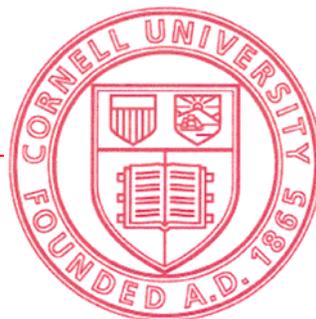


College of Agriculture and Life Sciences

2014—2015

Research Honors Program Abstracts



The College of Agriculture and Life Sciences (CALs) is among the finest of its kind in the world. CALs students, faculty, and staff are leading science and education towards a resilient future. With programs spanning food and energy systems, life sciences, environmental sciences, and social sciences, we are committed to knowledge with public purpose as a basis for sustainable improvement in the lives of people throughout New York, across the country, and across the globe.

An engaged and inspired student body is critical to the CALs' success. The 2014-2015 honors thesis projects described in this booklet demonstrate an impressive capacity for personal dedication, mature scholarship and intellectual growth. The original research contained herein examines some of the most pressing and relevant questions of our time.

Many students consider the research projects they undertake as undergraduates in CALs to be among the most challenging, enduring, and rewarding of their Cornell experiences. As a faculty member, I have witnessed first-hand among my own advisees the formative impact that undergraduate research can have on budding young scientists. As dean, I am dedicated to fostering the college's unwavering commitment to providing our undergraduates with these life-changing research opportunities.

I am extremely proud of our undergraduate students and their achievements, and I wish them the very best in their future endeavors. I am also appreciate the dedicated faculty who supervised these honors research projects and mentored these students to their fullest potential. On behalf of the CALs community, we welcome them as the next generation of scientific leaders and innovators.

Kathryn J. Boor, Ph.D.
*The Ronald P. Lynch Dean of
Agriculture and Life Sciences*

Table of Contents

Animal Sciences

- 9 Investigation of the Spike Protein Function and Activation of Two Bat Coronaviruses, BatCoV-HKU4 and BatCoV-HKU5
EMILY P. BERMAN
- 9 Algorithms for Neuroanatomical Localization in Cats and Dogs
ANNE E. BUGLIONE
- 10 Identification of Altered Lipoprotein Receptor Expression for Potential Targeted Treatment of Canine Lymphoma
KRISTINA M. CERES
- 10 Tissue Factor Expression and Knockdown in Canine Hemangiosarcoma
NICOLE ELYSE DEANGELIS
- 11 Feeding Layer Hens Defatted Green Microalgae Produced Dose-dependent Enrichments of Eicosapentaenoic Acid (EPA) and Docosahexaenoic Acid (DHA) in Their Egg Yolk and Tissues
THEODORE J. DERKSEN
- 11 Evaluating the Growth of Lambs under Artificial and Natural Rearing Methods
ANN E. DIPASTINA
- 12 The Effect of Luteinizing Hormone and Estradiol on Sperm Detachment from Bovine Oviductal Epithelium
GILAD FEFER
- 13 Evaluation of Lactational Response to Dietary Supplementation with Free or Encapsulated 2-hydroxy-4-(methylthio) butanoic acid in Holstein Cows
RHEANNA I. FOLEY
- 13 Nerve Specific Extracellular Matrix Alters Macrophage Phenotype Influencing Peripheral Nerve Repair in Rats
ALEXIS R. GIBSON
- 14 Characterization of Body Size Diversity in African Goat Breeds and Relationships to Genetic Markers
MARY E. HANNON
- 15 “A sorrel is hot...” A Genetic Investigation of the Horseman’s Myth
LAUREN N. JACOBS
- 15 The Effects of Hairy Vetch (*Vicia villosa* Roth) Toxicity on Sheep
BRIDGETTE WRAY KENNEDY

- 16 Optimization of an Immunofluorescent Antibody Test for *Aelurostrongylus abstrusus* Infection in Cats
ALEXANDRA R. KRAVITZ
- 16 Testing the Effects of NGF- β , IL-4, and an Agarose+LMT Drug Delivery System, on Motor Neurite Outgrowth
MEGAN L. LEE
- 17 Targeted SNP Testing of Horses Bearing Sarcoid Tumors
HANNAH J. LYNAUGH
- 17 Evaluation of Immunosuppressive Effects of Aflatoxin in Broiler Chickens
JULIANNE BOULD MCDONOUGH
- 18 Ethanol Extraction of Aflatoxin from Contaminated Peanut Meal and the Effects on Broiler Chicks Fed Diets Using Ethanol Extracted Peanut Meal
MANA OKUDAIRA
- 19 An Investigation of Antioxidant Supplementation on Microalgal Broiler Diets
ELEANORE V. O'NEIL
- 19 Genotypes of Cornell Dorset and Dorset Crosses Compared with Romneys for Melatonin Receptor 1a
CHRISTIAN J. POSBERGH
- 20 Relationship Between Growth Hormone Axis Polymorphisms and Fertility in Lactating Dairy Cows
VICTORIA SAMPSEL
- 20 Inflammatory Response of Canine Endothelial Cells to Oxidized Lipoproteins
CHRISTOPHER S. SHIPRACK

Biological Sciences

- 22 Identifying and Characterizing Behavioral Patterns in Two Hawkmoth Species: *Manduca sexta* and *Hyles lineata*
TRISHA BASU
- 22 Deep-water Dragonets (Teleostei: Callionymidae: *Foetorepus*) of the Mid Atlantic Bight: A Little-known Genus from the Edge of the Continental Shelf
KATHERINE ELLIOTT BEMIS
- 23 Sirt1 Modulation as an Eating Disorder Therapy
KAYLA E. BROOKS

- 23 Simulation of *in vivo* Hormonal Environment in an Attempt to Improve *in vitro* Canine Oocyte Maturation Rates
ZACHARY T. DVORNICKY-RAYMOND
- 24 Investigating the Innate Immune Response to Mammalian Orthoreovirus Using Ribosome Profiling
JAMES EAGLESHAM
- 25 Extracellular Recordings of the Medial Prefrontal Cortex and Behavioral Inhibition in Rats
CALVIN FANG
- 25 The Effects of Prostaglandins (E₁, E₂, F_{1α}) on Bovine Sperm Motility
MOHAMMAD FAROOQ
- 26 Investigation of Bacteria Inhabiting Asymptomatic and Symptomatic Asteroidea on the North American Pacific and Atlantic Coasts
PARKER FOSTER
- 26 The Epithelial-to-mesenchymal Transition (EMT) in Pancreatic Cancer Cell Lines: an Analysis of Circulating Tumor Cell Detection Markers and a Potential Role of Extracellular Vesicles
CONOR GRUBER
- 27 Thermal Biology of Old World Suboscines and Other Mid-sized Bornean Birds
ERIC GULSON
- 28 The Subcellular Localization of Grapevine Red Blotch-associated Virus Proteins V2 and V3
TAI WEI GUO
- 28 Determining the Optimal Relative Humidity Conditions for Release of the Pest Control Agent *Trichogramma ostriniae*
MARGARET HENDERSON
- 29 Sidewall Microarchitecture Provides Hyperactivated Bull Spermatozoa with a Biophysical Advantage over *Tritrichomonas foetus*
DILLON G. HICKMAN
- 29 Neuromodulator and Olfaction Deficits in an MPTP Mouse Model of Parkinson's Disease
SACHIDHANAND JAYAKUMAR
- 30 Identification of Novel Targets for Therapeutic Intervention of Crohn's Disease
JEFFREY Y. JIAN
- 30 Study of Intermolecular Interaction of Spacer Peptide Assembly Domain in *in vitro* Assembly of Rous Sarcoma Virus Gag Protein
DANNI JIN

- 31 Stable Isotope Studies Revealing Influences of Diet and Reproductive Condition in the American Red Squirrel (*Tamiasciurus hudsonicus*) in Alaska
BRIAN MAGNIER
- 32 Characterization of CD8 α ⁺ Dendritic Cell Responses to *Toxoplasma gondii*, a Major Opportunistic Pathogen of Humans and Animals
COURTNEY E. MCDUGAL
- 32 The Potential of New Sesquiterpene Lactones for Targeted Therapy in Acute Myelogenous Leukemia (AML)
DAVID MERY
- 33 Eatfit-GIST: The Effectiveness of a Fuzzy-Trace Theory-Based Obesity Prevention Curriculum in Adolescents and Young Adults
ANNA C. MORANT
- 34 Impacts of Early Life Family Structure and Foraging on Maternal Care and the Behavioral Development of Offspring
JIE YUEN ONG
- 34 Effects of Plumage Color and Age on Reproductive Success in the Red-backed Fairy-wren
CONNOR ORRICO
- 35 RNA-Guided CRISPR-Cas9 Induced Mutagenesis via Root Transformation in *Medicago truncatula*
MARSHALL WELLS TYLER
- 35 Does Risk of Herbivory Drive Pollinator Shifts?
BRIAN M. WORTHINGTON
- 36 eIF4A1, eIF4A2 and ZCCHC8 are Potential Regulators of miRNA Function
YINGYUE ZHOU

Entomology

- 37 Induced Tuber Formation of *Solanum tuberosum* in Response to Damage by the Colorado Potato Beetle
RACHEL AU
- 37 Niche Overlap among Introduced and Native California Praying Mantids
CAMERON M. JONES
- 38 Testing the Parameters of Sociality: The Influence of Kinship and Age-Sex Class on Rock Sharing in a New Social Huntsman Spider
CAMERON M. JONES

39 Effects of Bacteria and Bacterial Metabolites on Oviposition of *Drosophila melanogaster*
GEON HO KIM

39 The Evolution of a Genus of South African Melittid Bees: *Rediviva*
GRAHAM ALLEN MONTGOMERY

Natural Resources

40 Diameter Growth and Fine Root Biomass Response to Fertilized Forests
ELI EGAN-ANDERSON

40 Modeling Functional Genetic Differentiation in a Delaware Bay Eastern Oyster (*Crassostrea virginica*) Population Along an Environmental Salinity Gradient
MARY FISHER

41 Anthropogenic Impacts on YOY Brook Trout, *Salvelinus fontinalis*, Length in Pennsylvania's Marcellus Region
PERI GERSON

41 Personality Traits as a Prediction of Parental Effort and Reproductive Success
SARAH RUBENSTEIN

42 The Impacts of Ecotourism on Available Water Supply for, and Wastewater Disposal by Local Residences in Santa Elena, Monteverde
KELLY WONG

Nutritional Sciences

43 Placental Calcium Transporter Expression and Calcitropic Hormones in Pregnant Teens
JOYCE MATHEW

Physical Sciences

44 A Theoretical Apex System Using Morphometric Methods to Address Taphonomic Problems with High-Spired Gastropods
ERYNN JOHNSON

44 Climate Change Effects on Fire Risk in the U.S. Northeast
Gauge Hunter Kerr

45 Anomalously Early Onset of Spring in the CESM Large Ensemble
ZACHARY LABE

- 45 Diagnosing the Structure of Finite Amplitude Wave Activity in the Polar Stratosphere
AARON MATCH

Plant Sciences

- 47 Understanding the Biology of the Mycoplasma-related Endobacteria of Arbuscular Mycorrhizal Fungi
EZEKIEL AHN
- 47 Biomass Production and Flowering of *Galinsoga quadriradiata*, and Its Competition with *Lactuca sativa*, in Response to Nitrogen and Phosphorus
XIANA GARCÍA FREIRE

Social Sciences

- 49 Diversified Farming Systems: Understanding the Economic and Social Impacts of Alternative Farming in the Finger Lakes
JESSICA BRESLAU
- 49 Beauty in a Globalized World: Uncovering the Fair Skin Beauty Standard in Indonesia
BAGAS YOGA DANARA
- 50 Text Format Effects on Recall and Comprehension Dyslexic College Students
CHRISTINE H. FERGUSON
- 50 Anticipating the Future of African Fertility Transitions: An Examination of Changing Youth Fertility Patterns in Sub-Saharan Africa
BENJAMIN GANDESBERY
- 51 Barriers to Birth Control: Understanding Sexual Health Knowledge, Attitudes, and Practice
ANNA GROSSHANS
- 51 Issue Framing and Public Support for the Affordable Care Act and its Major Provisions: The Implementation Period
KRISTEN HOLL
- 52 Iron Deficiency Anemia throughout India: A Comparative Look at a Way Forward
ALEXANDER N. KING
- 52 An Analysis of Social Media Communication Strategies Utilized by NOAA's Office of National Marine Sanctuaries and the National Marine Sanctuary Foundation
ALEXANDRA KIRBY
- 53 Perceived Importance of Dental Hygiene: A Risk Compensation and Social Norms Perspective
JESSICA LI

53 Exploring the Misalignment between Public Perception and Scientific Knowledge of the Food System: A Case Study of Cornell University Students

ALYSSA PRITTS

54 In Pursuit of Happiness: Trends and Correlates of Self-Reported Happiness Among U.S. Young Adults (1972-2012)

GREGORY REPPUCCI

54 Deception and Self-Presentation in Mobile Dating Applications

ABIGAIL SONNENFELDT

Investigation of the Spike Protein Function and Activation of Two Bat Coronaviruses, BatCoV-HKU4 and BatCoV-HKU5

EMILY P. BERMAN

Under the supervision of Dr. Gary Whittaker
Department of Microbiology and Immunology

Middle East respiratory syndrome coronavirus (MERS-CoV) is a recently emerged pathogenic human virus. Two coronaviruses (CoVs) isolated from bats, BatCoV-HKU4 and BatCoV-HKU5, are phylogenetically related to MERS-CoV. Recent work suggests that MERS-CoV may have entered humans after transmission from bats into camels. Coronavirus spike (S) is a surface glycoprotein responsible for binding to host cell receptors and for mediating fusion of viral and host membranes. Mutations in S protein can drive changes in host species tropism. Coronavirus S protein must be proteolytically cleaved to be fully activated during the viral life cycle. Here, we investigate the functions of BatCoV-HKU4 and BatCoV-HKU5 S proteins. We show that BatCoV-HKU4 and BatCoV-HKU5 S can be detected using anti-MERS-CoV antibodies, and both S proteins can be incorporated into pseudotyped viral particles using a murine leukemia virus (MLV) pseudoviral system. Both viral S proteins were able to mediate cell-cell fusion in the presence and absence of trypsin, indicating that S is activated in both cases. Trypsin was shown to cleave both the S1/S2 and S2' cleavage sites of BatCoV-HKU5 S using fluorogenic peptides. However, pseudotyped viral particles were not infectious in cell lines expressing (endogenously or by transfection) the MERS-CoV receptor dipeptidyl peptidase 4 (DPP4) in the presence or absence of trypsin. Together, these results show that while both bat viruses have not been cultured *in vitro*, we can study in detail the function of their respective S proteins. This approach can shed light on fundamental similarities and differences between these bat viruses and MERS-CoV.

Algorithms for Neuroanatomical Localization in Cats and Dogs

ANNE E. BUGLIONE

Under the supervision of Dr. Howard Howland
Department of Neurobiology and Behavior

The project consists of the development of several algorithms for the localization of lesions within the nervous system of cats and dogs. This work may easily be converted into an application for use on multiple smartphone operating systems, for use by those without extensive training in neurology. Each algorithm begins with a neurologic sign that may be observed in veterinary practice, and progresses by posing successive questions regarding further description of the sign and/or presence of associated signs. The structure is hierarchical, such that each response narrows the anatomical localization to an increasingly specific area of the brain, spinal cord, or peripheral nervous system. For unilateral lesions, the side of the lesion is also determined based on the presence of lateralizing signs. Information required to construct each algorithm was taken from reference texts, case series, peer-reviewed articles, and from the personal experience of Dr. Richard Joseph DVM, DACVIM

(Neurology), Co-founder and Medical Director of the Animal Specialty Center in Yonkers, NY. Decisions regarding the content to be incorporated into a particular algorithm, and the sequential order in which such content was to be placed, was made based on the relative localizing specificity of each sign or characteristic.

Identification of Altered Lipoprotein Receptor Expression for Potential Targeted Treatment of Canine Lymphoma

KRISTINA M. CERES

Under the supervision of Dr. Erica Behling-Kelly
Department of Population Medicine and Diagnostic Sciences

Altered lipid metabolism is a well-documented hallmark of cancer. Cancer cells need a constant supply of cholesterol to build new cell membranes and to enable cellular functions. Previous studies have shown that human cancer patients exhibit abnormal plasma lipoprotein concentrations, but there is a lack of information on lipoprotein metabolism in canine cancer cases. In this study we investigate the relationship between low density lipoprotein receptor (LDL-R) and scavenger receptor class B, type I (SR-BI) expression and canine lymphoma tumor grade to determine if these lipoprotein receptors are overexpressed in canine lymphoma cells. Degree of lipoprotein receptor expression was determined using immunohistochemistry on low and high-grade B and T cell lymphomas. We found no correlation between LDL-R and SR-BI expression and tumor grade in canine lymphoma cases overall. We found overexpression in a distinct subset of cases. The overexpression of LDL-R and SR-BI in canine lymphoma could be exploited therapeutically for canine lymphoma targeting LDL-R and SR-BI for drug delivery in dogs that overexpress one or both of these receptors.

Tissue Factor Expression and Knockdown in Canine Hemangiosarcoma

NICOLE ELYSE DEANGELIS

Under the supervision of Dr. Tracy Stokol
Department of Population Medicine and Diagnostic Sciences

Hemangiosarcoma (HSA) is a common, aggressive cancer which originates from the endothelium of the blood vessel in dogs. The prognosis for HSA is poor in part because it is associated with the coagulopathy, disseminated intravascular coagulation (DIC), which contributes to the high morbidity and mortality in affected dogs. Given this coagulopathy, the role of tissue factor (TF), the initiator of coagulation, is of particular interest in the pathogenesis of HSA. Therefore, in Goal 1, we constructed a TF knockdown in order to understand the role TF might play in procoagulant potential. This knockdown was created with a lentivirus transduction system, which uses short interfering RNA to degrade TF mRNA. We evaluated the efficiency of the knockdown by using flow cytometric analysis for assessment of changes in surface expression of TF and thrombin generation assays for evaluation of changes in TF procoagulant activity. Our preliminary results indicate

reduced surface expression in TF shRNA knockdown cells with a longer lag time of thrombin generation compared to mock-transduced cells. In Goal 2, we aimed to assess the parallels between canine HSA and the human equivalent of this cancer, angiosarcoma (AS), by evaluating TF surface expression and TF procoagulant activity of AS cells. Preliminary results indicate similarities in TF expression between these cancers, hopefully indicating that the dog can be used as a model to study both of these diseases.

Feeding Layer Hens Defatted Green Microalgae Produced Dose-dependent Enrichments of Eicosapentaenoic Acid (EPA) and Docosahexaenoic Acid (DHA) in Their Egg Yolk and Tissues

THEODORE J. DERKSEN

Under the supervision of Dr. Xingen Lei
Department of Animal Science

There is little EPA or DHA present in the yolks of eggs produced by hens fed corn-soybean meal-based diets. The purpose of this experiment is to enrich egg yolks with omega-3 fatty acids by feeding hens with a new, previously un-researched strain of defatted green microalgae. Fifty White Leghorn hens (46-wk old, 1.70 ± 0.27 kg BW) were housed individually in cages, divided into five groups ($n = 10$), and fed a corn-soybean meal-based diet containing 0, 2.9, 5.8, 11.5, or 23% defatted green microalgae (*Nannochloropsis oceanica*, Cellana, Kailua-Kona, HI) for six weeks. The microalgae supplementation produced dose-dependent linear ($P < 0.01$) enrichments of EPA, DHA, and total omega-3 fatty acids consistently in egg yolk ($R^2 > 0.9$) assayed biweekly and of DHA in liver ($R^2 = 0.78$), breast ($R^2 = 0.82$), and thigh ($R^2 = 0.66$) assayed at week six. Concentrations of EPA + DHA in egg yolk, liver, breast muscle, and thigh muscle of hens fed 23% microalgae were 3.2, 2, 9.5, and 16 times greater ($P < 0.001$) than those in the controls, respectively. Supplemental microalgae had no negative effects on the hens' health. In conclusion, defatted green microalgae was very effective in elevating EPA and DHA in the egg yolk, liver, and muscle tissues of layer hens. Eggs produced by hens fed the 23% defatted green microalgae diet may serve as a major food source of EPA and DHA to meet human needs.

Evaluating the Growth of Lambs under Artificial and Natural Rearing Methods

ANN E. DiPASTINA

Under the supervision of Dr. Debbie Cherney
Department of Animal Science

Artificial rearing has been studied as a method of enhancing feed efficiency of growing animals, reducing rearing costs and increasing profitability. Sustainability is also a priority in agricultural systems, resulting in the exploration of human food waste as a feed source for livestock. In this study, we aimed to evaluate the chemical composition of ewe's milk versus commercial milk replacer. We also studied each milk source's effect on lamb growth from birth until weaning (30

days). Our third objective was to determine the efficiency of plate waste as a supplement to lamb creep feed in the hopes of providing evidence for an alternative use of plate waste. Milk replacer was, on average, equivalent to ewe's milk in protein and fat percent. Lactose percent decreased as lactation progressed ($p < 0.0001$) while protein percent increased ($p < 0.05$). Fat, protein, and lactose content did not vary throughout the day. Milk yield varied by time of day with the greatest yield in the mornings ($p < 0.05$). Creep feed intake did not differ between artificially and naturally reared lambs, but artificially reared lambs grew at a greater rate ($p < 0.05$). Lambs offered standard creep feed ate more per day than the lambs fed a plate waste supplemented feed ($p < 0.0001$) and grew faster ($p < 0.0001$) but tended to consume less milk replacer per day ($p < 0.0001$). Results indicate that artificial rearing can lead to increased growth rates for lambs when managed intensively. In addition, plate waste was shown to produce acceptable growth rates in lambs pre-weaning.

The Effect of Luteinizing Hormone and Estradiol on Sperm Detachment from Bovine Oviductal Epithelium

GILAD FEFER

Under the supervision of Dr. Susan Suarez
Department of Biomedical Sciences

Once sperm travel through the uterus and enter the oviduct, they bind to epithelial cells in the oviductal isthmus to form a sperm storage reservoir. Sperm detachment from the epithelium and release from the reservoir is coordinated with ovulation. Sperm continue to attach and detach several times from oviductal epithelium while moving to the site of fertilization. Right before sperm travel to the site of fertilization, there is a three-fold rise in the secretion of luteinizing hormone from the anterior pituitary. Furthermore, LH stimulates an increase in estrogen secretion by the ovaries. Such changes suggest that these hormones affect epithelial cell surfaces and their interaction with sperm. We hypothesized that the decline of LH and estradiol stimulates detachment of sperm from oviductal epithelial cells via their effects on the epithelium. In order to test this hypothesis, we primed oviductal explants from the ampulla with no hormones, LH, estradiol, and both hormones for ten hours. We then removed the hormones and added sperm to the explants. We measured the number of sperm attached at hour zero and hour four. There was no significant difference in sperm binding at hour zero and hour four among different treatment groups. However, LH was the only treatment group that showed a trend in the difference in binding at hour zero and hour four. Such findings suggest the need for further research into LH and other hormones to determine whether changes in hormone levels trigger sperm detachment.

Evaluation of Lactational Response to Dietary Supplementation with Free or Encapsulated 2-hydroxy-4-(methylthio) butanoic acid in Holstein Cows

RHEANNA I. FOLEY

Under the supervision of Dr. Thomas Overton
Department of Animal Science

Increasing milk components and decreasing nitrogen excretion are increasingly important to dairy farmers and nutritionists because of the emphasis on protein and fat production in milk pricing systems and growing emphasis on reducing the environmental impact of milk production. The effectiveness of two supplemental methionine sources was evaluated, separately and in conjunction, for their effectiveness at increasing milk production and improving milk composition. Sixty multiparous cows in early lactation were randomly assigned to four treatments: 1) a methionine-deficient control, 2) 2-hydroxy-4-(methylthio) butanoic acid (HMTBa), 3) encapsulated HMTBa, or 4) a combination of the two methionine sources. The basal diet was a corn silage based total mixed ration with smaller inclusions of legume silage, wheat straw, and concentrate fed ad libitum. The experiment was divided into a 2-wk pre-treatment period and an 8-wk treatment period. Dry matter intake and milk production were measured daily and milk composition weekly. The encapsulated HMTBa significantly increased milk true protein concentration and caused a trend for increased milk true protein yield. Supplementation with HMTBa had a tendency to decrease milk yield. Dry matter intake, body weight, and body condition score were not affected at a biologically significant level by any of the treatments. Encapsulated HMTBa is a viable methionine supplement to support increased milk protein production by dairy cows.

Nerve Specific Extracellular Matrix Alters Macrophage Phenotype Influencing Peripheral Nerve Repair in Rats

ALEXIS R. GIBSON

Under the supervision of Dr. Jonathan Cheetham
Department of Clinical Sciences

Biomaterials derived from extracellular matrix (ECM) have been used in the reconstruction of tissues, including skin, muscle and nerve. A tissue-specific ECM is typically more successful than ECM from other tissues. The mechanism of ECM promoted tissue regeneration is not fully understood, although the alteration of macrophage phenotype at the site of injury has been observed. Post-implantation, two populations of macrophages are observed; pro-inflammatory (M1), associated with transplant rejection and pro-regenerative (M2), associated with tissue remodeling. The purpose of this study was to evaluate the nerve specific ECM (NS-ECM) injectable hydrogel in rat nerve injury models. Macrophage phenotype and Schwann cell recruitment were examined to assess degree of regeneration.

A critical gap of 15mm was surgically induced in the sciatic nerve of adult female Sprague-Dawley rats (n=14) and sutured into silicone conduits. Treatment group (n=7) conduits were filled with NS-ECM and control group (n=7) conduits left empty. Rats recovered for 21 days before euthanization. The nerve was harvested, fixed, paraffin embedded and 4µm sections cut for immunohistochemistry. Slides were labeled for M1 (CD68⁺, CCR7⁺) and M2 (CD68⁺, CD206⁺) and Schwann cells (GFAP⁺) separately. Multiple high power fields were taken, spliced together using Adobe Photoshop and analyzed using Volocity software. Number of Schwann cells and macrophages and distance from site of transection was measured.

The NS-ECM group showed an increase in migration of both macrophages and Schwann cells along with an increased M2:M1 ratio (p=0.002). These results suggest that the use of NS-ECM may promote *in vivo* repair of peripheral nerves.

Characterization of Body Size Diversity in African Goat Breeds and Relationships to Genetic Markers

MARY E. HANNON

Under the supervision of Dr. Heather Huson
Department of Animal Science

Goats contribute to the human food supply in many rural areas of Africa. Genetic improvement of goats has become stagnant because of negative selection and a lack of understanding in certain areas of animal husbandry. Previous programs demonstrated that crossbreeding with high producing imported breeds is not an effective means of improving local indigenous goat populations. Therefore, the first objective of this project was to add value to indigenous goat breeds while characterizing them based upon body measurements. The second objective of this project was to enhance understanding of the goat genome - and more specifically regions that influence body size - so tools can one day be developed to improve genetic selection for producers. In this study, several collaborators aided in sampling 2,911 goats from 13 countries. Quality control measures assured that the data set was reliable before breed summary characterizations, multi-breed and multi-country comparisons, and Principle Component Analysis was performed. Considerable variation existed both within and across breeds.

Biological samples from select subsets of goats were genotyped using the Illumina 50K goat SNP chip. Genotypic information was analyzed for associations with the results of the principle component analysis of body measurements to identify markers for body size. A genome-wide association study revealed two genomic regions significantly associated with body size. However, no obvious candidate genes within these regions were identified as regulating body size.

“A sorrel is hot...” A Genetic Investigation of the Horseman’s Myth

LAUREN N. JACOBS

Under the supervision of Dr. Samantha Brooks and Dr. Heather Huson
Department of Animal Science

Shared signaling pathways utilized by melanocytes and neurons result in pleiotropic traits in coat color and behavior in many mammalian species. Equine base coat color is determined by polymorphisms at the Melanocortin-1 Receptor (*MC1R*) and Agouti Signaling Protein (*ASIP*) loci, creating black, bay, or chestnut. In humans, polymorphisms at *MC1R* cause red hair, correlating to increased heat sensitivity and lower pain tolerance. In deer mice, rats and foxes, *ASIP* polymorphisms causing black coat color lead to more docile demeanors and less activity, as melanin pigments have a similar developmental pathway to stress response hormones. Our goal was to investigate correlations between genetic loci for coat color and temperament traits in the horse. We genotyped a total of 215 North American Tennessee Walking Horses for the two most common alleles at the *MC1R* (*E/e*) and *ASIP* (*A/a*) loci using previously published PCR and RFLP methods. The horses had a mean age of 10.5 years, there were 83 geldings, 25 stallions, and 107 mares. To assess behavior, we adapted a previously published survey for handlers to score horses from one to nine on 20 questions related to specific aspects of temperament. We utilized principle component analysis to combine the individual survey scores into four factors of variation in temperament phenotype (JMP Pro 10, SAS Inc.). A significant difference was seen between the factor component detailing self-reliance, where black mares (*aa*) were more at ease when by themselves than bay mares (*A_*) ($p = 0.0063$).

The Effects of Hairy Vetch (*Vicia villosa* Roth) Toxicity on Sheep

BRIDGETTE WRAY KENNEDY

Under the supervision of Dr. Dan Brown
Department of Animal Science

Hairy vetch (*Vicia villosa* Roth) is a legume used as a cover crop by farmers due to its ability to fix nitrogen (N) and its expansive root system that helps prevent erosion. Hairy vetch, however, contains toxins vicine, convicine, canavanine, and γ -glutamyl- β -cyanoalanine. If vetch is not fully terminated as a cover crop, it can contaminate the main crop that follows in the rotation, and cause health issues for livestock. Here we evaluate the impact of feeding hairy vetch contaminated hay to ram lambs for 28 days. The control group was fed uncontaminated hay. The vetch group was fed hay contaminated with hairy vetch. The incremental group was fed a mixture with a 5% per day increase in percent contaminated hay as part of the diet. Each group included four rams. Results show the vetch and incremental groups took in significantly more energy than the control group. The control group lost 3.21% of its bodyweight while it was expected to lose 2.20% based on energy intake. The incremental group was expected to gain 1.10% but gained 1.46%. The vetch group was expected to gain 2.42% in weight based on energy but lost 4.13%. The lysis point and methemoglobin tests,

taken weekly, did not report significant changes over time. We conclude the toxins in the vetch reduced the efficiency of the rams causing them to be unable to fully utilize the energy they took in. The incremental group did not experience the same inefficiency suggesting adjustment to the vetch during the study.

Optimization of an Immunofluorescent Antibody Test for *Aelurostrongylus abstrusus* Infection in Cats

ALEXANDRA R. KRAVITZ

Under the supervision of Dr. Dwight Bowman
Department of Microbiology and Immunology

Aelurostrongylus abstrusus is a globally distributed metastrongyle infecting cats' lungs. Studies have linked *A. abstrusus* infections to anesthesia-associated death in cats and though commonly infections are subclinical, they are potentially fatal. *A. abstrusus* infections are diagnosed by direct examination of the larvae through fecal examination or bronchioalveolar lavage. Cats usually do not have larvae in their feces before 30 days post infection (DPI) and after 100 DPI thus falsely appear negative. This and the fact infected cats only shed larvae within a relatively short period of their infection makes elucidating an exact prevalence rate difficult. Recently, an immunofluorescent antibody test (IFA) was developed to detect *A. abstrusus* antibodies in cat serum. Experiments were designed to optimize this IFA and examine the antibody levels in cats of known infection status. In addition, a method was sought to cryopreserve larvae for use in the IFA. Experiments determined larval storage in 5% DMSO at -20°C and a 1:48 cat serum and 1:180 secondary antibody dilutions were ideal for the IFA, resulting in bright fluorescence in infected cats' serum and limited fluorescence in uninfected cats' serum. Infected cat serum illustrated a general increase in antibody titer as infections progressed with positive titer at 478 DPI. However, barrier-housed cat serum (1 of 10), a definite negative, tested positive indicating possible cross reactivity. This cross reactivity remains to be further examined along with additional IFA optimization. Future research goals include larval fixation to a slide and moving to a colorimetric assay similar to an ELISA.

Testing the Effects of NGF- β , IL-4, and an Agarose+LMT Drug Delivery System, on Motor Neurite Outgrowth

MEGAN L. LEE

Under the supervision of Dr. Jonathan Cheetham
Department of Clinical Sciences

Peripheral nerve injury produces a substantial decrease in function and quality of life. There has been growing interest in understanding and modifying the local environment of a nerve injury site. Interleukin-4 (IL-4), which promotes the conversion of macrophages to a M2 pro-regenerative phenotype, and nerve growth factor beta (NGF- β), are potential therapeutic agents to promote nerve regeneration. In this study an *in vitro* motor neuron culture from embryonic day 15 Sprague Dawley

rats was established, and the dose response curves of IL-4 and NGF- β on *in vitro* motor neuron extension were measured. We additionally tested the biosafety of 0.7% agarose in combination with lipid microtubules (LMTs), as a potential biocompatible, slow releasing drug delivery vehicle. We also evaluated the effects of pre-constructed LMT monomers using our *in vitro* assay. We demonstrated a potential dose dependent relationship on neurite extension for IL-4, Agarose+LMTs and Agarose+LMT pre-constructed monomers. No evidence for a dose-response effect for NGF- β was observed. Ongoing studies are aimed at further optimizing our *in vitro* culture and dose response results, with an alternate positive control, B-27. Future applications exist for investigating other biomolecules, and for co-culture studies of motor neurons with other cell types involved in nerve repair and viability such as Schwann cells and macrophages.

Targeted SNP Testing of Horses Bearing Sarcoid Tumors

HANNAH J. LYNAUGH

Under the supervision of Dr. Douglas Antczak
Baker Institute for Animal Health

Sarcoid tumors are the most common skin neoplasm in horses. This study tested the hypothesis that two genetic loci within the horse genome contribute to the susceptibility to equine sarcoid tumors based on previous research conducted by the Equine Genetics Center at Baker Institute at Cornell University. These two genetic regions were discovered to be the Major Histocompatibility Complex Class II region on equine chromosome 20 (ECA 20) and a locus near the *PROCR* gene on equine chromosome 22 (ECA 22). Allelic discrimination assays were utilized to genotype formalin fixed paraffin embedded (FFPE) samples submitted to Cornell's Animal Health Diagnostic Laboratory. There were 272 sarcoid positive case samples tested as well as 90 non-sarcoid skin condition control samples. The samples were further subjected to PCR amplification of the Bovine Papilloma Virus (BPV) long control region (LCR), followed by restriction enzyme-mediated digestion to determine BPV type. The ECA-22 SNP assay showed no difference in allele frequency between case and control samples. The assay showed a slight increase in frequency for the case samples over control samples for the ECA-20 SNP though it was less significant than in the original study. These results lead us to believe that the originally detected genetic associations on ECA-20 and ECA-22 may be involved in severe sarcoid cases, but not in mild forms.

Evaluation of Immunosuppressive Effects of Aflatoxin in Broiler Chickens

JULIANNE BOULD MCDONOUGH

Under the supervision of Dr. Dan Brown and Dr. Jerrie Gavalchin
Department of Animal Science

Sixty-seven 3 day-old broiler chicks were divided into five groups and were fed a reference diet, a soybean-based diet comparable to commercial broiler feed containing no aflatoxin for 21 days. For the final 13 days, one group continued to be fed the reference diet while the other four groups were

fed one peanut meal-based diet that contained one of the following amounts of aflatoxin: 41.3ppb, 67.5ppb, 76ppb, or 120ppb. Peanut meal used in the 76ppb and 41.3ppb diets underwent an ethanol treatment to extract aflatoxin. At day 34, all chicks were weighed, had blood drawn, and were humanely euthanized. The bursa, thymus, and spleen were weighed and preserved. The serum was analyzed for IgY concentration by ELISA. There was a significant difference in final body weight between the reference group and experimental groups. There was no significant difference in the relative weights of the bursa, thymus, and spleen among groups. Histopathological analysis of the bursa indicated that there was a dose-dependent relationship between aflatoxin exposure and loss of structural integrity of the bursa. Preliminary immunohistochemical analysis of the bursa indicated that there was decreased cell proliferation, measured by expression of PCNA, in chicks fed the diet containing 120ppb aflatoxin compared to chicks fed the reference diet. Analyses of other groups and organs are ongoing. ELISA indicated that there was a statistically significant difference in IgY concentration between diets. Further analyses should be completed on the diets, but these preliminary results suggested that aflatoxin has dose-dependent immunosuppressive effects on chickens.

Ethanol Extraction of Aflatoxin from Contaminated Peanut Meal and the Effects on Broiler Chicks Fed Diets Using Ethanol Extracted Peanut Meal

MANA OKUDAIRA

Under the supervision of Dr. Dan Brown
Department of Animal Science

Aflatoxins are toxic compounds produced by the fungi *Aspergillus flavus* and *Aspergillus parasiticus*. These mycotoxins are the primary contaminants of peanuts and are especially problematic in countries such as Haiti where ideal climate conditions for fungal growth and toxin production are combined with a general laxity in food safety regulations. The present study addresses this issue by seeking a safe way to divert the contaminated peanuts for use in broiler chick feed. To reduce the level of contamination in the peanuts, ethanol extraction was applied to two samples of contaminated peanut meal with a “high” and “low” level of contamination. Unlike some approaches to decontamination, this method can be adapted to the Haitian environment where ethanol is readily available in the form of *clarin*, a cheap, local Haitian spirit. Four experimental diets were formulated that varied in aflatoxin level and whether the peanut meal had received the ethanol treatment. A reference diet was formulated in an identical manner using soybean meal in place of peanut meal and received no ethanol treatment. Diets were fed to 3-week old broiler chicks over the course of 13 days. Our data indicate that neither the aflatoxin levels used in this study nor the ethanol treatment had any significant effects on the weight gain of the chicks. When compared to the reference group, all experimental groups differed significantly in their growth suggesting that there may have been confounding variables. Significant interaction effects were seen in relative liver sizes. Overall, our results indicate that further analysis of the nutrient composition of the diets, specifically in their amino acid content is necessary to explain the trends in growth we observed. Nonetheless, this study showed that broiler chicks feeding on an aflatoxin contaminated peanut-meal based diet can be grown to at least 50% of the weights of chicks feeding on the standard soybean meal based diet.

An Investigation of Antioxidant Supplementation on Microalgal Broiler Diets

ELEANORE V. O'NEIL

Under the supervision of Dr. Xingen Lei
Department of Animal Science

Omega-3 fatty acid enrichment with eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) in broiler thigh and breast would make a healthier meat product. This experiment sought to determine if dietary defatted microalgal inclusion could enrich broiler muscle with EPA or DHA and whether antioxidant supplementation could improve lipid stability. 120 three-week old Cobb broilers were divided into twenty-four pens fed either a corn-soybean basal diet (BD) (CON), BD + 10% microalgae (ALG), BD + 10% microalgae + vitamin E (DL- α -tocopheryl acetate, 150 IU/kg) (ALG+E), or BD + 10% microalgae + selenium (selenium-enriched yeast, 0.5 mg Se/kg) (ALG+S) for a three-week period. Body weights and feed intake were determined throughout the experiment. Plasma, tibias, various tissues and muscles were collected for analyses. Body weight and feed intake were unaffected by diet. Plasma levels of triglycerides, non-esterified fatty acids, uric acid, and glucose were unaffected by diet, but broilers fed CON diet had lower plasma cholesterol than broilers fed ALG+E. Diet had no effect on tibia strength. Diet did not impact EPA or DHA in thigh, breast, and fat pad; broilers fed ALG, ALG+E, or ALG+S had more overall omega-3 fatty acids in their livers than birds fed the CON diet but not in the form of EPA or DHA. Lipid stability was unaffected by diet. In conclusion, dietary inclusion of the defatted microalgal biomass did not enrich EPA or DHA and antioxidant supplementation did not improve lipid stability. Dietary microalgal inclusion has no adverse effects on broiler growth performance or tibia strength.

Genotypes of Cornell Dorset and Dorset Crosses Compared with Romneys for Melatonin Receptor 1a

CHRISTIAN J. POSBERGH

Under the supervision of Dr. Michael Thonney
Department of Animal Science

Sheep are seasonally polyestrous breeders, meaning they breed when day length shortens in the fall. Ewes respond to these changing day lengths through chemical pathways involving melatonin receptors. However, certain breeds such as Dorset, are known to be less seasonal with some individuals being able to breed and lamb year round. The Melatonin Receptor 1a (MTNR1A) gene was identified as a candidate gene for out of season breeding. The first studies found a Single Nucleotide Polymorphism (SNP) that was associated with a shorter time to first lambing and a shorter period between lambing using ewes managed under the Cornell STAR accelerated lambing system. The favorable allele was denoted the M allele and the unfavorable allele, the m allele. This study compared allele frequencies of this polymorphism in the Cornell flock with commercial Romney flocks not selected for out of season breeding. Frequencies of the M allele were higher in the Cornell flock. Using 72 genotyped Cornell ewes, having two or greater lambing records, ewes

with the M allele did not have increased lambings per year, lambs delivered per year, lambs born alive per year, or lambs weaned per year compared with ewes that were mm. This study shows that the M allele may not be a beneficial marker for use within flocks seeking to improve production and the ability to lamb out of season. These findings warrant future research of the genetics of aseasuality in sheep.

Relationship Between Growth Hormone Axis Polymorphisms and Fertility in Lactating Dairy Cows

VICTORIA SAMPSEL

Under the supervision of Dr. W. Ron Butler
Department of Animal Science

The aim of this work was to determine the effects of a growth hormone receptor (GHR) AluI polymorphism and an insulin-like growth factor (IGF-I) SnaBI polymorphism on fertility in lactating dairy cows. The cows (N=209) were selected for the study based on availability of breeding records and pregnancy information. Dairy Comp 305 software was used to compile records regarding the number of artificial insemination (AI) services required for pregnancy and records from pregnancy checks through 210 days of lactation. For genotyping, DNA was extracted from buffy coat of blood samples and the presence of alleles determined after polymerase chain reaction and digestion with the restriction enzyme unique to each gene of interest. Among the cows, the allele frequency for GHR AluI polymorphism was 0.61 and 0.39 for alleles B and A, respectively. The conception rate to first AI was not different among genotypes ($P = 0.67$). Cows possessing the AA genotype had a median number of days for achievement of pregnancy that was significantly less than the other genotypes ($P = 0.025$). With respect to the IGF-I SnaBI polymorphism examined, the allele frequency was 0.59 and 0.41 for the A and B alleles, respectively for the cows (N=71) selected for analysis. There was no difference in any of the fertility parameters measured among genotypes. The growth hormone axis should continue to be explored for relationships between polymorphisms and fertility in dairy cows. GHR polymorphisms are related to improved fertility, while more research is needed into IGF-I polymorphisms.

Inflammatory Response of Canine Endothelial Cells to Oxidized Lipoproteins

CHRISTOPHER S. SHIPRACK

Under the supervision of Dr. Erica Behling-Kelly
Department of Population Medicine and Diagnostic Sciences

Acute and chronic inflammation are fundamental characteristics of cardiovascular conditions such as atherosclerosis and chronic thrombosis. Endothelial cells, once thought to be inert, have in the past few decades proved to be key players in the inflammatory responses of these pathologies. The inflammatory response of human endothelial cells to modified lipoproteins has been well established with regard to production of chemokines, cytokines and immunoadhesion molecules. These same

responses have not yet been examined in a canine model. The aim of this study is to assess the inflammatory response of canine aortic endothelial cells (CAEC) treated *in vitro* with native and oxidized lipoproteins by determining production of TNF- α and E-selectin proteins. TNF- α concentrations were determined by ELISA using pre-validated antibodies. CAECs treated with oxidized lipoproteins did not demonstrate any significant secretion of TNF- α into the media. CAEC lysates had measurable quantities of TNF- α but did not demonstrate statistical significance between treated and untreated groups. E-selectin production was determined by western blot utilizing a polyclonal E-selectin/CD62E antibody. Preliminary data indicate that CAEC do express E-selectin in response to treatment; further work to verify this claim is currently in progress. These results indicate that hyperlipidemia induced inflammatory diseases, that are considered global killers in human medicine, may not have identical etiologies in dogs compared to humans. Further research is necessary to determine the degree of deviation between human and canine inflammatory etiology.

Identifying and Characterizing Behavioral Patterns in Two Hawkmoth Species: *Manduca sexta* and *Hyles lineata*

TRISHA BASU

Under the supervision of Dr. Robert Raguso
Department of Neurobiology and Behavior

Circadian rhythms are endogenous rhythmic patterns, found in all major taxonomic groups of life, which oscillate with a period of approximately 24 hours. These rhythms synchronize organismal mechanisms such as locomotor activity, sleep, growth and development, gene regulation, and migration with environmental patterns. The ability to internally regulate time allows an organism to successfully interact with the biotic and abiotic factors in its environment. *Manduca sexta* and *Hyles lineata* are two widespread, nectar-feeding hawkmoths (Lepidoptera: Sphingidae) that have overlapping geographical niches but differ in foraging and locomotor activity. The model organism, *M. sexta* is a strict specialist that only forages from night blooming flowers while the related *H. lineata* is a generalist reported to feed from a broad spectrum of flowering plants. Previous anecdotal accounts of each species have classified *M. sexta* as nocturnal and *H. lineata* as arrhythmic. This study seeks to experimentally determine the existence of and classify circadian rhythms in these pollinator species. Both *M. sexta* and *H. lineata* display circadian rhythms in their adult locomotor activity that can be explained by their interactions with the external environment. *Manduca sexta* is a nocturnal species while *Hyles lineata* is cathemeral.

Deep-water Dragonets (Teleostei: Callionymidae: *Foetorepus*) of the Mid Atlantic Bight: A Little-known Genus from the Edge of the Continental Shelf

KATHERINE ELLIOTT BEMIS

Under the supervision of Dr. Irby Lovette and Dr. Patrick Sullivan
Laboratory of Ornithology / Department of Natural Resources

The ranges of two rare species of deep-water dragonets—the Spotfin Dragonet (*Foetorepus agassizii*) and the Palefin Dragonet (*F. goodenbeani*)—overlap on the outer continental shelf of North America in the Mid Atlantic Bight. I studied more than 500 specimens collected between 2009-2014 by the Northeast Fisheries Science Center to better characterize the geographic and depth distributions of the two species, describe aspects of their reproductive biology, and consider general questions about deep shelf and continental slope habitats. The two species occurred in a subset of locations within the sampled area (71 of 3887 stations), and their densities were related to latitude, longitude and depth. Density hotspots were associated with areas near submarine canyons. Although *F. agassizii* and *F. goodenbeani* occur at similar latitudes and longitudes in the Mid Atlantic Bight, *F. agassizii* occurs at greater depths, 50 m deeper than *F. goodenbeani*. Macroscopic and histological analysis of reproductive condition indicated active spawning by both species in September and October; females collected in these months had oocytes in many stages, indicative of asynchronous oocyte development and batch spawning. Collection locations and depths in spring

and fall were similar, suggesting *F. agassizii* and *F. goodenbeani* do not migrate seasonally, perhaps because they occur in habitats with stable year-round temperatures. Many species of outer continental shelf and slope fishes remain poorly known, and these two species of *Foetorepus* offer a window into the general biology of shelf fishes.

Sirt1 Modulation as an Eating Disorder Therapy

KAYLA E. BROOKS

Under the supervision of Dr. Christiane Linster
Department of Neurobiology and Behavior

Anorexia Nervosa (AN) is a devastating eating disorder with the highest mortality rate of any mental disorder (Arcelus et al. 2011). The neural mechanisms of AN can be studied in model organisms, mostly through a model known as activity-based anorexia (ABA). Sirt1 is an NAD⁺-dependent deacetylase, known to affect longevity, food intake, anxiety, exploratory behaviors, as well as susceptibility to addiction. This makes it a likely factor in the development and progression of AN. Here, we investigate the role of brain Sirt1 in modulating ABA. We found that Sirt1 brain-specific knock-out animals (T1KO) or animals treated with specific Sirt1 inhibitor (EX527) were more resistant to ABA, compared to controls. Conversely, Sirt1 brain-specific overexpressing animals (T1OX) lost slightly more body mass and activity, and had generally faster progression of this disease. The progression of the disease in this AN model was monitored by measuring daily food intake, activity levels and body mass. Additionally, we identified the putative mechanism through which Sirt1 affects AN progression. We found that expression of the gene encoding the N2A subunit of the NMDA receptor, Grin2a, and tyrosine hydroxylase (TH) are significantly elevated in T1KO animals and those treated with EX527, compared to wild-type littermates. At the same time, Grin2a and TH are markedly reduced in T1OX mice. Thus, Sirt1 inhibition may be used to understand and treat AN, and the mechanism of action involves change in composition of NMDA receptor and tyrosine hydroxylase levels.

Simulation of *in vivo* Hormonal Environment in an Attempt to Improve *in vitro* Canine Oocyte Maturation Rates

ZACHARY T. DVORNICKY-RAYMOND

Under the supervision of Dr. Alexander Travis
Department of Biomedical Sciences, Baker Institute for Animal Health

Despite decades of research, *in vitro* fertilization (IVF) in the domestic dog remains unsuccessful, partly due to the unique reproductive physiology of canids. Most canids experience highly variable, prolonged inter-estrus periods and must undergo post-ovulatory maturation of oocytes prior to fertilization. Recent research has sought to develop assisted reproductive technologies (ART) to address these concerns, with efforts focused on the *in vitro* maturation of follicular oocytes for use in IVF. Doing so would improve endangered species population management and facilitate gamete

recovery and development of transgenesis. Here, we simulated the *in vivo* conditions of the periovulatory bitch with the goal of enhancing nuclear maturation rates. Oocytes from follicles ≥ 2 mm were extracted from ovaries of 8 month to 4-year-old bitches and incubated for 48-72 hours in modified TCM-199 supplemented with progesterone (P4) and/or equine chorionic gonadotropin (eCG). Neither progesterone nor eCG priming had a detectable impact on the completion of nuclear maturation. The mean percentage of oocytes reaching metaphase II (MII) was 4.36%, although high MI rates were observed (28.75%). Due to the low control group maturation rates in this study, it remains inconclusive whether progesterone influences *in vivo* maturation rates. Therefore, this experiment must be repeated in a study that has higher control MII maturation rates. Furthermore, recent studies have suggested indirect effects of progesterone on oocyte maturation via influence on follicular and oviductal cells. Future studies should investigate the progesterone-influenced relationships between the canine oocyte, preovulatory follicular environments, and the oviduct during the periovulatory period.

Investigating the Innate Immune Response to Mammalian Orthoreovirus Using Ribosome Profiling

JAMES EAGLESHAM

Under the supervision of Dr. John Parker
Baker Institute for Animal Health

Global translational responses to viruses infecting human cells are poorly understood. In the past, relatively insensitive proteomics-based approaches have yielded low-resolution pictures of the changes in protein expression in virus-infected cells. Here, we use ribosome profiling, a technique utilizing deep-sequencing of ribosome-associated RNA, to examine the global translational response of A549 human airway epithelial cells to infection with mammalian orthoreovirus. In particular, we will focus on translation of innate immune response genes to better understand innate immunity to reovirus in airway epithelial cells. Genes involved in response to viruses, the immune response, and apoptosis regulation were overrepresented among genes more than 5 fold upregulated 18 hours post-infection. Among the most upregulated genes were interferon-lambda, RIG-I like receptors RIG-I and MDA5, 2'-5' oligoadenylate synthetases, IFIT genes, and other interferon stimulated genes. We identified several genes that were upregulated in response to reovirus infection which had not previously been observed to be upregulated in published microarray and proteomics studies. Our dataset provides information on temporal dynamics of the translome during the course of reovirus infection, and is the first study to document in detail the impact of reovirus infection on host cell translation.

Extracellular Recordings of the Medial Prefrontal Cortex and Behavioral Inhibition in Rats

CALVIN FANG

Under the supervision of Dr. David Smith
Department of Psychology

Inhibition is a vital function of the prefrontal cortex. It resolves conflicts in responses, strategies, memories and more, allowing the cortex to make a decision and pursue goal-oriented behaviors. Many studies have shown that lesions in the prefrontal cortex result in poor performances on tasks that require inhibition, such as the Stroop task or the Wisconsin Card Sort Task in both human and rat studies. The purpose of this study is to look at the activity of neurons in the prefrontal cortex during a task involving inhibition, a continuous matching to sample task. The rat would receive a reward on match trials, when the current odor matched the odor of the previous trial, and no reward on nonmatching trials, when the current odor did not match that of the previous trial. As the animals were first trained to dig into cups for sugar pellets, they must inhibit the behavioral response of digging during nonmatching trials. Thus, match trials can be thought of as go trials, and nonmatch trials can be thought of as no-go trials. I found neurons that responded differentially for nonmatching trials and match trials, suggesting that activity in the PFC corresponds to inhibition. Furthermore, neurons that were found to have more activity for nonmatching trials were found to have reduced activity when errors were made on those trials. Thus, these recordings corroborate the lesion studies, as there is evidence of an inhibitory no-go signal.

The Effects of Prostaglandins (E₁, E₂, F_{1α}) on Bovine Sperm Motility

MOHAMMAD FAROOQ

Under the supervision of Dr. Susan Suarez
Department of Biomedical Sciences

Defects in sperm motility are a major cause of infertility. A thorough understanding of sperm motility is necessary for treatment of infertility and development of effective contraceptives. Hyperactivation, a specialized motility pattern exhibited by mammalian sperm, is vital for fertilization. Hyperactivation allows sperm to swim through the viscoelastic fluids in the oviduct and to escape from the sperm reservoir at the base of the oviduct. Evidence suggests that Ca²⁺-modulated activation of CATSPER membrane ion channels on sperm is the mechanism behind hyperactivation. However, it is still unknown what signal induces hyperactivation *in vivo*. Prostaglandins are hormone-like molecules that exist in the lower oviduct and have been shown to affect sperm motility. In this study we tested the effects of prostaglandins E₁, E₂, and F_{1α} on bovine sperm hyperactivation. These studies suggested the possibility that prostaglandins may be inducing hyperactivation in bound sperm. The effects of prostaglandins were subsequently tested on free-swimming sperm; it was hypothesized that prostaglandins would induce hyperactivation. For free-swimming sperm, none of the three prostaglandins had any measurable effect on hyperactivation

when compared to control treatments. Less than 2% of sperm displayed an intermediate motility pattern which was not quite fully hyperactivated. Our results suggest that prostaglandins do not induce hyperactivation in free-swimming sperm. We also tested whether PGE₂ would induce hyperactivation in sperm bound to oviductal epithelium, because this would more closely mimic the condition of sperm in vivo at the time of hyperactivation; however, only slight effects were observed. It may be possible that prostaglandins work in other conditions or with other signaling factors to induce hyperactivation. Further studies need to be conducted.

Investigation of Bacteria Inhabiting Asymptomatic and Symptomatic Asteroidea on the North American Pacific and Atlantic Coasts

PARKER FOSTER

Under the supervision of Dr. Ian Hewson
Department of Microbiology

Sea stars (Echinodermata, Asteroidea) have a unique (to phylum) property of drawing in seawater to their coelom and vascular system, yet little is known about microbiome composition and how it differs between these environments. This study explored the composition of bacteria colonizing these fluids, and compared them between asteroid species living in two ocean basins. Bacterial communities associated with asymptomatic asteroids, assessed by 16S rRNA cloning and sequencing, were compared against asteroids showing symptoms of sea star wasting disease (SSWD). Our results show the dominant bacteria colonizing the fluids were *Mycoplasma* and *Sphingomonas*, and that the bacterial communities inhabiting SSWD-affected asteroids contained different compositions than those in asymptomatic hosts. The sphingomonads and mycoplasma have each been associated with inhabiting a variety of hosts as well as invading host cells, thereby evading immune responses. Further investigation is needed to distinguish whether bacteria randomly colonize the asteroid or if the host influences the establishment of a microflora with symbiotic relations via a recruitment mechanism.

The Epithelial-to-mesenchymal Transition (EMT) in Pancreatic Cancer Cell Lines: an Analysis of Circulating Tumor Cell Detection Markers and a Potential Role of Extracellular Vesicles

CONOR GRUBER

Under the supervision of Dr. Brian Kirby
Sibley School of Mechanical and Aerospace Engineering, Cornell University; Division of Hematology and Medical Oncology, Department of Medicine, Weill Cornell Medical College

Owing to rapid, symptom-free disease progression, pancreatic cancer (PC) is typically not diagnosed until after metastasis, a stage when treatment outcomes are dismal. Central to the invasive nature of PC is the process of epithelial-to-mesenchymal transition (EMT), in which cancer cells alter their phenotype and behavior to facilitate invasion and entry into circulation. Despite its pathological

importance, the molecular triggers that initiate EMT, and the resulting effects on molecular profiles are inadequately understood. The consequence of EMT on marker expression is particularly vital to the isolation of circulating tumor cells (CTCs), as standard technologies rely on recognition of specific epithelial markers for capture and detection of CTCs.

In this study, a protocol to determine the status of EMT was developed, and robust induction of EMT was accomplished. Three PC cell lines were assessed for EMT induction by treatment with epidermal growth factor (EGF) and transforming growth factor- β (TGF- β). These treatments induced contrasting effects on the expression of epithelial cell adhesion molecule (EpCAM) and cytokeratin (CK), two markers central to CTC isolation. This finding suggests that EMT may hinder epithelial-targeted CTC capture when triggered by TGF β . To further demonstrate the importance of the diversity of factors capable of initiating EMT, we demonstrated a novel form of EMT induction by treatment with extracellular vesicles derived from EMT-induced.

Thermal Biology of Old World Suboscines and Other Mid-sized Bornean Birds

ERIC GULSON

Under the supervision of Dr. David Winkler
Department of Ecology and Evolutionary Biology

When regulating their internal body temperature, birds use their unfeathered bills and legs to exchange heat with the environment and save on more costly ways of maintaining homeostasis. Previous studies have found that larger bills help birds dispense of excess heat. I tested this idea using the various canopy and understory levels of the Bornean lowland forest as a hot/cool environmental gradient created by differences in solar loading and focused on a range of mid-sized birds, particularly Old World suboscines, in this gradient.

I used a climate-controlled chamber with a thermal imaging camera to record surface temperatures on birds exposed to a temperature range spanning 20 to 40 °C, analyzed the temperatures of each body part with custom software, and used equations for radiative and convective heat exchange to calculate heat lost from the body and the bill. All birds actively used their bills and legs to thermoregulate by warming them rapidly in relation to their body as ambient temperature approached internal body temperature, meaning they all had control over blood flow to these areas to more efficiently lose heat. Birds that lived in the canopy had proportionately larger bills and lost a significantly higher proportion of heat, relative to the body, than did birds from the middle and lower strata. These data indicate that the bill is indeed an important component in the thermoregulation of mid-sized canopy birds. Selection for larger bills in some of these taxa may have come from thermoregulatory pressures at least as much as those associated with prey capture and processing.

The Subcellular Localization of Grapevine Red Blotch-associated Virus Proteins V2 and V3

TAI WEI GUO

Under the supervision of Dr. Keith Perry
School of Integrative Plant Science, Plant Pathology and Plant-Microbe Biology Section

The Grapevine red blotch-associated virus (GRBaV) is a recently discovered DNA virus of family Geminiviridae found in North American grapevines, and is associated with leaf discoloration and decreases in fruit quality. Two of its six open-reading frames, V2 and V3, are unknown in function and share no obvious homologies with plant or viral genes. Transient expression of these ORFs with fluorescent tags demonstrates that V2 localizes in the nucleoplasm, Cajal bodies, and cytoplasm; and V3 localizes in the nucleus.

Determining the Optimal Relative Humidity Conditions for Release of the Pest Control Agent *Trichogramma ostrinae*

MARGARET HENDERSON

Under the supervision of Dr. Robert Raguso
Department of Neurobiology and Behavior

Trichogramma ostrinae is a parasitoid wasp which can be used as a biological control for several lepidopteran agricultural pests. This project examined the effect of ambient relative humidity (RH) on the ability of female *T. ostrinae* wasps to locate and parasitize eggs of the host *Manduca sexta*. In a binary RH choice assay, significantly more wasps chose 75% over 20%, 90% over 20%, and 90% over 45% RH, suggesting a general preference for high RH over low. However, 75% was preferred to 90%, suggesting an aversion to >90% RH. In a naturalistic egg-searching task (a chamber at fixed RH containing two host eggs on top of a leaf disk), latency time to the first leaf contact was significantly shorter at 75% or above than at 45% or below, and mean probabilities of transition from searching to interaction with the leaf disk, and from interaction with the leaf disk to egg drumming, were significantly higher at 75% RH or above than at 45% or below, suggesting these behaviors are facilitated by high RH. In contrast, mean probability of transition from egg drumming to drilling, as well as latency time from first leaf contact to first drill, showed no significant effect of RH treatment, which may indicate that the effect of RH is less significant after the drumming process has started. These results support 70-80% as the optimal RH range for release of *T. ostrinae* as a biological control agent.

Sidewall Microarchitecture Provides Hyperactivated Bull Spermatozoa with a Biophysical Advantage over *Tritrichomonas foetus*

DILLON G. HICKMAN

Under the supervision of Dr. Susan Suarez
Department of Biomedical Sciences

Little information is known about the swimming behavior of the sexually transmitted pathogen, *T. foetus*, relative to sperm in the bovine female reproductive tract. In addition, nothing is known about how hyperactivated sperm behave as they approach sidewalls. Hyperactivated sperm are characterized by high amplitude and asymmetrical flagellar beating and are necessary for fertilization. Sidewalls are relevant to the microarchitecture of the bovine reproductive tract, which contains walls of tissue that line grooves in various surfaces. This study investigated the swimming behavior of *T. foetus* and hyperactivated sperm as they approach sidewalls. Our hypothesis was that *T. foetus* and hyperactivated bull sperm behave differently in aqueous media when encountering a sidewall boundary. Digital video microscopy and subsequent cell tracking revealed that hyperactivated sperm behaved much differently than *T. foetus* after wall contact. Hyperactivated sperm exhibited the tendency to swim along a sidewall, with most cells exiting at very low outgoing angles relative to the sidewall. In contrast, *T. foetus* moved away from the wall in an essentially random direction. The results indicated that microarchitecture of the female reproductive tract may provide sperm with a preferential way to ascend the tract over *T. foetus*.

Neuromodulator and Olfaction Deficits in an MPTP Mouse Model of Parkinson's Disease

SACHIDHANAND JAYAKUMAR

Under the supervision of Dr. Christiane Linster
Department of Neurobiology and Behavior

The aim of this project is to quantify the olfactory dysfunctions associated with Parkinson's Disease in a mouse 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP) model. Parkinson's Disease, like many neurodegenerative diseases, gives rise to olfactory deficits during the early nonmotor stages of disease development. The MPTP neurotoxin model is a common method to study this early state progression due to the slow, realistic rate of neuronal degradation it causes throughout the brain. Even with the presence of such a model, a focus on the predominant motor aspects of the disease has left these smell losses inadequately explored from a neurochemical and behavioral level. Thus, the two objectives of this study are: to assess olfactory deficits in the MPTP model through discrimination/duration tests, and to correlate these behavioral results to previously observed changes of dopamine (DA) levels in the striatum. These results will help connect the behavioral progression of PD with the existing knowledge of olfactory processing networks. Beyond learning about the mechanisms themselves, the eventual hope is that such knowledge can be applied to the patient setting to develop a reliable disease marker before the onset of conventional PD symptoms.

Identification of Novel Targets for Therapeutic Intervention of Crohn's Disease

JEFFREY Y. JIAN

Under the supervision of Dr. Kenneth Simpson
Department of Clinical Sciences

Crohn's Disease (CD) is a form of Inflammatory Bowel Disease (IBD) characterized by granulomatous intestinal inflammation. In afflicted individuals, through genetic predisposition and/or environmental influence, a novel pathotype of *Escherichia coli*, Adhesive and Invasive *E. coli* (AIEC), has been found to be prevalent in ileal CD. AIEC is thought to be able to successfully metabolize nutrients associated with CD, including glycerol, ethanolamine, and glutamine. This metabolic advantage may contribute to outcompeting commensal species in intestines of CD patients, leading to microfloral dysbiosis. We are interested in the genes involved in metabolism of inflammation associated substrates and how these gene products participate in CD pathogenesis. To identify genes in AIEC utilization of CD associated nutrients, we employed signature tagged mutagenesis (STM) of NC101, a known AIEC strain in the murine intestine. We screened the 1,800 mutant STM library for the ability to grow in chemically defined media with fucose or glycerol as carbon sources, and ammonium chloride as a nitrogen source. We successfully identified 118 STM mutants with severely attenuated growth phenotypes, and determined a set of 49 genes, in 19 functional groups, necessary in metabolizing these substrates. Additionally, we confirmed that these genes were globally mutually exclusive from those necessary in bacterial adhesion and invasion. This work is a significant step in our ultimate goal of identifying the specific genes in AIEC for effective therapeutic intervention in CD.

Study of Intermolecular Interaction of Spacer Peptide Assembly Domain in *in vitro* Assembly of Rous Sarcoma Virus Gag Protein

DANNI JIN

Under the supervision of Dr. Volker Vogt
Department of Molecular Biology and Genetics

Gag protein, the multidomain structural protein of a retrovirus, mediates viral budding from a host cell. Purified Gag protein can assemble *in vitro* to form virus-like particles. Rous sarcoma virus (RSV) Gag protein consists of three domains: matrix (MA), capsid (CA), and nucleocapsid (NC). The spacer peptide (SP) located between CA and NC, along with some flanking residues, is named the SP assembly (SPA) domain. It is hypothesized that the SPA domain of RSV Gag has a helical structure, and that a six-helix bundle is formed when Gag assembles into viral particles. I introduced exogenous cysteine residues in the SPA region that is predicted to form disulfide bond. Gag hexamer was formed upon oxidation, indicating SPA-SPA intermolecular interaction. The endogenous cysteine residues are important for efficient assembly. Introducing exogenous cysteine residues can partially rescue cysteine defects, and affect the kinetic properties of Gag assembly.

Stable Isotope Studies Revealing Influences of Diet and Reproductive Condition in the American Red Squirrel (*Tamiasciurus hudsonicus*) in Alaska

BRIAN MAGNIER

Under the supervision of Dr. Jeremy Searle
Department of Ecology and Evolutionary Biology

The American Red Squirrel (*Tamiasciurus hudsonicus*) is a widespread arboreal rodent. It can be found across North America, from Nova Scotia across the northern United States and throughout Canada, south to New Mexico and all the way up to Alaska. It is often found alongside human settlements as well as in natural forested environments, and has much potential as a wild rodent model system. Stable isotopes are increasingly being used in ecological studies of wild mammal populations to understand movement patterns, diet, and trophic interactions, but have been relatively under-used in ecological and physiological studies of rodent populations. Here I use stable isotope analysis in a study of wild American Red Squirrels. By analyzing the ratios of heavy to light isotopes of carbon and nitrogen in different tissues of squirrels, I was able to look at the physiological effects of reproductive condition in squirrels, and analyze differences in diet between geographic locations. Overall, 52 squirrels were sampled from six different locations in southern Alaska, including two sites near campgrounds. Carbon-13 ($\delta^{13}\text{C}$) and nitrogen-15 ($\delta^{15}\text{N}$) were the isotopes analyzed, and three different tissues were sampled from each individual (liver, blood, and hair). Samples closer to campgrounds had significantly heavier $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values than those in pristine forests, indicating a shift in diet or behavior due to human impact. $\delta^{15}\text{N}$ in hair was enriched in pregnant females compared to lactating females. This difference could indicate an increased usage of protein-rich foods in pregnant females in relation to fetal growth, or that the lactating females were re-routing nitrogen to help with nutrient-stress associated with milk-production. Adult males showed enriched $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ relative to immature males, most likely indicating an increased usage of high-protein foods, such as meat or mushrooms, and of human foodstuffs, in adults. Additionally, a Bayesian mixed model was used to estimate the relative proportions of chosen food sources in squirrel diets. Heavier-than-expected $\delta^{13}\text{C}$ levels may indicate a substantial involvement of lichen in their diet. From these various results, it can be seen that stable isotope analysis can provide insights into the ecology of the American Red Squirrel that would be difficult to obtain otherwise. In this way the diet and physiology of the rodent can be better understood, which will help explain its wide distribution and its potential to survive in close contact to humans. Considering my study overall, because of the short timescale and small sample sizes, the results obtained need to be treated with caution; however, the strong patterns observed encourage further work.

Characterization of CD8 α^+ Dendritic Cell Responses to *Toxoplasma gondii*, a Major Opportunistic Pathogen of Humans and Animals

COURTNEY E. MCDUGAL

Under the supervision of Dr. Eric Denkers
Department of Microbiology and Immunology

Dendritic cells (DC) are the major immune cells responsible for control of *Toxoplasma gondii* infection. Here, I assess the role of the CD8 α^+ DC subset on parasite control using MutuDC1940s, a newly described cell line with the properties of this major DC subset. I found that IL-12, a central cytokine in *T. gondii* control, was produced at high levels rapidly after parasite stimulation in a manner dependent upon signaling by β -catenin. Production of IL-12 increased in the presence of IFN- γ , while decreased in the presence of IL-10. I also found that the thymus and activation-regulated chemokine (TARC/CCL17) was produced in response to parasite stimulation, though only after an extended period of incubation. CCL17 showed a similar decrease in the presence of IL-10. In striking contrast to IL-12, production of CCL17 decreased in the presence of exogenous IFN- γ . The expression of costimulatory molecule CD86 was shown to increase on CD8 α^+ DCs post parasite stimulation. This result was amplified upon incubation with IFN- γ , but was blocked in the presence of IL-10. Together, these results reveal novel information regarding the role of CD8 α^+ DCs in the response to *T. gondii*, and they increase our knowledge of how these cells are controlled by immunoregulatory cytokines. Enhanced knowledge of immune system and parasite interaction can help reduce the rates of parasite-related morbidity and mortality.

The Potential of New Sesquiterpene Lactones for Targeted Therapy in Acute Myelogenous Leukemia (AML)

DAVID MERY

Under the supervision of Dr. Eloy Rodriguez
School of Integrative Plant Science, Plant Biology Section

Although high remission rates are obtained through current chemotherapeutic treatments of adult acute myelogenous leukemia (AML), most cases result in relapse. Leukemia stem cells (LSCs) are central to relapse by maintaining and initiating the AML population. LSCs represent a heterogeneous population of quiescent cells and thus resistant to current chemotherapy regimens. Novel therapies are seeking to target specific features shared by LSC and AML blasts. The natural product parthenolide (PTL) is a sesquiterpene lactone (SL) that has been shown to preferentially target LSC and AML blasts by inducing redox instability and NF κ B inhibition by its α -methylene- γ -lactone group with specific free thiols, involved in regulating highly oxidative environment of AML, and cysteine on NF κ B. The objective of this study was to isolate new SLs from *Parthenium hysterophorus* and *Parthenium confertum lyratum* to determine the ability of other sesquiterpene lactones to selectively target AML cells and induce ROS, compared to PTL. The sesquiterpene lactones Parthenin (PRT) and Tetraneurin-e (TET) were isolated from *Parthenium hysterophorus*

and *Parthenium confertum* var. *lyratum*, respectively. Antitumor activity of nine cell lines showed PRT to have LD50s in the range of 2.43–8.67 μ M. PTL had a higher range of 5.75–(>20 μ M) and TET was not active. PRT showed slight toxicity at high doses 6.35–200 μ M. PRT caused higher redox instability by depleting free thiols better than PTL. PRT was able to inhibit NF κ B and Nrf2 cytoprotective responses better than PTL at the RNA and protein level. TET did not target PTL targets. Molecular modeling (SYBYL-x) revealed a lipophilic signature that was shared by PTL and PRT, but not TET. Therefore, this study is an initial attempt to study how new sesquiterpene lactones target AML.

Eatfit-GIST: The Effectiveness of a Fuzzy-Trace Theory-Based Obesity Prevention Curriculum in Adolescents and Young Adults

ANNA C. MORANT

Under the supervision of Dr. Valerie Reyna
Department of Human Development

One of the most pressing health concerns in the United States today is obesity. Increasing numbers of both adults and children are overweight with over half of adults overweight or obese in 2014 and associated effects on heart disease, diabetes and other diseases.

We used an interactive tutorial, EatFit Gist-based Intelligent Semantic Tutoring (EatFit-GIST), to teach about obesity prevention to 35 high school and 50 college students. The intervention was aimed at improving gist understanding of nutrition and fitness based on Fuzzy-trace theory (FTT), a dual-process theory of memory and decision-making. The two processes are represented in parallel during information acquisition: gist as the bottom-line meaning of information and verbatim as detailed, surface form.

Participants took a pre- and post-intervention survey, which included measures of knowledge, gist principles, psychosocial mediators of behavior and intentions perform healthy nutrition and fitness behavior, and memory for intervention.

After completing the intervention, subjects demonstrated greater knowledge of fitness and nutrition and indicated greater perceived behavioral control, beliefs, understanding of categorical risk, and better intentions to perform healthy behaviors. College students performed better than high school students on measures of knowledge and other psychosocial mediators of behavior, including those guided by FTT. In the memory test, there was higher memory for both true and false verbatim items than gist items. Participants with more accurate post-intervention memory more highly endorsed gist principles.

These results are consistent with theory and previous experiments that show that gist-based manipulations cater to intuitive mental processes and can improve healthy decision-making.

Impacts of Early Life Family Structure and Foraging on Maternal Care and the Behavioral Development of Offspring

JIE YUEN ONG

Under the supervision of Dr. Alexander Ophir
Department of Psychology

Prairie voles are an excellent model for studying family dynamics given that, similar to humans, they are monogamous and biparental. Studies have shown that family dynamics (e.g., dad present or absent) play an important role in pup development, suggesting that variation in parental care can have lasting impacts on an individual. To date, studies have examined parental variation by removing the father or letting the father remain in the family homecage. However, such studies have yielded no significant effects on maternal care. Here, we investigate how being a single and/or working mother affects maternal care. In order to mimic a “working lifestyle,” parents must “forage” for food by traversing an incline that forces them to temporarily leave their pups while they eat. In order to quantify maternal care, daily video recordings from postnatal day 1 (PND 1) through PND 21 are taken of the families in 4 conditions: non-working single moms, working single moms, non-working biparental families, and working biparental families. Parental behaviors quantified include allogrooming, pup retrieval, and time in contact with pups. Additionally, we are also examining the effects of being raised in such conditions on pup behavioral development. Once pups have reached young adulthood, they are tested for various social behaviors, including dominance and strength of pair bonds, as well as spatial cognition and exploratory behavior. Although this experiment is still in the preliminary stages, it stands to elucidate variables in the early family environment that affect maternal care and the behavioral outcomes of offspring.

Effects of Plumage Color and Age on Reproductive Success in the Red-backed Fairy-wren

CONNOR ORRICO

Under the supervision of Dr. Mike Webster
Lab of Ornithology

Studies of female mate choice in sexual selection have produced an inconsistency in the degree to which females may favor more brightly colored, ornamented males. In many instances, these studies consider a difference in male ornament as discontinuous, often as it concerns alternative mating phenotypes. The question of female mate choice in males exhibiting continuous ornamentation within one mating phenotype, however, has been relatively unexplored. The red-backed fairywren is a model system for exploring the effects of continuous ornamentation of plumage color on reproductive success because the bright male phenotype in the two subspecies differs in plumage color from red to orange continuously and the males exhibit much variation in reproductive success due to high rates of extra pair paternity. This study used ten years of field data on morphology, quantified plumage coloration, and reproductive success to test the hypothesis that naturally redder

males, if available to females within a population of high plumage color variation, will be favored over orange conspecifics due to sexual selection. The predictions were that hue would positively correlate with extra-pair young and best explain reproductive success, independent of effects of age and condition. Using generalized linear mixed models, support was found for the hypothesis, as predictions were successful. In addition to supporting female mate choice hypotheses, the results of this study corroborate the sexual selection hypothesis that the asymmetrical introgression of plumage color across this system's hybrid zone is driven by extra-pair paternity, perhaps via sensory bias in female choice.

RNA-Guided CRISPR-Cas9 Induced Mutagenesis via Root Transformation in *Medicago truncatula*

MARSHALL WELLS TYLER

Under the supervision of Dr. Maria Harrison
Boyce Thompson Institute for Plant Research

Clustered regularly interspaced short palindromic repeats and associated Cas9 endonuclease (CRISPR-Cas9) gene editing technologies have facilitated genetic research in labs across the world. However, the efficacy of such technologies for root transformation in the model legume *Medicago truncatula*, a species of plant that forms a symbiosis with arbuscular mycorrhizal (AM) fungi, has not been addressed. To establish the ability of Cas9 to edit the *M. truncatula* genome, a Cas9 protein was expressed with a guide RNA molecule designed to target a 20 base pair segment of the GFP sequence in stably transformed GFP lines. The sequences coding for the protein and guide RNA were introduced into *M. truncatula* roots by *Agrobacterium rhizogenes*-mediated transformation. Plants were allowed to grow for a period of two weeks, after which mutations in the targeted site were analyzed both qualitatively and quantitatively. 45% of the transgenic roots lacked GFP fluorescence. 83% of the analyzed GFP sequences presented some type of indel mutation. This study demonstrates the viability of CRISPR-Cas9 for gene editing in *Medicago truncatula* and encourages the use of this system for the study of AM symbiosis.

Does Risk of Herbivory Drive Pollinator Shifts?

BRIAN M. WORTHINGTON

Under the supervision of Dr. Robert Raguso
Department of Neurobiology and Behavior

Conflict may arise within a plant-pollinator mutualism when the pollinator species also plays the role of herbivore at an earlier life stage. The hawkmoth *Manduca sexta* (Sphingidae) often oviposits on tobacco leaves (*Nicotiana* spp.; Solanaceae) while visiting flowers to drink nectar. Its caterpillars – tobacco hornworms – feed on *Nicotiana* leaves, causing severe fitness costs to the plant. To avoid the linked cost of herbivory while attracting a pollinator, a plant may adjust its strategy to attract alternate pollinators such as hummingbirds. Hawkmoths and hummingbirds pollinate the wild

tobacco species *Nicotiana sylvestris* and *Nicotiana langsdorffii* respectively, but while hornworm caterpillars are major herbivores, hummingbird pollination is associated with no such costs. I measured oviposition by *M. sexta* on these two tobacco species to gain insight into the potential role that risk of herbivory plays in the divergence of floral traits. I predicted that *M. sexta* should oviposit more frequently on *N. sylvestris*, which has more accessible floral nectar rewards. My results support this prediction, with greater oviposition observed on the flowering life stage of *N. sylvestris*. However, when given the choice for oviposition on either host species, female *M. sexta* show significant preference for oviposition on flowering *N. langsdorffii* over flowering *N. sylvestris*. Oviposition preference by female *M. sexta* reflects that other aspects of plant chemistry, aside from floral nectar, play a significant role in pollinator attraction. The preferential oviposition on *N. langsdorffii* may help us better understand why this species is thought to have made an evolutionary switch from ancestral hawkmoth pollination to its present hummingbird pollinator.

eIF4A1, eIF4A2 and ZCCHC8 are Potential Regulators of miRNA Function

YINGYUE ZHOU

Under the supervision of Dr. Andrew Grimson
Department of Molecular Biology and Genetics

MicroRNAs (miRNAs) are small non-coding RNAs that post-transcriptionally down regulate gene expression. They target mRNAs for degradation or translational repression via base-pairing with complementary sequences within 3' untranslated regions (3' UTRs) of mRNAs. Abnormalities in miRNA expression and targeting can cause human disease, including many cancers. While miRNAs are known to repress gene expression, the mechanism of miRNA-mediated repression remains elusive. An RNAi screen identified eIF4A1 and ZCCHC8 as top candidate regulators of miRNA-mediated translational repression. Here we validate the screening results by knocking down candidate genes by RNA interference (RNAi) and assessing knockdown effects on miRNA function using luciferase reporter assays. We report that single knockdowns of the candidates eIF4A1 and ZCCHC8, together with eIF4A2, which has recently been implicated as participating in the miRNA pathway, slightly reduced miRNA-mediated repression of luciferase reporters, indicating impeded miRNA function; and double knockdowns of candidate genes yielded significant derepression. Our data show that the paralogs eIF4A1 and eIF4A2 together with ZCCHC8 are potential regulators of miRNA-mediated translational repression.

Induced Tuber Formation of *Solanum tuberosum* in Response to Damage by the Colorado Potato Beetle

RACHEL AU

Under the supervision of Dr. Katja Poveda
Department of Entomology

Plant-herbivore interactions are ubiquitous on our planet. Plants have evolved various defense strategies to tolerate herbivory. One such strategy is overcompensation – an extreme form of tolerance in which tissue removal through herbivory results in higher biomass or seed production compared to undamaged plants. Three mechanisms have been proposed to explain overcompensatory responses: (1) the release of previously dormant buds and meristems, (2) the reallocation of resources, and (3) the up-regulation of primary metabolism. An astonishing example of overcompensation has been shown for a Colombian potato variety (*Solanum tuberosum* cv. Pastusa Suprema) in which an up-regulation of the primary metabolism and reallocation of resources have been proposed as the mechanism for the two-fold increase in tuber production described after tuber herbivory. The purpose of this study was to test how aboveground foliar herbivory affects tuber production (of Pastusa Suprema) in terms of growth and formation, if the response to defoliation is dependent on the amount of tissue removed, and if there is herbivore specificity of this response. I used the Colorado Potato Beetle (*Leptinotarsa decimlineata*, Say 1824; Coleoptera: Chrysomelidae) as the foliar herbivore of *Solanum tuberosum*. My findings demonstrate that aboveground foliar herbivory induces tuber formation – as predicted by the hypothesis of meristem dormancy release – with no apparent herbivore specificity, and that formation is maximized at low leaf tissue damage. This response is different than the previously described response to belowground tuber herbivory, where tissue damage induces tuber growth but not formation, specifically in response to *Tecia solanivora* larvae regurgitate. This different response suggests that this potato variety is capable of tolerating damage through at least two different mechanisms: increased tuber formation and increased allocation of resources to individual tubers. Disentangling the exact mechanisms that elicit and induce both types of responses would deepen our understanding of plant tolerance and provide invaluable tools for increased crop productivity.

Niche Overlap among Introduced and Native California Praying Mantids

CAMERON M. JONES

Under the supervision of Dr. Cole Gilbert
Department of Entomology

Introduced generalist predators can have broad impacts on an ecosystem including the displacement of native predators through resource or interference competition and intraguild predation. However niche partitioning can allow native predators to resist displacement and coexist with invaders. We investigated whether two native species of California praying mantids, *Litaneutria minor* and *Stagmomantis limbata* were resisting displacement by two introduced mantis species, *Iris oratoria*

and *Mantis religiosa*. We quantified spatial and temporal niche separation by conducting field experiments to determine the height within the vegetation each species occupies throughout development. We examined resource competition and intraguild predation by conducting feeding trials to determine optimal prey size ranges of sympatric species at instars that overlapped in time. The hypothesis of spatial niche partitioning is supported at Site 1 where the native *Litaneutria minor* occupies much lower levels in the vegetation than the invaders *I. oratoria* and *M. religiosa*. At Site 2, however, individuals of native *S. limbata* overlapped considerably with those of both *I. oratoria* and *M. religiosa*. Further optimal prey size experiments suggest that *S. limbata* and the two invasive species are engaging in direct competition, as well as intraguild predation. This hypothesis is also supported by low numbers of observed *S. limbata* and suggests that *S. limbata* is at risk for extirpation. Furthermore, recently established *M. religiosa* may displace *I. oratoria*.

Testing the Parameters of Sociality: The Influence of Kinship and Age-Sex Class on Rock Sharing in a New Social Huntsman Spider

CAMERON M. JONES

Under the supervision of Dr. Linda Rayor
Department of Entomology

The prolonged subsocial huntsman spider, *Delena lapidicola*, lives in family groups under rocks on granite headlands in Australia. In lab studies, we investigated whether *D. lapidicola* choice to have their own or share a rock retreat was influenced by the spider's kinship, age, sex, or prior residency. Spiders of all ages from three distinct populations were given 24hr choice tests to associate in a single retreat, occupy their own retreat across the arena, and/or to engage aggressively with one another. In stark contrast to their more social sister species, *D. cancerides*, that intensely compete for rare retreats under bark and are likely to attack and kill non-colony mates older than 6th instar, *D. lapidicola* were remarkably tolerant. Our results show that *D. lapidicola* preferentially aggregate with all conspecifics, regardless of kinship, age or sex. Only once in 38 trials was there mortality or indications of conflict. In contrast, similar choice tests in 20 adult female *D. cancerides* pairs resulted in all 20 females under separate retreats and with 15% mortality. Our results suggest that because competition for rock retreats is far less intense for *D. lapidicola* than for tree based retreats for *D. cancerides*, the spiders may not need to as aggressively defend retreat sites from potential competitors. But the level of peaceful cohabitation of *D. lapidicola* in the same retreats was unexpected.

Effects of Bacteria and Bacterial Metabolites on Oviposition of *Drosophila melanogaster*

GEON HO KIM

Under the supervision of Dr. Angela Douglas
Department of Entomology

Many organisms bear beneficial microorganisms in their system, and microbial metabolites can affect their nutrient contents, development rate, and even survival rate. Perhaps due to such benefits that microbes confer and their coevolution with the host, those organisms often show preference for their symbiotic bacteria. Despite such close relationship between the host and microbes, however, specific compounds that promote such preference have not been well studied, especially in case of gut microbes of *Drosophila melanogaster*. Results showed that flies have strong preference for food inoculated with certain gut microbes as well as some organic acids that could be produced by those bacteria as byproducts. Although the egg-laying preference for the bacteria and the organic acids were similar, their effects on flies' development were strikingly different. For instance, flies inoculated their gut microbes showed accelerated development rate, whereas those reared in acidic environment showed reduced larval development rate. In case of gnotobiotic flies, larval development rate was accelerated. Such difference suggests that the acids might be a cue for the beneficial microbes, but could be detrimental to the flies when they consume such acids without the microbes.

The Evolution of a Genus of South African Melittid Bees: *Rediviva*

GRAHAM ALLEN MONTGOMERY

Under the supervision of Dr. Bryan Danforth
Department of Entomology

The primary goal of this study was to provide the first phylogenetic hypothesis for the genus *Rediviva*, a group of South African bees in the family Melittidae. From an evolutionary perspective, this genus is especially interesting because of its diffuse co-evolution with *Diascia* (Scrophulariaceae) flowers, its oil-collecting nature, and novel characteristics such as the extraordinarily elongated forelegs found in females. We inferred a phylogeny from DNA nucleotide data using seven gene fragments (including both mitochondrial and nuclear DNA) and applied parsimony, maximum likelihood, and Bayesian methods to the resulting alignments. From these phylogenetic hypotheses, we were able to map and infer evolution of the ratio of tarsus length/forewing length, type of foreleg pilosity, orchid visitation, *Diascia* visitation and geographic range. We have demonstrated that the genus *Rediviva* is paraphyletic with respect to the genus *Redivivoides*, and our results may give insight into how pollinators and their host-plants co-evolve. We also propose a new subgeneric classification for *Rediviva* and discuss the phylogenetic placement of *Redivivoides*.

Diameter Growth and Fine Root Biomass Response to Fertilized Forests

ELI EGAN-ANDERSON

Under the supervision of Dr. Timothy Fahey
Department of Natural Resources

Net primary production is made up of below and aboveground growth. Our study looked at the effect of adding nitrogen and phosphorus fertilizers alone or in tandem to a northern hardwood forest ecosystem. Diameter growth of the trees and fine root biomass were measured in seven treated stands in the White Mountains of New Hampshire. The expected trends were that diameter growth would increase with fertilizers because of the added nutrients and that fine root biomass would decrease. There were not enough significant results in the aboveground growth to draw a conclusion, but fine root biomass increased significantly in fertilized plots, the opposite trend from what we were expecting. These results suggest that belowground responses to nutrient addition are more complex than current theory suggests.

Modeling Functional Genetic Differentiation in a Delaware Bay Eastern Oyster (*Crassostrea virginica*) Population Along an Environmental Salinity Gradient

MARY FISHER

Under the supervision of Dr. Matthew Hare
Department of Natural Resources

Eastern oysters in the Delaware Bay estuary have been shown to possess strong genetic differentiation between high and low salinity reefs, despite high levels of larval dispersal. We propose that these patterns are the result of local selection acting on both a multigenerational and within-generation scale, with a stronger relative contribution of within-generation adaptation. We used the simulation program quantiNEMO to (1) explore the empirical effects on genetic divergence of factors hypothesized to be important within the Delaware Bay system, (2) determine the relative values of those parameters which generate similar genetic patterns as seen in empirical measurements, and (3) explore the extent to which within-generation adaptation can contribute to the observed genetic differentiation under high gene flow conditions. Interaction effects between high selection intensity and low population size were found to cause truncation of realized dispersal, which has implications for population structure and the sustainability of local populations in marginal habitats. It is therefore necessary to carefully monitor effective population size and consider strategic supplemental outplants in order to maintain populations in marginal habitats and promote the ability of the Delaware Bay population to maximize niche breadth through within-generation adaptation. This study also highlights the need for more precise measurements of key demographic and environmental factors, including the width of larval dispersal and selection strength. While this study specifically addresses a single eastern oyster population, it answers key questions regarding the genetic and environmental factors that contribute to the adaptability and persistence of similar sessile benthic marine invertebrates.

Anthropogenic Impacts on YOY Brook Trout, *Salvelinus fontinalis*, Length in Pennsylvania's Marcellus Region

PERI GERSON

Under the supervision of Dr. M. Todd Walter
Department of Biological and Environmental Engineering

The brook trout's, *Salvelinus fontinalis*, suitable habitat range is drastically decreasing due to anthropogenic effects, a fact worrisome to ecologists and sports fishermen alike. The Marcellus Shell region in the Northeast generously overlaps the brook trout's historic territory. Increased horizontal hydraulic fracturing in the Marcellus region increases the potential for water contamination, a development that could be detrimental to brook trout because of their need for pristine habitat. Young-of-the-year brook trout in Hyner Run State park were significantly shorter in length within stream catchments that contain active hydraulic fracturing in comparison to streams whose catchments did not have well pads or active drilling. Differences in growth between treatments were not significant. The stream characteristics most likely the cause for differences in brook trout length were elevated concentrations of sodium and chloride, which also increased stream conductivity. The source of the chloride and sodium contamination is not likely from road salt because of the subject streams similar proximity to roads and the pattern of chloride concentrations across seasons. All streams whose catchments contain hydraulic fracturing had elevated chloride and sodium concentrations, whereas all of the streams that were free of hydraulic fracturing did not. The elevated levels cannot be directly linked to hydraulic fracturing, but it seems the most probable cause.

Personality Traits as a Prediction of Parental Effort and Reproductive Success

SARAH RUBENSTEIN

Under the supervision of Dr. Mike Webster
Department of Neurobiology and Behavior

Studies have shown that certain behavioral traits are often associated with reproductive success. We explored a specific pathway through which this link may be occurring. We examined how male aggression and female boldness are associated with parental effort and reproductive success in the black-throated blue warbler, *Setophaga caerulescens*, hypothesizing that more aggressive males and bolder females would both have higher reproductive success. Our results did not reveal a relationship between either aggression or boldness and reproductive success, but aggression (and not boldness) did predict parental effort. However, the cumulative parental effort is a better predictor of reproductive success than male or female provisioning rates alone. These results show that personality is not a direct indicator of reproductive success, but that it is associated with parental effort and potentially other traits that are affecting reproduction or other measures of fitness.

The Impacts of Ecotourism on Available Water Supply for, and Wastewater Disposal by Local Residences in Santa Elena, Monteverde

KELLY WONG

Under the supervision of Dr. Rebecca Schneider
Department of Natural Resources

Ecotourism is viewed as a sustainable solution to travel to natural areas because it involves conserving the environment and the wellbeing of local people, while supporting recreation and educating the public. The Monteverde Region of Costa Rica, which encompasses Santa Elena, is considered a leading example of an ecotourism destination. While ecotourism promotes protection of the biodiversity of the region, studies show other environmental impacts need to be considered. This study evaluated the potential ecotourism impacts on water resources for local communities. Surveys of 50 residents and 36 restaurants were conducted. Results of the survey indicated that frequent water supply shortages were experienced by residents, but not by restaurants. There appears to be a correlation between frequent water shortages and proximity to the center of ecotourism. Acueductos y Alcantarillados (AyA) is the main supplier of potable water to both residents and restaurants. Within Santa Elena, they focused on water supply sources and water shortages, but failed to focus on proper wastewater disposal and treatment. However, residents reported pollution from improper disposal of both raw sewage and greywater is a frequent problem. Recommendations on this study focused on developing outreach to both local and foreign stakeholders, local engagement, implementing systems for alternative water supply sources, and looking at a more holistic view of the environment and the local communities.

Placental Calcium Transporter Expression and Calcitropic Hormones in Pregnant Teens

JOYCE MATHEW

Under the supervision of Dr. Kimberly O'Brien
Division of Nutritional Sciences

Calcium is a fundamental mineral and intracellular messenger, especially during pregnancy, where the placenta facilitates maternal-fetal calcium exchange. Pregnant adolescents are especially at risk for calcium deficiency due to competing needs from both the mother and the growing fetus.

The goal of this study is to examine the associations between placental calcium transporters and calcitropic hormones such as parathyroid hormone, calcidiol, and calcitriol in pregnant teens in order to form a more complete picture of calcium transport in the placenta.

An investigation of placental calcium transporters: plasma membrane calcium ATPase 1 and 4 (PMCA1, PMCA4) and transient receptor potential cation channel, subfamily V, member 6 (TRPV6) mRNA through qPCR was conducted in 74 pregnant adolescents from a longitudinal study assessing maternal and fetal bone health.

The study's results demonstrated that all calcium transporters (PMCA1, PMCA4, TRPV6) were significantly positively correlated with one another, suggesting coordinate regulation (R^2 range 0.26-0.45, $p < 0.0001$). Neonatal PTH was inversely associated with placental expression of PMCA1 and PMCA4, while maternal serum calcium was inversely associated with all three transporters. Further studies will include investigation of placental protein expression of these transporters to supplement the mRNA data.

This research has helped create the first complete diagram of calcium transport through the placenta. No studies so far have looked at all three main placental calcium transporters within the same context. This research may help us better understand maternal-fetal calcium transport and prove useful in assessing how a mother's calcium and vitamin D status may affect the fetus.

A Theoretical Apex System Using Morphometric Methods to Address Taphonomic Problems with High-Spired Gastropods

ERYNN JOHNSON

Under the supervision of Dr. Warren Allmon
Department of Earth and Atmospheric Sciences

Investigators working with high-spired gastropod shells are often challenged by broken specimens. Such specimens may be broken by a number of processes including transport, compaction, and predation. Incomplete specimens create specific problems for work involving frequency and location of drilling by predators. Many studies have chosen to address this issue by considering only complete specimens. Ignoring incomplete specimens creates potential for systematic bias. If specimens containing drill holes are more or less likely to be broken than their undrilled counterparts, preferential breakage may bias data collected from only complete specimens. Preferential breakage has been understudied in gastropods making the impact of excluding of broken specimens from data collection unclear. Here I present a new approach—the Theoretical Apex System—which allows for the application of a simple equation to identify a hypothetical shell apex, enabling data to be generated and compared for both complete and incomplete specimens. With this method investigators can approximate the length of shell lost from the apical end of incomplete specimens, providing a reference point for the location of drill holes. This will allow for comparison of specimens of varying completeness.

Climate Change Effects on Fire Risk in the U.S. Northeast

GAIGE HUNTER KERR

Under the supervision of Dr. Arthur DeGaetano
Department of Earth and Atmospheric Sciences

Widespread forest fire risk, historically speaking, has not been an area for concern in the U.S. Northeast. But a dense population, high fuel loads, and low preparedness demand an examination of forest fire risk for this vulnerable region under global climate change. The changes in fire risk were evaluated across 20 Northeastern and Midwestern states and Washington, D.C. with the Canadian Forest Fire Weather Index System (CFFWIS). Locations of fire prone regions as well as the timing of the peak of the fire season were analyzed for the historical period, 1979—2000, and future period, 2038—2070.

The CFFWIS-driven results revealed the spatial distribution of fire-prone areas remains relatively static during the future period with minor increases of fire-prone areas on the fringes of historically-high regions. However, fire weather index (FWI) values experience increases of up to 40% through much of the Northeast. Results suggest that the peak of the fire season, loosely defined as the Julian date of yearly extreme FWI, will become significantly earlier throughout the focus region.

Thus the results of this research provide an outlook for forest fire risk in the U.S. Northeast as global climate change alters temperature and precipitation patterns in the latter part of the 21st century.

Anomalously Early Onset of Spring in the CESM Large Ensemble

ZACHARY LABE

Under the supervision of Dr. Toby Ault
Department of Earth and Atmospheric Sciences

Identifying seasonal transition remains a source of great uncertainty in climate prediction albeit their potentially significant impacts to a wide variety of natural and physical systems. While the effects of anomalously early season warmth across North America are widely documented, their frequency and predictability under climate change remain unclear. The following study utilizes the Extended Spring Indices model to classify the onset of spring through a variety of gridded observational and model data sets. Using the new 1° x 1° Community Earth System Model Large Ensemble project, this study documents the frequency, magnitude, and mechanisms for early spring onset through historical and future simulations. The threshold for extreme early season warmth is established by the record breaking spring in March 2012. The primary geographic region for the analysis is across the central and northern United States. While these events are nearly statistically random in historical observations, the modeled results indicate a significantly increased frequency and earlier timing of spring during the 21st century as a result of both internal climate variability and climate change. In addition, the long wave patterns during these synoptic warm events reveal notable similarities in jet dynamics and structure. These findings suggest early spring onset may have further temporal predictability despite the influence of climate change.

Diagnosing the Structure of Finite Amplitude Wave Activity in the Polar Stratosphere

AARON MATCH

Under the supervision of Dr. Gang Chen
Department of Earth and Atmospheric Sciences

Planetary waves play a central role in our understanding of stratosphere-troposphere coupling. For a surface or stratospheric perturbation, the response in wave activity flux depends on the vertical structure of planetary waves. We investigate planetary wave dynamics in the stratosphere using a novel decomposition of finite amplitude wave activity into contributions by wavenumber. Variability in finite amplitude wave activity relates to zonal wind accelerations/decelerations through the non-acceleration theorem. We analyze the annual cycle and transient variability of finite amplitude wave activity in total and decomposed by wavenumber. Finite-amplitude wave activity in the stratosphere exhibits a maximum in spring, when the winter polar vortex breaks down. We analyze sudden stratospheric warmings (SSWs) as archetypical examples of planetary wave dynamics, and investigate the relative importance of activity in wavenumbers one and two. While both displacements and splits types strong wavenumber one signatures in the 15 days prior to onset, they

separate into wavenumber one dominant (displacements) and wavenumber one and two co-dominant (splits). We suggest that finite amplitude activity may serve to categorize SSWs in the historical record and in real-time predictions of vortex dynamics.

Understanding the Biology of the Mycoplasma-related Endobacteria of Arbuscular Mycorrhizal Fungi

EZEKIEL AHN

Under the supervision of Dr. Teresa Pawlowska
School of Integrative Plant Science, Plant Pathology and Plant-Microbe Biology Section

Arbuscular mycorrhizal fungi (AMF) are symbionts of more than 80% of vascular plants on earth. By trading mineral nutrients and carbon, AMF and vascular plants are forming mutually beneficial relationships. AMF harbor two types of endobacteria: *Candidatus Glomeribacter gigasporarum* (beta-proteobacteria) and the mycoplasma-related endobacteria (MRE). The Glomeribacter endobacteria are known to be beneficial to AMF. In contrast, the biology of MRE, which are recently discovered novel endosymbionts of AMF, is almost entirely unknown. Based on MRE evolution patterns, it is hypothesized that MRE are parasites of AMF. To better understand the interaction between MRE and AMF, my work is focused on the ecology of this symbiosis in the North Atlantic coastal dunes supporting nearly monospecific stands of American beachgrass (*Ammophila breviligulata*). In this exploratory study, I surveyed the distribution of MRE across AMF associated with dune vegetation. Exploring the patterns of MRE distribution across AMF in the dune habitat is expected to give us baseline information on how these organisms interact along an environmental gradient. My project is the first attempt to reveal patterns of MRE distribution in a natural system. Based on statistical analyses, there are obvious patterns in community structure of AMF and in MRE frequency across both the AMF spores in different samples and AMF species at the Cape Cod National Seashore.

Biomass Production and Flowering of *Galinsoga quadriradiata*, and Its Competition with *Lactuca sativa*, in Response to Nitrogen and Phosphorus

XIANA GARCÍA FREIRE

Under the supervision of Dr. Charles Mohler
School of Integrative Plant Science, Soil and Crop Sciences Section

Hairy galinsoga is a troublesome weed in lettuce and other low-growing crops. Chemical control options for hairy galinsoga are limited, and mechanical control can be difficult. Many important weed species are more responsive to fertilizer than major crops, and hence potentially more competitive under fertile conditions; this study tested if this was true of hairy galinsoga when grown with field lettuce. A greenhouse experiment assessed the biomass production and flowering response of this weed to various rates of nitrogen and phosphorus, and a field experiment examined hairy galinsoga biomass production, flowering, and competition with lettuce under the same fertilizer conditions. The sixteen nutrient treatments were arranged in a phosphorus series, where phosphorus was variable while nitrogen was either low or high; and a nitrogen series, where nitrogen was variable and phosphorus was either low or high. We found that hairy galinsoga performed better when grown with lettuce, and its competitive ability was enhanced by high rates of phosphorus fertilization. Hairy galinsoga dry weight responded very strongly to phosphorus addition, especially when nitrogen was abundant. Although high

phosphorus delayed first flowering, it also increased flower production per unit mass. Fresh weight of lettuce increased with the rate of both phosphorus and nitrogen, but the response to phosphorus was stronger. Lettuce dry weight, however, was unaffected by fertility. Both fresh and dry weight of lettuce was decreased by competition from hairy galinsoga. We conclude that high application rates of phosphorus increase the competitive advantage of hairy galinsoga, and therefore should be avoided.

Diversified Farming Systems: Understanding the Economic and Social Impacts of Alternative Farming in the Finger Lakes

JESSICA BRESLAU

Under the supervision of Dr. Rachel Bezner Kerr
Department of Development Sociology

Diversified Farming Systems (DFS) use dynamic and case-specific agricultural practices through the intentional inclusion of multiple varieties of species of crops and animals over time and space on a farm. This study looks specifically at the greater Finger Lakes area in New York State, with the hypothesis that the Finger Lakes region has a high rate of DFS. Understanding the selection process by which farmers chose their DFS practices and the social and economic impacts that these practices have on the greater Ithaca area will help to identify what type of support systems are essential for farmers using this approach to thrive. In an effort to learn about the social and economic impacts of DFS on the greater Ithaca area a survey was sent to about 60 diverse small farms from which four farmers were selected for in-person interviews. Findings suggest that farmers practicing diversified farming practices are driven to farm due to the intrinsic value that agriculture holds and base their agricultural practices on environmental protection, profit maximization and consumer preference. Farmers' main concerns in regards to their profession are insufficient income, better access to technical support and greater community involvement. Drawing on the concepts of 'civic agriculture' and a 'moral economy' I argue that DFS farmers are re-embedding the farming system into the local social and economic system. These findings support the argument made by others that further investment in DFS is needed.

Beauty in a Globalized World: Uncovering the Fair Skin Beauty Standard in Indonesia

BAGAS YOGA DANARA

Under the supervision of Dr. Lindy Williams
Department of Development Sociology

Fair skin beauty standard is a social phenomenon that exists in many countries around the world. The purpose of this thesis is to see how common it is, what independent variables are significantly associated with its adherence, and who would use these skin brightening products and why from a sample of students at an elite university in Indonesia. Following an extensive literature review, two hypotheses were made. The first hypothesis is that cultural legacy from past colonialism and classism, as well as from globalization, have shaped preference for fair skin as the ideal form of beauty. The second hypothesis is that a respondent's amount of time exposed to Western media influences how much they would use skin brightening products and how they feel about their skin tone compared to others around them, and compared to what they want it to be. Through a quantitative survey and quantitative analysis, this thesis seeks to find a positive statistical relationship between exposure to media and adherence to fair skin beauty standard in order to fulfill its purpose. Based on the analysis of the data collected, there appears to be no significant positive

relationship between exposure and adherence. However, there are other variables that show more significant association to the adherence such as gender, and age.

Text Format Effects on Recall and Comprehension Dyslexic College Students

CHRISTINE H. FERGUSON

Under the supervision of Dr. Dawn Schrader
Department of Communication

An estimated ten percent of people suffer from a reading disability. Concomitantly they have learning styles which differ from the general population. This may pose a problem for them when experiencing standardized or historically traditional methods of teaching in today's American education system. This study examines how different reading text formats affect the comprehension and episodic recall of both reading disabled and non-reading disabled students.

In a pretest demographic survey, all participants self-identified whether or not they have a reading disability. Each participant also answered a set of questions used to identify any tendencies typical of a reading disabled individual. Total scores in this section were tallied, and all participants received a reading disability score (RD) for analysis purposes only. Participants read two short texts that were either formatted with notes presented in the main text in the center of the page, or on the periphery of the page, and completed a comprehension and vocabulary questionnaire. Verbal scores were measured out of six and comprehension scores were measured out of five.

Results indicate that comprehension score for all participants are not affected by the format of the text regardless of their reported reading disability or reading disability score. However, as RD scores increased, scores on the vocabulary test decrease when text was in the centered format. Additionally, those who self-identified as reading disabled performed better on the vocabulary section when the very same text was presented in the bordered format. Results suggest that vocabulary scores, which function with semantic recall, are affected with manipulations in the text format such that the presentation of text in the traditional bordered format may be most beneficial to reading disabled individuals.

Anticipating the Future of African Fertility Transitions: An Examination of Changing Youth Fertility Patterns in Sub-Saharan Africa

BENJAMIN GANDESBERY

Under the supervision of Dr. Sarah Giroux and Dr. Parfait Eloundou-Enyegue
Department of Development Sociology

Population trends in sub-Saharan Africa have significant implications for the region's social and economic development. There have been gradual declines in African fertility since the 1980's, but average fertility remains high. I specifically examine youth fertility, which plays an important role in shaping overall population trends. I use data from eighty-one Demographic and Health Surveys (DHS) to examine patterns of change in youth fertility and Desired Family Size (DFS). I observe

gradual reductions in both youth fertility and DFS. I find that inequality in youth fertility between Socio-Economic Status (SES) groups is increasing through the fertility transition, while inequality in youth DFS does not. I also use a mixture of linear regression and aggregate decomposition to determine the relative contributions of SES-structure changes, behavior changes shared by all SES groups, and behavior changes in higher-SES groups. I find that falling average youth DFS is primarily driven by broad changes affecting all SES groups, while falling average youth fertility is primarily due to fertility declines concentrated in higher SES strata. Together, these findings suggest that while youth fertility preferences are declining evenly at all SES levels, youth fertility reductions are wealth-dependent. Changing SES structure does not seem to be a major contributor to youth fertility changes. Observed increases in youth fertility inequality are concerning because they threaten to exacerbate wealth inequality.

Barriers to Birth Control: Understanding Sexual Health Knowledge, Attitudes, and Practice

ANNA GROSSHANS

Under the supervision of Dr. Parfait Eloundou-Enyegue
Department of Development Sociology

Previous research shows a relationship between educational attainment and sexual health knowledge, attitudes, and practice (KAP). Still, even among the most highly educated groups, high levels of unintended pregnancy and a lack of sexual health knowledge persist. This study zooms in on a highly educated group of people, students at Cornell University, to understand the barriers that prevent students from receiving the sexual health information they need and from protecting themselves against unintended pregnancy. I use a survey to collect data on sexual health knowledge, attitudes, and practice. I find that there is a significant lack of knowledge about most methods of birth control, including the most common forms. Furthermore, very few students have used the most effective methods, long-acting contraceptives. In addition to the lack of knowledge and use, I also find that many students do not know where they can go on campus to receive information and counseling on sexual health and contraceptives.

Issue Framing and Public Support for the Affordable Care Act and its Major Provisions: The Implementation Period

KRISTEN HOLL

Under the supervision of Dr. Jeff Niederdeppe
Department of Communication

The Affordable Care Act (ACA) remains a subject of fierce political debate and implementation is still underway. There is significant value to understanding how various ways of describing the law (framing) has continued to shape public approval of the law after its passage. This study identifies different frames used in polling questions to ask about the ACA and several of its key provisions—

the expansion of Medicaid coverage, the individual mandate, employer mandate, and coverage for pre-existing conditions—from March 23, 2010 (the date President Obama signed the ACA into law) to November 4th, 2014. The study further examines how variation in the terms and frames used to describe the law influence levels of support reported by polling firms during this timeframe. Results of best-fit OLS regression models reveal that levels of approval for the ACA and several of its key provisions post- passage depended heavily on the frames used in polling questions – that framing and word choice matter a great deal and can produce divergent conclusions about public sentiment about the law.

Iron Deficiency Anemia throughout India: A Comparative Look at a Way Forward

ALEXANDER N. KING

Under the supervision of Dr. Prabhu Pingali

Dyson School of Applied Economics and Management / Division of Nutritional Sciences

Iron deficiency and anemia have long been issues in India, reaching endemic levels throughout every part of the population, especially pregnant women and children. This study aims to analyze the congruencies between various parts of the Indian life, including dietary intake, changing food habits, sanitation conditions, and cultural aspects, to see how it all contributes to anemia being so prevalent. Using the Structural Transformation Model as a framework, India will be compared to two other countries in different spots both economically and anemically- China and Japan. Looking to the diets of China and Japan, along with how they approached similar issues contributing to malnutrition in the past, potential solutions to the Indian problem of anemia will be proposed. The study found that, in order to fully address iron deficiency and anemia in India, a multifaceted approach must take place, encompassing improved sanitation, education efforts, and fortification initiatives.

An Analysis of Social Media Communication Strategies Utilized by NOAA's Office of National Marine Sanctuaries and the National Marine Sanctuary Foundation

ALEXANDRA KIRBY

Under the supervision of Dr. Bruce Lewenstein

Department of Communication

Science communication comes in many forms and, currently, social media has become a tool for nonprofit and governmental organizations to communicate about science to the public. Various forms of social media, including Facebook and Twitter, have been used to increase civic engagement, support and action. This study analyzes the National Oceanic and Atmospheric Administration's Office of National Marine Sanctuaries, a governmental organization, and the National Marine Sanctuary Foundation, a nonprofit organization, to identify similarities and differences in both organizations' communication methods via Facebook and Twitter, as well as the most effective way to communicate to the public about national marine sanctuaries.

Perceived Importance of Dental Hygiene: A Risk Compensation and Social Norms Perspective

JESSICA LI

Under the supervision of Dr. Jonathon Schuldt
Department of Communication

Although periodontal disease is estimated to affect approximately 75% of U.S. adults in their lifetime, statistics suggest that a large fraction of American adults still lack good oral hygiene practices—including brushing and flossing behaviors. Drawing on the theories of risk compensation and normative social behavior, I hypothesize that personal oral hygiene practices may depend on an individual's perception of how others engage in oral hygiene practices. To explore this hypothesis, I conducted a survey on a sample of American adults asking how frequently they believe they should be flossing after they were told that the average American brushes either once a day or three times a day (Study 1). I also conducted a Web-based survey on a sample of college students that examined individuals' perception of the importance of flossing after being primed with either a low range or high range categorical scale in reference to a question asking about the time they spend brushing their teeth. Results suggest that when individuals perceive that their brushing behaviors are superior to other people's brushing behaviors, they are less likely to believe that flossing is important. Additionally, information-seeking and knowledge of general science and health fields were found to be significant determinants of belief that good oral hygiene practices are important.

Exploring the Misalignment between Public Perception and Scientific Knowledge of the Food System: A Case Study of Cornell University Students

ALYSSA PRITTS

Under the supervision of Jeffrey Perry
School of Integrative Plant Science, Horticulture Section

As we grow to a world of 9 billion people by the year 2050, finding ways to sustainably increase food security is necessary for the wellbeing of our planet. Although the solution to solving this global challenge is multi-faceted, investment in agricultural R&D is proven to be pivotal in increasing food security (Pingali, 2010). Despite this undeniable link between agriculture and food security, fewer people are directly involved in production agriculture and the complexity of agricultural issues, causing a high percentage of the population to be agriculturally illiterate and hold misconceptions about the food system (Pope, 1990). An instrument was developed to assess agricultural literacy and identify misconceptions held by Cornell University students about the food system. Comparisons were made between students based on demographic factors, according to overall mean agricultural knowledge scores calculated from the questionnaire. Students who identified as living on a farm held the highest agricultural literacy scores, followed by students that had taken a class in agriculture. Students that had never taken a class in agriculture held the lowest average agricultural literacy score. However, despite prior exposure to agriculture, a major

misconception was identified in the population regarding the prevalence of GM fruits and vegetables on the market.

In Pursuit of Happiness: Trends and Correlates of Self-Reported Happiness Among U.S. Young Adults (1972-2012)

GREGORY REPPUCCI

Under the supervision of Dr. Parfait Eloundou-Enyegue
Department of Development Sociology

This study examines the historical trends in happiness in the United States, focusing on two aspects that have eluded attention in previous studies. The first is a focus on young adults (18-29), who are at a critical life stage of personal, professional and social development. The second is focus on the bottom-end of the happiness scale, i.e., individuals who actually express dissatisfaction rather than lukewarm or positive expression of happiness. Using data from the General Social Survey (GSS), I find a V trend in unhappiness. Between 1972 and 1990, the levels of unhappiness have declined but have tended to rise since then, despite some economic growth and gains in educational attainment for the young adult population. Although there has been some convergence among racial groups, this historical trend holds for all groups, raising profound questions about generational changes in expectations and the pursuit of happiness.

Deception and Self-Presentation in Mobile Dating Applications

ABIGAIL SONNENFELDT

Under the supervision of Dr. Jeffrey Hancock
Department of Communication

This study examines 39 profiles on Tinder, a mobile geo-social dating application, and subsequent surveys. The purpose of the study was to determine if Tinder users engage in deceptive behavior, and to compare these practices to those of online daters. Deception occurs at a similar rate on both platforms, but those on Tinder were keener on self-preservation and consequently, less aware of or less willing to consider their behavior as deceptive. Though a platform meant for meeting people, most participants stated they have not physically congregated with their matches. Our findings suggest that mobile dating platforms are more fleeting in nature, and therefore used “for fun”. Deception that did occur was due to the nature of the application, which strongly focuses on physicalities. Implications are discussed.

College of Agriculture and Life Sciences
Research Honors Program Committee 2014-2015

ANIMAL SCIENCES

Susan Quirk, Chair

Yves Boisclair
Debbie Cherney
Jerrie Gavalchin
James Giles
Heather Huson
Pat Johnson
Quirine Ketterings
Thomas Overton
Mike Thonney

BIOLOGICAL SCIENCES

Colleen Kearns, Coordinator

Michael Goldberg
Ron Harris-Warrick
Drew Harvell
Christiane Linster
Ellis Loew
Eugen Madsen
Yuxin Mao
Thomas Owens
David Wilson

BIOLOGY & SOCIETY

Suman Seth, Chair

ENTOMOLOGY

Cole Gilbert, Chair

LANDSCAPE STUDIES

Josh Cerra, Chair

NATURAL RESOURCES

Joseph Yavitt, Chair

NUTRITIONAL SCIENCES

Cha-Sook You, Chair

PHYSICAL SCIENCES

Mark Wysocki, Chair

PLANT SCIENCES

Olena Vatamaniuk, Chair

Antonio DiTommaso
Jenny Kao-Kniffin
Teresa Pawlowska
Margaret Smith-Einarson

SOCIAL SCIENCES

Nancy Chau, Chair

Natalya Bazarova
Parfait Eloundou-Enyegue
Susan Fussell

RESEARCH HONORS PROGRAM

Don Viands, Chair