



**26<sup>th</sup> ANNUAL COLSA  
UNDERGRADUATE  
RESEARCH CONFERENCE**

Memorial Union Building  
Granite State Room and Theatre II

April 22, 2017  
7:45 am – 12:45 pm



**University of New Hampshire**

**ORAL PRESENTATION ABSTRACTS**

**26<sup>th</sup> ANNUAL COLSA  
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## Entanglement of Grey (*Halichoerus grypus*) and Harbor seals (*Phoca vitulina*) at Duck Island ledges, ME

James A Coyer, Meghan K Carr, Andrea Bogomolni, Nadine Lysiak

Grey (*Halichoerus grypus*) and harbor seals (*Phoca vitulina*) congregate at Duck Island ledges, a haulout located in the Isles of Shoals, ME. This site was monitored using shipboard photographic mark-recapture surveys to assess population health during summers 2011-2016. Incidence of diseased, injured and entangled seals was noted. Entangled animals were assessed according to the severity of their wounds, type of entangling gear, and location of entanglement on the body.

During summers 2011-2016, 63 grey seals and 86 harbor seals were observed entangled in marine debris at Duck Island and its surrounding ledges. Most entanglements (85%) were located on the neck, while 6% affected the face, flippers, or body and 9% affected multiple parts of the body. Of the identifiable entangling gear, monofilament line and gillnet were most common. Though the dominant local fishery is lobstering, no seals were observed entangled in lobster fishing gear, possibly due to the heavy lines associated with the gear. Severe or very severe wounds were noted in 95%\* of *P. vitulina* entanglements and 89%\* of *H. grypus* entanglements (\*entanglements that could be scored). The relative entanglement rate for *P. vitulina* was higher than *H. grypus*. The high incidence of entanglement at this site identifies a significant threat to both Gulf of Maine seal populations, as an increase in entanglement-associated mortality will result in reduced reproductive success.

## Comparative Sociobiology and Ecology of a Small Carpenter Bee

Sandra M Rehan<sup>2</sup>, Sean Steven Lombard<sup>1</sup>

<sup>1</sup>Department of Biological Sciences, UNH Durham

<sup>2</sup>Department of Molecular, Cellular, & Biomedical Sciences, UNH Durham

Social complexity is evolutionarily derived, though how selection pressures mediate the transition from solitary states, where each individual passes on their own genes, to derived states, where most individuals forgo reproduction, remains unclear. To understand the process by which solitary species have adapted to form social collectives over time, it is essential to study species in the intermediate stages between social and solitary behavior, like *Ceratina calcarata*. This small carpenter bee species is considered intermediately social because of the maternal manipulation of her first offspring to produce a dwarf eldest daughter (DED), which forgoes reproduction to assure the survival of her siblings. Previous work on *C. calcarata* has identified a broad range of populations in North America, and differences in social behaviors across this ecological gradient. Populations at the northern extent of the species' range are well documented throughout their active seasons, late spring and summer.

The present study compares newly collected data of the ecological habits of *C. calcarata* at the southern extent of its range, with former studies on northern populations. The results showed different periods of activity between northern and southern populations, significantly larger clutch sizes and smaller body sizes in southern populations. *C. calcarata* in southern populations also produce DEDs. Percentage of female offspring in both southern and northern populations were not significantly different, though both suggestively positively correlated, maternal head width. These results suggest that although latitudinal gradient effects the seasonal phenology, brood development rates, body size and number of offspring of the species while overall sex ratio, maternal investment and social structure remain unchanged.

## Daily Distance Moved and Home Range Analysis of Female Cheetahs (*Acinonyx jubatus*) on Namibia's Commercial Farmland

Andrew B Conroy, Elisabeth N Wise, Laurie Marker  
Thompson School of Applied Science, UNH Durham

Fewer than 10,000 cheetahs remain in the wild of Sub-Saharan Africa. Namibia has the largest population, estimated to be 4,000 cheetahs. Radio telemetry was used to investigate the seasonal variation in home range size among nine female cheetahs on commercial farmlands on or near the Cheetah Conservation Fund in Otjiwarongo, Namibia. ArcGIS 10.3 and Geospatial Modeling Environment were used to calculate the 95% and 50% (overall and core home range size) kernel density estimation. This was estimated for the overall, annual, monthly, and seasonal variants for each individual cheetah. Nine female cheetahs were tracked in this study, 6 of them were rewilded and 3 of them were wild. The average number of GPS locations collected for the 6 rewilded cheetahs was 4,165.5 and the 3 wild cheetahs was 1,219.3. The average number of months the nine female cheetahs were tracked under GPS radio telemetry was 10.2 months and the average age of the cheetahs was 64.2 months. The wild cheetahs had a larger home range estimation compared to the rewilded cheetahs with an average 95% and 50% kernel of 1,738.7 km<sup>2</sup> and 302.7 km<sup>2</sup>. The home range size and average distance moved (km) between GPS locations had no significance between the seasons based on the Kruskal Wallis and Post-hoc test (R 3.2.1). These results in combination with further research can help formulate a long term conservation plan for the remaining and rewilded cheetah population on Namibia's commercial farmland.

## **Effects of Land-Use Change on Soil Nitrogen Retention at the University of New Hampshire Organic Dairy Research Farm**

Kathryn A Slebodnik, Alexandra R Contosta  
Natural Resources and the Environment, UNH Durham

The expansion of local agriculture in the New England region is putting increased pressure on farmers to expand their arable land base. While clear-cutting is a traditional method of converting forested land to agriculture, it is known for having adverse ecological impacts. To minimize these impacts, farmers can create a silvopasture which incorporates a portion of the original forest canopy into pasture or crop fields. This study evaluates the impact of land-use changes for agriculture on soil N retention. In particular, this study investigates the differences in soil N turnover, gaseous loss, and aqueous loss among an established forest, established pasture, clear-cut converted pasture, and converted silvopasture systems over a 30-day incubation period. We found significant differences in N mineralization, immobilization, and denitrification among treatments, with evidence that a forest-to-silvopasture conversion can successfully support soil N retention within the the first two years of implementation. This may have been due to the presence of coarse woody debris inputs from forest cutting and its effect on the soil carbon (C) to N ratio. Nitrogen retention in silvopastures may also result from partial preservation of the forest canopy. Our results suggest that farmers who are looking to expand their agricultural land base through forest clearing may be able to use silvopastures as a way of retaining soil nutrients while at the same time putting land into production.

## Is There a Connection Between Performance on Problem-Solving Tasks and Dominance Levels in *Canis familiaris*?

Leslie J Curren, Nina E Coffey

Dominance is not only vital to social hierarchies and reproductive success, but is also highly connected to learning and development. Cognition in domestic dogs, *Canis familiaris*, has been tested using problem-solving tasks to compare skills among breeds and ages, but comparisons have not been made across dominance levels. Here, we examined whether a dog's degree of dominance is correlated with its performance on problem-solving tasks. Because dominant individuals lead others within a social group, advanced problem-solving skills may be vital to establishing a high dominance status. We therefore hypothesized that dominant dogs have a higher level of problem-solving cognition than submissive dogs. We predicted that dogs portraying more dominant behaviors would complete problem-solving tasks faster and more often than dogs portraying fewer, particularly as the difficulty of the task increased. We first evaluated a dog's dominant behaviors based on results from a questionnaire administered to the owner. The dogs were then presented with three food puzzles of varying difficulty. We used regression models to ask if a dog's dominant behaviors predicted the number of puzzles the dog completed and, when applicable, the time it took to complete them. If problem-solving skills increase with dominance, owners may be able to better create a customized enrichment routine for their dogs, potentially decreasing boredom and destruction.

## Neuroanatomical Mapping and RNA Expression and Localization in the Brain of a Basal Vertebrate, the Sea Lamprey (*Petromyzon marinus*)

Stacia A. Sower<sup>1</sup>, Emily R Van Gulick<sup>2</sup>, Mihael Freamat<sup>1</sup>

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<sup>2</sup>Molecular, Cellular, and Biomedical Sciences, UNH Durham

Lampreys are classified as agnathans, a group of extant jawless fish that diverged from the vertebrate lineage around 550 million years ago. Consequently, the sea lamprey is a critical model species for understanding the development and evolution of the neuroendocrine system. Our work aimed to create a neuroanatomical database following the collection of histological images and the visualization of RNA expression and localization in larval, parasitic, and adult sea lamprey brains. We will present annotated 2D images; comparative 3D brain and pituitary reconstructions; and RNA expression of important hormones and receptors from each life stage. One aspect of our work focused on gonadotropin-releasing hormone (GnRH), which is the master molecule regulating reproduction in all vertebrates. Lampreys have three hypothalamic GnRHs, (I)GnRH-I, -II, and -III. Our triple-labeled *in-situ* hybridization assays suggested that IGnRH-I and -II are predominant in larval and parasitic phase and IGnRH-I and -III are predominant in adult male and female lampreys. These data provide further evidence for differential physiological roles for the three GnRHs at each life stage and sex. Our work has created reference data and helps to further refine and support existing hypotheses on the evolution of hormones and receptors in vertebrates. Co-authors include M. Freamat and T. Marquis. Supported by NSF, NH-AES (to S.A.S.) and the Anderson Family Undergraduate Scholarship (to E.V.G.).

## The Influence of Medial Thalamus on the Response Properties of Neurons in Medial Prefrontal Cortex

Robert G Mair<sup>1</sup>, Brett M Gibson<sup>2</sup>, Cynthia L Holler<sup>3</sup>

<sup>1</sup>Department of Biological Sciences, UNH Durham

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<sup>3</sup>Psychology, UNH Durham

Studies have uncovered reciprocal connections between medial thalamus and medial prefrontal cortex (mPFC). These connections are important for flexible goal directed behavior, as lesions to medial thalamus impair behavior during delayed nonmatching to position tasks (DNMTP). To examine the influence of medial thalamus on mPFC function during a DNMTP task, we temporarily inactivated medial thalamus by injecting the GABA<sub>A</sub> agonist muscimol, and observed the resulting firing frequencies. We hypothesized that thalamic inactivation will disrupt the response properties and firing frequencies of mPFC neurons. Single unit activity was recorded in mPFC using drivable electrodes. Recordings were analyzed to identify single neurons and to correlate activity with events of the task using peri-event histograms. Firing frequencies were analyzed as peri-event spectrograms. On day one of the experiment, mPFC cells were identified and the electrode was left in place such that the same cells would be recorded on two subsequent days. On day two, the same mPFC cells were recorded after medial thalamus was temporarily inactivated by muscimol. On day three mPFC cells were recorded from the same location after the injection had worn off. After each three-day series the electrode was driven down to reach a new population of cells and the experiment was repeated. In support of our hypothesis, we found that day two inactivation was associated with a significant decrease from day one in power of firing frequency within the 0-1 hz range across all response types. No significant difference in power of firing frequency was found between day one and three, as expected. These data indicate medial thalamus plays a role in mPFC activity in relation to goal directed behavior.

**The relationship of life stage to daily social patterns of captive African elephants (*Loxodonta africana*) and the correlation of handler perceptions of elephant personality to demonstrated social behaviors**

Alison R Jeffrey, Vanessa L Grunkemeyer, Clare Padfield, Debbie Young  
Biology, UNH Durham

Social interactions between herd elephants include affiliative, agonistic, and ambiguous behaviors and depend on many factors, such as maternal lineage, age, and sex. This study was designed to determine how social behaviors among a herd of captive African elephants vary throughout the day and to establish if the frequency of social interactions and age class are correlated. The study also aimed to determine if perceptions of elephant personality were an accurate predictor of social behaviors. Research took place with the African Elephant Research Unit at Knysna Elephant Park (KEP) in South Africa. The herd included 7 elephants in 3 age groups: juvenile, young adult, and adult. Continuous, all-occurrence sampling of pre-determined affiliative, agonistic, and ambiguous social behaviors was performed. Results indicate that there is a statistically higher rate of affiliative, agonistic, and total social behavior during mid-morning than mid-afternoon. Elephant handlers were individually surveyed regarding perceptions of each elephant's personality traits, including dominance, activity level, boldness, confidence, curiosity, sociability, and aggressiveness. This characterization was compared to the recorded elephant social behaviors, and results indicate that there is a strong positive correlation between observed agonistic rate of social behavior and rated activity levels. Results are intended to influence the management of captive elephants at KEP and elsewhere.

**POSTER PRESENTATION ABSTRACTS**

**26<sup>th</sup> ANNUAL COLSA  
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## Does Sex Predict Rate of Rapid Mimicry During Play in Domestic Dogs?

Leslie J Curren, Mia Jacqueline Cullerot  
Department of Biological Sciences, UNH Durham

Rapid mimicry is when an individual subconsciously copies the facial expression or body language of another individual with which it is socially interacting. Previous research has shown that the rate of rapid mimicry between domestic dogs (*Canis lupus familiaris*) during play is correlated with longer duration of the play bout, possibly due to the mimicry's facilitation of social bonding. It is therefore possible that dogs exhibiting more mimicry have higher levels of other types of social intelligence, but this relationship has not been tested. To test this hypothesis, I videotaped pairs of dogs playing and quantified mimicry events. I then administered a social cuing test in which a human experimenter pointed to the location of a food reward. If mimicry is indicative of broader social intelligence, I predicted that dogs that exhibited higher rates of mimicry would also pass a greater number of social cuing trials. A connection between mimicry and performance in the social cuing test could further support the idea that the function of mimicry is to improve social relationships, and thus, socially adept dogs may use it more often to facilitate this bonding.

## **The Influence of Snow Density on CO<sub>2</sub> Flux Measured with Eddy Covariance over a Forested Canopy at Thompson Farm, Durham, NH**

Taylor Conte<sup>1</sup>, Elizabeth Burakowski, and Cameron Wake  
Environmental Science

Winter carbon dioxide (CO<sub>2</sub>) flux in a forest canopy is critical to determining ecosystem respiration and evapotranspiration. Understanding the impact of snow cover on CO<sub>2</sub> flux provides better modeling potential of dynamic ecosystem health. In situ measurements of canopy CO<sub>2</sub> flux was regularly taken at 30-minute intervals using an eddy covariance system mounted above a mixed forest canopy during the 2014-15 and 2015-16 winter seasons at Thompson Farm in Durham, NH. CO<sub>2</sub> flux data was analyzed with other environmental and meteorological data including soil moisture, soil temperature, surface temperature, air temperature, wind speed, and wind direction. The CO<sub>2</sub> flux and environmental data were also evaluated with daily snow depth, density, and snow water equivalent measurements collected through the Community Collaborative Rain, Albedo, Hail, and Snow network. Using a bivariate fit, a strong relationship between snow density and soil moisture was found but CO<sub>2</sub> flux did not have a significant relationship with the other measured variables, contrary to the results of known studies, which have shown that CO<sub>2</sub> flux can be influenced at the snow-soil surface. Showing that the variants do not have a significant influence on a forested canopy CO<sub>2</sub> flux provides that other factors besides those considered may be at work and must be further researched for better modeling potential.

## Using chemical cross-linking and mass spectrometry to identify the binding mechanism of PU-H71 on heat shock protein 90 (Hsp90) in embryonic stem cells

Feixia Chu<sup>1</sup>, Hieu T Nguyen<sup>2</sup>

<sup>1</sup>Department of Molecular, Cellular, & Biomedical Sciences, UNH Durham

<sup>2</sup>Molecular, Cellular and Biological Sciences, UNH Durham

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

## ***Frankia* Mediated Bioremediation of Dioxin Like Compounds**

Louis S Tisa<sup>1</sup>, Celeste M Souza<sup>2</sup>

<sup>1</sup>Department of Molecular, Cellular, & Biomedical Sciences, UNH Durham

<sup>2</sup>Molecular, Cellular, & Biomedical Sciences, UNH Durham

With soil contamination on the rise, bioremediation efforts are in need to eliminate toxic, organic pollutants from soils. Of these harmful pollutants includes dioxin and dioxin like compounds. These compounds are the byproducts of combustion, incineration, forest fires, volcanic eruptions, and other industrial chemical processes (Sally et al 2009). Dioxin and dioxin like compounds have been found to be toxic and can result in: cancer, cardiovascular disease, developmental problems in children, infertility problems in adults, endometriosis, miscarriages, altered immunological response, and altered metabolism (Sally et al 2009).

Research has been focused on developing remediation techniques to eliminate dioxins and dioxin like compounds from soils. Dioxins are released into the air and soil through the processes listed above and are highly stable due to the aryl group, making them resistant to environmental degradation (Sally et al 2009). Dioxins enter ground water through the soil, which humans can end up consuming. Livestock can also consume the contaminated water or soil allowing for the dioxins to enter their body. Once in their body the dioxin can be transferred to humans by the consumption of produce. Dioxin can also enter the human body through bioaccumulation from the food chain. Dioxins can cause harm to humans in multiple ways. When dioxin enters the body it binds to a protein known as the aryl hydrocarbon receptor (AhR). The binding can alter the expression or function of certain genes leading to adverse health effects.

Soil contamination of dioxin and dioxin like compounds can compromise the growth of alder plants and reduce the population of microbial symbioses (Ridgeway et al 2004). There is known to be a beneficial plant-microbe symbiosis between actinorhizal plants and *Frankia* (Lefrancois et al 2010). This symbiosis allows for the survival of actinorhizal plants in polluted areas of dioxin and dioxin like compounds.

It is thought that *Frankia* strains Eu11c and EUN1f can assist in the decomposition of dioxin like compounds. This study is trying to demonstrate the metabolic activity of *Frankia* in the presence of dioxin like compounds: biphenyl, dibenzofuran, and 4-chlorobiphenyl. Varying concentrations of the dioxin like compounds were used (0.5mM, 1.0mM, 2.0mM). One half of the samples include a carbon source (Glucose for Eu11c and fructose for EUN1f). An MTS assay was used to quantify the viability of *Frankia* (Belanger et al 2001).

The initial results of this experiment show that at concentrations of 0.5mM and 1.0mM biphenyl plus a carbon source the growth of *Frankia* increased. At 2.0mM biphenyl without a carbon source did not allow for optimal growing conditions of *Frankia*.

## ***Rickettsia* Bacteria in Michigan Tick Samples**

Jeffrey T Foster, David J Macomber

Department of Molecular, Cellular, & Biomedical Sciences, UNH Durham

*Rickettsia* are obligate intracellular bacteria transmitted by arthropods, including ticks, fleas, mites, and lice, and are the cause of several human diseases, most notably spotted fever and typhus. One way these bacteria may spread is through migrating birds that carry infected ticks during migration. Determining the prevalence of infected ticks within different locations and which *Rickettsia* species are present will help us understand transmission and spread of potential pathogens. . I used quantitative real-time Polymerase Chain Reaction (qPCR) with *Rickettsia*-specific primers on 250 tick DNA samples that were collected from birds from Michigan to quantify prevalence of *Rickettsia* infections. Of these samples, 14 were positive for the presence of *Rickettsia*. Subsequently, I conducted Sanger sequencing to determine the species of *Rickettsia*. Of the 14 samples, 8 successfully sequenced, containing *Rickettsia* species from the Spotted Fever group but are species that are not known to be pathogenic to humans. In summary, roughly 5 percent of ticks collected from these Michigan birds harbored bacteria from the *Rickettsia* genus, and greater than 50 percent of those were species from the Spotted Fever group. This research can be expanded in the future to detect the presence of *Rickettsia* in birds elsewhere, to monitor the spread of potentially disease-causing bacteria.

## **Beyond Dining and Recreation Services: How Does the Greater UNH Campus Support a Healthy Lifestyle?**

Jesse Stable Morrell<sup>2</sup>, Julia E Boisselle<sup>1</sup>, Mary E Hammar<sup>1</sup>, Courtney A Pusz<sup>1</sup>, Tanya Horacek, Laura Brown, Genevieve Gray

<sup>1</sup>Molecular, Cellular, and Biomedical Sciences , UNH Durham

<sup>2</sup>Department of Molecular, Cellular, & Biomedical Sciences, UNH Durham

<sup>3</sup>Molecular, Cellular, and Biomedical Sciences, UNH Durham

Environmental factors play a large role in shaping diet and lifestyle behaviors. While improvements in dining and recreation facilities is a main focus of many universities, less attention is directed towards other factors that may affect eating and physical activity patterns. The purpose of this study was to assess if the greater UNH campus environment promotes a healthy lifestyle by conducting the Healthy Campus Environmental Audit (HCEA), a USDA multistate survey. Using methods developed by Syracuse University, four evaluators surveyed convenience stores (n=6) and vending machines (n=15) to determine the availability and adequacy of healthy options; walking/biking paths (n=28) were also assessed. The results showed that healthy options were frequently available in most convenience stores but limited in vending machines. Two-thirds of convenience stores had  $\geq 1$ -3 fresh fruit and fresh vegetable options, respectively, while vending machines contained an average of 20% healthy snacks and 16% healthy beverages. The campus was also found to be conducive to walking and biking. Of the paths evaluated, 92% had suitable walking surfaces, such as sidewalks or paths completely away from the road, and 89% had a designated bike lane or a path wide enough to accommodate both bicycles and pedestrians. The findings from the HCEA may help UNH administrators to improve the campus environment and further contribute to the development of a validated assessment tool.

## Open-Sand Pit Shelter use by American Lobsters (*Homorus americanus*)

Leslie J Curren, Lindsay Grace Anibal  
Biological Sciences, UNH Durham

Shelter is a basic habitat need for many species, and as such may limit an animal's behavior within its habitat. American lobsters (*Homorus americanus*) are nocturnal and reside in covered shelters during the day. Until this point, covered shelters have been the only known type to be used by lobsters, but in 2016 I observed lobsters in the Gulf of Maine (GoM) using open depressions in sand ("pits") as shelters. I attempted to document this behavior in captivity and test two hypotheses explaining its occurrence: H1) Lobsters prefer covered shelters but are unable to access them in the GoM and resort to digging pits; or H2) Lobsters in the GoM prefer pits to covered shelters. To encourage lobsters to dig pits, I placed them in a tank containing only sand. After 72 hours I added a covered shelter option, and observed sheltering behavior. If lobsters make pits because they lack better options, I predicted that lobsters would abandon pit digging once they were presented with other shelter options. If lobsters prefer pits, I predicted that they would ignore the new shelter options and continue digging pits. It is important to understand lobster sheltering behavior because studies indicate that shelter availability could be a limiting factor to populations of lobster, an important U.S. fisheries species. If lobsters preferentially make shelters in open sand, shelter availability may be more widespread than previously thought, and less of a limiting factor in the Gulf of Maine.

## Parasite Susceptibility of *H. diversicolor*, *A. virens*, and *A. succinea*

Larry G. Harris, Jacqueline Irene Carey  
Department of Biological Sciences, UNH Durham

The red queen hypothesis proposes that organisms must constantly evolve and adapt in order to survive in an ever-changing environment, filled with predators that are also evolving. This hypothesis best describes the host-parasite coevolutionary oscillations, and explains the evolutionary selection pressures on parasites which causes the organism to specialize to a particular host (Moritz *et al.* 1991). The purpose of this investigation is to determine if there is a variation of susceptibility of the parasite *Zoogonus rubellus* across three species of nereid worm. The investigation can also shed some insight on the physical and biological differences between the species that can also affect the success of the parasite.

**Examining animal behavior through dual lenses: indigenous stories predate but also highlight western ethological principles in the form and function of its animal characters**

Carrie L Hall, Jenna N O'del, Daniel R Howard  
Department of Biological Sciences, UNH Durham

Animal behavior is woven within the fabric of American Indian/First Nations traditions, and represents a defining component of cultural identity for many indigenous groups. Animals make frequent appearances in tribal folklore, and in their roles exhibit numerous behaviors. Many animal behaviors described in indigenous stories fall into the same categories that occupy the research attention of our scientific discipline today. We examined 166 traditional stories from 77 tribal nations, and found reference to seventy unique taxa. This taxonomic distribution included mammals (58.7%), birds (29.7%), fish (4.4%), invertebrates (4.4%), amphibians (2.2%) and reptiles (1.1%). The animal behaviors in twenty-six representative indigenous stories fell into the following ethological categories: social behavior (21.6%), predation and foraging (21.6%), communication (14.6%), life history (9.9%), ecological effects (7%), courtship and mating (6.4%), parental care (1.8%) and other behaviors (19.3%).

## **Adaptive Exploitation of Noise; Phonotactic Response to Feeding Sounds in the Green Sea Urchin (*Strongylocentrotus droebachiensis*)**

Renee A Loeffel, Daniel R Howard  
Biological Sciences, UNH Durham

The intertidal zone is a noisy environment, with both abiotic and biotic elements contributing to ambient sound levels. Green sea urchins (*Strongylocentrotus droebachiensis*) contribute to the noisescapes by grazing on rock substrate, increasing the background noise level by 2-3 dB at dawn and dusk. Due to the resonance properties of their endoskeletons, larger urchins produce sounds of lower frequency than smaller sea urchins. It is not known however, if sea urchins detect or respond to the sound produced by feeding individuals and/or aggregations. We hypothesized that if sea urchin feeding noise functions as a food source cue to nearby conspecifics, then urchins seeking food would exhibit phonotaxis in response to playbacks of feeding sounds. More specifically, we predicted that this effect would be size dependent, with smaller sea urchins moving toward high frequency but away from low frequency feeding sounds while large urchins would exhibit positive phonotaxis to either sound types. We conducted three acoustic playback trials (high frequency, low frequency & control; n = 20 each) and recorded their phonotactic response, conducting subsequent path analysis in Ethovision software to test whether movement was random with respect to sound source position in the behavioral arena. Our findings illustrated that urchins did move in response to sound, with preliminary findings suggesting a stronger attraction towards high frequency sound across both size groups.

## **Let the BOD POD be thy Teacher: An Advanced Understanding of Body Composition Testing**

Kevin J. Pietro, Haylee G Colannino, Carly Rose Orlacchio, Elizabeth A Suschana  
Nutrition, UNH Durham

In an effort to deepen and broaden our understanding of sports nutrition, a handful of students at the University of New Hampshire (UNH) encouraged the development of an independent study, in conjunction with UNH Athletics and the Registered/Certified Sports Dietitian. The students have participated in a comprehensive training protocol and have been able to assess nearly 100 student-athletes. As part of a one-hour seminar, students are encouraged to think critical regarding: the validity and reliability of various body composition testing methods, the impact and difficulty of accurately measuring thoracic gas volume, and the identification of the appropriate predicted equation for multi-racial athletes. This independent study offers students with a passion for sports nutrition a valuable, experiential learning opportunity and has led to the creation of a sustainable, mutually beneficial relationship between the Nutrition program and UNH Athletics. The success of this model is due in part to the staggered and multi-level enrollment. It is through this process that students have had the opportunity to learn from one another and assume leadership type roles. Having students with a strong interest in the field of sports nutrition at the under graduate level has motivated the nutrition program to foster these valuable learning opportunities. As this student-led, faculty-guided independent study evolves, it is the hope that through continuous data collection and the creation of an appropriate means to capture dietary intake between testing sessions, that the students of this course will pursue publication.

## Entanglement of Grey (*Halichoerus grypus*) and Harbor seals (*Phoca vitulina*) at Duck Island ledges, ME

James A Coyer, Meghan K Carr, Andrea Bogomolni, Nadine Lysiak

Grey (*Halichoerus grypus*) and harbor seals (*Phoca vitulina*) congregate at Duck Island ledges, a haulout located in the Isles of Shoals, ME. This site was monitored using shipboard photographic mark-recapture surveys to assess population health during summers 2011-2016. Incidence of diseased, injured and entangled seals was noted. Entangled animals were assessed according to the severity of their wounds, type of entangling gear, and location of entanglement on the body.

During summers 2011-2016, 63 grey seals and 86 harbor seals were observed entangled in marine debris at Duck Island and its surrounding ledges. Most entanglements (85%) were located on the neck, while 6% affected the face, flippers, or body and 9% affected multiple parts of the body. Of the identifiable entangling gear, monofilament line and gillnet were most common. Though the dominant local fishery is lobstering, no seals were observed entangled in lobster fishing gear, possibly due to the heavy lines associated with the gear. Severe or very severe wounds were noted in 95%\* of *P. vitulina* entanglements and 89%\* of *H. grypus* entanglements (\*entanglements that could be scored). The relative entanglement rate for *P. vitulina* was higher than *H. grypus*. The high incidence of entanglement at this site identifies a significant threat to both Gulf of Maine seal populations, as an increase in entanglement-associated mortality will result in reduced reproductive success.

## Examining the Presence of Magnetoreception in the American Lobster (*Homarus americanus*)

Winsor H Watson, Cameron Barnes  
Department of Biological Sciences, UNH Durham

Animals across many taxa use magnetoreception for navigation and geolocation. In the marine realm, the Caribbean spiny lobster has been shown to possess highly sophisticated navigational abilities based on magnetoreception. However, little research has been done on the American lobster (*Homarus americanus*). In this study, juvenile lobsters were put into aquariums with a pair of small plastic “pucks,” one containing a magnet and one without. The tanks were monitored with video recordings, and time spent interacting with either puck was measured. Though the study is ongoing and these results are preliminary, the data suggest lobsters spent more time interacting with the magnetic puck than the nonmagnetic control. This study provides some of the first evidence for a magnetosensory system in an iconic and economically important marine species of New England, and suggests further investigation of lobster magnetosensory capabilities will likely improve our understanding of their behavior and ecology.

## **A Historic Understanding of Urbanized Tree Growth at UNH**

Steven M Moroni, Mark J Ducey

The primary objectives of this research project are to assess growth rate, mortality rate, biomass, and species diversity of urban trees across the UNH Durham campus. There was a previous study on the UNH Durham campus that did a similar assessment of trees surrounding buildings from 2001 – 2002. Comparing and contrasting the previous study with the current study (2016 – 2017) will be a vital step in determining the success of the urban trees on campus. To ensure that the current data is comparable, a portion of the previously studied buildings areas were reassessed and recorded. The trees were being sampled for parameters such as diameter at breast height (DBH), height, crown spread, general health, and species type. To get this information the following equipment was used - compass, clinometer, DBH tape, DME Haglof device, and a tape measure. To determine rates of mortality and growth, individual trees from the 2016 – 2017 period were tallied and matched to those from the 2001 – 2002 period. Biomass, basal area, and leaf were assessed using published procedures for urban trees. The estimates of change will facilitate the understanding of whether the services and benefits of the urban trees are increasing or decreasing over the timeframe. The tree surveying period is still ongoing, so final results and conclusions are yet to be determined.

## **Diet composition of nestling prairie warblers (*Setophaga discolor*) raised in an active gravel pit in southeastern New Hampshire**

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Prairie Warblers (*Setophaga discolor*) are a shrubland-obligate bird species that require large areas of dense low-growing vegetation that occurred historically in pine barren habitats and in regenerating forests following large natural disturbances such as hurricanes. Since mid-1900, prairie warblers have experienced significant population declines resulting from habitat loss. Recent surveys of prairie warblers throughout southeastern New Hampshire indicate that large gravel pits may function as important breeding habitat for this species, but these habitats have never been studied to determine whether prairie warblers can raise young successfully in gravel pits. As part of a larger study investigating the reproductive success of prairie warblers breeding in a large (>50 ha) gravel pit in Dover, NH, we set up video cameras at eight prairie warbler nests to determine the specific prey items that adult prairie warblers feed to their nestlings to provide the first quantification of the diet composition of nestling prairie warblers raised within an active gravel pit.

## **Determining the Importance of Local Hops in Craft Beer**

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Craft beer generally constitutes small scale independent brewers who provide a high quality product. As demand for local products increases the local designation becomes increasingly valuable. There have been many studies aimed at determining consumer willingness to pay for local products, but very few that look at the importance of ingredient locality. A survey is to be conducted to help gauge consumer willingness to pay for craft beers which are produced with local hops. The survey will provide quantitative data and qualitative data, providing insights into the culture of craft beer consumption. The survey is to be conducted among the local population. Currently, agricultural production of hops is concentrated in the Pacific Northwest of the United States. In calculating consumer willingness to pay for craft beer using local hops it can help determine potential economic benefits and markets for increasing local hops agriculture.

## Effects of feeding sugar and flax oil on performance of Holstein cows fed flaxseed meal

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Flaxseed oil is an excellent energy source for dairy cows and is shown to affect the productivity of the cow as well as the health of the humans ingesting the milk. Flaxseed contains high levels of  $\alpha$ -linolenic acid, an omega-3 fatty acid that is transferred to milk fat. Feeding flaxseed also has shown to increase the concentration of conjugated linoleic acids (CLA) in milk. Ingestion of both omega-3 fatty acids and CLA by humans has been linked to several potential health benefits, including heart health and weight loss. Furthermore, nutritionists often include sucrose in dairy cow diets to improve the energy density of the diet and thus improve milk production. The objective of this study was to evaluate the effects of feeding flaxseed oil and sugar on dairy cow performance, as there currently is a lack of studies on their combined effect. In this study, 16 lactating Holstein cows were randomly assigned to feeding treatments in a replicated 4 x 4 Latin square design. The treatment diets (dry matter basis) are: 1) control diet with soybean and corn meal; 2) 15% flaxseed meal (FM) and 5% sugar; 3) 15% FM and 3% flaxseed oil (FO); and 4) 15% FM, 3% FO, and 5% sugar. For all animals, body weight and dry matter intake data and milk samples were taken before the study and at the end of each trial period. Overall, the data showed a significant decrease in dry matter intake, milk yield, and milk fat from the control diet to the FM and sucrose diet to FM and FO diet to the FM, FO, and sucrose diet. In addition, there was no significant change in the milk protein, milk lactose, milk urea nitrogen, and milk somatic cell count for any of the diets. There was a negative associative effect between sugar and flaxseed oil on performance of dairy cows fed flaxseed meal as the major protein supplement.

## **Evaluation of Eastern Skunk Cabbage, *Symplocarpus foetidus*, as a Heat Source for Winter Grown Lettuce Inside a Controlled Environment**

Andrew B Ogden, Jacob L Mayerson

All plants create heat through metabolic activity. Some plants create a significant amount of heat and are considered thermogenic. Some thermogenic plants create enough heat to melt through ice in late winter (Lamprecht, Schmolz, Blanco, & Romero, 2002). In the northern latitudes heat is a constant need for growing crops indoors. Heating greenhouses consumes fossil fuels and becomes very costly for farmers. For this project I will be studying the impact of intercropping thermogenic plants with cash crops. The focus the study, do thermogenic plants have the ability to impact the growth of cash crops from the radiated heat of thermogenic plants. The thermogenic plant used for this study is commonly known as Skunk Cabbage and will be intercropped with head lettuce. The study will be conducted in low tunnels constructed inside an unheated high tunnel. There will be four low tunnels which contain skunk cabbage and head lettuce planted amongst each other. Four additional tunnels will contain only head lettuce as the control group. To collect heat exchange data, four head lettuce plants from control and treatment low tunnels will be wired with thermocouple wire. The thermocouple wire will measure heat radiated to the head lettuce plants. Air temperature in control and treatment low tunnels will be measured using thermocouple wire. Leaf and air temperature data will be compared and analyzed with statistical analysis. At the end of the study the wet weight of the head will of the control low tunnels will be compared to the treatment tunnels.

## Exploring Campus Policies at UNH via the Healthy POINTS Audit

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Campus policies have the potential to influence student behaviors, create safer environments, and promote health. Developed by Syracuse University (SU) as part of a multi-state research initiative, the Healthy POINTS audit evaluates the extensiveness of policies, programs and interventions on campus. The POINTS audit evaluates 34 topics such as dining, recreation services, active environment, sustainability, etc. Following training by SU, data were collected via web research in Feb 2017. Each topic was rated as having: No Evidence, Evidence of Intervention/Initiative, or Written Policy. Subscores (range 0-100) were created for 4 categories: Stimulant, Disease Prevention, Active Environment, and Nutrition. Results indicate that UNH provides interventions/initiatives for 85% of topic areas; only 3 written policies were found (smoking, alcohol, active environment). No evidence of any intervention, initiative or policy was found for 5 topic areas (healthy habit challenge, health education for credit, physical education for credit, healthy food subsidies, food security initiative). The POINTS subscores for Stimulant (100%) and Active Environment (92%) were higher than those for Disease Prevention (40%) and Nutrition (52%). Examining student health through the perspective of policy can be useful to evaluate the healthfulness of the campus environment and prioritize areas in need of intervention.

## **Farmers' Market Food Preferences & Food Habits Among the Local Older Adults**

Kevin J. Pietro, Chloe Rebecca Schmir  
Molecular, Cellular, and Biomedical Sciences, UNH Durham

The purpose of this study is to help Seacoast Eat Local improve its program and resources available to their older adult clientele (those 60 years old and above). Seacoast Eat Local is an organization that promotes eating locally among the community. In addition to running farmers' markets and a Mobile Market, Seacoast Eat Local also runs a SNAP/EBT program, produces a local farms directory (Seacoast Harvest), sponsors workshops and events, and provides information on local eating. The aims of this project are to 1) identify and understand the local older adult population and their awareness with Seacoast Eat Local and its resources and 2) to find out the local older adults' food preferences and food habits in farmers' markets. The study will be conducted at local senior housing authority sites, retirement communities, and community gatherings through the network of Seacoast Eat Local. The consenting subjects will engage in a paper-survey, which should take approximately 5-10 minutes to complete. The data will be analyzed using both quantitative (for yes/no/option answers) and qualitative (for fill in the blank answers) methodologies to help address the research questions. The data will be analyzed with Excel and SPSS v.23.

## Genetic Interactions of Protein Phosphatase 2A Subunits in Roots during Salt Stress

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Plants use a variety of mechanisms to respond to environmental stressors like high salinity. In the plant *Arabidopsis thaliana*, one protein implicated in the salt (NaCl) stress response is Protein Phosphatase 2A (PP2A). The PP2A holoenzyme consists of three subunits (A, B, and C), with each subunit encoded by multiple genes. There are five C subunit genes in the *Arabidopsis* genome. Single C subunit mutants were tested in a standardized root growth assay and some mutants showed altered root growth under high salt conditions. To characterize how the C subunits interacted genetically, double mutants were created by crossing single mutants and the identity of the double mutants was confirmed by genotyping. The phenotypes tested in response to salt stress were root length and root angle. The data were used to construct four genetic interaction networks. Results indicated that C subunits have both unique and redundant functions.

## **Microwave-Assisted Glycosaminoglycans Labeling Using 1-phenyl-3-methyl-5-pyrazolone Followed by MALDI-TOF-MS Analysis**

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Glycosaminoglycans (GAGs) are linear polyionic polymers that participate in a host of critically important biological processes such as blood anticoagulation, pathogen infection, cell differentiation, growth, migration and inflammation, etc. Analysis of these glycans holds substantial significance in the field of medicine as knowledge of protein function and structure are essential to breaking down barriers to disease causation and function. The objective of this experiment is to determine which temperature and time protocol would be best used for 1-phenyl-3-methyl-5-pyrazolone (PMP) labeling of GAGs. Glycosaminoglycan disaccharides used in this experimentation were treated to three different temperatures (70°C, 100°C, 150°C) and four different time frames (30 minutes, 1 hour, 2 hours, 3 hours) in microwave radiation. After reaction, the PMP-labeled glycans were analyzed by Matrix-Assisted Laser Desorption/Ionization Time-of-Flight Mass Spectrometry (MALDI-TOF-MS).

## **New Hampshire Citizen Planner: Engaging Municipal Boards to Inform Content and Training in Rockingham County, NH**

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In the Summer of 2016 a needs assessment was conducted on behalf of the University of New Hampshire Cooperative Extension to gather information on what municipal boards, particularly planning boards and conservation commissions, in Rockingham County need in terms of trainings and resources to run their boards more effectively and to address specific community topics. Research methods used throughout this needs assessment project included conducting interviews with community volunteers, compiling and analyzing data and presenting it to Extension staff and external partners. The data gathered from the research was used to update Extension's online resource, New Hampshire Citizen Planner ([NHcitizenplanner.org](http://NHcitizenplanner.org)). NH Citizen Planner provides opportunities for volunteer citizen planners and municipal boards to access trainings, materials, resources and a network of planning professionals throughout the state of New Hampshire. The goal of the NH Citizen Planner Needs Assessment was to provide useful, updated resources and trainings on the NH Citizen Planner website for municipal board volunteers based on the feedback they provided through the survey and interviews. This research project highlights the methodology and results of the NH Citizen Planner Needs Assessment Research that took place in Rockingham County in the summer of 2016.

## Testing the utility of dental morphology in refining diet group classifications of rodents

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### Abstract

Rodents are the most numerous and diverse group of mammals occupying a wide range of habitat conditions and consuming a diverse array of food resources. Many species specialize on certain food types and that specialization can be seen in the type, size, and shape of their teeth. Research shows that rodents with similar diets present convergent morphology even with their independent evolutionary histories. For example, species that eat insects (insectivores), vegetation (herbivores) and seeds (granivores) show differences in their incisors, molars, and rostrums. In contrast, omnivores which eat a variety of foods, have the least specialized teeth. These consistent differences suggest that dental morphology can be used to correctly determine beyond major diet groups of rodents and closer inspection may reveal fine scale differences within diet groups. For 28 species of rodents, my research measured nine morphological features of the skull thought to reflect diet: the condylobasal length, rostrum length and width, upper incisor depth and width, maxillary toothrow length and width, jaw lever length, and lower incisor width. I analyzed the data using ANOVA and Principal Component Analysis. I used this information to determine how well morphology aligns to dietary class and to identify finer scale differences among rodents in the Great Basin.

## The Prevalence of *Avian Malaria* in Hawaiian Birds from 2014-2016

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*Plasmodium relictum*, a blood parasite that causes the disease avian malaria, has devastated native bird populations in Hawaii, potentially threatening several species with extinction. The extent of infection of native and non-native birds on the islands of Oahu, Kauai, and Maui remains poorly known. This project seeks to identify the prevalence of malaria infection of native and invasive birds, as well as to evaluate prevalence within the mosquito vector. Blood was obtained from hundreds of birds, as well as mosquitoes, and DNA was extracted. Once the DNA was isolated, real-time PCR was conducted to test for the presence of *P. relictum* DNA. These results will lead to a better understanding as to which native and non-native species are being infected by malaria, and thus identifying the importance of different hosts and transmission pathways.

## **The influence of shrubland type and area on the abundance and age structure of male prairie warblers**

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Shrublands are habitats with low-growing, woody vegetation with little to no tree canopy. Today, many shrubland-obligate songbirds such as prairie warblers are declining due to a loss in shrubland habitat. These species now require anthropogenic habitats such as transmission line rights-of-way, gravel pits, old-fields and recent clearcuts, but it is unclear how these shrublands compare as habitat for birds. Current efforts to monitor the populations of shrubland-obligate songbirds include identifying where shrubland birds occur in the landscape and comparing the demographics of bird populations occurring in different habitat types. This information is helpful for assessing the habitat value of different shrubland habitat types for birds.

We evaluated the presence/absence, abundance, and age structure of prairie warblers occurring in transmission line rights-of way, old fields, clearcuts and gravel pits in southeastern New Hampshire during the summer of 2016. We will combine our results with those collected from prairie warblers captured in different shrublands of similar types in 2015. Within this combined dataset, we will determine if there are differences in the abundance, age structure, and/or likelihood of prairie warblers occurring among these different shrubland types. Our results will help managers determine which shrublands are most important for conserving prairie warblers in our region.

## Untangling the Effects of TadC in the *Vibrio fischeri* - *Eupryma scolopes* Symbiosis

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In order to study the mechanisms behind symbiotic adaptations, a non-native strain of *Vibrio fischeri* (MJ11) was evolved through the squid, *Eupryma scolopes*, light organ. The results of this evolution were eight distinct mutations in the *binK* sensor kinase gene, which enhanced *V. fischeri*'s ability to colonize the light organ. One of the evolved alleles, *binK1*, specifically improved the aggregation at the site of entrance to the light organ, increased the biofilm production, and resisted binding by host haemocytes. Additionally, in this same population, the evolved strain gained a secondary mutation in *tadC*, a pilus assembly protein, later in the evolution. We would like to investigate what effects the mutated *tadC*, termed *tadC1*, is having on colonization and squid associated phenotypes. Specifically we will test the hypothesis that the secondary mutation is beneficial and also contributes to the symbiosis either 1) by enhancing symbiosis traits not conferred by *binK1*, or 2) by correcting for negative side effects of the *binK1* adaptive allele. Previously collected data suggests that *tadC1* confers improved growth; however, ongoing experiments to confirm this have been ambiguous. To study the effects, we will generate a mutant that contains the evolved *tadC1* mutation in the wildtype *binK* background utilizing standard genetic techniques and natural competence. This will allow us to untangle the effect that BinK1 has on the symbiosis and understand what TadC1 is actually doing. We will answer the question: "does TadC1 need the BinK1 alteration, or does TadC1 alone improve fitness?" Once the mutant is generated, we will assess if any beneficial traits are conferred by *tadC1*. The experiments will reveal the steps that bacteria may undergo during adaptation to a novel host environment, potentially uncover new symbiosis traits, and provide insight into how bacteria are able to so rapidly evolve.

## **A Quantitative Analysis of the Value-Enhancing Effects of Nicotine and Varenicline**

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Of the many addictive substances in the United States, tobacco is the leading cause of preventable death due to the addictive effects of its main ingredient, nicotine. With approximately 480,000 smoking-related deaths annually and another 41,000 deaths due to second-hand smoke, there are few treatment options available for nicotine dependence that have proven to be successful. Specifically, the lack of pharmacological treatment options for nicotine addiction is primarily due to the lack of knowledge regarding the physiological properties of addiction. Varenicline is one of the most commonly prescribed drugs that is used to treat nicotine addiction. This drug reduces the reinforcing properties of nicotine and diminishes the symptoms of withdrawal. In order to evaluate the effects that varenicline has on the value-enhancing effects of nicotine we developed an experimental design that quantifies the relationship between nicotine and varenicline.

## A Step Further in Recipes for *A New England Food Vision*

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The purpose of this project was to analyze the nutrient profile 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. Two guiding questions informed this research: 1) How to design a 7-day meal plan following the OD pattern and the OD pattern with the new 2015 Dietary Guidelines? 2) What is its OD nutrient profile? A menu plan was devised based on the food groups identified in the OD pattern. The nutrient analysis was conducted using the USDA v28 online food database. 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.

## A Study of p53 Cytoplasmic Sequestration in Acute Myelogenous Leukemia Patient Samples

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Although healthy human white blood cells may become cancerous, molecular mechanisms exist to combat neoplasia. In this study, we investigate a clinical population of human acute myelogenous leukemia cells (AML). In healthy white blood cells, the transcription factor p53 resides in the cytoplasm of blood cells where it can be translocated to the nucleus, induce apoptosis (programmed cellular death) and remove neoplastic cell. This defense keeps cancerous cells from proliferating and forming diffuse blood tumors or leukemia. In many cancerous cells, wild type p53 is sequestered in the cytoplasm and cannot move into the nucleus and promote apoptosis.

Here we investigate patient samples from a clinical population with AML. Our research attempts to verify where p53 resides within the cells. This is accomplished by reanimation of the patient samples, separation of the cytoplasmic and nucleic fractions, running Western blots on these fractions using a monoclonal antibody for p53 and using immunocytochemistry to localize p53 within these AML cells. Our results demonstrate that p53 is sequestered in the cytoplasm in ~50% of patient cells. This defines a subset of AML patients with cytoplasmically sequestered p53. We are also investigating the role of the mitochondrial Hsp70 protein as a protein anchor involved in sequestration of p53.

## Assessing Coupled and Decoupled Aquaponic Systems Through Water Quality and Nutrient Analysis

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Aquaponics is a closed- loop system that produces fish and plants, creating a symbiotic relationship. The water is circulated through the system, carrying the fish excretions that provide nutrients that can be taken up by the plants. Through proper filtration along with nitrifying bacteria, the fish waste in the form of ammonium is converted into nitrite and nitrate, to a form that can be received by the plants. While Aquaponics is a closed loop system in terms of water circulating through, it is still often necessary to add some form of fertilizer or N-P-K solution to cater to the plant needs.

While in the process of filtering and "cleaning" the system, there is a large amount of "waste water" that is high in nutrient content, that is currently being disposed out of the system. The filtering process helps remove the "bad bacteria" that cannot be taken up by plants. I am working on a project under Professor Todd Guerdat, that focuses on how we can use the waste water and the concentrated nutrients within, and eventually put them back into the system so that they are not wasted, and to further close the loop. I am currently sampling the waste water in two ways, both anaerobic and aerobically. As of now, I have three replicates of both anaerobic and aerobic treatments, set up in 1000 mL Erlenmyer flasks. Soon, we will be switching to larger 2L and most likely 4L Erlenmeyer flasks, to sample larger amounts of waste water at a time. Towards the end of the project, we will create a system that allows for both anaerobic and aerobic respiration to occur, with a nutrient dense substrate for our end product.

To collect data, I will be taking several samples weekly: checking pH, Alkalinity, and running nutrient analyses for Nitrate, Nitrite and Ammonia concentrations in the water. We predict that our data will show distinct differences in the nitrite, nitrate and ammonia levels in the anaerobic vs. aerobic experiments. On a short term level, we are interested in looking at how long the anaerobic and aerobic processes take to reach full potential, and what that product will look like. Long term, we are interested in observing the waste water over several months and establishing an end product (somewhat like a fertilizer), that could be put back into the system. We hope to have an end product that eventually could be sold on a market scale.

## **Bicistronic regulation of the CERS1/GDF1 transcript**

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Eukaryotic gene regulation has widely and historically been regarded as a strictly monocistronic system, meaning that one gene codes for a single protein. However, there are several exceptions to this rule that are present in humans, including the bicistronic transcript for ceramide synthase 1 (CERS1) and growth differentiation factor 1 (GDF1). Regulation of transcriptional outcome is controlled by alternative splicing, the process by which differential mRNA variants are produced from a single gene. Mutations in splicing factors, such as serine and arginine splicing factor 2 (SRSF2) and splicing factor 3b subunit 1 (SF3B1), have been linked to poor clinical outcomes in patients with myelodysplastic syndrome (MDS). We aim to characterize the effects of altering GDF1 on sphingolipid metabolism, which can influence cell fate and function. We hypothesize that dysregulation of splicing factors, whether through direct action or epigenetic control, leads to differential expression of CERS1 and GDF1. In turn, this imbalance causes aberrant sphingolipid metabolism and GDF1 signaling, potentially aiding in development of MDS or other myeloid hematological disorders.

## Behavioral and Biological Markers Underlying Vulnerability to Heroin Abuse

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Illicit drug use costs our nation \$193 billion annually in expenditures related to crime, lost work productivity, and health care. Heroin abuse is a major contributor to these rising costs. During the past fifteen years alone, a six-fold increase in the number of heroin-related overdose deaths have occurred. The etiology of heroin addiction is unknown; however, one risk factor is exposure to severe psychological stress or trauma. In particular, heroin addiction may be associated with post-traumatic stress disorder, as sufferers self-medicate to alleviate their anxiety. Thus, research has begun to focus upon individual differences in stress reactivity to determine the role of stress in drug addiction. A better understanding of this relationship is required, as the behavioral and physiological consequences of heroin use can persist for years after drug use is discontinued. To date, this study is the first to examine individual differences in stress sensitivity to heroin consumption. We developed an experimental design that will evaluate the individual differences in response to stressors and compare that to heroin self-administration using a rodent model.

## **Bioaccumulation of Cyanobacteria Toxins in the Blood of American Bald Eagle Nestlings**

James F Haney, Jacob P Moore, Sofia Rose Licht, Patricia Jarema  
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The bioaccumulation of the cyanotoxins microcystin and BMAA has been linked to neurological and liver damage in human and wildlife around the world. Biomagnification of numerous pollutants and toxins has been recorded in bald eagles, and recent studies investigating deaths of bald eagles in the southern United States have shown that these cyanotoxins may also accumulate in these birds. Freeze-thaw extraction and ELISA techniques were used to test if microcystin and BMAA could be successfully detected and quantified in dried blood collected from 36 American Bald eaglets in Michigan. After initial analysis, variations in the measured cyanotoxin levels led to questions of whether blood toxicity was associated with sampling location and age or weight of the eaglets. Biomagnification in northern bald eagles could indicate that these birds may be at risk of the negative effects of BMAA and microcystin. Our results could indicate the biological pathways that cyanotoxins take within this aquatic food webs.

## **Bioaccumulation of Cyanotoxins Microcystins and BMAA in Phytoplankton and Zooplankton**

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Cyanobacteria are photosynthetic prokaryotic organisms that are some of the earliest life on earth. Their ability to exist in almost any habitat, and produce a wide range of harmful toxins is emerging as a growing concern in human disease and the health of ecosystems. We investigated two different cyanobacteria-derived toxins; microcystins (MC) and beta-Methylamino-L-alanine (BMAA) and their ability to biomagnify at the lowest trophic levels of lake ecosystems: phytoplankton and zooplankton. Plankton samples were collected from three lakes in Wyoming and three lakes in Maine. Samples were processed using the phototactic response (ZAPPR) method to separate phytoplankton from zooplankton. BMAA and microcystins were then extracted from the samples using cycles of sonication, vortexing, freezing and thawing. The cyanotoxin content of each sample was then analyzed using ELISA antibody testing for BMAA and microcystins. The differences between concentrations of cyanotoxin found in phytoplankton and the zooplankton was used to calculate a biomagnification factor for each toxin. This factor was then used to determine the potential of each toxin to biomagnify or biodilute as it moves up the food web. The findings of this study contribute to a better understanding of what role cyanotoxins play in the health of Loon populations, and the risk of human exposure to these toxins as they accumulate in the aquatic food web.

## Characterization of a palmitoyl-transferase mutant in *Arabidopsis thaliana*

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Palmitoyltransferases (PATs) are integral membrane proteins involved in the modification of both cytosolic and membrane proteins by the addition of the 16-carbon fatty acid, palmitic acid. Palmitoylation regulates many important cellular processes including intracellular trafficking, membrane localization and protein stability. In *Arabidopsis thaliana*, 24 genes encode PATs; our research has focused on *PAT21*. A putative *pat21-1* mutant did not produce a full length *PAT21* transcript due to a large T-DNA insertion within the gene. These putative mutant plants also had a sterility phenotype. A 1:2:1 genotypic ratio was predicted for offspring from the self-fertilization of a *pat21-1* heterozygote; however, all of the offspring appeared to be heterozygous for the *PAT21* gene, which called into question the veracity of the genotyping assay. The PCR product used for genotyping the T-DNA junction was the expected size but was sequenced to confirm its identity. Unexpectedly, the PCR product was identified as part of a proteasome activating protein gene unrelated to *PAT21*. This research highlights the importance of confirming the sequence of PCR products when unexpected results are obtained from genotyping.

## Characterizing an unknown blue whale (*Balaenoptera musculus*) population in the South Atlantic Ocean through acoustic analysis of song

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Blue whale (*Balaenoptera musculus*) populations worldwide produce regionally distinct songs composed of units varying in structure, tone, and frequency. Song variability serves as a metric for identifying regional populations and quantifying their spatial distributions. An unknown song has been observed in the South Atlantic Ocean surrounding Ascension Island with two tonal components at 26 Hz and 32 Hz. The goal of the study is to determine the acoustic presence and seasonality of the unknown blue whale population over an annual cycle through acoustic tracking. Hydrophones were deployed in the deep sound channel around the island that recorded continuously at 250 Hz resulting in a usable frequency range up to 125 Hz. From March 2006 - March 2007, variability was observed insomuch that both components of the call were not always present. Preliminary analysis indicates that the 32 Hz tone is rarely encountered alone outside the austral fall season. The 26 Hz tone and combination of the 26 Hz and 32 Hz tones were observed consistently throughout a greater portion of the year. While this could be due to the seasonal propagation environment, it more likely that the two components or their combination may contain unique communicative information. Identifying the population will provide baseline information useful for further understanding the variation, function, and significance of blue whale song, as well as geographical knowledge and distribution of this unknown population.

## Cnidarian Behavior Under Various Adenylate Cyclase Drug Regulating Conditions

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Cnidarians, such as the freshwater polyp *Hydra magnipapillata*, display a surprisingly complex sensory repertoire capable of responding to light, chemical, and mechanical stimuli. The photo response in hydra is driven by an opsin-mediated phototransduction cascade that utilizes cyclic nucleotide gated ion channels. However, the intermediary enzymes involved in cnidarian phototransduction have not been directly examined. Previous work has demonstrated an increase in cytosolic cyclic adenosine monophosphate (cAMP) in heterologous gene expression studies of a jellyfish opsin. In eukaryotic cells, cAMP is generated by adenylate cyclase (AC) and a cross-reactive antibody against AC stained the photoreceptor layer of a jellyfish eye rhopalium. In this study, we directly test the possibility that AC plays a role in the cnidarian phototransduction pathway using photo response pharmacology-behavior experiments in the freshwater polyp *Hydra magnipapillata*. Here, dark-adapted hydra are exposed to adenylate cyclase inhibiting and activating drugs and are observed and assayed for contraction, a reproducible light-driven behavior. Other colleagues in this study have reported an exhaustive phylogeny of metazoan AC genes that show cnidarian genomes possess orthologs of metazoan AC9, and have demonstrated that riboprobes against hydra AC9 co-localize with opsin in a range of hydra sensory neurons. Through behavior, genomic, and biochemical methods, our results suggest that AC activity is involved in the hydra photo response and may be a general feature of cnidarian phototransduction. We discuss these results in light of current hypotheses on the origin and diversification of animal phototransduction cascades.

## Comparing cortical activity of prefrontal neurons while rats perform two tasks with different decision making requirements

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Medial prefrontal cortex (mPFC) is critical for executive functions including decision making; whereby cortical dysfunctions can lead to disorders such as Alzheimer's disease, ADHD, addiction, and Schizophrenia. Tetrode bundles were utilized to record single cell neurons in mPFC in order to study their network contributions. Previously, rats were recorded running on a delayed non-match to position (DNMTP) task. In a sequence of four lever presses, rats must retain information about the sample reinforcement location over a delay period to choose correctly between two response alternatives. The Serial Level Press (SLP) task was developed in order to maintain the action sequence of DNMTP but eliminate the decision making requirements. We hypothesize that cell types tied to decision making will drop out during SLP when they are no longer needed for successful task performance. In order to test this hypothesis, two different comparisons of the tasks were done. A between-subjects experiment was performed by comparing one rat that was trained on SLP to one that was trained on DNMTP. A within-subject comparison has the rat run both tasks in a single session to see if the mPFC neurons immediately update in response to a change in task requirements. Task order was counterbalanced within a single session to see if cells drop out or become stronger dependent upon on the task order (DNMTP or SLP first). 900 cells were recorded from DNMTP compared to 122 in SLP during the between-subjects experiments. Initiation, delay, and movement cell types dropped out during SLP. Here, we found that neurons in mPFC do update to reflect task requirements. Single neurons change their response properties based on whether or not the rats had to make a choice. 247 cells were recorded from the within-subject experiments. 39 cells with response types were found in DNMTP and 35 in SLP. Although response profiles in DNMTP rats were different from SLP, the correlated cells were not observed to switch in a single session. There was no effect of task order and cell types were not sensitive to the within session switch. Thus, mPFC does reflect decision making requirements, but is not always sensitive to subtle or immediate updates when the same strategy can be applied.

## Comparing the regulation of alternatively spliced isoforms of ceramide synthases in AML

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Acute myeloid leukemia (AML) is a common form of blood cancer that is classified as an overproduction and clustering of white blood cells in the body that interfere with the production and function of normal blood cells. There are a wide variety of treatment options for this aggressive cancer, but many are only temporary fixes. In cancer cells, pro-apoptotic factors are commonly dysregulated and this includes sphingolipid ceramides. Ceramide is a bioactive sphingolipid commonly known to regulate cell stress and to induce apoptosis. Strategies that result in the accumulation of ceramides in cancer cells are being developed as cancer therapeutics. The basis of this project is to identify if there are changes in the expression of different transcripts due to alternative RNA splicing of ceramide synthase isoforms in AML. The rational for this study is to determine if differential regulation of ceramide synthases, which results in different subspecies of the sphingolipid ceramide, are more closely associated with disease severity in acute myeloid leukemia. Completion of this project may identify regulation of ceramide synthases by alternative splicing as an important target for anti-AML therapeutic development.

## Comparison of single cell response types encoding movement information in prefrontal cortex and central thalamus

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Thalamus, once believed to be a simple relay, is now considered an integral part of the circuits controlling executive function. With dense reciprocal connections to prefrontal cortex (PFC), thalamus communicates information related to actions, outcomes, and the context in which they occur. We recorded cellular activity from central thalamus and PFC, while rats performed a delayed non-match to position (DNMTP) task, requiring planning, memory recall, spatial orientation, and organization of a sequence of events. We recorded 900 total cells in PFC, compared to 1,634 in thalamus. In both areas, we found cells encoding information related to movement, lever press, reinforcement, and memory delay. We identified three types of movement cells, which generally are active when a rat travels along pathways towards a lever location. Movement 1 cells (PFC = 63, thalamus = 105) respond along all paths of movement. Movement 2 cells (PFC = 13, thalamus = 23) are active when rats are moving towards reinforcing levers. Finally, Movement 3 cells (PFC = 0; thalamus = 11) fire during a specific task event and along a restricted path. Finding discrete movement cells in PFC and thalamus indicates the importance of organizing a sequence of events needed to achieve a goal. Additionally, the third movement type is unique to thalamus, suggesting that activity linking spatial context to task events is generated in thalamus without communication to PFC.

## Cutting Height is Critical in Control of Invasive Glossy Buckthorn

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Glossy buckthorn (*Frangula alnus*) is a shrub, native to Europe, that is invading North American forests and forest edges. Competition with buckthorn is limiting seedling height and biomass of the economically important eastern white pine (*Pinus strobus*). Chemical and mechanical control methods both alone and in combination have been investigated to reduce buckthorn abundance, but few data are available on the effectiveness of stem cutting. We tested the hypothesis that repeated stem cutting would have greater negative effects on buckthorn growth and survival when cuts were made at ground level than at 20 cm (8 inches) above the ground. Experimental buckthorn plants were transplanted as seedlings to the UNH Kingman Research Farm and were treated after one year of growth. Three clippings, each four weeks apart, resulted in the death of every experimental plant clipped at ground level. None of the plants clipped at 20 cm died and all of these gained biomass by the end of the growing season, although only one plant produced fruit. However, plants cut at 20 cm did not approach the size and vigor of uncut control plants, which grew to at least 1.4 m (55 inches) in height and produced 1500 seeds each. The complete mortality of plants clipped at ground level was probably due to reduced leaf surface and potential for carbohydrate storage, thus reducing the ability of plants to recover. An effective means of buckthorn control could be undertaken by repetitive clipping at ground level.

## Cyanobacteria toxins in Loon Feathers and Water

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Across the country, loons are mysteriously disappearing. As an apex predator in lakes, this can adversely impact the aquatic ecosystem, potentially causing a trophic cascade. One possible explanation for the decline of loon abundance could be biotoxins that are released by cyanobacteria. The cyanobacteria nerve toxins beta-methylamino-L-alanine (BMAA) and liver toxins microcystins (MC) were extracted from the feathers of loon chicks as a method of assessing the bioaccumulation of these toxins in the young loons. The concentration of BMAA and microcystins were determined with high sensitivity ELISA antibody tests. Data were analyzed for correlations between the concentration of cyanobacteria toxins found in each lake and the corresponding concentration of BMAA and MC in loon feathers. Possible effects of these toxins on Common Loon populations are discussed.

## **Dairy cow preference for free-stall barn versus an outdoor open bark mulch pack**

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Dairy cows have a strong preference for access to pasture at night in summer, but prefer to remain indoors for the majority of the day, when the humidity and temperature are high (Legrand et al., 2009; Falk et al., 2012). As pasture access is not feasible on all farms or during all seasons, there is merit to investigate how cows would use an alternative outdoor area to pasture. I participated in a study that investigated dairy cow preference for a free-stall barn versus an outdoor open bark mulch pack, when given 24 hours access a day.

## Detection and Quantitative Analysis of Leptospirosis in Rodent Feces From the Kahanahaiki Forest of Oahu, Hawaii

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Leptospirosis is a zoonotic bacterial disease responsible for a high morbidity rate worldwide. Often occurring in tropical regions, infections are caused by *Leptospira*, a spirochete most commonly transmitted through the urine of infected animals, notably dogs and rats. In 1995, Hawaii led the U.S. in reported annual incident rates. The focus of this study was to analyze rat feces from the Kahanahaiki forest of Oahu, Hawaii for the presence of *Leptospira* spp. After DNA extraction of feces, samples were tested using a real-time quantitative PCR assay (SNP111) that detects both pathogenic and intermediate forms of the bacteria. Preliminary data suggest the presence of leptospirosis in rats of the Kahanahaiki area. The geographical distribution of leptospirosis is important for epidemiologic data where it can provide information about ecological transmission and various reservoirs. Further investigation is needed, as leptospirosis remains to be an under recognized threat to public health.

## **Diel and Seasonal Changes in Old Durham Reservoir**

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Lakes are subject to fluctuations on daily and seasonal scales, yet limnology has been largely focused on summer daytime sampling. This is because sampling in the summer and during the day is easier, less expensive, and more convenient. Old Durham Reservoir in Durham, NH was sampled in October and February. Fall samples were collected over a 24-hour period at 6-hour intervals from 4 different depths; winter samples were collected at a 10-hour interval from 2 different depths. Additionally, a multiparameter sonde was used to create a profile of the lake conditions. Phyto- and zooplankton community composition was determined for the samples. Further, whole lake water and a  $<50 \mu\text{m}$  fraction were measured using a fluorometer to determine the concentration of photosynthetic pigments chlorophyll (all phytoplankton) and phycocyanin (cyanobacteria). Findings were compared over daily and seasonal scales, and patterns identified.

**Differential gene expression patterns contributing to color mimicry within the imitator poison dart frog (*Ranitomeya imitator*)**

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Prey species frequently employ mimicry strategies as highly effective defense mechanisms. Müllerian mimics are sympatric noxious species, which avoid predation by converging on a single conspicuous phenotype. While mimicry contributes to phenotypic convergence between species, it often also results in mimetic radiation, wherein a single species has multiple phenotypes conferring mimicry patterns. *Ranitomeya imitator*, more commonly known as the imitator poison dart frog, is a Müllerian mimic with four distinct color morphs. With the use of a high quality *R. imitator* skin transcriptome, I performed differential gene expression analyses between these color morphs in order to elucidate the genetic underpinnings of color polymorphism in this species. This is the first study, to my knowledge, to explore the genetic mechanisms of color polymorphism in the imitator poison dart frog.

## Dissolved Gas Concentrations in Two Reservoir Systems

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Lakes, streams, and reservoirs are often net sources of carbon and methane to the atmosphere and are important to consider in continental scale carbon cycling (Cole et al. 2007, Bastviken et al. 2011) As both carbon dioxide and methane are harmful greenhouse gases, it is important for studies to quantify the amount of greenhouse gases emitted by these systems. The shallow waters of these systems are populated by large aquatic plants known as macrophytes. The effect of macrophytes on gas emissions depends on a variety of factors, including the morphology of the plant. For example, emergent, leaved plants can deplete oxygen levels because oxygen is released to the atmosphere whereas rooted, submerged plants can pump oxygen into the water column and sediments (Caraco et al. 2006). It is hypothesized that there will be low oxygen and high CO<sub>2</sub> levels in the water near emergent macrophyte beds relative to submerged macrophyte beds. Although oxygen concentration within the water will be lower, methane concentration is anticipated to remain low due to low organic carbon inputs. Greenhouse gas concentration was calculated at the surface and at depth in two systems; a naturalized beaver pond and a manmade reservoir. Average CO<sub>2</sub> was found to increase and average DO was found to decrease with depth at all locations likely due to respiration within the sediment. This is not consistent for methane. The submerged macrophytes in this study do not exhibit patterns consistent with elevated DO concentrations at depth. Methane concentrations were significantly higher in the beaver pond than the reservoir suggesting that the beaver pond acts more like a wetland. N<sub>2</sub>O concentrations were relatively constant at the surface and at depth suggesting that the gas was produced upstream and transported uniformly downstream.

## Effect of Niacin and Beta-Carotene Supplementation in Pre-Partum Holstein Cattle on Acquisition of Immunity and Growth in Calves

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The effects of nicotinic acid and  $\beta$ -carotene supplementation in prepartum cows were evaluated in relation to metabolic disease in the dam, calf acquisition of immunity, colostrum quality, and calf growth. Four treatments of nicotinic acid (0, 16, 32, and 48 g/day) and two treatments of  $\beta$ -carotene (0, and 7 g/day) were randomly assigned and top dressed onto the universal total mixed ration (TMR), to be fed once daily starting at 4 weeks prepartum. Cows were weighed once weekly, and urine and blood samples were taken from coccygeal veins three times weekly until parturition. Within 90 minutes of parturition, calves were removed, weighed, and fed maternal colostrum. Blood samples were taken from the calf jugular vein (also at 24 hours), and maternal colostrum was collected and weighed. Once weekly, skeletal measurements of calves were recorded and three times weekly blood was drawn from the jugular vein. Colostrum was analyzed for immunoglobulin concentration (g/L), colostrum yield (L), protein (%), fat (%), solids (%), ash (%), and lactose (%). Coccygeal samples were analyzed for nonesterified fatty acid (NEFA). Both the tri-weekly jugular samples from the calves and the tri-weekly coccygeal samples from the dam were analyzed for  $\beta$ -hydroxybutyrate (BHBA) levels. Dry matter intake of cows and calves was recorded, and the water intake for calves was recorded. Jugular samples taken at 0 and 24 h were analyzed for IgG concentrations and their absorption efficient (AEA).

## Effects of Camera-Trap Study Design on Avoidance Behavior in Fisher Cats (*Martes pennanti*)

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Human-introduced bias is a concern in many scientific studies, and scientists take precautionary steps in study design and execution to minimize it. Some species are wary of camera traps and actively avoid approaching them. Although this behavioral phenomenon is well documented, little research has been done on how study design may affect it. To address this knowledge gap, I asked how camera trap setup may be manipulated to reduce camera shyness in fishers. Specifically, I tested the effects of camera concealment and bait type. I attached camera traps to trees in two setups: S1) unconcealed, knee height, food-baited (control); and S2) concealed behind foliage, knee height, food-baited. I then reviewed footage of fishers captured on the camera traps and quantified avoidance behavior. I predicted that fishers would display fewer avoidance behaviors when the camera was placed out of their line of sight (S2) than when it was placed near the ground in full view (S1) because they would be less likely to notice it. These results can assist wildlife researchers in designing camera studies, providing useful population data such as numbers, sex, and body condition to inform management practices.

## Effects of Garlic Mustard Invasion and Additional Abiotic Stressors on Fine Root Biomass of Native Tree Species

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The invasive plant *Alliaria petiolata* (garlic mustard) produces secondary compounds toxic to mycorrhizal fungi and is associated with lower total soil carbon (C). Rising temperatures can also stimulate net loss of total soil C, while nitrogen (N) deposition can increase total soil C. As average temperatures and N-deposition rates increase globally, abiotic stressors might interact with *A. petiolata* to effect total soil C and diminish fine root biomass, an important soil C pool. In this field study, we examined the effects of soil warming, N-deposition, and *A. petiolata* invasion on fine roots at the Harvard Forest Long Term Ecological Research Site (LTER) in Petersham, MA. Soils were collected from all plots in June, 2016 and fine roots were picked from both organic and mineral soil horizons to be quantified. I predicted that [1] plots containing *A. petiolata* would have lower fine root biomass across all abiotic treatments and [2] uninvaded plots with all abiotic treatments would increase fine root biomass. In contrast to my hypotheses, invasion alone had no effect on fine root biomass. In the uninvaded, fertilized plots, fine root biomass greatly surpassed all other treatments, but this was not observed in the invaded, fertilized plots. The effects of N-deposition on fine root biomass were expected while *A. petiolata* invasion is more complex in its relationship with fine roots than formerly believed and will impact fine roots differently in a warmer, fertilized environment.

## Effects of Land-Use Changes on Nitrate Concentrations in Four New England Watersheds

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Water quality is a complex issue tied up in many of the things we do in our everyday lives. We all live within a watershed and, therefore, all have an impact on the water resources around us. In this study, the effects of land use on the nitrate concentration within the water is studied. This study looked at four different watersheds; the Lamprey and Oyster in New Hampshire and the Ipswich and Parker in Massachusetts, with nutrient data spanning from 1998-2015. GIS methods and the National Land Use Dataset were used to determine how much land use in these four watersheds has changed over the time span from 2001-2011. Preliminary results showed that land use did not change much over the 10-year period for which there was data. As a result, nitrate levels did not change much either. If a longer time span of data were to be used, this study could tell us much about the impact that humans have on their surroundings and actions we can take to reduce these impacts.

## **Evaluation of UNH's Dining Facilities & Campus Eateries: Does the Food Environment contribute to Healthy Eating?**

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Dining halls play an important role in college students' life, and may influence eating habits that they carry into adulthood. The purpose of this project was to evaluate the dining environment on the greater UNH campus. As part of the USDA multistate research initiative, we examined six UNH venues using Syracuse University's (SU) FRESH audit. The audit included 35 items and evaluated characteristics such as: freshness at the salad bar, if foods were fried, grilled, etc.; the type and healthfulness of drinks available. Following training by SU, a group of four researchers conducted the audit on- and off-campus in October 2016. On average UNH Dining facilities had healthier food options compared to off-campus facilities. For example, UNH dining had > 3-4 fruits and vegetable options compared to off-campus facilities. On-campus food-related signage was also rated better: 100% of the signage on campus promotes healthy eating. Future research will compare individual campus data to other campuses across the country to further examine how the environment supports health promotion and obesity prevention.

## Evaluation of UNH's Recreation Services: A Key Component of a Healthy Campus Environment

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As exercise plays a crucial role in stress management, disease prevention, and emotional health, college campuses with accessible and welcoming recreation services help to promote overall wellness. As part of a USDA multistate research project focusing on improving the health of college students, this research aimed to examine the offerings and accessibility of UNH's recreation services using the Healthy Campus Environmental Audit developed by Syracuse University. In Feb 2017, 3 evaluators completed trainings, practice audits and inter-rater reliability tests before evaluating on- and off-campus facilities (n=3) using a 22-item audit. Via 5 point Likert scales, the audit assessed the hours, amenities, and availability of the facility's equipment and staff. All facilities were evaluated as very clean and had both available and knowledgeable staff members. All facilities were classified as having aesthetically pleasing features. At both the UNH Hamel Recreation Center and Wildcat Fitness  $\geq 20\%$  of the cardio equipment was available at the time of auditing. Data from this assessment can be used to identify strengths and weaknesses of UNH's recreation services. Further, this data will contribute to the validation of a campus auditing tool.

**Exploring the Prospect of Kin Recognition in the Planarian Species *Dugesia dorotocephala***

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Kin recognition is the ability to distinguish between relatives and non-relatives, and can be achieved through multiple sensory mechanisms, including chemosensation, which is used by many species with limited vision. Although planaria, flatworms capable of regeneration, have a complex nervous system relative to other invertebrates, they are unable to see and rely on chemoreception. There has been research on planarian learning, but it is unclear if planaria are capable of kin recognition. I sought to address that question and to ask if they distinguish between asexually reproduced kin and regenerated kin. To test these ideas, I began with unrelated individual brown planaria (*D. dorotocephala*) that I labeled as “hosts.” These hosts first asexually reproduced, then were cut in half and regenerated, which resulted in each host having two different types of genetically identical kin: offspring and clones. I then placed each host in a choice chamber where it had the option to move toward one of two individuals, using the following pairings: offspring/non-kin, clone/non-kin, and offspring/clone. I predicted that if planaria are capable of kin recognition, they would prefer kin over non-kin. I did not expect to see a difference in the host’s preference between the two types of kin because of the assumed identical chemical makeup. If kin recognition is demonstrated in planaria, it could contribute to a further understanding of the phylogenetic evolution of other primitive species.

## Exploring the Recent Dominance of the Spiny Dogfish (*Squalus acanthias*) in the Gulf of Maine

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The ecology and movement patterns of the Spiny Dogfish (*Squalus acanthias*) were analyzed using temperature data collected at depth (50-70m) over Jeffrey's Ledge (30mi) and Platt's Bank (54mi) extrapolated with daily commercial catch in the Gulf of Maine. Spiny Dogfish have recently become a commercial desirable fishery in the Gulf of Maine in light of stock depletions of historically prosperous ground fish species, including Atlantic Cod (*Gadus morhua*). It was proposed that water temperature plays a critical ecological role in Spiny Dogfish movement during their annual migrations along the Northeast Shelf Large Marine Ecosystem (NESLME). Determination of temperature at arrival and temperature at departure for Spiny Dogfish in commercially important fishing areas could thus improve the efficiency of locating the species while also avoiding bycatch from the recovering ground fish stocks. From Spring 2014-Fall 2016, cooperative extension with local NH gillnet fishermen involved attachment of pressure resistant temperature loggers to experimental gill nets during the fishing season (June-October). Data from 2014 focused on the time of arrival (TOA) of dogfish in early June. Data from 2015 focused on the time of departure (TOD) in late August/early September. Data from 2016 focused on the entire season from June-October. Results from the project indicated a strong relationship between TOA and water temperature increasing above 5 °C. Results also supported increasing dogfish catch through the summer, but decreasing catch by late August despite water temperature continuing to rise (8+ °C). This phenomenon indicated that other variables outside of water temperature play a role in dogfish movement and behavior. Future research seeks to explore the role of pupping (dogfish spawning) associated with water temperature at the aforementioned areas.

## First Impressions: Somersworth

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NH First Impressions is a program run by the UNH Cooperative Extension for evaluating the existing assets and needs of a community's downtown. It uses ArcGIS Collector, a mobile data collection application to allow participants to make comments about certain features or aspects of the downtown. UNH Extension identified interest in studying the thoughts of college students on downtowns. College students provide a unique view into how younger generations perceive downtown communities. The UNH Student Planning Organization volunteered to conduct the first impressions project in downtown Somersworth, NH. The week before visiting downtown Somersworth, students completed a pre-visit survey. The pre-visit survey collected information about students preexisting ideas about the city. The site visit to downtown Somersworth was on November 5<sup>th</sup> during which data was collected on Arc GIS Collector. A post-visit survey was also completed by the students. From the data, existing assets and needs of the downtown can be identified and help communities to focus planning efforts on their primary needs. The data set will be analyzed with qualitative methods. This will be done primarily through identifying common themes in the commentary data. Identifying the key themes in the data will allow the students to analyze the assets and needs in downtown Somersworth and evaluate what college students find important in a downtown. This research will be submitted to the Somersworth city planner for reference.

## Fungal Responses to Elevated Temperature and Soil Nitrogen Availability

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The soil microbial community controls decomposition of organic residues which constitute a large portion of soil organic matter. Microbial growth is impacted by global changes such as warming and soil nitrogen (N) availability. Carbon use efficiency (CUE) is an important parameter that influences soil C dynamics by partitioning organic matter between soil C and CO<sub>2</sub> pools. This research focuses on the growth of different fungal species' exposed to varying temperatures and N availabilities, while quantifying respiration (CO<sub>2</sub> flux) and microbial growth. To assess individual fungal isolates, we constructed a sterilized artificial soil medium to mimic a sandy loam soil by mixing 70% sand, 20% silt, and 10% clay. Several fungal species of the phyla *Ascomycota* and *Basidiomycota*, were individually grown in this media at different temperatures (15 and 25°C) and N amendment treatments. Soil respiration was measured over the incubation period. Fungal biomass was estimated by chloroform fumigation extraction. Our results indicate that fungi were able to grow effectively and reproducibly in the artificial soil medium, demonstrating that using an artificial soil is an effective method for assessing individual species responses. Temperature and nutrient availability had a positive affect on C mineralization and biomass, suggesting that fungi are sensitive to these parameters.

## Generating Random Samples for the Reference Data of Cropland Maps

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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. To create these maps we must use high resolution images of the Earth to determine where cropland is and is not. Looking at every inch of the Earth's surface is not efficient and is a waste of time. Sampling is a technique done to conserve time and money and to interpolate the remaining area of the Earth that has not been reviewed. Different random sample designs were tested with the images provided by LANDSAT and MODIS, which are two different remote sensing satellites, to determine which methods would give the best sample. Various tools in Google Earth and ArcMap were used to generate the random samples and map the specific crop areas throughout Mongolia.

## **Histological and Physiological Analysis of Neonatal Black 6 Mice Termination Caused By The Gene Ablation of Type 3 Adenylate Cyclase In Neuronal Primary Cilia**

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It was observed that knockout neonatal pups perished within 24 hours of birth through the ablation of type 3 adenylate cyclase in neuronal primary cilia. Physiological observation and histology staining of whole mounted 40-micron pup slices were explored to ascertain the potential area and source of the neonatal death. There were no identifiable changes in organ structure, or anatomical orientation. Histological analysis showed no observable proliferative behavior in cell nuclei or change in nuclei structure. Hippocampal analysis also showed no observable change based on nuclei or structural aberration. It was determined that to identify the cause of this neonatal death further study would have to be taken to isolate the root of death after the ablation of AC3 in the neuronal primary cilia.

## Historical Changes in Distribution and Floral Associations of Bumble Bee (Apidae: *Bombus*) Species of Greatest Conservation Need in New Hampshire

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Bees are essential pollinators for the majority of our food crops and for wild plants. Studies show that bees in North America and worldwide are experiencing declines, some severe. In New Hampshire, four bumble bees – *Bombus affinis*, *B. terricola*, *B. pensylvanicus*, and *B. fervidus* – are listed as species of greatest conservation need. However, little is known about the local status of these species and potential others in decline. Using records of thousands of specimens from UNH's Insect Collection and recent summer fieldwork, it has been possible to track changes in the distribution and abundance of bumble bees in New Hampshire over the past 150 years. With the help of GIS mapping technology, data concerning shifts in climate, land use, and other factors are used to evaluate the state's bumble bee populations through time and space, revealing patterns and possible causes of decline for species of concern. Along with detailed networks of current and historical floral associations, this provides foundational information about the ecology, diversity, and status of New Hampshire's bumble bees. This research supplies critical baseline knowledge of native bumble bees to better inform management decisions, including the possible identification of additional native bee species requiring conservation attention.

## **How would the University of New Hampshire's nitrogen footprint change if we achieved other sustainability scenarios?**

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The nitrogen footprint of the University of New Hampshire was first calculated in 2014. A nitrogen footprint measures the amount of reactive nitrogen generated and released into the environment from food and energy consumption. The footprint is broken down into sectors of food production, food consumption, utilities, transportation, fertilizer, research animals, and agriculture.

Estimated changes in the University's nitrogen footprint will be presented for 4 possible sustainable scenarios. These scenarios are the following: 1) accomplishing a zero waste campus, 2) achieving the carbon footprint reduction goal, 3) earning 2 additional points in AASHE STARS by increasing the amount of sustainable food purchases, and 4) earning 1 additional point in AASHE STARS by decreasing the amount of conventional animal purchases. AASHE STARS is a global program that assesses campus sustainability. The scenarios will be run using the nitrogen footprint calculation from fiscal year 2016 and will be compared to the 'business as usual' nitrogen footprint to assess their impact. The proposed scenarios all align with exploring a more sustainable future for the University of New Hampshire.

## **How do you hydrate? Using hydration stations versus purchasing bottled water across UNH colleges**

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At the University of New Hampshire, sustainability and raising awareness for environmental practices is at the forefront of what this institution considers to be vitally important. One of the many ways we can gauge our progress is through understanding trends in student behavior. For our study, we wanted to develop an understanding of plastic water bottle consumption and use of water hydration stations throughout campus. Plastic waste are a well-known environmental hazard; whether that be because of it being disposed of inaptly, or by the unsustainable methods in which it gets re-purposed through recycling. Hydration stations were installed at UNH with the goal of encouraging the re-use of water bottles. Developing an understanding of the awareness and use of water hydration stations provides valuable input in campus planning.

A survey was created in two different forms; a paper survey and a qualtrics survey, both were administered in person. The surveys yielded 351 respondent. The survey questions gathered information to get a better understanding of how aware students were of the hydration stations located throughout campus, how often they used them, and reasons why they purchase water bottles instead of a reusable container. The findings of this study concluded that there is a significant amount of hydration station use, yet awareness of these stations is relatively low.

## Identification of Signal Molecules from *Frankia* that Induced the Early Step of Nodule Development in *Casuarina*

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*Frankia* is an actinobacteria that forms a symbiotic relationship with eight families of angiosperms including *Casuarina glauca*. This nitrogen fixing symbiotic association results in root nodule formation. The *Casuarina* and *Frankia* pair is useful in the environment based on its ability to restore uninhabitable soil. The signaling pathways between the host plants and *Frankia* are currently unknown. Identification of bacterial signal molecules is the key to understanding this association. Root nodulation is triggered by the early induction of the *CgNIN* genes (Nodule INception). In order to identify the signal molecules that induce nodulation, transgenic *Casuarina* plants were created with reporter genes *GFP* or *GUS* fused to the promotor region of *CgNIN*. These *Casuarina* plants are used as a bioassay to observe induction of the *NIN* gene by various treatments of *Frankia* supernatant. Enrichment treatments of the signal molecules have been tested on the transgenic plants in order to identify their structure. An ethyl acetate extraction showed the signal molecules segregating with the aqueous phase, indicating a hydrophilic molecule. Size fractionation indicated that the molecule in question is smaller than 3,000 Daltons. Testing with protease treatments is ongoing and further testing regiments will follow. Development of this bioassay will help to identify the structure and the class of signal molecules of *Frankia*.

## **Impact of Management Intensive Grazing on Soil Carbon Sequestration and Greenhouse Gas Emissions at Organic Dairy Farms in the New England Region**

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Management intensive grazing (MIG) is one strategy used by organic dairy farmers to increase forage productivity and soil carbon (C) sequestration, while meeting organic certification requirements for dry livestock feed. However, this management technique has the potential to stimulate the release of potent greenhouse gases from soils to the atmosphere. This study investigates the impact of MIG on soil C sequestration and greenhouse gas emissions between grazed and ungrazed pastures at three organic dairy farms in the New England region. Preliminary results indicate that physical soil characteristics such as bulk density and sand content may have a significant impact on labile soil C, soil carbon to nitrogen (C:N) ratio, and greenhouse gas emissions between grazed and ungrazed fields.

## Impacts of a Predator Free Area on Vegetation Growth and Health

Rebecca M Kammerer, Timothy C Curry, Robert H Keefe, Nicolette M Niemiec, David Clarke

Warrenheip Reserve is one of the first areas in New Zealand, enclosed with the Xcluder™ pest proof fence, containing 16 hectares of forest. This study looks at how a pest free area effects vegetation's growth, regeneration and dispersal. Information about canopy cover, shade, ground-level vegetation, stem count, and DBH was collected throughout three days. With data from 2000, 2003, 2008, 2011 and 2016 this study found that the vegetation within the reserve has increased number of stems, and DBH on average. The trees within all twelve plots, nine plots inside the reserve and three plots outside of the reserve, had a range of 31 species. Plants covering the most number of plots include *Melicytus ramiflorus* and *Kunzea ericoides*. The Warrenheip Reserve has converted into a successful forest, with pioneer plants being out competed by other local flora, with help from the pest proof fence.

Key Words: Biodiversity, Mainland Islands, Pest eradication, Cambridge, NZ

## Imprinting Kin Recognition in Adult Male Guppies (*Poecilia reticulata*)

Leslie J Curren, Maegan K Ryckman

The ability to distinguish kin from non-kin plays an important role in development and evolution. There are different mechanisms of kin recognition, with olfactory cues being the most common among fish. Previous research on kin recognition in guppies (*Poecilia reticulata*) has shown that juvenile siblings use olfaction to identify each other shortly after birth, but it is unclear how adult males imprint on their offspring (fry). I hypothesized that male guppies learn their fry's olfactory phenotype by imprinting on the mother before fry are born. To test this, I randomly mated guppy pairs, then placed the male in one of three treatments: T1) with his mated female for the gestation period, and with their fry after their birth; T2) in a different mated female's tank for gestation, and with her fry (his non-kin) after their birth; or T3) in a tank with an unmated female for a typical gestation period, and then with his reintroduced fry after their birth. I then compared paternal behavior toward the fry across the treatments. If offspring recognition is learned by males imprinting on the mother, males who were with a pregnant female during gestation (T1, T2) would show more paternal care toward her fry than the males who were with an unmated female during gestation and then reintroduced to their own fry (T3). By determining if kin recognition in guppies is learned, other mechanisms of kin imprinting can be researched to further understand how various species identify their kin.

## Investigation of Aggregation Patterns of Soluble Htt Protein Complexes Using Analytical Ultracentrifugation with Fluorescence Detection System

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The huntingtin gene is highly expressed in neurons and encodes a polyglutamine (polyQ) domain within the huntingtin protein (Htt). Huntington's disease (HD) is caused by a genetic mutation resulting in an expansion of the polyQ region beyond a threshold of 36 glutamines. Abnormal polyQ expansion leads to misfolding and aggregation of Htt, interfering with neuronal function and resulting in progressive neurodegeneration. The pathway by which these aggregates initiate cellular death is unclear. While there is no cure for HD, therapeutic strategies are sought to prevent and mitigate Htt aggregation in neurons. Our first objective was to investigate whether the Htt aggregation pattern develops *in vitro* differently than *in vivo*. Our second objective was to determine if the aggregation pattern could be altered by introducing a green tea derivative, EGCG, treatment. These studies were conducted using a yeast model system containing Flag-Htt-103Q-GFP, a polyQ stretch linked to extreme yeast cytotoxicity. We found the aggregate pattern does not shift *in vitro* in crude cell extracts or samples of purified Htt aggregates. EGCG treatment appears to accentuate the aggregate pattern, yet more studies will be needed to confirm this conclusion. Our third objective was to examine the development of the aggregation pattern in yeast carrying Flag-Htt-47Q-GFP, a polyQ stretch that has shown intermediate toxicity in yeast. The Flag-Htt-47Q-GFP demonstrated a delayed development of aggregates of the specific size associated with cytotoxicity. The novel technique of fluorescent detection system coupled with analytical ultracentrifugation was used to identify and discriminate the relative abundances and sizes of soluble Htt aggregates up to 200S. These studies provide further insight into the specific sizes of aggregates and patterns of aggregate formation that develop with time and that are linked to cytotoxicity.

## **Is More Always More? Female Prairie Mole Crickets Select Mates More Deliberately when Evaluating Multimodal Signals**

Rebecca J Migotsky, Daniel R Howard  
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Multimodal signals can provide receivers with more diverse or more intense information sets. Assumed costly to produce, multichannel signals can also be expensive to monitor, especially if a secondary sensory modality is coopted from functions with high fitness stakes. Here we test whether lek-mating female prairie mole crickets utilize vibrational cues associated with the male call in mate localization or choice. We ran two-speaker behavioral assays where females were provided acoustic signals with and without substrate-borne vibration, and examined female choice and path dynamics to test whether the presence of vibration together with the acoustic component of a signal influenced female phonotaxis. We found that females did not prefer multimodal signals, but exhibited slightly shorter paths when responding to signals with a substrate-borne component. Additional path analyses indicated that females neither exploited the seismic information for mate localization benefits nor were distracted by the presence of a second channel of information in male calls. Here the cost of multimodality likely outweighs the benefits, with females coopting the channel for non-mating functions.

## Is There a Connection Between Performance on Problem-Solving Tasks and Dominance Levels in *Canis familiaris*?

Leslie J Curren, Nina E Coffey, Kadianne Kiera Tommasi

Dominance is not only vital to social hierarchies and reproductive success, but is also highly connected to learning and development. Cognition in domestic dogs, *Canis familiaris*, has been tested using problem-solving tasks to compare skills among breeds and ages, but comparisons have not been made across dominance levels. Here, we examined whether a dog's degree of dominance is correlated with its performance on problem-solving tasks. Because dominant individuals lead others within a social group, advanced problem-solving skills may be vital to establishing a high dominance status. We therefore hypothesized that dominant dogs have a higher level of problem-solving cognition than submissive dogs. We predicted that dogs portraying more dominant behaviors would complete problem-solving tasks faster and more often than dogs portraying fewer, particularly as the difficulty of the task increased. We first evaluated a dog's dominant behaviors based on results from a questionnaire administered to the owner. The dogs were then presented with three food puzzles of varying difficulty. We used regression models to ask if a dog's dominant behaviors predicted the number of puzzles the dog completed and, when applicable, the time it took to complete them. If problem-solving skills increase with dominance, owners may be able to better create a customized enrichment routine for their dogs, potentially decreasing boredom and destruction.

## Is the expression of tissue-degrading enzymes in the skeletal muscle of spiny dogfish correlated to capture stress?

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An evolutionarily-conserved family of enzymes known as the matrix metalloproteinases (MMPs) play major roles in tissue remodeling. While much is known about MMPs in mammalian vertebrates, their presence and function in non-mammalian vertebrates is not well studied. In teleosts, MMPs have been shown to degrade skeletal muscle and thus, may affect the quality of fillet at market. Standard commercial fishing practices can be stressful, which could also adversely affect fillet quality. Interestingly we observed that MMPs are expressed in skeletal muscle of the spiny dogfish, *Squalus acanthias*. Therefore, we hypothesized that skeletal muscle MMP expression in dogfish is correlated to capture method. Skeletal muscles were obtained from dogfish caught under high stress (24-hr tow) and low stress (hook and line) conditions. Dogfish skeletal muscle proteins were extracted and subjected to gelatin zymography to identify MMPs. Among them, a few were differentially expressed in dogfish caught using high and low stress methods. These results may have implications for commercial fishing practices that ultimately provide a high-quality product to consumers.

## Loss of One Protein Phosphatase 2A A-subunit Gene in *Arabidopsis* is Partially Complemented by Other A-Subunit Genes

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Protein Phosphatase 2A (PP2A) is a highly conserved heterotrimeric protein in eukaryotes. The A subunit has both scaffolding and regulatory functions, the B subunit is regulatory, and the C subunit is the site of the enzymatic activity. Each subunit is encoded by a multigene family. In this experiment, we examined the interchangeability of the A subunits (A1, A2, and A3) in root responses to NaCl stress in the model plant *Arabidopsis thaliana*. When grown on medium with elevated levels of NaCl, roots of an *a1* mutant have a strong curling response while roots of *a2* or *a3* mutants are straight, similar to wildtype. As expected, the root curling phenotype of the *a1* mutant is fully complemented by transformation with the wildtype *A1* gene. Next, the *a1* mutant was transformed with the *A2* or *A3* genes under the control of their respective promoter. Transformed plants were genotyped to confirm their identity and then tested in a standardized root growth assay in the presence or absence of NaCl. Preliminary results showed that extra copies of the *A2* or *A3* genes partially complemented the phenotype of the PP2A *a1* mutant, suggesting that further increasing the dosage of the A2 or A3 subunits may enable full complementation of the *a1* mutant by other A subunits.

## Measuring somatic mutation in the nematode, *Caenorhabditis elegans*

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Somatic mutations underlie cancer and many other human disorders. However, they are poorly understood because they are difficult to measure, since they are not passed on to the next generation. To gain a better understanding of the nature and rates of such mutations, whole genome sequence analysis was used to identify and characterize somatic mutations in early embryos of the nematode *C. elegans*. This is an ideal system for such studies for many reasons; most notably, the complete genome sequence is available as a reference for identifying de novo mutations and the embryonic cell lineage is completely known and invariant. To accomplish this, hundreds of embryos were collected, sorted by cell number using a fluorescent cell sorter and dispensed individually to wells of microtiter plates. Each embryo was subjected to whole-genome DNA sequence analysis using an Illumina HiSeq 2500 automated sequencer in the Hubbard Center for Genome Studies here at UNH. Using a combination of bioinformatics and statistical analyses, new mutations that arose within the first few cell divisions in each embryo were analyzed. These studies will provide important insight concerning what kinds of mutations occur in somatic cells and the rate at which they occur.

## Medial prefrontal neurons encode information about stimuli signaling reinforcement

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The medial prefrontal cortex (mPFC) encodes information about reinforcement in order to shape adaptive decision making. Information about reward is used to update action outcome associations in order to choose options that are most beneficial. Using electrophysiology to record single cell neurons while rats run a goal directed task tell us about how changes in electrical activity are related to reinforcement delivery and anticipation. In general, about 1/3 of neurons in mPFC respond to reward and reward related stimuli. Here, we recorded rats performing the Serial Lever Press (SLP) task, is a series of four lever presses in which rats must simply chase the available lever to receive water reinforcement. The stimuli signaling reward are manipulated. During training a panel light is always paired with water delivery making it possible that the panel light could take on reinforcing properties through Pavlovian conditioning. In SLP water can be paired with light, water can be delivery alone, or light can be presented without water. We hypothesize that single neurons in SLP will encode discrete information related to the reinforcement stimuli manipulations. Out of 122 cells recorded, 35 were involved in reinforcement. There is no evidence that the light took on reinforcement properties. These results show that cells in mPFC are encoding discrete information about reinforcement in order to aide in decision making.

## Mutational Analysis of Salt Tolerance In *Casuarina* Isolate *Frankia*

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An actinorhizal tree known as *Casuarina* is able to form a mutualistic relationship with *Frankia*, a nitrogen-fixing actinobacteria. Through this relationship, *Casuarina* is able to grow in soil with high salt concentration where many other plants cannot. Currently little is known about the molecular mechanism behind the salt tolerance of *Frankia* and its plant host. Due to the alarming global increase in soil salinity, it is very beneficial to grow these plants and reclaim degraded land. In order to better understand how *Frankia* assists the growth of *Casuarina* in salt-affected soil, mutational analyses of candidate genes will be performed on the bacteria using an innovative technique known as CRISPR/Cas9. These mutations will knock out certain genes and the bacteria will then be characterized through its ability to grow in the presence of high salt. This research will greatly contribute to the understanding of the genetics of *Frankia* and its symbiotic relationship with *Casuarina*.

## **Nutritional Quality of Lettuce grown in Hydroponic system vs Aquaponic system**

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Department of Biological Sciences, UNH Durham

This research focuses on the nutritional quality and uptake of lettuce grown in two different soilless systems, hydroponics and aquaponics.

## Predator induced plasticity in the model organism, *Ambystoma mexicanum*, the Mexican Axolotl

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Amphibian development depends on both internal genetic instructions, and the interaction of external epigenetic factors (EFs). EFs, or signals from the embryo's environment, can affect phenotypic expression; such environmentally induced changes are termed phenotypic plasticity. EFs that may induce phenotypic plasticity include: temperature, salinity, pH, exposure to light, and chemical/physical cues from other organisms. Many species show an adaptive form of phenotypic plasticity - namely the ability to develop defensive structures - when developing in the presence of predators. We investigated predator-induced plasticity in the model salamander, the axolotl (*Ambystoma Mexicanum*). Although the axolotl has been used as a developmental model for decades, little is known about its predator-induced morphologies. To fill this gap, we reared axolotl embryos from early blastula to larval stages in the presence of three potential predators: goldfish, crayfish, and adult axolotls. Axolotl larvae delay hatching in the presence of predators, as has been found in other amphibians; this may be an adaptation to help newly hatched larvae survive in a hostile environment. Preliminary results also suggest axolotls exposed to predators may develop broader tail muscles and larger heads. In the absence of predators it is beneficial to not delay hatching; larvae still retain some yolk and do not have to immediately forage. In the presence of predators it is beneficial to delay hatching to continue developing to hatch at a larger size. The significant differences of the measured variables of predator absence and presence supports plasticity of development to prepare larvae for different ecological conditions.

## Processing Pumpkin Varieties

Andrew B Ogden, Crysta N Harris, James Brent Loy

Canned pumpkin is widely used in the United States around the holidays for culinary purposes. The varieties of pumpkin, or correctly termed as squash, have remained constant for years; however, some improvements can be made if more information is gathered. This study examines the processed pumpkin industry and works to reveal ways that the industry can increase profit by changing squash varieties. A squash used for processing should have a desirable consistency, which can be predicted by dry matter and starch contents of the fruit. The objective in this study is to evaluate the way the percent dry matter content of the fruit influences the amount of water weight the fruit will lose through processing (% water loss). It was found that the percent dry matter content of the squash fruit (%DM) has a strong influence on the percent of water that will be lost (% WL) during the 'mimicked' processing procedures. If the processors used fruit with higher dry matter content, the yields would likely increase, because of the decrease in percent lost by water. Increased yields, using different varieties, could increase profit for the processing companies.

## Profiling the Involvement of Polyamines in the Drought and Salt Tolerance of Rice

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Abiotic stresses are important constraints on crop productivity. Rice, grown in paddies, is particularly susceptible to drought and salt stress, which have negative effects on carbon and nitrogen intake that may limit plant growth and grain yield. Polyamines, mainly putrescine, spermidine, and spermine, are important molecules in plant metabolism and have been implicated in abiotic stress responses, both as protectors of plants from stress and preparing the plant for tolerance of stress. This has led to genetic engineering of plants to manipulate polyamine metabolism aimed at improving drought and salt tolerances in rice and several other crops. Preliminary to overexpressing polyamine biosynthetic genes in order to produce a multiple-stress-tolerant rice plant, I am profiling the response of a commercial rice variety to drought and salt stress in terms of changes in their polyamine and amino acids content. I am also studying the interactions of changing polyamine levels with changes in the levels of total carbon and nitrogen, chlorophyll, proteins, fresh weight, and dry weight of plants to gain a more holistic picture of the rice plant's metabolic response to stress.

## **Profiling the health, wellness, and nutrition of collegiate dancers**

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Osteoporosis and disordered eating are health risks associated with dancers. Research is lacking concerning the incidence of these health risks in collegiate dancers. The purpose of this study is to establish a health profile for collegiate dancers focusing on bone health and the prevalence of disordered eating. An online survey was distributed to dancers (n=20) at the University of New Hampshire; questions assessed overall health and wellness, perceptions of health, and prevalence of disordered eating. Anthropometric data, including height, weight, waist circumference, body composition, and bone density, were collected from each subject by trained study personnel. Participants completed a 3-day diet record. Survey results indicate 70% of participants correctly described their weight as about the right weight, however, 57% of those participants reported they were trying to lose weight. Twenty-five percent of participants reported disordered eating habits. Anthropometric assessment data indicate 95% of dancers had healthy body composition and 85% had normal bone accrual for their age. Collectively, these results help to identify the unique health concerns of collegiate dancers.

## **Regulation of the angiogenic inducer, CCN1, in the bovine corpus luteum: A preliminary study**

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In the ovary, growth of a new vascular network, or angiogenesis, is a hallmark of corpus luteum (CL) development. This process requires several angiogenic factors and matrix metalloproteinases (MMPs). Recently, we reported the expression of an angiogenic inducer, Cysteine rich 61-Connective tissue growth factor-Nephroblastoma overexpressed (CCN1), in the bovine CL. However, it is not known how CCN1 is regulated in the CL. Therefore, the goals of the present study were 1) to determine the temporal expression of CCN1, and 2) to determine the regulation by insulin-like growth factor (IGF-1) and luteinizing hormone (LH), during the early (Day 4), mid (Day 8), and late (Day 16) stages of CL development. Following cell culture and quantitative polymerase chain reaction (qPCR), preliminary results showed that CCN1 was rapidly induced within 2 to 4 hours. As such, luteal cells were then treated for 2 hours with IGF-1 (50 ng/mL and 100 ng/mL) and LH (10 ng/mL and 100 ng/mL). Treatment with IGF-1 may increase CCN1 expression in the Day 4 but not in the Day 8 and Day 16 CL, while LH may not have any effect on CCN1 expression in CL cells. Currently, we are evaluating the roles of IGF-1 and LH in MMP expression through analysis of conditioned medium from cell cultures using gelatin zymography. These experiments will be repeated to confirm our observations

## Role of *Daphnia* in the Production of Toxic Lake Aerosols

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Aerosols released from lakes with toxigenic cyanobacteria represent a potential threat to wildlife and humans. Factors regulating the emission of lake aerosols have not been identified. The effect of *Daphnia carinata* on the amount of dissolved toxins and aerosol production by lake water is largely unknown. It was thought that because *Daphnia* eat cyanobacteria, the aerosols should decrease in their presence. Previous experiments suggest that they increase the amount of dissolved toxins, perhaps by releasing the toxins after they break down the cyanobacteria that produces them. To test this observation, six flasks with lake water from Lake Quannapowitt, with and without *Daphnia carinata*, were tested over a 24 h period. Glass fiber filters collected particles that are aerosolized, and a Milli-Q water trap retained dissolved microcystin that passed through the filter. Toxins were tested in the water at the start and finish of the experiment. Cyanobacteria in the lake water fractions were analyzed using fluorometry. Toxin levels in the Milli-Q from the trap indicated the importance of *Daphnia* in increasing the dissolved aerosolized toxins. Further experimentation is needed to determine the mechanisms used by *Daphnia* to increase toxin levels.

## Role of the BinK Regulator in Symbiotic Bioluminescence Regulation

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Bioluminescent *Vibrio fischeri* strain ES114 forms a monospecific light organ symbiosis with the Hawaiian bobtail squid, *Euprymna scolopes*. *V. fischeri* provides counterillumination protective camouflage for the squid while it is foraging at night. Bioluminescence is under the regulation of quorum sensing (QS), a cell density dependent signaling process where bacteria produce and detect pheromone-like autoinducers, which trigger a signaling transduction system. In the absence of pheromone signals, hybrid-histidine kinases (HHK) LuxQ and AinR phosphorylate a histidine phosphotransferase protein (HPT) LuxU, which then phosphorylates a response regulator (RR) LuxO, where LuxO represses luminescence. At high cell density the acceptance of QS signals causes LuxQ and AinR to act as phosphatases via their receiver (REC) domain on LuxU causing a dephosphorylation of LuxO, leading to the activation of luminescence. We have discovered a new regulator of QS and bioluminescence, a HHK which is termed BinK (<https://doi.org/10.1101/067025>). The goal of this study is to determine how BinK regulates luminescence. BinK has at least two different internal residues that participate in phosphorelay which include 1) a HisKA domain that autophosphorylates and transfers phosphates internally and 2) a REC domain that receives phosphates, typically from the HisKA domain, and can transfer phosphates to a HTP protein. We hypothesize that BinK uses the REC domain to remove a phosphate from LuxU/LuxO triggering luminescence activation, and that it doesn't need the HisKA domain for this activity. To test the role of the REC domain, a truncated BinK (BinK $\Delta$ REC) and the REC domain alone were overexpressed demonstrating that the REC domain is necessary but it was unclear whether it is sufficient for luminescence regulation because the REC domain alone did not stimulate luminescence as much as the full length protein. We hypothesize that the REC phosphorylation site is sufficient for luminescence regulation, but that the REC domain alone may have been less stable without the rest of the protein. To address the ambiguous data we will generate two point mutant alleles: the first will eliminate the function of the REC domain which we predict will eliminate luminescence regulation; the second will eliminate the function of the HisKA domain, which we predict will have no impact on luminescence. The discovery of the BinK regulator shows how there are more ways that bacteria modulate their QS than previously thought. This shows there is more to QS than just population control and this will expand the field in how and why bacteria use other cellular processes to communicate with one another.

**Seeing what sticks: an integrative approach to examine the effect of adhesion mutation in experimentally evolved *Vibrio fischeri* symbionts**

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The study of symbiotic relationships between bacteria and animal hosts increases our understanding of microbes' role in animal development and homeostasis. The natural symbiotic relationship between the Hawaiian-Bobtail squid *Euprymna scolopes* and its bioluminescent bacterial symbiont *Vibrio fischeri* is a model that addresses the questions regarding the nature of symbioses. The goal of my Summer Undergraduate Research Fellowship was devoted to identify and characterize the role of the *tad* locus *in situ* in *V. fischeri*. With the help of Dr. Sabrina Pankey, our objectives were to observe pilus formation and attachment in wild-type and *tad*-mutant *V. fischeri*. Our experiments were driven by the question of whether mutations in the *tad* pilus assembly lead to increased or reduced attachment to host tissue. Increased attachment could promote symbiotic initiation by allowing better aggregation at the light organ surface during colonization. Alternatively, decreased attachment could reduce binding by host macrophages and/or explain the improved persistence of the symbionts following the squid's nightly epithelial shedding. Following traditional histological methods, microscopy, and image analysis, we attempted to quantify *in vivo* host epithelia adherence differences among *tad* mutants. By using confocal and traditional microscopy, in collaboration with Dr. David Needle at the UNH Veterinary Diagnostics Lab, we characterized and compared the adherence *in vivo* by experimentally-evolved and native squid-symbiotic *V. fischeri* strains. Various *in vitro* assays were performed to examine the functional consequences of these *tad* mutations on motility. Our goal was to be able to evaluate the data from the experiments to shed light on traits that confer selective advantages in an evolving symbiosis.

## Sequencing and Characterization of S-Acyl Transferase Mutants from *Arabidopsis thaliana*

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Protein palmitoylation or S-acylation is the reversible, covalent, post-translational lipid modification of cysteine residues with the 16-carbon fatty acid palmitic acid. Protein S-acyl transferases (PATs) catalyze this reaction. PATs are integral membrane proteins with four to six transmembrane domains and a cytoplasmic DHHC motif that is essential for enzymatic activity. Palmitoylation promotes membrane association of cytosolic proteins, regulates protein activity, or impacts protein stability. S-acylation influences cell size, growth, and polarity within eukaryotic cells. However, knowledge of S-acylation in plant cells is limited in comparison to other organisms. Here, we have used the model plant *Arabidopsis thaliana* to study the role of S-acylation in plants. *Arabidopsis* has twenty-four PAT genes. I genotyped *pat21-2* mutants, created by T-DNA insertion, using PCR and gel electrophoresis to determine whether the mutants were heterozygous or homozygous for the mutation or had lost the mutant allele. Plants with homozygous mutations in the *pat21* gene will help further our understanding of the general function of *PAT21* in *Arabidopsis*.

## Silviculture and Wildlife

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Silviculture is the management of growing and cultivating timber within a forest. Different management techniques will have different impacts on the ecosystem. Wildlife habitat quality can be assessed based on factors of the forest that generally provide better habitat. This study looked at how species composition, understory species composition, vertical diversity, and volume of down dead wood influenced wildlife habitat quality. It was expected that increased diversity within these factors would lead to increased wildlife diversity. Tree species were identified and assigned a crown class in 24 quarter acre plots in compartment 22 of Bartlett Experimental Forest. Within each plot four mil acre plots were used to sample the understory. Volume of dead wood and decay class assignments were made based on what crossed diagonal transects through each plot. The plots were then treated in 1959 and again in 2003. Plots that had undergone the same two treatments were grouped together giving us eleven groups of treatment types. The biodiversity for the species composition, understory composition, and vertical diversity were ranked from most to least diverse using the Shannon-Weaver Index. There was a significantly greater volume of dead wood in the (uncut/uncut) plots. Overall no significant patterns were observed across the treatments for being more diverse in all factors.

## **Stream salinization by road salt and the effects on local NH macroinvertebrates**

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Salting roads during long icy winters is becoming a regular practice. Although the practice has been effective in reducing winter-related vehicle accidents, it is introducing a large quantity of salts into the stream and environment. The effects of salting require additional research and applicable methods for testing the effects. These methods include the husbandry and standardization of living conditions of macroinvertebrates. Macroinvertebrates include secondary and tertiary feeders that provide abundant food sources. The biota of macroinvertebrates in a stream have been used as a standard to determine stream viability and pollution. By examining three local streams in South Eastern New Hampshire, new methods for analyzing macroinvertebrate environments were established. These innovative methods can be used for future studies on the effects of varying road salts.

## Submersible Oceanic Aquaculture of Kelp (SOAK)

M Robinson Swift, Angela Mary Sarni, Hannah M Root, Megan Margaret Savoie, Jamie Ellen Barton, Michael D Chambers

Aquaculture has been expanding rapidly due to increased populations and seafood demand. When conducted properly, it can serve as a sustainable and efficient way to produce protein. It can also decrease fishing pressures on wild stocks that are over fished. Since World War I, sugar kelp (*Saccharina latissima*) has been harvested to help feed soldiers, and continues to supply food around the world. It is used in many other products such as agar, carrageenan, beer, Japanese dishes, and some holistic medicines. Kelp culture in the US is in its infancy and new ways are being developed to grow it offshore. As a result, we designed a submersible kelp frame for grow out. The frame is composed of fused HDPE pipe that will be moored about 3m below the surface, just offshore NH. The frame's specified depth is to keep the growth below harsh wave conditions. The frame is designed to withstand the forces produced by the site conditions which include strong currents, due to its location near the opening of the Piscataqua River. Kelp seedlings are being cultured at the Coastal Marine Lab. PES (Provasoli Enriched Seawater Media) is used during the nursery stages to increase growth and prevent diatom competition on the seedling line. Sugar kelp spawns seasonally with the best growth rates in the spring of the year. The frame and kelp will be deployed in March for a 2 month field evaluation.

## The Influence of Nitric Oxide on Rhythmic Feeding Behavior in *Melibe leonina*

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Nitric oxide (NO) is a gaseous molecule produced by the enzyme nitric oxide synthase (NOS). It acts as an intracellular messenger in the central nervous system, and in mollusks NO also acts as a modulator of rhythmic activity. The goal of this study was to test the hypothesis that NO is released in response to feeding stimulants and activates the characteristic rhythmic feeding and swallowing movements of the sea slug *Melibe leonina*. First, I used our *Melibe* RNA transcriptome to determine the sequence of *Melibe* NOS. Then I compared it to other NOS sequences and found that there was a greater similarity between *Melibe* NOS and human (*Homo sapiens*) and mouse (*Mus musculus*) NOS than between *Melibe* NOS and *Drosophila melanogaster* NOS. Therefore, I was able to use an antibody designed to bind to mammalian NOS to visualize *Melibe* neurons that might produce NO. This experiment revealed a single pair of bilaterally symmetrical cells in the midline of the brain. Next, I found that addition of the NO donor, sodium nitroprusside (SNP), caused the same increase in feeding activity as adding prey (*Artemia salina*) to the aquarium. Furthermore, the NOS inhibitor, N-nitro-L-arginine methyl ester (L-NAME), prevented the onset of feeding activity typically induced by the addition of prey. These data, taken together, suggest that stimuli associated with *Melibe* prey, likely activate NOS, which produces the messenger NO, and this activates the neural networks associated with rhythmic feeding.

## The Aerosolization of Biotoxins as a Potential Link to Amyotrophic Lateral Sclerosis

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Cyanobacteria are photosynthetic organisms that are known to produce biotoxins such as microcystins (MC) and  $\beta$ -Methylamino-L-alanine (BMAA). These particular toxins are established liver and neurotoxins, respectively, that have been linked to illness and neurodegenerative diseases in humans. Humans can be exposed to these toxins through many different pathways, including the inhalation of aerosols. Based on previous studies and the prevalence of incidence clusters around lakes with known cyanobacterial blooms, the inhalation of aerosolized cyanobacterial toxins has been hypothesized to trigger the neurodegenerative disease Amyotrophic Lateral Sclerosis (ALS). To better understand this relationship, water samples and aerosol collection filters were taken from six New England lakes and processed to determine the concentration of MC and BMAA present. In collaboration with Dartmouth Hitchcock Medical Center, the samples were analyzed for toxins using enzyme-linked immunosorbent assays (ELISA). The goal of this study was to establish a correlation between the concentration of toxins in surface water and aerosols. A significant correlation between the two would demonstrate that water quality may affect public health even without direct contact.

## **The Raised Gillnet: The Application of a Novel Gear Modification to Improve Fishing Efficiency and Selectivity**

Benjamin D Gallo, Stephanie L Sykes, Erik W Chapman  
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Commercial fishermen in the Gulf of Maine have recently been noticing unusual patterns of catch associated with groundfish species. This news come in light of recently depleted stocks of historically important species, such as Atlantic Cod (*Gads morhua*). Commercial markets and fishermen have begun exploring more abundant species, such as Spiny Dogfish (*Squalus acanthias*) as an alternative to the aforementioned depleted species. Ecologically speaking, Spiny Dogfish inhabit similar areas and occupy the same niche as Atlantic Cod and other groundfishes, therefore both species are often caught together. The rebuilding ground fish are thus caught as bycatch, harming management efforts to restore their populations. This project seeks a novel solution in proposing dogfish are typically caught a few feet off of the bottom while gadoid (e.g. Atlantic Cod) species typically do not rise far off the bottom. The "Raised" gillnet, is therefore a gear modification exemplified by a 2-4 foot gap at the bottom of the net that allows dogfish to still be caught while Cod etc. slip through the gap at the bottom. This project remains in its preliminary stages with initial field data beginning during 2016. This poster details the cooperative extension between fishermen and researcher and further modification that were made to the original design. Preliminary results from 2016 are also provided.

## The distribution and possible roles of the neuropeptide SCP in *Melibe leonina*

Winsor H Watson, Allison M Nash  
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The neuropeptide small cardioactive peptide (SCP) plays an integrative role in exciting various motor programs involved in the feeding and locomotion of a number of gastropod species. In this study, immunohistochemical staining using monoclonal antibodies against SCP was used to localize SCP neurons in the central nervous system (CNS) and map their connections to the esophagus of the Nudibranch *Melibe leonina*. A large number of SCP-immunoreactive neurons (37-45) were identified in the *Melibe* brain, as well as one large neuron in each of the buccal ganglia. There were also a very large number of SCP-immunoreactive axons and terminals in each pedal ganglion. We demonstrated that these originated from neurons in the opposite pedal ganglion, using a combination of Neurobiotin backfills and staining for SCP. Extensive SCP innervation was also seen along the length of the esophagus. Studies using live preparations showed that perfusion with SCP stimulated peristaltic contractions of the esophagus. Furthermore, *Melibe* injected with SCP at night swam for a longer duration of time than control animals injected with saline, while animals injected during the day, when they are normally not active, yielded no significant response in comparison to controls. These data suggest that SCP enhances the swimming behavior that normally occurs in this nocturnal species. Finally, the close association of circadian clock neurons and SCP neurons in this species suggests that SCP could be released at night to stimulate the expression of both feeding and swimming motor programs in *Melibe leonina*.

## The genome of *Mya*, a molluscan model for p53-related animal cancers

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This poster presents a draft genome for the soft-shelled clam, *Mya arenaria*. We demonstrate substantial conservation and intriguing variation in the p53 apoptogenic pathway between this protostome, humans and other deuterostomes after ~400M years of separately evolving from a common ancestor. A spontaneously occurring hemocyte cancer that may be virally induced, or directly transmitted from clam to clam affects *M. arenaria*. Our genomic data indicate both substantial similarities and important differences between the p53 related apoptogenic mechanisms of clams and humans and other protostome and deuterostome organisms. Among those we have identified: 1) clams have a single gene yielding two splice variants and two p53 related gene products, while humans have separate genes on 3 different chromosomes and three gene products: 2) the clam transcriptional activation domain for the gene products shares either 6 or 9 residues of the 15 in the human TAD and both include all of the mdm2 binding domains while the fly TAD shares only 2 of the 15 and lacks the mdm2 binding domain (also mdm2 exists in the clam genome and not in the fly genome); 3) most of the downstream apoptogenic or DNA repair transcriptional targets for p53 are highly conserved between clams and humans (excluding BH3 only sequences found in humans and not in deuterostomes generally and the ARF and Waf1 proteins). Presumably p53 function was originally related to protection of the germ line and later became important for transcriptional control of apoptosis and DNA repair in somatic cells; 4) functional data on the existing isoforms of p53-like proteins in the clam mirror both nuclear-directed transcriptional and mitochondrial-directed, non-transcriptional apoptogenic mechanisms identified for human cancers, where avoiding apoptosis is key in resisting carcinogenesis. In light of these observations, the *in vitro* and *in vivo* clam hemocyte cancer model is of high value and can serve as a pre-clinical model for testing p53 related cancer therapy agents.

**The relationship of life stage to daily social patterns of captive African elephants (*Loxodonta africana*) and the correlation of handler perceptions of elephant personality to demonstrated social behaviors**

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Social interactions between herd elephants include affiliative, agonistic, and ambiguous behaviors and depend on many factors, such as maternal lineage, age, and sex. This study was designed to determine how social behaviors among a herd of captive African elephants vary throughout the day and to establish if the frequency of social interactions and age class are correlated. The study also aimed to determine if perceptions of elephant personality were an accurate predictor of social behaviors. Research took place with the African Elephant Research Unit at Knysna Elephant Park (KEP) in South Africa. The herd included 7 elephants in 3 age groups: juvenile, young adult, and adult. Continuous, all-occurrence sampling of pre-determined affiliative, agonistic, and ambiguous social behaviors was performed. Results indicate that there is a statistically higher rate of affiliative, agonistic, and total social behavior during mid-morning than mid-afternoon. Elephant handlers were individually surveyed regarding perceptions of each elephant's personality traits, including dominance, activity level, boldness, confidence, curiosity, sociability, and aggressiveness. This characterization was compared to the recorded elephant social behaviors, and results indicate that there is a strong positive correlation between observed agonistic rate of social behavior and rated activity levels. Results are intended to influence the management of captive elephants at KEP and elsewhere.

## **Transitioning From Sun-Grown System to Shade-Grown System of Coffee—A bioeconomic model**

Shuhan Long, Shady S Atallah  
NR, UNH Durham

Coffee is the main export commodity of many tropical nations, which crucial to their GDP. Many coffee farmers in this region now face the uncertainty associated with climate change. Warmer temperatures are expected to negatively affect the sustainability of coffee production. Evidence indicates increasing levels of infestation by insects during warmer seasons, leading to a decrease in coffee yields and farm revenues. An adaptation strategy that is recommended to farmers facing warmer climates consists of transitioning from sun-grown to shade-grown coffee system, by planting shading trees on the farm. This method has proven to be beneficial, and influence the yield of coffee by providing many ecosystem services: shade trees provide pest control services, crop growth services through improved soil fertility, and timber. However, beyond a certain shading level, there is competition for resources and reduced revenues. A model was developed to identify the shading levels that are optimal both ecologically and economically, under various ecological and economic conditions (Atallah, Gomez, and Jaramillo 2017). Here, we conduct computational sensitivity analyses and parameter variation experiments to identify the parameters values for which the optimal shading recommendation changes and the conditions under which a transition from sun-grown to shade-grown might not be economically sustainable for a farmer, unless consumers are willing to pay a price premium for shade-grown coffee.

## Using Fluorometry to Create a Citizen-Based Monitoring System of Cyanobacteria

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Cyanobacteria are the first photosynthetic organisms on Earth; they can reside in most environments with living conditions that are mild to harsh. Cyanobacteria can form blooms that can contain a variety of toxins harmful to humans as well as aquatic life. Citizen monitoring through fluorometry can be a simple, effective method used in tracking cyanobacteria bloom formation and degradation. Fluorometers can be used to measure the fluorescence of photosynthetic pigments, phycocyanin (PC) and chlorophyll-a (Chl a). Phycocyanin (PC) is an accessory light harvesting pigment in cyanobacteria that is an indicator of cyanobacteria in lake water samples. The focus of the project is to formulate a simple, yet effective method for concentrating the level of PC and Chl a in a sample, thereby increasing the lower detectable limit. PC time trend markers include baseline values of bloom formation, estimates of bloom degradation and a peak in the data indicating a cyanobacteria bloom. With sonication and freeze-thaw techniques, we amplified the signal of PC and Chl a allowing measurement below the current detectable limit. Our end goal is that the EPA will adopt our method into their standard operating procedure (SOP) to be used by water treatment facilities and lake water quality monitors.

## Understanding a Rare Pediatric Cancer Cluster Along the New Hampshire Seacoast

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Recently, a cluster of rare pediatric malignancies has been identified in the Seacoast region of New Hampshire. This cluster includes 42 cases of rhabdomyosarcoma (RMS) and pleuropulmonary blastoma (PPB). RMS is a rare cancer that affects developing skeletal muscle tissue, while PPB affects the lungs and pleural cavity. In June 2016, a governor's taskforce was convened to investigate links between this cancer cluster and sites of environmental contamination. The initial focus of this taskforce has been on contamination potentially associated with the Coakley landfill. This has focused on surface and groundwater contamination with perfluorinated chemicals (PFCs) and 1,4-dioxane. At some sites, PFC levels were found to be 12.5 times higher than the EPA Policy Health Advisory. More so, 1,4-dioxane was detected sampling wells near the Coakley landfill. These observations highlight concerns within the local communities, because of potential links between PFCs and 1,4-dioxane and cancer. Scientific studies have reported that PFCs act as developmental toxins and carcinogenic agents in mice. Similarly, studies have noted that 1,4-dioxane can also promote tumor formation in rodent models. Therefore, it is imperative to urge the continuation of an investigation of the contamination around the Coakley landfill, as well as other nearby sites of contamination. These include the Pease Tradeport, Portsmouth Naval Shipyard, Seabrook Nuclear Power Station, and the Schiller Plant. Additionally, the persistence of this pediatric cancer cluster in the New Hampshire Seacoast region highlights the need for additional studies evaluating underlying biology of these rare cancers, as well as the development of new therapeutic modalities. The University of New Hampshire may be in a unique position to participate in these pediatric cancer research efforts, as well as evaluations of the impacts of contamination on the marine ecosystem and fisheries along the Seacoast.

## Using Comparative Transcriptomics to classify Taste and Opsin genes from the Evolutionary Ancient Cnidarian *Hydra magnipapillata*

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Animals sense their environment using specialized proteins called sensory receptors. We use the cnidarian freshwater polyp *Hydra magnipapillata* as a model to understand the early evolution of animal sensory systems. Ongoing work has identified a set of sensory genes that function in the hydra including the photosensitivity gene Opsin and Taste 1 Receptors (T1Rs). The full-length T1R transcript was cloned from the hydra using Rapid Amplification of cDNA Ends. Using comparative transcriptomics and genomics this full-length sequence was confirmed. Constructing the hydra transcriptome also allowed us to distinguish between the sensory genes being expressed and the pseudo-sensory genes present. This characterization provides a better understanding of pseudo gene production specific to each sensory gene class.

## Using Genome Wide Association Studies (GWAS) to Identify Candidate Genes Affecting Plant Root Phenotypes

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Genome wide association studies (GWAS) are used to test the assertion that phenotypic variation is determined by genotype. The GWAS program compares whole genomes of individuals or populations and identifies DNA sequence polymorphisms that are most likely to be associated with a certain trait. *Arabidopsis thaliana* is a model plant that is well suited for these studies due to the existence of numerous phenotypically diverse natural populations (accessions) with well-characterized genomes. The purpose of this study was to identify areas of the genome that affect plant root formation. The roots that were primarily studied were lateral and adventitious roots. Lateral roots develop from the primary root, whereas adventitious roots develop from non-root tissue. Experiments performed aimed to identify candidate genes affecting formation of adventitious roots at a mature plant stage in order to compare that to previously determined candidate genes affecting formation of adventitious roots at a juvenile stage. Another GWAS attempted to locate genes involved in formation of lateral roots. Knowledge on how *Arabidopsis* initiates and regulates both adventitious and lateral rooting is important to understand how plants respond to their environment and can be applied to clonal propagation of plants.

**Bioaccumulation of Cyanotoxins in the Blood of Common Loons (*Gavia immer*)**

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Cyanobacteria are prokaryotic, photosynthetic organisms that can produce toxic secondary metabolites. Two of these toxins are  $\beta$ -N-methylamino-L-alanine (BMAA), a neurotoxin, and microcystin (MC), a hepatotoxin. When cyanobacteria are present in fresh water bodies they produce toxic blooms potentially harming aquatic organisms. This study focuses on the bioaccumulation and biomagnification of BMAA and MC in an apex predators in lakes, the common loon (*Gavia immer*). Dried blood samples collected from loons across North America were collected and dried blood samples were extracted using freeze thaw techniques. BMAA and MC concentrations were quantified through Enzyme-Linked-Immunosorbent-Assays (ELISA). Toxin levels in the blood were compared to lake trophic levels (nutrient level) from sample locations. Positive correlation between high trophic level and high MC concentration suggest nutrient pollution may affect the bioaccumulation of toxins at the highest trophic level.

## Does Type III Adenylyl Cyclase Regulate Memory Formation in Adult Mice?

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It is mostly agreed upon that new neural pathways must be built in order to store a memory, but what drives the construction of this network of snapshots? Certain molecules must be required for the construction of new pathways, but which molecules they might be is still unknown. Structures called neuronal primary cilia have recently received a lot of attention for their potential roles in various brain-related functions. Defects of neuronal primary cilia lead to many neurological disorders including developmental abnormality and cognitive impairment in humans. Neuronal primary cilia are known to have high concentrations of an enzyme called type III adenylyl cyclase (AC3), which mediates the cAMP signal transduction pathway there. It has been found that AC3 conventional knockout mice exhibit a number of neurological deficits, including memory deficits, but no one has been able to circumvent the possibility that the memory deficits observed could be due to developmental complications. Using recently developed conditional AC3 mice to ablate AC3 temporally, I aim to determine if AC3 plays a role in memory formation in adult mice. This will be made possible by employing a set behavior paradigms used widely as memory tests in animals. The first of the behavior paradigms is known as the novel object recognition test, which uses a familiarized arena and pair of objects to test a subject's recognition memory. The second behavior paradigm is a test known as the Morris Water Maze, which examines a subject's spatial memory and learning rate over the course of one week. The statistical comparison between experimental and control groups will directly investigate the relationship between the presence of AC3 and the ability of an adult mouse to properly form a memory.

## Exploring the Diversity of Tropical Pumpkin in Costa Rica

Elizabeth R Gill, Andrew B Ogden

Current decrease in crop biodiversity within the commercial agricultural sector has prompted plant breeders to explore and utilize landraces from crop regions' of origin to provide enhanced resistance to biotic and abiotic stresses. This study explores the diversity of the economically significant tropical pumpkin (*Cucurbita moschata*) present in Costa Rica. Through a 9 week IROP, independently designed and funded research grant, I collected 43 tropical pumpkin accessions by traveling to geographically different cities and farmers' markets around Costa Rica and communicating with local farmers. I spent the weekdays with Costa Rican professors at the University of Costa Rica (UCR) Fabio Baudrit Agricultural Station to assess physical and genetic variation among the regionally collected tropical pumpkin accessions. The completed project provides a detailed inventory of the collected *Cucurbita moschata* and shows the wide variety of tropical pumpkin present in Costa Rica. Finally, a high presence of international hybrid varieties observed in market suggests an agricultural shift occurring in Latin America.

## Effect of Land Use on Sediment Transport in Streams Draining Coastal Watersheds

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### 1-Abstract

This research is conducted to understand sediment dynamics in streams of varying land use around Durham, New Hampshire (NH). Sediment deposition in the coastal environment can modify forest production as well as biological habitats, affecting food webs and fish populations (Gamvroudis et al. 2014). The response of sediment transport to land use change in shallow sloped coastal watersheds, across different flow levels is not entirely understood. The study will focus on the impacts of land use, flow levels, and stream slope on sediment concentration and transport in streams. This study is part of a larger study conducted by the Plum Island Ecosystem Long Term Ecological Research program, funded by the National Science Foundation (Wollheim et al. 2005). The research will focus on measurement of suspended sediments draining streams (channel of sediments) of different land use across different flow levels in the Oyster River watershed. The study will compare sediment concentrations and fluxes in one forested headwater stream, one urban headwater stream, and one agricultural stream. These will be compared to the concentrations and fluxes at the mouth of the Oyster River where it enters into the Great Bay in order to quantify retention by the river network. At each site, we will target sampling of sediments across a range of flows to estimate the concentration vs. discharge relationships. Existing water level loggers already deployed will be used to estimate discharge at each site. Findings will inform how land use change alters stream loading to the river network, and how effective the river network is at retaining incoming sediments across different flow conditions.

## Mitigating Transportation Stress in Striped Bass (*Morone saxatilis*) Using Salt and Anesthetics

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The stress response from transportation has been shown to have adverse effects on the performance of many fish species. The recent demand for striped bass (SB) as a food and sport fish has generated interest in developing effective transport methods. Previous research has shown that adding a low dose of anesthetic (MS-222) or salt ( $\text{Na}^+\text{Cl}^-$ ) during transport can reduce the magnitude of SB plasma cortisol, the stress hormone in fishes. No studies have compared cortisol responses among different genetic strains of SB or using other commercially available anesthetic agents. Recent studies have shown that the anesthetic metomidate (Aquacalm®) can mitigate some stressors associated with routine handling. In this study, groups of twelve SB, six wild (Florida), and six domesticated (NCSU), were randomly assigned to a transport treatment: fresh (0ppt) or brackish water (10ppt) alone, or containing either metomidate (1mg/L), or MS-222 (25mg/L). Fish were netted and driven for one hour in insulated containers. Following transport, six fish from each treatment (3 per strain) were bled from the caudal vein and plasma cortisol levels were measured by enzyme-linked immunoassay. The remaining fish were put in a freshwater recirculating system and monitored for seven days. Results showed significant differences in cortisol responses among treatments. Strain, feed consumption, and health were not correlated with cortisol which calls into question its value as a stress indicator.