Biology Annual Report • 2005-07

Department of Biology

McMaster University












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Annual Report 2005-07

Annual Report Committee

Bhagwati P. Gupta, Ph.D.

Kimberley Dej, Ph.D.

Kathy Greaves

 The research activities described here cover the time period of January 2005 through December 2007. The research findings must not be cited or discussed in official forum since some of it is still ongoing and not complete.

Cover artwork was carved and hand painted by graduate student Maria Abou Chakra.
The McMaster campus photographs were taken by Bhagwati Gupta in early spring 2008.
Pictures of various events and activities were kindly provided by the Biology Graduate Students Society.

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Message from the Chair

Student interest in Biology undergraduate and graduate programs continues to be very strong. The past two years have seen the introduction of enrollment caps on all Biology undergraduate courses and we have seen an increase in the number of specializations within our program. This year, for the first time, high school students applying to Science at McMaster have the ability to choose entry into the Life Sciences "stream". I note that Dr. Pat Chow-Fraser and colleagues have spent considerable energy reworking the Life Science Program in the faculty of Science. How the first year streaming and other program changes affect the Biology Department over the coming years will be interesting to observe.

Major changes in the Biology Department over the past two years include the retirement of long serving staff members Debbie Bernardo, Ian Giles, Paul Hoffman, and Rob Gillies. These will soon be joined by Pat Hayward who recently announced she will be retiring this spring. In turn, we are pleased to welcome Alison Cowie, George Bijelic, and J. P. King to our undergraduate teaching support staff. We also welcome our most recent faculty hiring's, Dr. Joanna Wilson and Dr. Jonathan Dushoff. Jonathan adds to our faculty complement in Computational Biology and this is particularly timely as 2008-09 is the first year of a new Computational Biology program. Joanna's research is centered in Environmental Science/Physiology and hence she is an excellent fit to contribute in the new specializations of Physiology and Biology and Environmental Science.

I am delighted to draw your attention to a new manuscript written by Dr. Stan Bayley that outlines the history of Biology at McMaster from the 1930's to 1990. It is interesting and sobering to read that issues such as "what courses should constitute a core biology undergraduate curriculum?" occupied the attention of faculty members fifty years ago as it did over the past two years. I would also like to acknowledge and thank Louise Barber for her initial work on the Biology history.

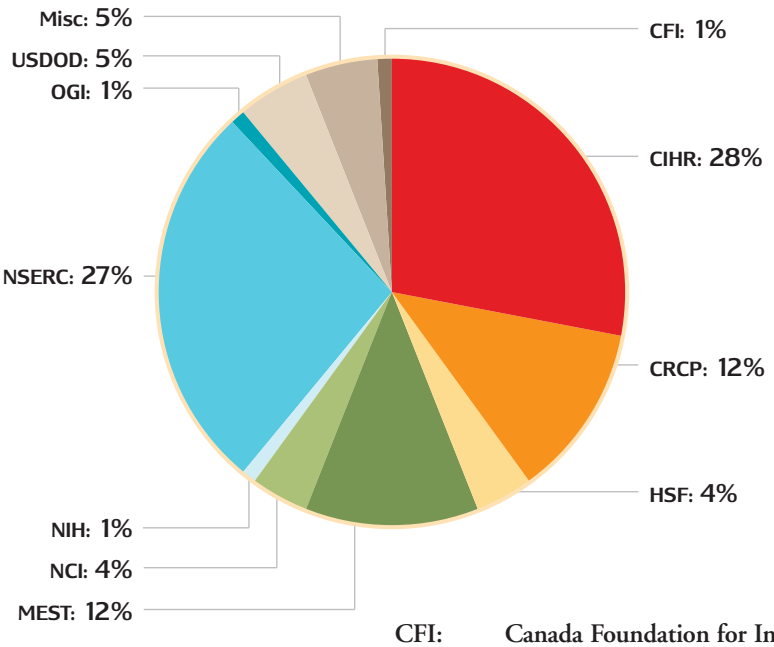
As my second term as Chair of the Department of Biology is coming to an end, I would like to take this opportunity to thank all members of the Biology department over the past eight years for assisting me. It has been an interesting and for the most-part a fun experience! I wish to take this opportunity to give special thanks to Associate Chairs Drs. Pat Chow-Fraser and Elizabeth Weretilnyk for all their work on undergraduate and graduate matters and to John Lott for his earlier work concerning space in the Life Sciences Building and the undergraduate laboratory space in Burke Sciences. I am also extremely grateful for all the help and encouragement received from Kathy Greaves, Kathy McIntosh, Marge Geroux (and earlier Hanna Lindeman) and Marvin Gunderman.

This report was prepared by Dr. Bhagwati Gupta, Dr. Kim Dej and Ms. Kathy Greaves. We are grateful to them for their persistence and good humor in obtaining the various documents – I congratulate them on the report and thank them for their work.

Dr. Turlough Finan
Chair, Department of Biology

Highlights

Total budget (2005-07): $9.6 Million



* City of Burlington, City of Hamilton, International Copper Association Ltd., Canadian Water Network, Environment Canada, G.B.A. Foundation, Hamilton Port Authority, Human Resources Development Canada, International Lead Zinc Research Organization Inc., Indian and Northern Affairs Canada, International Nickel Company, Metals in the Environment Research Network, Nickel Producers Environmental Research Association, Noranda Inc., Ontario Ministry of Research and Innovation, The Open Door University, Teck Cominco Limited

CFI:	Canada Foundation for Innovation
CIHR:	Canadian Institutes of Health Research
CRCP:	Canada Research Chairs Program
HSF:	Heart and Stroke Foundation
MEST:	Ministry of Energy, Science and Technology
NCI:	National Cancer Institute of Canada
NIH:	National Institutes of Health
NSERC:	Natural Science and Engineering Research Council
OGI:	Ontario Genomics Institute
USDOD:	U.S. Department of Defense Breast Research Program
Misc:	Miscellaneous Sources*

Number of Publications

A total of 225 research papers/articles in peer reviewed international journals and book chapters were published during 2005-07.

Teaching

In 2005-7, we taught 9155 students, of which 3117 were in Level 1 and we taught a total of 54 courses.

Achievements and Awards

FACULTY

Journal Editors

Dr. B. Golding – Co-Editor, Genome
Dr. B. Golding – Associate Editor Molecular Ecology Notes – Barcoding Section
Dr. R. Cameron – Senior Editor, Physiological and Molecular Plant Pathology
Dr. P. Chow-Fraser – Associate Editor, Journal of Great Lakes Research
Dr. J. Dushoff – Academic Editor, PLoS Medicine

Research Grant Panels

Dr. C. Baron (NSERC, CIHR)
Dr. A. Campos (CIHR, NSERC)
Dr. J. Daniel (CIHR)
Dr. S. Igdoura (NSERC, CIHR)
Dr. C. Wood (NSERC)

Canada Research Chairs

Dr. C. Wood (Tier I, Environment and Health)
Dr. B. Golding (Tier I, Environmental Genomics)
Dr. B. Gupta (Tier II, Developmental Biology)
Dr. M. Elliot (Tier II, Microbial Genomics)

University Committees and Appointments

Dr. C. Baron (Member), University Senate
Dr. C. Baron (Member), University Senate, Committee for Academic Integrity
Dr. C. Baron (Member), University Biosafety Committee
Dr. A. Bedard (Member), Science Graduate Curriculum
Dr. A. Bedard (Member), Science Research Advisory Group
Dr. R. Cameron (Member), Science & Engineering Tenure & Promotion Committee
Dr. A. Campos (Member), Science & Engineering Tenure & Promotions Committee
Dr. P. Chow-Fraser (Member), Science Academic Policy and Planning Committee
Dr. J. Daniel (Member), Search Committee for Associate Dean of Studies
Dr. J. Daniel (Member), University Senate
Dr. J. Daniel (Member), McMaster Inclusion Steering Committee
Dr. J. Daniel (Member), Presidents Advisory-Building an Inclusive Community
Dr. J. Daniel (Member), Campus Ministries Council

Dr. S. Dudley (Chair), University Committee for Northern Studies
Dr. T. Finan (Member), Science Faculty Council
Dr. B. Golding (Director), Center Environmental Genomics and Biotechnology
Dr. B. Golding (Member), School of Computational Engineering and Sciences
Dr. B. Golding (Member), High Performance Computing Research Committee
Dr. B. Golding (Member), Origins Institute Steering Committee
Dr. B. Gupta (Member), Origins Institute
Dr. S. Igdoura (Member), Presidential Biosafety Committee
Dr. S. Igdoura (Member), The Center for Functional Genomics
Dr. S. Igdoura (Member), Science iTeach Committee
Dr. S. Igdoura (Member), Science iSci Committee
Dr. S. Igdoura (Member), Faculty Health Sciences Animal Advisory Committee
Dr. R. Jacobs (Member), Faculty Science Rep to Faculty of Engineering
Dr. R. Jacobs (Member), Faculty of Science Rep to STAO
Dr. R. Jacobs (Member), Faculty of Science Life Science Restructuring Committee
Dr. K. Dej (Member), Science Careers and Co-operative Education Advisory Board
Dr. J. Kolasa (Member), Faculty Science Organizing Committee MacCafe Scientifque
Dr. G. McClelland (Member), University Animal Advisory Committee
Dr. J. Quinn (Member), Faculty of Science Joint Health & Safety Committee
Dr. D. Rollo (Member), Animal Research Ethics Board (Presidential Committee)
Dr. H. Schellhorn (Member), Faculty Association Joint Committee
Dr. H. Schellhorn (Member), Faculty Association Executive
Dr. H. Schellhorn (Member), Faculty Association Budget Advisory Committee
Dr. H. Schellhorn (Member), Ad hoc Committee to review Travel Policies
Dr. R. Singh (Member), Peace Coordinating Council
Dr. R. Singh (Chair), Gandhi Lectureship
Dr. R. Singh (Chair), Gandhi Peace Festival
Dr. R. Singh (member), Rep to Shastri Indo-Canadian Institute
Dr. J. Stone (Associate Director), Origins Institute
Dr. J. Stone (Member), Deans Integrative Science (iSci) Curriculum Committee
Dr. J. Stone (Member), Science Liaison Committee
Dr. E. Weretilnyk (Member), University Faculty Adjudicator, Faculty of Science
Dr. X-D. Zhu (Member), Centre for Functional Genomics

STAFF

Kathy McIntosh – Presidents award for outstanding service
For over 24 years Kathy has provided outstanding service to students, faculty, peers, future students and their parents. She has also worked with charity fundraising and food donations campaigns. Her efforts have made a positive contribution to McMaster's reputation.

We Remember Them

At the rising of the sun and at its going down,
We remember them.

At the blowing of the wind and in the chill of Winter,
We remember them.

At the opening of buds and in the rebirth of Spring,
We remember them.

At the blueness of the skies and in the warmth of Summer,
We remember them.

At the rustling of leaves and the beauty of Autumn,
We remember them.

At the beginning of the year and when it ends,
We remember them.

As long as we live, they too will live;
for they are now a part of us, as we remember them

In Memory

Mrs. Beryl Piccinin, Instructional Assistant – February 11, 1952 to July 7, 2008

Dr. Douglas Davies, Professor – May 11, 1919 to February 1, 2008

Dr. Ann Oaks, Professor – June 4, 1929 to January 13, 2006

Mr. Herb Pohl, Senior Demonstrator – March 26, 1930 to July 17, 2006

Research Areas and Faculty

New Appointments

Jonathan Dushoff

Jonathan Dushoff joined the Department of Biology in July 2007. His research focuses on the evolution and spread of infectious diseases of humans. Dr. Dushoff's laboratory applies a broad range of statistical, mathematical and bio-informatic methods to investigate pathogen evolution, transmission and population-level spread. He received his Ph.D. in 1996 from Princeton University and held a post-doctoral fellowship for three years at the Academia Sinica in Taipei. Before joining McMaster, he was a Research Biologist at Princeton.

Joanna Wilson

Joanna Wilson joined the Department of Biology in June 2006. Her research focuses on environmental physiology and aquatic toxicology. Dr. Wilson's laboratory utilizes genomic, molecular, biochemical and histological techniques to study the evolution and function of cytochrome P450 enzymes and the impacts of environmental contaminants in aquatic vertebrates, particularly fish. She received her Ph.D. in 2003 from MIT and Woods Hole Oceanographic Institution's Joint Program in Oceanography. Before joining McMaster, she was a post-doctoral investigator in John Stegeman's laboratory at the Wood Hole Oceanographic Institution in the US.

Areas of Research Activities*

Bioinformatics and Functional Genomics

Deriving functional information from the data of large scale genome sequencing projects of bacteria and of eucaryotes is one of the biggest challenges of modern biology. The faculty members with interest in this area use state-of-the-art computational, genomics, transcriptomics (DNA chip), metabolomics and systems biology approaches to understand the function(s) of biological systems and of their evolution. Models analyzed in the Biology Department are the agriculturally important bacterium *Sinorhizobium meliloti,* the environmental stress-tolerant plant *Thellungiella salsuginea,* the human pathogen Brucella suis and the model bacterium *Escherichia coli.* Student participation in the inter-disciplinary research at the interface of informatics and biology will contribute to applications such as new treatments for bacterial infectious diseases and improved agricultural practice.

Developmental Biology

The combination of molecular genetic technologies with other contemporary tools of biology, such as electrophysiology, electron microscopy, immunochemistry and DNA chip analysis has fueled dramatic advances in both cell and developmental biology. Our laboratories use recombinant genetics, mutagenesis, biochemistry, confocal and electron microscopy, tissue culture, and transgenic organisms to work on models such as the nematode *Caenorhabditis elegans,* the fruit fly *Drosophila melanogaster* and mammalian cells. Currently studied research questions encompass gene regulation, cancer biology, neurosystem and reproductive system development and function. Students at all levels are welcome to get involved in this research, which will influence applications in medical therapy, diagnostics and applied biotechnology.

Cell and Molecular Biology

Researchers on the Biology Department carry out basic and applied research in this area using state-of-the-art methods such as tissue culture, RNAi technology, transgenic animals, DNA chip, laser dissection and immunofluorescence technology. The different laboratories study a wide variety of models such as the tissue cell culture, the domestic mouse *Mus musculus,* the nematode *Caenorhabditis elegans,* the plant *Arabidopsis thaliana* and the fruit fly *Drosophila melanogaster.* The research is of immediate relevance to human heath in different areas, such as breast cancer, genetic diseases and disease resistance, DNA repair, neurosystem development and function. Work in the Biology Department gives students at all levels the opportunity to contribute to scientific progress, which may lead to improved treatment of diseases.

Microbiology and Plant Biology

The natural biodiversity of microorganisms surpasses that of all other organisms and their metabolic capabilities, adaptability and interactions with plants and animals shape our planet. Researchers in the Biology Department study a variety of metabolic processes, such as the stress response of *Escherichia coli* and of plants and their seeds, *Arabidopsis thaliana* plant disease resistance, the agriculturally important legume plant symbiotic interaction with *Sinorhizobium meliloti,* human diseases caused by *Brucella suis,* population genetics of human pathogenic fungi and gene transfer from *Agrobacterium tumefaciens* to plants and between antibiotic-resistant bacteria, antibiotic production and multicellular development by *Streptomyces coelicolor.* Students at all levels are involved in this research, which is highly applicable to industrial and agricultural biotechnology and health research.

Environmental Physiology

Studies on the adaptation of animals to environmental changes, pollutants and stress conditions have high relevance for human health. Researchers in the Biology Department use a variety of modern techniques such as microinjection, patch-clamp analysis, tissue culture, confocal immunofluorescence analysis, transcriptome and proteome analysis to study models such as mice, fish and human cells. The research covers diverse areas such as environmental physiology and aquatic toxicology of aquatic animals, heavy metal metabolism, the effect of hypoxia on ion channel function in the neurosystem, growth hormone action and exercise physiology. Students at all levels can contribute to this research, which is relevant for the protection of human health and of the environment.

*These research areas are not necessarily the same as those recognized by OCGS.

Ecology and Evolution

The analysis of natural biodiversity and of the impact of modern society on ecosystems plays a major role for the conservation of our environment. Research in this area is supported by collaborations with regulatory agencies, the Royal Botanical Garden and conservation authorities in other parts of the country, which facilitates field studies. Faculty research interests cover theoretical and evolutionary ecology. Research in the Biology Department on the impact of environmental pollution on health has raised a lot of attention showing the impact of research, which is being conducted by students at all levels.

Population and Evolutionary Genomics

Population genetics is the theoretical powerhouse of evolutionary biology. The discipline of population genetics in combination with technical breakthroughs in molecular biology has opened the floodgate of large-scale genomic comparisons between distantly related species that were not possible before. Biology Department members are carrying out population and evolutionary genomic research on a variety of organisms including bacteria, *Drosophila,* fungi, plants, fishes and humans. These studies are meant to shed light on mechanisms of adaptation, host-pathogen interactions and co-evolution, sexual reproduction, sexual selection and speciation. A new area of research in germ cell genomics, using model organisms such as mouse, *Drosophila,* nematode and trout, promises to revolutionize the science of gamete biology and fertilization systems.

Research Faculty

PROFESSOR

André Bédard
Characterization of cell proliferation and transformation

Ana R. Campos
Genetic and molecular analysis of visual system development in Drosophila melanogaster

Patricia Chow-Fraser
Assessment of anthropogenic impacts on the functional ecology of freshwater ecosystems, in particular, lakes and wetlands of the Great Lakes basin

Turlough M. Finan
Molecular genetic analysis of the N2-fixing bacterium Sinorhizobium meliloti

G. Brian Golding
Molecular evolution, genomics, bioinformatics, computational biology

J. Roger Jacobs
Developmental genetics, cancer genetics

Jurek Kolasa
Ecology of aquatic communities: Organization and function in context of heterogeneity, habitat hierarchy, and scale; responses to environmental gradients using tropical microcosms

Colin A. Nurse
Cellular and molecular mechanisms of O2, and CO2/pH sensing in vertebrates

Michael J. O'Donnell
Ionoregulation and excretion in invertebrates and fish: Cellular mechanisms and control of epithelial transport

James S. Quinn
Genetic relatedness, parentage and behavioural ecology of colonial and cooperative-breeding birds and anthropogenic induction of germline mutations in gulls and mice

Andrew J. Rainbow
Molecular mechanisms for DNA repair in mammalian cells and their role in human disease using viruses as probes

C. David Rollo
Exploration of the regulatory integration of mammalian form and function utilizing transgenic mice as probes

Herbert E. Schellhorn
The regulation of stress genes in Escherichia coli

Rama S. Singh
Population and evolutionary genetics, molecular evolution and speciation

Elizabeth A. Weretilnyk
Plant abiotic stress tolerance; Metabolomics; Environmental genomics; Chemical biology

Christopher M. Wood
Environmental physiology and aquatic toxicology of aquatic animals

ASSOCIATE PROFESSOR

Christian Baron
Pathogenic bacteria, antimicrobial drugs, chemical biology

Robin Cameron
Elucidation of the signal transduction pathways that lead to, and the processes responsible for, induced resistance responses, including Systemic Acquired Resistance (SAR) and Age-related Resistance (ARR)

Juliet Daniel
Roles of Catenins and Transcription Factors in Normal Cell Growth and Development

Susan A. Dudley
Evolutionary ecology of carbon acquisition traits in plants; natural selection, quantitative genetics, and phenotypic plasticity of adaptations to drought stress and competition

Suleiman Igdoura
Molecular genetics of Tay-Sachs disease and Sialidosis

Jianping Xu
Molecular Ecology and Evolutionary Genetics

ASSISTANT PROFESSOR

Jonathan Dushoff
Theoretical, statistical and computational investigations of the evolution and spread of infectious diseases

Ben Evans
Molecular evolutionary analysis of biodiversity and gene duplication

Marie Elliot
Development in multicellular bacteria; Regulation by small RNAs; Antibiotic production

Bhagwati P. Gupta
Development and evolution of the reproductive system in nematodes

Grant McClelland
Integrative physiology of muscle and animal performance, environmental stress

Jonathan Stone
Computational Biology conducted at multiple heirarchical levels

Joanna Wilson
Cytochrome P450 enzymes in vertebrates; aquatic toxicology

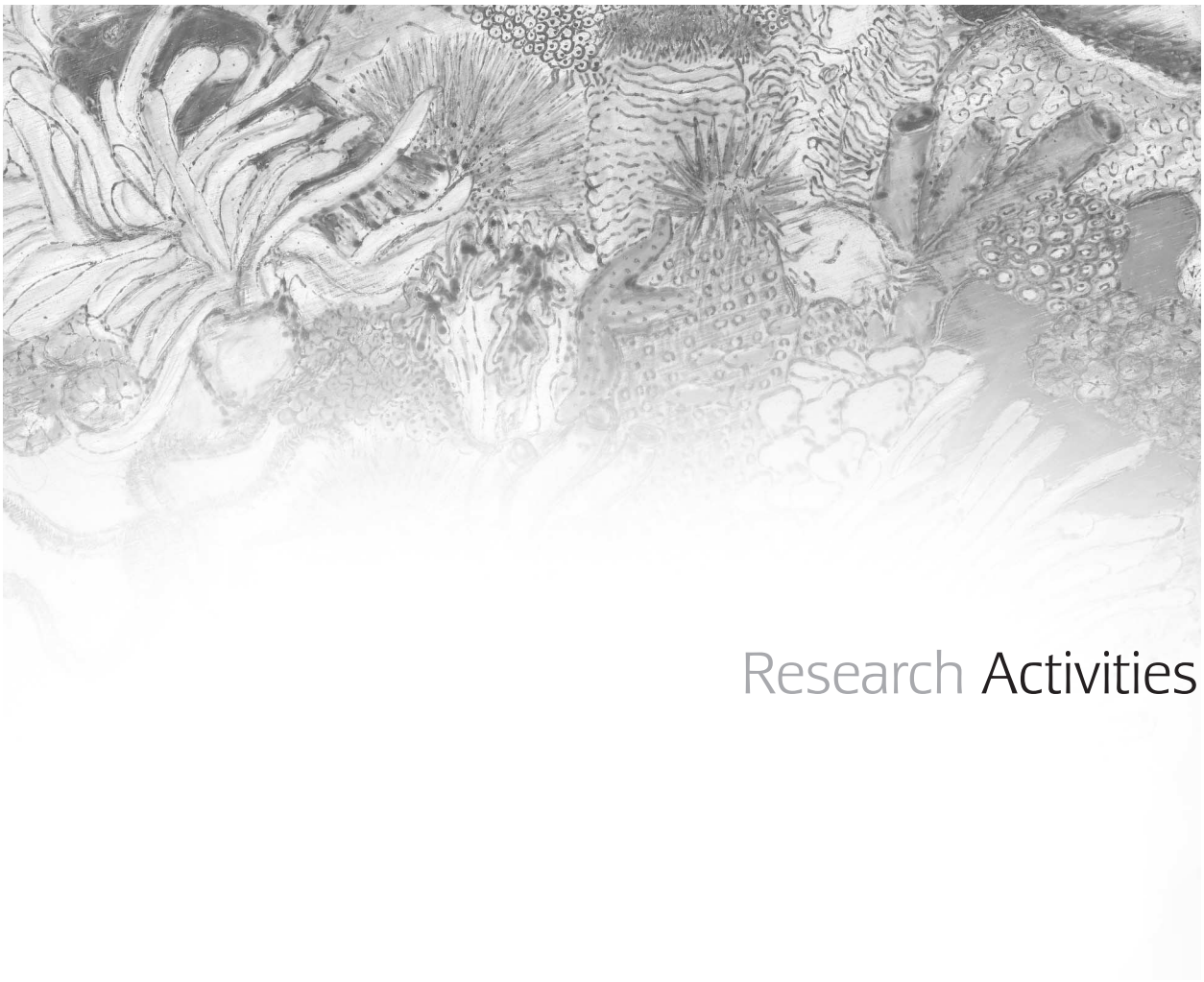
Xu-Dong Zhu
Functional analysis of DNA repair complexes at human telomeres

CLA/Teaching Faculty

ASSISTANT PROFESSOR

Kimberley Dej
Regulation of chromosome segregation in Drosophila melanogaster; Dynamics of chromosome condensation and sister-chromatid cohesion in mitosis and meiosis

Lovaye Kajiura
Organismal ecology, resource allocation and life history, impact of biotechnology on physiology, endocrinology, nutrition, and behaviour, analysis of the transgenic rat growth hormone mouse model



Research Activities

Associate Professor

Christian Baron

Functional Proteomics, Anti-Microbial and Anti-Cancer Drugs, Synthetic Biology

Laboratory Personnel

Research associate: Dr. Athanasios Paschos; *Ph.D. students:* Khaled Aly, Chan (Daphne) Gao, Durga Sivanesan; *M.Sc. student:* Michelle Melone; *Lab assistant:* Greg Rekas

Research Collaborators

Dr. Juliet Daniel (McMaster University), Dr. David O'Callaghan (INSERM, Nîmes, France), Dr. Jurgen Sygusch (Montréal), Dr. Renée Tsolis (UC Davis), Dr. Gabriel Waksman (London), Dr. Patricia C. Zambryski (UC Berkeley)

Funding

Canadian Institutes of Health Research (Operating grant), Canadian Institutes of Health Research (Novel Antimicrobials grant), Natural Sciences and Engineering Research Council (Discovery grant), Canada Foundation for Innovation (Infrastructure grant), Ontario Innovation Trust (Infrastructure grant)

Genome sequencing and proteome analyses have revolutionized our insights into the workings of life. The next step of research will be to apply this knowledge for synthetic approaches to engineer organisms useful for biotechnology and to develop novel approaches to cure diseases. We use comparative genomics, functional proteomics, cell and structure biological methods to analyze protein-protein interactions in three different projects on (1) **the type IV secretion systems (T4SSs) of pathogenic bacteria,** (2) **the E-cadherin cell adhesion complex of mammalian cells and** (3) **the adaptation of pathogenic alpha-proteobacteria to life with mammalian cells.** We have developed a comprehensive protein-protein interaction map of T4SS components using peptide array analysis, bi-cistron expression, pulldown assays, cross-linking and native electrophoresis. As next step of our research, we apply a two-pronged strategy to probe specific protein-protein interactions and this will give basic mechanistic insights and enable the design of inhibitors. First, we develop peptides and peptide apatmers, which have proven to be exceptionally valuable for basic research on protein-protein interactions and drug design. Second, we pursue chemical genomics approaches using assays for small molecule screening that we have established in collaboration with the McMaster HTS laboratory. We currently apply these strategies to develop small molecules and peptides as probes for T4SS assembly and the E-cadherin-p120catenin interaction. Also, we analyze the life style of pathogenic alpha-proteobacteria with cell biological methods and the regulation of their virulence genes with molecular biological methods. The methods developed in our laboratory are broadly applicable to protein-protein and pathogen host interactions and will lead to novel approaches for the design of anti-microbial and anti-cancer drugs.

Selected Publications

Aly, K.A. and Baron, C. (2007) The VirB5 protein localizes to the T-pilus tips in Agrobacterium tumefaciens. *Microbiology* 153: 3766-3775.

Paschos, A., Patey, G., Sivanesan, D., Gao, C., Bayliss, R., Waksman, G., O'Callaghan, D. and Baron, C. (2006) Dimerization and interactions of Brucella suis VirB8 with VirB4 and VirB10 are required for its biological activity. *Proc. Natl. Acad. Sci. USA* 103: 7257-7257.

Professor

André Bédard

Control of Cell proliferation and Transformation

Laboratory Personnel

Graduate Students: Jenny Wang, Bart Maslikowski, Alicia Pepper, Romita Ghosh; *Post-Doctoral Fellow:* Maria Papaconstantinou; *Research Technician:* Ying Wu

Research Collaborators

Dr. A. Campos (McMaster University), Dr. Alexander Mazo (Thomas Jefferson University), Dr. Thomas Kusch (Rutgers University), Dr. Tim Westwood (University of Toronto), and Dr. Liliana Attisano (University of Toronto)

Funding

Canadian Institutes of Health Research (Operating grant), Natural Sciences and Engineering Research Council (Discovery grant)

Transformation by the v-Src Oncoprotein

My laboratory is interested in the study of cell proliferation and transformation by the v-Src tyrosine kinase. Through the characterization of genes activated aberrantly in transformed cells, we have identified several transcription factors and signaling pathways targeted by the v-Src oncoprotein. Particular attention is devoted to the study of JunD/AP-1 and NF-kB, two transcription factors providing a survival advantage to v-Src transformed cells. Using a variety of approaches of cellular and molecular biology, we are characterizing the role of v-Src regulated genes, activated by these transcription factors, in cell transformation (funded by the Canadian Institutes of Health Research).

Characterization of the Menin Tumour Suppressor

Our studies on AP-1 led to the finding that v-Src transformed chicken embryo fibroblasts (CEF) express reduced levels of the Menin tumour suppressor. Menin, the product of the multiple endocrine neoplasia type I gene *(Men1)* has been implicated in several biological processes including the control of gene expression, apoptosis and MAPK signaling pathways. However, the mechanism(s) by which Menin exerts its function of tumour suppressor is unknown. Therefore, we have initiated the study of Menin in the model system *Drosophila melanogaster,* a project done in collaboration with Dr. Ana Campos in the Department of Biology at McMaster University. Using tools unique to *Drosophila,* we have uncovered a role for Menin in the control of the stress response and, in particular, in the expression of heat shock proteins. This work led to the conclusion that Menin is required for the response of *Drosophila* to several stresses including heat shock, hypoxia, hyper-osmolarity and oxidative stress. The relationship between the action of Menin in the stress response and its function of tumour suppressor is the subject of current investigations in the *Drosophila* model system (funded by the Canadian Institutes of Health Research).

Characterization of Growth-Arrest Specific (Gas) Gene Expression

Cells exiting the cell cycle induce the expression of a class of genes known collectively as growth-arrest specific or gas genes. By in large, the function of this class of genes remains unknown. Our research program on gas genes has for objective to elucidate the function of the products of these genes and to characterize the regulatory mechanism of their induction in quiescent cells. While several factors can induce cell quiescence, we are particularly interested in the control of gas genes by contact inhibition. Using the p20K lipocalin gene as a model, we identified C/EBPβ as the central activator of this gene in contact inhibited CEF. We have demonstrated a role for C/EBPβ in the inhibition of CEF proliferation and in the induction of several other gas genes. Other transcriptional activators of gas genes, working cooperatively with C/EBPβ, are presently under investigation (funded by the Natural Sciences and Engineering Research Council of Canada).

Mechanisms of cell transformation by v-Src

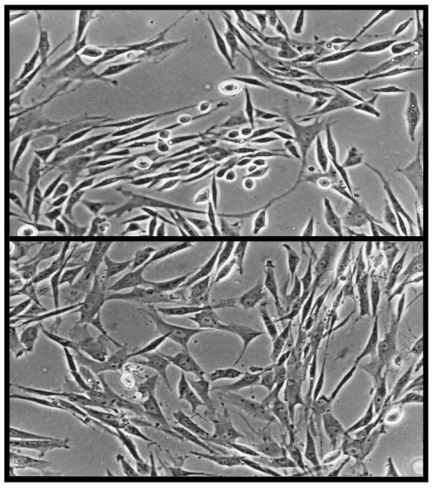


FIGURE: The Menin tumor suppresssor is down-regulated in v-Src-transformed chicken embryo fibroblasts (CEF), which exhibits the elongated and refractile morphology of transformed cells (upper panel). The re-expression of Menin results in the flattening of the cells and a more normal morphology (lower panel).

Associate Professor

Robin Cameron

Elucidation of the signal transduction pathways that lead to, and the processes responsible for, induced resistance responses, including Systemic Acquired Resistance (SAR) and Age-related Resistance (ARR)

Laboratory Personnel

PhD student: Fadi Al-Daoud, Jessie Carviel; *MSc student:* Jennifer Faubert *Undergraduate Students:* Sanam Taheri, Nausheen Mian

Research Collaborators

Pierre Fobert and Marc Champigny (Plant Biotech Inst., Saskatoon), Nancy Dengler, Daphne Goring, Keiko Yoshioka and Wolfgang Moeder (University of Toronto), Dan Klessig and Corina Vlot (Boyce Thompson Institute, Ithaca New York), Robert Campbell (U of Alberta).

Funding

Natural Sciences and Engineering Research Council (Discovery grant)

SAR is induced by an initial “immunizing” infection in one part of the plant resulting in broad non-specific resistance throughout the plant to normally virulent pathogens. The outcome of the SAR response is similar to vaccination in mammals except that it protects the plant against many different unrelated pathogens (bacteria, viruses, fungi, nematodes). The accumulation of a set of pathogenesis-related (PR) proteins (anti-microbial) and salicylic acid (SA) has been correlated with SAR in tobacco, cucumber and in Arabidopsis thaliana. A long distance signal moves, perhaps via the phloem, from the “immunized” leaf to the rest of the plant where it is perceived and the plant becomes primed or "immune" as indicated by SA accumulation and subsequent PR-1 expression. Upon challenge with a virulent pathogen, the plant responds in a resistant manner, which includes production of a number of anti-microbial PR proteins and compounds. It is thought that different subsets of these are effective against different pathogens, resulting in the broad spectrum of resistance observed during SAR. Little is known about the nature of the long distance SAR signal or how it translocates from the induced leaf via the vasculature to distant leaf cells to produce a primed or "immune" plant. Our studies will contribute to elucidation of long distance signaling during SAR and will form the basis to genetically modify crops to respond to many diseases in a resistant manner.

Over the years we have observed that in some experiments, older Arabidopsis displayed resistance to normally virulent Pseudomonas syringae pv tomato (Pst). This Age-Related Resistance (ARR) has been described in the literature in a number of plant species and in a few cases the resistance observed is correlated with anti-microbial phytoalexin production. Studies in our lab using plant lines which do not accumulate SA (NahG, sid1, sid2) demonstrate that ARR is a distinct defense response from SAR, but is similar to SAR in that SA accumulation is required. Intercellular washing fluids (IWFs) from plants expressing ARR exhibit anti-bacterial activity to Pst. These data suggest that SA may accumulate in intercellular spaces and act as an anti-microbial agent during ARR, rather than as an intracellular signaling molecule as it does in SAR. Our studies (measuring SA levels in IWFs, adding SA destroying enzymes or SA to the intercellular space) suggest that SA must be present in the intercellular space for a functional ARR response, providing support for an anti-microbial/non-signaling role for SA during ARR. Very little is known about the genes required for the ARR response. Therefore, we have also taken a molecular genetic approach to identify genes involved in ARR, using classical and reverse genetics (ARR microarray/T-DNA knock-out lines).

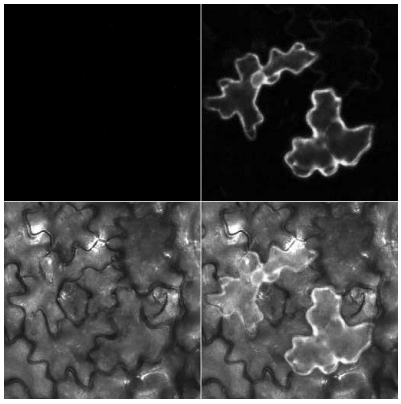
ARR

A number of interesting genes are up-regulated during ARR and to determine which of these genes are actually required for the response, T-DNA knock-out lines from the SALK collection have been obtained and characterized at the molecular level (reverse genetics). Seven T-DNA mutant lines exhibited a reduced ARR response indicating that these genes are required for ARR (discussing potential for genetic manipulation with Performance Plants Inc, Kingston ON). Moreover, mapping and ultimately cloning of the ARR mutant (iap1-1, important for ARR pathway) identified by classical genetics is ongoing and should provide key insights into ARR signaling. Recent experiments with iap1-1 and wild type plants suggest that salicylic acid accumulates in the intercellular space and contributes to suppression of Pst growth via its anti-microbial activity.

SAR

Studies in our lab using dir1-1, a SAR-defective mutant, indicate that dir1-1 can perceive the SAR signal present in petiole exudates (enriched for phloem sap) from wild type SAR-induced plants, but dir1-1 exudates do not contain this signal indicating that DIR1 is required for long distance signaling during SAR. Protein gel blot analysis demonstrated that DIR1 protein is present in petiole exudates of SAR-induced wild type, but not dir1-1 or mock-inoculated plants. These results suggest that DIR1, which encodes a putative lipid transfer protein (LTP), may be involved in transporting a lipid signal to distant tissues (perhaps via the phloem) to establish SAR. We have constructed a number of transgenic Arabidopsis lines to localize DIR1/LTP in healthy plants and track its movement during SAR. Our data to date indicate that DIR1 is expressed in all cell types in leaves including the vasculature. Additionally we can rescue the dir1-1 SAR defect by expressing DIR1:GFP protein in one leaf (Agroinfiltration). We hope to also use this experimental set up to track the movement of DIR1:GFP from the induced leaf to distant leaves using confocal microscopy thus providing evidence that DIR1 is indeed a chaperone or part of the long distance SAR signal.

DIR1:YFP transiently expressed in tobacco epidermal cells using Agroinfiltration. DIR1:YFP localizes to the cell periphery.



Selected Publications

Y. Haffani, N. Silva-Gagliardi, S. Sewter, M. Aldea, Z. Zhao, A. Nakhamchik, R. Cameron, D. Goring. Altered Expression of PERK Receptor Kinases in Arabidopsis Leads to Changes in Growth and Floral Organ Formation. *Plant Signaling and Behavior* 1:5, 251-260, September/October 2006.

Professor

Patricia Chow-Fraser

Assessment of anthropogenic impacts on the functional ecology of freshwater ecosystems, in particular, lakes and wetlands of the Great Lakes basin

Laboratory Personnel

Ph.D. Students: Sheila McNair, Titus Seilheimer, Anhua Wei, Kristina Kostuk, Lyndsay Smith; *M.Sc. Students:* Kristina Kostuk, Mel Croft, Maja Cvetkovic, Jon Midwood, Dan Rokitnicki-Wojcik, Stephanie Yantsis*; Undergraduate Students:* Leah Brevik, Rachel deCatanzaro, Tim Hurley, Eric Smyth, Michelle Kenny; *Social Science Internship:* Patrick Brandon Gidley

Research collaborators

Lake Huron Management Unit, Owen Sound (Ontario Ministry of Natural Resources), Georgian Bay Association (Georgian Bay Foundation), Dr. Nick Eyles (University of Toronto)

Funding

Natural Sciences and Engineering Research Council (Discovery grant), Ontario Ministry of Natural Resources, Canada-Ontario Agreement, Environment Canada, Parks Canada

Coastal wetlands are among the most productive ecosystems in the world, comparable to tropical rain forests and coral reefs. Despite their great ecological value, many of the large wetland complexes in settled areas of the Great Lakes basin have been either lost due to draining, dredging or filling, or have been severely degraded because of their sensitivity to altered land uses (agricultural and urban development) and to invasion by exotic species. My research program on wetlands began in 1991 when I became involved in the restoration of Cootes Paradise Marsh. Using a 60-y data record, I showed that reduction in cover of emergent vegetation (from 85% in 1934 to 15% in 1993) was significantly related to increased water levels (Chow-Fraser et al. 1998; Chow-Fraser 2004; Wei and Chow-Fraser 2005). A spatial model has also been developed to examine the effect of long-term water-level fluctuations on emergent plants in Cootes Paradise Marsh, while taking into account other factors such as urbanization and invasive species (Wei and Chow-Fraser 2006). This model, which is based on a digital elevation model, has been applied to ten wetlands in eastern Lake Ontario, and the results indicate that changes in cover of emergent plants can be accurately predicted from water-level and detailed bathymetric information alone (Wei and Chow-Fraser, in submission).

The disappearance of submergent macrophytes and a decline in species richness in degraded wetlands has been linked to increased eutrophication and water turbidity (Chow-Fraser et al. 1996; Lougheed et al. 1998; Lougheed and Chow-Fraser 1998; Wei and Chow-Fraser 2006). In addition, we demonstrated that the disappearance of submergent vegetation affected the zooplankton, benthic invertebrate and ultimately the fish communities (Chow-Fraser et al. 1998). Sources of turbidity in such degraded urbanized wetlands include sediment resuspension by wind and wave action, disturbance by a large population of common carp, and excessive growth of algae, as well as sediment input from the watershed (Chow-Fraser 1999). We were able to use *in situ* experiments in Cootes Paradise to determine how different size and biomass of carp affected water turbidity, nutrient levels and the plankton community. These results were used to predict the effectiveness of a marsh-wide carp removal program (Chow-Fraser 1998; Lougheed et al. 1998). We also conducted experiments in 1999 and 2000 to determine other confounding factors that may slow down restoration efforts, such as internal loading from the historically enriched sediments (Kelton and Chow-Fraser 2004; Kelton and Chow-Fraser, 2005). Through my research, I initiated a pilot planting program using community volunteers that has become a model for other restoration projects (Chow-Fraser and Lukasik, 1995; Chow-Fraser 1999b). Research results stemming from our work in Cootes Paradise Marsh have provided guidance to wetland managers elsewhere regarding the general feasibility of biomanipulation

as a restoration strategy to restore wetlands (Angeler et al. 2003).

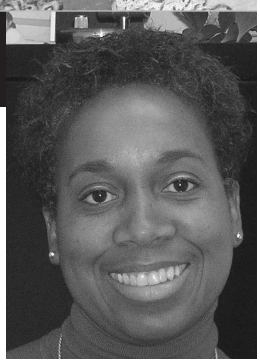
The research I conducted to guide the restoration of Cootes Paradise Marsh indicated clearly that polluted runoff associated with altered land in the watershed played a major role in marsh degradation. In 1996, I began a parallel research program that specifically addressed the impact of land use alteration on water and sediment quality in wetlands (Crosbie and Chow-Fraser 1999). In Chow-Fraser and Albert (1999), I highlighted the need to develop ecosystem-level indicators of wetland quality to track changes in habitat quality. In 2000, I led a team of bi-national researchers to develop ecological indicators to specifically assess fish habitat in coastal wetlands of all five Great Lakes, because coastal wetlands provide critical spawning and nursery habitat to the Great Lakes fish community (Goodyear et al. 1982). Products of this research program include the development of indicators of wetland quality based on data collected from over 200 wetlands throughout Canada and the U.S. shoreline of all five Great Lakes. We have published indicators based on macrophyte species richness (Lougheed et al. 2001), zooplankton indicator species (Lougheed and Chow-Fraser 2002), periphyton biomass (McNair and Chow-Fraser 2003), water quality parameters (Chow-Fraser 2006), fish indicator species (Seilheimer and Chow-Fraser 2006, 2007) and macrophyte species (Croft and Chow-Fraser 2007). We are now applying these indices to assess the ecological status of coastal wetlands of Georgian Bay and the North Channel, which are two areas of the Canadian shoreline that are being threatened by recreational development.

We have also created a Great Lakes GIS database that contains the current and historical distribution of fish, plant and macro-invertebrates, and some associated land-cover information. This database is being enriched with information derived from our sampling program, and we are in the process of making it available to managers and other researchers through our WIRE Net website (Wetland Inventory for Research and Education Network; http://www.wirenet.info). It is also being used to investigate the spatial relationship between fauna/flora and coastal wetlands at the scale of all five Great Lakes. Using historical fish surveys and wetland maps, we have already demonstrated that more than two-thirds of all Great Lakes fishes are spatially associated with coastal wetlands in Lake Ontario (Wei et al. 2004).

Use of traditional field-based method to detect and record the change in aquatic vegetation in Great Lakes wetlands is a daunting task because of their wide distribution throughout the Great Lakes shoreline. Mapping wetlands for such a large geographic area necessitates the use of remote sensing technology to obtain an accurate inventory of these ecosystems. Wei and Chow-Fraser (2007) succeeded in using IKONOS satellite imagery to map different types of aquatic vegetation and habitat features in coastal wetlands of Fathom Five National Marine Park in Lake Huron and an area of eastern Georgian Bay. The comparison of results of the image analysis with reference data indicated that the overall accuracy of mapping was approximately 90%. This suggests that high resolution IKONOS imagery can be used effectively to monitor the change in aquatic vegetation and thus track alterations in fish habitat in Great Lakes coastal marshes.

Associate Professor

Juliet Daniel



Catenins and Transcription Factors in Normal Cell Growth, Cancer and Development

Laboratory Personnel

Ph.D. Student: Nickett S. Donaldson; *M.Sc Students:* Michelle Anstey, Kyster Nanan, Sonali Weerawardane

Research Collaborators

Dr. Pierre McCrea (University of Texas MD Anderson Cancer Center), Dr. Mungo Marsden (University of Waterloo), Dr. Rudi Winklbauer (University of Toronto)

Funding

Canadian Institutes of Health Research (Operating grant)

Our research program seeks to understand the cellular and molecular basis of cadherin-mediated adhesion in normal cell growth, development and tumourigenesis. Currently, we are most interested in the primary epithelial cell-cell adhesion system involving E-cadherin and its cytosolic cofactors, the catenins α-, β-, γ- and $p120^{ctn}$. This adhesion system is perturbed in ~50% of human metastatic tumours, and its malfunction correlates with the metastatic, invasive phenotype. Hence a thorough understanding of the factors that regulate and control cell adhesion and motility would significantly facilitate the development of improved cancer therapies. Recently, in addition to their established roles in cell-cell adhesion, the catenins were found to also play a role in signal transduction via their transcriptional regulation of target genes involved in tumourigenesis. One of the least characterized components of the cadherin-catenin complex is the catenin $p120^{ctn}$ that was first identified as a Src kinase substrate. We recently identified the BTB/POZ transcription factor Kaiso as a specific binding partner for $p120^{ctn}$ and this discovery has further underscored the dual roles of the catenins in cell adhesion and signal transduction. Our discovery has also opened new areas of research in the cadherin-catenin field.

Kaiso as a negative regulator of Wnt signaling in a mammalian model.

Kaiso is a member of the POZ-ZF family of transcription factors with roles in cancer and development. It was the first POZ-ZF transcription factor characterized with dual-specificity DNA-binding and transcriptional repression ability; Kaiso binds and recognizes either a sequence-specific Kaiso binding site, TCCTGCNA or methylated CpG-dinucleotides. To date Kaiso target genes include *metastasin, matrilysin, siamois* and *cyclinD1,* some of which are also target genes of the canonical Wnt/β-catenin signaling pathway. In fact, Kaiso overexpression suppressed β-catenin-mediated activation of *matrilysin* and *siamois,* and suppressed β-catenin-induced secondary axis formation in the *Xenopus laevis* model organism. Our findings thus implicate Kaiso as an inhibitor of the Wnt signaling pathway and a regulator of genes involved in tumourigenesis and development. Current studies are focused on (i) assessing Kaiso misexpression effects on cell proliferation, apoptosis and invasion and (ii) clarifying Kaiso's role as a modulator of Wnt signaling using a mouse model.

POZ-ZF transcription factors and vertebrate development.

Recently my lab has expanded its research expertise to include the *Xenopus laevis* (frog) model system to help us elucidate the role of Kaiso and its binding partner, Znf131, in signaling and development. Znf131 is a minimally characterized POZ-ZF protein that was first identified by others in a screen for transcription factors linked to developmental and malignant disorders. Like Kaiso, Znf131 depletion consistently produced striking blastopore closure defects during gastrulation in *Xenopus* embryos (**Fig. 1A**). More importantly, ectopic Kaiso expression partially rescued (~ 40%) the Znf131-depleted blastopore closure developmental defects (**Fig. 1B**). Interestingly, Kaiso-overexpression *Xenopus* embryos display a remarkable ectodermal cell shedding phenotype, suggestive of cell

adhesion defects (**Fig. 2**). Current studies are aimed at (i) elucidating the transcriptional properties of Znf131 & identifying potential Znf131 target genes, and (ii) determining which *Xenopus* developmental processes and molecular networks are perturbed by xZnf131 and Kaiso misexpression.

Collectively our data allude to $p120^{ctn}$ and Kaiso as key modulators of cell adhesion and motility in development and cancer. We are now strategically poised to unravel the putative adhesion-signaling pathway and elucidate the role of the $p120^{ctn}$-Kaiso interaction in development and tumourigenesis. Our research offers exciting promise for the development of therapeutic strategies and animal models for the treatment of malignant tumours or developmental disorders.

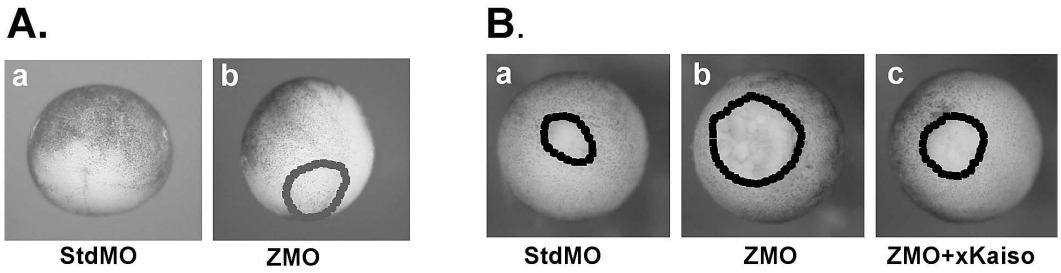


FIGURE 1: Znf131 misexpression effects and rescue by Kaiso. (**A**) *Xenopus* embryos injected with an xZnf131-specific morpholino (ZMO-ATG) exhibit gastrulation defects in blastopore closure at stage 12/13. (**B**) Ectopic Kaiso partially rescues the Znf131 blastopore closure defect.

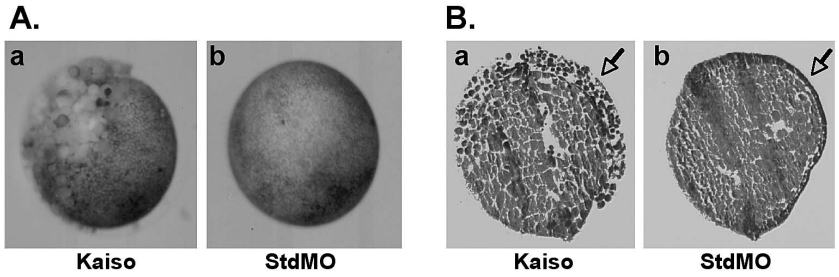


FIGURE 2: Kaiso-overexpressing *Xenopus* embryos display a "cell shedding" phenotype. (**A**) *Xenopus* embryos overexpressing Kaiso display a striking ectodermal cell shedding phenotype (a) compared to a (b). (**B**) Representative sections through (a) a Kaiso overexpressing embryo versus (b) a control embryo with an intact ectodermal cell layer.

Associate Professor

Susan A. Dudley

Evolution of plant carbon acquisition traits in response to variable environments

Laboratory Personnel

M.Sc. student: Guillermo Murphy; *Undergraduate students:* Clarise Chan, Amanda File, Jake Graham, Tanner Hukezalie.

Research collaborators

Lisa Donovan (University of Georgia)

Funding

Natural Sciences and Engineering Research Council (Discovery grant)

My research program integrates ecology, evolutionary biology, and developmental biology to determine how plants adapt to different environments through their carbon acquisition traits. Though individuals in different environments may differ in phenotype, either because of genetic differentiation or phenotypic plasticity, such differences cannot be assumed to be adaptive. In my research, I study the fitness consequences of phenotypic plasticity and local adaptation. By contrasting natural selection between environments on a suite of interacting traits identified from functional literature, I can better compare the results with the expected costs, benefits, and constraints among these traits.

My research program on the evolution of plant carbon acquisition traits has included studies that integrate the physiological ecology of drought stress with the natural selection on drought stress traits, and genetic differentiation between populations from environments differing in water availability and salinity and other stresses. My predominant focus, however, has been plant adaptation to neighbour densities. I have examined the fitness consequences of phenotypic plasticity to density in the field, conclusively demonstrating that this is adaptive plasticity. I demonstrated genetic differentiation between wood and clearing populations for responses to the light quality cues of density. I have investigated phenotypic plasticity for gas exchange, allocation, and leaf and stem morphology traits in response to R:FR and to high densities. I have contributed to reviews and conceptual syntheses for the evolution of physiological traits and phenotypic plasticity. I developed new approaches and statistics within my papers. I have been first to measure plant responses to both R:FR and root neighbour cues of competitors. Currently, my lab examines plant responses to R:FR and root competitors in soybean. Phenotypic plasticity is as important for plants as behaviour is for animals: it allows plants to defend against herbivores, compete, and forage for mineral nutrients and water. I now ask whether phenotypic plasticity in plants, like animal behaviour, evolves in response to kin selection.

Hamilton's theory of kin selection recognizes that individuals can increase their inclusive fitness through behaviour that increases the fitness of related individuals. However, there have been relatively few plant studies of kin selection in competition, likely because of the belief that plants have limited abilities to interact with one another. It is now known that plants do have a form of social behaviour. Plants sense the presence of other plants, and responses to cues of neighbours are important in competition. Plants have a well-studied aboveground mechanism for sensing neighbours. In the natural environment, the ratio of red to far-red wavelengths of light (R:FR) is only reduced by the presence of chlorophyll in plants. Plants have a photoreceptor, phytochrome that perceives the relative abundance of red and far-red photons. Recent studies have shown that plants have a second, belowground system to sense the presence of neighbours. Recent studies that kept belowground resources constant, while manipulating

the presence or absence of root neighbours, demonstrated that plants respond to roots of other plants, often by increasing their allocation to roots. In a collaboration with Lisa Donovan (University of Georgia), we manipulated both root neighbour and R:FR cues independently. We showed that in *Chenopodium album* plants responded to root and R:FR cues simultaneously, confirming that plants can sense competitors both above- and belowground. But in contrast to previous studies, we found that in *C. album,* the belowground cue elicited responses that increased aboveground competitiveness, though only when belowground resources were abundant.

Some very intriguing results have been found in this new field of responses to root neighbours. Effects of root neighbours on root allocation vary from increases, to no effect, to reductions, apparently depending on species. Individual root growth responses depend on the genotype of the neighbour, the species, and whether the neighbouring root is self or non-self, even in genetically identical individuals. For herbaceous plants, neighbours may be trees, interspecific competitors of similar size, unrelated intraspecific competitors, or close kin. Moreover, the densities of neighbours will range greatly. While the R:FR signal strongly conveys information about density, there is the possibility that the root signal may convey specific information about the nature of the competitor. Highly structured monospecific stands create an opportunity for kin selection in plants. If plants have a kin recognition mechanism, the evolution of less selfish competitive responses in such stands becomes possible if not probable.

Assistant Professor and
Canada Research Chair in Microbial Genomics

Marie Elliot

Development and protein secretion in multicellular bacteria; Regulation by small RNAs; Antibiotic production; Cell wall remodelling

Laboratory Personnel

Post-doctoral fellows: Mary Yousef, Jan Bobek; *Ph.D. Students:* David Capstick, Henry Haiser, Hindra; *M.Sc. Student:* Julia Swiercz; *Undergraduate Students:* Patricia Pak and Marin Franchetto; *Research Technician:* Christina DiBerardo

Research collaborators

Dr. Greg Hannon (Cold Spring Harbor Laboratories); Dr. Justin Nodwell (McMaster University)

Funding

Canadian Institutes of Health Research (Operating grant), Natural Sciences and Engineering Research Council (Discovery grant), Natural Sciences and Engineering Research Council (CRD grant with J. Nodwell), Canada Research Chairs Program

The goal of our research is to understand development and regulation in multicellular bacteria, using *Streptomyces coelicolor* as a model system. The streptomycetes are extremely important to the pharmaceutical industry as they make a large number of 'secondary metabolites' having a profound medical benefit, including anti-cancer agents, immunosuppressants, and the majority of clinically useful antibiotics. They are also unusual in that they have a complex, multicellular life cycle and are capable of differentiating into distinct tissue types. Intriguingly, this differentiation process coincides with the production of secondary metabolites. One aspect of our research is focused on understanding the components necessary for differentiation, and centres on a novel family of proteins, termed the chaplins, that are essential for the transition from one differentiated state to another. We are also interested in the regulatory networks that control differentiation, metabolism, and environmental adaptation in *S. coelicolor,* and are focussing on a newly emerging, and universally important, class of regulators known as the small RNAs.

Aerial development in S. coelicolor

The multicellular development of *S. coelicolor* is a complex process, and the transition from vegetative growth to aerial hyphae formation is tightly regulated. Using microarray analysis, we have identified a novel family of hydrophobic proteins, termed the chaplins, that are required for aerial hyphae formation. The eight chaplin proteins are secreted from the cytoplasm, and are all localised to the cell wall. Three of the chaplins (the 'long' chaplins) have a C-terminal extension that is covalently anchored to the peptidoglycan, and we believe that these long chaplins act as nucleation sites for the binding and polymerisation of the other 'short' chaplins. The chaplins are predicted to coat the surface of the aerial hyphae, forming a hydrophobic layer that allows the hyphae to extend into the air, and resist desiccation. Current studies are focussed on (1) understanding the nature of chaplin polymerisation; (2) investigating the interaction of the chaplins with other cell-wall components and morphogenetic factors; and (3) using the chaplins as a model system to study protein secretion and cell wall anchoring.

Regulation by small RNAs

The last five years have seen the small RNAs emerge as important regulators in bacteria, archaea, and eukaroyotes. There is considerable interest in identifying and characterising these sRNAs to provide an understanding of their prevalence, mode of action, and impact on cellular processes, as they are predicted to be a 'missing link' in many

important pathways. We have begun to mine the *S. coelicolor* genome for sRNAs, and are taking a direct cloning approach to identifying these novel regulators. We have identified antisense regulators that impact antibiotic production and remodeling of bacterial cell walls. The long-term aim of this work is to define novel sRNA regulatory networks, and integrate sRNA regulation into known cascades controlling morphogenesis and antibiotic (secondary metabolite) production, thus providing fundamental insights into the biology of these medically and developmentally important bacteria.

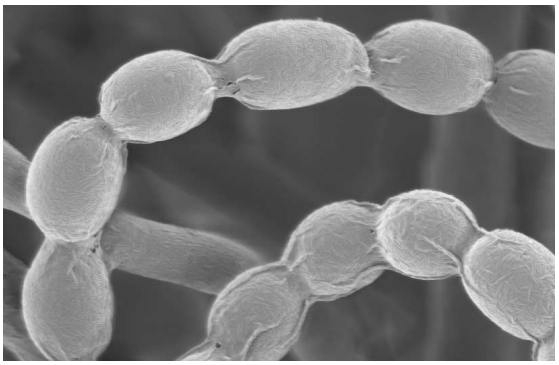


FIGURE 1: Sporulating *S. coelicolor*

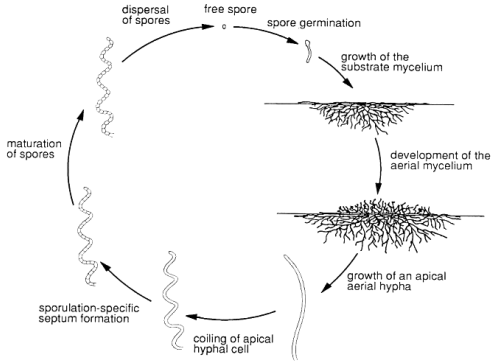


FIGURE 2: Life cycle of *S. coelicolor*

Assistant Professor

Ben Evans

Molecular evolutionary analysis of biodiversity and gene duplication

Laboratory Personnel

Ph.D. Students: Frederic Chain, Iqbal Setiadi; *M.Sc. Student:* Dave Anderson

Research Collaborators

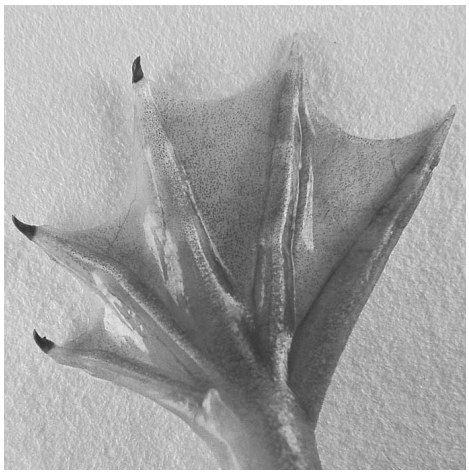
Darcy Kelley (Columbia University); David Cannatella (University of Texas Austin); Don Melnick (Columbia University); Jim McGuire (University of California, Berkeley); Rafe Brown (University of Kansas); Richard Tinsley (University of Bristol); Jatna Supriatna (University of Indonesia); Noviar Andayani (University of Indonesia)

Funding

Natural Sciences and Engineering Research Council (Discovery Grant), National Science Foundation, Canadian Foundation for Innovation (Infrastructure grant)

In 2006 and 2007, we completed three studies of molecular evolution and expression of duplicate genes in polyploid clawed frogs. These studies are published in *PLoS Genetics, Genetics,* and *BMC Evolutionary Biology.* These studies and other related ones are discussed in a review article in *Frontiers in Bioscience.* They (1) test the applicability of alternative explanations for the persistence of duplicate genes, (2) detail a non-random pattern of gene silencing of paralogous copies of the RAG-1 locus in these polyploids, and (3) explore molecular evolution and expression of duplicate genes after whole genome duplication (WGD) in clawed frogs. Results test the applicability of hypothesized mechanisms that operate within a genome to promote duplicate gene persistence. Our findings also demonstrate that in allopolyploid species, the nexus of gene expression and genetic interactions may be influenced by the evolutionary history of each gene copy. Additionally, expression divergence after WGD was substantial in tetraploid clawed frogs whereas functional constrains on expressed duplicates so far have remained relatively constant.

We also recently submitted a paper on patterns of evolution in multiple, distantly related species (monkeys and toads) on the Indonesian island of Sulawesi to the journal *Biology Letters.* This paper uses coalescent simulations tests alternative demographic scenarios for vertebrate diversification on the Indonesian island of Sulawesi. Conservation implications of this study and of other observations we have made in the field are published in a chapter of the book "Biodiversity and human livelihoods in protected areas; case studies from the Malay Archipelago".



Additionally, we recently submitted a description of a new species of clawed frog to the journal *Zootaxa.* A picture of the foot of this new species is below. This species occurs only on the Itombwe Plateau in the Democratic Republic of the Congo, and highlights the unique fauna and high conservation value of this special region.

Professor Turlough Finan

Genomic analyses of the soil bacterium *Sinorhizobium meliloti*

Laboratory Personnel

Ph.D Students: Allyson MacLean, Branislava Poduska, Ye Zhang; *M.Sc. Students:* Katerine Kibitkin; *Postdoctoral Fellow:* Catharine White; *Research Associates:* Jiujun Cheng, Rahat Zaheer

Research collaborators

Drs. B. Golding, J. P. Xu, D. Morton, B. McCarry (McMaster University), Dr. Philip Poole, (University of Reading, UK)

Funding

Natural Sciences and Engineering Research Council (Discovery grant), ORDCF

The soil bacterium *Sinorhizobium meliloti* is best know for its ability to form N2-fixing root nodules on alfalfa. The genome of this bacterium consists of three replicons – a chromosome and two megaplasmids pSymA and pSymB. In 1991, we constructed a genetic map for the 1700 kilobase pSymB megaplasmid and ten years later, we were part of the international consortium that determined the DNA sequence of the genome of this organism – all 6,691,694 base pairs. Analysis of this sequence revealed that it contained 6,204 protein-coding genes, and interestingly the functions of about 2,500 of these genes are unknown. Many of these proteins of unknown function have homologues or similar genes in other organisms. Our major research focus is directed to determining the biological roles for these genes of unknown function. We have constructed a library in which many of the *S. meliloti* genes are fused to easily assayed reporter genes. This library is being used to study groups of genes that are physiologically related – including genes encoding the > 300 transport systems in the *S. meliloti* genome and genes whose expression is regulated by the concentration of phosphate in the environment.

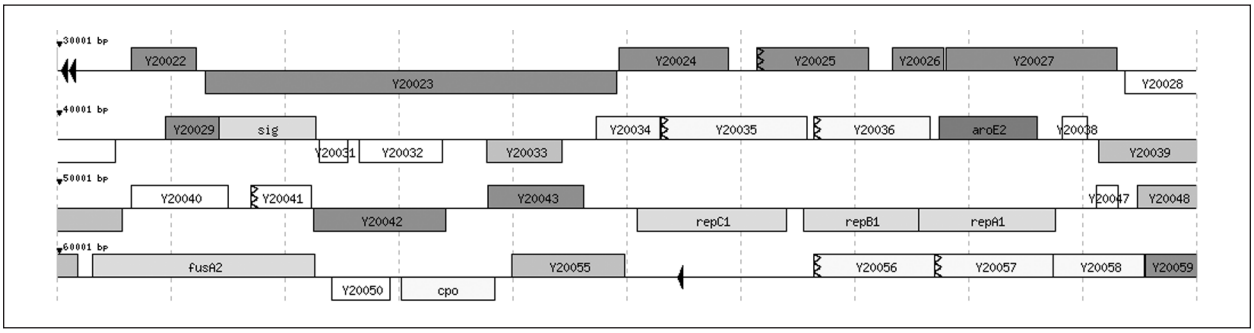


FIGURE: Schematic of a gene region from the *Sinorhizobium meliloti* pSymB megaplasmid including the *repA1, repB1* and *repC1* genes together with several genes of unknown function prefaced by a Y.

More environmentally related studies in our lab focus on growth and survival of *S. meliloti* in soil. In addition, we are performing molecular genetic analyses of several gene clusters that are involved in the uptake and metabolism of specific carbon sources that are available to bacteria in the soil environment. There include _-glucans (celliobiose), aromatic compounds (protocatechuate), and amino acid derivatives (hydroxyproline).

The growth of many organisms in soil and water is limited by the low concentrations of available phosphate in these environments. To learn more about the growth and survival of bacteria in soil, we are studying how *S. meliloti* responds to phosphate limitation. We have identified approximately 30 gene clusters in *S. meliloti* whose expression is regulated by the Pi-response regulator PhoB. Ongoing research is aimed towards assigning function to the PhoB-regulated genes, many of which have no similarity to genes with known function. To investigate the general importance of these genes in bacteria, we are examining the distribution and regulation of members of the Pho-regulon in other diverse bacteria.

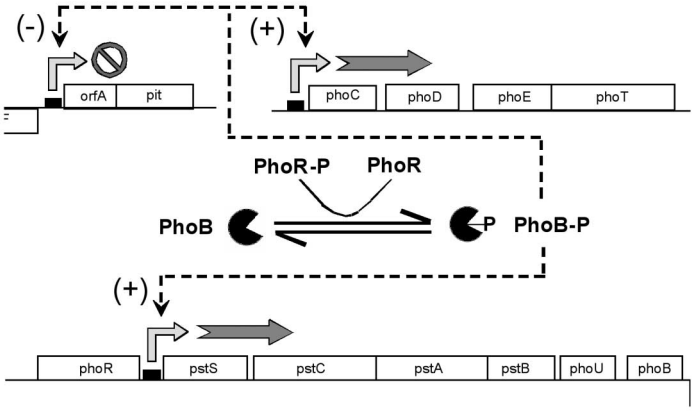
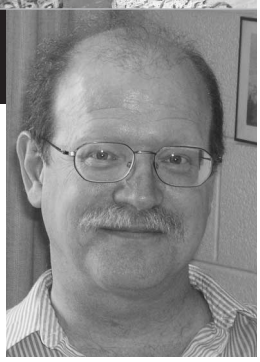


FIGURE: Regulation of phosphate transport systems via PhoB-PhoR in *S. meliloti*

Professor and Canada Research Chair
in Environmental Genomics

Brian Golding



Molecular Evolution, Genomics, Bioinformatics, Computational Biology

Laboratory Personnel

Postdoctoral Fellows: Mihai Albu; *Graduate Students:* Danya Konrad, Melanie Lou, Stephanie Sun, Wilson Sung.

Funding

Natural Sciences and Engineering Research Council (Discovery grant), Natural Sciences and Engineering Research Council (Network grant), Genome Canada, Canada Research Chairs Program

Our research interests are in the area of bioinformatics, molecular evolution and DNA sequence analysis. Our research attempts to understand how the processes of evolution act to cause the changes actually observed between molecules, between genes and between genomes. The recent advances in molecular genetics are providing a storm of new data on DNA sequences, on gene structure and higher order genomic structure. However, the implications of these new data are not always clear. This area of scientific inquiry is called bioinformatics and is a relatively new inter-disciplinary field between biology, computer science and mathematics.

We make use of computer based analysis, statistical analysis and mathematical models to answer broad questions about the biology of all organisms. We are presently investigating the following,

I. The frequency and properties of genes that have been horizontally transferred between bacterial species. We are developing methods to detect these unusual events and to measure their extent of transfer.
II. We are uncovering the determinants of the rates of amino acid replacements as they relate to the three-dimensional structure of proteins. This has involved the development of new statistical methods to measure evolutionary signal across a potentially large phylogenetic history.
III. We are determining the properties and determinants of simple repeats within individual proteins. This has included demonstrating that these repeats can form a significant proportion of the genomic protein sequence.
IV. We are participating in a large scale, multi-university project termed the BARCODE OF LIFE initiative, to determine and archive a single piece of DNA from all organisms. This piece will be used as a marker to identify species. We are analyzing how this marker changes within and between species.
V. We are involved in the creation of genomic databases. In these projects we collaborate with scientists from other departments at McMaster and from other universities.

Individual projects within these themes change over time but they are united by a consistent, broad interest in the fields of genomics, bioinformatics and molecular evolution.

Assistant Professor
and Canada Research Chair

Bhagwati P. Gupta

Development and evolution of reproductive system in *C. elegans* and related nematode species

Laboratory Personnel

M.Sc. students: Ashwin Seetharaman, Katyayani Joshi, Sujatha Marri, B. Nagagireesh; *Undergraduates:* Navid Khezri, Nazmus Sakib, Hayoung Kim, Tram Nguyen, Cindy Lai, Mark Hindle, Prateek Goyal, Ahmad Jomaa, Riya Ganguly, Rajneet Kuner; *Technician:* Karen Haines

Research Collaborators

Dr. Paul Sternberg (California Institute of Technology), Dr. David Baillie (Simon Fraser University), Dr. Raymond Miller (Washington University School of Medicine), Dr. Eric Haag (University of Maryland), Dr. Scott Baird (Write State University), Dr. Helen Chamberlin (Ohio State Univesity), Dr. Rama Singh (McMaster University), Dr. Cecile Fradin (McMaster University), Dr. Ray LaPierre (McMaster University)

Funding

Natural Sciences and Engineering Research Council (Discovery grant), National Institutes of Health, Canada Research Chairs Program, Canadian Foundation for Innovation (Infrastructure grant), Ontario Innovation Trust (Infrastructure grant)

Our laboratory uses the nematode *Caenorhabditis elegans* to understand how genes and signaling pathways function to control cell identity and organ formation in metazoans. Our system of choice is the hermaphrodite vulva, a tubular organ necessary for mating and laying fertilized eggs. We take classical genetic, molecular, genomic and computational approaches to identify and study gene function and their network of interactions.

One of our projects focuses on the regulation and function of a LIM homeobox (LHX) family of transcription factor *lin-11.* LHX genes are present in all metazoans and control diverse morphogenetic events. Targeted deletion and RNA interference (RNAi) of some of the family members in vertebrates (mouse, chick and *Xenopus*) have been shown to cause severe growth and viability defects. In *C. elegans,* mutations in *lin-11* give rise to an egg-laying defective phenotype due to the defects in the hermaphrodite vulval tubule and vulval-uterine connection. Our work has established that these abnormalities result from the failure in morphogenetic processes such as cell adhesion, polarity and migration. Thus, *lin-11* plays an essential role in vulval tubule morphogenesis. We have recently demonstrated that *lin-11* orthologs in three other *Caenorhabditid* species (*C. briggsae, C. remanei* and *C. brenneri*) play a similar role in the vulva suggesting that the mechanim of *lin-11* regulation in *Caenorhabditid* nematode species is evolutionarily conserved.

Another project in my lab focuses on the genetic analysis of vulval development in non-*elegans* species. We have isolated mutants in *C. briggsae* that exhibit defects in vulval cell proliferation and differentiation. Some of these strains display phenotypes not observed in *C. elegans* vulval mutants suggesting differences in the mechanism of vulva formation between the two species. One class of mutants (defined by the reference allele *sy5353*) exhibits unique pattern of induction such that the anterior half of the vulval precursor cells (VPCs) are frequently induced to give rise to vulval progeny whereas the posterior half of VPCs fail to do so. We have cloned the *sy5353* locus and shown that it encodes an ortholog of PRY-1 in *C. briggsae.* PRY-1 is a member of the vertebrate Axin family and functions in the canonical Wnt signaling pathway. Since the phenotype of *C. briggsae pry-1* mutant differs from what has been observed in *C. elegans pry-1* animals, we are focusing on other Wnt pathway components to understand evolutionary changes in *pry-1*-mediated Wnt signaling function *C. briggsae* vulval development.

To facilitate the genetic analysis of vulval mutants in *C. briggsae,* we are working with other laboratories to develop resources and tools for comparative studies. In collaboration with Paul Sternberg (California Institute of Technology) and David Baillie (Simon Fraser University), we have isolated more than 200 mutants to construct the genetic linkage map of *C. briggsae* based on phenotypic markers. We have mapped several of these mutants and identified at least five *C. elegans* orthologs leading to the definition of six linkage groups (five autosomes and an X-linked). We are also collaborating with Dr. Raymond Miller (University of Washington School of Medicine) to integrate our mutant-based genetic map with his SNP-based map. A high-resolution linkage map will not only benefit our own research but will also be a valuable resource for the entire *C. briggsae* research community.

Selected Publications

Gupta, B. P., Johnsen, R. and Chen, N. (2006). The genomics and biology of the nematode *Caenorhabditis briggsae.* Wormbook (doi/10.1895/wormbook.1.136.1).

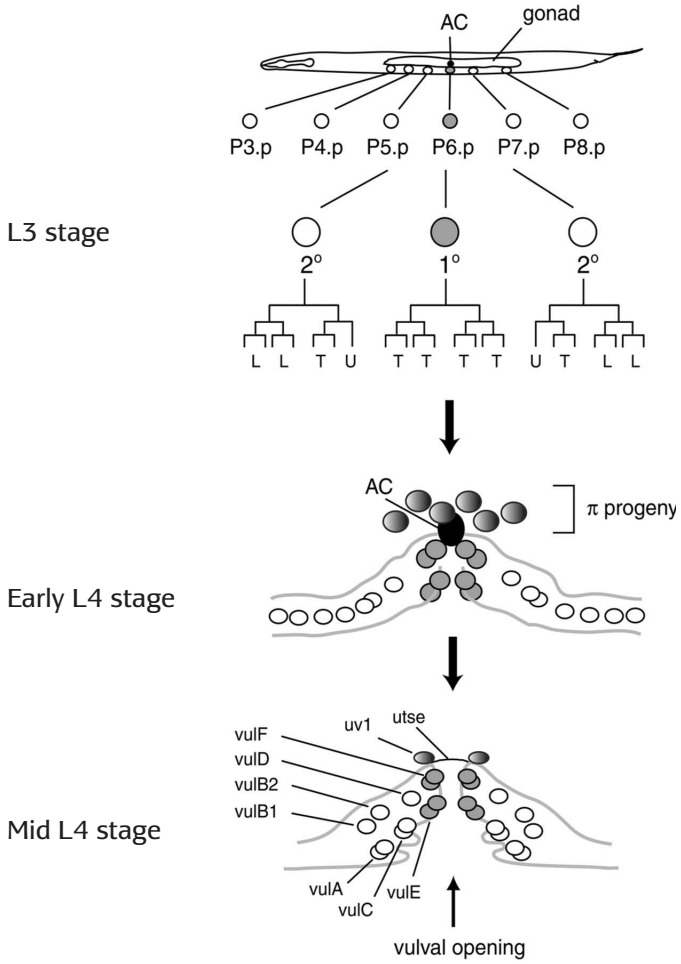
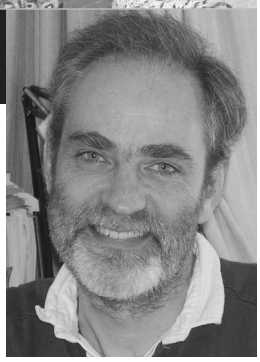


FIGURE: Vulval development in Wild-type *C. elegans* and *C. briggsae.* During the L3 stage, three precursor cells (P5.p, P6.p and P7.p) are induced to adopt 20-10-20 cell fates and execute stereotypic pattern of cell divisions (L, longitudinal axis; T, transverse axis; U, undivided). By early L4 stage, vulval cells have invaginated. The anchor cell (AC) penetrates the 10 lineage cells and creates an opening. Later, AC fuses with the surrounding uterine p progeny to give rise to vulva-uterine connection (utse) and uv1 cells. vulA to vulF refer to the differentiated fates of the cells.

Professor

J. Roger Jacobs

Developmental Genetics, Cancer Genetics



Laboratory Personnel

Ph.D. Students: Leena Patel, Katie Moyer, Noor Hossain; *M.Sc. Students:* Katerina Vassilieva, Lulu de Vazquez; *Undergraduate Assistants:* Shirley Liang, John Mansbridge, Lauren Brady; *Technician:* Mihaela Georgescu

Funding

Natural Sciences and Engineering Research Council (Discovery grant), Canadian Institutes of Health Resaerch (Operating grant)

Our research program explores the molecular and genetic basis of cell to cell signaling events in developing and mature tissues. We employ *Drosophila* as a model organism, because the rapidity with which we can isolate new mutations, or otherwise modify gene expression. *Drosophila* is a relatively complex organism, wherein the functions of most genes are reflected by conserved (similar in structure) mechanisms in humans. All of our three research streams examine cell to cell signaling that is conserved at the molecular level, but less well understood in humans. Through applying an unbiased genetic approach in *Drosophila,* we can discover new dimensions of signaling events that are impossible or difficult to uncover in mammals.

Function of Veli in polarised signaling

The formation of sheets of cells, and their derivatives, like tubes, requires that cells develop a top, a bottom, and junctions with other cells in their sheet. We are using a genetic and molecular approach to revealing the function of Varicose, a protein that acts in assembling the junctions between cells in sheets. *Drosophila* that lack this protein cannot seal the tubes in their respiratory system, and suffocate. We have shown that this protein acts late in the formation of junctions, and may act to stabilise them. Further, this protein appears to play a role in cell polarity in the developing brain and in egg development. Our work on this gene is now being reviewed for publication, and has been presented at two conferences

Molecular and genetic analysis of the morphogenetic functions of Slit

The formation of complex tissues in the embryo requires the directed movement of cells (migration) or directed growth of cell processes, like the axons of the nervous system. We co-discovered the primary repellent guidance signal for migration in the nervous system, called Slit, in 1999. Today we are examining its function in the assembly of a simpler tissue, to better understand the molecular basis of its activity. We focus on the *Drosophila* heart, whose development mirrors the vertebrate heart up to the point of looping morphogenesis. We have discovered that Slit can act as an attractant in heart cell migration events, and that this function is strongly affected by other cell adhesion signals, in particular from the integrin family (MacMullin and Jacobs, 2006). Currently we are using gene misexpression tools, and timelapse studies of cell movements in living tissue, to see how cells react to the intersecting signals of attraction, repulsion and adhesion.

Genetic dissection of mammalian ErbB2 signaling in *Drosophila*

Nearly a third of human breast cancers involve a change in the regulation or expression of a major cell to cell signaling system, involving ErbB2, a member of the Epidermal Growth Factor Receptor family. ErbB2 signals growth and differentiation signals, and in cancer, unregulated cell growth, by recruiting and activating many intracellular messenger proteins, called second messengers. Clinicians and scientists would like to determine what specific outcomes result from the activation of each second messenger, so that we may identify more specific targets for therapeutic intervention. Scientists looking at the mammalian model have designed altered forms of ErbB2 that can only activate a small set of second messengers at a time. Technically, it is very slow and expensive to determine the effects in living mammalian models of cancer.

Drosophila shares a signaling pathway that is strongly conserved with vertebrate ErbB2. We have discovered that expression of mammalian ErbB2, including the altered forms, can signal through *Drosophila* second messengers. Moreover, we can apply genetic approaches in *Drosophila* to identify which second messengers, or discover new second messengers that are required for specific signaling pathways that radiate from ErbB2. We have completed a massive mutant screen to identify the genes required for natural silencing of active receptors. To our surprise, a specific silencing output of ErbB2 does not activate receptor mediated endocytosis, thought to be the major method of receptor silencing. Identification of 14 genes we have isolated that are required for this process will enable us to map out this novel pathway

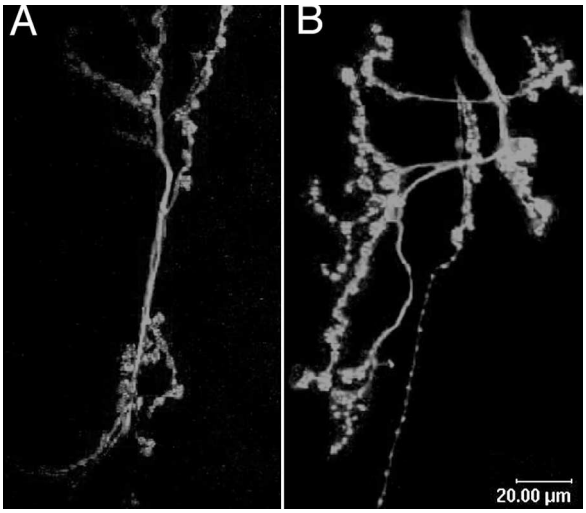


FIGURE 1:
The distribution of Varicose protein in the epithelia of the *Drosophila* embryo is labelled in green. The lumen of the trachea, the air distribution system in insects, is labelled in red in this confocal fluorescence image.

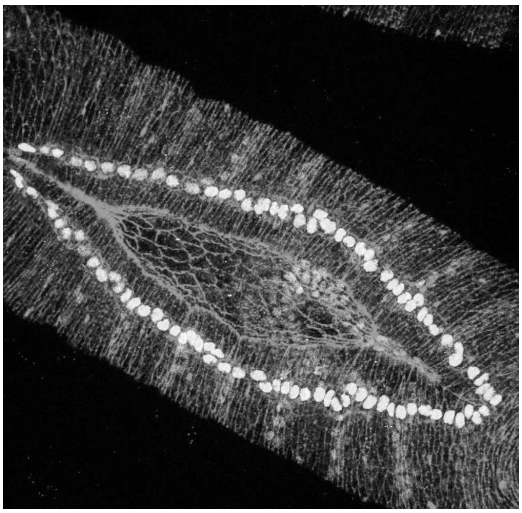
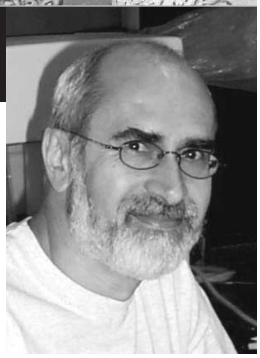


FIGURE 2:
The eye in panel A is expressing low levels of the oncogene NeuYE, causing minor pattern defects, such as extra, undersized ommatidia. The eye at right also expresses low levels of NeuYE, and also having half the normal level of endocytosis gene expression *(cbl)*. Many more pattern defects arise because NeuYE is not effectively inactivated.

Professor

J. Kolasa



Interactions Between Habitat Structure and Variability and Biodiversity Patterns

Laboratory Personnel

Ph.D. Students: Jaan Marquez, Shubha Pandit

Research Collaborations

David Jenkins (South Florida Univeristy); Beatrix Beisner (Universite Du Quebec A Montreal); Larry Li (Univ California, Riverside)

Funding

Natural Sciences and Engineering Research Council (Discovery grant)

Our main focus is on organization and function of ecological systems and their biodiveristy in context of heterogeneity, habitat hierarchy, and scale.

One of the conceptual bottlenecks of ecology is posed by the multitude of interacting components and factors such as individuals, populations, habitat patches, abiotic resources, disturbances, and others, affecting or expressed in any single community or ecosystem. I am interested in analytical approaches to such complex ecological systems, with special focus on aquatic habitats and their fauna. Specific areas of research include organization and structure of aquatic communities as a function of spatial and temporal scale and habitat heterogeneity. Much of the field work is being conducted at a site in Jamaica and include experimentation of rock pool communities and coral reef fish. Recently, we have focused on conditions under which species diversity affects stability of whole communities, probability of species extinction, and fluctuations of individual populations. These conditions may include body size structure, system productivity, habitat variability, or interactions among these factors.

Assistant Professor

Grant McClelland

Integrative physiology of muscle and animal performance, environmental stress

Laboratory Personnel

Ph.D. students: Paul Craig, Marie-Pierre Schippers, Andrea Morash; *M.Sc. student:* Jacqueline Beaudry; *Undergraduates students:* Kristina Arvai, Mike Galus, Lara Jenitens

Research Collaborations

Reuven Dukas (McMaster University); Chris Wood (McMaster University); Martin Gibala (McMaster University); Jim McGeer (Wilfred Laurier University); Jim Staples (University of Western Ontario); Steve Britton and Lauren Koch (University of Michigan); Glenn Tattersall (Brock University), Mike Wilkie (Wilfred Laurier University)

Funding

Natural Sciences and Engineering Research Council (Discovery grant), Natural Sciences and Engineering Research Council (Research Tools grant), Natural Sciences and Engineering Research Council (CRD grant with C. Wood), Great Lakes Fisheries Commission (with M. Wilkie), CIHR (Operating grant with M. Gibala), Canadian Foundation for Innovation (Infrastructure grant), Ontario Early Researcher Award

Our lab focused on gaining a better understanding of the cellular, molecular, genetic, environmental and evolutionary determinants of muscle metabolism. In the last 2 years we focused on several major research themes:

Vertebrate muscle metabolic remodeling

This research focuses on muscle plasticity to environmental and energetic stress and how this impacts on whole-animal performance. Using adult zebrafish and trout as model systems we have been investigating an apparent paradox concerning the qualitative changes in mitochondrial biogenesis with chronic increases or decreases in muscle metabolism. We are examining the regulation of muscle lipid metabolism in response to environmental stress at both the genetic and nongenetic level. Dogfish sharks are used as a novel model of lipid metabolism.

Lifetime performance and muscle physiology

We have also been investigating the relationship between lifetime learning and foraging performance changes in relation to muscle physiology in honeybees. (With R. Dukas)

Toxicogenomics

We are using zebrafish as a model tropical species to examine the effects of chronic metal exposures via biochemical & genomic endpoints.

Interactions between oxygen delivery and fuel metabolism

To examine the relationships between oxygen delivery and fuel metabolism we are using lines of rats selectively bred for high and low aerobic running capacity. This model system is ideal to study the relationship between exercise intensity and fuel kinetics. We are also examining adaptations to high altitude using high and lowland species of mice in the Peruvian Andes.

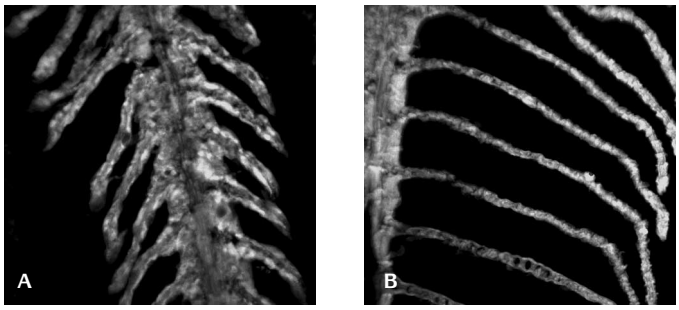
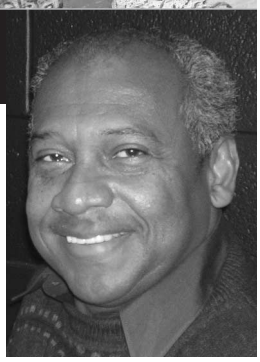


FIGURE:
Gills from plainfin midshipman, Porichthys notatus before (A) and after a 6 hour air exposure (B). This simulates naturally occurring low tides which leave the fish air exposed on rock nests.

Professor

Colin Nurse



Cellular and molecular mechanisms of O_2, and CO_2/pH sensing in vertebrates

Laboratory Personnel

Ph.D. students: S. Brown, J. Buttigieg, Nikol Piskuric; *M.Sc. students:* K. Clarke, L. Dookhoo, S. Salman; *Post-doctoral Fellows:* P. Reyes; V. Campanucci; *Lab Manager/ Research Assistant:* Cathy Vollmer; *Research Associate:* Min Zhang.

Research Collaborators

Ernest Cutz (Hospital For Sick Kids); Peter MacLeish & Byron Ford (Morehouse School of Medicine); Alison Holloway (McMaster University), Chris Wood (McMaster University), Ana Campos (McMaster University)

Funding

Canadian Institutes of Health Research (Operating grant), Natural Sciences and Engineering Research Council (Discovery grant), Heart and Stroke Foundation

My laboratory is interested in the cellular and molecular mechanisms by which cells sense changes in oxygen (O_2), CO_2, and pH, and make appropriate physiological responses. For example, we study specialized receptor cells and neurons that respond to low O_2 (hypoxia) by activating a signaling cascade leading to regulation of plasma membrane K^+ channels, and release of neurotransmitters (e.g. catecholamines, ATP, nitric oxide). We combine primary cell culture, patch clamp electrophysiology, Calcium imaging; Confocal immunofluorescence, RT-PCR, Chemiluminescence methods, Western blotting techniques, and Microarrays with the use of cell lines to characterize key components in the signaling pathway. A major focus has been on characterization of O_2, CO_2, and pH sensing in specialized chemoreceptors of the mammalian carotid body (CIHR funded), in nitric oxide-producing autonomic neurons that regulate carotid body function (CIHR funded), and in chromaffin cells of the neonatal adrenal medulla (HSFO funded). We have also characterized an immortalized O_2 -sensitive cell line from the rat adrenal medulla (MAH cells) to aid studies on the role of the mitochondrial electron transport chain in acute oxygen sensing, and on the regulation of gene expression by chronic hypoxia and chronic nicotine (HSFO and NSERC funded). Finally, we are exploring cellular/ molecular O_2-sensing mechanisms in vertebrates from a comparative and evolutionary perspective, by focusing on innervated neuroepithelial cells in gills of water-breathers, e.g. zebrafish and *Xenopus* tadpoles (NSERC funded).

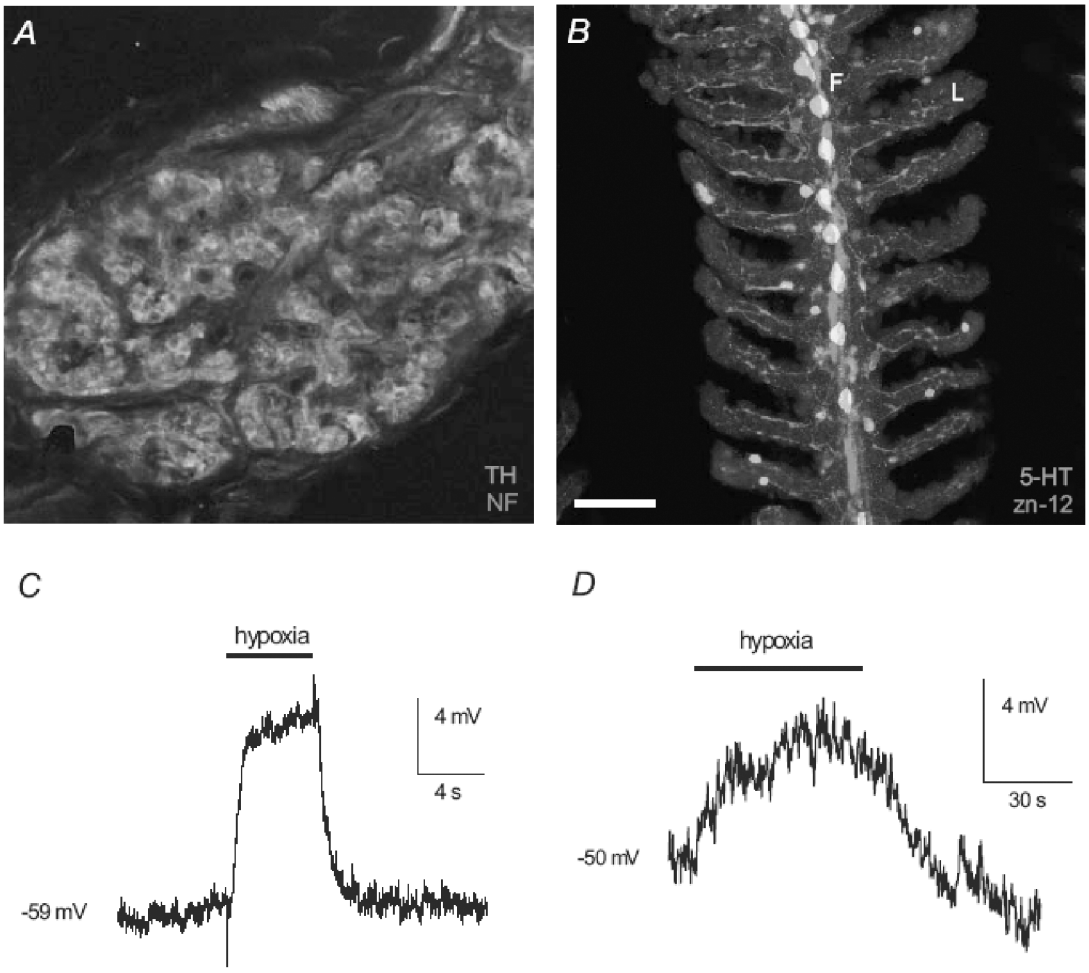
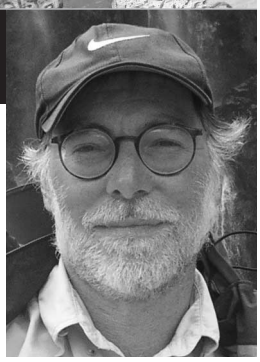


FIGURE: Fluorescence images of O_2 receptors, their innervation, and their physiological response to hypoxia in rat carotid body (A,C) and zebrafish gill (B,D). For colour photo and details see article by Jonz & Nurse *(Physiol. News: 2005).*

Professor

Michael J. O'Donnell



Membrane Physiology of Ion transport and Excretion

Laboratory Personnel

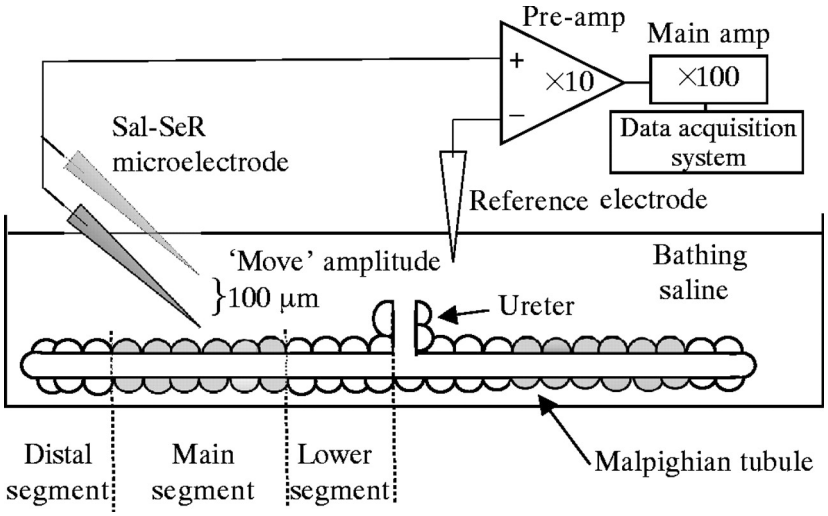
Postdoctoral fellow: Dr. Andrew Donini; *Graduate students:* Esau Ruiz-Sanchez, Sarah Chahine, Erin Leonard, Andrea Kocmarek; *Undergraduate Students: Hons. Thesis:* David Irwin, Alison Fernandes, Melanie Pavlovski, *BioPharm Co-Op student:* Marko Spaic

Funding

Natural Sciences and Engineering Research Council (Discovery grant)

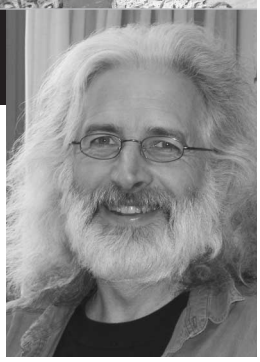
The primary goal of my research program is to elucidate the cellular and molecular mechanisms of excretion and ion transport, particularly by insect epithelia. We study how such processes are controlled by hormones and intracellular second messengers, and how mechanisms for excretion and ion transport are altered in response to changing environmental conditions. Blood feeding insects such as mosquitoes are of enormous importance as vectors of diseases such as malaria, and our studies of physiological mechanisms of ionoregulation and excretion provide insights that we hope will aid development of novel, environmentally-benign insecticides for pest species. Recently we have become fascinated by the ability of insects to rid themselves of toxins. Co-evolution of insects with flowering plants means that many insects are extraordinarily effective at detoxifying synthetic or natural pesticides, and the excretory system plays an important role in elimination of toxins or their metabolites.

My research makes extensive use of electrophysiological methods, including intracellular recording, ion-selective microelectrodes and patch clamping. My students and I develop or adapt specialized micro-techniques for measuring pH or ion concentrations inside or adjacent to epithelial cells, or in nanoliter samples of biological fluids. We have recently developed a method of measuring transport of fluorescent substrates of ion transporters by means of confocal laser scanning microscopy of nanoliter droplets of secreted fluids, and we have used this technique to assess the roles of transporters related to p-glycoproteins and multidrug resistant proteins (MRP) in insect Malpighian (renal) tubules. We are also one of the few labs in Canada to make use of the Scanning Ion Electrode Technique (SIET). Transport of ions into or out of cells perturbs the concentration of ions in the unstirred layer (USL) near the surface of the cell. SIET uses computer-controlled stepper motors to position ion-selective microelectrodes near cells and measure tiny changes (<0.04%) in ion concentration between two positions within the USL. The difference in ion concentration is then used to calculate the rate of ion transport using the Fick equation. In the figure below, the arrangements for recording with Salicylate-selective self-referencing (Sal-SER) microelectrodes from the Malpighian (renal) tubules of insects are shown. These studies help us to understand how animal cells transport ions and potential toxins, including organic anions such as salicylate. We use similar arrangements with different microelectrodes to determine how the toxic metal cadmium is transported.


Pre-amp
Main amp
+
×10
×100
−
Data acquisition system
Sal-SeR microelectrode
Reference electrode
'Move' amplitude
}100 μm
Bathing saline
Ureter
Distal segment
Main segment
Lower segment
Malpighian tubule

Professor

Jim Quinn



Genetic relatedness, parentage and behavioural ecology of colonial and cooperative-breeding birds and anthropogenic induction of germline mutations in gulls and mice

Laboratory Personnel

Post-Doctoral Fellow: Dr. Hammad Khan; *Graduate Students:* Gregory Schmaltz, Megan Barclay, Annika Samuelsen; *Undergraduate Students:* Jason Miller, Fiona Rutka, Raagula Sivayoganathan

Research Collaborators

Dr. Mark Hauber (University of Auckland), Dr. Steve Schoech (Memphis University), Dr. Jonathan Wright (Trondheim University), Dr. Ian Jamieson (Otago University), Dr. Joanne Parrotte (Environment Canada), Dr. Jim Sherry (Environment Canada), Dr. Warren Foster (McMaster University), Dr. Carole Yauk (Health Canada)

Funding

Natural Sciences and Engineering Research Council (Discovery grant), Great Lakes Clean-up Fund, Premier Research Excellence Award, City of Hamilton, City of Burlington, Hamilton Port Authority

Our research has focused on three general areas, cooperative breeding birds, germ-line mutations and anthropogenic pollution, and conservation of colonial waterbirds.

First, we have been trying to understand the complex social system of a communal plural breeding joint-nesting bird, the smooth-billed ani *(Crotophaga ani)*. Progress on that front follows: We have developed microsatellite markers for smooth-billed anis and a species of future research interest – pukeko *(Porphyrio porphyrio)*. In the field we have made significant improvements in techniques and equipment for capturing and video taping anis in Puerto Rico. Recent local studies of colonial nesting waterbirds have allowed the development of techniques for non-destructive sampling and isolation of maternal DNA from the external surface of eggs (Fig. 1). This latter method, which appears effective for ani maternal genotyping, will represent an important advance in field studies as it limits the need to sample the mother directly and it increases the statistical power of identifying the father by allowing a focus on specifically paternal alleles.

We have extracted DNA samples from several hundred ani adults and chicks from 45 territories over the past 9 years. Many of these have been genotyped with 5 microsatellite loci using ^{33}P labelled primers. Preliminary analyses have revealed that a) both sexes have extra-pair fertilizations and b) young from most groups disperse to join other groups. Most groups (N = 13) examined were unrelated adults (10% of within-group dyads are related) while two groups had many more related dyads (about 30 to 66.7% of within-group dyads related), suggesting that offspring in these two groups had not dispersed.

In 40 communal nests analyzed, we found that 56% of all eggs laid ended up buried or tossed. We found that early laid eggs in a clutch were at very high risk of being tossed or buried. As a result, the number of eggs incubated per capita significantly decreased with increasing group size. Because of intense competition during egg-laying in anis, we expect females to adjust their laying behavior to advantage their offspring. Results suggest that females do so in different ways. First, we found that as female group size increases, females lay more eggs per capita. Second, we found that females deposit more testosterone and corticosterone in late-laid eggs Vs early laid eggs. Because of burial and tossing, eggs laid later are more likely to hatch. Females therefore seem to adjust testosterone concentrations in eggs depending on the probability of a given egg to hatch.

Ongoing work addresses smooth-billed ani mate choice. We will compare the condition and quality of a female's social mate to her extra-pair mate to learn what male characteristics are important in female mate choice. Several quality indices will be analyzed: dominance, ectooparasite and endoparasite loads (about 30 samples from males), UV reflectance off feathers (about 140 samples), and morphometric measurements such as max-bill depth and size (about 130 males measured).

Novel field methods for pukeko studies have already been worked out. We have established three microsatellite markers that will facilitate rapid genotyping of eggs and adults in some pukeko groups. I have established an important collaborative relationship with Dr. Mark Hauber at University of Auckland that will facilitate field studies of pukeko north of Auckland, New Zealand. This project is the main objective of my sabbatical visit planned for August 2008.

In a second area of research we followed up on our previous findings that air pollution can induce mutations and that the particulate component is responsible. This work was accomplished through experimental exposure of lab mice in to air pollution in "mouse hotels" located downwind of Hamilton's industrial core compared with those housed 35 km north on a non-polluted reference site. This work has led to prominent and important publications in PNAS and *Science* showing that germ-line tandem repeat DNA mutations in gulls and mice are related to particulate air pollution associated with heavy industry and diesel exhaust. I hope that demonstrations such as these will lead to reductions in pollution-inducing urban sprawl and a tightening of restrictions on the release by industry and traffic of particulate air pollution that has already been implicated in deadly cardiac and respiratory disorders.

The third area of research involves monitoring and managing colonial nesting waterbirds. Our latest efforts to protect herring gull *(Larus argentatus)* nesting habitat from double-crested cormorants *(Phalacrocorax auritus)* involved the use of two singing, dancing, motion detector-driven battery-powered Santas. These robotic figures were placed in the herring gull colonies that were under threat from nesting cormorants. Cormorants, being very frightened by humans, were scared from the colony sites. This allowed herring gulls, a species that is in decline in the harbour, to have access to breeding habitat and to successfully raised young.

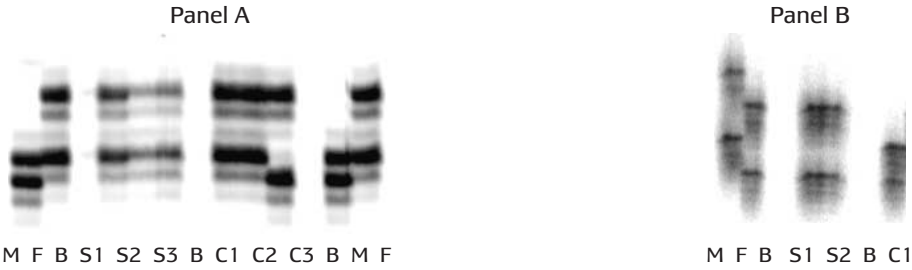
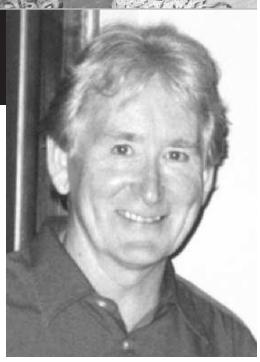


FIGURE: Representative microsatellite patterns at two different loci for two herring gull families (nest 123 at locus LARZAP12 for panel A and nest 193 at locus LARZAP14 for panel B). For clarity, we loaded the two adults in consecutive lanes (M for male and F for female), left a blank lane (B), loaded the swabs (S1 for swab a, S2 for swab b, and S3 for swab c), followed by another blank lane, and finally the chicks (C1 for chick A, C2 for chick B, and C3 for chick C). As swab bands tended to be fainter than adult or chick bands, we loaded 1.5µl of PCR products in the adult and chick wells, and 2.5ml in the swab lanes for these two figures.

Professor Andrew J. Rainbow



Molecular mechanisms for DNA repair in mammalian cells and their role in human disease using viruses as probes

Laboratory Personnel

Research Assistant: Natalie Zacal; *Graduate students:* Diana Dregoesc, Prachi Sharma, Shari Yasin and Derrik Leach

Research Collaborators

Dr. Jaime Angulo (Institut de Radiobiologie Cellulaire et Moléculaire, Commissariat L'Energie Atomique), Dr. Girish Shah (Laval University), Dr. Gurmit Singh (Juravinski Cancer Centre), Dr. Xu-Dong Zhu (McMaster University)

Funding

National Cancer Institute of Canada, Ontario Cancer Research Network

Many cancer causing agents act by damaging DNA. Normally, cells can repair damaged DNA, but if repair mechanisms are absent or abnormal, a cell with damaged DNA may die or become cancerous. For example, the majority of xeroderma pigmentosum (XP) patients are deficient in nucleotide excision repair (NER) which repairs a type of DNA damage induced by ultraviolet light and the incidence of sunlight-induced skin cancer in these patients' approaches 100%. In this way DNA repair plays a major role in protection from cancer. Our research objective is to understand the role of DNA damage and DNA repair in the induction of human cancer as well as to improve protocols for radiation therapy and chemotherapy of cancer.

Our research uses cell culture, recombinant DNA techniques and viruses as probes and expression vectors to examine DNA damage induced by ionizing radiation, ultraviolet light, cisplatin and other cytotoxic agents and the repair of this damage in several different mammalian cell types. DNA damage and DNA repair play an important role in the response of tumour cells to radiation therapy and chemotherapy. Our approach uses a human adenovirus as a probe for DNA repair. This allows us to examine repair of the viral DNA in untreated as well as UV-treated cells using a technique called "host cell reactivation" and therefore determine whether repair pathways are inducible. The inducible responses are expected to be of considerable importance in the prevention of human cancer, especially skin cancer. In our research we are also examining the response to DNA damaging and other cytotoxic agents of tumor cell lines with an altered response to radiation, chemotherapeutic agents and/or photodynamic therapy (PDT) treatment. The information we gain from these studies is expected to lead to new approaches which reduce the detrimental effects of DNA damaging agents in the environment and help in the management of individuals at high risk for carcinogen induced malignancy. Such knowledge will also be used to improve protocols for radiation therapy, chemotherapy and photodynamic therapy (PDT) of cancer.

Ultraviolet light is made up of several different wavelengths from UVA to UVB to UVC and each of these parts of the UV spectrum can produce a different type of DNA damage. UVC results in DNA damage that removed by NER. In contrast, UVA produces a large amount of oxidative DNA damage that is repaired by base excision repair (BER). In recent years a major finding of our laboratory is that pre-treatment of normal human skin cells with low exposure to UVC light or heat shock enhances the repair of UVC-induced DNA damage, indicating an inducible NER response in human. NER has two sub-pathways: transcription coupled repair (TCR) that preferentially repairs lesions in the transcribed strand of active genes and global genomic repair (GGR) that repairs the non-transcribed transcribed strand of active genes and inactive regions of the genome. We have examined which genes are required for this induced NER and show that some aspects of induced NER are dependent on p53 a well known

"tumor suppressor" gene. In recent work we report that increased expression of p53 alone can enhance both the TCR and GGR sub-pathways of NER (Dregoesc et al. 2007, DNA Repair, 6, 588-601). In collaboration with other groups we have examined the role of several other genes associated with NER, including XPF and TRF2 (Wu et al. 2007, DNA Repair, 6, 157-166), poly(ADP-ribose) polymerase-1 (Ghodgaonkar et al. 2008, DNA Repair, in press) and the XPC associated genes hHR23A and hHR23B (Rainbow and Angulo 2008, in preparation).

We are currently examining BER of oxidative damage induced by UVA and other oxidizing agents in order to determine the genes involved in this repair process and to determine whether BER is inducible also. In the past year we have reported that BER of oxidative damage is deficient in XP patients with a mutation in the XPC gene as well as in human cells deficient in the mismatch repair gene hMSH2 (a deficiency common in patients with hereditary non-polyposis colorectal cancers) (Kassam and Rainbow 2007, Biochem. Biophys. Res. Commun., 359, 1004-1009; Pitsikas et al. 2007, Mutagenesis, 22, 235-243). We find also that BER can be induced by pre-treatment of cells with UVC. Since cancer cells are often in a hypoxic environment in the tumor, we are examining the effect of hypoxia on repair of DNA damage. Preliminary results of the past year indicate hypoxia can influence the repair of DNA damage induced by UVC or cisplatin and thus may contribute the clinical outcome of radiotherapy and chemotherapy.

It has been suggested that combination treatment of high dose rate (HDR) intraluminal brachytherapy and photodynamic therapy (PDT) in non-small cell lung cancer (NSCLC) may improve the efficacy of treatment, reduce the toxicity and improve quality of life for patients. To provide a cellular basis for this approach we have examined the in vitro sensitivity of normal lung fibroblasts and NSCLC cells following HDR radiation, PDT and combined HDR radiation and PDT. Our results suggest that by using the combined treatment an equivalent tumour cell kill in vivo may be possible at reduced systemic effects to patients (Sharma et al. 2008, in preparation). One of our approaches to examine the mechanisms of PDT is by inducing and selecting PDT-resistant cell variants and determining alterations in gene expression that lead to resistance. We have generated several photosensitizer specific PDT resistant cell variants of HT29 human colon adenocarcinoma cells and recently reported that these cells show cross-resistance to UVA but not UVC (Zacal and Rainbow, 2007).

Professor

C. David Rollo

Regulatory Intregration: From evolutionary ecology to gene transcription

Laboratory Personnel

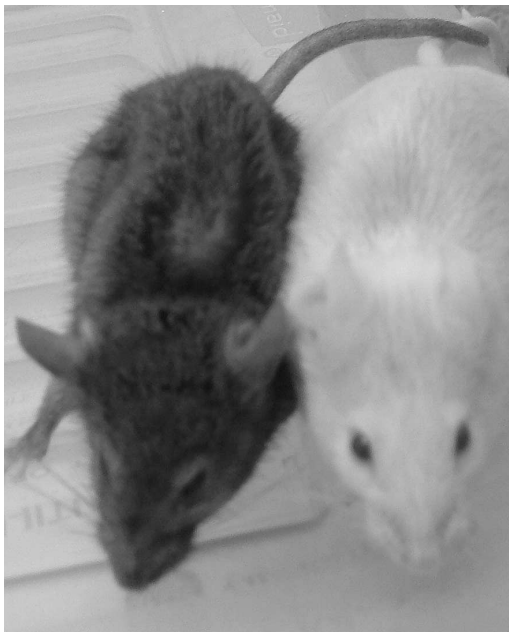
Ph.D. student: Vadim Aksenov; *M.Sc. student:* Janice Lynn; *Undergraduate Students:* Adrienne Borrie, Magda Choruzy, Donna Degeer, Alvin Leung, Mezhgan Hekimi, Sonali Lokuge, Erin Bourns, Sara Chauhan, Janet Yu, Caitlan Mroz, Cindy Richardson, Wida Naikkhwah

Research Collaborators

Jiankang Liu (University of California), Henry Szechtman (McMaster University), Boris Sakic (McMaster University), Douglas Boreham (McMaster University), Carmel Mothersill (McMaster University), Jennifer Lemon (McMaster University), Jack Rosenfeld (McMaster University), Biomarker Pharmaceuticals, Jane Foster (St. Josephs Hospital)

Funding

Natural Sciences and Engineering Research Council (Discovery grant)



Our research evaluates tradeoffs among system-level organismal functions (Evolutionary Ecology), how the adaptive allocation program is coordinated (Evo-Devo and Integrative Physiology) and how decisions are transmitted via cellular transduction signalling to tissue-specific functions and gene regulation (Cell and Molecular Biology). Models include various transgenic and mutant mice. We are also developing a cricket model for gerontological research. Size and growth rate most strongly determine other attributes of form and function so transgenic growth hormone mice (TGM) are ideal subjects. What are the impacts (tradeoffs) among other functions for a mouse that grows to double mature sizes at twice normal rates?

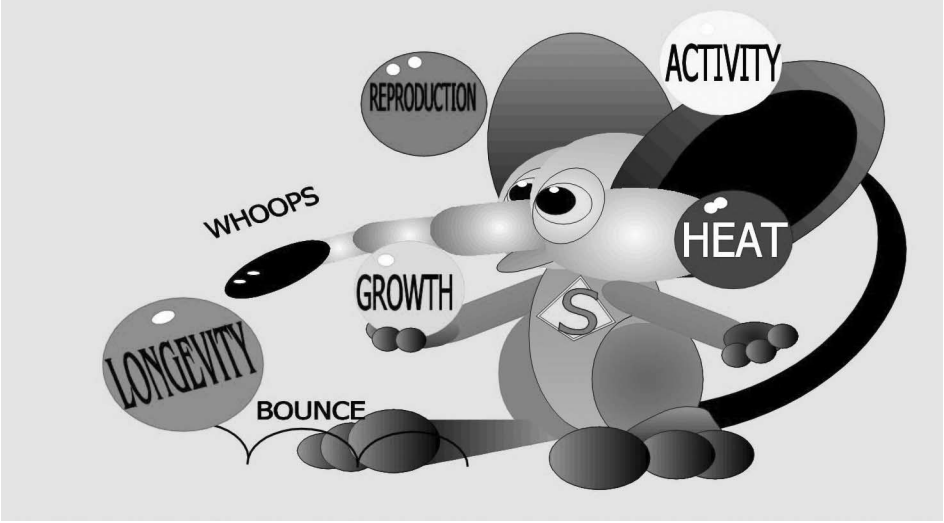
At the forefront of current interest is the fact that TGM express accelerated aging (Gerontology) associated with elevated free radical processes. This makes them excellent models for studying both aging and radiation biology. TGM have enhanced youthful learning, but subsequent drastic deterioration of cognition and brain (Psychology, Neuroscience). They sleep excessively, a feature we found was ameliorated by energy supplements.

We developed a theory of regulatory organization suggesting that anabolic and catabolic functions are temporally separated between sleeping (GH axis) and waking (stress hormone axis). TGM expressed greatly increased growth efficiency that involves diversion of energy from thermogenesis and locomotion. Alterations in mitochondrial metabolism are suggested. My meta-analysis (n = 796) of intra-specific longevity demonstrated that longevity declined with increasing size in both mice and rats. We designed an “anti-aging” dietary supplement that significantly increased longevity of TGM and normal mice. The mice illustrated are siblings of the same age. The

aged mouse on the left is untreated. The mouse on the right received the supplement.

Based on evidence that sleep synergizes memory we tested TGM and showed that they learn a complex maze at double normal rates when young but these abilities rapidly decline with age.

Remarkably, the supplement completely preserved youthfully enhanced cognition. TGM have larger youthful brains but their cognitive decline traces to loss of > 50% of their brain cells (similar to Alzheimer's). The supplement completely prevented this loss of brain cells. We are currently examining major mechanisms associated with aging and associated pathologies (insulin resistance, free radical, antioxidants, inflammation, mitochondrial functioning, membrane integrity, NADPH oxidases, cancer, ion channels and stem cells).



Professor

Herb E. Schellhorn

The regulation of stress genes in *Escherichia coli*

Laboratory Personnel

M.Sc. Students: Sarah Chiang, Tao Dong, Daniel Gyewu, Charlie Joyce, Daniel Li, Thuraya Shaban, Mirella Younes; *Undergraduate students:* Ali Lessan, Eva Diakun, Nicole Stieber

Funding

Canadian Institutes of Health Research (Operating grant), Natural Sciences and Engineering Research Council (Discovery grant)

My laboratory examines how bacteria adapt to suboptimal growth conditions by turning on expression of specific sets of genes. Recent advances in genome sequence information, bacterial chromosome modification and gene expression detection technology permit new approaches in out ongoing studies. Using microarray and gene fusion technology, we have demonstrated that many (~250) genes are controlled by RpoS, a primary regulator of adaptive genes in *Escherichia coli,* a bacterium that has long served as a model for regulation and metabolism. Because RpoS is a conserved regulator (found in many bacteria…) and has been implicated in human, animal and plant disease processes, understanding the signals that activate this regulator will further our understanding of bacterium/host interaction. A second project in my laboratory, as described below, examines the role of vitamin C metabolism in mammals.

RpoS-regulated genes and RpoS regulation in *Escherichia coli*

Sarah Chiang, Daniel Gyewu, Mirella Younes, Eva Diakun, Nicole Stieber

We have recently reported the culmination of an extended project in my lab to identify members of the RpoS regulon by a genetic screen that is based upon the differential levels of expression of β-galactosidase expression in wild type and RpoS mutant strains. In the course of this work, we identified, by phage isolation DNA sequencing, over 100 operon fusions that depend on the RpoS sigma factor for expression. Because many of the independent genes identified are members of operons, about 120 genes were found in total and further, since the mutant library we used was estimated to have hits to about half the genes in *E. coli,* the size of the RpoS regulon is likely ~200 genes, the number that is in fairly close agreement with the 200+ genes that we have found by microarray analysis (Patten et al. 2004).

Manipulation of RpoS levels itself may contribute to our understanding of which genes depend on RpoS directly for expression (as opposed to be indirectly controlled through an intermediate regulator). To directly alter cellular levels of RpoS, we have generated constructs that either over express (Chen and Schellhorn, 2003) or attenuate cellular levels of RpoS (Chen et al, 2003). Interestingly, mutations in the *rpoS* gene can be selected (and reverted) under specific conditions which has led us to propose that such mutations may function as a molecular switch to modulate expression of the large RpoS regulon.

Physiological Role(s) of RpoS regulated genes

Tao Dong,

As RpoS controls many seemingly-unrelated metabolic functions, understanding the individual physiological function of each gene is necessary to understand the adaptive process. Catalase regulation (Dong), phosphate utilization (Dong) GABA utilization and regulation of genes of unknown function (Choi, Hughes) are being actively examined using common technologies (gene knockout, gene complementation, enzyme assays and gene expression detection). We are also using mass spectrometry (chemical biology) to identify subtle changes in metabolite pools in bacterial strains carrying defined mutations.

Vitamin C metabolism

Daniel Li, Thuraya Shaban

Humans (and other primates) are unusual mammals because we lack a key enzyme required for the synthesis of vitamin C. The endogenous human gulonolactone oxidase gene is defective--having been inactivated by mutation about 40 million years ago. Since vitamin C is essential for life, why did we lose this function? To examine this, we cloned murine gulonolactone oxidase gene from a mouse liver cDNA library and used this to construct an adenovirus vector that can express the gulonolactone oxidase activity in human cells (Ha et al, 2004). This adenovirus vector should be useful in pre-clinical gene therapy to examine the role of endogenous vitamin C synthesis in antioxidant physiology of mammals that lack the enzyme (i.e. humans and guinea pigs). Vitamin C is of topical interest, not just because of its importance as an antioxidant, but because of recent findings that it may stimulate embryonic stem cell differentiation and that high affinity transport of this vitamin into essential for post-natal development (mouse models lacking the high affinity transporter die at birth).

Selected Publications

Dong T, C. Joyce and H.E. Schellhorn. 2007. The Role of RpoS in Bacterial Adaptation. In Bacterial Physiology-A Molecular Approach. Walid M. El-Sharoud (ed.) Springer, Heidelberg.

Li, Y.D., and H.E. Schellhorn. 2007. New Developments and Novel Therapeutic Perspectives for Vitamin C in Research and Nutrition. Journal of Nutrition ;137(10):2171-84.

Li, Y.D., and H.E. Schellhorn. 2006. Can age-related degenerative diseases be ameliorated by administration of vitamin C at pharmacological levels? Medical Hypotheses 68(6):1315-7.

Professor

Rama S. Singh

Population and evolutionary genetics, molecular evolution and speciation

Laboratory Personnel

Postdoctoral Fellows: Dr. Wilfried Haerty; *Ph.D.:* Carlo Artieri, Abha Ahuja

Funding

Natural Sciences and Engineering Research Council (Discovery grant)

In the past two decades, our laboratory has been focusing on understanding the rapid evolution of Sex and Reproduction Related (SRR) traits and genes, and how they may be implicated in speciation. We have used Drosophilid, Cenorhabditid, and Mammalian models in our investigations to elucidate and understand the mechanisms underlying hybrid sterility and reproductive isolation. In addition to studying their potential role in speciation, we are also interested in several other aspects involving SRR genes such as (1) the similarities and differences in the patterns of evolution of these genes in males and females, (2) investigating whether interacting SRR genes from males and females evolve through co-evolution, (3) understanding the dynamics of how sexual selection may shape the evolution of SRRs, and (4) investigating the evolution of the patterns of expression of these genes in both Drosophilids and Caenorhabditids.

The Genetic Architecture of Hybrid Sterility

One major lines of research that our lab has focused on is elucidating and understanding the genetic basis Haldane's rule and the genetic architecture of hybrid sterility. Previous approaches to this problem that our group has pursued involved the transfer of genetic material (genes, chromosomes) from one species to another, through which we identified specific regions of chromosomes as well as a number of genes that may be involved in fertility breakdown in hybrids. This line of investigation is now being pursued at the gene expression level using high-resolution microarray technology, coupled to comparative genomics, to study the architecture of breakdown in gene expression in *Drosophila* hybrids. We have now categorized genes that are commonly misexpressed in all species of the *Drosophila melanogaster* clade; an important piece of information essential to our understanding of the functional basis of hybrid sterility. Our next step is to characterize the expression patterns of genes over the course of development of several species of the *D. melanogaster* subgroup as well as their hybrids. We are interested in the following questions: a) Are the patterns of genes expressed at earlier stages of development more conserved between species than those expressed in later stages? And b) do the patterns of misexpression of parental genes observed in hybrids occur at all stages of development, or does the misexpression of a few key regulatory genes early in development lead to a cascading effect such that progressively larger fractions of the transcriptome become misexpressed over the course of development?

Faster Evolution of Sex and Reproduction Related Genes

Another major line of investigation of our laboratory is the comparative and functional analysis of Rapidly Evolving Genes (REGs) and how rapid evolution is involved in the process of speciation. We have been on the leading front of this area of research, showing that a) SRR proteins are evolving faster than non-SRRs, b) the reproductive systems have a higher proportion of REGs compared to non reproductive systems, and c) we now have results suggesting that sex-specific proteins compared between very closely related species may have experienced accelerated evolutionary rates during or very near to the process of speciation. More recently, we have shown that there is a positive correlation between rapid evolution of genes at the protein and expression levels between species as well as the degree to which these genes are misregulated in interspecific hybrids (Figure 1). We have also demonstrated a

link between the strength of sexual selection within an organism and the acceleration of its male SRR genes relative to other gene categories through comparison of sexual vs. hermatphroditic species of *Caenorhabditis.* Presently, our lab is investigating how the timing of expression over the course *Drosophila* development plays a role in affecting the evolutionary rates of SRR and non-SRR genes, as the opportunity for sexual selection occurs during sexual maturity in the adult stage.

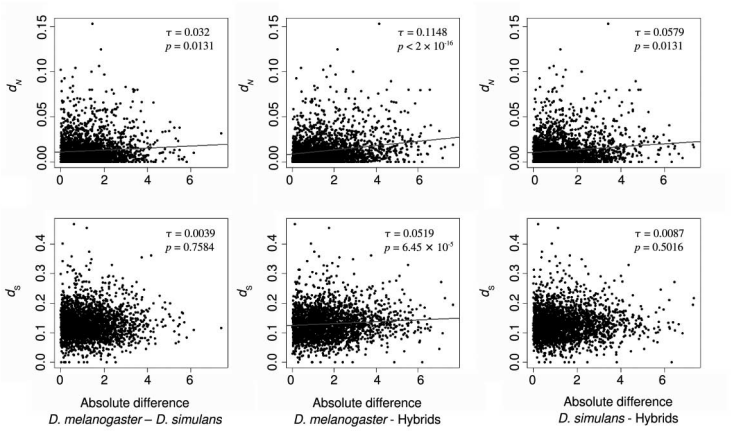


FIGURE 1: Relationship between sequence divergence (d_N, d_S) and absolute gene expression difference between *D. melanogaster* and *D. simulans* species and between parental species and hybrids. Kendall rank sum coefficients of correlation (…) and *p*-values are shown in each frame.

Genetic architecture of variation in male sex comb bristle number

We are also investigating the role of rapidly evolving sexual traits in the phenomenon of speciation. The male sex combs of *Drosophila,* an array of specialized bristles on the foreleg, exhibit high intra- and interspecific variation in morphology. Bristle number has been shown previously to have varying effects on female preferences in different species, making these a model trait for studies of sexual trait variation and their role in reproductive isolation. We conducted long term artificial selection for extremely high and low sex comb bristle numbers in *D. melanogaster* and developed two replicates of highly inbred, genetically divergent lines (Figure 2). These lines will now be used to characterize the molecular genetic basis, functional significance and evolutionary dynamics of the sex comb bristle number variation in *Drosophila.*

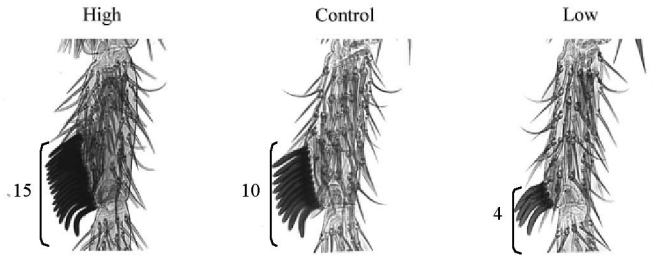
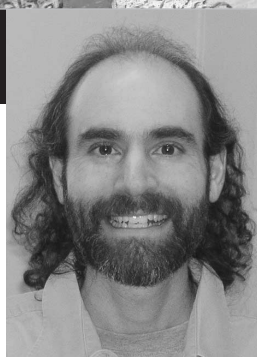


FIGURE 2: Forelegs of males showing sex comb from High, Control and Low lines of *D. melanogaster* after 24 generations of artificial selection. Sex Comb bristle number is indicated in the lower left corner.

Assistant Professor

Jonathan Stone



Computational Biology conducted at multiple heirarchical levels

Laboratory Personnel

Ph.D. student: Maria Abou Chakra; *M.Sc. student:* Alexandra Pontefract; *Undergraduate Students:* Carmen Cheung, Kyle D'Arcey, Alicia DiBattista, Iain Hall, Nina Kirischian, Andrea Lam, Maggie McRea, Amit Mistry, Will Moniz, Irene Nicholaou, Reena Patel, Jimmy Turner.

Research Collaborators

Mats Björklund (Uppsala University), Brian Hall, (Dalhousie University), Greg Wray, (Duke University)

Funding

Natural Sciences and Engineering Research Council (Discovery grant), Canadian Foundation for Innovation (Infrastructure grant), Ontario Innovation Trust (Infrastructure grant)

Projects involving search algorithms for DNA sequence motifs, genetic analyses performed on evidence for legal trials, positive selection measures, gene regulation evolution, extremophile astrobiology, umbilical cord properties, skeleton development and evolution, population breeding structure, leg-lifting in territory marking mammals, phylogenetic correlation studies, and complexity theory were advanced.

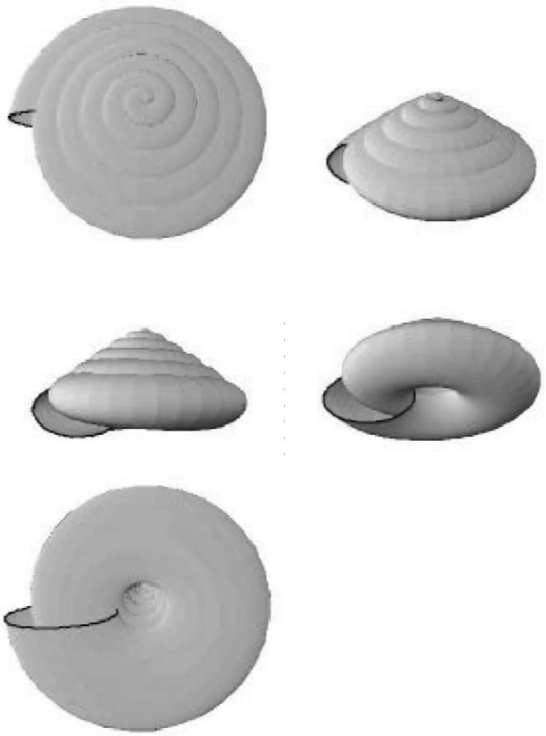


FIGURE: Computer-simulated sundial snail shell observed from different orientations

Professor

Elizabeth Weretilnyk

Plant abiotic stress tolerance; Metabolomics; Environmental Genomics; Chemical Biology

Laboratory Personnel

Ph.D. students: Michael BeGora, David Guevara; *M.Sc. students:* Mitchell McLeod, Amber Gleason, Ashley Tattersall

Research Collaborators

G. Brian Golding (McMaster University), Peter Summers (McMaster University), Brian McCarry (McMaster University), Barbara Moffatt (University of Waterloo), Gordon Gray (University of Saskatchewan)

Funding

Natural Sciences and Engineering Research Council (Discovery grant), NSERC/AAFC Industrial Partner Support Program/PerformancePlants

My program is directed towards identifying environmental stress tolerance traits in plants using physiological, biochemical, and functional genomic approaches. The molecular basis underlying tolerance traits in plants is complex and our understanding of how plants survive (and even thrive) in adverse environments is very incomplete. We are also using metabolomics approaches to help identify functions of uncharacterized gene products in plants.

With respect to plant abiotic stress, we have focused on two research objectives: 1) To examine the synthesis and accumulation of the compatible solute glycine betaine by plants subjected to osmotic stress. Our recent work has been on characterizing enzymes involved in choline synthesis using gene products cloned from *Arabidopsis thaliana* and 2) In collaboration with G.B. Golding and B. McCarry (Chemistry, McMaster) and G. Gray and B.A. Moffatt (Saskatchewan and Waterloo, respectively), we are studying a highly stress tolerant native plant, *Thellungiella salsuginea.* This plant is a member of the Crucifer family that is closely related to the genetic model plant Arabidopsis and canola which is Canada's most important oilseed crop. In contrast to Arabidopsis, Thellungiella shows an exceptional capacity to withstand adverse environmental conditions. Thellungiella endures freezing temperatures, semiarid conditions and grows on saline and alkaline soils of the Yukon. We have been able to use and benefit greatly from the abundant genetic resources developed for research on Arabidopsis for our studies of stress tolerance in its extremophile relative. *(Dave Guevara and Ashley Tattersall)*

Choline is a precursor for glycine betaine in all multicellular plants studied to date. Despite the ubiquitous nature of choline, not all of the genes encoding enzymes responsible for its synthesis have been identified from plants (or non-plants). We used functional complementation of a choline-requiring yeast mutant to clone genes involved in choline metabolism. At least two enzymes that rescue the yeast mutant are S-adenosylmethionine-dependent methyltransferases. Comparisons of the biochemical properties of these enzymes can identify how their activities contribute to plant growth under non-stress conditions and whether changes in their properties are required to accommodate glycine betaine accumulation under stress. *(Michael BeGora, Mitch McLeod and Amber Gleason)*

Using controlled environment chambers Thellungiella was subjected to increasing salinity, to drought imposed by withholding water and during recovery of the plant when watering is resumed following drought. However, it is impossible to replicate field conditions in growth cabinets so our studies have been supplemented using plants growing in field sites in the Yukon. In all cases, plant tissues were harvested and RNA extracted to generate cDNA libraries and perform microarray analyses (under the direction of our collaborators at Waterloo). In our lab,

metabolome profiles of well-watered and stressed plants have been obtained by gas chromatography/mass spectrometry and are being analyzed to identify metabolic phenotypes associated with stress tolerance. Information from these profiles will complement and add value to the information arising from our ongoing physiological and genomics studies with this plant. By all criteria, the physiological data indicates that Thellungiella is extremely drought and salt tolerant and we believe that this plant is as an excellent physiological and genetic model for future studies in plant tolerance to environmental stress. *(Dave Guevara, Ashley Tattersall, Peter Summers and Jeff Dedrick, MSc 2007)*

Thellungiella grows on highly alkaline salt flats in the Yukon. Plants were harvested from a number of field sites for transcriptome and metabolome analysis by researchers at McMaster and Waterloo.

Photo by J. Dedrick

Assistant Professor

Joanna Wilson

Cytcohrome P450 enzymes in vertebrates, aquatic toxicology

Laboratory Personnel

M.Sc. Students: Marcus Scornaienchi, Emily Smith; *Undergraduate Students:* Birgit Krattenmacher, Stefanie Sardellitti, Farhana Alam, Eric Hirsch, Caroline Jesuthesan

Research Collaborators

Dr. S. Balshine (McMaster University), Dr. D. Nelson (University of Tennessee), Dr. C. Metcalfe (Trent University), Dr. J. Parrot (CCIW), Dr. G. Van der Kraak (Guelph University), Dr. T. Moon (University of Ottawa), Dr. V. Trudeau (University of Ottawa), Dr. M. Servos (University of Waterloo).

Funding

Natural Sciences and Engineering Research Council (Discovery grant), Natural Sciences and Engineering Research Council (Strategic Project grant), Natural Sciences and Engineering Research Council (Research Tools and Instruments grant), Canadian Water Network/Best in Science (MOE), Canada Foundation for Innovation/Ontario Innovation Trust (Infrastructure grant)

Cytochrome P450 enzymes are members of a very large protein superfamily responsible for production of important biomolecules (e.g. steroid hormones) and metabolism of endogenous and exogenous compounds including environmental contaminants. While the function and role of cytochrome P450 (CYP) enzymes in mammals has been well studied, in aquatic species such as fish, the function of these enzymes is less clear. The completion of the fugu and zebrafish genomes has identified novel CYP genes that are not found or quite divergent from those found in mammals. Our research is aimed at understanding the evolution, function and toxicological relevance of CYP enzymes. Our lab is particularly interested in the role of CYPs in metabolism and toxicity of endocrine disruptors and pharmaceuticals in aquatic ecosystems.

The CYP1 family contains genes divided into several sub-families: CYP1A and CYP1B genes are common across vertebrates while CYP1C and 1D subfamily members are found in at least some non-mammalian vertebrates including fish. The expression of CYP1 genes is induced by common environmental contaminants such as polycyclic aromatic hydrocarbons and polychlorinated biphenyls. They have an overlapping role in metabolism of estrogens and environmental contaminants in mammals. Current studies in our lab are examining the function of the fish CYP1 enzymes including their ability to metabolize estradiol.

The CYP2 family is important for drug metabolism in mammals. Sequences in fish are quite diverse from mammals and the function of CYP2s in fish is far less clear. We are examining the evolution and function of CYP2s in fish with a particular focus on drug metabolism. Current studies include the annotation of CYP2s in medaka and stickleback genomes and functional studies involving the metabolism of and CYP inhibition by fluoxetine (marketed as Prozac), a common pharmaceutical found in wastewater effluent.

Our studies of environmental toxicology and CYP function in fish make use of several species. In particular, we use the zebrafish *(Danio rerio)* and rainbow trout *(Oncorhynchus mykiss)* as model fish species. We are also using the round goby *(Neogobius melanostomus),* an invasive fish species that is important for the Great Lakes region.

F.R.S.C. / Distinguished University Professor
Canada Research Chair in Environment and Health

Chris Wood

The Physiology of Transport Processes and Metabolism, and the Aquatic Toxicology of Metals in Fish and Crustaceans

Laboratory Personnel

Postdoctoral Fellows: Dr. Jasim Chowdhury, Dr. Tania Ng, Dr. Li Zhang, Dr. Derek Alsop, Dr. Matilde de Francesco Dr. Reehan Mirza (joint with Dr. G. Pyle); *Ph.D. Students:* Michele Nawata, Carol Bucking, Joel Klinck, John Fitzpatrick (joint with Dr. Sigal Balshine); *M.Sc. Students:* Fathima Iftikar; *Visiting Researchers:* Dr. Pierre Laurent, Claudine Chevalier; *Technicians:* Linda Diao, Sunita Nadella

Research Collaborators

Dr Grant McClelland (McMaster University), Dr. Pat Chow-Fraser (McMaster University), Dr. Mike O'Donnell (McMaster University), Dr. Colin Nurse (McMaster University), Dr. Sigal Balshine (McMaster University), Dr. Carmel Mothersill (McMaster University), Dr. Colin Seymour (McMaster University), Dr Martin Grosell (University of Miami), Dr. Yuxiang Wang (Queens University), Dr. Colin Brauner (University of British Columbia), Dr. Jeff Richards (University of British Columbia), Dr. Patricia Schulte (University of British Columbia), Dr. Tony Farrell (University of British Columbia), Dr. Pat Wright (University of Guelph), Dr. Jim Ballantyne (University of Guelph), Dr. Michael Wilkie (Wilfrid Laurier University), Dr. Jim McGeer (Wilfrid Laurier University), Dr. Scott Smith (Wilfrid Laurier University), Dr. Greg Pyle (Nipissing University), Dr. Ora Johannsson (DFO, Burlington), Dr. Alex Ip (University of Singapore), Dr. Kath Sloman (Plymouth University), Dr Bernardo Baldisserrotto (Brazil), Dr. Adalto Bianchini (Brazil), Dr. Adalberto LuisVal (Brazil), Dr. Sue Clearwater (NIWA), Dr. Jonathan Wilson (University of Oporto), Dr. Gudrun DeBoeck (Universty of Antwerp), Dr. Pat Walsh (University of Ottawa), Dr. Chris Glover (Scion Research), Dr. Fern Galvez (University of Louisiana).

Funding

Natural Sciences and Engineering Research Council (Discovery grant), Natural Sciences and Engineering Research Council (CRD grant), Natural Sciences and Engineering Research Council (Strategic grant), Natural Sciences and Engineering Research Council (Metals in the Human Environment Strategic Research Network), International Copper Association, Copper Development Association, Nickel Producers Environmental Research Association, International Lead-Zinc Research Organization , International Zinc Association, Xstrata, Teck Cominco, & Inco, Canada Research Chair Program

Our lab studies the basic mechanisms by which ions, nutrients, respiratory gases metabolic wastes, and acid-base equivalents are transported across environmental and internal surfaces in fish and crustaceans, and how these processes are impacted by environmental stressors. In our applied research program, the stressors of interest are waterborne and dietary metals, and our goal is to use data on physiological responses to develop models that can be used to generate more protective and cost-effective environmental regulations for metals. While our starting point is always basic mechanistic physiology, we use tools of molecular biology, proteomics, cell biology, organismic physiology, behavioral analysis, field studies, geochemistry, and modeling to address these questions.

A selection of ongoing projects in the laboratory is listed below:

(i) The role of the gastrointestinal system in ion and acid-base regulation in freshwater and marine fish, and the impact of feeding on systemic physiology.

(ii) The mechanisms by which dietary metals (Cu, Zn, Ni, Cd, Pb, & Ag) are transported by the gastrointestinal tracts of freshwater fish, and the protective actions of naturally occurring cations (Ca, Na)

(iii) Urea transport, ion and water balance, metabolism and cocoon function in aestivating lungfish

(iv) Ion and metal transport by reconstructed gill epithelia in primary culture in vivo

(v) The impact of feeding on urea and salt metabolism in ureo-osmotic elasmobranchs, and the role of the rectal gland in homeostasis

(vi) The impact of chronic waterborne and dietary metal exposure on olfaction and on behavioral responses to intraspecific chemical signals in fish

(vii) Ammonia transport processes in the freshwater fish gill

(viii) Metal uptake and depuration in daphnia and chironomids

(ix) Proteomic and molecular analysis of ionoregulatory proteins in the fish gill

(x) Analysis of the mechanism(s) by which natural organic matter ("NOM, DOC") alters the electrical and ion transporting properties of fish and daphnia gills, and its relationship to NOM composition.

(xi) Development of "Biotic Ligand Models" to predict water quality criteria that are protective against acute and chronic metal toxicity to a range of different fish and invertebrate species. Fig. 1 below illustrates one such model.

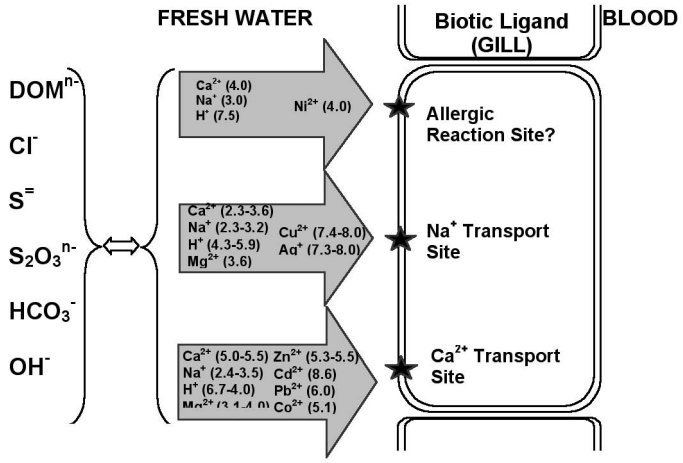


FIGURE: A Biotic Ligand Model showing the binding strengths (log K values) of various metals to the physiological sites of toxicity in the gills of freshwater rainbow trout *(Oncorhynchus mykiss)*. Log K values for competitive, protective binding by certain naturally occurring cations are also shown.

Associate Professor

J. P. Xu

Molecular Ecology and Evolutionary Genetics of Microorganisms

Lab Personnel

Postdoctoral Fellow: Timothy James; *Ph.D. Students:* Sheng Sun,Sanjay Hiremath; *M.Sc. Student:* Mochan Li, *Undergraduate Students:* Jessica Graham, Paul Zaugg, Irina Skosireva, Mavis Vas

Research Collaborators

H. S. Randhawa (University of Delhi); Magnus Gottfredsson (Landspitali University); Zhu-Liang Yang (KIB, CAS); Feng-Yan Bai (IM, CAS); Joseph Heitman (Duke University); Huamin Wang (Hainan Medical College); Ke-Qin Zhang (Yunnan University)

Funding

Natural Sciences and Engineering Research Council (Discovery grant), National Science Foundation of China, Premier's Research Excellence Award

The overall objective in our research is to understand how microbes evolve. We examine the patterns, the rates, and the mechanisms of microbial evolution. We study microbial populations from the environment, human hosts, clinics, and the laboratory-evolved to address a variety of issues such as the rates and effects of spontaneous mutations; the persistence and spread of mutations in natural environments and human populations; and the origins of novel traits, strains and species. Our research uses microbiological, molecular, ecological and quantitative genetic tools.

During the 2006-2007 academic year, I was on sabbatical in China working on the population biology of several fungal species, including both edible gourmet mushrooms such as *Tricholoma matsutake* and human pathogenic yeasts such as *Candida albicans* and *Candida tropicalis.* Some of the collaborations we established during this year will continue for the next several years.

Our work with the human pathogenic yeasts *Candida* focused on population samples from Hainan Island in China. We identified a low oral yeast carriage rate (~4%) for college students there, much lower than that of the general population in both China (~60%) and North America (~30%). Interestingly, we found that the genetic diversity for the predominant species *(Candida albicans)* among the college students to be comparable to the genetic diversity of the global populations (Wang et al. 2007a, b; Mycopathologia; Fungal Genetics and Biology). Our collaborators in this project include Prof. Wang and Prof. Guo at Hainan Medical College.

Our work with the gourmet mushroom Tricholoma matsutake identified a large number of single nucleotide polymorphic sites for samples from southwestern China. This was achieved through genomic library construction, DNA sequencing, and bioinformatics analyses. The applications of these markers in analyzing 17 geographic populations from southwestern China identified evidence for recombination and gene flow among those populations (Xu et al. 2007 Microbiology; Xu et al. in press, Molecular Ecology). Our goal for the next couple of years will be to analyze the global population of this species/species complex.

For the main organism that we work with, the human pathogenic yeast Cryptococcus neoformans, we constructed the first genetic linkage map of a hybrid cross between strains of serotypes A and D. Our results identified suppressed recombination in most chromosomal regions (Sun and Xu 2007 Genetics). In addition, our work with

mitochondrial inheritance continued in this species and we identified a second gene sxi2a (the first we identified was sxi1alpha) involved in uniparental mitochondrial inheritance (Yan et al. 2007 Current Genetics). We also identified both UV exposure and high temperature promote biparental mitochondrial inheritance (Yan et al. 2007, Fungal Genetics and Biology), suggesting environmentally modulated patterns of mitochondrial inheritance in this species.

Assistant Professor

Xu-Dong Zhu

Functional Analysis of Protein Complexes Involved in Telomere Maintenance

Lab Personnel

M.Sc. students: Taylor Mitchell, Megan McKerlie, Kimberly Glenfield; *Research assistants:* Sichun Lin, Nishi Singh

Research Collaborators

H. S. Randhawa (University of Delh); Magnus Gottfredsson (Landspitali University); Zhu-Liang Yang (KIB, CAS); Feng-Yan Bai (IM, CAS); Joseph Heitman (Duke University); Huamin Wang (Hainan Medical College); Ke-Qin Zhang (Yunnan University)

Funding

Natural Sciences and Engineering Research Council (Discovery grant), Canadian Institutes of Health Research (Operating grant), CIHR New Investigators Award

Telomere length homeostasis is implicated in tumorigenesis and aging. Mammalian telomeric DNA is composed of tandem TTAGGG repeats to which shelterin, a telomere-specific complex, binds. Shelterin is composed of six protein subunits including TRF1, TRF2, TIN2, hRAP1, TPP1 and POT1. TRF1 and TRF2 bind specifically to duplex telomeric DNA repeats whereas POT1 has a high affinity for single-stranded telomeric DNA. TIN2, hRap1 and TPP1 do not bind telomeric DNA and their association with telomeres requires TRF1 and TRF2. The Shelterin complex functions not only to protect telomeres from being recognized as double strand breaks (DSBs) but also to control telomere length maintenance through a TRF-mediated negative regulatory pathway. Aside from Shelterin, mammalian telomeres are also associated with many telomere non-specific proteins, including ATM, Mre11/Rad50/Nbs1 (MRN) and XPF/ERCC1. ATM and the MRN complex are involved in double-strand break repair pathway and plays a central role in maintaining genome stability as mutations in ATM, MRE11 and NBS1 genes give rise to ataxia-telangiectasia (AT), ataxia-telangiectasia-like disease (ATLD) and Nijmegen breakage syndrome (NBS), respectively. AT, ATLD and NBS are cancer-prone diseases. On the other hand, the XPF/ERCC1 complex plays an important role in nucleotide excision repair as patients carrying mutations in XPF gene are sensitive to UV light and have late onset of skin cancer. ATM, MRN and XPF/ERCC1 are associated with human telomeres, interact with shelterin and play a role in telomere maintenance. Elucidating the molecular mechanism underlying the functions of these complexes in telomere biology is the research focus in my laboratory.

Assistant Professor, CLA

Kimberley Dej

Regulation of chromosome dynamics during mitosis and meiosis

Undergraduate thesis students:

Kirsten Avarmaa, Amanda Buchanan, Chandra Chappel, Philip Cumbo, Rebecca de Souza, Courtney Hampel, Aimee Lam, Kathryn McGinnis, Kyster Nanan, Mina Nashed, Meagan Nolan, Fariz Remtulla, Daina Search, Rajbir Singh, Ravonne Stuart, Hina Zaidi

Research interests:

Cells reproduce by a highly coordinated process of cell division. The integrity of the genome is contingent upon the faithful replication of the DNA and the accurate segregation of the duplicated copies of the genome into the two daughter cells. I am interested in the pathways that ensure that sister chromatids separate precisely at anaphase of mitosis. Separation too early or too late can lead to aneuploidy and chromosome breakage. Research has correlated the occurrence of aneuploidy with tumorigenesis.

During mitosis, the large nuclear DNA molecules must be compacted so that they can be easily transported on the mitotic spindle. This requires the process of chromosome condensation. Condensation factors form an integral part of the mitotic chromosome, yet the mechanisms of condensation remain elusive. One important component appears to be the pentameric complex called the condensin complex. My postdoctoral studies focussed on a genetic analysis of one subunit of the condensin complex in Drosophila called dCAP-G. These studies revealed dramatic defects in the resolution of sister chromatids and the segregation of chromatids at anaphase. In addition, these studies revealed a role for dCAP-G during interphase in the regulation of gene expression in heterochromatic regions of the genome.

I strongly believe in the role of undergraduate research and apprenticeship in learning. I have continued some of my postdoctoral research through the work of McMaster undergraduate students pursuing fourth year thesis projects (Biology 4CO9). The fourth year thesis is an extraordinary opportunity within the Department of Biology for undergraduates to pursue original, independent research. My earlier research identified several additional mutations that affect the separation of sister chromatids in both mitosis and meiosis. These thesis projects have focused upon the application of genetic techniques in the analysis of these mutations including complementation tests, recombination mapping, P-element transposition, and nondisjunction assays.

Educational interests:

Cell Biology, Genetics, Molecular Biology

As one of the Department of Biology's teaching faculty, I teach a range of undergraduate courses and I have a ongoing role in course and curriculum development.

Courses taught:

Biology 1AO3:	Cellular and Molecular Biology
Biology 2BO3:	Cell Biology
Biology 2CO3:	Genetics
Biology 3QO3/3QQ3:	Peer Mentoring in Biology
Biology 4IO3:	Inquiry in Biology
Biology 4CO9:	Senior Thesis

Assistant Professor, CLA

Lovaye Kajiura

Organismal ecology, resource allocation and life history, impact of biotechnology on physiology, endocrinology, nutrition, and behaviour, analysis of the transgenic animal models.

I am the **Level 1 Biology Undergraduate Course Coordinator** and hold a **Teaching Faculty** appointment in the Department of Biology. I coordinate and teach the following courses during the Fall, Winter, Spring, and Summer academic terms.

Biology 1A03	Cellular and Molecular Biology
Biology 1AA3	Biodiversity, Evolution, and Ecology
Biology 3Q03 & Biology 3QQ3	Peer Mentoring in Biology I & II

BIOLOGY 1A03 and BIOLOGY 1AA3

Students acquire the academic and technical skills essential for upper-level biology courses and biology-related fields of study. Upon completion of Biology 1A03 & 1AA3, students are able to i) effectively discuss the fundamental concepts and underlying processes related to cellular and molecular biology/biodiversity, evolution, and ecology, ii) implement laboratory technical skills necessary for biological sciences; and iii) work independently and in collaboration with others to compile, analyze, interpret, and present scientific data using oral, written, and diverse internet/multimedia formats.

Biology 3Q03 and Biology 3QQ3

Give undergraduate students theoretical and practical experience with teaching methods in biology and provide an introduction to scientific writing and presentation exploring cellular/molecular/evolution/ecological concepts. Lectures focus upon: the benefits of peer mentoring, effective presentation and communication skills, implementation of classroom technology and online learning management systems, motivating and inspiring students, lesson planning, creating rubrics, evaluating knowledge via factual, conceptual, and application questions, mentoring effective study habits, designing concept maps, learning styles and intelligences, creating surveys for student feedback, curriculum development, generating interactive open-ended questions, dealing with student diversity, effective listening skills, creating mentoring/teaching dossiers, effective goal setting, and performance improvement.

Adjunct and Associate Members

ADJUNCT MEMBERS

Gary Chiang

Department of Biology, Redeemer University College, Ancaster, ON, Canada

My research investigates the structure and function of the autonomic nervous system using the blood-feeding insect, Rhodnius prolixus, as a model system. I am exploring four separate autonomic processes in this insect: i) the relationship between circulation and egg production, ii) the control of the rate of the heart beat, iii) the control of contractions of visceral muscle associated with the vagina, and iv) the electrical activity of neurosecretory cells of the hypocerebral ganglion, a nervous structure involved with feeding. Most of this work takes place in my research facility at Redeemer University College located a few kilometres from McMaster. Some of this work is carried out in collaboration with Mike O'Donnell at McMaster.

David A. Galbraith

Department of Research and Natural Lands, Royal Botanical Gardens, Hamilton, ON , Canada

I am interested in evolution, biodiversity, and conservation: consequences of the activities of our own species, and interactions among animal and plant species and communities and human populations. To date most of my research has been on the ecology, conservation biology and population biology of reptiles and plants. These groups some important practical and theoretical constraints. Both plants and reptiles are relatively sedentary compared to mammals, birds, and even many insects, and both groups include members which are very long-lived. Both have been systematically under-represented in public perception of conservation priorities. Plants are often viewed either as a source of raw materials or as habitat for more interesting animals. Reptiles have suffered at best from benign ignorance and at worst from terror and fear. Both offer opportunities to study the structuring of population genetic information at varying scales, especially as it relates to conservation issues. At present I'm collaborating with Prof. Brad White at Trent University on the population genetics of endangered wood poppies (Stylophorum diphyllum). I'm also involved in the development of research and conservation programs at botanical gardens, and in promoting the role of these institutions in support of sustainable development and biodiversity initiatives. At Royal Botanical Gardens I'm responsible for managing the research programs, library, archives and herbarium of the institution as well as working with extramural researchers and institutions to promote the use of our facilities and properties in support of research.

Pierre Laurent, Professor

Department de Morphologie Fonctionnelle et ultrastructurale des Adaptations, Center d'Ecologie et de Physiologie Energetique, CNRS, Strasbourg, France

As a cell biologist I have long been interested in the structure to function relationship in the fish gill in relation to environmental variables, particularly in euryhaline species. In the current project Chris Wood and I combined our complementary expertise and focussed on some cellular responses of ionic regulation during the rapid transfer of the estuarine killifish, Fundulus heteroclitus, from sea to fresh water. We are investigating the links between the populations of the different cell types present in the gill and functional changes in branchial ion transport machinery. Experiments combine a range of classical and modern morphological techniques, as well as cell turnover, apotosis, molecular expression, and ion transport studies.

James Pringle

Royal Botanical Gardens, Hamilton, ON, Canada

My work focuses on systematics of the flowering plants, including naming and description of new species, revised classifications, improved identification guides, nomenclature, geographic distribution, and spread of invasive species. My research involves Gentianaceae of the Americas, Syringa, and the history and biography of natural history and field biology. I am also interested in nature interpretation, and teach the course in systematics of the flowering plants in the Ontario Universities Program in Field Biology.

ASSOCIATE MEMBERS

Sigal Balshine

Associate Professor
Department of Psychology, McMaster University

My lab is interested in understanding the mechanisms of animal behavior and evolution. Current areas of research interests are: (1) The evolution of cooperation, (2) Parental care and breeding system evolution, (3) Sperm competition, (4) Effects of contaminant exposure, and (5) Species introductions and extinctions.

Selected Publications

Buston, P. M. and Balshine, S. (2007). Cooperating in the face of uncertainty: a consistent framework for understanding the evolution of cooperation. *Behavioural Processes,* 76:152-159.

John Fitzpatrick, J.L. et al. (2007). Reproductive-tactic-specific variation in sperm swimming speeds in a shell-brooding cichlid. *Biology of Reproduction,* 77:280-284.

Stiver, K.A. et al. (2007). Evidence for size and sex-specific dispersal in a cooperatively breeding cichlid fish. *Molecular Ecology,* 16:2974-2984.

Aubin-Horth, N. et al. (2007). Masculinized dominant females in a cooperatively breeding species. *Molecular Ecology,* 16:1349-1358.

Richard G. Butler

Professor
Pathology and Molecular Medicine, McMaster University

Research in my lab involves studies on the plasticity of highly differentiated cells in adult mammals. Two ongoing projects explore different features of the response of such highly differentiated, non-dividing cells to dramatic changes in their environment.

The first project involves motoneuron plasticity. Unlike normal motoneurons, mammalian motor nerve fibres which are regenerating following injury can innervate two different types of muscle cells simultaneously. Not only do they innervate two different muscle types, but also they do it with different types of terminals. In a parallel study, intact motoneurons were offered a choice of regenerating targets to innervate - their normal muscle and one they had never seen before. The intact nerves not only reinnervate their normal target but also the very different new target, and the new target induced the neurons to develop a new type of terminal which the neurons had never produced before. The second project involves the traumatic reduction of ventricular myocytes into viable fragments and the subsequent regeneration of functioning myocardium from these myogenic elements.

Selected Publications

Butler R. (1988). Functional maturation of muscle spindles in the tenuissimus muscles of kittens. In *"Mechanoreceptors-development, structure and function"*, P Hnik, T Soukup, R Vejsada and J Zelena (eds). Plenum Press pp. 71-72.

Butler R. (1989). Evidence for regenerative capacity in adult mammalian cardiac myocytes. *Am. J. Physiol.,* 256:R797-R800.

Martin Daly

Professor
Department of Psychology, McMaster University

For many years, my primary research interests concerned the behavioural ecology of desert rodents. My current research animal, however, is *Homo sapiens,* whose behaviour I study from the perspective of an evolutionist. I and my students use archival data bases to study such things as the epidemiology of homicide and risk-taking, and we use both experimental and survey methods to study decision-making under uncertainty, future discounting, social cognition, familial sentiments, and various consequences of the uncertainty of paternity. In all of this work, the hypotheses that we test derive from the same theories of natural and sexual selection that motivate most contemporary research in animnal behaviour.

Selected Publications

Mishra S. et al. (2007). One woman's behavior affects the attractiveness of others. *Evolution & Human Behavior,* 28:145-149.

Wilson M. and Daly M. (2006). Are juvenile offenders extreme future discounters? *Psychological Science,* 17:989-994.

Daly M. and Wilson M. (2005). *Carpe diem:* adaptation and devaluing the future. *Quarterly Review of Biology,* 80:55-60.

Daly M. and Wilson M. (2005). Human behavior as animal behavior. Pp. 393-408 in J.J. Bolhuis & L.-A. Giraldeau, eds., *Behavior of animals: mechanisms, function and evolution.* Oxford: Blackwell.

Reuven Dukas

Associate Professor
Department of Psychology, McMaster University

I examine the evolutionary biology of cognition, defined as the neuronal processes concerned with the acquisition, retention and use of information. Much of the current work in my lab focuses on the following three topics.

Adaptive significance of learning in fruit flies. We integrate mechanistic and evolutionary knowledge for quantifying how fruit flies (Drosophila spp) benefit from learning and how learning influences courtship and mate choice. We also examine how learning influences processes of sexual selection and speciation.

Life history of learning. Learning is one of a few factors that contribute to an increase in individual performance throughout life in many animals including humans. In spite of the importance of learning, no experimental research program has quantified the relative contribution of learning to performance throughout the lifespan. We use honey bees as a model system for measuring how learning, physiology and effort interact to affect foraging success throughout workers' lifetime under natural settings and in controlled experimental environments.

Predation and pollination. Research on animal-flower interactions has traditionally focused only on two trophic levels. We have examined how pollinators' predators influence these interactions and documented that some predators, such as bumblebee wolves, can have large negative effects on bee density and plant fitness.

Selected Publications

Dukas, R. (2008). Evolutionary biology of insect learning. *Annual Review of Entomology,* 53:145-160

Dukas, R. et al. (2006) Courtship strategies of male insects: when is learning advantageous? *Animal Behaviour,* 72:1395-1404.

David J. D. Earn
Professor
Mathematics and Statistics, McMaster University

I develop and analyze mathematical models of biological systems, primarily for applications in epidemiology, ecology and animal behaviour.

One of the main themes of my research is understanding and controlling extinctions. In the ecological context, I investigate strategies for conservation of endangered species. In the epidemiological context, I study strategies for eradication of parasites that cause infectious diseases. From a mathematical point of view, these are very similar problems.

Another area of my research concerns the application of game theory to the evolutionary dynamics of behavioural traits. This work clarifies the adaptive significance of animal behaviour, ranging from cooperation and parental care to foraging and cannabilism.

Selected Publications

Wagner, B. G. and Earn, D. J. D. (2008). Circulating vaccine derived polio viruses and their impact on global polio eradication. *Bulletin of Mathematical Biology,* 70:253-280

Earn, D. J. D. (2007). Comment on `Parameter estimation for differential equations: A generalized smoothing approach' by James O. Ramsay, Giles Hooker, David Campbell and Jiguo Cao. *Journal of the Royal Statistical Society,* 69:779-780

Dushoff, J. et al. (2007). Vaccinating to protect a vulnerable subpopulation. *PLoS Medicine,* 4:921-927

Margaret Fahnestock
Professor
Psychiatry & Behavioural Neurosciences, McMaster University

My laboratory uses molecular techniques to study the regulation and biosynthesis of neurotrophic factors and their involvement in neurological diseases. Neurotrophic factors such as nerve growth factor (NGF) and brain-derived neurotrophic factor (BDNF) are necessary for peripheral and central nervous system development, maintenance and response to injury. The levels of these factors are tightly controlled, and their biological activity is regulated by a number of processes including transcriptional regulation, proteolytic processing of precursors, and binding to inhibitors and receptors. Our research studies the mechanisms that regulate NGF and BDNF biosynthesis in rodent and human experimental systems, using cell culture and molecular methods, with a particular focus on NGF in human CNS conditions such as Alzheimer's disease, schizophrenia and epilepsy. Current projects focus on the four major areas: (1) Function of neurotrophin precursors, (2) BDNF in neurological disease, (3) Neurotrophic factors and axon guidance molecules in the development of epileptic seizures and in seizure-induced neuronal sprouting, and (5) Sensory protection of muscle following peripheral nerve injury.

Selected Publications

Garzon DJ & Fahnestock M. (2007). Oligometric amyloid decreases basal levels of brain-derived neurotrophic factor (BDNF) mRNA via specific downregulation of BDNF transcripts IV and V in differentiated human neuroblastoma cells. *Journal of Neuroscience,* 27(1): 2628-2635.

Batt J, et al. (2006). Differential gene expression profiling of short and long term denervated muscle. *FASEB Journal,* 20(1):115-117.

Bennett G. Galef, Jr.
Professor Emeritus
Department of Psychology, McMaster University

My lab has been studying the role of social learning in development of adaptive patterns of behaviour in animals as diverse as Norway rats and Japanese quail. The results of our experiments provide evidence of an important role for social learning in development of behavioural repertoires. Such evidence is important because, in the endless arguments over whether instinct or individual learning guides development of behaviour in adaptive directions, the possibility that animals might learn what to do as a result of interaction with more experienced conspecifics was ignored. We have been kept busy filling the gaps both providing evidence that, for example, animals can learn where to eat, what to eat, and when to eat from their fellows, and analyzing behavioural and sensory processes supporting such social learning.

Selected Publications

White, D.J., & Galef, B.G., Jr. (2000). Differences between the sexes in direction and duration of response to seeing a potential sex partner mate with another. *Animal Behaviour,* 59:1235-1240.

White, D.J. & Galef, B.G., Jr. (2000). 'Culture' in quail: Social influences on mate choice of female Coturnix japonica, *Animal Behaviour,* 59:975-979.

Galef, B. G., Jr. and Whiskin, E. E. (1997). Effects of social and asocial learning on longevity of food-preference traditions. *Animal Behaviour,* 53:1313-1322.

Ashok K. Grover
Professor
Department of Medicine, McMaster University

Coronary artery, calcium pumps, NCX and oxidative stress: Coronary artery smooth muscle contraction makes the arteries narrower and relaxation makes them wider. This helps regulate blood supply to the heart. Calcium ions are brought into cell cytoplasm by various channels and removed from it by three main pathways: plasma membrane calcium pumps (PMCA), sarco/endoplasmic reticulum calcium pumps (SERCA) and sodium-calcium-exchanges (NCX). Our lab has works on these mechanisms with a current focus on NCX. NCX extrudes calcium ions from cells under normal electrochemical gradients of sodium and calcium. Typically high calcium concentrations in the artery muscle cells cause them to contract. Arteries also contain an inner lining of endothelial cells. Increasing calcium in endothelial cells causes them to produce substances such as nitric oxide that can relax the smooth muscle cells. Thus high calcium in smooth muscle and endothelial cells have opposite effects. Therefore, our first goal is to understand the effects of this balance on the two cell types. We are also exploring the hypothesis that NCX and SERCA may be linked.

Caloxins are inhibitors of PMCA that can be used to study coronary artery function. We invented a prototype PMCA4 selective caloxin (1c2) that will be a milestone for solving complex problems in PMCA biology, e.g., distinction between the roles of caveolar vs. non-caveolar PMCA (or PMCA in lipid rafts vs. outside the lipid rafts in neurons). Caloxins may also become useful in understanding the role of PMCA isoforms in hypertension, heart failure and stroke.

Selected Publications

Szewczyk M. M. et al. (2007) Ca2+-pumps and Na+-Ca2+-exchangers in coronary artery endothelium versus smooth muscle *J. Cellular Molecular Medicine,* 11:129-138.

Chen, T. et al. (2007). Characterization of SERCA2b Ca2+-Mg2+ ATPase mRNA decay by nuclear proteins. *Cell Calcium,* 41:581-592.

Hendrik N. Poinar
Associate Professor
Department of Anthropology, McMaster University

I am a molecular evolutionary geneticist and biological anthropologist by training, and rely heavily on interdisciplinary research. I use both chemical and molecular techniques to elucidate the state of preservation within forensic, archeological and paleontological remains. This information is subsequently used to devise novel techniques to extract the molecular information (DNA and/or protein sequences) which is then used to address evolutionary and anthropological questions, such as the "relatedness" of Archaic humans and Neanderthals from a genetic standpoint, sex and diet from prehistoric Native Amerindian hunter-gatherer populations using coprolites samples, and the timing and origin of HIV using archival blood and brain tissue samples.

Selected Publications

Poiner, H. N. et al. (2006). Metagenomics to Paleogenomics: Large-Scale Sequencing of Mammoth DNA. *Science,* 311:392-394.

Henry Szechtman
Professor
Department of Psychiatry, McMaster University

Chronic exposure to psychostimulant drugs has two behavioral effects that are of particular interest. The first one is a progressive increase in the drug response with chronic treatment, a phenomenon termed behavioral sensitization. The phenomenon is puzzling from a mechanistic point of view because it is not known why chronic drug exposure would result in sensitization, rather than in the expected tolerance. Sensitization is also puzzling from a functional perspective because it may be linked to the emergence of psychosis, mania, post-traumatic stress disorder, panic disorder, and addiction. Behavioral analysis in my lab has characterized sensitization induced by the dopamine agonist quinpirole as a process of build-up and strengthening of performance, thus casting sensitization as a normal biological process of enhancing motor capacity. We are now investigating the hypothesis that increased motor vigour under the drug reflects enhanced activity of dopaminergic neurons controlling energy expenditure.

The second interesting effect of chronic exposure to psychostimulant drugs is the resultant transformation in the organization of activity: under quinpirole, for instance, behavior is strikingly organized, despite a marked increase in hyperactivity. In a large open field, sensitized rats move repeatedly along paths that are rigid and restricted to only a portion of the environment. As they travel, they tend to stop in specific places along their route and display fixed motor acts. Their behavior appears as if it were a compulsive motor ritual. We are testing the hypothesis that this quinpirole-induced transformation represents an animal model of obsessive-compulsive disorder (OCD).

Selected Publications

Szechtman H. et al. (2001). Compulsive checking behavior of quinpirole-sensitized rats as an animal model of Obsessive-Compulsive Disorder (OCD): form and control. BMC Neuroscience, 2:4 (12 Apr 2001).

Eva S. Werstiuk
Professor
Department of Medicine, McMaster University

We are studying the cellular mechanisms of action of selected purines, such as adenosine, guanosine, inosine and GTP to elucidate their roles in the regulation of cell growth and differentiation, and apoptosis in different cell types, including glial cells and neurons.

Specific studies include: 1) Pharmacological and functional characterisation of purine nucleoside and nucleotide receptors, their intracellular signalling pathways, and their roles in mediating cell growth and differentiation of a number of different cells. 2) Investigation of the cellular mechanisms which mediate the effects of purines on apoptosis of glial cells and neurons.

Selected Publications

Jiang S. et al. (2005). Acceleration of blood-brain barrier formation after tansplanting enteric glia into the spinal cord of rats. *Experimental Brain Research,* 162:56-62.

Bau C. et al. (2005). Enhancement by guanosine of NGF-dependent neurite outgrowth from PC12 cells: evidence for the involvement of carbon monoxide and cyclic GMP. *Purinergic Signalling,* 1:161-172.

Professors Emeriti/Retired Faculty

Dr. Stanley T. Bayley

Dr. Douglas Davidson

Dr. Allan D. Dingle

Dr. Frank L. Graham

Dr. Kenneth A. Kershaw

Dr. John Lott

Dr. Richard A. Morton

Dr. Stanley Mak

Dr. Ludvik A. Prevec

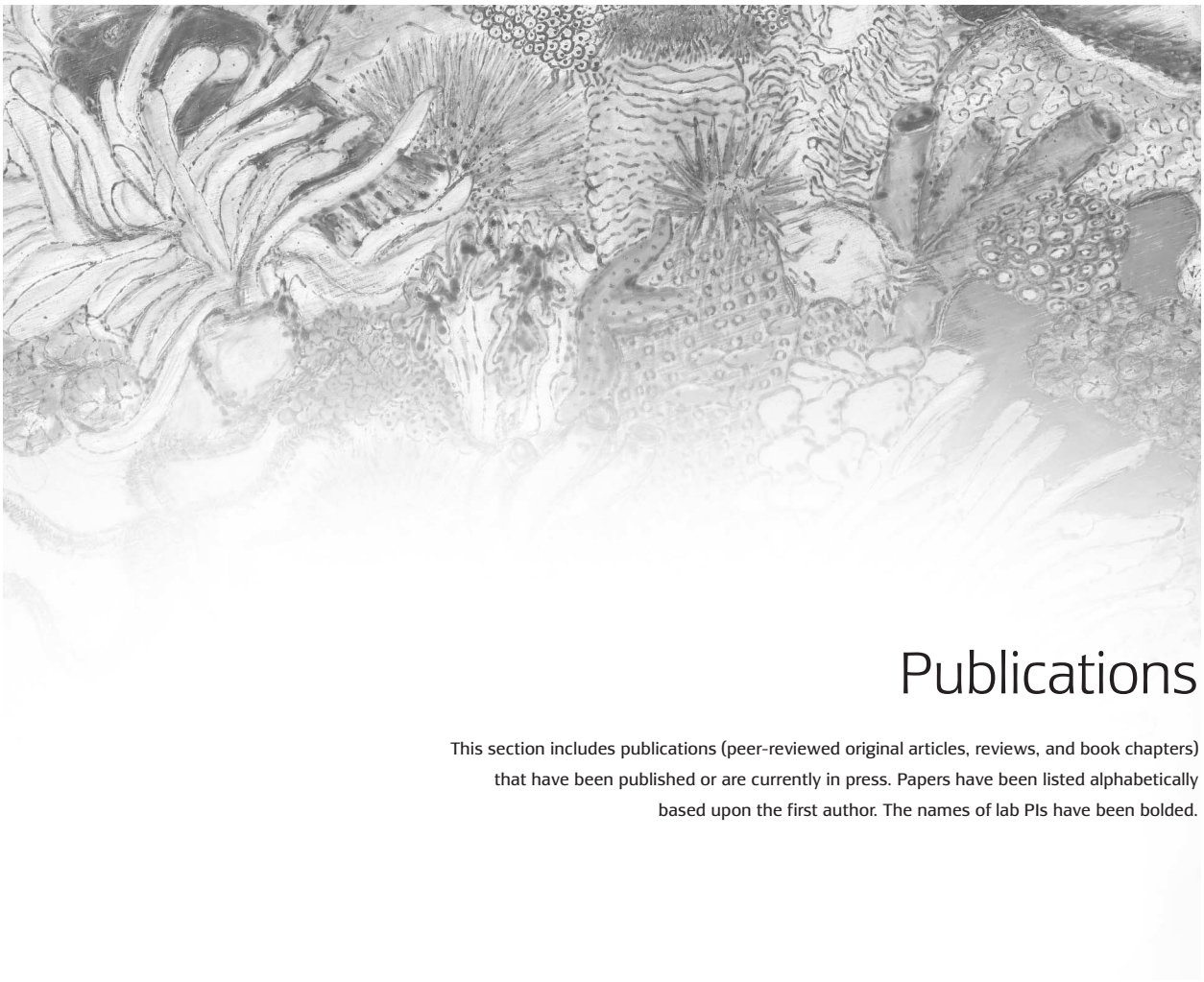
Dr. George J. Sorger

Dr. François Takahashi

Dr. Stephen F.H. Threlkeld

Dr. Jean E.M. Westermann

Dr. Bradley N. White



Publications

This section includes publications (peer-reviewed original articles, reviews, and book chapters) that have been published or are currently in press. Papers have been listed alphabetically based upon the first author. The names of lab PIs have been bolded.

Abdo, Z. and **Golding, G.B.** (2007) A Step Toward Barcoding Life: A Model Based, Decision Theoretic Method to Assign Genes to Pre-existing Species Groups. Systematic Biology 56: 44-56.

Alves, L and **Wood, C.M.** (2006) The chronic effects of dietary lead in freshwater juvenile rainbow trout *(Oncorhynchus mykiss)* fed elevated calcium diets. Aquat. Tox. 78 : 217-232.

Alves, L., Glover, C.N. and **Wood, C.M.** (2006) Dietary Pb accumulation in juvenile freshwater rainbow trout *(Oncorhynchus mykiss).* Arch. Environ. Contam. Toxicol. 51: 615-625.

Aly, K.A. and **Baron, C.** (2007) The VirB5 protein localizes to the T-pilus tips in Agrobacterium tumefaciens. Microbiology 153: 3766-3775.

Artieri, C.G., Haerty, W., **Singh, R.S.** (2007) Association between levels of coding sequence divergence and gene misregulation in Drosophila male hybrids. *Journal of Molecular Evolution* 65: 697-704.

Ausmees, N., Wahlstedt, H., Bagchi, S., **Elliot, M.,** Buttner, M., Flardh, K. (2007) SmeA, a small membrane protein with multiple functions in Streptomyces sporulation including targeting of a SpoIIIE/FtsK-like protein to cell division septa. Molecular Microbiology. 65: 1458–1473.

Baldisserotto, B., Chowdhury, M.J. and **Wood, C.M.** (2006) Intestinal absorption of cadmium and calcium in juvenile rainbow trout fed with calcium and cadmium supplemented diets. J. Fish Biol. 69:658-667.

Baron, C. (2006) VirB8: A conserved type IV secretion system assembly factor and drug target. Biochem. Cell Biol. 84: 890-899.

Baron, C. and Coombes, B. (2007) Targeting bacterial secretion systems: Benefits of disarmament in the microcosm. Infect. Disord. Drug Targets 7: 19-27.

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Visitors, Post-doctoral Fellows and Research Associates

Post-doctoral Fellows

Albu, Mihai (working with G.B. Golding)
Ph.D. Max Planck Institute, Germany
Studies of mtDNA evolution with regard to its use for Barcoding Life.

Fishchhoff, Ilya (working with J. Dushoff)
Ph.D. Princeton University
Animal movement, social behavior and life history, mostly in equids.

Defranceso, Matilde (working with C. Wood)
Kinetics of copper and cadmium binding to olfactory and gut epithelia in fish.

Hung, Ching Yee (working with C. Wood)
Molecular physiology of ammonia and urea transporters in fish.

James, Timothy (working with J.P. Xu)
Population genetics and molecular ecology of fungi.

Khan, Hammad Ahmad (working with J. Quinn)
Higher Education Commission (Pakistan) Post-doctoral Fellow
Microsatellite genotyping of smooth-billed anis.

Mirza, Reehan (working with C. Wood)
Effects of chronic metal exposure on olfaction in fish.

Ng, Tania (working with C. Wood)
Ph.D. University of Melbourne
Trophic transfer of metals from invertebrates to fish.

Papaconstantinou, Maria (working with A. Campos)
Ph.D. McMaster University
The function of Mnn1 tumour suppressor gene in the stress response and genomic stability in Drosophila melanogaster.

Reyes, Pablo (working with C. Nurse)
Ph.D. Pontificia Universidad Catolica De Chile
Mechanisms of O2 and CO2/pH chemotransduction.

Scantlebury, Nadia (working with A. Campos)
Ph.D., McMaster University
Conducting a behavioural and genetic analysis of the response to light in the fruit fly larva.

Tommy Tsui (working with C. Wood)
Ph.D. Univeristy of Hong Kong
Transport processes in primary cultured gill epithelia of fish.

White, Catharine (working with T. Finan)
Ph.D. Cornell University
The biochemistry and genetics of hydroxyproline metabolism in the legume symbiont Sinorhizobium meliloti.

Yousef, Mary (working with M. Elliot)
Ph.D. The Ohio State University
Cell wall remodeling in the bacterium Streptomyces coelicolor

Zhang, Li (working with C. Wood)
Ph.D. Hong Kong University of Science and Technology
Role of ammonia in ventilatory control in fishSmith, Richard (Working with C.M.

Research Associates

Cheng, Jiujun (Working with T. M. Finan/ G. B. Golding)
Ph.D., University of Wales Swansea
Analysis of bacterial genes of unknown functions.

Chowdhury, Jasim (working with C. Wood)
Ph.D. University of Antwerp
Chronic effects of copper and nickel in fish.

Haerty, Wilfried (Working with R. Singh)
Ph.D., University of Pierre et Marie Curie, Paris VI
Analysis of genes involved in hybrid male sterility in the Drosophila simulans clade.

Paschos, Athanasios (Working with C. Baron)
Ph.D., Ludwig-Maximilians-University, Munich-Germany
Chemical biology approaches to isolate inhibitors of type IV secretion systems.

Smith, Richard (Working with C.M. Wood)
Proteomics in freshwater fish.

Zaheer, Rahat (Working with T.M. Finan)
Ph.D., Punjab University, Lahore, Pakistan
Characterization of PhoB regulated genes in Sinorhizobium meliloti.

Zhang, Min (Working with C.A. Nurse)
M.D., Shandong University in China,
Chemosensory mechanisms in carotid body and sensory neurons.

Graduate Studies

Graduate Program Structure

Programs

The Biology Department offers graduate programmes leading to M.Sc. and Ph.D. degrees. The programmes offer graduate students the opportunity to participate in one of the over thirty faculty research labs. Areas of research cover a broad range and include: biochemistry, bioinformatics, cancer biology, cell biology, developmental biology, population ecology, environmental physiology, evolution, genetics, immunology, microbiology, molecular biology, and others. Often, a research project of any one laboratory involves more than one of these categories.

Students in the Biology graduate programme will enter directly into their chosen research lab in their first year of study. Therefore, students are encouraged to consider their research interests and acquaint themselves with the research programmes of professors in the applicable fields. They then arrange to meet with the professors and discuss the possibility of pursuing a graduate degree in the lab.

The graduate programmes are designed to teach students the research and communication skills required for a successful career as an independent scientist. Many graduates go on to careers in universities, research institutions, or the biotechnology industry, and a growing number choose areas such as consulting, science writing, technology transfer, and patent law.

The average programme length is 2 to 3 years for a M.Sc. and 4 to 5 years for a Ph.D. Currently there are 56 students in the M.Sc. programme and 53 Ph.D. candidates.

M.Sc. degree

The M.Sc. programme requires the submission of a research thesis and is recommended for anyone planning to proceed later to a Ph.D. or otherwise to continue in research.

A candidate for the M.Sc. in Biology must spend at least one calendar year in full-time graduate study at McMaster University and must complete satisfactorily one full graduate course (or two half courses) in biology or related fields. Upon completion of their research, the candidate must present a thesis embodying original results, and have an oral defense before a departmental examining committee.

This is a brief overview of the M.Sc. programme. For details on programme requirements, please see the *Guide to Graduate Studies in Biology at McMaster University* or contact Graduate Assistant.

Ph.D. degree

Candidates may enter the programme with an Honours B.Sc. or an M.Sc. It is customary for graduate students holding a bachelor degree to enter a M.Sc., rather than a Ph.D. programme. If the student wishes to proceed to a Ph.D., at the end of an appropriate period of study, they will be asked to submit a critical report on their research to date. The candidate will be examined on this report for evidence of research potential to determine whether they will be granted permission to transfer to the Ph.D. programme.
The requirements to complete a Ph.D. in Biology are:

- Satisfactory completion of at least two and one half full graduate courses beyond the baccalaureate degree in biology or related fields.
- Successful completion of a comprehensive examination designed to test the Ph.D. candidate's breadth of knowledge and competence in biology. The examination will be comprised of two parts: the preparation of a formal research proposal and the presentation of a public seminar, followed by a meeting with the examination committee.
- While not a requirement, most students hold teaching assistantships during their graduate career. The financial remuneration forms a significant part of the graduate stipend and affords the opportunity to learn teaching skills.
- Successful defense of a thesis of original research. Upon completion of their research, a Ph.D. candidate is required to present and defend a thesis embodying the results of their original research.

This is a brief overview of the Ph.D. programme. For details on programme requirements, please see the *Guide to Graduate Studies in Biology at McMaster University* or contact Graduate Assistant.

Departmental Participation

The Biology Faculty welcome input from graduate students in matters governing the Department. Graduate students in Biology elect two of their members to attend the regular Departmental faculty meetings, one member to serve on the Graduate Studies Committee, and one member is elected to the Department Curriculum Committee. The Biology Graduate Studies Committee is responsible for maintaining the integrity and academic excellence of the graduate program.

STUDENT SOCIETY ACTIVITIES

Biology Graduate Students' Society

The Biology Graduate Students' Society (BGSS) is comprised of elected graduate students from within the Department of Biology. BGSS members act as representatives for biology graduate students to the department of biology on issues ranging from undergraduate and graduate academics to health and safety. In addition, the BGSS hosts 3 annual social events: the summer picnic, the Welcome Week BBQ and the winter holiday formal the Holly Frolic. Other smaller events and socials we have held in past include karaoke nights, movie/potluck nights, Oktoberfest trip, trip to Wonderland, wine tours, free coffee breaks, and pumpkin carving contests.

Graduate Students Association (GSA)

The mandate of the Graduate Students Association of McMaster University (GSA) is to promote the welfare and interests of McMaster graduate students, to represent the members before the duly elected and appointed authorities of McMaster University, and to promote communication and participation in all matters of common interest between the members of the Association and the members of other student organizations.

The GSA owns and operates the Phoenix restaurant and bar, providing an opportunity for graduate students and other members of the McMaster community to interact in a casual restaurant/pub setting.

The GSA periodically hosts seminars and colloquia, including Graduate Students Day annually. The GSA also provides financial and media support for departmental and faculty seminar days, colloquia, etc. The GSA also publishes a monthly newsletter, *The GSA Today,* that provides news and information relating to graduate issues and events throughout McMaster University.

Graduate Distinguished Honours

SCHOLARSHIPS (2006-2007)

Natural Sciences and Engineering (NSERC)

Megan Barclay (Quinn Lab)
Katherine Clarke (Nurse Lab)
Alicia Pepper (Bédard Lab)
Anhua Wei (Chow-Fraser Lab)
John Fitzpatrick (Balshine Lab)
Allyson MacLean (Finan Lab)
Frederic Chain (Evans Lab)
Paul Craig (McClelland Lab)
Lyndsay Smith (Chow-Fraser Lab)

NSERC Postdoctoral Fellowships

Marylene Boulet (Gibbs Lab)
Melanie Huntley (Golding Lab)
Mark Rheault (O'Donnell Lab)

Ontario Graduate Scholarship (OGS)

Abraham Yang (Igdoura Lab)
Sarah Chiang (Schellhorn Lab)
Sheng Sun (Xu Lab)
Michael BeGora (Weretilnyk Lab)
Branka Poduska (Finan Lab)

Heart and Stroke Scholarship

Stephen Brown (Nurse Lab)
Josef Buttigieg (Nurse Lab)
Jyoti Pande (Grover Lab)

Ontario Graduate Scholarship in Science and Technology (OGSST)

Maria Abou Chakra (Stone Lab): The Bank of Montreal Scholarship
Carol Bucking (Wood Lab): The Bank of Montreal Scholarship
Maria Papaconstantinou (Campos Lab): The David and Grace Prosser Scholarships

CIHR: Kevin Kelly (Daniel Lab)

Ontario Graduate Fellowship: Nickett Donaldson (Daniel Lab)

CONACYT Scholarship: Esau Ruiz Sanchez (O'Donnell Lab)

Ministry of Science, Research and Technology, Islamic Republic of Iran: Raheleh Masoudi (Fahnestock Lab)

Government of Egypt Scholarship: Hatim Abdel-Ghafor Abou-Ouf (Kolasa Lab)

GRANTS, AWARDS AND BURSARIES

The Lee Nielson Roth Award: Kevin Kelly (Daniel Lab)

Monica Scarabello Memorial Bursary: M. Iqbal Setiadi (Evans Lab)

Northern Scientific Training Program Grants: Jeff Dedrick (Weretilnyk Lab)

McMaster Biology Travel Awards (April 2006)

Abha Ahuja
Carol Bucking
Stephen Brown
Josef Buttigieg
Jessie Carviel
Frederic Chain
Sarah Chiang
Paul Craig
Bijan Dey
Tao Dong
Diana Dregoesc
John Fitzpatrick
Chan Gao
David Guevara
Henry Haiser
Sheng Sun
Weilong Hao
April Hayward
Melanie Huntley
Allyson MacLean
Sujatha Marri
Bart Maslikowski
Khaled Mohamed
Shubha Pandit
Maria Papaconstantinou
Monika Patel
Branka Poduska
Veronica Rodrigues Moncalvo
Nadia Scantlebury
Marie Pierre Schippers
Gregory Schmaltz
Zhun Yan

Degrees Conferred:

Karen Bechard (Wood)
Toxicity of CD, CU, PB, N1 and ZN to Chironomids and Trophic Transfer to CD from Chironomids to Zebrafish.

Taryne Chong (Igdoura)
Over Expression of Sialidase (NEU1) Promotes Interleukin-6 Induced Inflammation in Human Neuroglia and Monocytic THP-1 Cells.

Melanie Croft (Chow-Fraser)
Aids for the Conservation of Great Lakes Coastal Marshes: Development of a Macrophyte Index and a Novel Macrophyte Sampling Protocol.

Jeffrey Dedrick (Weretilnyk)
Physiological and Biochemical Responses of Yukon and Shandong Thellungiella to Water Deficits.

Dorothy DeSousa (Campos)
The functional Characterization of the Disco-Interacting Protein 1(DIP 1).

Bijan Kumar Dey (Campos)
The Role of the Drosophila Zinc Finger Transcription Factor Disconnected (Disco) in the Development of Ventral Appendages: A Molecular Genetic Study.

Warren Green (Wood and Pyle)
Progress Towards the Development of a Chemosensory-Based Biotic Ligand Model in Fathead Minnows (Pimephales Promelas) and Wild Yellow Perch (Perca Flavescens)

Weilong Hao (Golding)
Lateral Gene Transfer in Bacteria.

April Hayward (Kolasa)
The Role of Organism Metabolism in Determining Patterns in Structure and Function at Higher Levels of Biological Organization.

Melanie A. Huntley (Golding)
The Structure, Function, and Evolution of Protein Repeats.

Santosh Jagadeeshan (Singh)
Rapid Evolution of Sex and Reproduction Related Traits and Speciation in Drosophila

Kevin Kelly (Daniel)
Nucleocytoplasmic Trafficking and Biological Functions of Kasio and p120 ctn.

John-Paul King (Igdoura)
Molecular Mechanisims of Tay Sachs Disease: Calcium Excitoxicity and Apoptosis.

Christina Kostuk (Chow-Fraser)
Great Lakes Coastal Wetlands Monitoring and Assessment Techniques.

Tatiana Kozlova (Wood and McGeer)
Development of an Acute Biotic Ligand Model for N1 in Toxicity to Daphina pulex: Effects of Ca, Mg, Na, K, C1, pH and Dissolved Organic Matter.

Melanie Lou (Golding)
Studies of the Molecular Evolution of C01.

Shawn MacLellan (Finan)
Study of Megaplasmid Partitioning and Replication Initiation.

Sujatha Marri (Gupta)
Molecular Genetic Study of Vulval Morphogenesis in C. elegans and related Nematode Species.

Shelia McNair (Chow-Fraser)
The use of Primary Producers for Assessing and Monitoring Aquatic Habitat Quality in Great Lakes Coastal Wetlands.

Kristina Murphy (McClelland)
Fuel selection in Genetically Selected Endurance Running Rats as Submaximal Exercise Intensities.

Alicia O'Neill (Mothersill)
Non-Targeted Effects of Ionizing Radiation in Fish Cell Lines.

Abena Otchere (Daniel)
Characterization of Cyclin D1 as a Putative Kasio Target Gene.

Maria Papaconstantinou (Campos)
Functional Characterization on the Mnn1 Tumour Suppressor Gene in Drosophila melanogaster.

Susan Pattison (Igdoura)
Biogenesis: Trafficking and Mutation of the Human Lysosmal Sialidase (Neu 1).

Jason Peters (Hassell)

Frances Raftis (Golding)
Structural Determinats of Amino Acid Replacement Rate Heterogeneity.

Mark Rheault (O'Donnell)
Transport of Organic Cations and Anions by the Isolated Malpighian Tubules of Insects.

Clinton Robbins (Stampfli)
Impact of Cigarette Smoke Exposure on Immune Inflammatory Responses Toward Pathogenic and Non-Pathogenic Agents.

Esau Ruiz-Sanchez (O'Donnell)
Characterization and Regulation of Salicylate Transport by Insect Renal Epithelia.

Andrea Sartor (Finan)
Expression Analysis of the Transporters of Sinorhizobium meliloti.

Nadia Scantlebury (Campos)
The Drosophila Larval Response to Light: A Behavioural and Genetic Analysis.

Titus Seilheimer (Chow-Fraser)
Development and Use of Fish-Based Indicators of Wetland Quality for Great Lakes Coastal Wetland.

Morivarid Shahid (Xu)
The Effect of Environmental Factors on Hybrid Fitness in Cryptococcus Neoformans.

Laura Smallbone (Finan)
Malic Enzymes of Sinorhizobium Meliloti: A Study of Metabolomics and Protein-Protein Interactions.

Anhua Wei (Chow-Fraser)
Forecasting the Response of Coastal Wetlands to Declining Water Levels and Environmental Disturbances in the Great Lakes.

Zhun Yan (Xu)
Mating System and Mitochondrial Inheritance in a Basidomycete Yeast (Cryptococcus Neoformans).

Shari-Lynne Yasin (Rainbow)
The Effects of Mismatch Repair Proteins and Hypoxia on the Repair of Cisplatin-Induced DNA Damage.

Mirella Younes (Schellhorn)
Competition Between Sigma Factors: Effect on the Expression of RPOS Dependent Genes.

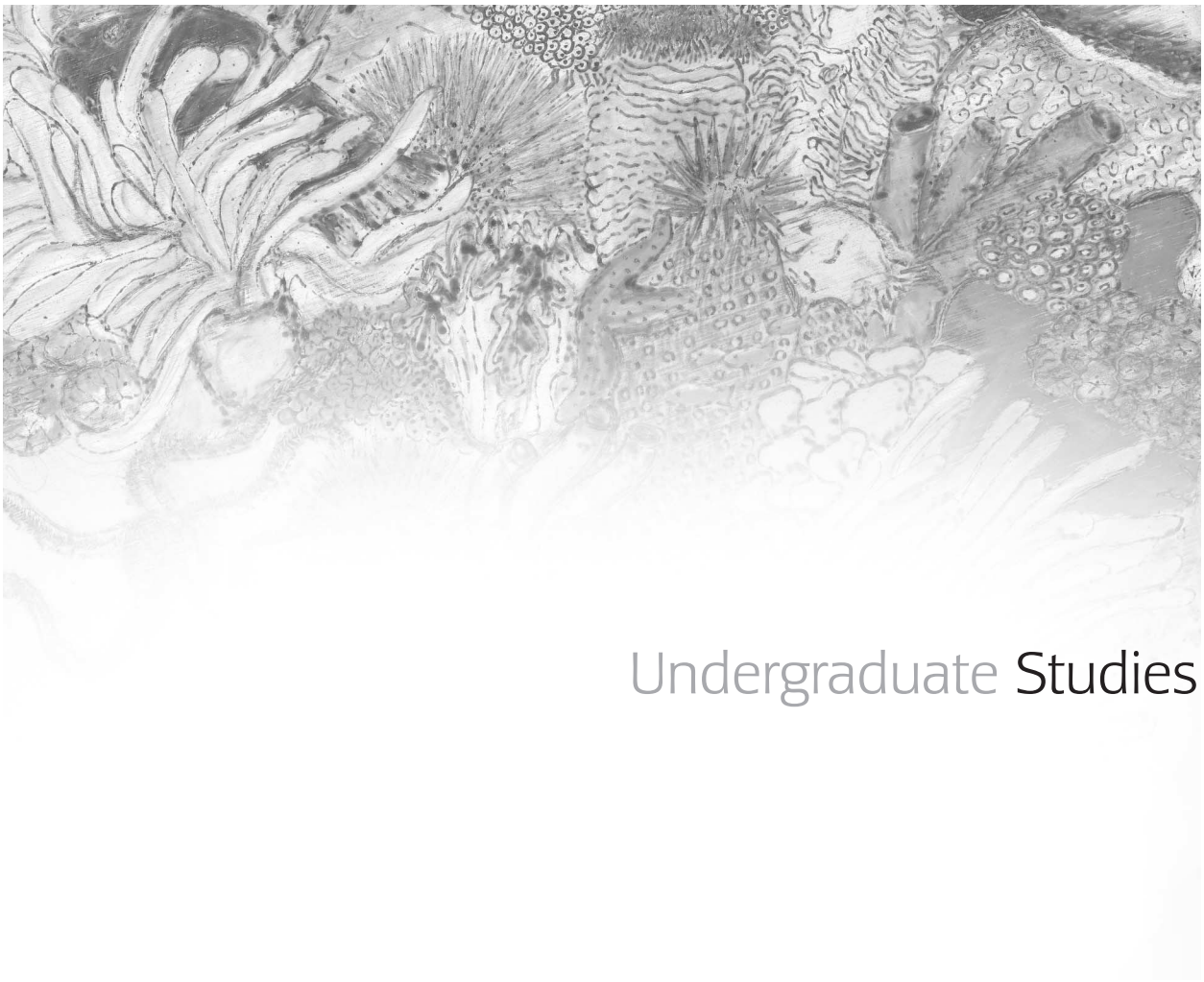
Shujie Xiao (Zhu)
Functional Analysis of RAD50 Mutants.

Full-time Students
Ph.D. Students

Abha Ahuja (R. S. Singh)
Hatim Abo-Ouf (S.Igdoura)
Maria Abou Chakra (J. Stone)
Vadim Aksenov (R.D.Rollo)
Fadi Al-daoud (R.Cameron)
Carlo Artieri (R.S. Singh)
Michael Begora (E.Weretylinik)
Stephen Brown (C.A. Nurse)
Carol Buckley (C.M. Wood)
Josef Buttigieg (C. A. Nurse)
David Capstick (M.Elliot)
Jessie Carviel (R.Cameron)
Frederic Chain (B. Evans)
Sarah Chiang (H.Schellorn)
Andrew Clack (H.Poinar)
Paul Criag (G.McClelland)
Nickett Donaldson (J. Daniel)
Tao Dong (H. E. Schellhorn)
Dregoesc, Diana (A. J. Rainbow)
Khaled Elmosrati (T.Finan)
John Fitzpatrick (S. Balshine)
Chan Gao (C. Baron)
David Guevars (E.Weretylinik)
Henry Haiser (M.Elliot)
Hindra (M.Elliot)
Noor Hossain (J.R. Jacobs)
Joel Klinck (C.M. Wood)
Derrik Leach (A.J. Rainbow)
Melanie Lou (G.B.Golding)
Allyson MacLean (T.M. Finan)
Juan Marquez (J.Kolasa)
Bart Maslikowski (A.Bedard)
Raheleh Masoudi (M.Fahnstock)
Khaled Mohamed (C. Baron)
Andrea Morash (G.McClelland)
Katie Moyer (J.R. Jacobs)
Guillermo Murphy (S.Dudley)
Michele Nawata (C.W.Wood)
Jyoti Panda (A.K. Grover)
Shubha Pandit (J.Kolasa)
Leena Patel (J.R. Jacobs)
Nikol Piskuric (C.A. Nurse)
Branislava Poduska (T.M. Finan)
Veronica Moncalvo Rodriguez (A.Campos)
Marie Pierre Schippers (G.McClelland)
Iqbal Setiadi (B.Evans)
Durga Sivanesan (C.Baron)
Lindsay Smith (P.Chow-Fraser)
Sheng Sun (J.P.Xu)
Magdalena Szewczyk (A.K. Grover)
Lixhen Wang (A. Bedard)
Abraham Yang (S.Igdoura)
Ye Zhang (T.Finan)

Full-time Students
M.Sc. Students

David Anderson (B.Evans)
Michelle Anstey (J.Daniel)
Megan Barcley (J.S.Quinn)
Sarah Chahine (M.J.O'Donnell)
Katie Clarke (C.A. Nurse)
Maja Cvetkovic (P.Chow-Fraser)
Aidan Dineen (A.Campos)
Leema Dookhoo (C.A. Nurse)
Jennifer Faubert (R.Cameron)
Amanda File (S.Dudley)
Romita Gosh (A.Bedard)
Amber Gleason (E.Weretylnik)
Kimberly Glenfield (Xu-Dong Zhu)
Daniel Gyewu (H.Schellhorn)
Gabriel Gyulay (S. Igdoura)
Sanjay Hiremath (J.P.Xu)
Fathima Iftikar Mohideen (C.M. Woods)
Katyayani Joshi (B.Gupta)
Charlie Joyce (H. Schellhorn)
Katerine Kibikin (T.Finan)
Andrea Kocmarek (M.J. O'Donnell)
Danya Konrad (G.B. Golding)
Ivy Kuszczak (A.K. Grover)
Sinah Lee (S. Dudley)
Erin Leonard (M.J. O'Donnell)
Daniel Li (H.Schellhorn)
Mochan Li (J.P. Xu)
Janice Lyn (C.D. Rollo)
Mitchell MacLeod (E.A. Weretylnik)
Megan McKerlie (X.D. Zhu)
Michelle Melone (C.Baron)
Jonathon Midwood (P.Chow-Fraser)
Jason Miller (J.S. Quinn)
Jason Mitakidis (G.B. Golding)
Taylo Mitchell (X.-D. Zhu)
Kyster Nanan (J.Daniel)
Alicia Pepper (A.Bedard)
Alexandra Pontefract (J.Stone)
Emmanuel Popo-Ola (A.Campos)
Daniel Wojcik Rokitnicki (P.Chow-Fraser)
Shaima Salman (C.Nurse/S.Igdoura)
Annika Samuelson (J.S. Quinn)
Marcus Scornaienchi (J.Wilson)
Ashwin Seetharaman (B.Gupta)
Thuraya Shaban (H.Schellhorn)
Emily Smith (J.Wilson)
Stephanie Sun (G.B.Golding)
Wilson Sung (G.B.Golding)
Julia Swiercz (M.Elliot)
Ghada Tarbah (S.Igdoura)
Ashley Tattersall (E.Weretylnik)
Lulu Vasquez Paz (J.R. Jacobs)
Katerina Vassilieva (J.R. Jacobs)
Sonali Weerawardane (J.Daniel)
Stephanie Yantsis (P.Chow-Fraser)
Manhal Younes (R.S. Singh)



Undergraduate Studies

Undergraduate Program Structure

Overview

Staff and faculty in the department of Biology teach, support and administer some of the largest courses and degree programmes in the Faculty of Science. We constantly strive to meet the changing academic and social needs of students by offering the most current and innovative means of support available.

Program Enrolment

Honours Biology Programmes	2002/03	2003/04	2004/05	2005/06	2006/07*	2007/08*
Biology Core (non-Specialist)	76	147	236	257	244	221
Biodiversity	7	15	25	26	25	21
Genetics	41	80	97	107	116	102
Genetics Co-op	n/a	6	11	17	16	16
Microbiology & Biotechnology	n/a	n/a	n/a	n/a	13	26
Origins	n/a	n/a	n/a	n/a	n/a	5
Physiology	n/a	n/a	n/a	n/a	n/a	34
Interdisciplinary Honours Programmes	**2002/03**	**2003/04**	**2004/05**	**2005/06**	**2006/07***	**2007/08***
Biology/Mathematics	6	5	9	9	11	12
Biology/Pharmacology Co-op	46	47	47	54	58	48
Biology/Psychology	92	107	112	128	121	111
Molecular Biology	28	23	21	22	26	19
Arts & Science/Science Programmes	**2002/03**	**2003/04**	**2004/05**	**2005/06**	**2006/07***	**2007/08***
Arts & Science & Biology	4	4	3	4	5	5
Life Sciences						
TOTALS	**300**	**434**	**561**	**624**	**635**	**620**

* The statistics of 2006/07 and 2007/08 are yet to be approved by the Office of the Registrar.

Undergraduate Programs

CORE BIOLOGY/NON-SPECIALIST

Counsellor: Dr. Susan Dudley

This programmes permits the greatest flexibility in the selection of courses. Students may choose biology courses following their own interests, or to develop an interdisciplinary approach to biology that may include obtaining a minor. This is excellent background for graduate studies if it includes a Biology Thesis or Project and includes Level III and IV courses from Science.

GENETICS SPECIALIZATION ANS GENETICS CO-OP

Counsellors: Dr. Xu-Dong Zhu and Dr. Herb Shellhorn (Co-op)

This programmes emphasizes practical applications of genetics in the study of human and animal disease, molecular models of development, molecular microbiology, evolutionary processes, gene expression, and the growing field of bioinformatics. Students will obtain practical training in molecular biology laboratory skills, communication skills and will thus be well prepared for a postgraduate career in academia, the health field or in the rapidly developing biotechnology industry.

The Genetics specialization requires the completion of an Honours Thesis in fourth year.

BIODIVERSITY SPECIALIZATION

Counsellors: Dr. Pat Chow-Fraser

Biodiversity is the diversity of life itself, at all levels of organization from the gene to the ecosystem. Without question, the preservation of biodiversity will be the single greatest challenge for the human race in the 21st century. The goal of the Biodiversity Specialization is to train students with the interdisciplinary skills they will need to deal with Biodiversity issues.

Required courses include Inquiry courses in years 2 and 3 and an Honours Thesis in fourth year.

ORIGINS RESEARCH SPECIALIZATION

Counsellor: Dr. Jonathon Stone

The Origins Institute is an intellectual enterprise that promotes, maintains and strengthens interdisciplinary collaboration among researchers who are interested in solving scientific problems concerning 6 themes:

- The origin of our universe
- The origin of elements
- The origin of structure of our universe (eg. Solar systems, planets)
- The origin of life
- The origin of species
- The origin of humans

Required course include two inquiry courses and a fourth year Honours Thesis.

PHYSIOLOGY SPECIALIZATION

Counsellor: Dr. Colin Nurse

MICROBIOLOGY SPECIALIZATION

Counsellor: Dr. Marie Elliot

This programme provides students with the opportunity to explore the many aspects of biology from a microbial perspective. This programmes has significant laboratory and problem-based learning components which allow students to focus on basic research as well as applied aspects of microbiology. The skills and experience gained through the programme will provide an excellent foundation for future careers in academia, the biotechnology industry or health-related professions.

Required course include a fourth year Honours Thesis.

Senior Thesis Project

Honours Biology students are invited in their fourth year to participate in novel, independent research in laboratories in the Department of Biology and throughout the University in the Departments of Anthropology, Medicine, Pathology & Molecular Medicine, Psychology, Neuroscience & Behaviour, and Psychiatry & Behavioural Neurosciences. Participation in a 9-unit thesis or a 6-unit project may be considered. The thesis may be completed by any Honours Biology Student, but is required for Students in th the Genetics, Biodiversity, Origins, Microbiology and Physiology specializations.

Thesis projects have covered a wide diversity of topics including human biology, population genetics, cancer biology, tropical ecology, evolutionary biology, fish physiology, microbiology, neuroscience, animal behaviour, plant pathogen resistance, and wetland ecology.

Examples of thesis titles:

- The Effects of Pollution in Hamilton Harbour on the Ability of Snails to Detect Predators
- The Effects of an Anti-aging Dietary Supplement on the Behaviour and Cognition of a Hyperactive Mouse
- Plant responses to belowground competition with siblings and strangers: A test for kin recognition
- In vivo complementation of Vitamin C deficiency using gene therapy preparation and characterization of gene therapeutic vectors
- Storm Event Monitoring of Water Quality in a Disturbed Watershed: Red Hill Creek
- A comparative analysis of the genes involved in the germ line proliferation and differentiation in nematodes

In 2005/06, 96 honors thesis projects and in 2006/07, 136 honors thesis projects were completed by Biology Students!

Ontario Biology Day

Ontario Biology Day has become a tradition for senior Biology undergraduate thesis students at McMaster University. The weekend conference is open to students of all Ontario Universities who undertake a senior thesis or project. It is an opportunity for them to reveal their findings and to meet representatives of other schools.

In 2006 the meeting was held at the University of Western Ontario. McMaster students numbered 46 of the 110 attendees at this year's Ontario Biology Day. In addition 10 thesis advisors participated in the event.

In 2007 the meeting was held at the McMaster University. There were 250 registrants from McMaster and other Ontario universities. There was a total of 160 presentations, both oral and poster. The Canadian Botanical Association Award was presented to McMaster's Jon Midwood.

Biology Undergaduate Symposium (BUS)

During the week following Ontario Biology Day, undergraduate students participated in McMaster Biology's poster day. Submissions covered areas of research as diverse as our department.

Honours, 2006

	Oral Presentations	Poster Presentations
Ecology/Physiology		
Winner:	Lindzie O'Reilly (Chow-Fraser)	Caroline Gross (Balshine/Earn)
Hon. mention:	Amanda File (Dudley)	Judith Ancheta (Rollo)
	Fathima Iftikar Mohideen (Wood)	Elaine Keung (Rollo)
Cell/Molecular Biology		
Winner:	Michelle Anstey (Finan)	Kevin Skoblenick (Mishra)
Hon. mention:	Barkha Patel (Tarnopolsky)	Yi Daniel Li (Schellhorn)
	Sarah Scattalon (Foster)	May Sanaee (Petrich)
Genetics/Evolution		
Winner:	Menaka Kanagaratnam (Golding)	Teresa Domladovac (Stone/Lovric)
Hon. mention:	Ashlee Vincent (Xu)	Amanda Cocca (Elliot)
	Brady Tracey (Evans)	Faiza Upal (Jacobs)
	Nancy Fairbarn (Stone/Evans)	

Honours, 2007

	Oral Presentations	Poster Presentations
Ecology/Physiology		
Winner:	Daniel Wojcik (Dudley/Chow-Fraser)	Laura Pierca (O'Donnell/Wood)
Hon. mention:	Christina Humniski (Chow-Fraser/Wilson)	Kira Shelton (O'Donnell/Kolasa)
	Christine Madliger (Chow-Fraser/Dudley)	Stefanie Sardellitti (Wilson/McClelland)
Cell/Molecular Biology		
Winner:	Sonali Fonsec (Wright/Burrows)	Swiercz (Elliot/Schellhorn)
Hon. mention:	Katie Taylor (Mossman/Daniel)	Erin Falconer (Baron/Coombes)
	Kyster Nanan (Dej/Jacobs)	Amin Sandhu (Richards/Trigatti)
Genetics/Evolution		
Winner:	Katie Mendelsohn (Stone/Dej)	Megan Dodd (Hortelano/Potter)
Hon. mention:	Lulu Vasquez Paz (Dej/Gupta)	Kirsten Avarmaa (Dej/Campos)
	Laura Golding (Quinn/Dudley)	Hina Zaidi (Dej/Campos)

Undergraduate Committees and Activities

BUGS Committee

The Biology Undergraduate Studies Committee, or BUGS, is a group of faculty, staff and students who meet regularly to discuss and resolve issues involving Undergraduate Studies in the Department of Biology. There are two student representatitves on the committee who act as advocates for their fellow students and help address their concerns to the department. The committee members are: Pat Chow-Fraser (Associate Chair), Robin Cameron, Kimberley Dej, Susan Dudley, Marie Elliot, Roger Jacobs, Lovaye Kajiura, David Rollo, Lori Goff, Kathy McIntosh, Jim Quinn, Joanna Wilson.

McMaster Biology Society

Presidents: P. Ostrovsky (2005-06), J. Wronzberg (2006-07); Vice presidents: N. Egber (2005-6), A. Sirisegaram (2006-7)

Back row: Nida Jabrani, Ryan Walker, Sonya Rai, Jordan Wronzberg, Mark Messih, Sunci Avlijas, Niraj Kadiaka, Arif Varani, Nina Kirischian, Aditi Kandewal
3rd row: Rabiya Hasan, Farhana Alam, Ben Connolly, Jen Faubert, Irina Skosireva, Alaina Baker, Katheen Cheung
2nd row: Jac Zemniak, Nicole Stieber, Reena Patel, Caitlin Mroz
Front row: Abby Siris

About Us

- A dedicated group of undergraduate students who
- Listens to the voices of fellow biology undergraduate students
- Organizes events to enrich undergraduate lives of peers
- Interacts with Faculty

Awards

MSU Academic Club of the year

Activities

- Second Year Welcome
- Bake Sales
- Thesis Night
- Career Night
- Resume Workshop
- Road to Professional School
- Halloween Night
- Formal
- Second Year Info
- Quarters Night
- Coffee House

Distinguished Honours

Our students in the undergraduate Biology programs are some of the best McMaster University has to offer. From 2006-2007, many of our students were recipients of University Scholarships and Awards for their academic excellence and contributions to the community.

The Anatomy Prize

Connor O'Sullivan
Richard Rotenberg

The Barbara & Ronald Bayne Gerontology Internship Award

Leslie Malloy-Weir

The Bentall Scholarships

Timothy Soh

The Abe Black Memorial Prize

Nikol Piskuric

The Josephine Staples Brien Scholarship

Priya Sharma

The Burke Memorial Ring

Jordan Wronzberg

The Edwin Marwin Dalley Memorial Scholarships

Rachel De Catanzaro	Joanna Jarecki	Duc Nguyen
Alison Fine	Kristen Krysko	Timothy Soh
Shirley Ho	Ali Lessan	

The Douglas Davidson Scholarship in Genetics

Ivan Quach

The D. M. Davies Prize

Kevin Freiburger
Priya Sharma
Steven van de Hoef

The Dubeck Biochemistry Award

Gayathri Vaidyanathan

The J.L.W. Gill Prizes

Kristen Krysko	Maria-Alexandra Petre	Timothy Soh
Andrea Lam	Nikol Piskuric	Kathryne Taylor
Emma Mazurek	Marko Skrtic	

The Anna Marie Hibbard Scholarship

Rebecca Jarvis

The Bertram Osmer Hopper Scholarship

Nikol Piskuric

The Jensen Medal

Paul Cassar
Igal Raizman

The Dr. Harry Lyman Hooker Scholarships

Amna Ahmed
Heather Ambraska
Erin Bourns
R.de Catanzaro
Kristina Dudley
Alison Fine
Michelle Ford
Laura Golding
Prateek Goyal
Sara Gracie
Rebecca Haque
Mark Hindle
Shirin Hosseinpour
Timothy Hurley
Alexandra Inman
Danielle Jarecki
Charlie Joyce
Maheen Khalid
Navid Khezri
Martin Komosa
Kristen Krysko
Andrea Lam
Mathew Leonardi
Ali Lessan
Yi Daniel Li
Christine Madliger
Michelle Melone
Lindzie O'Reilly
Patricia Pak
M. Petre
Laura Pin
Nikol Piskuric
Ivan Quach
Amin Sanhu
Leah Schmidt
Eric Siu
Irina Skosireva
Marko Skrtic
Timothy Soh
Kathryne Taylor
Ryan Walker
Ashley Whitehead
Michael Wortzman
Sina Zere
Mohammad Zubairi

The Dr. Ronald V. Joyce "Amazing Grace" Awards

Christine Kerr

The Ernest Robert MacKenzie Kay Scholarships

Laura Golding
Timothy Soh
Wilson Yu
Tracy Kok
Jordan Wronzberg

The Catherine MacNeill Prize

Christine Kerr

The Esther McCandless Memorial Prize

Simon Grafe
Lindzie O'Reilly

The J. J. Miller Prize

Rebecca Haque
Irina Skosireva

The Provost's Honours Roll Medal

David Diodati
Rebecca Jarvis
Navid Khezri
Mathew Leonardi
Marko Skrtic
Timothy Soh
Kathryne Taylor
Ashley Whitehead

The Psychology Society Prizes

Joanna Jarecki
Navid Khezri

The Herbert A. Ricker Scholarships
Simon Grafe
Emma Mazurek

The Rotary Club of Hamilton Scholarship
Rebecca Jarvis

The Dr. Sina Sazgar Memorial Scholarship
Simon Grafe
Rebecca Jarvis

The Science Alumni Scholarships
Rachel de Catanzaro
Ryan Walker

The Margaret A. Service Book Prize
Nadia Bashir
Hilary Noad

The Gerald and Verna Simpson Memorial Scholarship
Simon Grafe

The University Prizes for Special Achievement
Rachel de Catanzaro

The University (Senate) Scholarships:

Jacqueline Anand
Michelle Anstey
Kirsten Anwender
Niran Argintaru
Dipannita Basu
Erin Bourns
Alvin Choi
Nolan D'Souza
Linda Dang
Darren de Sa
Sonali Fonseca
Michelle Ford
Mina Girgis
Elizabeth Golesic
Sara Gracie
Caitlin Gregory
Mark Hindle
Shirley Ho
Timothy Hurley
Vladimir Jokic
Charlie Joyce
Sivanesan Kalaichandran
Julie Kim
Martin Komosa
Andrea Lam
Amy Lamothe
Kimberley Lewis
Mitchell MacLeod
Laura Mendelsohn
Andra Nica
Patricia Pak
Ivan Quach
Parastoo Salehi
Amin Sandhu
Leah Schmidt
Bernice Tsoi
Gayathri Vaidyanathan
Ashley Whitehead
Samantha Wong
Rosemary Yu
Diana Zilvytis
Nicole Zimmerman

Biology Academic Achievement Awards:
Top academic achievers in first year Biology courses:
Bio1A03 – Cellular & Molecular Biology
Bio1AA3 – Biodiversity, Evolution and Ecology

2005-06: BIO 1A03

Nadia Bashir	Nadia Bashir
Alison Fine	Nicole Cuevas
Briana Howarth	Alison Fine
Rebecca Jarvis	Tiffany Florindo
Wing Lo	Rebecca Jarvis
Zaid Mammo	Rebecca McDermott
Adam Rosanally	Adam Rosanally
Konrad Salata	Leah Schmidt
Leah Schmidt	Melissa Su'en Wu
Ryan Walker	Fang Yuan

2006-07: BIO 1A03

Katherine Alguire	Katherine Alguire
Andrew Chen	Benjamin Connolly
Muhammad Furqan	Ramnik Dhaliwal
Mayank Jha	Aretha (Hilary) Esdon
Matthew Kennedy	Muhammad Furqan
Andrea Matos	Matthew Kennedy
Asher Pasha	Aditi Khandelwal
Bryce Poirier	Jia-Huey Lin
Neha Verma	Hillary Noad
Radhika Voleti	David Tse

NSERC Undergraduate Summer Research Awards:

Summer 2006

Rachel Decatanzaro	Charlie Joyce
Christopher Dowding	Michelle Melone
Michelle Ford	Nikol Piskuric
Julie Gammon	Amit Rahalkar
Mina Girgis	Parastoo Salehi
Laura Golding	Timothy Soh
Mark Hindle	Jordan Wronzberg
Shirley Ho	Mohammad Zubairi

Summer 2007

R. de Catanzaro	Martin Komosa
Darren de Sa	Ali Lessan
Julie Gammon	Patricia Pak
Laura Golding	Nikol Piskuric
Sara Gracie	Ivan Quach
Caitlin Gregory	Irina Skosireva
Timothy Hurley	Ryan Walker
Navid Khezri	Jordan Wronzberg

Lecturers

INTERNAL

Dr. Ermias Azeria (sessional)
BIOL 3TT3 Community Ecology
Dr. Azeria is a postdoctoral fellow in the Department of Biology at McMaster University.

Dr. Dorothy DeSousa (sessional)
BIOL 3H03 Molecular Biology of the Nucleus
Dr. DeSousa is a recent graduate of the Department of Biology at McMaster University.

Dr. Andrew Donini (sessional)
BIOL 1A03 Cell & Molecular Biology
Dr. Donini is a postdoctoral fellow in the Department of Biology at McMaster University.

Dr. Linda Ellis (sessional)
BIOL 1K03 Biology for the Humanities & Social Sciences, BIOL 3K03 Animal Histology

Dr. David Galbraith (sessional)
INQ 4SB3 Inquiry in Science II (Biology), Science 2K03 Heredity, Evolution and the Environment.
Dr. Galbraith is an Adjunct faculty member in the Department of Biology. For more information on his research interests and professional activities, please look under the Adjunct Faculty section of this report.

Dr. John Lott (retired faculty)
BIO 3BB3 Ultrastructure, Development and Function of Plant Cells
Dr. Lott is a Professor Emeritus and continues to participate in teaching and research in the Department of Biology.

Dr. Sheila McNair (sessional)
BIOL 2G03 Inquiry 1 – Current Issues in Biodiversity
Dr. McNair is a recent graduate of the Department of Biology at McMaster University

EXTERNAL

Dr. Larry Belbeck
Department of Pathology and Molecular Medicine, McMaster University
BIOL 4G06 Human Anatomy

Dr. Richard Butler
Department of Pathology and Molecular Medicine, McMaster University
BIOL 3F03 Vertebrate Anatomy, BIOL 4G06 Human Anatomy

Dr. Bryan Clarke
Department of Pathology and Molecular Medicine, McMaster University
BIOL 4G06 Human Anatomy

Dr. Margaret Fahnestock
Department of Psychiatry and Behavioural Neurosciences
BIOL 4T03 Neurobiology

Dr. Ashok Grover
Department of Medicine, McMaster University
BIOL 3AA3 Fundamental Concepts of Pharmacology

Dr. Padman Jayaratne
Microbiologist in the Molecular Microbiology Division, Hamilton Regional Laboratory Medicine Program at St. Joseph's Hospital
BIOL 4P03 Medical Microbiology

Dr. John Waye
Department of Medicine, McMaster University
BIOL 4R03 Human Genetics

Dr. Peter Whyte
Department of Pathology and Molecular Medicine, McMaster University
MOL BIOL 4H03 Molecular Biology of Cancer

Biology Staff

OFFICE PERSONNEL

Name	Position
Marg Biggs	Administrative Secretary
Marge Geroux	Biology Administrator
Kathy Greaves	Administrative Secretary to the Chair & Administrator
Pat Hayward	Administrative Assistant – Graduate
Luce Lavigne	Administrative Secretary
Kathy McIntosh	Administrative Assistant - Undergraduate
Barb Reuter	Administrative Secretary

DEPARTMENT PERSONNEL

Name	Position
George Bijelic	Instructional Technician
A. Seong Cheong	Undergraduate Laboratory Assistant
Marvin Gunderman	Technical Coordinator / Instructor of Entomology
Alexandria Jewell	Glassware Technician / Biomedical Waste
John Paul King	Instructional Technician
Klaus Schultes	Electron Microscopy Specialist
Rafeek Abou Shaar	Computing Services Coordinator
Sharon Stray	Undergraduate Laboratory Assistant
Arthur Yeas	Greenhouse Technician

RESEARCH PERSONNEL

Name	Supervisor/Lab
Linda Diao	Chris Wood
Christina DiBerardo	Marie Elliot
Aline Fiebig	Suleiman Igdoura
Mihaela Georgescu	Roger Jacobs
Sunita Nadella	Chris Wood
Gregory Rekas	Christian Baron
Cathy Vollmer	Colin Nurse
Ying Wu	Andre Bedard
Natalie Zacal	Andrew Rainbow
Xiaoli Zhao	Ana Campos

INSTRUCTIONAL ASSISTANTS

The Instructional Assistants act a bridge between the students and faculty. An Instructional Assistant often runs the lab component of the course, keeps track of all student marks, reschedules students in lab sections and deals with student conflicts. An Instructional Assistant may develop new labs or modify existing ones and are very familiar with the course content.

Lori Ann Goff

Biology 1A03/1AA3, Cellular & Molecular Biology/Biodiversity, Evolution & Ecology

I received my B.Sc. in Molecular Biology and Genetics from the University of Guelph and then continued on at Guelph to do an M.Sc in Botany (Molecular Biology) with Dr. John Greenwood. I have a Certificate in Adult Education from Durham College and am in the process of completing a Masters in Education degree, part-time, through Brock University. Being an Instructional Assistant for the first year Biology courses provides many interesting challenges and, together with faculty from the department of Biology, I am currently involved in curriculum development for the new courses planned for the upcoming academic year. I love to travel, although with a new addition to our family, we seem to be trading the extended vacations and flights overseas trips in for weekend getaways and backyard camping trips! In my spare time I love the challenge of a new craft or home renovation project!

Marvin Gunderman

I have a very interesting position in the Department of Biology. As Technical Coordinator I supervise 13 staff members comprising 8 technical staff and 5 instructional assistants. As Instructor of Entomology I teach a insect taxonomy field course for the Ontario Universities Program in Field Biology, run insect related labs (in Biology 2F03, 3FF3) and guest lecture in several others (Biology 2G03, 2F03 and Origins 2FF3). I also give insect lectures for various groups on and off campus. As curator of our departmental insect collection and McMaster's expert contact for insect-related issues I also perform a wide variety of public relations activities involving stints on the radio (CHML) and TV (CH TV, Cable 14 and 23). Finally, as instructional assistant I help professors in several courses maintain marks and deal with student issues (Biology 2F03, 3SS3 and 3UU3). I did both my B.Sc. and M.Sc. here at McMaster.

Thelma Leech

Biology 2B03 Cell Biology; Biology 2D03 Plant Biodiversity.

A Hamilton native, I attended the University of Guelph where I obtained an Honours Bachelor of Science (Agriculture) degree with a Major in Environmental Biology and a sub-specialization in Plant Pathology. I left Guelph and worked briefly as plant manager at Clargreen gardens, Mississauga. It gave me the practical experience I needed to come to McMaster University as the greenhouse supervisor for the Biology Department. When I was hired I was the first women hired by McMaster University in a supervisory technical position. In addition to supervising the Biology greenhouse facility I was also senior TA for all botany courses in the Biology department. Over the years my position with Biology has evolved with the changing needs of the department and I became a full time Instructional Assistant. Currently I am the Instructional Assistant for Biology 2D03 and 2B03 (Cell Biology). When I became a full time Instructional Assistant I started a second Master's degree, this time at McMaster University. This degree was a Master of Science (Teaching). While science is a profession to provide a living, the Arts make life worth living. My personal interests reading Canadian and European history; collecting antique furniture, sewing & cooking tools; cooking with real foods; container & perennial gardening; hand sewing & quilting; attending music concerts; spending quality time with my cats, parrots, wild birds and garden.

Ray Procwat

Biology 2C03, Genetics

I obtained a B.Sc (Biology) from McMaster University (1973) and a B.Ed (Science and Math) from University of Toronto (1975). I taught Math and Science (1975-76) at Port Hope Secondary School. I started work at McMaster University in September 1976. I operated the Biology Resource Room and organized the Tutorials for Biology 1C6, the Genetics course. I enjoyed that year so much, that I stayed on until the present day. From 1993 to 2006, I spent the summers teaching Geometry in England and traveling through Europe. Now, I enjoy my summers traveling and golfing. I enjoy seeing plays at Theatre Aquarius and Toronto. I also enjoy working as a statistician for the Hamilton Bulldog Hockey team.

Alison Cowie, L.I.Biol, M.Sc

Biology 2EE3, Biology 3H03, Biology 3HH3, Biology 3V03

I grew up in England and worked for several years as a research assistant at the Imperial Cancer Research Institute in London at a time when molecular biology as we know it today was coming into being. It was an exciting time and it was there that I developed a love for research. I moved to the US in the 80's to work at one of the first start-up biotechnology companies in Boston. After 4 years there I moved again, this time to San Francisco to UCSF. There I met a young Canadian doing his post-doc, we married and I found myself in Hamilton, Ontario. In my 40s I decided it's never too late to learn so I applied to grad school here at McMaster and got my M.Sc in Dr. Finan's lab. I have worked in several labs in the department, I am a dyed in the wool molecular biologist by training, I even did a couple of years in the Mobix sequencing lab, but I am happy now to hang up my pipettors and enjoy the teaching aspect of the University as an Instructional Assistant. In my spare time I like to work on my garden at home and at the weekends I often volunteer at the Royal Botanical Gardens as a member of the Auxillary.

George Bijelic, Instructional Technician

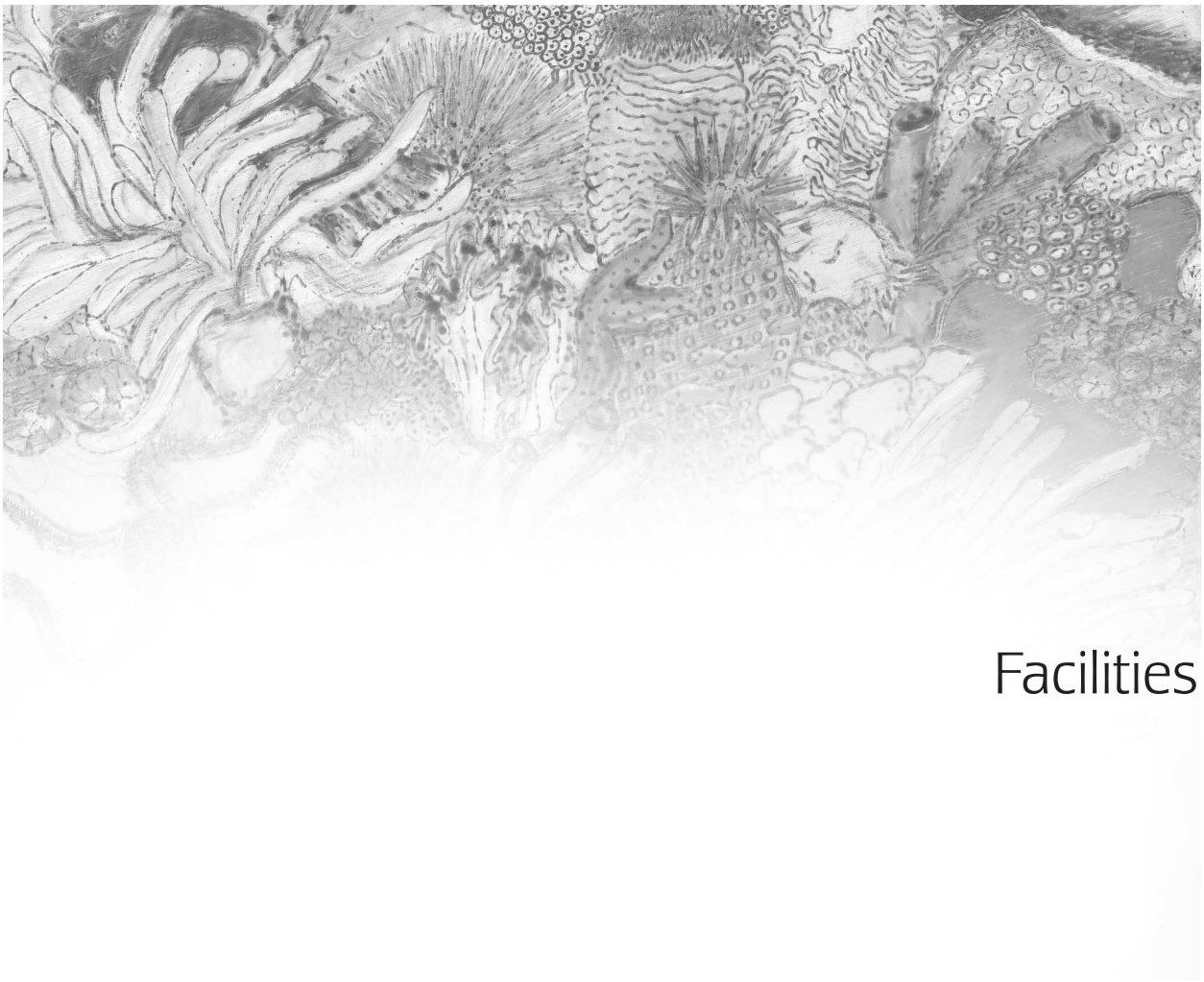
Biology 3M03, 3U03, 3MM3, 3B03 and 4Y03

The Department of Biology at McMaster University has been my home for quite some time as I earned both my undergraduate and masters degrees here. My masters research focused on the toxicology of organic cations and transport regulation of those molecules by Drosophila melanogaster under the supervision of Dr. Michael O'Donnell. In my current role, I am an instructional technician involved with several undergraduate courses including Animal Physiology, Plant Physiology, Invertebrate Form and Function, Developmental Biology and Ecology of Inland Waters. During my spare time you can find me playing baseball, golfing and rollerblading.

John Paul King, Instructional Technician

Biology 2D03, 2B03 and 2A03

JP King graduated from Memorial University with a BSc. in biology 2004. He completed his undergraduate thesis under the supervision of Dr. Helen Volkoff to investigate the effect of various hormones on feeding in goldfish. From here, he attended McMaster University's graduate school program with Dr. Suleiman Igdoura and investigated the underlying molecular mechanisms of Tay Sachs disease and its relation to excitotoxicity. After completing his Masters in 2007, JP continued his research career in the Laboratory for Functional Tissue Engineering at the Universiy of Toronto with Dr. Milica Radisic. Shortly after, he transferred to McMaster University to fulfill the role of Instructional Technician for Cell Biology and Animal Physiology. He currently resides in Dundas where he enjoys swimming, jogging, and cooking.



Facilities

OVERVIEW

The Department of Biology has a wide range of core facilities that are available to its research labs. These include the insect rooms, the fish facilities and the plant facilities (greenhouse and plant growth chambers). We also have a wide range of imaging equipment available in the Microscope facilities.

The Institute for Molecular Biology and Biotechnology (MOBIX) manages the MOBIX lab, a centre that provides a wide range of molecular biology services to McMaster University.

MICROSCOPE FACILITIES

These facilities provide scientists with the equipment and training necessary to generate and interpret microscopic images. Faculty and staff with expertise in electron microscopy can help design, conduct and interpret your analyses.

Resources:

Surface Imaging

Samples that are dry, wet or oily can be observed without the aid of any metal coating in our new Environmental SEM (Electroscan 2020 ESEM). Dynamic changes can be studied as samples are subjected to changes in temperature on a 1500° C heating stage, applied tension or compression (up to 1000 pounds and 1000° C) or changes in hydration. Wet or oily samples can viewed on a low-temperature control stage (-5° to + 30° C) or at ambient temperature.

Low-Temperature Preparation

Cryogenic techniques are available for studying samples on our Transmission Electron Microscope (TEM).

Image Analysis

Areas, dimensions, volumes and many other features of images can be quantified.

Element Composition

Energy dispersive x-ray (EDX) analysis provides information about elements present in very small areas of the sample. Elemental distributions can sometimes be mapped. Standardless semi-quantitative or fully quantitative results can be obtained.

Interior Imaging

Thin sections (>40 nm) of epoxy resin embedded samples can be viewed for ultrastructure and/or element composition. Wet samples can be frozen, cryosectioned, and the frozen sections observed using a cryostage on our TEM.

Particles and Flocs

Dry particulate samples can be studied for structure and composition. Colloids and flocs can be observed.

Electron Microscope Facility

The Electron Microscope Facility is located in the basement of the Life Sciences Building. The facility is managed by EM Specialist Klaus Schultes.

The facility is equipped with:

Confocal microscope

- BIO RAD Microradiance Confocal Microscope
- The system is attached to a Nikon E800 conventional epi-fluorescence microscope
- Lasers include an Argon Ion (488, 514) and Helium Neon (543)
- Z-drive with a focus resolution of 0.05 microns
- Transmission detector installed
- Dual Photomultipliers
- LaserPix 2D software for analysis and enhancing of your images

Nikon Eclipse TE2000-S Inverted Fluorescent Microscope

- Nikon DXM1200F digital camera
- Computer with ACT-1 imaging software
- 2x,10x,20x,60x, and 100x oil objectives

Environmental scanning electron microscope

- ESEM 2020
- Full environmental capabilities with LaB6 filament
- Peltier cold stage for viewing wet samples
- Fullam tensile/ 1000 ° C heating stage for compression or tension studies (1000lb, 50lb, & 250 gr load cells and linear transducer) coupled to Mtest windows live readout system.
- Electroscan 1500 ° C heating stage
- Micromanipulator with ability to add liquid or gases to samples in situ
- PGT microanalysis system with PRISM light element detector, semi or full quantitative analysis software/ image analysis software
- VCR recording available with miroVIDEO video digitizing and editing system

Scanning Transmission electron microscope

- JEOL 1200EX11 STEM
- 120 KV LaB6 Scanning Transmission Electron Microscope
- Gatan cryo transfer system installed
- Single tilt and double tilt goniometers
- PGT IMIX microanalysis system with beryllium detector, semi and full quatitative software package/ image analysis software

MOLECULAR BIOLOGY FACILITIES

MOBIX lab

Is a part of the Institute for Molecular Biology and Biotechnology (MOBIX) (See web page http://www.science.mcmaster.ca/mobix, contact: mobix@mcmaster.ca for more information)

MOBIX Lab is committed to providing diligent service and support in Oligo synthesis, DNA sequencing and fragment analysis with exceptional quality, accuracy and value. We believe in integrity and teamwork in everything we do. We will continue to progress with the purchase and sharing of state-of-the-art equipment and introduction of new services. Mobix Lab is located in the Life Sciences Building, Room B123

Resources:

Oligo Synthesis

Oligos are synthesized on an ABI 394 DNA/RNA Synthesizer, an ABI 3400 DNA/RNA Synthesizer or an ABI 3900 High Throughput DNA Synthesizer. We have recently partnered with Integrated DNA Technologies (IDT) in order to provide our customers a more cost effective lower scale oligo synthesis (30¢per base) and modified oligos.

Sequencing
DNA cycle sequencing in our lab is performed using ABI BigDye terminator chemistry and ABI PRISM® 3730S Genetic Analyzer. This is a 48-capillary machine using a multi-color fluorescence-based DNA analysis system, which is fully automated from sample loading to data analysis.

Fragment Analysis
Fragment analysis, Microsatellite analysis and SNP

Equipment Available
Alpha Imager 2200, Kodak Image Station 440, and a STORM 820 Phosphorimager.

Phone: 905-525-9140 Ext. 27048
FAX: 905-526-1427
Email: mobixlab@mcmaster.ca

Facility Manager: Galina Kataeva
Technicians: Liliana De Sousa and Leanne Blanchard

CENTER FOR ENVIRONMENTAL GENOMICS

Environmental genomics is a multi-disciplinary field that uses the techniques of genetics, molecular biology and chemistry to examine the impacts of environmental pollutants (and nutrients) on the genomes of organisms. This research is inherently multi-disciplinary and crosses the borders of each of these traditionally distinct fields of research. We have developed a team of scientists that cross many of these areas and who can work together in this new and exciting field. Genomics itself is the analysis via high throughput means of the genome structure and constituent genes from organisms. The rapid development of automated means to practice molecular biology techniques will revolutionize the fields of genetics and biology. This center originated through funding from Genome Canada, Ontario Research Fund, Canadian Foundation for Innovation and McMaster University. Equipment in the Environmental Genomics Center is housed in rooms LSB-507 and LSB-516 and includes a Hewlett Packard 6890 Gas Chromatograph with auto-sampler and FID detector, a Thermo-Finnigan GC-MS system, a Tecan Safire Fluorescence and Absorbance plate reader, a Multiprobe Automatic liquid handling system, a Genomic Solutions automatic colony picker (GeneTAC G3), and a Microarray Scanner (ScanArray Express, Packard).

Contact: Turlough Finan (Phone: 905-525-9140 Ext. 22932, email: finan@mcmaster.ca)

COMPUTER FACILITY

The Biology Computer Lab, located in LS-215, has 18 on-line pcs with WinXP Professional and office professional productivity applications as well as specialized course-specific applications are installed on these systems. Laser printing and scanning services are also offered to account holders in this facility. As the lab may be booked for classes, as well as open access for staff, faculty, undergraduate and graduate students.

Contact: Mr. Rafeek Abou Shaar (Phone: 905-525-9140 Ext. 24027, email: aboushr@mcmaster.ca)

ANIMAL FACILITIES

Insect rooms

The LSB has a small insectary used for housing live insects for physiology experiments. The insects include the American cockroach, *Periplaneta americana,* and the true bug *Rhodnius sp.* The former is used in undergraduate physiology labs and the latter in research labs by Dr. Mike O'Donnell.

Marvin Gunderman is our instructor of entomology and curator of biology's insect collection. The collection has pinned specimens from the 1930's right up to 2006 and is thus a valuable resource for presence/absence and range data for insects from mostly southern Ontario. Student collections from Marvin's courses are integrated into the departmental collection ensuring growth. There is a small liquid collection of mostly larvae and pupae. The collection has been used by several researchers for range data, especially the Lepidoptera (butterflies only) and Coleoptera (Coccinellidae and Cicindelidae).

Contact: Marvin Gunderman (Phone: 905-525-9140 Ext. 23556, email: gunderman@mcmaster.ca)

Fish facilities

The aquatic laboratories are a multi-user facility housed in five separate rooms (B101, 575 sq. ft; B102, 185 sq. ft; B109, 200 sq. ft; B112, 895 sq. ft; B135, 250 sq. ft.) in the basement of Life Sciences Building. It has the capacity for maintaining fish of various sizes in tanks ranging from 1.5 - 500 L, as well as conducting experimental procedures and analytical work. The facility currently maintains a variety of fish species including the freshwater rainbow trout *(Oncorhynchus mykiss)* and yellow perch *(Perca flavescens),* the tropical zebrafish *(Danio rerio),* the euryhaline killifish *(Fundulus heteroclitus),* and the aestivating African lungfish *(Protopterus annectens).* In addition to fish, invertebrate cultures are held in B112 including the midge larva, *Chironomus riparius* and the cladoceran, *Daphnia magna.* The facility is used in part to study the effects of environmental stressors on homeostatic mechanisms in fish. In particular, the laboratories of Drs. Wood and McClelland are currently performing industrially-supported research to gain a better understanding of impact of metals to aquatic biota. The research is expected to yield valuable information that will be used in the derivation of a new generation of environmental regulations for metals. A large basic research component is focused on understanding basic physiological questions relating to acid-base and ion regulation, and nitrogenous waste excretion. The facility is equipped with a unique swim tunnel, to allow for research on exercise physiology, as well as X-ray equipment, and a Passive Integrated Tagging (PIT) system to enable fish identification and tracking. A breeding colony of zebrafish and microinjection equipment allows for studies of reproduction and development. In the past five years more the 15 undergraduate students, 15 graduate students, 16 postdoctoral fellows and a number of visiting professors have used the facilities to conduct experiments.

Contact: Chris Wood (Phone: 905-525-9140 Ext. 23537, email: woodcm@mcmaster.ca)

PLANT FACILITIES

Greenhouses

The Biology Greenhouse, which is located to the west of The James Stewart Center (formerly Hamilton Hall), is used extensively, for teaching and research purposes. Each year hundreds of students either use the greenhouse in their laboratories or use plants provided by the greenhouse. A number of research projects use green facilities, especially those of Susan Dudley.

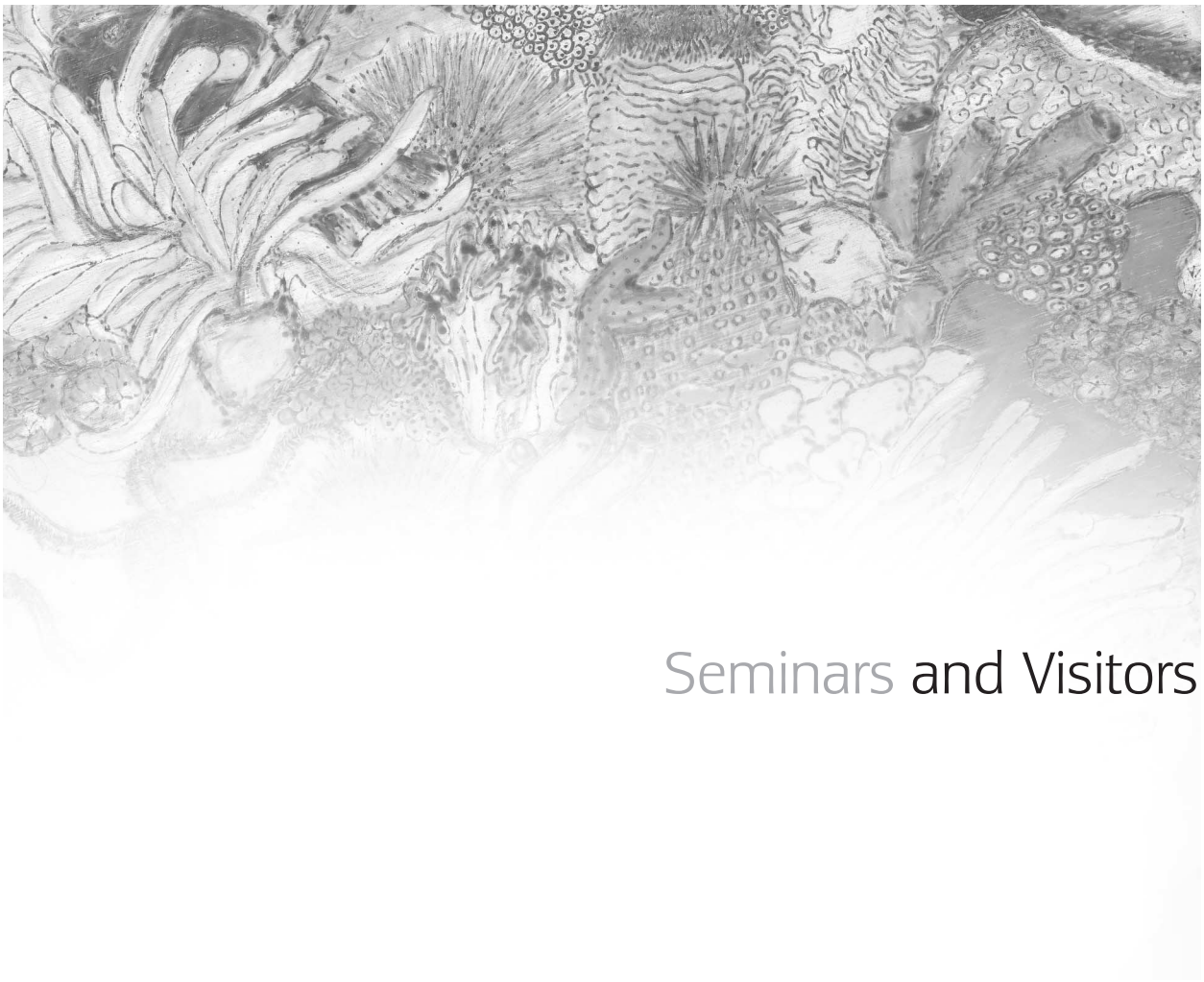
Contacts:

Mr. Art Yeas, (Phone: 905-525-9140 Ext. 24284, email: yeasart@mcmaster.ca)

Dr. Susan Dudley, (Phone: 905-525-9140 Ext. 24004, email: sdudley@mcmaster.ca)

BARC (Bay Area Restoration Council)

Bay Area Restoration Council (BARC) is at the centre of efforts to restore and protect the ecosystem heath of Hamilton Harbour and its watershed. Located in the Life Sciences Building, Room B130F, BARC's Great Lakes and Hamilton Harbour Resource Centre contains 1000's of documents on Great Lakes Clean-up projects, with a particular emphasis on the Hamilton Harbour Remedial Action Plan (RAP), Cootes Paradise marsh and the McMaster Ecowise program. The resource centre is open to visitors most weekdays from 10 am to 3 pm. Students may borrow items for one week. Volunteer activities and public meetings are listed on the web site: learnlink.mcmaster.ca/barc. You can also email BARC at barc@mcmaster.ca or call 905-525-9140 Ext: 27405.



Seminars and Visitors

Visitor Seminars

Biology Seminar Series

2006

Dr. Bhagwati Gupta, McMaster University
(January 12, 2006)
Development and Evolution of Reproductive Ssytem in C. elegans and Related Nematode Species.

Dr. Antonia Monteiro, University of Buffalo
(January 26, 2006)
Butterfly Eyespots: Function, Development and Evolution

Dr. Kim Jones, McMaster University
(February 9, 2006)
Biological Interactions with Biomaterials.

Dr. Eric Masse, University of Sherbrooke
(February 23, 2006)
Regulation Iron Homeostasis Through mRNA Stability.

Dr. Joel Levine, University of Toronto
(March 9, 2006)
Social Control of Biological Clocks.

Dr. Stephan Schoech, University of Memphis
(March 23, 2006)
Food Supplementation and Timing of reproduction: Studies in the Florida Scrub-Jay.

Dr. Matthew Spencer, University of Liverpool
(September 21, 2006)
Evolution of Gene Content in Prokaryotes: Conditioned Genome Reconstruction, Parasites, and Heterotachy.

Dr. Wen-Hsiung Li, University of Chicago
(October 6, 2006)
Some Current Issues in the Evolution of Duplicate Genes.

Dr. Francois Fagotto, McGill University
(October 12, 2006)
How Cells Sort To Form Tissues: Insights From The Frog Embryo

Dr. Sara Otto, University of British Columbia
(November 16, 2006)
Why Have Sex? The Population Genetics of Sex and Recombination.

Dr. Ryan Gregory, University of Guelph
(November 23, 2006)
The Evolution of Genomes at Large.

Dr. Daniel Klessig, Boyce Thompson Institute for Plant Research (November 30, 2006)
Salicylic Acid, Salicylic Acid-Binding Proteins and Plant Immunity.

Dr. Sally Assmann, Pennsylvania State University
(December 1, 2006)
Systmes Biology of Hormone Signalling in Guard Cells.

Dr. Michel Loreau, McGill University
(December 14, 2006)
Biodiversity and Ecosystem Functioning: Linking Theory and Experiment.

2007

Dr. Greg Wray, Duke University
(January 25, 2007)
Gene Expression in Primate Evolution: Natural Selection and Phenotypic Consequences.

Dr. Mick Bhatia, McMaster University
(February 8, 2007)
Characterization and Regulation of Human Stem Cells.

Dr. Xin Li, University of British Columbia
(February 15, 2007)
MOS4 Associated Complex (MAC) in Plant Innate Immunity.

Dr. Cameron Currie, University of Wisconsin
(February 22, 2007)
Ants, Agriculture and Antibiotics.

Dr. Otto Geiger, Univ. Nacional Autonoma de Mexico
(March 1, 2007)
Biosynthesis Function and Replacement of Membrane Lipids in Bacteria.

Dr. David Baillie, Simon Fraser University
(March 8, 2007)
Transcriptional Profiling in C. elegans: A Comparison of Three Genome-wide Approaches.

Dr. Stephen Michnick, University of Montreal
(March 22, 2007)
How are Biochemical Networks Organized in Living Cells?

Dr. Carolyn Price, University of Cinncinnati
(March 29, 2007)
Stirring the Pot: Surprises in Telomere Protection

EEE (Evolution, Ecology, Ethology) Seminar Series

2006

Roberto Quinlan, York University
(January 4, 2006)
Paleolimnological perspectives on long term changes in aquatic ecosystems.

Robert Baker, University of Toronto
(January 11, 2006)
Behavioural ecology of dragonflies: responses to predators and parasites.

Aneil Agrawal, University of Toronto
(January 18, 2006)
Parasite load and sexual selection.

Rudi Winklbauer, University of Toronto
(January 25, 2006)

Maria Abou Chakra, McMaster University
(February 1, 2006)

Ken Davey, York University
(February 8, 2006)
From insect ovaries to sheep red blood cells: a tale of two hormones.

Melanie Huntley, McMaster University
(February 15, 2006)

Boris Igic, Cornell University (February 22, 2006)

Hendrik Poinar, McMaster University (March 1, 2006)

Robert Hanner, University of Guelph (March 8, 2006)
DNA barcodes demystified.

Paul Higgs, McMaster University (March 15, 2006)

Karl Cottenie, University of Guelph (March 22, 2006)

Gary Sprules, University of Toronto (March 29, 2006)
Are patchy prey necessary for the survival of aquatic predators in nature?

Dawn Bazely, York University (April 5, 2006)

John Stinchcombe, University of Toronto
(September 13, 2006)
Ecological genomics of plant life history and morphology

Stephen Wright, York University (September 20, 2006)
Testing for the role of genetic drift vs. local adaptation in plant divergence

Dick Morton, McMaster University
(September 27, 2006)
Evolution of the Bacterial Origin of Replication

Leslie Warren, McMaster University
(October 18, 2006)
Geobiology of Acid Mine Drainage Biofilms

Wilfried Haerty, McMaster University
(October 18, 2006)
Gene expression comparison in testes of D. melanogaster subgroup species and their hybrids

Chris Lortie, York University (October 25, 2006)
Using community ecology to explore invasive plant species dynamics: two case studies.

Rich Glor, University of Rochester (November 8, 2006)
Species Diversification in the Adaptive Radiation of Caribbean Anolis Lizards

Chris Eckert, Queens University (November 15, 2006)
Reproductive assurance and the evolution of uniparental reproduction" or "The pros and cons of mating with yourself

Jonathan Newman, University of Guelph
(November 22, 2006)
Community Structure and Ecosystem Function in Micro Communities: Treeholes and Laboratories for Community Ecology

Spencer Barrett, University of Toronto
(November 29, 2006)
Evolution of Plant Sexual Diversity: The Complex Sex Life of Wild Daffodils

2007

Roger Jacobs, McMaster University (January 3, 2007)
Climate Science: Moving from Observation to Experimentation

John Fitzpatrick, McMaster University
(January 10, 2007)
Social control of reproduction in a cooperative fish

Bob Montgomery, Queens University
(January 17, 2007)
How birds get their colours

Thomas Merritt, Laurentian University
(January 24, 2007)
The Drosophila melanogaster NADP enzymes as a model for metabolic complexity and control

Elizabeth Boulding, University of Guelph
(January 31, 2007)
Escalated microevolutionary change in shelled mollusc prey after an invasion by durophagous predators

Dan Mennill, University of Winsor (February 7, 2007)
Rare Sounds: Bioacoustic tools for tracking Ivory-billed Woodpeckers and Neotropical Wrens

Darren Grocke, McMaster University
(February 14, 2007)
A North American transect of hydrogen and oxygen isotope ratios in beetles

Asher Cutter, University of Toronto
(February 28, 2007)
Population genetic variation in Caenorhabditis nematodes: Inferences about demography and selection

Bennett (Jeff) Galef, McMaster University
(March 7, 2007)
Social influences on what animals choose to eat and with who they choose to mate.

David Guttman, University of Toronto
(March 14, 2007)
Evolutionary and molecular dissection of a co-evolutionary arms race

Bob Murphy, Royal Ontario Museum
(March 21, 2007)
Genetics and the conservation of the desert tortoise, Gopherus agassizii

Alberto Civetta, University of Winnipeg
(March 28, 2007)
Sperm under the eye of selection

Ron Pearlman, York University (April 4, 2007)
Tetrahymena megalomics: update and specifics from the Tetrahymena thermophila genome project

Origins Institute Seminar Series

2006

Robert Logan, University of Toronto
(January 16, 2006)
The Extended Mind: The Origin of Language and Culture

James Kasting, Penn State University
(January 23, 2006)
The Extended Mind: The Origin of Language and Culture

Ford Doolittle, Dalhousie University
(February 6, 2006)
The Extended Mind: The Origin of Language and Culture

Ken Ragan, McGill University (February 13, 2006)
The Extended Mind: The Origin of Language and Culture

Francis Halzen, University of Wisconsin
(February 27, 2006)
The Extended Mind: The Origin of Language and Culture

Timothy Beers, Michigan State University
(March 6, 2006)
Carbon Enhancement in the Galaxy -- A New Probe of the First Stars

Richard T.W. Arthur, McMaster University
(March 20, 2006)
The Origins of Newton's Laws

Debra Shepherd, Natl. Radio Astronomical Observatory
(April 6, 2006)
Links Between Star and Planet Formation

Adam Burrows, University of Arizona
(September 25, 2006)
Links Between Star and Planet Formation

Barbara Sherwood Lollar, University Of Toronto
(October 2, 2006)
H2-rich fluids in the deep Earth: Potential for chemoautotrophic microbial ecosystems

Anna-Louise Reysenbach, Portland State Univ.,
(October 16, 2006)
Integrating geology, geochemistry and biology reveals new discoveries at deep-sea hydrothermal vents

Amanda Karakas, Origins Institute (October 23, 2006)
Germanium Production in Astrophysics

Cliff Burgess, McMaster University, Perimeter Inst. (October 30, 2006)
Cosmic Inflation: The Ultimate Free Lunch

Todd Lowe, Ucsc Rna Center (November 6, 2006)
Life at Boiling Temperatures: Surviving in a Rough Neighborhood

Arthur L. Koch, Indiana University (November 13, 2006)
Life at Boiling Temperatures: Surviving in a Rough Neighborhood

Carolyn Eyles, Indiana University (November 20, 2006)
Was it cold enough to make snowballs in the Proterozoic?

Penny Morrill, Carnegie Institution (November 27, 2006)
Distinguishing biogenic from abiogenic gases – challenging a biosignature paradigm

Jurek Kolasa, McMaster University (December 4, 2006)
Emergence of complexity - is biodiversity a beneficiary or a victim?

2007

Sergey Mashchenko, McMaster University (January 8, 2007)
Galaxy formation from first principles: are we there yet?

Brian Golding, McMaster University (January 22, 2007)
An examination of rates and patterns of lateral gene transfer

John Spray, University Of New Brunswick (January 29, 2007)
The evolution of Mars and conditions for past and present life

Richard Leveille, Canadian Space Agency (February 5, 2007)
Of Microbes and Minerals…and Mars

Peter Brown, University of Western Ont. (February 12, 2007)
Meteoritic Delivery of Primitive Solar System Materials to the Earth

Lee Smolin, Perimeter Institute (February 26, 2007)
Meteoritic Delivery of Primitive Solar System Materials to the Earth

Dr. Wesley A. Traub, Nasa Jpl (March 5, 2007)
Exoplanets and the Search for Life

Gianfranco Vidali, Syracuse University (March 12, 2007)
Making Molecules in Space: a View from the Laboratory

Ben Evans, McMaster University (March 26, 2007)
The Struggle For Persistence After Gene Duplication

Leslie Orgel, Salk Institute For Biological Studies (April 9, 2007)
The First RNA World

External Seminars

(Seminars given at outside institution by faculty members of the Biology department)

Baron, Christian
Max-Planck Institute for Terrestric Microbiology, Marbug, Germany, December 17, 2007
Analysis of protein complex assembly in the bacterial cell envelope: The model of type IV secretion systems.

INRS Institut Armand-Frappier, Laval, Canada, November 6, 2007
Applications de la biologie structurale et chimique au désarmement des bactéries pathogènes: Le modèle du système de sécrétion de type IV.

Concordia University, Department of Biology, Montréal, Canada, October 10, 2007
From Bioremediation to Biowarefare: On the Impact and Mechanism of Type IV Secretion Systems.

Université de Montréal, Dépt de Microbiologie et Immunologie, Canada, Oct. 5, 2007
Applications de la biologie structurale et chimique au désarmement des bactéries pathogènes: Le modèle du système de sécrétion de type IV de Brucella suis.

University of Guelph, Department of Pathobiology, Canada, September 28, 2007
Structure and Chemical Biology Approaches to Understand the Brucella suis Type IV Secretion System.

Université de Montréal, Département de Biochimie, Canada, April 16, 2007
Analyse de l'assemblage des complexes protéiques membranaires: Le modèle des systèmes de sécrétion de type IV.

Queens University, Department of Microbiology and Immunology, Kingston, March 29, 2006
From bioremediation to biowarfare: On the impact and mechanism of type IV secretion systems.

60th Annual Brucellosis Research Conference, Chicago, USA, January 12, 2007
Small Molecule Screening to Isolate Inhibitors of the Brucella Type IV Secretion System.

Montréal Structural Biology Meeting, Mont-St-Hilaire, Canada, November 27, 2007
Structure and Chemical Biology Approaches to Understand the Function of Type IV Secretion Systems.

Bedard, Andre
Meeting on Molecular Chaperones and the Heat Shock Response. Cold Spring Harbor Laboratory, NY. May 3-7, 2006
The Menin tumour suppressor is a regulator of the stress response in Drosophila melanogaster.

47th Annual Drosophila Research Conference, Houston Texas, March 29-April 2, 2006
Dissecting the function of the Mnn1 tumour suppressor gene in Drosophila melanogaster.

Cameron, Robin
Canadian Phytopathological Society, Eastern regional meeting. University of Guelph, May 11, 2007.
Induced Resistance in the Arabidopsis-Pseudomonas model system.

University of British Columbia, Department of Botany, March 29th, 2007
Systemic Acquired Resistance And Age-Related Resistance, two distinct Induced Resistance Pathways that both require salicylic acid.

University of Laval, Department of Biochemistry, February 28th 2007
Systemic Acquired Resistance And Age-Related Resistance, two distinct Induced Resistance Pathways that both require salicylic acid.

University of Sherbrooke, Department of Biology, February 27th, 2007
Systemic Acquired Resistance And Age-Related Resistance, two distinct Induced Resistance Pathways that both require salicylic acid.

American Phytopathological Society Annual Meeting, Quebec, Canada, July 2006
Multiple roles of salicylic acid in defense.

Chow-Fraser, Pat
The Great Lakes United Annual General Meeting. Ryerson University, Toronto, June 16, 2007.
The Last Frontier: Submerged emergent lands in a changing climate.

Tadenac Club Workshop. Tadenac Bay, Georgian Bay, June 5/6, 2007
Biodiversity values of the Tadenac Bay wetlands.

Pointe au Baril Islands Association Environmental series, Ojibway Club, Pointe au Baril, July 14, 2007.
The importance of coastal wetlands of eastern Georgian Bay for fish communities of Lake Huron.

MacGregor Bay Cottage Association. MacGregor Bay, August 12, 2007
Georgian Bay coastal wetlands: there's no life like it.

Annual Lake Huron Liaison Committee Meeting. Wye Marsh Center, Midland, September 26, 2007.
Impacts of low water levels on fish habitat of Georgian Bay wetlands.

A.D.Latornell Conservation Symposium, Barrie, November 12-15, 2007
Major threats to fish habitat in coastal wetlands of eastern Georgian Bay: too many people and too little water.

University of Toronto, Department of Surgery, Toronto, 2007
Convergence of the catenin p120ctn and Kaiso on downstream targets of the Wnt/b-catenin Signaling Pathway.

McMaster WISE (Women in Science and Engineering) Seminar Series, 2007
Roles of the POZ-ZF Transcription Factor Kaiso in Wnt Signaling and Vertebrate Development.

MD Anderson Cancer Center, Dept. of Biochemistry and Molecular Biology, Houston, Texas, 2006.
The POZ-ZF transcription factor Kaiso: roles in Wnt signaling and development.

Univ. Minnesota Cancer Center, University of Minnesota, Minneapolis, 2006
Convergence of the catenin p120ctn and Kaiso on the Wnt/b-catenin signaling pathway.

Dudley, Susan
Society for the Study of Evolution, Stony Brook, New York, June 27, 2006
Plant Responses To Below ground Competition With Siblings And Strangers: A Test For Kin Recognition.

Elliot, Marie
American Society for Microbiology Annual General Meeting, Toronto, May 2007
Regulation and Development in Streptomyces coelicolor.

University of Alberta, Edmonton, March 2007
The chaplins: cell surface proteins essential for aerial development in Streptomyces coelicolor.

Evans, Ben
University of Guelph, Department of Integrative Biology, 2007
Speciation genetics and duplicate gene evolution in clawed frogs (Xenopus).

University of Windsor, Department of Biology, 2007
Testing alternative demographic scenarios of sympatric species: Implications for biodiversity conservation in Indonesia.

Harvard University, Department of Organismal and Evolutionary Biology, 2007
Duplicate gene evolution and expression.

Laurentian University, Department of Biology, 2007
Testing alternative demographic scenarios of sympatric species: Implications for biodiversity conservation in Indonesia.

Queens University, Department of Biology, 2007
Testing alternate demographic histories: implications for biodiversity conservation on Sulawesi Island, Indonesia

York University – Eastern Great Lakes Molecular Evolution, 2007
Vertebrate demography on Sulawesi Island , Indonesia.

Finan, Turlough M.
20th North American Symbiotic Nitrogen Fixation Conference, University of Milwaukee, Wisconsin, July 10-14, 2007.
Genomics of Sinorhizobium.

Canadian Society of Microbiology Conference. Montreal, Quebec June 17-20, 2007
Phosphate metabolism in bacteria.

15th International Congress on Nitrogen Fixation, Cape Town International Convention Center, Africa, January 21-26, 2007.
Solute transport defining the transportome.

Golding, Brian G.
Genome Canada ICI meeting, Guelph, June 17, 2007
Data archiving and analysis: Barcode analysis futures.

Eastern Great Lakes Mol Evolution, Toronto, May 5, 2007
Searching for the species of origin for gene sequences.

American Society of Microbiologists, Toronto, May 22, 2007
Genome content evolution in the genus Mycobacterium.

Intl. Phylogenomics Conference, St. Adele Quebec, March 16-19, 2006
Lateral transfer among bacteria.

SMBE meeting Tempe Arizona, May 24-28, 2006
Lateral transfer among bacteria.

Bioinformatics Graduate student conference, University of Montreal, Nov. 13-14 2006
Lateral transfer among bacteria.

Gupta, Bhagwati
Genetics Society of Canada (GSA) 50th annual meeting, Montreal, 2007
Vulval development in nematodes C. elegans and C. briggsae.

Department of Molecular Biology and Biochemistry, Simon Fraser University, Vancouver, November 2007.
Evolution of developmental mechanisms in nematodes C. elegans and C. briggsae.

Jacobs, Roger
Ecology and Evolutionary Biology Seminar Series, McMaster University, January 2007
Climate Science

Kolasa, Jurek
Ecological Society of America Annual Meeting, San Jose, California, 2007
Predictions and postdictions from the hierarchical representation of habitat.

Ecological Society of America Annual Meeting, Memphis, Tennessee, 2006
Hump-shaped diversity-productivity relationship may be caused by habitat variability and involve community variation.

McClelland, Grant
Trent University, Department of Biology, Peterborough, November 2007
Muscle metabolism: Ontogeny, plasticity and phylogeny.

University of Ottawa, Department of Biology, Ottawa, November 2006
Muscle metabolism: Ontogeny, plasticity and phylogeny.

APS Intersociety Meeting: Comparative Physiology, Virginia Beach, October 2006
Conserved aspects of exercise fuel selection.

Canadian Society of Zoology Meeting, Edmonton, May 2006
Submaximal exercise fuel selection patterns are conserved with artificial selection for aerobic capacity in rats.

University of Guelph, Dept of Integrative Biology, Guelph, March, 2006
Using fish as a model for vertebrate muscle (metabolic) plasticity

Nurse, Colin
Novartis Foundation Symposium. Wiley, Sussex, UK
Signalling pathways in acute oxygen sensing.

Xth Oxford Conference on Modeling and Control of Breathing, Lake Louise, Alberta.
Sept 19-24, 2006

Joint Congress/ Symposium of Anatomical Society in Giessen, Germany, March 31, 2007
Excellence Cluster Cardiopulmonary System.

O'Donnell, Mike
Canadian Society of Zoologists 46th Annual Meeting, Montreal, May 21-25, 2006
Too much of a good thing: How insects cope with excess ions or toxins in the diet.

American Physiological Society Intersociety Meeting: Comparative Physiology Integrating Diversity, Virgina Beach, VA, October 8-11, 2006
Rapid regulation of ion transport by the anal papillae of mosquito larvae in response to changing salinity.

Quinn, Jim
Laurentian University, Sudbury, Ontario, 2007
Air pollution induced germ-line mutations following ambient exposures of mice and gulls.

Kairos, Burlington, 2007
Water and Air as Commons: Heritable Mutations – a shared cost of pollution.

Hamilton Naturalists Club, Burlington, Ontario, 2006
Cooperation and Conflict in Communal Nesting Birds.

Origins Institute workshop "The Genomic Revolution and the Origin of Humanity", McMaster University, Hamilton, 2006
Pollution induced germ-line mutations in gull and mouse tandem repeat DNA.

Environmental Health Sciences, Ohio State University, Columbus OH, 2006
Pollution induced germ-line mutations in gull and mouse tandem repeat DNA.

Biological Sciences, University of Windsor, 2006
Conflict and cooperation in capitalist and communist birds.

Rainbow, Andrew
Peter MacCallum Cancer Centre Research Seminar Series, Melbourne, Australia, Feb/07
Constitutive and inducible nucleotide excision repair in human cells: Studies using a recombinant adenovirus encoded reporter gene.

School of Life and Environmental Sciences, Deakin University, Geelong, Victoria, Australia, February 2007.
Constitutive and inducible nucleotide excision repair in human cells: Studies using a recombinant adenovirus encoded reporter gene.

Molecular Pathology Research Division, Department of Pathology, Peter MacCallum Cancer Centre, Melbourne, Victoria, Australia, February 2006.
Use of a recombinant adenovirus encoded reporter gene to examine constitutive and inducible repair of UV-damaged DNA in mammalian cells.

Westmead Institute for Cancer Research, Westmead Millennium Institute, Sydney, NSW, Australia, February 2006.
Use of a recombinant adenovirus encoded reporter gene to examine constitutive and inducible repair of UV-damaged DNA in mammalian cells.

Rollo, Dave
Canadian Society of Zoologists Annual Meeting, Edmonton, Alberta, May 2006
Alterations in Transgenic Growth Hormone Mice with Particular Emphasis on Aging.

NATO Advanced Research Workshop on Multiple Environmental Stressors and Risk Assessment, Minsk, Belarus, November 2006.
Multidisciplinary aspects of regulatory systems relevant to multiple stressors: aging, xenobiotics and radiation.

Lyon Mathematical and Quantitative Biology Conference, Lyon, France, May 2007
Overview of Research on Giant Transgenic Mice: From Evolutionary Ecology to Gene Transcription.

Toward a unification of stress responses, aging, and radiobiology: a glimpse of the regulatory bauplan.

Symposium on Low Dose Radiation Effects, Nevada Cancer Center, July, 2007
Radiation and the Regulatory Landscape of Neo2-Darwinism.

Singh, Rama
Burlington Baptist Church. November 18, 2007
Invited to comment on a film dealing with evolution vs Intelligent Design contoversy.

The Fourth Gandhi-King Conference on Peacemaking. Gandhi Centre, Christian Brothers University, Memphis, USA, October 13-14, 2007
The biological basis of human freedom: violence is not in our genes.

Pugwash World Youth Conference for a Hunger-Free World. M.S. Swaminathan Research Foundation, Chennai (India). January 29-February 1, 2007
Role of women in sustaniable development.

Conference sponsored by Shastri Indo-Canadian Institute. McGill University, Montreal.
May 3-5, 2007.
Women and Social Change

The Sixth Annual Mahila Shanti Sena (Women's Peace Brigade) Conference, Sarnath (Varanasi), India.
February 14-16, 2007.
I was the organizer and the chair of the conference.

Stone, Jonathan
Eastern Great Lakes Molecular Evolution Meeting, University of Buffalo, May 6, 2006
Achieving Goals in Regulation Time: Computer Simulated Promoter Region Evolution.

Wood, Chris
28th Annual Meeting of SETAC, Milwaukee, Wisconsin, U.S.A. November 11-15, 2007
Gill-copper binding, acute copper toxicity, and oxidative stress in the tropical freshwater zebrafish Danio rerio as a function of water chemistry.

International Conference of Comparative Physiology, Biochemistry and Toxicology & 6th Chinese Comparative Physiology Conference, Hangzhou, China, October 10-14, 2007
The Biotic Ligand Model: Using physiology, geochemistry and modelling to predict metal toxicity.

7th International Congress of Comparative Physiology and Biochemistry, Salvador, Bahia, August12- 16, 2007,
Brazil. Knut Schimdt-Neilson Memorial Lecture. In praise of expeditionary physiology.

46th Annual Meeting of the CSZ, Montreal, Canada, May 21-25, 2007
Post-feeding alkalosis in the dogfish shark: Does the alkaline tide go out?

Annual Meeting of the Society for Experimental Biology, Scotland, April 31- March 4, 2007
Cultured branchial epithelia from freshwater trout.

Soc. for Environmental Toxicology and Chemistry 27th Ann. Meeting, Montreal, Nov. 5-9, 2006.
The influence of dietary chemistry on responses of fish to metals: towards a dietary BLM.

American Physiological Society Conference, Virginia Beach, October 8-11, 2006
Discoveries in basic physiology from fish living in extreme pH environments.

VIIth International Congress on the Biology of Fish, St. John's Newfoundland, July 18-22, 2006.
How hard is that diet? Implications for metal accumulation and Toxicity.

Annual meeting of the Society of Experimental Biology, CBP-A, University of Kent at Canterbury, UK, April 2-7, 2006.
Physiological consequences of feeding in the dogfish shark, Squalus acanthias.

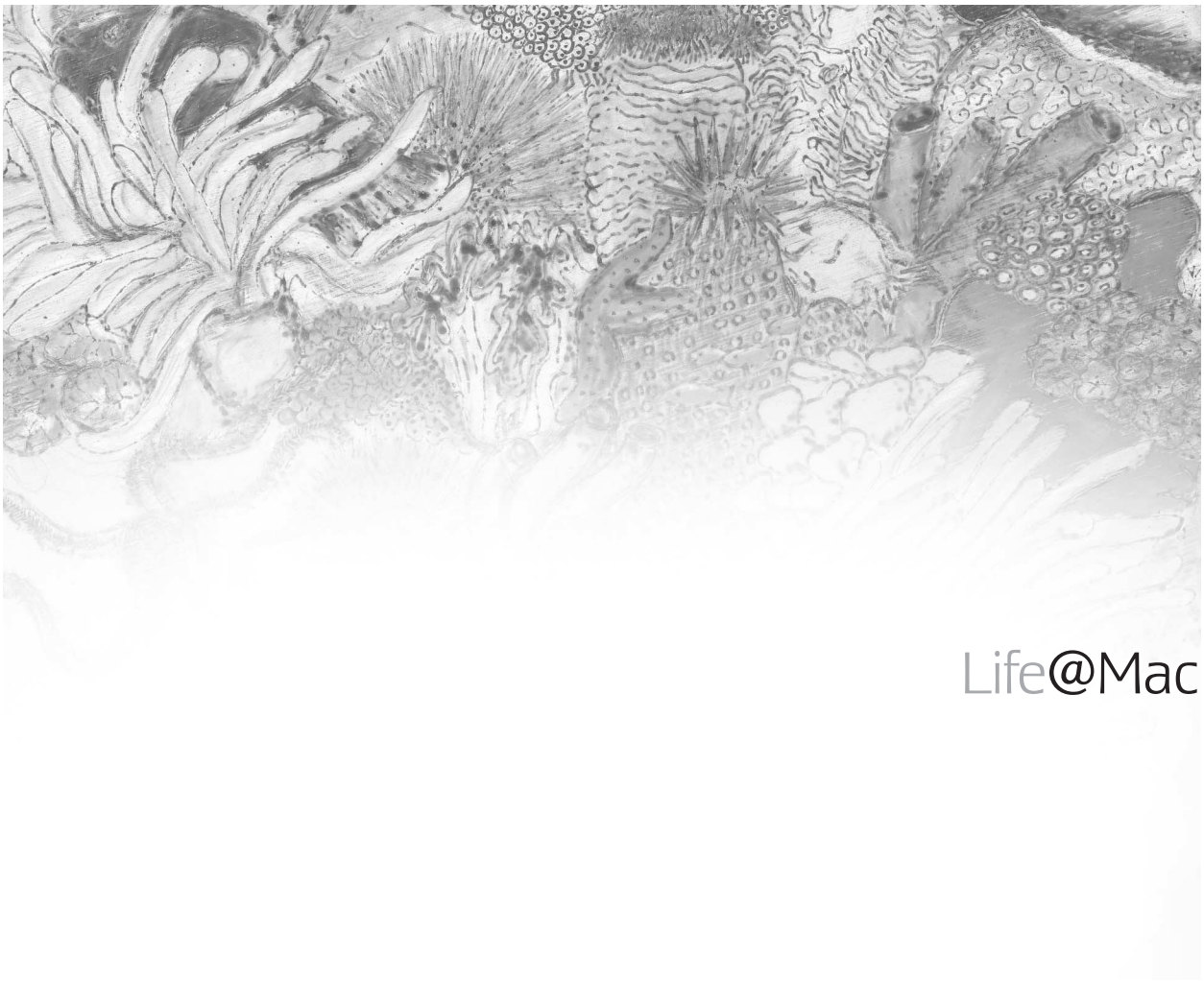
45th annual meeting of the Canadian Society of Zoologists, University of Alberta, Edmonton, May, 2-7, 2006.
An Appreciation.

Zhu, Xu-Dong
Cold Spring Harbor Laboratory Meeting on Telomeres and Telomerase, Long Island, NY. May 4, 2007.
Control of TRF1 by Rad50 and ATM in telomere length maintenance

Bloomfield Centre for Research in Aging, Sir Mortimer B. Davis Jewish General Hospital, McGill University.
Nov. 28, 2006.
The Role of DNA Repair Complexes at Human Telomeres.

Fifth Canadian Symposium on Telomeres and Telomerase. Calgary, Canada. May 13, 2006.
The Role of Rad50 at Human Telomeres

Cancer Biology Retreat, McMaster University, Nov. 21, 2006
The Role of DNA Repair Complexes at Human Telomeres.



Life@Mac

Campus and City Life

McMaster University

McMaster University, established in 1887, has occupied its present site in the beautiful west end of Hamilton. Faculties include those of Science, Engineering, Health Sciences, Humanities, Business and Social Sciences. The campus has grown significantly since it officially moved to Hamilton in 1930 and currently houses 55 buildings. Full-time student enrolment at McMaster is approximately 19,000 undergraduate and 2,800 graduate students. The main campus is bicycle and pedestrian friendly and easily accessible by local transit and out of town buses.
Collaboration between the various departments of McMaster and studies in interdisciplinary areas are a valuable feature of the scientific research programmes in the University. In the Department of Biology, research may be undertaken entirely within the Department or in conjunction with other Departments such as Anatomy, Biochemistry, Geology & Geography, Pathology, Physics and Psychology.

The University has recently completed a new Multi-Sport Complex. This new facility is located at the north end of the Ivor Wyne Centre. Highlights include: a new wellness and fitness centre that will rank among the best in Canada; the only indoor track in Hamilton, with four 200-metre lanes and sprint lanes; four new squash courts, suitable for international competitions; an additional 15,000 square feet of gymnasium space, double the current capacity; a high performance strength and conditioning area; an indoor climbing wall and cycling studio; multipurpose studios for karate, yoga, dance and tai chi; and an expanded sports medicine and rehabilitation centre. Among the sports activities organized in the University, a renowned Climbing and Caving Club deserves special mention. At appropriate seasons, golf, skiing and sailing are available in the area.

Among various building projects underway is the construction of the New Ronald V. Joyce Stadium. The $30 million, 5,000-seat Stadium will create an impressive venue for university football and soccer. It will build on a fan base for university athletics that is already one of the most supportive in the country. It will also position McMaster and Hamilton as the number one destination in the Golden Horseshoe for amateur sporting events, attracting fans and sport tourism dollars into the City.
For more information about the University and its facilities and services visit
www.mcmaster.ca/welcome/aboutmac.cfm

Hamilton – The City

Hamilton (a city with population ~500,000) is located between Toronto and Niagara Falls. It is situated at the extreme western tip of Lake Ontario. The Niagara Escarpment (locally known as "the mountain), cuts through the city provides an excellent view of the city and its natural harbour. Hamilton is about an hour's drive from Toronto International Airport. In addition, it is less than two hours away from the Buffalo (N.Y.), the closest border of United States.

The city has two major sports activity centres, the Victor K. Copps Coliseum and the Ivor Wynne Stadium. Copps Coliseum is home to the Hamilton Bulldogs hockey team and the stadium is used by the Hamilton Tiger Cats Football team. In addition, Hamilton Place, is one of the finest concert halls in Canada which attracts a variety of plays, musicals, ballets and concerts throughout the year.

The average winter temperature in Hamilton ranges between 0 and –5oC. The snowfalls are lighter compared to the other Canadian cities. The summer temperatures range between 20 to 35oC.
For details about Hamilton, **please visit the website** www.myhamilton.ca.

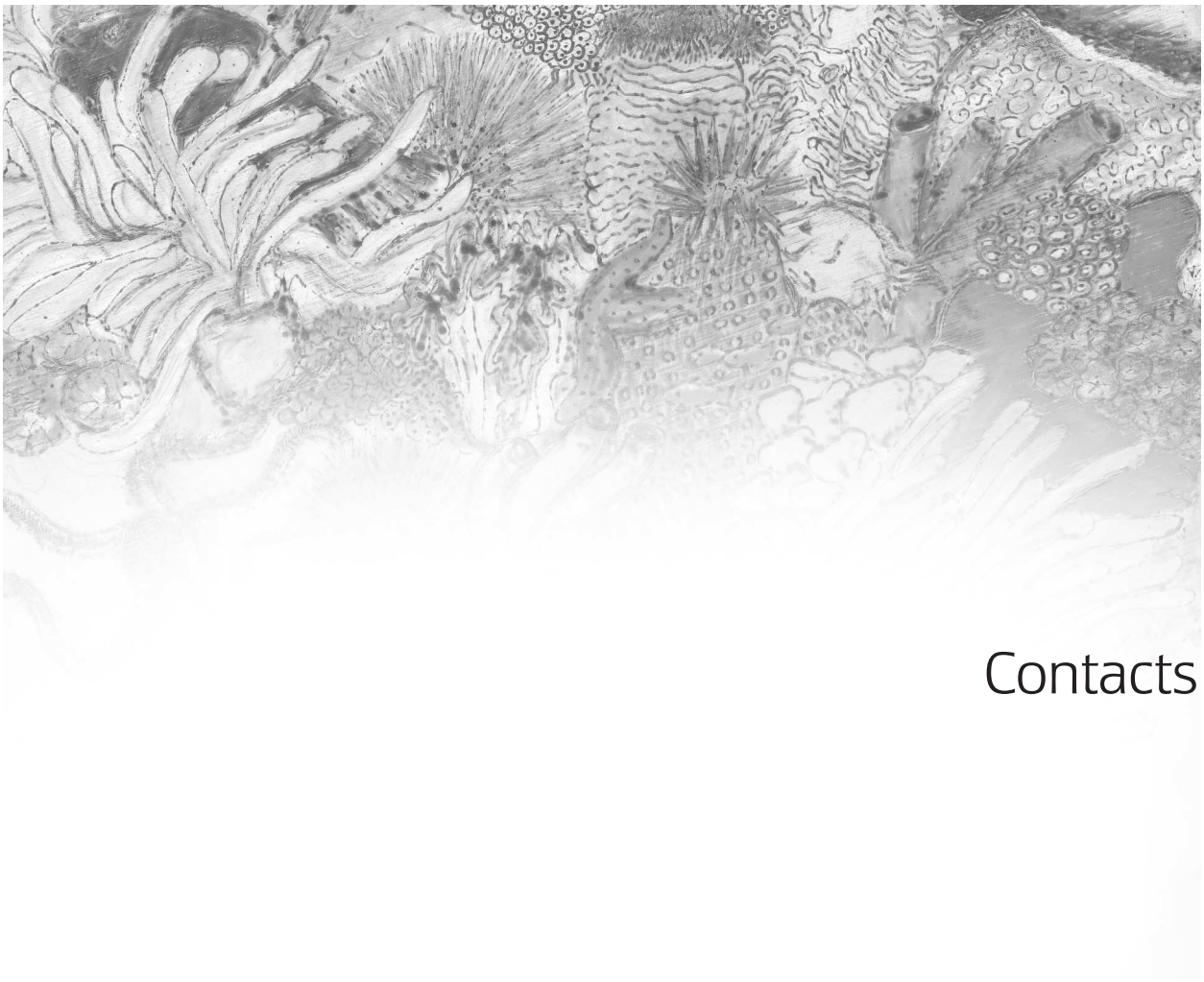
Housing

The housing in Hamilton is generally easy to find around the University campus. There are a large number of condos and detached houses within 10 km of the University. While rents vary depending upon the location and condition of the building, they range between $500 to $2000 per month.

The local newspaper "Hamilton Spectator" is a good source for accommodation advertisements. In addition, the McMaster student housing office (in McMaster University Student Centre) also provides help.
Please check out the website http://macoffcampus.mcmaster.ca.

Tourism and transportation

The City and surrounding areas have efficient transportation services. There are many ways in which you can travel in Hamilton. For further information on how to travel to/from and around Hamilton by car, plane, bus, train, bicycle or boat, go to the following **website:** www.tourismhamilton.com



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