ABSTRACTS FOR

ORAL PRESENTATIONS

(in order of presentation)

EFFECTS OF AGE, DENSITY, AND SEASONALITY ON MOLT PATTERN IN THE MAMMAL GENUS *PEROMYSCUS*

Rebecca Graves[1], Ryan Stephens[2], and Rebecca Rowe[2]
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Molting, or replacement of hair in mammals, occurs during ontogeny as individuals transition from juveniles to adults. In addition, molting can occur year round for thermoregulation and camouflage purposes. Molting is energetically costly and differences in molt timing and pattern in adults may be affected by resource availability. Past studies of various mammal species have found differences in molt pattern and timing depending upon age, and between captive reared and wild caught individuals. However, there has been little investigation into the molting characteristics of mice, *Peromyscus leucopus* and *P. maniculatus*, specifically in comparison to juvenile molts (ontogenetic) and adult molts (reproductive status). We used molt observed from individuals captured at Bartlett Experimental Forest over a three-year period to determine if there are evident molt patterns in both *Peromyscus* spp. Specifically, we tested for differences in percent molt and number of individuals molting as a result of seasonality, age, and density. Molts were digitized in Photoshop and pattern and symmetry were analyzed in ImageJ. In both species, individuals show a seasonal (June-Sept.) trend in molt timing and pattern. This may reflect differences in resource availability and energy expenditure among years.

EFFECTS OF AUDIBLE HUMAN DISTURBANCE ON KOALA (*PHASCOLARCTOS CINEREUS*) BEHAVIOUR IN QUEENSLAND, AUSTRALIA AND IMPLICATIONS FOR MANAGEMENT

Galina Kinsella[1], Andrew Conroy[2], Leslie Curren[3], and Alistair Melzer
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[3]Department of Biological Sciences, UNH

As the growing human population continues to encroach on wildlife habitat, species are forced to adapt in order to survive. In addition to causing habitat loss, human presence can create more subtle disturbances, such as noise pollution, that disrupt wildlife behavior. Adapting to human presence is particularly difficult for species with specialized resource needs or low mobility. The koala (*Phascolarctos cinereus*), a national icon of Australia, meets both these criteria. Koalas were once abundant throughout Australia, but are now classified as "threatened." Habitat loss is at least partly responsible for this decline, but anthropogenic noise may also be a factor. The purpose of my study was to examine koala behavior in response to noise disturbance in two sites: an area of high human density and a national park. I used a logistic regression to compare behavioral responses to two types of disturbances, human-induced and natural (non-human), in both sites. The probability of a koala responding to a human disturbance was twice as great in the densely populated site (0.55) as it was in the natural park (0.27). These results demonstrate that regular exposure to human activity can actually hypersensitize wild animals to human disturbances, rather than desensitize them. Broadly, this study shows how a change in wildlife behavior can give insight into anthropogenic effects on a population. This type of information can help conservation biologists prevent further population declines.

A PROTO-PLURITROPIC CELL TYPE AND ITS EXPRESSION OF NOVEL GLYCOPROTEIN HORMONES IN THE PITUITARY OF THE BASAL VERTEBRATE, THE SEA LAMPREY

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In jawed vertebrates, the classical pituitary glycoprotein hormones (GpHs) are follicle stimulating hormone (FSH), luteinizing hormone (LH) and thyroid stimulating hormone (TSH), which consist of the common α subunit (GpA1) and specific β subunits (FSHβ, LHβ, TSHβ). In contrast, only one GpH has been identified in lampreys (jawless vertebrates) and consists of unique α and β subunits (GpA2/GpHβ), which form a functional heterodimer; there is evidence for a putative thyrostimulin in lampreys, consisting of GpA2/GpB5. The objectives of this study were to determine the localization of the GpH and thyrostimulin subunits in the pituitary of sea lampreys, using histology, electron microscopy, *in-situ* hybridization and immunohistochemistry. lGpA2 and lGpB5 were expressed in all regions of the anterior pituitary (rostral pars distalis (RPD), proximal pars distalis (PPD) and pars intermedia (PI)); lGpHβ was localized to the PPD. The α and β subunit pairs were co-expressed, suggesting they are synthesized in the same cells, and we have identified two classical tropic cell types in the lamprey pituitary and discovered a novel proto-pluritropic cell that may differentially produce lGpH and thyrostimulin. In summary, our studies show that there are differences in expression of the lamprey GpH and thyrostimulin subunits and that they are co-expressed; thus, providing supporting evidence along with our other studies that lampreys only have two heterodimeric pituitary glycoprotein hormones. Supported by NSF IOS-1257476, AES NH00571, AES NH00624 to SAS, and UNH Undergraduate Research Award to TJM.

WASTE WATER TREATMENT IN NEW HAMPSHIRE

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Fresh water supplies are decreasing and waste water treatment is a vital method to reuse the water. Waste water treatment plants are designed to improve the quality of wastewater and allow for future reuse. Although reusing waste water was initially an innovative solution, current wastewater treatment plants are deteriorating, causing a demand for not only new plants, but inventive and advanced treatment methods. This research analyzes the existing systems and accomplishments in New Hampshire and identifies future projects, proposals and prospective developments. The basis of the research is to identify cost effective methods that are also economically and environmentally sustainable.

THE RELATIONSHIP BETWEEN KINSHIP AND PHYSICAL PROXIMITY IN CAPTIVE PRIMATES

Tricia Gunther[1] and Leslie Curren[2]
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There has been much effort to understand primate social dynamics in wild populations, but how these social interactions manifest in captivity has been less widely explored. One important force that can shape social dynamics is kin selection, which posits that an individual should preferentially cooperate with its genetic relatives to obtain indirect fitness benefits. In many social species, physical proximity can be used as a proxy for cooperation. With this in mind, I investigated the relationship between kinship and physical proximity in four species of captive primates. I tested the hypothesis that the genetic relatedness of two individuals would relate to their physical proximity, with the expectation that more closely related individuals would be found closer to one another. I used scan sampling to measure the distance between pairs of individuals over multiple observation sessions, and then compared these distances to the relatedness values for each pair. This type of information can make important contributions to general husbandry questions, such as how to create an enclosure that can maximize quality of life. The results from this study can also be compared to studies done with wild populations to further investigate whether or not and how social interactions change in captivity.

EFFECTS OF FETAL ALCOHOL SPECTRUM DISORDER ON DISTRACTIBILITY AND ATTENTION

Michael Workman[1] and Jill McGaughy[2]
[1]Department of Biological Sciences, UNH
[2]Department of Psychology, UNH

The term fetal alcohol spectrum disorder (FASD) describes individuals affected by prenatal alcohol exposure. In the United States and Western European countries it is estimated that 24 to 48 per 1000 children suffer from FASD, which impairs many cognitive domains including executive function, motor control, learning, and memory. Retrospective studies in humans often lack details concerning stage in pregnancy, dose, consumption pattern, or include polydrug use. The present study uses a rat model to simulate FASD in utero to allow control over timing and dose of ethanol not possible in human studies. Rats exposed to prenatal alcohol were tested as adults in a sustained attention task (SAT) to determine the effects on attention and susceptibility to distraction. Preliminary results in this study show prenatal exposure to alcohol during the third trimester produces vulnerabilities to distraction. Prior work has shown acetylcholine (ACh) within the prefrontal cortex (PFC) controls top-down cognitive processes which are necessary to ignore irrelevant stimuli and distractions, so density of ACh in the PFC was assessed to evaluate whether the behavioral effects seen in alcohol exposed rats were caused by cholinergic damage in this area. The long-term goal of this study is to develop a better understanding of the neuroanatomical and neurochemical bases of cognitive deficits in FASD in order to investigate pharmacological strategies to remediate them.

ABSTRACTS FOR

POSTER PRESENTATIONS

EFFECTS OF AUDIBLE HUMAN DISTURBANCE ON KOALA (*PHASCOLARCTOS CINEREUS*) BEHAVIOUR IN QUEENSLAND, AUSTRALIA AND IMPLICATIONS FOR MANAGEMENT

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IMPLICATIONS OF NEW ENGLAND COTTONTAIL HABITAT MANAGEMENT ON THE METAPOPULATION DYNAMICS OF DECLINING SHRUB-DEPENDENT SONGBIRDS – A PILOT STUDY

Randy Shoe, Erin Smith, and Matthew Tarr
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Efforts to recover endangered New England cottontails (NEC) in New Hampshire and Maine are focused on increasing the acreage of their required shrubland habitats. Specifically, multiple shrubland openings juxtaposed within the known dispersal range of rabbits are being created to allow NEC to establish a "metapopulation" where rabbits breed in certain openings and produce offspring that disperse to and breed with rabbits in nearby openings. These efforts are expected to similarly benefit declining shrub-dependent songbirds such as eastern towhees (EATO), field sparrows (FISP), alder flycatchers (ALFL) and prairie warblers (PRAW), which use habitats similar to NEC. The extent to which NEC openings actually benefit these birds, where juvenile birds disperse, and how adult birds use multiple openings within a landscape is unknown. We will use point counts and broadcast vocalizations to determine all shrublands where EATO, FISP, ALFL, and PRAW breed within ten southern NH NEC management areas. All adults of these species will be mist-netted, color banded, and blood samples will be taken for DNA to monitor juvenile dispersal and adult movements between openings over time. We will test the efficacy of point counts to accurately determine the abundance of these birds by comparing point count results to our known population of marked birds.

EFFECTS OF EXERCISE ON INTERMITTENT SWIM STRESS-INDUCED ULTRASONIC VOCALIZATIONS AND SUBSEQUENT BEHAVIORAL DEPRESSION.

India Stribling[1], Nate Stafford[2], and Robert Drugan[2]
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Studies have shown that stress is associated with negative psychological effects that promotes the risk and progression of diseases and disorders. Including, mental health problems such as depression. There are current treatments available to aid these problems, however, there are those that are resistant to the treatments and are unable to be helped. These treatments can also have a multitude of side effects and worsen the symptoms of depression. This is why it's important to look into studies of stress and resilience. Exercise is a behavioral method of resilience as it promotes protective effects against uncontrollable stress by neurogenesis, the development of new neurons. Our lab has looked at ultrasonic vocalizations (USVs) being emitted during intermittent swim stress (ISS) events, an animal model that is similar to traumatic events in clinical samples. The USVs are phenotypic indicators of resilience to stressors and combined with exercise will blunt the effects of the ISS. The proposed study could offer insight between stress resilience and exercise. Therefore, this current project will seek to answer whether or not exercise promotes stress buffering effects towards ISS-induced depressive symptoms and find a correlation between the neural mechanisms that relate USVs and exercise.

EFFECTS OF BUGLING ON ROOSEVELT ELK (*CERVUS CANADENSIS ROOSEVELTI*) VIGILANCE

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Vocal communication is an important form of animal signaling because it allows for the signaler to simultaneously provide multiple recipients with information. Vocal calls can transmit a range of information, such as rank, age, and reproductive state. Bugling is one way that male Roosevelt elk (*Cervus canadensis roosevelti*) communicate. Male elk may gauge another male's strength and likelihood of winning a contest based on his bugle, but how females respond to bugles is less well understood. To investigate this, we studied two elk harems: one with a young male and young females, and one with an older male and older females. We played an unfamiliar bugle to the harems and observed the frequency of vigilant behaviors exhibited by each elk. We found that the females in the younger harem were more vigilant after the bugle than the females in the older harem. This could have been because of differences in experience or curiosity between the younger and older elk. Alternatively, perhaps the younger females had less confidence in their less experienced male's ability to defend them than the older females had in their more experienced male. This might have led the younger females to react with more vigilance to the unfamiliar bugle than did the older females because they were interested in a new mating opportunity, whereas the older females were not. This research will shed further light on how elk process auditory information and what life history traits affect their reactions.

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Michael Workman[1] and Jill McGaughy[2]
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The term fetal alcohol spectrum disorder (FASD) describes individuals affected by prenatal alcohol exposure. In the United States and Western European countries it is estimated that 24 to 48 per 1000 children suffer from FASD, which impairs many cognitive domains including executive function, motor control, learning, and memory. Retrospective studies in humans often lack details concerning stage in pregnancy, dose, consumption pattern, or include polydrug use. The present study uses a rat model to simulate FASD in utero to allow control over timing and dose of ethanol not possible in human studies. Rats exposed to prenatal alcohol were tested as adults in a sustained attention task (SAT) to determine the effects on attention and susceptibility to distraction. Preliminary results in this study show prenatal exposure to alcohol during the third trimester produces vulnerabilities to distraction. Prior work has shown acetylcholine (ACh) within the prefrontal cortex (PFC) controls top-down cognitive processes which are necessary to ignore irrelevant stimuli and distractions, so density of ACh in the PFC was assessed to evaluate whether the behavioral effects seen in alcohol exposed rats were caused by cholinergic damage in this area. The long-term goal of this study is to develop a better understanding of the neuroanatomical and neurochemical bases of cognitive deficits in FASD in order to investigate pharmacological strategies to remediate them.

VETERAN TRANSITION ASSISTANCE PROGRAM

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Student veterans face unique challenges in their transition from active duty military to post-secondary education. In response to this, a Veteran Transition Assistance Program has been designed and implemented at UNH. This program seeks to pair the incoming veterans with a peer from the student body who is familiar with the transition. Together, they follow the developed curriculum that focuses on academic success, social integration, and campus orientation. The findings of the first semester revealed that the program helped to alleviate a vast majority of the stress associated with the transition. It also gave the incoming veterans an outlet to voice their questions or concerns. The current student veterans acted as academic coaches by sharing what they have learned so far concerning note taking, study skills, etc. They also took the time to tour campus resources with the students. This program was extremely helpful for the incoming veterans and it is our hope that, with help from university staff, it will continue to serve these men and women in their difficult time of transition.

A REVISION OF THE ANT-LIKE LITTER BEETLE GENUS *CUSTOTYCHUS* (COLEOPTERA: STAPHYLINIDAE: PSELAPHINAE)

Sarah Geromini and Donald Chandler
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The genus *Custotychus* is a well-defined monophyletic group of the ant-like litter beetles (Coleoptera: Staphylinidae: Pselaphinae). The species range from the mid-Atlantic to the Southwest regions of the United States. A taxonomic revision based on morphological characters has produced thirteen species, nine of which are newly described species. The species *C. pocahontas* has been discovered to be the junior synonym of the species *C. spiculifer*. All species were identified and described through the use of dissections, characterization of diagnostic features, and the illustration of these features through drawings and the use of a scanning electron microscope. The most important feature in placing specimens of*Custotychus* species is the genitalia, which must be dissected out of these 1.8 mm beetles to be observed, with also the position and form of the metasternal tubercle being important.

DOES STAGE OF CHANGE MEDIATE THE IMPACT OF A MOTIVATOR TO INCREASE ACTIVITY LEVELS AMONG COLLEGE STUDENTS?

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Activation of a motivational memory has been shown to increase reported physical activity in college students. It is unknown if this motivator impacts activity level depending on students' stage of change (SOC) for physical activity. This study investigates if the use of a motivator increases physical activity in undergraduates (ages 18-24) in the precontemplative/contemplative (P/C) and preparation (P) SOC, compared to those in action (A) and maintenance (M) SOC. Students (n=295) recruited from an intro nutrition course in fall 2014 completed all parts of the study (77% female). SOC were measured via online questionnaire at baseline. Students were randomly assigned to one of three conditions: positive memory prompt (n=99), negative memory prompt (n=95), or control (n=101). Students' activity levels were measured for 7 days via pedometer (New Lifestyles, SW401). At baseline, 57% of students classified themselves in M SOC, 18% in A, 11% in P, and 13% in P/C SOC. On average, students took 8,426 steps/day. Group differences were analyzed between PC&P SOC vs. A&M SOC. Students in PC&P took less steps/day vs. students in A&M (7,353 vs. 8,773 steps, $p<.05$). Average number of steps/day was not affected by the use of a motivator in either the PC&P or A&M groups. Though a positive or negative memory did not increase physical activity, students' average steps per day differed by their SOC. Findings suggest there is a relationship between SOC classification and students' activity level.

HOW DOES INACCURATE PERCEPTION OF WEIGHT COMPARED TO ACTUAL BMI STATUS AFFECT THE DIET SCORE OF COLLEGE STUDENTS?

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As self-perception of health can influence behavior, accurate understanding of weight status may be important for making healthy choices. This study examined the relationship between the accuracy of college students' weight perception, as well as their weight status intentions, to the quality of their diet. Students (n=1330), ages 18-24, were recruited from the ongoing CHANAS study at UNH. Perception accuracy was determined by comparing students' self-identified weight status (overweight, underweight, about right) to their measured BMI. Weight status intentions were evaluated via responses to "What are you trying to do with your weight?" 3-day food records evaluated nutrient intake; diet quality was determined via 4-item score (5-20). One-third of men and one-quarter of women incorrectly identified their weight status. No significant relationship with weight perception and diet score was seen. No significant differences with men's weight perception and goals were seen; women trying to lose or gain weight had significantly more accurate weight perception than those trying to maintain or do nothing. Men trying to lose weight had significantly lower diet scores than those trying to maintain or gain weight (11.2 vs. >12 $p<.05$). Women trying to lose weight had significantly lower diet scores than those trying to maintain or do nothing (11.7 vs. >12, $p<.05$). Findings suggest attempts to alter weight may lead to lower diet scores.

EARLY SLEEP MIDPOINTS ARE ASSOCIATED WITH INCREASED FRUIT, WATER, AND FIBER INTAKES AND DECREASED DISCRETIONARY CALORIES IN A YOUNG ADULT COHORT

Amy Parker and Jesse Morrell
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Previous research suggests a link between poor sleep quality and increased consumption of energy dense foods. However, little is known about the timing of sleep and whether or not it affects dietary intake. The purpose of this study was to determine if early, middle, or late sleep midpoints were associated with healthier diets among students participating in the ongoing College Health and Nutrition Assessment Survey at the University of New Hampshire between 2012-14 [n= 1,302; 69.6% female; mean age=19]. Sleep behaviors were collected from an online questionnaire and dietary intakes were assessed using three-day food records and nutrient analysis software (Diet Analysis Plus). Sleep midpoints were calculated from self-reported bed times and rise times on usual weekdays and subsequently divided into tertiles. On average, students reported 8.14 hours of sleep and had a sleep midpoint time of 3:54 am. As compared to those in the latest sleep midpoint tertile, students in the earliest tertile had higher intakes of fruit (1.52±.050 vs. 1.27±.049 cups, $p<0.05$), fiber (23.12±.434 vs. 19.77±.431 grams, $p<0.05$), total water (2.08±.088 vs. 1.80±.088 L, $p<0.05$), and a lower ratio of discretionary calories to total calories (28.9±.5 vs. 30.8±.5%, $p<0.05$). No differences were seen in fat or carbohydrate intake between tertiles. Findings from this project suggest college students with earlier sleep midpoints consume healthier diets, including more fruit and less discretionary calories.

FOOD INSECURITY AMONG UNDERGRADUATE STUDENTS

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In 2013, 49.1 million Americans lived in food insecure households. As college students are excluded from national surveillance data, the prevalence of food insecurity among this population is unknown. The purpose of this study was to determine the prevalence of food insecurity among undergraduate students and what characteristics are associated with food insecurity. Students (18-24 years) were recruited from the ongoing College Health and Nutrition Assessment Survey at UNH. A 26-item online survey was developed by combining the USDA's 6-item Short Form U.S. Household Food Security Survey and Child Food Security Survey and 11 UNH-specific food access items. The survey was administered to all students enrolled in a general nutrition class in fall 2014; response rate=50.5% (n=211, 84% female). Survey results indicated 11.4% of students reported low food security and 6.2% reported marginal food security during their childhood. During the past 12-months, 12.4% reported experiencing low food security and 5.7% reported marginal food security. Students who lived in on-campus housing were more likely to report food security as compared to those living in off-campus apartments (86% vs 57%, $p<.05$); no differences in race, sex, marital status, or parents' education were observed between students who were food secure vs. insecure. The findings of this study suggest that food insecurity exists on the UNH campus and further research related to food availability and education is needed.

ATMOSPHERIC NUCLEAR WEAPON TESTING HORIZONS: ESTABLISHING DEPTH-AGE RELATIONSHIPS IN AN ALASKAN ICE CORE

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Detailed analysis of ice cores provides the data to reconstruct past climate change. However, before reconstructing climate change, a reliable depth-age relationship must be developed. Positive identification of atmospheric nuclear weapon testing horizons via analysis of Cs-137 is one means to establish the depth age relationships for the past 50 years. Cs-137 is a man-made isotope and significant quantities were released into the atmosphere from 1953 to 1964 when extensive atmospheric nuclear weapons testing occurred. The Cs-137 fell out of the atmosphere and became trapped in the snow which then became ice. In May 2013, two surface-to-bottom ice cores were recovered from 13,000' on Mt. Hunter in Denali National Park, Alaska. Samples of one of the Mt. Hunter ice cores were melted, acidified, filtered, and analyzed via nondestructive gamma spectrometry (using a 24 hour count time). The data allowed for the identification of the 1954 and 1963 reference horizons as well as the creation of a reliable depth-age relationship over the past half century.

INVESTIGATING ALTERNATIVE PEST MANAGEMENT STRATEGIES FOR 'CABBAGE MAGGOT' *DELIA RADICUM* ON RADISHES

Waylin Clegg[1] and Richard Smith[2]
[1]Department of Biological Sciences, UNH
[2]Department of Natural Resources & the Environment, UNH

Resistance to the synthetic pesticide Diazinon has been reported in the herbivorous root feeding larvae 'Cabbage Maggot' *Delia radicum*, an important pest of cruciferous crops. We evaluated the effects of alternative pest management strategies on *D. radicum* damage and radish *Raphnus sativus* (cultivar 'Manolo') marketable yield. The field study was conducted during the summer of 2014 in Swansea, MA on a horse pasture. The experiment included a whole plot treatment of tillage (conventional vs. no-till) and a split-plot treatment of control practice (marigolds, nematodes, nematodes + marigolds, or the pesticide Diazinon). We hypothesized that no-till treatments that included a combination of nematodes and marigolds would result in the least damage from *D. radicum* maggots. Data on adult *D. radicum* fly populations, marketable crop yield, and yield damaged by *D. radicum* maggots were collected and analyzed using analysis of variance (ANOVA). Results suggested that the use of conventional tillage, the pesticide Diazinon, or the two in combination results in more effective cabbage maggot damage control and higher radish marketable yields compared to the alternative control practices evaluated in this study.

CHANGES IN TURBIDITY IN MAINE ESTUARIES: EFFECT ON *NEOMYSIS AMERICANA* AND *MYSIS STENOLEPIS* FEEDING BEHAVIOR AND DIET

Katherine Cart and Jonathan Pennock
School of Marine Science and Ocean Engineering, UNH

Mysid shrimp perform vital ecosystem functions such as linking the pelagic zone to the benthos and the aphotic to the euphotic through their foraging behavior and migration patterns. This increase in trophic connectivity between habitats has a stabilizing effect on community dynamics in the Gulf of Maine. Mysids are also important prey organisms for many commercially harvested fish in Maine, such as Atlantic salmon, alewives, smelt and flounder. Mysids are often associated with areas of high turbidity, but little research has been done specifically concerning the effect of turbidity on their feeding behavior. To study this, I used visual observations of feeding behavior of mysids on zooplankton prey at various levels of turbidity in laboratory mesocosm experiments and mysid gut comparisons to environmental factors. These studies were conducted at the University of Maine's Darling Marine Center in Walpole, Maine.

MICROANALYSIS OF PHOTO-ACTIVE GRADIENTS IN THE COLONIAL CYANOBACTERIA NOSTOC USING FIBER-OPTIC PROBE TECHNOLOGY

Bregieta Arvidson and Alan Baker
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Nostoc is a colonial genus of cyanobacteria photosynthetically active throughout the entire colony. An oxygen microsensor (PreSens) was used to create a microprofile relative to light and dark periods, gauging the change in photo-activity throughout the colony. Colony responses were individualistic regarding DO range and similar in photo-activity, with light periods reaching oxygen concentration supersaturation (~600 µmol L^{-1}). Colony gradient reached anoxia during dark periods. The filaments in the lower portion of the colony were less reactive due to light filtered from the upper portion of the colony. Damage to the colony gel (mucopolysaccharide matrix) from the microprobe did not seem to alter the light-dark reaction gradient range. Implications of understanding optimum conditions for *Nostoc* productivity are discussed as important for polyculture systems and potential tertiary treatment of wastewater.

EFFECTS OF NANOPARTICLES AND POLYAMINES ON GENE TRANSFER

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Nanoparticles and polyamines interact with cells in unique ways. Nanoparticles are an exciting area of research because of their potential use as novel drug delivery systems for cancer therapies. Biogenic polyamines are unique in that they play a variety of physiological and developmental roles in bacteria, plant, and mammalian cells. Most nanoparticles and biogenic polyamines have an inherent ability to cross a cell's plasma membrane and interact with DNA. Based on their structures and charge interactions, it can be hypothesized that they could impact the movement of macromolecules (e.g. DNA) from the environment into cells. Consequences of enhancing DNA uptake includes promoting the transfer of antibiotic resistant genes among bacteria which would be potentially harmful, especially in clinical settings. If these molecules inhibit transformation then it may shed insight on the mechanisms by which they interact with DNA. With this objective in mind, the present study is aimed at using genetic engineering methods including heat shock and electroporation to analyze bacterial transformation in model experimental systems of *Escherichia coli* (*E. coli*) bacteria and plant cell cultures in response to treatments with gold and silica nanoparticles as well as three biogenic polyamines: putrescine, spermine, and spermidine. Preliminary results indicate that silica nanoparticles enhance transformation efficiency while polyamines inhibit it.

GENETIC IDENTIFICATION OF HOST SPECIES FROM BLOODMEALS OF BLACK-LEGGED TICKS

Stephanie Royka[1] and Adrienne Kovach[2]
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New Hampshire, as well as the rest of New England, has seen a dramatic increase in Lyme disease cases over the past ten years. Studies have suggested that the increased tick abundance in certain areas may be due to increased forest fragmentation and the resulting biodiversity changes. Based on this information, researchers want to know how fragmentation is affecting tick host species in New Hampshire. To help answer this, I developed a procedure that uses DNA analysis to identify the host species of both questing and engorged ticks. The bloodmeals from the collected ticks were extracted using a modified Qiagen tissue extraction kit protocol, amplified in a nested PCR with universal vertebrate primers, visualized using gel electrophoresis, and sequenced. Once sequenced the host species was identified using a BLAST search. 24 engorged and 84 questing ticks were extracted with successful identification of 13 questing and 23 of the engorged tick host species. For questing ticks, a range of animal hosts were isolated including *Canis lupus* (dog), *Felis catus* (cat), *Sciurus carolinensis* (eastern gray squirrel), *Odocoileus virginianus* (white-tailed deer), and *Bos taurus* (cattle). The hosts isolated from engorged ticks included *Canis lupus* (dog), *Felis catus* (cat), *Microtus pennsylvanicus* (vole), various *Peromyscus* species (mice) and *Tamias striatus* (eastern chipmunk). This study will be helpful for future research aimed at studying the spread of Lyme disease using tick bloodmeals.

GROWTH RATE OF CALCIUM- FERTILIZED SUGAR MAPLE AND YELLOW BIRCH TREES AT HUBBARD BROOK

Stacie Powers, Matthew Vadeboncoeur, and Heidi Asbjornsen
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Acid deposition in soils from the effect of pollution has limited growth in northern forests, especially sugar maple trees. I want to know if a watershed that was fertilized with calcium silicate showed a positive response with tree ring growth and water use efficiency when compared to a control watershed. I will answer this by using tree cores that have been collected from a control watershed and measuring the width of tree rings to see what years had significant growth. I expect that the trees in the calcium fertilized watershed will show a positive response in growth, and the trees in the unfertilized watershed (W3) will not show an increase in growth. This study will be important to see the effects of the pollution that humans cause, and the impact that it has on forest ecosystems. It will also verify the results of the calcium fertilized watershed.

SEARCHING FOR SEX DETERMINATION MARKERS IN COLD HARDY KIWI (*ACTINIDIA ARGUTA*) VIA RAPD PCR

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As a dioecious perennial, cold-hardy kiwis (*Actinidia arguta*) presents a unique breeding challenge, with seedlings needing to grow for 3-5 years before genders can be determined. Because male plants do not bear fruit, they are culled from fruit-related breeding populations as soon as they can be identified. By developing and validating sex-linked molecular markers for cold-hardy kiwis, sex selection could be accomplished genotypically within weeks of germination, thereby freeing up limited breeding program resources such as land, time, and labor, while effectively increasing population sizes. In this study, the random amplified polymorphic DNA (RAPD) method of PCR was used as a means to discover sex-linked markers. Although RAPD has led to marker development in other kiwi species, the modest number of markers screened here have led to only a few possible markers that need more experimentation to determine their reliability as a sex determination marker. As such, there has not been any positive results as of yet.

INVESTIGATING NON-TRANSCRIPTIONAL APOPTOSIS IN SEVERELY STRESSED HUMAN ACUTE MYELOGENOUS LEUKEMIA CELLS THROUGH BLOCKAGE OF P53 NUCLEAR IMPORT

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Recent studies in several laboratories have demonstrated that in addition to its role as a nuclear transcription factor, p53 has a direct role in promoting programmed cellular death (apoptosis) at the mitochondrial membrane when the cell is severely stressed. The intent of this experiment was to show that induction of apoptosis occurs at the mitochondria in human acute myelogenous leukemia (AML) cells under severe stress when access to the nucleus is blocked. Cells of the AML cell line KG-1 were pretreated with FITC-labeled wheat germ agglutinin (WGA) using the Chariot protein delivery system followed by treatment with 5 μM etoposide (a genotoxin). Apoptosis was detected using the TUNEL apoptosis assay and immunocytochemistry was used to detect the localization of p53 following treatment (slides developed with the Vectastain ABC Elite Rabbit IgG kit). It was found that WGA effectively blocked nuclear pores within 3 hrs but that by doing so, the cells rapidly underwent apoptosis (5.5 hrs) without etoposide treatment. A 5.5-hour survival period proved insufficient for the introduction of genotoxic damage by etoposide to induce apoptosis. This prevented further investigation of the non-transcriptional activity of p53 when nuclear access is blocked. The study has been shifted to conduct the same experiment on the SKBR3 breast cancer cell line, which generally have better survivability than KG-1.

CULINARY ASSESSMENT OF SWEET POTATO VARIETIES

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Sweet potatoes are of interest to New England farmers and consumers. While the average consumer is familiar with the one or two varieties available in the grocery store, there are many potential varieties to add culinary interest and nutritional quality to the diet. The purpose of this study was to explore the physiochemical and culinary applications of sweet potato varieties grown at the Woodman Farm at the University of New Hampshire. Ten varieties of sweet potatoes where grown, harvested and stored at Woodman Farm, part of the NH Agricultural Experiment Station at UNH. All ten varieties were tested for density, moisture, starch and soluble sugars. Six varieties were selected for sensory evaluation in which 13 volunteers sampled five culinary preparations including mashed, baked, fried, roasted, and in a casserole. All food preparation and sampling was performed at the culinary kitchen of Paul College of Business and Economics. Qualitative and quantitative evaluation of the sensory qualities as related to culinary technique and chemical analysis will be presented. Information will be summarized in a UNH Extension Fact Sheet and shared with farmers, growers and consumers.

AN INVESTIGATION OF THE POTENTIAL IMPACTS OF INVASIVE GREEN AND BLUE CRABS ON THE AMERICAN LOBSTER FISHERY IN THE GREAT BAY ESTUARY

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This study seeks to understand the impacts and interactions of three crustacean species that inhabit the Great Bay estuary (GBE). Two of them are invasive species (the European green crab, *Carcinus maenas*, and the Atlantic blue crab, *Callinectes sapidus)* and the third is the American lobster *(Homarus americanus)*. Blue crabs are relatively new to the GBE because they have been moving northward due, most likely, to warming ocean waters. They are also extremely aggressive and have the potential to disrupt the estuary ecosystem. To evaluate potential impacts, a pilot study was conducted during which we videotaped paired behavioral interactions between green crabs, blue crabs, and American lobsters of varying size classes. We observed aggressive encounters and attacks, which may indicate how each species might influence the abundance and distribution of the others. Trials were conducted in a more natural habitat, with multiple green crabs, blue crabs, and lobsters of various size classes. Through these experiments, we hope to understand how the invasive blue and green crabs might influence the very lucrative and important lobster fishery both in the GBE and other estuaries bordering the Gulf of Maine.

THE IMPACT OF FEEDING ON HORSESHOE CRAB ACTIVITY

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Limulus polyphemus are found along the Atlantic coast of the United States and are valued for their blood, as bait, as a source of nutrition for migrating birds, and because they are important members of marine and estuarine ecosystems. In previous studies of the movements of horseshoe crabs in the Great Bay estuary, we noted that animals would occasionally stop moving for long periods of time. We believe that this occurs because after they find food, they become inactive while they were digesting it. In order to test this hypothesis we monitored the activity of horseshoe crabs before and after they were fed in circular cages within larger flow through tanks at the Jackson Estuarine Laboratory. A total of 83 horseshoe crabs were tested over the course of three years. Activity was monitored using waterproof accelerometers that were attached in the center of their carapace. Their activity rhythms were recorded for one week, then they were fed blue mussels and movement data were collected for another week. Approximately sixty percent of the horseshoe crabs tested were found to have a decrease in their activity after feeding. Another common trend was for individuals to change from their original patterns of activity, which were either tidal or nocturnal, to strictly diurnal (daily) activity. These data support our hypothesis that after horseshoe crabs consume their prey their activity changes for several days.

MANAGEMENT PRACTICES OF A 4000 HEAD GRASS-FED BEEF FARM IN NEW YORK

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The project highlights genetic goals, reproductive management, pasture management, marketing, forage production, calving, winter management, and the massive hay operation at G&T Farm in Richfield Springs, New York. I have worked on G&T Farm off and on for the last 3 years, learning a great deal about an operation this size. In addition this project explored the benefits of grass fed beef on human health, land health, and cattle health. The cattle are raised on this farm using intensive rotational grazing and have a diet composed of 100% grass. This is rapidly growing sector in the beef industry. Looking beyond how we manage cattle on my own farm, this project has forced me to dig deeper into the various aspects of the way the farm is run.

ISOLATION AND ANALYSIS OF GLYCOLIPIDS, N-LINKED GLYCANS, AND O-LINKED GLYCANS FROM A SINGLE SAMPLE OF HUMAN SERUM

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Proteomics has been useful for our understanding of protein expression and interaction, yet most proteins are post-translationally modified, and require an understanding of glycomics in order to reap full biomedical advancements. Cell-pathogen reactions are often through glycan-protein interactions; therefore it is important to understand the glycan make-up of biological samples such as human serum. Mass spectrometric glycomics via MALDI-MS and LC-MS can also monitor changes for oncogenic biomarkers which allow for prompt diagnoses. Serums in particular, such as human serum, are of particular glycomic importance considering approximately half of all of their proteins are glycosylated. Glycolipid extraction was completed and hexose polymers were removed to isolate the glycolipids. Proteolysis followed by N-linked release and elution separated the N/O linked glycans. The N-glycans were reduced and the O-glycans were released and permethylation of all samples were necessary to view results for MALDI-TOF and HPLC analysis. Analysis will hopefully yield clear m/z peaks for glycans, and through the knowledge of dolichol processing in the endoplasmic reticulum, along with software such as Glycomod and GlycoWorkbench, our findings should produce not only correct subunit make-up, but correct orientation as well.

A PROTO-PLURITROPIC CELL TYPE AND ITS EXPRESSION OF NOVEL GLYCOPROTEIN HORMONES IN THE PITUITARY OF THE BASAL VERTEBRATE, THE SEA LAMPREY

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In jawed vertebrates, the classical pituitary glycoprotein hormones (GpHs) are follicle stimulating hormone (FSH), luteinizing hormone (LH) and thyroid stimulating hormone (TSH), which consist of the common α subunit (GpA1) and specific β subunits (FSHβ, LHβ, TSHβ). In contrast, only one GpH has been identified in lampreys (jawless vertebrates) and consists of unique α and β subunits (GpA2/GpHβ), which form a functional heterodimer; there is evidence for a putative thyrostimulin in lampreys, consisting of GpA2/GpB5. The objectives of this study were to determine the localization of the GpH and thyrostimulin subunits in the pituitary of sea lampreys, using histology, electron microscopy, *in-situ* hybridization and immunohistochemistry. lGpA2 and lGpB5 were expressed in all regions of the anterior pituitary (rostral pars distalis (RPD), proximal pars distalis (PPD) and pars intermedia (PI)); lGpHβ was localized to the PPD. The α and β subunit pairs were co-expressed, suggesting they are synthesized in the same cells, and we have identified two classical tropic cell types in the lamprey pituitary and discovered a novel proto-pluritropic cell that may differentially produce lGpH and thyrostimulin. In summary, our studies show that there are differences in expression of the lamprey GpH and thyrostimulin subunits and that they are co-expressed; thus, providing supporting evidence along with our other studies that lampreys only have two heterodimeric pituitary glycoprotein hormones. Supported by NSF IOS-1257476, AES NH00571, AES NH00624 to SAS, and UNH Undergraduate Research Award to TJM.

TRACING THE METABOLISM OF 13C-LABELED AMINO ACIDS AND GLUCOSE IN FUNGAL CULTURES

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Many studies have examined the uptake of amino acids using specific ^{13}C-labeled amino acids but the generality of these results is questionable because microbes assimilate a broad range of amino acids and these amino acids vary greatly in the extent of fungal retention of the amino acid carbon. The purpose of our study is to quantify the assimilation of carbon into ectomycorrhizal fungi from isotopically labeled glucose and amino acids. *Amanita muscaria* and a *Boletus sp.* were plated on media at three C:N ratios of 10, 24, and 75 to simulate a potential range in nitrogen availability. Protein was extracted and the isotopic labeling in the bulk biomass and protein fractions measured to estimate the retention of glucose-derived and amino acid-derived carbon. Calculated incorporation of amino acid-derived carbon into cultures primarily varied with the supplied C/N, and at a supplied C/N of 10, 24, and 75, was estimated for *Amanita* at 0.350, 0.275, and 0.149 and for *Boletus* at 0.347, 0.246, and 0.049. Our results suggest that soil-derived organic nitrogen probably preserves a carbon signature in fungal protein after uptake, and furthermore suggest that this carbon will also show up in the non-protein components of fungi. The improved understanding from this study of retention patterns of organic nitrogen by ectomycorrhizal fungi will be important to interpreting bulk radiocarbon patterns in fungi to assess ectomycorrhizal status (Hobbie *et al.*, 2002).

STRESS REACTIVITY AND DEPRESSIVE-LIKE BEHAVIOR FOLLOWING LONG VERSUS SHORT ACCLIMATION PERIOD IN RATS EXPOSED TO INTERMITTENT SWIM STRESS OR HOME CAGE CONTROL

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In many rodent models of stress that use naïve adults as experimental subjects, the rodents are obtained from a supplier approximately near the end of the developmental period. Following arrival to the experimental institution, a 1-week acclimation period is typically employed and theoretically nulls the effect of transport. Previous work demonstrates transportation is a significant stressor to both domesticated and laboratory animals and there is substantial evidence that demonstrates that an initial one-time stressors affect stress reactivity later on in life. In particular, our laboratory is concerned with how the length of acclimation affects our intermittent swim stress (ISS) procedure. Therefore, the current project will examine how the length of acclimation (prior to experimentation) affects ISS reactivity. In order to systematically examine the effects of different acclimation time, subjects from the early and late acclimation groups will be treated in a home cage control (HCC) and then tested in the novel cage test. Furthermore, in order to further detect if and how adding a stress paradigm differs in the animals stress reactivity between the early and late arrival groups, animals will be subjected to ISS then tested in a novel cage test. Due to literature on transportation stress, one might expect transportation to have a lasting effect on laboratory rodents. If this is the case there should be no differences in ISS reactivity or home cage activity between acclimation periods. However if the effect of transportation does attenuate over time, then differences should be found between the acclimation groups and emerge following ISS exposure. This may also suggest introducing a stressor following acclimation, may serve as a primer to stress reactivity following transportation.

THE EFFECTS OF POLYBROMINATED DIPHENYL ETHER (PBDE) DOSE ON HEPATIC PHOSPHOENOLPYRUVATE CARBOXYKINASE (PEPCK) ENZYME ACTIVITY IN RATS

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Flame retardants are in many consumer products and migrate into our bodies. One class of flame retardants, polybrominated diphenyl ethers (PBDE), are known endocrine disruptors. Using the rat model, the Carey laboratory has shown that daily administration of 14 mg PBDE/kg body weight for 28 days disrupts normal fat and liver metabolism, including significant suppression of liver phosphoenolpyruvate carboxykinase (PEPCK), a vital enzyme in lipid and glucose metabolism. The effect of a low dose of PBDE on PEPCK activity is unknown. This study tested the hypothesis that chronic administration of a low PBDE dose would suppress PEPCK activity as severely as a high PBDE dose. Twelve rats were gavaged daily with either corn oil (CON), corn oil containing 1.4 mg (LOW) or 14 mg (HIGH) DE-71/kg body weight/day for 28 days (n=4/group). Rats were fasted on days 26 and 27. On day 28, rats were euthanized, and livers were removed, weighed, and frozen for PEPCK assay. The PEPCK activity will be measured in cytosol prepared from livers of CON, LOW and HIGH groups using an enzyme-linked spectrophotometric method measuring NADH production. Km and Vmax values for each liver preparation will be determined, and between group differences will be analyzed using one-way ANOVA followed by pairwise comparisons. These findings will add to our understanding of the influence of PBDE dose on liver metabolism.

SKBR-3 BREAST CANCER CELLS DISPLAY INCREASED PROLIFERATION WHEN TREATED WITH CALCIUM IONOPHORE A23187

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Incubation with calcium ionophore is known to cause inactivation of map kinase (MAPK) in unfertilized sea urchin eggs. In SK-BR-3 breast cancer cells, activation of the MAPK/ERK cell-signaling pathway is important for cell proliferation. In opposition, MKT-077, a mortalin inhibitor, is known to induce apoptosis in cancer cells. Apoptotic cells exhibit a shift of mortalin from the perinuclear to pericytoplasmic regions during times of apoptosis. The present study examined the effect of calcium ionophore on SK-BR-3 cell proliferation, with regards to the MAPK/ERK signaling pathway, through the application of the mortalin staining pattern. SK-BR-3 cells were incubated with calcium ionophore at 5 and 10 uM concentrations, and with MKT-077 at a 10uM concentration, for a period of 48 hours. Analysis methods included immunocytochemistry (mortalin, p53 antibodies; Texas Red and peroxidase stains), flow cytometry to measure cell viability and apoptosis, TUNEL assay, and western blot analysis for MAPK (ERK) protein. Incubation of the SK-BR-3 cells with MKT-077 indicated mitochondrial-induced apoptosis, as seen using the TUNEL assay. In contrast, treatment of SK-BR-3 cells with calcium ionophore demonstrated an increase in cell proliferation as calcium concentration was increased, with mortalin remaining in the perinuclear region, indicating a lack of apoptosis.

CHICKEN COOPS AND RICE PADDIES: EXPERIENCING PANAMA THROUGH GLOBAL BRIGADES

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The objective of this project is to be able to reflect and relate my experiences in Panama with UNH Environmental Global Brigades back to UNH, but also my values, my major in Sustainable Agriculture, and the similar types of programs we have here in the United States. In addition to educating others and promoting what UNH offers outside of the classroom that enriches education, I will also reflect on the challenges, rewards, differences, and similarities that I came across while working with the indigenous tribe, Piriati Embera. Global Brigades is a non-profit, volunteer based organization that works to improve the livelihoods of indigenous communities in developing countries with the use of a Holistic Model program. The goal is to be able to work with instead of for the community members to implement these practices long term and eventually be able to leave the community. There are four different countries Global Brigades works with and there are ten different kinds of brigades that focus on a particular part of development based on the community's needs. The Environmental Brigade is a fairly new brigade that is only based in Panama. This brigade focuses on empowering rural communities to reverse the effects of degradation to help preserve and restore their natural environment through sustainable agriculture practices.

TRUFFLE ABUNDANCE AND MYCOPHAGY BY SMALL MAMMALS IN NORTHERN NEW ENGLAND FORESTS

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Ectomycorrhizal fungi are important for structuring plant community and forest health as they assist trees in the uptake of water and nutrients. Many species of ectomycorrhizal fungi produce fruiting bodies below ground, called truffles. Truffles are limited in their dispersal capability and rely on small mammals to uncover, consume, and disperse their spores throughout the forest by defecation. Additionally truffles can comprise a large portion of a small mammal's diet. To help understand the interaction between ectomycorrhizal fungi and small mammal communities in New England forests, truffles were collected and identified at 12 locations across three forest cover types, hardwood (n = 4), softwood (n = 4), and mixed (n = 4) in Bartlett Experimental Forest, New Hampshire. Associations between truffle species and environmental variables were identified. Truffle species were then compared to spores found in fecal pellets of three common small mammals. Across all grids, 6,326 truffles were collected comprising five genera and 15 species. The truffles were identified to 15 species across five genera, with the genus *Elaphomyces* being the most common. Using fecal microscopy, truffle spores of more than 12 genera have been identified across the diets of the three small mammal species.

DO DIETS OF WOODLAND JUMPING MICE AND SOUTHERN RED-BACKED VOLES DIFFER ACROSS FOREST TYPES?

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The woodland jumping mouse and southern red-backed vole provide essential ecosystem services in northern forests by consuming and dispersing seeds and spores, and acting as food sources for predators. This study explores differences in diets of the woodland jumping mouse and the southern red-backed vole in hardwood, softwood, and mixed forest types at the Bartlett Experimental Forest, New Hampshire. We compared isotopic data from hair samples and the potential food sources (insects, seeds, and truffles). Samples were analyzed for carbon and nitrogen isotope ratios (^{13}C:^{12}C and ^{15}N: ^{14}N, expressed as $\delta^{13}C$ and $\delta^{15}N$ respectively). Forest type did not affect isotopic patterns in food sources for either species. Seeds were high in $\delta^{13}C$ and low in $\delta^{15}N$, truffles were low in $\delta^{13}C$ and high in $\delta^{15}N$, and arthropods were high in $\delta^{13}C$ and intermediate in $\delta^{15}N$. Red-backed voles averaged 2‰ higher in $\delta^{15}N$ and 0.8‰ lower in $\delta^{13}C$ than woodland jumping mice, indicating greater fungivory (feeding primarily on fungi) in red-backed voles and greater granivory (feeding primarily on seeds) in woodland jumping mice. Both species play substantial roles in the dispersal of symbiotic fungi and their host plants.

VARIATION IN TRUFFLE CONSUMPTION BY *MYODES GAPPERI* BETWEEN MANAGED AND UNMANAGED FORESTS IN NORTHERN NEW HAMPSHIRE

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Ectomycorrhizal fungi play an important role in forested ecosystems by increasing the uptake of nitrogen and water to tree roots. Ectomycorrhizal fungi reproduce using underground fruiting bodies known as truffles, which contain reproductive spores and are dependent upon small mammals, such as *Myodes gapperi* (southern red-backed vole), for dispersal. In turn, *M. gapperi* rely on truffles for key nutrients and carbohydrates. Considering the importance of the truffle-small mammal interaction, little is known about how forest age may impact dispersal dynamics. We used microscopy techniques to census truffle spores in the stomachs and cecum's of *M. gapperi* captured in old growth (never harvested) and young forests (20 years since clearcutting) at the Bartlett Experimental Forest. Dominant truffle genera in the samples differed between old growth and young forests supporting the idea that forest management has an effect on both truffle composition and diets of *M. gapperi.* The cecum incorporates a diet signal over multiple days and thus had a higher richness and diversity of truffle spores than the stomachs, which represent only the last meal. This may reflect differences in daily foraging habits of *M. gapperi* or truffle availability. Understanding the dynamics between forest management, the distribution of truffles, and the ability of small mammals to disperse spores is critical to our understanding of how to maintain healthy and diverse forest communities.

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

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The Panama Canal is important for both the Panamanian and global economy, while simultaneously providing water supply and flood control ecosystem services for the local community. These services require ecosystem conservation and restoration around the Panama Canal Watershed. Decisions regarding land management and water within the watershed also require knowledge about ecosystem scale water cycling. My study's objective is to understand the water use dynamics of teak (*Tectona grandis*) plantations at both the tree and stand level. This ecohydrologic analysis requires sap flow techniques whereby heat ratio sensors are installed in tree stems to measure water uptake. Specific questions I seek to answer include 1) Does a reduction in intraspecific competition within teak monocultures lead to greater total water use and productivity? 2) Can a reduction in intraspecific competition through thinning lead to decreased water stress due to improved water and nutrient availability? 3) Does a reduction in intraspecific competition through thinning lead to greater moisture stress due to increased light exposure? The comparison between thinned and unthinned teak plantations will tease apart teak physiology and may offer insight into better management practices for the preservation of a balanced ecosystem that is not overly stressed for water resources. Initial results obtained from the summer of 2014 will be followed up with additional field work during the summer of 2015.

CARBON FLUXES ACROSS FOUR LAND USE TYPES IN NEW HAMPSHIRE

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As part of the EPSCoR Ecosystems & Society project, researchers across the state of New Hampshire are studying the environment in an effort to support better management of the state's natural resources, so that population growth and development proceed in a sustainable fashion, without threatening the quality of life that makes New Hampshire a desirable place to live and visit. We are interested in understanding the interactions between land use/land cover and climate in order to better assess the impacts of land use change. The land surface interacts with the atmosphere primarily through the movement of greenhouse gases (e.g. CO_2) and energy (e.g. heat, light), and these fluxes of gas and energy vary by land use/land cover type. Using the eddy covariance method and biometeorological sensors, we are measuring CO_2 fluxes, evapotranspiration, and albedo over four land use types that broadly represent the NH landscape: forest, hayfield/pasture, corn/agriculture, and residential/paved. Understanding how these fluxes vary over different land cover types will help us to better assess the future impacts of land use change on local and global climate. Here, we present preliminary results from our first year of data, comparing CO_2 fluxes across the four land use types.

PRESENCE OF β-N-METHYLAMINO-L-ALANINE IN SEDIMENT AND PLANKTON SAMPLES FROM NEW HAMPSHIRE LAKES

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This study investigated the concentrations of the cyanotoxin β-N-Methylamino-L-alanine (BMAA) in selected samples from Lake Mascoma & Goose Pond located in Enfield, NH. BMAA has been linked with neurodegenerative conditions in previous studies associated with people living in close proximity to high concentrations of cyanobacteria. This study investigated the bioaccumulation of the BMAA toxin in lake food webs by analyzing the concentration (ng/g±SE) in sediment & plankton samples. Sediment in Lake Mascoma (10.0±11) contained lower concentrations than that in Goose Pond (31.4±31.4). However, plankton in Lake Mascoma (134.5±36.4) contained higher concentrations than Goose Pond (74.2±10.0). Muscle, kidney, & liver tissue of a 20 year old carp from Lake Mascoma was also analyzed. Of these tissues, muscle contained the lowest concentration (129.1±0), the highest was found in kidney (613.4±87.8), and in between was the concentration in liver (200.7±28.3). Results from this experiment indicate the biomagnifications of BMAA through increasing trophic levels in the Lake Mascoma & Goose Pond food webs. These results support the hypothesis that BMAA biomagnification could lead to contamination in humans and other large animals living around the Enfield, NH. Further investigations near Enfield, NH are needed to determine how BMAA might be transported from the lake ecosystem to people living near the lake.

PRESENCE OF THE HEPATOTOXIC MICROCYSTINS IN *VACCINIUM* SPP. IN NEW HAMPSHIRE LAKES

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Lake cyanotoxins are a widespread problem for humans and animals. Little is known about the accumulation of cyanotoxins in foods and whether lakes may contaminate nearby vegetation. The aim was to see if the hepatotoxin microcystins (MC) are detectable in *Vaccinium* spp. (lowbush blueberries) growing near two of New Hampshire's lakes: York Pond and Christine Lake. York Pond (YP) is highly eutrophic and known to contain high levels of cyanobacteria. Christine Lake (CL), is oligotrophic with lower concentrations and diversity of cyanobacteria. Berries, leaves, and stems were collected in triplicate from *Vaccinium* spp. from both lakes. Samples were split to compare two extraction methods of toxins for microcystin ELISA: freeze/thaw with 80% MeOH and freeze/thaw milli-Q water. The levels of MC (pg MC/g tissue±SE) detected in berries at York Pond (889.0±227.7) and Christine Lake (86.4±15.8) were significantly different ($p<0.05$). However comparisons of both leaves (YP=3158.0±643.2; CL=2641.9±825.0) and stems (YP=1735.2±308.1; CL=2882.0±601.6) between the two lakes were not ($p>0.05$). The results indicate MC may be absorbed and accumulated by *Vaccinium* spp. from surrounding bodies of water with elevated levels of cyanobacteria. Mechanisms of transfer of the toxins to the plants are not known.

BELOW GROUND ROOT GROWTH IN RELATION TO SOIL NUTRIENT AVAILABILITY

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This project aims to improve the understanding of root growth under various nutrient availability conditions in soil. While many studies have found information on a range of optimal soil conditions for various types of plants, very little information is known about the relationship between root growth and nutrient availability in soil. Quantifying below ground growth can facilitate further understanding of carbon allocation in plant species, as well as the below ground root formation of plant species in high and low nutrient availability soils. In order to determine root growth according to nutrient availability, 15 sites were sampled across a range of nutrient availability soil types at the Bartlett Experimental Forest in NH. At each site, 15 root "cores" were sampled that spanned both organic and mineral soils. At the end of the experimental time frame, cores were brought to the lab in order to determine the weights of new root matter. From these measurements we will estimate root growth for each site and compare growth rates with various soil types and nutrient availability.

INVESTIGATING FAILED LOON EGGS: A MODEL FOR BIOACCUMULATION IN LAKE ECOSYSTEMS

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Recently there has been an increase in the number of failed loon eggs in New England waters. We set out to test whether cyanotoxins could be contributing to the high egg mortalities. The Loon Preservation Committee (LPC) donated tissues from failed loon eggs. The ELISA method was used to detect microsystins (MC) and beta-N-methylamino-L-alanine (BMAA), which are biotoxins commonly by cyanobacteria. Thirteen loon egg samples were tested from Squam Lake, Lake Winnipesauke, Lake Umbagog, and Dan Hole Pond. Both MC and BMAA concentrations were detected in all thirteen samples. A regression analysis between MC and BMAA concentrations show that there is not a direct relationship between the concentrations of the two cyanotoxins in the loon eggs. However, these results suggest that MC and BMAA influence the loon eggs in different ways due to their unique biological makeup. It is hypothesized that biotoxins bioaccumulate through the food web. Concentrations of MC and BMAA will be measured in samples of phytoplankton and zooplankton by ways of the ELISA method. The concentrations of MC and BMAA from the ELISA will construct a preliminary model that describes how the transmission of biotoxins from plankton through the food web could ultimately impact a top predator, such as loons, in freshwater ecosystems.

ECOLOGICAL AND EVOLUTIONARY IMPLICATIONS OF MATERNAL INVESTMENT IN A SMALL CARPENTER BEE

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Maternal manipulation is a mechanism by which mothers can completely control the fate of their offspring. In Hymenoptera (ants, bees, wasps) mothers have complete control over the sex and size of their offspring. Maternal investment and variation in the quantity and quality of resources invested in each offspring have strong implications for offspring survival, body size and reproductive status. *Ceratina calcarata* is a small carpenter bee that produces two classes of females. 'Dwarf eldest daughters' are small, workers, which do not survive to reproduce. 'Regular daughters' are larger, future reproductives, which overwinter as adults. Previous studies have shown that dwarf eldest daughters are allocated smaller quantities of pollen than their reproductive sisters. However the relative quality of resources invested in these two classes of offspring has not been characterized. Here I measure the pollen diversity and protein concentration invested in offspring to determine if maternal investment varies quantitatively and qualitatively in these two classes of females. Moreover, seasonal variation in pollen diversity and relative abundance of pollen observed in the provision masses reveal floral hosts and foraging preferences for this important native pollinator.

COMPARISON OF MULTIPLE METHODS USED TO ESTIMATE FOLIAR PRODUCTION AND CANOPY COMPOSITION OF A FOREST

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Accurate estimates of forest species composition and foliar production is crucial for understanding the role of forests in the carbon cycle, particularly under changing climate regimes. While harvesting entire forests would yield the most accurate estimates of foliar production, this method is clearly not feasible. For this reason, estimates of both foliar production by species and canopy composition rely on making measurements for a number of targeted field locations within a forest, and applying methods to scale those measurements to the entire forest. This study will compare multiple methods of estimating foliar production and canopy composition. Specifically, litter-fall data and allometiric equations based on measured tree DBH (Diameter at Breast Height) will be compared for foliar production by species in a forest. Four different methods of estimating canopy composition will also be assessed, including those based on litter-fall data, allometric equations, camera point transect, and stem basal area. Results from each method will be analyzed for statistical significant differences.

DETECTION OF CYANOTOXINS FROM FEATHERS OF COMMON LOON CHICKS WITH IMPLICATIONS FOR MEASURING BIOACCUMULATION OF CYANOTOXINS FROM LAKES

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The Common Loon *(Gavia immer)* breeds in freshwater lakes across the northern Unites States. Adults may feed on a variety of organisms, including fish, as they are able to digest more complex materials; however, the chicks are fed fish and crayfish directly from the lakes so they could be a bioindicator species for the accumulation of biotoxins such as cyannobacteria toxins. Cyanobacteria toxins are also suspected as a possible cause for mortality in loons. Since cyanobacteria toxins have never been examined in loon chick feathers, we tested extraction techniques for down, breast, and tail feathers of *G. immer* chicks to determine the presence of the liver toxins, microcystins (MC), and the neurotoxins beta-Methyl-L-alanine (BMAA). The feathers were collected and donated by the Biodiversity Research Institute (Portland, ME) from lakes in Montana, Minnesota, New York, Massachusetts, New Hampshire, and Maine. The presence of these cyanotoxins from feathers will allow us to determine if *G. immer* chicks accumulate significant levels of toxins and how this bioaccumulation is related to the water quality conditions in the lake.

TOXIC TIME LINES TOLD BY TREES

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Tree cores have been used as historical markers and frequently used to identify different periods, such as drought or other climate and/or biological events. In this study, we set out to test if tree cores could also be used to determine the toxic footprint of certain lakes. Trees growing adjacent to two lakes of contrasting water quality, York Pond and Christine Lake in New Hampshire were sampled because each has known toxigenic cyanobacteria. Replicate trees sampled were selected based on their close proximity to the water. Tree cores were taken from White Birch (*Betula papyrifera*) and Eastern Hemlock (*Tsuga canadensis*) trees. The cores were dried, tree rings aged and separated into five-year segments. The cyanotoxins microcystins (MC) and beta-Methylamino-L-alanine (BMAA) were extracted from the segments by freeze/thaw cycles in distilled water, followed by Enzyme-linked Immunosorbent Assays (ELISA). Both the White Birch and the Eastern Hemlock had detectable levels of microcystins. Throughout the examined time, highest levels of MC-toxicity occurred at both the early and late years of the trees life. Both BMAA and MC in the White Birch from York Pond had similar patterns, although they had different concentration levels. No BMAA was detected in trees sampled from Christine Lake. Extraction techniques and tree types will be further tested to try to determine if tree cores are an effective source for the examination of past history of lake

THE INFLUENCE OF EXTRACELLULAR-REGULATED KINASES (ERKS) ON GRANULOSA CELL FATE IN THE BOVINE FOLLICLE

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Each year, infertility in cows costs the dairy industry over $400 million. This project is focused on the onset of follicular atresia in cows; the process by which the egg-bearing follicles die prematurely and can lead to infertility. The cellular mechanisms that influence programmed cell death, or apoptosis, of bovine granulosa cells (bGCs) within follicles are being investigated. In general, the extra-cellular regulated kinases (ERKs) are intracellular signaling proteins believed to influence the proliferation, survival, and differentiation of cells. In the context of follicular atresia, however, the relationship between the onset of apoptosis of bGCs and the effects of ERKs is relatively unknown. In the present study we are utilizing a constitutively active mitogen activated protein kinase (MEK1) to upregulate ERKs in bGCs, and then determine the effect on bGC sensitivity to apoptosis. Cultured bGCs were genetically modified via transduction using a constitutively active MEK1 adenovirus. Currently we are verifying the efficiency of viral transduction, overexpression of MEK-1, and downstream activation of ERK by flow cytometry and immunoblotting. Preliminary results indicate a lack of MEK1 up-regulation in transduced bGCs. Subsequent experiments will focus on optimizing adenovirus transfection in order to test the hypothesis that upregulated ERKs prevent cytokine-induced apoptosis of bGC. Supported by USDA Grant #2013-67016-21071 and the UNH Agricultural Experiment Station.

AEROSOLIZED CYANOTOXINS FROM NEW ENGLAND DAMS

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Higher incidences of diseases, such as ALS, have been found near lakes with high levels of toxic cyanobacteria. Cyanotoxins have been measured in aerosols from still lake water but the effect of disturbed water aerosols, such as sprays from dams, has not been studied. In the laboratory, we simulated aerosolization of phytoplankton from lake dams using aquaria and lake water from various New England lakes. Aerosols were collected pumping air through 0.45 micron membrane filters. Using epifluorescence microscopy, we estimated the concentrations of cyanobacteria released in sprays and aerosols from lake water. ELISA tests of microcystins collected on the filters indicate lake dams may enhance the release of cyanobacteria toxins into the surrounding air. Our findings suggest dams could pose elevated health risks associated with aerosolization of cyanobacteria cells and toxins.

ISOTOPIC ANALYSES OF POST-FIRE FUNGI INDICATE THAT *MORCHELLA* IS SAPROTROPHIC

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Morchella is a common post-fire fungus that is generally considered saprotrophic, although there is evidence for mycorrhizal status. This study investigated the mycorrhizal status of post-fire *Morchella* in 2003 and 2004 in Oregon and Alaska. Our initial hypothesis was that stable isotopes would suggest *Morchella* is saprotrophic, and radiocarbon analyses would indicate that *Morchella* was assimilating old carbon, and not current-year photosynthate. Comparisons of radiocarbon and stable isotopes with concurrently collected foliage and with literature values will be used to determine likely isotopic values for mycorrhizal versus saprotrophic fungi. *Morchella* averaged 5‰ enriched in 13C and 5‰ enriched in 15N relative to foliage. High 15N enrichment in *Morchella* suggested that recent litter was not the primary source for *Morchella* nitrogen, and similar 13C and 15N enrichments suggest that *Morchella* may assimilate its carbon and nitrogen from the same source pool. Carbon in *Morchella* averaged 11±6 years old whereas carbon in foliage averaged 1±2 years old, clearly indicating that *Morchella* was assimilating old carbon. We conclude that *Morchella* is saprotrophic.

COMPARATIVE SOCIAL EVOLUTION IN THE AUSTRALIAN SMALL CARPENTER BEE

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The evolution of social complexity from solitary ancestors to caste-differentiated societies is an open question in the field of biology. The Australian small carpenter bee, *Ceratina australensis,* is a useful model system to expand current understandings of how the shift from solitary to social life took place. *C. australensis* is facultatively social which means that there are both solitary and social nests of the same species in the same populations. Social nests are comprised of two sisters. Long-term studies of *C. australensis* in a single population have shown that sociality is not necessarily beneficial for the bees that remain in social nests. In fact, solitary females have higher reproductive success than social sisters on average. This begs the question: why do some bees form social nests if there is a fitness advantage to nesting solitarily? Previous studies have shown that parasitism rates, nest availability and weather conditions are not contributing factors to this behavior. This project evaluates new data collected across several previously unstudied populations of *C. australensis*. Here, I compare the nesting biology, reproductive success and social behavior of this facultatively social bee across the three different ecoregions in order to help determine what factors may cause these bees to form social nests.

THE IMPLICATIONS OF BRAIN OSCILLATIONS ON THE RELATIONSHIP BETWEEN SOURCE MEMORY AND MAO-A GENE VARIATIONS

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The gene MAO-A, which codes for monoamine oxidase (MAO), has been associated with various mental tendencies including impulsivity and aggression. In this study, the effect that MAO-A variations and inherently monoamine oxidase levels have on source memory is examined. Subjects with more effective transcription of MAO will have lower levels of monoamines such as serotonin and norepinephrine. As such, it is hypothesized that there will be a significant difference in oscillations, during source memory task performances, between subjects with 4R/NR gene vs non 4R variation carriers.

NEW HAMPSHIRE DAIRY FARM SUCCESSION: CONVERSATIONS ABOUT STRATEGIES AND CHALLENGES OF PRESERVING THE FAMILY FARM

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This research looks at farm succession on New Hampshire dairy farms and the ways that farmers navigate the difficult process. Farmers want to preserve their farm business and the assets it includes, as well as their heritage and personal identities attached to the farm. These case studies expose the challenges and strategies that farmers face in order to successfully pass the farm on to the next generation. Better pinpointing the big issues that are part of a farm transfer allows farmers to be better prepared and execute a smooth transition.

LOON CHICK BLOOD AS A BIOINDICATOR OF CYANOTOXINS

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Cyanobacteria in lakes produce toxins that can harm organisms. Two of these toxins are β-N-methylamino-l-alanine (BMAA), a neurotoxin with a suspected link to neurodegenerative diseases, and microcystins (MC), a liver toxin. The overall goal of the study was to test extraction methods, and measure these cyanotoxins from small quantities of chicks' blood from dried blood spot samples collected on paper, since loons breed and feed their chicks from lakes. Blood was drawn from loon chicks from 43 lakes in the US and Canada and collected by the Biodiversity Research Institute of Gorham ME. The blood was extracted from the filter paper using water, sonication and flash-freezing techniques to test extraction methods using ELISA (enzyme-linked immunosorbent assay).

MULTI-LEVEL COMPARISON OF CGI DISTRIBUTION ACROSS THIRTY-SIX ANIMAL GENOMES

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The DNA code consists of adenine, guanine, thymine and cytosine. The relationship of these nucleotide bases and their products constitutes all the complexities of biology as we know it. The cliché relationship most familiar is sequences of nucleotides called genes encode proteins that control biology. Research has shown us that this is not the whole story, and other particular relationships of nucleotides are just now being fully appreciated. One such relationship involves CpG Islands (CGIs), or cytosine-phosphate-guanine islands. CGIs have been found to heavily correlate with gene promoter regions, thus making them effective gene markers. CGIs are also characterized by chemical alterations called methylation. This alteration is commonly thought to regulate gene expression. CGIs have been implicated in different disease and disorders, most notably cancer, gene silencing, X inactivation, and genetic imprinting. Since CGIs have been established as useful gene markers, and have been suggested to play roles in so many genetic regulatory processes, this study attempted to obtain evolutionary context of CGI development by running a statistical analysis across a representative sample of thirty-six animal genomes. To provide alternative windows through which to understand and explain possible patterns of CGIs across our spectrum, we also looked at relationships of CGIs and genome size, background GC content, methylation patterns, and number of protein coding regions.

COMPLEX ENCODING OF INFORMATION ABOUT ACTIONS AND CONTEXT IN RAT PREFRONTAL CORTEX IN CORRELATION WITH CELL WIDTH

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Medial prefrontal cortex (mPFC) plays a critical role in executive functions that allow us to respond flexibly while performing goal-directed actions. To understand how adaptive behavior emerges from neurons that comprise mPFC we recorded neural activity in rats as they performed a dynamic delayed non-match-to-position (DNMTP) task. Activity was recorded with tetrode arrays that were advanced incrementally through mPFC across 40 to 60 recording sessions. Electrophysiological recordings were analyzed offline to identify signals from isolated neurons and to correlate activity with specific behavioral events as rasters and peri-event time histograms (PETH) and with spatial location as place fields. Cellular width of action potentials was also analyzed in correlation with known behaviors of neurons in DNMTP task.

IDENTIFICATION AND CHARACTERIZATION OF GENES INVOLVED IN ROOT GROWTH UNDER SALT STRESS IN *ARABIDOPSIS*

Lisa Flaman, Nicole Petersen, Melissa Ryan, Megan Thompson, and Estelle Hrabak
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Multiple genes and many pathways are involved in directing root growth in plants. Some of these genes are important in the root response to salt stress. We are interested in identifying genes required to maintain normal root growth in the presence of sodium salts. In agricultural settings, most crop plants cannot tolerate elevated levels of salt, leading to reductions in plant vigor and yield. Our lab previously identified several mutants in which the shape of root cells was altered in response to sodium stress. The goal of this project is to screen a publicly available collection of *Arabidopsis thaliana* T-DNA mutants to identify additional mutants with similar root defects. Mutants that passed all three stages of the screen were analyzed by TAIL-PCR (Thermal Assymetric Interlaced-Polymerase Chain Reaction), followed by DNA sequencing, to identify the mutation site in the *A. thaliana* genome. To date, mutation sites for eleven different mutants have been determined; 8 of the mutations are in intergenic regions, while 3 are intragenic. As part of the initial characterization of each mutation, the pattern of inheritance (dominant vs recessive) is being determined by outcrossing to wildtype.

ENCODING OF INFORMATION ABOUT ACTIONS AND CONTEXT IN RAT PREFRONTAL CORTEX: EFFECTS OF THALAMIC INACTIVATION

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Medial thalamus is organized to regulate the activity of prefrontal cortex (PFC) and PFC-related circuits that play a critical role in flexible goal-directed responding. The mediodorsal nucleus is the primary source of specific thalamo-cortical projections to middle layers of PFC and receives direct cortico-thalamic and indirect cortico-striato-pallidal input from PFC. Medial thalamic lesions have well-known effects on prefrontal function that include impairment of delayed non-matching to position tasks (DNMTP). To elucidate the influence of medial thalamus on prefrontal function, we examined the effects of temporary thalamic inactivation on the response properties of prefrontal neurons in rats performing a DNMTP task. Cellular activity was recorded throughout medial PFC using a drivable array of tetrodes. Electrophysiological recordings were analyzed offline to identify signals from isolated neurons and to correlate activity with specific behavioral events as rasters and peri-event time histograms (PETH). Video tracking analyses were used to construct place fields and egocentric maps. These analyses investigate how information about actions and context are encoded in medial PFC and identify the role of thalamus in shaping PFC responses.

IDENTIFICATION OF PALMITOYLTRANSFERASE LOSS-OF-FUNCTION MUTANTS IN *ARABIDOPSIS THALIANA*

Judith Hoskin, Thomas DuBois, and Estelle Hrabak
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Arabidopsis thaliana is a small flowering plant often used as a research model because of its short lifecycle, prolific seed production and ease of growth. This research focuses on a family of 24 genes in *A. thaliana* that encode protein S-acyl transferases (PAT). PATs catalyze palmitoylation, the thiol esterification of a C16:0 fatty acid to a cysteine residue in a substrate protein. Palmitoylation of substrate proteins can affect their membrane association, stability and protein-protein interactions. Plants with mutations in PAT genes will be important tools in understanding the role of PATs in plant growth and development. The goal of this study is to identify null mutants that no longer produce any PAT transcript. First, potential homozygous PAT mutant lines of *A. thaliana* were genotyped using PCR. Once a homozygous mutant was confirmed, the region around the mutation site was sequenced to identify the exact position of the mutation within the gene as well as any alterations to the genomic DNA. So far, 11 different mutations in 5 PAT genes have been confirmed to be homozygous for the mutant allele and the sequence of the mutated region has been determined. RNA was isolated from these 11 mutants and reverse transcribed into cDNA. The cDNA pool was analyzed by PCR to detect PAT transcript. Two loss-of-function mutants have been confirmed and analysis of the remaining 9 mutants is underway.

ENCODING OF INFORMATION ABOUT ACTION AND CONTEXT BY MEDIAL THALAMUS IN THE RAT

Adam Aasen[1], Kaleigh Erickson[1], Daniel Minukhin[1], Elizabeth Smedley[1], Robert Mair[2], and Brett Gibson[2]
[1]Department of Biological Sciences, UNH
[2]Department of Psychology, UNH

Medial thalamus plays a critical role in prefrontal function. Previous work in our lab has shown that lesions of the mediodorsal nucleus (MD) produce delay-dependent impairment of delayed matching and non-matching (DNMTP) to position tasks while larger lesions involving adjacent midline (M) and rostral intralaminar (IL) nuclei produce delay-independent impairment of these tasks, comparable to the effects of prefrontal lesions. To elucidate the influence of MD, M, and IL on prefrontal function we recorded the activity of neurons in these nuclei in rats performing a dynamic delayed non-match- to- position (DNMTP) task. Electrophysiological recordings were analyzed offline to identify signals from isolated neurons and to correlate activity with specific behavioral events as rasters and peri-event time histograms (PETH) and with spatial location as place fields. PETH analyses revealed a wider range of response types than we observed in parallel studies of prefrontal cortex. In general, thalamic neurons exhibited higher levels of activity and PETH patterns that were not as sharp as those found in prefrontal cortex. Video tracking analyses revealed place fields consistent with PETH results. Our results are consistent with the hypothesis that the medial thalamus plays an active role in shaping response properties of prefrontal cortex.

THE INFLUENCE OF OMNIGEN AF ON IMMUNE CELL ACCUMULATION, OVULATION RATE AND FERTILITY IN THE FEMALE RAT

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Infertility is one of the major economic issues challenging the dairy industry today. Currently in the United States, expenses stemming from dairy cow infertility are estimated to exceed $350M per year. Several factors contribute to this problem, including the inability of the cow to ovulate a fertilizable egg, or "anovulation". Acknowledging that the occurrence of ovulation is facilitated by the actions of immune cells and the immune system, we began to investigate whether immune cell accumulation within the ovary plays an important role in ovulation, and thus fertility. OmniGen AF, a dietary supplement produced and distributed by Prince Agri Products, Inc., and the Phibro Animal Health Corporation is reported to enhance immune cell activity in animals. In the current study, we investigated the effects of feeding female rats OmniGen AF by measuring immune cell accumulation within the ovary and ovulation rate. Preliminary results showed that the average number of macrophages within the ovary of control vs. OmniGen AF fed rats (n=2) was 292 (± 5.75) and 616 (± 258) respectively. The average number of leukocytes in the blood of control vs. OmniGen AF fed rats was 265 (± 66) and 455 (± 140) respectively. This work is ongoing to assess the effect of OmniGen feeding on ovulation rate and fertility. The findings will be used to assess whether translational studies of OmniGen AF supplementation in cows are warranted. This project is supported by the McNair Scholars Program and Prince Agri Products, Inc.

ENCODING OF INFORMATION ABOUT ACTIONS AND OUTCOMES BY MEDIAL THALAMUS IN THE RAT

Elizabeth Smedley[1], Rikki Miller[1], Robert Mair[2], and Brett Gibson[2]
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Medial thalamus plays a critical role in prefrontal function. Previous work in our lab has shown that lesions of the mediodorsal nucleus (MD) produce delay-dependent impairment of delayed matching and non-matching (DNMTP) to position tasks while larger lesions involving adjacent midline (M) and rostral intralaminar (IL) nuclei produce delay-independent impairment of these tasks, comparable to the effects of prefrontal lesions. To elucidate the influence of MD, M, and IL on prefrontal function we recorded the activity of neurons in these nuclei in rats performing a dynamic delayed non-match- to- position (DNMTP) task. Our current findings are consistent with the hypothesis that the medial thalamus plays an active role in shaping response properties of prefrontal cortex.

THE MINION: A MINIATURIZED DNA/RNA SEQUENCER

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The MinION device by Nanopore technologies is a miniature device that can be used for electronic single-molecule sensing. The MinION is USB compatible to give real-time experimental data for both DNA sequencing and RNA sequencing. The MinION uses nanopores along with a sensor chip comprised of individual wells that each act as single electronic channels. The membrane lays on top of the wells and contains the nanopores. An ionic current is passed through the nanopores and as a single stranded DNA or RNA passes through it the nanopore measures the change in the current to determine the identity of each base. These nanopores can process read lengths up to tens of kilobases and it can handle complex samples such as blood and serum. We are actively participating in the Beta phase of testing of this device. This project looks to further characterize the devices' efficiency at RNA sequencing using both mouse and ladybug models.

CHARACTERIZING THE ANGIOGENIC PROPERTIES OF BRAIN CANCER CELLS USING THE GLIOMA U-373 CELL LINE

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In the U.S., nearly 700,000 people are battling with brain tumors, e.g. gliomas. A common trait of tumors is angiogenesis, which is the formation of new blood vessels from pre-existing ones. Through angiogenesis, glioma cells are able to receive oxygen and nutrients to support their rapid growth. Also, tumor cells can travel from primary to secondary sites via the lymphatic and circulatory systems, a process known as metastasis. In order to better understand the process of tumor angiogenesis in gliomas, the current study seeks to characterize some of the angiogenic properties of the U373 glioma cell line by using zymography to determine the ability of these cells to produce matrix metalloproteinases (MMPs) and cell culture techniques to assess proliferation rate. Gelatinolytic activity was present in conditioned medium collected 2, 4, 8, 24 and 48 hours after fetal bovine serum was removed. Two enzyme species with relative molecular masses of approximately 63 and 89 kDa were detected, consistent with MMP2 and MMP9 family members, respectively. The 63 kDa species was detected in samples collected at all time points, while the 89 kDa species was detected only in samples collected at 24 and 48 hours. Preliminary results showed that mitotic activity was slow for the first 48 hours of culture. Future work will determine the presence or absence of the angiogenesis-related protein, fibroblast growth factor.

NOREPINEPHRINE AND THE ATTENTIONAL SET SHIFTING TASK IN A RAT MODEL OF FETAL ALCOHOL SPECTRUM DISORDER

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In humans prenatal exposure to alcohol causes a multitude of cognitive defects, including attentional deficits and this disorder is called fetal alcohol spectrum disorder (FASD). However, the tasks used in humans cannot identify specific neuroanatomical or neurochemical causes so the underlying neural mechanisms of FASD remain poorly understood. Until now, animal models of this disorder have not assessed attentional impairments. We sought to elucidate the specific attentional impairments in a rodent model of FASD by measuring performance on the intradimensional/extradimensional (ID/ED) attentional set shifting task and to assess the effects of fetal alcohol on prefrontal function that is critical to this task. The task measures attentional set shifting, response inhibition, and distractibility and is impaired by the loss of norepinephrine to the prefrontal cortex. We hypothesized that a rodent model exposed to alcohol during a critical period of development, which is equivalent to the third trimester in humans, would produce attentional impairments similar to those found in human FASD patients. Post-mortem the density of noradrenergic fibers in the prelimbic cortex (PL) and lateral orbital (LO) region of the brain were quantified as these regions have been shown to be critical to executive function.

A COMPARATIVE QUANTITATIVE STUDY OF ANATOMICAL HOMOGENEITY BETWEEN THE DISTAL AND PROXIMAL REGIONS OF A SUNFLOWER LEAF

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Besides photosynthesis, leaves also function as a driving force for water movement (transpiration), day length detection, temperature radiation etc. The anatomy of leaves can be strongly influence by environmental factors (e.g., light levels, temperature, etc.) potentially resulting in leaves on the same plant with variant anatomy. Our study will determine whether leaf anatomy is homogeneous throughout the same leaf from base to tip. Our rational is that the developmental period from bud to mature leaf is long (weeks) providing ample opportunity for the creation of a variant anatomy within one leaf. Four quadrants in each of three mature leaves from different plants will be sampled. These samples will be fixed, embedded, sectioned and stained for the light microscope. Photographs will be made of each section and analyzed using quantitative technique known as stereology. Using these techniques we will measure the volume of the different leaf tissues and air spaces and the surface area of cells in contact with air spaces or other cells. These parameters have important physiological implications for the leaf. Data will be analyzed using statistical methods to determine whether significant differences exist in the anatomical structure from different parts of the leaf.

TIMELINE OF PHENOTYPIC DEVELOPMENT IN THE ASIAN MULTICOLORED LADY BEETLE (*HARMONIA AXYRIDIS*)

Lindsay Havens, Kaelina Lombardo, and Matthew Macmanes
Department of Molecular, Cellular, & Biomedical Sciences, UNH

The Asian multicolored ladybug (*Harmonia axyridis*), a species of ladybug native to Asia, is known for its colorful spotted back. Unlike many species, the patterns and numbers of spots is highly variable, ranging from no spots to 21. The genetic mechanisms that dictate the wide phenotypic variation in this species is still unknown. To study spot variation, ladybugs were collected in and around Durham, NH and raised in the MacManes lab. Animals were housed in breeding pairs which allowed us to detail (1) their developmental patterns and (2) the heritability of spots, given that offspring come from known parentage. Though the latter goal remains a work in progress, this study has allowed us to rigorously define the timeline of their phenotypic development, from egg to adult.

TOXIC CYANOBACTERIA AEROSOLS: TESTS OF FILTERS FOR CELLS AND TOXINS

Sean Perry, Alexis Mack, Amanda Murby, and James Haney
Department of Biological Sciences, UNH

Aerosolization of toxic cyanobacteria released from the surface of lakes is a new area of study that could uncover a previously unknown route of exposure to toxic cyanobacteria. Since toxic cyanobacteria may be responsible for adverse human health effects, proper testing methods and equipment need to be tested and established for monitoring these airborne bacteria. The primary focus of this study was to create controlled laboratory experiments that mimic natural lake aerosol production. I set out to test for the best type of filter paper to collect and analyze the aerosolized cells as small as 0.2-2.0 μm, known as picoplankton. To collect these aerosols, air was vacuumed from just above a sample of lake water passing through either glass fiber filters (GFF precombusted) or 0.2 millipore membrane filters. Filter collections were analyzed through epiflourescence microscopy for determining cell counts and Enzyme-Linked Immunosorbent Assay (ELISA) methods to determine hepatotoxin production, referred to as microcystins. Data analysis revealed that 0.2 millipore membrane filters were the best option for cell enumeration providing better epiflourescence optical quality and higher cell counts.

THE IDENTIFICATION OF PALMITOYLTRANSFERASE MUTANTS IN *ARABIDOPSIS THALIANA*

Thomas DuBois and Estelle Hrabak
Department of Molecular, Cellular, & Biomedical Sciences, UNH

Palmitoyltransferases (PAT) are a family of integral membrane proteins found in all eukaryotes. Functions of PATs in animal and fungal cells include both inter- and intra-cellular signaling, regulation of molecular transport across membranes, as well as stabilization of integral membrane protein substrates. PATs catalyze palmitoylation - the addition of a fatty acid to a target protein. For cytosolic proteins, the increase in hydrophobicity conferred by palmitoylation results in association with lipid membranes and, because palmitoylation is reversible, provides a mechanism for regulating residence time at the membrane. The roles of PATs in plant cells are mostly unknown. We are using a reverse genetics approach in *Arabidopsis thaliana* to identify plants that lack functional *PAT* genes, with the ultimate goal of determining the phenotype caused by the *pat* mutation. By use of PCR and gel electrophoresis, plants were genotyped to confirm that they were homozygous for a mutated allele in one of their PAT genes. So far plants with seven different PAT mutations have been genotyped, four of which were confirmed to be homozygous for the mutated allele. The study has also detected the addition or deletion of DNA around the mutation site in the genome. The next step is to test *pat* mutant plants for the presence of transcripts from the mutated gene to confirm that the *PAT* gene is non-functional.

FEEDING AND SATIATION OF *MELIBE LEONINA*

Corey Collins, Colin Lee, and Winsor Watson
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Melibe leonina are predatory sea slugs found on the west coast of North America. In order to observe the effects of stomach distention on satiation in *Melibe*, feeding trials were conducted with various manipulations. Manipulations included tears in the stomach and injections of a bulk substance. Bulk injected *Melibe* tend to feed for a shorter duration than sham injected *Melibe*. The *Melibe* with stomach tears, who's stomachs can't be distended by food, feed for a longer duration than the control. In conclusion, in *Melibe* satiation is a result of stomach distention and an empty stomach results in a greater motivation to feed (i.e. hunger).

THE EFFECT OF PLANT NODULATION ON CU^{2+} TOLERANCE BY *HIPPOPHAE RHAMNOIDES*

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Hippophae rhamnoides is an actinhorizal pioneer species which forms root nodules with the nitrogen fixing bacteria *Frankia.* Besides being cultivated for its berries, the plant is also used in land reclamation efforts on agriculturally-degraded lands or contaminated soils and it is tolerant of oxidative stress conditions. In China, *Hippophae* are used extensively to reclaim heavy metal contaminated coal mine spills, suggesting that the plant is tolerant of elevated levels of heavy metals. The bacterial partner of the symbiosis, *Frankia* have shown different levels of metal resistances. Our working hypothesis is that symbiosis increases *Hippophae* tolerance to heavy metals. *Frankia* strain EuI1c which is tolerant of elevated (2 -5 mM) levels of Cu^{2+} was used to inoculate *H. rhamnoides.* To test this, *H. rhamnoides* plants that were either nodulated with *Frankia* or uninfected controls were grown under hydroponic conditions with different Cu^{2+} levels. The growth response of the plant to Cu^{2+} and potential uptake into the stems and roots are being monitored as well as the overall plant health.

DOES BEING ALONE INDUCE STRESS IN DOMESTIC DOGS (*CANIS LUPUS FAMILIARIS*)?

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As social animals, domestic dogs (*Canis lupus familiaris*) require regular contact with others. Dogs have been shown to solicit more social behavior from humans than from other dogs, indicating that human contact is even more important to dogs than is contact with conspecifics. Dogs that have not been properly socialized have been known to develop separation anxiety (SA), a condition resulting in extreme stress-related behaviors during periods of isolation. Although stress-related behaviors in dogs with SA during periods of isolation are well-documented, whether or not well-adjusted adult dogs also exhibit signs of stress when left alone remains unclear. I hypothesized that well-adjusted adult dogs would exhibit signs of stress when left alone at their homes by owners. Specifically, I predicted that dogs would: 1) exhibit more stress-related behaviors when left alone than when their owner is present, 2) exhibit more stress when left alone than when left with another dog, and 3) exhibit more stress when left with only another dog than when only their owner is present. Owners recorded videos of their dog under each condition (alone, with another dog, and with the owner). I then compared the stress-related behaviors exhibited by the dogs across the three conditions. If the presence of humans or another dog can alleviate stress, owners can use this knowledge to better the lives of their pets.

REGULATION OF THE SURFACTANT SERRAWETTIN W2 IN *SERRATIA* SP. STRAIN SCBI

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A novel *Serratia* sp (termed SCBI) forms an association with nematodes (South African *Caenorhabditis briggsae*) that were isolated by bait trapping in the greater wax moth, *Galleria mellonella*. This association represents a new microbe-nematode relationship and potentially a nascent entomopathogenic lifestyle. Inactivation of the hemolysin in *Serratia* sp. SCBI resulted in loss of hemolysis, but did not attenuate insecticidal activity. Unexpectedly, inactivation of the hemolysin gene in *Serratia* sp. SCBI resulted in significantly increased motility and a dramatic increase in mRNA levels of a nonribosomal peptide synthetase gene, *swrA*, which produces the surfactant serrawettin W2. A series of mutations in the 17 Kb *swrA* gene gave variable results in antibiotic activity, motility, virulence and hemolysin activities. The locations of three of the four mutations were confirmed by PCR analysis. The regulation of the expression of the *swrA* and hemolysin genes in *swrA* and hemolysin mutants was investigated by RT-qPCR using primer sets for different regions of these two genes. Furthermore, the cDNA of the 17 Kb transcript of *swrA* was generated by reverse transcription and was analyzed by PCR with the primers used to confirm the *swrA* mutants. The results of these gene expression experiments will be presented and the regulation of the *swrA* gene will be discussed.

EVALUATING THE ROLE OF PRIVATE LANDS IN THE CONSERVATION OF BIODIVERSITY

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Changes in land use due to anthropogenic activity have resulted in loss, degradation, and fragmentation of habitat, which pose significant threats to global biodiversity. Although designating protected public land has provided important areas for enhancing biodiversity conservation, the purpose for designation of protected public lands is often not primarily for biodiversity protection. Further, because these protected areas do not represent all community types necessary to support many species, private land has a large role to play in global biodiversity protection. However, land in private ownership has varying degrees of protection. In this study, I evaluate the role of conservation on private property for protecting biodiversity. I assess the effectiveness of existing incentives and payment mechanisms for encouraging landowners to conserve the biodiversity harbored on their property in three different locations – California, Costa Rica, and New Zealand. These locations were chosen due to their long running private lands conservation programs, and because they are considered global hotspots for biodiversity, with high rates of endemism. I compare the efficacy and transferability of these regions' seminal approaches to private lands conservation. I will present these results and the implications for integrating biodiversity conservation with private land management in attempt to reduce current gaps in protection.

EVALUATING GENETIC DIVERSITY BETWEEN POPULATIONS OF NEW ENGLAND COTTONTAIL (*SYLVILAGUS TRANSITIONALIS*) AND EASTERN COTTONTAIL (*SYLVILAGUS FLORIDANUS*).

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The New England cottontail (*Sylvilagus transitionalis*), an early successional specialist native to New England and New York, has experienced a precipitous decline in population size over the last 50 years.due to habitat loss and fragmentation. Another potential threat is competition with the eastern cottontail (*Sylvilagus floridanus*), which has more generalist habitat requirements and is expanding in population size and range. Declining populations often experience reductions in genetic diversity. In order to address this issue, we studied genetic diversity and relatedness of New England cottontail populations in Connecticut, New Hampshire, and Maine using DNA analysis of fecal and tissue samples collected in study patches. We also compared the same variables between populations of New England and eastern cottontail found in the study patches in Connecticut. We expected New England cottontails in Connecticut to have greater genetic diversity and lower relatedness than those in New Hampshire and Maine due to larger population sizes, greater habitat availability and less fragmentation in Connecticut. We also predicted that New England cottontails from Connecticut would have lower genetic diversity and higher relatedness than eastern cottontails because eastern cottontails exist in greater abundance. These analyses can help elucidate variation in genetic diversity across the range of the New England cottontail and reveal how population decline may negatively impact diversity.

THE RELATIONSHIP BETWEEN KINSHIP AND PHYSICAL PROXIMITY IN CAPTIVE PRIMATES

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There has been much effort to understand primate social dynamics in wild populations, but how these social interactions manifest in captivity has been less widely explored. One important force that can shape social dynamics is kin selection, which posits that an individual should preferentially cooperate with its genetic relatives to obtain indirect fitness benefits. In many social species, physical proximity can be used as a proxy for cooperation. With this in mind, I investigated the relationship between kinship and physical proximity in four species of captive primates. I tested the hypothesis that the genetic relatedness of two individuals would relate to their physical proximity, with the expectation that more closely related individuals would be found closer to one another. I used scan sampling to measure the distance between pairs of individuals over multiple observation sessions, and then compared these distances to the relatedness values for each pair. This type of information can make important contributions to general husbandry questions, such as how to create an enclosure that can maximize quality of life. The results from this study can also be compared to studies done with wild populations to further investigate whether or not and how social interactions change in captivity.

ALTERATION OF FLIGHT INITIATION DISTANCE IN HOUSE SPARROWS (*PASSER DOMESTICUS*) IN RESPONSE TO POTENTIAL PREDATORS AND ENVIRONMENTAL FACTORS

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For many animals, time spent foraging is a trade-off between meeting caloric needs and the increased predation risk often associated with feeding. Consequently, if an individual detects a potential predator, the decision of when to initiate escape is influenced by its need to forage and the proximity of the predator. This decision can be quantified by measuring the prey's "flight initiation distance" (FID), which is the prey's distance from the predator when it initiates escape. For songbirds, the FID may be affected by such factors as time of day and the type of predator. Time of day might influence FID by dictating the amount of caloric intake birds need to maintain homeostasis. Songbirds should perceive both humans and dogs as potential predators, but which predator species is perceived as a greater threat is unknown. We compared the FID of house sparrows (*Passer domesticus*) in response to three conditions (exposure to a single human, a single dog, or a combination of one human/one dog), and collected data early or late in the day. We hypothesized that dogs would be seen as a greater threat because dogs can approach birds at a faster rate, so we predicted dogs to induce a greater FID than humans. We also expected birds to decrease their FID later in the day because of increased caloric needs as the cold night approached. This study could serve as an example of how human-wildlife interactions can impact animal behavior.

GRID PARITY AND COMPARATIVE ENERGY COSTS

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The purpose of this research is to approximate grid energy costs in comparison with the costs associated with alternative energy while also projecting how prices may change based on the true cost of different energy sources and possible subsidy changes. In this study, time series data of electricity and alternative energy costs were used to estimate when parity will occur on a /kWh basis in the Northeast. The costs of natural gas, coal, wood, oil and nuclear generation are compared against the costs for alternative energy sources such as wind and solar. All costs analyzed for grid energy will include, projected price increases as a cause of increased production costs (nuclear, coal, and others). All alternative energy costs will be analyzed from a grid-tied but fully self-sufficient basis i.e. all energy demanded in a household supplied by alternative energy source.

EXPERIMENTAL ADAPTATION OF A CLINICAL CYSTIC FIBROSIS ISOLATE TO BIOFILM CONDITIONS

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The ability to adapt to a fluctuating environment is common among human pathogens. Previous work has shown that the same three colony morphotypes repeatedly arise in the adaptive diversification of the environmental isolate, *Burkholderia cenocepacia (*HI2424). We seek to determine if ecological niches are filled by homologous morphotypes in the environmental strain and a clinical strain, *B. cenocepacia (*H111). *Bc* H111 was isolated from the lung of a cystic fibrosis (CF) patient, and evolved under the same conditions as *Bc* HI2424 in the previous study. Maintaining the conditions allowed us to determine if the replicate populations of *Bc* H111 all produce the same morphotypic variants, as they did in *Bc* HI2424. *Bc* H111 was evolved for 225 generations in our model of the biofilm environment associated with lung infections in CF patients. Within the six replicate populations, eight colony variants distinct from the ancestor were collected. Of the three morphotypes previously observed in the environmental strain, one also arose in the clinical strain. Genetic sequencing was used to understand the genotypic basis of the morphotypes and their respective biofilm and fitness phenotypes. We found that there are common patterns in the adaptive evolution of the environmental and clinical strains of *B. cenocepacia*, but there is variation in colony morphotype, fitness and biofilm formation depending on the genetic background of the ancestor.

MECHANISMS UNDERLYING LOBSTER TRAP SATURATION

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The American lobster (*Homarus americanus*) fishery is one of the most vital fisheries to New England's economy. Sound management of the fishery requires an accurate assessment of the abundance of lobsters and these data are often obtained by state agencies using ventless traps (traps with no escape vents). However, catch in these ventless traps does not always correlate with the number of lobsters on the bottom because, after a day of fishing, the total catch reaches a plateau. Although several hypotheses have been suggested, the mechanisms underlying this phenomenon are still poorly understood. We used a combination of methods to test two different hypotheses: 1) bait deterioration over time, and 2) depletion of all lobsters in the area fished by the trap. We found that entry rate into traps and catch decreased on day two vs. day one, but the number of lobsters around the trap did not. In addition, we found that replacing old bait with fresh bait on day two increased catch on day two. These, and other data, suggest that bait deterioration is the primary cause of trap saturation in ventless traps.

DETECTING THE PRESENCE OF MICROCYSTINS IN LAKE ERIE

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Lake Erie experienced a toxic *Microcystis* cyanobacteria bloom during the summer of 2014 and the municipal water system of Toledo, Ohio was closed. Water samples were collected at various depths for the detection of the hepatotoxins, microcystins. Fifteen water samples were sent to the University of New Hampshire to be analyzed for toxicity and relative cell abundances. Fluorescence of chlorophyll and phycocyanin, pigments associated with cyanobacteria, were measured to determine relative cell concentrations. Enzyme-Linked Immunosorbent Assay (ELISA) methods were used to detect microcystins. This event indicated the need for improved monitoring methods of freshwater for a more effective remediation of toxic cyanobacteria from eutrophic waters. Public awareness must also be increased, as these cyanotoxins pose a major health concern for drinking water suppliers.

INVESTIGATION OF A FAS "DECOY" RECEPTOR IN THE BOVINE CORPUS LUTEUM

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Immune-response mechanisms contribute to ovarian function in the cow and can have long-term consequences on fertility. Within the ovary, a structure known as the corpus luteum (CL) is responsible for regulating length of the estrous cycle and supporting pregnancy throughout gestation. The lifespan of the CL is in part influenced by immune cells and their ability to trigger programmed cell death (apoptosis) of the luteal cells that comprise the tissue. Immune-mediated hormones called cytokines initiate apoptosis. Among these, the molecule Fas ligand induces apoptosis of bovine luteal cells. Interestingly, we were surprised to discover recently that the cellular receptor that binds Fas ligand, Fas, is elevated on bovine luteal cells of early stage, developing CL compared to late stage, regressing CL. The objective of the current study was to investigate whether an alternative Fas "decoy" receptor exists in the bovine CL to enable Fas ligand binding, but prevent luteal cell apoptosis and regression of the CL. To do this, total RNA isolated from the two stages of CL will be used. Following purification and amplification to cDNA, the samples will be subjected to quantitative real-time polymerase chain reaction using sequence-specific primers to bovine Fas, Fas "decoy", and β-actin to quantify transcript expression. It is anticipated that Fas "decoy" transcripts will be elevated in developing CL compared to regressing CL, preventing Fas-induced apoptosis during early development.

THE ACCURACY AND SENSITIVITY OF HANDHELD FLUOROMETERS AS A TOOL FOR MONITORING CYANOBACTERIA IN LAKES

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The importance of monitoring toxic cyanobacteria in lakes has recently been acknowledged by US government agencies. The Environmental Protection Agency (EPA), Region 1 (New England) has begun developing a citizen-based monitoring program to measure the abundance of cyanobacteria in lakes. The purpose of this study was to determine the accuracy of a proposed new fluorometer (Beagle FluorQuick, Amniscience Design, we tested fluorescence measurements of phycocyanin and chlorophyll of New England lake water against the Turner Design AquaFluor, hand-held fluorometer. Both devices absorb at two wavelengths, 630-715nm and 660nm to determine the relative concentrations of these pigments associated with cyanobacteria as well as chlorophyll a respectively. Samples of lake water and cyanobacteria cultures were tested and the devices were compared using a paired t-test. When testing for phycocyanin content, over 50% of the results of the two devices read significantly different and the tests for chlorophyll a content varied significantly in more than 70% of the readings. A possible re-calibration of the Beagle may help to fix these accuracy issues as the monoculture of Microcystis showed it was possible to determine the Beagle's measurements with the Turner's measurements with an adjusted R2 greater than 0 .99 for both chlorophyll a and phycocyanin content.

EFFECTS OF POLYBROMINATED DIPHENYL ETHER (PBDE) DOSE ON LIVER GLOBAL GENE EXPRESSION IN RATS

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Polybrominated diphenyl ethers (PBDEs) are flame retardants present in household items such as couches, carpet and electronics. Previous research by the Carey Laboratory demonstrated that PBDE treatment of Wistar rats adversely affects glucose and lipid metabolism. The purpose of this experiment was to investigate the effects of two doses of PBDEs on liver global gene expression. Twelve rats were randomly assigned to one of three treatment groups and gavaged with either corn oil (C), 1.4mg PBDEs/kg body weight (L), or 14mg PBDEs/ kg bdy wt. (H). Gavage occurred daily for 28 days, RNA was extracted from liver samples with mRNA preparation kits. Quality control was preserved using a Bioanalyzer system, and global gene expression was measured by Illumina sequencing. Statistically significant changes in gene expression across the three groups were observed; C x H=1936 genes, C x L= 633, H x L=1395. Comparing C vs. H groups, significant increases in genes for drug metabolizing enzymes Cyp2b2 (249-fold), Cyp1a1 (2611), Cyp2b1 (100), and Cyp2v6v1 (12) were measured. No statistically significant fold changes were observed in the C vs L group, indicating a lack of induction of drug-metabolizing enzymes at the low PBDE dose. Low PBDE dose, representing human exposure levels, affects overall liver gene expression, but does not up-regulate expression of drug metabolizing enzymes. Findings should be used to justify further research on the possible health effects of PBDEs.

EFFECTS OF LAND USE ON DOC BIOAVAILABILITY IN STREAM WATER

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The research for this project is important because what land is used for will continue to change as the population grows. This experiment will help to understand if changing what land is used for will also change the amount of carbon bioavailability. In this project, I ask the research question, “Does land use affect the percent carbon loss in water?” I hypothesized carbon quality varies with changing land use because different land use areas (e.g. forest, developed, wetland, agriculture) contribute different types of Carbon inputs. To test this hypothesis, I sampled 28 streams in June 2014 and 43 streams in August 2014. Two samples were taken at each site, where one was instantly filtered, and the other was out through a 28 day incubation period. At the end of the 28 day incubation, I measured the amount of dissolved organic carbon remaining, and calculated the percent lost by taking the original sample and subtracting it from the 28 day sample. The preliminary results indicate that there is no correlation between the percentage of forest cover surrounding each site and the amount of carbon consumed by stream microbes over the 28 day incubation period.

HOW DO DOMESTICATED DOGS RESPOND TO DIFFERENT MODALITIES WHEN USING SKYPE™?

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Two modalities that animals use to receive sensory information are audition and vision. The mammalian brain processes auditory and visual stimuli differently, and attentiveness to each type can vary among species. Owners of domestic dogs (*Canis lupus familiaris*) commonly attempt to communicate with their dogs from afar using video technology, but which aspects of these interactions the dogs cue into are not well understood. Here, I tested three hypotheses regarding which modality dogs rely on most when engaging with their owners over Skype™. If dogs primarily rely on auditory cues (H_1), then they should respond more to the sound of their owner's voice than to the video image of their owner. If they primarily rely on visual cues (H_2), then they should respond more to the visual image of their owner than to their owner's voice. If dogs combine auditory and visual processing when Skyping™ with their owners (H_3), then they should respond more to a combination of the owner's voice and image than when either modality is removed. To test these predictions, I had dog owners Skype™ with their dogs under each of four experimental conditions: 1) no sound or video, 2) sound only, 3) video only, and 4) both sound and video. I captured the dog's behavior during each trial and quantified its engagement with its owner. The results of this study can strengthen owner-dog communication by helping focus on the modalities to which dogs are most attentive.

SUPPLEMENTATION OF *CIONA INTESTINALIS* IN THE DIET OF THE GREEN SEA URCHIN *STRONGYLOCENTROTUS DROEBACHIENSIS*

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Fishmeal is one of the most well used aquaculture diets for a wide variety of species including the green sea urchin, *Strongylocentrotus droebachiensis* (*S. droebachiensis*). The overuse of fishmeal ingredients has led to the depletion of wild fish populations, subsequently increasing the demand for an alternative culture diet. This study utilized an otherwise nuisance species in the development of an alternative food source for cultured organisms. Dried tunicate, *Ciona Intestinalis* (*C. intestinalis*), and plant components were added together as an alternative pelleted diet for cultured *S. droebachiensis.* Preliminary studies have shown that *S. drobachiensis* will readily eat *C. intestinalis* tissue, yet proper evaluation of increased growth has not been conducted. Therefore, this study looked more closely at the supplemented diet's effect on urchin growth.

EFFECTS OF ALLELOPATHIC CHEMICALS PRODUCED BY *ALLIARIA PETIOLATA* ON ARBUSCULAR MYCORRHIZAE FUNGI

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Alliaria petiolata (garlic mustard) is a common non-mycorrhizal invasive herbaceous plant that poses a threat to native forests by producing allelopathic chemicals that have been found to inhibit the mutualistic relationship between arbuscular mycorrhizal fungi (AMF) and native plants. To determine the effects of allelopathic chemicals on AMF biomass, *A. petiolata* was grown with *Impatiens capensis* (jewelweed) in order to simulate an invaded forest edge. Soils were inoculated with activated carbon to see if amendment would buffer the impacts of allelopathy. Root, leaf, and soil glucosinolate concentrations were analyzed using a glucose-release method. We analyzed AMF biomass using phospho- and neutral lipid fatty acid analysis. We hypothesized that invasion would reduce AMF biomass which would correlate with high glucosinolate production. We found that glucosinolate production was positively correlated with AMF biomass in plant leaves and the presence of activated carbon broke this relationship. An increase in AMF biomass was positively associated with leaf glucosinolate production (R^2=0.9862), however we did not find a relationship between AMF biomass and glucosinolate concentrations in roots or soil. This may be because AMF were negatively affecting garlic mustard through root-hyphae interactions. Further work should explore the relationships between non-mycorrhizal invaders and native mycorrhizal plants.

NOVEL PRODUCTION METHODS FOR GREENHOUSE AFRICAN MARIGOLDS: SENSOR BASED IRRIGATION AND CONTROLLED RELEASE FERTILIZERS

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Controlled release fertilizers offer increased efficiency of water use and nutrient release in greenhouse crops. Sensor based irrigation systems have shown reduced amounts of water usage in greenhouse growing operations. The experiment aims to investigate the optimal levels of water and controlled release fertilizer application in greenhouse grown African marigolds (*Tagates erecta* 'Taishan Gold'). One hundred and forty eight African marigolds were seeded and grown in Pro-Mix BX, a peat-perlite soilless media. Of these plants, one hundred and twenty were transplanted two to four weeks after seeding into round, plastic, 4.5" pots containing said media. ECH_2O EC-5 soil moisture sensors were used to monitor volumetric water content. A Campbell Scientific CR1000 datalogger was used to trigger drip irrigation to occur at 30%, 40%, 50%, and 60% volumetric water content. Each irrigation set point comprised one set of four water treatments. A second type of treatments consisted of fertilizing at rates of 285 ppm-N, 570 ppm-N, and 854 ppm-N (4, 8, and 12 lbs/yd^3) with polymer coated NPK fertilizer, Osmocote 12-7-8 was combined with each water treatment. Each combination of irrigation set point and fertilizer concentrations were repeated ten times. The combined water and fertilizer treatments were randomly dispersed into ten sets of twelve pots. The results obtained will assist in the development of best management practices regarding the use of sensor based irrigation and controlled release fertilizer in greenhouse production of African marigolds.

CHARACTERIZATION OF PLANT PALMITOYLTRANSFERASE MUTANTS IN *ARABIDOPSIS THALIANA* USING GENETIC AND BIOCHEMICAL APPROACHES

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Palmitoylation is a post-translational modification that is integral to normal growth and development of many organisms. Palmitoylation involves thioesterification of a saturated fatty acid, usually C16:0 palmitate, to a cysteine residue. Palmitate serves to anchor a cytosolic protein to various lipid membranes in the cell. This reaction is catalyzed by a palmitoyltransferase (PAT). Palmitoylation can affect protein trafficking, cell structure, and cell signaling. Eukaryotic organisms have multiple PAT genes within their genomes, and each PAT likely has a unique collection of substrates. The plant *Arabidopsis thaliana* has 24 palmitoyltransferase genes, and our objective is to characterize their functions. As a starting point, plants homozygous for a mutation in a single palmitoyltransferase gene were analyzed to detect mutant phenotypes. Loss-of-function mutations in nine genes were studied: *pat1, pat3, pat4, pat6, pat8, pat13, pat14, pat16,* and *pat24.* Plants were measured throughout their life cycle to analyze changes in germination time, root architecture, root length, and plant size. Under normal growth conditions, no obvious phenotypic changes were observed for most of the parameters that were measured; however, a *pat16* mutant was delayed in germination, while *pat14* mutants and *pat24* mutants had smaller rosettes than wildtype.
This project was funded by a REAP award from the Hamel Center for Undergraduate Research.

THE EFFECTS OF SEX AND AGE ON DOGS' ABILITY TO IMPROVE ON A NOVEL COGNITIVE TASK

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Cognition is an aspect of learning that is affected by many factors. Understanding cognition in domestic dogs (*Canis lupus familiaris*) is particularly important for training and selecting individuals for service and rescue jobs. Previous research on beagles demonstrated that older dogs do not benefit from previous experience with a task as much as younger dogs do. This suggests that as age increases, dogs lose cognitive plasticity, which reduces their ability to improve on tasks. However, whether these results can be generalized to all breeds remains unclear. Furthermore, female dogs have been found to have higher cognitive abilities than males on some types of cognition tests, but whether this sex difference extends to their ability to improve on the same task over multiple trials (i.e., learn) is unknown. I sought to address these gaps in our understanding by exploring how dogs' ability to solve a wooden puzzle improved over the course of three identical trials. I hypothesized that the sex and age of a dog would affect its ability to improve its performance when attempting to solve the same cognitive puzzle multiple times. I predicted that younger dogs would exhibit greater improvement than would older dogs, and females would show greater improvement than would males. This study will provide further insight into the life history components that may influence a dog's ability to improve on cognitive tasks.

HUMAN IDENTIFICATION AMONG NONHUMAN PRIMATES

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Many animals have the ability to recognize individuals of their own species, which can enable them to remember prior interactions with an individual and react accordingly. A few species have even demonstrated the ability to recognize individuals of a different species; this skill may be particularly salient for captive animals that regularly encounter humans. However, the mechanisms behind heterospecific recognition are unclear. Here, I tested two hypotheses for how captive primates identify individual zookeepers. I first proposed that captive primates identify zookeepers based on the zookeeper's sex (H1). I therefore predicted that primates cared for by women should exhibit fewer threat responses (e.g., alarm calls) in response to an unfamiliar woman than to an unfamiliar man. Alternatively if primates identify zookeepers based on clothing (H2), they should exhibit fewer threat responses to individuals wearing the familiar zoo uniform than to individuals wearing other colors. To test these hypotheses, I exposed captive primates of several species to three types of people (familiar women, unfamiliar women, and unfamiliar men) in each of two treatments: wearing the zoo uniform and wearing a different color. I then compared the threat responses of the primates to determine if sex or uniform aid in individual recognition of humans. Understanding how captive primates identify individual humans could be used to reduce the stress on animals when encountering new zookeepers.

EFFECTS OF DISTRACTEDNESS ON ACCURACY IN A COGNITIVE TASK

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It has been well established in many animals that learning can have profound impacts on behavior. The rat (*Rattus noruegieus*) is one species that has been studied extensively due to its accessibility in laboratories. Cognitive tasks have made a large contribution to our understanding of learning in animals, behaviorally and neurologically. Past studies have explored such topics as the accuracy of test subjects during a task and the neural transmissions in specific parts of the brain during the task. However, less attention has been paid to whether other aspects of performance have an effect on the accuracy of individual subjects. Though rats can quickly learn a varying four lever task, distractedness could negatively affect this learning process by delaying it. Here, I asked whether the duration of time a rat was distracted (not performing the task) in a four lever cognitive task influenced the overall accuracy of an individual's performance. Accuracy was defined as the percent of trials performed correctly. By analyzing videos of rats performing the task, I recorded the length of distractions between correct lever processing. Based on the hypothesis that distractedness would negatively impact accuracy, I predicted that the longer a rat spent idle between the pressing of each subsequent lever, the more overall errors the rat would make during a trial. This information can help advance our understanding of behaviors that may influence the process of task learning.

ASSOCIATION BETWEEN POLYMORPHISMS IN THE SEROTONIN TRANSPORTER GENE AND BRAIN OSCILLATORY POWER DURING SOURCE MEMORY

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Variance between the long (l) and short (s) alleles of the 5-HTTLPR polymorphic region of the serotonin transporter (SERT) coding gene SLC6A4 affects performance on memory tasks in which homozygotes of the l-allele perform better. Homozygotes of the l-allele have increased serotonin (5-HT) reuptake, causing lower levels of synaptic 5-HT. This study will address whether SERT polymorphisms affect underlying brain oscillations during source memory retrieval. Tasks involving source memory rely on a subject's ability to recall an item's contextual details. Sixty-four subjects of known genotypes performed a source memory retrieval task while undergoing EEG recording. Brain oscillations during the task will be used to infer the extent to which subjects employed cognitive control while recalling a contextual detail. Alpha oscillations (7.5-12.5 Hz) are thought to facilitate communication between neural networks. It is hypothesized that alpha oscillatory power will increase in the prefrontal cortex during source memory retrieval in order to disregard irrelevant details. Furthermore, it is predicted that homozygotes of the l-allele will exhibit larger alpha oscillatory power during the source retrieval task relative to s-allele carriers. If a disparity in brain oscillatory power during the source retrieval task is observed between carriers and non-carriers of the s-allele, this data will link serotonergic function with the underlying mechanism of source memory retrieval.

DOES THE UNH CAMPUS OFFER A HEALTHY EATING ENVIRONMENT?

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The availability of healthy food options on campus is important to student health. The goal of this study was to evaluate the accessibility of healthy food choices on the greater UNH campus using the Healthy Campus Environmental Audit (HCEA) developed by Syracuse University. The HCEA evaluated the presence of signage promoting health eating habits and the abundance of nutritious food options. Prior to data collection, video training, methodological practice, and inter-rater reliability was completed by four evaluators. The HCEA showed that 100% of UNH-sponsored facilities offered ≥3 fresh fruit options, while only 40% of non UNH-sponsored facilities met the same criteria. Similar findings were observed with the availability of vegetable and whole grain options. Data suggested that UNH-sponsored dining facilities focused on offering healthy options to students, while non-UNH sponsored venues tended to promote unhealthy eating behaviors. Findings from the HCEA may be used to inform UNH administrators and surrounding eating venues of potential improvements to provide a healthier eating environment.

DETERMINATION OF P53 DISTRIBUTION AND FUNCTIONALITY IN CANINE ACUTE MYELOID LEUKEMIA

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Canine acute myeloid leukemia (AML) belongs to a group of highly fatal myeloproliferative diseases which afflict dogs regardless of age, gender, or breed. The molecular basis of the disease is largely unknown, although certain forms of human and animal AML have been linked to cytoplasmic sequestration and deactivation of the pro-apoptotic transcription factor p53 though binding to mitochondrial heat shock protein 70 (Hsp70). The purpose of this work was to determine the cellular location of p53 in a canine AML cell line (termed ML-1), ascertain whether coupling to Hsp70 had occurred, and evaluate the functionality of the p53 gene product. To accomplish this, the cellular compartmentalization of p53 was first determined through western blotting and immunocytochemistry. Cells were then treated with etoposide and subjected to the TUNEL assay for apoptosis to determine the activity of p53 following topoisomerase inhibition. Data concerning post-treatment changes in p53 expression levels and cellular localization was then collected through a second western blot assay. From this work, it was determined that p53 in canine ML-1 cells is nuclear in distribution and fully functional. Thus, de-regulation of the p53 apoptotic pathway does not appear to be problematic in ML-1 cells, leading to the conclusion that aberrations in alternative cellular pathways most likely account for cancer development.

O-GLCNACYLATION ALTERS KERATIN 8/18 ARCHITECTURE OF HPV-16 INFECTED CERVICAL CANCER (SIHA) CELLS

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Cervical cancer is a leading cause of cancer mortality in women. Elevated keratin 8/18 (K8/18) intermediate filament expression is indicative of tumor progression. Intriguingly, K8/18 filament structure and interaction in cells may be altered by O-linked N-acetylglucosamine (O-GlcNac). Hyper-O-GlcNAcylation of K8/18 filaments solubilizes them to become monomers; whereas hypo O-GlcNAcylation triggers dynamic reorganization and aggregation. In the current study, we proposed that O-GlcNAcylation in cervical cancer cells is similarly important for modifying K8/18 filament formation. Hyper- and hypo-O-GlcNAcylation was induced in immortalized cervical cancer cells (SiHa) by treatment with an O-GlcNAcase inhibitor (PUGNAc) and an O-GlcNAc transferase inhibitor (Alloxan), respectively. Organization of K8/18 filaments was assessed by immunocytochemistry and bright-field light microscopy. Diminished K8/18 filament immunostaining and a spindle-shaped morphology were evident in SiHa cells exposed to Alloxan compared to controls. SiHa cells exposed to PUGNAc exhibited even less staining for K8/18 filaments compared to control and Alloxan-treated cells. These initial results suggest that O-GlcNAcylation regulates K8/18 filament organization in cervical cancer cells. Acknowledging that K8/18 filaments function as cellular scaffolding, altering this architecture could similarly alter signaling events within the cell. Supported by the COLSA Karabelas Fund (DHT) and an NSF GRFP (NMJ).

HEALTHY GREEN CAMPUS: MEASURING FLAME RETARDANTS IN UNH DORMS

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Flame retardants are synthetic chemicals incorporated into many consumer products. It is known that flame retardants migrate from consumer products into dust, but the degree to which they appear in college dormitory rooms, and the residents' bodies, is unknown. The purpose of this study is to measure flame retardant levels in dust from UNH dormitory rooms and in blood of residents of those rooms. Six to 8 dormitory/suites and approximately 30 students will participate in this IRB-approved study. Dust sampling will occur using a Eureka Mighty-Mite vacuum equipped with a specially designed PTFE Teflon crevice tool attachment modified to collect dust into a cellulose extraction thimble (19 x 90 mm). Dust will be stored frozen until analysis for flame retardants via gas chromatography/mass spectrometry at the University of Antwerp. A fasted blood sample will be collected from each participant and serum will be separated and stored frozen until analysis at Fluid Management Systems, Watertown, MA. Data will be analyzed for 23 to 60 flame retardant congeners in dust and in blood, and the correlation between dust and blood levels will be determined. The results of this study, the first of its kind on a college campus, will not only inform researchers about environmental exposure of students to flame retardants, but will inform nation-wide campus furniture purchasing policies. (Support from the Silent Spring Institute, Newton, MA).

THE ESTABLISHMENT OF INVASIVE SHRUB GLOSSY BUCKTHORN (*FRANGULA ALNUS*) IN NATURALLY OCCURRING FOREST CANOPY GAPS IN SOUTHERN NEW HAMPSHIRE

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The objective of the research was to determine if naturally occurring forest canopy gaps facilitate the establishment of the non-native, invasive shrub glossy buckthorn (*Frangula alnus*). I compared the presence and abundance of *F. alnus* in both canopy gaps and non-gap forest understory in white pine-hardwoods and hemlock-pine-hardwoods forests in southeastern New Hampshire. None of the non-gap forest understory plots in either forest type contained *F. alnus*. Colonization of *F. alnus* in canopy gaps in the hemlock-pine-hardwoods stands was minimal, with size class <1m being the only significant ($p < 0.05$) class. It is likely that *F. alnus* can initially establish in the canopy gaps due to increased light, however, it cannot persist due to dense hemlock cover. *F. alnus* was well established in canopy caps formed in the white pine-hardwood stands. All size classes of *F. alnus* were significant ($p < 0.05$) except for <1m class. The high levels of light reaching the understory in canopy gaps, the amount of *F. alnus* <1m was high. However, after competitive exclusion, only a small number of *F. alnus* can persist. The relationship between canopy gap age, area, and the amount of intolerant and tolerant regeneration, and the establishment of *F. alnus* were tested. The presence of intolerant regeneration was the only factor to have direct correlation to *F. alnus* establishment. Increased light levels in canopy gaps are ideal conditions for intolerant regeneration.

IN VITRO EFFECTS OF O-GLCNACYLATION ON KERATIN 8/18 FILAMENTS IN CERVICAL CANCER CELLS

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Cervical cancer is a leading cause of cancer-related death among women. The SiHa cell, a cervical cancer cell line, expresses keratin 8/18 (K8/18) intermediate filaments that when elevated is indicative of neoplastic changes. The keratin 18 monomer of keratin filaments is glycosylated by N-acetylglucosmine (O-GlcNAc). In general, hyper-O-GlcNAcylation is a common characteristic of many cancers. However, potential connections between O-GlcNAcylation, K8/18 filament expression, and the tumorigenic potential of cells expressing these traits have not been explored. Here we tested the hypothesis that O-GlcNAcylation in SiHa cells promotes tumorigenic potential. Accordingly, growth experiments indicated that SiHa cells grown under controlled culture conditions multiplied faster than cells exposed to Alloxan, an O-GlcNAcylation inhibitor (0.31 vs. 0.08 doublings/day, respectively), and had a shorter generation time (2.27 vs. 8.78 days, respectively; n= 3 experiments). A wound-healing assay demonstrated that SiHa cells migrate faster after injury vs. cells exposed to Alloxan (5.5 vs. 4.1 μm/hour, respectively; n=3 experiments).These initial observations suggest that O-GlcNAcylation in SiHa cells, possibly via K8/18 filaments, increases tumorigenic potential. The results provide further insight about the potential influence of glycosylation and keratin filaments on cell physiology beyond simply being a diagnostic measure of cancer. Supported by the COLSA Karabelas Fund (DHT).

COMPETITIVE ADVANTAGE OF *VIBRIO PARAHAEMOLYTICUS* HARBORING LYSOGENIC F237-LIKE PHAGE

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In 2013, an outbreak from *Vibrio parahaemolyticus* occurred on the Northeast Atlantic coast that was traced to an invasive sequence type (ST) 36 strain from the Pacific. The invasive strain harbored a newly-discovered lysogenic bacteriophage, which when dormant in a host provides protection from killing infections, but is capable of switching to the lytic cycle, killing the host and susceptible proximal bacteria. We hypothesize that phage-harboring strain populations (PHS) are more competitive than those lacking the phage. We are applying pairwise competitions to examine whether the PHS can outcompete phage-deficient strain populations (PDS) that vary in relatedness and clinical or environmental status. If PHS have no competitive advantage over PDS, the phage may be unable to infect the PDS, which will be detected through soft-overlay plaque assays. Alternatively, the PDS may have acquired the phage into the genome, which will be tested through PCR and gel electrophoresis to reveal if this allowed PDS survival. These results will further elucidate this newly-discovered phage, and demonstrate if the presence of phage can alter population structure for both ST36 and environmental *V. parahaemolyticus* strains. Elucidating any competitive advantages harbored by invasive strains may promote understanding as to how these strains successfully established a niche within the resident population.

LOOKING BACK TO PLAN AHEAD: MACROALGAL TRENDS IN THE GREAT BAY ESTUARY 1978-2014

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Over the past 30 years, scientists studying the Great Bay Estuary have observed ecosystem shifts from valued eelgrass habitat to nuisance macroalgae as nutrient inputs to the Estuary have grown due to increasing population and impervious surfaces in the watershed. Sporadic surveys from 1978 to 2014 at different sites around the Great Bay have shown an increasing trend of nuisance algae (i.e. Ulva lactuca and Gracilaria spp.) Photographs of macroalgal cover framed within 0.25 m2 quadrats were taken at four different elevations at several sites including Cedar Point and Wagon Hill Farm in Little Bay and Depot Road, Lubberland Creek, Sandy Point, and Sunset Hill Farm in Great Bay over three different time periods (1978, 2008-2009, and 2013-2014). Similar, but not identical, sampling methods were used over the three time periods. Average abundance for each species of macroalgae was determined at each site using two different approaches: percent cover and point intercept converted to percent cover. Funded by the Piscataqua Region Estuaries Partnership, a new analysis of the photographs from all three sampling periods was performed using both methods. Averages and trends found over the three time periods can inform managers of changes in the health of the Great Bay Estuary.

DEVELOPMENT OF MODEL TO PREDICT COLOSTRUM QUALITY USING DAIRY HERD IMPROVEMENT DATA

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Previous research has linked quality of colostrum fed to heifers with long term production and overall health. Colostrum quality is measured in IgG concentration. Acceptable levels of IgG are classified as 50-60 g/L or more. There are several tools available to measure IgG, but frequently dairy farms do not employ any method to classify colostrum quality fed. Regression procedure of SAS was used to create a statistical model for evaluation of IgG concentration using information readily available from Dairy Herd Improvement data for Holstein cows. A variance inflation factor assay was conducted on samples from 110 Holstein cows from 10 farms in New Hampshire. Related variables were removed, then the backwards elimination procedure was conducted to generate the following model:
Ln IgG (Y) = (4.40107) + ln Fat yield (2.55494) + ln Fat/Protein (-2.38846) + ln Protein yield (-2.50062) + ln Protein Pounds (1.92248) + Somatic Cell Score (0.02751) ln Parity (0.14762) + paswks (-0.00596) + sex (of calf) (-0.06945) + Predicted Transmitting Ability Milk (PTAM) (-0.00034454) + Predicated Transmitting Ability Daughter Stillbirth (PTADS) (8.205582E-7) + Days Above 23°C (0.00088913). The above model appears promising with an r2 value of 0.60. Validation of the model was performed on colostrum samples from 10 different farms in New Hampshire. A total of 31 samples were analyzed for IgG concentration using radial immunoassay.

EVALUATING THE ADEQUACY AND ACCESSIBILITY OF RECREATION FACILITIES AT UNH

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The recreation facilities on a college campus support physical activity and overall health. The purpose of the present study was to evaluate the adequacy of the UNH recreation facilities using Syracuse University's Healthy Campus Environmental Audit (HCEA). In February 2015, two evaluators completed extensive training, practice, and inter-rater reliability testing prior to data collection at the Hamel Recreation Center and Swasey Pool. The availability of exercise equipment, fitness classes, intramural sports, locker rooms, and other amenities were assessed by the HCEA via staff interviews, observations, and information provided on the facilities' websites. To ensure accuracy, data were collected at peak hours. Many positive observations were documented at the Hamel Recreation Center including: over ten health-related offerings, sixteen to twenty varieties of fitness classes offered, clean environment, refillable water stations, music, and reading materials. However, only 20-39% of aerobic machines at the Hamel Recreation Center were available during the HCEA. At the Swasey Pool, the HCEA revealed no drinking fountains or windows and scarce amenities in the locker rooms. However, the facility was clean and staffed with trained and knowledgeable employees. The adequacy and accessibility of UNH's recreation facilities will likely improve upon the completion of upcoming renovations to both the UNH Field House and Hamel Recreation Center.

APPLYING NEMATODE CHEMOTAXIS FOR ASSESSMENT OF *VIBRIO PARAHAEMOLYTICUS* VIRULENCE

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Vibrio parahaemolyticus (*V.p.*) is an opportunistic pathogen responsible for most of the seafood-borne bacterial gastroenteritis cases in the world. A serious limitation for preventing infection is the lack of accessible animal models for the study of virulence. We seek to evaluate the use of *Caenorhabditis elegans* nematodes for examining virulence by *V.p.* through altered chemotaxis. Prior observation of infected nematodes indicated that they move more slowly (Sun, 2014). Since virulence-associated traits of clinical strains of *V.p.* are expressed more highly at body temperature than at ambient temperatures, emulation of this condition in these assays could improve virulence quantification (Mahoney *et al*., 2010). We evaluated whether coordinating the movement of nematodes in the assay by providing a chemoattractant would improve accuracy of this assay. Unfortunately, due to a high degree of natural genetic instability in strains and other technical difficulties, we have not resolved differences in virulence between clinical and non-clinical strains. Thus, it is unclear whether the addition of a chemoattractant in this assay will sufficiently improve the method for assessing the virulence of *V.p.* The experimental basis for inconsistencies needs to be addressed and intrinsic factors such as nematode stress response, genetic instability of *V.p.*, and presence of contamination during experimentation are all under investigation as potential confounding variables.

ASSESSING METHODS FOR GENERATING ESTIMATES OF LEAF AREA INDEX IN NORTHERN TEMPERATE FORESTS

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Leaf area index (LAI) is generally defined as the total surface area of foliage in a canopy per unit of ground area. In broadleaf forests, LAI usually represents one-sided green leaf area; for needle-leaf forests, LAI is typically the total projected needle-leaf area. Leaf surface area is directly correlated to forest productivity. Obtaining accurate measurements of LAI is important for evaluating and understanding different forest ecosystem fluxes, including those of light, heat, moisture, carbon and nitrogen. Because measuring LAI is labor intensive and time consuming, there are many different techniques for estimating LAI, and each comes with its own advantages and disadvantages. Using data collected at the Bartlett Experimental Forest and Hubbard Brook Experimental Forest in northern New Hampshire, as well as in forests in the Durham, NH area, we will assess three techniques for calculating LAI including allometric equations, collected leaf litterfall, and an optical method called LAI-2000. Our results will allow us to better understand the tradeoffs among the three methods, inform our estimates of productivity across these forests, and help direct efforts for estimating LAI for ongoing and future projects.

HEALTHCARE DATA INFORMATICS: UNH PANAMA 2015

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Panama has the most extreme inequality of wealth distribution in the Western Hemisphere and a resulting medical system that contributes to poor health. The primary objective of this presentation is to increase awareness and understanding of the type of health care provided to these indigenous and Latino communities by evaluating the data on patients' symptoms, diagnoses, and care outcomes. A group of 217 Panamanians from 6 different communities and a large age distribution sought care from UNH Medical & Dental Brigades for 3 days. Patients went through a series of clinical stations in order to generate records, relay symptoms, and receive medical and dental care. Children between the ages of 5-9, representing 11.01% and 9.63% of total females and males, respectfully, composed the highest attendance. The ratio of females to males was approximately 6:4. The chief complaints or concerns were respiratory (28.99%), musculoskeletal (14.29%), and general wellness (14.29%). Most of the medications prescribed were analgesic/anti-inflammatory (28.67%), vitamins (19.65%), and oral anti-parasitic (18.50%). In addition to providing essential medications to treat current medical and dental needs, the UNH team educated patients on how to prevent the most prevalent diseases within the community. Looking to the future, we hope to continue providing support where necessary and help shift the role of external aid from primary to secondary care.

THE ROLE OF DIETARY-DERIVED PIGMENTS IN THE NUDIBRANCH *MELIBE LEONINA*

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It is well known that many classes of the plant and animal kingdom are involved in symbiotic relationships that benefit both species. For example, certain gastropods, such as *Elysia*, harbor chloroplasts obtained from algae, and they appear to provide the slug with nutrients from photosynthesis. The nudibranch *Melibe leonina* has clear skin that allows light to pass through to extensive vein-like branching from its digestive tract, through which ingested pigmented material is pumped. Moreover, they appear to prefer a moderate sunlight, suggesting they might also use photosynthetic pigments they acquire from their prey, like *Elysia*. In order to test this hypothesis we used thin layer chromatography to separate and identify pigments in the diverticuli. While likely some carotenoids were present, we found no evidence of chlorophyll. These data were confirmed with the use of high-performance liquid chromatography, as well as full spectrum scans of the diverticuli extracts. We also measured the oxygen consumption of *Melibe leonina* in dark and light conditions to determine if they contained chlorophyll related pigments that would produce oxygen in the light. These data also indicated the pigments under the skin of *Melibe* are likely not used for photosynthesis. Taken together, all our data suggest that the pigments in *Melibe* likely serve as camouflage and perhaps for protection from UV damage due to the bright light in shallow waters.

EFFECTS OF INCREASED SOIL MOISTURE ON AGGRESSIVE BEHAVIOR IN PAVEMENT ANTS

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Human-induced climate change will continue to challenge the survival of many species by altering the environment. For example, climate change is predicted to increase storm intensity, which might result in stochastic changes in soil moisture levels. For animals with strict habitat requirements, these environmental changes could alter various aspects of their ecology, including their behavior, which could subsequently affect how a species functions in its ecosystem. With this in mind, I explored the effects of increased moisture on aggressive behavior in pavement ants (*Tetramorium caespitum*), a species crucial to decomposition and a food source for other species. I collected ants from two different colonies, housed them separately, and exposed them to either wet or dry soil. I then pitted ants from different colonies and different moisture conditions, as well as different colonies and the same moisture conditions, against one another and observed the frequency of aggressive behavior of each ant. I hypothesized that in the wet soil, the added moisture would increase the soil temperature, thereby raising the body temperature of the ectothermic ants. Because muscles work faster at higher temperatures, I expected the ants housed in the wet soil to exhibit more intercolony aggression than the ants housed in the dry soil. This study aimed to investigate the potential impacts of one of many environment alterations our planet will face as it undergoes human-induced climate change.

PRODUCTION OF ESTRADIOL AND MATRIX METALLOPROTEINASES BY AN IMMORTALIZED HUMAN GRANULOSA CELL LINE

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The immortalized human granulosa cell line (HGrC1) was derived from a 35 year old woman's normal ovarian follicle. In order to study steroidogenic processes, estradiol (E2) production was investigated. The HGrC1 cells were cultured with (0.1 μM, 1 μM, 10 μM) or without testosterone (T) substrate. Conditioned medium was collected at 2, 24, and 48 hrs of culture, and analyzed by E2 radioimmunoassay. While E2 was undetectable in cultures supplemented with 0.1 μM T, its concentrations increased in cultures supplemented with 1 μM and 10 μM T, reaching 288 pg/mL. Matrix metalloproteinase (MMP) production was also studied. Matrix metalloproteinases are a family of enzymes that break down the extracellular matrix during ovulation and corpus luteum formation. To investigate MMP production, HGrC1 cells were cultured without serum for 2, 4, 8, 12, 24, and 48 hrs. At each time point, conditioned medium was removed for analysis of MMPs using gelatin zymography. Samples at all time points contained a single gelatinolytic protein with a relative molecular mass of approximately 68-70 kDa, which is consistent with MMP2 family members. Incubation of samples with 1,10-phenanthroline, a metalloproteinase inhibitor, resulted in the disappearance of this band, indicating that it is a metal-dependent enzyme, such as MMP. In summary, the ability to aromatize testosterone and to produce MMPs by HGrC1 cells is similar to other normal granulosa cells.

EARLY SIGNALING EVENTS INVOLVED IN ESTABLISHING THE SYMBIOTIC RELATIONSHIP BETWEEN *ELAEAGNUS ANGUSTIFOLIA* AND *FRANKIA* SP. STRAINS EAN1PEC, EUI1C, AND EUN1F

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The nitrogen-fixing bacteria of the genus *Frankia* form mutualistic symbioses with over two hundred different plant species representing eight families. These actinhorizal plants are capable of growing in and help to reclaim nutrient depleted soils. Host plant recognition signaling has been shown for the restrictive *Frankia-Casuarina* symbiosis, but has not been demonstrated for broad-host-range *Frankia*. The effects of water-soluble host (*Elaeagnus angustifolia*) and nonhost (*Casuarina cunninghamiana*) plant root exudates on the physiology of *Frankia* sp. strains EAN1pec, EuI1c, and EuN1f were investigated. Exposure to host root exudates increased the onset of nodule formation on *E. angustifolia* while nonhost plant exudates had no effect. qPCR results will confirm the presence of *Frankia* within the nodule. These results indicate that *Elaeagnus-Frankia* strains employ a different signaling molecule from the *Casuarina-Frankia* isolates.

DETERMINING THE EFFECTS OF THERAPY DOG INTERACTIONS ON HUMAN BLOOD PRESSURE AND SALIVARY STRESS HORMONE CONCENTRATIONS

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Animals have become an integral part of society as domesticated helpers, especially for their role in animal-assisted therapy (AAT). AAT is a form of therapy used for individuals that have a variety of emotional, psychological, and social problems. Research has been primarily conducted on the psychological and psychosocial aspects of AAT, while relatively little research has focused on the physiological aspects. As such, the objectives of the present study were to determine the effects of therapy dog interactions on blood pressure and salivary cortisol concentrations. During the 2014 summer and fall semesters, four UNH undergraduate students were recruited for the study, following the results of a perceived stress survey. These students were exposed to 30 minutes of interaction with therapy dogs once a week for a period of four consecutive weeks. Over the course of the experiment, their systolic and diastolic blood pressure was measured and saliva samples were collected during pre- and post-interactions. Overall, with the variation of blood pressure among the students, no differences ($P>0.05$) were found in systolic and diastolic blood pressure between pre- and post-interactions. The saliva samples from the students are currently being analyzed for cortisol using radioimmunoassay (RIA).

DOES THE PRESENCE OF HEMOLYSIN GENES CORRELATE WITH THE COMPETITIVE FITNESS OF *V. PARAHAEMOLYTICUS*

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Whereas most strains of *Vibrio parahaemolyticus* are harmless, rare pathogenic strains can cause human gastric infections. Pathogenic strains are traditionally identified by the presence of hemolysin genes (*tdh* and *trh*). In recent years, the abundance of hemolysin producers has risen. Concurrently, a strain harboring both hemolysin genes invaded the region causing many infections. These suggest hemolysins encoding islands could provide a competitive advantage. The purpose of this project was to examine: 1) the competitiveness of hemolysin producers over non-producers, and 2) the correlation of the *trh* gene with urease. In simple binary competitions, there was no significant growth advantage for hemolysin producers over non-producers regardless of whether they were environmental or clinical isolates. The urease test is a simple, quick, and cost-effective method to detect the presence of *trh* gene, and it was used to evaluate its effectiveness to replace a more complex and costly gene detection method, PCR, for identifying pathogenic *V. parahaemolyticus* during surveillance. Analysis showed a significant correlation between the presence of *trh* gene and urease positive test indicating Urease is a suitable surrogate for surveillance. Since the presence of hemolysin genes is not essential for *V. parahaemolyticus* growth, further research into hemolysin-harboring strains could help identify if there is any other survival advantage these genes may provide in *V. parahaemolyticus* species.

INFLUENCE OF PHENOTYPIC SWITCHING ON VIRULENCE BY EMERGENT *VIBRIO PARAHAEMOLYTICUS*

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Our lack of understanding of virulence by *Vibrio parahaemolyticus* (Vp) has been a major obstacle for preventing disease. Vp has only recently been linked outbreaks in New England that were caused by an invasive strain (ST36) from the Pacific that appears hyper virulent. Previous research suggests an inability to sense a high density (quorum blindness) enhances virulence and is an avenue for evolution of virulence. This study compared the extent that phenotypic switching, a surrogate for quorum sensing ability, is maintained in clinical and environmental strains and evaluated whether quorum blindness is likely the result of laboratory handing rather than a natural avenue to enhanced virulence. The study also determined the phenotypic switching state in ST36 isolates. There was no correlation of switching ability with laboratory handling of clinical strains, nonetheless, clinical strains were more often locked in one phase (high density locked or low density locked) compared to environmental strains. Thus, phenotypic traits that are the hallmark of quorum blindness and the inability of isolates to sense high density are not an artifact of handling. The virulence of strains locked in high and low density states are being compared in a recently developed nematode infection model. Results obtained from this study will improve our understanding of the evolution of this pathogen's virulence, which may help in minimizing human diseases caused by this and other similar pathogens.

THE EFFECTS OF TEMPERATURE ON RELATIVE FITNESS OF *V. PARAHAEMOLYTICUS* STRAINS FROM THE GREAT BAY ESTUARY

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Whereas abundance and diversity of *Vibrio parahaemolyticus* correlates with temperature, the effects of temperature on individual strains of *V. parahaemolyticus* are unknown. Understanding how individual strains react to temperature will aid in our understanding of population dynamics, as environmental populations are composed of genetically distinct individual strains, which may have evolved to grow optimally at different temperatures. We evaluated the relative fitness of strains of *V. parahaemolyticus* isolated from the Great Bay Estuary, N.H., in pairwise competitions under conditions mirroring the seasonal changes in the Northeast Atlantic. We hypothesized that the temperature at which a strain was isolated would dictate the temperature of optimal fitness. We expect that strains abundant during cooler months would be outcompeted by strains collected during warmer months when competing at warm temperatures, but would outcompete warm isolates at cooler temperatures. Should this hypothesis be proven correct, it would suggest as ocean temperatures rise in the region, the relative distribution of strain types may change. If proven false, it may indicate that native strains are well adapted to a broader range of temperatures. These studies will inform how resilient the local, virtually pathogen-free populations are, and can be used to evaluate genetic components associated with fitness at each temperature to predict how populations may change with ecosystem temperature change.

CARNIVORE DIET IDENTIFICATION THROUGH SCAT AND GENETIC ANALYSIS IN NAMIBIA, AFRICA

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Worldwide the cheetah population is declining making them Africa's most endangered large cat. Namibia, Africa currently has the largest population of cheetahs in the world. During the summer of 2014, I did scat analysis of carnivores on the property of the Cheetah Conservation Fund (CCF) in Namibia in order to better understand the predators that compete with the cheetah and how the ecosystem works as a whole. I worked at CCF for nine weeks to analyze the diets of carnivores in the area through genetic and scat analysis. Analyzing carnivore feces would ultimately identify the diet of various carnivores in the area. About one hundred various carnivore scat samples were analyzed including jackal, hyena, genet, serval, leopard, African wildcat, caracal, civet, aardwolf and cheetah samples. This information would help CCF understand how the entire ecosystem interacts and aid them in their efforts to manage and protect the wild cheetah. DNA was extracted from each scat sample to determine the species each sample came from. The DNA was then amplified using polymerase chain reaction. Ultimately, the sequences were compared to a genome reference database and the species were determined by sequence similarity. The scat samples were then washed and the contents were analyzed microscopically and macroscopically. Microscopic analysis involved burning hairs to create imprints and looking at the patterns underneath a microscope. My results revealed that the cheetahs are primarily competing with leopards for their prey. When CCF releases cheetahs back into the wild they will now be able to take my findings into consideration to locate the best release site.

PERSONALITY TYPE IN RELATION TO LEARNING PERFORMANCE IN GOATS (*CAPRA AEGAGRUS HIRCUS*)

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Animal personalities encompass cognitive and behavioral patterns that are consistent over time or context. Previous research on non-human animal personality has focused on the bold/shy continuum, which can be quantified by an organism's behavior towards a novel object. This personality axis has been connected to how an individual stores information. The learning strategy of bold individuals is often to maximize the input of new information to solve a problem, whereas shy individuals tend to make connections to stored information from past experience. This difference in learning strategies can affect an animal's ability to solve a novel cognitive task, but how does personality affect learning over repeated trials? We explored this question in domestic goats (*Capra aegagrus hircus*), which have been largely absent from past research on learning. We first presented goats with a novel object to assess their degree of boldness/shyness. We then assessed each goat's ability to solve a puzzle box over three identical trials. We predicted that bolder goats would solve the puzzle box faster than shyer goats in the first trial because they would try a wider range of techniques. We also hypothesized that goats characterized as shy would rely more on stored information, and would therefore show greater improvement over subsequent trials than would bolder goats. For farmers, understanding livestock personalities could play a role in learning how to successfully create a healthy environment.

TOXIC CYANOBACTERIA AEROSOLS FROM LAKE ATTITASH, MA AND IMPLICATIONS FOR PUBLIC HEALTH

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Amyotrophic Lateral Sclerosis (ALS), is a serious neurodegenerative disorder with a high occurrence in residents of Northern New England living around lakes with frequent cyanobacterial blooms. It has been proposed that the presence of the neurotoxin BMAA (beta methyamino-L-alanine) in cyanobacteria blooms is an environmental trigger for ALS. MC (Microcystin), is a monocyclic heptapeptide hepatotoxin that can cause serious damage to the liver. The purpose of this study was to determine whether MC and BMAA were detectable in aerosols from a lake with cyanobacteria blooms (Lake Attitash, MA) and to determine the potential inhalation exposure to these cyanotoxins. During the summer 2014, aerosol, water samples, and water quality data were collected under natural conditions and in a mesocosm manipulation. MC and BMAA were measured using the ELISA method. The abundance of cells on air and water sample filters were enumerated using epiflourescence microscopy. The average concentration of MC in aerosols was 15.44-6.32 pg/m^3. BMAA levels were near or below the detection limit in the air and water samples. The mesocosm experiment revealed an increase in aerosolized toxins with enhanced phytoplankton, and an even greater increase of aerosolized toxins with enhanced zooplankton. Understanding possible links between cyanobacteria toxin exposure routes and public health concerns could lead to improved plans for controlling cyanobacteria and the risk of their potent toxins.

EFFECTS OF DIABETIC CONDITIONS ON ENDOTHELIAL CELL FUNCTION IN RELATION TO ATHEROGENESIS

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Atherosclerosis, an inflammation of the arteries, is the basis for cardiovascular diseases (CVD) and diabetes can accelerate atherogenesis. CVD is the leading cause of morbidity and mortality in the United States. With increased rates of obesity and the correlated Type II diabetes, there is increased risk for CVD. The inflammatory response initiated by dysfunctional endothelial cells (EC) is often caused by oxidative damage. We investigated two diabetic conditions on EC: hyperglycemia and dyslipidemia. Aortic endothelial cells in vitro were exposed to healthy conditions, levels of hyperglycemia, dyslipidemia, both together and TNF-alpha (positive control) for 48 hours. In addition, an experiment with the addition of the antioxidant, butylated hydroxytoluene (BHT), to each treatment was conducted. Cell metabolism and viability were determined with an MTS metabolic assay, cell morphologies were compared, and medium was measured for ICAM-1, an inflammatory molecule. Conditions were in quadruplicate for statistical analysis.

THE FLAVOR OF ANIMAL LIFE: DOUBLE IN SITU HYBRIDIZATION OF EVOLUTIONARILY ANCIENT SENSORY RECEPTORS IN THE 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 the animal sensory systems. Here we report results from in situ hybridization experiments that demonstrate the expression of the photoreceptor gene Opsin and the chemoreceptive gene Taste 1 Receptor (T1R) in a polymodal sensory cell type in the hydra. In addition, we report results from behavioral trials that demonstrate that both light and chemical cues from the environment are capable of modulating the discharge behavior of stinging cells called cnidocytes. We propose a hypothesis on the composition of the signal transduction cascade that parses multimodal sensory input from both opsin and T1Rs in cnidarian sensory neurons.

A TALE OF TWO EVOLUTIONARY PATHS: A COMPARISON OF SYMBIOTIC EVOLUTION OF *VIBRIO FISCHERI* COLONIZATION OF *EUPRYMNA SCOLOPES* AND LABORATORY CULTURE DRIVEN EVOLUTION

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Vibrio fischeri is a bacterium that enters into an intimate symbiosis with the Hawaiian bobtail squid where its luminescence camouflages the squid by erasing its shadow. Strains that are successful in navigating past host barriers are rewarded with food in a specialized light organ, thus squid colonists are the most successful strains in habitats with squid. Squid-naive strain MJ11 is a poor colonist, but derivatives that evolve better colonization can outcompete their ancestors. Identification of associated mutations could provide insight into symbiosis, especially if compared to isolates evolved in a contrasting environment such as broth cultures, which presumably would select for fast growers. MJ11 derivatives that were experimentally evolved through successive squid light organs developed convergent mutations in a hybrid histidine kinase, and these mutations confer improved colonization and improved biofilm. In contrast, derivatives evolved in broth cultures did not acquire convergent mutations, and were unimproved in squid. Even though the squid evolved isolates were more fit in squid, they had decreased fitness in the contrasting laboratory culture environment. This supports the idea that the evolution is a balancing act, and that increased fitness under one condition of selection may be at the cost of reduced fitness in other environments. The squid selected for traits that were specific to its environment rather than selecting for general vigor.

OPTIMIZED SEPARATION OF ESTUARINE PLANKTON TO DETERMINE ASSOCIATIONS WITH *VIBRIOS*

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Human *Vibrio*-related illness is linked to ecosystems and conditions that support proliferation of pathogenic strains. To study separate planktons, trials were designed to adapt a fresh water plankton separator created by Nancy Leland and Dr. Jim Haney of UNH, for use in estuarine ecosystems. It utilizes zooplankton phototaxis to separate zooplankton from phytoplankton with little intermixing. Chlorophyll *a* concentrations from fluorometry and biomass were evaluated at varying time periods on two sample dates to determine when the most pure separation occurred. The optimum time occurs when chlorophyll *a* concentrations are lowest in the zooplankton fraction and highest in the phytoplankton fraction, and the time required for the most zooplankton biomass to move out of the phytoplankton fraction into the zooplankton fraction. The greatest separation was variable, possibly due to negative taxis, yet achieved between 10 and 30 minutes during low and high tide. Study results between replicates and tides were variable yet contribute valuable information for understanding the association of pathogenic *Vibrios* with different planktons. The upcoming sampling season will benefit from this novel protocol to better understand the interactions between planktons and *Vibrios*.

THE EFFECTS OF CYTOKININ ON ADVENTITIOUS ROOT FORMATION IN *ARABIDOPSIS THALIANA*

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Adventitious rooting leads to new root formation from a stem or leaf cutting and can be used to establish a new plant. Although this process of vegetative, asexual propagation is utilized extensively it is not well understood genetically. The process of adventitious root formation is fascinating since it involves the genetic reprograming of differentiated cells in one organ type (stem or leaf) in order to generate an entirely different organ (root). The plant growth hormones auxin and cytokinin are both known to regulate cell division and differentiation yet only a role for auxin has been well established in adventitious root formation. In this study the role that cytokinin plays in adventitious root formation was investigated by manipulating the level of cytokinin signaling in *Arabidopsis thaliana.* This was done by using mutants with altered sensitivity to endogenous and exogenous levels of cytokinin. Elevated levels of cytokinin signaling reduce the formation of adventitious roots. However, lower than normal levels of signaling does not necessarily increase formation of adventitious roots. The effect that altered cytokinin signaling has on auxin signaling was observed utilizing plants transformed with auxin reporter constructs. The reporter construct CyclinB1:GUS was used to visualize cell divisions in root meristems. The expression of this reporter in the different cytokinin mutants suggests that cytokinin signaling may affect the cell cycle.

EVOLVING THE PLASMA FREE AA DOSE-RESPONSE TECHNIQUES TO DETERMINE BIOAVAILABILITY OF MET IN RP-MET SUPPLEMENTS

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Methionine (Met) and lysine are the first two limiting amino acids (AA) in dairy cow diets. Rumen-protected (RP)-Met supplements are fed to dairy cows to increase the availability of Met for synthesis of milk and milk protein in the mammary gland. The UNH plasma free AA dose response approach was used to determine the bioavailability of Met in a commercial RP-Met product. Ten ruminally-cannulated Holstein cows, fed a Met-deficient diet, were assigned to a replicated 5 x 5 Latin square with 7-d experimental periods. Treatments were: 1) 0 g/d Met, 2) 12 g/d abomasally infused Met, 3) 24 g/d abomasally infused Met, 4) 15 g/d of a RP-Met supplement, and 5) 30 g/d of a RP-Met supplement. The RP-Met products was mixed with 1 kg of total mixed ration, placed in rubber tubs, and fed to the cows 30 min before each of the 3 daily feedings. If the RP-Met product was not consumed within 15 min, it was placed directly in the rumen through the rumen cannula. Tail vein samples were collected at 2, 4, 6, and 8 h after the morning feeding in the last 3 d of each period. Deproteinized plasma samples were composited by cow/d and stored (-80°C) until AA analysis. Bioavailabilities for the RP-Met product averaged 74.4, and 81.8% when expressed as plasma Met or total sulfur AA concentrations, respectively. Due to interactions of Met with other sulfur AA, it is recommend to express bioavailability of RP-Met products as a proportion of total sulfur AA concentration.

TEMPORAL CHARACTERIZATION OF THE DNA DAMAGE RESPONSE IN HUMAN EMBRYONIC KIDNEY CELLS TREATED WITH THE CYTOTOXIC DRUG CAMPTOTHECIN

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Histone proteins are essential for the efficient organization of DNA, and thus play an important role in the common yet complex nuclear process of DNA damage repair. The addition of chemical groups to histones affects the spatial relationship between histones and DNA, and provides a binding spot for repair machinery. However, the specific way in which histone modifications interact with the DNA damage repair pathway remains unclear. It is hypothesized that their relationship is dependent on the temporal and spatial context of chromatin structure. To elucidate the orchestration of chromatin pathways in response to DNA damage, a temporal characterization of the damage-sensitive histone variant yH2AX in response to treatment with the cyctotoxic drug camptothecin was completed. The treatment measures for drug introduction were optimized via cell viability assays, western blot analysis, and immunofluorescent microscopy. The most active damage response was found to be within one hour after drug administration. Current mass spectromic analysis will identify proteins upregulated concurrently with yH2AX foci formation, and co-immunfluorescent microscopy will be used to analyze their temporal interactions during the DNA damage response.

PRODUCTION OF DECAFFEINATED TEA THROUGH GENETIC ENGINEERING

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With more research published recently indicating potential adverse effects of caffeine on human health, there is a growing market for decaffeinated tea. The current industrial methods used to extract caffeine from tea leaves result in tea deficient in taste, aroma, and nutrients. Genetic manipulation of the synthesis of caffeine in the common tea plant, *Camellia sinensis*, provides a solution to this matter. The primary enzyme responsible for caffeine biosynthesis in tea is caffeine synthase (CS). The gene responsible for coding this enzyme has been previously cloned and characterized. The objectives of our research are to use this information to produce CS knockout and knockdown plants where the production of caffeine will be largely eliminated or reduced. Furthermore, it is envisioned that reduction of caffeine will concomitantly increase the accumulation of its precursors like theophylline and theobromine, whose physiological effects are opposite of caffeine. The experimental approach involves genome-editing, antisense RNA and iRNA techniques, producing a plant with all of its original taste, flavor and aroma. The plants could be further propagated by cloning or by seed production.

EFFECT OF WHOLE GRAIN CONSUMPTION ON MARKERS OF METABOLIC SYNDROME

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Whole grains (WG) are an important aspect of a high quality diet. Consumption of WG has been linked to prevention of weight gain and associated diseases. The metabolic syndrome (MetS) predicts the development of chronic diseases and involves a clustering of abnormalities including large waist circumference, high blood triglycerides, low HDL-cholesterol, high blood pressure, and/or high fasting blood glucose. The purpose of this study was 1) to determine if WG intake was related to markers of the metabolic syndrome in college students and 2) to compare the Nutrition Data System Research (NDSR) software's assessment of WG intake with the USDA's MyPlate definition of a WG serving. Daily intake of whole and total grains were assessed with NDSR software using 3 day food records from the College Health and Nutrition Assessment Survey at the University of New Hampshire (n=66). Thirty-two percent of students were consuming the recommended WG intake (≥50% grains). Students were grouped according to their intake of WG: very low (0-25% WG, n=24), low (25-49%, n=21), meets WG recommendations (≥50%, n=21). Though no differences in triglycerides, HDL, waist circumference, or blood pressure were observed between WG groups, students who met WG recommendations had significantly lower levels of fasting blood glucose than those with very low whole grain intake (80.5 vs 87.5 mg/dl, $p<0.05$). Future analyses will address part 2 of the study.

THE EFFECTS OF *NOCARDIA* STRAINS CAS13 AND FA12 ON ACTINORHIZAL PLANT NODULATION AND SYMBIOSIS

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Actinorhizal plants form a symbiotic association with the nitrogen-fixing actinobacteria *Frankia*. These plants provide important economic and ecological benefits including land reclamation, soil stabilization, and reforestation. Many non-*Frankia* actinobacteria have been isolated from actinorhizal root nodules. One hypothesis is that these actinobacteria are suspected of enhancing the nodulation process during co-infection of the plants with *Frankia.* Two *Nocardia* strains, Cas13 and Fa12, were isolated from *Casuarina* root nodules found in Tunisia. We were interested in understanding the how these *Nocardia* benefit the health of the plant and the role that they play in the infection process as potential "helper" bacteria. Our objectives were to successfully fulfill Koch's postulates for the two *Nocardia* isolates and elucidate their effects on the *Frankia*-plant symbiosis via a co-infection study. Both *Nocardia* strains Cas13 and Fa12 formed root nodules on *Casuarina cunninghamiana.* The presence of the bacterium within the root nodule will be confirmed using 16s rRNA sequencing and qPCR techniques. Co-infection experiments with *Nocardia* and *Frankia* shown an early onset of plant nodulation timeline compared to plants infected with *Frankia* alone. Co-infection also caused an increase in the number of nodules present on the plants. These results indicate that the *Nocardia* bacteria serve as "helper" bacteria to increase plant nodulation and provide other benefits to plant health.