

**2002
Research Honors Program
Abstracts**

College of Agriculture and Life Sciences

©2002 Cornell University

Originally Published by Media and Technology Services,
Cornell University, in 2002

Re-published by
The Internet-First University Press

This manuscript is among the initial offerings being published as part of a new approach to scholarly publishing. The manuscript is freely available from the Internet-First University Press repository within DSpace at Cornell University at

<http://dspace.library.cornell.edu/handle/1813/62>

The online version of this work is available on an open access basis, without fees or restrictions on personal use. A professionally printed and bound version may be purchased through Cornell Business Services by contacting:

digital@cornell.edu

All mass reproduction, even for educational or not-for-profit use, requires permission and license. We will provide a downloadable version of this document from the Internet-First University Press. For more information, please contact dcaps@cornell.edu.

Ithaca, N.Y.
April 2005

2002
RESEARCH HONORS
PROGRAM ABSTRACTS



The College of Agriculture and Life Sciences at Cornell University is considered by many to be the best of its kind in the nation. One reason for this reputation is that we attract the best and brightest students who thrive in an atmosphere of exploration and discovery.

Our students are offered many opportunities to pursue their interests in an environment that both stimulates and inspires them to excel in their chosen fields. Students in CALS have taken advantage of our wealth of academic resources and research facilities to conduct original research, from probing unanswered questions in the life sciences to exploring critical issues in the social sciences.

I am proud of our students and their achievements. They are the leaders and problem-solvers of tomorrow. I would like to thank our dedicated faculty who supervised these research projects for nurturing and guiding our students to their fullest potential.

Susan A. Henry, Ph.D.

The Ronald P. Lynch Dean of Agriculture and Life Sciences

Table of Contents

Animal Science

Effect of Supplemental Feeding of Rumen-Protected Conjugated Linoleic Acid on an Intermittent Basis to Dairy Cows Melissa A. Bischoff	1
Evaluation and Application of the Cornell Net Carbohydrate and Protein System for Dairy Production in Honduras Alice S. Green	2
Effect of Breed, Parity, and Stage of Lactation on Milk Fat Content of Conjugated Linoleic Acid in the Dairy Cow Julie A. Kelsey	3
Mutational Probing of Cdc42Hs Switch I Structure Benjamin E. L. Lauffer	4
Effects of Short-term Drenching of Transition Cows with Propylene Glycol on Performance and Subclinical Ketosis Incidence on Commercial Dairy Farms Victoria E. Lenkaitis	5
An Improved Enzymatic Method for the Determination of Percent Total Starch in Animal Feeds Stevie Elizabeth Smith	6
The Development of a Bacterial Expression System for the Distal-less-3 Protein Kyle Ann Stevenson	7
The Direct and Indirect Effects of Urea on the Development of Bovine Embryos in Vitro Matthew D. VerMilyea	8
Persistent Mullerian Duct Syndrome in the Dog: MISRII as a Candidate Gene Kristin K. VyhnaI	9
Health Issues Affecting Periparturient and Lactating Dairy Cows Brenda L. Weissman	10

Biological Sciences

A Molecular and Genetic Analysis of the alpha-Glycerophosphate Oxidase (α -GPO) Locus in <i>Drosophila melanogaster</i> Alissa M. Bovee	11
The Relationship Between Individual Flight Performance and Clutch Initiation Date in Female Tree Swallows, <i>Tachycineta bicolor</i> Melissa S. Bowlin	12

Incorporation of Rous Sarcoma Virus Gag-Pol Polyprotein into In Vitro– Assembled Virus-Like Particles	
Matthew B. Brecher	13
Effect of Elevated in Vitro Temperature on Steroid Production by Bovine Follicular Cells	
Melissa A. Brusie	14
Membrane Fusion Induced by Sucrose Gradients	
Brendan J. Camp	15
Genetic Investigation of the Roles of Proteolysis in <i>Drosophila melanogaster</i> Seminal Fluid	
Heather I. Cohn	16
Production and Purification of Mcm5p and Investigation of Its Potential Role in Transcriptional Regulation	
Bernie J. Daigle, Jr.	17
Biodegradable Microspheres as Vehicles for Targeted Oral Vaccine Delivery	
John L. Falcone	18
Adaptation, Selective Regimes, and the Comparative Method: A Case Study of the African Snake Genus <i>Dasypeltis</i>	
Gabriel E.A. Gartner	19
What Can Naked Mole-Rats Communicate About a New Food Source?	
Christopher T. Hood	20
Effects of Parasitic Infection by <i>Toxoplasma gondii</i> on Cellular Nuclear Transport	
Cathryn L. Kubera	21
Identification of Negative Regulator Genes Affecting the Stabilization of a Mitochondrial Reporter Construct, <i>cox2::arg8^m-43</i>	
Erin E. Kull	22
Molecular Characterization of the Loci Responsible for Feeding Specialization in Divergent Host Races of the Pea Aphid, <i>Acyrtosiphon pisum Harris</i>	
Jennifer A. Nead	23
Effects of Thymulin on Avian Innate Immunity to Disease	
Molly Ann Oliver	24
Cellular Kinetics of the Local Immune Response to Muscle Stage <i>Trichinella</i> <i>spiralis</i>	
Victoria L. Roberts	25
Identification of Possible Host-Protein Interactions with <i>C. trachomatis</i> Inclusion-Membrane Protein, IncD	
Karla M. Stucker	26

Gabon-Clade *Brienomyrus* Electric Organ Discharges: Waveform Diversity and Species Recognition

Timothy D. Uschold 27

Multimodal Communication in Jumping Spiders (Araneae:Salticidae): Behavior and Anatomy

Nicole D. VanderSal 28

Isolation and Suppression Analysis of Conditional Mutations in the *Saccharomyces cerevisiae* MLH1 DNA Mismatch Repair Gene

Marc P. Waase 29

Reductive Dechlorination of Chlorinated Benzenes by *Dehalococcoides ethenogenes* Strain 195 and a Vinyl Chloride Degrading Culture

Susan F. Wilson 30

The Role of the Genes *sodB*, *sodC*, *adhI* and *bolA* in Protection Against Nitrosative and Oxidative Damage in *Rhodobacter sphaeroides* 2.4.3

Rebecca E. Zordan 31

Entomology

Inbreeding Avoidance by Recognition of Close Kin in the Pea Aphid, *Acyrtosiphon pisum*

Ming Hua Huang 32

Effects of Water Concentration on the Maturation of *Entomophaga maimaiga* (Zygomycete: Entomophthorales) Resting Spores Stored in Clay and Differences in Maturation Between Two Isolates

James R. McNeil 33

The Effects of Freezing and Winter Temperature Conditions of Three Alpine Lakes on Macroinvertebrate Community Composition

Gavin J. Svenson 34

Aquatic Invertebrates as Bioindicators of Wetland Habitat Quality: A Comparison of Invertebrate Communities in Natural and Cadmium-Disturbed Ponds

Alani N. Taylor 35

General Studies

Taste Sensitivity to 6-N-Propylthiouracil and Perception of Fattiness, Sweetness, and Saltiness in a High-Fat and a Low-Fat Graham Cracker

Heidi Sicherman 36

Natural Resources

Seed Dispersal by *Gopherus polyphemus* at Archbold Biological Station, Florida

Jane E. Carlson 37

Carbon Resources and pH as Controls of Microbial and Microarthropod
Communities in a Northern Hardwood Forest
Will R. Kessler 38

The Response of *Polygonum bistorta* to Fertilization in Acidic and Non-acidic
Tundra
Lauren McSherry 39

Evaluating the Potential for Garden Mosaics to Increase Self-directed
Learning in Youth Participants
Celeste J. Richie 40

Lake-Level Management: Impacts on the Land-Lake Interface and
Groundwater Seepage
Travis C. Spier 41

Physical Sciences

Closing the Academic Gap: Supplemental Course Instruction Plays a
Fundamental Role for Target Students at Cornell University
Lisa D. Eisenhauer 42

Depressive Disorders, Suicide Symptoms, and Food Insufficiency in U.S.
Adults
Alexander T. Pearson 43

Classification of Running Water Hydro-Morphological Segment Habitats via
Quantifiable Physical Components
Tasi B. Perkins 44

Examining Wave-Propagation Patterns in the Jovian Atmosphere Using the
EPIC Model
Alexander C. Ruane 45

Plant Sciences

Identification of *Phaeolus schweinitzii* on *Pinus radiata* in New Zealand
Megan E. Ackerman 46

Anti-Fungal Plants of the Peruvian Amazon: A Survey of Ethnomedical Uses
and Biological Activity
Anna W. Herforth 47

A Reverse Genetic Approach to Study a Potential Accessory Factor for a
Nucleus-Encoded Organellar RNA Polymerase
Wirulda Pootakham 48

Identification of Candidate Tomato (*Lycopersicon esculentum*) Proteins that
Interact with the Effector Protein, HopPsyV of *Pseudomonas syringae* pv.
syringae B728a
Ryan A. Rapp 49

Social Sciences

Personality Types and Their Relationship to Seating Position and Participation in a College Classroom Susan E. Cohen	50
Relativism in College: September 11th as a Catalyst for Epistemological Development Meghan M. Condra	51
A Cross-Cultural Comparison of the Anti-Drug Campaigns in the United States and Singapore Laura Ann Granka	52
Media Use and the Educational Setting: How Were Cornell Students Affected by the Tragedies of September 11th? Jessica S. Groppe	53
Painting a Bleak Picture: Media Framing of Renewable Energy in the Deregulated Marketplace Joanna M. Radin	54
Effects of Music Genre on Television-Advertising Recall Carl F. Regelman	55
Impulsivity and Smoking Among College Students Jami D. Rothman	56
Did the Antidumping Policy against Chinese Garlic Imports into the United States Fundamentally Change the Welfare of U.S. Garlic Producers? Li Tao	57

Effect of Supplemental Feeding of Rumen-Protected Conjugated Linoleic Acid on an Intermittent Basis to Dairy Cows

MELISSA A. BISCHOFF

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

Abomasal infusion and dietary supplements of rumen-protected trans-10, cis-12 CLA have shown to cause milk fat depression. The objective of the present experiment was to determine the effects of feeding supplements of rumen-protected CLA on short, two-week intervals. Twenty Holstein cows were allocated into either a treatment group or control group. The treatment group (n = 10) received a rumen-protected calcium salt of CLA during two separate treatment periods. The supplement was fed to provide 30.4 g/d of CLA with the predominant isomer, trans-10, cis-12, making up 28.9 percent of the total CLA content. The control group (n = 10) received no supplement. After each two-week treatment period, there was a two-week recovery period during which the cows received no supplement. Results indicated a 9 percent reduction in milk fat content and a 10 percent reduction in milk fat yield during the period when rumen-protected CLA was fed. There were no other effects on milk yield or other milk components (lactose and protein). The magnitude of milk fat depression led to further investigation involving a reanalysis of the CLA supplement. It was found the actual composition of the CLA supplement was 2.2 g/d of CLA, indicating that much of the CLA had been lost, presumably via oxidation. This accounts for some of the differences in reduction of milk fat versus similar studies, but results also suggest that the trans-10, cis-12 CLA isomer is not the only fatty acid intermediate that causes milk fat depression. Results of the study demonstrate a clear need to investigate the stability of the CLA in the calcium salt formulation.



Evaluation and Application of the Cornell Net Carbohydrate and Protein System for Dairy Production in Honduras

ALICE S. GREEN

Under the supervision of Alice N. Pell
Department of Animal Science

Dairy production in Honduras is primarily limited by forage quality. The Cornell Net Carbohydrate and Protein System (CNCPS) is a model that has the potential to be very useful in Honduras because it accounts for many of the animal, feed, and environmental factors that affect nutrient supply and requirements. This study evaluated the effectiveness of the CNCPS and demonstrated its potential applications at the farm level in Honduras. Fourteen species or cultivars of pasture grasses, 10 species of legumes, 4 byproduct feeds, and 7 commercial concentrates were analyzed for nutrient content. Ruminal degradation rates of carbohydrate fractions were determined for 4 of the grasses and all of the byproducts and commercial concentrates. For the grasses, the average rates of degradation were 35.7 percent/hour and 8.3 percent/hour for the neutral detergent soluble (NDS) fraction and the neutral detergent fiber (NDF) fraction, respectively. The mean rates for the byproducts were 22.6 percent/hour and 14.6 percent/hour for the NDS and NDF fractions, respectively. For the commercial concentrates, the mean rates were 25.7 percent/hour and 5.6 percent/hour for the NDS and NDF rates, respectively. After on-farm evaluations of the CNCPS, it was concluded that the major deficiencies of the CNCPS are in the prediction of dry matter intake of tropical cattle and the modeling of low-producing cattle. Using the CNCPS, guides for supplementing cattle grazing *Digitaria suazilandensis* were created. Citrus pulp and soybean meal were together an excellent supplement, providing the same nutritional benefits as corn meal and soybean meal at a lower cost. The CNCPS has the potential to be very useful in the tropics, but more research and some adjustments are required.



Effect of Breed, Parity, and Stage of Lactation on Milk Fat Content of Conjugated Linoleic Acid in the Dairy Cow

JULIE A. KELSEY

Under the supervision Dale E. Bauman
Department of Animal Science

In biomedical studies with animal models conjugated linoleic acid (CLA) has been shown to possess a variety of health benefits. Foods of ruminant origin are the major dietary source of CLA. The major source of milk fat CLA is endogenous synthesis via Δ^9 -desaturase from trans-11 C_{18:1}. The four primary substrates for Δ^9 -desaturase are C_{14:0}, C_{16:0}, C_{18:0}, and trans-11 C_{18:1}. The ratio of these and their products (desaturase index) serves as a proxy for Δ^9 -desaturase activity. Diet has a major influence on milk fat CLA; however, the effect of animal-related aspects is largely unknown. Our objectives were to determine the influence of breed, parity, and stage of lactation on milk fat content of CLA and to examine their effects on the desaturase index. Holstein (n = 116) and Brown Swiss (n = 106) cows were fed the same TMR diet, and milk was sampled on the same day to eliminate diet and seasonal effects. Milk was composited, and the fat cakes were sent to Cornell for fatty acid analysis. Cows ranged from 7 to 624 days in milk (DIM) and varied in parity (primiparous = 97 and multiparous = 125). Fatty acid analysis demonstrated that stage of lactation and parity had minimal effect on CLA. Breed differences were significant (p < 0.05) but of small magnitude; CLA averaged 4.4 ± 0.1 vs 4.1 ± 0.1 mg/g fatty acid for Holsteins and Brown Swiss, respectively. Similarly, trans-11 C_{18:1} concentration was higher in Holsteins than Brown Swiss (11.4 ± 0.2 vs 9.5 ± 0.2 mg/g fatty acid). Overall, the proportion of fatty acids that were <C₁₆, C₁₆, and >C₁₆ were 20.7 ± 0.2 , 30.7 ± 0.1 , and 48.7 ± 0.3 for Holstein, and 22.5 ± 0.2 , 30.7 ± 0.1 , and 46.8 ± 0.3 for Brown Swiss. There was a three-fold variation among individuals in milk fat content of CLA and in the desaturase index for all desaturase pairs. Results indicate that breed, parity, and stage of lactation had only minor effects on CLA concentration, but substantial individual variation existed in CLA content and desaturase index of milk fat.



Mutational Probing of Cdc42Hs Switch I Structure

BENJAMIN E. L. LAUFFER

Under the supervision of Robert E. Oswald
Department of Molecular Medicine

Cdc42Hs is a member of the Ras superfamily of low-molecular-weight G-proteins. Cdc42Hs and other Ras superfamily proteins such as Ras, Rac, and Rho have been widely characterized for their GTP-dependent contributions to signaling, cell motility, and cell growth. They mediate these processes by binding to various effector molecules in an active, or GTP-bound, state. Structural studies of G-proteins have indicated that effector-binding regions are confined mainly to areas that somehow change when GDP is exchanged for GTP. In Ras-like proteins these regions are known as switch I and switch II. These areas are highly mobile and thought to exist predominantly in two conformations that can normally exchange in a small fraction of a second. While this flexibility is important to binding, it also provides difficulty in elucidating the structures that allow this region to bind. A threonine residue has been found to play a critical role in conserving structural dynamics as well as binding function in Ras. Using an ^1H , ^{15}N HSQC NMR experiment, mutations of this threonine (T35) and a surrounding proline (P29) in the switch I region of GDP-Mg $^{2+}$ -bound Cdc42Hs were compared to the wild type. This structural characterization indicated shifts in the position of various submolecular regions in each mutant. However, mutations to the threonine residue also allowed detection of other residues in the switch I region that are invisible with this study of the wild type. This indicates that the region has lost mobility in these mutants, which may provide a means to study the structural nature of this region as well the importance of this threonine residue for flexibility and binding in G-proteins



Effects of Short-term Drenching of Transition Cows with Propylene Glycol on Performance and Subclinical Ketosis Incidence on Commercial Dairy Farms

VICTORIA E. LENKAITIS

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

Four hundred and fifty-seven Holstein dairy cows (multiparous n=265, primiparous n=192) on three commercial dairy farms were used to evaluate performance effects of short-term oral drenches of propylene glycol beginning at parturition. Cows were assigned to either a control (no drench; n=266) or a propylene glycol treatment (500ml; n=291), administered on the day of parturition and two subsequent days. Milk yield and percentages of fat and true protein in milk during the first four monthly test days were not affected by treatment. Body condition scores decreased as cows transitioned from late pregnancy to early lactation; however, differences between the two treated groups were not significant. Concentrations of β -hydroxybutrate (BHBA) in plasma obtained on one day during day 5 through 10 of lactation and incidence of most metabolic disorders were not affected by treatment. Incidence of retained placenta was decreased in the groups treated with propylene glycol. Overall, short-term drenches with propylene glycol appear to be of little benefit to performance and subclinical ketosis incidence in herds with well-managed transition cow programs.



An Improved Enzymatic Method for the Determination of Percent Total Starch in Animal Feeds

STEVIE ELIZABETH SMITH

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

This project evaluated a variety of common animal feeds—including cereals, by-products, and forages—to determine if the official method of the AACC and AOAC allowed for accurate and reproducible values of percent total starch. Using the official method, the variation in percent total starch for animal feeds ranging in starch content was unacceptable (>1.73 standard deviations for 52 percent of feed samples), and the sample size did not permit accurate measuring of glucose resulting from starch hydrolysis. Factorial designs were used to test different buffering systems, incubation times, heat-stable alpha-amylases, amyloglucosidases, and equations used to quantify the percent glucose. A more precise method was developed for use in common animal feeds, which lack the homogeneity of cereal flours for which previous methods were developed. The developed method includes a larger sample size that is analyzed in beakers and uses a seven-fold increase in buffering solution. As in the official method, megazyme amylase and amyloglucosidase were found to be superior to other sources, and MOPS buffering solution resulted in significantly higher total percent starch data with minimal variation, thus allowing for the most complete degradation of starch to glucose. An incubation time of 30 minutes was determined to be optimal, resulting in the least variation while still allowing for complete gelatinization and enzymatic degradation. The developed method provides precise and accurate total starch values for cereal, by-product, and forage feeds included in animal diets. Measurements of total percent starch are required by nutritionist and computer modeling programs that rely on chemical analysis, such as total starch, to formulate rations and predict animal responses.



The Development of a Bacterial Expression System for the Distal-less-3 Protein

KYLE ANN STEVENSON

Under the supervision of Mark S. Roberson
Department of Biomedical Sciences

The homeobox protein Distal-less-3 (Dlx-3), a transcriptional activator, assists in activating the gene that encodes the α -subunit of human chorionic gonadotropin (hCG) by binding to the junctional regulatory element (JRE) within the promoter region of the α -subunit. An extremely important hormone, hCG is required for the establishment and maintenance of early pregnancy in humans and other primates. In DNA binding assays, Dlx-3's interaction with the α -subunit promoter region of hCG results in the formation of two complexes. However, it is only clear that one of the complexes contains Dlx-3. Research was conducted to develop a successful bacterial expression system for Dlx-3 so that the resulting recombinant Dlx-3 protein could be used in a protein-protein interaction assay to determine the identity of the other protein(s) that may interact with Dlx-3 and thus regulate the α -subunit gene of hCG. The results of a DNA miniprep and analytical digest confirmed that a bacterial expression vector for Dlx-3 had been successfully developed. Western blot analysis confirmed that the recombinant Dlx-3 had been produced successfully. However, DNA binding assays revealed that the bacterially expressed Dlx-3 protein did not bind DNA efficiently. On the other hand, recombinant Dlx-3 protein prepared in rabbit reticulocyte lysates bound DNA quite efficiently. Thus, bacterial expression of recombinant Dlx-3 resulted in a protein of limited usefulness in subsequent DNA binding assays. The expression of Dlx-3 in a eukaryotic system (reticulocyte lysates) may prove to be a more promising method of pursuing the other protein partner(s) that interact with Dlx-3 and potentially regulate the α -subunit of hCG.



The Direct and Indirect Effects of Urea on the Development of Bovine Embryos in Vitro

MATTHEW D. VERMILYEA

Under the supervision of W. Ronald Butler and Jonathan R. Hill
Departments of Animal Science and Clinical Sciences

This study was undertaken with two objectives: to determine the direct toxicity effect of urea on embryos in vitro, and to determine the indirect toxicity effect of urea with uterine epithelial cells on embryo development in vitro. Bovine embryos were produced by in vitro maturation and fertilization (IVM/IVF) and cultured in a two-by-two factorial design at day 5. Blastocyst and expanded blastocyst development and quality were compared for the four treatment groups (culture media conditioned by primary culture of bovine uterine epithelia, CSOF; conditioned media with 60mg/dl urea, CSOF + urea; control; control with 60mg/dl urea, control + urea). This study demonstrated that the in vitro culture of embryos in the presence of urea does not decrease the progression of development to the blastocyst and expanded blastocyst stages of the bovine embryo, although conditioned media increased this progression. Urea did have a direct detrimental effect on the number of inner cell mass cells in the developing embryo during the blastocyst and expanded blastocyst stage. Embryos experienced a decreased inner cell mass to total cell count ratio (ICM:TCC) due to direct effects of urea in the culture media.



Persistent Mullerian Duct Syndrome in the Dog: MISRII as a Candidate Gene

KRISTIN K. VYHNAL

Under the supervision of Vicki Meyers-Wallen
Department of Biomedical Sciences

Mullerian inhibiting substance (MIS), a member of the TGF-
B superfamily, is secreted by the fetal testes. In the mesenchyme
surrounding the Mullerian duct, it binds to a type II receptor (MISRII),
which then associates with a type I receptor to stimulate production
of a paracrine signal. This signal is received by the epithelium of the
Mullerian ducts and results in their regression. In dogs with persistent
Mullerian duct syndrome, regression does not occur, and the male
animal retains the derivatives of the Mullerian system: the oviducts,
uterus, and anterior vagina. The condition is inherited as an autosomal
recessive trait. Previous research has shown that the embryonic testes of
affected dogs produce bioactive MIS in sufficient quantities during the
critical period to induce regression of Mullerian ducts in rat urogenital
ridge in vitro. This indicates the possibility of target organ resistance
due to a faulty receptor for the MIS ligand. The purpose of this study
was to identify and sequence the MISRII gene and compare the
sequences of normal and affected dogs. Preliminary results show this
gene is present in the dog, though we have not yet sequenced the gene.



Health Issues Affecting Periparturient and Lactating Dairy Cows

BRENDA L. WEISSMAN

Under the supervision of W. Ronald Butler
Department of Animal Science

The main objectives of this study were threefold: to monitor the body temperature fluctuations in periparturient Holsteins, to relate periods of elevated body temperatures with mastitis and the predominant mastitis-causing species, and to understand the possible role of bovine herpesvirus-4 (BHV-4) in causing mastitis in cows. For the first study, 80 Holstein cows were fitted with body temperature telemetry devices, and data from 31 cows around the recorded time of calving were studied. The average body temperature decreased two days prior to parturition until a sharp temperature increase occurred 10 hours before calving. For the second study on mastitis, the 80 dairy cows with telemetry boluses were monitored for elevated body temperatures and mammary gland infections during their lactation periods. Fevers were found in 48 percent of mastitis cases, and there was also evidence of a seasonal relationship between time of infection and specific pathogens, such as the predominance of *Staph.* species in the colder, first- and fourth-quarters of the calendar and the prevalence of yeasts in the summer. *Strep.* species were the most prevalent microorganisms cultured throughout the 15 months of this study. In the third study, blood and milk samples were taken from 48 cows with clinical mastitis and 48 age-matched, lactation- stage-matched control cows, and then again three to four weeks following the onset of mastitis, to determine BHV-4 presence in association with intramammary infections. Although 25 percent of mastitic cows were found to have antibodies to BHV-4, there was not a significant relationship between mastitis and BHV-4 infection. Present results of the study suggest that body temperature monitoring can be applied at dairy facilities to monitor both the onset of calving and possible health problems.



A Molecular and Genetic Analysis of the alpha-Glycerophosphate Oxidase (α -GPO) Locus in *Drosophila melanogaster*

ALISSA M. BOVEE

Under the supervision of Ross J. MacIntyre
Department of Molecular Biology and Genetics

Alpha-glycerophosphate oxidase (α -GPO) is a mitochondrial inner-membrane protein critical to flight in *Drosophila*. In combination with alpha-glycerophosphate dehydrogenase (α GPDH), it makes up the α -glycerophosphate cycle. This couples glycolysis to oxidative phosphorylation and allows *Drosophila* to operate flight muscles for extended periods of time without build-up of lactic acid. Mutants of 52D α -GPO were obtained for enzymatic, developmental, regulatory, and genetic studies. Potential mutants of the 5-foot regulatory region were made using P element-induced male recombination and P element excision. Recombinant flies were screened using a variety of crosses, enzyme assays, PCR, and Southern blotting techniques. Five out of 73 strains that were tested indicated low enzyme activity using spot tests. One male recombinant and 3 excision strains showed low enzyme activity with spectrophotometric assays. All the strains tested showed a normal-sized 52D α -GPO coding region. By PCR analysis, four male recombinants and four excision strains showed a larger-sized band for the region including the 5-foot regulatory region of 52D α -GPO, suggesting a duplication. Nine male recombinants failed to amplify the putative 5-foot regulatory region, suggesting a deletion of the region and/or the flanking P element. Male recombination, therefore, appears to be a valuable method for studying the regulatory elements of structural genes in *Drosophila*. Two known α -GPO mutants, previously identified in the lab, were sequenced using an RT-PCR based approach in an effort to pinpoint and characterize their defects. Seven changes were found in α GPO²⁹¹, five of which were synonymous substitutions. Ten changes were found in α GPO^{nPO3}—two were synonymous, one was a frameshift, one was a nonsense, and five were missense mutations.



The Relationship Between Individual Flight Performance and Clutch Initiation Date in Female Tree Swallows, *Tachycineta bicolor*

MELISSA S. BOWLIN

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

To test the hypothesis that variation in individual flight performance explains some of the observed variation in the clutch initiation dates of female tree swallows (*Tachycineta bicolor*), a flight-performance test tunnel was used to measure the flight ability of female swallows during the 2000 and 2001 breeding seasons. In 2000, females were tested when they had ten-day-old chicks, in order to eliminate any variation in flight performance due to variation in breeding phenology. In 2001, females were tested in one of two groups: “biological-day birds” were tested on the eleventh day of incubation, in order to standardize breeding phenology as in 2000, and “chronological-day birds” were tested on the same date, regardless of breeding phenology, in order to control for variation in flight performance due to variation in environmental conditions during the tests. No significant relationships between flight performance and individual clutch initiation date were detected in 2000, presumably due to low statistical power and the fact that environmental conditions varied during the trials because the birds were tested on different days. In 2001, individual clutch initiation date was negatively correlated with average acceleration among the chronological-day birds, suggesting that natural variation in flight performance could explain some of the observed variation in individual clutch initiation date in female tree swallows. In addition, a significant negative relationship between wingbeat frequency and wing length was detected in 2000, but not in 2001. Finally, tree swallow flight kinematics were described using high-speed video analysis; while accelerating in the tunnel, tree swallows utilized a vortex-ring gait.



Incorporation of Rous Sarcoma Virus Gag-Pol Polyprotein into In Vitro–Assembled Virus-Like Particles

MATTHEW B. BRECHER

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

__MBD__PR, a truncated form of the Rous Sarcoma Virus (RSV) structural protein, can be assembled in vitro into virus-like particles with an immature morphology. However, to date, no one has incorporated Gag-Pol, the polyprotein containing Reverse Transcriptase (RT) and Integrase (IN), into an in vitro–assembled particle. In order to accomplish this, I constructed a clone coding for Gag-Pol and expressed the protein by in vitro translation. The Gag-Pol was mixed with __MBD__PR under assembly conditions, and assembly products were assayed by pelleting, equilibrium density sedimentation, and rate zonal sedimentation. These assays showed that Gag-Pol was associated with __MBD__PR in in vitro assembly products with a density and size corresponding to that of a virus-like particle. In order to express Gag-Pol protein in an amount relevant to an actual virus, I expressed H6 Gag-Pol with baculovirus in sf9 insect cells. Because the protein was highly insoluble, it was denatured in guanidine and purified by refolding on a nickel column. While the yield of protein was satisfactory, I found that protein produced by this method had very little assembly competence, possibly indicating incorrect refolding during purification.



Effect of Elevated in Vitro Temperature on Steroid Production by Bovine Follicular Cells

MELISSA A. BRUSIE

Under the supervision of Joanne E. Fortune
Department of Biomedical Sciences

Environmental heat stress decreases fertility in cattle due primarily to lower conception rates during summer and early fall. Experiments were designed to assess the effects of varying thermal conditions—such as heat stress—on follicular steroid production in vitro. Large, dominant follicles were obtained from Holstein heifers during the luteal and follicular phases of the estrous cycle. Pieces of follicle wall were cultured for 96 hours in medium alone or with the gonadotropins, luteinizing hormone (LH, 2 ng/ml and 100 ng/ml), or follicle stimulating hormone (FSH, 2 ng/ml and 100 ng/ml). Cultures were performed at three different incubation temperatures (37°C, 39°C, and 41°C) and the media collected/replaced every 24 hours for determination of estradiol, progesterone, and androstenedione secretion. In control cultures of follicle wall, estradiol and androstenedione secretion was reduced at 41°C, an incubation temperature consistent with heat-stress conditions in vivo. Similar decreases in estradiol and androstenedione also were observed in varying gonadotropin treatments. In contrast, secretion of progesterone was greater at 41°C compared to 37°C in both control cultures of follicle wall and cultures treated with low doses of gonadotropin. These results indicate that elevated temperature may be inducing an acute, premature luteinization of follicle wall in vitro. The results suggest that this experimental model may be a useful in studying the direct effects of temperature on steroidogenic functions of follicles.



Membrane Fusion Induced by Sucrose Gradients

BRENDAN J. CAMP

Under the supervision of Peter C. Hinkle
Department of Molecular Biology and Genetics

The fusion of sucrose-rich liposomes to a synthetic bilayer membrane was investigated as a method of studying ion pumps. Lipid vesicles containing a high sucrose concentration, nystatin, and ergosterol were fused to a planar membrane while measuring conductance increases. As the intravesicular sucrose concentration was increased from 0 to 1.0 M, higher levels of fusion were obtained. To assess the applicability of the high-sucrose method to the study of ion pumps, the cytochrome reductase complex was used as a model transporter. Planar membrane behavior was observed to see if a current could be detected after fusing sucrose liposomes carrying the cytochrome reductase complex to a membrane containing a ubiquinol analog and adding cytochrome c.



Genetic Investigation of the Roles of Proteolysis in *Drosophila melanogaster* Seminal Fluid

HEATHER I. COHN

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

Upon mating, *Drosophila melanogaster* male accessory proteins (Acp62F) are transferred into the female reproductive tract along with sperm, causing several behavioral and physiological changes in the mated female, including a decrease in life span. Acp62F, a trypsin protease inhibitor in seminal fluid, has been shown to be toxic to *D. melanogaster* flies. I used ectopic expression assays to address the role of Acp62F in seminal fluid and the mechanism of its toxicity when it enters the female's circulation. Protease inhibitors have several proposed functions—protect the sperm and/or seminal proteins from proteolytic degradation, regulate the processing of seminal fluid proteins, and regulate semen coagulation. To investigate the potential role of Acp62F as a protease inhibitor, I used the UAS-Gal4 system to induce ectopic expression of Acp62F. I found that ectopic expression of Acp62F does not appear to change the proteolytic cleavage of Acp26Aa and Acp36DE and does not appear to increase the stability of sperm in storage. However, entry of Acp62F into the female's circulatory system during mating might impair normal function of her immune system.



Production and Purification of Mcm5p and Investigation of Its Potential Role in Transcriptional Regulation

BERNIE J. DAIGLE, JR.

Under the supervision of Bik Tye
Department of Molecular Biology and Genetics

The Mcm5 protein in *Saccharomyces cerevisiae* is an essential DNA replication factor that is a member of the Mcm2-7 family. This study begins the investigation into Mcm5's role in transcriptional regulation of genes encoding DNA replication proteins. Mcm5p was purified from the *S. cerevisiae* Mcm5 gene through an expression vector cloning and inducible protein purification protocol. As tested by a protein gel electrophoresis, an approximately 97 kD protein fragment was produced that is presumably native Mcm5. Current work is focusing on raising antibodies specific for Mcm5 and performing gel mobility shift assays to determine whether Mcm5 binds to DNA replication gene promoters either alone or through the Mcm1 protein. Preliminary analysis of antibody serum has suggested that an Mcm5-specific antibody may be present. Gel shift assays have suggested that Mcm5 interacts indirectly with DNA replication gene promoters through a binding-promoting interaction with Mcm1. If additional experiments support this interaction at these promoters, it would imply that Mcm5 has some role in transcriptional regulation of replication proteins in *S. cerevisiae*.



Biodegradable Microspheres as Vehicles for Targeted Oral Vaccine Delivery

JOHN L. FALCONE

Under the supervision of W. Mark Saltzman
Department of Chemical Engineering

Poly (lactic co-glycolic acid), or PLGA, microspheres are potential candidates for the successful targeting of orally delivered vaccine to intestinal M cells. A study of Ovalbumin (OVA) binding to PLGA microspheres was done. A PLGA polymer with ester end groups and a PLGA polymer with carboxylic acid end groups were used to make different microspheres with either a polyvinyl alcohol (PVA) or a polyethylene co-maleic acid (PEMA) stabilizer. Trial microsphere conjugations to OVA were done in the presence and absence of chemical carbodiimide coupling cross-linkers. Overall, no significant differences were seen in protein binding with the PVA stabilizer in the conjugations involving cross-linkers compared to trials without cross-linkers. Significant binding differences were apparent in PEMA trials. The highest average protein binding was found for PLGA microspheres made with PEMA stabilizer at approximately 2.0 μg OVA/mg spheres. The highest levels of OVA binding make these biodegradable PLGA microspheres with PEMA stabilizer the strongest candidates for future studies involving targeted delivery of oral vaccine.



Adaptation, Selective Regimes, and the Comparative Method: A Case Study of the African Snake Genus *Dasypeltis*

GABRIEL E.A. GARTNER

Under the supervision of Harry W. Greene
Department of Ecology and Evolutionary Biology

Critiques of the adaptationist program over the last 25 years have forced biologists studying adaptation to consider non-adaptive evolutionary mechanisms. The development of the comparative method and the acceptance of phylogenetic systematics have allowed for rigorous studies of organisms with traits thought to be adaptive. I examined morphological features associated with the head and trunk in the African egg-eating snake, *Dasypeltis scabra*, to determine if they were adaptive to egg eating. I used the common kingsnake, *Lampropeltis getula*, for comparison. I analyzed selective regimes in both southern Africa and the eastern United States to look for environmental factors that would favor evolution of traits adaptive to egg eating. I found a large performance advantage in *D. scabra* when compared with *L. getula* and found evidence of a selective regime in southern Africa that would support the fixation of traits adaptive to egg eating in snakes.



What Can Naked Mole-Rats Communicate About a New Food Source?

CHRISTOPHER T. HOOD

Under the supervision of Paul W. Sherman
Department of Neurobiology and Behavior

Naked mole-rats, *Heterocephalus glaber*, are small rodents that live underground in arid regions of northeastern Africa. They are highly colonial and their social system resembles that of eusocial insects. They feed on patchily distributed bulbs and tubers. Often the location of nest sites can be far from the nearest food source through a labyrinth of tunnels. In the laboratory when an individual mole-rat discovers a new food source, it returns to the nest, often carrying a piece of food, and gives a special vocalization. Recruits then return to the food source, following an odor trail left by the specific forager; the scout does not physically lead recruits back to the food source or give them “map directions.” I studied three captive colonies to see whether successful foragers communicate any additional information about a newly found food source— such as its quality, quantity, or distance from the nest—to colony mates. I found that colony mates (recruits) overwhelmingly visited the site where the initial forager had obtained food over an empty alternative goal that no scout had visited. Recruits also preferentially visited the site where a scout found a higher quality food source over the site where another scout found a lower quality food source. They preferentially visited a food source discovered by a scout closer to the nest over a site where another scout discovered a food source farther away from the nest. However, recruits did not prefer to visit the site where a scout discovered a large piece of food over a site where another scout discovered a smaller piece of the same food. My results indicate that in addition to its location, naked mole-rats can communicate the quality of a food source and its distance from the nest. This study adds to the number of intriguing parallels between the foraging recruitment system of *H. glaber* and those of other social vertebrates and insects.



Effects of Parasitic Infection by *Toxoplasma gondii* on Cellular Nuclear Transport

CATHRYN L. KUBERA

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

Toxoplasma gondii, a cellular parasite that blocks nuclear import of transcription factor NF- κ B, has been hypothesized to cause a general blocking of nuclear import in macrophages. Bone marrow–derived murine macrophages and MDBK cells were tested with a nuclear import assay and, by double infection with *Toxoplasma* and influenza, a negative stranded RNA virus that replicates in the nucleus. The import assay, which adds a GFP-nuclear localization signal (NLS) fusion protein to semi-permeabilized cells, did not provide conclusive information regarding the effects of *T. gondii* on nuclear import. Influenza infection was an indicator of nuclear import occurrence. Macrophage cells, an immune-cell type, exhibited at least partial blockage of influenza infection when also infected with *Toxoplasma*. MDBK cells, which are epithelial cells, did not display this trend. Other epithelial cell types yielded results similar to MDBK cells, suggesting action of *Toxoplasma* may be cell-type specific. This pattern is possibly due to the ability of macrophages to produce cytokines (immune signaling molecules activated by NF- κ B), and *Toxoplasma*'s attempts to suppress the immune response. Concurrent vesicular stomatitis virus (VSV) and *Toxoplasma* infection were used to control for the ability of viral infection to occur during *T. gondii* infection, since VSV replicates in the cytoplasm but is otherwise similar to influenza. A large number of variables make the conclusions of this study tentative. We plan to further test cells by transfecting with a vector coding for a protein that localizes to the nucleus, inducing the cells to express the protein, and then infecting with *T. gondii*.



Identification of Negative Regulator Genes Affecting the Stabilization of a Mitochondrial Reporter Construct, $\text{cox2}::\text{arg8}^{\text{m}}-43$

ERIN E. KULL

Under the supervision of Thomas D. Fox
Department of Molecular Biology and Genetics

This study utilized *Saccharomyces cerevisiae* as a model system for the study of mitochondrial gene expression, specifically at the cyclooxygenase-2 (COX2) locus. A screen was carried out that made use of a reporter construct, $\text{cox2}::\text{arg8}^{\text{m}}-43$, and a transposon disruption library to identify unknown regulators of COX2. Of the sixteen mutants isolated, only two were found to be useful to pursue. These mutants, referred to as EEK5 and EEK11, were discovered to have mutations in the genes ENA2 and MDS3, respectively. ENA2 is thought to function in lithium and sodium ion efflux, while MDS3 has been shown to negatively regulate early meiotic activator genes. Although the $\text{ena2}::\text{Tn}$ mutation has been shown to increase the steady-state levels of disabled Arg8p, the mechanism by which ENA2 is regulating COX2 is unclear. MDS3 may be acting either upstream, downstream, or parallel to the adenylate cyclase/cAMP-dependent pathway, which has been shown in previous work to be involved in $\text{cox2}::\text{arg8}^{\text{m}}$ stabilization. The $\text{mds3}::\text{Tn}$ mutation also has been shown to increase steady-state levels of dArg8p—but not wtArg8p—suggesting that protein stabilization, and not simply an increase in translation, is the mechanism by which the Arg phenotype has been generated. However, other results give us reason to question whether MDS3 is responsible for the Arg⁺ phenotype.



Molecular Characterization of the Loci Responsible for Feeding Specialization in Divergent Host Races of the Pea Aphid, *Acyrtosiphon pisum* Harris

JENNIFER A. NEAD

Under the supervision of Marina C. Caillaud
Department of Entomology

Populations of the pea aphid, *Acyrtosiphon pisum* Harris, occupying closely adjacent fields of clover and alfalfa display striking genetic divergence in demographic performance on the host plants. The proximal determinant of this host specialization is the behavioral acceptance of the plant, rather than toxicity of the food source. Pea aphids rapidly assess alfalfa and clover plants and reject non-host plants based on chemical cues that are perceived before the initiation of feeding. Few loci influence the acceptance of alfalfa and clover as host plants, and the loci are located on different chromosomes—host-plant preference is not determined by alternative alleles of the same loci. Suppression-subtractive hybridization (SSH) is a molecular tool that allows mRNA populations of different entities—such as species, strains, healthy and diseased tissue—to be compared. Previous to my thesis work, subtracted libraries containing differentially expressed cDNAs were created using mRNA of two genotypes of pea aphids, an alfalfa and a clover specialist. In my thesis work, I performed differential screening of these subtracted libraries and identified 47 putative differentially expressed candidate clones (28 alfalfa specialist and 19 clover specialist). Eleven candidate clones were sequenced and the sequences were matched to existing proteins in the Flybase and Genbank databases. Putative alfalfa specialist candidate clones include an ABC transporter, a 26S proteasome, a hydrogen-transporting ATPase, and two cyclophilins. Three of the alfalfa specialist candidate clones failed to match to existing protein sequences and are therefore believed to be novel proteins. Putative clover specialist candidate clones include a Rab-related protein and two proteins with unknown functions.



Effects of Thymulin on Avian Innate Immunity to Disease

MOLLY ANN OLIVER

Under the supervision of James A. Marsh
Department of Microbiology and Immunology

The effects were evaluated of in vivo thymulin treatments on avian NK-cell (natural killer–cell) cytotoxicity, NK-cell responsiveness to recombinant chicken interferon-gamma (ChIFN- γ), and viral clearance. Five-and-a-half-week-old K-strain chickens infected with avian infectious bronchitis virus (IBV) served as the model for these experiments. Daily carboxymethyl-cellulose (CMC) control and thymulin injections of 10ng/100g body weight (Bwt) began prior to and post-infection. A cytolytic release assay was used to determine the activity of the NK cells harvested via lung lavage from the respiratory tracts of the chickens. The experiments showed that in vivo thymulin treatments enhance NK-cell cytotoxicity. The greatest enhancement of NK-cell cytotoxicity was observed at 10 days post-infection in those chickens that began receiving thymulin post-infection. The experiments that compared 10ng and 50ng/100g Bwt thymulin doses found that the 50ng/100g Bwt dose significantly depressed the cytolytic activity of the NK cells in comparison to both the 10ng/100g Bwt dose and the control. The next set of experiments examined the ability of thymulin to enhance viral clearance through the inoculation of specific-pathogen-free (SPF) embryonated eggs with 10-fold dilutions of fluid recovered from the respiratory tracts of the infected chickens. Embryo mortality rates indicated the chickens receiving thymulin treatments post-infection had a significantly lower viral load than those receiving control treatments. In the final set of experiments, there was a significant increase in responsiveness to ChIFN- γ in those NK cells harvested from chickens receiving thymulin treatments, as compared to control treatments. These results support the hypothesis that thymulin enhances NK activity by up-regulating IFN- γ receptor expression.



Cellular Kinetics of the Local Immune Response to Muscle Stage *Trichinella spiralis*

VICTORIA L. ROBERTS

Under the supervision of Judith A. Appleton
Department of James A Baker Institute for Animal Health

The human pathogen *Trichinella spiralis* is a parasitic nematode known to infect mammals and birds. Rodents are natural hosts for *T. spiralis* (Murrell et al. 1987). Humans become infected with the pathogen by consuming infected, undercooked meat. *T. spiralis* has two habitats in the infected host: the small intestine and the muscle. Both habitats are intracellular. In muscle, *T. spiralis* lives in a cell surrounded by a protective collagen capsule. This unique structure is called a nurse cell. Although much research has been done on the intestinal phase of *T. spiralis* and the host's immune response therein, far less is known about the immune system's interaction with the nematode once *T. spiralis* invades the muscle. This study sought to characterize the cellular kinetics of the local immune response to muscle stage *T. spiralis* in rats. Lymphocytes recovered from diaphragms and cervical lymph nodes of orally infected rats were surface phenotyped using flow cytometry. CD8⁺ cells were increased on days 10 and 21 post infection. CD4⁺ cells peaked at day 10 post infection, and CD45RA⁺ B-cell numbers were highest on day 21. All lymphocyte subsets decreased dramatically by day 28 post infection. IL-4 was present in the diaphragm on day 10 of infection, corresponding with the influx of T lymphocytes. These results show that in the muscle, *T. spiralis* elicits a T-lymphocyte response followed by a B-lymphocyte response, with a dramatic decline in those cells by the 28th day of infection.



Identification of Possible Host-Protein Interactions with *C. trachomatis* Inclusion-Membrane Protein, IncD

KARLA M. STUCKER

Under the supervision of Marci Scidmore
Department of Microbiology and Immunology

The obligate intracellular bacterium, *Chlamydia*, is a significant human pathogen whose developmental cycle is carried out entirely within a vacuole, termed an inclusion. Recently, at least seven chlamydial-derived inclusion-membrane proteins have been identified. Characterization of inclusion-membrane proteins through the identification of the host proteins that interact with them should help determine how chlamydiae survive within their host. To identify host proteins that interact with one specific *C. trachomatis* inclusion-membrane protein, IncD, a yeast two-hybrid approach was utilized. Using this method, several potential interacting host proteins were identified, including BNIP₃, a proapoptotic mitochondrial-localized protein. To confirm whether BNIP₃ interacted with IncD in infected HeLa cells, the intracellular localization of FLAG-tagged BNIP₃ was analyzed by indirect immunofluorescence microscopy. BNIP₃ localized to the mitochondria in both infected and uninfected cells. In infected cells, the mitochondria were closely associated with the inclusion membrane suggesting that in infected cells BNIP₃ may potentially interact with cytoplasmically exposed portions of IncD. These results suggest that IncD may play a role in usurping control of host-cell apoptosis for the benefit of chlamydiae. Further characterization of BNIP₃/IncD interactions, as well as the additional interactions that were identified during this study, should help to elucidate the biological functions of IncD.



Gabon-Clade *Brienomyrus* Electric Organ Discharges: Waveform Diversity and Species Recognition

TIMOTHY D. USCHOLD

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

Mechanisms of premating isolation such as recognition signals serve as important substrates for the forces of selection [Panhuis et al. 2001]. Within mormyrid fishes, electric signals (EODs) facilitate a variety of functions including mate recognition via the Knollenorgan electroreceptor pathway [Hopkins and Bass 1981], leading to interest in how the electrosensory modality's communicative function has shaped the evolution of EOD waveform diversity. The Gabon-clade *Brienomyrus*, a recently discovered species-flock of electrogenic mormyroid fishes from West Central Africa, serves as a model for inquiry as to the evolutionary origins, nature, and maintenance of signal characteristics [Sullivan et al. 2002]. We used EOD waveform measurements of time, voltage, slope, and FFT landmarks from eight field-recorded *Brienomyrus* taxonomic units to assess the species-specificity of electric discharge waveforms. For the majority of cases, we report quantitative species-level differences in waveforms sufficient for separation and discrimination by multivariate ordination statistics. Knollenorgan electroreceptor coding patterns for EODs of sympatric species subsequently were examined to assess the potential utility of EOD waveform as the principal mechanism of species recognition. We found that temporal differences in peripheral electroreceptor coding of sympatric EOD waveforms may be sufficient to facilitate discrimination between most *Brienomyrus* congeners. We also note, however, one case of striking signal convergence between two congeners (*B. curvifrons* and *B. longicaudatus*), where both multivariate statistics and Knollenorgan electroreceptor coding patterns could not distinguish between their signals. Our results suggest that the observed diversity of *Brienomyrus* EODs may be sufficient in many cases to confer species identity and facilitate the maintenance of reproductive isolation among sympatric genera.



Multimodal Communication in Jumping Spiders (Araneae:Salticidae): Behavior and Anatomy

NICOLE D. VANDERSAL

Under the supervision of Ronald R. Hoy
Department of Neurobiology and Behavior

Visual aspects of jumping spider (Family Salticidae) courtship have been extensively documented and believed to be the basis for species recognition and female choice. However, my observations show that jumping spider courtship can contain low-amplitude, substrate-born vibratory cues simultaneous with visual cues. My findings show that in at least two of the four species observed (*Phidippus audax*, *Evarcha spp.*), males use elaborate combinations of visual and vibratory cues during courtship displays. Histological data on visual sensory systems reveal highly developed optic neuropils, which function as higher-order neural processing structures. I also found that the most sensitive vibration-receptor organ, the metatarsal lyriform organ, has a relatively large number of vibration receptor slits (17) compared to many other arachnids. With these behavioral, morphological, and neuroanatomical findings, I provide a foundation for the future studies of jumping spiders as a model system for the study of multimodal signal processing.



Isolation and Suppression Analysis of Conditional Mutations in the *Saccharomyces cerevisiae* MLH1 DNA Mismatch Repair Gene

MARC P. WAASE

Under the supervision of Eric E. Alani
Department of Molecular Biology and Genetics

The DNA mismatch repair (MMR) system plays a key role in the integrity and stability of prokaryotic and eukaryotic genomes by repairing errors made during DNA replication. The MMR proteins that recognize mismatches, which are highly conserved from bacteria to mammals, are well characterized; however, few downstream MMR functions have been characterized in eukaryotes. In the MMR of eukaryotes, members of the Mut L Homolog (MLH) gene family have been proposed to act as a key molecular matchmaker, coordinating mismatch recognition with downstream repair functions. To identify downstream components of the MMR pathway of baker's yeast (*Saccharomyces cerevisiae*), we took advantage of the fact that *mlh1 pol3-01* haploids are inviable (Smith and Alani 1999) to identify four conditional MLH1 mutants. Each allele confers a temperature-sensitive phenotype for viability in a *pol3-01* strain and for mutator phenotype in *POL3* strains, behaving like wild-type at 26°C and null at 35°C. Two of the *mlh1* conditional mutations (*mlh1-T113A*, *-I147T*) mapped to regions in the MutL crystal structure that are thought to be important for ATP binding, and two (*mlh1-F228S*, *-I296S*) mapped to conserved regions that appear to provide general stability and may contribute to the formation of a ssDNA binding domain. Using a targeted gene approach, I tested whether overexpression of potential downstream repair factors, exonuclease EXO1 and helicases SGS1 and SRS2, could suppress the mutator phenotype of these alleles. EXO1 overexpression did partially suppress the mutator phenotype of one of the alleles (*mlh1-I296S*) at 35°C, probably by stabilizing MLH1, but SGS1 and SRS2 overexpression had no significant effect on the alleles. These genetic studies further show that conditional mutations in the MLH1 gene could be used to identify interactions between mismatch recognition proteins and the downstream repair components.



Reductive Dechlorination of Chlorinated Benzenes by *Dehalococcoides ethenogenes* Strain 195 and a Vinyl Chloride Degrading Culture

SUSAN F. WILSON

Under the supervision of Stephen H. Zinder
Department of Microbiology

Chlorinated benzenes are commonly manufactured compounds and by-products of large chemical industries that threaten the environment by their recalcitrance toward degradation and their suspected carcinogenic nature. In this study, *Dehalococcoides ethenogenes*, a novel green non-sulfur eubacterium capable of complete reductive dehalogenation of tetrachloroethene to ethene and phylogenetically related to microbes with similar reducing abilities, was tested for the possible dechlorination of higher chlorobenzenes (tetra- through hexachlorobenzenes). Another purified culture, able to reduce vinyl chloride to ethene, also was tested for monochlorobenzene-dechlorinating ability. Partial dehalogenation was observed for all five chlorobenzenes incubated with *D. ethenogenes*, with several experiments all resulting in 1,2,3,5-tetrachlorobenzene, 1,2,4- and 1,3,5-trichlorobenzene production. These results support the recent finding of several putative dehalogenase enzymes within the microbe's genome. Deduced dechlorination routes indicated nucleophilic substitution on the most positively charged carbon atom, as observed in previous research with other anaerobes. All experimental cultures, except 1,2,3,5-tetrachlorobenzene, were successfully transferred to new media tubes containing their respective chlorobenzene, indicating the ability of these compounds to serve as sole electron acceptors for *D. ethenogenes*, consistent with dehalorespiration. No dechlorination of monochlorobenzene was observed for the vinyl chloride culture. The positive results obtained with *D. ethenogenes* introduce the idea of incorporating this novel microbe into bioremediation techniques of chlorobenzene-contaminated sites and increase the curiosity about how broad a spectrum of environmentally problematic compounds *D. ethenogenes* is capable of reducing.



The Role of the Genes *sodB*, *sodC*, *adhI*, and *bolA* in Protection Against Nitrosative and Oxidative Damage in *Rhodobacter sphaeroides* 2.4.3

REBECCA E. ZORDAN

Under the supervision of James P. Shapleigh
Department of Microbiology

Rhodobacter sphaeroides 2.4.3 is a purple non-sulfur bacterium that is capable of denitrification. This strain of cells was noted to have a tolerance to toxic derivatives of nitric oxide (NO), which is a free radical intermediate of the denitrification process created by the sequential reduction of nitrate (NO₃___) and nitrite (NO₂___). This study focuses on ways *R. sphaeroides* 2.4.3 protects itself against oxidative and nitrosative damage by toxic NO derivatives. A transposon mutagenesis was conducted in order to identify genes that confer this tolerance, but no reasonable candidates were found. The investigation then focused on genes of known function that may protect cells against NO derivatives. Superoxide dismutases (SODs) were studied because they reduce superoxide, thus preventing peroxynitrite formation in the cell. Through taxis assays with *sodB* mutants, it was found that FeSOD is necessary for growth in aerobic conditions but is not necessary for response to NO₂___. CZSOD, encoded by *sodC*, was found to have consistently low activity, and expression did not increase to compensate for a loss of FeSOD in *sodB* mutants. Thus, preliminary results indicate neither of the SODs are necessary for protection from nitrosative damage. The gene *adhI* was studied because it has been implicated in the breakdown of certain NO derivatives (S-nitrosoglutathione). This study found *adhI* insertional inactivation mutants in denitrifying and nondenitrifying *R. sphaeroides* strains respond similarly to nitrate and nitrite, so it was concluded that *adhI* is not involved in protection against nitrosative damage. The *bolA* gene, thought to be under the same regulation as the denitrification genes that produce and degrade NO, was shown to be highly expressed in all conditions and thus is not considered to be important in the cellular response to nitrosative stress.



Inbreeding Avoidance by Recognition of Close Kin in the Pea Aphid, *Acyrtosiphon pisum*

MING HUA HUANG

Under the supervision of Marina C. Caillaud
Department of Entomology

Inbreeding depression has detrimental effects on many organisms, but its effects are potentially greater in organisms such as pea aphids (*Acyrtosiphon pisum*) that have at least one asexually reproducing life stage. In such organisms, matings producing a progeny with a coefficient of inbreeding (r) equal to 1 is possible. Therefore, it is crucial for pea aphids to possess a mechanism to avoid inbreeding with close relatives and especially genetically identical individuals. Here, I examined two possible inbreeding avoidance mechanisms. One mechanism tested was the recognition and mating avoidance of partners of identical genetic makeup. A second possible mechanism tested was the recognition and mating avoidance of partners of the same body color. Results showed that matings between males and females of the same color were as successful as matings between partners of different colors. Thus, body color was not used as a proxy for genetic relatedness. In contrast, the success of mating between genetically identical partners was consistently reduced compared to that of matings between genetically unrelated partners (14.6 versus 40.3 percent). Interestingly, mating between genetically identical individuals proceeded normally until the very last stage of the reproductive sequence during the physical coupling of the male and female genitalia. Males spent as much time (about 20 minutes) copulating with genetically related females as unrelated females. However, the female's spermatheca often remained empty when mating had involved close kin. This is suggestive evidence of cryptic female choice. However, approximately 14.6 percent of inbred matings still resulted in a successful transfer of sperm to the spermatheca. Since females mate multiply, other post-copulatory mechanisms, such as male sperm competition or further cryptic female choice, could be involved in reducing the likelihood of inbred fertilizations.



Effects of Water Concentration on the Maturation of *Entomophaga maimaiga* (Zygomycete: Entomophthorales) Resting Spores Stored in Clay and Differences in Maturation Between Two Isolates

JAMES R. MCNEIL

Under the supervision of Ann E. Hajek
Department of Entomology

Entomophaga maimaiga is most often distributed for control of gypsy moth as environmentally resistant resting spores. Although much current research is focusing on how to produce these resting spores in the lab, not much research is directed toward their storage or distribution. One possibility is storage in clay, and this study examines the effects of water concentration on the maturation of *E. maimaiga* resting spores stored in clay, as well as differences between isolates in how resting spores mature. Resting spores were stored at 4°C in water:clay mixtures of 5:10, 9:10, and 15:10 parts by mass and on water agar. Maturity was measured at zero, one, and two months using morphological characters. Two isolates of *E. maimaiga*, one from Japan and the other from New York, also were compared over two weeks to see how events in their maturation differed. The results indicate that resting spores kept in the drier treatments matured more completely over the two-month period of the study than those in wetter treatments, possibly due to the suppression of saprophytic microbes. The comparison between isolates showed significant differences ($p < 0.001$) and is a warning about making generalizations about how *E. maimaiga* resting spores mature. Further work into the effects of clay storage needs to be done before clay-stored resting spores can be used to distribute *E. maimaiga*.



The Effects of Freezing and Winter Temperature Conditions of Three Alpine Lakes on Macroinvertebrate Community Composition

GAVIN J. SVENSON

Under the supervision of Barbara L. Peckarsky
Department of Entomology

To persist in alpine lakes, populations must be able to withstand extreme winter temperatures (freezing) and annual thermal variability. Although challenging to obtain, direct measurements of winter conditions and comparisons of macroinvertebrates in alpine lakes before, during, and after lake freezing can provide insights into effects of different freezing patterns on community composition. In this study comparisons were made of the physical characteristics, thermal regimes, macroinvertebrate species diversity, and abundances among three alpine lakes located in the White Mountains, New Hampshire, during October, January, and June 2000–2001. Two of the lakes (Upper Lake of the Clouds and Star Lake) froze solid for about a third of the year, while some areas of substrate in the third lake (Lower Lake of the Clouds) never reached temperatures below zero, thereby providing refuges from freezing for benthic invertebrates. Species diversity was greatest in Lower Lake, but invertebrate abundance also was low, possibly because this lake had fewer cumulative degree-days above zero (a shorter growing season) than either Upper Lake or Star Lake. While total benthic macroinvertebrate densities did not differ significantly among the three lakes, individual taxa were influenced differently by winter conditions in the study lakes. The invertebrate fauna of all three lakes was dominated by the dipteran family Chironomidae, some species of which are known to have evolved the ability to overwinter in frozen benthic substrates. Species in the subfamily Chironominae (especially *Chironomus* spp.) and Tanypodinae were common in the most extreme lakes; while Orthocladiinae were most common in the lake that did not freeze solid. These taxa often predominate in alpine and arctic aquatic systems and can serve as indicators of extreme winter conditions.



Aquatic Invertebrates as Bioindicators of Wetland Habitat Quality: A Comparison of Invertebrate Communities in Natural and Cadmium-Disturbed Ponds

ALANI N. TAYLOR

Under the supervision of Barbara L. Peckarsky
Department of Entomology

Aquatic invertebrates have long been used in stream communities to assess habitat quality. Less is known about their value as bioindicators of wetland communities. In this study, we looked at invertebrate populations in ponds, some of which had been disturbed by residual cadmium. In some of the ponds, we also had to account for the presence of fish (bluegill and pumpkinseed sunfish and fathead minnows) in determining the impact of the cadmium. We quantified the effects of this disturbance using non-parametric statistics, indices of abundance and diversity, and two published multi-metrics tests. Cadmium effects could not be seen in the fish ponds because of the influence of fish predation. However, cadmium had a significant influence on invertebrate taxa abundance but not diversity. Neither multi-metrics test was able to detect a cadmium effect. Individual taxa were affected in different ways. From our results, we suggested that certain taxa (*Gammarus*, *Psectrocladius*, *Ischnura*, *Crysops*, etcetera) may have value as bioindicators for heavy-metal disturbance. We hope that this study can be used in developing future wetland biomonitoring protocols.



Taste Sensitivity to 6-N-Propylthiouracil and Perception of Fattiness, Sweetness, and Saltiness in a High-Fat and a Low-Fat Graham Cracker

HEIDI SICHERMAN

Under the supervision of Virginia Utermohlen
Division of Nutritional Sciences

This study tested the hypothesis that individuals who are more sensitive to 6-n-propylthiouracil (PROP) are more sensitive to fat, and, therefore, that individuals who are highly sensitive (HST) to PROP would discriminate fat in graham crackers better than moderately sensitive tasters (ModST) or mildly sensitive tasters (MildST). Subjects rated graham-cracker samples varying in fat level for the intensity of fattiness, saltiness, sweetness, and overall liking. Each of the three groups was able to pick out differences in the cookies. However, HST perceived bigger differences than ModST and MildST. Furthermore, HST were able to perceive differences in sweet and fat levels, whereas the other groups attributed differences to saltiness. Therefore, taster status may play a role in how people perceive fattiness in food.



Seed Dispersal by *Gopherus polyphemus* at Archbold Biological Station, Florida

JANE E. CARLSON

Under the supervision of Peter L. Marks and Eric Menges
Department of Ecology and Evolutionary Biology

The objective of this study was to investigate the potential for the herbivorous gopher tortoise (*Gopherus polyphemus*) to act as an agent of seed dispersal at Archbold Biological Station, Florida. Scat dissection, as well as foraging observations, were used to determine the seed species and plant taxa consumed by the tortoises during the months June through July 2001. Germination tests were performed on the two seed species of greatest abundance in the scat, *Paspalum notatum* (bahiagrass) and *P. setaceum*, and the percent germination of each was compared with undigested conspecifics collected from the field. The diet of the gopher tortoise consisted mainly of grasses and sedges, and these—in combination with *Pinus elliottii*, *Galactia* sp., *Vaccinium myrsinites*, and *Gaylussacia dumosa*—made up more than 90 percent of the plant taxon occurrences found in the scat. The percent germination of digested *P. notatum* seeds was significantly less than the germination of the undigested conspecifics; less than 1 percent of digested seeds germinated, compared to 27 percent germination of undigested seeds. In contrast, many seeds of *P. setaceum* germinated after digestion, and there was no significant difference between digested and undigested seeds of this species. The results indicate that grasses and sedges make up a large portion of the gopher tortoise's summer diet. Although a large number of bahiagrass and *P. setaceum* seeds are consumed, only the seeds of the native grass, *Paspalum setaceum*, remain germinable post-digestion. Thus, gopher tortoises may be agents of dispersal for *P. setaceum* in habitats with both the grass and the tortoise.



Carbon Resources and pH as Controls of Microbial and Microarthropod Communities in a Northern Hardwood Forest

WILL R. KESSLER

Under the supervision of Melany C. Fisk and Timothy J. Fahey
Department of Natural Resources

Soil microorganisms and soil fauna (for example, microarthropods) are important trophic groups in northern hardwood forests. Both play integral roles in forest-floor food webs and consequently influence the nutrient cycling of the greater ecosystem. We examined the compound effects of carbon (C) resource additions and pH manipulation on the microbial and microarthropod communities in the soil. In June 2000, additions of both C and calcium (Ca) were performed on five sites within the Bear Brook watershed of the Hubbard Brook Experimental Forest in northern New Hampshire. Plots received 667 g m^{-2} Ca, in the form of wollastonite (CaSiO_3), and 120 g C m^{-2} , in the forms of glucose and cellulose. Soils were then sampled and analyzed for pH, microbial biomass C and nitrogen (N), soil respiration, and microarthropod density. In Ca-amended plots, pH increased by roughly one unit, and microbial field respiration showed an increase, likely due to stress associated with a change in soil chemical environment. Though no significant response to Ca was seen in microarthropods, there was evidence of a decline in number with raised pH. This may indicate raised pH affected the character of the microbial community, resulting in altered food resources for microarthropods. It is possible a pH-driven decrease in the fungal-to-bacterial ratio had trophic consequence for the primarily fungivorous microarthropods. Thus, we saw tentative evidence of a bottom-up pH control of the microarthropod community adapted to acidic forest soils.



The Response of *Polygonum bistorta* to Fertilization in Acidic and Non-acidic Tundra

LAUREN MCSHERRY

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

Although the plant-species composition of Alaskan tundra differs considerably among acidic and non-acidic sites, the forb *Polygonum bistorta* occurs in both sites (even though many forbs that occur in non-acidic tundra do not occur in acidic tundra). The question motivating this study was: Is *P. bistorta* insensitive to pH, and is it able to obtain nutrients at low and high pH? Consequently, the objective of this study was to examine whether *P. bistorta* would respond differently to nutrient addition in acidic tundra versus non-acidic tundra in a nitrogen and phosphorus treatment and in a lime treatment. I measured plant biomass, total number of leaves/m², number of flowers/m², growth rate, and specific leaf area (SLA). In addition, foliar nitrogen and nitrate reductase (NR) activity were measured to determine whether nitrogen was being used differently in acidic tundra versus non-acidic tundra. I hypothesized that low calcium availability at the acidic tundra site might limit *P. bistorta*, which has high foliar concentrations of Ca⁺ compared to other tundra plant species. Results of the study indicate that the abundance of *P. bistorta* does not significantly differ between sites or among treatments. In addition, a correlation between biomass and NR activity could not be established. Last, I found increased SLA in the N+P treatment in acidic tundra, suggesting that shading by competing dominant species—such as *Betula nana*—may be affecting the response of *P. bistorta* to N+P fertilization.



Evaluating the Potential for Garden Mosaics to Increase Self-directed Learning in Youth Participants

CELESTE J. RICHIE

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

Garden Mosaics is an environmental education program created at Cornell University in response to a societal need for enhanced science education. The goal of the program is to create opportunities for youth to be engaged in original research. The program implements participatory action research (PAR) activities in community-based gardens. I used document analyses, personal and group interviews, literature reviews, and participant observation as a trained program facilitator to conduct a formative evaluation of the program. A formative evaluation differs from an outcome evaluation in that it determines the level of consistency among the program goals, means for achieving those goals, theoretical underpinnings used to select means, design of program actions, and implementation of program actions. When consistency among these program components is high, the likelihood that the program can attain its goals also is high. I found several inconsistencies among program components that would not have been identified through a summative evaluation. One important implied goal revealed through interviews with the program designer was development of self-directed learning (SDL) in youth participants. Based on literature review, I developed a theoretical foundation pertaining to progression of SDL and insights about the means necessary to achieve that progression. The characteristics of the PAR activities designed into the program are only partially consistent with the means necessary to achieve SDL. Program actions based on PAR are unlikely to lead to SDL progression. In addition, a group interview with trained program facilitators revealed inconsistencies between their perceptions of program goals and indicators of success and the perceptions of the program designer. Results of this formative evaluation provide opportunities to enhance the likelihood of SDL progression in youth through redesign of program actions and revision of facilitator training.



Lake-Level Management: Impacts on the Land-Lake Interface and Groundwater Seepage

TRAVIS C. SPIER

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

Lake-level management is a prevalent practice in North America, but the past few decades have seen changes in the commonly held notion of lakes and ponds as relatively static, disconnected systems. A growing body of evidence is demonstrating that lakes are linked to their surrounding terrestrial habitat by subsurface groundwater flow. However no research has examined how groundwater-seepage processes are impacted by lake-level management practices and associated shifts in the land-lake interface. Oneida Lake in New York state provided an ideal study site to examine this issue. U.S. Geological Survey records of the lake level dating from 1904 through 2000 were located and analyzed. Resulting hydrographs indicated that since the 1950s, instead of steadily rising water levels in the late fall, average February lake level is 3.0 feet (0.91 m) lower than the historical average low. This trend persists into the spring, where average April peak is 2.7 feet (0.83 m) lower than the historical average peak. As a result of these changes, more than 9 km² of wetlands adjoining the lake are no longer connected to the lake during spring inundation. Groundwater seepage was monitored at Shackelton Point on the south shore of Oneida Lake in the summer of 2001 and again in the late fall once drawdown had occurred. The fall drawdown resulted in exposure of the shoreline where seepage normally would occur and appeared to result in elevated rates of seepage further offshore. It is expected that all these changes resulting from lake-level management have had serious impacts on the biota and ecosystem function.



Closing the Academic Gap: Supplemental Course Instruction Plays a Fundamental Role for Target Students at Cornell University

LISA D. EISENHAUER

Under the supervision of Russell C. Lloyd
Department of Biological Statistics and Computational Biology

Cornell University offers supplemental instruction (“oo” courses) to students in introductory biology, chemistry, math, economics, and physics classes. These courses are hosted by the Learning Strategies Center (LSC), part of the Center for Learning and Teaching (CLT). Upon admittance into Cornell, students are identified as being either “target” or “non-target” students. The main reason for this identification process is that some high schools have more rigorous curriculums than others, which results in varying preparation levels of incoming freshmen. Most target students are members of underrepresented minority groups (Latino-, African-, Asian-, or Native Americans) affiliated with the Higher Education Opportunity Program (H/EOP) or the Education Opportunity Program (EOP), or from an educational background that may not be as strong as other applicants (Helene Selco, associate director of the CLT and director of the LSC, in a personal communication, October 2001). A total of 803 students from 11 supplemental instruction courses were studied. The model predicted mean standardized exam scores based on three factors: the target/non-target status of the student, attendance rates to the “oo” sessions, and the interaction between the two. Non-parametric binomial tests showed significant patterns among classes where target students have lower mean standardized test scores than non-target students, increased “oo” attendance leads to increased test scores for all students, and target students benefit more from attending “oo” sessions than do non-target students. A total of 123 students participated in “oo” sessions for a full academic sequence. These students were studied to test the cumulative effects of attending “oo” sessions. It was found that full attendance to the “oo” sessions can remove significant differences between mean standardized exam scores for target and non-target students. Results indicate that the “oo” sessions play a key role in advancing student academic growth.



Depressive Disorders, Suicide Symptoms, and Food Insufficiency in U.S. Adults

ALEXANDER T. PEARSON

Under the supervision of Steven J. Schwager and Edward A. Frongillo
Department of Biological Statistics and Computational Biology and
Division of Nutritional Sciences

While it has been established that hunger correlates with a decline in general health, food insufficiency that may underlie chronic hunger has not been studied in relation to adult depressive disorders and suicidal symptoms in the general population. We investigated the relationship between food insufficiency and symptoms of depression, controlling for various socio-demographic factors. The analysis was done using a subset of the National Health and Nutrition Examination Survey (NHANES) III data set, including participants aged 17 to 39 who have complete information on their symptoms of depression and food insufficiency status ($n=8573$). In adults aged 17–35 the lifetime prevalence of major depressive disorder was 7.7 percent; for dysthymia, 6.2 percent; for suicide attempt, 5.7 percent; and for any suicidal symptom, 37.4 percent. Females were more likely than males to suffer from major depressive disorder, dysthymia, and any symptom of suicide. Whites were more likely than non-whites to suffer from major depressive disorder but less likely to suffer from dysthymia. Mexican-Americans were significantly less likely than non-Mexican-Americans to suffer from any suicidal symptoms. There were no significant differences between income levels for major depressive disorder, but dysthymia, any depressive symptom, and all suicidal symptoms were less likely to afflict those in the highest income bracket. Unemployed individuals were more likely to suffer from any depressive symptom and any suicidal symptoms than those who were employed. Logistic regression for explaining food insufficiency by depressive symptoms was performed after controlling for socio-demographic factors. The relationship between food insufficiency and most symptoms of depression studied was significant after controlling for socio-demographic factors. Food-insufficient adults significantly were more likely to suffer from dysthymia, major depressive disorder, and suicidal ideation. This indicates a strong relationship between food insufficiency and depressive disorder and suicidal symptoms in U.S. adults.



Classification of Running Water Hydro-Morphological Segment Habitats via Quantifiable Physical Components

TASI B. PERKINS

Under the supervision of Russell C. Lloyd
Department of Biological Statistics and Computational Biology

Ecologists combat fish-habitat destruction and population depletion through restoration and reintroduction efforts. One such project is underway in the Beaverkill River, long known for its trout-fishing potential, which has lost a significant portion of its fish population in the last century (Van Put 261). Restoration must be preceded by a study of fish collected by electrofishing, and that in turn must be preceded by a sound sampling methodology (Crotty 1). In order to ensure a representative sample of fish habitats, the streams of interest must be broken down into smaller, homogenous segments. Sampling across segment types ensures representation of various fish habitats, and this introduces the need to determine what makes two segments the same type. However, precise quantitative data painfully measured on individual segments does not yield much information beyond that which can be explained by cursory glances at the right factors. This study demonstrates that the Beaverkill River is home to about a dozen types of stream segments, which can be discerned from one another with a couple of simple observations.



Examining Wave-Propagation Patterns in the Jovian Atmosphere Using the EPIC Model

ALEXANDER C. RUANE

Under the supervision of Joseph Harrington
Center for Radiophysics and Space Research

Drawing from thermal observations of Jupiter's lower stratosphere and upper troposphere, simulations using the Explicit Planetary Isentropic-Coordinate (EPIC) Model evolve wave-like features over a 100-day period. Three resulting patterns in propagation speeds emerge, with the equatorial region experiencing unpredictable non-linear turbulence, the mid-latitudes experiencing consistent propagation, and isolated regions demonstrating a periodic drift in propagation speed reminiscent of, but much faster than, a similar drift in the speed of the Great Red Spot. Comparisons between the vertical mean zonal wind profile and the mean propagation speed profile demonstrate the westward propagation of thermal features. We associate these with Rossby waves. Vertically developed wave modes also can form as a result of the vertical propagation of energy, especially in the troposphere, where the tropopause acts as a ducting lid.



Identification of *Phaeolus schweinitzii* on *Pinus radiata* in New Zealand

MEGAN E. ACKERMAN

Under the supervision of Kathie T. Hodge
Department of Plant Pathology

Nuclear ribosomal DNA sequences of the internal transcribed spacer (ITS) region were used as characters in a phylogenetic analysis to determine the identity of a fungus growing on *Pinus radiata* in Invercargill, New Zealand. The sequences were determined in both directions using primers ITS1, ITS5, and/or ITS4. These were then compared to ITS sequences obtained from GenBank. The sequence of the Invercargill specimen matched a *Phaeolus schweinitzii* specimen from the United States with only 1.03 percent nucleotide difference; other taxa included in the analysis were more distantly related. The New Zealand fungus is hypothesized to be a strain of *Phaeolus schweinitzii* that was introduced to New Zealand from the United States.



Anti-Fungal Plants of the Peruvian Amazon: A Survey of Ethnomedical Uses and Biological Activity

ANNA W. HERFORTH

Under the supervision of Eloy Rodríguez
Department of Plant Biology

In this study botanical treatments for dermal mycoses and vaginal yeast infections used among villagers of the Yarapa River region, Loreto, Peru were tested for bioactivity. Treatments of dermal mycoses included preparations of *Vismia angusta* (Clusiaceae), *Senna reticulata* (Fabaceae), *Senna macrophylla* (Fabaceae), *Genipa americana* (Rubiaceae), and *Cecropia membranacea* (Cecropiaceae) and the beetle larvae that consume it. Remedies for vaginal yeast infections, used by midwives separately and in mixtures, are *Spondias mombin* (Anacardiaceae), *Maytenus macrocarpa* (Celastraceae), *Campsiandra spruceana* (Fabaceae), *Psidium guajava* (Myrtaceae), *Coussapoa nitida* (Cecropiaceae), *Brosimum acutifolium* (Moraceae), *Brosimum rubescens* (Moraceae), *Swartzia polyphylla* (Fabaceae), *Anacardium giganteum* (Anacardiaceae), *Maquira coreacea* (Moraceae), *Croton lechleri* (Euphorbiaceae), *Copaifera paupera* (Fabaceae), *Chenopodium ambrosioides* (Chenopodiaceae), and an unidentified white fungus. Disk diffusion assays were conducted against two yeasts, two dermatophytes, two gram-positive bacteria, and three gram-negative bacteria. In addition, a crystal violet bioassay was conducted on skin and colon cancer cell lines to assess the cytotoxicity associated with the use of these anti-fungal plants. Most of the extracts showed bioactivity against several of the test organisms; all but two were active against *Candida albicans*, the fungus responsible for yeast infections. *Copaifera paupera* and *Croton lechleri* were the only two extracts found to be significantly cytotoxic.



A Reverse Genetic Approach to Study a Potential Accessory Factor for a Nucleus-Encoded Organellar RNA Polymerase

WIRULDA POOTAKHAM

Under the supervision of David B. Stern
Departments of Plant Biology and Molecular Biology and Genetics

In *Arabidopsis*, three nucleus-encoded organellar RNA polymerases (NEP)—RpoT1, RpoT2, and RpoT3—were identified. RpoT2, which has been shown to localize to both mitochondria and plastids, was used as bait in a yeast two-hybrid screen, and genes encoding two NEP interacting proteins (NIPs), designated NIP1 and NIP2, were identified. To study the function of NIP1, a reverse genetic approach was applied. The NIP1-T-DNA insertion line was screened from a population of 60,480 transformed *Arabidopsis* lines established by the Arabidopsis Knockout Facility at the University of Wisconsin. Mitochondrial and chloroplast transcript accumulation in wild-type and NIP1 null mutants was compared. NIP1 mutants accumulated the mitochondrial COX1, COX2, and COX3 mRNAs near the corresponding wild-type amounts, suggesting that NIP1 might not play an important role in mitochondrial transcription. Several effects on chloroplast transcript levels were observed. There was a 43 percent decrease in one *atpB* transcript and a 33 percent decrease in *psbA* transcript accumulation. In contrast, the chloroplast mRNA *rbcL* accumulated to a 1.8-fold higher level in the NIP1 mutants. A nuclear transcript, *rbcS*, also exhibited increased accumulation in mutant plants. The changes observed in this study in chloroplast transcript level may suggest that NIP1 plays a role in chloroplast transcription.



Identification of Candidate Tomato (*Lycopersicon esculentum*) Proteins that Interact with the Effector Protein, HopPsyV of *Pseudomonas syringae* pv. *syringae* B728a

RYAN A. RAPP

Under the supervision of Alan R. Collmer
Department of Plant Pathology

Strains of the bacterium *Pseudomonas syringae* attack nearly every crop species. The mode of attack presents similarities to other bacteria in the genera *Xanthomonas*, *Yersinia*, *Ralstonia*, and *Erwinia*, some of which are pathogenic to animals. These genera all use the type III secretion system to inject effector proteins into host cells (Galán and Collmer 1999). These organisms all use a suite of secreted proteins to achieve parasitism in their target host. One gene, *yopJ*, from *Yersinia pestis*, has been well characterized as a cysteine protease (Orth et al. 1997). The genes *avrRxv* and *avrBst* both contain a cysteine protease conserved catalytic triad, yet their function has not been characterized (Ciesiolka et al. 1999). The HopPsyV of *P. syringae* pv. *syringae* B728a encodes sequence homologous to *AvrRxv* and *AvrBst*, suggesting a role in pathogenicity. Previous studies also have shown HopPsyV to be secreted via the type III pathway. Here, the yeast two-hybrid technique was used to identify a CDPK, a leucine-rich receptor-like kinase, and an ubiquitin carrier protein that interact with the HopPsyV protein. Phylogenetic analyses also were used, along with physical evidence, to show that HopPsyV was a likely horizontal acquisition into the bacterial genome.



Personality Types and Their Relationship to Seating Position and Participation in a College Classroom

SUSAN E. COHEN

Under the supervision of Dawn E. Schrader
Department of Education

This thesis examines the relationship of personality to seating location and participation in a college classroom. Students enrolled in Psychology of Adolescence (Education 317) at Cornell University were used as the sample. Student personality type, based on Myers Briggs preference types, was determined by the Kiersey Temperament Sorter. Students also answered a survey about participation and seating area. Results revealed a significant relationship between extroversion and greater participation. In addition, the theory of “action zones” was supported by this study, such that students who choose to sit in action-zone locations in the classroom reported greater rates of participation than those who did not choose to sit in the action zone. This suggests that personality type does have an underlying effect on student rate of participation; however, questionnaire results indicate that other factors within the person and the classroom also have an effect on participation and seating selection.



Relativism in College: September 11th as a Catalyst for Epistemological Development

MEGHAN M. CONCRA

Under the supervision of Dawn E. Schrader
Department of Education

This study seeks to understand how Cornell University students educate themselves and form opinions about current events. The unique case of September 11th and its widescale impact on the world was used as a focus. The research project attempted to better understand how such an event can act as a push to help students develop the ways in which they view knowledge and, subsequently, how they may become more active knowers and participants in local and world communities.



A Cross-Cultural Comparison of the Anti-Drug Campaigns in the United States and Singapore

LAURA ANN GRANKA

Under the supervision of Dietram A. Scheufele
Department of Communication

This study examines the anti-drug campaigns of the United States and Singapore and investigates cultural variables and attitudes that could affect anti-drug perceptions. Data were collected from 421 college students in the United States and Singapore. Subjects were shown a series of five advertisements, two of which were anti-drug ads selected from each country's campaign. Subjects subsequently answered a questionnaire testing for three cultural variables—authoritarianism, family values, and low/high context culture—in addition to measures of drug usage and government perceptions. Findings from this study indicated that viewing anti-drug ads had only a marginal influence on anti-drug attitudes and perceptions. Nonetheless, there were significant differences between U.S. and Singapore students in all of the cultural variables tested. Singapore students expressed lower levels of influence from and communication with their parents, while U.S. students were less authoritarian and processed information more extensively. Understanding that differences such as these are present between cultures is particularly important for marketing campaigns, as this will help advertisers to effectively structure messages to reach their intended audiences. Implications regarding trends of drug-use by youth and recommendations for future anti-drug ads also are discussed.



Media Use and the Educational Setting: How Were Cornell Students Affected by the Tragedies of September 11th?

JESSICA S. GROPPE

Under the supervision of Dietram A. Scheufele
Department of Communication

Students are influenced by many factors, including exposure to the media and interpersonal interactions with friends, family, peers, co-workers, and the educational system. During periods of crisis—in school, in the community, or even globally, the educational system plays a significant role in helping students handle the situation and, as well, contributes to their knowledge, tolerance, and involvement concerning the issue at hand. The educational setting is a key matter in determining some or all of these outcomes of crises. Newspaper and television media also are factors in determining the extent of these three outcomes.

This thesis is based on a case study that examined influences of the September 11th tragedies on Cornell students, particularly relating the actions (or lack thereof) taken by the Cornell community. How have the actions taken by professors influenced students' knowledge or opinions about the incident and its future consequences? And to what extent does the educational system matter in the context of this tragedy? Data came from a survey of about 300 students at Cornell University. The questionnaire focused on emotional responses among the student body. It assessed how students' personal networks and the Cornell community helped them cope with the terrorist attacks. The results of this research can assist the university community to pinpoint how actions might be generalized to other future crisis situations.



Painting a Bleak Picture: Media Framing of Renewable Energy in the Deregulated Marketplace

JOANNA M. RADIN

Under the supervision of Bruce V. Lewenstein
Department of Communication

I seek to use communication theory to identify how the media frame the use of renewable energy resources (solar, wind, hydroelectric, geothermal, and biomass) within the context of the deregulated marketplace. I had three hypotheses: the media is unlikely to portray renewable energy as viable, the predominant justification for discouraging renewable energy is likely to be attributed to a lack of cost-effectiveness due to high initial start-up costs—indicating an economic frame, and in the few cases where renewable energy is framed as certain (both viable and something consumers should use), the media will provide sources of information, or channels, whereby consumers can gain more information. I conducted a quantitative content analysis of 183 newspaper articles to identify both the key frames (economic, political, environmental, and technological) used by the media to discuss renewable energy, as well as to assess the level of uncertainty the media attaches to renewable energy in the deregulated marketplace. I also undertook a qualitative analysis to investigate non-media channels of information about renewable energy. The findings indicate that the media indeed is unlikely to portray renewable energy as certain, largely blaming cost issues. Further research is necessary to determine exactly how this framing actually influences consumer attitudes about and choice of renewable energy. The findings also reveal that the media has provided, though infrequently, links to valuable channels of information about renewable energy. Further investigation should seek to explore the potential for these alternative channels to influence consumer attitudes.



Effects of Music Genre on Television-Advertising Recall

CARL F. REGELMANN

Under the supervision of Clifford W. Scherer
Department of Communication

This study analyzes the effects of music genre on the recall of television advertisements. Soundtracks to various commercials were manipulated by replacing the original sound with classic rock or classical music, and subjects were tested for the recall of the advertised products. The findings show that the genre of music did not play a significant role in affecting the recall or the likability of the commercials. The content of the visual element, independent of the music genre, was determined to have the most significant impact on the recall of the commercials. The study provides possible explanations of the results and their potential impact on the advertising industry.



Impulsivity and Smoking Among College Students

JAMI D. ROTHMAN

Under the supervision of Shelly Campo
Department of Communication

Drug users are thought to be more impulsive than non-users. However, studies have ignored the effect of impulsivity on nicotine addiction, rather focusing on alcohol and opioid dependence. The current study examined whether smokers are more impulsive than non-smokers by using personality and behavioral measures of impulsivity, investigating relationships between attitudes towards smoking and propensity to use tobacco, and exploring social influences of tobacco addiction. Of the 118 participants, 53.4 percent had used tobacco. Tobacco users were found to score higher on only one measure of impulsivity—sociability—as compared with nonusers of tobacco. The study also found that attitudes towards occasional smoking affected one's inclination to experiment with tobacco products and attitudes regarding the severity of risks associated with nicotine use were related to one's overall frequency of tobacco usage. Finally, it was discovered that the most significant social influence on an individual's tobacco usage is the older sibling. Namely, those with older siblings who smoke exhibit a greater tendency to experiment with smoking, as well as a higher frequency of tobacco usage. The findings of this study will be relevant to health promotion campaigns and public policy making in regard to smoking-cessation initiatives.



Did the Anti dumping Policy against Chinese Garlic Imports into the United States Fundamentally Change the Welfare of U.S. Garlic Producers?

LI TAO

Under the supervision of Ho Yan Chau
Department of Applied Economics and Management

Research in the field of antidumping policies had few conclusive theories to explain the applicability of antidumping policies on the agricultural industry. While many investigations in the United States have led to imposition of antidumping duties against foreign imports, the extent of the benefits and losses sustained by U.S. domestic producers and consumers remains unsolved. This research examines the specific case of antidumping investigation launched against Chinese fresh garlic exports to the United States and provides some insights into the damages that U.S. domestic producers of garlic experienced as a result of the imposition of the antidumping duty. Specifically, I proposed five hypotheses in testing the theory that domestic producers suffered losses in parallel markets abroad or at home as a result of the changing export strategies exercised by Chinese garlic exporters responding to the imposition of the antidumping order. This study is a first attempt to explain the issue of antidumping in agricultural products through the examination of individual data points. Based on my analysis, monthly U.S. import data from Mexico presents some strong evidence suggesting off-season imports might have substituted for garlic of Chinese origin. Other data also seem to support speculations raised by industry observers on the issue of the impact of the antidumping policy on the garlic industry.



CALS Research Honors Program Area Chairs

2001–2002

PROGRAM AREA	CHAIR
Animal Science	W. B. Currie
Biological Sciences	L. E. Southard
Biology and Society	D. Pimentel
Entomology	B. L. Peckarsky
Natural Resources	J. B. Yavitt
Nutritional Sciences	C. A. Bisogni
Physical Sciences	J.-Y. Parlange
Plant Sciences	R. L. Obendorf
Social Sciences	R. E. Ostman

Cornell University is an equal opportunity, affirmative action educator and employer.

Produced by Media and Technology Services at Cornell University

www.mediasrv.cornell.edu

3/03 725 ICS MTS10848

