy human cells and how defects in these genes contribute to genomic instability seen in cancer cells requires the knowledge of how and why specific mutation occurs. This study bridges a critical gap in knowledge, how genomes of multicellular organisms respond to genome instability when essential genes involved in the DNA repair pathway are mutated.

QUANTITATIVE SURVEY OF THE FLORA OF APPLEDORE ISLAND, MAINE

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A vascular plant survey (July, 2015) was completed on Appledore Island, seven miles off of the coast of Maine. Previous studies have provided comprehensive floral inventories of Appledore. However, they did not allow for quantitative analysis of floristic data. Our study utilized a quantitative approach to document the major plant communities, species richness, and percent cover. Data were collected using transects on which quadrats were haphazardly placed in each habitat. Ground, shrub and canopy covers were assessed and species in each cover class were identified. In addition, species of interest (rare and invasive) were noted and their population centers geo-located. We documented 68 genera, 83 species, from 35 families, representing 24.3% of the total taxa observed by prior floral inventories. The most common taxa noted per sampling plot were *Ilex verticillata* (32.8%) and *Prunus serotina* (26.6%). However, presence was not necessarily a predictor of dominance. *Ilex verticillata* was both common and a dominant component of plot-wise percent cover (43.1%), while *Solidago rugosa* was common (21.9% per sampling plot), but a minor component of cover (9.4%). Recognizing that a complete floral inventory of the island already exists, our study builds upon these data to provide critical information on the spatial distribution of habitats and the species they contain, allowing for long term assessment of floristic stability and population fluctuations over spatial and temporal scales.

THE RELATIONSHIP BETWEEN HEALTHY LIFESTYLE FACTORS AND PERCEIVED STRESS AMONG COLLEGE STUDENTS

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College is a unique time period in which students begin to adopt various health promoting behaviors. However, little is known about the relationship between adherence to these health behaviors and students' perceived stress (PS). This study assesses the relationship between 5 healthy lifestyle factors (HLFs) and PS among undergraduates (ages 18-24). Anthropometric, dietary and lifestyle data were collected from students (n=1584, 18.8±1.0 years, 71% female) participating in the ongoing, cross-sectional College Health & Nutrition Assessment Survey between Aug 2012-May 2015. PS was measured via online 10-item questionnaire with scores ranging 0-40. PS scores ranged from 0 to 36 (15.1±.2); females reported higher PS compared to males (15.7±.2 vs 13.7±.3; $p<.05$). HLFs included healthy BMI (75%), healthy diet (44%), non-smoker (94%), non-binge drinker (37%), and physically active (40%). The mean number of HLFs was 2.9±.03. Participants were grouped according to total # of HLFs (0-1, 2, 3 & 4-5); females were more likely than males to display 4-5 HLFs (31% vs 18%, $p<.01$). Among females, PS scores were negatively correlated with # of HLFs ($p<.01$); no correlation was observed for males. Group difference between PS scores were also examined by sex. Females with 2 HLFs reported higher PS than those with 3 or 4-5 HLFs (16.5±.4 vs 15.3±.3; vs 15.1±.3, $p<.01$); there were no differences for males Findings suggest that, among college females, PS may be reduced with greater adherence to HLFs.

EXAMINING THE RELATIONSHIP BETWEEN FRUIT AND VEGETABLE CONSUMPTION, DIET QUALITY, AND METABOLIC SYNDROME

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Most U.S. adults fail to meet daily fruit and vegetable (FV) intake recommendations. In 2013, the adults meeting fruit and vegetable recommendations were 13% and 9% respectively. Eating more FVs adds essential nutrients to the diet and may reduce one's risk for metabolic syndrome (MS). The purpose of this study was to see if there is a relationship among mean adequacy ratio (MAR), FV consumption, and MS criteria in college students. The MAR was calculated by averaging a person's nutrient adequacy ratio (NAR) of 5 nutrients: folate, vitamin A, vitamin K, fiber, and vitamin C. The NAR was found by dividing the average intake of each nutrient by the RDA; nutrient intake was based on analysis of 3-day food records (DA Plus). NAR values were capped at 1. Participants (n=5024, 74% female, ages 18-24) were divided into 3 categories based on their FV intake (cups/day): adequate (if male and $FV \geq 5$ or female and $FV \geq 4.5$), low (if male and $2.5 < FV < 5$ or female and $2.25 < FV < 4.5$), and very low (if male and $FV \leq 2.5$ or female and $FV \leq 2.25$). FV consumption was positively correlated to MAR (male $r=0.521$; female $r=0.491$; both $p<.05$). In ascending order of FV groups, the mean MARs were 0.58, 0.69, 0.77 for men and 0.60, 0.71, 0.76 for women. No significant relationship between MAR and MS or FV and MS were observed. Findings suggest that college students who eat more FVs have a more nutrient-dense diet. Future research may study the correlation among other diet scores and MS parameters.

ANALYZING THE EFFECTS OF SPHINGOLIPID ENZYMES IN LINKING OBESITY AND ACUTE MYELOID LEUKEMIA

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Acute myeloid leukemia (AML) is a hematological malignancy which is characterized by an expansion in the number of myeloid cells. Previous studies have shown that obesity may be a risk factor for the development and progression of AML. An area of increasing relevance in cancer research is that of sphingolipid biology. Sphingolipids are bioactive molecules, which are involved in cellular signaling pathways and membrane structure. This study suggests that cellular conditions modeling obesity will induce changes in sphingolipid metabolism, leading to characteristics of more severe disease. AML cell lines were raised in a control media as well as a media containing the fatty acid, palmitic acid. The results show alterations in levels of sphingolipid enzyme expression in the cell lines cultured in high fat media, compared to the control media. These results provide biological insights for the development of more specific nutritional interventions or sphingolipid-modulating therapeutics for AML.

FROM VISION TO REALITY: RECIPES FOR *A NEW ENGLAND FOOD VISION*

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The purpose of this project was to analyze the nutrient profile, and associated costs, of the proposed Omnivore's Delight (OD) dietary pattern as explored in *A New England Food Vision* (published in 2014). The OD reflects a pattern of eating in which 50 % of the food consumed could be produced in the New England region. Three guiding questions informed this research: 1) What would an actual week of menus look like following the OD pattern and the OD pattern with the new 2015 Dietary Guidelines? 2) What is its OD nutrient profile? 3) What are the costs of following the OD pattern, comparing conventional to organic products? A menu plan was devised based on the food groups identified in the OD pattern. The nutrient analysis was conducted using the USDA v27 online food database. Costs for both organic and conventional products were determined using a mix of online and in store visits. Results indicate that it is possible to design meals that follow the OD but that it requires thoughtful planning. The OD macronutrient profile falls within national guidelines. Though the costs for organic products were generally higher than conventional, the long-term investment in sustainable production practices may be an offset that was not calculated within the scope of this research.

ORGANIC AGRICULTURE: A CASE STUDY IN HOI AN

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After spending the semester learning about development in Vietnam, I wanted to take a deeper look at how organic agriculture is developing in the country. There is very limited research about organic farming in Vietnam, and while this made the study a little more difficult, it also made it more important. Thanh Dong organic farm in Hoi An is one model of agriculture that is run by a NGO called Action for the City. Focused on learning about how the development of organic agriculture looked in Vietnam, the farm offered an insight to one way Vietnamese farmers are adapting. The following elements were also looked at in depth: the demographics of the farmers; their investment and desired return on it; the environmental impact of the Thanh Dong model; its profitability and its ability to be replicated. All these factors lead into a singular question, “Is the Action for the City community organic model at Thanh Dong farm sustainable?” Through a combination of interviews, shadowing, and document analysis we are led to the complicated answer to this question.

IDENTIFICATION OF GENES INVOLVED IN *ARABIDOPSIS THALIANA* ADVENTITIOUS ROOT FORMATION

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Arabidopsis thaliana is one of the most prominently utilized model organisms in biological research. The root system of *A. thaliana* consists of multiple types of roots, including the primary root, lateral roots, and adventitious roots. Lateral and adventitious roots share several similarities but have distinct differences in terms of development, regulation, and susceptibility to environmental influence. In *A. thaliana*, adventitious roots do not form under normal conditions as lateral roots do, but develop as a complex adaptive response to trauma. While much research has been completed on primary and lateral root development, less is known about the genetic regulation of adventitious root development. In this study, adventitious roots were induced in eighty-eight ecotypes of *A. thaliana* from differing locations throughout the world in order to determine phenotypic differences in the process of adventitious root formation. Subsequently, single-nucleotide polymorphisms of the *A. thaliana* ecotypes were analyzed in a genome-wide association study to identify potential gene regions associated with the phenotypic differences in adventitious root formation. Overall, this study aims to provide insight into the complicated phenomena of adventitious root formation.

MEASURING CARBON FLUX AND ENERGY USING ALTERNATIVE METHODS TO DETERMINE AN ECOSYSTEM SERVICE BASED CARBON USE EFFICIENCY

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To better assess land-climate interactions in NH under future change scenarios, we are measuring greenhouse gas, energy, and radiation fluxes across four different land cover types that broadly represent the NH landscape: forest, field/pasture, corn/agriculture, residential/paved. Carbon flux and energy measurements are primarily made using data from eddy covariance flux towers and bio meteorological sensors across the four land cover types. Here we present complimentary data on production of aboveground biomass. Measurements of biomass production will be used to both validate and improve fluxes from our towers as well as provide an assessment of an ecosystem service based carbon use efficiency (the fraction of carbon that is turned into usable products) for each land cover type. We will discuss the impacts of different land cover types on greenhouse gas emissions and usable products and any tradeoffs between them.

ISOLATION AND IDENTIFICATION OF BACTERIAL ENDOSYMBIONTS IN THE BROODING BRITTLE STAR *AMPHIPHOLIS SQUAMATA*

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Symbiotic relationships with subcuticular bacteria (SCB) have been identified and studied in numerous echinoderms, but have not been examined using current sequencing technologies in the brooding brittle star, *Amphipholis squamata*. Previously, *A. squamata* SCB were placed in the genus *Vibrio* (*γ-Proteobacteria*), but recent evidence suggests the SCB is primarily composed of *α-Proteobacteria*. The present study clarifies the taxonomic composition of SCB associated with *A. squamata* from the Northwest Atlantic. Isolated gDNA was amplified using 16S rRNA gene-targeted PCR and sequenced on an Illumina HiSeq at the UNH Genomics Center. Results suggest the presence of a single dominant bacterial type within the family *Rhodobacteraceae*, which composes 70-80% of the *A. squamata* microbiome. The majority of sequences within *Rhodobacteraceae* were identified as members of the genus *Octadecabacter* (97% similarity). By comparison, adjacent seawater and sediment support significantly more diverse bacterial communities, with members in the phyla *Proteobacteria*, *Bacteroidetes*, *Cyanobacteria*, *Verrucomicrobia*, and *Actinobacteria*. Thus, distinct SCB communities are clearly evident in *A. squamata*. Although metatranscriptomic study is needed to characterize specific functions within the SCB community, we have identified a discrete and potentially beneficial symbiont that may support metabolic requirements and nutrient uptake vital to the reproduction of *A. squamata*.

CURRENT STATE OF COMPOSTING IN THE SEACOAST REGION

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Composting is a natural way to create soil from recycling organic wastes due to natural decomposition. Composting helps improve landfill diversion. Today, nearly half of the waste in landfills are compostable materials. The methane produced from those landfills make up around 20% of the country's methane production. The purpose of this study was to report on the current state of composting in the Seacoast region. Items such as yard clippings, manures, vegetables, fruits, pastas and other foods are all material that can be composted. However, the Department of Environmental Services has limited what can be composted in New Hampshire. Meat and Dairy are among the items not permitted in compost. These regulations have impacted the composting industry and local towns waste municipalities. The scope of this study includes Durham, Lee, Portsmouth, Eliot, Barrington, New Market, Epping and Stratham. The study identified what is working and what is not working for composters in the Seacoast. Some sites that have composting programs that can be considered successful include the University of New Hampshire. For around ten years UNH was able to sell the compost they produced until the DES heightened regulations in order for them to sell their compost which included dining hall food organics. Successful models like that can be used to help other areas implement efficient composting. Composting our waste helps reduce landfill waste, can create economic benefits and much more.

FORAGING ECOLOGY AND PARENTAL INVESTMENT IN A SMALL CARPENTER BEE

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Understanding the basic biology and life history characteristics is of critical importance to the maintenance and assured health of native bee populations. This past summer we studied a species of small carpenter bee native to New Hampshire. In this study we establish a detailed time period of when nest founding, egg laying, and active brood care are most prevalent. Detailed observation of foraging activity on 180 nests was conducted over the season. At the end of the foraging season examination of all nests was conducted for analysis of brood productivity and colony fitness. The number of offspring correlated with the size and foraging rates of the nest founder provide an index of total parental investment. This study provides important information on the foraging ecology of a native bee to understand their life cycle and habitat requirements.

USE OF PHOSPHODIESTERASE INHIBITORS AS POTENTIAL NEMATICIDES

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Plant parasitic nematodes cause an estimated 80-100 billion dollars of damage in lost crops per year. Therefore, it is imperative to find means of limiting the activity of these parasitic nematodes. Our lab is investigating the use of phosphodiesterase (PDE) inhibitors as potential nematicides, which may offer an environmentally safer alternative to current chemical control methods. Our previous research has shown that PDE inhibitors can disrupt the physiology of both laboratory-cultured roundworms (*C. elegans*) and root-knot nematodes (*M. hapla*). This led us to hypothesize that pharmacological differences between human and nematodes PDEs might permit development of nematicides that are specific for parasitic nematodes and that lack adverse effects on other animals or crops. To test this, the catalytic domain of *C. elegans* and human PDE4 were isolated and purified. Enzyme assays were performed to determine rate of cAMP hydrolysis with and without a PDE inhibitor present. We found that certain PDE inhibitors inhibited human and *C. elegans* inhibitors with similar potency (e.g., IBMX), whereas compounds designed to selectively inhibit human PDE4 (e.g., roflumilast, ibudilast) showed reduced ability to inhibit *C. elegans* PDE4 compared with human PDE4. This supports the feasibility of future efforts to design compounds that will bind more effectively to nematode PDEs than to human PDEs and thus serve as potent and selective nematicides for parasitic nematodes.

GENERATING REFERENCE DATA FOR VALIDATING GLOBAL CROPLAND MAPS DERIVED USING SATELLITE IMAGERY

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Crop type maps help us to determine where and when certain crops grow and can give us an estimate of how much food is being produced to sustain our population as it grows. With the help of satellite imagery, we can deduce which crop types grow where and how well they can survive under current conditions. The imagery that is used during this research was collected from LANDSAT, which is a remote sensing system onboard a satellite that collects resource information from Earth's surface. A second satellite system that collects spectral information that is used for this research is the Moderate Resolution Imaging Spectrometer (MODIS). A number of accuracy assessments were done to compare the reference data (CDL) to the map. Google Earth and ArcMap were used to identify and map the specific crop areas throughout Australia, North America, and Africa.

ANALYSIS OF CARPENTER BEE CUTICULAR HYDROCARBON CHAINS ACROSS A LATITUDINAL GRADIENT

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Recently there has been rising concern that the activities of humans have had a negative effect on bee populations, and there is evidence that many bee populations across North America are in decline. This is important because native bees provide pollination services necessary for one third of our food supply. It is important to understand the ecology and evolution of native bees in order to protect them. Cuticular hydrocarbon chains (CHCs) are surface molecules with known roles in anti-desiccation and chemical communication in insects. The small carpenter bee, *Ceratina calcarata,* is a common and wide spread native bee ranging from Georgia to New Hampshire. Here I characterize the CHC composition of three *C. calcarata* populations across a latitudinal gradient. The populations collected all occupy different climatic regions and possibly vary in their CHC composition in response to adaptation to local temperatures. I found that southern populations have longer chain CHCs, likely to prevent water loss in hot and humid conditions, and northern populations have shorter chain CHCs, probably due to the cooler climate. Understanding the CHC composition of bees in important to maintaining their health.

INVESTIGATING THE PATHWAYS OF MICROCYSTIN AND BETA-MYTHYLAMINO-L-ALANINE ACCUMULATION IN PLANKTON FROM FRESHWATER ECOSYSTEMS

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The purpose of this study is to understand how toxins, produced by cyanobacteria, accumulate through aquatic food webs and impact Common Loon health in lakes across North America. Microcystins (MC) and beta-Methylamino-L-alanine (BMAA) are two toxins that are widely recognized as detrimental to the health of aquatic organisms and humans. This study analyzed 111 samples of phytoplankton and zooplankton from 17 lakes. The toxins were extracted from the plankton and analyzed with ELISA antibody testing. The results were then examined for biomagnification and compared with levels of these toxins in the blood and feathers of Common Loons collected at the same sites.

CULTURING CYANOBACTERIA FROM LAKE AEROSOLS

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This study involves culturing aerosolized cyanobacteria (blue-green algae) from lake samples across the New England region. The lake samples were collected using Whatman 25mm Glass Fiber Filters (0.6µm pore size) and were collected during the Summer 2015. Cyanobacteria research has increased in intensity since the beginning of the 21st century in large part due to the linkage made between cyanobacteria and toxins including microcystin and Beta-methylamino-L-alanine (BMAA). These toxins have been linked to human disorders including acute liver disease and Amyotrophic Later Sclerosis (ALS) respectively. This project investigates the ability to culture cyanobacteria in a laboratory setting and determine if aerosolized cyanobacteria from freshwater samples produce any of the aforementioned toxins. Potential findings from this study could yield vital information concerning public health awareness of citizens living around hazardous freshwater bodies of water in New England.

OCEAN ACIDIFICATION RECIRCULATING SYSTEM (OARS)

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Ocean and coastal acidification is a growing concern as CO^2 levels continue to increase. When CO^2 is absorbed into the ocean, chemical reactions cause the levels of carbonate to decrease. This carbonate is used in calcium carbonate and is an extensive part of shell building in calcifying organisms. To better understand the effects of acidification on local species, members of the team designed and built a recirculating system. Three tanks housed organisms while a fourth, larger tank was the reservoir. CO^2 was bubbled into the reservoir tank until the desired pH level was reached. The water was then circulated through the system. Effects on various organisms were observed and recorded.

EFFECTS OF SUPPLEMENTAL LACTOFERRIN IN MILK REPLACER ON FECAL IGA CONCENTRATIONS IN PREWEANED HOLSTEIN CALVES

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The objective of this study is to protect the health of dairy calves by evaluating the effects of adding supplemental lactoferrin to milk replacer. Lactoferrin is found naturally in the secretions of most mammals, and is a protein that has bacteriostatic effects as it competes with pathogens for available iron in the blood. Lactoferrin has shown to have positive effects on overall health of calves by increasing growth rates and decreasing the amount of sick days. These studies have not pinpointed a direct cause of this response, which we believe to be an increase in IgA concentration. IgA is one of the most critical components in fighting infection as part of the immune system, and is even more important in the naive immune system in dairy calves. Our study hypothesizes that additional lactoferrin supplemented to calves in milk replacer will have a positive effect on the immune system that will be quantified by increased IgA levels in fecal samples. Should this prove effective, it will potentially offer insight into preventing sick calves, which can be problematic and expensive for dairy farmers.

FOOD SYSTEM EDUCATION AMONG HIGH SCHOOL STUDENTS

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As the American public school system is currently designed, the average student is likely to graduate high school without ever having received any formal instruction regarding the food system in which they take part as consumers. This research project seeks to demonstrate the effectiveness of a single lesson that introduces the basics of the modern American food system to a high school biology classroom. A pre-survey is to be conducted by high school biology students online at least a week prior to the in-class administration, following the food system lesson, of a post-survey consisting of the same or similar questions. The results of the two surveys, which are designed to generate both quantitative and qualitative data, are to be compared in order to indicate the lesson's potential and thereby be used to argue for the consideration of the subject of food systems as part of the realm of crucial general knowledge, a form of knowledge that should at the very least be offered as an elective option in high schools around the country for the purpose of yielding future generations of informed consumers.

CAN TROPICAL TEAK PLANTATIONS BE MANAGED SUSTAINABLY FOR BOTH TIMBER AND WATER? AN EXPERIMENTAL THINNING STUDY IN PANAMA

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The Panama Canal is important for both the Panamanian and global economy, while simultaneously providing water supply and flood control ecosystem services for the local community. These services require ecosystem conservation and restoration around the Panama Canal Watershed. Decisions regarding land management and water within the watershed also require knowledge about ecosystem scale water cycling. My study's objective is to understand the water use dynamics of teak (*Tectona grandis*) plantations at both the tree and stand level. This ecohydrologic analysis requires sap flow techniques whereby heat ratio sensors are installed in tree stems to measure water use. Specific questions I seek to answer include 1) Does a reduction in intraspecific competition within teak monocultures lead to greater total water use and productivity? 2) Can a reduction in intraspecific competition through thinning lead to decreased water stress due to improved water and nutrient availability? 3) Does a reduction in intraspecific competition through thinning lead to greater moisture stress due to increased light exposure? The comparison between thinned and unthinned teak plantations will tease apart teak physiology and may offer insight into better management practices for the preservation of a balanced ecosystem that is not overly stressed for water resources.

HISTORICAL DECLINES IN BUMBLE BEES IN NEW ENGLAND

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There has been recent concern about the widespread decline of native bees caused by human activity and its impacts on the environment. Bumble bees are native bees which provide many essential pollination services and whose populations have been showing significant decrease in both size and range. Many factors are thought to play a role in native pollinator loss, especially those related to agricultural land management such as habitat fragmentation, pesticide use, and reduction in floral availability. Historical records compiled from museum specimens are used to determine the habitat requirements for local bumble bee species as well as changes in their range and abundance over time. By comparing 150 years of bumble bee records we can determine the causes and consequences of their declines. These data provide crucial information to conservation and protect native pollinators.

AN EVALUATION OF THE AMMONIA REMOVAL PERFORMANCE OF A HYDROPONIC MEDIA-FILLED BED FED FROM A RECIRCULATING AQUACULTURE SYSTEM

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A traditional aquaponic system combines the components of a recirculating aquaculture system for fish production and a hydroponic plant production system. The waste generated from the fish provide nutrients for the plants, which purify the water. For improved plant growth, the ammonia from the recirculating aquaculture system must first be converted to nitrate via nitrification. This study evaluated nitrification in a hydroponic media bed used for growing food plants while simultaneously converting ammonia to nitrate in a recirculating aquaponic system. In order to assess the nitrification performance of the media-filled bed, water samples were analyzed from 5 locations located lengthwise along the water flow path of the bed. Analysis was conducted to determine the concentrations of total ammoniacal nitrogen (TAN), nitrite-nitrogen (NO_2-N), nitrate-nitrogen (NO_3-N), pH, dissolved oxygen (DO), alkalinity, temperature, total dissolved salts (TDS), and total organic carbon (TOC). The analysis of water quality allows for an evaluation of how nitrification in a media-filled bed is affected under actual recirculating aquaponic conditions. Additionally, factors such as flow rate across the bed or inlet TOC may affect nitrification. The combined use of a hydroponic media-filled bed for plant production and as a nitrification biological filter offers an alternative to costly traditional biological filters in low-cost recirculating aquaponic systems.

DO FUNGAL COMPETITORS PREVENT INFECTION BY *PSEUDOGYMNOASCUS DESTRUCTANS*?

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White-nose syndrome is an emerging infectious disease of bats in the North America that is caused by the pathogen *Pseudogymnoascus destructans.* The fungus was first identified in 2006 in a caves near Albany, New York. Originally from Europe, the fungus has spread to most part of eastern North America, killing millions of bats. Bats play an essential role in terrestrial ecosystem. They help to decrease the number of insects that harm human population and agriculture. Previous research done on *P. destructans* has helped identify several different factors about this fungus. Studies have shown that there are close relatives of *P. destructans* present on hibernating bats and cave sediments. Surprisingly, these relatives do not harm bats. *P. destructans* probably has acquired some adaptations that are making it a pathogen causing this disease. In this study, I will assess the microbiome of the bats to see if related pseudogymnoascus species play any role in protecting the bats against the pathogen. This will include use of qPCR and result from that will be analyzed statistically through Microsoft excel. Quantitative PCR (qPCR) is a technology that can be used to precisely measure how much DNA and which species is present in a sample. My hypothesis is that, when relative *Pseudogymnoascus* species are present in a microbiome of bats, it protects them against infection by *P. destructans*. If my hypothesis is supported, then exposing *Pseudogymnoascus* relatives in infected caves and bats can help reduce the chances of White-nose syndrome

LOCALIZATION OF THE CIRCADIAN CLOCK IN THE CENTRAL NERVOUS SYSTEM OF THE NUDIBRANCH *MELIBE LEONINA*

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Endogenous circadian clocks are responsible for the daily rhythms expressed by most organisms. The overall goal of this research project was to localize the circadian clock that controls the swimming and crawling behaviors of a nudibranch, *Melibe leonina*. We use this animal because it has large, identifiable neurons, which make them an ideal model species for investigating the link between circadian clocks and behavior. In order to identify clock neurons, we used antibodies generated against homologs of proteins that are known to be part of the molecular mechanisms that drive circadian rhythm. First, we used antibodies against CRY (cryptochrome) and CLOCK (Circadian Locomotor Output Cycles Kaput) proteins, and we identified eight neurons in the central nervous system that contained CLOCK and four that contained CRY. Currently, we are extending this investigation to PER (Period), and two different CRYs. Our goal is to see if any of these proteins co-localize with each other, which would provide strong evidence that the stained cells would be clock neurons. To date, we found one strong candidate neuron in the buccal ganglion that contains CLOCK, PER and one type of CRY.

UNDERSTANDING IMMUNOGENIC ASPECT OF INFECTION BY *VIBRIO PARAHAEMOLYTICUS* USING CACO-2 CELL LINE AND IL-8

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Our lack of understanding of virulence by *Vibrio parahaemolyticus* (Vp), which causes diarrhea and acute inflammation of intestinal epithelial cells, has been a major obstacle for preventing disease. Virulence in VP has been in some aspect linked to hemolysin and capsule production but it doesn't fully explain virulence in many strains. Bacteriophages are natural viral predators of bacteria. Nonetheless, not all phages are capable of killing bacterial cells. In this study bacteria with and without phage will be compared between sequence type 36 and 631 strains. This study focused on investigating the cytotoxicity of ST631 and ST36 on cell line of intestinal epithelial cell (Caco-2) using LDH release assay. Caco-2 cells monolayers were exposed to each bacterial strain for thirty minutes and cell damage was access by LDH release. Although there was a general trend showing that bacteria without phage were more virulent, it lacks statistical support.

OPTIMIZATION OF PAKT EXPRESSION AND DETECTION IN BOVINE GRANULOSA CELLS

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The cellular mechanisms that regulate the fate of granulosa cells in the bovine follicle remain relatively unknown. One pathway believed to be involved in regulation is the protein kinase B (pAkt) pathway. In general, the pAkt proteins are intracellular kinases that are thought to have a role in cell survival, preventing apoptosis, and cell proliferation. However in the context of bovine granulosa cells (bCGs) the conditions that lead to upregulation of pAKt are not entirely clear, nor is the effect of pAkt. In the present study we tested the conditions and procedures for cell culture and immunodetection which would optimize the protein expression and detection of pAkt in bGCs. Future work will focus on determining if pAkt signaling influences granulosa cell resistance to immune-mediated apoptosis.

MISSING DIGITS IN SHREWS: INSIGHTS INTO A SECRET LIFE

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Shrews are small insectivorous mammals common in Northeast forests and play important roles as both predators and prey. Yet despite their importance, little is known about the natural life of shrews. My project examines the frequency, placement, and severity of missing digits in four co-occurring shrews (*Sorex cinereus, S. fumeus, S. hoyi* and *Blarina brevicauda*). Specifically, I examine whether behavioral or environmental factors are correlated with injury type. Almost half the missing digits were broken off, indicating that digits were bitten off rather than frostbitten. Missing digits were greatest in older animals. Additionally, males were found to have a higher prevalence than females. All shrews showed more missing in the front paws. This could be an indication that shrews are fighting head to head, where the front paws are most accessible. In the rear paws, missing digits were predominately located on the sides of the feet, this may indicate that they were being bitten off when the animal was facing away. The *Sorex* spp. showed more severe injuries in the rear paws than the front, this may indicate that they retreat from fights. Inversely, *Blarina* showed more severe injuries to their front paws, indicating they may be more aggressive with their fighting. These findings shed more light on the aggressive interactions of shrews which may be related to mate and territory disputes.

EPIGENETIC REGULATION OF SPHINGOLIPID METABOLISM IN ACUTE MYELOID LEUKEMIA

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Bioactive sphingolipids have shown to control cell survival, proliferation and apoptosis in cancer cells. Sphingosine-1-phosphate is an anti-apoptotic bioactive sphingolipid and promotes proliferation and cell survival in cancer cells. Ceramide, another kind of bioactive sphingolipid, has been shown to be pro-apoptotic and promote cell death in cancer cells. Many therapeutic approaches promote the accumulation of ceramide in cancer cells. However, ceramide metabolism is the primary mechanism of resistance to these approaches. Ceramide can be metabolized to S1P, as well as many other sphingolipids that promote cell survival or multidrug resistance. In this experiment leukemia cells lines were incubated in different types of media, one containing the hypomethylating agent, decitabine and a control media. Hypomethylating agents block DNA methyltransferase activity, therefore serve as epigenetic regulators of gene expression. Decitabine is also considered an analog of DNA nucleotides so it can be incorporated into DNA sequences. When the leukemia cell lines are incubated in media containing small amounts of decitabine, they respond better to liposomal ceramide treatment. Leukemia cells exposed to decitabine had alterations in the expression of genes associated with ceramide metabolism. This indicated that hypomethylating strategies could be used to downregulate ceramide metabolism such that ceramide cannot be converted to prosurvival bioactive sphingolipids.

THE EFFECT OF PH ON GROWTH RATES AND ACTIVITY BUDGETS OF GHOST SHRIMP (*PALAEMONETES PALUDOSUS*)

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Climate change is lowering the pH of marine and aquatic ecosystems through snowmelt, acid rain, drought, and human carbon emissions. By the end of this century, it is estimated that global ocean pH will drop from 8.1 to 7.1. If ocean pH continues to decrease as predicted, any change to the development and survival of marine species has the potential to affect other organisms and systems. This is particularly true for keystone species such as ghost shrimp (*Palaemonetes paludosus*). Ghost shrimp inhabit both aquatic and marine ecosystems, are prey to many fish and bird species, and build extensive burrowing systems in the sediment, which increases nutrient cycling in the water column. Although studies of other aquatic vertebrates showed that a decrease in pH resulted in skeletal deformities and decreased growth rate, it is unclear how ghost shrimp are affected by pH change. Our study aims to address this question. We predict that a decrease in pH will result in slower growth rates and decreased activity budgets. We will test this by raising juvenile aquatic ghost shrimp in five different pH levels. We will take morphometric measurements (mass and carapace length/width) of the shrimp three times per week and quantify activity budgets once per week. Our results can provide valuable insight into the broader impacts that climate change has on aquatic and marine ecosystems.

THE EFFECT OF THE EARTH'S MAGNETIC FIELD ON THE RESTING POSITION OF *CANIS FAMILIARIS*

Allison Onofrio and Leslie Curren
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With dogs (*Canis familiaris*) in over 43 million households in the U.S., learning more about their behavior can enrich our relationship with them. Although much research has been done on certain sensory modalities in dogs, magnetoreception has received relatively little attention in this species. Hart et al. (2013) found that dogs use the Earth's magnetic field to preferentially defecate on a north/south (N/S) axis. If the magnetic field affects a dog's defecation alignment, might it also impact a dog's resting alignment? Pilot data I have collected suggest that dogs do use the Earth's magnetic field to orient themselves when lying down. Here, I follow up on this preliminary work. Based on Hart et al.'s findings regarding defecation, I first hypothesize that dogs will show a similar preference when lying down and show a collective preference for the N/S axis. Alternatively, dogs may exhibit individual preferences for a magnetic axis when lying down; this predicts that dogs will show within-individual consistency regarding their resting alignment, but no universal patterns across individuals. To test these predictions, I will use a compass to record the directional alignment of a dog's thoracic spine when it lies down. I will make 20 observations per dog for each of 60 dogs. This research will not only enhance our understanding of dog behavior, but more broadly, it may also contribute to our knowledge of how animals use the Earth's magnetic field to make behavioral decisions.

WHICH BEST PREDICTS THE PARAMETERS OF METABOLIC SYNDROME IN COLLEGE STUDENTS: BODY MASS INDEX, WAIST CIRCUMFERENCE, OR BODY COMPOSITION?

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Metabolic syndrome (MbS) is a clustering of risk factors that predicts future development of cardiovascular disease and diabetes mellitus. Although 47 million Americans have MbS, there is limited research among young adults. This study analyzed whether body mass index (BMI), waist circumference (WC), or body composition (BC) best predicted multiple criteria of MbS [elevated blood glucose, low high-density lipoprotein cholesterol (HDL), elevated triglycerides, elevated systolic or diastolic blood pressure (SBP and DBP)]. Data from the ongoing cross-sectional College Health and Nutrition Assessment Survey were collected between 2009-2012. Subjects (n=4,167; 71% female) were recruited from an introductory nutrition course at UNH. All measures were obtained in a fasted state via calibrated equipment following standard protocols by trained staff. Four hundred four students (18% of men and 8% of women) had ≥ 2 criteria of MbS. Using logistic regression elevated body fat was observed to be the strongest predictor of having ≥ 2 criteria (OR=2.3, $p<.05$); elevated WC was also a significant predictor (OR=1.6, $p<.05$), while BMI ≥ 25 kg/m^2 was not a significant predictor of ≥ 2 MbS criteria. These findings suggest that BC and WC may be useful in screening young adults for the development of MbS, while BMI ≥ 25 kg/m^2 alone may not be a clinically significant predictor of MbS in this young adult population.

CYANOBACTERIAL TOXINS IN LOON BLOOD IN RELATION TO ENVIRONMENTAL CONCENTRATIONS

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Cyanobacteria are photosynthetic organisms that inhabit lakes, and can produce several toxic compounds. Two of these toxins are β-N-methylamino-l-alanine (BMAA), a neurotoxin linked to neurodegenerative diseases, and the liver toxin microcystin (MC). When present in water bodies, these toxins can affect the health of organisms living in the aquatic system. The focus of this study was the common loon (*Gavia immer*) whose numbers have been declining, possibly due to the bioaccumulation of cyanobacterial toxins. To make this connection, blood samples were collected by the Biodiversity Research Institute from adult breeding pairs and chicks at 43 lakes across eight states in the U.S.A. and British Columbia in Canada. The blood samples were extracted from sample cards using water, sonication, and freeze-thaw techniques. The samples were then analyzed using ELISA (enzyme-linked immunosorbent assay) kits for both BMAA and four variants of MC including MC-RR, MC-LR, MC-LA, and MC-YR. The results were then compared to levels of BMAA and MC in plankton, and loon feather samples from the same lakes in order to establish a relationship.

THE CHARACTERIZATION OF FINE ROOT PRODUCTION IN NEW HAMPSHIRE FORESTS AND ITS RESPONSE TO DROUGHT

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The root systems of trees and plants play a major role in the overall production within a forest. Fine roots are very important for water and nutrient uptake and cycling in an ecosystem. In some cases, trees allocate more carbon to their belowground root systems then to their above ground components. However, root systems are not widely monitored and are underrepresented in many ecosystem studies. Predictions of future weather patterns in New England include increases in frequency and severity of drought events due to climate change. The effects of drought on belowground dynamics and fine root production in Northern forests is not well understood. Fine root production was collected over a growing season (June-October) at the Thompson Farm forest in Durham, NH and at Hubbard Brook Experimental Forest in Woodstock, NH. These sites are part of a larger experimental drought network and contain throughfall-exclusion structures which reduce the amount of precipitation that falls on the forest floor. This study aims to quantify the variation of fine root production in New Hampshire forests and the effects of drought on these belowground systems.

EFFECTS OF HYPO-O-GLCNACYLATION ON KERATIN 18 FILAMENTS AND CYTOKINE-INDUCED APOPTOSIS IN SIHA CERVICAL CANCER CELLS

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Cervical cancer is among the leading causes of cancer morbidity and cancer mortality in women worldwide. There are a variety of mechanisms by which carcinogenesis occurs, but elevated expression of Keratin 8/18 (K8/18) has been indicative of tumor progression in cervical cancer cells. Intriguingly, K8/18 structure and interaction with other proteins may be altered via post-translational modification by O-linked N-acetylglucosamine (O-GlcNac). Hyper-O-GlcNAcylation has been seen to stabilize keratin filaments and provide cellular resistance to programmed cell death, or apoptosis. Effects of hypo-O-GlcNAcyltion on cervical cancer, however, is still relatively unknown. Here, SiHa cells were treated with potent O-GlcNAc inhibitors, Alloxan and DON, to induce hypo-O-GlcNAcylation. Caspase assays of Alloxan-treated SiHa cells suggests hypo-O-GlcNacylation increases SiHa cells' susceptibility to TNF-α and Fas-L induced apoptosis. A decrease in activation of Akt, a cell-survival effector protein, was also observed in Western Blot analysis. Interestingly, immunofluorescence of SiHa cells may also indicate altered K18 filament architecture and decreased expression of TRADD, a molecule important in mediating TNF-α induced apoptosis and known to associate with K18.
This project is supported by the Hamel Center for Undergraduate Research SURF Grant (CH), COLSA Karabelas Fund (DHT), and an NSF-GRFP Grant (NJ).

REGROWTH POTENTIAL OF ANNUAL ALTERNATIVE FORAGE CROPS IN NEW ENGLAND

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Alternative forage crops (AFC) can be used as feed during periods when pastures are dormant or weather-stressed. Our research examined monocultures and mixtures of annual AFC intended for grazing or harvest during the "summer slump", when high temperatures and drought can limit productivity. We were interested in understanding how the timing of initial harvest affected AFC regrowth potential. Treatments established in May 2015, included monocultures of BMR sorghum, buckwheat, teff, millet, oats, chickling vetch, a mixture containing all six species, and a "super-mix" that included seven additional cool- and warm-season AFC species. We assessed biomass at three time periods spaced approximately two-weeks apart, then quantified forage regrowth in the clipped areas of each plot approximately three weeks after each initial harvest. Our study indicated that individual summer-available AFC treatments differed in their ability to supply additional forage and regrowth potential was dependent on timing of initial harvest. Buckwheat produced high levels of dry matter at initial harvest, but did not regrow and therefore had little additional summer forage value. In contrast, millet, which also produced relatively high levels of dry matter at initial harvest, had relatively high subsequent regrowth (as much as 225 g dry matter in three weeks). In addition, regrowth in oat, sorghum and the summer mixtures was also dependent on timing of initial harvest. This project was funded by a URA award from the Hamel Center for Undergraduate Research.

THE EFFECT OF WARMING TEMPERATURES ON COMPETITION BETWEEN TWO INVASIVE SPECIES OF CRAB

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Invasive species can disrupt the structure of the ecosystems into which they are introduced, causing native species to suffer from increased competition, predation, and habitat loss. The European green crab (*Carcinus maenas*) was introduced to the east coast of the U.S. in the mid-1800s and contributed to a decline in shellfish populations in that region. The Asian shore crab (*Hemigrapsus sanguineus*), another invasive species, was discovered along the eastern coast of the U.S. in the 1980s. These two species are known to compete for shelter and food in the intertidal zone, and in direct physical contests, the Asian shore crab has been shown to dominate. Previous research has also demonstrated that the ability of green crabs to compete with native crabs improves as water temperature increases, but the effect of a rise in temperature on contests between green crabs and Asian shore crabs has not been studied. In order to investigate this question, I will stage competitions between green crabs and Asian shore crabs over food items at 12^{o}C (the current average) and 16^{o}C (the predicted temperature in 2090) and record which species wins each contest. With ocean temperatures rising globally due to climate change, it is imperative to understand the effects that this rise will have on species interactions, because the outcomes could lead to other changes throughout the ecosystem.

DOWN IN THE DUMPS: DEMOGRAPHICS OF GARBAGE-RAIDING ELEPHANTS IN WASGAMUWA, SRI LANKA

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Consumption of human garbage by the Sri Lankan elephant is an overlooked facet of the country's human-elephant conflict. We assessed demographic factors of garbage-raiding elephants south of Wasgamuwa National Park, in central Sri Lanka. The study area, an open dumping site for the city of Hettipola, is adjacent to an elephant migratory route. While it is known that elephants commonly visit the disposal site, there is a lack of empirical data on their age, gender, and social groups. Based on dung circumference, using keys from previous dung surveys, dung samples found in three areas of varying proximity to the dumping site were measured to determine the age and possible gender of elephants visiting each site. All samples found at the disposal site, as well as samples with embedded trash found at other sites, were classified as indicative of a garbage-raiding elephant. 48.6% of samples left by garbage-raiders fit into the sub-adult male/adult female size class, 39.20% were adult males, and 12.20% were juveniles or sub-adult females. Observations and the low incidence of juvenile samples suggested a majority of samples in the sub-adult male/adult female class belong to sub-adult males, as adult females are typically found in groups with juveniles. It is commonly assumed that only sub-adult and adult males come into human territories. Evidence of juvenile garbage-raiders has implications for determining the most appropriate management strategies moving forward.

CHARACTERIZATION OF ROD AND CONE Pγ AFFINITY FOR PDE6 CATALYTIC DIMER AND EFFICIENCY OF ACTIVATION BY TRANSDUCIN

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The ability to see is a result of a complex biochemical cascade, triggered by the visual pigments in the eye. The vertebrate retina contains two distinct photoreceptor cells: rods and cones. Rods mediate night vision, while cones mediate day vision. Phototransduction in these two cells is regulated by phosphodiesterase (PDE6), an enzyme that degrades the intracellular messenger, cGMP. PDE6 is composed of an alpha and beta subunit, and two identical inhibitory gamma subunits (Pγ). A secondary protein, transducin (Tα), can bind the Pγ subunits and relieve the inhibition from PDE6. Differences between the rod Pγ and cone Pγ amino acid sequences may result in different affinities for the PDE6 catalytic dimer or the efficiency of activation by transducin. We hypothesize that the transducin α-subunit has a greater binding affinity to rod Pγ than the cone. We have expressed recombinant rod Pγ and cone Pγ, and tested their ability to inhibit the purified catalytic dimer. Results show that cone Pγ has a lower affinity to bind to and inhibit rod Pαβ. We are currently testing the ability of Tα to activate purified PDE6 containing rod and cone Pγ subunits. This work provides a biochemical basis for the physiological differences between rod and cone phototransduction pathways.

SUGAR AND LIPID ANALYSIS OF *CERATINA CALCARATA* BROOD CELL POLLEN BALLS

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Bees make up the largest and most active group of pollinators on the planet. Wild bees in particular are very important for pollination of both wild and domestic plants. *Ceratina calcarata* are a local pollinator species and differ from the model bee species, *Apis mellifera*, the Western Honey Bee, in several ways including maternal care and social order and can provide insight into the evolution of bee behavior. Mother *Ceratina* bees provide all the nutrients their developing offspring need to mature from an egg into an adult in the pollen balls they provide for each brood cell. By analyzing the sugar and lipid constructs of collected pollen balls we can better understand maternal care in bee families, bee social constructs, and overall bee nutrition.

OASIS - OPTIMAL *A*GRICULTURE *S*KILLS INITIATIVE FOR *S*TUDENTS

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Waterbury is one of the oldest and most iconic urban community in Connecticut, today it is experiencing economic and food security concerns. Brass City Harvest, a local Community Supported Agriculture (CSA) Non-Profit organization was founded to support the city's food security through organizing year-long farmer's markets and producing products at their own facilities. Within the next year they will be expanding their outreach program to provide more opportunities to Waterbury citizens, public school students, Global Leadership Initiative (GLI) summer intern students from Taft School in Watertown, CT and statewide National FFA Organization chapters. This project's goal is to build an outreach program to support, sustain and grow the Greater Waterbury area's agriculture future. With the support of the Brass City Harvest Team and Waterbury Public School administrators the OASIS handbook and curriculum was developed to present information on geographic target areas and populations, a wide-ranging lesson plan set, and methods to evaluate lessons. OASIS is a pilot program designed to be modified as necessary based on the results of assessments done by the instructors after lesson completion and third party evaluators connected with the Waterbury Public School System and GLI counselors. It is my sincere wish that this curriculum will provide an avenue for Waterbury citizens to partake in their food system and strive to build an "oasis" in their "food desert."

INVESTIGATION OF THE RELATIONSHIP BETWEEN THE THYROID AND REPRODUCTIVE SYSTEMS IN SEA LAMPREY, *PETROMYZON MARINUS*

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Thyroid hormones control developmental and metabolic activities in jawed vertebrates. These hormones coordinate and integrate metabolism with reproductive processes. However, in lampreys, one of only two extant jawless basal vertebrates, the roles and interactions of thyroid hormones with the reproductive system have not been fully established. We hypothesize that there is an overlap and coordination between the neuroendocrine system in the control of reproduction and thyroid activity in a basal vertebrate. Therefore, the objective of our study was to determine the effects of thyroxine on the brain concentration of gonadotropin releasing hormone (GnRH), the master hormone controlling reproduction. In an *in vivo* experiment, thyroxine was injected at 50 µg/kg and 100 µg/kg, along with 10% DMSO (control), into adult female sea lampreys during their final maturational stages. Lamprey GnRH-I, II and –III were extracted, eluted via HPLC, and brain concentrations were determined by radioimmunoassay. There was a demonstrated decrease in l-GnRH-I, II, and III concentrations of lampreys treated with thyroxine compared to controls ($p>0.05$). These data provide the first direct evidence of a feedback system between the thyroid and reproductive systems in lamprey. Funding provided by NSF-105-1257476, AESNH 00624 to SAS and UNH SURF to RS, CC, and EM.

TUMOR NECROSIS FACTOR (TNF) EXPRESSION IN BOVINE GRANULOSA CELLS

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Programmed cell death (apoptosis) is not fully understood at the molecular level. Apoptosis is directly linked to infertility in women and in cows because it influences the number of follicles available to produce eggs for fertilization. Factors of the immune system, particularly a cytokine known as tumor necrosis factor alpha (TNFα), play a role in both apoptosis and proliferation of granulosa cells within follicles. This occurs by stimulating the actions of tumor necrosis factor receptor 1 and 2 (TNFR1 and TNFR2), respectively. Cells were aspirated from ovary tissue and grown in culture to confluency, RNA isolation and PCR methods were performed and evaluated by gel electrophoresis. This study aimed to identify the conditions under which the granulosa cells express these two types of receptors, using a culture system to manipulate and then measure the expression of TNFR1 and TNFR2 by analysis of band density from gel electrophoresis.

ASSESSING THE INFLUENCE OF ELEVATION, SLOPE, AND ASPECT ON FOLIAR %N AT THE HUBBARD BROOK EXPERIMENTAL FOREST

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The concentration of nitrogen (%N) in foliage influences a variety of important ecosystem processes at leaf, plant and whole canopy scales, including photosynthesis and leaf respiration, as well as wood growth and net primary production. For this reason, methods for estimating foliar %N over several scales are crucial for improving our understanding of terrestrial carbon and N cycles. The emergence of high spectral resolution (or hyperspectral) aircraft remote sensing has led to its wide use as a tool for landscape-scale estimates of canopy %N because reflectance in particular regions of the electromagnetic spectrum have been shown to correlate strongly with field measured %N. Canopy %N has been previously derived for the Hubbard Brook Experimental Forest in northern NH using hyperspectral imagery. In this study we examined brightness gradients observed in these remotely sensed estimates of %N on north- versus south-facing slopes to determine whether or not the brightness gradients were a result of physiological and biological factors, rather than solely being a product of sun and sensor angles. To accomplish this, we compared field measurements of leaf-level foliar %N by species at three different elevations on north- and south-facing slopes and tested for significant differences by aspect and elevation. We then related field-measured foliar %N, elevation, slope, and aspect to reflectance from the hyperspectral imagery to derive an improved canopy %N map for Hubbard Brook.

DETECTION OF CYANOBACTERIA TOXINS IN COMMON LOON (*GAVIA IMMER*) CHICK AND ADULT FEATHERS

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The Common Loon *(Gavia immer)* breeds in freshwater lakes across the northern Unites States. Adults may feed on a variety of organisms, including fish, as they are able to digest more complex materials while chicks are fed fish and crayfish directly from the lakes. Loons therefore may be a bioindicator for the accumulation of cyanobacteria toxins, suspected as a possible cause for mortality in loons. We tested extraction techniques for down, breast, head and tail feathers of *G. immer* chicks and adults to determine the presence of the liver toxins microcystins (MC), and the neurotoxins beta-Methyl-L-alanine (BMAA). The feathers were collected by the Biodiversity Research Institute (Portland, ME) from lakes in Montana, Minnesota, New York, New Hampshire, Maine, Washington and Wyoming. The presence of these cyanotoxins in feathers will allow us to determine if *G. immer* chicks and adults accumulate significant levels of toxins and how this bioaccumulation is related to the water quality conditions in the lakes. We compared the efficiency of a methanol extraction and a water extraction technique using statistical analysis. Six of the ten methanol samples had detectable levels of microcystins, whereas only three of the ten water extractions had detectable microcystins. Overall, the methanol extraction technique was found to be more efficient at extracting toxins from the feathers than the water extractions. Further testing is being done to confirm these results.

CHARACTERIZATION OF THE *PAT14* PROTEIN S-ACYLTRANSFERASE MUTANT IN *ARABIDOPSIS THALIANA*

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Protein S-acyltransferases (PATs) catalyze the post-translational addition of palmitic acid (C16:0) to cysteine residues in target proteins. Palmitoylation can anchor cytosolic proteins to various lipid membranes in the cell or alter the structure of integral membrane proteins. The plant *Arabidopsis thaliana* has 24 *PAT* genes and each is assumed to have a unique collection of target substrates. *PAT14* is of particular interest because *pat14* mutant plants have reduced growth and an early senescence phenotype. *pat14* mutant plants were characterized with a variety of biochemical and genetic approaches. The early death phenotype of *pat14* mutants led to the hypothesis that pathogen response (PR) or senescence associated genes (SAG) might be downstream effectors of PAT14. Real-time PCR showed that PR1 is upregulated in *pat14* mutant plants, and a SAG gene is currently under investigation. Germination time, root length, and rosette area were measured to quantify how the loss of *PAT14* affected development. Transgenic plants expressing a PAT14 - GUS reporter construct are being used to identify the timing and specific tissues where PAT14 is expressed during development. Together, these assays have helped to characterize the function of PAT14 in *Arabidopsis thaliana*. This project was funded by a SURF award from the Hamel Center for Undergraduate Research.

PERCEIVED STRESS AND ALCOHOL INTAKE COMPARISON IN FIRST GENERATION COLLEGE STUDENTS AND THEIR PEERS

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Nearly 30% of college students are considered first generation students (FGS), i.e. neither parents have earned a 4-year college degree. These students may face unique stressors, such as adjustment issues, financial strain, and anxiety. Excessive stress is linked to a number of negative health consequences and behaviors, including alcohol consumption. In general, there is a lack of research looking at FGS. The purpose of this study was to determine if FGS have a higher perceived stress (PS) compared to non-FGS and if alcohol consumption differs between the two groups. FG-status and PS (10 item questionnaire; scale 0-40) were obtained via online questionnaire and ethanol intake (g) was measured via 3-day dietary record. Twenty-eight percent (n=1,601) were classified as FGS. The average perceived stress score was 15.2±6.4 and the mean ethanol intake was 6.0±15.4 grams. PS scores were higher among females than males (15.9±6.4 vs. 13.8±6.4, $p<.05$); ethanol intake was higher among males than females (10.0±20.2 vs. 4.3±12.5, $p<.05$). No differences in PS scores between FGS and non-FGS were observed (15.4±6.5 vs. 15.1±6.4, $p>.05$). Among male students, consumption of ethanol was higher in the non-FGS vs. FGS (11.3±21.9 vs. 6.1±12.8 grams, $p<.05$); there were no differences in ethanol intake between FG and non-FG females. Data do not support PS differences between FGS and non-FGS. Further, differences in alcohol intake between FGS & non-FGS were only observed in males.

THE CHARACTERISTICS OF THE *PAT21* PALMITOYLTRANSFERASE GENE IN *ARABIDOPSIS THALIANA*

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Palmitoyltransferases (PAT) are a family of integral membrane proteins found in all eukaryotes. Functions of PATs in animal and fungal cells include both inter- and intra-cellular signaling, regulation of molecular transport across membranes, as well as stabilization of integral membrane protein substrates. PATs catalyze palmitoylation - the addition of a fatty acid to a target protein. For cytosolic proteins, the increase in hydrophobicity conferred by palmitoylation results in association with lipid membranes and, because palmitoylation is reversible, provides a mechanism for regulating residence time at the membrane. The roles of PATs in plant cells are mostly unknown. This research focuses on one member of the *Arabidopsis PAT* gene family, *PAT21*. *pat21-1* plants that lacked a full-length *PAT21* transcript had a sterile phenotype. Using transgenic plants containing translational fusions to either the GFP or GUS reporter genes, the *PAT21* protein appeared to localize in the plasma membrane as previously predicted by other published studies and to have high gene expression in both root and shoot meristems. Lower expression was observed in the pistil of young flowers and in flower stems. Further research into other *PAT21* mutant alleles and complementation of the *pat21-1* mutant are being conducted to confirm the sterile phenotype.

ELEMENTS THAT CAUSE STRESS TO A CAPTIVE PRIMATE

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It is well known that captive habitats can cause stress in zoo animals, but evaluating this stress remains a challenge. Observing behavior can be one non-invasive way to gauge if an animal is comfortable in its enclosure. For example, changes in activity patterns, such as degree of movement, can be one indicator of stress. However, it is unclear what aspects of captivity cause stress, particularly because stressors are not universal across species. Here, I explore two possible factors, the presence of human spectators and the presence of a male conspecific, in a case study on a single captive female potto (*Perodicticus potto*), a prosimian primate. To test these hypotheses, I will periodically observe the female over the course of three months. I will record the female's movement level, using increased movement as a proxy for stress because pottos do not typically move much in the wild. To assess the impact of human visitors, I will ask if the female's movement correlates with the number of people at her exhibit. To assess the impact of the male's presence, I will compare the female's movement when the male is present to when he is absent, and ask if there is a relationship between how often the two interact and the female's movement. Like many species, pottos have difficulty breeding in captivity, possibly because of stress. Identifying which factors stress females is therefore a crucial step toward improving the pottos' exhibits and, by extension, their quality of life.

EFFECTS OF TEMPERATURE CHANGE ON PARTICLE AEROSOLIZATION IN A LABORATORY SETTING

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Small particles are released into the air from lake water may be toxic as a result of toxigenic cyanobacteria. Cyanobacteria are one of the most atmospherically abundantly aerosolized bacteria over both aquatic and terrestrial habitats. Although the toxicity of lake aerosols varies it is not known if an environmental change, such as water temperature, significantly affects aerosolization. In a controlled environment in the lab, the effect of temperature change was tested using a closed system of a known amount of lake water and filtered air. The lake water was mixed and equilibrated for an hour and the resulting aerosols were measured using a laser particle counter, Temperature was manipulated within a range found naturally in the fresh water environments. Results indicate a larger the differential temperature between air and water results in a higher rate of aerosolization.

USE OF HAND GESTURES AND COMMUNICATION ABILITIES IN VARIOUS PRIMATES

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Like humans, non-human primates greatly depend on gestures, which are movements of the hands or body that contain some meaning, intention, or emotion. Non-human primates have demonstrated greater flexibility in their use of hand and body gestures than in vocalizations. This flexibility is made possible by the hippocampal region of the brain, which is responsible for emotions, memory, and spatial navigation. Prosimians (lemurs and pottos) have evolved in isolation from simians (monkeys and apes), resulting in physiological differences between these two taxa, including the relative size of the hippocampus, despite many ecological similarities. Because prosimian cognition has received little attention, we do not yet know if these differences apply to gesture ability. I am therefore comparing the rate of hand gestures in prosimians and simians. Given that prosimian hippocampi are smaller relative to their body size than those of simians, I predict that prosimians will demonstrate less frequent use of hand gestures than will simians. I will use all-occurrence sampling to record and compare the rate of hand gestures performed by individuals from four species of prosimian and ten species of simian at zoos in New England and New York. The results of this study can give us insight into how gestures relate to relative brain size, which can lead us to better understand communication in primates.

DOES ENCLOSURE SIZE DRIVE STEREOTYPICAL BEHAVIOR IN FELIDS?

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Animals living in captivity face a number of psychological and physical challenges. For example, they may lack the opportunity to exhibit natural behaviors, such as hunting or socializing. When animals can no longer perform natural behaviors, they sometimes cope by engaging in a form of abnormal behavior known as stereotypy. Stereotypy is any repetitive behavior pattern with no specific function that occurs in animals in captivity. Which specific aspects of captivity most induce stereotypy, however, remain unclear. Here, we test the hypothesis that stereotypical behavior in captive felids is driven by the relative size of the enclosure, which predicts that the smaller the enclosure relative to the body mass of the animal, the more likely the animal is to exhibit stereotypic behaviors. To test this, we will observe captive feline species of a variety of body sizes at the Franklin Park Zoo and Stone Zoo. We will record the stereotypic behaviors of pacing, over-grooming, and self-mutilation, and then compare the incidence of these behaviors to each individual's relative enclosure size. The results of this study will bring awareness to which facets of captivity cause stereotypy, which can hopefully improve captive welfare in the future.

CHALLENGES TO FORAGING AND NESTING SEA TURTLES: SPONGE POPULATION AND EROSION IN COSTA RICAN HABITATS

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Due to global climate change, ocean acidification, sedimentation, sea level rise, and global mean water temperature increases in recent years, Costa Rican sea turtle populations face serious threats to their foraging zones and nesting beaches. This past summer, I traveled to Ojochal de Osa in Costa Rica and alongside my research partner and my mentor at the Reserva Playa Tortuga, conducted a study on the protected foraging zones of *Eretmochelys imbricata* and a protected nesting beach of the *Lepidochelys olivacea*. Through a series of survey dives, I gathered information on the local sponge species in six different dive sites at the Marine Ballena National Park in order to examine the community structure as well as note any evidence of *E. imbricata* foraging. I similarly gathered daily information on beach erosion, salinity, and temperature of the locally protected *L. olivacea* nesting beach, Playa Tortuga, over a nine-week period. The results of my study provide a baseline for future research and a continuation of my surveys at the Reserva Playa Tortuga, whose principle focus is sea turtle conservation.

CHARACTERIZING THE OVARY AND TESTES TRANSCRIPTOME OF THE CAPE AND LESSER MASKED WEAVER

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My project is focused on characterizing the transcriptome of the Cape and Lesser Masked Weaver. These are birds which are native to South Africa. They were collected by a collaborator, Prof. Rauri Bowie of UC Berkeley. With the use of a bioinformatics pipeline, I was able to analyze gene expression in the ovary and testes of these birds. My analyses followed the Oyster River Protocol which is a set of adjusted and enhanced practices for transcriptome assembly developed by Matt MacManes. All bioinformatics analyses were done using a computer running the Linux operating system. The datasets were assembled on a high memory server that enables the analyses of genomic data which are outside the capabilities of my own computer. Looking at gene expression, I was able to identify which genes are most highly expressed in each given tissues. This allowed me to compare similarities and differences of genes between the two tissues and develop hypotheses as to why some may be present and others may not be. I characterized the tissue-specific transcripts and was also able to determine the corresponding predicted proteins.

INVESTIGATIONS OF CHANGE DETECTION IN PEOPLE AND PIGEONS

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Change detection, the awareness of a change in your surroundings, is important in daily life in both human and non-human animals for attending to a varied array of changes, from noting specific individuals as they enter a room to detecting new food items in a field. While detecting environmental changes may sound simple, studies have found humans and non-human animals to be blind to many changes in visual scenes; a phenomenon referred to as change blindness. We tested visual change detection in both humans and pigeons in this study, seeking to determine if the perceptual mechanisms involved are similar in both species, such as to allow pigeons to be used as a model for understanding change detection in humans. In this study, a varying number of items were briefly presented on a computer and after a short delay, one, all, or none of the images were changed, and subjects then had to identify whether or not there was a change in the scene. Both humans and pigeons were found to respond similarly, with change awareness decreasing as the number of images on the screen increased, and as fewer images were changed (i.e. one image vs. all images). While the results are quantitatively different between both groups, they are qualitatively the same, suggesting that underlying visual mechanisms may be the same in humans and pigeons, despite their varied evolutionary histories. This implies that these basic mechanisms of change detection have likely remained the same over time.

DEXAMETHASONE EFFECTS ON VASCULAR ENDOTHELIAL GROWTH FACTOR PRODUCTION BY OVARIAN MACROPHAGES

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Bovine infertility is a major economic issue in the dairy industry. Several factors contribute to this problem, including anovulation (inability to ovulate a fertilizable egg). Our hypothesis is that decrease of ovarian immune cells, specifically macrophages, will lower macrophage-derived vascular endothelial growth factor (VEGF) production. VEGF promotes vascular development important to follicular development, ovulation and corpus luteum formation, all of which are important to successful reproduction. Female rats were divided into 2 groups (n=3): one treated with dexamethasone (DEX), an immunosuppressant steroid, and the other an untreated control. Frozen histological sections of each ovary were reacted with monoclonal antibodies for macrophages (CD163 antigen) and polyclonal antibodies for VEGF and visualized with secondary antibodies labeled with AEC (red dye). Results for both were quantified using light microscopy and image analysis software (SPOT). Data was collected on the number of macrophages and the amount of VEGF present and compared using a Student's T-test. The results will provide insight about the role of macrophage-produced VEGF in normal ovulation and future such studies in dairy cows may provide information about potential ways to improve their fertility via improved ovulation.

A GOOD LIFE IN OLD AGE: A THAI MODEL FOR CROSS-CULTURAL GERONTOLOGY IN THE UNITED STATES

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With the elderly population growing at a rapid rate worldwide, strains are being placed on the international economy, healthcare systems and social welfare programs, thereby prompting the implementation of new policies regarding elderly care across many countries and cultures. Long-standing policies, like the U.S. Older Americans Act (OAA) of 1965, promote "aging well", "helping to maintain the health and well-being of seniors" and "meeting the needs" of the elderly population, as stated in the OAA Brief released by the U.S Department of Health. Yet, elderly populations carry with them a variety of culturally-specific views of "aging well." This is particularly true in the United States. According to U.S. Census Bureau, the elderly population is expected to double between 2012 and 2050, and in the process become more racially and ethnically diverse. Addressing cultural difference in gerontology policy and practice therefore requires defining successful aging in the eyes of the elderly. This study uses Thailand's healthcare system as a model to investigate how healthcare professionals accommodate elderly patients' views, values and motivations surrounding successful aging. Drawing on ethnographic research in Bangkok, this research provides insights into how cultural competency can be accomplished within healthcare policy and practice, and takes a first step in establishing a methodology for exploring definitions of successful aging in culturally unique contexts.

EFFECT OF DIRECT-FED MICROBIALS AND ENZYME SUPPLEMENTATION IN PREPARTUM HOLSTEIN COWS ON COLOSTRUM AND CALF IMMUNITY

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In cows, colostrum is composed of several antibodies and nutrients to provide immunity and energy to the calf. Feeding calves high quality colostrum has been shown to improve calf health, leading to reduced mortality in calves and greater milk production in cows. The addition of direct-fed microbials (DFM) to cow diets has been theorized to improve feed efficiency and milk production, with studies showing mixed results. However, few experiments have studied the effect of feeding DFM on colostrum quality. In this experiment two treatments were given, 1) DFM and 2) DFM and enzymes (DFME). Colostrum was analyzed to determine if yield, composition, and immunoglobulin (IgG and IgA) concentration were affected. Calf serum IgG and IgA concentrations were analyzed to determine if 24 h concentrations and apparent efficiency of absorption (AEA) were affected. There were no differences with regard to yield or IgA concentration. The percent of true protein (TP) showed a positive trend, indicating a higher percentage with the treatments ($p=0.067$). The treatments had no effect on the other components analyzed. The results for the IgG concentration were not significant ($p = 0.174$) although an increase was observed from 77.1 mg/mL in the control to 92.6 mg/mL in the DFME treatment. Neither treatment had an effect on calf immunoglobulin concentration or AEA. Based on the results, feeding DFM or DFME improves percent TP and might increase IgG concentration, but further research is necessary.

IMPACT OF HEALTH BEHAVIORS ON ACADEMIC PERFORMANCE IN COLLEGE STUDENTS

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The transition to college can shift health behaviors. Limited studies explore the effects of health on academic performance in undergraduate populations. This study examines whether healthy lifestyle factors (HLF) impact academic performance among students. First-year students (FYS) (n=790), who had participated in an ongoing, cross-sectional study examining health status and behaviors during the 2013-15 academic years, were invited one year later to answer a five item, online survey. Respondents included 229 students who self-reported grade point average (GPA) (29% response rate). Using data collected during the students' first year, five HLFs were identified including healthy BMI (74%), non-smoker (97%), non-binge drinker (42%), physically active (81%), and healthy diet (45%). During their first year, 43% of students had 4-5 HLFs. One year later, 38% of students reported a GPA ≥3.5; 44% with GPA 3.0-3.49; and 18% reported GPA 2.0-2.99. Non-binge drinkers were more likely than binge drinkers to report GPA≥3.5 (50 vs. 30%, $p<.01$). Students with healthy diets tended to report a GPA≥3.5 more often than those with unhealthy diets (46 vs. 31%, $p=.057$). FYS with 4-5 HLF were more likely than FYS with 0-3 HLF to report a GPA≥3.5 (51 vs. 32%, $p<.05$) one year later. Findings suggest that a healthy lifestyle as a FYS, particularly abstaining from binge drinking and eating a healthy diet, increases the likelihood of a higher GPA as an upper-class student.

LANDSCAPE ECOLOGY BASED ASSESSMENT OF UNIVERSITY OF NEW HAMPSHIRE CAMPUS LANDS AND RECOMMENDATIONS FOR FUTURE DEVELOPMENT

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The General Ecology class conducted ecological assessments of four forested landscape areas: College Woods, Woodman Farm, West Edge, and Old Durham Reservoir. Wildlife inventories were accomplished by use of trail cameras, animal tracks in the snow, and bird surveys. The information was recorded and entered into iNaturalist and displayed as maps in Google Earth. Species observed through these methods include both grey and red squirrels (*Sciuris carolinesis and vulgaris*), fisher (*Martes pennanti*), raccoons (*Procyon lotor*), coyotes (*Canis latrans*), white-footed mouse (*Peromyscus leucopus*) and grey fox (*Urocyon cinereoargenteus*). In addition, habitat assessments were carried out using field observations and Google Earth measurement tools. One goal of this assessment was to provide ecological information for future development of University lands. Based on our findings we make recommendations for ways to improve the biodiversity and ecological integrity of the University's properties.

GENETIC STRUCTURE OF AN ISOLATED NEW ENGLAND COTTONTAIL (*SYLVILAGUS TRANSITIONALIS*) POPULATION

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Habitat loss and fragmentation have contributed to substantial range contraction of the New England cottontail, an early-successional obligate species. Once distributed throughout the northeast, New England cottontails are now restricted to small patches in New England and southeastern New York. This project is focused on a geographically isolated population of cottontails located in Columbia County, New York. Cottontails in this population may be affected by a variety of issues associated with small population size, such as genetic drift, vulnerability to environmental and demographic stochasticity, and inbreeding depression. Limited dispersal of individuals between habitat patches may exacerbate these problems. To address these issues, I genotyped 35 individuals at 12 microsatellite loci and evaluated genetic diversity and variation in relation to landscape features. This information will be useful for understanding the factors influencing New England cottontail population structure in New York and have implications for management and conservation planning.

OPTIMIZING A PROTOCOL FOR DNA EXTRACTION FROM HISTORIC BOBCAT (*LYNX RUFUS*) SKULL SPECIMENS

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As human activity has changed the New England landscape, pressures influencing wildlife populations have also shifted. An understanding of how drivers of wildlife population dynamics have changed over time can lead to more successful management efforts. In that context, historic specimens combined with advances in molecular techniques can provide valuable information for the reconstruction of past genetic patterns. However, for successful comparisons, validated protocols for DNA extraction and amplification from historic material are needed. Our objective was to optimize a protocol for extracting DNA from a set of spatially referenced bobcat skulls collected between 1951 and 1964. The skulls have been stored in suboptimal conditions for much of the time since their collection. We compared concentrations of extracted DNA and success of microsatellite PCR amplifications among five parts of the skull, between two cleaning techniques, and between two sample preparation techniques. Preliminary results suggest extraction from the condylar process after full homogenization yields the highest DNA concentration. These results will make a contribution to understanding how anthropogenic factors have impacted New Hampshire's bobcats.

INNOVATIVE TECHNIQUES IN CYANOBACTERIA MONITORING FOR HUMAN HEALTH AND AWARENESS

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Cyanobacteria abundancy is an increasing problem in common lakes and ponds due to the toxins they release into the water. The primary toxin produced is microsystin (MC); a hepatatoxin that targets the liver. Animal and human interaction with affected waterbodies can yield hazardous health effects, causing severe illness and even death in extreme cases. Current Environmental Protection Agency (EPA) monitoring through cell counts is slow and not always accurate. Smaller cells and fragments can often be missed. Fluorometry is an emerging technique to detect chlorophyll-α and phycocyanin, a unique pigment to freshwater cyanobacteria. Successful use of fluorometry would allow for quick and straightforward results that are both user friendly and reliable. Varying sizes of cells have been studied by filtering lake water through different size mesh in order to look at the fluorescence of cells that are often overlooked by traditional counting methods. Between 39-97% of fluorescence is found within the fraction <50µm indicating cell counts miss 39-97% of the potential toxicity. Enzyme Linked Immunosorbent Assay (ELISA) testing was used to determine the MC concentration of these fractions. A significant amount of toxins were found within smaller fractions, demonstrating that cell counts are not an accurate representation of cyanobacteria abundance or toxicity.

COMPARISON OF MOVMEMENT PROPERTIES BETWEEN SUBTHALAMIC NUCLEI

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The thalamus contains distinct nuclei including mediodorsal nucleus (MD) and midline and rostral intralaminar nuclei (IL). Single cell recording from separate thalamic nuclei in rats performing a delayed non-matching to position task (DNMTP), have shown that each subregion carries unique coding properties. While MD projects mainly to middle layers of PFC, IL provides modulatory inputs to deep and superficial layers of PFC and to anatomically-related areas of the basal ganglia and hippocampus. It would be expected that because these nuclei contribute to different modulatory networks, response properties would also differ. Thus far, we have found a distinct difference between MD and IL neurons where MD exhibits more movement related coding. Finding distinct coding properties of MD and IL would suggest that they each influence prefrontal cortical connections in unique ways.

CONDITIONAL CODING PROPERTIES OF REINFORCEMENT RESPONSES IN RAT PREFRONTAL CORTEX

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Prefrontal cortex (PFC) is critical for executive functions such as working memory, attention, and decision making. We are recording single neurons in PFC while rats perform a serial lever press task (SLP), where rats receive water reinforcement upon making two consecutive lever presses. Panel lights above each lever signal reinforcement. Individual cells in PFC respond and anticipate water reinforcement, and encode errors. Here, we investigate if neurons in PFC associate the panel light with reinforcement through Pavlovian conditioning by examining different sample contingencies where the second lever press in the sequence is randomly selected to pair light and water (~60%), present light alone without water (~20%), or deliver water without a light signal (~20%). If light has been associated with water reinforcement, then presenting light alone will elicit a conditioned reinforcement response. We have found neurons in PFC that respond selectively to each of the sample conditions. All neural correlates associated with the presentation of light only, respond as if it is an error due to the absence of water reinforcement. Therefore, the panel light in our behavioral task is not paired with water and does not carry any reinforcing properties on its own.

REVEALING THE MECHANICS BEHIND SINGLE CELL RECORDING: ASSEMBLY OF DRIVABLE MULTI-TETRODE ARRAYS

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In vivo single cell recording examines how one, out of the billions of neurons in the brain, contributes to higher order cognitive functions. Neurons communicate through chemical and electrical signals, forming intricate neural networks to support complicated brain functions. Electrophysiology, capturing and measuring electrical signals, in conjunction with behavioral measures, provides insight on how the activity of a single cell translates into population encoding of executive functions. Rodent models are ideal for studying the neural underpinnings of cognitive functions as homologous findings in humans, non-human primates, and rodents, support parallel processes between species. Our aim is to discuss the mechanics behind single cell recording in rodent prefrontal cortex (PFC). Neural activity is recorded from a driveable electrode array consisting of 4 tetrodes, each with 4 twisted platinum iridum microwires, housed in a stainless steel cannula, which is advanced incrementally through PFC. Electrical signals are recorded in vivo from the 16 microwire electrodes, with TTL pulses marking time stamps of behavioral events occurring in the task. Signals are processed using Spike Sort 3D software to classify cells and separate signal from noise. Examining the information carried by a single neuron allows us to extrapolate the function of PFC at large.

INVESTIGATING MOVEMENT PROPERTIES IN THE RAT PREFRONTAL CORTEX DURING TASK SPECIFIC EVENTS

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Prefrontal cortex is known to support executive functions necessary to successfully complete the delayed non-match to position (DNMTP) task. Recording the activity of single neurons in PFC of rats performing DNMTP we have found 288 (32%) of neural responses related to preparation, action, delay, and reinforcement. Of those response types, 76 (26%) were related to the rats' movement during the behavioral task. Movement 1 cells describe a significant increase in cell firing while the rat is moving between all levers. Movement 2 cells display increase firing for only 2 of the 4 lever press sequences. Place maps depict highest firing rates occurring between all 4 lever paths for Movement 1, whereas Movement 2 cells show highest firing rates between only 2 lever paths. Here, we investigate the patterns of activity that emerge when we isolate analyses to a single task event surrounding either the start, sample, delay, or choice lever press. By examining the activity at specific events, we have found that most Movement 2 activity is derived specifically from the sample response. Also, there are instances in Movement 1 cells where each path of activity represents a specific event. Together, these results suggest that single neurons in PFC respond selectively to specific events reflective of task requirements.

WHAT IS THE UNIVERSITY OF NEW HAMPSHIRE'S NITROGEN FOOTPRINT?

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Humans create reactive nitrogen through processes such as the burning of fossil fuels and the Haber-Bosch process. After reactive nitrogen is lost to the environment it can cause environmental and human health problems. The amount of reactive nitrogen created by a process or institution has been named the "nitrogen footprint." The first institution-level nitrogen footprint model was developed at the University of Virginia. The model allows universities and institutions to track the amount of reactive nitrogen they are creating through its food purchases (and the loss from food production), utilities, transportation, fertilizer, research animals and agriculture. UNH is part of the first cohort of universities using and testing the model. The preliminary result for FY 2014 was a total nitrogen footprint of 228 tonnes N. Food purchases accounted for 83%, utilities was 6%, transportation was 9% and fertilizer was 3% of the total nitrogen released. This poster will highlight the calculation of a sewage treatment nitrogen reduction factor, and our result was an estimated 88% nitrogen removal rate. Data were provided by the Durham WWTF and results will be used as a nitrogen credit that lowers UNH's total nitrogen footprint. Preliminary results for UNH will be compared to the other cohort universities. We will also be running scenarios and projections in order to identify a nitrogen footprint reduction goal to complement UNH's carbon footprint reduction goal.

IDENTIFICATION OF THE IAA BIOSYNTHESIS GENES IN *NOCARDIA* STRAIN BMG51109 AND THEIR UP-REGULATION IN RESPONSE TO ROOT EXUDATES OF THE HOST PLANT, *CASUARINA*

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Actinorhizal plants form a symbiotic association with the nitrogen-fixing soil bacteria *Frankia*. Consequently, root nodule structures develop on the plant roots at sites of infection. Recently, many non-*Frankia* actinobacteria have been isolated from actinorhizal root nodules suggesting that they play a role in aiding the plant. Two *Nocardia* strains, BMG11209 and BMG51109, were isolated from *Casuarina* root nodules found in Tunisia and have been studied physiologically. Indole-3-acetic acid (IAA) is an important phytohormone, of the auxin class, that regulates plant growth, and is speculated to be involved in this phenomenon. The synthesis of phytohormones is ubiquitous amongst plant-associated bacteria and the production of IAA by BMG51109 was detected by our colleagues. Bioinformatic analysis of BMG51109 genome sequence revealed the presence of genes that could produce IAA and other phytohormone auxins. Plants are known to exude signaling compounds and nutrients from their roots that modify the metabolism of soil and plant-associated bacteria. The effect of *Casuarina* root exudates on the expression of these genes in *Nocardia* BMG51109 was tested via RT-qPCR. Preliminary results show that the expression of genes within the potential IAA biosynthetic pathway were elevated for BMG51109 cells exposed to root exudates compared to our control. This knowledge provides new insight into the mechanisms that non-*Frankia* bacteria play in the actinorhizal symbiosis.

CAN CYTOPLASMICALLY SEQUESTERED AND APOPTOTICALLY INACTIVATE P53 IN A SUBSET OF AML PATIENTS FROM A CLINICAL POPULATION BE REACTIVATED BY MKT-077 AND WITHANONE?

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In certain human cancers, cytoplasmic sequestration and inactivation of p53 result when mortalin is over-expressed. Extra-mitochondrial mortalin abrogates p53-dependent apoptotic outcomes. The dye MKT-077 and herbal medicine withanone compete with p53 for binding mortalin and promote apoptosis. A repository of cases from a clinical population of acute myelogenous leukemia cells was interrogated using immunocytochemistry, western blotting and co-immunoprecipitation for p53 and mortalin and treatment with the mortalin/p53 binding competitors, MKT-077 and withanone. Among 37 AML cases a sub-sample of eleven were positive for cytoplasmic sequestration of p53. Additionally, p53 in these patients was complexed with mortalin and treatment with both MKT-077 and withanone resulted in nuclear translocation of p53 and apoptosis. We have shown that p53 is tethered in the cytoplasm by mortalin in a sub-set of AML cases and that cytoplasmic sequestration of p53 and abrogation of apoptosis is overcome by treatment with mortalin inhibiting agents.

EXPRESSION AND PURIFICATION OF FUNCTIONALLY ACTIVE RECOMBINANT PDE6

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Rod and cone photoreceptors in the retina respond differently to light, but little is known about the differences in the signaling pathways that generate the electrical response to light. Phosphodiesterase-6 (PDE6) is the central enzyme in the visual signaling pathway, with different genes for the PDE6 catalytic and inhibitory subunits being expressed in rods and cones. Our hypothesis is that differences in rod and cone PDE6 catalytic and inhibitory subunits confer different regulatory properties that account for differences in rod and cone light sensitivity. To test this, we subcloned the regulatory domains of rod and cone PDE6 (called GAFab) into bacterial expression vectors and expressed and purified the recombinant PDE6 protein. We found that chicken cone GAFab consisting of amino acids 44-458 was expressed at high levels, could be purified to homogeneity, and was capable of binding cyclic GMP at its regulatory site. Efforts to express and purify either the corresponding human clone GAFab or the chicken rod GAFab protein have been unsuccessful to date. Current work focuses on creating different truncations of the GAFab amino acid sequence to enhance expression of functional recombinant protein. Understanding the regulation of rod and cone PDE6 will aid efforts to find therapeutic solutions for retinal diseases caused by mutations in PDE6 subunits.

ARE WOLBACHIA PRESENT IN *HARMONIA AXYRIDIS*?

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Wolbachia infect several species of arthropod. These bacteria affect their ability to reproduce through killing or feminization of males, cytoplasmic incompatibility between gametes or the ability of females to create clones. This experiment attempted to determine the prevalence of Wolbachia in *Harmonia axyridis* (ladybugs). Ladybugs were collected from Durham, New Hampshire and separated by sex. DNA was extracted from 108 ladybugs (42 males and 66 females). PCR was performed on the ladybug DNA using a primer for the *wsp* gene of Wolbachia.

NH CITIZEN PLANNER: DISCOVERING THE NEEDS OF MUNICIPAL VOLUNTEERS TO SUPPORT VIBRANT COMMUNITIES

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This research describes the challenges and needs of municipal volunteers in Strafford County, New Hampshire. In fall of 2015, UNH Cooperative Extension partnered with the UNH Planning Club to investigate the challenges and needs of communities in Strafford County. Planning Club students visited with planning boards, energy commissions, and conservation commissions for short informal interview. Community board members throughout Strafford County have also taken an online survey. This data will inform the NH Citizen Planner program, a resource dedicated to volunteers working on planning issues in communities.

KDAMPS: ANTIBIOTICS OF THE NEXT GENERATION

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Antibiotics have been the main source in which bacteria, that cause harm to our bodies, have been killed by. However due to mutation and the ability to exchange plasmids containing antibiotic resistance genes, many of the pathogenic bacteria have become resistant to antibiotics. And so, we are frantically trying to find alternates to antibiotics. The discovery of certain small peptides found, that have antibacterial activity, has provided some hope to combat infections; a Keratin-derived Antimicrobial peptide (KDAMP) has attracted attention. This peptide comes from the protein Kertain 6A, produced by the epithelial cells in the human eye. The human eye is exposed to many types of potentially harmful bacteria, yet the eye has always been clear of bacteria. Research has shown that this peptide plays a role and over the years they have not developed resistance to this peptide. Our research aims at the production of this peptide in large scale in bacteria and in plants using synthetic genes containing repeat DNA sequences that would produce 14-mer and 17-mer versions of this peptide. Work to date has shown that it is a feasible approach to produce the effective forms of these peptides for further testing. Next steps will focus on the production of similar peptides in transgenic tobacco plants.

PHYSICAL AND EMOTIONAL IMPROVEMENTS OF PATIENTS THROUGH DOLPHIN-FACILITATED HEALING EXPERIENCES - SOME CASE STUDIES

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Dolphin facilitated healing experiences are a relatively new and understudied aspect of the therapeutic approach, as is animal partnership in the application of holistic therapies. Dolphin Integrated Vitality Experiences (DIVE) are integrative holistic health bodywork sessions in the water with dolphins serving as co-facilitators, accompanying practitioners of the healing arts in administering treatment for clients. A variety of case studies representing the mammal's healing abilities in the therapeutic world already exist. We examined two clients who underwent 5 one-hour DIVE sessions in a one-week time frame and their reactions to the experience. We observed structural, muscular, postural improvements; collected subjective data on their specific symptom changes; and collected the subjective reflection of our client's personal experiences and perceived changes within their physical, spiritual, emotional and cognitive awareness. We anecdotally assessed the behavior, participation and responses of the dolphins during each session. We discovered that the dolphins participated willingly in the sessions, made therapeutic contact with the clients, and were engaged in the experience without fish rewards. The clients exhibited positive objective and subjective outcomes, suggesting that DIVE is a valid form of alternative holistic health.

FLUOROMETRY AND TOXIN ANALYSIS OF NEW ENGLAND FRESHWATER BODIES

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Clusters of patients with the neurodegenerative disease amyotrophic lateral sclerosis (ALS) have been found near New England lakes with cyanobacteria blooms. High incidence of ALS, Alzheimer's disease and Parkinson's Disease in an Indigenous people in Guam were linked to the cyanobacteria neurotoxin beta-Methylamino-L-alanine (BMAA). As part of a collaborative study with UNH, members of the Dartmouth Hitchcock ALS Clinic gathered samples from nine New England lakes from June to August 2015. Samples of water were measured with fluorometry and cells counted to estimate concentrations of cyanobacteria. Aerosol filters were tested for cyanobacteria cells (epifluorescence) and enzyme-linked immunosorbent assay (ELISA) for toxins. Results for each lake were compared with estimates of ALS incidence based on epidemiological studies.

CHARACTERIZING THE ANGIOGENIC PROPERTIES OF GLIOMA U373 CELLS

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In the United States, nearly 700,000 people have been diagnosed with brain tumors, e.g., gliomas. A common trait among tumors is angiogenesis, which is the formation of new blood vessels from pre-existing ones. Through angiogenesis, glioma cells are able to receive oxygen and nutrients to support their rapid growth. In order to better understand the process of tumor angiogenesis in gliomas, the current study sought to characterize some of the angiogenic properties of the U373 glioma cells by using gelatin zymography to determine their ability to produce matrix metalloproteinases (MMPs) and cell culture techniques to assess proliferation rate. While gelatinolytic activities were robust when cells were grown in the presence of fetal bovine serum (FBS), these activities, however, persisted for 2, 4, 8, 12 and 24 hours in the absence of FBS. At all 4 time points, at least two enzyme species, with relative molecular masses of approximately 73 and 96 kDa were detected, consistent with MMP2 and MMP9 family members, respectively. Future work will determine the proliferation rate of these U373 glioma cells.

COMPARATIVE GENOMIC ANALYSIS OF ENVIRONMENTAL STRAINS OF *VIBRIO PARAHAEMOLYTICUS*

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Vibrio parahaemolyticus (Vp) is a marine bacterium that can be pathogenic and a major cause of gastroenteritis worldwide. Exposure is often through consumption of raw oysters. Relaying oysters, i.e. moving oysters to waters with lower *Vibrio* levels, can significantly reduce *Vp* levels. Oysters were relayed from the upper Piscataqua River in Dover, NH to Spinney Creek in Eliot, Maine during 2011-14. *Vp* levels in relayed oysters were decreased in all years except 2013, when *Vp* levels instead increased. *Vp* isolates from 2011-14 Spinney Creek water and oyster samples have been sequenced using next-generation Illumina sequencing. Comparative analysis is underway to determine what happened to the *Vp* population in Spinney Creek in 2013 compared to other years. We predict that the dramatic increases in *Vp* levels were a function of the evolution of new *Vp* strains or the introduction of non-native strains to Spinney Creek. Strain types will be identified using multilocus sequence typing. Genomic variants such as single nucleotide polymorphisms and the presence of virulence genes will also be determined. Whole genome phylogenetic trees and heat maps will be constructed to determine relationships between strains relative to the sample year and to samples with different *Vp* levels. We hope to better understand the mechanism underlying this unusual *Vp* proliferation in Spinney Creek during 2013 to then optimize oyster relaying to reduce human health risks.

AMINO ACID PROFILE OF PLASMA, WHOLE BLOOD, AND RED BLOOD CELLS IN LACTATING DAIRY COWS

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Plasma amino acids are used to measure concentrations of amino acids including lysine and methionine, which are limiting for lactating dairy cows. We investigated two questions: (1) do plasma amino acids provide a different measure of amino acid concentration of lysine and methionine compared to whole blood and red blood cells?, and (2) is there a difference in amino acid concentration between whole blood and red blood cells? To answer these questions, blood was collected from three lactating dairy cows over a six week period in 10 mL vacutainer tubes containing 15% EDTA. Tubes were centrifuged at 3,300xg for 20 min at 5°C and 4 mL aliquots from plasma samples were deproteinized using 15% SSA and stored at -80°C. Whole blood and red blood cells were lyophilized for 48h and stored at 20°C until amino acid analysis, which was done at the University of Missouri using high performance liquid chromatography. Results indicated that there were small numerical differences between red blood cells and whole blood for lysine (55.5 and 53.7μM, respectively) and methionine (7.8 and 7.0μM, respectively). Conversely, plasma had numerically higher values for lysine (92.3μM) and methionine (28.2μM) compared to whole blood and red blood cells. This indicates that plasma resulted in higher concentration of lysine and methionine than red blood cells and whole blood, and researchers should take this into account when selecting blood fractions for amino acid studies.

CHARACTERIZING *ARABIDOPSIS* SODIUM-INDUCED ROOT SKEWING MUTANTS *SRS*4 AND *SRS*10

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Development of a normal root system is essential to plant growth. Multiple signaling pathways are required to maintain normal root growth under both optimal and stress conditions. In *Arabidopsis thaliana*, the Hrabak lab has shown that mutations in certain protein phosphatase genes result in a novel root skewing phenotype when seedlings are under NaCl stress. Our goal is identify other genes whose disruption results in a similar root phenotype. A large collection of *A. thaliana* mutants was subjected to a multi-part screen to identify seedlings whose roots skewed in response to sodium but not potassium or chloride. A small number of mutants fit these criteria and two were chosen for further characterization. TAIL-PCR was used to locate the mutation in the genome. The *srs4* mutant contained a mutation in an exocyst complex component gene, while *srs10* contained two mutations, one located in a carbohydrate X8 domain protein gene and the other located between an expansin gene and a retrotransposon. Both the *srs4* and *srs10* have a recessive mode of inheritance of the root-skewing trait, determined by analysis of the F_1 generation. For the *srs10* plants, two methods are being used to determine which gene is responsible for the root skewing phenotype. One method is to determine which gene correlates with the phenotype by analyzing the F_2 generation and the other approach is to screen individual mutants in the two genes identified.

THE EFFECT OF GONADOTROPHIN RELEASING HORMONE ON THE PROLIFERATION RATE OF A MELANOMA CELL LINE

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Gonadotropin releasing hormone (GnRH) is a decapeptide hormone found in the hypothalamus of vertebrates. In the sea lamprey, three GnRHs have been identified. GnRH-III, in particular, has been shown to bind to low and high affinity GnRH receptor (GnRH-R) sites on human cells. Studies have also shown that GnRH-Rs are generally more highly expressed in cancer cells than in normal cells. In these cancer cells, it has been hypothesized that binding of GnRH-III to low affinity receptor sites may exert anti-proliferative activities. Indeed, such anti-proliferative effects of GnRH-III have been shown in several types of GnRH-R positive tumor cells. In the present study, the effects of lamprey GnRH-III on the melanoma cell line (BLM) were investigated. BLMs were seeded into 96-well plates and treated daily for six consecutive days with lamprey GnRH-III (0.1 to 50 uM). Proliferation rate was assessed by the Methylthiazol Tetrazolium (MTT) assay (American Type Culture Collection). The results from the present study may provide insight regarding the use of lamprey GnRH-III as a therapeutic agent for melanomas and other cancers.

PLANT PRODUCTIVITY IN HYDROPONIC VERSUS AQUAPONIC SYSTEMS

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As the world's population increases rapidly, alternative and integrated agricultural systems are being explored to increase people's ability to grow crops in more sustainable ways. Aquaponic systems are growing in popularity as the integration of aquaculture and hydroponic production systems. In a hydroponic system, nutrients must be introduced, using outside sources, while aquatic species provide nutrients for the plants in aquaponic systems. However, research is needed to determine which method is the most effective in terms of plant productivity. In this study, a hydroponic and aquaponic system will be set up to identify which one promotes the best productivity for lettuce. Physical parameters of each plant will be measured in both systems, including plant diameter, width, and the weights of wet and dry roots and leaves. This experiment will be used to identify the system type effect on plant productivity and assist future experiments in the expansion of agriculture.

THE IMPACT OF FEEDING ON HORSESHOE CRAB ACTIVITY

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Limulus polyphemus are found along the Atlantic coast of the United States, from Florida to Maine. They are important members of marine and estuarine ecosystems, their eggs provide nutrition for migrating birds, and they are harvested to provide bait for eel and whelk fisheries and to provide blood for the biomedical industry. They are also an excellent model system for investigating biological rhythms, because they express both daily and tidal rhythms in the field and laboratory. In some of these previous studies, we noted that they would occasionally stop moving for long periods of time, perhaps because they found food and then became inactive while they were digesting it. In order to test this hypothesis, we monitored the activity of 77 horseshoe crabs before and after they were fed in outdoor tanks at the Jackson Estuarine Laboratory, NH. Activity was monitored using waterproof accelerometers that were attached in the center of their carapace. Their activity rhythms were recorded for one-week control period, then they were fed blue mussels, and then their activity was recorded for another week. Approximately sixty-five percent of the horseshoe crabs tested decreased their activity after feeding. In addition, 45% of the animals changed their original patterns of activity (either tidal, nocturnal, or diurnal), to a different pattern. These data support our hypothesis that after horseshoe crabs consume their prey, their activity changes for several days.

DETERMINING PROTEIN PHOSPHATASE 2A C-SUBUNIT GENE INTERACTIONS ON ROOT GROWTH UNDER SALT STRESS

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Environmental stressors, such as high soil salinity, can be detrimental to plants not only in the wild but also in agriculture. To cope with stressful conditions, plants use a variety of molecular mechanisms. I have studied a protein implicated in salt stress response called Protein Phosphatase 2A (PP2A) in the plant *Arabidopsis thaliana*. PP2A is made up of three subunits, and each subunit is encoded by several genes. Based on a root growth assay of PP2A mutant plants, only some of the PP2A genes appear to regulate root growth under high salt conditions. I used PP2A double mutants to determine how different PP2A subunit genes interact to regulate root growth under high salt conditions. Plants carrying distinct single mutations in PP2A genes were crossed to incorporate both mutations in a single plant. The offspring were tested to identify the desired double mutants, and an assay was performed in order to quantitatively compare root responses to stressors. I will present a preliminary genetic interaction map for the C-subunits.

DO THE SNPS SUPPORT THE STUDIES? A GENOMIC LOOK INTO THE OVERDIAGNOSIS OF SCHIZOPHRENIA

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As of today, 2.2 million Americans are diagnosed with Schizophrenia. One growing concern in the field of mental health is the overdiagnosis of Schizophrenia, specifically in the African American population. The objective of this experiment is to begin an investigation into the genetic underpinnings of Schizophrenia in order to assess whether or not the disease is, in fact, overdiagnosed. To do this, the human reference genome and 30 human sample genomes will be obtained from the 1,000 Genomes Project database. The sample genomes will include Americans of African ancestry, Americans of Mexican ancestry, and Japanese of Japanese ancestry. Genomic analysis will include mapping samples to the reference, marking duplicates and sorting, realigning indels, recalibrating bases, variant calling, and variant filtering of Schizophrenia-associated SNPs. The genetic SNP data will then be compared between and among populations and the findings will be applied to support or deny the prediction that Schizophrenia is overdiagnosed in African Americans.

NEW INSIGHTS ON THE FUNCTIONAL ECOLOGY OF CNIDARIANS AND THE ORIGINS OF BILATERIAN SENSORY NEURONS REVEALED BY CYTOARCHITECTONIC INVESTIGATIONS OF THE HYDRA

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Animals with bilateral symmetry like humans, flies, or worms display the most complex nervous systems in nature. In order to understand how this complexity evolved, we study the earlier branching phylum Cnidaria that is the evolutionary sister to bilaterians. We use the freshwater cnidarian, *Hydra magnipapillata,* as a model system to investigate the evolution of complex bilaterian sensory processes. Here, we apply confocal microscopy and *in situ* hybridization to characterize the fine structure of the nervous system of the hydra. Using a suite of antibodies directed against important components of bilaterian nervous systems, we show that the peptidergic neurotransmitter RFamide is expressed in sensory neurons that are apposed to cnidocyte (stinging cell) bearing complexes. In addition, synaptotagmin, an important Ca^{2+} sensor in bilaterian pre-synaptic membranes, is also expressed in cnidarian synapses. These expression patterns correlate with the expression of photosensitive *Opsin* and chemosensitive taste 1 receptors (*TIR*) in the hydra. Together these data suggest the presence of a novel photosensitive and chemosensitive peptidergic sensory neuron with bilaterian-like synapses in the hydra, an evolutionary sister to bilaterian animals. We discuss implications of our findings for the functional ecology cnidarians and the evolution of bilaterian nervous systems.

MISSING SOURCES AND SINKS: EXPLORATION OF MINERAL SOILS AS A NITROGEN BANK

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Nitrogen saturation of ecosystems from atmospheric deposition (nitrogen pollution) can lead to soil acidification and increased leaching of nitrogen, which can negatively impact local streams and watersheds. As forests age and biomass reaches equilibrium it is expected that excess nitrogen entering the forest will leach out. Despite predictions that anthropogenic nitrogen pollution will lead to nitrogen saturation and leaching in Northeastern forests, long-term monitoring at Hubbard Brook Experimental Forest has revealed anomalies in the nitrogen budget. Young forests have been found to take up more nitrogen than is annually deposited, while old growth forests, demanding less nitrogen, are not experiencing increased nitrogen leaching. The missing source-sink dynamic has prompted further inquiry into the hypotheses that the mineral soil horizon is acting as a nitrogen bank where excess nitrogen is stored until it is mined by young trees in search of a supplementary nitrogen source. To explore this hypothesis, and subsequent storage mechanisms, a chronosequence of three forested watersheds in the New Hampshire White Mountains were sampled. Soil solution chemistry and mass balance calculations were used to explore N bank hypothesis.

THE EFFECT OF ZOOPLANKTON GRAZING ON AEROSOL PRODUCTION *IN SITU*

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Aerosolization involves small particles breaking the surface tension of water. It has recently been observed that toxic cyanobacteria escape from lakes and become mobilized in the air. Little is known about the factors that regulate the rate of aerosolization of lake water. Pilot studies conducted at UNH have found that the number of aerosolized particles from lake water increased in the presence of biological activity, specifically, the grazing by zooplankton. Our goal was to test this grazing hypothesis under controlled laboratory conditions. The model organisms used were the picocyanobacteria *Synechococcus* and the zooplankton *Daphnia magna*. Aerosols were quantified in seven size categories from 0.2 to 10 μm with a laser particle counter. Experimental treatments included *Daphnia magna* and *Synechococcus*, *Synechococcus* without *Daphnia magna*, and a control with Milli-Q water. Potential effects of toxic aerosols produced by Daphnia grazing are discussed.

TARGETING BREAST CANCER: THE INTEGRAL RELATIONSHIP BETWEEN CANCER AND THE IMMUNE SYSTEM

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The aim of this project is identify polymorphisms that may influence expression of immune genes, leading to increased risk of breast carcinogenesis, following by *in vitro* validation of findings to allow development of targeted, personalized immunotherapies for breast cancer patients.

EATING LOCAL IN DURHAM: A SYSTEMS APPROACH TO THE ENVIRONMENTAL, ECONOMIC, AND COMMUNITY RELATIONSHIPS

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Over the last several decades, the industrial agricultural model has taken over the majority of food production within the U.S. Industrial agriculture has been a large contributor to issues such as food waste, infertile soils, water shortages, deforestation, loss in biodiversity, increased hormone and chemical exposure, and increased greenhouse gas production. The mission of UNH Eat Local is to educate the Durham community on the importance of local farming, along with increasing the accessibility and purchasing of food from local farms. We will work to promote local business and economy while building relationships within the community, and reducing local waste production and carbon emissions.

EXPLORATIONS IN MYCOCYCLING: ANALYSIS OF CHEMICAL, POLLUTANT, AND NUTRITIONAL VALUES IN *PLEUROTUS OSTREATUS* GROWN USING DIFFERENT AGRICULTURAL AND INDUSTRIAL WASTES

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Waste reduction and the efficient recycling of resources is of critical importance to achieving a more sustainable society. Fungi, among the most complex and dominant organisms, may offer solutions to problems of waste disposal and pollution, as well as assist with improving soil fertility and addressing the growing issue of food insecurity. In my project I will be conducting experiments on the production of specific strains of oyster mushrooms (*Pleurotus ostreatus*) using common industrial and agricultural wastes as substrates. Cardboard, waste paper, other cellulose and lignin based industrial wastes, and even some plastics can be effectively broken down by fungal mycelium, transforming these materials into valuable soil amendments. Compostable agricultural wastes such as coffee grounds, plant and leaf litter, wood, grain crops byproducts, and many others can be easily inoculated with mushroom spawn. This intermediate step could create value-added products for farmers in the form of gourmet mushrooms. I plan to inoculate different waste materials and determine colonization rate, fruiting rate, and yield by substrate. I will also research local access to these materials, cost of operations, and potential markets for these value-added crops, and attempt to determine their safety and nutritional value.

A COMPARATIVE STUDY INVESTIGATING DIFFERENT DIETS ON *STRONGYLOCENTROUS DROEBACHINSIS* AND *MYSIS SP.* FOR USE IN MULTI-TROPHIC AQUACULTURE SYSTEMS

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The primary goal of this study is to investigate the opportunity to incorporate shrimp to the urchin aquaculture industry in the Gulf of Maine. The shrimp *Mysis sp.* is found in abundance in inter tidal areas of the Gulf of Maine and can be used as a test subject for this study with the intention of applying results to a similar species, *Pandalus borealis*, in practice in fisheries. The opportunity to incorporate a new species into integrated multi-tropic aquaculture systems represent the potential for economic and environmental gains for the Gulf of Maine. Studies will be conducted testing three different types of diets: omnivorous, carnivorous, and herbivorous. A preliminary study was performed to test diet and fecal habits of the green sea urchin *Strongylocentrous droebachinsis*. Results showed that this species benefited the most and produced a greater quantity and quality of feces when fed a diet of fish pellets over kelp. The three different types of diets supplied to the urchins will all take the form of a pellet to test if the shrimp will use the urchin feces as a diet supplement and which diets will benefit their growth and reproduction the most.