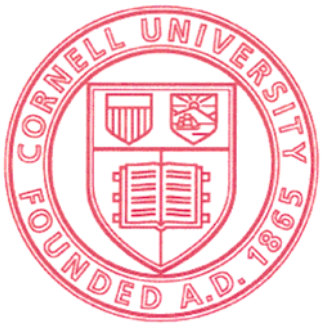
College of Agriculture and Life Sciences

2010—2011

Research Honors Program Abstracts



The College of Agriculture and Life Sciences is considered the best college of its kind in the nation, if not the world. Our mission is to discover, integrate, disseminate, and apply knowledge about agriculture and food sciences, applied social sciences, environmental sciences and the life sciences as a basis for sustainable improvement in the lives of people throughout New York State, the nation, and the world.

Nothing is more critical to the success of the college's mission than an engaged and inspired student body, as exemplified by the students who earn a bachelor's degree with honors. The 2010 honors thesis projects described in this booklet demonstrate an impressive capacity for personal dedication, mature scholarship and intellectual growth. The original research contained in this booklet examines some of the most pressing and relevant questions of our time.

Many students consider the research they undertake as undergraduates in CALS to be the most challenging, enduring, and valuable experiences of their time at Cornell. As a faculty member, I have witnessed this first-hand with my own advisees. As a new dean, I will continue to foster the college's unwavering commitment to undergraduate research.

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 proud of the dedicated faculty who supervised these honors research projects and mentored these students to their fullest potential. As you can see from reading the following abstracts, these new graduates will soon take their place among tomorrow's thought leaders.

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

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Investigating the DNA Damage Response Mechanisms in Lung Tumor Development Using an Oncogenic Kras Mouse Model

ALINA ALI

Under the supervision of Dr. Robert Weiss
Department of Biomedical Sciences

Adenocarcinomas currently represent 30-40% of lung cancers diagnosed in the United States. Between 1/4 and 1/2 of human lung adenocarcinomas contain mutations in the Kras oncogene. Reduced capacity for DNA repair is known to increase cancer susceptibility. Hus1 functions in the Atr DNA damage checkpoint pathway, which plays a critical role in maintaining genomic integrity following DNA damage and oncogenic signaling. Using conditional alleles ($Hus1^{flox}$) and (LSL-KrasG12D) that can be regulated by exposure to Cre recombinase, we studied the physiologic effects of Hus1 loss and Kras activation in adult mice. Mice carrying both conditional alleles, as well as appropriate control animals, received AdenoCre virus intratracheally, and were then analyzed for DNA damage signaling. Lungs were harvested 7 and 14 days post infection, in order to analyze cells soon after oncogene activation. Tissues were sectioned and DNA damage was examined using gamma-H2AX immunohistochemistry and western blotting. We expected an increase in DNA damage and a decrease in proliferation in mice with Hus1 inactivation as compared to mice with wild-type Hus1 based on multiple studies suggesting that Hus1 loss causes genomic instability and impaired proliferation. Activated Kras was expected to cause an increase in proliferation and DNA damage. Preliminary results show that while levels of proliferation were maintained across genotypes, DNA damage was highest in mice that exhibited Hus1 loss and activated Kras. The results of this study suggest that Hus1 impairment may reduce the likelihood of tumor development if the damaged cells are cleared from the lungs.

The Role of Various Colostrum Components on the Metabolic Programming of Neonatal Dairy Calves

SCOTT BROWN

Under the supervision of Dr. Mike Van Amburgh
Department of Animal Science

The importance of colostrum ingestion to the health of neonatal dairy calves has long been recognized; however, the specific components of colostrum responsible for these positive effects are currently unknown and have been solely associated with immunuglobulins. The purpose of this study was to evaluate which components in colostrum might be responsible for these positive effects and determine whether they can be measured in plasma shortly after colostrum ingestion. Twenty-four Holstein calves were assigned to one of three treatments: high colostrum (4 L colostrum), low colostrum (2 L colostrum), or colostrum deprived (2 L milk replacer). An initial blood sample was taken before feeding, then, samples were taken periodically during the first thirteen hours of life. The metabolite, glucose, and hormones insulin, IGF-1, and growth hormone along with immunoglobulins

were studied to determine their role as factors that could potentially signal a programming event. The concentration of each component in colostrum and plasma at various intervals illustrated how colostrum is absorbed and metabolized. For each treatment, a rise in plasma glucose concentration induced endogenous production of insulin as a regulatory mechanism within the first hours of life. Additionally, the GH-IGF-1 axis responded normally following the first feeding of colostrum, with IGF-1 levels rising steadily, and GH levels falling. This rise in circulating levels of IGF-1 following colostrum ingestion suggests it could be responsible for part of the observed effects on programming. Also, given the rise in insulin with the first meal, it is possible that endogenous insulin production is important in this process.

Benefits of Gonadotropin Releasing Hormone Treatment for Ovulation and Fertility in Lactating Dairy Cows

PATRICIA DALGLISH

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

The dairy industry has experienced tremendous change in the past fifty years resulting in increased annual milk yield. Unfortunately, there has an associated decrease in fertility. Gonadotropin-releasing hormone (GnRH) injection has been shown to increase the frequency of estrus and ovulation before day 60 postpartum while previous studies suggest a positive correlation between early ovulation and fertility. The main objectives of this study were: 1) to evaluate the effects of GnRH for inducing ovulation in follicles producing either high or low levels of estradiol; and 2) investigate the benefits of early ovulation and its influence on fertility later in the breeding period. For this study, 44 Holstein cows were sampled between 10 and 25 days postpartum. Measurements of estradiol, progesterone, nonesterified fatty acids and β-hydroxybutyrate were analyzed from daily blood samples, days 10-25. Follicle growth was measured from rectal ultrasound examination that took place every other day beginning with day 10. All cows received a single dose of GnRH (100 ug IM) between days 16-18 days when a large ovarian follicle (>14 mm) was observed. Cows were grouped based upon estradiol concentration in relation to a 2.7 pg/ml threshold (Butler et al, 2006) and upon follicle outcome, ovulatory or nonovulatory. Level of estradiol production and follicle size at injection were significantly different ($P<0.05$) between cows with low (n=21) and high (n=14) levels of estradiol. Days open was significantly ($P<0.05$) lower in cows that ovulated in response to GnRH compared to cows that did not ovulate in response to GnRH, 131 days and 222 days, respectively. Reproductive efficiency is a major factor of profitability in a dairy herd and inducing ovulation with GnRH indicates improved days open and subsequent fertility.

Effects of Corn Prolamin Content on *in vitro* Starch Digestibility as Measured by Various Methods

SAMUEL FESSENDEN

Under the supervision of Dr. Michael Van Amburgh
Department of Animal Science

Prolamin proteins, or more familiar zein proteins, create a physical barrier to microbial starch degradation. Twenty seven samples of corn grain were selected based on an initial screening of protein content and were analyzed to study the relationship between prolamin content and in vitro digestibility as measured by various methods. The specific in vitro methods used were the measurement of gas production from fermenting corn grain in a rumen fluid - buffer solution, and the determination of starch disappearance through direct measurement of residual starch (IVSD) after fermentation at five time points (3, 6, 12, 24, 48 hours). Gas production and starch disappearance were fitted to a curve using non-linear regression techniques and the gas production was converted to a rate of digestion by fitting to an exponential equation. The overall mean fractional rate of degradation was calculated at 0.081 h-1 using in vitro digestibility and 0.056 h-1 using gas production techniques. Corn prolamin content was negatively associated with rate of digestion when rates were calculated using gas production ($P<0.02$), and when calculated d using data from the IVSD measurements ($P<0.05$). However, a significant difference ($P<0.0001$) was observed between the rates calculated from the two methods for estimating rates of degradation, indicating challenges with the use of rates calculated from a variety of in vitro methods. It was concluded that gas production alone as a proxy for ruminal starch digestion does not properly account for the effects prolamin on the kinetics of digestion.

Whole and Defatted Algal Meals Effectively Replace Soybean Meal in Diets for Weanling Pigs

EMILY ISAACS

Under the supervision of Dr. Xin Gen Lei
Department of Animal Science

Marine microalgae have recently emerged as a new exciting source of biofuel. Our objective was to determine whether defatted *Nanofrustulum* algal biomass from biofuel production could replace a portion of soybean meal in diets for weanling pigs. A total of 27 weanling pigs (Yorkshire-Landrace-Hampshire crossbred, BW = 10.69 ± 0.22 kg) were divided into 3 groups (n = 9/group), and fed a corn-soybean meal basal diet, a corn-soybean meal diet with 6.6% whole algal meal replacing soybean, or a corn-soybean meal diet with 7.2% defatted alga replacing soybean (provided by Cellana, Kailua-Kona, HI) for 6 wk. All three groups of pigs showed similar weekly and overall growth performance (Wk 6 BW = 39.07 ± 0.77, 38.62 ± 3.74, and 38.00 ± 3.55 kg). Plasma urea nitrogen concentration, an indicator of dietary protein utilization efficiency, was not affected by the treatments as the three groups of pigs had similar values at Wk 3 (112.4 ± 9.4, 93.3 ± 11.0, and

102.1 ± 9.1 mg/L) and Wk 6 (163.0 ± 22.1, 170.8 ± 14.7, and 155.9 ± 16.9 mg/L). There was no group difference in plasma alanine aminotransferase or alkaline phosphatase activity at either time-point. Ultrasound scans of vertebral fat and muscle depth of individual pigs at Wk 3 and Wk 6 predicted similar body lean yield among all the 3 treatment groups (Wk 3: 50.7 ± 0.2, 50.8 ± 0.2, and 50.7 ± 0.1%; Wk 6: 52.2 ± 0.2, 52.1 ± 0.4, and 52.4 ± 0.1%). In conclusion, adding 6.6% of whole algal meal or 7.2% of defatted algal meal into a corn-soybean basal diet for weanling pigs effectively replaced the same amount of soybean meal without adverse effect on growth performance, protein metabolism, or animal health.

Predicting Mild Cognitive Impairment and Alzheimer's Disease: Examining *APOE*-ε4 and Other Risk Factors

ANNA KENNEY

Under the supervision of Dr. Charles Brainerd
Department of Human Development

To better develop preventative treatments for Alzheimer's disease (AD), researchers must work to recognize and define early stages of the disease. One promising diagnosis is known as Mild Cognitive Impairment (MCI). This is a category for older adults with memory impairment but with little loss of executive function. Apolipoprotein ε4 (*APOE)*, the best known genetic risk factor for transition to AD, has also been shown to have predictive value in MCI subjects. From 2001-2006, 856 individuals underwent rigorous testing for the Aging, Demographics and Memory Study (ADAMS), which is a nationally representative subset of the Health and Retirement Study (HRS) supported by the National Institute on Aging. Predictive value of *APOE* ε4, tobacco use, and alcohol use for transition to AD and MCI were examined. AD mean age of onset was also examined. The Wechsler Test IIB indicated differences between groups that transitioned from normal to AD and MCI. Additionally, it distinguished those MCI subjects at Wave A who transitioned to AD from those who did not transition; and between subjects who were normal at baseline from those who transitioned to MCI and AD. In this population, not ever smoking and avoiding problems with drinking was shown to delay onset by 3.6 years in *APOE* ε4 non-carriers and 9.3 years in *APOE* ε4 carriers.

Cloning and Expression of Recombinant Regenerating Islet-Derived 3-Beta in *Pichia Pastoris*

KRYSTAL LUM

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

Regenerating islet-derived protein 3-beta (Reg3β) is a calcium-dependent lectin associated with high expression in pancreatitis-induced and Type 1 diabetes mice models. The objective of this study was to clone and express Reg3β protein in the methylotrophic yeast, *Pichia pastoris*. Creating these

constructs would allow for in-depth protein studies that could help elucidate many of its mechanistic and functional mysteries, including in vitro and in vivo studies focused on pancreatic function, and use in protein pull-down assays to determine possible binding interactions of Reg3β. RNA from the liver of a wild-type mouse was extracted and RT-PCR was used to synthesize cDNA. The Reg3β gene both with and without a C-terminus 6x polyhistidine tag were separately ligated into the expression vector pPICZαA, and cloned into and expressed in *P. pastoris*. Through buffer and ion exchange chromatography, Reg3β protein (no His tag) was purified from *P. pastoris* supernatant. Through dialysis and Ni-NTA affinity chromatography, Reg3β protein with a 6x polyhistidine tag was purified. Coomassie blue-stained SDS-PAGE and Western blot analysis using Reg3β antibody showed that Reg3β (no His tag) was purified at an eluted concentration of 1.1mg/mL, as determined through a BCA protein assay. For Reg3β protein (C-terminus His-tag), the SDS-PAGE gel showed a definitive band of purified protein at the expected molecular weight, while Western blot analysis using mouse anti-Histidine antibody, showed weak but present protein bands. Low protein recovery may be due to low expression of His-tag protein in *P. pastoris*, or use of non-optimal purification conditions during Ni-NTA affinity chromatography.

Analysis of *SRY*, *FGF9*, *NR5A1* and *AR* as Candidate Genes for XY Disorder of Sexual Development in Labrador Retrievers

SHANA MINTZ

Under the supervision of Dr. Vicki Meyers-Wallen
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XY Disorders of Sexual Development (XY DSD) are a group of congenital disorders that occur when there is an error in the development of gonadal or phenotypic sex in XY individuals. XY DSD has been reported in dogs with a Labrador Retriever genetic background, but the genetic cause has never been discovered. These dogs show a phenotype of small, abdominal testes and partially masculinized (ambiguous) genitalia, which could be the result of two XY DSD types: 1) Gonadal Dysgenesis or 2) Disorders of androgen synthesis or action. Four canine genes important to the development of normal male gonadal and phenotypic sex were analyzed: *SRY*, *FGF9*, *NR5A1* and *AR*. A mutation in *SRY*, *FGF9*, or *NR5A1* would cause Gonadal Dysgenesis, and a mutation in *AR* would cause a disorder of androgen action (specifically, Androgen Insensitivity Syndrome). The genes were sequenced in three XY DSD dogs (two Labrador Retrievers and an Australian Labradoodle) and compared to the dog genome. Although three sequence differences were observed between the affected dogs and the dog genome, each was eliminated as a potential genetic cause of XY DSD. Therefore, it was concluded that the cause of XY DSD in Labrador Retrievers is not a mutation in the coding regions of *SRY*, *FGF9*, *NR5A1* or *AR*. Future research should focus on comparing other candidate genes to the dog genome, including *SOX9*, *SOX8*, *LHCGR* and *HSD17B3*.

Developing and Implementing a Zebrafish Model to Test Vertical Transmission of Viral Hemorrhagic Septicemia Virus IVb

ANTHONY MONROE

Under the supervision of Dr. James Casey
Department of Microbiology and Immunology

Viral hemorrhagic septicemia (VHS), one of the most important viral diseases of finfish worldwide, is caused by novirhabdovirus viral hemorrhagic septicemia virus (VHSV). Between 2005 and 2007, massive seasonal die-offs occurred in the Great Lakes region due to an isolate of VHSV, genotype IVb, raising concerns about the persistence of VHSV within fish populations. Fish infected with VHSV-IVb shed virus in ovarian fluid suggesting potential vertical transmission. To determine whether VHSV-IVb can be transmitted vertically, a zebrafish model was designed with specific parameters, testing for viral infectivity and viral presence using cell culture and quantitative RT-PCR, respectively. When testing the embryos for permissive temperatures it was found that zebrafish embryos could be hatched at temperatures as low as 22°C. Breeding was temperature sensitive, and found not to occur at 15°C, but reached optimal levels at 26°C. We determined at which temperature infected fish would give the optimal number of embryos while still allowing viral replication. The optimal temperature condition to both satisfy virus replication and zebrafish breeding was a shift from 15°C to 26°C. Vertical transmission was tested by bath challenging equal amounts of males and females with $1.0X10^6$ pfu/ml of VHSV, allowing infection to proceed, re-exposing fish to host breeding permissive temperatures and screening resulting embryos for VHSV-IVb. All three vertical transmission experiments conducted failed to produce viable embryos that could be disinfected and screened. Based on this work, vertical transmission of VHSV is not a significant contributor to the persistence of VHSV in the Great Lakes.

The Role of Chemokine CXCL12 in Osteoarthritis in an Equine Model

NIKHITA PARANDEKAR

Under the supervision of Dr. Alan Nixon
Department of Clinical Sciences

Chemokine CXCL12 (SDF-1α) is thought to be involved in the inflammatory mechanism underlying osteoarthritis. Evidence suggests that the production of CXCL12 is proportional to the severity of the disease. To explore this role further, we analyzed samples of synovial fluid from horses affected with different severities of osteoarthritis in order to quantify the gene and protein expression of CXCL12. We found that protein concentration of CXCL12 does increase with severity of disease, but gene expression does not. In order to understand this process further, chondrocyte monolayers were created and treated with interleukin-1 beta (IL-1β) and tumor necrosis factor alpha (TNF-α) in order to mimic an osteoarthritis-like environment. After a series of experiments, we found that CXCL12 production is most strongly influenced by TNF-α, but with continued discrepancies between gene and protein expression. Analyses of the monolayers over time showed that both gene and protein expression increased and decreased somewhat cyclically, indicating that there is some

kind of feedback regulation system in place that controls CXCL12. In order to determine a potential for downstream effects of CXCL12, the same monolayers were analyzed for gene expression of the degenerative factors matrix metalloproteinase-3 (MMP-3), MMP-13, aggrecanse-1, aggrecanse-2, and IL-1β. MMP-3 and MMP-13 appear to be a part of the same regulatory system as CXCL12.

Exploring the Roles of SERTAD1 and PFDN5 as Cofactors of ZFP568, a KRAB Domain Protein Required for Mammalian Morphogenesis

ANGELA PRING-MILL

Under the supervision of Dr. Maria Garcia-Garcia
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ZFP568 is a novel KRAB domain zinc-finger protein required for anterior-posterior axis elongation and placental morphogenesis during mammalian development (Garcia-Garcia et al., 2008; Shibata et al., 2011). KRAB domain proteins function as transcriptional repressors by binding to TRIM28, a co-repressor protein that recruits chromatin-modifying enzymes involved in gene silencing. ZFP568 interacts with TRIM28; however ZFP568 repressive activity may require recruitment of additional proteins. A yeast two-hybrid screen identified potential ZFP568 interactors, including two transcriptional regulators, SERTA domain-containing protein 1 (SERTAD1) and Prefoldin subunit 5 (PFDN5). SERTAD1 is a transcriptional activator of cell cycle regulatory proteins and can bind to TRIM28 through its PHD-bromodomain (Lai et al., 2006). PFDN5 is a member of the prefoldin chaperone complex, which assists in protein stabilization and folding (Siegert et al., 2000). PFDN5 can also bind to TRIM28 and repress the transcription of other transcription factors, including c-Myc (Satou et al., 2001). We hypothesized that ZFP568 may interact with SERTAD1 and/or PFDN5 *in vivo*, and influence ZFP568-TRIM28 repressive activity during mammalian morphogenesis.

To test the relationship of ZFP568 with these potential interactors, I performed co-immunoprecipitation experiments and transcription reporter assays in mammalian cells. Additionally, I analyzed the effect of SERTAD1 and PFDN5 ectopic expression on ZFP568 subcellular localization by immunohistochemistry. Results from these experiments suggest that SERTAD1 and PFDN5 have indirect effects on ZFP568-mediated transcriptional repressive activity.

Purification of the Metalloprotease of *Listeria monocytogenes*

GABRIELA WAGNER

Under the supervision of Dr. Hélène Marquis
Department of Microbiology and Immunology

Listeria monocytogenes is a gram-positive bacterium and the causative agent of listeriosis, a food-borne infection. During infection, the bacterium invades host cells and lyses phagocytic vacuoles to gain access to the cytosol where it multiplies. One of the virulence factors involved in escape from vacuoles is a secreted zinc-dependent metalloprotease (Mpl). Mpl is made as a zymogen of ~55 kDa

and is composed of a propeptide and a catalytic domain. Mpl maturation occurs by autocatalysis in a pH-dependent manner. To better understand the mechanism of Mpl autocatalysis, we aimed to purify Mpl for structure/function analysis. Mpl was purified in its natural host, *L. monocytogenes*, grown under conditions that favor the expression of Mpl, and the supernatant was recovered by centrifugation and filtration. Secreted proteins, including Mpl, were concentrated by ammonium sulfate precipitation, recovered by centrifugation, dissolved in water, and passed through a buffer exchange column to eliminate the salt. Mpl was purified by ion-exchange chromatography at pH 7.0, and eluted from the column at 500 mM NaCl. It was further purified via Flag-tag affinity chromatography. Fractions containing Mpl were identified by Western immunoblot with an anti-Mpl antibody, and Coomassie Blue staining of protein gels was used to verify purity. At the conclusion of these experiments, 4 nonspecific proteins in very small concentrations were found to co-purify with Mpl.

Quantifying Skeletal Variation in the Rabbit

EVE WATERS

Under the supervision of Dr. Nathan Sutter
Department of Clinical Science

The rabbit (*Oryctolagus cuniculus)* was domesticated ~1000 years ago as a source of meat and pelts. Today rabbits are more commonly kept for conformation ("fancy") shows. Due to intense selection for coat colors and patterns, hair length, body size and shape, the 47 recognized U.S. breeds are highly divergent in these traits. For example, the small and delicate Britannia Petite weighs 2.5 pounds at maturity while the Flemish Giant weighs 20 pounds. We are interested in discovering and quantifying the patterns of skeletal variation in rabbit breeds and finding genes contributing to this variation. Here, we have assessed skeletal variation in rabbits using a set of 10 body measurements. After we identified and contacted rabbit owners on the web, 23 owners returned measurements for a total of 134 rabbits. These represent 21 distinct breeds, including very large breeds (Flemish Giant, Californian) and small-bodied breeds (Britannia Petite, Netherland Dwarf). Principal Components Analysis (PCA) of the body measurements has demonstrated trends among the differences in size (PC1). We have also used information from previous studies that have identified a number of genes contributing to size variation in dogs and humans in order to select and test for association with candidate genes for body size. We sequenced four PCR amplicons from the *HMGA2* locus in each of 24 rabbits to assess association with body size. We discovered three single nucleotide polymorphisms (SNPs) and one poly T region. Additional sequencing or mapping will be needed to evaluate control of size in the rabbit.

Sequencing and Expression of *Clostridium difficile* Toxin Genes

KATHERINE WU

Under the supervision of Dr. Yung-Fu Chang
Department of Population Medicine and Diagnostic Sciences

Clostridium difficile is a bacterium that is part of the genus *Clostridium*, and is gram-positive, spore-forming and anaerobic. *C. difficile* is the infectious agent of *Clostridium difficile* Infection (CDI). The symptoms produced from CDI range from nosocomial antibiotic-associated diarrhea to pseudomembranous colitis, which can ultimately lead to death. When a person consumes antibiotics, the existent microflora in his or her intestines is destroyed, subsequently allowing *C. difficile* to invade and colonize. There are several exotoxins generated by *C. difficile* that cause disease. Two in particular are believed to be key virulent factors in CDI and are known as toxin A (TcdA) and toxin B (TcdB). These toxins cause cell death by catalyzing the transfer of glucose onto the Rho family of GTPases and inactivating them when inside of host cells. The most important functional domains of the A and B toxins are the N and C terminals. In this study, we successfully cloned the full length of *C. difficile* TcdA and TcdB genes using PCR technique and expressed the N and C terminals of TcdA and TcdB in *Escherichia coli* to obtain highly purified recombinant proteins. These proteins can be used for future research towards a vaccine or for diagnostic purposes to further our understanding of CDI.

Biochemical and Genetic Analyses of *Arabidopsis thaliana* Mutants to Better Understand the Contribution of Plastoglobules to Chloroplast Stress Responses

MASON APPEL

Under the supervision of Dr. Klaas van Wijk
Department of Plant Biology

Plastoglobules (PGs) are lipoprotein particles attached to thylakoid membranes of chloroplasts. These PGs are formed by the swelling of the outer lipid leaflet of the thylakoid membrane, creating a hydrophobic interior comprised of quinones, α-tocopherol and neutral lipids. An active role for PGs in chloroplast development and stress responses is suggested by their varying size in response to (a)biotic conditions and recent proteome, metabolite and genetic analyses. The plastoglobule proteome includes six ABC1K proteins which are putative protein kinases. *Arabidopsis thaliana* T-DNA insertion mutants in *ABC1K2* and *ABC1K3* showed a conditional senescence-like phenotype upon high-light stress treatment. RT-PCR analysis of senescence marker genes (eg *SAG12,13*) confirmed this visible phenotype. I identified and phenotyped single homozygous null mutants in 6 other PG proteins. However no visible phenotypes under optimal conditions, nor under high light stress or nitrogen deprivation were observed. This lack of phenotype is likely due to the presence of experimentally observed PG-localized homologues, leading to functional redundancy. Because PGs accumulate chlorophyll breakdown products under N starvation[4], I tested the *k2k3* mutant under restricted nitrogen conditions; leaves turned yellow with a direct relation between the severity of the phenotype and nitrogen limitation. This conditional phenotype is consistent with a role for PGs and ABC1K2,3 in chlorophyll breakdown and recycling, as well as thylakoid membrane remodeling. To explore *k2k3* light stress phenotype in more detail, I compared the PG metabolome of WT and *k2k3* using thin-layer chromatography (TLC) and gas chromatography coupled mass spectrometry (GC-MS). This showed increased accumulation of ß-carotene, as well as several unidentified compounds, which may represent isoprenoid derivatives, but reduction in tocopherol and free fatty acid. The determination of these unknown metabolites is the subject of ongoing investigation and may provide functional clues toward specific ABC1K functions in the PG.

Identification of *Mycobacterium avium subspecies paratuberculosis* Antigen 85 Complex-Binding Motif on Fibronectin

HANNAH BELL

Under the supervision of Dr. Yung-Fu Chang
Department of Population Medicine and Diagnostic Sciences

Mycobacterium avium ssp. *paratuberculosis* (MAP) is a pathogen of cattle, sheep, goats and other ruminants. MAP is also suspected to cause human Crohn's disease. MAP infection may lead to severe enteritis in cattle, with symptoms such as diarrhea and weight loss. The disease reduces the productivity of dairy farms and is of considerable economic cost to the U.S. dairy industry. Adhesion is the initial step in bacterial infection and several adhesins known as Microbial Surface Components

Recognizing Adhesive Matrix Molecules (MSCRAMM) contribute to this step. Antigen 85 complex (Ag85) is one of the dominant secretory proteins of MAP and is involved in the adhesion of the bacterium to host tissues, specifically extracellular matrix proteins (ECM). In addition, Ag85 is involved in synthesis of critical cell wall constituents and is therefore a possible drug target. My honors project involved the characterization of the binding interaction between MAP Ag85 and human fibronectin (Fn). Fn is a 220 kDa ECM protein that has been shown to facilitate *M. tuberculosis* infection in murine macrophages and uptake through murine intestinal M cells. In this study, we determined that a short, 13-residue motif, $_{14}$TPNSLLVSWQPPR$_{26}$, within the heparin-binding domain (Hep-2) of Fn is a critical in binding motif to MAP Ag85.

The Ontogeny of Thermoregulation and Feather Development in Tree Swallow (*Tachycineta bicolor)* Nestlings

ALYSON BROKAW

Under the supervision of Dr. David Winkler
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The ontogeny of thermoregulation in nestlings is influenced by a variety of factors, including increase in body mass, energy constraints; environmental factors and development of feather cover. This study investigates the age of endothermy in nestling tree swallows, defined as the ability to maintain an internal body temperature within a tight range against a decreasing temperature gradient. Experimental cooling of individual nestlings (aged 3-12 days) and adults at 20° C for 30 minutes was used to determine when nestlings develop effective endothermy (as determined by initial thermal inertia (*K1*), cooling rate (*K2*) and equilibrium temperature (*Teq*) during the 2009 and 2010 field seasons. During the 2010 season, feather development was also measured in chicks aged 1-14 days to determine how feather cover may play a role in the thermoregulatory ability. Infrared (IR) images of nestlings were used in 2010 to investigate how feather cover and surface temperatures were related. *K2* was not significantly influenced by nestling age or mass. *K1* was significantly influenced by age, but not by mass or the interaction between age and mass. Age also had a significant influence on *Teq* and *Tch*. Feather score significantly influenced all parameters except for *K2*, suggesting the development of feather cover plays a significant role in the development of thermoregulatory ability. Temperature ranges of nestling surfaces obtained by analysis of IR images were also significantly influenced by age, with a quadratic relationship between range of temperatures and both age and feather score.

Cell Survival and Division Are Affected by Loss of *Jagged1* in the Subventricular Zone of the Embryonic Murine Brain

CHRISTOPHER BROWN

Under the supervision of Dr. Ellis Loew
Department of Physiology

Notch signaling is known to be important for maintaining progenitor and stem cell populations in the brain. However, the function of *Notch* ligands, such as *Jagged1*, in this process is not well understood. Here I report how inactivation of the *Jagged1* ligand affects neurogenesis within the subventricular zone (SVZ) of the murine brain. Loss of *Jagged1* results in a two-fold increase in cell death within the SVZ. In vitro analysis using neurospheres cultured from control and mutant SVZ showed a 25% reduction in size of *Jagged1* null neurospheres. *Jagged1* is therefore crucial for neural stem cell growth and the inactivation of this ligand leads to increased cell death in the SVZ.

The Effects of Appetitive and Aversive Odor-Taste Conditioning on Discrimination Ability in Rats, *A Pilot Study*

PRESHITA DATE

Under the supervision of Dr. Thomas Cleland
Department of Psychology

Previous literature has shown that odor discrimination is enhanced following both appetitive and aversive conditioning in a variety of paradigms. However, given the procedural differences of the conditioning paradigms, it is difficult to compare the two forms of learning. In this study, the aim was to establish a paradigm that would minimize these procedural differences between appetitive and aversive conditioning. Such a paradigm would allow direct behavioral and neurological comparison of the two types of conditioning. We implanted rats with intra-oral cannulae, then used an automated infusion paradigm to pair an odor (conditioned stimulus, CS) with sucrose or quinine hydrochloride (unconditioned stimuli, U.S.) for appetitive or aversive conditioning, respectively. We piloted various parameters in an attempt to evoke the most robust learning possible. Our results showed mixed levels of significance; only a small number of animals showed sharpened discrimination between an odor and its enantiomer after conditioning. The eventual goal is to compare brain activation in the two sets of rats and attempt to characterize the underlying neurological mechanisms of appetitive and aversive learning.

Effects of Social Stimuli on Testosterone, Aggression, and Fighting Behavior in Male Golden Hamsters (*Mesocricetus auratus*)

DEIRDRE DULAK

Under the supervision of Dr. Robert Johnston
Department of Psychology

Testosterone has long been implicated in aggression. However, evidence for its role is contentious. This study examined the influence of testosterone on aggression but also aimed to further explore the effect of previous social stimuli on the outcome of male-male fights. Experimental males were exposed to animal stimuli (males, diestrus females, or estrous females) through a mesh barrier, and then testosterone levels were measured. The following day, control males with no prior exposure fought experimental males, and fighting behavior was recorded. It was hypothesized that exposure to

social stimuli, especially exposure to estrous females, would induce testosterone surges in males. These surges would increase aggression in fights, thereby improving fighting ability in males with prior exposure. It was predicted that higher aggression would translate into experimental males winning significantly more fights than their control counterparts. However, results were rather ambiguous. A significant testosterone surge in males was only found after exposure to diestrus females. Males exposed to estrous females exhibited nearly significant testosterone surges, whereas males exposed to other males showed no significant changes in testosterone. The significant testosterone rise in males exposed to diestrus females did seem to increase aggression during fights compared to males with only male exposure. However, this did not predict the outcomes of the fights as expected.

Macroevolution of Defense and Secondary Metabolism in the Stem Succulent African Genus *Pachypodium* (Apocynaceae)

MARGARETE JOHNSON

Under the supervision of Dr. Anurag Agrawal
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The genus *Pachypodium* (Apocynaceae) is a small clade of 27 stem succulent plants native to Madagascar and South Africa. It is comprised of both tree and shrub forms, and there is evidence that *Pachypodium* species are both chemically and physically defended. In this study we explore the macroevolution of defense and secondary metabolism in 22 species of *Pachypodium* grown in a common environment. Latex exudation and spine length are quantified as measures of physical defense. Quantifications of phenolic classes (caffeic acid derivatives, coumaric acid derivatives, and flavonoids) along with quantification of potential cardenolides and a bioassay of caterpillar performance on plant extracts are used as measures of chemical defense. Several traits show phylogenetic signal. Theory has predicted associations between defensive traits in syndromes, and trade-offs between defensive traits and plant growth strategy. We examine correlations between defensive traits as well as correlations between defensive traits and growth strategy (growth rate and growth form) while accounting for phylogenetic history. We find no correlations between defensive traits. Principal components analysis is used to collapse seven traits into four principal components. We find repeated evolution of spine length with plant growth traits, and repeated association between PC2 (mostly a measure of spine length and toxicity) with growth traits over the history of the genus. Latex exudation appears to evolve separately from other defensive traits. This study is one of relatively few that attempts to trace the evolution of plant defense on a phylogeny and test hypotheses about their abundance and distribution.

The Evolution of Luminescent Courtship Signals in Caribbean Ostracods

HILARY KATES

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Males of a unique group of Caribbean ostracods use luminescence in their mating process. These ostracods show high microhabitat specificity and complex extracellular species-specific luminescent courtship displays, which result in a symphony of firework-type displays over shallow Caribbean reef systems after nightfall. Each ostracod's mating signal consists of a train of light pulses composed of an initial slow "call phase" and a terminal targeting "trill phase" of regular, more rapid and shorter, narrowly spaced pulses. Ostracod displays play a crucial role in sexual selection and therefore speciation in this group. We examined which characteristics of these displays might be used by individuals among three clades of luminescent Caribbean ostracods (Photeros-group, Kornickeria-group and 'H'-group, based on morphological and molecular work) to differentiate conspecifics from other species. We hypothesized that the more variable initial phase characteristics used in species recognition are more important in shaping the evolution of Caribbean ostracods than those characteristics that make up the constrained trill phase. We combined frame-by-frame analyses of videos of displays from the field for two undescribed species with analyses of 22 species based on published data. We overlaid our findings onto an independently derived phylogeny based on molecular and morphological data of 14 of these 24 species to determine possible signal evolution patterns. Our findings suggest phylogenetic signatures in 5 aspects of the display signal: the duration of the complete signal train, duration and length of the initial phase, the number of pulses in the trill phase, and the amount of time between consecutive pulses in the trill.

Bovine Seminal Plasma Protein A3 (BSPA3) is Modified by Bovine Sperm after Cryopreservation

LINDSAY KNABLE

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When cattle are inseminated, millions of sperm enter the female reproductive tract. Only a few thousand of these sperm enter the oviduct, and are soon trapped to form a sperm storage reservoir in the initial segment of the oviductal isthmus by binding to the oviductal epithelium. Three proteins in the Bovine Seminal Plasma (BSP) protein family, PDC109, BSPA3, and BSP30K, coat the sperm head and were identified as the proteins that cause sperm to bind to the oviductal epithelium. During capacitation, which is a process that occurs in the female reproductive tract and prepares sperm to fertilize an oocyte, sperm show reduced affinity for the epithelium, and there is evidence that PDC109 is shed from sperm; however, it is not known what happens to BSPA3. Western blot analysis was used in this study to assess the effect of capacitation on BSPA3. Frozen- thawed sperm were used due to the fact that approximately two-thirds of dairy cattle in the United States are bred by artificial insemination using frozen semen samples. Western blots containing protein extracts from frozen-thawed sperm, incubated in TALP with or without capacitating agents, probed with anti-BSPA3 antibodies detected three proteins. In addition to the native 15 kDa BSPA3 protein, both a protein of higher molecular mass (just under 20 kDa) and a protein of lower molecular mass (13 kDa) were visualized. These findings suggest that BSPA3 is modified by sperm. In contrast, unpublished results from a parallel experiment executed by Dr. Chris Hung revealed that, when fresh sperm were incubated, only the native 15 kDa BSPA3 protein and the 13 kDa protein appeared over

time. These results suggest that an enzyme on sperm modifies BSPA3 to produce the 13 kDa band and that cryopreservation of sperm further produces a 20 kDa band.

Disorganized Dendrites: Dynamics of Neuronal Development and Synaptogenesis in Murine WT and *reeler* Models through Multiphoton Microscopy

SEAN LAWLESS

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Reelin is a protein that coordinates early brain development. Mice with deficiencies in Reelin (a.k.a. *reeler*) show a "reeling" gait and an improperly formed cerebral cortex that shows inverted and disordered layering. It is known that Reelin signaling promotes proper cellular layer formation in the cerebral cortex, but the specific function(s) of Reelin signaling remains controversial. We hypothesized that observation of cortical layer formation in normal and *reeler* brains would provide insights into Reelin function, and cerebral cortex formation. We investigated Reelin's role in development by using multiphoton and confocal microscopy to image fluorescently labeled neurons within brain explants and fixed tissue from both WT and *reeler* mice. The challenge is using these methods to view layer 6 cortical neurons over a crucial period of development as they approach the brain surface and start forming a cortical layer. Our results now show that L6 neurons dynamically extend dendrites, coincident with the formation of their cortical layer, and that this process may be perturbed in the *reeler* mutant. Dendrites in both WT and *reeler* mice extend and retract over time, but WT dendrites are oriented perpendicular to the pial surface and generally increase in overall length and branching complexity over time. Dendrites of neurons in the *reeler* mutant are instead oriented significantly differently. While Reelin does not function as a chemoattractant, it is necessary for migrating L6 neurons to extend their dendrites into the marginal zone of the developing brain, suggesting it may direct dendritic growth by overcoming an unidentified chemorepellant.

Climate Change and Temperature Effects on the Breeding Success of Tree Swallows (*Tachycineta bicolor*)

MILES LUO

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Department of Ecology and Evolutionary Biology

Historical trends of Tree Swallow (*Tachycineta bicolor*) breeding success in Ithaca, NY, USA have shown punctuated years of high nestling mortality in the midst of years of healthy fledgling production. Global climate change has shown that some birds, including Tree Swallows have started to advance the time of clutch initiation. This study sought to examine the potential effects that climate and temperature may have on the food supply and breeding success of swallows, especially the frequency of years with high chick mortality. A long-term database was used to obtain

information on flying insect abundance, daily temperature, and the occurrence of chick deaths throughout four select breeding seasons. These data were used to develop the concept of a cold snap, which was defined as a string of consecutive days in which the maximum temperature of a given day did not reach a certain threshold. This threshold was calculated using the insect abundance and maximum temperature data. Cold snap distribution and chick mortality events throughout the breeding seasons of four select years were looked at to examine if there was a clear link between temperature, the occurrence of cold snaps, food supply, and chick mortality. While there appears to be visual evidence of a link between these factors, a formal statistical test has not yet performed, meaning that few concrete conclusions can be made at this time. Preliminary results suggest that earlier breeding in Tree Swallows may subject them to earlier, colder temperatures, resulting in more frequent years with pronounced chick mortality.

Historic Trends in Deuterium (δD) in Bird Feathers

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Deuterium, a stable isotope of hydrogen expressed as δD, has been recorded in precipitation around the world since the 1960's and those 40-year averages are often used in the study of avian ecology. Deuterium varies geographically and temporally throughout the year due to temperature changes. This study hypothesized that deuterium may have also increased over time due to temperature increases caused by climate change. Deuterium was investigated in avian museum specimens from the last century in Tompkins County, New York. Specimens were chosen using two different criteria: one including a wide variety of species to investigate general trends and the other restricted to a few species to reduce noise in the data. Across a wide variety of passerine species, δD demonstrated an increasing trend over time, but the explanatory power of time was low (r^2=0.1134). When analysis was restricted to a single species, this relationship disappeared. The relationship between temperature and δD rarely explained more than ten percent of the variation in the data. Statistically significant differences were found between species and between the sexes, suggesting the need for further research in these areas.

Changes in Fecal Microbial Populations in Horses Maintained on Various Diets

LAUREN NEUENDORF

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Department of Animal Science

Laminitis, a condition of the hoof, is one of the most common and devastating conditions that affects the horse (*Equus caballus).* The most common factors responsible for triggering laminitis are intake of excess grain or exposure to lush pastures where high starch rich diets are consumed, although the connection between the gut and the hoof is not well understood. When horses are fed starch rich

diets, like grain commonly found in the diets of race and performance horses, the balance of microbial species present in the digestive tract of the horse become disturbed, leading to lactic acidosis in the horse. The objective of this study was to identify and quantify the fecal microbial populations in horses maintained on various diets. Microbial populations present in the equine hindgut were assayed by using bacterial ribosomal DNA fragments present in fecal samples. Identification and quantification of specific bacterial species, using bacterial primers and florescent probes, can be detected by quantitative real-time PCR (qPCR). This study focused on equine hindgut streptococcal species (EHSS), including *Streptococcus lutetiensis,* which accounts for approximately 70% of the microbiota present in the hindgut prior to the onset of laminitis. Our results suggest that avoidance of pasture for all laminitic prone horses may need to be reevaluated as the hindgut microbe sensitivity to diet is unique for each individual horse. The use of these assays will be valuable in future work exploring the changing microbial populations present in the equine hindgut.

A Genetic Screen for Arf1 Mutants that Disrupt a Transport Pathway in *Saccharomyces cerevisiae*.

BERTHELEAU NGAKAM

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Intracellular transport pathways are very important to cell viability and function and can determine a cell's ability to survive and reproduce. ADP-ribosylation factors (Arfs), a family of small GTPases, play a key role in the regulation of intracellular membrane trafficking. Chitin synthase 3 (Chs3) is a model for a transport protein that cycles between the Trans Golgi Network (TGN) and the plasma membrane in yeast.

Two Arf-dependant transport pathways are involved in trafficking Chs3p. Exomer, an Arf-dependant cargo adaptor complex, is responsible for trafficking Chs3 to the plasma membrane through the exocytic pathway while AP-1, another Arf-dependant cargo adaptor protein complex controls retention at the TGN. Both Exomer and AP-1 function is dependent on the membrane-associated Arf1. We are conducting a genetic screen, to find Arf1 mutants that may distinguish these two recruitment pathways, under the assumption that there is a difference between Arf1-Exomer interaction and Arf1-AP-1 interaction. To test our hypothesis, we produced a library of Arf1 mutants on plasmids by both random and site-directed mutations. The DNA was used to transform yeast and the phenotype was observed under different conditions. None of our Arf1 mutants obtained by site-directed mutations were able to provide us with a positive result that would verify our hypothesis. However, preliminary results indicate that we may have found one or more Arf1 mutant/s from our random mutant library that disrupt trafficking of Chs3 to the plasma membrane but do not disrupt retention of Chs3 at the TGN by AP-1.

Deregulation of the miR-376b/cIAP1 Pathway in Cancer Stem Cells and Its Role in Mammary Carcinogenesis

SAMANTHA PALMACCIO

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Tumor-initiating, tumor-propagating or cancer stem cells (CSC) represent a subpopulation of highly tumorigenic self-renewing cells believed to be largely responsible for tumor formation and progression in a broad variety of cancers. CSC frequently demonstrate increased resistance to traditional chemotherapy reagents thereby leading to cancer recurrence. Thus identification of pathways critical for self-renewal and maintenance of CSC is of utmost importance. Recently our laboratory established a mouse model of mammary carcinoma associated with deficiency for tumor suppressor genes p53 and retinoblastoma. In this model we identified a population of CD24+CD49f+ CSC, which yielded carcinomas much earlier and were able to reconstitute all tumor cell populations more efficiently than CD24-CD49f- cells in secondary and tertiary transplantations. We have determined that CSC are characterized by downregulation of microRNA miR-376b and upregulation of its target, cellular Inhibitor of Apoptosis 1 (cIAP1). Reconstitution of the miR-376b or siRNA mediated knockdown of cIAP1 decreased proliferation and increased apoptosis in mammary carcinoma cells. Notably, cIAP1 siRNA and particularly miR-376 decreased self-renewal of mammary CSC, according to serial mammosphere formation assay. Likewise, treatment with Smac mimetics which inhibit IAP activity also decreases mammosphere formation. Consistent with cell culture studies, administration of miR-376 and cIAP1 siRNA reduced growth of mammary carcinomas in vivo. Importantly, indicating depletion of CSC pool, primary cells isolated from tumors exposed to miR-376 alone or in combination with cIAP1 siRNA had significantly reduced number of mammmospheres. Examination of several human breast cancer lines has identified a similar function of the miR-376b/cIAP pathway in human breast cancer stem cells. Taken together, these studies uncover miR-376b - cIAP1 pathway as a promising novel target for CSC-specific therapy.

Longitudinal Characterization of Follicle Populations in Women with Polycystic Ovary Syndrome: a Pilot Study

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Polycystic Ovary Syndrome (PCOS) is a common reproductive disorder characterized by an unusual abundance of small antral follicles within the ovaries. These follicles display characteristics of more mature follicles, yet fail to progress to ovulation -a phenomenon termed "follicle arrest". High-resolution transvaginal ultrasonography is a non-invasive technique that might allow for a prospective and longitudinal assessment of follicle growth kinetics during anovulatory periods. The

objective of this study was to compare follicle growth patterns in healthy women with regular ovulatory cycles and women with anovulatory PCOS using serial ovarian ultrasonography. Five women with PCOS and five control subjects had their ovaries scanned every other day over a 30-day period or one inter-ovulatory interval, respectively. Changes in both the size and number of follicles throughout the study interval were compared among groups. As expected, women with PCOS had significantly greater total follicle counts on any given day compared to controls (80.6 ± 16.0 vs. 24.8 ± 6.6 follicles, respectively; $p<0.0001$). Both women with anovulatory PCOS and controls showed distinct fluctuations in total follicle populations over the study interval (Maximum Change in Total Follicle Count: 44.0 ± 22.3 versus 17.8 ± 7.9 follicles, respectively; $p=0.0384$). In summary, women with PCOS showed changes in follicle populations which are consistent with active phases follicle growth and regression despite failure of ovulation. Future studies aimed at understanding the precise nature of follicle arrest in PCOS will allow for the identification of nutritional and metabolic factors that influence recruitment, growth and selection of ovarian follicles.

Computational Analysis Toolkit for Examining Respiration Synchronized Neural Activity in the Rat Olfactory Bulb

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Neural activity in the olfactory bulb of rodents can be strongly patterned by respiration. Such temporal information may play a role in odor processing, and it is therefore important to analyze neural activity from the olfactory bulb in relation to an animal's respiration. Here we present a data analysis toolkit for analyzing respiration phase-locking in electrophysiological recordings. The software computes spike 'phase' values from spike times and the simultaneously measured respiration signal and represents the information using vector strength, best phase, inter-spike interval and several other methods. The functional utility of the software is illustrated in the context of mitral cell recordings from the rat olfactory bulb under various conditions of odor presentation as well as cholinergic manipulation. While there is insufficient data to make statistically significant conclusions on the observed respiration synchrony, we compare the preliminary results to previous findings to draw conclusions on the validity of the data analysis software. Finally, we discuss the potential for extending the software to other contexts in which neural activity is analyzed with respect to ongoing periodic signals.

Recognition Memory Produces Differential Fos Expression in the Male Golden Hamster Brain

DAVID ROLLINS

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Department of Psychology

Recognition memory is prevalent in nature and is used in the maintenance of pair bonds, dominance hierarchies, and cooperation. Here, we use the male golden hamster in the context of the Coolidge effect—that a male expresses preference for a less familiar over a more familiar female—to first test for the presence of individual recognition in male hamsters and then to analyze what brain regions may be activated in such a capability. First, we show that males do have individual discrimination because they are able to differentiate between two familiar females in a habituation-discrimination task. Second, using a habituation-dishabituation task, we show that males do cross habituate to the odors of a familiar female but not to the odors of a novel female. Furthermore, we show that the flank gland odor from a novel female causes correspondingly higher neural activation in the following brain regions used in recognition memory: perirhinal cortex, posterior piriform cortex, lateral entorhinal cortex, and prelimbic cortex.

Utilizing microCT to Study Placental Vascular Defects and Potential Therapeutic Effects of VEGF in the BPH/5 Model of Pre-eclampsia

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Preeclampsia, a common and sometimes severe pregnancy disorder, has puzzled physicians for centuries. Much remains unknown, for its pathogenesis is complicated by an intricate balance of angiogenic factors mitigating vasculogenesis. The BPH/5 mouse model is the only animal model to spontaneously develop the hallmark symptoms of preeclampsia (hypertension and proteinuria) and exhibits placental pathology similar to that found in human preeclamptic pregnancies. BPH/5 mice typically exhibit embryo clustering, and deliver smaller litters compromised by fetal growth restriction as visualized by ultrasound. Histological studies show BPH/5 mice experience impaired spiral artery growth in the decidua. Studies in our laboratory have indicated resolution of hallmark symptoms when mice are injected with adenovirus encoding a soluble isoform of growth factor VEGF. In this study, we quantified vascular defects in the BPH/5 model using cutting-edge microCT technology, an advanced tool which expands upon histological and ultrasound studies of the past, enabling precise 3D and 2D analysis of placental vasculature. Our goals were two-fold: 1) to examine potential vascular defects at E7.5 and 2) to examine effects of VEGF therapy at E12.5. Though embryo clustering occurred in BPH/5 mice, blood volume delivered to the implantation site was not compromised. Our results revealed that VEGF treatment had profound ameliorative effects on BPH/5 impaired vasculature, enhancing arterial volumes and diameters well beyond those of the unimpaired control C57 group. These exciting findings not only point to VEGF therapy as a promising prospect but also provide valuable insight about the dynamic vascular changes that occur during preeclampsia at the placental level.

Optimization of Novel Thermo-gelling Tri-block Co-polymeric Carriers for the Delivery of Paclitaxel for the Treatment Glioblastoma Multiforme

CODY SCHLAFF

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Glioblastoma multiforme (GBM) is the most aggressive primary brain cancer in adults and unfortunately, characterized by a poor prognosis. Standard treatments like surgical resection and chemotherapy are marginally effective. Despite aggressive therapy, the disease ultimately recurs. Local control-released chemotherapy may be administered via carmustine (BCNU) polymer-loaded biodegradable wafers (Gliadel® wafers) to the cavity upon surgical resection. One significant limitation of this modality is the instability of BCNU in aqueous media. Moreover, the effective therapeutic distance of the wafers extends only a few millimeters from the resection cavity, while recurrences occur often centimeters away. New carriers and pharmacological agents are being actively explored. One such carrier is derived from a novel set of poly(DL-lactide-co-glycolide-b–ethylene glycol-b-DL-lactide-co-glycolide) (PLGA-PEG-PLGA) thermo-gelling tri-block copolymers capable of sustained release of paclitaxel. Paclitaxel has been shown *in vitro* and *in vivo* to be effective against glioma cells while having a much slower degradation rate than carmustine; this slower degradation rate may allow deeper penetration into the brain, and as a result, effective concentrations can be sustained for longer periods. We seek to test whether thermo-gelling hydrogel carriers of paclitaxel could result in novel therapies for the treatment of GBM. We also seek to optimize the configuration of the thermo-gelling hydrogels within the resection cavity to maximize drug delivery to the surrounding brain.

Parameters that Determine the Interaction of ZFP568 with TRIM28 and their Effects on ZFP568 Activity

NATALIA SHYLO

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Zinc-finger proteins containing Kruppel-associated box (KRAB) domains make up the largest family of transcriptional regulators in mammals. However, few genes in the family have well characterized functions. *Chato,* an ENU-induced mutation in the KRAB domain of ZFP568 causes embryonic arrest at E 9.0, indicating a distinct function of ZFP568 in embryonic development. The *chato* allele of ZFP568 contains a T to C substitution in a conserved residue of its first KRAB domain. Genetic complementation experiments indicated that the *chato* mutation completely disrupts ZFP568 activity, since a genetrap allele of *Zfp568 (Zfp568*^{RRU161}*),* encoding a truncated ZFP568 protein lacking all functional domains, causes a similar embryonic phenotype to the ZFP568^{chato} allele. TRIM28, a known transcriptional co-repressor of KRAB zinc fingers has been found to interact with the KRAB domains of ZFP568. We hypothesized that the *chato* mutation disrupts the activity of

ZFP568 by affecting its ability to interact with TRIM28. Here I present results from yeast two-hybrid experiments indicating that the ability of ZFP568 to interact with TRIM28 is decreased by the *chato* mutation, but not completely disrupted. By introducing mutations in the first and second KRAB domains of ZFP568, I have been able to determine that the interaction between ZFP568 and TRIM28 is mediated by both the first and second ZFP568 KRAB domains. In contrast with the ability of both domains to recruit TRIM28, only mutations in the first KRAB domain of ZFP568 completely eliminate its transcriptional repression activity. My results indicate that the KRAB domains of ZFP568 are differentially required for interaction with TRIM28 and for ZFP568 function.

Immunohistochemical Quantification of $5HT_{2C}$ Receptors and Ca_V 1.3 Channels after Spinal Cord Injury in the Upper Lumbar Mouse Spinal Cord

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The mammalian hindlimb central pattern generator (CPG) for locomotion is located in the lumbar spinal cord, and coordinates contralateral alternation of the hindlimbs and intralimb flexor/extensor muscle alternations. Serotonin (5HT) plays an important role in enabling CPG functionality. All serotonergic input to the lumbar cord descends from the medullary Raphe nuclei; these inputs are lost after a complete spinal cord lesion. We used immunohistochemical methods to determine whether spinal cord injury (SCI) affects the expression levels of $5HT_{2C}$ receptor clusters and Ca_V 1.3 channel clusters. Quipazine is a $5HT_2$ agonist and its regular administration has previously led to partial locomotor recovery. We sought to determine if daily administration would reduce the SCI-induced homeostatic changes in $5HT_{2C}$ receptor and Ca_V 1.3 channel levels. Half the SCI mice were treated with quipazine, and half were saline vehicle treated. A combination of ImageJ and Matlab was used to determine the number, size, and intensity of $5HT_{2C}$ receptor clusters after SCI, as well as the percentage of the frame area covered by Ca_V 1.3 channels and their average brightness. After SCI, there is a significant upregulation in the number of $5HT_{2C}$ receptor clusters, and $5HT_{2C}$ receptor clusters are significantly larger. Neither is reduced by quipazine. There is no significant change in the average brightness of $5HT_{2C}$ receptor clusters after SCI. Additionally, the area and intensity of Ca_V 1.3 channels are significantly larger in SCI/saline mice than in intact mice. Ca_V 1.3 channels were not examined in SCI/quipazine mice due to a small sample size.

She1, Ldb18, and Stu1: *Saccharomyces cerevisiae* Microtubule-associated Proteins Involved in Mitotic Spindle Function

PATRICK WU

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Proper segregation of chromosomes during cellular division (mitosis) is an essential cellular process in unicellular and multi-cellular organisms. Improper segregation in humans can result in diseases such as Down syndrome or cancer. All eukaryotic cells use a complicated molecular machine called the mitotic spindle to carry out this task. The mitotic spindle is made up of microtubules (MTs) and a variety associated proteins that regulate MT assembly, connect MTs to cellular structures, and produce force. I have worked on three projects, each involved the study of a different microtubule-associated protein. First, I examined She1's potential role in anchoring astral MTs at the yeast spindle pole body. Using co-immunoprecipitation experiments, I have found that She1 does not secure the attachment of astral MTs to the γ-tubulin complex by binding to the proteins, Tub4 and Spc97. Second, I explored the possible modification of the dynactin component Ldb18, and found that it is not modified by either of the ubiquitin-related modifiers, Urm1 and Rub1. Furthermore, I have mutated all the individual lysines and cysteines to alanine in Ldb18 utilizing site-directed mutagenesis, and discovered that the modification is not attached to any of the two residues. In the third project, I am studying how Stu1 controls MT dynamics *in vitro* using TIRF microscopy.

Models for Phage Therapy with Reduced Bacterial Lysis at High Population Density

JACOB WYNNE

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Pioneered by Felix d'Herelle in the early 20th century, phage therapy is the treatment of bacterial infection using bacterial viruses known as bacteriophage. Several different models have been constructed in order to predict the success of this therapy, incorporating such important biological processes as bacterial and phage evolution (Levin and Bull, 2004) and the reduction of phage infection with increasing bacterial density (Weitz and Dushoff, 2007). However, experimental results (Efrony et al., 2009) show that there is a critical period after infection beyond which phage therapy is no longer effective. This important property of host-bacteria-phage systems has not yet been accurately captured by any existing model.

Here, we re-examine extant models of phage therapy in order to formulate an accurate depiction of the important mechanistic processes underlying the dynamics of the bacteria-phage system. We focus primarily on the effect of bacterial population dynamics on vulnerability to phage infection and the processes that might explain the observed critical period and reduction in bacterial lysis as bacterial populations approach carrying capacity (Middelboe, 2000, Bull et al., 2002). We then compare this new model to a standard model of nutrient limitation of bacterial growth.

Biochemistry of a Mutant, Cancer-causing DNA Licensing Protein MCM4

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Under the supervision of Dr. John Schimenti
Department of Biomedical Sciences

Chromosomal instability is a hallmark of cancer cells and impaired DNA replication is a major cause of chromosome instability. This thesis investigates the mutant allele *Chaos3* (chromosome aberrations occurring spontaneously 3) isolated in a N-ethyl- N-nitrosourea (ENU) mutagenesis screen of mice for chromosome instability. This mutation causes high levels of chromosome instability. Over 80% of mutant female homozygous mice develop mammary adenocarcinomas with a mean latency of 12 months.

The *Chaos3* mutation occurs in the *Mcm4* gene (minichromosome maintenance 4) and causes a single amino acid change (F345I) in a highly conserved region. *Mcm4* encodes the MCM4 subunit of the hetero-hexameric MCM2-7 complex. MCM2-7 is a DNA replicative helicase. During DNA replication, MCM2-7 is loaded on the replication origins as double hexamers.

The goal of this study was to characterize the biochemical consequence of the point mutation, focusing on protein interactions measured by co-immunoprecipitation. Here, we report that the *Chaos3* mutation causes a dramatic decrease of MCM4-MCM6 interaction and a slight decrease of MCM4-MCM7 interaction. This finding suggests that the loss of interaction might cause structural instability of the replicative machinery, leading to increased number of stalled replication forks and chromosome segregation defects. Another finding was identifying an interaction between MCM4 and HSP70.

Identifying Genes that Interact with Calcineurin during Egg Activation in *Drosophila melanogaster*

REBECCA ZUCKERMAN

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Department of Molecular Biology and Genetics

When an egg is fertilized, before the new embryo can begin to develop, the egg must be "activated." The process of activation triggers the egg to complete meiosis, to begin translating new proteins, to degrade proteins and RNAs that are no longer required, and to modify its membranes to form a harder outer covering. The universal signaling event is an increase in calcium levels that occurs in the egg at this time. In many cell types, calcium causes changes through a conserved signaling pathway by binding to a protein called calmodulin, which in turn regulates the activities of other proteins.

Calcineurin, a phosphatase, is one of those other proteins. It has been proven experimentally that calcineurin plays a critical role in regulating egg activation in fruit flies and in frogs. For example, *Drosophila* females expressing a constitutively active calcineurin (*cnA-act*) in their germline are sterile. To identify the proteins in the pathway by which calcineurin regulates egg activation, the Toshiro Aigaki lab tested whether there were *Drosophila* genes that interact genetically with calcineurin mutations. To do this, they searched for chromosomal regions whose deletion suppresses the sterility of *cnA-act* female flies. Fourteen large chromosomal regions were identified.

To define the precise gene(s) within each region that suppresses the sterility of *cnA-act* females, I have tested smaller deletions, and then individual mutations, within the five regions I am examining for interaction with *cnA-act*. For three of the deletions, I have identified a gene or genes whose mutants significantly restore fertility of *cnA-act* females, and thus is a candidate to act within the calcineurin pathway. The first is *CG6927*, a gene that is expressed in the ovary but currently has no known function. The second is *eIF3-S8*, a transcription initiation factor. The third is *RpS24*, a ribosomal protein. The fourth is *CG42565*, which like *CG6927*, has no known function. In the other two regions, I have narrowed down the *cnA-act* interacting genes to a small number of candidates, instead of the hundreds of genes within the original large region. I am currently testing the remaining candidates.

Effect of Temperature on the Behavior and Physiology of Gypsy Moth, *Lymantria dispar*, Infected by the Fungus *Entomophaga maimaiga*

KEITH CICCAGLIONE

Under the supervision of Dr. Ann Hajek
Department of Entomology

The entomopathogenic fungus *Entomophaga maimaiga* is a natural pathogen of larvae of the invasive pest, *Lymantria dispar*. However, other Entomopthoralean fungi have been demonstrated to have their growth inhibited at temperatures greater than 30°C and some insects have been shown to thermoregulate to increase their body temperature. Rising global temperatures, the slow spread of *L. dispar* south, and the possibility that gypsy moth larvae thermoregulate suggest that, in the future, *E. maimaiga* may no longer function as a natural control agent. To ascertain the affect temperature may have on infected *L. dispar* larvae, larvae were microinjected with *E. maimaiga* protoplasts and exposed to a temperature gradient to record their thermoregulatory behavior as well as to a constant temperature regime and limited exposure to high temperatures.

Infected *L. dispar* larvae were observed to prefer the same temperatures as uninfected larval. Gypsy moth larvae exposed to temperatures greater than 26°C for an extended period of time were cured of their fungal infection, but larvae reared for a limited amount of time at those temperatures, less than 48 hours, were shown to have a significantly greater chance of mortality. Thus, temperature was not shown to affect the behavior of *L. dispar* larvae infected by *E. maimaiga*, however, time length of exposure and the temperature of those exposures were revealed to significantly affect the probability of larval mortality.

These results suggest that rising ambient temperature of the gypsy moths habitat will reduce the efficacy of *E. maimaiga* to control *L. dispar* populations.

Investigating the Effect of the Number of Outgroups on Topological Rooting: Introducing TRASSO, with Apoidea (Insecta: Hymenoptera) as a Case Study

ANDREW DEBEVEC

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Topological rooting has been an open question in phylogeny reconstruction since the birth of the field of systematics. While outgroup rooting is currently the standard method for rooting topologies, it is not well understood how small numbers of outgroups can affect the rooting of the ingroup. A method called TRASSO (Topology and Root Ambiguity: Stochastic Subsampling of Outgroups) was developed in order to answer this question, and the bees (Hymenoptera: Apoidea) were used as a case study. We analyzed a dataset involving an extensive selection of outgroup samples for the Apoidea and used TRASSO to subsample from this pool in order to understand the impact the

number of outgroup taxa has on ingroup rooting. This group was chosen due to both the high number of outgroup taxa available and the unresolved question of where the bees are rooted. The bees are major pollinators of angiosperms and compose roughly 20,000 species worldwide. Due to the hypothesized coevolution between bees and angiosperms, the resolution of the root of the bees will shed immense light on early angiosperm evolution. TRASSO demonstrated that the results changed dramatically when small numbers of outgroups were sampled versus large numbers of outgroups. This demonstrates the need for greater taxon sampling within the outgroups for modern molecular studies. Melittidae is hypothesized to be either monophyletic, and sister to the rest of the bees, or paraphyletic, with subfamily Meganomiinae as sister to the rest of the bees.

Obesity, Sex, and Death: Life-long Implications of Varied Prey Availability to Larval *Coccinella novemnotata* and *Coccinella septempunctata*

JAMES KOPCO

Under the supervision of Dr. John Losey
Department of Entomology

The nine-spotted ladybug, *Coccinella novemnotata*, was once among the most common ladybugs in the northeastern United States, but has declined dramatically in the early 1980s. This decline may be due to competition with the introduced seven-spotted ladybug, *Coccinella septempunctata*. Recently collected specimens of *C. novemnotata* were noticeably smaller than their historically common counterparts. This study aims to explore the possibility that the size of *C. novemnotata* can be influenced by the food available to the larvae, and to examine any other life-long consequences of prey availability during development. The study also compares *C. novemnotata* to *C. septempunctata*, its potential competitor, reared under the same conditions. Increased prey availability was expected to lead to increased larval survivorship, growth rate, adult size, fecundity, longevity, and appetite for both species. While *C. septempunctata* conformed to expectations, only adult size, growth rate, and appetite were found to increase continuously with food availability in *C. novemnotata*. Comparison between the beetles in historical collections and the adult beetles reared under controlled feeding suggest that *C. novemnotata* fed less than *C. septempunctata in situ*, even before *C. septempunctata* was introduced. *C. novemnotata* experienced decreased fecundity and survivorship at extreme prey levels. *C. septempunctata* had higher survivorship in most treatments than did *C. novemnotata*, but lower survivorship when fed three aphids per day. The range of sizes of *C. novemnotata* produced in this experiment encompassed the sizes of historical and recently collected individuals, suggesting that larval nutrition may be driving the decrease in size of wild beetles.

Impact of Interspecific and Intraspecific Prey Competition on Larval Nine-spotted and Seven-spotted Lady Beetles

JASON LAI

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Department of Entomology

The nine-spotted lady beetle (*Coccinella novemnotata*), or C9, and the seven-spotted lady beetle (*Coccinella septempunctata*), or C7, are both ecologically important predators of agricultural pests. C9 is native to the northeastern United States and was common until its drastic decline shortly after the introduction of C7 in the area. It has been suggested that C9 was outcompeted by C7 in its native habitat, a hypothesis experimentally tested in this study.

Two coetaneous *Coccinella* larvae were raised in the same cage under constant prey density from hatch until eclosion. Three pairings were used: C9 with C7 (n=32), C9 with C9 (n=21), and C7 with C7 (n=14). Mortality was assessed daily and adult weight and size recorded following eclosion. Data were combined with those from a previous study assessing *Coccinella* larvae reared in the absence of competition.

Only 3.1% of C9 larvae survived to adulthood when reared with C7, which is significantly less than the 40.6% of C7 larvae that survived when reared with C9. Mean adult mass and mean adult size were significantly greater among C7 reared with C9 than among C7 reared alone. I conclude that C7 larvae consume more of the shared aphids than C9 larvae when reared together, and that the disappearance of native C9 throughout the Northeast can be attributed to exploitative competition from invasive C7. The recent ecological history of C9 and C7 is another salient example of the deleterious effects that biological control can have on native populations.

An Examination of Behavioral and Physiological Responses to Prey Limitation in Social and Solitary Huntsman Spiders

CAROLYN LAROW

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Department of Entomology

Competition for prey is a significant cost associated with the aggregation of predators. Nevertheless, social behavior is found within vertebrate and invertebrate predators of a number of species. Previous studies suggest that social carnivores may have a depressed metabolic rate compared to that of their solitary kin (Gilbert, Zimmerman, & Rayor, in revision). A depressed metabolic rate is predicted to lower competition for prey by lowering prey requirements of individual predators. To test the link between sociality and lower prey intake requirements, the growth and survival of *Delena cancerides* and three species of solitary huntsman spiders (*Holconia nigrigularis, Delena gloriosa,* and *Isopedella pessleri*) were measured at three prey levels in both individual experiments and group experiments. Deaths, including cannibalism in groups, were recorded daily and spiders were weighed at two-week intervals. It was found that *D. cancerides*, the social huntsman species, thrived in terms of growth and survival when compared to the solitary species. *Delena cancerides* were the last species to start dying and had overall survival rates that were better than *H. nigrigularis*, D. *gloriosa* and *I. pessleri.* Moreover, at the low prey level, *D. cancerides* continued to grow while the solitary species all decreased in weight. The results of this series of experiments suggest that *D. cancerides* does do better than the solitary species of huntsman in terms of growth and survival when prey is limited, thereby

demonstrating a link between lowered prey requirements and lower metabolism, and the possible impact on social behavior in carnivores.

Female Mating Behavior and Polyandry in the Dengue Vector Mosquito, *Aedes aegypti*

MELISSA ROSE ORTEZA

Under the supervision of Dr. Laura Harrington
Department of Entomology

In this experiment, I tested the hypothesis that mating induces a mature virgin *Aedes aegypti* female to a sexual refractory state that acts within 5 hrs and lasts for at least 48 hrs. To test this hypothesis, I evaluated a mated female's willingness to re-mate with another male within a 5 hr and 48 hr period. In order to detect the presence of multiple matings, I first mated virgin females of the Higg's White Eye strain with virgin males of a Mexican strain and then re-mated the non-virgin females with virgin Higg's White Eye males. The progeny of females exposed to two mating events were then screened for eye-color to determine paternity.

My results indicate that females spend significantly more time in copula with males during their first mating compared with their second mating, regardless of the 5 hr or 48 hr time interval after the first mating. Additionally, a significant increase in the number of female-initiated rejections and pseudo copulations were observed during the second mating regardless of time interval. Furthermore, I detected that at least 4.8% of females engage in multiple matings and this small proportion showed higher fecundity compared to females that only mated once. Overall, I conclude that mating induces sexual refractory behavior in most mature *Ae*. *aegypti* females within 5 hrs and lasts for at least 48 hrs.

The results from my honors research contribute to a better understanding of *Ae. aegypti* mating behavior, which is important for the development of genetic vector control strategies.

Serial Homology in the Coxal Propriosensory-motor System in a Flesh Fly (Diptera: Sarcophagidae)

AVERY RUSSELL

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In order to sense when a leg has been extended or withdrawn it is necessary to have some sort of mechanosensory organ that can determine the leg's position around the joint and thus monitor posture of the leg. In Sarcophagidae (Diptera), this problem has been solved by hairplates, which are made up of several fine hairs that protrude from the coxa, the first segment of the leg, and press against the thorax as the leg changes position. The three pairs of legs of these flies are evolutionary repeats of one another, a

condition termed serial homology, but each pair has a different functionality. The front legs have the greatest range of motion, and along with the hind legs, are used extensively for grooming. The middle legs in turn are specialized for jumping. Is the functional and morphological modification of the legs accompanied by differences in the hairplates of each leg? By examining hairplates of each coxa microscopically and then injecting them with fluorescent dye to reveal the axonal projections into the thoracic CNS, we are investigating similarities and differences among the hairplates. Externally, there are two hairplates on each coxa, with a third on the procoxa. Although they differ in position, the arrangement of hairs among homologous hairplates is identical. From an internal perspective, there are many similarities between the axonal projections from the hairs of each hairplate into the central nervous system. These results indicate that perhaps that the external and especially internal morphology of hairplates is strongly conserved.

A Site's History: The Ithaca Gun Company

RACHEL HENDRICKS

Under the supervision of Dr. Kathryn Gleason
Department of Landscape Architecture

The Ithaca Gun Factory, located in Ithaca, New York above one of the city's most prominent and scenic features, Ithaca Falls, laid abandoned for several decades before its demolition in the year before this thesis was written. The Gun Company long stood along Fall Creek as one of the last enduring beacons of that area's industrial core, and in its absence persists a cultural narrative on the role of the industrial landscape in today's society. This thesis is a collection of important or pertinent information on the history and current conditions of the site of the factory and the land in its immediate vicinity. Although the site is highly visible within the Ithaca community, it lacks accurate and comprehensive documentation. While a formal survey has yet to be conducted, this work is intended as a collection of the full breadth of data from the site's industrial beginnings, to its most recent history.

This thesis is divided into two parts, the first being a study of the Gun Company's history, from the land's ancient geological beginnings, through its inception among other formative industries, to the toxic circumstances leading up to its eventual dilapidation and razing, with proposals for its redevelopment opening a new chapter in the site's history. The second part documents the site in its extant condition, focusing on its specific landscape characteristics that portray the site's significance as well as its shortcomings. The historical documentary information was assembled from a variety of primary and secondary sources including historic maps, photographs, correspondence, reports, environmental assessments, written histories, and past studies conducted on the site. The description of existing conditions is based on site visits and previous documentation of the site's components and partial surveys of its vegetation and topographical features.

Landscape Scale Variation in Soil Respiration in a Northern Hardwood Forest, Massachusetts

JOANNA BLASZCZAK

Under the supervision of Dr. Joseph Yavitt
Department of Natural Resources

Soil respiration (SR) impacts turnover of soil carbon, but rates can be highly variable and strongly influenced by several environmental factors. This study addressed SR at the landscape scale for 337 ha of mixed forest at the Prospect Hill tract of the Harvard Forest LTER, Petersham, MA. Sampling locations (N = 50) were determined with GIS with several stand type and soil drainage class combinations, and SR was quantified using a LiCor portable gas analyzer four times during summer 2010. Rates of SR were correlated with soil temperature, soil moisture, root biomass, forest stand type, soil drainage class, soil C:N ratios, and climate. Mean rates were between 3.84 $\mu mol*m^{-2}s^{-1}$ and 5.90 $\mu mol*m^{-2}s^{-1}$, generally increasing with time, except for lower rates in early-July with drought and lower temperature. Variation in SR within 12 different stand types with three different drainage classes showed consistently greater values for both well drained (WD) and moderately well drained (MWD) sites versus very poorly drained (VPD) sites, except for the mixed stand types (Hemlock Mixed, Red Oak Mixed, Red Pine Mixed, and White Pine Mixed). Root biomass and C:N ratios in the organic and mineral horizons varied with SR. To evaluate SR at the landscape scale, the site was divided into six equal 0.3-mile zones arrayed north to south and east to west. The range across the gradient was 1.24 $\mu mol*m^{-2}s^{-1}$ for north-south and 0.82 $\mu mol*m^{-2}s^{-1}$ for east-west. These results suggest that at the landscape scale, despite wide variations in SR rates among local sites, the combinations of the many different forest attributes allows for a fairly consistent mean efflux across landscapes.

Soil Health Restoration in Desertifying Landscapes of Northern China: Evaluating Soil Amendments to Increase Soil Water Retention

NEWELL DANIEL

Under the supervision of Dr. Rebecca Schneider
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Soil degradation caused by long-term deforestation and livestock overgrazing has caused major problems in China and worldwide. This experiment measures the capacity for soil moisture retention of different types and combinations of organic matter and surface litter commonly available in China. The approach was to monitor soil moisture evaporation rates from a set of replicated soil microcosms that contain different treatments of soil organic matter and surface litter. Base soil is sandy loam with less than 1% organic matter; organic amendments were mixed with the base soil in treatments of 2%, 4%, and 10% weight-to-weight basis, with and without surface litter addition. Plant species being compared include common species available in large quantities in Yinchuan: *Populus tremuloides, Robinia pseudoacacia, Typha latifolia,* and *Salix babylonica*. Biochar was also

included due to its recent attention in the relevant literature. There were clear and significant differences among the different treatments in the amount of water retained over time, with a maximum difference of 30% more water retained in 10% *P. tremuloides* + surface litter treatment as compared with control soil after two weeks. The results support our hypothesis that organic matter amendments and litter treatments increase the water retention capacity of the soil microcosms.

Effectiveness of Various Pesticide Treatments and Winter Temperatures on Hemlock Woolly Adelgid (Hemiptera: Adelgidae) Survival within Cascadilla Gorge, Cornell Plantations, Ithaca, NY

KATHRYN GRAZIANO

Under the supervision of Robert Wesley
Cornell Plantations

Hemlock woolly adelgid (HWA) (*Adelges tsugae* Annand) is a non-native, invasive pest that feeds on Eastern Hemlock (*Tsuga canadensis*), and threatens to decimate native hemlock populations in the eastern United States. Pesticide treatments and low winter temperatures both function to curb the growth of adelgid populations, but many pesticides can be harmful to the aquatic organisms in nearby streams, lakes and wetlands. The effectiveness of the pesticide 'Soluneem,' which is derived from natural compounds of the neem tree (*Azadirachta indica*), was compared to traditional Imidacloprid pesticide treatments across a variety of application methods. A significant difference in adelgid mortality between treatment groups was observed, but the Ima-jet stem injection was the only treatment group with significantly higher adelgid mortality than the control group ($F=3.53$, $df=8$, $df=31$, $p=0.005$). Furthermore, rate of infestation on each branch sample was negatively correlated with height, and infestation was dependent on DBH. The effect of winter conditions on adelgid mortality was compared between 2009 and 2010. Winter conditions were shown to have a significant yearly effect on the average survival of adelgids ($F=6.27$, $df=1$, $df=18$, $p=0.022$). The average winter mortality of adelgids within the control groups in 2009 was 61% (± 25), while in 2010 the average winter mortality of control groups was 36% (± 18).

Effect of Light, Prey Density, and Prey Type on the Feeding Rates of the Invasive Mysid Shrimp, *Hemimysis anomala*

KATHLEEN HALPIN

Under the supervision of Dr. Lars Rudstam
Department of Natural Resources

Hemimysis anomala is a near shore invertebrate originally from the Ponto-Caspian region of Eurasia that has recently invaded Great Lakes ecosystems. Little is known about the behaviors of this invasive species in its new Great Lakes environment, however their recent expansion and establishment throughout the Great Lakes basin suggests their potential to disrupt near shore food webs. In this study, I investigate the feeding rates and prey preferences of adult and juvenile

Hemimysis in a controlled laboratory setting. For both size classes, I measured feeding rates as a function of prey abundance, prey type (*Bosmina longirostris, Daphnia pulex,* and *Mesocyclops sp.*), and light level. Mean feeding rates on *Bosmina longirostris* were as high as 23 ind. h^{-1} in the light and 16 ind. h^{-1} in the dark conditions at an initial prey density of 100 ind. L^{-1}. Both size classes displayed higher feeding rates on *Bosmina* than on *Daphnia* or *Mesocyclops sp.* Adults displayed higher feeding rates than juveniles, irrespective of prey type. When given a choice of all three prey types, juveniles strongly favored *Bosmina* over *Daphnia* or *Mesocyclops*, and adults significantly preferred both types of cladocerans over *Mesocyclops*. These results suggest that both size classes of *Hemimysis* strongly prefer the less evasive cladocerans over *Mesocylcops* and that they are capable of consuming large numbers of both cladocerans and copepods relative to other carnivorous zooplankton in the Great Lakes. Light enhanced feeding rates at only the highest prey density treatment when fed *Bosmina*, suggesting that *Hemimysis* predominantly use hydromechanical cues to hunt at densities below 100 ind. L^{-1}.

Bait Preferences and Population Status of Small Mammals in Great Smoky Mountains National Park

ALEXANDER KUMAR

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Small mammal bait preferences and population status were studied in Great Smoky Mountains National Park during summer 2010. The possible occurrence of Least Weasel, *Mustela nivalis*, in the Park was also assessed. Traps baited with peanut butter caught significantly more small mammals than empty traps or traps baited with potted meat. The overall number of small mammals caught during this study was significantly less than an extensive study in the Park during 1999-2003, although the effort (measured as trap-nights) for the two studies was comparable. A drought that occurred between the two studies and/or the recent appearance of the Coyote, *Canis latrans*, is thought to have contributed to the significantly lower numbers of small mammals caught in the 2010 study. The implications of climate change for small mammal populations are discussed.

The Least Weasel was not trapped during the study. Future, more intensive studies are recommended to explore thoroughly the possibility of Least Weasel inhabiting the Park and the effects of Coyote on small mammal populations within the park.

The Role of Environmental Awareness in Water Policy and Allocation in the Jordan River Basin

SAMARA LEVY

Under the supervision of Dr. Richard Stedman
Department of Natural Resources

The Jordan River Basin (JRB) is a transboundary water system that is shared among five riparian nations: Israel, Jordan, Lebanon, Syria, and the Palestinian Authority. Originating from freshwater springs in northern Israel and Lebanon, the JRB flows south for 250km, forming much of the border between Jordan and Israel. The annual flow of this river has plummeted from 1.3 billion cubic meters in the 19th and 20th centuries to approximately 30 million cubic meters today. The JRB is valued as an important water source to a region characterized by political instability, high water demand and low water supply; however, the traditional approach of prioritizing water needs of humans over those of the ecosystem deserves re-examination. Over-allocation by the five riparian nations has led to degradation in the water quality and sustainability of the system, and has resulted in the decline of Dead Sea levels. The purpose of this project was to investigate the emergence of water policies that guide water allocation decisions for the basin and to compare these policies with actual allocation values. The project was conducted through a chronological analysis of the text present in policies, conventions, global events, and NGO actions. Written policy documents were coded to differentiate text that represented human versus ecosystem-based rationales for water conservation. Allocation data were assembled from national reports and interviews. The data revealed a shift toward ecosystem-based policies between 1989 and 1994 as evidenced by a change in policy text favoring ecosystem protection over human needs. An increase in the concern about JRB ecosystem health occurred and resulted in the creation and implementation of international regulations and bilateral agreements, as well as a heightened pro-environmental activity amongst NGOs and through global environmental events. However, there has been no associated decrease in JRB allocation. The barriers inhibiting the translation of JRB water policy into practice need to be determined.

Community Response to Marcellus Shale Drilling: Examining the Capacity of County-level Task Forces to Address Community Impacts

ELIZABETH MARTIN

Under the supervision of Dr. Richard Stedman
Department of Natural Resources

County-level task forces have emerged recently in New York State to address the possible positive and negative effects of hydraulic fracturing and natural gas drilling in the Marcellus shale region. This study examined the capacity of these groups to address local concerns and their role in fostering regional resilience to future environment or development stresses. Semi structured interviews were conducted with members from task forces in Yates County, Tioga County, and Tompkins County, selected because they represented a wide range of task force sizes, group maturity levels, and county level socio-economic characteristics. Interview topics included motivation behind group formation, their use of resources, and their representation of the interests of community members. These task forces formed in response to state-level actions focused on environmental, social, and economic impacts, and have been successful in creating certain tools at the local municipality-level. However this undertaking has not been easy, and all groups struggle to understand (and in some cases, attempt to influence) their legal jurisdiction under energy mining restrictions that prohibit local level "regulation" of the natural gas industry. Members have found useful information or related resources through universities and ongoing hydraulic fracturing in Pennsylvania. In order to achieve a distinct

purpose from other community groups addressing Marcellus shale impacts, two of these task forces have adopted a "neutral" stance where members are urged not to defend their anti- or pro- drilling leanings but to focus on municipal opportunities and impacts. The emergence of these task forces and their ability to mobilize resources under limited legal jurisdiction suggests their capacity to navigate the community landscape and their potential ability to foster regional resilience to gas drilling and related issues.

Indigenous Knowledge for Conservation of Natural and Cultural Resources: A Case Study in the Wet Tropics World Heritage Area of Far North Queensland

SHERRY MARTIN

Under the supervision of Dr. Karim-Aly Kassam
Department of Natural Resources

In the Wet Tropics World Heritage Area (hereafter WTWHA) of Queensland, Australia inclusion of indigenous knowledge into cooperative land management is at its first stages of development. Current policies have sought to recognize indigenous knowledge and participation in planning, though research and policy has failed to produce significant evidence to nominate the WTWHA for cultural values. Using 27 interviews combined with literature analysis this research investigates the barriers and benefits resulting from the 1988 World Heritage Listing solely for ecological values. Since Listing, numerous publications have documented the cultural continuance of traditional indigenous owners through cultural maps, written histories and anthropological evidence. This paper presents preliminary findings from qualitative research informed by government agencies, scientists, traditional owners and land consultants of the WTWHA. Interviews suggest that inclusive land management will enhance the protection of the natural and cultural resources that have defined this area for millennia. World Heritage listing is a barrier to the incorporation of aboriginal customary law[1] into statutory law[2] and common law.[3] In protected area land management, WHL lacks the ability to: appreciably include traditional owners as co-managers of the land, develop lasting partnerships and recognize the universal value of endemic cultures to the Wet Tropics.

An Evaluation of Development Program Sustainability in Mongolia's Vegetable Agriculture Sector

LINDSAY MYRON

Under the supervision of Dr. James Lassoie
Department of Natural Resources

Faced with strong international competition and harsh climatic conditions, Mongolia's less prominent vegetable agriculture sector has struggled to develop since the Democratic Revolution of 1990. Several development programs have attempted to alleviate poverty and income insecurity in vegetable producing regions, but with little research regarding the sector itself, development strategies have thus far been unilateral and their effects unsustainable. This paper presents an

illustrative case study of Shaamar district, a salient vegetable producing region in northern Mongolia. The situation in Shaamar delineates current problems in the sector, supply chain, and environment, and identifies key areas for development. Three development programs working in Shaamar were evaluated using a Sustainable Development Grid tool, which plotted development program objectives against sector problems and underlying challenges. I conclude that high-value horticultural development would be the most sustainable objective for organizations to pursue in Mongolia's vegetable agriculture sector.

Roots of the Appalachian Trail: Recognizing Historical Priorities in the Modern Footpath

SARAH SCHOENBERG

Under the supervision of Dr. Jim Tantillo
Department of Natural Resources

The Appalachian Trail is a cultural artifact often viewed as a natural construct that moderates a significant portion of the country's experience with wilderness. In this study, I analyze the historical context in which the Trail was created in order to uncover the roots of modern interpretations, meanings, and management practices of the Trail. Essential elements of the Appalachian Trail, including the emphasis on regional planning, the encouragement of decentralized volunteer base, and the active opposition to suburban sprawl can all be traced to the beginning years of the Trail.

Under-hoof: White-tailed Deer, Earthworms, and the Degradation of Northern Forests

CHARLOTTE THURSTON

Under the supervision of Dr. Bernd Blossey
Department of Natural Resources

The ever-increasing pressure of non-native species and the rapid expansion of certain dominant species presents a growing threat to the diversity and community structure of deciduous forests in the northeastern United States. In New York, the literature and professional observations suggest that the pressure and impacts of white-tailed deer (*Odocoileus virginianus*) could promote the simultaneous invasions and impacts of non-native earthworms. I conducted a survey in the vicinity of Ithaca, NY, using 9 different sites where deer had been excluded using fences. I took random samples inside the deer exclosures and in adjacent control areas testing earthworm abundance, worm species frequency, soil moisture, soil compaction, qualitative earthworm impact, and the mass of annual leaf litter input. Results revealed few widespread significant differences between plots where deer had been excluded and adjacent open plots, but there were significant differences when both plot and age of exclosure were used as predictors. Great differences in worm biomass in the oldest exclosed site and among sites with different worm species pointed to the need for further investigations, particularly assessing the development of earthworm communities over longer time periods. If the presence of deer increases earthworm population and impacts, this will have important

implications for forest management. These results could lead to greater discussions of deer population control in local forests where browsing is a dominant selective force. Deer browse may affect other ecosystem processes and changes, including the persistence of non-native/invasive species and loss of biodiversity.

Life Cycle Assessment of Composting and Anaerobic Digestion as Municipal Organic Waste Management Strategies

KRISTEN VITRO

Under the supervision of Dr. Norm Scott
Department of Biological and Environmental Engineering

This project examines industrial composting and anaerobic digestions as municipal organic waste management strategies by using principles of Life Cycle Analysis and attempts to clarify and further define various aspects that must be explored and analyzed to conduct such a comparison. Parameters for the comparison between the two systems were identified, including the energy input for processing, the need for specialized equipment or pretretment, economic costs, incentives, beneficial use of the final product, greenhouse gas emissions, and various qualitative aspects. The best available quantitative data were used to compare these two treatment options via cost / benefit analysis. Although Life Cycle Analysis is an important tool for comparing municipal organic waste management treatment options, significant obstacles were evident, especially in parameter estimation. Additionally, I found that a combined system of anaerobic digestion and industrial composting might maximize benefits of each individual system and provide a municipality with an appropriate treatment option for industrial waste.

Quantifying the Cost of Inexperience: Reduced Reproductive Success for Young Herring Gulls (*Larus Argentatus*) on Appledore Island, Maine

CHRISTINE WILKINSON

Under the supervision of Dr. David Bonter
Cornell Lab of Ornithology

In many seabirds, adult breeders often experience greater reproductive success than sub-adult breeders. The goal of this study was to quantify the reproductive success of Herring Gull (*Larus argentatus)* pairs where at least one member was likely breeding for the first time (still in sub-adult plumage, hereafter "sub-adult") and pairs where both individuals were experienced (in adult plumage, hereafter "adult"). We investigated reproductive success and nest attributes (e.g., distance to nearest neighbor, presence of a cover around the nest) of pairs in these two age groups on Appledore Island, Maine. In almost all of the sub-adult nests, the sub-adult individual was a male. No age-based differences were detected in maximum clutch size, egg size, egg volume, or and the proportion of chicks hatching. Chicks from adult nests hatched an average of 3 days earlier and weighed more at hatching than chicks from sub-adult nests. Parental age did not affect chick growth

rates, and in both age groups, first hatched chicks grew fastest. Chicks were more likely to survive to fledging if both parents were adult, if the eggs hatched early in the season, if the chicks were relatively heavy on hatch day, and if their nest was located in dense nesting colonies. There were no significant age-based differences in the average distance from a Herring Gull nest to the nearest Great Black-backed Gull nest (*Larus marinus*, the primary predator of Herring Gull eggs and chicks), or average distance to the 3 nearest conspecific neighbors. Pairs with a sub-adult member constructed nests in areas with significantly more cover material adjacent to the nest than did adult pairs. Overall, Herring Gull pairs consisting of two adults were more successful than pairs with one sub-adult. Our study shows that having just one sub-adult breeder as part of a breeding pair can profoundly influence reproductive success.

Material Properties of *Salpa thompsoni* in the Waters off of the Antarctic Peninsula

KATHARINE WURTZELL

Under the supervision of Dr. Patrick Sullivan
Department of Natural Resources

Acoustic assessment of the pelagic tunicate, *Salpa thompsoni,* can provide useful information about its abundance and distribution if acoustic scattering characteristics are known. The amount of acoustic energy that is scattered by an organism is strongly affected by the organism's density contrast with the surrounding seawater (*g* value). G values of *S. thompsoni* were measured in December 2010 (n=134) from nine different trawl stations along the western Antarctic Peninsula and South Shetland Islands. The range of g measurements was 1.0000 to 1.0036 with a mean and standard deviation of 1.0008 ±.0005. These results are consistent with previous studies of *S. thompsoni* in the Antarctic region (Wiebe *et al.*, 2010). Results suggest that certain environmental conditions, including water density, temperature, and chlorophyll-a concentration, have significant effect on organism g-value. The results of this study can be used in physics-based scattering models and improve scientists ability to use acoustics to measure the distribution and abundance of salps, as well as more accurately measure the abundance of Antarctic krill.

Placental Heme-Oxygenase 2 Expression, but not Heme- Oxygenase 1, is Associated with Placental Iron Content and FLVCR Expression

THOMAS BEMIS

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

Heme oxygenase-2 (HO-2) functions in part to catabolize intracellular heme. This enzyme is present in the human placenta but its potential relationship to iron (Fe) status remains poorly described. Placental HO-2 and Fe status were measured in term placental tissue obtained from 54 pregnant adolescents (age 17.6 ± 1.1 y). Placental expression of HO-2 and the heme transporter, Feline Leukemia Receptor Virus subclass C Receptor (FLVCR), were measured by western blot. Serum ferritin (SF) and transferrin receptor (sTfR) were measured at mid-gestation (25.1 ± 3.5 wks) and in maternal/cord blood at delivery (39.8 ± 1.1 wks). Of the teens studied, 12/43 of teens were anemic at delivery (Hb<11), 20/48 had depleted Fe stores (SF<20 ug/L), and 6/43 had tissue Fe deficiency (sTFR>8.5ug/L). Placental Fe content averaged 300.5 ± 105.8 ug Fe/g tissue and neonatal SF averaged 124.5 ± 57.9 ug/L.

Placental Fe content was not correlated to maternal or neonatal iron status indicators. HO-2 expression was positively correlated with placental Fe content ($p<0.003$, $n=40$) but was not significantly associated with other maternal or neonatal Fe status indicators. Placental HO-2 expression was significantly associated with placental FLVCR expression ($p<0.002$, $n=38$) which may suggest that HO-2 plays a role in placental Fe utilization.

Effects of Vitamin E and/or Selenium Supplementation on Oxidative Stress: Evidence from a Randomized Study

RACHAEL GRANT

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Inflammation and tissue damage from oxidant stress are documented to be key mechanisms in the pathophysiology of chronic obstructive pulmonary disease (COPD). Thus, evaluating whether oxidant stress, as indicated by a biomarker in urine, namely 8-iso-prostaglandin F2-alpha (8-iso-PGF2α), responds to treatment with vitamin E, selenium, or both will clarify a possible pathway by which pulmonary risk can be improved. In a 4-arm randomized controlled trial, 8-iso-PGF2α was measured in 517 male participants (mean age 64) in the Respiratory Ancillary Study (RAS) to the Selenium and Vitamin E Cancer Prevention Trial (SELECT) to test the effects of vitamin E (400 IU/day rac-a-tocopherol acetate) and/or selenium (200 µg/d selenomethionine) on oxidant levels. Among study participants, the mean 8-iso-PGF2α was 477 ng/pg creatinine (SD 548), and the median was 308 ng/pg creatinine with a range of 19 to 4465. In the double placebo arm, both current smokers and men with COPD had higher levels of 8-iso-PGF2α in comparison to their healthy

counterparts and smokers with COPD had the highest mean levels. In all men, treatment lowered urine 8-iso-PGF2α by 129 ng/pg creatinine (p=0.05), 153 (p=0.02), and 122 (p=0.06) in the selenium, vitamin E, and combination arms, respectively. Investigation of the hypotheses that antioxidant supplements lower oxidative stress more in men with COPD and/or smokers found the effect of supplementation to lower oxidative stress was always stronger in men with disease and in men who were smokers. The study findings support the hypothesis that supplementation is more beneficial when oxidant stress levels are higher, providing evidence that may be useful for targeting interventions and personalizing nutrition advice.

Morphology and Pathology of the Cysteine Dioxygenase Knockout Mouse: *Evaluating Skeletal and Connective Tissue Abnormalities*

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Cysteine catabolism is dependent upon cysteine dioxygenase (CDO), a thiol dioxygenase encoded by the gene *CDO1.* The clinical literature and, more recently, the study of CDO polymorphisms in disease and control populations have illustrated a strong association of impaired metabolism of cysteine to sulfate and taurine and/or CDO loss-of-function mutations with a variety of autoimmune and neurodegenerative diseases. The Stipanuk research group has recently generated a germ-line CDO knockout ($CDO^{-/-}$) mouse that clearly has metabolic and phenotypic abnormalities. Phenotypically, CDO knockout (null) mice exhibit signs of connective tissue and skeletal abnormalities, especially joint hyperlaxity (hypermobility) and wry nose (contortions in the nasal bone). Our studies indicate that CDO null mice have clear connective tissue abnormalities. Key abnormal features include significant increases in lung air space, measured by mean linear intercept; lung elastic fiber disarray and entanglement; significant increase in matrix metalloproteinase-12 (MMP-12), an enzyme involved in degrading elastin, in the lung; and skeletal development retardation.

Predicting Energy Expenditure from Physical Activity, Heart Rate and Anthropometry in Female Indian Tea Pluckers

ERIC PRZYBYSZEWSKI

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The objective of this study was to test a methodological procedure for estimating energy expenditure for a population of Indian female tea pluckers. Subjects (N=40; age20-50y) working on a tea estate in West Bengal, India participated in the study. Each subject wore an Actigraph accelerometer, Polar heart rate monitor and Cosmed $K4b^2$ indirect calorimeter during a 90-minute period to assess minute-by-minute physical activity (PA), heart rate (HR) and energy expenditure (EE), respectively.

The testing period was meant to replicate a normal tea plucker's work day which included 2 periods of rest, 3 periods of picking while carrying weight (0, 5, and 10kg) and 3 periods of walking while carrying weight (15,20, 25kg). An EE prediction equation was generated using a branched method that first distinguishes time during normal workday activities (picking, walking, resting) using accelerometer counts. Resting EE was estimated from age and weight, while minute-by-minute non-resting EE was estimated from HR and BMI. Rather than creating individually calibrated curves for each subject, individuals can be grouped based on BMI categories (<18.5, $18.5 \geq BMI \leq 24.5$, >24.5) to predict EE during the work day. Predicted EE will be used to evaluate the efficiency of performing work (weight of tea plucked/kcal EE) relative to iron status in an independent sample of 248 tea pluckers. We conclude that energy expenditure can be accurately predicted with a branched equation based on PA, HR, age and BMI for a specific population participating in a known set of activities.

Phytochemicals and Antioxidant Activity of Blueberry-added Yogurt

GUANG HAN

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Yogurt is generally considered as a type of healthy food. It is rich in proteins and various vitamins. But more importantly, the unique probiotics it contains can potentially help the immune system fighting many diseases, including certain types of cancers. Studies on yogurt have been focusing so much on the quoted subjects that the importance of phenolics present in yogurt is neglected. Phenolic compounds, a group of phytochemicals, are considered to be the major bioactive compounds that can contribute to human health because of its antioxidant capacity. Previous studies implied that phenolic compounds could be increased by deliberate addition of specific flavoring ingredients. In this study, blueberry was chosen as the addition for its extraordinary content of phenolics and flavonoids, the major phenolic compounds. In the experiment, the total phenolic and flavonoid contents were measured, and the antioxidant capacity profiles of plain yogurt and blueberry-added yogurt were compared with respect to shelf-life (0, 2, and 4 weeks after fermentation). Analyses were performed for total phenolics and flavonoids, and the results were compared to the antioxidant capacity measured by a rapid Peroxyl Radical Scavenging Capacity (PSC) Assay. A six-fold increase in phenolics ($p<0.05$) caused by the addition of blueberry when compared to the control was observed. Significant declines of total phenolics and antioxidant activity ($p<0.05$) of blueberry-added yogurt during each period of storage time were observed. There was a strong correlation between total phenolic content and antioxidant activity ($R2=0.941$, $p<0.05$). The flavonoids are weakly correlated to the antioxidant activity ($R2=0.623$, $p<0.05$).

Pore Structure and Gas Storage Mechanisms in the Marcellus Shale

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This research is focused on determining the pore structure and gas solid interactions in organic rich shales. Samples from the northern extent of the Marcellus Formation were collected and analyzed for the purpose of elucidating the nature of gas storage in shales. Low pressure N_2 adsorption experiments were performed; it was discovered that an extensive network of nanoscale pores exist within the shale. Average pore diameters range between 3 and 7 nm. This result was confirmed with scanning electron microscopy (SEM) imaging of the samples. Energy dispersive X-ray (EDX) spectroscopy was utilized to identify that this nanoscale pore network is primarily contained within organic material. Total organic carbon (TOC) measurements were made for each of the samples. A positive relationship was observed between surface area and TOC, for TOC values between 0 and approximately 13 weight percent (wt%). There appears to be diminishing marginal surface area returns with increasing TOC. The measured surface areas decline beyond 13 wt% TOC. This

behavior is believed to be the result of sediment compaction due to overburden pressure. Samples with relatively low TOC are less vulnerable to surface area reduction because the relatively soft organic matter is shielded from compaction by the surrounding matrix of load bearing minerals. On the other hand, samples with high TOC values lack the necessary mineral matrix to be shielded from compaction and are subject to greater surface area reduction upon burial. The study confirms that there is tremendous compositional heterogeneity within a relatively small vertical column of the formation; this heterogeneity profoundly influences gas storage processes.

Differential Extinction of Large, Fast Growing Clades of Turritelline Gastropods during the Plio-Pleistocene Regional Mass Extinction

ELIZABETH PETSIOS

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The Plio-Pleistocene multi-phased regional extinction saw the disappearance of nearly all Western Atlantic Turritelline gastropod species from Florida to Virginia. The survivors of this extinction are noticeably smaller than species that became extinct, pointing to selective pressures against large body size, and possibly growth rate. Isotopic analysis was conducted to test the hypothesis that a fast growth rate was linked to extinction susceptibility. In addition, it was hypothesized that the phylogenetic distribution of extinction susceptible characteristics (large body size and possibly growth rate) would reveal whether or not differential extinction was occurring at the clade level in this group. The phylogeny that results from this method allows for the study of distribution of body size, growth rate, and longevity in different clades. A phylogenetic analysis of the 17 most abundant species suggests that extinction survivorship, body size, and growth rate is, for the most part, conserved within clades, and that differential extinction of the clade containing the large and fast growing species has occurred.

The Effect of Phenolic Compounds on the Growth of Spoilage Yeasts in a Synthetic Wine Model System

DIANE SCHMITT

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Department of Food Science

The spoilage of wine from the growth of non-*Saccharomyces* yeasts is a major concern in the wine industry. This study investigated the effect of phenolic acids on the growth of spoilage yeasts in a synthetic wine model system. Yeasts studied included *Dekkera bruxellensis, Pichia anomala*, and *Saccharomycodes ludwigii.* Phenolic acids used included the hydroxycinnamic acid, caffeic, and the hydroxybenzoic acids, gallic, and syringic acids. This study showed that the phenolic acids, caffeic and syringic acid, significantly increased the growth of *D. bruxellensis* and *P. anomala*, and that gallic acid significantly increased the growth of *P. anomala*, but significantly decreased the growth

of *D. bruxellensis*. Caffeic, gallic, and syringic acids did not significantly affect the growth of *S. ludwigii* compared to the control. More research should be done with other spoilage microbes, different wine phenolic acids and with increased concentrations of the phenolic acids to determine if phenolic acids can be used as antimicrobials in wine processing and storage.

The Taste Properties of Potassium Chloride Alone and in Mixtures with Sodium Chloride Using a Check-All-That-Apply Method

DOMINIQUE SINOPOLI

Under the supervision of Dr. Harry Lawless
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As consumers try to reduce their sodium consumption for health purposes, the food industry seeks ways to reduce its level in products while maintaining palatability. One potential solution for lowering sodium chloride (NaCl) content is using potassium chloride (KCl) as a substitute. However, many people find KCl to have unpleasant offtastes, which limits its effectiveness to replace NaCl. This study examined the taste properties of KCl using a check-all-that-apply (CATA) ballot. The objectives were to see which terms people use to describe KCl and in what ways this changes in various combinations with NaCl. One-hundred panelists were served 9 mixtures of varying NaCl and KCl concentrations, plus salt and water controls, and evaluated them using a set of 26 predetermined terms. Frequency counts were taken, and binomial and McNemar tests were performed to see which stimuli changed the most between samples. Results showed that adding KCl increased salt perception slightly, and increased significantly when in combination with NaCl. Adding NaCl in a mixture with KCl decreases unpleasant side tastes associated with KCl, such as bitter, chemical and metallic.

Late Cenozoic Volcanism in the Hövsgöl Rift Basin: Source, Genesis, and Evolution of Intraplate Volcanism in Mongolia

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Diffuse, intraplate volcanic deposits are prevalent throughout Mongolia. This study sought to examine Late Cenozoic lavas (9.5-17.1 Ma) from the Hövsgöl rift basin in order to better understand their source, genesis, and evolution. The relationship of these volcanic rocks to the Baikal Rift Zone (BRZ) and the extent to which these lavas are involved in, or derived from, rifting has important implications for lithospheric development of Mongolia and Central Asia. The alkaline basalts have similar light rare earth element enrichments (La/Yb = 9.1-31.9) and $^{87}Sr/^{86}Sr$ ratios in the range of .7039 to .7050. Major and trace element and isotopic data reveal that low degrees of partial melting of garnet lherzolite occurred at depths greater than 65 km. Enrichment in fluid-mobile elements (e.g. Sr and Ba), lower La/Nb ratios, and a calc-alkaline trend suggest that hydrous minerals may have

contributed to the melt. Nb enrichment (>35 ppm), along with the melting of hydrous minerals, may be attributed to the melting of a metasomatically enriched lithospheric mantle source. The mixing of minor asthenospheric upwelling with a volatile-rich, metasomatized lithospheric mantle may have produced melts without requiring extremely elevated temperatures, consistent with other published studies that show a small, shallow thermal anomaly under Mongolia.

Effect of Cell Density and Growth Phase on Malolactic Fermentation by *Oenococcus oeni*

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Department of Food Science

Oenococcus oeni is a species of lactic acid bacteria that is used in winemaking to perform malolactic fermentation, a conversion of malic acid to lactic acid. Not much is known about the impact of cell concentration and stage of growth on the ability of *O. oeni* to metabolize malic acid, but this information would be useful to winemakers who experience stuck malolactic fermentation. Corresponding optical absorbance at 650 nm and concentration data, based on viable cell plating, were collected for Alpha and MCW strains of *O. oeni* over time. This data was used to estimate viable cell concentrations and timing of growth phases for each strain using optical density measurements. Each stain was grown up to late stationary phase, washed and resuspended in buffer. Cells were then diluted to concentrations of 10^7 cells/mL, 10^6 cells/mL, 10^5 cells/mL, 10^4 cells/mL, 10^3 cells/mL, and 10^2 cells/mL and placed in a buffer that did not support growth. Malic acid was added, and samples were taken every half hour for four hours and analyzed for malic acid concentration by enzyme assay. This was repeated with cells that were harvested at the early exponential, mid exponential, late exponential/early stationary, and late stationary phases of growth adjusted to cell concentrations of 10^7 and 10^6 cells/mL. Results indicated that both strains performed malolactic fermentation from mid exponential to late stationary phase and that there was malolactic fermentation activity at both low and high concentrations (10^2 and 10^7 cells/mL). No conversion of malic acid occurred in cells harvested at the early stationary phase of growth.

Mapping the Genes Controlling Inulin Content in Wheat

CELESTE FALCON

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As a widely consumed staple food, wheat (*Triticum aestivum*) is a good vehicle for inulin, a complex carbohydrate which improves gastrointestinal microfauna populations thereby increasing the body's ability to take up micronutrients and improving the immune system. This set of studies was conducted to determine the amount of variation for inulin content in wheat, the trait's heritability and the level of environmental effects on this trait, and to find quantitative trait loci for inulin content. Amongst 87 varieties, inulin content ranged from 0.04% to 1.46% of dry weight with a median value of 0.70%, demonstrating that there is significant genetic variation for inulin content. When 20 varieties were grown in 6 different locations, inulin content was found to have a low heritability (H^2=0.198999), and GxE effects were a significant factor in predicting inulin content. From a population consisting of 101 doubled-haploid lines created from a cross between AC Reed and Grandin, composite interval mapping detected major QTLs on chromosomes 2BL-2 and 5BS which explained 20.15% and 15.28% of the

variation for inulin content, respectively. The results of these studies indicate that, although the heritability is relatively low, there is sufficient genetic variation for improving inulin content in a wheat breeding program and that marker-assisted selection would be useful.

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Public Opinion of the Use of Eminent Domain for Phase Two of the Cayuga Waterfront Trail

STEPHEN ALBONESI

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Eminent domain, the right of a government to take private property for public uses, was originally intended for projects with clear public purposes, such as the construction of utility lines. However, the use of eminent domain has become increasingly controversial because it has also been used for more discretionary projects, such as recreational trails.

The purpose of this study was to gain insight on public opinion of the use of eminent domain for Phase Two of the Cayuga Waterfront Trail in Ithaca, NY. A secondary purpose was to observe how opinions of eminent domain differ across demographic groups. A telephone survey of a listed sample of 250 Ithaca residents was administered through the Cornell Survey Research Institute.

Results indicate that Ithaca residents support the use of eminent domain both in theory and in accomplishing Phase Two. Residents favored eminent domain in general and for Phase Two by a ratio of about 5 (in favor): 3 (opposed): 2 (undecided). Younger to middle-aged people who hold at least a bachelor's degree were most apt to favor the use of eminent domain. In general, those who favored eminent domain in theory also approved of eminent domain for Phase Two, and vice versa.

The study demonstrates strong community support for the use of eminent domain for Phase Two. For the City of Ithaca, the survey data can be a useful application in addressing counter positions to Phase Two. Public surveys of eminent domain are therefore important tools in the public decision making process.

An Evaluation of the Salience of Risk on Facebook

ALLISON FISCHLER

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Facebook has been at the center of most recent online privacy debates not only because of its changing privacy policies, but also because of new innovations, like Places, that incentivize the sharing of personal information. But with looming financial, safety, and social risks, why do so many college students create profiles and voluntarily disclose personal information online? Many of the studies that discuss the risks associated with online information disclosure focus on financial and safety risks, specifically identity theft and cyberstalking. Although important, these threats may not seem immediately relevant to a college-aged Facebook user. Wildavsky (1990) proposed that "people worry most about the risks that seem most directly to threaten their well being at the

moment." Thus, it is possible that the social threats of embarrassment in front of peers and superiors will be more salient to college-aged Facebook users than financial and safety risks, and will be more likely to cause them to change their behavior.

This study seeks to determine the relationship between salience of different kinds of risk and willingness to expose personal information on Facebook. Participants in the study were primed with either an article about identity theft, cyberstalking, embarrassment in front of peers, or in front of superiors. (Participants in the control group were not exposed to a prime.) The data suggests that the participants found the two risks of embarrassment to be more relevant, and participants in the employer embarrassment condition were most likely to intend to make changes to their privacy settings. Actual behavior change for all conditions was low, but this could be explained by the fact that the majority of participants already had secure settings. Implications for how risk communication about online behavior is targeted at college-aged students will be discussed.

An Analysis and Recommendations of the Use of Social Media within the Cooperative Extension System: Opportunities, Risks, and Barriers

LUCAS FUESS

Under the supervision of Dr. Lee Humphreys
Department of Communication

In recent years, social media has become a huge and integral component of how people spend their time online; from wikis to blogs and from Facebook to Twitter, people are spending enormous amounts of time on websites used to share information and connect with people. New forms of relationship building and social capital occur through social networking sites. Within Cooperative Extension, it is imperative to keep up with evolving forms of communication to connect with an ever changing audience. Interviews were conducted throughout New York and Wisconsin with educators in both rural and urban counties, with varying amounts of social media experience, and varying ages and backgrounds. A cross state study was conducted to determine if results were consistent in unique areas. Questions asked determined how Cooperative Extension is utilizing social media to connect with people in different ways, if social media was an effective communication platform, and if it is worth it for Cooperative Extension to utilize this resource. Data was collected about the uses of social media and its perceived opportunities, risks, and barriers for use. Conclusions drawn indicate people are excited about a new, free, and easy opportunity to connect with others. Concerns include time spent using social media, a perceived lack of privacy and control of the websites, and a lack of training opportunities for extension educators. As technology continues to evolve, Cooperative Extension needs to evolve as well in order to most effectively communicate with constituents.

Grading "GRADE": Assessing the Strategies and Impact of an "Elite-Driven" Participatory Program in Ebebda, Cameroon

SARAH KOZYN

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With the increasing suspicion of the benefits of the development work that international non-governmental organizations task themselves with, in recent years, more emphasis has been placed on the positive work that grassroots- and community-based development associations are capable of. What changes, then, if these associations come from the upper echelons of a poor community? Is this still grassroots development, or simply the same imposed type of initiative, but with a more familiar face? GRADE, a community development association in Ebebda, Central Region, Cameroon is a case study of this complicated and previously deemphasized scenario. With a final objective of examining the role that GRADE plays in its community and understanding development as community members see it, this paper seeks not to offer suggestions for how GRADE should set forth, but to comprehensively observe and comment on the role that the association has played so far. Hopefully, this commentary will prove useful to association members in the realization of GRADE's ambitious goals of improving the wellbeing of community members in Ebebda.

Understanding Humor Persuasion in Health Messages

REGINE MECHULAN

Under the supervision of Dr. Michael Shapiro
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Although a popular form of entertainment media, humor has yielded inconsistent results when used as a persuasive appeal. Specifically, little research has been done on the effectiveness of humor in promoting health messages. This study explores how gender and empathy relate to humor liking and message enjoyment of two different humor paradigms (superiority and incongruity) found in humorous health PSAs. Results show the more feminine the participants, the more they liked the humor and enjoyed the messages in the incongruity videos. More masculine individuals had greater humor liking and message enjoyment of superiority videos. Lastly, empathy was the strongest predictor for humor liking and message enjoyment of both humor styles. Exploring individual differences in humor persuasion can help campaign creators more effectively target their PSAs using humor appeals.

Distorted Markets and Deadweight Loss Under the American Clean Energy and Security Act of 2009: Allocations to Local Distribution Companies

CLAYTON MUNNINGS

Under the supervision of Dr. Antonio Bento
The Charles H. Dyson School of Applied Economics and Management

In an attempt to reduce the costs of climate legislation, recent bills have allocated emissions allowances to local distribution companies (LDCS) for consumer protection. LDCs would use these allowances to subsidize residential electricity. From an economic point of view, the efficacy of these allocations depends on whether or not the subsidy provides welfare gains. I consider three effects in my determination of welfare: the Pigouvian, revenue and interdependency effect. If a tax is set, and each of these effects are not considered, a sub-optimal tax will likely result. I find that an electricity subsidy may actually increase welfare, compared to a simple carbon tax, because revenues would likely increase–allowing policy-makers to offset distortionary taxes to a larger degree.

Relocalizing a Global Food System in Crisis: A Comparative Analysis

MEREDITH PALMER

Under the supervision of Dr. Philip McMichael
Department of Development Sociology

The current global agri-food system is dominating and influencing nation-states and peoples around the world, and has specific socio-historical roots and is deeply political in nature. This system is failing consumers and producers, and damaging the environment. These crises are being made visible by food rioters, international institutions, academics, and localized food justice groups. The response of 'relocalization' of food systems is emerging in towns, cities, and neighborhoods across the globe, and is aimed at resituating food and agriculture into interconnected systems that support ecosystems, economies, democracy, sovereignty, and rights. I examine the proposition that movements that aim to relocalize food systems can in fact identify and redress social and environmental injustice in the global agri-food system through institutionalization. Via incorporated comparison, I will evaluate and relate the geneses, claims, accomplishments, and shortcomings of the Secretariat for Food Policy and Supply (SMAAB) in Belo Horizonte, Brazil, and the Toronto Food Policy Council in Canada, to a largely market-based yet evolving approach in Tompkins County, New York. Food was first declared a human right in 1976 by the United Nations, yet now it is clear that neither the global market nor federal governments are the proper guarantor of that right. Therefore, what is at stake at this historical conjuncture marked by crises is, who will guarantee the peoples' right to food and viable ecosystems, and how. I find that market-based and globally-scaled approaches alone are highly insufficient, and possibly deleterious, and that the 'local' is not necessarily more just. Nonetheless, networks of locally bound and globally connected actors do have the ability to overcome injustices in the food system through reflexive action politicizing food and agriculture, on a path to food sovereignty.

The Socio-environmental Implications and Effects of the Gulf Oil Spill: Impact on Citizens, Rights, and Recovery in the Debate Over Accountability

ALEXANDRA POPOVICI

Under the supervision of Dr. Philip McMichael
Department of Development Sociology

The Deepwater Horizon oil spill was an environmental catastrophe that wreaked havoc on populations, habitats and livelihoods within the gulf region. As most studies inspect the environmental impacts resulting from this type of event, I have chosen to examine the implications of the conflicts that arise over the management of the spill within the state of Louisiana (the clean-up and response to victims). This study provides a lens into understanding how the claiming of rights and the abdication of responsibility gets played out through these debates. Investigating these disputes between British Petroleum (BP), the Louisiana State Government, the national government and the Louisiana victims allows for a more in-depth look into how the handling of disasters can further exacerbate the problems these regions face. In this study a variation of national and local newspapers were used to gather information over the discourses of the debate. These two perspectives provided a spectrum of political viewpoints, public opinions and experiences that were useful in the analysis. These include the various ways that the debate was framed by key parties involved, how the displacement of blame developed and how the eligibility requirements and process of the BP compensation fund had severe implications for the victims. These investigations add to our understanding of how the shifting of responsibility, the accessibility of rights, the acts of blaming and acceptance of accountability develop and persist in the wake of this detrimental calamity. This study is part of a growing body of research on environmental citizenship within the field of political ecology. In uncapping information on the interpretations and progression of disputes over managing the spill, this project will be able to contribute to future research on similar topics.

"I Ate Breakfast for My Pet": Using Virtual Pets and Mobile Phones to Motivate Adolescents to Eat a Healthy Breakfast

DANIELA RETELNY

Under the supervision of Dr. Geri Gay
Department of Communication

Virtual pets, such as the Tamagotchi, have been popular since the 1990s and research has shown that users become attached to these virtual pets and that they can be used to increase motivation and influence behavior. This research utilizes a virtual pet game on mobile phones, the ultimate medium for the delivery of persuasive messages, in the hopes of delivering timely messages and feedback to adolescents to encourage healthy eating habits at the point of decision. *Time to Eat* is a mobile phone-based game geared towards motivating adolescents to change their eating behaviors by caring

for a virtual pet. Participants in the game receive an eating tip, such as "eat a hot breakfast," take pictures of what they are eating, and receive feedback via the state of a virtual pet. Players' scores are calculated based on the healthfulness of the food consumed and range from -2 (no photo submitted) to a +2 (a healthy meal). This paper synthesizes the results of two separate studies conducted using the Time to Eat application in two different demographics.

Adolescents in both studies scored higher (i.e., ate healthier) in the game if they formed an emotional attachment to the pet. Further, the choice of pet also influenced their performance in the game. Mobile technologies can combine with gaming to provide new means to increase motivation and ultimately encourage individuals to change their attitudes and behaviors. However, as the results of these studies show, good, audience-specific design is crucial to engaging and persuading users.

Corporate Strategy: Managerial Decisions and Firm Profitability

JORDAN SMITH

Under the supervision of Dr. Garrick Blalock
The Charles H. Dyson School of Applied Economics and Management

The primary objective of this study is (i.) to analyze the relationship between managerial decisions and impact on firm performance, (ii.) to assess whether management made an appropriate decision with the information available, and (iii.) to provide a methodology for examining the profitability of single management decisions. Three large strategic decisions are examined to determine impact on revenue growth, firm profitability, market share, and common equity. Each case involves a different industry and scenario, outlining market conditions and future outlook at the time of the decision.

Research uses these three cases to analyze the decision making framework for management strategy in high stakes scenarios. The analysis proposes that managers across industries can make more tactical decisions by assessing key aspects of product lines, competitors, and market characteristics.

A chronological case study approach is used to illustrate the challenges facing management and the subsequent initiatives implemented. In order to examine product expansion and themes in competitive strategy, Kimberly Clark is used as a case study. Pfizer's 2009 purchase of Wyeth serves as a case study in mergers and acquisitions, intellectual property rights, and addressing the threat of new market entrants. The development of the first personal computer by Xerox relates to licensing decisions, marketing new technology, and trade secrets.

Research results indicate that disbanding core divisions in favor of pursuing brand recognition in markets with fewer competitors may be more beneficial to shareholders than remaining in a core market with high substitutes. Managers must evaluate whether product lines can remain profitable in the face of many market participants or substitute technologies.

Research confirms that acquisitions can offer avenues by which to diversify product lines, and declines in equity markets can result in attractive acquisition opportunities that serve the long-term interests of the firm. The results of the analysis indicate that although financially beneficial, the

Wyeth merger only partially mitigated obstacles facing the acquirer, and did not solve any of the continuing challenges confronting most large firms in the pharmaceutical industry.

Failure to license or allocate adequate resources to marketing disruptive new technologies can result in new entrants developing the industry, as illustrated by Xerox. Development of the personal computer and Ethernet systems were advanced, yet the inability to realize and cultivate the potential for consumer and business markets resulted in billions of lost profits.

Quantitative and qualitative models are used to assess whether the decisions of management were conducive to designing profitable strategies. This analysis has applications in evaluating decision processes for mergers and acquisitions, competitive strategy, licensing and product portfolio management.

Potential Land Sources for Switchgrass Production in Nebraska: A Partial Equilibrium Analysis

ELIZABETH SPINK

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The United States Energy Independence and Security Act of 2007 mandates an increase in the production of biofuels from cellulosic biomass to 16 billion gallons by the year 2022. Potential feedstocks for cellulosic biofuels include perennial grasses such as switchgrass (*Panicum virgatum*). In order for switchgrass to have minimal environmental and food system effects, the production of the feedstock must not interfere with crop production. If cropland is converted to switchgrass production, then direct and indirect land use change will likely occur as a result. One possible location for the production of switchgrass is Conservation Reserve Program (CRP) land. The CRP program gives annual payments to landowners to take highly erodible and degraded land out of production to be replaced with vegetation cover for environmental benefits. Producing switchgrass on CRP land may adhere to the aims of the CRP program in addition to providing a source of idle land for cellulosic biomass production. This study attempts to model the potential land sources for switchgrass production in Nebraska given the presence of a market for cellulosic biomass. The profitability of three major crops in Nebraska was estimated in order to determine the amount of cropland expected to be converted to switchgrass production and the expected amount of CRP land estimated to be used for growing switchgrass at various market prices of switchgrass. This study finds evidence for potential conversion of cropland to switchgrass production resulting in likely direct and indirect land use change given the presence of a market for switchgrass.

How Attractive Are You Really?: The Role of Time and Anticipated Future Interaction in Constructing Online Profiles

THAISA TIRADO

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This study investigates the role of technological affordance and social factors in the perception of selective self-presentation strategies among online daters. One hundred and forty-nine undergraduates constructed online dating profiles of themselves under two sets of conditions: limited vs. unlimited time to create the profile, and anticipation of meeting other daters face-to-face, via email, or not at all. Four hundred and thirteen judges viewed these profiles and rated them on a variety of dimensions, such as attractiveness and trustworthiness. Results suggest that daters who constructed their profiles with unlimited time were perceived as more attractive, more dateable, and more trustworthy than daters with limited time. Furthermore, judges recognized these daters as putting more effort into their profiles and more motivated to meet someone through the profile. However, anticipated future interaction (AFI) moderated this effect, suggesting that when daters had unlimited time and no AFI, they constructed the most attractive and trustworthy profiles relative to any other condition. These findings give empirical support to the hyperpersonal model of impression formation, as well as extending the understanding of the role of AFI in online dating.

Coping and Self-Compassion as Mediators of Adolescent and College-Aged Girls' Relational Aggression

EMILY WEINSTEIN

Under the supervision of Dr. Dawn Schrader
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How can we teach adolescent girls to manage stressful social situations and, in particular, relational aggression? The literature focuses on the negative outcomes of relational aggression, specifically negative effects to self-esteem and harmful behavioral outcomes. However, as research has pointed to undesirable effects of increasing global self-esteem, the potential benefits of mitigating relational aggression effects through enhancing self-esteem are called into question. A new way of developing a positive emotional stance toward the self, self-compassion, provides an opportunity for positive processing and management. We conducted a study using 16 college women to investigate their phenomenological relational aggression experiences, as well as the ways in which they thought about and responded to experiences, with a specific emphasis on coping skills and self-compassion. All subjects were given the Brief COPE (Carver, 1997), the Self-Compassion Scale (Neff, 2003), and a relational aggression interview developed for this study. Interviews were coded using a coding manual, which included definitions of the nine strategies from the Brief COPE and definitions of the six subscales from the Self-Compassion Scale, all adapted to fit relational aggression. Additionally, the manual included patterns that emerged from the data, which were not included in either measure.

This study explores the question of how college-aged girls experience and manage relational aggression, and seeks to identify specific skills and elements of self-compassion used by college women that can be taught to adolescents struggling with relational aggression. Results indicate that girls do utilize a variety of coping skills in their relational aggression experiences, including active coping, emotional support, planning, self-distraction, acceptance, venting, and behavioral disengagement. We also suggest that coping must be looked at holistically, rather than as a process of identifying one particular skill. Additionally, self-compassion appears to be a relevant construct, with specific dimensions appearing in girls' own reflections on their relational aggression experiences. Phenomenologically, the girls' stories indicate that there may be a shift in the nature of relational aggression experiences from more "typical" behaviors, to issues stemming from increasingly complex social situations.

Online Predation: A Linguistic Analysis of Online Predator Grooming

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Under the supervision of Dr. Jeffrey Hancock
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Current theory about online sexual predation suggests that predators engage in a grooming process with their victims. Grooming consists of three main stages: friendship and relationship forming, risk assessment and exclusivity, and sexual. This thesis examines whether predators utilized different patterns of language use across each of the stages that can be identified through computerized text analysis. The transcripts of 43 convicted predators were spliced into three equal sections according to word count and a computerized text analysis was performed to look at the different types of language that are expected in each stage based on grooming. The results reveal that predator language differs significantly throughout the three stages of grooming, and that the grooming stages can predict language patterns that are used most frequently in each stage. The theoretical and practical implications of these findings are discussed in terms of grooming theory and the use of computerized text analysis to identify predators and educate youth.

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