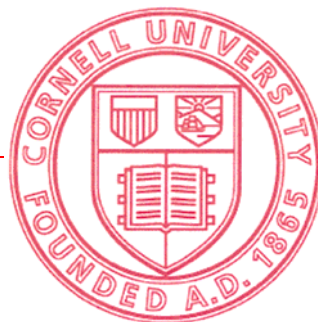


# College of Agriculture and Life Sciences

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**2007—2008**

## **Research Honors Program Abstracts**





**W**ith an academic mission that embraces four areas of great importance to life in the 21<sup>st</sup> century—our land grant mission, the applied social sciences, the environmental sciences, and the new life sciences—the College of Agriculture and Life Sciences offers an extraordinary range of research opportunities to the committed undergraduate. Many students consider the research they undertake as undergraduates in CALS to be the most challenging, enduring, and valuable experiences of their time at Cornell.

The students who sought to undertake the research projects described in this booklet and thereby earn a bachelor's degree with honors have demonstrated an impressive capacity for mature scholarship and intellectual growth. With some very special faculty expertise, academic resources, and research facilities to support them, they have conducted original research and examined some of the most pressing and relevant questions of our time.

In our increasingly global community, many people are faced with significant issues involving food security, environmental health and safety, communication, political strife, and economic hardship. Our college is dedicated to tackling these issues and others through basic and applied research, teaching, and outreach that advance knowledge, develop leaders, and improve lives. Our contributions to the people of New York State, the nation, and the world are very substantial indeed.

I am extremely proud of our undergraduate students and their achievements, and I wish them the very best in their future endeavors. I am also proud of the dedicated faculty who supervised these honors research projects and mentored these students to their fullest potential. These new graduates will take their places among tomorrow's leaders; as you will see in reading about their research, they give us reason to hope for a better future for all.

Susan A. Henry, Ph.D.  
*The Ronald P. Lynch Dean of  
Agriculture and Life Sciences*

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## Effect of Trace Mineral Amount and Source on Aspects of Immune Function in Dairy Cows

DESIRÉE GENTILE

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

Previous studies have shown a relationship between trace mineral supplementation and improved immune function. In this experiment, 48 multiparous Holstein cows were utilized to determine if trace mineral supplementation of inorganic or chelated organic sources at National Research Council or higher commercial levels would exhibit improved immune function after vaccination with a mastitis vaccine (J-5) and during a LPS challenge. Cows were fed a diet formulated to meet or exceed NRC (2001) requirements for all nutrients except the trace minerals of interest: Zn, Cu, and Mn. Cows were then assigned to four treatments containing organic or inorganic trace mineral sources at commercial or NRC levels. At the end of week two of treatment, cows were administered a J-5 vaccine and blood samples were collected to measure level of IgG production. At the end of week six of treatment cows were subjected to an intramammary LPS challenge. Heart rate and rectal temperature were measured and blood samples were drawn throughout the eight-hour challenge at thirty-minute intervals and again at 24 and 48 hours post challenge. Plasma IgG levels from samples collected on a weekly basis were highest for cows supplemented trace minerals in an organic form regardless of amount. Heart rate and rectal temperatures following LPS challenge did not vary between treatments. Overall, results imply that supplementation of trace minerals in chelated organic form improves immune function and may be an effective tool in enhancing cattle health. However, further study is warranted to determine the optimal level of trace mineral supplementation.

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## The Effect of Linoleic Acid and Dietary Vitamin E Supplementation on Maintenance of Conjugated Linoleic Acid Production in Milk Fat from Dairy Cows

NEIL S. MITTELMAN

Under the supervision of Dale E. Bauman  
Department of Animal Science

Conjugated linoleic acid (*cis*-9, *trans*-11 18:2, CLA), a bioactive fatty acid (FA) found in dairy products, has potential human health benefits. Milk fat CLA can be increased by diet, but high levels are difficult to maintain as rumen biohydrogenation shifts resulting in milk fat depression (MFD). We feed a typical corn based-diet and investigated if vitamin E and soybean oil supplementation would sustain enhanced milk fat CLA without MFD. Holstein cows (n = 48) were assigned to a randomized complete block and received (28 d) one of four treatments: 1) control (C), 2) 10,000 IU/d vitamin E (E), 3) 2.5% soybean oil (Oil), and 4) vitamin E plus soybean oil (Oil/E). Percent milk fat decreased in both oil diets. Milk yield, however, was increased by the Oil/E diet; therefore milk fat yield was lower only for cows fed the Oil diet. Milk protein percent was higher for cows fed the Oil diet. Milk fat concentration of CLA more than

doubled in cows fed the oil diets, with concomitant increases in *trans*-10 and *trans*-11 18:1 FA. Furthermore, milk fat from the oil diets had 34% more long chain preformed FA and 31% less *de novo* synthesized FA. Dietary soybean oil supplementation caused a reduction in milk fat and a shift in FA composition characteristic of MFD. Dietary vitamin E failed to overcome the oil-induced reduction in milk fat percent or changes in FA profile, but mitigated the reduction in fat yield by increasing milk yield.

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## The Effects of Group-Housing on the Behavior of Domestic Cats (*Felis Sylvestris Catus*) in an Animal Shelter

CAROLINE S. MONK

Under the supervision of Katherine Albro Houpt  
Animal Behavior Clinic / Department of Clinical Science

This study investigates the effects of group housing on the stress and behavior of domestic cats in an animal shelter. Twenty-four cats one-year of age and older were observed in the Tompkins County SPCA for three consecutive days. All behavior was continuously recorded. Density of cats in the room and length of stay at the shelter were also recorded. To measure the effects of group housing on a cat's behavior in relation to humans, a temperament test was performed each month for four months on a separate group of twenty-nine cats from the Tompkins County SPCA.

A reduction in stress was noted in cats staying in the shelter for over 8 months. These cats had a reduced ratio of negative (aggressive or defensive) interactions to total interactions, slept a more normal amount, and did not have inhibited grooming or movement. The number of cats in the room was correlated with an increased activity level and decreased sleep, because larger rooms had more human traffic. Negative interactions were positively correlated with time spent eating, indicating that cats had to stop avoidance behavior in order to reach the communal food bowl. The score the cat received on the temperament test did not vary significantly between test months.

Results indicate that the entry to the shelter environment is stressful, and the adjustment to group housing takes over 8 months. A four month stay in group housing did not seem to affect the temperament of a cat in relation to its behavior towards humans.

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## Whistle Production Rates in a Group of Bottlenose Dolphins (*Tursiops Truncatus*) among Changes in Group Composition in Sardinia, Italy

COURTNEY N. PATSON

Under the supervision of Debbie J. Cherney / Bruno Díaz López  
Department of Animal Science / Bottlenose Dolphin Research Institute

This study focused on the whistle characteristics and production rates of a resident group of bottlenose dolphins (*Tursiops truncatus*) in Golfo Aranci, Sardinia, Italy. All recordings and observations were conducted at the local fish farm located 200 meters from the shore in Golfo Aranci. Three hundred and eighty minutes of underwater sounds were recorded using a single hydrophone system during the months of June and July 2007. Whistles were separated both according to group size and group composition for statistical analysis. The acoustic characteristics of 176 whistles were classified based on eight parameters and compared with data of previous studies. A significant positive correlation ( $r = 0.457$ ,  $p \leq 0.001$ ) was observed between whistle rates and group size observed at the time of measurement, supporting our hypothesis that whistle rates increase in groups of larger numbers as compared to groups of smaller numbers. Additionally, whistle production rates of adults in the presence of an immature calf showed a significant difference to those of any other group ( $p \leq 0.05$ ) having a higher whistle production rate (median = 0.5 whistles/minute/individual), while all other groups were not significantly different in the production of whistles ( $p$  values  $> 0.05$ , median = 0 whistles/minute/individual). Whistles recorded at Golfo Aranci were of longer duration and higher maximum and minimum frequencies than previous studies. The results suggest that bottlenose dolphin whistle rates are affected by both group size and composition, with higher whistle rates in larger groups and in the presence of immature dolphins.

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## Effect of Dietary Fat Level on the Ability of Conjugated Linoleic Acid (CLA) to Inhibit Milk Fat Synthesis in Lactating Mice

MEGAN M. ROBBLEE

Under the supervision of Dale E. Bauman  
Department of Animal Science

*Trans*-10, *cis*-12 conjugated linoleic acid (CLA) is a fatty acid intermediate produced during rumen biohydrogenation of dietary linoleic acid and is a potent inhibitor of milk fat synthesis in the cow. This effect of CLA has also been demonstrated in rodent models. The present study aimed to determine whether dietary fat level affects the response of the mammary gland to CLA in lactating mice. Wild type C57Bl/6J mice ( $n=31$ ) nursing 6-8 pups were fed semi-purified diets containing either 4% fat (LF) or 24% fat (HF) starting 4-6 d after parturition. High oleic acid sunflower oil was substituted for corn starch to increase the fat content of the HF diet. After a 2 d pretreatment period, dams were orally dosed with water (control) or *trans*-10, *cis*-12 CLA (20 mg/d) for 5 d. CLA treatment decreased growth of the nursing litter similarly for both diets; no effect of dietary fat or interaction with CLA was observed. Milk

fat percent was increased 16-17% by the HF diet and decreased 12-13% by CLA. Both CLA and the HF diet reduced the proportion of short and medium chain fatty acids in milk fat; these originate from *de novo* synthesis in the mammary gland. Conversely, the milk fat concentration of fatty acids >16 carbons in length was increased 62-63% by the HF diet, and substantial incorporation of dietary oleic acid into milk fat was observed. In conclusion, CLA caused a reduction in milk fat percent and litter growth that was not overcome by increased dietary fat.

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## Effects of Gestational Exposure to Mercury on Mitogen and Antigen-Specific Immune Responses

LAUREN A. WEILER

Under the supervision of Jerrie Gavalchin  
Department of Animal Science

Because *in utero* exposure to mercury has been shown to induce phenotypic changes in fetal immune cells that persist in adult offspring, we examined the effects of *in utero* exposure to mercuric chloride ( $\text{HgCl}_2$ ) on the immune response to an antigen, DNP-KLH. Pregnant BALB/c dams received either plain tap water or water containing 10ppm  $\text{HgCl}_2$  *ad libitum* throughout gestation, and were switched to plain water after parturition. Adult offspring were immunized with 100 $\mu\text{g}$  DNP-KLH, and six weeks later, splenocytes were analyzed for immune phenotype and function.  $\text{HgCl}_2$  exposure resulted in alterations in splenocyte phenotype in response to DNP-KLH in male and female mice and increased proliferation of splenic lymphocytes to ConA or LPS; in female mice, there was a specific increase in the proliferative response to LPS.  $\text{HgCl}_2$  exposure did not affect IL-2 production by splenocytes in response to DNP-KLH. There was no effect of  $\text{HgCl}_2$  exposure on IFN- $\gamma$  or IL-4 production; however, the production of IFN- $\gamma$  or IL-4 in response to DNP-KLH was greater in mercury-exposed male versus female mice. IL-10 production by splenocytes in response to ConA was greater in mercury-exposed male versus female mice. After cells were cultured in media alone, cells from male mice produced greater levels of DNP-KLH-specific IgG as a result of  $\text{HgCl}_2$  exposure during gestation.  $\text{HgCl}_2$  exposure did not significantly affect the production of the DNP-KLH-specific immunoglobulins in response to DNP-KLH. Taken together, these data suggest that *in utero* exposure to  $\text{HgCl}_2$  may result in long-term gender-specific alterations of immune system responses.

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## Children in Rural Poverty: Neurological Consequences of Exposure to Chronic Stress

SHOSHANA C. ALEINIKOFF

Under the supervision of Gary W. Evans  
Department of Human Development

Various mechanisms can be explored to help explain the link between poverty and cognition. One mechanism which has received attention is the exposure to chronic stress experienced disproportionately in poverty. A number of studies have documented the effect cortisol can have on cognition, particularly in the hippocampus and the prefrontal cortex. This study aimed to further explore increased circulating cortisol, a biological response to chronic stress, as a mediator between poverty and cognition. In order to explore this relationship, twenty subjects were monitored from birth to age seventeen to determine socioeconomic status, and in turn, determine the proportion of life spent in poverty. At age nine, thirteen and seventeen, cortisol levels were measured using an overnight urine collection and respective analysis. Neurocognitive functioning was measured at age twenty-two using six tasks. The first two tasks, a Hidden Treasure Task and an Object Two Back Task tested spatial working memory. Two tasks were used to test cognitive control: a Number Stoop Task, and a Flanker Task. Finally, two tasks were used to test short term memory: an Incidental Face Recognition Task and an Incidental Object Recognition Task. It was predicted that those individuals who had grown up in chronic poverty would experience heightened levels of cortisol at age seventeen, and heightened error levels on the neurocognitive tasks at age 22, as compared to their more fortunate counterparts. Correlational analyses suggest a relationship between duration of poverty and cortisol levels, and indicate a significant correlation between cortisol levels and neurocognitive functioning. Additionally, mediational analyses suggest that heightened cortisol may account for the well-documented elevated error rates in the spatial working memory tasks and the short term memory tasks. This exploration suggests that individuals who have grown up in poverty have heightened levels of cortisol, and in turn experience neurological deficits affecting cognition, particularly memory.

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## CD103-expressing Foxp3<sup>+</sup> Regulatory T Cells Are Essential for Host Survival in Chronic Schistosomiasis

SIDDHARTHA BAJRACHARYA

Under the supervision of Matthias Hesse  
Department of Microbiology and Immunology

Schistosomiasis is a major tropical infectious disease caused by a trematode parasite. Infection with this pathogen causes a severe inflammatory response against trapped parasite eggs, particularly in the liver and intestine. Survival of the host requires a carefully balanced and tightly controlled inflammatory response against the trapped eggs. T regulatory cells (T regs) are a crucial population of cells for modulating the immune response to the eggs, as an uncontrolled immune response can rapidly result in severe morbidity and heightened mortality.

The mechanism by which the relatively small and constant number of T regs found in schistosomiasis infections are able to suppress the large population of T effector cells is still unknown. The model that we are testing proposes that the contact of T regs and B cells effectively forms a “trap” for T effector cells as they seek restimulation by antigen-presenting B cells. We speculate that activated T regs bind to egg-antigen-presenting B cells via the interaction of the surface antigen CD103 on T regs with its ligand e-cadherin on the surface of activated B cells. We found that CD103-deficient mice have increased liver pathology leading to death, but that transfer of wild-type T regulatory cells rescues them. These mice show no deficiency in Th2 effector response. We also found CD103+ T regs and e-cadherin+ B cells *in vivo*, and that activated CD103+ T regulatory cells have increased suppressive capacity *in vitro*. Fluorescent microscopy revealed close physical contact of T regs and e-cadherin+ cells, as well as increased effector cytokine response in CD103-/- mice. We conclude that CD103+ T regs play a significant role in immune regulation in schistosomiasis, particularly for local cytokine control. CD103+ T regs may also be important in allergies and immune disorders, as well as chronic inflammatory conditions.

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## Stability of Spirometry-Based Classifications for Chronic Obstructive Pulmonary Disease Over Five Years in an Elderly Population

JESSICA L. BROWNELL

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

**Rationale:** The efficacy of pulmonary function (spirometry) testing in detecting the presence of Chronic Obstructive Pulmonary Disease (COPD) for either clinical or research purposes has recently been questioned. Cross-sectional studies have compared the Global Initiative for Chronic Obstructive Lung Disease (GOLD) spirometry-based disease definition to alternative definitions. However, the stability of these disease classifications over time has yet to be addressed. **Objectives:** This study examined the stability of classifications of COPD using variations on the GOLD disease definition (either the standard forced vital capacity (FVC)-based or a forced expiratory volume in 6 seconds (FEV<sub>6</sub>)-based definition) over a five year period. **Methods:** Data from 2,095 participants in a longitudinal study of the elderly comprised the baseline population. Statistical methods included contingency tables, linear and logistic regression, and receiver operating characteristic curves. **Results:** When baseline spirometry data were used to identify participants with COPD, only 19.6% and 12.2% of the cases were similarly classified after five years for FVC and FEV<sub>6</sub>-based disease definitions, respectively (C-statistics: 0.580, 0.586). Neither the proximity of the starting ratio to threshold nor demographic variables explained this result. When baseline spirometry parameters were considered as continuous predictors of subsequent rapid decline in FEV<sub>1</sub>, predictive value improved (C-statistics: 0.886 [declining >3%/yr], 0.879 [declining >4%/yr]). **Conclusions:** Spirometry-based COPD definitions have little consistency over five years in an elderly population, raising questions about spirometry as a stable indicator of the underlying chronic condition. An estimate of annual FEV<sub>1</sub> rate of decline may better reflect both risk of COPD and COPD progression.

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## Impacts of Divergence on Ovulin, a Rapidly Evolving *Drosophila* Seminal Protein

ADAM B. CHRISTOPHER

Under the supervision of Mariana F. Wolfner  
Department of Molecular Biology and Genetics

One major focus of the Wolfner Lab is the study of the Accessory Gland Proteins (Acps) of *Drosophila melanogaster*. Acps are produced in males and passed to females during mating as a component of the seminal fluid. On entering the female reproductive tract, Acps have a variety of effects on the female including increased appetite, increased egg-laying rate, decreased remating rate, decreased lifespan, and also can play a role in sperm storage. One Acp known as ovulin (due to its function in increasing ovulation rate) is of particular interest because it has been shown to be one of the most rapidly evolving genes in the *D. melanogaster* genome.

Further study of ovulin showed that despite its rapid evolution, there are specific conserved residues in ovulin of species as distantly related as *D. pseudoobscura*. This sequence analysis combined with Yeast Two-Hybrid and GST-Pulldown assays indicate the existence of an ovulin dimer with a coiled-coil motif within the female reproductive tract. The fact that the residues that allow for this structure are conserved despite ovulin's significant divergence suggests that dimer formation is necessary for ovulin function.

I tested the interaction of ovulins of 9 different *Drosophila* species including *D. melanogaster* using the Yeast Two-Hybrid system. I found that although ovulins of 4 of the most closely related species showed strong interaction, distant relatives did not show dimer formation despite conserved residues. This suggests that the conserved residues are necessary for dimer formation, but not sufficient.

In order to test the ability of ovulin of two different species of *Drosophila* to interact *in vivo* I could develop a complex scheme of matings involving multiple transgenic lines, but I recently realized that hybrid flies that are the result of a mating between two closely related species should also express ovulin of both parental species. Using a *D. simulans* fly line obtained from the Barbash Lab which is null for a gene titled Lethal Hybrid Rescue (Lhr<sup>-</sup>), I am able to create hybrid male flies which express both *D. simulans* and *D. melanogaster* ovulin within their accessory glands. Preliminary results suggest that I am able to detect the *in vivo* interaction of the two species of ovulin.

To further investigate the mode of action of ovulin, I have been working to test the ability of ovulin of various species of *Drosophila* to induce ovulation when ectopically expressed in virgin *D. melanogaster* females. I developed the transgenic lines that should have made this test possible. During my testing of these new lines, I found that the expression of these ectopic proteins was not as it should be and, therefore, I continue to troubleshoot possible problems. Also, I am carrying out ovulation assays using other control flies.

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## Dynamics of C4 Photosynthetic Differentiation in Maize Bundle Sheath Vascular Bundles

BRIAN M. CONNOLLY

Under the supervision of Klaas van Wijk  
Department of Plant Biology

As a C4 plant, maize utilizes two distinct cell types known as bundle sheath (BS) and mesophyll (M) cells to facilitate a carbon concentration mechanism that helps to maximize CO<sub>2</sub> fixation. BS and M cells are arranged in a Kranz anatomy and accumulate distinct sets of enzymes that allow them to cooperate in carbon fixation and other metabolic functions. A developmental gradient exists within the leaf with incompletely differentiated cells at the base and mature, fully differentiated C4 cells at the leaf tip. The goal of this honors thesis is to describe the differentiation process of BS cells and to determine regulatory, metabolic, and structural functions at different stages of leaf development. To provide an overview of the metabolic and structural changes along the gradient, the soluble and membrane proteomes were extracted from BS strands of 12 day old plants and subjected to 1D SDS-PAGE and MALDI-TOF MS. The soluble proteome was further analyzed with 2D IEF-PAGE and MALDI-TOF MS or LC-ESI-MS/MS. Over 100 spots were matched, quantified, and identified. Three general trends were observed: i) the development of the C4 pathway in the tip was seen by the loss of M specific phosphoenolpyruvate carboxylase and pyruvate orthophosphate dikinase and the appearance of the BS specific NADP-dependent malic enzyme; ii) a well defined source and sink relationship between the tip and base was observed as the tip contained Calvin cycle proteins and the base contained the catabolic sucrose synthase 2 and proteins involved in glycolysis and the Krebs cycle; iii) S-adenosylmethione (SAM) cycle proteins showed extensive localization to the base. The exact reason for this localization is not known, but is likely related to the high demand for methyl groups for cell wall, amino acid, and/or chlorophyll synthesis. Finally, it was also observed that different homologues of a protein can exhibit different localization patterns along the gradient most likely reflecting specific functions within the protein family.

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## Identification of DAF-16 Target Genes in *Caenorhabditis elegans*

RACHEL A. DAVIDOWITZ

Under the supervision of Sylvia Lee  
Department of Molecular Biology and Genetics

The DAF-2/DAF-16 insulin-like signaling pathway in the nematode *Caenorhabditis elegans* controls diverse processes, including longevity, metabolism, stress response and dauer formation, and is orthologous to the human insulin and IGF-1 pathways. DAF-16, a forkhead transcription factor, is the major downstream effector of this pathway. For a complete understanding of the insulin-like signaling pathway, all of the genes that are regulated by DAF-16 must be identified. Our lab previously used bioinformatics to predict evolutionarily conserved DAF-16 targets. The informatic search found that 115 genes contained a DAF-16 consensus binding site in the intergenic regions of both the *C. elegans* and



Drosophila orthologs, suggesting that those genes contain functionally conserved DAF-16 binding sites. In this study, the expression levels of the 115 predicted DAF-16 target genes were screened in DAF-16 active and DAF-16 inactive mutant backgrounds. Nine of those genes were found to be differentially expressed in the DAF-16 activated strain compared to the DAF-16 deletion strain, suggesting that those genes were regulated by DAF-16. Most of the 9 genes were found to be highly expressed in younger, larval stage 1, worms compared to larval stage 4 worms, and several of the genes were differentially regulated under heat shock and starvation stress conditions. One of the 9 genes, F48D6.3 (*hll-13*), was of particular interest because of its homology to a human pancreatic gene and was therefore chosen for further study. Since the 9 genes found in this study were not identified in any previous searches for DAF-16 targets, our screening method appears to be effective for finding DAF-16 target genes that are activated under specific developmental conditions.

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## The Effect of Modifying Dopamine in the Avian Basal Ganglia on Context-Dependent Singing

CHRISTOPHER D. DELANEY

Under the supervision of Timothy J. DeVoogd  
Department of Psychology

The song of the male zebra finch varies in predictable ways between social contexts in terms of several characteristics. Number of introductory notes, motif duration, and songs per bout vary depending on whether the male is singing alone (undirected context) or is singing to a female (directed context). Area X is a large nucleus of the Anterior Forebrain Pathway (AFP) that forms a motor feedback loop with the dorsolateral nucleus of the medial thalamus (DLM) and the lateral magnocellular nucleus of the anterior nidopallium (LMAN). The AFP functions in song learning early in life, but later functions in real-time song modulation. Area X contains both D1 and D2 dopamine receptors and receives dopaminergic inputs from several brain areas. The activity of these dopamine inputs varies by social context, activity within Area X increases during undirected song and decreases in directed song. To determine whether the activity observed in Area X plays a role in the modulation of the aforementioned song structure characteristics, guide cannulae were implanted in zebra finches directed at Area X. Dopamine D1 and D2 agonists and antagonists were infused and characteristics of song were assessed. Experimental data did not yield meaningful conclusions as to the effects of the specific receptor subtypes in Area X. However, the results suggest a possible motivational role for the AFP in the zebra finch.

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## The Role of Telomerase and Small G-proteins in Senescence of Articular Chondrocytes

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As age increases, changes in the cellular regulatory mechanisms have been noted due to the finite number of replications the cell can undergo before senescence. It has been suggested in previous studies that replicative senescence is initiated by telomere erosion. Telomerase is a ribonucleoprotein that adds telomeres to the ends of eukaryotic chromosomes. A decline in telomerase activity during the ageing process is linked with telomere shortening. The Rho family of small GTPases, which includes Rho, Rac, and Cdc42, are known to interact with cellular target proteins to regulate a variety of cellular responses including cell cycle regulation. In this honors thesis study, horse (*Equus equus*) chondrocytes, or cartilage cells, were used as a cellular model for studies of endogenous telomerase activity in somatic cells and to investigate the potential of small GTPases to alter telomerase activity. Chondrocytes were transfected with constitutively active, dominant negative, and wild type forms of Rho, Rac, and Cdc42. Telomerase activity was measured using a combined telomere repeat amplification protocol (TRAP) and enzyme-linked immunosorbent assay (ELISA) assay. Telomerase remained active in chondrocytes until 10 months of age, and cell lysates prepared from chondrocytes obtained from prepubescent and pubescent age groups had significantly more telomerase activity than samples from post-pubescent and mature chondrocytes. However, active GTPases did not restore telomerase activity in mature chondrocytes or decrease telomerase activity in prepubescent chondrocytes. These results suggest that small G-proteins do not mediate telomerase activity in mature and prepubescent chondrocytes. Experiments are currently being conducted which suggest that Cdc42 wild type and Rho wild type increase telomerase activity in pubescent horses older than 10 months.

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## Investigating the Role of NMNAT-1 in the Regulation of NAD<sup>+</sup> Consumers in the Nucleus: The Interaction of NMNAT-1 with PARP-1 and SIRT1

MICHELLE E. DUMOND

Under the supervision of W. Lee Kraus  
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Nicotinamide adenine dinucleotide (NAD<sup>+</sup>) is an important substrate for proteins carrying out vital cellular functions. In the nucleus, NAD<sup>+</sup> is the substrate for poly(ADP-ribose)-ylation reactions that are carried out by a number of poly(ADP-ribose) polymerases (PARPs) including PARP-1. Nuclear NAD<sup>+</sup> is also a substrate for silent information regulator (SIRT1), an ADP-ribosyl transferase and protein deacetylase. Both PARP-1 and SIRT1 have a number of functions in the nucleus, including transcriptional regulation. It has previously been determined that changes in local concentrations of NAD<sup>+</sup> around active PARP-1 and SIRT1 have an impact on the activity of the enzymes themselves, suggesting that the regulation at the level of NAD<sup>+</sup> local concentrations may play a key role in modulating the activities of NAD<sup>+</sup> consumers [31]. One hypothesis for this regulation is the binding of

NAD<sup>+</sup> synthesizers to the NAD<sup>+</sup> consumers. This mechanism supplies an individual NAD<sup>+</sup> substrate for the consumer at a specific concentration regulated by the NAD<sup>+</sup> producer. Nicotinamide mononucleotide adenylyl transferase-1 (NMNAT-1) is a potential player because it is the final enzyme in the synthetic pathway of nuclear NAD<sup>+</sup> production, and it has been shown to affect PARP-1 activity in vitro [4]. Therefore, NMNAT-1 is a good candidate for investigating the role of NAD<sup>+</sup> producers in regulating NAD<sup>+</sup> consumers.

In my analysis of the interaction between NMNAT-1 and PARP-1, as well as NMNAT-1 and SIRT1, I generated a GST-tagged version of NMNAT-1 as well as two GST-tagged catalytically inactive NMNAT-1 mutants, and I looked for binding to endogenous PARP-1 and SIRT1. Using a GST pulldown assay, I found that NMNAT-1 binds PARP-1 and SIRT1 independent of its catalytic activity. This interaction provides evidence for a potential regulatory role of NMNAT-1 binding in the activities of PARP-1 and SIRT1.

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## Effect of a Mutation on the Channel-opening Equilibrium of a $\gamma$ -Aminobutyric Acid Receptor Linked to Epilepsy

KYLE P. EAGEN

Under the supervision of George P. Hess  
Department of Molecular Biology and Genetics

$\gamma$ -Aminobutyric acid A (GABA<sub>A</sub>) receptors are a family of neurotransmitter receptors that participate in regulating signal transmission between the  $\sim 10^{12}$  cells of the mammalian nervous system by controlling the amount of chloride ion (Cl<sup>-</sup>) flux across the cell membrane. GABA<sub>A</sub> receptor-mediated Cl<sup>-</sup> influx into a neuronal cell inhibits signal transduction between cells. Differential activity of excitatory *versus* inhibitory neurotransmitter receptors is believed to be linked to epileptogenesis by an abnormal downregulation of inhibitory neuronal transmission. Two independent mutations in the  $\delta$  subunit of the GABA<sub>A</sub> receptor – a glutamate-to-alanine mutation at residue 177 or an arginine-to-histidine mutation at residue 220 – cause a decrease in GABA<sub>A</sub> receptor-mediated Cl<sup>-</sup> influx and are linked to epilepsy [Dibbens *et al.* (2004) *Hum. Mol. Genet.* 13, 1315-1319]. Previous work showed that the primary effect of the  $\delta$  subunit mutations is to reduce the mean channel-open time of the receptor [Feng *et al.* (2006) *J. Neurosci.* 26, 1499-1506]. However, the value of the channel-opening rate constant ( $k_{op}$ ), and consequently the value of the channel-opening equilibrium constant ( $\Phi^{-1} = k_{op}/k_{cl}$ ), of the receptor is unknown. Using a rapid reaction technique, the cell-flow technique [Udgaonkar, J. B., and Hess, G. P. (1987) *Proc. Natl. Acad. Sci. U. S. A.* 84, 8758-8762], I have determined the value of the dissociation constant of GABA for both the wild-type and mutated forms of the receptor. In addition, I show that  $\alpha$ CNB-caged GABA inhibits the wild-type receptor and, therefore, cannot be used for the transient kinetic photolysis technique [Milburn *et al.* (1989) *Biochemistry* 28, 49-55] to determine the value of the channel-opening and -closing rate constants. Finally, I show that two compounds, phenobarbital and tracazolate, potentiate the mutated form of the receptor and may be potential compounds to alleviate the malfunction of the mutation.

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## Emotional Memory Consolidation During Sleep: The Relationship Between Active Avoidance Learning and REM Sleep in Humans

FRANK A. FETTEROLF

Under the supervision of Helene S. Porte  
Department of Psychology

Research strongly suggests that affective memory consolidation depends on post-training rapid eye movement (REM) sleep. Many of these findings have come from animal literature employing the emotional learning paradigm, active avoidance. Human studies involving fear conditioning and sleep have yet to be accomplished. In this experiment, a computer adaptation of the shuttle-box task was created and piloted for effectiveness. Baseline and post-training polysomnographic recordings were done for each participant. In accordance with findings in animals, human participants who learned the shuttle-box analog had a higher percentage of REM sleep compared to baseline. Performance in the task also positively correlated with the amount of REM sleep increase. These findings are consistent with findings in animals, and strengthen the notion that REM sleep is critical for the consolidation of affective memory.

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## Geographic Variation in Genetic Structure of an Atlantic Coastal Forest Endemic Reveals Regional Differences in Habitat Stability

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Climatic oscillations throughout the Pleistocene combined with geological and topographic complexity resulted in extreme habitat heterogeneity along the eastern Atlantic coast of Brazil. Understanding how these historic landscape patterns have structured the current diversity of the region's biota is important both for academic and conservation purposes. Here we evaluate potential historical scenarios of diversification in the Atlantic Coastal Forest of Brazil by investigating the population genetic structure of a frog endemic to the region. Using a panel of mitochondrial and nuclear loci, we created a Bayesian population-level phylogeny of the *Thoropa miliaris* species complex. We found deep genetic divergences between five geographically distinct clades. Southern clades were monophyletic and nested within paraphyletic northern clades. Analyses of historical demographic patterns suggest an overall north to south population expansion, likely associated with regional differences in habitat stability during the early Pleistocene. However, genetic structure among southern populations is less pronounced and likely represents more recent vicariant events resulting from sea-level oscillations in the Holocene. Our analyses corroborate previous suggestions that the Atlantic Coastal Forest has been a biogeographically dynamic landscape historically and suggest the high diversity of its fauna and flora has been shaped by a combination of climatic events from the early-Pleistocene to the present.

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## Genera-level Variation in *Asclepias* in Photosynthetic Function: The Influence of Pubescence and Epicuticular Waxes

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Department of Ecology and Evolutionary Biology

*Asclepias*, a genus of 108 species arrayed across a wide range of microhabitats, is thought to have undergone rapid speciation from an original six species. Rapid speciation has created high morphological diversity within the genus, especially in terms of leaf structure and physiology. Leaf pubescence and epicuticular waxes appear to have arisen numerous times in the evolutionary history of the genus. Both traits are known to confer anti-herbivory protection, participate in photoprotection and influence photosynthetic function through adjustments to leaf boundary layer resistances and energy balance. In the present study, we explored photosynthetic performance across the genus under common-garden conditions. Maximum photosynthesis was higher in plants with hairy and waxy leaves compared to glabrous leaves. However, lower foliar  $\delta^{13}\text{C}$  was observed in hairy and waxy leaves compared to glabrous suggesting higher ratios of leaf internal to external  $\text{CO}_2$  concentration. The response of plants to increasing internal  $\text{CO}_2$  concentration (i.e., A-c<sub>i</sub> curves) suggested that glabrous leaves exhibit both the highest rates of  $\text{CO}_2$  diffusion into the leaf and the highest rate of electron transport. In contrast, hairy and waxy leaves had higher levels of total leaf nitrogen compared to glabrous leaves suggesting hairy and waxy leaves may have more carboxylation enzyme (Rubisco) per unit leaf area. Diurnal measurements of photosynthesis showed that all leaf types have similar net carboxylation and stomatal conductances. It appears that across the *Asclepias* genus, leaf morphological characteristics vary in response to a large array of factors, but this variation is modulated by significant trade-offs to maximize photosynthetic performance for any given morphology.

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## Sperm Competition in *Drosophila melanogaster* and Its Association with Variation in Male Reproductive Genes on the X Chromosome

LEAH J. GREENSPAN

Under the supervision of Andrew Clark  
Department of Molecular Biology and Genetics

Variation in reproductive success has long been thought to be mediated by differences in the genotypes of seminal proteins. Due to the absence of genes encoding accessory gland proteins found on the X chromosome, this chromosome has not thoroughly been studied for its affect on reproductive phenotypes. In this study I explore the affect of different polymorphisms found in genes on the X chromosome on reproductive phenotypes. Using 57 naturally variant X chromosome substitution lines, I scored the differential success in sperm competition experiments both when the males from the wild-extracted line were the first to mate (“defense crosses”) and when they were the second to mate, after a

standard tester male (“offense crosses”). I determined if there was significant variation among lines in fecundity of both offense and defense experiments, proportion of progeny sired when the experimental male was either the first or second to mate, re-mating rate, and refractoriness. Eleven candidate genes were chosen based on previous studies, and portions of these genes were sequenced in all 57 lines. A total of 94 polymorphisms and indels were identified and tested for associations with the reproductive phenotypes using ANOVA. Nine polymorphisms out of 4 genes were found to have nominally significant associations with the reproductive phenotypes ( $p < 0.05$ ).

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## *Toxocara canis* Antigen Detection

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The ascaridoid parasite *Toxocara canis* infects dogs and can cause intestinal obstruction, anemia, and respiratory disease in this host. This project aims to discover those antigens that will best characterize a canine infection. In isolating these, antibodies can be made, which can be tested for specificity of binding to *T. canis* antigens. Different organs of the body in male and female adult nematodes have been isolated and proteins from each part were compared to each other and to proteins collected from the whole nematodes. Proteins of three different mass ranges isolated by electrophoresis from the female reproductive tract were used to make three antibodies in inoculated chickens. The antibodies made to smaller mass ranges cross-reacted with all body parts of *T. canis*. Those made to the large and medium mass range of the antigen profile were specific to their respective masses in the female reproductive antigen. The large mass range antibodies were also specific to female body parts. This suggests that the heavier antigens of the female reproductive tract are specific to this parasite. Additionally, the female reproductive tract proteins were deglycosylated and specific bands from an electrophoresis gel were isolated to create polyclonal antibodies. These polyclonal antibodies cross-reacted with *T. cati* and some other parasites. This suggests a carbohydrate determines the specificity of *T. canis*.

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## Phagotrophy and Exotoxins as Important Initial Selective Pressures in the Evolution of Multicellularity

JASEN P. MURRAY

Under the supervision of H. Kern Reeve  
Department of Neurobiology and Behavior

A hostile environment is one selective pressure that has played an important role in the evolution of group living through prolonged association of offspring with parents. Here, I construct a general model of the origin of undifferentiated multicellular colonies by offspring adhesion in response to selective pressure from harsh environmental conditions. This general model predicts optimal colony sizes in the many thousands of cells as death-causing factors in the environment increase in concentration for biologically reasonable values of the cost/benefit parameters. Two special cases of this general model:

predation from phagotrophic cells and predation from exotoxin secreting cells were also analyzed in order to generate more specific, testable predictions. Phagotrophy is predicted to readily favor colony sizes just large enough to completely prevent ingestion but no more, regardless of the intensity of selection. The exotoxin secretion model predicts an exponential increase in optimal colony size as exotoxin concentration increases and will favor spherical colony geometries. More generally, the ways in which fitness and group size vary with different cost/benefit parameter values may at least partially explain variation in colony geometry found in nature.

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## Phenotypic Variation Across Genetically Distinct Regions of a Neotropical Anuran: Discordance in Body Size, Color Pattern, and Advertisement Call

MICHEL E. OHMER

Under the supervision of Kelly Zamudio  
Department of Ecology and Evolutionary Biology

Patterns of intraspecific geographic variation in morphology and behavior, when placed in a phylogenetic context, can provide insight into the mechanisms of speciation. Here, we quantified variation in body size, dorsal pattern frequency and male advertisement call among genetically divergent regions of the hourglass treefrog, *Dedropsophus ebraccatus*, in Costa Rica and Panama, and tested the covariance of these characters with geographic distance and phylogenetic history. This species was previously considered to be uniformly polymorphic across its range. However, we demonstrated regional divergence in body size, dorsal pattern frequencies, and advertisement call. These characters did not covary with phylogenetic history or geographic proximity, with the noted exception of a gradual change in body size with respect to geographic distance of populations along a linear spatial array. Our comparison of divergence patterns in morphological and behavioral characters indicated the importance of highly localized selection pressures, likely in combination with genetic drift, acting among genetically isolated regions to drive phenotypic distinctions. Differentiation among populations can easily be overlooked, especially in anuran species that appear homogenous across large portions of their range. This study underscores the importance of detecting regional patterns of phenotypic diversity to identify populations and species prone to diversification, even over relatively small spatial scales.

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## Photoperiod Modulated Ovarian Development in Siberian Hamsters (*Phodopus sungorus*)

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In Siberian hamsters (*Phodopus sungorus*), day length significantly modulates ovarian development. By 10 wks of age, substantial differences in ovarian histology are apparent in hamsters raised in short days (SD; 10h light/day) as compared to long days (LD; 16h light/day). In particular, SD ovaries have a

larger pool of primordial follicles and an abundance of hypertrophied granulosa cells (HGC) that surround atretic oocytes. HGCs in SD ovaries appear to be endocrinologically active and are immune-reactive to anti-Müllarian hormone (AMH), a hormone known to inhibit primordial follicle activation. Therefore, the increased AMH in SD ovaries, which may be attributed to the abundance of HGC, is a potential mechanism to explain the unusual ovarian phenotype in SD hamsters. To determine when the SD phenotype is first observed and if AMH contributes to the development of the SD phenotype, an assessment of ovarian histology and AMH expression patterns in animals from 1-12 wks of age was completed. In this study, it was found that paired ovarian, body and uterine mass were significantly less in SD than in LD by 3, 4 and 6 wks of age, respectively. Additionally, marked differences in ovarian histology were observed by 6 wks of age. These results indicate that the SD phenotype develops between 4 and 6 wks of age. Histological observations also revealed that the SD condition is not a transitional state in development through which the ovary passes in hamsters raised in LD, but rather is unique to the SD hamster. A more detailed study of the differences between SD and LD ovaries at 4 wk and 10 wk was completed to analyze the role of AMH in the development of the SD phenotype. At 4 wks of age both LD and SD females are juveniles and their ovaries, histologically, are very similar. Conversely at 10 wk, the ovarian phenotypes have diverged and while LD hamsters have matured, SD females have remained juvenile. Serum AMH concentration did not differ significantly by age or photoperiod but AMH tended to be higher in LD females at both ages. Additionally, *Amh* mRNA was significantly higher at 4 wk than 10 wk of age, and at 10 wk *Amh* tended to be higher in SD than LD ovaries. The comparable *Amh* mRNA levels in LD and SD ovaries at 4 wk of age lessened the likelihood that AMH drives the development of the SD phenotype.

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## Genetic Consequences of Habitat Specialization and Climate Fluctuations in the Texas Alligator Lizard, *Gerrhonotus infernalis*

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Habitat specialization, that is, the adaptation of a species to particular habitat, may be best considered as a continuum from more generalist species that occur over a broad range of environmental conditions, to more specialist species that occur only under a narrow range of conditions. Most species lie towards the middle of this continuum, however even these species are likely to be affected by this specialization. We used mitochondrial DNA to study the effects of habitat specialization and to assess the population structure and historical demography of the Texas Alligator Lizard, *Gerrhonotus infernalis*, in the Edwards Plateau and Big Bend regions of Texas. This species is an inhabitant of mesic forests in a region that has experienced climatic fluctuations due to Pleistocene glaciations and a severe mid-Holocene drought. Thus, *G. infernalis* is an ideal species with which to test hypotheses about the effects of habitat specialization and climate fluctuations on genetic structure and diversity within species. We sequenced 1,645 base pairs of mtDNA spanning two gene regions (ND4 and COIII) in 24 individuals from 8 populations, including populations from the Chisos Mountains in the Big Bend and five of the six major drainages of the Edwards Plateau. We found a deep divergence between the Edwards Plateau and Chisos Mountains, but only low levels of divergence within the Edwards Plateau. We also found evidence for a dramatic population expansion of Edwards Plateau populations occurring between



40,720 and 114,362 years before present, during the most recent glacial period. The low genetic diversity within the Edwards Plateau and the recent population expansion indicate that *G. infernalis* may have recently colonized the Edwards Plateau from populations further west or south. Our data underscore the importance of historical landscape changes and their interaction with evolved habitat preferences in determining intraspecific genetic variability.

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## Nutrient Limitation and Nitrogen Source Preference of *Aspergillus sydowii*, the Causative Agent of Aspergillosis of Sea Fan Corals

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Department of Ecology and Evolutionary Biology

Coral reefs have been declining for at least the last three decades. A significant contributor to this decline is disease. Caribbean sea fan corals (*Gorgonia ventalina*) are currently impacted by aspergillosis, a disease caused by the terrestrial fungus, *Aspergillus sydowii*. There is little known about the factors regulating marine diseases, such as aspergillosis. One factor likely to play an integral role in aspergillosis prevalence and severity in gorgonians is increasing concentrations of nitrogen and phosphorus in the local environment, which are believed to exacerbate coral disease dynamics and subsequently, coral reef decline. This study examined the impact of nutrient concentration and nitrogen source (gorgonian vs. nitrate) on five strains of *A. sydowii* to 1) identify limiting nutrients to growth, 2) determine whether *A. sydowii* is capable of assimilating gorgonian-derived nitrogen, and 3) to ascertain fungal preferences for different nitrogen sources. The growth of *A. sydowii* did not vary significantly with small, ecologically relevant changes in the concentrations or proportions of nitrogen and phosphorus, but *A. sydowii* growth under these conditions varied among strains. After a 10-fold increase in nutrient concentrations, variations in colony diameter did not suggest N-limitation; however, these diameters were significantly larger than those under the lower nutrient concentrations. Stable isotope experiments demonstrate that *A. sydowii* can assimilate gorgonian N (72% of total N) and preferentially assimilates organic N from the sea fan over nitrate. All fungal strains varied in their assimilation ability, suggesting that individual variation in fungal metabolism is high.

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## C Fos Expression in Subordinate Male Hamsters Following Agonistic Behavior Against Both Sexes

LAUREN E. ROTMAN

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Department of Psychology

Previous studies have assessed the connection between brain activation in male hamsters following both aggressive and sexual experiences. These connections have allowed for comparison of male brain activation following exposure to both males and females. However, performing this comparison in the

context of two such different experiences as aggression and copulation may affect the comparison that can be made. This study attempts to account for this inconsistency by comparing male brain activation upon exposure to both males and females each in the context of aggression. Patterns of c-Fos activation in subordinate male golden hamster brains were compared for both males experiencing aggression from another male and males experiencing aggression from a female. The results of this study indicate similarities in activation for both male-male and male-female fights in the anteroventral part of the bed nucleus of the stria terminalis. Male-male fights selectively activated the anterointermediate and anteromedial parts of the bed nucleus of the stria terminalis, the ventral part of the premammillary nucleus, and the ventromedial hypothalamic nucleus. Male-female fights selectively activated the posteromedial part of the bed nucleus of the stria terminalis. The small amount of significant c-Fos activation similarities indicated between the two social experimental groups (male-male and male-female aggression) weakens the proposed theory of a social-neural network activated in response to all social experiences.

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## Malignant Transformation of Mesenchymal Stem Cells in a p53 and Rb Deficient Mouse Model

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Under the supervision of Alexander Nikitin  
Department of Biomedical Sciences

Currently, soft tissue sarcoma (STS) diagnosis is difficult due to a limited understanding of their origin and pathogenesis. Our lab aims to detail the formation of these cancers through conditional inactivation of *p53* and *Rb* tumor suppressor genes using the Cre-recombinase-loxP system and an adenovirus expressing vector (*AdCMVCre*) in mice. Aberrations in these two genes occur frequently in STSs, with over 50% of cancers exhibiting altered p53 status alone. Similar to human STSs, our model's tumors show multilineage differentiation, indicating that mesenchymal stem cells (MSC) may be the target for carcinogenesis. To evaluate this possibility, male  $p53^{loxP/loxP}Rb^{loxP/loxP}$  mice were used to create plastic adherent dermal (PAD) tissue cultures. Cells then underwent Fluorescence Activated Cell Sorting (FACS) after staining with Stem Cell Antigen-1 (Sca-1) antibody and were isolated into 3 populations based on fluorescence intensity: negative, low, and high. Non-transformed Sca-1<sup>low</sup> cells showed an increase in growth rate, indicating possible MSC enrichment. Further, PAD cells are shown to differentiate in tissue culture along specific lineages seen in our mouse model, including skeletal muscle and endothelium. Following induced transformation with *AdCMVCre*,  $p53^{loxP/loxP}Rb^{loxP/loxP}$  Sca-1<sup>low</sup> cells were found to have an increased potential for invasion, greater motility, and were most capable of anchorage independent growth in soft agar. When using the additional stem cell marker CD13, results show that Sca-1<sup>low</sup>CD13<sup>+</sup> cells represent a more select population with a greater potential for invasion than Sca-1<sup>low</sup>CD13<sup>-</sup> cells. Taken together, our results indicate that MSCs cells act as oncogenic precursors in STSs associated with *p53* and *Rb* deficiency. Furthermore, Sca-1<sup>low</sup>CD13<sup>+</sup> cells represent a better defined population useful for further study of MSCs and their role in STSs.

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## Phylogeography, Species Limits, and Conservation of the Palm-Tanagers (*Phaenicophilus*)

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Laboratory of Ornithology

The Tiburon Peninsula of Haiti is a biodiversity hotspot, with many endemic species and populations threatened by extensive habitat loss. The Palm-Tanagers, *Phaenicophilus palmarum* and *P. poliocephalus*, are parapatric sister species whose ranges meet near the base of the Tiburon Peninsula. These forms have been considered conspecific, especially after the discovery of a hybrid zone. *Phaenicophilus poliocephalus* is of conservation concern because of its restriction to Haiti, and taxonomic resolution will aid in conservation efforts. Molecular phylogeographic analyses can identify evolutionarily distinct populations in *Phaenicophilus* which can be used as units for conservation management. We used a multilocus coalescent analysis based on sequences from one mitochondrial gene and three nuclear introns to examine patterns of divergence and migration between *Phaenicophilus* populations. We compared patterns of divergence based on the genetic phylogeographic structuring in the genus and those based on morphological measurements. Mitochondrial haplotypes formed two reciprocally monophyletic groups separated by substantial divergence. Nuclear intron alleles formed congruent genealogical patterns with less divergence, but with reciprocal monophyly at two of the three loci examined. Coalescent analyses indicate a non-zero divergence time for the two groups and low levels of migration, as expected given the existence of a hybrid zone between the species. The two species differ significantly in body size and bill shape. The most likely topographic barrier to gene flow is the ancient sea channel that once split the Tiburon Peninsula from the mainland, suggesting allopatric divergence followed by secondary contact near the Peninsula. The significant phylogeographic structuring congruent with currently defined species limits, the lack of population structure within either clade, the high degree of mitochondrial divergence, and the significant morphological differences all support the continued recognition of two Palm-Tanager species. This work confirms *P. poliocephalus* as Haiti's only endemic bird species, lending conservation support for the only reserve that currently protects it, the Macaya Biosphere on the Tiburon Peninsula.

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## Electric Signaling and Knollenorgan Receptor Properties In the Genus *Campylomormyrus* (Mormyridae)

NATALIE TRZCINSKI

Under the supervision of Carl D. Hopkins  
Department of Neurobiology and Behavior

Natural selection acts upon both signalers and receivers to ensure that communication signals are economically generated and efficiently detected and discriminated (Hopkins, 1976). Mormyrid fish communicate using weak pulse-type electric signals (electric organ discharges, or EODs) that vary

according to the species and sex of the signaler. These fish sense EODs using the Knollenorgan, one class of tuberous electroreceptor which is specialized for communication. It has been proposed that this receptor's filtering characteristics should enhance features of the species-specific EOD such that these fish may better discriminate between conspecifics and heterospecifics. In particular, the receptor's membrane electrical resonance allows the cell to respond best to a certain frequency (Bennett, 1971). Previous work has demonstrated electroreceptor tuning to conspecific EOD frequency in gymnotiforms (weakly electric fish from South America) (Hopkins, 1976, Bastian, 1977). However, there has never been a comprehensive study comparing the electroreceptor tuning properties across several species of mormyrids that exhibit EODs of various durations.

This study sought to describe these properties in an unusual genus, *Campylomormyrus*, which contains species with EODs ranging from 0.2 msec to 10 msec long and peak frequencies from 6500-200 Hz. We sampled fish from four species of *Campylomormyrus* which had EOD durations of 0.2-2.5 msec and peak frequencies of 6500 to 500 Hz. A majority of Knollenorgans across four species of *Campylomormyrus* were preferentially tuned around 1 kHz, and tuning across these four species did not match the EOD peak frequency. Knollenorgans were found to be more broadly tuned than those observed in several species of gymnotiforms. We observed that two *C. alces* individuals' EOD waveforms elongated and changed shape over the course of five months. In addition, we found an unusual receptor property in three species sampled: unlike the usual single spike-like receptor potential recorded in other mormyrid Knollenorgans, we saw receptor potentials exhibiting depolarizations 0.1 msec after the initial spike. We referred to these as "spikelets."

We believe that this genus may be characterized by EOD alteration during a fish's lifetime. A recent study suggests a similar phenomenon of EOD elongation in *C. numenius*, particularly during male sexual maturation (Feulner, 2006). Therefore, it may be advantageous for these fish to have electroreceptors broadly tuned, versus sharply tuned to their current EOD peak frequency, if they are encountering conspecifics with EODs of varying durations. It may be also advantageous for these fish to have Knollenorgans tuned to lower frequencies if EOD elongation is common during sexual maturation. We are unsure of the exact purpose of the unusual receptor potentials, or "spikelets" or how they are related to altered electroreceptor morphology. They may be functioning to increase transmission of high frequency signals in those fish with very short EODs. This data encourages further investigation of the EOD stability across the entire genus of *Campylomormyrus*, and supports the hypothesis that Knollenorgan properties may be more complicated than previously envisioned and may filter the electric signal in ways not yet described.

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## Effect of Macroinvertebrates on Leaf Decomposition in a North Temperate and a Tropical East African Stream

DEREK C. WEST

Under the supervision of Alexander S. Flecker and Christine L. Goodale  
Department of Ecology and Evolutionary Biology

The process of leaf breakdown in streams may differ markedly between temperate and tropical streams. Studies in tropical streams have indicated a paucity of shredding macro-invertebrates relative to

temperate streams, possibly due to an underestimation of the impact of large mobile shredders. To investigate the impact of shredders on leaf decomposition, this study was conducted in third order streams in Ithaca, NY and Gombe Stream Park, Tanzania. Fine and coarse mesh packs were used to assess the impact of excluding all shredders while a cage exclusion experiment was used in Tanzania to exclude large mobile crabs. Leaves of black alder (*Alnus glutinosa*) and three local species were used in each site. *A. glutinosa* decayed extremely rapidly ( $k > 0.1$ ) in coarse packs in Tanzania, which was significantly faster than breakdown in Ithaca ( $k = 0.023$ ). Breakdown of *A. glutinosa* was approximately twice as fast in coarse packs as in fine mesh packs at both sites. Local leaves generally decayed faster in Tanzania than in Ithaca. Only one of three local leaves at each site showed significant differences between fine and coarse mesh packs. Surprisingly, no significant differences were observed between crab treatments. In Tanzania, less than 3% of invertebrates associated with the leaf packs were identified as shredders, which appear to be a small but important part of leaf breakdown in this system. In contrast to other tropical sites with large crustaceans, crabs are not an important contributor to the breakdown of the leaf species studied in Tanzania.

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## Significant Effects of D2 Receptor Modulation on Odor Discrimination

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Under the supervision of Christiane Linster  
Department of Neurobiology and Behavior

Previous experiments in our lab showed that D1 and D2 receptors, when modulated through systemic injections, have opposing effects on odor discrimination learning (Yue et al., 2004). To test whether these dopaminergic effects were mediated via the first processing stage, the olfactory bulb, we followed up on Yue's study using twelve cannulated male Sprague-Dawley rats. Direct infusion of D1/D2 agonists and antagonists into the olfactory bulb allowed us to more specifically investigate how localized modulation of these two receptor types affects olfaction. D1 (agonist SKF 82958, 14.61mM, 43.82mM, 143.64mM; antagonist SCH 23390 HCl, 13.36mM, 40.09mM, 60.14mM) and D2 (agonist quinpirole, 78.19mM, 117.28mM, 156.37mM; antagonist sulpiride, 0.29mM, 0.88mM, 2.93mM) receptor activation was manipulated during simultaneous odor discrimination tasks. We determined that bulbar modulation of D2 but not D1 receptors significantly affected rats' odor discrimination performance. A significant positive correlation (Pearson's R,  $p < 0.01$ ) between blockade of D2 receptors and discrimination performance was observed, and a significant negative correlation between discrimination performance and D2 receptor activation was also observed.

## The Roles of Food Odorants and Diet in Larval Development of *Drosophila melanogaster*

NICHOLAS A. LEDESMA

Under the supervision of Brian Lazzaro  
Department of Entomology

Resource assessment via sensory information has been shown to have internal effects on physiology as well as more noticeable behavioral effects. Specifically, the regulation of longevity and fecundity in *Drosophila melanogaster* adults is connected to diet restriction and olfactory sensing of nutrient availability. The effects of this food odorant/diet restriction response on the development of *D. melanogaster* larvae have never been tested, despite the possibility that nutrient availability, and, therefore, nutrient sensing, may be more important to this developmental stage than to an emerged adult fly. This study was performed to determine the effects of diet restriction and food odorants on the time and success of pupation and emergence in *D. melanogaster*. Equal numbers of eggs from two lines of flies, a mutant for the olfactory receptor gene *Or83b* and a control with the same genetic background, were exposed to four treatments of normal diet or restricted diet with or without yeast odorants. It was found that genotype and diet, but not odorant exposure, had a great impact on larval development.

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## Degradation of Sulfonamides in Aqueous Solution by Membrane Anodic Fenton Treatment

KATHERINE J. NEAFSEY

Under the Supervision of Ann T. Lemley  
Department of Fiber Science and Apparel Design

Two agricultural antibiotics used heavily in agriculture, sulfamethazine and sulfadiazine, were degraded in an aqueous system by the anodic Fenton treatment (AFT), an advanced oxidation technique that has been shown to be effective in degrading various pesticides but had never been applied to antibiotics. The effects of the  $\text{H}_2\text{O}_2$ :  $\text{Fe}^{2+}$  ratio, Fenton reagent delivery rate, and initial contaminant concentration on the degradation of sulfamethazine by AFT were determined. The optimal  $\text{H}_2\text{O}_2$ :  $\text{Fe}^{2+}$  ratio was determined to be 10:1 and the optimal Fenton reagent delivery rate was found to be between  $38.9 \mu\text{M}\cdot\text{min}^{-1}$  and  $54.4 \mu\text{M}\cdot\text{min}^{-1}$ . Under these conditions, sulfamethazine was completely degraded at a range of concentrations ( $18 \mu\text{M} - 250 \mu\text{M}$ ) commonly found in manure lagoons, contaminated rivers, and groundwater within 10 minutes. Using the same optimal conditions, the effect of pH on the degradation of sulfadiazine by AFT was analyzed, and it was determined that  $100 \mu\text{M}$  sulfadiazine degrades within 6-8 minutes of treatment at a range of pH values (3.1 – 7.1) could potentially be found in the aquatic environment. Degradation products and pathways were proposed for both compounds and it was determined that the AFT degradation products of sulfadiazine and sulfamethazine are unlikely to retain the same antibiotic properties as their parent compounds.

## A Need for Change: Rethinking the Design of Modern Swine Production Facilities

G. DANIEL CASTLE

Under the supervision of Peter J. Trowbridge  
Department of Landscape Architecture

For nearly 9,500 years humans have bred domesticated hogs. Once a business dominated by small rural farms, pig farming has now become a specialized industry where thousands of swine are produced in a single facility. This specialization of American farms has reached across the world, and has greatly changed the agricultural industry since the 1960's and continues to affect rural life everywhere.

Intensification of production has modified animal environments in facilities; swine and poultry being most affected. In many cases, what has made management easier for humans has created substandard conditions for livestock. Systems that have turned to intensification have created situations where production animals are unable to express their natural behavior thus causing increased stereotypes, and general apathy. These production practices that have developed in the past forty years must be assessed and other options tried in order to continue to better the animal environments we create.

Along with devising alternative systems and procedures for current production facilities, many new technologies can be incorporated into commercial pig farming. These technologies can capitalize on the resources available to swine producers and help cut costs incurred in facility management.

With this thesis I plan on exploring production facility alternatives in place of gestation crates while encouraging the use of alternative energy sources related to these facilities. My hope is to consider different options to provide a quality environment for pigs which allows them to carry out their "natural" behaviors while also appealing to the economics of the commercial pig farmer and the increasing pressure for industries to become "sustainable" and "green."

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## The Necessity of Place

BONNIE C. KIRN

Under the supervision of Deni Ruggeri and Daniel W. Krall  
Department of Landscape Architecture

Potential is what landscape architects design for. Potential is the catalyst of passion, purpose, and the will to make the world better. It seems foolish to suggest that landscape architects can forget what they are designing for, but it is entirely true in the design field. It is easy to get caught up in the act of design, easy to use the unique opportunity to make a place an icon representative of the designer, rather than a reflection of existing conditions and circumstances. It is the responsibility of a designer to channel the desire to represent his or herself in the design opportunity, into a productive, intelligent, and passionate expression of place. Designers have the unique opportunity to use their holistic understanding of spatiality and of human behavior to mold lost landscapes into prospective places. It is the responsibility



of the designer to consider human behavior in the design of their spaces. The three parts of this thesis aim to show the necessity of understanding place for designers and the approachable process that a designer may go through in order to understand how to design for the idea of place.

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## Line and the Landscape: An Exploration into the Process of Making Landscapes

KASEY R. TOOMEY

Under the supervision of Andrea G. Hammer  
Department of Landscape Architecture

The interaction of man with his environment rests in a linear relationship of representation, form making, and dialectic. As referenced through the theory of painting, pictorial form is created through the use of point and line to plane. An inherent parallelism is established between the act of creating form on a surface and man's act of creating landscape. As humans we create the landscape through the body from eye to mind to hand. The idea of the point is expressed as the physical form of man in relation to the surface of the earth. Man interacts with his environment through the activation of that point into linear form. The intersections of linear form created makes visible the language of man's relationship with his environment by creating, framing, and forming the horizontal plane of the landscape. The exploration into this process of making the landscape exposes man's perception of his environment in a manner that begins a personal dialogue between the landscape and me. Using this exploration I begin a personal grounding of the landscape with my hometown of Altoona, Pennsylvania. Formalizing the relationship I have had to the landscape I was born into establishes a framework for continual intrigue into the making of the landscape.

### The Effects of Increased Nitrogen Deposition, Elevated Carbon Dioxide and Nitrogen Dioxide Fumigation on Mycorrhizal Fungi and Root Hairs

RENEE A. DILLON

Under the supervision of Jed P. Sparks  
Department of Ecology and Evolutionary Biology

Concentrations of reactive nitrogen and carbon dioxide in the atmosphere have increased due to human activities such as fossil fuel burning, deforestation, and agricultural. These increases have altered the chemical reactions and composition of the atmosphere and the soil of many ecosystems, with potential to significantly influence multiple ecosystem properties and the interactions among species. In this study, I examined the roots of sugar maple (*Acer saccharum*) to determine how changes in nitrogen deposition, elevated carbon dioxide, and fumigation with nitrogen dioxide influence the colonization and infection by arbuscular mycorrhizal fungi (AMF) and the abundance of root hairs. Sugar maples are a native tree to the NE, however numbers of trees have been decreasing for unknown reasons. As tree roots and soil structures are essential to survival, I felt this to be an important area to study. Presence of AMF and root hairs were not affected by eCO<sub>2</sub>, but both decreased in response to Nitrogen treatments. Future research is needed to determine the long-term effects of these decreases, but it is likely that changes in the dynamics of mycorrhizal associations with plants will be far reaching in terms of both plant performance and ecosystem function.

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### Neophobia and Personality in Western Bluebirds, *Sialia mexicana*

ALLISON FRITTS-PENNIMAN

Under the supervision of Janis L. Dickinson  
Department of Natural Resources

The objectives of the study were to determine 1) whether western bluebirds, *Sialia mexicana*, exhibit neophobia in response to objects placed near their nests; 2) whether the expression of neophobia differs in males versus females; 3) whether individual variation in neophobic reactions represents expression of personality; and 4) whether proximity to human activity affects neophobic behavior in *S. mexicana*. Fifty-six breeding pairs were observed while feeding nestlings to gauge their reaction to a leaf and a novel object (checkered bow) placed on their nest boxes. We found that western bluebirds increased their latency to entering the box both when a leaf and when a checkered bow were present. The difference in latency to entering with the bow present versus the leaf was greater for males than for females. Male latency to entering with leaf and bow present were positively correlated, showing repeatability of this neophobic behavior. Males had a greater latency to entering with the bow present if they lived in proximity to humans. The strong neophobic reactions shown by males were consistent with the fact that males are philopatric while females disperse far.

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## Attitudes of Cornell University Undergraduate Students about Sustainability Issues on Campus and in Their Lives

MEREDITH A. ODATO

Under the Supervision of Jody W. Enck  
Department of Natural Resources

Global climate change is one of the most pressing environmental issues of the early 21<sup>st</sup> century. To help address the issue locally, Cornell President Skorton signed the American College and University Presidents Climate Commitment in February 2007. In doing so, the Cornell administration pledged to achieve a state of “climate neutrality,” where the amount of greenhouse gas emissions produced on-campus is effectively zero. Through a variety of campus sustainability initiatives, Cornell faculty, staff, and students are encouraged to adopt behaviors that reduce their personal and Cornell’s institutional carbon footprints—the amount of emissions measured in units of carbon dioxide. However, data are lacking about the extent to which students support personal or institutional actions to reduce carbon emissions.

To help fill this data void, I administered an on-line questionnaire in December 2007 to a random stratified sample of 2,000 Cornell undergraduate students to determine their attitudes and beliefs about environmental issues and the behaviors necessary to mitigate global climate change. My goal was to measure students’ responses to Cornell’s climate commitment initiatives, particularly their willingness to change personal behavior to help Cornell minimize greenhouse gas emissions. Current students held the greatest concern for global climate change compared to other environmental issues. Most respondents described themselves as sympathetic toward, but not active in, the environmental movement. They generally held positive beliefs about reducing their personal carbon footprint, but worried about higher tuition and increased travel time between campus and home. Perhaps most notably, they also held positive beliefs about Cornell’s efforts to become a model university for achieving climate neutrality.

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## The Effect of Mercury, Selenium and Their Interaction on Fish Mortality, Growth and Condition

TALIA WISSNER-LEVY

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

Two experiments using a fully factorial design were conducted to measure growth, condition and mortality of yellow perch and brown bullhead in varying treatments of mercury and selenium. I wished to look at both the direct effect of mercury (Hg) and selenium (Se) and the interaction of these two elements, emphasizing a possible antagonistic relationship between them. Although others have investigated selenium's effect on mercury toxicity in fish, I am not aware of any controlled experiments examining mercury's role in selenium toxicity. In my first experiment, high concentrations of selenium and mercury caused substantial mortality. Mercury levels of 100 µg/L caused higher mortality than Se levels of 100 µg/L and there was no antagonistic effect—the highest mortality occurred in the treatment with the highest mercury and Se concentrations. The fish lost weight and condition in all treatments and there were no differences between treatments, likely due to high mortality. In the second experiment run with mercury and selenium concentrations up to 20 µg/L, the higher Se levels resulted in lower mortality and a higher condition in perch. No interaction between mercury and selenium was found. Brown bullhead showed no mortality and gained weight throughout the experiment, although their condition declined from initial values. The interaction between mercury and selenium was significant for the condition of the bullhead, showing an antagonistic relationship—selenium reduced mercury toxicity. However, I could not show the reciprocal relationship of mercury reducing selenium toxicity. Under low and high mercury concentrations, condition increased with more selenium.

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## Iron (Fe) Bioavailability from Mung Beans: Effects of Household Processing and Form of Fe Fortificants

VIDYA ENDRAIYANI

Under the supervision of José Moisés Laparra Llopis and Dennis D. Miller  
Department of Food Science

Mung beans (*Vigna radiata*) constitute a popular crop in Southeast Asian countries but contain phytates, and polyphenols that impair Fe absorption. One of the key causes of Fe deficiency is poor bioavailability of dietary Fe. Food fortification is a good strategy for combating Fe deficiency. This study compares the *in vitro* Fe bioavailability (bioaccessibility and cell uptake) from mung beans prepared by household cooking procedures, boiling and soak-boiling, and fortified with selected Fe fortificants. To estimate Fe bioavailability, an *in vitro* digestion/Caco-2 cell model was used. Mung beans can constitute a good source of Fe since their concentrations were  $60.1 \pm 1.5$   $\mu\text{g/g}$  beans (dry basis). Although boiling did not affect Fe concentration in mung beans, the soak-boiling procedure decreased the Fe content by 16%. However, soak-boiling increased the Fe bioaccessibility up to 21% relative to boiled (9.1%) and raw beans (not detectable). Both cooking procedures decreased the content of phenolics; however, soak-boiling increased the soluble phytate in the digests. When comparing the effect of different fortificants, Fe bioavailability from beans fortified with Sprinkles™ was higher than either FeSO<sub>4</sub> or ferrous fumarate.

In conclusion, 1) cooking enhanced Fe bioavailability in non-fortified beans, and 2) fortification with Sprinkles™ was the most effective strategy.

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## Inference of the Demographic History of the Domestic Dog (*Canis lupus familiaris*)

JULIE M. GRANKA

Under the supervision of Carlos D. Bustamante  
Department of Biological Statistics and Computational Biology

The domestic dog (*Canis lupus familiaris*), the oldest domesticated species, has a unique demographic history through its domestication from the gray wolf (*Canis lupus*) and in the formation of behaviorally and morphologically diverse dog breeds. Using information contained in the site frequency spectrum of purebred dogs and the Poisson Random Field framework, we infer the demography of the dog at domestication, in the formation of individual dog breeds, and of several wild canid populations. First, we find evidence for a slight contraction in population size approximately 15,000 years ago during the domestication of the dog. As these results may be an artifact of using breed dogs to infer a pre-breed dog population, it is likely that continued introgression between dogs and wolves or multiple domestication events have maintained high levels of dog diversity. Demography in the formation of several dog breeds is also examined, where the relatively rare breeds of the Bernese Mountain Dog and Pekingese appear to have gone through the most severe population contractions. In contrast, less severe contractions are found for the Golden and Labrador Retrievers, both popular breeds, and the Akita, which has likely

introgressed with wolves. Finally, we examine data from several wild canid populations, finding evidence for population contractions in the gray wolf populations of Spain and Israel, but none in North American populations or coyote. We have developed a more comprehensive picture of the domestic dog's demographic history, which can prove useful in its application to other studies of the domestic dog currently underway.

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## Iron Fortified Sugar: Evaluation of Four Fortificants

KIMBERLY M. STANGL

Under the supervision of Dennis D. Miller  
Department of Food Science

The objective of this study was to compare the impact of selected iron fortificants on the color of granulated sugar and two products sweetened with the sugar.

Granulated white sugar was fortified with NaFe-EDTA, iron bis-glycinate, elemental iron powder, or ferrous sulfate to yield an iron concentration of 0.12 mg/g sugar, with plain sugar as a control. Color change was monitored over three months by dissolving samples in water, and measuring the absorbance at 350 nm. A 12.5 g sugar sample was added to 250 mL of brewed green tea after each month and was monitored at 560 nm. Hard candy was made with each fortified sugar and the control (unfortified sugar), stored for three months, and monitored for color changes at 350 nm.

Color intensities of the fortified sugar relative to the unfortified control were as follows: iron bis-glycinate, NaFe-EDTA, ferrous sulfate, and elemental iron. These rankings changed little over time. Tea sweetened with fortified sugars ranked (most to least different from the control) as ferrous sulfate, iron bis-glycinate, NaFe-EDTA, and elemental iron. The candy didn't visually change over time, although there were initial differences from the control candy. The color of the samples ranked (most to least different from the control candy) as iron bis-glycinate, ferrous sulfate, elemental iron, and NaFe-EDTA.

The best fortificant for sugar depended on the application. Elemental iron was the best for granulated sugar, but NaFe-EDTA was most suitable for the candy, and perhaps the tea, since the elemental iron is insoluble in water.

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## Biochemical Differences Contributing to the Rate of Photosynthesis among Wild Strawberry Genotypes

RACHEL J. FRANK

Under the supervision of Marvin P. Pritts  
Department of Horticulture

Recent recognition of the narrow genetic base of the cultivated strawberry has led to research on genetic improvement through modern breeding, including the potential for photosynthetic improvement. Previous studies have shown that *Fragaria chiloensis* had a significantly higher maximum photosynthetic carbon exchange rate (CER) than the cultivated strawberry, *F. x ananassa*, and its other progenitor species, *F. virginiana*. In order to test the hypothesis that the higher photosynthetic rate of *F. chiloensis* is due to increased activity of key enzymes in the Calvin Cycle, gas exchange and plant morphology were measured to quantify differences within and between species and biochemical analysis was completed to determine variations in key enzymes associated with photosynthesis. Five wild genotypes from each of the progenitor species were evaluated in a randomized complete block design. Photosynthetic data were collected in the greenhouse. Leaf discs were collected and biochemical analysis was completed for photosynthetic enzyme extraction. Five enzymes, ribulose-1,5-bisphosphate carboxylase/oxygenase (Rubisco), NADP-glyceraldehyde-3-phosphate dehydrogenase (GAPDH), phosphoribulokinase (PRK), stromal and cytosolic fructose-1,6-bisphosphatase (FBPase), and sucrose-phosphate synthase (SPS), that catalyze potential rate limiting steps of the Calvin cycle were measured. Physiological data confirm the higher photosynthetic rate of *F. chiloensis* ( $19.1 \mu\text{moles CO}_2 \text{ m}^{-2} \text{ s}^{-1}$ ) in comparison to *F. virginiana* ( $14.6 \mu\text{moles CO}_2 \text{ m}^{-2} \text{ s}^{-1}$ ). Biochemical analysis showed that *F. chiloensis* had 2.5 times higher Rubisco activity per unit area ( $133.1 \mu\text{moles m}^{-2} \text{ s}^{-1}$ ) and 1.4 times higher per unit weight ( $363.2 \mu\text{moles kg}^{-1} \text{ s}^{-1}$ ) in comparison to *F. virginiana*. In *F. chiloensis* PRK was 1.7 times higher per unit area ( $596 \mu\text{moles m}^{-2} \text{ s}^{-1}$ ) and GAPDH was 2.5 times higher per unit area ( $141 \mu\text{moles m}^{-2} \text{ s}^{-1}$ ). The results indicate potential avenues of research for the improvement of the photosynthetic rate of the cultivated strawberry through the use of wild species.

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## In-Field Spatial Variability of Soil Test Phosphorus and Implications for Agronomic and Environmental Phosphorus Management

SCOTT R. GRANDT

Under supervision of Quirine M. Ketterings  
Department of Crop and Soil Sciences

Spatial and seasonal variability of phosphorus (P) presents a challenge for accurate soil sampling for agronomic and environmental management of farm fields. Our objectives were to evaluate the impact of within-field soil test P variability on soil sampling guidelines and the use of Mehlich-3 to Morgan P soil test conversion equations for fields sampled in the summer versus the fall, with or without manure application prior to fall sampling. Two 4.05 ha fields of corn (*Zea mays* L.), were sampled in July and

November. One field received manure two weeks before the November sampling. Semi-variograms were constructed to investigate spatial dependence for each sampling round while simulations were done to determine the number of samples required to obtain a confidence interval of  $\pm 2 \text{ mg kg}^{-1}$  Morgan P and to eliminate seasonality in the Morgan P data. Variability in Mehlich-3 P, Ca, Al and pH were studied for their impact on P conversion equations. A minimum of 8 to 9 samples per ha were needed to obtain a confidence interval of  $\pm 2 \text{ mg kg}^{-1}$  for all sampling rounds. Manure application reduced spatial dependence and both timing of sampling and application of manure greatly impacted the accuracy of Mehlich-3 to Morgan conversions currently in use in New York ( $P < 0.001$ ). We conclude that current guidelines for timing of sampling and number of samples per ha should be adjusted for most accurate P guidelines, especially if Mehlich-3 to Morgan P conversion equations are used.

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## The Effect of Canopy Management on Yield and Fruit Composition of Noiret Wine Grape (*Vitis* sp.)

BENJAMIN M. RICCARDI

Under the supervision of Justine Vanden Heuvel  
Department of Horticulture

Noiret is a complex interspecific hybrid red wine grape (*Vitis* sp.) released by Cornell University in 2006 for cold-climate growers. Shoot thinning (ST), before capfall, to 15 shoots per meter and basal leaf removal (BLR) to 75% visual exposure of pea-sized berries were performed separately and in combination (ST/BLR) and tested versus control vines of field-grown vertically shoot positioned Noiret grapevines. Vine size was excessive in this experiment and crop load ratios (yield/pruning weights) ranged from 1.9 to 2.2. Using point quadrat analysis, it was determined that BLR and ST/BLR improved cluster exposure versus ST, but there were no differences from the control. All treatments were similar in soluble solids, titratable acidity, and pH except shoot thinning which lowered the pH to 3.76 versus 3.84 in the control. Canopy management treatments did not affect total phenolics, flavonols, tartaric esters, anthocyanins, color density, or hue. This work shows that the canopy management tools used were minimal in their effects, likely due to the excessive vigor of the vines.



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## Communication Issues Associated with the Likelihood of HPV Vaccine Acceptance among College Students

BENJAMIN A. ABRAMOFF

Under the supervision of Katherine A. McComas  
Department of Communication

*Background.* The purpose of this honors thesis is to examine the knowledge, attitudes, and behaviors of a key target audience for the HPV vaccine – college undergraduates (particularly female) – to determine what factors may be influencing its acceptance of the HPV vaccine. This study is based on the framework of Elaboration Parallel Processing Model and also looks into other risk perception issues such as optimistic bias.

*Methods.* 269 Cornell undergraduates returned a survey regarding sexual history, sexual health practices, understanding of the HPV vaccine, and attitudes toward the HPV vaccine. All participants were assured anonymity, and no identifying information was connected to their survey responses. The survey used a modified risk diagnostic scale in order to measure mindsets toward the HPV vaccine. The survey also used measures for optimistic bias and knowledge.

*Results.* Among key findings was a significant relationship between optimistic bias, perceived susceptibility, and perceived severity. Specifically, as optimistic bias increases, perceived susceptibility and perceived severity decrease. On the other hand, discriminating value scores increase as optimistic bias increases. General knowledge of HPV showed significant positive correlations with perceived severity, response-efficacy, self-efficacy, and perceived susceptibility. Exploratory analysis examined other factors for statistical significance.

*Conclusions.* The use of the risk diagnostic scale appears useful for understanding issues involved in acceptance and receiving of the HPV vaccine. Furthermore, by looking into key attributes such as knowledge, discriminating value, optimistic bias, and vaccine rates, the investigation was able to come up with concrete results that may be of use to health communicators and practitioners.

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## Are You Lying Now? A Linguistic Examination of Deceptive Utterances in Online Conversation

BARRETT E. AMOS

Under the supervision of Jeffery T. Hancock  
Department of Communication

Extensive research has been done to identify linguistic cues to deception, especially in the rapidly growing field of computer-mediated communication. However, most past research contains an important methodological flaw: the failure to break down deceptive and truthful topics into individual utterances.

When assigning research participants to a deceptive role (say, asking them to lie to an unknowing receiver) previous studies have generally given the deceivers a topic to lie about and then asked them to go ahead and communicate with their partner. The deceivers were assumed to be lying whenever they were talking about the topic on which they were supposed to deceive their partners. However, in practice not *all* of the utterances within a deceptive conversation topic are lies. Some are truths used to support the overall lie. Past research has failed to make this distinction, drawing into question previous findings on linguistic cues. This study sought to validate four of the more well-known linguistic cues to deception by examining them at the utterance level. The results reveal that while there often is a distinction between the linguistic cues at the overall topical level (deceptive topics vs. truthful topics), those markers do not always hold true at the utterance level. Even more interestingly, there is often a large difference between truths told in support of an overall deceptive topic and truths told in support of an overall truthful topic. These findings open up new areas of research into the linguistic cues to deception.

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## Comparing Best Management Practices of Community Based Monitoring between Habitats in the Literature and in Reality

AMY E. FREITAG

Under the supervision of Max J. Pfeffer  
Department of Development Sociology

Community based monitoring projects, often called citizen science, have been on the rise for the last decade. Although they provide the benefit of large data sets from a wide area, the quality of the data is often questioned because they are collected by ‘laypeople’ with limited field experience. However, there are a number of side benefits of utilizing volunteers in research that may outweigh this concern: increased stewardship of the monitored habitat, educational benefits to participants, and community support for such research. The goal of many of these projects often is restoration or preservation of an area, and these side benefits may aid in meeting the end goal as much as the actual data collected. Many community based monitoring projects publish their results in scientific or technical literature with recommendations for similar future projects. This study determines if these recommendations match the best management practices actually used by programs. Also, this study compares recommendations and practices by habitat to see if more specificity is needed in thinking about improving the data coming from monitoring programs and allowing them to succeed at fulfilling their mission. A series of surveys of program coordinators and primary investigators were compared to recommendations in the literature to determine if published recommendations are a realistic representation of practices that occur in the field. Results showed that although the top recommendations of the literature and survey respondents were similar (championing collaboration with experts, consistent methodology, and presentation of data to policymakers), the means and implications of achieving these goals differs by habitat. Specific habitats were associated with slightly different types of mission statements that have implications for their definition of reliable data and overall success.

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## Revealing Online Deception: The Discrepancy between Deceptive Belief and Practice Online

CAMERON W. HALL

Under the supervision of Jeffrey T. Hancock  
Department of Communication

Do we really encounter as many lies as we think online? The present study examines the possibility of a *prevalence paradox*, or the discrepancy between one's beliefs about deception online and actual encounters with deception. This research tests several factors that may influence the prevalence paradox in mediated communication, including characteristics of the user (e.g., experience) and of the communication environment (e.g., synchronicity and evanescence). Participants reported on their beliefs and experiences with deception in email, instant-messaging, blogs, and social networks. Although the results from this study did not support the predicted factors for the prevalence paradox, they did confirm the existence of the paradox in each of the communication environments.

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## Detecting Emotion in Psychopathic Language: Emotional Valence and Locus in Language Produced by Psychopathic Offenders

ROBIN M. KORNET

Under the supervision of Jeffrey T. Hancock  
Department of Communication

This study examined the presence of emotional references in psychopathic communication. The analysis in this study is on secondary data, consisting of 54 interviews conducted with psychopathic and non-psychopathic offenders. It was hypothesized that emotional differences in psychopathic and non-psychopathic communication will be evident in terms of frequency, emotional locus, and emotional valence. The results supported these predictions. Overall, psychopaths produced fewer emotional references in their language use. Compared to non-psychopathic controls, psychopaths produced significantly fewer emotional references indicating empathy for others. Of all emotional terms produced by psychopaths, a significantly higher proportion of the emotional terms were negative. The results of this study indicate that emotional variations are evident in psychopathic language production.

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## Using Student Concern Forms for Creating a Sense of Safe, Caring, and Fair Schools and School Connectedness

NICOLE MANGIERE

Under the supervision of Dawn E. Schrader  
Department of Education

For decades reserachers have explored school climate and conflict resolution; however, few have engaged in a specific case study analysis of the impact of democractic voice in the construction of school climate. This research explores how the use of Student Concern Forms (SCFs) helps create the sense of a safe, caring, and fair community by giving students and teachers the opportunity to voice when there are infractions against individuals and the school norms; and how participation relates to school connectedness and the sense of taking part in the creation of a moral community. The SCFs were implemented by the principal of a middle school to facilitate comprehensive reporting of student concerns in relation to any aspect of school life (i.e., bullying, conflicts with peers and teachers, etc.). The SCF, initially created as reporting tool, was reintroduced into the school context to open the channels of communication between all parties involved in the reported concern. The forms are reviewed by the administrators of the school, and students are involved in resolution process. This paper analyzes the incidents reported and the actions taken by administrators and students to address the concerns. Specifically, this thesis examines the behaviors reported; what do the teachers and principal write about how the problem is resolved? How are students involved in the resolution process? What is the student's sense of personal and interpersonal safety? Do these forms create a positive moral climate in the school? I explore whether or not students' participation in voicing their concerns has a positive effect on their sense of personal, emotional, and interpersonal safety, their connectedness to school, and sense of creating a more moral environment.

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## Female Millenial Interest in and Consumption of Sports Media and Imperatives and Pressures in the Sports Media Market

ERIKA L. NOLTING

Under the supervision of Tarleton L. Gillespie  
Department of Communication

This research is an exploratory study comparing the interview responses of sports and sports media professionals to the questionnaire responses of female Millenials from a sample population of undergraduates at three universities in different regions of the U.S. The data reveals the structural barriers in sports media that deter female sports media consumption and which result from the hegemonic impositions of pre-Title IX sports cultural constructs on the production of sports media. Moreover, the data shows the fluidity of the boundaries of the term "sports fan" and the conflict between how interview participants personally define "sports fan" versus how they deploy the term within the walls of the sports media industry. Although sports media professionals want to reach a broad fan base

that includes more women, what shows up in sports media is always the product of complex negotiations impacted by constraining factors such as socio-cultural expectations, advertiser pressures, and the limitations of research findings. However, sports media organizations should not be dismissed from taking responsibility for the societal implications of the content they produce; future topics from research and what sports media can do to appeal more to females are discussed.

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## Children and the Media: Self-Other Perceptions of Occupational Portrayals in the Media

HAUWA O. OTORI

Under the supervision of Michael A. Shapiro  
Department of Communication

A majority of our youth, more specifically minorities, are not interested in pursuing careers in science which may be explained by the negative depiction of scientists in the media. An experiment examined whether middle school students believed others would be influenced by a negative portrayal of a scientist character in a movie character. This is known as the third person perception phenomenon (TPP), when messages influence others more than the self. This experiment tried to determine whether race, gender, and valence would influence the inferences people make about public opinion in regards to careers. Results showed a third person effect. But contrary to predictions, public opinion perception did not have an influence on participants' thoughts about a career in science while participants' perception of the realism of the characters did. This experiment enhances our understanding of TPP and persuasive press inference in the context of entertainment.

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## It's a Jungle Out There: A Real-World Analysis of Lying in Instant Messaging

JOSHUA C. PERLIN

Under the supervision of Jeffrey T. Hancock  
Department of Communication

Analysis of instant messaging deception has never been conducted using real-world data. This study tracked and analyzed deceptions in participants' real-life instant messaging conversations, analyzing them on a message-by-message basis instead of merely a conversation-by-conversation basis. The results show that people frequently deceive in instant messaging, and that the magnitude of these deceptions is positively correlated with instant messaging use. Deceptions are told in clusters, suggesting strategic usage of deception in instant messaging, and although people underestimate how frequently they deceive, they have a very good sense of how much they are straying from their normal deception rates.

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