Graduate Studies Day 2011
Abstracts

Keynote speaker presentation

Sunny Hartwig
Understanding Kidney Stem Cells and Disease

Renal dysplasia, defined as tubular malformation of the kidney, is the most common cause of end-stage renal failure (ESRF) in young children. The congenital human kidney diseases Frasier Syndrome, Denys Drash and WAGR (*W*ilms' tumour, *A*niridia, *G*enitourinary abnormalities and mental *R*etardation) Syndrome, are characterized by severe renal dysplasia, and are associated with a poorer quality of life, the need for dialysis, and in severe cases, ESRF requiring kidney replacement. All of these syndromes are linked to mutations in the *Wilms' Tumour Suppressor-1 (WT1)* gene. *WT1* mutations are also causally-linked to the paediatric kidney cancer, Wilms' tumour (nephroblastoma), the most common solid tumour of childhood. *WT1* plays an essential role in normal kidney stem cell differentiation during kidney development *in vivo*. However, the molecular mechanisms and target genes that mediate WT1 function are largely undefined. Neither is it understood how mutations in *WT1* cause disease. The aim of my research program is to define the role of WT1 and its downstream *SoxC* effectors in controlling stem cell differentiation during early kidney development, and to gain insight into the pathogenesis of WT1-dependent diseases. Ultimately, our goal is to help lay a foundation for therapeutic stem cell-based strategies that will treat, reverse, and ultimately prevent kidney disease in these children.

Dr Hartwig is an Assistant Professor at the Department of Biomedical Sciences, Atlantic Veterinary College.

Student oral presentations

Clayton D'Orsay[a], Donna Giberson[a], David McCorquodale[b]
Pasture management and grazing intensity and beetle species richness and abundance on a managed Nova Scotia dairy pasture.

Intensive use of pasture can reduce production costs for dairy farmers, providing high quality feed for livestock. Management intensity and grazing rate can influence pasture quality, affecting the diversity of organisms using the pasture, and the ecological services they provide. Beetles are known indicators of ecological disturbance in various habitats and their presence/absence and abundance can be informative of pasture condition. The most abundant pasture beetle taxa; Carabidae (ground beetles), Staphylinidae (rove beetles) and Curculionoidea (weevils) were sampled from an experimental dairy pasture that had been divided into eight replicates of four management intensity treatments. 2,461 specimens were collected representing 85 species. Species richness was shown to increase as management intensity increased, while intensification reduced beetle abundance, which was influenced by a few species of seed-feeders with higher density in the extensively managed treatments. This study illustrates that intensive pasture management is not detrimental to pasture beetle diversity.

Author's affiliation: [a]Biology Department, [b]Biology Department-U Cape Breton

Iskandar Saada[a], Rabin Bissessur[a], Douglas Dahn[b]
Novel nanocomposite materials for lithium-ion polymer batteries

Currently utilized lithium-ion polymer batteries possess excellent conductivity properties, however prolonged charge time and environmental sustainability are still a concern for this technology. Therefore the highlight of today's research is geared towards obtaining enhanced conductivity, thermal stability from environmentally benign materials, utilizing intercalation chemistry. Intercalation chemistry is a type of guest-host chemistry which allows for the insertion of solid polymer electrolytes into layered structures. The layered structure of interest is lithium hectorite. Lithium hectorite and solid polymer electrolyte nanocomposites are anticipated to combine the conductivity of the polymer along with the thermal stability of the layered structure, yielding a highly conductive

and environmentally sustainable material. The presentation will illustrate the enhanced properties obtained from the new materials synthesized.

Author's affiliation: [a]Chemistry Department, [b]Physics Department

Kevin Sorochan, Pedro A Quijon
Stage-specific abundance and horizontal distribution of Dungeness crab (*Cancer magister*) larvae in an inland sea

Horizontal distribution patterns provide basic information to understand larval dynamics in a particular system. Stage-specific patterns of Dungeness crab (*Cancer magister*) larvae were described in the Strait of Georgia, B.C. Larvae were sampled from a grid of stations in late April 2009 and 2010. First stage larvae were restricted to the southern region and the eastern margin of the central strait. In 2009, second and third stage larvae were widespread, whereas in 2010, they remained prevalent only within the eastern half of the strait. Fourth stage larvae were only present the central region. Horizontal patterns suggest that most larvae are released from the southern region and along the central mainland coast. Larvae then appear to either concentrate in the middle of the central region or are retained along the eastern margin. These patterns have serious implications for the set up of marine protected areas.

Author's affiliation: Biology Department

Edward D Cross, Michael P Shaver
Stereocontrolled synthesis of polymer brushes based on poly(lactones)

Non-linear biomaterials have been popularized because of their low toxicity, controlled properties and lowered production costs, with applications in a vast array of different fields. Within this constellation of materials, polymer brushes have received considerably less attention, but can also serve as a diverse platform for bioassimilable drug delivery vectors with easily tunable properties. Our group has recently reported the first controlled polymerization of vinyl acetate by a vanadium-based catalyst through a controlled radical process.[1] This allows access to poly(vinyl acetate) with well-defined molecular weight, which can then be transformed into poly(vinyl alcohol)s. This poly(vinyl alcohol) backbone then serves as a multi-functional macroinitiator for the ring-opening polymerization of cyclic lactones to access desired polymer brushes. These biodegradable materials are easily modified through the length of the poly(vinyl alcohol) core as well as the percent lactone composition. In the case of poly(lactic acid) and poly(3-hydroxybutyrate), further control over material properties of the resulting polymer brushes may be attained by varying the tacticity of the brush arms.

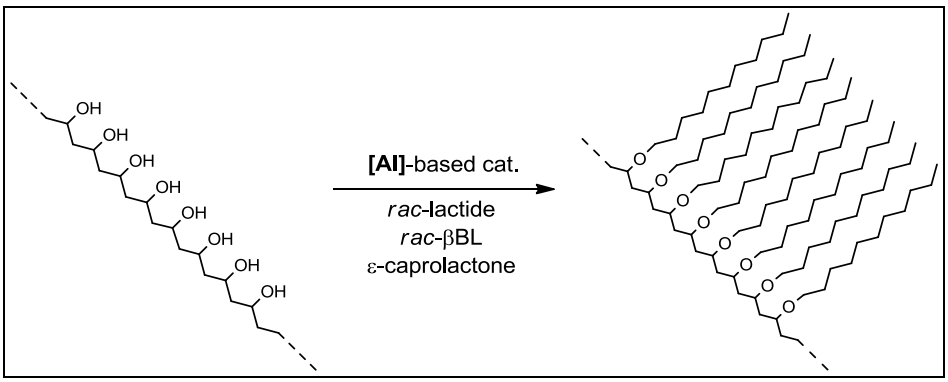

Figure 1: Ring-opening polymerization of various cyclic lactones by aluminum-based catalysts using a poly(vinyl alcohol) macroinitiator.

[1]Shaver MP, Hanhan ME, Jones MR. *Chem. Commun*. **2010**, *46*, 2127.

Author's affiliation: Chemistry Department

Guru Selvaraj[a,b], Marva Sweeney-Nixon[a], Bourlaye Fofana[b]
Paving the way for the functional characterization of Flax Lignan biosynthetic genes

Flax (*Linum usitatissimum* L.) is a versatile crop contributing to 1% and 3% of the world's food and fiber production. Canada is a leading producer representing 40% of the global supply. With its numerous nutraceutical properties, flax is an emerging functional food. Seeds are rich in secoisolariciresinol diglycoside (SDG) lignans, a precursor of the mammalian lignans enterolactone and enterodiol. SDGs are diphenolic nonsteroidal phytoestrogens with potential health benefits to human, with antidiabetic and anticancer properties. *In planta,* lignans are found glycosylated and glycosylation alters the stability, solubility, reactivity, thereby affecting bioavailability and bioactivity. 1-Uridine diphosphate glycosyltransferases (UGTs) act as key enzymes in catalyzing sugar residue transfer from an activated donor to an acceptor and function together with other biosynthetic enzymes such as Pinoresinol-Lariciresinol Reductases (PLRs) and Malonyl Transferases (MTs). However, less information is available on the flax glycosylation machineries. This presentation will focus on the identification and molecular characterization of flax lignan glycosylation genes

Author's affiliation: [a]Biology Department, [b]Agriculture and Agri-Food Canada

Student poster presentations

Evans Monyoncho[a], Iskandar Saada[a], Rabin Bissessur[a], Douglas Dahn[b]
Nanocomposite materials based on layered structures for green energy

Energy is one of the vital components of our economies and lifestyles. Unfortunately, most of the current energy sources are non-renewable such as crude oil and coal or are environmentally hazard such as nuclear energy. Our research is focused in developing materials which can be utilized in renewable energy devices especially lithium ion polymer batteries. Lithium ion polymer batteries are the most promising candidate based on their high energy density, recyclability, and environmental sustainability. Our methodology of developing these new materials employs intercalation chemistry. Intercalation Chemistry is a growing field of research[1] which combines organic and inorganic compounds. The resulting nanocomposites can exhibit properties synergistically derived from the two components such as improved mechanical strength, higher electronic conductivity, increased ionic conductivity and enhanced thermal properties.

Author's affiliation: [a]Chemistry Department, [b]Physics Department

Mitchell MacMillan, Megan Tesch, Pedro A Quijon
Stranded seaweeds and their influence on sandy beach invertebrates

Almost all life on earth relies on plant primary producers. Sandy beaches are a unique ecosystem in that there is almost a complete lack *in situ* primary production, so resident invertebrates (>1 mm in size) must obtain their food from materials imported from the sea, namely, phytoplankton, seagrasses and algae. It was hypothesized that (1) algae which become stranded on the beach (henceforth "wrack") support higher abundances than nearby bare sediments, and (2) invertebrates prefer the most nutritionally valuable species of wrack. These hypotheses were tested by manipulating two common species of wrack on sandy beaches, sampling their associated fauna, and measuring the wrack's amounts of protein, lipids and carbohydrates. Our results show that stranded wrack supported higher abundances of invertebrates than bare sediments, and that one species of wrack, the rockweed, showed higher amounts of protein, lipids and carbohydrates, was inhabited preferentially. These results suggest that the supply of wrack to sandy beaches may play a major role in structuring invertebrate communities.

Author's affiliation: Biology Department

Evan Owen[a], Brian Wagner[a], William Whelan[b]
Fluorescence Studies for an Early Detection Method for Mastitis in Cows

Mastitis, an inflammation of the tissues of the mammary glands, is a significant issue for the dairy industry, due to its effects on milk production and health care costs. Clinical diagnosis of mastitis can be time consuming, and may not indicate its presence at an early stage. It would therefore be advantageous if a simple, sensitive method

was developed for *in vivo* detection of mastitis. Currently, we are testing molecular beacons, which consist of a fluorescent molecule attached to a quencher group through a peptide chain, to determine whether cleaving of the molecular beacon to restore fluorescence occurs. A matrix metalloprotein, MMP-9, has been shown to cleave the beacon and has been reported in the literature to be present in elevated levels in the presence of mastitis. Two molecular beacons are currently being tested for detection sensitivity, thermal and photochemical effects, and different reaction pathways for cleavage by MMP-9, for potential use in a fluorescence detection method for mastitis.

Author's affiliation: [a]Chemistry Department, [b]Physics Department

Tyler Pickering, Luke Poirier, Pedro Quijon
Prey preferences of the European green crab (*Carcinus maenas*) among three commercially important bivalves in Prince Edward Island

The invasive European green crab (*Carcinus maenas*) is emerging as an important bivalve predator in Prince Edward Island and Atlantic Canada. To better understand green crab impacts and to aid in prioritizing future research, this study investigated green crab prey preference on three commercially important bivalves native to PEI: American oysters (*Crassostrea virginica*), blue mussels (*Mytilus edulis*), and soft-shell clams (*Mya arenaria*). In field and laboratory experiments, and with two sizes of prey, small, medium, large green crabs were given a choice among these bivalves and their daily feeding rates were monitored for three days. In general, green crabs showed an early preference for soft-shell clams and, only as they declined in numbers, a switch towards mussels and subsequently towards oysters. The results are further discussed in relation to differences in bivalve shell thickness and the ongoing spread of green crabs along PEI's southern shore.

Author's affiliation: Biology Department

Mitchell Perry, Laura EN Allan, Michael Shaver
Bis(imino) Pyridyl Catalysts for Vinyl Ester Polymerization

Polymeric materials offer an extraordinary range of properties suitable for many applications and are thus a growing staple in the modern era. Optimization of these procedures can lead to improved properties and more useful materials. One such important monomer, vinyl acetate (VAc), is the starting material for poly(vinyl acetate) (PVAc). Hydrolysis of PVAc yields polyvinyl alcohol (PVOH), a water-soluble polymer with many uses. Present radical polymerizations of vinyl acetate (VAc) suffer from a lack of control, which lead to materials with undesirable properties. Vanadium has been shown to be an active as a catalyst in organometallic mediated radical polymerization (OMRP), capable of generating PVAc in a controlled manner.[1] However, thermally robust systems are still needed for industrial synthesis of PVAc, and furthermore, the generation of PVOH. A series of symmetric *para*-substituted vanadium catalysts based on bis(iminopyridine) ligand frameworks have been prepared in order to test the electronic effects relating to substitution and activity. Also, steric factors will be studied by altering the aryl substitution (Figure 1), ideally offering longer catalyst lifetimes and high activities.

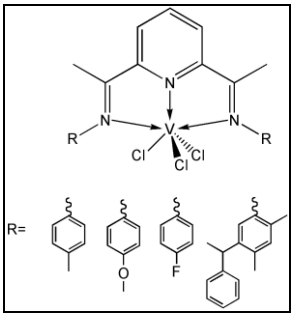

Figure 1: *p*-substituted bis(iminopyridine) based complexes
1. Shaver, M.P.; Jones, M. R.; Hanhan, M.E., *Chem. Comm.*, **2010**, 46, 2127-2129.
Author's affiliation: Chemistry Department

Knysh Kyle, Donna Giberson, Michael van den Heuvel
Aquatic invertebrate diversity within cold springs of eastern Prince Edward Island, Canada with special reference to agricultural land use impacts.

The objective of this study is to determine whether invertebrate diversity in cold springs of eastern Prince Edward Island is related to local agricultural land use. The fauna of cold springs in Canada has been poorly reported in relation to other freshwater systems, this being especially true in Prince Edward Island. To test whether agricultural runoff is affecting the springs, I am sampling a number of headwater spring-fed streams in areas with predominantly forested cover and comparing them to areas under agricultural production. Spring faunal diversity and abundance will be evaluated with an emphasis on arthropod groups, and compared to agricultural intensity, water chemistry, hydrology, and potential food sources (Detritus and plant diversity and abundance).

Author's affiliation: Biology Department

Mark A Robbins[a], Cathy L Ryan[b], Tracy A Doucette[a]
Alterations in Behavior and Neurochemistry in Adult Rats Following Neonatal Domoic Acid Treatment

Schizophrenia is a debilitating neurological disorder that affects approximately 1% of the population. This disorder is characterized by positive, negative, and/or cognitive symptoms which are believed to be due, in part, to alterations in the mesocorticolimbic dopamine system. The current study examined early alterations to glutamate signaling, using DOM, as a novel animal model of schizophrenia. Subjects were assessed for social withdrawal, a negative symptom, temporal memory dysfunction, a cognitive symptom, and alterations in tyrosine hydroxylase, the rate-limiting enzyme in dopamine synthesis, in the mesocorticolimbic system. It was demonstrated that male subjects demonstrated social withdrawal, as evidenced by an increase in social behaviour and a decrease in avoidance behaviour. Temporal memory dysfunction was also observed as subjects directed a higher proportion of their exploratory behaviour at a more "remote" object than at a more "recent" object in a paradigm that assessed memory for temporal order of objects. The immunohistochemical portion revealed a significant decrease in tyrosine hydroxylase in the prefrontal cortex in male subjects, and a significant increase in tyrosine hydroxylase in the left shell and right core of the nucleus accumbens in female subjects.

Author's affiliation: [a]Biology Department, [b]Psychology Department

Sarah Sparks[a], Jennifer Taylor[a], Paul Veugelers[b], KJ Hernandez[b], Deborah MacLellan[a]
Changes in Children's Lunch time nutrient intakes after three years of school nutrition policy implementation

Objective: to assess the quality of elementary school children's lunchtime dietary intakes and examine changes in intakes over 3 years of SNP implementation (2007-2010). Method: An in class survey was used to assess Grade 5 & 6 children's lunch time food intakes in 2007 (n=1980) and 2010 (n=1642). Differences between years in the proportion of students with adequate nutrient intakes were assessed using Chi Square tests. Results: More students in 2010 consumed an adequate intake of nutrients at lunch-time including protein, fiber, magnesium, calcium, zinc, vitamin A, thiamin, riboflavin, niacin, vitamin B_6, and folate compared to 2007 ($p<0.05$). In both years, most students had the recommended level of protein but were consuming too much carbohydrate and too little fat. Conclusion: This is the first Canadian study that has shown an improvement in children's lunchtime nutrient dietary intakes after implementing a school nutrition policy. However, overall diet quality continues to be poor.

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Annie Laderoute, Michelle Patterson, William Whelan
Optoacoustic Detection of Laser Heated *Ex-vivo* Bovine Liver

Laser thermal therapy has been explored as a minimally invasive method for treating solid tumors. It involves inserting a scattering optical fiber into tissue and heating to temperatures between 55^{o}C and 95^{o}C for several minutes resulting in coagulation and cell death. Optoacoustic imaging is being investigated as a method for real-time imaging and monitoring of laser thermal therapy. Optoacoustics exposes an optically absorbing medium to pulsed laser light. Rapid heating within the target causes a pressure increase and induces acoustic waves, also known as the optoacoustic signal. Optoacoustic data was collected using a prototype reverse-mode optoacoustic

system consisting of a pulsed laser operating at 1064nm and 775nm and an eight element annular array transducer with a central frequency of 4MHz. Preliminary experiments tested the capabilities of optoacoustics to detect changes in bovine liver tissue properties (coagulation) as it was heated using an 810nm diode laser at constant power. Results of these studies conducted in our lab will be presented and discussed.

Author's affiliation: Physics Department

MD Shafiullah, Christian R Lacroix
Comparative gene expression patterns in aerial and aquatic forms of *Myriophyllum aquaticum*.

Myriophyllum aquaticum is a plant with highly dissected simple leaves consisting of several lobes. It can produce two morphologically different forms of leaves based on whether they are aerial or aquatic. We hypothesize that the early stages of development of both aerial and aquatic leaves of *M.aquaticum* are similar, and that the visual and morphological differences appear during later stages of development. *KNOX1 (KNOTTED1-LIKE HOMEOBOX)* genes are believed to have played an important role in the evolution of leaf diversity. Down-regulation of *KNOX1* in the shoot meristem during leaf primordium formation leads to simple leaf forms, whereas its upregulation triggers compound leaf forms. Upregulation and subsequently overexpression of *KNOX1* during leaf primordium initiation can also lead to leaf dissection in plants with simple leaves. Our results revealed that the aerial meristem, and leaf primordia of *M. aquaticum* inserted at levels 1 (youngest), 2, and 3 show gene expression throughout these structures. The level of expression of this *KNOX1* gene progressively decreases in older leaf primordia (levels 4 to 7), and no expression is detected in leaf primordia at level 8 and beyond. In aquatic forms of *M. aquaticum*, high levels of expression persist in primordia of level 6. The expression of *KNOX1* decreases in successive primordia and is absent in leaf primordia of level 12. Our results show that leaf dissection is linked to the level of expression of *KNOX1*, and that the highly dissected leaf morphology in aquatic forms of the plant is the result of a longer period of expression.

Author's affiliation: Biology Department

Invited presentations

Karen Thorpe
Differential sensitivity to an anti-androgen affects fish population dynamics

Dr Thorpe is a Post-Doctoral Associate in the Biology Department. Due to unanticipated circumstances she was unable to submit an abstract/poster for the event.

Jennifer Slemmer[a], Jessica Livingston-Thomas[b], Katherine Gottschall-Pass[a], Marva Sweeney-Nixon[b]
Enzymatically-digested cranberries and wild blueberries alter cytoprotective glutathione mechanisms in differentiated intestinal Caco-2 cells

Fruits and vegetables contain antioxidant compounds which have been shown to stimulate endogenous cytoprotective mechanisms, such as glutathione (GSH), and current trends in nutritional sciences are focused upon the benefits of "whole foods". To this end, we subjected wild blueberries (BB) and cranberries (CB) to a battery of digestive enzymes, as a treatment for differentiated Caco-2 cells, as these cells represent a model of small intestinal endothelial uptake. We measured the ability of digested berry homogenates to modulate GSH cytoprotection, through either an increase in the reduced to oxidized GSH ratio, or increased activity of enzymes involved in GSH metabolism. Taken together, these data indicate that BB and CB digested homogenates may act as slight pro-oxidants, in the sense that they increase cytoprotective gene transcription for when intestinal cells are at rest, or are metabolizing other foods.

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Dr Slemmer is a Post-Doctoral Associate in the Family and Nutritional Sciences Department

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Our deepest gratitude to everyone contributing presentations and attending the event
Science Graduate Studies Committee