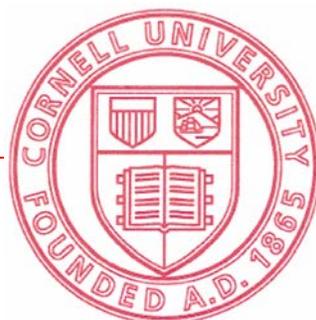


College of Agriculture and Life Sciences

2015–2016

Research Honors Program Abstracts



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

An engaged and inspired student body is critical to the CAL S' success. The 2015-2016 honors thesis projects described in this booklet demonstrate an impressive capacity for personal dedication, mature scholarship and intellectual growth. The original research contained herein examines some of the most pressing and relevant questions of our time.

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

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

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

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Variability of the Corn Stalk Nitrate Test and Opportunities for Improved Sampling Strategies

RACHEL S. BRESLAUER

Under the supervision of Dr. Quirine Ketterings
Department of Animal Science

Corn production in New York is nitrogen (N) limited. The corn stalk nitrate test (CSNT) is a post-harvest plant test that provides feedback on N supplied to the crop for that season and can be used to adjust N management over time. Currently it is recommended that farmers sample at a density of 1 stalk/acre and send in a composite sample per field for analysis. However, it is well established that soil properties are highly variable in New York. Consequently CSNT results are expected to be highly variable. This thesis aimed to characterize CSNT variability (i) among farms and fields within farms, (ii) over multiple years for the same fields, and (iii) spatially within a field. Chapter 1 examined whole farm CSNT distributions for eight farms and presents the results of a survey of two farm managers. We found that CSNT distribution varied greatly and that knowing a weighted average will help identify management options. Manager experience with the fields helps inform grouping of similar fields for reduced sampling cost. In Chapter 2, changes in CSNT over 3 years in 51 fields were modeled. Analysis showed that initially excess fields had decreasing CSNT over time and initially low fields had an increase in CSNT over time. Chapter 3 evaluated a yield targeted sampling approach and the yield to CSNT ratio as potential tools to improve CSNT utility on farm. Both tools are promising but these approaches need to be evaluated on more farms before general recommendations can be made.

Reducing aggression and injury in *Sus scrofa domesticus* through the use of enrichment

EMMA C. HALLOWELL

Under the supervision of Dr. Eva Conant and Dr. Patricia Johnson
Department of Animal Science

Enrichment, a practice that increases an animal's lifespan, reproductive fitness, and cognitive function, varies per species. This study tested the effects of enrichment, commercially provided toys and food treats, on reducing negative behavior, reducing injury, and increasing weight gain in the domestic pig. One-month old piglets were separated into four treatment groups, while balancing for weight, gender, litter, and presence of injury. Toys (TOY treatment) included BiteRite sticks and two freely moving balls. Food treats (FOOD treatment) included grapes, watermelon, pears, apples, broccoli, etc. The TOY treatment, FOOD treatment, and a combination of toys and treats (BOTH treatment) significantly reduced time spent engaged in negative behavior in comparison to a barren environment (CONTROL treatment) ($p=0.0418$, 0.0274 , 0.0034 , respectively). The provision of toys increased the occurrence of injury, but the provision of both toys and food greatly reduced injury ($p=0.0263$). Treatment group had no effect on weight gain. Litter number, presumably due to genetics, had a significant effect on weight gain in Replication 2 ($p=0.0003$). Piglets in Replication 1

gained more weight, possibly due to decreased crowding ($p < 0.001$). Overall, the piglet group receiving both toys and food benefited most by reducing negative behaviors and decreasing injury. This treatment can greatly benefit pigs raised in commercial farms, where waste collection does not allow for substrate enrichment. Commercial farms are advised to provide both food and toys during a pig's early life in order to reduce possible injury and increase welfare.

The Effect of Storage Environment on the Stability of Somatic Cells in Cow Milk

DANIELLE R. HARRIS

Under the supervision of Dr. Jessica McArt
Department of Population Medicine & Diagnostic Sciences, College of Veterinary Medicine

The objective of this study was to determine the stability of white blood cells for evaluation of somatic cell count (SCC) in cow milk samples under different storage conditions over time. Somatic cell count was determined by a fluoro-opto-electronic cell counter. Samples were stored at room temperature, refrigerated at 4°C with or without bronopol preservative, or frozen at -20°C with or without bronopol preservative. SCC of room temperature samples was analyzed at 0, 2, 6, 12, 24, or 48 hours after collection, refrigerated samples were analyzed at 24 and 48 hours, and frozen samples were analyzed at 24 hours or at 14, 30, or 60 days, depending on treatment. Time 0 SCC analysis was used to determine baseline SCC and categorize samples into low, medium and high SCC groups. There were significant differences in SCC over time across all three SCC groups, especially for the high SCC group. Somatic cell count generally decreased over time. There were also significant differences between preservative and non-preservative samples, again especially for the high SCC group. Our results suggest that when milk samples are going to be stored for later analysis, they should be cooled to at least refrigerated temperature in less than 6 hours. Refrigerating samples for up to 48 hours had no impact on SCC evaluation. SCC analyzed from frozen samples is more accurate when preservative is used, and SCC in frozen samples with preservative is stable for up to 30 days.

The Development of LAMP for the Detection of Resistance in *Haemonchus contortus*

KIMBERLY R. LAYNE

Under the supervision of Dr. Dwight D. Bowman
Department of Microbiology and Immunology, Cornell University College of Veterinary Medicine

The pathogenic nematode *Haemonchus contortus* is of primary concern for small ruminant livestock owners. The strongyle is capable of consuming more than 0.05 mL of blood per day from the host and can lead to acute anemia and death. Timely treatments to eliminate *H. contortus* infections are crucial; however, many strongyle populations are becoming resistant to anthelmintic treatment with the benzimidazole (BZ) class of drugs. Therefore, our study aims to develop a set of specific loop-mediated isothermal amplification (LAMP) primers which may have the potential to identify

resistant populations of *H. contortus* in a cost and time effective manner. Using Primer Explorer software, two sets of LAMP primers consisting of a F3, B3, FIP, and BIP primer were designed to amplify the isotype 1 β -tubulin gene which contains codons necessary for resistance to BZs. One set of primers has been able to amplify DNA extracted from two female *H. contortus* worms, while the other set has yet been able to amplify the strongyle DNA. Upon sequencing the product with the F3, B3, FIP, and BIP primers, the results were inconclusive as to whether or not the product contained the isotype 1 β -tubulin gene or the resistant codons. Further work will go into sequencing the amplified product with an F2 primer and attempts to optimize the LAMP primer sets in order to detect and visualize BZ resistant codons is ongoing.

A Comparison of the Virulence of Four Viral Hemorrhagic Septicemia Virus Strains in Lake Chautauqua Muskellunge

CHAUNTE KEYARA LEWIS

Under the supervision of Dr. Rodman Getchell
Department of Microbiology and Immunology, Cornell University College of Veterinary Medicine

Viral hemorrhagic septicemia virus (VHSV) has been found in fish populations throughout the Great Lakes Basin since 2003. It is a single stranded RNA virus that affects a number of fish species, including muskellunge (*Esox masquinongy*), a major predator in these waters. The purpose of this experiment was to compare the virulence of 4 strains of VHSV IVb (MI03, vcG002, FPL2013-002, and FPL2014-001). Juvenile muskellunge were randomly assigned one of the strains, and exposed to either a high dose (5×10^5 PFU/ml) or low dose (5×10^4 PFU/ml) for 1 h by immersion. Fish were then monitored for clinical signs of infection such as petechial hemorrhages, lethargy, and death, where upon brain and pooled organ samples were harvested using aseptic technique. Quantitative reverse transcription polymerase chain reaction assays were performed along with viral isolation in order to confirm the presence of VHSV. The results of the cox hazard test showed that fish that were infected with FPL2013-002 died the earliest, followed by vcG002. When comparing viral load in muskellunge visceral tissues, it was found that MI03 had the highest viral load, followed by vcG002, FPL2013-002, then FPL2014-001. There was only a statistical difference in brain tissue viral loads between FPL2013-002 and FPL2014-001. This data suggests that the earlier isolates were more virulent than the later isolates. While this result did not support our hypothesis, the earlier time to death of FPL2013-002 did. A repeat of this study with lower doses closer to the LD50 may clarify these different interpretations of virulence properties of VHSV IVb.

Pregnancy Specific Protein-B Dynamics around Parturition in Lactating Dairy Cows with Uterine Diseases

MIRANDA MEDRANO

Under the supervision of Dr. Julio Giordano
Department of Animal Science

Our objective was to evaluate the circulating concentrations of Pregnancy Specific Protein-B (PSPB) from approximately three weeks pre-calving to two weeks post-calving in lactating dairy cows with or without uterine disease (UTD; metritis or retained placenta). We performed a case control study in a commercial dairy herd, we included 49 UTD (22 primiparous and 27 multiparous) and 50 healthy cows (22 primiparous and 28 multiparous). Blood samples were collected at 18 ± 3 d, 11 ± 3 d and 4 ± 3 d days pre-calving and 3 ± 1 d, 7 ± 1 d, and 14 ± 1 d post-calving. Circulating PSPB concentrations were measured using a commercially available ELISA (BioPRYN, BioTracking, LLC). Data was analyzed by ANOVA with repeated measures using the PROC MIXED of SAS. There was no effect ($P=0.49$) of UTD, UTD by day interaction ($P=0.35$), parity ($P=0.14$), number of calves ($P=0.64$) or gestation length ($P=0.39$). PSPB concentrations tended to be greater ($P=0.10$) for cows giving birth to a male (384.6 ± 17.1 ng/mL) than a female (324 ± 19.0 ng/mL) calf, and were affected ($P < 0.01$) by day. Greatest ($P < 0.05$) concentrations were observed on Day -4 (756.5 ± 36.3 ng/mL) followed by Day 3 (521.7 ± 22.9 ng/mL), Day 7 (283.7 ± 14.6 ng/mL), Day -11 (252.1 ± 21.2 ng/mL), Day 14 (132.5 ± 7.6 ng/mL) and Day -18 (87.4 ± 61.7 ng/mL). When considering the post-calving period only, PSPB concentrations were greater ($P < 0.01$) for multiparous (237.6 ± 21.9 ng/mL) than primiparous (266.3 ± 17.6 ng/mL) cows. In summary there was no observed relationship between UTD and PSPB concentrations between -18 and 14 days with respect to calving. Circulating PSPB concentrations remained higher during the post-calving period in multiparous cows.

Survey using Immunofluorescent Antibody Test of feline sera from rural New England for *Aelurostrongylus abstrusus* specific IgG

SOFANY MONTOYA

Under the supervision of Dr. Dwight Bowman
Department of Microbiology and Immunology, Cornell University College of Veterinary Medicine

Aelurostrongylus abstrusus is a nematode parasitizing the respiratory tract of felines. Most cats are asymptomatic or present with respiratory conditions, such as chronic cough and sneezing; however, infections can sometimes cause severe signs or be fatal. Diagnosis is typically by the demonstration of larvae in feces using the Baermann technique. Infected cats develop circulating antibodies to the infection that have been shown to be detectable using an immunofluorescent antibody assay (IFA). In this study, a previously developed and optimized IFA was used to determine the prevalence of *A. abstrusus*-specific IgG in cats from rural regions of New England. Sera collected from cats in New England, and from presumed non-endemic regions, were supplied by IDEXX laboratories and examined by IFA. First-stage larvae were used to test these samples for *A. abstrusus* antibody presence with epifluorescence microscopy using fluorescein-conjugated goat IgG fraction to cat IgG (Cappel, MP Biomedicals, LLC) and UV 450-490 nm excitation; the negative control sera was a commercial pooled serum from normal cats (Bethyl Laboratories). A fluorescent index of 0 (negative) to 3 (highly positive) was used to score the larvae. Under these conditions, comparing the mean fluorescent index score of individual test samples to those of the 99.9% CI of the negative control set of samples, 57.9% of the samples from New England were positive for *A. abstrusus* IgG.

Analysis comparing the positivity index of each sample to the maximum of 3 standard deviations above the mean of the negative control sera found 76.6% of the samples positive for *A. abstrusus* IgG.

Effect of Melatonin Receptor 1A Gene on Reproduction in Cornell Sheep

RACHEL J. MURPHY

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

Sheep are seasonally polyestrous breeders in that they breed in the fall in response to a shorter photoperiod and an increased production of melatonin, and lamb in the spring. The Melatonin Receptor 1A gene (*MTNR1A*) has been identified in previous studies as a potential candidate gene influencing aseasonal reproduction. The allele, G, has shown a dominant effect on the ability of ewes to breed out of season. In this study, 228 ewes from the Cornell sheep flock managed under the Cornell STAR Accelerated Lambing System were genotyped for *MTNR1A* as GG, GA, or AA. A one-way analysis of variance was completed to determine the effect of genotype on several reproductive factors, including number of lambs delivered, lambs born alive, and lambs weaned, along with other production measures. The results demonstrate that the G allele was not associated with an increased ability to breed aseasonally, but this may be due to the high level of selection for accelerated lambing in the flock. Contradictory results regarding the effect of *MTNR1A* on reproductive rate in different studies over the years illustrate the need to continue researching this gene and other candidates that potentially control aseasonality in sheep.

Population Study of *Dirofilaria repens* in the Czech Republic

MARCELA NOVOTNA

Under the supervision of Dr. Dwight Bowman
Department of Microbiology and Immunology Cornell University College of Veterinary Medicine

Dirofilaria repens is a filarial nematode causing dirofilariasis in dogs, cats and other carnivores as well as in humans. The parasite is transmitted to its vertebrate host by a mosquito vector. Infections by *Dirofilaria repens* are usually asymptomatic and for that reason not treated, and thus allow for the continued spread of this disease through the European continent.

The goal of this project was to determine the current prevalence of *Dirofilaria repens* in the Czech Republic. Privately owned dogs, as well as dogs from animal shelters were sampled. These samples were screened for microfilariae using Modified Knott's test technique, as well as IDEXX SNAP® 4Dx® test for presence of *Dirofilaria immitis* antigen. All samples were also screened by polymerase chain reaction.

Out of the 392 dogs sampled, 26 were positive for *Dirofilaria repens* giving overall prevalence of 6.6%. Out of the total, 175 dogs never traveled outside of the Czech Republic. Six of these non-traveling dogs were positive, giving prevalence of 3.4%.

This study included multiple areas of the Czech Republic, as opposed to previous studies, which focused only on South Moravian region. This resulted in lower prevalence of this parasite. However the area of infections seems to be increasing, with infected dogs having been found over 100km from the previously identified epicenter of the infection. This suggests the need for continuous testing and treatment of infected animals to mitigate the spread of this parasite as well as decrease the number of infections.

Evaluating the effect of a plant origin prebiotic (stachyose) on iron status, intestinal functionality, and intestinal bacterial populations *in vivo*

SARINA J. K. PACIFICI

Under the supervision of Dr. Elad Tako
Department of Food Science

Iron (Fe) deficiency is the most common nutritional deficiency worldwide. Certain prebiotics have been shown to improve Fe absorption. This study investigates the effectiveness of the prebiotic stachyose in improving Fe status, intestinal functionality, and the cecal microbiome in the chicken by using the intra-amniotic administration procedure (stachyose is present in staple food crops that are consumed in regions that suffer from dietary Fe deficiency). Eighty fertile eggs were divided into 4 groups (n=20) on day 17 of embryonic incubation, and the respective prebiotic treatment solutions were injected into the amniotic fluid of the eggs. Treatment groups were as follows: 1. 5% stachyose (in H₂O); 2. 10% stachyose (in H₂O); 3. H₂O; 4. non-injected. At hatch, the cecum, small intestine, liver, and blood were collected for assessment of the relative abundance of the gut microflora, relative expression of brush border membrane (BBM) and Fe-related genes, ferritin levels, and hemoglobin levels, respectively. Stachyose increased the relative expression in aminopeptidase, sucrase isomaltase, and sodium glucose co-transporter 1, which are proteins that reflect the functionality of the intestinal enterocyte BBM (p<0.05), and decreased the relative expression of Fe-related proteins including ferroportin and divalent metal transporter 1 (p<0.05). Stachyose increased the relative abundance of *Bifidobacterium* and *Lactobacillus* (p<0.05), but not *E. coli* or *Clostridium*. Stachyose also increased the villus surface area (p<0.05). Taken together, these results suggest that stachyose beneficially affected the gut microflora, Fe bioavailability, and BBM functionality. Our investigations have led to a greater understanding of this prebiotic's effects on intestinal health.

Determination of Optimum Nitrogen Rate for Winter Cereals Grown as Forage Double Crop Using Yield Response Curves and Economic and Environmental Indicators

ZHEHAN TANG

Under the supervision of Dr. Quirine Ketterings
Department of Animal Science

Growing winter cereals such as cereal rye (*Secale cereal L.*), winter wheat (*Triticum aestivum L.*) and triticale (*x Triticosecale Wittm.*) as forage double crops after corn silage has become increasingly popular in the northeastern US. For the greatest profits, N fertilizer needs to be applied at the most economic rate of nitrogen (MERN). To develop a MERN recommendation system, 62 trials were conducted in NY in 2013-2015, with five N rates (0, 30, 60, 90, 120 lbs/acre) and four replications per trial. Quadratic plateau, exponential, and square root plateau models were selected to fit the yield response data. Statistical criteria (AICc, R^2), economic criteria (stability of MERN under different fertilizer to forage price ratios), and environmental criteria (apparent N recovery) were used to compare models. The quadratic plateau model was the best option because of its goodness of fit and stable MERN recommendations under changing price ratio. We developed a systematic approach to determine the MERN of a site that includes these steps: (1) analysis of variance (ANOVA) and linear regression to determine if N addition increases yield; (2) fitting of a linear plateau model to determine the yield plateau for N-responsive sites; (3) selection of sites where the yield plateau is reached with less than 120 lbs/acre N (highest N rate); (4) fitting of a quadratic plateau model to calculate MERN for these N responsive sites with MERN < 120 lbs N/acre. A follow-up evaluation needs to be done to determine what field characteristics explain site-to-site MERN difference.

Runs of Homozygosity Highlight Candidate Genes and Biological Pathways Related to Athletic Performance in Alaskan Sled Dogs

ALEXANDER J. VALENTI

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

Racing sled-dogs are a good illustration of how working dogs are selected and breeds are created. In this study, signals of selection were analyzed within sled dogs, focusing on variation in performance between dogs classified as “sprinters” versus “distance” runners. Sprinters have been optimized for speed, traversing courses of up to 30 miles. Distance runners have undergone selection for extreme endurance, running races traversing over 1000 miles. Multiple breeds have been introduced into the sled-dog population in an attempt to enhance performance; using several genome analysis tests we were able to identify the impact of these introductions on breed development. A principle component analysis (PCA), marker based F_{st} , and identification of runs of homozygosity were used to provide insight regarding genetic differentiation of these two classifications of dogs and how they vary from pure-breeds. The outputs of the PCA verified that significant genetic differentiation existed between sprint and distance dogs. Following PCA, runs of homozygosity (ROH) were identified and grouped by size. When comparing the two classifications, distance dogs exhibited a higher number of average runs (168) than sprinters (130) and also had a larger percentage of longer runs suggesting increased inbreeding. A homozygosity association test identified ROH correlated to either performance classification within sled dog or as compared to ancestral breeds. Biological significance of genomic variants was investigated using PANTHER gene pathway analysis.

Change in Plasma Vitamin E in Response to Vitamin E and Selenium Supplementation is Associated with Rate of Change of FEV₁ for Participants in the Respiratory Ancillary Study to the Selenium and Vitamin E Cancer Prevention Trial

JARED M. FELDMAN

Under the supervision of Dr. Patricia A. Cassano
Division of Nutritional Sciences

This study investigated the role of vitamin E supplementation in lung function decline in effort to identify possible clinical nutritional interventions to mitigate decline in pulmonary function. In this project, patient data was analyzed from the Respiratory Ancillary Study (RAS) to the Selenium and Vitamin E Cancer Prevention Trial (SELECT). A previous intent-to-treat analysis of the RAS study found no statistically significant association between vitamin E supplementation, alone or in combination with selenium, on rate of decline in the Forced Expiratory Volume in One Second (FEV₁). Nevertheless, this intent-to-treat analysis did not account for adherence or differential biological response to supplementation. The present study uses a per protocol analysis, based on measured biological markers of treatment, in effort to account for differential responses to the intervention. Using this approach, a highly statistically significant ($P=0.0161$) association between change in plasma vitamin E and rate of decline in FEV₁ was observed for RAS patients treated with both vitamin E and selenium. However, there was no relationship between change in plasma vitamin E and rate of decline in FEV₁ for patients treated with vitamin E alone ($P=0.6514$). A synergistic relationship between vitamin E and selenium in the glutathione peroxidase system may be responsible for the observed protective effect for individuals in the combined treatment arm of RAS. The men in this treatment arm may benefit the most from supplementation due to a higher availability of alpha-tocopherol to quench oxygen radicals.

Morphological Differences in the Feeding Apparatus of Three Species of Pacific Salmon, *Oncorhynchus tshawytscha*, *O. keta*, and *O. gorbuscha*

FRANCESCA F. GIAMMONA

Under the supervision of Dr. William E. Bemis
Department of Ecology and Evolutionary Biology

Several species of Pacific salmon (*Oncorhynchus*) coexist in the North Pacific Ocean, each with different feeding habits and ecological roles. In this study, I compared the anatomy of the main jaw closing muscle, teeth, and jaws of King Salmon (*O. tshawytscha*), Chum Salmon (*O. keta*), and Pink Salmon (*O. gorbuscha*) in order to understand differences potentially correlated with different feeding habits. I measured the mass, fiber lengths, and fiber angles of the bipennate adductor mandibulae. I studied tooth morphology using scanning electron microscopy. Finally, I modeled gape and muscle length changes in Maya 2016 by regioning the neurocranium and lower jaw in CT scans using OsiriX. I

found significant differences in every variable studied for the adductor mandibulae. The conclusions drawn from these bite force differences correspond to relative bite force estimate comparisons made between species via the Maya 2016 models. Tooth length differs between the three species, and, when examined in the context of bite force estimates, suggests a potential evolutionary trade-off between tooth length and bite force. Models also revealed differences in gape and muscle length changes, with King Salmon having the largest gape and muscle length change and Pink Salmon having the smallest. These results illustrate how closely related salmonid species differ morphologically in conjunction with differences in feeding habits, which could provide insight into how these species are able to coexist within the same geographical context.

Effects of EZH2 Inhibition in Canine B-cell Lymphoma

FIONA A. HENNIG

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Diffuse large B-cell lymphoma (DLBCL) is the most common hematologic malignancy in both humans and dogs. While treatable in both, cures are not obtained in all humans and are rare in dogs. This demonstrates the need to further research mechanisms of lymphomagenesis in order to develop new therapies. Enhancer of Zeste homolog 2 (EZH2) is the catalytic subunit of the polycomb repressive complex 2 (PRC2) that catalyzes the methylation of histone H3 lysine 27 (H3K27). The tri-methylation of H3K27 (H3K27me₃) is associated with transcriptional silencing of genes. EZH2 activity plays a role in the pathogenesis of various tumors, including human DLBCL. DLBCL in the dog parallels human DLBCL in many ways, including similar signaling pathway activation and germinal center phenotypes. Human DLBCL cell lines treated with an EZH2 inhibitor have shown genome-wide loss of H3K27me₃ and activation of PRC2 target genes, resulting in disruption of cell proliferation. However, the effect of EZH2 inhibition in spontaneously arising canine lymphoma has not been examined. Here, I report the effect of a selective EZH2 inhibitor on the expression of histone H3K27me₃ and its effects on cell cycle proliferation. The data demonstrate that EZH2 inhibition results in a time and concentration-dependent reduction in H3K27me₃. While further assay optimization is necessary, early data suggests EZH2 inhibition results in alteration of cell cycle progression in canine lymphoma cells. Further studies are needed to investigate potential clinical use of EZH2 inhibitors as therapy for canine B-cell lymphoma and thus a comparative model of study for human disease.

Localization of the Arf-GEFs Gea1 and Gea2 relies on several regulatory domains

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Arf GTPases are important regulators in Golgi trafficking. Gea1 and Gea2 are closely related proteins that are part of the Sec7 family of Arf-GEFs. Unlike other smaller members of the family, mechanisms of regulation and localization are poorly characterized for Gea1 and Gea2. In addition, it remains unclear whether Gea1 and Gea2 serve different roles in Golgi membrane transport. I establish here that a critical concentration of Gea (either Gea1 or Gea2) is necessary for viability of the cell. While this alludes to redundancy of the GEA1 and GEA2 genes, further experiments demonstrate differential localization of Gea1 and Gea2 to distinct Golgi compartments, indicating discrete means of recruitment to their specific target membranes. We find Gea2 more likely to colocalize with medial and late Golgi markers than Gea1, implying potential additional functions of Gea2 in later Golgi compartments. Furthermore, I dissect the particular domains necessary for proper localization of Gea1 and Gea2 to their respective Golgi cisternae. Gea1 and Gea2 constructs lacking their most C-terminal domain, HDS3, remain localized to the Golgi, demonstrating that the HDS3 domain is dispensable for recruitment. However, I show that yeast bearing the Gea1 Δ HDS3 or Gea2 Δ HDS3 constructs exhibit reduced viability in a genetic assay. Further experiments reveal the DCB-HUS domain in the N-terminus is necessary for differential localization of Gea1 and Gea2. Lastly, I identify the Rab GTPase Ypt6 as a potential interacting partner necessary for recruiting Gea2 to the Golgi.

Cornell Prime Dots (C' dots): Ultrasmall PEGylated Fluorescent Core-Shell Silica Nanoparticles for Cancer Theranostics

CARLIE MENDOZA

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Cancer is a prevalent concern in today's society. It is the second most common death in the US, exceeded only by heart disease. Currently, cancer treatment options include surgery, radiation, chemotherapy, hormone therapy, biological therapy, and targeted therapy. Within the past decade, there has been a huge upsurge in novel ideas and technology to combat this disease. From the 2000s, the Wiesner lab group has been working on silica-based nanomaterials for cancer "theranostics". The first generation of Cornell dots (C dots) was fluorescent PEGylated silica nanoparticles used as diagnostic and therapeutic probes in cancer patient care. These particles have already been tested in first-in-human FDA-approved clinical trials, making them the first inorganic-polymer hybrid diagnostic bio-probe to enter clinical trials. They can be injected in the body, flow through the bloodstream, and be excreted without major side effects. The next generation C' dots have been synthesized in aqueous solution to be even brighter particles than before. Brighter particles allow for clearer visualization in the body, which is especially beneficial when locating, imaging and excising a tumor. This is a valuable component of our particles because it allows for the effective treatment of cancer cells, while allowing healthy, living cells to remain unharmed.

The Development of a Quantitative Assay for the Detection of Grapevine Red Blotch-associated Virus in *Vitis vinifera* Identifies Significant Differences in Virus Distribution

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Grapevine red blotch-associated virus (GRBaV) is associated with red blotch disease which undermines optimal growth and development of grapevine (*Vitis vinifera*). Despite GRBaV's significant economical and biological impacts, existing diagnostic methods lack sensitivity and consistency. This study has developed, optimized and employed a reliable quantitative Real-Time PCR (qPCR) assay for the detection of GRBaV in a variety of host tissue types. Primers specific to GRBaV and an internal host control (NADP-dependent Glyceraldehyde 3-phosphate dehydrogenase (GAPDH)) were selected for use in qPCR based on their performance in initial validation tests. Controls consisted of 1) the internal GAPDH which served as relative reference of total input DNA and as a marker for template quality, 2) a dilution series of cloned target viral DNA, and 3) negative controls of water and total nucleic acid from uninfected vines. This method was then used to quantify the amount of GRBaV in multiple infected greenhouse- (GG) and field- (FG) grown vines. Absolute and relative quantification methods were shown to be strongly correlated ($R^2 > 0.84$) for both GG and FG. Viral DNA quantities varied in different tissue types and from one plant to another between and within a location, but most significantly between GG and FG, where only 56.0% of the total samples from the latter were determined as positive compared to 98.4% for the former. Petioles were consistently found to contain higher amounts of GRBaV compared to their corresponding leaves ($P \leq 0.0368$). Leaves proximal to the main stem were also found to contain higher amounts of GRBaV compared to leaves located in the apical part of the cane ($P \leq 0.0017$). Based on these findings, it is recommended that total nucleic acid extracted from multiple petioles of fully developed leaves are used for robust and reliable GRBaV diagnosis using qPCR. The described qPCR assay and recommended sampling procedures will contribute to efforts in GRBaV containment and red blotch disease control.

Cross-territorial visits in Western Bluebirds (*Sialia mexicana*): Extra-pair matings or kin visitation?

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Cryptic interactions in animal societies can be challenging to detect due to their rarity but can have important consequences for the individuals involved. I demonstrate the use of radio-frequency identification (RFID) technology to detect cross-territorial visits in Western Bluebirds (*Sialia mexicana*) to the nests of conspecifics. Western Bluebirds live in kin neighborhoods year-round and exhibit a low frequency of cooperative breeding. Various functions have been proposed for visitation. I asked whether cross-territorial visits in Western Bluebirds are for the purpose of extra-pair matings or maintaining relationships with kin. I found some evidence for an extra-pair mating function of visitation. Post-dawn visits made by males to unrelated females were significantly more

likely to occur during the period in which males seek within-pair matings than outside this period. Pre-dawn visitation could be an alternative strategy for seeking extra-pair matings, as male visits to unrelated females were significantly more likely pre-dawn than immediately post-dawn. I found no evidence that bluebirds preferentially direct visits to kin; the number of visits to relatives was within the distribution of visits predicted given the spatial arrangement of kin versus non-kin on the study site and the distances traveled by visitors. Visits made by both sexes occur throughout the nesting cycle, not just during the copulatory period, so other factors, such as prospecting for breeding opportunities, could also explain visitation. It is likely that cross-territorial visitation is a complex behavior initiated for different reasons in different individuals depending on their status.

Evaluating the Effect of Plant Origin Prebiotics (Raffinose) on Iron Status, Intestinal Functionality and Intestinal Bacterial Populations In Vivo

JAEHONG SONG

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Iron deficiency is common worldwide. Studies show administration of certain non-digestible oligosaccharides called prebiotics improve iron absorption (e.g. inulin). In this study, I assessed raffinose, a prebiotic present in staple food crops that are utilized as a main diet in iron deficiency risked countries, for its effect on iron status, brush border membrane functionality, and microflora in vivo (*Gallus gallus*) by conducting intra-amniotic administration. Fertile broiler chicken eggs (Cornish cross) were prepared and incubated. Treatment solutions of prebiotic compounds (1mL) were administered into the amniotic fluid at day 17. Injected solutions were the following (n = 20): 1. 5% raffinose (in 18Ω H₂O); 2. 10% raffinose (in 18Ω H₂O); control 1. 18Ω H₂O; control 2. non-injected. Upon hatch, cecum and small intestine samples were collected to measure relative abundance of gut microflora, and villus surface area, relative expression of brush border membrane, and iron-related genes respectively. In the raffinose treatment groups, aminopeptidase, sucrose isomaltase, and sodium glucose co-transporter 1 increased (p < 0.05) expression; divalent metal transporter 1, duodenal cytochrome b, and ferroportin expression decreased (p < 0.05); relative abundance of *Bifidobacterium* and *Lactobacillus* increased (p < 0.05) but not *E. coli* (p > 0.05), and *Clostridium* was downregulated (p < 0.05); additionally, increase in villus surface area (p < 0.05) was observed. Raffinose seems to promote an increase in iron bioavailability, gut microflora, and brush border membrane functionality upon administration. Greater understanding of raffinose's physiological influence on improving intestinal health factors and iron bioavailability was achieved.

The effect of phosphorylation on the Rab GTPase, Ypt7p

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Members of the Rab protein family are small GTPases involved in the regulated movement of vesicles, and play especially important roles in the process of endocytosis and secretory pathways. Rab proteins exhibit a number of posttranslational modifications at various different sites, including, most notably, a phosphorylation site in their GTP-binding domains that is highly conserved between Rabs of both yeast and humans. The yeast Rab GTPase Ypt7p has been shown to be phosphorylated *in vivo*, and was chosen as a model for this modification. My project aims to uncover the details of the Ypt7p pathway and understand how phosphorylation at position S73 may influence the protein's activity. Ypt7p facilitates vesicular trafficking to the vacuole. Absence of Ypt7p results in vacuolar fragmentation, an abnormal phenotype signifying defects in membrane trafficking. Study results reveal that phosphomimetic Ypt7p does not associate with membranes and is nonfunctional. Analysis of purified Ypt7p showed this impaired functionality is not due to decreased nucleotide binding ability. Rather, it is related to the absence of prenyl groups on its COOH-terminal tail, which mediate Rab proteins' interactions with membranes. Due to structural similarities between Rab Escort Protein and GDI, it can be theorized that S73 phosphorylation is a regulatory mechanism used to disrupt the ability of Ypt7p to be pulled off membranes by GDI. Given the conserved nature of membrane trafficking between yeast and humans, not only do these findings provide a more detailed understanding of Rab GTPases – they also translate to a better understanding of mammalian membrane trafficking.

A validation of methods to relate brain function (EEG) and recognition memory performance in infancy

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Previous studies link electroencephalography (EEG) measures of brain function to behavioral measures during recognition memory tasks in early infancy, but few in the context of nutrition status. Animal studies show that specific nutritional deficiencies affect the brain in targeted areas rather than as broad cognitive changes, but many current human studies only use general cognition measures. This thesis examines the relationship between behavioral and brain (EEG) measures of memory in the context of iron status to validate this methodology. Iron status affects hippocampal function, and so the specific measure used is recognition memory. EEG data were collected during a memory task where infants (4-7mo) observed novel and familiar stimuli of female faces. During a related behavior task, infants viewed two faces simultaneously and the look length at each was measured. The main EEG outcomes were the difference between novel and familiar stimuli in amplitude of negative component, a measure of attention, and late slow wave (Δ LSW), a measure of memory. The percent of time looking at novel stimuli (%Nov), and the total time looking were the main behavioral outcomes. Student's t-tests and regression modeling were used to analyze the association between Δ LSW and %Nov. Results show that Δ LSW is associated with both %Nov and total looking time with age as a significant covariate in each model (N=25). This combination of methods measures recognition memory and improves on previous

work with specific measures in the context of infant iron status. This thesis will inform future studies in nutrition and cognition fields.

Factors influencing cavity reuse in the Acorn Woodpecker

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Woodpeckers are primary cavity excavators that play an important ecological role in the ecosystem. Woodpeckers can either reuse old cavities or excavate new ones each nesting attempt, but patterns of reuse vary among species and populations. Nest reuse is predicted to occur when the benefits, such as saved energy and time, outweigh the costs, such as increased parasite load. Acorn Woodpeckers are unique in caching acorns that vary in abundance from year to year and living in cooperative groups of up to 15 birds with relatives. I examined the factors that lead to reuse or excavation of new nesting cavities using 19 years of data on a marked population. I found that a turnover in female or both male and female breeders, as well as a large acorn crop the previous fall, were significant positive predictors of using a new cavity. Fledging success the previous year was a weak predictor of nest reuse. I found no difference in fledging success between new and old cavities, suggesting that the negative effects of reuse do not outweigh the benefits for Acorn Woodpeckers. Life history traits, including the dependence on the acorn crop and changes in group composition, play a large role in determining nest reuse patterns in Acorn Woodpeckers.

Exploring Maternal Dietary Beliefs and Practices During Pregnancy and Lactation Among Mothers of Infants and Young Children in Adivasi Communities in the Nilgiris Biosphere Reserve, India

HOPE C. CRAIG

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Adequate nutrition during pregnancy and lactation play a major role in maternal and child health. A widespread combination of factors may influence nutritional status during these periods of heightened nutritional vulnerability. This research explores the dietary beliefs and practices of mothers of infants and young children in five Adivasi communities in the Nilgiris Biosphere Reserve (NBR), India. Guided by focused-ethnographic study (FES) methods, 32 key informant interviews were conducted in March and April of 2015 to elucidate maternal knowledge, beliefs, and practices, and explore maternal dietary behavior in relation to local beliefs and dietary recommendations. Maternal dietary beliefs were classified into two categories: food avoidances and acceptable food items. The cultural-ecological model was used as a framework for analysis and interpretation of mothers' perspectives and experiences. Many mothers demonstrated awareness of strongly held beliefs among community elders regarding food intake for pregnant and lactating women. However, differences between what women were advised to eat, felt they themselves should eat, and what they actually consumed created a complex system of judgments and decision-making opportunities. The perspectives reflected in this research offer a foundation of experience for exploring behavior-change programs to increase opportunities for adequate nutrition among pregnant and lactating women in Adivasi communities in the Nilgiris Biosphere Reserve.

The Dipteran Compass—Fly Larvae as Paleoenvironmental Indicators in the Middle Eocene Green River Formation

KYLE AMBROSE DEMARR

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Sites that exceptionally preserve organisms, Lagerstätten, provide optimal material with which to make inferences regarding conditions of ancient ecosystems. Larvae preserved *en masse* in four Lake Gosiute Green River assemblages dating to the Middle Eocene were identified as stratiomyine soldier flies (Diptera, Stratiomyidae, Stratiomyinae) through inspection of the cuticle and quantitative comparison of body proportions with Recent larvae. Further analysis of these insects offered insight into the seasonality and taphonomic conditions of the Middle Eocene Green River paleoecosystem. Larvae were measured and scored for position within the sedimentary matrix to infer relative timing and circumstances of burial. Differences in larval length variation between assemblages were documented, suggesting taphonomic events which occurred along a temporal gradient; furthermore, larvae hypothesized to have been buried at earlier seasonal periods were oriented along a uniform axis—suggesting a shift in water velocity possibly caused by flooding. Arising from a typically low preservative potential and the possession of discrete life stages, fossil dipteran larvae have the potential to serve as useful tools in assessing seasonal changes of paleoenvironments by eliminating elements of time-averaging—permitting temporal determination of assemblages to sub-seasonal scales.

The effect of copulation duration on sperm transfer and egg viability in *Coccinella novemnotata* and *Harmonia axyridis* (Coleoptera: Coccinellidae)

BLAKE ELKINS

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The transfer of sperm from males to females during mating is an essential part of sexual reproduction. I conducted a set of experiments designed to determine the rate of sperm transfer over time for two lady beetle species and how copulation duration affected viable egg production. This was accomplished by interrupting mating at various time points (15, 30, 60, and 120min) and quantifying the number of sperm transferred to females, and by determining the viability of the eggs laid by females that were mated for the different durations. The results showed that *H. axyridis* began transferring sperm earlier than *C. novemnotata*, between 15 and 30 minutes, whereas *Coccinella novemnotata* began transferring sperm after mating for a minimum of 30 to 60 minutes. *H. axyridis* also began laying viable eggs when mated for a shorter period of time compared to *C. novemnotata*, 15 to 30 minutes versus 30 to 60 minutes, respectively. This data suggests there are differences in the rate of sperm transfer between the two lady beetle species, however these differences did not affect the number of viable offspring produced. However, the ability of *H.*

axyridis to produce even a low number of viable eggs after a 15 minute copulation could represent a competitive advantage over *C. novemnotata*. This information is particularly important for laboratory rearing and reproduction experiments that measure egg production as a function of different treatments, and will allow for more accurate estimates of treatment effects when some beetles stop mating before 15-30 minutes.

Does an induced break in the brood cycle reduce *Varroa* mite densities in honey bee colonies?

PHOEBE A. KOENIG

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Viruses transmitted by the ectoparasitic mite *Varroa destructor* kill managed honey bee colonies (*Apis mellifera*) if the colonies are not treated with chemical miticides. Wild colonies, however, are also infested with these mites, but are persisting without treatment. We hypothesized that wild colonies control the density of mites in their nests by frequent swarming, which induces a broodless period which interrupts mite reproduction. We tested this hypothesis by establishing two groups of colonies; one group experienced a broodless period while the other did not. We followed the colonies from June to November, measuring mite density, mortality, bee population, and brood area to compare how a broodless period affects mite density and mortality. Colonies that had experienced a broodless period had a different mite density trajectory than colonies that had not, with fewer mites in August. Three of the eight colonies that had not experienced a broodless period had collapsed by late November. All ten colonies that had experienced a broodless period were still alive. These results suggest that the broodless period that follows swarming interrupts mite reproduction, and may help reduce *Varroa* density and the intensity of virus infection in wild honey bee colonies.

Comparing the fitness costs of induced chemical defense in native and introduced lady beetle species

BENJAMIN W. LEE

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Department of Entomology

The decline of populations of the nine spotted lady beetle *Coccinella novemnotata* Herbst in North America occurred shortly after the establishment and geographic spread of the invasive lady beetle *Coccinella septempunctata* L. To investigate whether differences in the fitness costs of producing defensive chemicals contributed to the success of invasives, we induced reflex bleeding daily in mated female beetles on *ad libitum* or restricted diets and measured the mass of reflex blood produced and the total number and viability of eggs laid. We also included the invasive *H. axyridis* (Pallas), as it the

dominant coccinellid in North America. There was no significant effect of induced reflex bleeding on the quantity or viability of eggs laid by any of the species. All three species laid significantly fewer total eggs when provided a low aphid density, with *C. novemnotata* laying 36% more than *C. septempunctata*. *H. axyridis* produced significantly less reflex blood than *C. septempunctata* or *C. novemnotata*, which may indicate potential variation in the defensive potency of reflex bleeding across species. These results demonstrate that while scarcity of resources has a negative impact on fecundity, sustained utilization of defensive fluid does not. These results on the quantity of defensive fluids provide the foundation for future studies that will quantify the chemical composition and effectiveness of reflex blood in deterring predators.

Taxonomic revisions of understudied genera belonging to Mimallonidae (Lepidoptera)

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Under the supervision of Dr. Jason Dombroskie
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The moth family Mimallonidae (Lepidoptera: Mimallonoidea) is incredibly understudied and has not been the focus of any holistic taxonomic revision since Schaus (1928). In order to gain a better understanding of this family for future work, I carried out morphological analyses of several genera in the family. The genus *Eadmuna* is revised to include *E. esperans*, *E. paloa* rev. stat., *E. guianensis* n. sp., and *E. pulverula* n. comb. The genus *Menevia* is revised to include 18 species, 11 of which are new: *M. rosea* n. sp., *M. torvameatoria* n. sp., *M. magna* n. sp., *M. menapia* n. sp., *M. mielkei* n. sp., *M. australis* n. sp., *M. vulgaris* n. sp., *M. franclemonti* n. sp., *M. vulgaricula* n. sp., *M. cordillera* n. sp., and *M. delphinus* n. sp. A neotype is designated for *Mimallo plagiata*, which has since been placed in *Menevia*. Two species, *M. ostia* n. comb. and *M. parostia* n. comb. are transferred from *Pamea* to *Menevia*. *Mimallo saturata* is interpreted to be a *nomen dubium*. Finally three new genera of Mimallonidae are described: *Tostallo* n. gen. is erected to contain *Tostallo albescens* n. comb.; *Auroriana* n. gen. is erected to contain *A. florianensis* n. comb. and two new species: *A. colombiana* n. sp. and *A. gemma* n. sp. *Micrallo* n. gen. is erected to include *M. minutus* n. sp.

Race, Wealth and Geography in Hong Kong over Time

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Hong Kong is often showcased as a success story of a post-colonial city without the violent social, political and economic upheaval that has plagued so many former colonies. In reality, however, since returning to China as a “special administrative region” in 1997, Hong Kong has undergone great social unrest. The thesis uses mapping as a tool to explore issues of inequality in Hong Kong over time.

Throughout Hong Kong’s colonial history, wealth and race have always been distinctly bound to the location of one’s residence. Using historical literature, zoning laws, census records and maps, this thesis seeks to investigate the connection between race, wealth and geography in Hong Kong over time and map that relationship in light of the change in political control over Hong Kong.

This study has shown that although race is still a significant force in the current post-colonial landscape of Hong Kong, recent purchases of the two most expensive properties in Hong Kong by Mainland Chinese present evidence that race may no longer play as determinant a role in geographic location of residence in Hong Kong as previously, and that wealth appears to be the single most important factor.

By acquiring residential property formerly owned exclusively by the British and which was used to demonstrate authority and superiority over the local population, Mainland Chinese homeowners may be following the historical pattern of colonization in Hong Kong, and may be seen by the local population as asserting themselves as a new “colonial power.”

Prenatal Nutrition as an Indicator of Community and Ecological Health in Lombok, Indonesia

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

This paper examines the dynamic between community nutrition and ecological health by observing the dietary practices of pregnant mothers in Lombok, Indonesia over the last forty years. As a part of the 'Coral Triangle' Indonesia, and the Nusa Tenggara Barat province in particular (see Illustrations 1 and 2), is home to incredible marine biodiversity. In the last ten years, Indonesia has become home to hundreds of thousands of Marine Protected Areas (MPAs) in an effort to preserve that biodiversity by restricting access to marine resources within designated areas. As Indonesia's economy has grown, the population has grown and become increasingly urban. This puts increased pressure on the environment, alters resource access for rural populations and impacts the diversity and accessibility of different food groups both in rural and urban settings. Nutritional status during pregnancy is a crucial determinant of infant and maternal health postpartum and it is greatly impacted by changes in resource access and consumer preferences, making it an interesting and relevant indicator of community health. The MPAs have the potential to deprive locals of necessary sources of micronutrients – for which prenatal need is higher – and so the MPAs are only effective as protectionary measures for community and ecological health when they balance the needs of an ecosystem that includes the human population. A better understanding of the relationship between conservation and human health and development is therefore crucial to foster successful policies and interventions to simultaneously address these issues. As results of the second survey are obtained, a comparison in food group consumption over time can be examined. This particular analysis focuses on a narrower scope: the dietary diversity of 38,338 pregnant mothers enrolled in the Supplementation with Multiple Micronutrients Intervention Trial (SUMMIT) in Lombok, Indonesia from 2001-2004. A review of literature on the current profile of maternal-child health in Indonesia provided further understanding of the current nutritional status of the population and its implications.

Tracing Decay of Fine Root Carbon into Aggregate Fractions of Forest Soils

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The major goal of this study was to determine the rate and pathways of decomposing root carbon (C) through forest soils. The three objectives of the experiment were (1) to determine the effect of different soil characteristics on root decay rates and aggregate formation, (2) to determine differentiation in decay of separate fine root size/structure classes, and (3) to model decay of root material over three years of decomposition.

Root fragments of *Acer saccharum* were enriched with ^{13}C isotopes and incubated in PVC soil cores to allow decay and incorporation of traceable C atoms into soil mineral structures. Roots were divided into two classes based on diameter, corresponding to the development of secondary woody material in older roots. Five forest soils were selected: one from the experiment site at Cornell's Turkey Hill Tree Plantation, a high pH soil, soil from the B-horizon of a typical forest spodosol, an iron rich extreme spodosol, and an 'organic' soil derived from an O-horizon (the latter four from the Adirondacks of NE New York). A subset of samples was harvested each year for three years after beginning decomposition in the field. Soil samples were separated by means of physical fractionation into seven aggregate fractions, and analyzed for isotopic and elemental signals with a Thermo Delta V isotope ratio mass spectrometer.

The results of the study concluded that more developed, higher-ordered roots decomposed more quickly than younger, finer roots, contrary to popular understanding of litter chemistry. Significant effects of soil type on decay rate or aggregate formation were not found after three years of incubation. A further comparison of results with a study of labeled root decomposition *in situ* revealed a disturbing misrepresentation of natural SOM dynamics caused by frequently used methodology when conducting decomposition studies, in reference to pretreatment preparation of root fragments. This research has important implications for the understanding of dynamics of soil C, which represents a significant global C pool, and for methodological decision making in future studies of root decay.

MATO, MANCHE RA JANAWAR (Soil, Man and Animal): How the relationships between humans, animals and land in Sikles, Nepal inform stewardship

ANNA E. BROWN

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

This research study: (1) assesses the relationships and interactions that exist between subsistence farmers, their animals and the land in Sikles, Nepal; and, (2) analyzes how these relationships inform stewardship i.e. the act of taking care or managing. Using the Human Ecological Lens (HEL) as a conceptual framework and data from a previous field research project this study demonstrates how the relationships between humans, animals and land are diverse and directly inform stewardship. This study explains how the subsistence farmers in Sikles have communal, spiritual, agricultural, and personal connections with their crop land, community forest, cows and buffalo. The animals survive because of the human's relationship with the land, just as the humans survive because of the symbiotic relationship between animals and land. These relationships exist and function by inducing stewardship.

Assessing Community Support and Feasibility for Bioenergy in the Northern Rivers Region, Australia

RACHEL ERLEBACHER

Under the supervision of Dr. Shorna Allred
Department of Natural Resources

This study aims to analyze the economic, social, and environmental feasibility of developing the bioenergy industry in the Northern Rivers Region of Australia. Because bioenergy is complex, unconventional, and locally sourced, it will not be successful unless there is community support. Recent research suggests that a Social License to Operate (SLO) can provide a framework for assessing local support and a process for engaging with the community to determine if an industry should be developed in a particular region. This study is the first to assess and define an SLO in terms of the bioenergy industry and serves as a pilot study. The author collected data through semi-structured interviews and an online survey. The findings suggest that there is low awareness amongst community members about bioenergy, and there are many unknowns about the availability of the bioenergy feedstocks in the region. The most accepted feedstocks included municipal waste, agricultural residues, and wet wastes, and the most accepted conversion technology was anaerobic digestion. Respondents noted that an SLO required transparency throughout the development process as well as active community engagement. Further research must be conducted to better understand what feedstocks are available, as well as a more in-depth community study before a bioenergy SLO can be achieved in the study region.

Imagined Ecologies: Nature and naturalness in James Joyce's *Ulysses*

ALYSON S. FAVILLA

Under the supervision of Dr. Jim Tantillo and Dr. Kevin Attell
Departments of Environmental Science and Sustainability and English

Using James Joyce's novel *Ulysses* as an example and case study, I will review Constructivist theories of nature and problems of environmental representation in literature. Metaphor and mimesis ultimately complicate environmental representation through the creation of natural kinds in literature. Different definitions of "naturalness" link my critique of idealized nature to the writings of Adorno and Horkeimer on scientific classification and the total domination of nature as commodity. This will allow us to address the tension that exists, historically, between nature as an aesthetic object, and the emergent meaning of natural use value, utility, and of natural resources within a capitalist system of exchange. The recognition and perception of fictional environments relies on systems of signification. This leads to the troubling persistence of environmental determinism, in theory and in fiction, and underscores the power of affective environments. In the process, I will

consider how “lost” historical spaces are located alongside imagined environments—dreams of country, of homeland, and of nation within the Irish literary conscience.

Bicycle exploration as a form of environmental education in INTAG, Ecuador

LAUREN GABUZZI

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

As the public becomes more aware of climate change and the rapid loss of ecologically significant areas, governments are implementing and improving environmental education programs to educate youth to be able to address global warming. Incorporating movement and place based learning into lessons can supplement natural science curricula and yield increased student engagement and deeper levels of understanding. Discussions between Cornell University’s Intag Project and community partners in Intag Ecuador unearthed the need for more engaging and place based environmental education for high school students, especially pertaining to Intag’s Cloud Forest and its unique and essential role in the water cycle. In August of 2015 I began working with the Director of Ciclo Ñan, Cristina Herdoiza. Throughout the fall of 2015, we planned a cycle exploration to address these needs. The Cornell and Intag partnership implemented the cycle exploration in January of 2016 with a total of 33 young Inteño adults. There were several complications in execution, mainly resulting from my little time spent in Ecuador, and communication issues stemming from the international partnerships. Due to these complications, proper pre- and post- session reflection workshops did not occur as planned. Therefore, proper qualitative and quantitative methods of evaluation could not be captured. However, through informal conversations with participants, and facilitating a mini post-session reflection with some of the participants, it was clear that the program was extremely successful in connecting students to Intag and fostering community within the region. This senior thesis will serve as preliminary groundwork for planning and implementing future cycle explorations as a tool for environmental education promotion

An assessment of co-management in the context of the Randilen Wildlife Management Area, Tanzania

KELSEY A. POLJACIK

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

The purpose of this research is to understand the implementation of the Randilen Wildlife Management Area of Arusha, Tanzania, and to assess whether the co-management initiative attempted in this setting has been successful. Wildlife Management Areas (WMAs) are implemented jointly by the state and local communities to conserve wildlife and natural resources while concurrently benefitting surrounding

communities, in a move away from top-down conservation and towards shared government and community management. The Randilen Wildlife Management Area was established in 2010 with the help of the African Wildlife Foundation (AWF), involving seven surrounding villages. Members from the villages Mswakini Chini and Mswakini Juu were interviewed for this study in the spring of 2015 to determine local perceptions of the WMA and gauge its support among locals. The results show that most people living in these villages are not aware of the WMA or of its proposed goals, and many do not trust nor support the WMA management. As a result, while the WMA has finally started to generate revenue, the government's lack of communication, transparency, and trust has led to unhappiness in the community. This research seeks to understand the co-management partnership being developed in the Randilen Wildlife Management Area in Arusha, Tanzania, and how local community perceptions of the WMA reflect whether its application has been successful or unsuccessful in achieving its goals. Furthermore, this research aims to better understand the implications of co-management in the setting of rural Tanzania given its colonial history and current context.

Responses of *Quercus alba* to Rising Atmospheric CO₂ Concentrations, and Climate Variability in NY and PA: Water Use Efficiency, Intercellular Carbon, and $\delta^{13}\text{C}$

STEFANO C. C. SARRIS

Under the supervision of Dr. Linah Ababneh and Dr. Marc Goebel
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White oak's (*Quercus alba* L.) physiological responses to elevated atmospheric carbon dioxide were analyzed from annually resolved tree ring samples at sites in NY and PA. I ran stable carbon isotope analyses from absolutely resolved tree-ring series and regression analyses to test the hypothesis of increased intercellular carbon dioxide concentration and intrinsic water use efficiency observed in plants at a global scale. At both sites in NY and PA, elevated atmospheric carbon dioxide resulted in statistically significant increases in intrinsic carbon dioxide concentration and water use efficiency in annually resolved tree-rings of white oak. In addition, I also found that mean seasonal growth temperature played a significant role in increasing tree's water use efficiency. More conclusive results will be achieved through a longer temporal analysis at additional sites and in comparison with other tree species.

Exposure to Honeybee Collapse Through the Lens of Agriculture in Africa, Asia, and South America

MICHELLE M. WEAVER

Under the supervision of Dr. Ariel Ortiz-Bobea
Charles H. Dyson School of Applied Economics and Management

Honeybees provide a highly valuable ecosystem service to agriculture - pollination. They are facing decline globally and dependence on animal pollinators was assessed for each country in Africa, Asia, and South America. The production value of animal pollinated crops in each country was weighted by their dependence on pollinators. These numbers were then divided by the country's total crop value. The [simple] average share of the value of total crop production attributed to animal pollinators was highest in South American countries at 11.15% while the averages in Asian and African countries were 8.61% and 6.86%, respectively. Dependence over time was analyzed; the time period 1991 to 2013 was chosen. Average dependence fell in African countries while it rose in Asian and South American countries. The contribution of coffee and cocoa to overall dependence was measured. The production of these crops contributed largely to dependence in South American and African countries but had little impact on Asian countries.

Satellite-derived glacier speeds and elevation change rates for Ross Island, Antarctica

NICOLE LANIER ABIB

Under the supervision of Dr. Matthew Pritchard
Department of Earth and Atmospheric Sciences

The Antarctic Ice Sheet is the largest ice mass on Earth. Since the Last Glacial Maximum 21,000 years ago, the melting of ice has caused the shape of the Earth to change through a process known as Glacial Isostatic Adjustment (GIA). This process causes the Earth's mantle and surface to rebound due to the decrease of mass on the Earth surface. GIA is constantly taking place, and has several impacts, such as sea level change and ground uplift, but can be difficult to measure when other factors cause ground uplift, like recent modern thinning at nearby glaciers. Changes in ice motion can impact the human placed GPS stations in Antarctica, which are essential for estimating the rate of GIA. GPS are sited at two scientific bases, McMurdo Station and Ross Station, on Ross Island, off the coast of mainland Antarctica. These sites can provide a future opportunity to study how the changes to glaciers impact our estimates of GIA. Despite this opportunity, relatively little is known about the glaciology of Ross Island. For this reason, I calculate glacial velocities over Ross Island and create the first high resolution composite ice velocity map for the region using a pixel tracking algorithm on WorldView and Landsat satellite imagery taken during the austral winter between 2001 to 2015. I found that the two most influential factors on successful measurements of glacier velocities with pixel tracking were shadows in optical imagery and time separation between the imagery. Successful pixel tracking results showed glacial velocities close to 0.5 m/day along the centerline of the Erebus Glacier Tongue. Similarly, other fast moving regions of Ross Island, like the "south strain area" reach a maximum speed of 0.45 m/day. Velocities on Cape Crozier and Hut Point reached 0.35 m/day on land, but they ramped up to 1.35 m/day on the Ross Ice Sheet off of the coast of Cape Crozier. Among the regions of Ross Island that have a flatter topographic gradient, such as Cape Royds, Mount Erebus, and Cape Bird, ice velocities remain around 0 m/day. As an independent measurement of glacier change, I calculate ice elevation change rates across the island through the use of a weighted linear regression of WorldView Digital Elevation Models (DEMs) and a fused Lidar/Topographic DEM. The high resolution calculation of ice movement on Ross Island show that although fluctuations in glacier velocities are present, these are within natural variations. Therefore, the contribution of ice movement on Ross Island to GIA will be minimal.

Estimating Effects of Forest Revitalization on the Seasonal Albedo Cycle in Ithaca, NY

CAROLINA A. BIERI

Under the supervision of Dr. Natalie M. Mahowald
Department of Earth and Atmospheric Sciences

Land use and land cover change have occurred due to many societal and biological factors over the course of the Earth's history. Recently, human-induced land use changes have increased due to

advances in agricultural production, among other factors. This has resulted in large-scale deforestation within the last 30 to 40 years. Now, as our world endeavors to mitigate the effects of a changing climate, widespread reforestation efforts have been underway, including the Cornell University campus in Ithaca, NY, USA, the focus point of this study. Trees act as effective terrestrial carbon sinks, ideal for taking up excess atmospheric carbon that leads to climatic warming. Reforestation, however, can cause land surfaces to become darker, lowering the amount of shortwave solar radiation reflected at Earth's surface (albedo) and resulting in radiative warming. Through analysis of two satellite-based datasets, this study estimates surface albedo changes due to land cover transitions in the Ithaca area, as well as shortwave radiative forcings induced by these changes. We find these forcings to be mostly positive. Our average calculated forcing for all land type conversions at the top of the atmosphere is 4.4 W/m^2 , and the carbon emission equivalent of this forcing is 1.4 kg/m^2 . These calculations indicate that changes in albedo are a source of warming associated with reforestation. However, other biophysical parameters and their forcings should also be considered to gain full understanding of the net climatic effects in land use change scenarios.

Grassland Restoration: The Effects of Organic Amendments on Soil Microbial Respiration

MARIELA GARCIA ARREDONDO

Under the supervision of Dr. R. L. Schneider
Department of Natural Resources

According to the UN Convention to Combat Desertification, about 168 countries across the world are experiencing desertification due to unsustainable practices, such as agricultural intensification and overgrazing ("UNCCD", 2010). To prevent further negative impacts from desertification, including food security, health, and social development, these soils must be remediated through the re-establishment of soil organic matter (SOM). Much work has focused on afforestation and agricultural infrastructure, however, more attention is required towards the use of organic matter amendments to restore soils. The objective of the present study is to evaluate the use of wood chips as a soil amendment, with the goal of quick-starting the formation of soil organic carbon (SOC) until a self-sustaining grassland community can be established. We are quantifying and comparing the effects of different organic matter amendments on soil respiration, which include *Robinia pseudoacacia*, and *Populus tremuloides* on microbially-active grassland soils obtained from the Northern Great Plains Research Laboratory in Mandan, North Dakota. Microbiota emit CO_2 during cellular respiration with varying rates depending on the climate and amendments used. We are using static chambers as a basis for a series of experiments on different amendment types under a range of nutrient regimes and different time scales. The two main amendments tested differ considerably along the C:N spectrum affecting their decomposition and impacts on soil respiration. Carbon dioxide emission rates were determined for each amendment, analyzed, and compared. *Robinia pseudoacacia* amendments produced significantly lower CO_2 emissions than amendments of *Populus tremuloides*, throughout all experiments and time scales. *Populus tremuloides* also produced higher emissions in the presence of nitrate whereas *Robinia pseudoacacia* had a slight decrease in its original emissions. This study's importance lies in its potential for using specific kinds of wood

chips in order to initiate the regeneration of desertified land internationally, while also regulating soil CO₂ emissions into the atmosphere.

Assessment of Meteorological Elements associated with Coastal Damaging Storms on Eastern Lake Ontario

MATTHEW B. GRIECO

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

For many years, coastal damaging storms have affected the shorelines of the Great Lakes. Communities near the coasts have felt the effects through loss of lives, property, and goods. Storms that affected Lake Ontario's eastern shoreline, specifically three counties in upstate New York, Wayne County, Jefferson County, and Oswego County, between 1979 and 2014 were investigated to determine the associated meteorological characteristics, frequency, and variation through time with respect to the El Niño Southern Oscillation (ENSO) cycle. Variables such as wind speed, wind direction, and water level were used to determine the timing of these high-impact events at two locations, Oswego and Sodus Bay. A wave height forecasting model was then run using calculated fetch and wind data to deduce the intensity of the events at each location. Results showed that with strong, persistent westerly winds along Lake Ontario, wave heights >3 m could be achieved at Oswego, and wave heights >2.5 m could be achieved at Sodus Bay. Though no significant trends were observed throughout the 36-year time series, preliminary results show an increase in some of the high-impact event occurrences through time. Common meteorological surface features are also observed during these high wind events. The passage of moderately intense cyclones with a cold front moving east over the Lake appears during these high-impact events. Results also illustrate the effects of ENSO on the frequency of these damaging coastal storms. During El Niño winters, the number of storms affecting these three counties along Eastern Lake Ontario drops considerably.

A Study of the Effects of Meteorology on Atmospheric Visibility

SHAUN THOMAS HOWE

Under the supervision of Dr. Natalie Mahowald
Department of Earth and Atmospheric Sciences

Atmospheric visibility observations have a widespread use beyond airplane safety. Haze can be observed when proper filters are applied to visibility observations. In this analysis, I use observational weather data from around the US to analyze relationships between atmospheric visibility, using the extinction coefficient, and meteorological variables such as temperature, relative humidity, specific humidity, and sea level pressure. Pearson correlations were made between these variables over the years 1973 to 1994 for four different seasons. Temperature is shown to be primarily positively correlated with the extinction coefficient in the Northeast but does appear to be

negatively correlated in the Western US. Relative humidity and specific humidity are both shown to be positively correlated with the extinction coefficient as well. Sea level pressure has been shown to be not strongly correlated with visibility but does show slight negative correlations. Atmospheric stagnation has also been previously studied as to its affects on air pollution. By observing the difference in extinction coefficient values between stagnation days and non-stagnation days, I have been able to show that, for this analysis, stagnation days do not play a statistically significant role in affecting the extinction coefficient across the US.

Secondary Mission Objectives and Payload for a Mars Sample Return Lander

BENNETT J. KAPILI

Under the supervision of Dr. Steve W. Squyres
Department of Astronomy

NASA’s proposed Mars Sample Return Campaign is a three-phase plan to obtain surface samples of Mars and send them to Earth. The second phase of the campaign, the Sample Return Lander (SRL), would retrieve the samples cached by a previous rover and launch them into martian orbit. NASA is currently studying the potential for the SRL to pursue secondary mission objectives, and this thesis proposes a suite of secondary science and human exploration mission objectives and an accompanying 14.81 kg payload. The proposed secondary mission objectives would study Mars’ surface meteorology and pursue novel investigations into the structure and dynamics of Mars’ lower atmosphere. The pursuit of atmospheric science investigations imposes minimal interference on achieving the SRL’s primary objective. The low-mass payload includes 1) a lidar capable of vertical profiling of winds and aerosols and 2) an instrument suite for monitoring surface meteorology (i.e., pressure, temperature, relative humidity, wind), characterizing physical dust properties, and determining turbulent eddy heat and momentum fluxes. By obtaining datasets that characterize the dynamics of Mars’ lower atmosphere, we can constrain and validate our current martian atmospheric models. Enhancing our models not only poses scientific benefits, but also improves the modeling of entry, descent, and landing (EDL) procedures for all future landed missions. Such improvements to EDL address one of NASA’s high priority Strategic Knowledge Gaps for the future human exploration of Mars. The payload would make progress towards achieving four of the Mars Exploration Program Analysis Group’s “high” priority investigations and one “medium” priority investigation.

Analysis of Diurnal Variation in Surface Dust Concentrations over Western Africa

THAILYNN MUNROE

Under the supervision of Dr. Natalie Mahowald
Department of Earth and Atmospheric Sciences

Meteorological events that affect dust mobilization in Northern Africa have a large impact on the local, regional, and global scales. The ability to accurately forecast these events using numerical models is highly dependent on understanding the forces that initiate these events, one of which being the nocturnal jet. Data from the Marticorena study on “Temporal Variability of Dust Concentrations” was analyzed using python. The hourly concentrations of dust were found to be highly variable when averaging over the entire year, but when broken down into individual months and seasons there seemed to be more of a diurnal pattern.

Batch Effect Correction and Standardization of Metabolomics Data in the Absence of Internal Standards

STEPHEN SALERNO

Under the supervision of Dr. Martin T. Wells, Dr. James G. Booth, and Jason W. Locas
Department of Biological Statistics and Computational Biology

With the surge of interest in metabolism and the appreciation of its diverse roles in numerous biomedical contexts, the amount of metabolomics data generated has substantially increased. However, variation in the data that occurs independent of biological signal and noise (i.e. batch effects) in metabolomics data can be substantial. Standard protocols for data normalization that allow for cross- study comparisons are lacking. Here, we investigate a number of algorithms for batch effect correction and compare their performance. We show that linear mixed effects models that account for latent (i.e. not directly measurable) factors produce satisfactory results in the presence of batch effects without the need for internal controls or prior knowledge about the nature and sources of technical variation in metabolomics data. We further introduce an algorithm – RRmix – within the family of latent factor models and illustrate its suitability for differential abundance analysis using metabolomics data with differences otherwise dominated by batch effects. Together this analysis demonstrates the feasibility of systematically standardizing metabolomics data.

Physicochemical factors affect bacterial attachment on food packaging surfaces

GENEVIEVE BENETTI SULLIVAN

Under the supervision of Dr. Carmen Moraru
Department of Food Science

Food packaging is a food contact surface and potential contamination source of foodborne pathogens. Bacterial attachment on the packaging surface can lead to biofilm formation, which decreases the effectiveness of cleaning and sanitizing procedures. Prevention of biofilm formation is key to controlling contamination from packaging materials. This study investigated the relationship between physicochemical properties and bacterial attachment of five commonly used food packaging plastics as well as Nafion. Surface zeta potentials and contact angles (surface energy) were significantly different among the surfaces ($p < 0.05$). There were also significant differences

observed for biomass accumulation results and exclusion zone thicknesses between surfaces and microbial strains. The biomass accumulation ranged from $0.094 \mu\text{m}^3/\mu\text{m}^2$ (PP) to $5.213 \mu\text{m}^3/\mu\text{m}^2$ (PET) for *E. coli* and $9.683 \mu\text{m}^3/\mu\text{m}^2$ (LDPE) to $20.278 \mu\text{m}^3/\mu\text{m}^2$ (MET) for *L. innocua*. The exclusion zones ranged from $5.35 \mu\text{m}$ (PP) to $88.94 \mu\text{m}$ (Nafion) for *E. coli* and $5.21 \mu\text{m}$ (PET) to $73.48 \mu\text{m}$ (Nafion) for *L. innocua*. These results can be used to understand theoretical predictions as a way to help food companies select food-packaging materials that are less prone to bacterial attachment.

Weed Abundance in a Long-Term Organic Vegetable Cropping Systems Trial

ASHLEY B. JERNIGAN

Under the Supervision of Dr. Matthew Ryan
Department of Soil and Crop Sciences

Weed management is a major constraint in organic cropping systems and research is needed to evaluate the long-term impacts of different organic management systems on weed population and community dynamics. In 2004, the Cornell Organic Cropping Systems Experiment was established in Freeville, New York using a split-plot randomized complete block design with two crop rotation entry points (split-plot factor). The experiment compared four organic vegetable cropping systems that varied in inputs and weed management strategies (main plot factor): 1) High Intensity (goal was to maximize crop production with inputs), 2) Intermediate Intensity (goal was to use legumes to provide nitrogen), 3) Bio-extensive (goal was to use cover cropping and fallow periods to reduce weed seedbank), 4) Reduced-tillage (goals was to use ridge tillage and controlled traffic). The High Intensity and the Intermediate Intensity systems simulated land limited farms that needed to invest more inputs into the soil using different strategies, the Bio-Extensive system simulated a farm with land abundance that was not dependent on cropping all available land every season, and the Reduced-Tillage system simulated a farm with ridge tillage that improved soil quality by not disturbing the ridge bases. All systems, except the Bio-Extensive system, followed a 4-year crop rotation of winter squash, cabbage, lettuce, and potato. The High Intensity system double-cropped the cabbage with peas and the lettuce with spinach. In 2014, a uniformity trial was conducted in which oats and then sorghum sudangrass and Japanese millet were grown uniformly over the entire experiment. Prior to sowing oats, soil samples were collected and a germination bioassay was conducted to determine if the systems differed in terms of soil weed seedbank density. After the oats reached the soft dough stage, oat biomass and weed density and biomass samples were collected from 0.25 m² quadrats. The sorghum sudangrass and millet was sampled using the same protocol. Soil weed seedbank density was affected by the interaction between cropping system and rotation entry point and ranged from 173 (Reduced-Tillage, entry point 2) to 16 (Bio-Extensive, entry point 1) seeds kg⁻¹ soil. The Bio-Extensive cropping system also tended to have lower weed biomass and weed density in oats when compared to the other three systems; however, the cropping systems did not differ in terms of oat biomass production. Weed density and biomass in the oats were also affected by the crop rotation entry point. Cropping system legacy effects on weed abundance were weaker in the sorghum sudangrass and millet than in the oats. Differences in weed abundance between the four cropping systems indicate that some management practices are more effective at weed suppression than others, and that maintaining a low level of weeds in organic vegetable production is possible if weed management is prioritized.

Modifying critical thresholds in Simcast to achieve better late blight management for moderately susceptible potato and tomato crops

YUANHAN WU

Under the supervision of Dr. William Fry
Department of Plant Pathology

A decision support system (DSS) for potato and tomato late blight management has been developed to provide disease management recommendations. The system is comprised of two disease-forecasting tools as well as a simulator. Results from simulation and field experiments with the system have shown that the DSS schedules on moderately susceptible crops did not achieve sufficient disease suppression under certain circumstances. We used weather data from 2000 to 2010 from over 140 weather stations to generate spray schedules. We then inputted schedules into the simulator to get disease severity and fungicide use efficiency. We then modified the default critical value in the disease-forecasting tool and compared those results and got the critical thresholds by improving disease suppression while maintaining similar fungicide use efficiency. The primary objective of this research was to improve disease suppression for moderately susceptible cultivars while maximizing fungicide use efficiency. This change has subsequently been programmed into the on-line version of the DSS.

Promoting Reconciliation in Post-Civil War Sri Lanka: A Case Study of Religiously Inspired NGOs

REHAN DADI

Under the supervision of Dr. Fouad Makki
Department of Development Sociology

In the aftermath of the protracted and violent Civil War in Sri Lanka, there is an urgent need for pursuing reconciliation and inclusion strategies between the Sinhala and Tamil ethnic communities. The relative lack of state initiative in this regard has been partially compensated by the work of faith-based NGOs. This research examines how these NGOs actively sustain platforms for dialogue, and foster social cohesion and inclusive cultural participation. Research locations included the small towns of Mannar and Vavuniya in the North that were greatly affected by the War, and Colombo where the head offices of many NGOs are located. NGOs examined include the larger Sarvodaya Movement, Caritas, and the smaller Action Aid, and the Center for Peace and Reconciliation (CPR). Interviews with NGO leaders and representatives have been combined with own participant observation and content analysis of current media reports and literature. This thesis is organized into seven sections. Section one provides a brief historical resume of ethnic conflict in Sri Lanka. Section 2 focuses on broad issues of conflict resolution and social cohesion. Section 3 discusses theoretical frameworks; Section 4 situates the research methodology. Section 5 concentrates on small and large scale NGOs and their strategies for creating trust and reconciliation between differing ethnic communities. Section 6 focuses on the enduring challenges and issues that has yet to be addressed in creating a stable peace and overall social cohesion. Section 7 offers observations on the need for reconciliation strategies to continue and become more effective in the future.

Know Your Worth: Angel Financing of Female Entrepreneurial Ventures

MELANIE R. SHAPIS

Under the supervision of Dr. Sharon L. Poczter
Charles H. Dyson School of Applied Economics and Management

This study explores success rates in obtaining angel financing based on the gender composition of entrepreneurial teams using data from the television program Shark Tank. Consistent with prior work, we find that women-owned teams receive lower company valuations and less capital to finance their new ventures relative to their male counterparts. However, we find that the likelihood of a team receiving an offer from an angel investor is independent of the entrepreneurs' gender. We discover women-owned firms initially value their companies at significantly lower amounts than teams consisting of all males. Thus, angel investors provide lower final company valuations to women-owned firms because women, on average, ask for less. These results hold when controlling for important entrepreneur and firm characteristics that may strongly impact the angel financing outcome, such as the size of the entrepreneurial team, company age and prior success of the firm.

We also find that the negative effect of a women-owned firm on the amount of financing received is highly dependent upon the industry the entrepreneurs choose to enter.

Affective and Cognitive Responses to Chinese Fonts in Web Interface Design

QIAN WANG

Under the supervision of Dr. Susan R. Fussell
Department of Information Science

The two major objectives of the study were (1) to understand the need for web interface design for Chinese characters, and (2) to determine what observable relationship, if any, exists between fonts, website type, website type and font interactions and users' affective responses. Eight website prototypes of two website categories in four representative Chinese fonts were designed for user testing. A sample of 67 Chinese international students at Cornell participated in the study. The study's results demonstrated that fonts, website types, and website type and font interactions all have significant effects on users' affective responses to various degrees under different circumstances. Web designers need to be mindful when choosing fonts for a website and consider the multitude of effects each font may have on users' perception of the website.

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