

**ABSTRACTS FOR**

**ORAL PRESENTATIONS**

**(in order of presentation)**

**ACOUSTIC MONITORING OF EBULLITIVE FLUX FROM A MIRE ECOSYSTEM IN SUBARCTIC SWEDEN**

Sophia Burke and Ruth Varner

Institute for the Study of Earth, Oceans, and Space, UNH

Methane (CH<sub>4</sub>) is twenty five times more effective as a greenhouse gas than carbon dioxide (CO<sub>2</sub>). Permafrost stores large amounts of soil carbon in the northern latitudes. Yet, with increased global temperatures, these areas are thawing allowing for the release of stored C as CH<sub>4</sub> and CO<sub>2</sub>. Previous experiments conducted at Stordalen Mire in northern Sweden have looked at the CH<sub>4</sub> flux from the thawing peat. Ebullitive flux, or flux from bubbles with high concentrations of CH<sub>4</sub>, has been found to be a significant source of CH<sub>4</sub> to the atmosphere. Acoustically monitoring these fluxes in lake and permafrost peat systems has occurred in the Stordalen Mire, Abisko, Sweden. I expanded this work in summer 2012 to include thaw ponds, intermediate thaw features. Eighteen sensors were deployed in the mire and sampled once a week. Gas samples were analyzed using a gas chromatograph for CH<sub>4</sub> concentration as well as a Quantum Cascade Laser for <sup>13</sup>C-CH<sub>4</sub>. The acoustic sensors recorded continuously from July through September. The acoustic data were chopped into six-minute sections and then run through a MATLAB program to determine the volume and timing of each ebullitive event. Based on the data collected, we found that CH<sub>4</sub> was released from the thaw ponds faster than from the peat or lake in 2011. Analysis of the <sup>δ13</sup>C-CH<sub>4</sub> of bubbles and sediment collected from the three-thaw pond sites suggest that CH<sub>4</sub> production pathways differ between all three-thaw pond sites.

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Year at UNH:	Senior
Career Interest:	Graduate school
Adviser:	Ruth Varner

**DEVELOPMENT OF AN OBESITY PREVENTION PROGRAM USING PARTICIPATORY ACTION RESEARCH**

Sara Fechner and Gale Carey

Department of Molecular, Cellular, & Biomedical Sciences, UNH

This research focused on developing an obesity prevention program for low-income families. The Participatory Action Research method was used to empower participants to play a role in development of the program, which allowed me to assess interest in the program. In the summer of 2012, focus groups (n=3 to 11 per group) were conducted in Dover, Rochester, Concord, and Manchester New Hampshire. Groups were queried about (1) their definition of health, (2) what they currently do to stay healthy, (3) what they would like to do to improve their health, (4) if they have ever participated in a health program, and (5) their reaction to a program that encompassed nutritional education with organized physical activity (hiking) and social support. Analysis of focus group responses revealed that participants were interested in healthy eating but felt healthy foods were too expensive. Most participants were enthusiastic about family, out-of-doors outings in a group setting and meeting new people. Participants at four out of the five sites expressed significant interest in the program, and the hope that it would be starting soon.

Author: Sara Fechner  
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Year at UNH: Senior  
Career Interest: Graduate school

Adviser: Gale Carey

**ABO BLOOD TYPE AND DIET CORRELATION STUDY**

Lauren Tassone and Adele Marone

Department of Molecular, Cellular, &amp; Biomedical Sciences, UNH

In his book, "Eat Right 4 Your Type," Dr. Peter J. D'Adamo claims that one can achieve a healthier state and an ideal weight by following a diet and exercise program specific to one's blood type. The purpose of my study was to determine if diet and exercise preferences of students enrolled at the University were affected by blood type. Volunteers were solicited from the Nutrition 400 class. These students were already participants in the CHANAS study, which examines the nutrition and exercise habits of college age students. Volunteers from the Nutrition 400 CHANAS study had their blood typed and completed an additional survey with questions specific to this study's purpose. Questions included diet preferences like weekly consumption of dairy, grains, and red meat, as well as preferences for types of exercise. Two blood groups were studied: type O (n=34) and type A (n=32). The information from the survey questions, along with nutritional data and exercise data collected from the CHANAS study was examined in relationship to blood type. Upon first examination of the data collected, there appears to be no correlation between blood type and diet and exercise preference. Data will undergo statistical analysis via IBM SPSS Statistics to further determine any significant correlation between blood type and diet or exercise preference.

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### **EFFECTS OF ABIOTIC STRESS FACTORS ON S-ADENOSYLMETHIONINE DECARBOXYLASE (SAMDC) GENES ON *ARABIDOPSIS THALIANA***

Ashley Klink<sup>1</sup>, Rajtilak Majumdar<sup>1</sup>, Lin Shao<sup>1</sup>, and Subhash Minocha<sup>2</sup>

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The enzyme S-Adenosylmethionine Decarboxylase (SAMDC) controls a key step in the biosynthesis of polyamines, which are organic polycations found in all living organisms. They play important roles in the growth, development and stress responses of plants through regulating cellular functions and metabolic pathways. The goal of my research is to understand the expression of two (out of five) members of the SAMDC gene family in response to salt and heavy metal stress. I used the gene of a reporter protein called b-glucuronidase (a.k.a. GUS – an enzyme that turns the cells blue when treated with its substrate called X-Gluc) attached to the *Arabidopsis thaliana* SAMDC3 and SAMDC4 promoters. The idea was to test if the genes for SAMDC3 and SAMDC4 were turned on in response to stress treatments, by observing the expression of the GUS gene because it is also controlled by the same promoter sequence. Two tests were performed on the tissue samples for expression of GUS. One involved visual analysis by observing blue cells following treatment with X-gluc; the second was a quantitative analysis that used MUG as substrate, which produces a fluorescent product. The results show that this technique is quite suitable to test my hypothesis that different SAMDC genes are expressed differently in different tissues and their expression responds differently to various stress factors. The results will help in understanding and improving stress responses in plants.

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 Career Interest: Medical School

Author: Rajtilak Majumdar  
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 Year at UNH: Graduate Student

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 Year at UNH: Graduate Student

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**FEEDING INCREMENTAL LEVELS OF GROUND FLAXSEED LINEARLY REDUCED MILK YIELD AND ENTERIC METHANE EMISSIONS IN ORGANIC JERSEY COWS**

Valerie Goeman, Nicole Antaya, and Andre Brito  
Department of Biological Sciences, UNH

Effects of feeding increasing levels of ground flaxseed on yields of milk and milk components, ruminal fermentation profile and enteric methane emissions were examined in 20 lactating organic Jersey cows housed at the UNH Organic Dairy Research Farm. Cows were randomly assigned to treatment sequences (0, 5, 10 or 15% of ground flaxseed) in 5 replicated 4×4 Latin squares. Each period lasted 21 days, with 14 days for diet adaptation and 7 days for sample collection. Cows were fed a total mixed ration and intake and milk yield were recorded throughout the study. Methane measurements were taken for 5 consecutive days using the sulfur hexafluoride technique. Yields of milk and milk components (fat and protein) were reduced linearly with incremental dietary levels of flaxseed. These decreases are explained by the linear reduction in dry matter intake in cows fed increasing levels of flaxseed. Enteric methane emissions were reduced linearly with increasing flaxseed, possibly as a result of decreased dry matter intake and enhanced molar proportion of ruminal propionate. Fatty acids from flaxseed are toxic for ruminal methanogens, thus shifting hydrogen utilization from methane to propionate production. Feeding flaxseed linearly reduced enteric methane emissions, which can decrease the environmental impact of dairy farming. However, linear decrease in milk yield, particularly with the highest level of flaxseed (i.e., 15% of diet dry matter), may limit flaxseed use by dairy farmers.

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Author's Major: Dairy Management  
Year at UNH: Graduate Student

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## IDENTIFICATION OF GENETIC LOCI INVOLVED IN *SERRATIA* SP. SCBI PRODUCTION OF ANTIMICROBIAL AGENTS

Kaitlyn LaCourse, Sheldon Hurst, Lauren Petersen, and Louis Tisa  
Department of Molecular, Cellular, & Biomedical Sciences, UNH

The recently discovered insect pathogen *Serratia* CBI (SCBI) forms a mutualistic association with the nematode partner *Caenorhabditis briggsae*. SCBI produces a variety of natural products including those with antimicrobial properties. These natural products may play a larger role in in nature the *Serratia-Caenorhabditis* relationship through signaling mechanisms. The aim of this study was to identify genes associated with the production of antimicrobial compounds from SCBI. The genome sequence of SCBI has already been established and provides a database to compare genes found with other closely related *Serratia* spp. A reverse genetic approach was taken using a library of transposon mutagenized SCBI and screening for changes in antimicrobial production. The mutants of interest were isolated, characterized, and the disrupted gene identified. Several mutants that showed a complete loss of antimicrobial activity had a transposon insertion within a 17kb non-ribosomal peptide synthetase gene. Causality of the mutation will be shown through complementation of the mutated genes. Further, the effect antimicrobial production has on the *Serratia-Caenorhabditis briggsae* symbiosis will be further investigated. The identification of the genes involved in the production of antimicrobial activity will contribute to our understanding of the role antibiotics play in this specific bacteria-nematode symbiosis.

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Author: Sheldon Hurst  
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Author: Lauren Petersen  
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**ANALYSIS OF BEHAVIOR AND SONG IN HYBRID MALE SALTMARSH X NELSON'S SPARROWS**

Evan Ehrlich, Molly Hunt, and Adrienne Kovach

Department of Natural Resources &amp; the Environment, UNH

In this study, our objective was to identify patterns in the behavior and song of hybridizing (interbreeding) Saltmarsh and Nelson's Sparrows. Based on evidence that hybridization is asymmetrical, we hypothesized that the behavior and song of hybrids would be more similar to that of Saltmarsh Sparrows. We captured adult sparrows with mist nets and marked 56 males with unique two color combination leg bands and 34 females with pink leg bands. Behavioral observations were conducted using binoculars and a spotting scope three mornings a week from a 14-foot observation platform, and behavioral time budgets were constructed. Songs of 19 sparrows were recorded using a Marantz® recorder and a parabolic microphone. Using RAVEN® software, we characterized the "alphabet" of songs and identified 13 syllables in Saltmarsh sparrows and 5 in Nelson's, respectively. The songs of Nelson's Sparrows were less variable in the frequency, duration, and pattern of syllables than that of Saltmarsh Sparrows. Nelson's Sparrows were found to be solitary and spent more time singing and competing with other males. Hybrid males did not sing a mixed song and behaved analogously to Saltmarsh Sparrow males. Our results contribute to an increased understanding of patterns of interspecific hybridization and have implications for the conservation of Saltmarsh Sparrows, threatened by an expanding hybrid zone.

Author: Evan Ehrlich  
 Author's Major: Wildlife and Conservation Biology  
 Year at UNH: Senior  
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Author: Molly Hunt  
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 Year at UNH: Senior  
 Career Interest: Veterinarian

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**BIOFILM ECOLOGY AND DIVERSITY ALLOWS FOR PERSISTENCE AFTER ANTIBIOTIC TREATMENT**

Megan McLaughlin and Vaughn Cooper

Department of Molecular, Cellular, &amp; Biomedical Sciences, UNH

Chronic biofilm infections of the cystic fibrosis lung are known to harbor multiple species communities. Biofilm communities generate complex niches, allow for microbial interactions and this diversity has been shown to exhibit increased persistence than less complex communities after antibiotic treatment. Experimentally evolved isolates of *Pseudomonas aeruginosa* and *Burkholderia cenocepacia* in a bead transfer model generated communities with strong parallelism with isolates sampled from chronic infections in terms phenotypic and genotypic diversity. Sequencing of experimentally evolved isolates reveal mutations allowing for adaptation to the biofilm environment. To determine the influence of community composition interspecies and intraspecies on the ability to generate persistence, diverse communities and monocultures of isolates were tested for the ability to survive treatment with Tobramycin in a biofilm lifestyle. The method of survival was assessed using a novel persistence assay. This assay separated methods of persistence into ecological niche associated or dormancy which has the potential to associate a phenotype or genotype with persistence in the face of antibiotic treatment.

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**ABSTRACTS FOR  
POSTER PRESENTATIONS**

**COMPARATIVE ANALYSIS OF TE MOBILIZATION IN *CAENORHABDITIS ELEGANS***

Jordan Ramsdell, Alison Cocchiola, Kazu Okamoto, Alyssa Piemonte, Andrew Quitadamo, Abigail VanNote, and W. Kelley Thomas

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Transposable elements (TE) are sequences within the genome that are capable “jumping” by inserting themselves into different regions of the genome. This makes them highly mutagenic. Recently DNA methylation has been shown to be a mechanism for transposable element suppression in animals and plants. This suggests that an impaired methylation mechanism and unchecked mobile elements in *C. elegans* should result in an increase of TE copy number. To test this hypothesis *C. elegans* strains which lack the genes for putative DNA methyltransferase (DNMT), the protein responsible for DNA methylation were propagated for many generations to allow for mobilization of transposable elements. Lines that showed phenotypic evidence of transposable element mediated mutations were then sequenced using Illumina sequencing technology. The sequence data was de novo assembled and the resultant contiguous sequence data were analyzed using custom Perl scripts that were created and implemented to survey the entire genome for direct evidence of TE mobilization. Based on these analyses we have developed modular tools to overcome difficulties in repetitive sequence analysis and tools that can be applied to large data sets to compare novel sequences created by TE insertions against the published reference. Furthermore, these tools can be applied to vast range of data sets where quantification of copy number and/or abundance of sequence type are important.

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Author: Alison Cocchiola

Author's Major: Biology      Year at UNH: Sophomore      Career Interest: Graduate School

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Author: Abigail VanNote

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**DOES FACIAL MASK SIZE REFLECT TERRITORY QUALITY FOR MALE COMMON YELLOWTHROATS?**

Sarah Dudek and Matthew Tarr

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Common yellowthroats (*Geothlypis trichas*) are songbirds that breed in shrub-dominated habitats throughout New England. Aviary experiments have demonstrated that male yellowthroats with large facial masks are dominant over those with smaller masks. Dominant males should secure higher quality territories than subordinate males, but it is unclear to what extent differences in mask size between males reflect actual differences in the quality of their territories. In New England, exotic shrubs are becoming increasingly prevalent in shrub-dominated habitats and can affect songbird territory quality by lowering food resources or by altering nest vulnerability to predators. In this study, I captured male common yellowthroats in powerline rights-of-way composed of different proportions of native and exotic shrub cover. I measured the size of each male's facial mask and determined if mask size was correlated with the proportion of exotic shrub cover measured within each male's territory. I also determined if mask size was correlated with caterpillar abundance, nest survival, nestling growth rates, or the number of young produced within each territory, which was measured as part of a larger, parallel study. I expected that males with the largest black masks would occupy the highest quality territories within a habitat patch.

Author:	Sarah Dudek
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Year at UNH:	Senior
Career Interest:	Wildlife Biologist
Adviser:	Matthew Tarr

### **A SCREEN TO IDENTIFY AND CHARACTERIZE MUTATIONS IN *ARABIDOPSIS THALIANA* CAUSING SODIUM-DEPENDENT ROOT SKEWING**

Matthew Cotton, Elora Demers, Kendall Milkey, Nicole Petersen, Megan Thompson, and Estelle Hrabak

Department of Molecular, Cellular, & Biomedical Sciences, UNH

Our research focuses on cell signaling in *Arabidopsis thaliana* and the role of the enzyme Protein Phosphatase 2A (PP2A) in root growth and elongation. PP2A is a heterotrimer with one A, one B and one C subunit. Mutations have been identified in specific A and C subunit genes that cause a root growth defect when plants are grown in sodium-supplemented medium. This sodium-induced root growth defect phenotype is novel and our goal is to identify other genes involved in this root response pathway. Our approach is to screen a large collection of T-DNA-mutagenized *A. thaliana* to identify additional plants with a similar phenotype. The screen has three parts. The primary screen identifies putative mutants with the root growth defect. The secondary screen confirms that the root defect is reproducible in the next generation. Finally, the tertiary screen confirms that the root defect is sodium-dependent and not caused by a different ion or by an osmotic effect. After identifying candidate mutants, the location of the mutation in the genome is determined by TAIL-PCR or plasmid rescue. Currently we have determined the location of the mutation in several individuals. Information generated from this screen will increase our understanding of root growth regulation and sodium effects on plants.

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Author: Elora Demers  
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Author: Nicole Peterson  
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 Year at UNH: Sophomore  
 Career Interest: Research

Author: Megan Thompson  
 Author's Major: Genetics  
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**ANIMAL PERSONALITIES**Jillian Corcoran<sup>1</sup> and Brett Gibson<sup>2</sup><sup>1</sup>Department of Biological Sciences, UNH<sup>2</sup>Department of Psychology, UNH

Until very recently, it was commonly believed that animals could not possess "personalities." It was thought a personality was something only capable by humans because of our superior brain. In recent years, however, many studies have been done to examine the possibility of differences in animal minds: in the way they think and react to the world around them. In this study, differences in the personalities of four Clark's nutcrackers, *Nucifraga columbiana*, were examined by observing their learning curves when introduced to new tasks as well as each individual's unique way of handling new things. The tasks used were ones that could aid in future husbandry needed to be done with the birds and the novel objects were enrichments designed to challenge them. All four of the birds worked with have unique ways of interacting with new objects and learning new tasks.

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Career Interest: Wildlife Education

Adviser: Brett Gibson

**DETECTION OF IMMUNOGLOBULIN A IN NEONATAL CALF SALIVA**Mallika Prabhakar<sup>1</sup>, Nate Smith<sup>2</sup>, and Paul Tsang<sup>1</sup><sup>1</sup>Department of Molecular, Cellular, & Biomedical Sciences, UNH<sup>2</sup>Cytosignet, Inc., Zeptomatrix, Inc.

Immunoglobulin A (IgA) protects the body from bacterial and viral pathogens. It is found on the mucosal surfaces of the gastrointestinal (GI) tract. IgA is also important during passive immunity from mother to offspring through the consumption of colostrum. For the dairy calf, this is especially important since it must consume colostrum within the first 24 hours of birth to acquire immunoglobulins through absorption at the GI tract. Failure of passive transfer could have serious health repercussions. Thus, in order to determine whether passive transfer was successful, a blood sample is taken to assess immunoglobulin status. However, it is not known whether an alternative body fluid, such as saliva, can be used. Therefore, the objective of the present study was to determine IgA concentrations in neonatal calf saliva at different time periods after birth. The saliva was collected by swiping the calf's cheek with cotton swabs. Then, an enzyme-linked immunosorbent assay (Bethyl Labs) was used to determine IgA concentrations. Our preliminary results indicate that IgA is present in the saliva of neonatal calves taken between 1 and 10 days after birth. While we will continue to determine IgA concentrations in saliva samples taken at other time periods, we conclude that IgA is detectable in calf saliva, which may be a good alternative, instead of using blood, to assess failure of passive transfer. Research was supported by Zeptomatrix Inc. and by the Multistate Project NE 1027.

Author: Mallika Prabhakar  
Author's Major: Biomedical Science  
Year at UNH: Senior  
Career Interest: Veterinary School

Adviser: Nate Smith  
Adviser: Paul Tsang

**ECOLOGY AND SOCIAL STRUCTURE OF BLACK BEARS IN CENTRAL NEW HAMPSHIRE**

Jonathan Trudeau and Peter Pekins

Department of Natural Resources &amp; the Environment, UNH

Knowledge of black bear (*Urus americanus*) kinship and social structure is relatively unstudied, leaving large gaps in knowledge about black bear relationships. Learning how bears interact with each other can create a new perception of black bears. Home ranges overlap between related and non-related bears and the way other bears interact with them are different. It is thought that black bears do not interact with one another unless they need to, but this study has shown otherwise. In a 27.2 square mile study area, 43 bears were observed at feed sites with trail cameras. There were related and non-related bears frequenting the sites before, during, and after the breeding season. By analyzing GPS data from radio-collared females, I was able to document reciprocity between unrelated individuals who have over-lapping home ranges. Photographs would confirm the assumption that the individuals are actually coming in close contact. Females who had cubs frequented fewer sites and had a smaller range than females who did not, but the differences were minimal and were primarily due to abundance of natural foods. At all sites, females dominated the area and gave credibility to the theory that black bears have a matriarchal hierarchy. Because bears communicate, tolerate, and share resources, nuisance activity by multiple bears could be easily diminished by simple elimination of human-related food sources.

Author:	Jonathan Trudeau
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Year at UNH:	Senior
Career Interest:	Wildlife Biologist
Adviser:	Peter Pekins

**GUIDING STARS AT THE UNH DAIRY BAR**

Alexandra Bourcy, Crystal Cascio, Sarah Maskwa, Jesse Morrell, and Gale Carey  
 Department of Molecular, Cellular, & Biomedical Sciences, UNH

Developed in 2006, "Guiding Stars"® (GS) is a point of selection rating system that uses the nutrient density of foods to categorize items as good (1 star), better (2 stars) or best (3 stars). In 2010 UNH Dining introduced the GS rating system to all three dining halls. The goal of this project is to determine if implementing GS at the UNH Dairy Bar (DB) influences patrons' choice of healthy foods. To meet this goal, a 5-item, anonymous survey of DB patrons was conducted during November 2012 (n=196, 73 female). This baseline survey revealed that 68% of DB participants felt that health and nutrition knowledge dictated their food choices all or most of the time and 79% thought healthy food choices were easily identified at the DB. The majority of participants cited that hunger, convenience, and taste influenced their food choices. Sixty percent of patrons reported no prior nutrition education; these patrons were less likely to cite the following factors influencing their food selection: nutrient content, posted nutrition information, organic, or locally produced/grown. The project's next steps will be to implement GS at the DB (March 2013) by placing GS icons near nutrient dense foods and menu items and develop signage and marketing items to promote GS at the DB. A follow-up survey (April 2013) will evaluate if the presence of GS at the DB influences patrons' food selections.

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Author: Sarah Maskwa  
 Author's Major: Nutrition  
 Year at UNH: Senior  
 Career Interest: Dentistry

Adviser: Jesse Morrell  
 Adviser: Gale Carey

**THE EFFECTS OF DIETARY FATTY ACIDS ON IMMUNE CELL FUNCTION**

Jenny Jing, Anne Ronan, and Anthony Tagliaferro

Department of Molecular, Cellular, &amp; Biomedical Sciences, UNH

Diets imbalanced in ratio of n-6 and n-3 polyunsaturated fatty acids (PUFA) have been suspected to cause an imbalance in immune cell function that may promote allergy development and related airway disease. Alveolar macrophages (AM) are cells of the innate immune system that also can be antigen- presenting to other immune cells and chemically stimulate other immune cells that are associated with allergy development. N-6 fatty acids are suspected to alter AM function toward allergy development. This investigation aims to study the effects of dietary fats that vary in n-6 / n-3 PUFA on chemical phenotype and genotype of AM, using 42, male 21 doa C57BL/6 mice. Mice were assigned randomly to one of three respective purified diets that contain milk fat in different ratios of n-6:n-3 PUFA: 1) Control [6:1], 2) Low [1:1], 3) High [15:1]; half of the animals were sensitized to egg protein (OVA). After cells were harvested via bronchial lavage, stimulated with LPS + OVA IgG complex over 24 hours, PGE<sub>2</sub>, a chemical marker of AM phenotype, will be measured by ELISA. Genetic transcription of AM from two animals, representative of each diet, will be profiled by PCR array. It is expected high PGE<sub>2</sub> expression will indicate an IL-10 transcription that down-regulates LPS-inducible mRNA expression of pro-inflammatory cytokines (TNF- $\alpha$ , IL-1, and IL-12), and an up-regulation of genes associated with allergy.

Author:	Jenny Jing
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Year at UNH:	Senior
Career Interest:	Graduate School
Adviser:	Anne Ronan
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**IDENTIFICATION OF THE CIRCADIAN CLOCK GENE AND PROTEIN CRYPTOCHROME-2 IN THE AMERICAN LOBSTER, *HOMARUS AMERICANUS***

Cody White<sup>1</sup>, Kevin Chesmore<sup>2</sup>, Scott Finnance<sup>1</sup>, Chris Chabot<sup>2</sup>, and Winsor Watson<sup>1</sup>

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Many organisms, including *Homo sapiens*, express daily rhythms of behavior that are, in part, under the control of endogenous biological clocks. These clocks tend to be located in the central nervous system and many of the genes and proteins responsible for generating the daily rhythms in these clock cells have been identified. The major goal of this study was to locate putative clock neurons in the American lobster (*Homarus americanus*). First, we extracted the DNA and had it sequenced, yielding a genomic database that could be searched with genomic software for orthologs of known "clock genes". Using this approach we identified a gene that codes for the protein Cryptochrome-2 (CRY). Cryptochrome-2 is not a photoreceptor, like Cryptochrome-1, but is responsible for controlling the expression of other clock genes and allowing animals to entrain to the natural light:dark cycle. Antibodies targeted for Cryptochrome-2 were then used to visualize lobster neurons containing Cryptochrome-2. We found approximately 4 CRY-positive neurons in each abdominal ganglion, except the last one, which has ~20. We are presently using Western Blotting to determine if lobster Cryptochrome-2 oscillates between high levels at dawn and low levels at dusk, as Cryptochrome-2 does in the clock neurons of other animals.

Author: Cody White  
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 Career Interest: Biotechnology

Author: Kevin Chesmore  
 Author's Major: Biology  
 Year at UNH: Graduate Student

Author: Scott Finnance  
 Author's Major: Neuroscience and Behavior  
 Year at UNH: Senior

Adviser: Chris Chabot  
 Adviser: Winsor Watson

## **MULTIVITAMIN/MINERAL USAGE, BODY MASS INDEX, AND EXERCISE AMONG COLLEGE STUDENTS**

Christie Mastriano, Leah Tully, and Jesse Morrell  
Department of Molecular, Cellular, & Biomedical Sciences, UNH

Studies have shown that multivitamin/mineral (MVM) usage has risen over the past decade in the United States and that MVM users have healthier BMIs and exercise more. The purpose of this study is to explore the relationship between supplement usage, BMI, and exercise among college students (18-24) participating in the ongoing College Health and Nutrition Assessment Survey (CHANAS) at the University of New Hampshire (n=5119; 73% female). MVM usage and amount of exercise were determined via questionnaire. BMI was determined via measured height and weight following standard protocols. MVM usage was reported in 33% of participants. Mean BMI (kg/m<sup>2</sup>) was higher among men than women (24.9 vs. 23.3, p <.05) but did not differ between MVM users and non-users (p=.73). Thirty-seven percent of participants reported exercising  $\geq$  5x/wk. MVM users were more likely than non-users to exercise  $\geq$ 5x/wk (44% vs. 34%, p<.05). These findings show that MVM usage may be related to increased amounts of exercise among college students. Supported by NHAES grant NH00541.

Author: Christie Mastriano  
Author's Major: Nutrition  
Year at UNH: Senior  
Career Interest: Nurse Practitioner

Author: Leah Tully  
Author's Major: Nutrition  
Year at UNH: Junior  
Career Interest: Health Promotion

Adviser: Jesse Morrell

**PATHWAYS OF DISTINCTION ANALYSIS OF EWING'S SARCOMA GWAS DATA**

Sean Santos and Thomas Davis  
Department of Biological Sciences, UNH

An algorithm called Pathways of Distinction Analysis (PoDA) was used to analyze genome wide association study (GWAS) data containing Ewing's sarcoma patients and healthy controls. The PoDA algorithm looks for biological pathways that contain single nucleotide polymorphisms (SNPs) occurring more frequently in cases than controls within, or closely around, genes that have been documented in a number of known and well explained pathways from online databases. PoDA generates a distinction score for each pathway that it analyzes, giving the probability of that pathway having cases that are more closely related to other cases than to controls in terms of their genotype. It compares this distinction score for each pathway to 10,000 randomly generated other pathways. A p-value is returned for the pathway giving the number of random pathways that had a higher distinction score than the original pathway divided by 10,000. In the Biocarta database, the role of nicotinic acetylcholine receptors in the regulation of apoptosis (ACH) pathway and the signaling pathway from G-protein families (GPCR) showed significant p-values. The genes in these pathways should be analyzed further as they may provide further insight as to what makes a person susceptible to Ewing's sarcoma.

Author: Sean Santos  
Author's Major: Biology  
Year at UNH: Senior  
Career Interest: Graduate School

Adviser: Thomas Davis

**SYNCHRONY AS A PROXY FOR MALE FITNESS IN BAITING BEHAVIORS OF THE SPOTTED HYENA, *CROCUTA CROCUTA***

Allison Brehm, Stephanie Walsh, and Leslie Curren  
Department of Biological Sciences, UNH

An animal's fitness is often advertised to potential mates through a variety of unique behavioral displays. The fitness displays and mate choice of the spotted hyena (*Crocota crocuta*) are not thoroughly documented, though the species is notably female dominant and males rarely behave aggressively towards females. Periodically, however, multiple adult males will direct aggression towards an adult female in a behavior known as "baiting." The function of baiting is unclear since it precedes no immediate or obvious act. One previous hypothesis is that baiting influences female mate choice because baiting frequency is positively correlated with a female's proximity to conception. Our study expands this hypothesis, focusing on synchrony of male behavior within a baiting episode as a proxy for fitness. Synchronous behavior occurs in social species as an adaptive signal for alliance membership, specifically around females. We predict that male synchrony will be most frequent close to female conception, and that degree of synchrony will positively correlate with annual male reproductive success. To explore this hypothesis, we will use the software program JWatcher to extract behavioral data from videos of baiting episodes. We hope that by analyzing videos of baiting in greater detail than has been done previously, we can ascertain the function baiting plays in mate choice.

Author: Alison Brehm  
Author's Major: Zoology  
Year at UNH: Senior  
Career Interest: Graduate School

Author: Stephanie Walsh  
Author's Major: Zoology  
Year at UNH: Junior  
Career Interest: Wildlife Conservation and Research

Adviser: Leslie Curren

**THE EFFECTS OF CYTOKININ ON THE TRANSCRIPTIONAL REGULATION OF PIN EXPRESSION IN *ARABIDOPSIS THALIANA***

Elizabeth Burgess and Dennis Mathews

Department of Molecular, Cellular, &amp; Biomedical Sciences, UNH

**ABSTRACT:** The processes of cell division and differentiation are critical to the development of any multicellular organism. During the formation of plant roots these processes take place at a region of the root tip called the meristem. Cytokinin and auxin are two plant growth hormones that influence this process. Although these two growth hormones are both necessary they also appear to have an antagonistic relationship that is fascinating. As meristematic root cells undergo differentiation they cease dividing. It has been proposed that the overall rate of root growth is determined by the balance between the rate of cell division, determined by auxin, and the rate of cell differentiation, determined by cytokinin. One of the ways cytokinin may have an antagonistic influence on auxin regulation is by limiting auxin transport. My experiment explores the relationship between these two growth hormones using real-time quantitative PCR to quantify the gene expression of PIN proteins (auxin transporters). My goal is to gain a better understanding of the intricacies of the relationship between auxin and cytokinin.

Author: Elizabeth Burgess

Author's Major: Genetics

Year at UNH: Senior

Career Interest: Medical School

Adviser: Dennis Mathews

**THE INVESTIGATION OF MICROBE-NEMATODE INTERACTIONS**

Chelsea Crepeau and Louis Tisa

Department of Molecular, Cellular, &amp; Biomedical Sciences, UNH

The symbiosis and entomopathogenicity of nematode strains and bacterial strains is a system that is extensively researched, but not well understood. The strain *Caenorhabditis briggsae* was found to have entomopathogenic relations with *Serratia marcescens* sp. SCBI in the natural environment. This relationship is of interest in the Tisa lab and has led to an attempt to manipulate and reproduce the relationship in a laboratory environment. The relationship has not yet been producible in a laboratory setting. In addition to experimenting with the *Caenorhabditis briggsae*/*S. marcescens* SCBI relationship, another research interest is in freezing mechanisms and freezing efficiency of the nematodes *C. briggsae* and *Heterorhabditis bacteriophora* species. A freezing protocol has been formulated for *H. bacteriophora*, but the efficiency and viability for worms is not ideal so more freezing experiments are planned to improve maintenance and storage of the nematodes. As a test, the freezing protocol of *C. briggsae* was also experimented with to ensure its efficiency.

Author:	Chelsea Crepeau
Author's Major:	Genetics
Year at UNH:	Senior
Career Interest:	Graduate Degree in Genetic Counseling
Adviser:	Louis Tisa

**AN EVALUATION OF MANAGED NESTING HABITATS FOR TURTLES IN SOUTHEASTERN NEW HAMPSHIRE**

Cameron Duquette and John Litvaitis  
Department of Natural Resources & the Environment, UNH

In response to declining connectivity in turtle habitat, land managers have experimented with enhancing the quality of local habitat features to reduce wildlife road crossings roadkill mortality. Turtles need areas of friable soil and little canopy cover to nest. Artificial nesting sites in Brentwood, Lee, and Newmarket, NH were created in 2012 to supplement existing habitat for painted turtles (*Chrysemys picta*), snapping turtles (*Chelydra serpentina*), Blanding's turtles (*Emydoidea blandingii*), and spotted turtles (*Clemmys guttata*). From May 21 to June 29, nest surveys were conducted in identified plots. Nests were identified as intact or depredated. If they remained intact through the end of the monitoring period, nests were considered successful. Predation was monitored with visual surveys and Bushnell game cameras. Successful and depredated nests were compared in slope, aspect, edge, soil type, and distance to edge and water. By the end of the survey period, I encountered 195 depredated and 19 intact nests. Nests were depredated at a rate of 15.8%, and primary observed predators were American crow (n=63) and raccoon (n=15). Depredated nests were on significantly higher slopes than intact nests. Results from this study will be used in both turtle nest monitoring projects and further nest area construction and maintenance.

Author: Cameron Duquette  
Author's Major: Wildlife and Conservation Biology  
Year at UNH: Senior  
Career Interest: Graduate School  
  
Adviser: John Litvaitis

**ANATOMICAL STUDY OF THE OAK APPLE GALL NURSERY CHAMBER**

John Micozzi and Wayne Fagerberg

Department of Molecular, Cellular, &amp; Biomedical Sciences, UNH

This research project focuses on the anatomical changes involved in the development of Oak Apple galls, specifically what controls the development of the Gall Nursery Chamber (NC). The formation of a gall occurs when a wasp (*Biorhiza pallid*) lays its egg in a budding oak leaf. The leaf bud then develops into the gall that we are studying. Once initialized, it is unclear what controls the development of the gall – wasp or tree. In order to understand the control of the NC development, we compared the cellular /anatomical structure of the NC to wasp stages of development. If there is a correlation, we feel this would support the idea that the wasp controls the Gall development. Sections of NC at various stages of wasp development were stained. Each stained sample was then photographed to use for data collection. We are currently quantifying NC cellular anatomical structural data, the results of which will be presented at the COLSA URC.

Author: John Micozzi  
Author's Major: Biomedical Science  
Year at UNH: Sophomore  
Career Interest: Graduate School, Research, Private Industry  
  
Adviser: Wayne Fagerberg

**ASAMANG, GHANA: A COMMUNITY PERCEPTION OF WATER QUALITY**

Elizabeth Sterndale<sup>1</sup> and Rosemary Caron<sup>2</sup>

<sup>1</sup>HMP/Nursing, UNH

<sup>2</sup>Health Management and Policy, UNH

In January of 2013 I travelled to Ghana in which I compiled independent research through cultural emersion. I attended a regional meeting and interviews, and also made water quality observations and obtained hospital data in order to understand how the people of this rural village in a third-world country comprehend water quality.

Author:	Elizabeth Sterndale
Author's Major:	Environmental Conservation Studies
Year at UNH:	Senior
Career Interest:	MPH in Global Health
Adviser:	Rosemary Caron

**ASSESSING INFLAMMATORY MARKERS IN GRAIN FED VS. PASTURE FED DAIRY COWS**

Daniel Gallant and Thomas Foxall  
Department of Biological Sciences, UNH

Milk produced by grass-fed dairy cows contains a healthier fatty acid content for humans than does milk from conventional grain/total mixed ration-fed cows. No study to date has compared the health of these animals. One indicator of overall health is inflammatory status. This study uses the measurement of plasma fibrinogen, an acute-phase glycoprotein circulating in the plasma that is essential in the blood coagulation process and also elevated in inflammation. Blood samples were collected from nine cows from both the UNH conventional dairy farm and the UNH organic dairy farm at two points within the pasture season. Plasma fibrinogen levels were analyzed by the ELISA method and compared between the two groups of cows. Blood smears were also read microscopically for differential and total white blood cell counts, which are also indicators of inflammation. Results are expected to show that the dairy cows fed by conventional methods will have higher plasma fibrinogen levels and white blood cell estimates, and therefore experience greater rates of inflammation than the pastured cows. The results of this study will help establish whether there is a difference in animal health of feeding fresh forage instead of high grain diets, which can be meaningful to dairy farmers in a number of ways.

Author: Daniel Gallant  
Author's Major: Biomedical Science  
Year at UNH: Senior  
Career Interest: Physician Assistant

Adviser: Thomas Foxall

**PLACE MATTERS: A COMPARATIVE STUDY OF RURAL DEVELOPMENT AND COMMUNITY AGRICULTURE PROJECTS IN AFGHANISTAN AND NEW HAMPSHIRE**

Charlene Higgins and John Halstead

Department of Natural Resources &amp; the Environment, UNH

This comparative study will examine the barriers that Rural Development and Community Agriculture projects encounter with an emphasis on the idea that "place matters." Focusing on the two diverse case studies of Afghanistan and New Hampshire demonstrates that while some common challenges exist, there is not a universal rural development process. Recognizing the challenges is an essential step in better understanding what the socio-cultural and economic impacts of these projects are or could be. Through working with non-profit organizations based in both New Hampshire and Afghanistan, I will conduct a series of interviews with various players in order to identify the barriers to successful and economically sustainable Rural Development and Community Agriculture initiatives. The results of the study aim to provide valuable information, insight, and recommendations for how to better grow the opportunities for Rural Development and Community Agriculture programs throughout our local and global communities.

Author:	Charlene Higgins
Author's Major:	Environmental and Resource Economics
Year at UNH:	Junior
Career Interest:	International development, Graduate School
Adviser:	John Halstead

**BIG CATS IN CONFLICT: NAMIBIA'S CHALLENGE IN MANAGING AND PROTECTING PREDATORS ON COMMUNAL AND COMMERCIAL FARM LAND**Patricia Calvin<sup>1</sup> and Andrew Conroy<sup>2</sup><sup>1</sup>Independent , UNH<sup>2</sup>Thompson School Applied Animal Science, UNH

Namibia's communal and commercial farmers have many conflicts with managing and protecting big cats, including cheetahs, lions, and leopards. These large predators have suffered in the past due to farmer's lack of understanding about how they can coexist with such animals. There are laws that protect the animals, but they are often ignored or not enforced. Recently, some conservation organizations, and farmer-run conservancies have found ways to help the locals live with the big cats and they have begun to see an increase in the numbers of big cats in some areas. For example, the cheetah population, which was almost complete eliminated in the past, has begun to increase and reached 2,500 cheetahs, making this population of cheetahs, the world's largest. Not all animals are making a come back, however. The current situation in Namibia seems to be a mix of success and failures, due to many factors.

Author:	Patricia Calvin
Author's Major:	Biomedical Science
Year at UNH:	Junior
Career Interest:	Graduate School
Adviser:	Andrew Conroy

**BINGE DRINKING, BLOOD PRESSURE, AND DURATION OF PHYSICAL ACTIVITY AS RISK FACTORS FOR CARDIOVASCULAR DISEASE IN COLLEGE STUDENTS**

Danielle Dubois and Jesse Morrell

Department of Molecular, Cellular, &amp; Biomedical Sciences, UNH

Inadequate physical activity (PA) and pre-hypertension (PH) are known risk factors for cardiovascular disease (CVD), however, their relationship with college binge drinking has not been closely examined. Data from the ongoing cross-sectional College Health and Nutrition Assessment Survey were collected between 2005-2012. Introductory nutrition students (n=5604) reported PA and drinking behavior via questionnaire; blood pressure (BP) was measured via automated cuff following standard protocol. The duration of daily PA was categorized as none, <30, 30-59, 60-89, or  $\geq 90$  min; BP was categorized as PH ( $\geq 120/85$ ) or normotensive ( $< 120/85$ ). Fifty-two percent of students reported binge drinking within the last two weeks. Male binge drinkers tended to be more likely than non-binge drinkers to spend  $\geq 90$  min/day engaging in PA (37% vs 32%,  $p=.07$ ). Female binge drinkers were more likely to spend 60-89 min/day engaging in PA vs non-binge drinkers (36% vs 31%,  $p<.01$ ). Male binge drinkers were more likely to have PH than non-binge drinkers (59% vs 45%,  $p<.01$ ); no difference in prevalence of PH among females were observed. Data suggests that binge drinking is associated with longer durations of PA in all students, and PH is more common among male students that report binge drinking as compared to those that report no binge drinking. Supported by NHAES grant NH00541.

Author: Danielle Dubois  
Author's Major: Nutrition  
Year at UNH: Senior  
Career Interest: Registered Dietician

Adviser: Jesse Morrell

**BIODIVERSITY OF LEAFHOPPERS IN ORGANIC AND NON-ORGANIC FARMS IN SOUTHERN NH: A COMPARISON OF DIFFERENT TRAPPING TECHNIQUES**

Emmaline Clarkson and Donald Chandler  
Department of Biological Sciences, UNH

This study was conducted over the summer at Brookdale, Rosaly, and Newfield Farms. Leafhoppers were collected using sticky traps, different colored pan traps, and sweeping nets. The samples were then identified to species and the data were examined in order to observe leafhopper trends. The species composition was compared between sites to see if chemical treatment had an effect on leafhopper diversity. Leafhopper attraction to different color pan traps was also examined in this study, along with the effectiveness of the various trapping mechanisms used in indicating diversity.

Author: Emmaline Clarkson  
Author's Major: Biology  
Year at UNH: Senior  
Career Interest: Medical School

Adviser: Donald Chandler

**BOHANAN FARM, CONTOOCCOOK, NH: THE FIFTH GENERATION, LOOKING TO THE FUTURE**Josiah Robertson<sup>1</sup> and Andrew Conroy<sup>2</sup><sup>1</sup>Thompson School, UNH<sup>2</sup>Thompson School Applied Animal Science, UNH

Bohanan Farm is a fifth generation family dairy farm, milking 170 cows in central New Hampshire, in the fertile Contoocook River Valley. In recent years, as the dynamics of agriculture have changed and the local food movement has grown, our farm has begun to look at a different farm model. Through my undergraduate coursework and capstone research, I have developed a more diversified farm plan, integrating different animal species, horticultural practices and more farmer-to-consumer interactions for the future of our farm.

Author: Josiah Robertson  
Author's Major: Integrated Agricultural Management: Veterinary Technology  
Year at UNH: Junior  
Career Interest: Farmer Owner/ Manager

Adviser: Andrew Conroy

**BOLDNESS IN THE ASIAN HOUSE GECKO, *HEMIDACTYLUS FRENATUS*, AND ITS RELATIONSHIP TO RUNNING SPEED, BITE FORCE, AND MASS**

Ashley Heim and Leslie Curren  
Department of Biological Sciences, UNH

The invasive Asian house gecko *Hemidactylus frenatus* has become distributed worldwide as a result of both international trade and travel and its versatile lifestyle. Particularly abundant in urban areas, *H. frenatus* is adept at sprinting and exhibiting aggression towards other gecko species. In this study, I first explored body mass as a possible predictor of boldness, and then asked if boldness predicts running speed and bite force. I hypothesized that larger body masses would increase the prevalence of bold behavior, as larger-massed individuals appear to take more risks in foraging contexts. I also conjectured that as individual boldness heightened, so too would the individual's bite force; a faster running speed would be observed in the shyer individuals. Bolder individuals tend to be more aggressive and take more risks, while shyer individuals are subordinate and easily disrupted from foraging. Personality tests for boldness measured routine activity and the proportion of time spent inside and outside of shelter. LED light gates were used to measure sprint speed, while a force transducer was employed to measure bite force. Linear models were used to explore the relationships between variables. Such relationships could have many implications on why *H. frenatus* is so successful in outcompeting its native counterparts and so harmful to their existence.

Author: Ashley Heim  
Author's Major: Zoology  
Year at UNH: Senior  
Career Interest: Graduate School

Adviser: Leslie Curren

**CHARACTERIZATION OF CELLULAR FLICE INHIBITORY PROTEIN (C-FLIP) IN CELLS OF HUMAN CERVICAL CANCER**

Caitlin McCarthy and David Townson

Department of Molecular, Cellular, &amp; Biomedical Sciences, UNH

The protein cFLIP is suspected to protect cells against programmed cell death (apoptosis) in human cervical carcinoma, and thus provide a mechanism to promote metastasis. The objective of this study was to determine the relative expression of cFLIP in a cervical cancer cell line (HeLa cells), known to contain cells both resistant and vulnerable to apoptosis, depending upon whether or not the cells express cytokeratin filaments. The HeLa cells that express (K+) or lack (K-) cytokeratin filaments were cultured and then exposed to culture medium alone (control), cycloheximide (a protein synthesis inhibitor), and/or Fas antibody (to induce apoptosis). A cell death assay confirmed K+ cells are more resistant to apoptosis than K- cells. The cells were subsequently lysed to separate cellular proteins using SDS-polyacrylamide gel electrophoresis (SDS-PAGE). SDS-PAGE followed by immunoblot analysis revealed no differences in c-FLIP expression (relative to  $\beta$ -actin) between K+ and K- HeLa cells under control culture conditions. However, further experiments in which the cells were exposed to cycloheximide and/or Fas agonist indicated cFLIP increased in K- cells, regardless of treatment. Additional experiments are underway to resolve these discrepancies, including a test of whether cFLIP might associate with keratin filaments to influence the abundance of immunodetectable cFLIP. Supported by a Hamel Center SURF Award (CMM) and the Karabelas Fund (DHT).

Author:	Caitlin McCarthy
Author's Major:	Biomedical Science
Year at UNH:	Junior
Career Interest:	Medical School
Adviser:	David Townson

**COLLEGE STUDENTS' MIDPOINT SLEEP TIME AND DIETARY INTAKE**

Evagelia Georgakilas and Anthony Tagliaferro

Department of Molecular, Cellular, &amp; Biomedical Sciences, UNH

America is experiencing high rates of obesity, with alarming trends among children and young adults. Research shows there is an association between sleep duration and energy consumption/obesity among young adults (18-24 yrs). The relationship between sleep timing and college students' dietary intake has not been extensively investigated. Students (n=146, 74.7% female) from the ongoing College Health and Nutritional Assessment Survey (CHANAS) completed a sleep questionnaire and three-day food record. Macronutrient intake, energy density (g/kg), and empty calories, as defined by MyPlate guidelines, were calculated via Diet Analysis+ 10.0. Midpoint sleep time was calculated using reported onset and rise time of usual weekday sleep; midpoint sleep times were then grouped by quintiles from earliest (1) to latest (5). On average, students reported 8.5±0.1 hours of sleep on weekdays; the average midpoint was 3:56AM. Students in the latest sleep quintile reported the greatest intake of empty calories compared to those in the earliest quintile (776±55 vs 525±60 kcals/day,  $p \leq 0.05$ ). The mean energy densities and macronutrient intakes between sleep midpoint quintiles were not different. Findings suggest that later midpoint sleep times may be related to increased consumption of empty calories among college students.

Author: Evagelia Georgakilas

Author's Major: Nutrition

Year at UNH: Senior

Career Interest: Registered Dietician

Adviser: Anthony Tagliaferro

**DETECTION OF PRESSURE IN JUVENILE *LIMULUS POLYPHEMUS***

Nicole Ashmankas and Winsor Watson  
Department of Biological Sciences, UNH

The American horseshoe crab, *Limulus polyphemus*, is typically most active during high tide. This pattern of activity is driven in part by an endogenous circatidal clock. Recent studies have also shown that it is possible to synchronize their activity rhythms to artificial tides. While it has been hypothesized they do this by sensing changes in water depth, and hence water pressure, this has not been conclusively verified. In this study all other stimuli associated with changing tides, such as currents, and changes in temperature and salinity, were removed by placing animals in a pressure chamber and increasing the overall pressure by specific increments. Most horseshoe crabs showed increased bouts of activity during times of increased pressure, which agrees with the trend of increased activity at high tide. The heart rates of animals were also monitored, as changes in heart rate can be an indicator the animal detected a change in the environment. The lowest pressure level tested was +1 psi, equivalent to a tidal increase of approximately 2.3 ft. Results from these tests indicated a significant increase in heart rate subsequent to the increase in pressure in 3 of the 5 animals tested at this pressure ( $P < 0.005$ ). Of the 14 animals tested with higher pressure increases (+1.5-4 psi), 10 had significant changes in heart rate. These data support the hypothesis that horseshoe crabs can sense small changes in pressure and likely use this sense to help entrain to tidal cycles.

Author: Nicole Ashmankas  
Author's Major: Zoology  
Year at UNH: Senior  
Career Interest: Endangered Animal Conservation

Adviser: Winsor Watson

### **DEVELOPING A PROTOCOL TO STANDARDIZE DETECTION RATES BY TRAIL CAMERAS USED TO MONITOR FOREST CARNIVORES**

Kelsey Wellington, Christopher Bottom, Cody Merrill, and John Litvaitis  
Department of Natural Resources & the Environment, UNH

With the increasing popularity of remotely-triggered cameras in field research, a variety of equipment and technologies have become available. The popularity of these cameras among non-scientists may also provide an opportunity to use volunteers in organized efforts to monitor the distribution or abundance of secretive and low-density forest carnivores. One concern when applying a citizen-science approach is the ability to standardize detections among various camera brands that volunteers are likely to bring. Previously, we reported that such features as camera trigger speed and detection zone had a substantial influence on detection rates by different camera models. In response to this potentially serious sampling bias, we are exploring methods to reduce or eliminate detection differences among camera configurations. Paired cameras with different trigger speeds, sensitivity levels, and detection zones were positioned in the field with a standard regiment of attractants. In addition to general scent attractants (coyote urine) that were liberally distributed throughout the immediate sampling area, we tied a chicken thigh to a wooden stake and positioned the stake 3 m from the paired cameras. Our expectation was that any animal attempting to retrieve the chicken thigh would spend sufficient time in front of the cameras to assure detection by both of them. Preliminary results indicate that we may indeed be able to obtain nearly equivalent results by using this protocol.

Author: Kelsey Wellington  
Author's Major: Wildlife and Conservation Biology  
Year at UNH: Senior  
Career Interest: Graduate School, field research in conservation of endangered carnivores

Author: Christopher Bottom  
Author's Major: Wildlife and Conservation Biology  
Year at UNH: Recent Graduate  
Career Interest:

Author: Cody Merrill  
Author's Major: Wildlife and Conservation Biology  
Year at UNH: Graduate Student

Adviser: John Litvaitis

**DEVELOPING AN INTEGRATED AGRICULTURAL ENTERPRISE ON 12 ACRES IN FARMINGTON, NH**

Marissa Huppe and Andrew Conroy  
Thompson School Applied Animal Science, UNH

This capstone project for the Integrated Agriculture Management program highlights the development of a diversified farm business on twelve acres in Farmington, New Hampshire. The farm plan includes resource assessments, production system selection, and market conditions for local direct sales to consumers. Soils were mapped and tested for nutrients and pH. Crop species were selected based on the local market, soil type and climatic conditions. The placement of crops were integrated into the farm based on best use in the available soils. Placement of high tunnels and crops were also integrated into the farm map. Animal species were selected based on feed resources and local demand. Finally, marketing strategies and projected cash flows are presented.

Author: Marissa Huppe  
Author's Major: Integrated Agricultural Management: Veterinary Tec  
Year at UNH: Sophomore  
Career Interest:

Adviser: Andrew Conroy

**DOES THE GLND NITROGEN METABOLISM REGULATOR MEDIATE REGULATION OF IRON UPTAKE BY THE GACA GLOBAL ACTIVATOR OF COLONIZATION IN *VIBRIO FISCHERI*?**

Sarah Gagne<sup>1</sup>, Evan DaSilva<sup>2</sup>, Randi Foxall, and Cheryl Whistler<sup>2</sup>

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

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

The bacterium *Vibrio fischeri* forms light organ symbiosis with squid. Beneficial symbioses are interesting because unlike pathogenic relationships both organisms must accommodate each other. *V. fischeri* benefits the nocturnal squid by producing light that is similar to moonlight which disguises the squid from predators, and the squid benefits *V. fischeri* by providing food. Since iron uptake molecules called siderophores are upregulated in squid, and two mutants defective in siderophore, GacA and GlnD, have symbiotic defects, it implies these molecules play a symbiotic role. A microarray of a GacA mutant indicates GlnD is downregulated, suggesting GlnD may be the cause of its siderophore defect. The goals for this research are to verify that GlnD regulates siderophore, verify that GacA regulates GlnD, and also determine if GlnD is the cause of the GacA mutants siderophore defect. Several GlnD transposon mutants have no siderophore defect; however, the insertions may not eliminate its function. Therefore, we will generate a deletion mutant, and assess its siderophore production. Since expression of GlnD did not restore the GacA mutant's siderophore, there may not be a role for GlnD in siderophore, the construct may need to be optimized, or GacA may not regulate GlnD. To further address these possibilities, I will quantify GlnD expression and generate a new GlnD construct for the GacA mutant. I will evaluate these strains for symbiosis to define the role of GlnD.

Author: Sarah Gagne  
 Author's Major: Biology  
 Year at UNH: Senior  
 Career Interest: Research

Author: Evan DaSilva  
 Author's Major: Genetics  
 Year at UNH: Graduate Student

Author: Randi Foxall  
 Author's Major: Undeclared  
 Year at UNH: Graduate Student

Adviser: Cheryl Whistler

**EFFECTS OF AGRICULTURAL MANAGEMENT PRACTICES ON SOIL PROPERTIES AND WEED SEED BANKS AT THE UNH ORGANIC GARDEN**Sophie Trusty<sup>1</sup> and Richard Smith<sup>2</sup><sup>1</sup>Department of Biological Sciences, UNH<sup>2</sup>Department of Natural Resources & the Environment, UNH

The UNH Organic Garden has been in operation since 2003 as part of the Food & Society Initiative of the UNH Sustainability Academy. The garden is student-run and completes USDA Organic Certification yearly under the supervision of an advisor. To evaluate the effects of previous agricultural management practices at the garden, soils were sampled in Fall 2012 from six areas of the garden. Each area underwent different management practices in the last year. The six areas included a high tunnel, a plot recently converted to agricultural use, a row which had undergone strawberry production, a row which had been cropped with potatoes, a row which had been cropped with corn, and a control sample from the surrounding grass area. Each soil sample was divided into two subsamples. One set of subsamples was analyzed for pH, organic matter content and nutrient status. The other subset was placed in the Macfarlane Greenhouse Facility for seed bank analysis using the direct germination method. Results of the study indicate that *Veronica* spp. were the dominant weed species observed across all plots. Weed seedling density was highest in the row cropped with corn, and lowest in the high tunnel. The soil test results indicated that the organic matter content was highest in the recently converted plot and the high tunnel and lowest in the control area. These findings suggest that previous management practices may have a strong effect on soil properties and potential weedy pest populations.

Author: Sophie Trusty  
Author's Major: Sustainable Agriculture and Food Systems  
Year at UNH: Sophomore  
Career Interest: Sustainable agriculture education with children

Adviser: Richard Smith

**EFFECTS OF COVER CROP SYSTEMS ON EARTHWORM COMMUNITIES**Matthew Morris<sup>1</sup> and Richard Smith<sup>2</sup><sup>1</sup>Department of Biological Sciences, UNH<sup>2</sup>Department of Natural Resources & the Environment, UNH

In order to understand the full effects of cover cropping systems, we must look at their impacts below the soil surface. For this research, we examined the carry-over effects of the previous season's cover crop on the abundance and species composition of the earthworm community. Cover crop treatments were established in summer 2011 at UNH's Woodman Farm and included monocultures of annual rye grass, white clover and tillage radish, as well as a control in which no cover crops were planted. All treatments were replicated four times in 3m x 3m plots. In early summer 2012 the cover crop treatments were plowed under and a test crop of sorghum-sudangrass was planted across the experimental site. In fall 2012, we measured earthworm communities in the location of the original cover crop treatment plots using excavation and a non-toxic irritant. All earthworms were collected from the soil samples and brought back to the lab for identification and weighing. Earthworm communities were dominated by *Lumbricus* and *Aporrectodea* species and tended to be least abundant in plots that were previously planted with annual rye grass. These results suggest that cover-cropping systems can exert effects on below ground soil communities that persist beyond the life of the cover crop.

Author:	Matthew Morris
Author's Major:	Sustainable Agriculture and Food Systems
Year at UNH:	Junior
Career Interest:	Graduate School
Adviser:	Richard Smith

**EFFECTS OF EXOTIC SHRUB GLOSSY BUCKTHORN (*FRANGULA ALNUS*) ON THE DIET COMPOSITION OF NESTLING COMMON YELLOWTHROATS.**Logan Cline<sup>1</sup> and Matthew Tarr<sup>2</sup><sup>1</sup>Department of Biological Sciences, UNH<sup>2</sup>Department of Natural Resources & the Environment, UNH

Caterpillars (*Lepidoptera*) represent an important food source for nestling songbirds that breed in shrubland habitats throughout New England. Exotic plant species, especially glossy buckthorn (*Frangula alnus*) have been shown to reduce the amount of caterpillars available to songbirds within shrublands; however, it is unknown what effect this has on the productivity of shrubland birds that rely on caterpillars to feed their young. I used video cameras placed at the nests of a common shrubland bird species, the common yellowthroat (*Geothlypis trichas*), to determine if the proportion of glossy buckthorn cover measured in yellowthroat breeding territories affects the proportion of caterpillars in the diet of nestling yellowthroats. Further, I analyzed videos recorded at yellowthroat nests to determine if the size of arthropods brought to nestlings, or if the adult provision rate (# of visits to nest with food/hr/nestling), are correlated with the proportion of exotic shrub cover in yellowthroat territories.

Author:	Logan Cline
Author's Major:	Biology
Year at UNH:	Senior
Career Interest:	Graduate School
Adviser:	Matthew Tarr

**PHOTOSYNTHETICALLY ACTIVE RADIATION ASSOCIATED WITH THE PRESENCE AND GROWTH OF AN INVASIVE TREE, CASTOR ARALIA (*KALOPANAX SEPTEMLOBUS*), IN A NEW HAMPSHIRE FOREST**

Andrew Campbell and Thomas Lee

Department of Natural Resources &amp; the Environment, UNH

The non-native tree castor-aralia (*Kalopanax septemlobus* = KS) has invaded forest understories in Durham, NH. If KS is shade tolerant, this species could potentially become a major problem in forests of New England. I hypothesized that KS is shade tolerant and can thus survive and grow in the understories of forests common in the region. I censused, mapped, and aged KS individuals in over half the invaded forest at the University of New Hampshire's Thompson Farm, measuring annual height growth for each plant. KS plants were found in the interior of the mixed hardwood forest as well as within 5 m of the forest/field edge. KS plants averaged 52 cm in height at the beginning of 2012 and grew an average of 21 cm in that year. Edge and interior plants did not differ significantly in height or growth. Twenty-six KS saplings (<2 m tall and >2 yr old) were randomly selected at the UNH Thompson Farm and each one was measured for height, annual height growth and age. The photosynthetically active radiation (PAR) incident on each plant was estimated on different summer days and different times of day, using quantum sensors. The results suggested that the plants were moderately shade-tolerant, as 11 of 26 plants were growing in  $\leq 2\%$  PAR as recorded on a horizontal surface, and 12 were growing in  $\leq 2\%$  peripheral PAR. Due to the ability of these plants to persist and grow in low light levels, this plant should be systematically removed from invaded forests.

Author:	Andrew Campbell
Author's Major:	Environmental Sciences
Year at UNH:	Senior
Career Interest:	Environmental Scientist
Adviser:	Thomas Lee

**PHYLOGEOGRAPHY OF THE NEW ENGLAND COTTONTAIL**

Elizabeth Natola and Adrienne Kovach

Department of Natural Resources &amp; the Environment, UNH

Over the past few decades, populations of the New England cottontail (*Sylvilagus transitionalis*) have declined rapidly, and it is now a candidate for federal listing under the Endangered Species Act. Today, these rabbits exist in just five geographically and genetically isolated regions across New England, and evidence points to habitat loss and fragmentation as the predominant reasons for the cottontail's decline. Conservation goals include captive breeding and translocation, but the implementation of these efforts is hindered by uncertainties in our knowledge of historical patterns of population connectivity. To characterize prior population structure, I conducted a phylogeographic study by sequencing 400 bp of the mitochondrial cytochrome b gene from 115 individuals across the five populations. I used the software GENEIOUS to align the cytochrome b sequences and calculate their nucleotide diversity and differentiation, and mapped individual haplotypes by their geographic occurrence. Phylogeographic structure from these data is being compared to genetic structure determined by nuclear, microsatellite DNA markers. From these comparisons, I will determine whether the current pattern of genetic structure is a result of recent fragmentation or whether current geographic populations have been separated for a longer period of time. This information can be used to guide future efforts to conserve this endangered species.

Author:	Elizabeth Natola
Author's Major:	Wildlife and Conservation Biology
Year at UNH:	Senior
Career Interest:	Graduate School
Adviser:	Adrienne Kovach

**PLANT NUCLEAR DNA QUANTITATION BY FLOW CYTOMETRY**Samuel Rafter<sup>1</sup>, Qian Zhang<sup>2</sup>, and Thomas Davis<sup>2</sup><sup>1</sup>Department of Molecular, Cellular, & Biomedical Sciences, UNH<sup>2</sup>Department of Biological Sciences, UNH

Flow cytometry is a useful and effective method of measuring nuclear DNA content in plants. The application of this procedure to strawberry genomic research is currently outsourced by the Davis lab to a service provider, but it would be much more efficient and economical if the process could be accomplished on the UNH campus. The objectives of this study were to 1) establish whether or not the FACSCalibur Cytometer maintained by the UNH Instrumentation Center is capable of performing nuclear DNA quantitation in *Fragaria* (strawberry), a genus with multiple levels of ploidy, and if so to 2) optimize nuclei isolation and DNA assay procedures for strawberry. The results of measurements taken on the UNH machine can be compared to data independently generated by the service provider in order to validate our results and procedures, which can then applied to previously unstudied strawberry species and hybrids to test hypotheses about their nuclear DNA contents, and by inference their chromosome numbers and genome compositions. The discovery of wild strawberry plants with unusual nuclear DNA contents and chromosome numbers has the potential to reveal the existence of previously unknown species, as recently occurred with the discovery of the decaploid species *Fragaria cascadiensis* in the Cascade mountain range in Oregon.

Author:	Samuel Rafter
Author's Major:	Biochemistry, Molecular and Cellular Biology
Year at UNH:	Senior
Career Interest:	Biology Teaching
Adviser:	Qian Zhang
Adviser:	Thomas Davis

**LAND-USE EFFECT ON SOIL DYNAMICS**

Caleb Maney and Stuart Grandy

Department of Natural Resources and the Environment, UNH

Agricultural practices have major impacts on the quality and characteristics of the soil. In this study the difference between varying agricultural practices was examined through the impact on soil properties. Samples were taken from four locations on a farm each with a different land use; these included grassland that has not been cultivated, a large vegetable garden, an area used for the cultivation of Christmas trees, and an old growth forest. The nutrient dynamics of the soil were examined along with bulk aggregate distribution, bulk density, total carbon and nitrogen content, soil organic matter content, dissolved organic nitrogen content, and dissolved organic carbon content. The results from these analyses were then used to determine the effect of the various land uses on soil quality.

Author: Caleb Maney  
Author's Major: Environmental Science  
Year at UNH: Senior  
Career Interest: Research

Adviser: Stuart Grandy

**PROTECTION OF *ARABIDOPSIS THALIANA* FROM ABIOTIC STRESSORS BY PUTRESCINE**Natalie Hall<sup>1</sup> and Subhash Minocha<sup>2</sup><sup>1</sup>Department of Biological Sciences, UNH<sup>2</sup>Department of Molecular, Cellular, & Biomedical Sciences, UNH

Natalie Hall, Lin Shao, Rajtajak Majumdar, Subhash C. Minocha Department of Biological Sciences, University of New Hampshire, Durham, NH 03824 Polyamines, such as putrescine, are organic molecules that play a fundamental role in plant growth and development and stress responses. The goal of my research is to evaluate putrescine's ability to protect the plant *Arabidopsis thaliana* from abiotic stressors such as salt and heavy metals. In most plants putrescine is synthesized through two biochemical pathways using enzymes a) arginine decarboxylase (ADC) and b) ornithine decarboxylase (ODC). The cellular content of putrescine can be manipulated either via exogenous application of putrescine or by the introduction of a new gene (e.g. mouse mODC). My research used genetically-engineered (transgenic) seedlings of *Arabidopsis* transformed with either constitutive (on at all times) and estradiol-inducible mODC gene to control levels of putrescine production. Wild Type and high putrescine (constitutive and inducible) mODC seedlings were treated with different concentrations of salt (NaCl) and heavy metals (Cu & Cd) and the effects of these treatments on root growth were measured. The results demonstrate that elevated levels of putrescine (estradiol induced mODC seedlings) protect the seedlings from the adverse effects of salt and heavy metal-induced stress.

Author:	Natalie Hall
Author's Major:	Plant Biology
Year at UNH:	Senior
Career Interest:	Graduate School
Adviser:	Subhash Minocha

**PROTEOMIC IDENTIFICATION OF PREFERENTIAL INTERACTIONS BETWEEN PDE6 CATALYTIC SUBUNITS AND ITS INHIBITORY SUBUNIT**

Katie Kozacka, Feixia Chu, and Rick Cote

Department of Molecular, Cellular, &amp; Biomedical Sciences, UNH

Phosphodiesterase 6 (PDE6) is central for visual transduction in rod and cone cells. PDE6 is a heterodimeric enzyme consisting of  $\alpha$  and  $\beta$  catalytic subunits ( $P\alpha\beta$ ) to which two identical inhibitory subunits ( $P\gamma$ ) are bound ( $P\alpha\beta\gamma\gamma$ ). Previous studies have shown two different classes of  $P\gamma$  binding sites on  $P\alpha\beta$ , but the structural basis for the differences in binding affinity of  $P\gamma$  is unknown. We hypothesized that  $P\gamma$  preferentially binds to one catalytic subunit due to differences in the amino acid sequence of the two catalytic subunits. To test this, we used chemical crosslinking of  $P\gamma$  to  $P\alpha\beta$  followed by mass spectrometric identification of which catalytic subunit was cross-linked over a range of  $P\gamma$  concentrations. Even at sub-stoichiometric levels of  $P\gamma$  relative to  $P\alpha\beta$ , we failed to observe a statistically significant difference in  $P\gamma$  binding to the  $P\alpha$  versus the  $P\beta$  subunit. Introducing photoactivatable cross-linkers into various positions of the  $P\gamma$  sequence revealed a preference of  $P\gamma$  for  $P\alpha$  for some of the  $P\gamma$  mutants that we tested. We conclude that the catalytic subunits of  $P\alpha\beta$  differ in their interactions with  $P\gamma$ , with the  $P\alpha$  subunit having an increased number of favorable interactions with the  $P\gamma$  subunit.

Author:	Katie Kozacka
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Year at UNH:	Senior
Career Interest:	Medical School
Adviser:	Feixia Chu
Adviser:	Rick Cote

**REAL-TIME PCR VALIDATION AND SENSITIVITY ANALYSES IN THE QUANTIFICATION OF HUMAN FECAL MOLECULAR MARKERS TO DETECT NON-POINT SOURCES OF NITROGEN IN SURFACE WATER**Andrew Walant<sup>1</sup>, Inga Sidor<sup>1</sup>, and John Bucci<sup>2</sup><sup>1</sup>Department of Molecular, Cellular, & Biomedical Sciences, UNH<sup>2</sup>Department of Natural Resources & the Environment, UNH

Fecal pollution from mammalian waste in surface water is a non-point source (NPS) that increases nitrogen and pathogen concentrations in aquatic ecosystems worldwide, and in particular, the Piscataqua River Watershed (Great Bay, NH). Nitrogen NPS pollution is difficult to detect and originates from sewer and septic system leaks, storm water and agricultural run-off, and atmospheric deposition. Our research team has previously demonstrated the effectiveness of a library-independent molecular assay similar to 16S rRNA gene sequence analyses of eukaryotic mitochondrial (mt) DNA, which is associated with nitrogen pollution. Exfoliated epithelial cells shed in abundance in fecal waste serve as a useful mtDNA target in determining the host species instead of the microorganisms excreted into the environment. The objective of our study was to improve assay efficacy of real-time PCR targets used for this molecular assay by conducting validation and sensitivity experiments. We designed species-specific primers and dual labeled probes for the isolation and detection of target DNA gene sequences present in surface water samples. Sensitivity analyses included a direct comparison between two extraction methods and human host specific biomarkers (mtDNA and Bacteroidales). Evidence of a valid NPS detection method will further refine contemporary techniques when used with bacterial, chemical, and spectrophotometric parameters to track fecal contamination in surface waters.

Author: Andrew Walant  
Author's Major: Biomedical Science  
Year at UNH: Senior  
Career Interest: Graduate School

Author: Inga Sidor  
Author's Major: Undeclared  
Year at UNH: Graduate Student

Adviser: John Bucci

**REGULATION OF THE ANGIOGENIC INDUCER CCN1 BY PROSTAGLANDIN F2A IN GRANULOSA CELLS**

Umija Durakovic, Christopher Cummings, and Paul Tsang  
Department of Molecular, Cellular, & Biomedical Sciences, UNH

Angiogenesis is a process by which new blood vessels form from pre-existing ones, and it is a hallmark of malignant tumors and metastasis. The formation of blood vessels requires angiogenic factors such as fibroblast growth factor and vascular endothelial growth factor. We recently discovered that human ovarian granulosa tumor cells (KGN), express the angiogenic inducer CCN1, however little is known about its regulation in these cells. Since CCN1 is transiently upregulated by prostaglandin F2a (PGF2a) in ovarian steroidogenic luteal cells, the objective of the present study was to determine if PGF2a regulates CCN1 expression in KGN cells. After KGN cells reached confluency in T25 flasks, they were serum starved (without fetal bovine serum; -FBS) for four hours. Afterwards, the cells were treated with serum (+FBS), 0.1uM PGF2a, or 1.0uM PGF2a for 30 minutes. One set of cells was not starved and had FBS present the entire duration of the experiment. Total RNA was isolated from cells using a Qiagen RNeasy Kit. Analysis was performed using quantitative PCR following generation of cDNA from RNA. Compared to the +FBS treatment, our preliminary results suggest that CCN1 mRNA expression in KGN cells was lower after treatment with either concentration of PGF2a. Future experiments will test different concentrations of PGF2a as well as lengthening the duration of treatments. (Supported by the Multistate Project NE1027)

Author: Umija Durakovic  
Author's Major: Biochemistry, Molecular and Cellular Biology  
Year at UNH: Senior  
Career Interest: Physical Therapy

Author: Christopher Cummings  
Author's Major: Biochemistry  
Year at UNH: Graduate Student

Adviser: Paul Tsang

### RELATING HEMATOLOGICAL PATTERNS IN RED-BACKED SALAMANDERS TO STRESS IN DIFFERENT HABITATS AND DENSITIES

Patrick Sargent<sup>1</sup>, Daniel Hocking<sup>2</sup>, and Kimberly Babbitt<sup>2</sup>

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

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The importance of hematological assays for evaluating stress and the response to stress has been realized in recent years. In particular, wildlife researchers now use counts of white blood cells (leukocyte differentials) to determine chronic environmental stress. Understanding sources of stress in wildlife can aid in conservation efforts because chronic stress can cause low fitness (e.g. low reproduction, inability to maintain territories, increased susceptibility to disease). We conducted leukocyte differentials on blood smears from Red-Backed Salamanders (*Plethodon cinereus*) raised in enclosures at the UNH Kingman Farm property in Madbury, New Hampshire. To determine the effect of habitat and density on salamanders, we stocked 68 enclosures with 0 – 4 salamanders per m<sup>2</sup> in three forest habitats (Eastern Hemlock, American Beech, mixed hardwood). We prepared standard smears from salamander blood samples taken after 5 months in the enclosures. We used a high neutrophil:lymphocyte ratio. (N:L) as an indicator of stress in individuals from the enclosures. Unexpectedly, during leukocyte differentials, we observed a high number of leukocytes early in the maturation series, including blasts, promyelocytes, myelocytes, metamyelocytes, immature erythroid cells and lymphoblasts. The reason for these early cells is unclear, but may indicate stress or infection. The number of blast cells we have observed in salamanders can indicate a terminal leukemia or other malignancy in mammals.

Author: Patrick Sargent  
 Author's Major: Biomedical Science  
 Year at UNH: Junior  
 Career Interest: Medical Laboratory Scientist

Author: Daniel Hocking  
 Author's Major: Environmental Science  
 Year at UNH: Recent Graduate

Adviser: Kimberly Babbitt

**RIG-1 STRUCTURE AND FUNCTION**

Yang Tang and Feixia Chu

Department of Molecular, Cellular, &amp; Biomedical Sciences, UNH

RIG-1 is a viral RNA receptor that plays an essential role in activating a specific immune response to viral infection. The protein consists of multiple domains, each with a different function in binding dsRNA. Previous studies have revealed that RIG-I monomers form filamental structures around viral dsRNA. The formation of filaments leads to a conformational change in RIG-I in the helicase-repressor domain (RD) complex, exposing 2 N-terminal caspase activation and recruitment domains (2CARD). 2CARD is responsible for recruiting MAVS (mitochondrial antiviral signaling protein), resulting in expression of IFN genes. Though the structure of RIG-I helicase and 2CARD domains has been solved, little is known how RIG-I monomers organize into filamental structures. Using chemical cross-linking and mass spectrometric analysis, we characterize the structure of RIG-I oligomer. Distant constraints of multiple intramonomeric cross-links are in good agreement with crystal structures of helicase and 2CARD domains. Furthermore, a cluster of intermonomeric cross-links elucidate a filamental architecture with RIG-I forming head-to-head and tail-to-tail interfaces. This arrangement provides the underlying mechanism for observed slow kinetics during filament formation. Structural characterization of RIG-I leads to a greater understanding of the viral specificity shown between RIG-I and similar vRNA receptors such as MDA5.

Author: Yang Tang  
Author's Major: Biomedical Science  
Year at UNH: Senior  
Career Interest: Biomedical Research

Adviser: Feixia Chu

**EFFECTS OF 'EFFECTIVE MICROORGANISMS' ON GROWTH AND FRUITING IN *PISUM SATIVUM* CV. SUGAR ANN**

Nathan Roe and Rebecca Sideman  
Department of Biological Sciences, UNH

Effective microorganisms® (EM) are a proprietary blend of 'beneficial microorganisms' used as a microbial inoculant, marketed by Teraganix (Alto, Texas). Since the development of EM in the 1970's by Dr. Teruo Higa in Okinawa, Japan, several benefits have been purported including pathogen suppression, expedited organic matter decomposition, improved nutrient use efficiency, increased fruit yield, and overall increases in plant biomass (Higa and Perr, 1994). During the spring of 2013, a study was conducted at the University of New Hampshire greenhouses to investigate the authenticity of these claims. Using pea (*Pisum sativum* cv. Sugar Ann) as a model organism, we evaluated the effects of EM application on plant biomass and fruit (pod) yield. Treatments included weekly application rates of EM (high- 1:128, low- 1:256, and a control-0) in combination with seven fertilization regimes with varying degrees of available nutrients in a factorial design. At maturity, overall wet and dry biomass production and dry fruit biomass relative to overall plant biomass were measured.

Author: Nathan Roe  
Author's Major: Environmental Science  
Year at UNH: Senior  
Career Interest: Sustainable Agriculture and Environmental Education

Adviser: Rebecca Sideman

**ROLE OF DNA METHYLATION IN TRANSPOSABLE ELEMENT MOBILIZATION IN  
*CAENORHABDITIS ELEGANS***

Andrew Quitadamo, Abigail VanNote, Alison Cocchiola, Kazu Okamoto, Alyssa Piemonte, Jordan Ramsdell, and W. Kelley Thomas

Department of Molecular, Cellular, & Biomedical Sciences, UNH

Transposons are highly mutagenic elements of eukaryotic genomes. Recently DNA methylation has been shown to be a mechanism for transposable element suppression in plants and vertebrates. This research aims to implicate DNA methylation as a regulatory mechanism of transposable elements in the nematode *Caenorhabditis elegans* (*C.elegans*). Initially, known DNA methyltransferase (DNMT) genes were used to search for homologues in *C. elegans*. We find that *C. elegans* appears to encode at least two DNA methyltransferases. One of these DNMT genes (P45698) was independently identified in a screen for co-suppressors of germline transgenes in *C. elegans*, suggesting a role in repeat inactivation. By culturing *C. elegans* DNMT knockout strains and using an UNC-22 nicotine assay, we identified and propagated lines of the knockout strains with putative mobilized transposable elements. These lines were then sequenced using Illumina sequencing technology to survey the entire genome for direct evidence of transposable element mobilization. The results of this study support previous research that DNA methylation acts as a suppressor of transposable element mobilization; it also provides evidence for the presence of DNA methyltransferase genes in *C. elegans*.

Author: Andrew Quitadamo

Author's Major: Biochemistry, Molecular and Cellular Biology

Year at UNH: Senior

Career Interest: Graduate School

Author: Abigail VanNote

Author's Major: Genetics Year at UNH: Sophomore Career Interest: Graduate School

Author: Alison Cocchiola

Author's Major: Biology Year at UNH: Sophomore Career Interest: Graduate School

Author: Kazu Okamoto

Author's Major: Biochemistry, Molecular and Cellular Biology Year at UNH: Graduate Student

Author: Alyssa Piemont

Author's Major: Biochemistry, Molecular and Cellular Biology Year at UNH: Senior Career Interest: Graduate School

Author: Jordan Ramsdell

Author's Major: Genetics Year at UNH: Senior Career interest: Graduate School

Adviser: W. Kelley Thomas

**GIS ANALYSIS OF DIET AND CANCER RATES IN MEDITERRANEAN COUNTRIES**

Matthew Blunt and Anthony Vannozi  
Thompson School of Applied Science, UNH

Various dietary staples and cancer rates in the Mediterranean region will be investigated. Geographic Information Systems will be utilized to visualize correlations between diet and cancer rates in order to enhance understanding of the relationships seen. Due to the diversity of diets across the region, relationships identified may be able to aid decision makers in advising populations regarding correlations between dietary choices and cancer risks. Assorted publicly available datasets will be combined and utilized in the analysis.

Author:	Matthew Blunt
Author's Major:	Applied Business Management and Civil Technology
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Career Interest:	Business and Technology
Adviser:	Anthony Vannozi

**THE EFFECT OF PH ON THE CHARGE OF A MONOCLONAL ANTIBODY**

Kadina Mazic, Dana Filoti, and Thomas Laue

Department of Molecular, Cellular, &amp; Biomedical Sciences, UNH

The unique specificity of monoclonal antibodies (mAb) has made them excellent therapeutics in the use of treatments of diseases once considered traditionally incurable. In the manufacturing of the mAb therapeutics a wide pH range is used through out the process that influences their colloidal properties. Electrostatic interactions of proteins in solution influence their stability, solubility, and affinity. In order to better understand these physical changes, we conducted a titration study for a monoclonal antibody, mAb A, with a pH scale from 2 to 12. The electrophoretic mobility was measured by using membrane confined electrophoresis (Spin Analytical MCE), and dynamic light scattering (Wyatt Möbius). The Stokes radius was measured via analytical ultracentrifugation (Beckman Analytical Ultracentrifuge). We found that at pH levels lower than pH 3 the antibody swelled and the charge increased, whereas at higher pH levels the antibody's radius remained unchanged and the charge was consistent.

Author:	Kadina Mazic
Author's Major:	Biochemistry, Molecular and Cellular Biology
Year at UNH:	Junior
Career Interest:	Graduate School
Adviser:	Dana Filoti
Adviser:	Thomas Laue

**THE EFFECT OF STOCKING DENSITY, TEMPERATURE, AND FISH SIZE ON AMMONIA PRODUCTION IN ALEWIVES (*ALOSA PSEUDOHARENGUS*)**

Aurora Burgess and David Berlinsky  
Department of Biological Sciences, UNH

With the exception of striped bass, populations of all anadromous fish species native to the northeast, including Atlantic salmon, American shad, alewives, rainbow smelt, blueback herring, and sturgeon are currently listed as threatened, endangered or "species of concern". The collapse of these populations is being cited as a probable cause for the decline of many marine teleost species that utilized them as prey. Together with smelt, alewives comprise the most dominant anadromous species in the Great Bay estuary system and both are listed as "species of concern". Efforts are underway to culture alewives as a baitfish, and possibly for stock enhancement, in recirculating aquaculture systems. For effective system design it is necessary to understand the metabolic ammonia production of the cultured species under specific environmental conditions. This research focuses on ammonia production from alewives of different sizes, held at various stocking densities and temperatures. Groups of four, eight and 12 alewives (~50 and 100 grams) will be held in polypropylene tanks containing 115 liters of seawater (18°C). Water will be sampled at 15-minute intervals to determine ammonia concentrations. This procedure will be repeated at 21 and 24°C. Ammonia samples will be measured using the phenol-hypochlorite method. These findings will help refine alewife culture techniques as well as provide important biological information about the species.

Author:	Aurora Burgess
Author's Major:	Marine, Estuarine and Freshwater Biology
Year at UNH:	Senior
Career Interest:	Graduate School
Adviser:	David Berlinsky

**THE INFLUENCE OF LIGHT AND HORMONES ON THE DAILY RHYTHMS OF THE NUDIBRANCH, *MELIBE LEONINA***

Stephanie Malanga and Winsor Watson  
Department of Biological Sciences, UNH

Many types of animals express biological rhythms, and the *Melibe leonina* is no exception. Previous studies have shown that *Melibe leonina* are more active at night and this tendency might be due, in part, to an endogenous circadian clock. This study had three goals: First, to confirm that *Melibe* do express a circadian rhythm when held in constant darkness. Second, to show that the clock controlling that rhythm is located in the brain and not the eyes. Finally, to identify some of the hormones that might be responsible for influencing their activity. The first study was conducted at the UNH Coastal Marine Laboratory, where animals were held in constant darkness for at least 10 days. Analysis of digital time lapse videos confirmed that they have a ~ 24 hour activity rhythm. In the second study the eyes, which are located on the brain of *Melibe*, were removed from animals and after they recovered, their activity was monitored in a normal light:dark cycle. They continued to express a ~ 24 hour rhythm, indicating that, like some gastropods, their biological clock is located in their brain and not their eyes. Finally, three *Melibe* were put in constant darkness for 11 days, and then injected with the neurohormone SCP (small cardioactive peptide). It appeared as if the SCP injection affected their circadian clocks so they remained active for much longer than normal. Currently, I am repeating these studies and using immunohistochemistry to map the distribution of SCP in the CNS of *Melibe*.

Author:	Stephanie Malanga
Author's Major:	Neuroscience and Behavior
Year at UNH:	Senior
Career Interest:	Medical School, Graduate School
Adviser:	Winsor Watson

**THE POSSIBLE ROLE OF EXTRA-OCULAR PHOTORECEPTORS IN THE ENTRAINMENT OF LOBSTER CIRCADIAN RHYTHMS TO LIGHT:DARK CYCLES**

Sara McKinney, Scott Finnance, and Winsor Watson  
Department of Biological Sciences, UNH

The American lobster *Homarus americanus* is a nocturnal organism whose daily rhythms of activity are driven, in part, by an internal biological clock. While this circadian clock is capable of producing a rhythm of ~ 24 hours on its own, it can also be entrained to light:dark cycles. Recent findings in our laboratory suggest that lobsters have photosensitive neurons throughout their nervous system (extra-ocular photoreceptors). The objective of this research was to test the hypothesis that these extra-ocular photoreceptors aid in entraining their daily rhythm of activity. First, the locomotion of juvenile American lobsters was measured in trials lasting 5-7 days under a normal 24 hour light/dark cycle. Then, after this "control" period, the lobsters' eyes were painted with black nail polish and their activity was monitored for an additional 5-7 days. During the control L/D trial, lobsters expressed increased locomotion at night, as expected. Interestingly, even after their eyes were covered, the lobsters continued to follow the same cycle despite the visual impairment. Although there was some individual variation with the group of lobsters with their eyes covered, there was a clear increase in locomotor activity at night. This indicates that *H. americanus* receives photoperiod input from both their eyes and extra-ocular photoreceptors. Additional studies are underway to localize these extra-ocular photoreceptors.

Author: Sara McKinney  
Author's Major: Animal Science  
Year at UNH: Senior  
Career Interest: Graduate School

Author: Scott Finnance  
Author's Major: Neuroscience and Behavior  
Year at UNH: Senior  
Career Interest:

Adviser: Winsor Watson

**THE ROLE OF DNA METHYLATION IN TRANSPOSABLE ELEMENT MOBILIZATION IN CAENORHABDITIS ELEGANS: UNC-22 NICOTINE ASSAY**

Alyssa Piemonte, Alison Cocchiola, Kazu Okamoto, Andrew Quitadamo, Jordan Ramsdell, Abigail VanNote, and W. Kelley Thomas

Department of Molecular, Cellular, & Biomedical Sciences, UNH

DNA methylation is known to occur in most eukaryotes, it is usually noted that methylation does not occur in *C. elegans*, a small roundworm. If *C. elegans* is not capable of DNA methylation it should be more prone to mutation and have an unstable genome with unchecked mobile elements. This project looks at the UNC-22 gene present in *C. elegans*. This gene codes for twitchin, a protein that affects muscle coordination and the regulation of muscle contraction. UNC-22 is a major target for transposable elements due to its transcript length of 38300nt and multiple transposable element insertion sites. Loss of function of UNC-22 in *C. elegans* leads to impaired movement and to the distinctive twitcher phenotype. The twitcher phenotype can be elicited by placing unc-22 knockout worms on 1% nicotine causing the mutants to twitch violently for many hours while wild-type animals become stiff and immobilized. We have produced the twitcher phenotype from two different strains of *C. elegans* which lack putative DNA methyltransferase (DNMT), the protein responsible for DNA methylation. This implies that the wild type *C. elegans* has some sort of methylation mechanism, as we did not have the nearly the same frequency of individuals with the twitcher phenotype. By comparing the patterns of DNA methyltransferase (DNMT) knockout methylation we can yield major contributions to understanding the role of DNA methylation and what its contribution is to genome stability and genome complexity.

Author: Alyssa Piemonte

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Year at UNH: Senior

Career Interest: Graduate School

Author: Alison Cocchiola

Author's Major: Biology Year at UNH: Sophomore Career Interest: Graduate School

Author: Kazu Okamoto

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Author: Jordan Ramsdell

Author's Major: Genetics Year at UNH: Senior Career Interest: Graduate School

Author: Abigail VanNote

Author's Major: Genetics Year at UNH: Sophomore Career interest: Graduate School

Adviser: W. Kelley Thomas

### **VARIATIONS IN CAROTENOIDS IN PLASMA FROM JERSEY COWS AT AN ORGANIC DAIRY COMPARED TO A CONVENTIONAL DAIRY OVER TIME**

Jillian Smith, Amy Beliveau, and Joanne Curran-Celentano

Department of Molecular, Cellular, & Biomedical Sciences, UNH

Interest in organic milk is increasing. By USDA Certified Organic standards, animals must be fed on pasture for a minimum of 120 days. Research indicates that various factors such as diet impact the nutritional quality and composition of milk. The objective of this study was to understand how feeding practices affected bovine plasma carotenoid concentrations over time. Plasma samples were collected from 9 cows fed on pasture at an organic dairy and from 9 cows fed total mixed ration (TMR) at a conventional dairy. Components were extracted from the plasma and separated via High Performance Liquid Chromatography. Results showed that plasma concentrations of lutein, zeaxanthin,  $\beta$ -cryptoxanthin, and  $\beta$ -carotene significantly changed from baseline at each dairy. The changes in plasma lutein, zeaxanthin,  $\alpha$ -carotene, and  $\beta$ -carotene concentrations were also significantly different between dairies. Plasma lutein, zeaxanthin,  $\alpha$ -carotene, and  $\beta$ -carotene concentrations were significantly higher in plasma from cows fed on pasture versus cows fed TMR. This suggests that diet and season affect the concentrations of measured components in plasma. These variations could influence the health of the animal and the nutrient composition of the resulting milk. Research support was provided by the Hamel Center for Undergraduate Research at the NH Agricultural Experiment Station, University of New Hampshire.

Author: Jillian Smith  
 Author's Major: Nutrition and Spanish  
 Year at UNH: Recent Graduate  
 Career Interest: Clinical Registered Dietician

Author: Amy Beliveau  
 Author's Major: Nutrition  
 Year at UNH: Recent Graduate

Adviser: Joanne Curran-Celentano

**NOVEL ANTIMICROBIAL AGENTS: EXPRESSION OF HUMAN KERATIN 6A IN PLANTS**Ethane Duane<sup>1</sup>, Ashley Matthews<sup>1</sup>, Olivia Fleszar, Lin Shao<sup>2</sup>, and Subhash Minocha<sup>2</sup><sup>1</sup>Department of Molecular, Cellular & Biomedical Sciences, UNH<sup>2</sup>Department of Biological Sciences, UNH

Keratins are structural proteins expressed in the cytoplasm of human skin cells, epithelial cells, and oral mucosa as well as in the hair and nails. There are many different types of keratins expressed in different cell types. Keratin 6A (K6A) is a 56 kDa human protein consisting of 564 amino acids encoded by the gene hKRT6A located on human chromosome 12.

K6A has been shown to have more functions than a simple structural protein. A recent study has found that human K6A also plays a role in the endogenous antimicrobial activity in the human eye. K6A fragments have shown bactericidal activity against multiple pathogens including *Staphylococcus aureus* and *Pseudomonas aeruginosa*. These keratin-derived antimicrobial peptides, called KDAMPs, may lead to the development of a new class of antibiotics. Since these peptides are found naturally in the human body, they could be a completely non-toxic novel remedy for infection.

The primary objective of this study is to produce K6A (and its peptides) in plants, such as tobacco and poplar (cell cultures), through genetic engineering. Production of the human K6A in the transgenic plants will allow for large amounts of the protein to be obtained in a cost effective manner and used in further study to analyze its effectiveness as an antimicrobial agent.

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**EFFECTS OF HEAVY METALS AND SALT ON WILD TYPE AND HIGH PUTRESCINE*****ARABIDOPSIS***

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Polyamines are organic compounds rich in nitrogen and carbon; they play an important role in plant growth and development. Chemicals like polyamines (i.e. putrescine) have been implicated in plant stress response. Plants better responded to stress when their polyamine levels were high, either by exogenous spray or by genetic engineering of the pathway. Our lab has been researching the effects that different stresses have on genetically modified plants. Results have shown that transgenic plants have an increase in polyamine levels. The objective of my research is to find out if plants whose polyamine levels have been elevated will be more or less tolerant of various forms of stress. In my experiments, I grew two types of *Arabidopsis thaliana* plants: Wild type and mODC-1-7 (transgenic); the latter produce as much as 20-30 fold higher amounts of the polyamine putrescine. I treated them with three different chemical compounds (sodium chloride, copper sulfate, cadmium chloride). Over a six day period I collected samples and tested the plants' polyamine levels (putrescine, spermidine, and spermine) as well as recorded the plants visual response to stress. The experiments showed that the transgenic plants (mODC-1-7) had higher levels of putrescine. Spermidine and spermine levels did not differ between the two types of plants. Visually the transgenic plants were better able to withstand the heavy metals and salt.

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