

# 2014

**Irving K. Barber School of Arts and Sciences**  
9<sup>th</sup> Annual Undergraduate Research Conference  
Thursday, April 3, 2014

## **ORAL PRESENTATION SCHEDULE & ABSTRACTS**

Time	Student Name	Supervisor	Presentation Title	Page #
<b>SESSION 1 – UNC 334</b>				
11:00 – 11:20	Malcolm Eaton	Joyce Boon, Jonathan Little	Determination of up-regulated myokines in response to high intensity interval training, in young healthy males	1
11:20 – 11:40	Tal Shalev	Joyce Boon, Michael Russello	Adaptive or neutral: Examining the evidence for divergence among stream and pond spawning ecotypes of Fire Salamander ( <i>Salamandra salamandra</i> )	1
11:40 – 12:00	Imel Khaleghi	Soheil Mahmoud	Genomic organization and genetic variation of major monoterpene synthases from <i>Lavandula</i>	2
12:00 – 12:20	Lucas Chataigner	David Jack	Ligand Effects of DAB and Ornithine on the Tautomeric Equilibrium of PLP-Ligand Complex from Ornithine 4,5 Aminomutase.	2
12:20 – 12:40	Chrystal Scholl	Daniel Durall	Evaluation of Yeasts in Pinot Noir and Chardonnay at Three Canadian Wineries	3
<b>SESSION 2 – UNC 334</b>				
1:00 – 1:20	GeetkamalHans	Louise Nelson	Abundance of Ammonia-Oxidizing Archaea and Bacteria in Apple and Grape Plots under different management practices	3
1:20 – 1:40	Venessa Ibsen	Mary Forrest	Transient overexpression of FADS1 in NIH 3T3 cell line increases cell viability when supplemented with various fatty acids	4
1:40 – 2:00	Megan Udala	Stephen Porter	Picture Perfect Memories?: The Effect of Emotional Priming on Memory Accuracy and Misinformation Incorporation	4
2:00 – 2:20	<b>BREAK</b>			
2:20 – 2:40	Taylor Burnett	Stephen Porter	Creep in a T-shirt, Genes: An evolutionary perspective on evaluations of 'creepiness'	4
2:40 – 3:00	Kelsey Lozenski	Zach Walsh	Cannabis as a Substitute for Alcohol and Other Substances: Measuring Factors that Affect Substitution Behaviours	5
3:00 – 3:20	Lisa Gillman	Michael Woodworth	Sex, drugs, and psychopaths: A linguistic investigation into the needs of psychopaths	5
3:20 – 3:40	Eric Failes	Barb Rutherford	Hemispheric Interaction: Mechanism for Bilingual Advantage	6
<b>SESSION 3 – ART 106</b>				
1:00 – 1:20	Michael Fraser	Jake Bobowski	Closed-Cycle Helium Refrigerators for Reaching Low-Temperatures	6
1:20 – 1:40	Jaklyn DeVos	Jake Bobowski	Magnetic Shielding for an Adiabatic Demagnetization Refrigerator	7
1:40 – 2:00	Graeme Douglas	Ramon Lawrence	LittleD: A SQL Database for Sensor Nodes and Embedded Applications	7
2:00 – 2:20	Eric Koch	Erik Rosolowsky, Jason Loeppky	Identifying Filamentary Structure in Molecular Clouds	7
2:20 – 2:40	Jesse Cresswell	Daniel Vollick	Lorentz gauge quantization in a general conformally flat space-time: Could quantum electrodynamics be the source of dark energy?	8
2:40 – 3:00	Caleb Ward	Erik Rosolowsky, Jason Loeppky	Sensitivity Analysis of Large Scale Astronomical Simulation Statistics	8
3:00 – 3:20	Preston Cooper, Riley Nairn	Shawn Wang	Resolvent Averages of Monotone Operators / Visualizing the Resolvent Average	8

3:20 – 3:40	Katrina Labun	Ben Nilson	Holy Henries: The First Tudor and the Cult of the Last Lancastrian	9
3:40 – 4:00	Sarah Lecouffe	Tirso Gonzales	A participatory research exploration of the indigenous plant Quinoa	9

#### SESSION 4 – LIB 302

1:00 – 1:20	Jennifer Davy	Susan Murch	Refining in vitro tissue culture protocols for <i>Artocarpus altilis</i>	10
1:20 – 1:40	Peter Dylan Zaitsiff	Miranda Hart	Arbuscular mycorrhizal fungi (AMF)	10
1:40 – 2:00	Tara Evans-Atkinson	Miranda Hart	The introduction of an exotic microbe into a natural ecosystem	10
2:00 – 2:20	Alexa Geddes	Bruce Mathieson, Mark Holder	Happiness and life satisfaction in people with an acquired brain injury: The role of social support, symptom severity, and location of injury	11
2:20 – 2:40	<b>BREAK</b>			
2:40 – 3:00	Amanda Davison	Mark Rheault	Functional Characterization of Isolated <i>Drosophila melanogaster</i> Organic Cation Transporters (orcts) in a Heterologous Expression System	11
3:00 – 3:20	Brian Muselle	Jason Pither	A meta-analysis comparing the diversity of insect assemblages inhabiting plant communities with and without invasive plant species	12
3:20 – 3:40	Breanne Cadham	Mark Rheault, Soheil Mahmoud	Repellent and Insecticidal activities of essential oils from <i>Lavandula angustifolia</i> , <i>Lavandula x intermedia</i> cv GROSSO, <i>Lavandula x intermedia</i> cv OKANAGAN (P1) on <i>Drosophila melanogaster</i>	12
3:40 – 4:00	Mackenzie Carnes	Louise Nelson	Biocontrol of post-harvest disease in Gala and McIntosh apple varieties by <i>Pseudomonas fluorescens</i> isolates 4-6, 2-28, and 1-112	13

#### SESSION 5 – LIB 304

1:00 – 1:20	Dan Kehila	Melanie Jones, Kirsten Hanam	The effects of irrigation with bicarbonate-containing water and application of wood chip mulch on the <sup>13</sup> C-signature of carbon dioxide released from agricultural soils	13
1:20 – 1:40	David Oliver	Susan Murch	Glutamine is a precursor in the biosynthesis of BMAA in cyanobacteria	14
1:40 – 2:00	Sydney Morgan	Daniel Durall	Composition, diversity, and dynamics of wine yeasts in inoculated and spontaneous fermentations of Pinot noir at four Canadian wineries	14
2:00 – 2:20	Adamo D'Ovidio	Andis Klegaris, Joyce Boon	Cathepsin B Enzymatic Assay Design	14
2:20 – 2:40	F. Paul Markin	Louise Nelson	Abundance of Nitrification and Denitrification Genes in Perennial Agricultural Soil Under Varying Soil Amendments and Effect of pH and Temperature on Denitrification in Vitro.	15
2:40 – 3:00	Ayden Gouveia	Andis Klegaris, Joyce Boon	Cytochrome C Alters Central Nervous System Inflammation	15
3:00 – 3:20	Corrie Allen	Lael Parrott	An agent-based computer model of cheetah-tourist vehicle interactions	16
3:20 – 3:40	Morgan Stone	Daniel Durall	Analysis of Yeast Populations During Alcoholic Fermentations in Chardonnay: A Comparison Study Between three Wineries	16
3:40 – 4:00	Larissa Laderoute	Bernard Bauer	River Bank Erosion and Boat Wakes Along the Lower Shuswap River, British Columbia	17

## Determination of up-regulated myokines in response to high intensity interval training, in young healthy males

**Student: Malcolm Eaton**

**Supervisor: Joyce Boon, Jonathan Little**

Exercise promotes numerous phenotypic adaptations in skeletal muscle that contribute to improved function and metabolic capacity. An emerging body of evidence suggests that skeletal muscles also release a myriad of factors during exercise, termed “myokines”. The purpose of this study was to examine the effects of high intensity interval training (HIIT) on the expression of several myokines, including the well-studied myokines FND5/irisin, and IL-6, as well as the putative myokine meteorin-like protein (METRNL). Both before and after 3 weeks of HIIT, 9 healthy males ( $20.5 \pm 1.5$  yr,  $179.7 \pm 11.3$  cm,  $80.2 \pm 14.5$  kg, means  $\pm$  SD) performed a standardized bout of interval exercise with skeletal muscle biopsy samples (vastus lateralis) collected in the basal state, immediately following exercise, and at 3 hours recovery. Our results showed acute up-regulation of METRNL and IL-6 mRNA at 3 hours recovery in the pre-training state only ( $p < 0.05$ ). Basal METRNL mRNA expression was higher following training ( $p < 0.05$ ), but there were no significant effects of training on IL-6 ( $p = 0.09$ ). The acute bout of exercise had no effect on FNDC5 mRNA, however, basal FNDC5 levels were increased in post-training skeletal muscle samples ( $p < 0.05$ ). This suggests that METRNL expression is linked to HIIT training in young healthy individuals, and contributes to the postulation that FNDC5 expression is positively associated with training status. The information from this study may be used to improve the current knowledge about myokines, as researchers work towards elucidating the role of myokines in endocrine signaling, disease prevention and treatment.

## Adaptive or neutral: Examining the evidence for divergence among stream and pond spawning ecotypes of Fire Salamander (*Salamandra salamandra*)

**Student: Tal Shalev**

**Supervisor: Joyce Boon, Michael Russello**

Ecological divergence of natural populations can occur across a variety of spatial distributions, extending from complete geographical segregation (allopatry) to complete range overlap (sympatry). Though allopatric speciation is quite common, speciation in sympatry has not been widely observed in nature. Fire salamanders (*Salamandra salamandra*) are a common species of salamander in Europe. Most subspecies are ovoviviparous and spawn in streams. However, previous studies have found an ecotype that spawns in shallow ponds, making this a potentially useful system for studying processes underlying fine-scale divergence. In this study, I investigated whether natural selection is driving ecotype divergence in fire salamanders using transcriptome-wide DNA sequence data collected for 12 individuals (six stream and six pond) from the Kottenforst region in Germany. I assembled the raw sequence reads into 14 556 contigs, with 3 768 and 1 216 contigs unique to the stream and pond ecotypes, respectively, possibly indicating divergent traits between ecotypes. I also assembled 2636 high (5.0x) coverage contigs that included all individuals and from which I identified a set of 1022 single nucleotide polymorphisms (SNPs). Forty-two outlier loci were identified as candidates for selection associated with ecotype divergence. Annotation of contigs containing outlier loci revealed sequence association with genes responsible for metabolic and structural processes. There was strong evidence of population structure at outlier loci, which is consistent with previous results indicating that reproductive divergence is due to adaptation and not geographic barriers to gene flow. Additional research should utilise the characterised SNP set as well as a larger sample population to more definitively infer the processes underlying ecotype divergence and to potentially guide taxonomic re-classification for conservation efforts.

## Genomic organization and genetic variation of major monoterpene synthases from *Lavandula*

---

**Student: Imel Khaleghi**

**Supervisor: Soheil Mahmoud**

This project aimed to identify the genomic organization of seven different Terpene Synthase (TPS) genes in *Lavandula angustifolia*, *Lavandula x intermedia* and *Lavandula latifolia*. Plant terpenoids, produced by the enzymatic reaction of TPS, play a vital role in plant defense and as a pollinator attractants, at the same time extensively used in human welfare. In specific, the project was developed to discover the intron number, size, placement, and exon sequences for TPS in the above mentioned species. Young budding or flower tissues were collected to obtain genomic DNA from *L x intermedia*, and used as a template to amplify the specific TPS gene. Subsequently, the gene of interest was ligated to p-GEM t-easy vector and transformed into JM109 *E.coli* cells. Plasmid DNA was extracted from the respective clone and was analyzed by restriction enzyme digestion to select potential candidate. Putative TPS genomic clones were sent to Plant Biotechnology Institute (PBI, Saskatoon, SN) for sequencing. So far, we have been able to successfully clone: Caryophyllene Synthase (CPS), Borneol Dehydrogenase (BDH), and Bergamotene synthase (BER) in *L. intermedia*. Additionally, our initial results indicated that Phellandrene synthase and Linalool synthase were also successfully cloned; however, comparisons of sequencing results to cDNA sequence were inconclusive for these two genes. Full sequencing results are expected to be received shortly from the vendor, which would enable us to assign the intron/exon arrangement for CPS, BDH and BER for the final portion of this study and will be included in the comprehensive report. It is projected that these new information about genomic organizations of TPS genes in *L x intermedia* would provide the foundation for finding conserved motifs and regions of differences across *Lavandula* species for TPS genes.

## Ligand Effects of DAB and Ornithine on the Tautomeric Equilibrium of PLP-Ligand Complex from Ornithine 4,5 Aminomutase.

---

**Student: Lucas Chataigner**

**Supervisor: David Jack**

Holoenzyme structures of coenzyme B12-dependent aminomutases require the cofactors adenosylcobalamin (AdoCbl) and pyridoxal 5'-phosphate (PLP) in order to act as a biological catalyst. Catalysis is facilitated in the active site of these enzymes by formation of a PLP-ligand complex that forms through covalent linking of the ligand substrate to PLP upon substrate binding. A number of factors further modulate the effects that PLP has on catalysis, including an intramolecular hydrogen bond between two moieties of the PLP in the PLP-Ligand complex. Depending on where the hydrogen from the stated bond is found the molecule can be referred to as either being in the oxoamino tautomeric, or hydroxyimino tautomeric form. Characterizing this tautomeric equilibrium for specific enzymes is of interest because it offers key mechanistic information about the catalysis performed by holoenzymes. For this reason, it was decided to characterize the tautomeric equilibriums of PLP-ligand complexes formed in the enzyme ornithine 4,5 aminomutase by ornithine the natural substrate, and diaminobutyric acid (DAB) an inhibitor of the enzyme. To do this, energy profiles were generated for the internal hydrogen transfer in PLP-Ornithine and PLP-DAB obtained from crystallographic data. This was done by obtaining energy values for the complexes as functions of hydrogen position during the internal transfer using the General Atomic and Molecular Electronic Structure System (GAMESS) software on Westgrid servers. Given the generated energy profiles, the proportion of the different tautomeric forms was determined by approximating each system as a harmonic oscillator and estimating in turn the energy levels of the hydrogen atom. With tautomeric populations at hand, the importance of substituent effects on the tautomeric populations of the PLP DAB complex in OAM were then quantitatively discussed.

## Evaluation of Yeasts in Pinot Noir and Chardonnay at Three Canadian Wineries

---

**Student: Chrystal Scholl**

**Supervisor: Daniel Durall**

Spontaneous fermentations are rare among wineries in North America, with winemakers choosing inoculated fermentations to ensure a consistent, reproducible product. However, spontaneous fermentations are known to produce more complex wines, as they allow a diversity of yeast species and strains to participate in fermentation. There is currently a lack of knowledge about yeast communities in spontaneous fermentations between white and red varieties. The objective of this study was to compare species/strain diversity and composition between Pinot noir and Chardonnay spontaneous fermentations at three Canadian wineries. Three fermentation vessels were sampled for each variety at each winery. Samples were taken from each tank at four stages of fermentation, as defined by Brix° levels. A total of 96 yeast isolates were obtained from each vessel during fermentation. Non-Saccharomyces yeast isolates were identified to the species level by sequencing the D1/D2 domain of the yeasts rDNA. Saccharomyces cerevisiae isolates were identified to the strain level using microsatellite loci. Results indicate that for both varieties, Hanseniaspora uvarum was the dominant non-Saccharomyces yeast at two of the three wineries, whereas Pichia spp. was dominant at the remaining winery. The diversity of S. cerevisiae strains was similar between varieties at all three wineries; however, each winery appeared to have a unique composition of commercial and indigenous S. cerevisiae strains for each variety. Both varieties demonstrated to have a higher frequency of occurrence of commercial S. cerevisiae strains rather than indigenous strains at all three wineries. Inoculation history at the wineries, as well as the winery location, is likely to have an influence on this. The diversity of Non-Saccharomyces species was significantly different between varieties, which is likely due to differences in winery location and differences in variety characteristics.

## Session 2 – UNC 334

## Abundance of Ammonia-Oxidizing Archaea and Bacteria in Apple and Grape Plots under different management practices

---

**Student: Geetkamal Hans**

**Supervisor: Louise Nelson**

Nitrous oxide (N<sub>2</sub>O) is responsible for 5-7% of the observed greenhouse effect and has a Global Warming Potential nearly 300 times greater than that of carbon dioxide. Ammonia-oxidizing bacteria (AOB), ammonia-oxidizing archaea (AOA) and denitrifying bacteria are responsible for ~70% of the anthropogenic global N<sub>2</sub>O emissions. AOA and AOB oxidize ammonia (NH<sub>3</sub>) to nitrite (NO<sub>2</sub><sup>-</sup>) via ammonium monooxygenase (amoA). Nitrite (NO<sub>2</sub><sup>-</sup>) can also be converted to nitrous oxide (N<sub>2</sub>O), contributing to the increase in greenhouse gas emissions. Little is known about the presence of nitrifying archaea in woody perennial cropping systems. The objective of this study was to quantify the nitrifying archaea and bacteria in apple and grape plots at two sampling times (August and September, 2013), at three depths (0, 15 and 30 cm) and with or without mulch. The apple plot was treated with two different concentrations of nitrogen (20 or 40 g N/tree) and the grape plot with 15 g N/vine applied as compost or urea via fertigation. The abundance of AOA and AOB was determined based on the copy number of the archaeal and bacterial 16S rRNA genes and the abundance of the nitrifying archaea and bacteria was determined based on the copy number of archaeal and bacterial amoA genes using quantitative PCR. The abundance of bacteria was higher in both plots compared to archaea. As depth increased from 0 to 30 cm the abundance of archaea and bacteria decreased significantly. However, the copy number of archaeal amoA gene increased with depth in August. The copy number of the bacterial amoA gene was higher in fertigated plots as opposed to compost treatment in the grape plot. The presence of nitrifying archaea in these agricultural soils suggests that they may contribute to nitrous oxide emissions.

## Transient overexpression of FADS1 in NIH 3T3 cell line increases cell viability when supplemented with various fatty acids

---

**Student: Venessa Ibsen**  
**Supervisor: Mary Forrest**

Chronic diseases such as diabetes, cancer, and cardiovascular disease have been linked to chronic inflammation. Many inflammatory precursors are poly-unsaturated fatty acids (PUFA) that are obtained through our diet. The metabolism of these fatty acids (FA) can lead to pro-inflammatory or anti-inflammatory precursors depending on whether they are omega-3 or -6 FAs. To study the effects of FA metabolism we upregulated fatty acid desaturase 1 ( $\Delta 5$  desaturase) in cell line NIH 3T3 via a transient expression vector.  $\Delta 5$  desaturase removes hydrogens from dihomogamma-linolenic acid and eicosatetraenoic acid in the metabolic pathway. The transfected cell lines were tested for viability and stress with rezasurin, JC-1 and glutathione assays while being supplemented with oleic acid ( $\omega$ -9 FA), linoleic acid ( $\omega$ -6 FA) and gamma-linolenic acid ( $\omega$ -6 FA). Supplementation of cell lines with  $\omega$ -6 FAs has been shown to negatively affect cell viability in previous research, however when FADS1 was upregulated in the cells there was a beneficial effect associated with  $\omega$ -6 FAs, especially gamma-linolenic acid. The output from FADS1 is arachidonic acid in the  $\omega$ -6 FAs route. The increase in viability could be due to increased arachidonic acid concentration within the cell, which has been shown to protect cardiac myocytes from death during ischaemic injury. Arachidonic acid activates phosphokinase C which has been shown to play a role in apoptosis and cell proliferation, depending on the isoform that is activated. Due to the results of this experiment, it would be likely that isoform  $\alpha$ ,  $\beta$  or  $\epsilon$  was activated and thereby induced cell proliferation. This information shows that  $\omega$ -6 FAs can protect cells and bolster cellular growth when the correct amount of enzyme, FADS1, is present.

## Picture Perfect Memories?: The Effect of Emotional Priming on Memory Accuracy and Misinformation Incorporation

---

**Student: Megan Udala**  
**Supervisor: Stephen Porter**

Despite the empirical support for the fallibility of human memory, eyewitness accounts continue to be key pieces of evidence in the courtroom. Of the 284 wrongful convictions overturned in part by efforts of The Innocence Project (2012) in the US, 75% of the flawed findings of guilt had relied on eyewitness testimony (consequently refuted by DNA evidence). Subsequently, investigation into the factors that influence the reliability of memory is of great importance. The present study examined the effects of emotional priming on susceptibility to misinformation and general memory accuracy. We utilized the Ambiguous Stimuli Affective Priming (ASAP; Porter et al., 2014) paradigm, in which written primes were created to induce emotion for ambiguous (i.e., "emotional neutral" images). Prior to a recall test, participants were presented with either non-leading or misleading information regarding the images they viewed. Following a delay, subsequent general accuracy and misinformation incorporation were assessed. Anticipated results are, in accordance with previous findings from Porter and colleagues (2008), negatively primed memories will be associated with increased accuracy scores and reporting of misinformation incorporation.

## Creep in a T-shirt, Genes: An evolutionary perspective on evaluations of 'creepiness'

---

**Student: Taylor Burnett**  
**Supervisor: Stephen Porter**

The term "creepy" is used ubiquitously, but to date, there have been few attempts to empirically define this term. The results of the initial investigations suggest that creepiness is most often a construct applied to males by females, and is used to describe individuals whom they perceive as a threat (Andrew & Koehnke, 2013; Porter, Strugnell, ten Brinke, Black, & Crossley, in prep). Females perceiving males as threatening dates back to our evolutionary roots, and as such, creepiness might be best examined through an evolutionary lens. Considering the features that females have been found to use to identify threatening males, I posited a three-pronged hypothesis about what might makes a male "creepy". The three prongs include poor genetic quality (as expressed by asymmetrical features), few financial resources (as expressed by a low earning occupation), and sexual threat/intent (as

expressed by facial features of sexual arousal). The current study sought to test this hypothesis of creepiness by having female participants (N = 104) rate 28 male faces and profiles on four traits; attractiveness, likability, trustworthiness, and creepiness. Each profile consisted of a computer-generated male face along with a name, occupation, and hobby. Each of the prongs was manipulated by altering the face/profile to reflect (a)symmetry, facial expressions of arousal (present/absent) and by manipulating listed occupation (high/medium/low income). Additionally, participants completed a number of measures of personality and emotional intelligence to further examine correlates of interpersonal evaluations of creepiness. Preliminary analyses indicate an inverse relationship between creepiness and trustworthiness and degree of creepiness and willingness to date a target. The results of additional analyses and the implications of this research will be discussed.

## **Cannabis as a Substitute for Alcohol and Other Substances: Measuring Factors that Affect Substitution Behaviours**

---

**Student: Kelsey Lozenski**

**Supervisor: Zach Walsh**

Behavioural economics views substance use behaviours in terms of a cost-demand relationship that is influenced by fluctuations in price and availability. Some substances are more elastic than others in this respect, giving rise to a phenomenon known as the substitution effect: the use of one psychoactive substance in the place of another. Research has demonstrated that cannabis may serve as an effective substitute for alcohol, prescription medications, and other illicit drugs (Atler, Lohrmann, & Greene, 2006; Crost & Guerro, 2012; DiNardo & Lemieux, 2001; Lucas et al., 2012; Reiman, 2009). It has been a commonly reported behaviour in both recreational and therapeutic contexts due to the reinforcing qualities and minimal negative side effects of cannabis compared to other medical and recreational substances. Currently, however, no standardized measure of cannabis substitution exists; what is known about it has come from a small number of questions embedded within broader studies of addictions or substance use. The current investigation aims to gain a more thorough understanding of the diverse factors that influence cannabis substitution by developing a comprehensive measure of the construct. The items of the measure were constructed following an exhaustive literature review on general substitution as well as cannabis-specific substitution. Each question is intended to examine a specific aspect of the substitution effect, ranging in terms of substituted substances, environments, and mood states. The measure was included among a battery of substance-use related questionnaires and administered online to undergraduate students. Data analysis is currently underway and will include exploratory factor analysis to establish construct validity, as well as regression analyses to establish external validity. The results of this study may have implications for the treatment of substance use disorders and the use of cannabis as a potential substitute for medication.

## **Sex, drugs, and psychopaths: A linguistic investigation into the needs of psychopaths**

---

**Student: Lisa Gillman**

**Supervisor: Michael Woodworth**

Psychopathy is an adverse disorder characterized by, but not limited to, an inability to appreciate or recognize emotion, deficiencies in forming deeper connections with others, and antisocial and aggressive behaviour. An examination of language use is thought to provide insight into a person's underlying conscious and unconscious cognitive and emotional processes (Pennebaker, Mehl, & Niederhoffer, 2003). In fact, research by Hancock, Woodworth, & Porter (2013) has found that psychopaths' emotional deficits are represented linguistically through their particular word usage. Specifically, psychopaths have been shown to use fewer words relating to higher level social needs and more words relating to lower level social needs while describing the homicide they committed. The aim of the present study was to extend previous findings by using a more heterogeneous sample of offenders, a more diverse sample of language, and a larger sample size. The sample consisted of 65 offenders (19 psychopathic and 46 nonpsychopathic) who were administered the Psychopathy Checklist – Revised (PCL-R; Hare, 2003). These interviews were videotaped and later transcribed. We used a sophisticated automated linguistic analysis program – the Linguistic Inquiry and Word Count (LIWC; Pennebaker et al., 2007) to analyze offender's linguistic output across the entire interview. We also looked at a subset of these offenders (n = 35; 17 psychopathic and 22 nonpsychopathic) responses to two specific questions: the happiest moment in their life and their most depressed moment. It was hypothesized that psychopathic offenders would use more words relating to

lower level social needs and fewer words relating to higher level social needs. Results will be discussed, along with clinical and research implications.

## Hemispheric Interaction: Mechanism for Bilingual Advantage

---

**Student: Eric Failes**

**Supervisor: Barb Rutherford**

Bilinguals have demonstrated advantages over monolinguals in several domains, such as attention control, and both phonological and working memory. As of yet, there is no theory that adequately explains why these advantages occur. Past studies suggest that bilinguals, relative to monolinguals, demonstrate greater interaction between the brain's hemispheres when completing language tasks. Further, it has been suggested that interaction between the brain's hemispheres may be advantageous for complex tasks. The present study employed a lexical decision task to test whether the increased hemispheric interaction observed in bilinguals will lead to a bilingual advantage in complex language tasks. Participants (119 monolingual speakers and 30 bilingual speakers) indicated whether letter strings on a computer screen spelled real words. Letter strings included high-familiarity words (e.g. apple), low-familiarity words (e.g. damsel), pseudowords (e.g. wute), and non-words (e.g. pchy). Letter strings were either presented alone or in combination with a blinking distractor in the left visual field (LVF) or right visual field (RVF). The distractor attracted the attention of the contralateral hemisphere of the brain; a distractor in the LVF attracted the attention of the right hemisphere, leaving only the left hemisphere to process the letter string, and vice versa. Letter strings presented with no distractor freed both hemispheres to interact. Repeated-measures analyses with the between-subjects variable of Language (monolingual vs. bilingual) were conducted for both reaction time and accuracy. Analyses revealed that bilinguals more accurately processed low-familiarity words than monolinguals with no attenuation in reaction time, regardless of distractor location. Though these results do not support increased hemispheric interaction in bilinguals, they do suggest the presence of a bilingual advantage in complex language processing.

## Session 3 – ART 106

### Closed-Cycle Helium Refrigerators for Reaching Low-Temperatures

---

**Student: Michael Fraser**

**Supervisor: Jake Bobowski**

When the thermal energy, or temperature, of a material is reduced below certain microscopic energy scales, one begins to access many different manifestations of quantum behaviours. Two remarkable examples are superconductivity and superfluidity. Studying these types of materials experimentally typically requires that one reach temperatures well below the boiling point of liquid nitrogen (77 K). The most common way to reach these temperatures is to use a bath of liquid helium which boils at 4.2 K. However, the price of helium has risen steadily in recent years making the cost of small-scale, low-temperature experimental physics prohibitive. In this talk I will describe the general operating principles of closed-cycle refrigerators that can be used to reach temperatures as low as 10 K. Because these refrigerators recirculate the same helium gas, they do not require a continuous supply of helium making the cost of operation minimal. I will also discuss a series of experimental tests of a two-stage Gifford-McMahon (GM) cryocooler. First, a commercial GM cryocooler was run as manufactured and a base temperature of 15.6 K was reached. Next, a heat shield was added to substantially reduce the radiation heat load incident on the coldest part of the refrigerator. With the heat shield installed, the base temperature was decreased to 9.2 K. Analysis of the equilibrium base temperature revealed temperature fluctuations with a dominant period of 15 seconds. A thermal low-pass filter with a time constant much greater than 15 seconds was designed and built to suppress these fluctuations. The thermal filter was experimentally tested during another cool down of the GM cryocooler. The base temperature fluctuations were substantially suppressed at the filter output providing a very stable low-temperature thermal stage that can be used for future low-temperature physics experiments.

## Magnetic Shielding for an Adiabatic Demagnetization Refrigerator

---

**Student: Jaklyn DeVos**

**Supervisor: Jake Bobowski**

With the resurgence of low temperature physics, strange phenomena have been discovered. Superconductivity and superfluidity are two remarkable material properties that have been observed in low-temperature physics experiments. Although the most common method of reaching sub-kelvin temperatures is a dilution refrigerator, this method can be expensive due to its high helium consumption and lengthy cooling times. Thus a more cost effective adiabatic demagnetization refrigerator has been developed. This type of refrigerator utilizes paramagnetic salts, which can be thought of as a system of magnetic dipoles or spins, whose entropy is dependent on the temperature and the magnetic field. The presentation will explain how the entropy and the magnetic fields can be manipulated as to cool the paramagnetic salt to the sought after sub-kelvin temperatures. One drawback of this method is the relatively large magnetic fields used to cool the system. Experiments on superconducting material require a zero magnetic field environment since the superconducting state is suppressed by magnetic fields. A shielding device would be necessary to conduct these experiments. Unlike shielding static electric fields, which requires only a hollow conductor, there is no equivalent “magnetic conductor” to shield a static magnetic field. This talk will discuss magnetic shielding with high-permeability materials and will include some simulated results.

## LittleD: A SQL Database for Sensor Nodes and Embedded Applications

---

**Student: Graeme Douglas**

**Supervisor: Ramon Lawrence**

Database systems have greatly reduced the cost of managing large collections of data. The use of small computing devices for collecting data, such as embedded microprocessors and sensor nodes, has greatly increased. Due to their limited resources, adequate database systems do not currently exist for the smallest of computers. LittleD is a relational database supporting ad-hoc queries on microprocessors. By using reduced-footprint parsing techniques and compact memory allocation strategies, LittleD can execute common SQL queries involving joins and selections within seconds while requiring less than 2KB of memory. LittleD has applications in environmental monitoring using sensor networks and embeddable and wearable electronics.

## Identifying Filamentary Structure in Molecular Clouds

---

**Student: Eric Koch**

**Supervisor: Erik Rosolowsky, Jason Loeppky**

It is widely accepted that all stars are formed within molecular clouds. However, our knowledge of where stars form within these environments is limited at best. Recent results from the Gould Belt Survey undertaken by the Herschel satellite of nearby molecular clouds (<1000 pc) have revealed an extensive network of substructure known as filaments. Filaments appear to be ubiquitous amongst all molecular clouds and likely have a significant role in the star formation process. We have developed an algorithmic approach to extracting filamentary structure in data sets of molecular clouds. Due to the limitations of pre-existing methods, many analyses have been completed “by-eye” which limit the number of objects analyzed and robustness of the results. Our method is based on mathematical morphology operators, namely the adaptive threshold method, and improves on pre-existing algorithms as we are able to extract filaments over a wide range in brightness. This allows, for the first time, a complete and statistically significant sample of filaments to be analyzed. This talk will highlight our extraction method, how we calculate properties of the filaments, and present our results using all available data from the Herschel Gould Belt Survey.

## Lorentz gauge quantization in a general conformally flat space-time: Could quantum electrodynamics be the source of dark energy?

---

**Student:** Jesse Cresswell

**Supervisor:** Daniel Vollick

One of the most important unsolved questions in physics is the nature of dark energy. It has been established since Hubble's initial observations that the universe is expanding. The effect of gravity is to slow expansion, but the unknown agent we call dark energy overcomes gravity and causes the rate of expansion to increase. Dark energy is a mysterious form of energy that has never been observed directly but has a very real effect on the universe. Almost nothing is known about what it is, where it comes from, and how it works. But it exists.

In the classical theory of electrodynamics light can be broken into ever smaller amounts. It has been known for over a century that there is in fact a smallest possible amount of light called a photon. These discrete packages of light, or quanta, are not accounted for in the classical theory which must be reworked in a process called quantization. Recent publications have suggested that dark energy may arise when the electromagnetic field is quantized. The process of quantization introduces two polarizations of light which do not appear in the classical theory but may contribute to the energy of the electromagnetic fields as dark energy. There are several well known ways to eliminate these extra polarizations from the theory, but only when gravitational effects are ignored.

This research considers quantization with some gravitational effects taken into account. In a general conformally flat space-time the electromagnetic field in the Lorentz gauge is treated as a constrained dynamical system and quantized canonically. There are extra transverse as well as longitudinal contributions to the Hamiltonian that do not vanish when acting on physical states. From the general state vector, a Minkowski space state vector is found from which particle production from a vacuum can be calculated.

## Sensitivity Analysis of Large Scale Astronomical Simulation Statistics

---

**Student:** Caleb Ward

**Supervisor:** Erik Rosolowsky, Jason Loepky

Star formation is a complex process that can be defined by a set of magnetohydrodynamic equations (MHD equations). These equations are sensitive to changes in their initial conditions. Numerous statistical metrics have been proposed to compare both simulated and observational data and determine the effects of varying initial parameters. These metrics are not created equal and some are able to pick up the changes while others cannot. Even with these inequalities no systematic test of the effectiveness of these metrics has been made. In this talk I will show how our research team made the first systematic comparisons of these different metrics.

To do this we ran fourteen different simulations using Enzo, a computer code that solves the MHD equations. For eight of these simulations we varied the initial parameters for the Mach, energy injection scale, temperature, and magnetic field. While we also had six runs that were given the same initial parameters; only differing with their random seed to create a base to test against. Each of these simulations create position-position-velocity cubes (ppv) cubes which are then compared against the six base simulations. We then assess if the metric can detect a change relative to the base runs by doing a least squares fit of the results of the metrics.

## Resolvent Averages of Monotone Operators / Visualizing the Resolvent Average

---

**Student:** Preston Cooper, Riley Nairn

**Supervisor:** Shawn Wang

Often in mathematics concepts are more difficult to understand due to an inability to properly visualize the concept. The resolvent average of monotone operators is a concept recently developed in the field of convex optimization and will be the focus of this presentation. In this presentation I will define the resolvent average of monotone operators and describe the calculations used in order to compute resolvent averages of simple monotone operators. I will also show plots I have made to aid in visualizing the resolvent average of those operators.

## Holy Henries: The First Tudor and the Cult of the Last Lancastrian

---

**Student: Katrina Labun**

**Supervisor: Ben Nilson**

Throughout most of his reign, Henry VII of England was engaged in intermittent negotiations with the papacy regarding the canonization of his predecessor, Henry VI, as a saint. Henry VI, who had been murdered in 1471 by agents of Edward IV, was one of the most popular saints in England at the time, but Henry VII's campaign for his official canonization eventually failed. While many historians have seen this campaign as motivated by Henry VII's cynical political opportunism, I argue that in this matter Henry VII's political aims cannot be understood as separate from his Christian piety. Contrary to his popular portrayal as the ultimate political manipulator, Henry VII was in fact a deeply pious man. His piety was very much informed by his upbringing in France and Brittany and by the pervasive late-medieval cult of holy monarchy. Medieval kings were believed to have a religious as well as a political role, and Henry VII demonstrated a strong interest in the sacral nature of his kingship. The cult of Henry VI also promoted the role of a holy king in establishing reconciliation and harmony, which accorded well with Henry VII's objective to restore peace and piety in England following decades of civil war. The campaign for Henry VI's canonization thus can only be properly understood within its own cultural sensibility, and within the context of Henry VII's piety and ideology of his reign as a whole.

## A participatory research exploration of the indigenous plant Quinoa

---

**Student: Sarah Lecouffe**

**Supervisor: Tirso Gonzales**

In recent years quinoa a pseudocereal has emerged from a reputation as South American's poor mans food and shifted towards international 'superfood' status. The english name for quinoa originates from the Quechua language of the people who domesticated quinoa some 4,000 years ago in the Andes. It is the incredible biocultural diversity of this region, as well as my own connection with growing quinoa in Salmon Arm that inspired this directed studies project. On the web in the english language there is a dearth of information on quinoa. The goal of this directed study was to compile and research unexplored areas of knowledge related to quinoa. The major term project took the form of a website ([quinoaproject.org](http://quinoaproject.org)). With a focus on experiential learning the assignments have been geared towards participating. Research articles from a decolonized history approach were written and integrated into the site. With the goal of exchanging knowledge I created and currently moderate the first online forum dedicated to discussing quinoa. In order to promote local food systems and seed diversity I held a table at this years' Seedy Saturday event in Enderby. There I met with over 250 collaborators. Participants took home our locally grown quinoa in exchange for sharing their knowledge and practices on the forum. Through independent reading and analysis I compiled an ongoing database of resources relating to quinoa: articles, books, videos, weblinks to market data, indigenous knowledge and practices, scientific research, producer organization, not-for-profit organizations, small scale subsistence farming, and food products. The Quinoa Project will continue to grow beyond the scope of this course; both locally and cross cutting the globe on the web.

## Refining in vitro tissue culture protocols for *Artocarpus altilis*

---

**Student: Jennifer Davy**

**Supervisor: Susan Murch**

*Artocarpus altilis*, commonly called breadfruit, is an Oceanic staple food crop that has recently been developed for worldwide distribution for food security. International distribution requires the production of large numbers of plantlets in sterile media that satisfies the requirements for agricultural transports. In vitro tissue culture methods provide this required plant material but have only been optimized for about 20 varieties. There are several hundred additional varieties that still require protocols for mass propagation. My research was designed to develop and optimize growth media for in vitro propagation of breadfruit. I optimized explant type, antioxidants, antibiotics, stress metabolites and growth regulators. De novo regeneration was induced on stem/petiole explants on a medium containing Murashige and Skoog salts with B5 vitamins, 2-aminoindan-2-phosphonic acid thidiazuron, zinc pyrithione, rifampicin and plant preservative mixture. The data generated in this study provides new approaches to optimization of in vitro protocols for mass worldwide distribution of breadfruit.

## Arbuscular mycorrhizal fungi (AMF)

---

**Student: Peter Dylan Zaitsoff**

**Supervisor: Miranda Hart**

Arbuscular mycorrhizal fungi (AMF) are fungi that form mutualistic symbiotic relationships with approximately 80% of vascular plants. These fungi provide many benefits to their host plants including enhanced nutrient acquisition, resistance to pathogens, stress tolerance to conditions such as drought or heavy metal contamination. Because of these traits, they are important determinants of above ground community structure. Currently, there are 244 described species of AMF, however these cultured isolates likely only represent easily cultured fungi possessing a single life-history strategy, specifically those with “weedy” growth habits. This observation suggests that the true diversity of AMF is actually much higher than currently thought and that our knowledge of these fungi is biased towards those from disturbed habitats. Using the MaarjAM public database (an AMF-specific ribosomal-DNA sequence database), we performed a meta-analysis on previously published studies describing AM fungal communities from various habitats and host plants. We found a greater proportion of uncultured AMF taxa in undisturbed habitats. Specifically, undisturbed forests and grasslands/savannahs contained significantly more uncultured taxa than human-impacted habitats. In addition, wild host plants were found to associate with more uncultured taxa than cultivar plants. These results confirm that the majority of AMF in natural communities have not yet been cultured and suggest that our understanding of AMF-plant symbioses is severely biased towards the associations of AMF with cultivar host plants and in disturbed habitats. Thus, our ability to understand and conserve natural plant communities may be limited by our lack of knowledge of AMF that live in these systems.

## The introduction of an exotic microbe into a natural ecosystem

---

**Student: Tara Evans-Atkinson**

**Supervisor: Miranda Hart**

Arbuscular mycorrhizal fungi (AMF) are fungi that form a mutualistic relationship with plant roots. The use of commercial AMF inoculum is growing in agriculture; however, inoculation of plants with non-native strains of AMF as a bio-enhancer is promoted without clear evidence of fungal persistence and spread into native communities. The purpose of this study was to determine whether or not the AMF, *Rhizophagus irregularis*, established and persisted when introduced into a novel ecosystem. Two host plants, *Achillea millefolium* and *Artemisia ludoviciana*, were inoculated with *R. irregularis*, a commercial AMF inoculant, before or

after being planted into a natural environment. Soil samples, 10 cm, 25 cm and 50 cm from each plant, were collected in spring and fall over a period of two years. Detection of the AMF in the field was through digital droplet PCR of the mtLSU rDNA; thus, the number of rDNA copies per mL could be measured, and the abundance, persistence and distal spread of *R. irregularis* could be determined. Collection of data still in progress, but there is evidence that the isolate was established in 45% of samples by the second sampling date (four months after planting).

## **Happiness and life satisfaction in people with an acquired brain injury: The role of social support, symptom severity, and location of injury**

---

**Student: Alexa Geddes**

**Supervisor: Bruce Mathieson, Mark Holder**

An acquired brain injury (ABI) is a common neurological impairment that occurs after birth as a result of various medical incidents and trauma, including stroke, anoxia, and motor-vehicle accidents (Jones et al., 2011). The consequences of ABI are generally associated with physical, emotional, social, and cognitive impairments as a result of extensive damage to the brain (Green et al., 2008). For the general population, social support – the experience of feeling loved and cared for by others, as well as being part of a social network – is correlated with subjective well-being (SWB), which is the cognitive and emotional evaluation of one's life (Diener, 1984; Taylor, 2007). Although individuals with ABIs often experience loneliness, rejection by peers, and fewer opportunities to develop close, personal relationships, the role of social relationships in the happiness and life satisfaction of these people has not been fully explored (Kozloff, 1987). To help address this gap in our understanding, we conducted one-to-one interviews with individuals with ABIs in order to explore the relations between SWB and social support. Understanding the importance of social support for this specific population is especially helpful in the context of rehabilitation and community reintegration. In addition, this study investigated how symptom severity and location of injury were related to SWB and social relationships. Given that adverse symptoms can interfere with many, if not all, aspects of an individual's life, it is not surprising that symptom severity may be a negative predictor of SWB (Green et al., 2008; Jones et al., 2011). As well, individuals may experience different symptoms and levels of SWB depending on the location of their brain injury (Starkstein & Robinson, 1994). For instance, lateralization of the processing of emotions may help explain the emotional changes associated with ABI (Abbott et al., 2012).

## **Functional Characterization of Isolated *Drosophila melanogaster* Organic Cation Transporters (orcts) in a Heterologous Expression System**

---

**Student: Amanda Davison**

**Supervisor: Mark Rheault**

Organisms depend on rapid excretion of endogenous compounds and xenobiotics to protect them from the accumulation of these potentially toxic substances. Many of these compounds are either organic cations (OCs) or are metabolized into OCs. Renal tissues of both vertebrates and invertebrates have been shown to excrete a wide range of organic compounds by an organic cation transport (OCT) system. OCTs have been well studied and characterized in vertebrates (rat, mouse, rabbit, human), but have not been well characterized in invertebrates (*C. elegans*, *D. melanogaster*). Homologs of OCTs cloned from *D. melanogaster* have 33.7% sequence similarity to the OCT cloned from the rat kidney. This low identity makes it impossible to infer the functional characteristics or substrate selectivity of invertebrate OCTs by comparison to characterized vertebrate OCTs. This study attempted to study the functional properties of isolated *D. melanogaster* orcts (orct and orct2) in a heterologous expression system. Briefly, we transfected insect sf9 cells with orct2 and performed in vitro uptake assays using the radiolabeled Type I OC Tetraethylammonium (TEA). Our results showed that TEA uptake by the untransfected cells was similar to the cells transfected with orct2. Further studies are necessary to determine if this lack of observed TEA uptake was due to poor expression of orct2 in the membrane of the sf9 cells, or if TEA is not a substrate for orct2.

## A meta-analysis comparing the diversity of insect assemblages inhabiting plant communities with and without invasive plant species

---

**Student: Brian Muselle**

**Supervisor: Jason Pither**

Most insects rely heavily on plants for food, shelter, and/or offspring rearing, so changes to the plant community structure are expected to impact insect assemblages. Exotic plants can have profound structural and functional impacts on entire ecosystems, yet comparatively few studies have considered their specific impacts on insect fauna. Those that have typically focused on the insects associated with the exotic plant itself, and not on community-scale effects. Moreover, these studies have rarely analyzed impacts at the taxonomic resolution of species. A recently published meta-analysis reported a significantly negative impact of the presence of exotic plants on insect abundance and richness, but did not evaluate evenness or beta-diversity - both of which are important contributors of community structure and function. I conducted a meta-analysis of published research to address these knowledge gaps. Based on recent findings, I predicted negative impacts not only on insect abundance and richness, but also on evenness and beta-diversity. To be included in the meta-analysis, studies must have (i) conducted paired comparisons between plant communities with and without exotic plant species, and (ii) provided an accounting of the plant and insect species in each sample. A total of 23 studies met these criteria. Preliminary findings run counter to expectations: none of the diversity measures analyzed exhibit significant differences between invaded and un-invaded plant communities. My study should be of broad interest to invasion biologists and ecosystem ecologists, as it is among the first to quantitatively assess the impacts of exotic plants on insect community diversity.

## Repellent and Insecticidal activities of essential oils from *Lavandula angustifolia*, *Lavandula x intermedia* cv GROSSO, *Lavandula x intermedia* cv OKANAGAN (P1) on *Drosophila melanogaster*

---

**Student: Breanne Cadham**

**Supervisor: Mark Rheault, Soheil Mahmoud**

Plant extracts are widely used for controlling pests. The essential Oils (EOs) extracted from three different lavender cultivars *Lavandula angustifolia*, *Lavandula x intermedia* cv GROSSO (GROSSO), and *Lavandula x intermedia* cv OKANAGAN (P1) were tested for their insecticidal and/or repellent effects activities on the adult *Drosophila melanogaster*. The EO composition of each lavender was determined by gas chromatography-mass spectrometry (GC-MS). *L. angustifolia* oil was characterized by relatively high concentrations of linalool and linalool acetate and relatively low levels of 1,8-cineole, camphor, and borneol. The GROSSO oil was characterized by moderately high linalool and linalool acetate, and increased relative percentages of 1,8-cineole, camphor, and borneol. The P1 oil was characterized by high concentrations of linalool, 1,8-cineole and borneol, and low levels of linalool acetate and camphor. In contact toxicity assays, *L. angustifolia* was the most toxic oil, with an LC50 of 0.011  $\mu\text{L}$  EO/fly and a confidence interval of 0.009-0.014  $\mu\text{L}$  EO/ fly. P1 oil showed the lowest contact toxicity, with an LC50 of 0.023  $\mu\text{L}$  EO/ fly and a confidence interval of 0.020-0.031  $\mu\text{L}$  EO/ fly. In the fumigation trials no significant difference was found between the three EOs; all EOs had LC50 values between 5.816 to 6.425  $\mu\text{L}$  EO/L air. Using a custom designed high throughput repellency assay chamber the repellency of each lavender essential oil was determined. The Spatial Activity Index SAI shows *L. angustifolia* had the greatest repellent effect, followed by P1, and GROSSO EO had the lowest repellency. The development of a technology for testing volatile repellency could provide a more economical alternative to modern repellency systems. Generally, all of the EOs showed strong toxicity and repellent effects. This suggests that Lavender EOs have the potential to be used as plant-based natural products for insect pest control in organic agriculture.

## Biocontrol of post-harvest disease in Gala and McIntosh apple varieties by *Pseudomonas fluorescens* isolates 4-6, 2-28, and 1-112

---

**Student: Mackenzie Carnes**

**Supervisor: Louise Nelson**

Product loss due to post-harvest disease has a significant economic impact on the British Columbia apple industry. Due to increasing concern about the detrimental effects associated with traditional chemical fungicides, alternative methods are desired. Previous studies have identified *Pseudomonas fluorescens* isolates 1-112, 2-28 and 4-6 as potential biocontrols to suppress the growth of the post-harvest pathogens *Botrytis cinerea*, *Penicillium expansum*, and *Mucor piriformis*. In vitro inhibition assays were performed with each *P. fluorescens* isolate and all three significantly inhibited the growth of the three pathogens with the exception of 4-6 against *B. cinerea*. The ability of each biocontrol to reduce the infection severity of the pathogens in vivo was tested on Gala and McIntosh apple varieties incubated at 4°C. The effect of varying *P. fluorescens* concentration was evaluated. The optimal concentration for control of each pathogen varied with apple variety and biocontrol strain. Apples inoculated with the *P. fluorescens* isolates and the fungal pathogens were compared to the commercial biocontrol BioSave<sup>®</sup> and the fungicide Scholar<sup>®</sup> with measurements at 5-week intervals. Isolates 2-28 and 4-6 reduced infection severity as efficiently as commercial products on both Gala and McIntosh apples infected with *B. cinerea*. *P. expansum* growth was inhibited by all isolates to the same extent as commercial products, except 1-112 and 2-28 on the McIntosh apples. Isolates 4-6 and 1-112 were as effective as the commercial products in reducing *M. piriformis* infection in Gala apples. However, none of the *P. fluorescens* strains decreased *M. piriformis* on McIntosh apples. Isolate 4-6 was most consistent with controlling the three pathogens on the two apple varieties. However, further testing is required to assess its commercial potential.

## Session 5 – LIB 304

### The effects of irrigation with bicarbonate-containing water and application of wood chip mulch on the $\delta^{13}\text{C}$ -signature of carbon dioxide released from agricultural soils

---

**Student: Dan Kehila**

**Supervisor: Melanie Jones, Kirsten Hanam**

Abiotic sources of carbon dioxide ( $\text{CO}_2$ ) are often not represented in measurements of  $\text{CO}_2$  emitted from soil surfaces (soil  $\text{CO}_2$  efflux or SCE). However, carbonates can contribute substantially to SCE in semi-arid and arid soils. In the summer of 2013, soils sampled directly adjacent to drip emitters in a 10-year-old Ambrosia apple (*Malus domestica*) orchard were observed to release  $^{13}\text{C}$ -enriched  $\text{CO}_2$  compared to soils that had not received direct inputs of irrigation water. Further investigation revealed that the emitters themselves were coated in a limescale that released  $^{13}\text{C}$ -enriched  $\text{CO}_2$  when treated with dilute hydrochloric acid. It was hypothesized that differences in the  $^{13}\text{C}$ -signatures of SCE observed at the two positions within the orchard were the result of sustained bicarbonate applications from irrigation. To examine this effect more closely, soil cores were systematically sampled from two positions (under and away from drip emitters) within the orchard. The cores were incubated at 30°C in a growth cabinet for four months. Water lost during incubation was replaced with bicarbonate-containing irrigation water or distilled water. A subset of samples was amended with wood-chip mulch to determine if organic-rich leachates would moderate the effect of irrigation on SCE.  $\delta^{13}\text{C}$  analysis of the SCE from the cores confirmed an enrichment effect of soil cores collected under vs. away from the drippers ( $P < 0.001$ ). Bicarbonate-containing irrigation water caused enrichment of SCE compared to distilled water ( $P < 0.0001$ ); mulch did not alter the  $\delta^{13}\text{C}$  signature of the SCE. Together the results demonstrate a significant contribution of short-term bicarbonate-containing irrigation inputs to SCE, which could have important implications for our understanding of management effects on greenhouse gas emissions in agricultural soils. Clearly, the contribution of inorganic carbon must be accounted for when examining the contributions of various pools to total respiration in soils with carbonates.

## Glutamine is a precursor in the biosynthesis of BMAA in cyanobacteria

---

**Student: David Oliver**

**Supervisor: Susan Murch**

BMAA, 2-amino-3-methylaminopropanoic acid, is a neurotoxic amino acid produced by cyanobacteria, and nothing is yet known about the biochemical pathway for its synthesis. We hypothesized that Gln is a precursor for BMAA synthesis. In order to investigate this process, axenic cultures of cyanobacteria Nostoc 29150 were grown in a controlled environment. An isotope tracing experiment was then conducted where the cultures were fed <sup>15</sup>N-labelled glutamine at either the amide or the alpha positions. In parallel experiments, <sup>15</sup>N-BMAA was fed to the cultures to provide both a positive analytical control and a measure of BMAA catabolism. <sup>15</sup>N was transferred from BMAA to both alanine and glycine but not to lysine. Both alpha and amide <sup>15</sup>N from Gln were incorporated into BMAA with higher frequency of incorporation from the alpha <sup>15</sup>N. The results indicate that glutamine is a nitrogen precursor of BMAA in cyanobacteria, and that BMAA serves as a nitrogen donor for other amino acids.

## Composition, diversity, and dynamics of wine yeasts in inoculated and spontaneous fermentations of Pinot noir at four Canadian wineries

---

**Student: Sydney Morgan**

**Supervisor: Daniel Durall**

Most Okanagan wines come from fermentations that have been inoculated with a specific commercial yeast strain, but some wineries also practice spontaneous fermentations. Inoculation practices, inoculation history, and winery age may all play a role in the diversity and composition of wine yeasts participating in fermentations. In this study, I investigated the effects of fermentation type as well as winery age on the diversity and composition of yeast species/strains taking part in inoculated and spontaneous fermentations of *Vitis vinifera* cv. Pinot noir grapes at four Okanagan wineries. At each winery, six fermentation vessels were analyzed throughout fermentation: three conducted spontaneous fermentations, and three conducted inoculated fermentations. Samples were collected from each fermentation vessel at four stages of fermentation. A total of 96 isolates per fermentation vessel were isolated. *Saccharomyces cerevisiae* isolates were identified to the strain level using microsatellites, and non-*Saccharomyces* yeasts were identified at the species level by sequencing the D1/D2 domain of the yeast rDNA. Non-*Saccharomyces* yeast diversity and composition were found to be similar between wineries as well as between fermentation types. *Saccharomyces cerevisiae* strain diversity was found to be much higher at all wineries in spontaneous than in inoculated fermentations. Among the spontaneous fermentations, each winery possessed a unique *S. cerevisiae* strain composition, composed of commercial strains as well as unknown, possibly indigenous, strains. Indigenous strains were found that were unique to each winery. Total yeast CFU/mL was determined for each tank at each fermentation stage and plotted. Each winery had a unique CFU/mL curve. These results suggest that the history of inoculation, as well as the commercial strains used, may affect the composition of *S. cerevisiae* strains participating in spontaneous fermentations at a winery. This may be of interest to newly-established wineries when deciding on the future fermentation and inoculation practices that will take place.

## Cathepsin B Enzymatic Assay Design

---

**Student: Adamo D'Ovidio**

**Supervisor: Andis Klegaris , Joyce Boon**

Alzheimer's disease (AD) is a neurodegenerative disorder, characterized by chronic inflammation in the brain. Under inflammatory conditions, microglia, the immune cells of the brain, become activated and secrete pro-inflammatory mediators and neurotoxic substances. Cathepsin B (CathB) is a neurotoxic lysosomal protease released from microglia during inflammation. CathB can also act as a  $\beta$ -secretase cleaving amyloid precursor protein, creating amyloid- $\beta$  protein, which plays a key role in the pathogenesis of AD. Therefore, inhibitors of CathB could be used as potential therapeutic agents for AD. The purpose of this project was to design a specific CathB enzymatic assay that could detect CathB release from microglia and could be also used to measure inhibition of CathB

by novel CathB inhibitors. This assay used the substrate, Z-Arg-Arg-7-amido- 4-methylcoumarin hydrochloride, due to its autofluorescence when cleaved by CathB. The fluorescent signal was recorded, and used to determine the rate of the reaction, which decreased in the presence of inhibitors. The CathB inhibitory activity of gold-containing auranofin was analyzed, along with E-64, a non-specific cathepsin inhibitor. CathB was mixed in solution with auroanofin or E-64 at different concentrations, and the percentage of remaining CathB activity was calculated. Both inhibitors reduced the activity of CathB, however, only E-64 produced statistically significant effects. Furthermore, the CathB assay was used to assess the release of CathB from human monocytic THP-1 cells stimulated for 24 hours with interferon- $\gamma$  and lipopolysaccharide. The assay for enzymatic activity of CathB released into the cultured supernatant has been performed, however, results from the experiment for CathB release have yet to be obtained. Overall, the CathB enzymatic assay provides a convenient and necessary tool for identification of novel CathB inhibitors, which may lead to the development of drugs that could be used to treat AD.

## Abundance of Nitrification and Denitrification Genes in Perennial Agricultural Soil Under Varying Soil Amendments and Effect of pH and Temperature on Denitrification in Vitro.

---

**Student: F. Paul Markin**

**Supervisor: Louise Nelson**

The International Panel on Climate Change has designated agricultural N as the main source of anthropogenic nitrous oxide (N<sub>2</sub>O), a well-documented greenhouse gas and ozone scavenger. Both nitrifying and denitrifying prokaryotes can contribute to N<sub>2</sub>O emissions and are themselves affected by different soil conditions. The aims of the current study were twofold: determine which soil amendments influenced copy numbers of genes coding for enzymes in the nitrification (amoA, ammonia monooxygenase) and denitrification (nirS, nitrite reductase and nosZ, nitrous oxide reductase) pathways using quantitative PCR (qPCR); and how pH and temperature influence evolution of N<sub>2</sub>O:N<sub>2</sub> ratios within a pure culture of *Pseudomonas syringae* 1-137. Eight different soil treatments were sampled in triplicate in an apple orchard and a vineyard following harvest in September 2013 at the Pacific Agri-Food Research Centre, Summerland, BC. Samples were obtained at a depth of 5-10 cm. There were no significant differences among soil treatments ( $p > 0.05$ ), however for grape-vine soil the amoA gene set yielded a significant difference between treatments at  $\alpha = 0.10$  ( $p = 0.08$ ). The gas evolution study compared five different nosZ positive strains in terms of N<sub>2</sub>O:N<sub>2</sub> emission using the acetylene inhibition method and gas chromatography. The least efficient strain was then incubated for 6 hours at pH levels of 5, 6, 7, and 8; followed separately by incubation at temperatures of 10, 15, 22, and 30°C. As pH decreased only N<sub>2</sub>O was produced, whereas efficiency was highest at pH 8 (N<sub>2</sub>O:N<sub>2</sub> = 0.07). Similarly, higher temperatures were more favourable for complete denitrification to nitrogen gas (N<sub>2</sub>O:N<sub>2</sub> = 0.09 at 22°C). This study confirms efficiency trends observed in the literature for similar species, and shows that postharvest gene copy numbers for both nitrifying and denitrifying prokaryote populations are highly variable within the first 10 cm of soil.

## Cytochrome C Alters Central Nervous System Inflammation

---

**Student: Ayden Gouveia**

**Supervisor: Andis Klegaris, Joyce Boon**

In the event of traumatic head injury or chronic central nervous system (CNS) inflammation molecules known as damage associated molecular patterns (DAMPs) are released from dying cells. DAMPs signal immune cells of the CNS to become activated and produce inflammatory and neurotoxic chemicals. This may lead to chronic neuroinflammation, which is the hallmark of neurodegenerative diseases such as Alzheimer's disease. One molecule that increases in the CNS following traumatic injury is the mitochondrial protein cytochrome c, a currently uncharacterized DAMP. Preliminary research has shown bovine cytochrome c greatly increases the production of toxic oxygen free radicals in a process called the respiratory burst. The aim of this study was to confirm these findings using purified human cytochrome c as well as identify a possible signalling mechanism responsible for the action of cytochrome c. To study this HL-60 cell line is incubated in the presence or absence of human cytochrome c were exposed to the respiratory burst stimulating compound formyl-methionine-leucine-phenylalanine. HL-60 cells treated with human cytochrome c showed higher production of oxygen free radicals, which indicates cytochrome c increases the activity of the respiratory burst. This experiment was repeated with the addition of a monoclonal antibody to block the cell surface receptor toll-like receptor 4, a candidate receptor for

cytochrome c. Blocking toll-like receptor 4 significantly reduced the respiratory burst priming effect of cytochrome c. These results confirm cytochrome c primes the respiratory burst of immune cells, and furthermore that cytochrome c signalling may be dependant on toll-like receptor 4. Further research into the extracellular signalling of cytochrome c in the CNS is required to further elucidate the role of DAMPS in chronic neuroinflammation.

## An agent-based computer model of cheetah-tourist vehicle interactions

---

**Student: Corrie Allen**

**Supervisor: Lael Parrott**

The Massai Mara National Reserve in Kenya is home to a large quantity of vulnerable species including the cheetah (*Acinonyx jubatus*). A large number of tourists are attracted to the reserve each year to view wildlife. Although literature is rich in describing cheetah hunting strategies, success rate, and habitat preferences, previous work has failed to consider how the presence of tourist vehicles can alter cheetahs' hunting success and spatial distribution. In this project, we developed an agent-based computer model to investigate the interactions between hunting cheetahs and tourist vehicles and the role that rules and regulations governing jeep movement can have in reducing jeep impact on cheetahs. Specifically, we consider and assess the impact of jeeps restricted to travelling on a road-network and jeeps permitted to wander throughout the landscape on cheetahs' ability to hunt. Our model indicates that jeeps following the road do not significantly influence cheetah hunting success but do alter their spatial location within the park. Comparatively, wandering jeeps permitted to travel throughout the landscape resulted in up-to a 2- fold decrease in cheetah hunting success. As a result, the conclusion was made that the rules and regulations in place are effective at maintaining relatively normal cheetah hunting success levels; however, can cause a change in cheetah distribution throughout the park. Ultimately this project will be used to provide a mechanism of managing tourist vehicles such that tourists have a good wildlife viewing experience without compromising the hunting success of the vulnerable cheetahs living in the Massai Mara National Reserve.

## Analysis of Yeast Populations During Alcoholic Fermentations in Chardonnay: A Comparison Study Between three Wineries

---

**Student: Morgan Stone**

**Supervisor: Daniel Durall**

During alcoholic fermentation, there is a progressive growth pattern of particular yeasts, with the final stages invariably being dominated by those responsible for alcoholic fermentation. Yeast composition, diversity and CFU/mL evolved during the production of Chardonnay was investigated under two fermentation conditions and between three wineries. The objective was to determine both the fermentation conditions and the wineries impact on yeast populations. The fermentation conditions were inoculated and spontaneous. Inoculated fermentation is suggested to produce a consistent, reproducible wine and deemed successful when more than 80% of the strains are the inoculant. Spontaneous fermentation is less reliable and rarely practiced; however, is suggested to produce a more complex wine due to a high diversity of yeast participating in the fermentation. The 3 Canadian wineries participating in this study carried out both inoculated and spontaneous fermentations. Three fermentation barrels were sampled for each fermentation at each winery. Samples were taken at four stages of fermentation defined by Brix° levels. 96 yeast isolates were obtained from each barrel. Non-Saccharomyces isolates were identified to the species level by sequencing the D1/D2 domain of the yeast's rDNA. Saccharomyces cerevisiae strains were identified using 7 microsatellite loci, and comparing allele numbers to both the UBCO and Richards et al. database (2008). Our results indicated that implantation was only successful between two wineries as the third had less than 10% implantation. Saccharomyces that remained in the inoculated fermentations other than the inoculum were predominately indigenous strains. Yeast isolated from spontaneously fermenting wines revealed very high diversity in the S. cerevisiae populations. Yeast composition in spontaneous tanks was significantly different between wineries. Lastly, CFU/mL patterns throughout the stages revealed variation between the wineries and the fermentation treatments. Understanding the population dynamics and evolution of yeast microflora can help winemakers control the quality and characteristics of their wine.

**Student: Larissa Laderoute**

**Supervisor: Bernard Bauer**

Chronic erosion of rivers banks and shorelines can be a significant challenge for natural resource managers in the Okanagan, but there is generally little quantitative information available to assess the magnitude and source of erosion. Local land owners claim that the wakes generated by recreational boat traffic are the main driver of bank erosion. This brings about concern for quality of drinking water, loss of property, and aquatic habitat integrity. The primary objective of this research project was to document the rate of erosion at seven sites along the Lower Shuswap River above the confluence with Mara Lake. Erosion-pin profiles were deployed in early May and were monitored, when accessible, through to the end of August to provide information on bank erosion rates. The volume of daily boat traffic from May to August was documented at two sites using remote camera systems that captured images every three seconds. The hydrodynamics of boat wakes and resulting sediment suspension plumes were assessed using electronic instrumentation (current meters, pressure sensors, and turbidity meters) deployed over a two-day experiment on the August long weekend when recreational boat traffic was intense. The data collected indicates peak boating period on the Shuswap River begins on the July long weekend and ends mid-August, with a large portion of traffic attributable to only a few boats that pass through the same river reach multiple times, usually in the context of water skiing or wake boarding. The downstream reaches, closer to Mara Lake, experience higher volumes of traffic (3152 boat passages at the Bruns Site) than reaches farther upstream (680 boat passages at the De Ruitter Site). Erosion along the river was not uniform (8.7 cm at the Bruns Site and 1.7 cm at the De Ruitter Site) due to the influence of boat traffic and river geometry.