Science Atlantic 2022-2023 Yearbook

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Letter from the Executive Director

Hello!

On behalf of Science Atlantic, I am pleased to present the 2022-2023 Student Awards Yearbook. Our awards recognize excellence in scientific research, science communication, mathematical problem solving, and computer programming. On the following pages, you will find the names and abstracts of 80 of our region's most talented emerging scientists. Congratulations to you all!

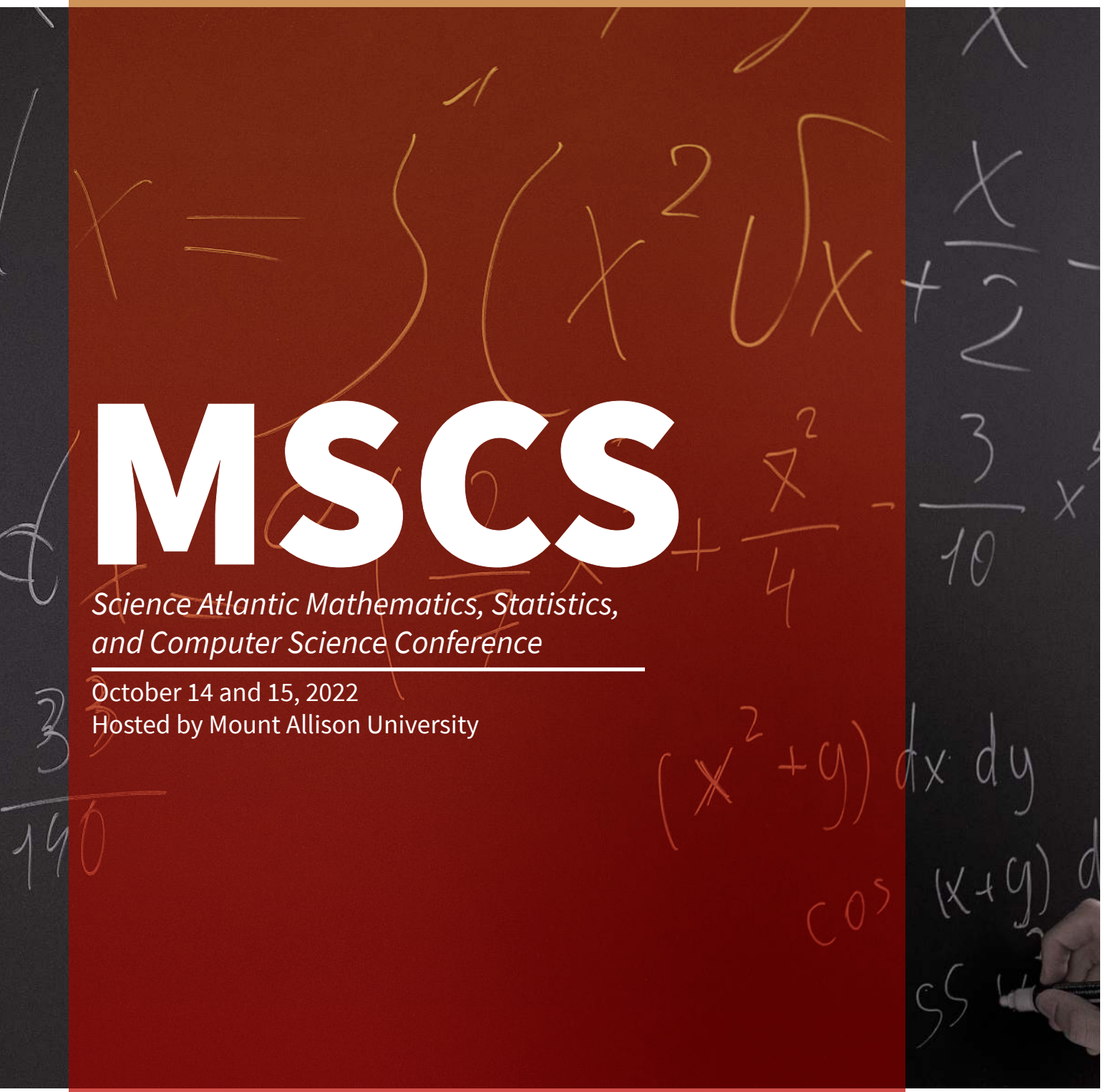
Through student presentations, keynote speakers, field trips, and workshops, these conferences foster and facilitate academic success, career development, and a strong scientific community. Professional conference experiences expose students to current research and connect them to their cohort of fellow scientists, which in turn promotes future academic and career opportunities.

I would like to express my thanks to the students, faculty, and staff who coordinated the 2022-2023 conferences. Your hard work is deeply appreciated, not only by Science Atlantic, but by the students whose education you help to enrich.

As well, I extend a warm thank you to our sponsors, listed after each conference in the following pages. Your support allows us to continue providing these experiential learning opportunities.

Finally, I'd like to recognize our summer graphic design student August Schaffler who designed this year's Yearbook. They brought the Yearbook to a whole new level and I hope that you will enjoy reading it.

Lois Whitehead



MSCS

Science Atlantic Mathematics, Statistics, and Computer Science Conference

October 14 and 15, 2022
Hosted by Mount Allison University

MSCS | Computer Science

Science Atlantic Science Communication Award

Alastair May
St. Francis Xavier University

Creating Visual Representations of Finite Automata

Alastair May[1]
[1]*St. Francis Xavier University*
Supervisors: Taylor Smith, Milton King

A finite automaton is an abstract model of computation that accepts or rejects strings of characters based on a finite sequence of computation steps. Visually, a finite automaton consists of a set of nodes that are called states, and transitions between states. This presentation about finite automata will present my work on adding functionality to a software named Grail. Grail allows you to interface with finite automata and perform various useful functions on them such as converting them to and from regular expressions. The new functionality I am adding is the ability to generate visual diagrams when given text files containing the specifications of automata produced by Grail.

MSCS | Computer Science

Science Atlantic Undergraduate Research Award

FIRST PLACE

Crystal Sharpe
Mount Allison University

Mutual Opacity Between Multiple Adversaries

Crystal Sharpe[1], *Hervé Marchand*
[1]*Mount Allison University*
Supervisor: Laurie Ricker

We investigate opacity, an information-flow privacy property, in a setting where there are two competing agents or adversaries whose objective is to hide their secrets and expose the secrets of the other agent. Each agent has only partial information about the state of the system, where the system and agents are modelled as finite automata. The agents can achieve their objective by enabling or disabling events from their set of controllable events. We examine two different scenarios. In the first problem, the agents are passive with no control capabilities, and we seek a global controller to enforce their mutual opacity. In the second problem, the formerly passive agents are autonomous and have control capabilities. We seek the plausibility of two controllers, one for each agent, to see if we can synthesize a winning control strategy so that one adversary can always discover the secrets of the other without revealing its own.

MSCS | Computer Science

Science Atlantic Undergraduate Research Award

SECOND PLACE

Patrick Bowen
St. Francis Xavier University

Fill in the Blank Stance Detection with Language Models

Patrick Bowen[1]
[1]*St. Francis Xavier University*
Supervisor: Milton King

Stance detection is a task in natural language processing that involves determining if a snippet of text is displaying an opinion that is in favour or against some topic. Automatically detecting the stance within text can assist organizations determine the opinions of people related to topics such as a product review or an action made by the organizations.

We approached this problem by tuning a pretrained language model (RoBERTa) on tweets that expressed their opinions on a specific topic. Language models are used to estimate the probability of a sequence of words based on the text they observe. By tuning a language model toward tweets that contain a stance, we are adjusting the probabilities of the language model to more closely represent the same stance. We then use this finetuned model to complete a blend of several "fill-in-the-blank", cloze-style sentences, which were used to assess stance present in the tweets. We evaluate our model on a subset of English tweets from the SemEval-2016 stance detection shared task.

MSCS | Computer Science

Atlantic Canadian Programming Competition Awards

A highlight of the annual Mathematics, Statistics, and Computer Science conference is the Atlantic Canadian Programming Competition (ACPC). Teams of up to three students have five hours to analyze problems, design solutions, and write computer programs to solve as many of the given problems as quickly as possible.

Until 2019, this competition was part of the world-wide Intercollegiate Programming Contest (ICPC) and was known as the Atlantic Canadian Preliminary Contest. Though it is now separate, the contest is designed to help university teams prepare to compete in the ICPC.

Atlantic Canadian Programming Competition Awards

FIRST PLACE

Sawyer Stanley, Logan Pipes, Crystal Sharpe
Mount Allison University

SECOND PLACE

Qingyu Zhang
Memorial University of Newfoundland

THIRD PLACE

Sean Lalla, Jonas Rouven Schoenauer, Praveen Yatelli
University of New Brunswick, Fredericton

MSCS | Mathematics and Statistics

Science Atlantic Science Communication Award

Lauren Farrell
Mount Allison University

A Pair Formation Model with Recovery of Monkeypox

Lauren Farrell[1], *Jane Heffernan*
[1]*Mount Allison University*
Supervisor: Matt Betti

Monkeypox is a disease which spreads through close prolonged contact with an infected individual, similarly to a sexually transmitted infection. However, the recent global outbreak of monkeypox is unique because spread is mainly concentrated in men who have sex with men and infected individuals can recover with lifetime immunity. This novel situation can be modeled by combining a pair formation model, which is generally used to model STI spread, with an SIR model.

MSCS | Mathematics and Statistics

Science Atlantic Undergraduate Research Award

FIRST PLACE

Logan Pipes
Mount Allison University

Bounding Real Tensor Optimizations via the Numerical Range

Logan Pipes[1], *Nathaniel Johnston*
[1]*Mount Allison University*
Supervisor: Nathaniel Johnston

Numerous bounds on a certain optimization problem over product tensors are discussed, with focus on utilizing the numerical range of a matrix. This bound is equal to the one attained by a common semidefinite relaxation technique but can be implemented without running any semidefinite programs.

MSCS | Mathematics and Statistics

Science Atlantic Undergraduate Research Award

SECOND PLACE

Dylan Pearson
Mount Allison University

Slow Localization

Dylan Pearson[1], *Danny Dyer, Melissa Hugan*
[1]*Mount Allison University*
Supervisor: Margaret Messinger

Localization is a turn-based pursuit-evasion game played on a graph where one player controls a set of cops, and another player controls a robber. The cops are not aware of the robber's location and attempt to locate them via distance queries. Both the cops and the robber can move to new vertices or stay put on their turn, with the cops being able to move to any vertices while the robber's movement is restricted to adjacent vertices. A variation of the localization game is studied where the cops are restricted to moving to adjacent vertices on their turn. The minimum number of cops required to locate the robber is called the slow localization number. We compare the slow localization number with the localization number on different graph classes and determine the slow localization number on caterpillars, wheels and cocoons.

MSCS | Mathematics and Statistics

Science Atlantic Mathematics Problem Solving Competition

The annual Science Atlantic Mathematics Problem Solving Competition has its roots in Atlantic Math Days, first held in 1977. Math Days were designed to bring together teams of high achieving students and their teachers for game-based problem solving. Over time, the focus was broadened and the competition became part of the annual Mathematics Conference, and in 1994, the Mathematics, Statistics, and Computer Science (MSCS) conference. Teams of two race to solve between six and nine problems during a three hour period, with only paper and pencil–no notes, calculators, computers, cellphones, or other aids.

Science Atlantic Mathematics Problem Solving Competition

FIRST PLACE

Xiaoyu Jia
Dalhousie University

SECOND PLACE

Eric Goulding, Daniel Gosse
Memorial University of Newfoundland

THIRD PLACE

James Petersen, Hayden Lees
University of New Brunswick

Conference Sponsors

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AUGC

Atlantic Universities Geoscience Conference

October 27 to 29, 2022
Hosted by Acadia University

AUGC

Science Atlantic Best Paper Award

Claire Gullison
University of New Brunswick, Fredericton

Microplastic in Beach Sediment From Marys Point, Shepody National Wildlife Area, Southeast New Brunswick

Claire Gullison[1], *Dave Keighley*[1]
[1]*University of New Brunswick, Fredericton*

The Shepody National Wildlife Area (NWA) hosts 50-95% of the world's Semipalmated Sandpiper population during their >3,000 km migration south. The sandpipers rest and feed on a variety of biota, including mud shrimp, other crustacea, molluscs, worms, biofilms, etc., that live on and in the NWA's intertidal mudflats backed by sand and gravel beaches. Plastic waste is now widely documented as polluting these environments, where it often breaks down into particles of <1 mm size (microplastic), becoming difficult to collect and remove, while becoming more available for ingestion by biota in the sediment and eventually accumulating progressively up the food chain, potentially in humans or sandpipers. Previous studies investigating the microplastic fraction have focused on the readily visible, surficial sediment (<5 cm depth), disregarding the processes active in sediment that may mix the vertical sediment column, distributing the plastic to a greater depth. This initial study aims to investigate microplastic distribution across and vertically within a sandy beach section at Mary's Point, using a sediment corer. Samples are analyzed in 4 cm depth increments, with microplastics separated and compositionally classified for each increment via a novel procedure using low-cost, non-toxic chemicals: four density separations, involving solutions with increasing densities (fresh water, saline water, and low and high concentration NaH_2PO_4 solutions), followed by an oleophilic separation. Separated microplastics were then further analyzed by microscopy to determine size, shape, colour, and degradation; compositions were validated using Raman Spectroscopy. Preliminary results indicate clear and blue fibres (from fishing gear, potentially) dominate.

Imperial Oil Best Poster Award

Leila Rashid
Saint Mary's University

Documenting Recent Human Influences Using Remote Sensing Techniques on the Tekes River Alluvial Fan, Xinjiang, China

Leila Rashid[1], *Philip Giles*[1]
[1]*Saint Mary's University*

The Tekes River alluvial fan is located in Xinjiang Province which has an arid to semi-arid climate as well as a historically unpredictable precipitation rate. Further, increasing population and urbanization means that all water resources must be used efficiently. The Tekes River alluvial fan has had a vast amount of human influence in recent decades in the form of dam construction, irrigation and agriculture expansion. Although development on and surrounding the Tekes River alluvial fan is apparent, there is a lack of research on how these human impacts have affected the fan. The primary objective of this project is to use remotely sensed image analysis to document the human influence that has occurred to the Tekes River alluvial fan. A 31-year time series (1990-2021) was created using Landsat imagery from 1990 – 2021. The results have found that four dams have been constructed upstream from the fan, irrigation canal length had increased by approximately 400 km, and agricultural fields had increased by approximately 250 km^2. Average seasonal NDVI values were calculated on agricultural fields and compared to natural vegetation in the area for seven dates in 2021. The results do not show great observable differences between agricultural field and natural vegetation cover. However, these results are limited temporally and spatially. Further research should continue to document and test NDVI as well as consider measuring groundwater levels to build upon this research and provide a greater understanding of the anthropogenic impacts on the fan.

The Imperial Oil Best Poster Award is given to the student presenting the best overall student poster on any topic at the annual AUGC. The award is judged primarily on the basis of the scientific quality of the topic, the amount of original work done by the student and his/her understanding of the subject.

This award has been sponsored by Imperial Oil since 2007. Imperial Oil recognizes that business success depends on the economic, social and environmental health of the communities where they operate and views community investment not simply as a responsibility but as an essential component in building a strong society.

Canadian Society of Petroleum Geologists (CSPG) Award

Nikita Lakhanpal
Saint Mary's University

Survey of Porewater Geochemistry within Deep Marine Hydrocarbon Seep Sediments of the Scotian Slope, Canada

Nikita Lakhanpal[1], G. Todd Ventura[1], Venus Baghalabadi[1], Natasha Morrisson[2], Adam MacDonald[2]
[1]Saint Mary's University, [2]Nova Scotia Department of Natural Resources and Renewables

The ocean floor surface sediments of the Scotian Slope, Nova Scotia are host to a complex network of microbially mediated reactions that knit together the various biogeochemical cycles. Limited diffusion between the upper water column and ocean floor mud pore spaces, coupled with competitive microbial ecological niche partitioning, leads to the formation of biogeochemically controlled redox gradients. These microbial biogeochemical zones change if surface sediments are impregnated by hydrocarbon seepage that migrates up from deeper within the basin. Porewater profiles of F^-, NO_2^-, NO_3^-, CO_3^{2-} and SO_4^{2-} were used to reconstruct biogeochemical stratification depth profiles that can provide comparative evidence for anion behaviour in active cold seep sites. A comparative study between two methods of data analysis was applied to the samples. The method of standard addition proved to be a better method than the external calibration curve method to measure porewater anion concentrations of natural samples with complex matrices and a varying range of concentrations. For this reason, porewater anion concentrations were compared using the standard addition method. Sulfate concentration decreases dramatically in both ambient and hydrocarbon impacted marine benthic sediments although, in hydrocarbon impacted sites, it appears to occur at a much shallower depth suggesting that the redox gradient is much more pronounced and as much sulfate reduction has not yet transpired with the ambient sediments at the same depth. Nitrate and NO2- trends also show similar pronounced reduction patterns occurring at shallower depths for hydrocarbon impacted sediments suggesting widespread increased microbial and bacterial activity in these regions.

The Canadian Society of Petroleum Geologists (CSPG) Award is awarded annually for the best presentation of a petroleum geology-related paper at the annual AUGC.

This award is sponsored by the Canadian Society of Petroleum Geologists. Founded in 1927, the mission of the Society is to advance the professions of the energy geosciences – as it applies to geology; foster the scientific, technical learning and professional development of its members; and promote the awareness of the profession to industry and the public.

The Frank S. Shea Memorial Award in Economic Geology

Taylor Mugford
Memorial University of Newfoundland

Mineralogy of the Boundary Volcanogenic Massive Sulfide (VMS) Deposit of the Tally Pond Group, Victoria Lake Supergroup, Newfoundland Appalachians

Taylor Mugford[1], *Stephen Piercey*[1]
[1]*Memorial University of Newfoundland*

The Cambrian Boundary volcanogenic massive sulfide (VMS) deposit is located in the Victoria Lake Supergroup in the Newfoundland Appalachians, Canada. The deposit is hosted within chlorite-sericite-quartz–altered rhyolite lapilli tuff and tuffs and represents one of the best preserved subseafloor-replacement-style VMS deposits globally. The purpose of this study is to provide insights into the mineralogical evolution of the replacement style mineralization in the North Zone of the Boundary using mineral textures, paragenesis, and reflected light microscopy, scanning electron microscopy (SEM), and electron probe microanalysis (EPMA). Initial textural results show that the Boundary deposit is dominated by an assemblage of pyrite, sphalerite, chalcopyrite, galena, and pyrrhotite. Pyrite is the dominate sulfide, displaying many textures including colloform, framboidal and euhedral forms. Chalcopyrite occurs as both, massive and disseminated, the latter occurring as sulfide stringers. Pyrrhotite is present as small inclusions in pyrite intergrown with chalcopyrite. Sphalerite is present in majority of the mineral facies, but its abundance varies from disseminated, massive, and sulfide stringers; sphalerite also locally exhibits chalcopyrite disease. Galena occurs as irregular grains commonly intergrown with sphalerite and pyrite. SEM and EPMA work are ongoing.

The Frank S. Shea Memorial Award honours the student making the best presentation regarding an aspect of or with implications for economic or applied geology.

During some 27 years, Frank Shea was engaged in mineral resources exploration and development activities in the Atlantic region. For more than 10 years he served as Chief Geologist and division director of the Mineral Resources and Geological Services Division in the former Nova Scotia Department of Mines.

The Frank S. Shea Memorial Award is sponsored by the Mining Society of Nova Scotia. Organized in the 1890s to promote the mineral industry, to share technical knowledge and to encourage fellowship, this Society was one of the founding members of the Canadian Institute of Mining and Metallurgy (CIM), the premier mining organization in Canada.

The Canadian Society of Exploration Geophysics (CSEG) Award

Megan MacDonald
Dalhousie University

Machine-learning Focal Mechanism Inversion for Hydraulic Fracking-induced Earthquake

Megan MacDonald[1], *Miao Zhang*[1]
[1]*Dalhousie University*

Hydraulic fracking has contributed to an increase in induced seismicity in recent years in Fox Creek, Alberta. Earthquake focal mechanisms, relying on polarities of earthquake first motions, provide insight into the state of stresses in a region. Traditional methods for manually determining the polarities of first motions are not suitable for microearthquakes due to the large volume of data, and owing to their low signal-noise ratio. Machine learning provides a reliable and efficient way for polarity classification. Using data obtained from the Tony Creek Dual Microseismic Experiment, this study aims to show that machine learning can reliably solve for polarities of earthquake first motions, and characterize the focal mechanisms of hydraulic fracking-induced earthquakes. The project will provide greater insights into the state of stresses and geologic structures (such as faults) in the study area and will improve our understanding of earthquake-triggering mechanisms during hydraulic fracking. In this presentation, we are going to introduce the seismic data, proposed methods, and preliminary results.

Established in 2008, the Canadian Society of Exploration Geophysicists (CSEG) Award is given to the student who presents the best overall geophysics paper at the AUGC conference.

CSEG was founded in 1949 around the time of the petroleum production boom of the Leduc and Redwater discoveries. Today, CSEG's mandate is to promote the science of geophysics, especially as it applies to exploration, and to promote fellowship and co-operation among those persons interested in geophysical prospecting.

Atlantic Geoscience Society (AGS) Environmental Geoscience Award

Julianna Whelan
Memorial University of Newfoundland

Methane Flux, Source, and Lipid Biomarkers of Serpentinite-hosted Groundwater Springs at Contrasting Sites of Terrestrial Serpentinization

Julianna Whelan[1], *Penny Morrill*[1]
[1]*Memorial University of Newfoundland*

Serpentinization sites are a point of recent scientific interest because of their implications toward primitive microbial metabolisms and astrobiological exploration. Serpentinization occurs when circulating groundwater hydrates ultramafic rocks, a reaction that is common in submarine environments and on land at ophiolite complexes. Three sites of terrestrial serpentinization were studied through their groundwater springs, which act as windows into the subsurface with respect to geochemistry and microbial activity. Serpentinization causes groundwater springs with unique parameters including ultra-basic pH levels (>10), low redox values, and methane and hydrogen gas enrichment. The Tablelands (NL, CAN), The Cedars (CA, USA), and Aqua de Ney (CA, USA), produce groundwater springs which act as endmembers, displaying a range of values with respect to the above properties. These sites have been extensively studied in the past and changes have been observed over the last decade, proving it imperative to characterize these changes and interpret the temporal variations in these systems, made possible through the present comparison. Through past research it has been determined that the source of methane gas is different at each of the sites, but the flux of methane gas had not been quantified. This study intends to relate the methane flux to their source, aqueous geochemistry, and lipid biosignatures. Through gas chromatography and mass spectrometry, this study contributes to the knowledge around what microbial life consumes, what it produces, and how these things are preserved in terrestrial serpentinization systems.

The Atlantic Geoscience Society (AGS) Award was established in 2015 to recognize the best project (talk or poster) at the annual AUGC involving a significant component of environmental geoscience.

The AGS exists to promote a better and wider understanding of the geology of Atlantic Canada, both to its members and to the public. An entirely volunteer association, the AGS brings together earth scientists from universities, government institutions, the environmental, mining, and petroleum industries, and consultants in the Atlantic provinces.

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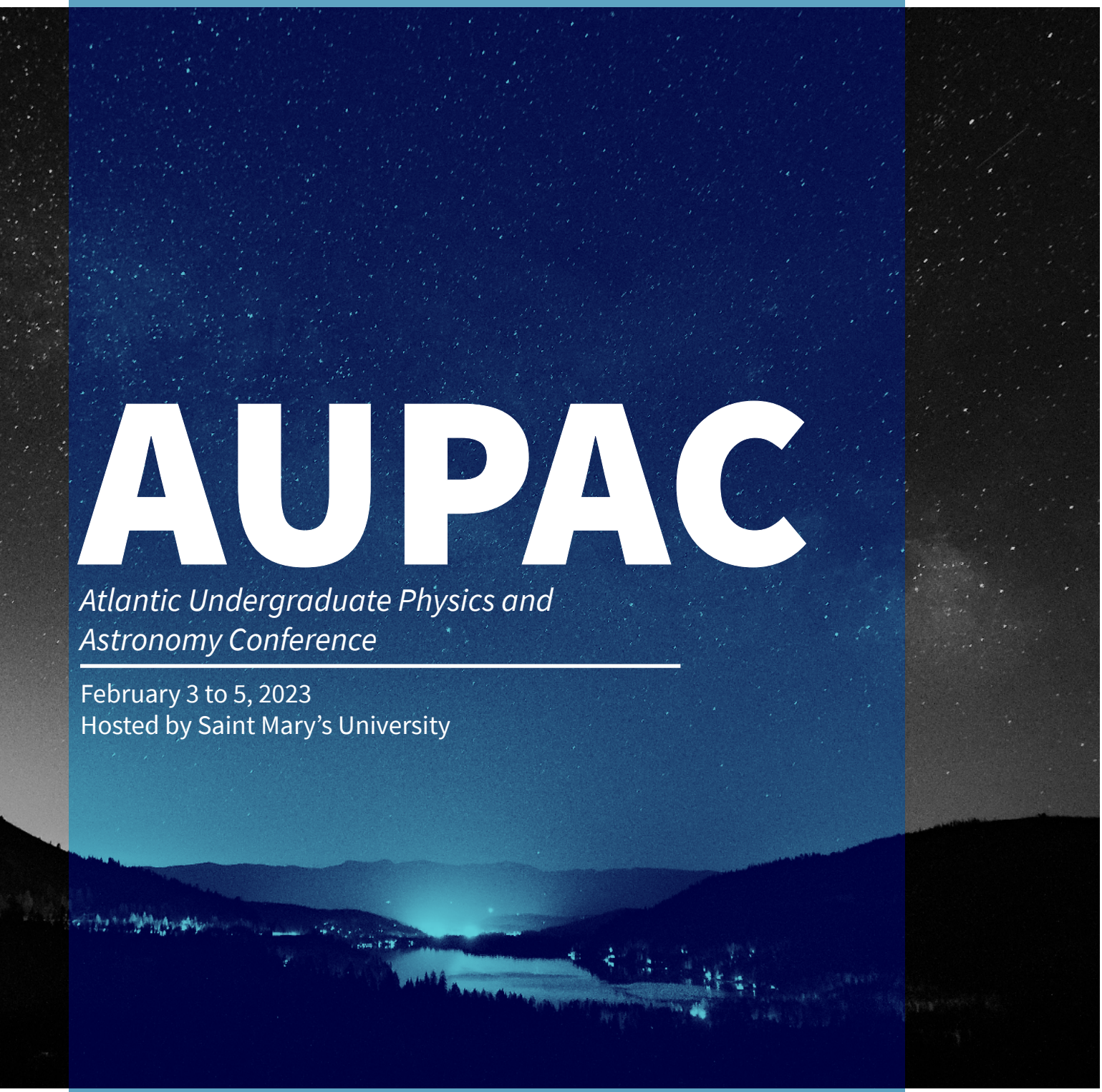
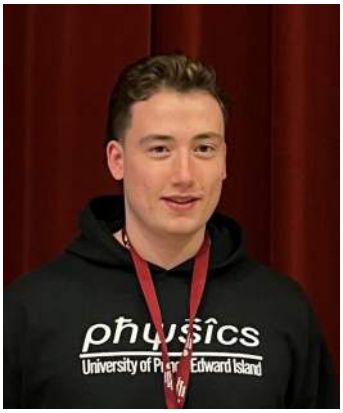


AUPAC

Atlantic Undergraduate Physics and Astronomy Conference

February 3 to 5, 2023
Hosted by Saint Mary's University

The Tindall/Steinitz Award in Research



FIRST PLACE

Liam MacNevin
University of Prince Edward Island

Force-Distance Relationship of Stretched Polycatenane Structures

Liam MacNevin[1]
[1]*University of Prince Edward Island*

Computer simulations were run to study the effects of varying forces on polycatenane structures. Any force-distance relationship is important to study as it gives insight into how the polymer reacts and responds to forces. This new type of polymer is interesting due to its linked ring configuration, and its physical properties should be studied. It was found the end-to-end distance increases with an increasing force, and that it approaches an asymptotic value. As well, when viewing the relationship between this end-to-end distance subtracted from its asymptotic value, an inverse relationship that is similar to the hard-sphere chain model is found between increasing force and this modified distance value. In addition, the thickness of the rings was changed for the same calculations above, and the same relationships were found regardless of the thickness of the rings in the polycatenanes. This research benefits the growing knowledge pool as this new type of polymer's properties are probed. If there ever becomes a reason to create these polymers for any such reason, knowing how they react to a force put on them will be critical just as knowing how forces react with DNA is critical in DNA research.

SECOND PLACE

Jay Allison
Mount Allison University

Exploring Multimode Pulsations in Classical Cepheids

Jay Allison[1]
[1]*Mount Allison University*

The objective of this research project is to use computer simulation to model a classical cepheid star which exhibits multimode pulsation, and then analyse the properties of this model to put forth a mechanism for why certain cepheids develop these pulsations. The majority of classical Cepheids, important distance candles in astronomy, pulsate in either the fundamental or first overtone. However, a small but significant minority appear to display a frequency modulated with a higher overtone. There is no currently accepted hypothesis as to why. This research project used a combination of software suites to simulate stellar evolution, and energy, density, and material flow within the star. A 7-solar mass model began displaying clear pulsation, and Fourier analysis of the luminosity data also suggests higher overtones are present.

The Tindall/Steinitz Award in Research

Science Atlantic Hall of Fame members Michael Steinitz (L) and David Tindall (R) at the 50th Anniversary of APICS/Science Atlantic, April 2012.
Photo: Heidi Steinitz

The Tindall/Steinitz Award in Research is the top prize given at the annual Atlantic Undergraduate Physics and Astronomy Conference (AUPAC), awarded to the undergraduate student giving the best research presentation. The Award is named in honour of two longstanding members of the Physics and Astronomy Committee.

Dr. David Tindall joined Dalhousie University's Physics Department in the early 1970's, where he did research on magnetic phenomena in solids. He is a dedicated teacher and was the department's undergraduate advisor. David was Dalhousie's representative to the APICS (later Science Atlantic) Physics and Astronomy Committee for over 25 years (1983–2011). Now retired, David continues to have a deep interest in astronomy and is active in promoting astronomy, physics, and science in general.

Dr. Michael Steinitz has been a physics professor at St. Francis Xavier University since 1973. He cares deeply about students, especially encouraging female students, those from Africa, and those with barriers to learning. He strongly feels that Science Atlantic students can compete with the best in the world. He also believes strongly in an education that includes the arts, human rights, and justice. Michael has been a constant promoter of the wonders of physics to the general public.

Science Atlantic Science Communication Award

FIRST PLACE

Scout McKee
St. Francis Xavier University

Analysis of the Hydrogen Bond Network in Simulations of Supercooled Water

Scout McKee[1]
[1]*St. Francis Xavier University*

Supercooled water is of interest because of its unusual properties, and because of its central role in many important phenomena, from cryopreservation to atmospheric science. Depending on the applied pressure, supercooled water has been shown to exist in high-density liquid (HDL) and low-density liquid (LDL) phases. Experimental and simulation evidence supports the existence of a sudden (first-order) transition between these two phases beginning at a critical temperature located at supercooled conditions. However, this liquid-liquid phase transition (LLPT) is challenging to observe experimentally since measurements must be taken extremely quickly before ice crystallization occurs. For this reason, computer simulations are often used to study supercooled water. Simulation models allow for structural analysis of both HDL and LDL near the critical point. This was done recently by Foffi, Russo and Sciortino for the TIP4P/Ice model [J. Chem. Phys. 154, 184506 (2021)]. They examined the structural changes across the LLPT by a novel analysis of the hydrogen bond (HB) network in TIP4P/Ice model. In their study, they found that “unambiguous differences in the HB network properties exist between the two liquids”. Another model of supercooled water is the ST2 model, a model for which the LLPT has been well studied. We conduct a similar analysis with the ST2 model to that done for TIP4P/Ice by Foffi, et al. We find that although both models have evidence for a LLPT, at the molecular level, the hydrogen bond networks of each model are qualitatively different.

SECOND PLACE

Kamal Shalaby
University of New Brunswick, Fredericton

Laser Frequency Stabilization with an Arduino

Kamal Shalaby[1]
[1]*University of New Brunswick, Fredericton*

We have stabilized a commercial diode laser operating at 780 nm, by locking its frequency to a transition in rubidium (Rb) gas. Using Doppler-free absorption spectroscopy. This method circumvents the velocity-broadening of the transition due to the temperature of the gas and provides a narrow spectral line to lock the laser. By modulating the frequency of the laser and feeding the resulting absorption signal into a lock-in amplifier, we generate an error signal with a zero-crossing at the peak of the spectral line. This error signal is sent to an Arduino that runs a digital proportional-integrator (PI) control algorithm and generates a feedback signal for the laser. In this talk, we discuss how we characterize this closed-loop feedback system in terms of both short-term and long-term relative frequency stability. This work is a crucial first step toward the realization of a laser-cooled source of ^{87}Rb atoms in a new laboratory for Quantum Sensing and Ultracold Matter (QSUM) at UNB.

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MARITIME LAUNCH

MDA

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Saint Mary's University

SAEC

Science Atlantic Environment Conference

March 25, 2023
Hosted virtually by Grenfell Campus,
Memorial University of Newfoundland

SAEC

Science Atlantic Undergraduate Research Award (Oral)

FIRST PLACE

Samantha Bennett
Saint Mary's University

Effects of Jumping Worms on European Worms and Soil Properties

Samantha Bennett[1], *Erin Cameron*[1], *Helen Phillips*[1]
[1]*Saint Mary's University*

Earthworms are ecosystem engineers, meaning that they alter soil structure and impact other organisms and ecosystem functioning. In 2014, pheretimoid "jumping worms" (*Megascolecidae* spp.) were discovered in Ontario, Canada, with later discoveries in New Brunswick (2021), and Nova Scotia (2022). Jumping worms have had substantial impacts on ecosystems in the northeastern United States, including effects on nutrient cycling and other soil organisms. In Canada, little research has been done to examine spread or effects of jumping worms since they have established only recently. Thus, we conducted sampling at a residential property in Oromocto, New Brunswick—the first location where jumping worms were found in the province. Our objectives were to examine: (1) how jumping worms impact soil properties (specifically nitrogen and carbon), (2) how their presence impacts the abundance of European earthworms, and (3) the effectiveness of different sampling methods. We found that jumping worms had significant impacts on soil nitrogen but did not have significant impacts on European earthworm species or soil carbon. The results also revealed that both sampling methods (i.e., mustard solution and wooden discs) are equally effective at detecting the presence of jumping worms at a site. Over the longer term, we hope to track the expansion of this population in order to determine rates of spread. Understanding the impacts and spatial spread of these species will be critical for future management of these invasions.

Photo: Maryam Nouri-Aiin/UVM Department of Plant and Soil Science

Photo: Nastassja Noell at Mushroom Observer

SECOND PLACE

Hailey Martin
Memorial University of Newfoundland, Grenfell Campus

Morphological and Physiological Adaptations of the Parasitic Lichen *Ochrolechia frigida* in Coastal Habitats of Newfoundland

Hailey Martin[1], Dmitry Sveshnikov, Michele Piercey-Normore, Andre Arsenault
[1]Memorial University of Newfoundland, Grenfell Campus

Ochrolechia frigida (Sw.) Lynge is a crustose lichen adapted to the harsh conditions of arctic/alpine regions. It has been found growing in the bogs of the island of Newfoundland on both the west and east coasts. *O. frigida* shares a symbiotic relationship with its algal partner and displays parasitic or saprotrophic behaviour towards a range of hosts from mosses to higher plants. There is limited research regarding the preference of *O. frigida* for particular plants, plant communities or microclimate conditions, as well as about its nutritional strategies or physiological and morphological adaptations. *O. frigida* exhibits two distinct morphological forms: photosynthetic verruciform granules and non-photosynthetic elongated spinules. The relative amounts of these morphologies present on any particular thallus is suggested to reflect the differences in water availability: spinules may improve the water supply from the air through increased surface area. This project assesses potential relationships between thallus morphology and moisture absorption, using anatomy studies and physiological recovery experiments, towards a better understanding of how the morphological plasticity of *O. frigida* contributes to its ecological success.

SAEC
Science Atlantic Undergraduate Research Award (Poster)

FIRST PLACE

Lenayah Ryan
Cape Breton University

The Impact of Chain Pickerel Invasion on Yellow Lampmussel and Their Fish Host in Cape Breton, Nova Scotia

Lenayah Ryan[1]
[1]*Cape Breton University*

Chain Pickerel (*Esox niger*) is a predatory fish that was first introduced into mainland Nova Scotia in 1945 and has since spread to 95 locations in the province. They were illegally introduced into Blacketts Lake, Cape Breton in 2010. This is particularly concerning because Blacketts Lake is home to the Yellow Lampmussel (*Lampsilis cariosa*), a freshwater mussel designated as a Species at Risk. The mussel depends on White Perch (*Morone americana*) to host its larvae for the completion of its lifecycle. Our research assessed the potential impact of Chain Pickerel on Yellow Lampmussel and its fish host within Blacketts Lake. Boat electrofishing carried out in 2017 and 2021 indicates that Chain Pickerel is now well established in Blacketts Lake making up 90% of fish sampled; no White Perch were found. Several large White Perch were collected in Blacketts Lake with gill nets in 2021 indicating that the species has not been completely eliminated. However, recent quadrat sampling found no Yellow Lampmussels younger than five years of age in Blacketts Lake, which is consistent with Chain Pickerel predation reducing the availability of Yellow Lampmussel fish host and their ability to complete their lifecycle. Two nearby lakes with no Chain Pickerel had evidence of recent Yellow Lampmussel recruitment. Risk assessment of Chain Pickerel invasion for 50 lakes in Cape Breton County based on connectivity and public access revealed 13 lakes at very high risk. However, the other Cape Breton lakes with known Yellow Lampmussel populations were found to be at low risk.

Credit: Duane Raver

Photo: Antoine Lamielle

SECOND PLACE

Julie Anne François
Cape Breton University

Examination of Diurnal Activity Patterns, Social Behavior, Enclosure Use, and Impact of Visitor Density in Four Species of Penguins in Captivity

Julie Anne Francois[1]
[1]*Cape Breton University*

Modern zoos design enclosures that mimic wild habitats with the goal of encouraging natural behaviours and enhancing animal welfare. Behavioural assessments of animals within these enclosures are needed to ensure this goal is achieved. Our research objective was to assess diurnal behaviour, social interactions, enclosure usage, and the impact of visitors on penguins housed at the Kansas City Zoo. We did scan and focal sampling of 74 penguins from four different species using live and archived webcam video. Behavioral activity differed significantly ($p<0.05$) among the four species and over time with Gentoo (*Pygoscelis papua*) being the least active, and behavioural inactivity peaking at night for all species. Patterns of habitat use within the enclosure also varied significantly among species, with King (*Aptenodytes patagonicus*) and Chinstrap penguins (*Pygoscelis antarcticus*) almost entirely restricted to concrete platforms and Kings spending less time in pools than other species. Gentoo and Macaroni penguins (*Eudyptes chrysolophus*) used the greatest range of habitats within the enclosure. High frequencies of social behaviours were also observed among Gentoos while Macaroni penguins engaged in significant amounts of agonistic behaviour towards other species. Visitor density impacted behaviour with penguins increasing their time in the pool closest to observation windows when visitor density was high. This suggests that visitors represent a source of enrichment. In the wild, penguins spend up to 75% of their time swimming. Future research should investigate the addition of enrichment and design features that could increase swimming activity in captive penguins at the Kansas City Zoo.

FIRST PLACE

Sarah Cusack
University of New Brunswick, Fredericton

Predictive Modeling of Habitat Suitability for Yellow Lampmussel *(Lampsilis cariosa)* in the Lower Wolastoq | Saint John River Watershed, New Brunswick

Sarah Cusack[1, 2], Michelle Gray[1, 2], Antoin O'Sullivan[1, 2], Bernhard Wegscheider[3], Jae Ogilvie [2]

[1]Canadian Rivers Institute; [2]Faculty of Forestry and Environmental Management, University of New Brunswick, Fredericton; [3]Institute of Ecology and Evolution, University of Bern, Switzerland

The population of Yellow Lampmussel *(Lampsilis cariosa*) (YLM) found within the Wolastoq | Saint John River watershed in New Brunswick, is one of two disjunct populations in Atlantic Canada. The objective of this research was to better our understanding of regional variables influencing the distribution of the species' preferred habitat in the Wolastoq, by producing a species distribution model for YLM in the lower portion of the watershed. We used existing mussel datasets and machine learning algorithms to determine if temporal landscape-scale variables that influence the availability of suitable habitats can accurately predict the presence and absence of YLM. The model had 96% training accuracy and 70% validation accuracy for the historic dataset. Snorkel surveys to ground truth model predictions identified two new occurrence locations for YLM. Understanding key habitat requirements of this species support important management decisions, including prioritization of conservation areas.

Photo: Paolo G. Albano, Barbara Bongiovanni, Pamela D'Occhio, Bruno Sabelli

Photo: Quang Nguyen Vinh

SECOND PLACE

Naizhen Yu
Cape Breton University

Cu-doped Anatase TiO_2: An Efficient Visible-Light Photocatalyst for Water Treatment

Naizhen Yu[1], Collins Nganou[1], Andrew Carrier[1], Mita Dasog[2], Xu Zhang[1]
[1]Cape Breton University, [2]Dalhousie University

Organic pollutants and pathogenic microbes exist in water systems causing many communities, especially in developing countries, resulting in a high risk of infection with water-borne diseases. Developing simple, cost-effective, and efficient sunlight-driven water treatment technologies is crucial for people to access clean and safe water. The most widely studied photoactive and antibacterial material is titanium dioxide (TiO_2). TiO_2 nanoparticles (NPs) can produce highly reactive free radicals to oxidize organic pollutants and deactivate biological pollutants. However, pristine TiO_2 NPs have a large band gap and only harvest solar radiation in the UV region, limiting its efficacy. This project focuses on developing a visible light photocatalyst by copper doping in regular white anatase TiO_2 ($wTiCuxO_2$) and evaluating its photocatalytic and antibacterial activity.

We synthesized $wTiCuxO_2$ NPs using a solvothermal approach. The photocatalytic performance was evaluated using the degradation of Rhodamine B (RhB) dye and disinfection of *Escherichia coli* (E. coli) under visible light irradiation. We show that Cu doping and surface defects on pristine TiO_2 enhance its photodegradation ability. The mechanism is hypothesized to be due to band gap narrowing and accelerated charge separation. In the project, an efficient photocatalyst was developed for water treatment; the mechanistic investigation of the catalyst increases our understanding of the heterogeneous catalysts, which are useful for engineering more efficient water treatment devices.

Science Atlantic Science Communication Award

Geneva Bahen
Dalhousie University

Telling the North American Beaver Tale: Modeling *Castor canadensis* Distribution in Mi'kma'ki (Nova Scotia, Canada)

Geneva Bahen[1]
[1]Dalhousie University

The American beaver (*Castor canadensis*) is a keystone species of significant ecological and biocultural importance in Mi'kma'ki (Nova Scotia). However, occurrence data in the province has never been systematically collected resulting in geographic knowledge gaps. This thesis generated a species distribution model (SDM), identifying landscape-scale drivers of beaver distribution, areas of high value, and investigated the relationship between human footprint and predicted probability of occurrence. Several variables are known to influence habitat selection, including distance to watercourse, stream gradient, and distance to preferred hardwood tree stands, yet specific distances and species vary greatly throughout their continental range. Using four environmental datasets, 25 raster layers characterizing beaver niche habitat were extracted in ArcGIS and spatially correlated layers were removed. Occurrence data from iNaturalist and AC CDC was compiled, and a 10-replicate cross-validated model was generated with a jackknife test measuring variable importance in Maximum Entropy software. The model produced a high averaged area under the receiver operating curve value, with stronger predictive capacity than a null model. The most deterministic variables according to permutation importance were 'Distance to Watercourse', 'Elevation', 'Distance to Gray Birch', 'Distance to Yellow Birch', and 'Distance to Aspen'. These findings are consistent with previous studies suggesting watercourses and hardwood species compose suitable habitat for beavers, while highlighting the important ecological relationships between beavers and the Wabanaki-Acadian Forest. The findings will contribute to future efforts to map biocultural connectivity in Unama'ki (Cape Breton) and can be used in future conservation, protection, and management efforts.

Photo: Ryan Hodnett

K.C. Irving Environmental Science Centre Acadian Forest Region Award

Levyn Radomske
Dalhousie University

Characterizing the Conifer Gradient from the Halifax Peninsula to the Hinterlands of the Halifax Regional Municipality

Levyn Radomske[1]
[1]*Dalhousie University*

The urban forest tree species composition is influenced by the urban environment and thus, by daily anthropogenic activity; however, in the naturalized woodlands, species composition is primarily influenced by natural disturbances. In moving away from the urban setting to the naturalized forest there is a shift in the environment, leading to a transition of dominant species, ultimately creating a species composition gradient. This study is interested in characterizing the existing conifer gradient, through assessing the Halifax Peninsula, surrounding communities, and the hinterlands of the HRM. The assessment of the conifer density on the Halifax Peninsula followed a non-probabilistic sampling technique in which ocular estimates were conducted, producing a conifer inventory for this study area. To assess the conifer density in the other study areas, two independent datasets were analyzed. Further analyses on other cities conifer densities were conducted to develop benchmark values for the city of Halifax. Through these assessments, it became apparent that there is a steep conifer gradient that exists in the transition from the urban environment to the naturalized environment. This data can be used to question the lack of conifers in the urban forest despite their prominence in the naturalized setting and in other cities.

The Acadian Forest Region Award is awarded annually at the Science Atlantic Environment Conference for the best oral or poster presentation of undergraduate student research relating to the flora or fauna of the Acadian Forest region. For the purpose of this award, student research on Boreal Forest in Newfoundland and Labrador is eligible as there is a large overlap of species.

This award is sponsored by the K.C. Irving Environmental Science Centre. The Centre is a place where nature and people meet and collaborate. Student art displays, performance recitals, and debates in the Garden Room provide the Arts with a brilliant space. The K.C. Irving Environmental Science Centre and Harriet Irving Botanical Gardens is open 365 days a year. Students, friends, and visitors are welcome anytime.

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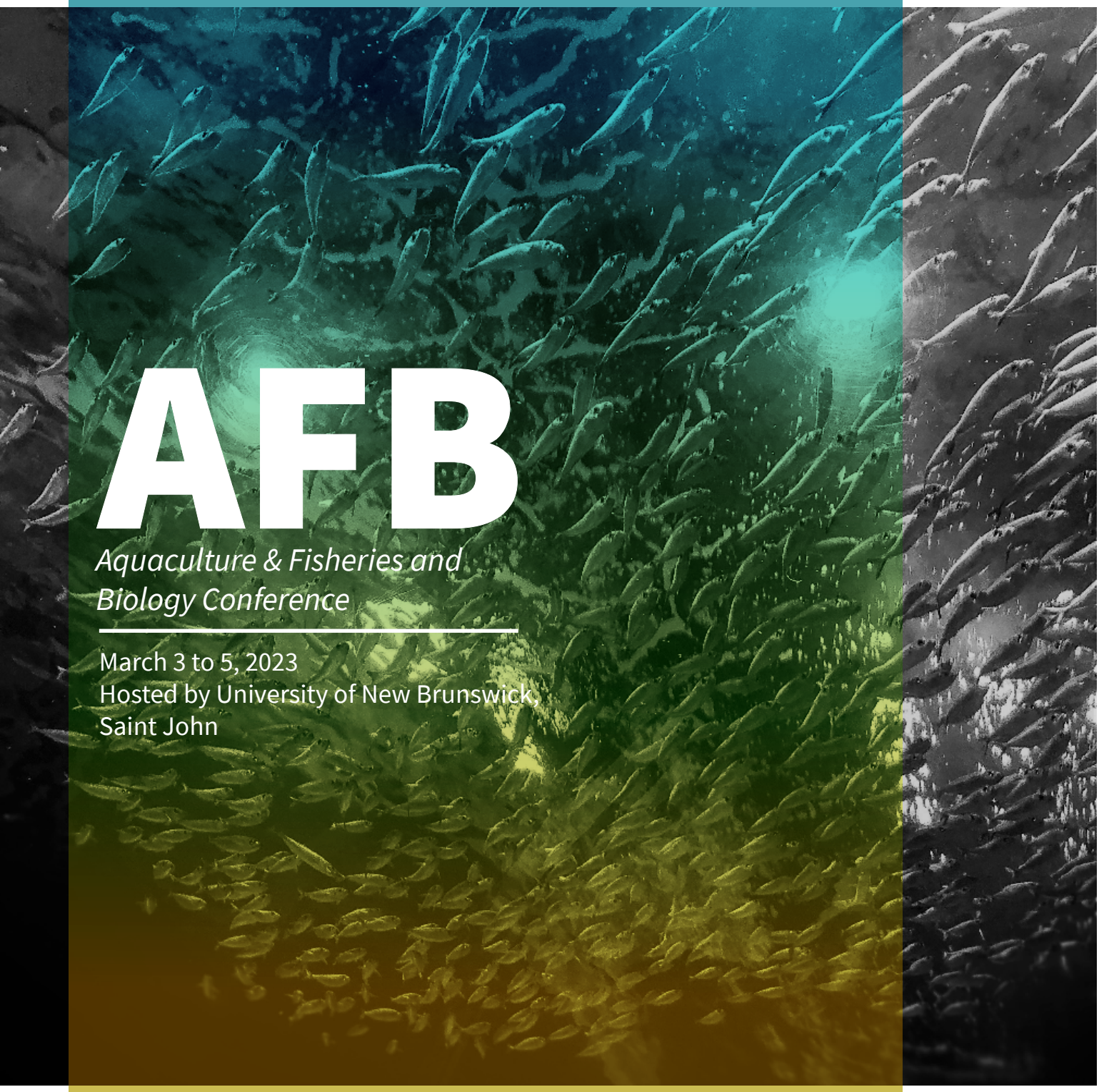


AFB

Aquaculture & Fisheries and Biology Conference

March 3 to 5, 2023
Hosted by University of New Brunswick, Saint John

Science Atlantic Undergraduate Research Award (Oral)

FIRST PLACE

Kate Storey
Acadia University

Macroinvertebrate Population of the Medway River and its Ramifications on Atlantic Salmon

Kate Storey[1]
[1]*Acadia University, Department of Biology*

This presentation will discuss my honours project supervised by Dr. Trevor Avery. This project analyzed macroinvertebrates in the Medway river to assess water quality and availability of Atlantic salmon prey. Sampling took place from June-August 2021 and May-October 2022 at 9 sites along the Medway, collecting a total of 2,084 macroinvertebrates. Macroinvertebrates from insect orders as well as amphipods and isopods were identified down to the family level, while other invertebrates such as Hirudinea and Oligochaeta were identified to class or subclass. This identification allowed biotic indices assessing water quality such as Hilsenhoff's biotic index and EPT richness index to be used. The results gathered from these indices will be discussed, as well as ecosystem composition, diversity, and the suitability of the Medway river as Atlantic salmon habitat.

Credit: Timothy Knepp

Science Atlantic Undergraduate Research Award (Oral)

SECOND PLACE

Sofia D'Angelo
Dalhousie University

Investigating the Thermal Biology of the Orange-Footed Sea Cucumber *(Cucumaria frondosa)*

Sofia D'Angelo[1]
[1]*Dalhousie University*

The orange-footed sea cucumber (*Cucumaria frondosa*) is the most common species of sea cucumber in the North Atlantic. These animals are commonly consumed in luxury cuisine, however, rising market demands have led to the overharvesting of many species. Despite an emerging commercial fishery in the North Atlantic, many uncertainties concerning the growth rate and physiology of *C. frondosa* persist, particularly in regard to the effects of elevated temperatures. This study therefore aimed to determine the thermal biology of *C. frondosa* under current and future seawater temperatures. To accomplish this goal, metabolic rates were analyzed to determine the acclimated and acute response of this species to rising temperatures. The acute response was examined by increasing water temperature from 4 to 16°C by 2°C per hour and metabolic rates were recorded every hour as temperature rose. To investigate the acclimated response, temperature was increased by 2°C per day to until the desired temperature was reached for four treatment groups (4, 8, 12 and 16°C). Upon reaching treatment temperatures, conditions were held for 14 days, and metabolic rates were subsequently recorded every hour for 24 hours. Together these experiments provide a detailed account of the thermal physiology of *C. frondosa* under elevated temperatures. This information can aid in the development of bioenergetic models and can assist in understanding the effect of temperature on the bioenergetics and growth in this species. This project fulfills the growing need to determine growth rates to ensure the sustainable management of holothurian fisheries in the North Atlantic.

Photo: Eric A. Lazo-Wasem

Photo: Jud McCranie

THIRD PLACE

Maddison Brown
Dalhousie University

Effect of Gear Type on Growth and Shell Shape of Cultured Eastern Oysters (*Crassostrea virginica*)

Maddison Brown[1], *J. Duston*[1]
[1]*Dalhousie University*

Optimizing shell shape for commercial oysters has received little attention, although the value of uniformly shaped oysters can be up to 60% more per oyster compared to irregularly shaped. This study looks at the creation of optimal shell shape of Eastern oysters (*Crassostrea virginica*) for commercial use using BOBRs and OysterGro gear. BOBR (benefit of being round), produced by Dockport LTD, is an off-bottom gear with a cylindrical shape for natural tumbling. Five BOBRs were filled with four litres of small oysters, and five with large oysters. Four litres of control oysters were placed in two OysterGro bags. The cages were held in the Robinson's Cove lease of Shandaph Oysters on Big Island Nova Scotia from June 29th until October 24th. Measurements of length, width, and depth were taken on June 29th, August 22nd, and October 24th. The Galtstoff index and a length/width index were calculated to assess shell shape. Hurricane effects caused the loss of OysterGro data for October 24th. Length, width, and LW ratio were found to be statistically significant using repeated measures analysis on day and size grade for BOBR treatments. Results indicate significant growth and an increase in optimal shell shape, although a lack of increase in depth for both BOBR size grades. Depth measurements in OysterGro agree with previous studies showing significant growth. Recommendations to use BOBR for young oysters for growth in an optimal shell shape then transferred to OysterGro for increased depth of cup during the finishing period.

Graduate Research Award (Oral)

FIRST PLACE

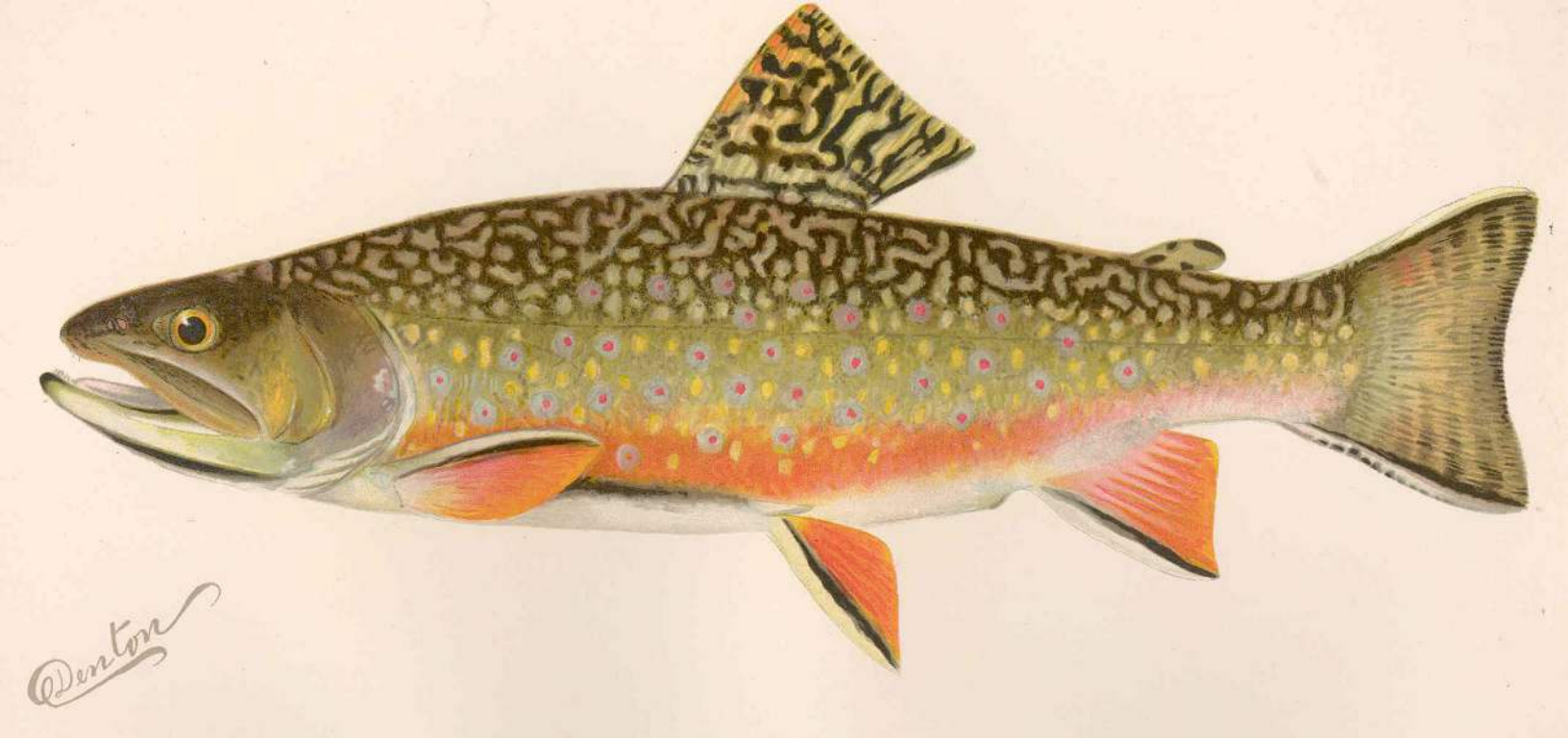
Abigale Culberson
University of New Brunswick, Fredericton

The Spatial Ecology of Invasive Largemouth Bass *(Micropterus salmoides)* in the Wolastoq (Saint John) River

Abigale Culberson[1], T. Linnansaari[1], K. Munkittrick[2], R.A. Curry[1], P. Harrison[1]
[1]University of New Brunswick, Fredericton; [2]University of Calgary

Species introductions often cause harm to local ecosystems through predation, biodiversity reduction and increased competition with endemics. Largemouth bass (*Micropterus salmoides*), a large, predatory fish, were first observed in the Wolastoq (Saint John) River in New Brunswick, Canada, in 2014. Despite the potential for interactions with native and endemic species, little is known about the movement ecology and dispersals of this non-native species in the Wolastoq system. In this study we tracked the movements of largemouth bass (n=43) over three years using radiotelemetry and active tracking. The resulting dataset is being used to investigate and compare spatial ecology metrics including movement, dispersal and home-range across seasons and years, as well as identify environmental drivers of these movements. Our findings are expected to increase our understanding of the impacts and dispersal of this recently introduced fish, and thus contribute to the design of effective management policy in the Wolastoq system and beyond.

Photo: Abigale Culberson



SECOND PLACE

Christopher Baker
University of New Brunswick, Fredericton

The Effect of Dietary Supplementation of Astaxanthin on Acute Hypoxia and Temperature Tolerance in Triploid and Diploid Brook Charr, *Salvelinus fontinalis*

Christopher Baker[1], *Tillmann Benfey*[1]
[1]*University of New Brunswick, Fredericton*

Triploid fish could be beneficial for increasing aquaculture sustainability due to their reproductive sterility which prevents the risk of interbreeding between wild and escaped farmed fish. However, research has shown that they are less tolerant than diploids of environmental stressors such as high temperatures and low dissolved oxygen. This study investigated whether dietary supplementation with the carotenoid astaxanthin (AX) improves the acute hypoxia and temperature tolerance of both triploid and diploid brook charr (*Salvelinus fontinalis*). Fish were fed diets with three levels of AX supplementation (17, 80, 189 mg/kg) for 8 weeks and then assessed for acute hypoxia tolerance by rapidly reducing oxygen content of the water and then determining the oxygen concentration at loss of equilibrium (LOE) and time taken to reach LOE. Using a similar approach, I then determined critical thermal maximum (CTmax) tolerance of different groups of triploid and diploid charr fed the same AX diets by rapidly increasing the temperature of the water and then determining the temperature at LOE and time taken to reach LOE. Triploids were less hypoxia tolerant then diploids, but ploidy did not affect CTmax, and AX supplementation also did not affect either hypoxia tolerance or CTmax. Additionally, it was observed that muscle pigment increases with dietary AX supplementation, suggesting that the primary purpose of AX is as a pigment enhancing agent for muscle tissue.

Photo: Scott Davis

THIRD PLACE

Jacob Reicker
University of New Brunswick, Saint John

Environmental DNA for Surveillance of Anadromous and Freshwater Fishes Upstream of the Mactaquac Generating Station

Jacob Reicker[1], P. Harrison[2], L. Roehl[1], A. Curry[2], S. Pavey[1]
[1]University of New Brunswick, Saint John; [2]University of New Brunswick, Fredericton

The Mactaquac Generating Station significantly impedes the upstream migrations of several notable species in the Saint John River. As a result, costly transporting programs, including the use of tanker trucks, have been implemented jointly by NB Power and the Mactaquac Aquatic Ecosystem Study. Environmental DNA offers a powerful, non-invasive strategy for the surveillance of such species within their habitats. We have utilized current environmental DNA procedures
to monitor several important species—Atlantic salmon (*Salmo salar*), American shad (*Alosa sapidissima*), Alewife and Blueback herring (*Alosa pseudoharen gus* and *Alosa aestivalis*, respectively; collectively known as River herring), Largemouth bass (*Micropterus salmoides*), and American eel (*Anguilla rostrata*) —along the Saint John River and key tributaries between Fredericton and Perth-Andover, New Brunswick. The data were collected between April and October 2022 and will inform the Mactaquac Aquatic Ecosystem Study on habitat usage of the noted species.

Poster Presentation Award

FIRST PLACE

Marijune Tiamzon
University of New Brunswick, Saint John

Impact of Maternal Size on Brood Size and Hatch Characteristics of American Lobster, *Homarus americanus* in the Bay of Fundy

Marijune Tiamzon[1], *M. Whipple*[1], *R. Rochette*[1]
[1]*University of New Brunswick, Saint John*

The body size of female American lobster (*Homarus americanus*) is a key aspect of the productivity and management of this iconic species, but surprisingly, little is known about the relation between female size and hatching. Whereas several studies have documented how fecundity at spawn increases with maternal size, few have examined this relation closer to hatch, or whether maternal size also influences other hatch characteristics. In this study, we used data and samples collected for a graduate student project during the summer of 2022, in which we reared 29 egg-bearing lobsters to observe hatch in a laboratory set-up simulating natural conditions. We quantified the relationship between female carapace length (CL, 89-135 mm) and the (i) number of larvae collected at the end of hatch, (ii) hatch duration, (iii) mean hatch date, and (iv) size of prezoa at hatch. We found a positive linear relationship between CL and brood size, but no significant relationship between CL and hatch duration, mean hatch date, or the size of prezoa. These results suggest that the size of an ovigerous American lobster impacts fecundity close to hatch, but not other hatch characteristics investigated in this study.

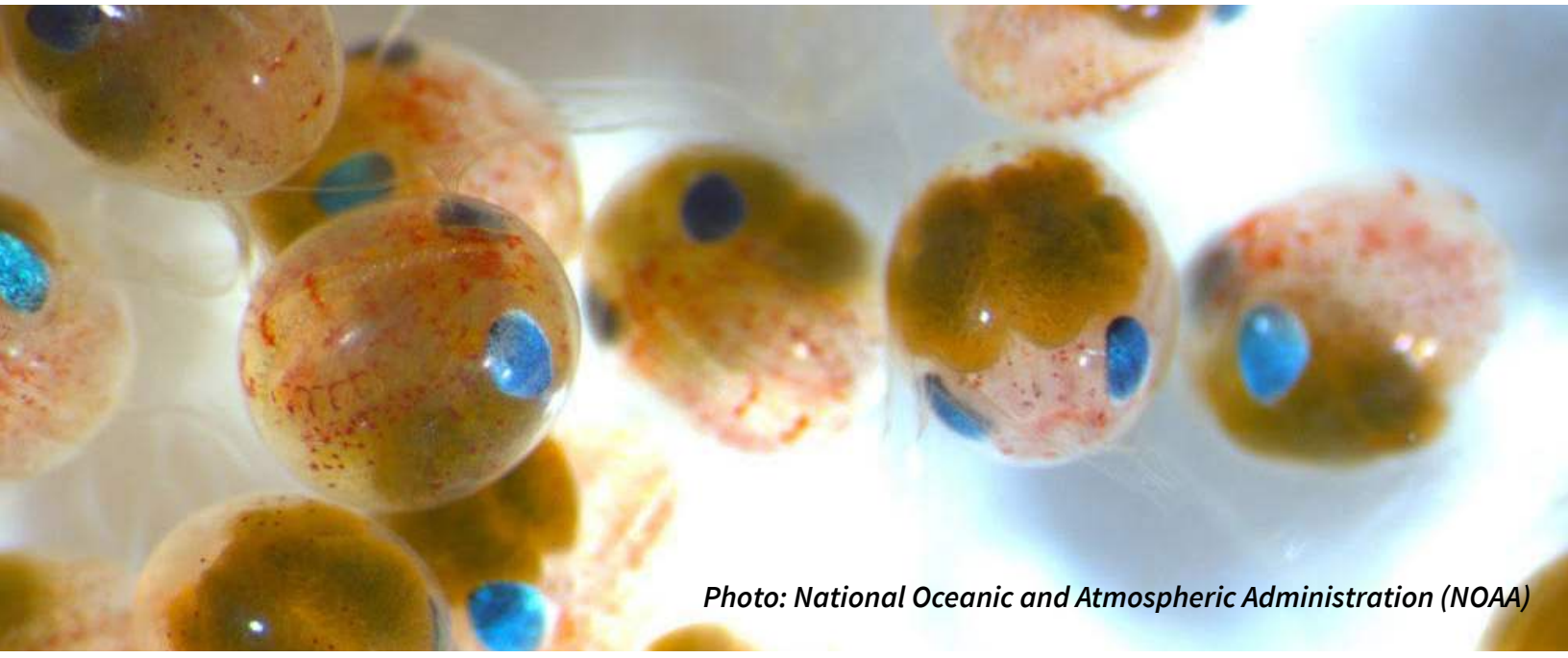


Photo: National Oceanic and Atmospheric Administration (NOAA)

Poster Presentation Award

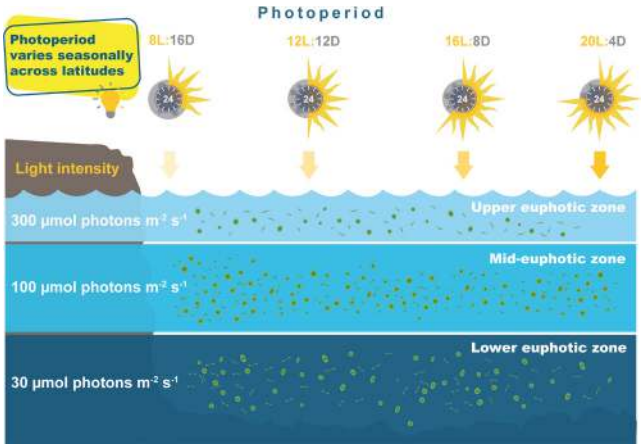
SECOND PLACE

Esther Ataikiru
Mount Allison University

Multi-Strain Analysis Quantifying the Simultaneous Effects of Photoperiod, Irradiance and Temperature on Picocyanobacterial Growth Rate

Esther Ataikiru[1], M. Berthold[1], Y. Farooqi[2]
[1]Mount Allison University, [2]Technical University of Denmark

The world ocean plays a central role in the regulation of the planet's climate, specifically, through the metabolic activity of the microorganisms it harbours. Among such microorganisms are picocyanobacteria, which despite their size (0.7-3 µm), are major aquatic producers of oxygen. Nonetheless, they may replace other phytoplankton species by dispersing into other latitudes due to climate change. Picocyanobacteria may impact food webs and biogeochemical cycles differently than other phytoplankton species. It is thus essential to study how their growth rate and physiology would be impacted under different photoperiods representing different latitudes to understand their potential impact in a future ocean. Six genetically identical, yet geographically dispersed strains of picocyanobacteria were simultaneously grown within a matrix of four photoperiods representing 0° to 60° North/South distribution, irradiance levels representing attenuation within the water column and one temperature representing future ocean summer temperatures. For a 7-day period, growth was measured as a change of optical density at OD680nm and OD750nm representing proxies for Chlorophyll and cell numbers, and growth rates were calculated using a modified Gompertz model. The temperate strains were found to be sensitive to photoperiod, irrespective of the photon flux density received. By contrast, tropical and subtropical strains were insensitive to photoperiod but exhibited a variable response to photon flux density. Defining optimal photoperiods and irradiance levels will help to predict latitudinal shifts in picocyanobacterial occurrences. Equally, this research will inform genomic studies to determine specific genes that correlate to photoperiod requirements based on genetic differences of such closely related strains.



Credit: Esther Ataikiru

Science Atlantic Science Communication Award

Kate Storey
Acadia University

Macroinvertebrate Population of the Medway River and its Ramifications on Atlantic Salmon

Kate Storey[1]
[1]*Acadia University, Department of Biology*

This presentation will discuss my honours project supervised by Dr. Trevor Avery. This project analyzed macroinvertebrates in the Medway river to assess water quality and availability of Atlantic salmon prey. Sampling took place from June—August 2021 and May—October 2022 at 9 sites along the Medway, collecting a total of 2,084 macroinvertebrates. Macroinvertebrates from insect orders as well as amphipods and isopods were identified down to the family level, while other invertebrates such as Hirudinea and Oligochaeta were identified to class or subclass. This identification allowed biotic indices assessing water quality such as Hilsenhoff's biotic index and EPT richness index to be used. The results gathered from these indices will be discussed, as well as ecosystem composition, diversity, and the suitability of the Medway river as Atlantic salmon habitat.

Credit: Timothy Knepp

Science Atlantic Undergraduate Research Award (Oral)

Mia Lauzon
Acadia University

Impacts of Pathogen Infection on the Winter Behaviour and Physiology of the Black-Legged Tick, *Ixodes scapularis*

Mia Lauzon[1], R. Easy[1], L. Ferguson[1]
[1]Acadia University

Since the early 1990s, the range of the black-legged tick (*Ixodes scapularis*) has expanded in Canada, increasing the risk of tick-borne pathogen infection in humans (e.g. Lyme disease). One factor that may contribute to the ability of *I. scapularis* to invade Canada is physiological and behavioural changes caused by pathogens that help the ticks survive the Canadian winter. Recent research indicates that *I. scapularis* infected with pathogens (e.g. the causative agent of Lyme disease, *Borrelia burgdorferi*) can survive the winter season better than uninfected *I. scapularis*. However, the mechanism through which this occurs is largely unknown. To determine how pathogen infection alters *I. scapularis* behaviour and physiology in the winter, we are comparing patterns of winter activity and gene expression between infected and uninfected *I. scapularis*. We maintained wild-caught, adult *I. scapularis* collected in Nova Scotia in an outdoor enclosure for 5.5 weeks in November-December 2022, and monitored their activity using TriKinetics Locomotor Activity Monitors (LAMs). After this period, we recorded tick survival and preserved the ticks at -80°C for gene expression studies. We will test the ticks for four of the most prevalent pathogens in the Atlantic provinces, including *Borrelia burgdorferi, Anaplasma phagocytophilum, Borrelia miyamotoi,* and *Babesia microti*. We will also examine the expression of three target genes in the ticks including: (1) a putative antifreeze glycoprotein (iafgp); (2) glycerol-3-phosphate dehydrogenase (gpdh), and; (3) heat-shock protein 70 (hsp70). Overall, this work will help to understand the drivers of range expansion and the future of tick-borne diseases in Canada.

Photo: Jim Gathany via the CDC

Science Atlantic Undergraduate Research Award (Poster)

Jack Nason
University of New Brunswick, Saint John

An Assessment of Inner Bay of Fundy Atlantic Salmon (*Salmo salar*) Spawning Success in Fundy National Park

Jack Nason[1], *K. Samways*[1], *S. Pavey*[1]
[1]*University of New Brunswick, Saint John*

Many strategies have been implemented in the effort of restoring Atlantic salmon (*Salmo salar*) populations around the world. One such restoration strategy, implemented by the Fundy Salmon Recovery project, involves the extraction of endangered inner Bay of Fundy salmon smolts from their natal rivers. Many of these smolts are then reared in sea cages at the world's first marine conservation site. The remaining smolts are taken to a freshwater facility to be reared. Upon maturity, these salmon are all returned to their natal rivers as adults. This release may be done by hand, by carrying the salmon to the water, or by carefully lowering them into pools using a helicopter. In my thesis study, I aim to determine whether these differences in rearing and release strategies led to significant changes in offspring production in the adults of two Fundy National Park rivers. Single nucleotide polymorphisms (SNPs) at 185 loci were used to match parents with the next year's offspring using Colony, a parentage analysis software. Using a fixed effects linear model, I found that there was no significant effect on offspring production caused by release strategy in both rivers. On the Point Wolfe River, rearing strategy was found to cause a significant effect on offspring production – with marine-reared adults out-performing freshwater reared adults. This suggests that the marine-rearing strategy, implemented by the Fundy Salmon Recovery project, out-performs the more traditional freshwater rearing strategy in terms of releasing high-fitness adult Atlantic salmon.

Photo: Hans-Petter Fjeld

Science Atlantic Science Communication Award (Oral)

Max Spiess
St. Francis Xavier University

The Acquisition of Symbiotic Green Algae in the Egg Masses of the Spotted Salamander

Max Spiess[1]
[1]*St. Francis Xavier University*

The unicellular green alga *Oophila amblystomatis* forms a mutualistic symbiosis with embryos in the egg masses of the spotted salamander *Ambystoma maculatum*. There is indirect evidence that *O. amblystomatis* enters egg masses from the surrounding pond water, but an endosymbiotic interaction in which cells of *O. amblystomatis* invade tissues and cells of embryos has raised the possibility of intergenerational transmission of algae. To obtain direct evidence for horizontal transmission, female salamanders were induced to oviposit in isolated chambers containing autoclaved pond water to which a wildtype (WT) or a green fluorescent protein (GFP) transformed strain of *O. amblystomatis* was added. Chambers containing normal and autoclaved pond water served as positive and negative controls, respectively, for algal invasion. A growth experiment was performed to verify the viability of algal strains in autoclaved pond water. Egg masses laid in normal pond water all accumulated algae, whereas only a few egg capsules in one egg mass laid in autoclaved water accumulated algae. By contrast, although WT and GFP strains were viable in treatment conditions, no invasion of these strains into egg masses was observed, either by visual inspection or with a diagnostic PCR test. When these same strains were recombined with isolated embryos, the endosymbiotic interaction was observed. These results confirm that horizontal transmission is the dominant mode and vertical transmission is either rare or absent. The reason why neither purified strains invaded egg masses is intriguing and remains the subject of future work.

Photo: Peter Paplanus

Science Atlantic Science Communication Award (Poster)

Makayla Butorac
St. Francis Xavier University

Body and Tentacle Movement Patterns of *Lymnaea stagnalis* in Different Environmental Conditions

Makayla Butorac[1]
[1]*St. Francis Xavier University*

Aquatic-odour based navigation is important for aquatic organisms as it allows them to locate distant odour sources, including food, predators and potential mates. To locate such odour sources, animals respond to two main navigational cues: flow directions and chemical concentrations. Depending on the environment, the fluid dynamics of water can greatly influence the dispersal of chemicals and thus, it can impact how animals find odour sources. Previous research has suggested that animals which inhabit multiple flow environments may have different navigational strategies for different environments. Evidence for or against the different navigational strategies can be gathered by analyzing the movement patterns of the animals. *Lymnaea stagnalis* is naturally found in varying flow conditions and is known to detect and respond to both flow and chemical cues. The goal of our research was to observe body and tentacle movement patterns of the gastropod, *L. stagnalis*, with or without food odour in both laminar (slow and smooth) and turbulent (fast and mixed) flow conditions. The snails' movements were tracked and behaviours were categorized using an ethogram. Our results suggest that in certain conditions *L. stagnalis* may navigate following chemical cues and in other conditions the snails may follow a combination of flow and chemical cues.

Photo: Peter Pfeiffer

Botany Award, sponsored by the Canadian Botanical Association (Oral)

Benjamin Caron
University of Prince Edward Island

The Temporal and Physiological Dynamics of the Heterophyllous Transition in *Myriophyllum aquaticum*

Benjamin Caron[1], C. Lacroix[1]
[1]*University of Prince Edward Island*

Water Milfoil (*Myriophyllum aquaticum* (Vell.) Verdc.) is an aquatic angiosperm that exhibits heterophylly—meaning it can develop distinct aerial and aquatic leaf forms depending on whether it is underwater or not. The leaf forms have been studied separately, but the transition between them is still undescribed. This study investigates how changes in environment mid-development influence the morphology of *M. aquaticum* leaves. We aimed to determine how exogenous hormone treatments affect the transition and to see if there is a stage in development after which leaves can no longer switch between forms. Our study used tissue-cultured shoots in two experiments; one allowed aquatic forms to grow from liquid to air, and the other allowed aerial forms to grow after liquid was added for set time periods. In each transition experiment, we assessed growth responses to treatment with plant developmental hormones—indole-3-acetic acid (IAA), abscisic acid (ABA), 1-aminocyclopropane-1-carboxylic acid (ACC), and gibberellic acid (GA3). ABA markedly affected heterophylly, biasing development toward aerial forms in either environment. Conversely, ACC treatment induced aquatic development in aerial conditions, but only for a short time. When plants emerged from the liquid, the first leaves above the liquid-air interface had more aquatic features than the subsequent leaves above. These results suggest that the transition between aquatic and aerial leaves in *M. aquaticum* occurs through mechanisms extending beyond leaf initiation and far into leaf morphogenesis. This prolonged developmental plasticity could result from the extended indeterminacy of M. aquaticum leaves due to their lobe formation patterns.

The Botany Award is presented annually for the top undergraduate presentation (oral or poster) at the Annual Science Atlantic Undergraduate Biology Conference.

This award is sponsored by the Canadian Botanical Association/ L'association botanique du Canada. The CBA/ABC serves as the national organization for botanists in Canada, including professional botanists at universities, colleges, schools, government, and industry, as well as students, technicians, and amateurs.

Botany Award, sponsored by the Canadian Botanical Association (Poster)

Courtney Strugnell
Mount Saint Vincent University

Does Methane Regulate Growth and Physiological Processes of Heat-Stressed Canola Plants?

Courtney Strugnell[1], *M. Qaderi*[1]
[1]*Mount Saint Vincent University*

Methane is the second leading greenhouse gas with a global warming potential of 34 times higher than that of carbon dioxide. As projected, the atmospheric greenhouse gases can lead to an increased global temperature of 5.7°C by 2100. While it is well understood that plants produce methane aerobically under stress conditions, its role in plant growth and development requires further studies. Methane has recently been investigated as a regulator of abiotic stress, but its involvement in the regulation of heat stress has not been examined. We used two temperature regimes (22/18°C and 28/24°C; 16 h light/8 h dark) and two supplemental methane treatments (0 and 50 µl ml-1 of air) to examine their effects on growth and physiological traits of canola (*Brassica napus* L. cv. 6056 CR). Seeds were germinated on one-layer of blue filter paper in Petri dishes for five days and the seedlings were transferred to pots. Then, nine plants were randomly assigned to each of four treatments and grown for 21 days. Under each temperature regime, half of the plants were supplied with methane every three days for four hours within a chamber. Plant traits, including growth, biomass, photosynthesis, chlorophyll fluorescence, photosynthetic pigments, flavonoids, nitrogen balance index, and anthocyanins, were measured. Overall, there were differences among treatments in plant growth and biomass, photosynthesis, chlorophyll fluorescence, photosynthetic pigments, and flavonoids. In some cases, supplemental methane reduced the adverse effects of higher temperatures on plants. This study revealed that temperature has greater effects on plant traits than supplemental methane.

Photo: Didier Descouens

People's Choice Award (Oral)

Taryn Muldoon
Acadia University

A Spatiotemporal Analysis of the Causative Agent of White-Nose Syndrome and Intestinal Macroparasites Based on DNA from Nova Scotia Bat Guano

Taryn Muldoon[1], L. Phinney[2], D. Stewart[1], D. Shutler[1]
[1]Acadia University, [2]Mersey Tobeatic Research Institute

Invasive species can have devastating effects on native wildlife. In 2006, *Pseudogymnoascus destructans* (Pd), causative agent of white-nose syndrome (WNS), was introduced from Europe to immunologically naïve bats in a New York hibernaculum. Pd has since spread across North America, causing extensive mortalities in multiple bat species. In Nova Scotia, Pd has caused a >90% decline in *Myotis lucifugus*, historically the most abundant species in the province. Whereas Pd principally infects bats during hibernation, Pd carried to summer roosting sites could assist spread of the pathogen. Bat guano may provide a substrate for tracking Pd at these summer roost sites and reveal how this relates to spread and exposure. Pd has not yet been formally detected in every county in Nova Scotia. However, because declines are province-wide, this is highly likely. Additionally, little is known about bat intestinal parasites in Nova Scotia, and most endoparasite data on bats have been based on dissections. There are also no studies on associations between bat endoparasite communities and WNS. This study quantified the spatiotemporal distribution of Pd in Nova Scotia summer maternity roosts using genetic testing of guano samples; Pd was recorded for the first time in three Nova Scotia counties. This study is also testing three newly designed primers on DNA extracted from bat guano to trial molecular identification of endoparasite diversity in Nova Scotia.

Photo: USFWS/Ann Froschauer

People's Choice Award (Poster)

Makatendeka Biton
Saint Mary's University

Developing a Localized Surface Plasmon Aptasensor For The Early Detection of Acute Myocardial Infarction

Makatendeka Biton[1], C. Brosseau[1]
[1]Saint Mary's University

During acute myocardial infarction (AMI) the coronary artery is blocked causing irreversible death of the myocardial wall leading to heart failure. Current clinical methods lack the sensitivity and time efficiency needed to effectively diagnose AMI events. Aptamer-based sensors (aptasensors) have been investigated as a potential rapid diagnostic technique for AMI. Cardiac troponin I (cTnI) is one of the protein biomarkers released into the bloodstream when an AMI event occurs. This thesis research explores localized surface plasmon resonance (LSPR) sensors for cTnI detection using aptamers. LSPR-based sensors are rapid, easy to use and highly sensitive to the dielectric environment on the surface of noble metal nano-structures and as such can be used to quantitatively determine the presence of the target analyte. The objective of this thesis was to build a plasmonically active aptasensor specific to cTnI using an LSPR sensor and a cTnI-specific aptamer. A glass cover slip was used as the substrate upon which silver nano-structures were assembled in a single layer using an optimized film over nanosphere (FON) method. The aptamer was allowed to adhere to this surface and thiol molecules were used to backfill the surface gaps to reduce non-specific binding to avoid false positives. The aptasensor was then tested to determine its ability to detect the presence of a standard cTnI sample. Delamination of the silver film on the substrate which destroys the plasmonic functionality of the sensor was found to be a significant issue.

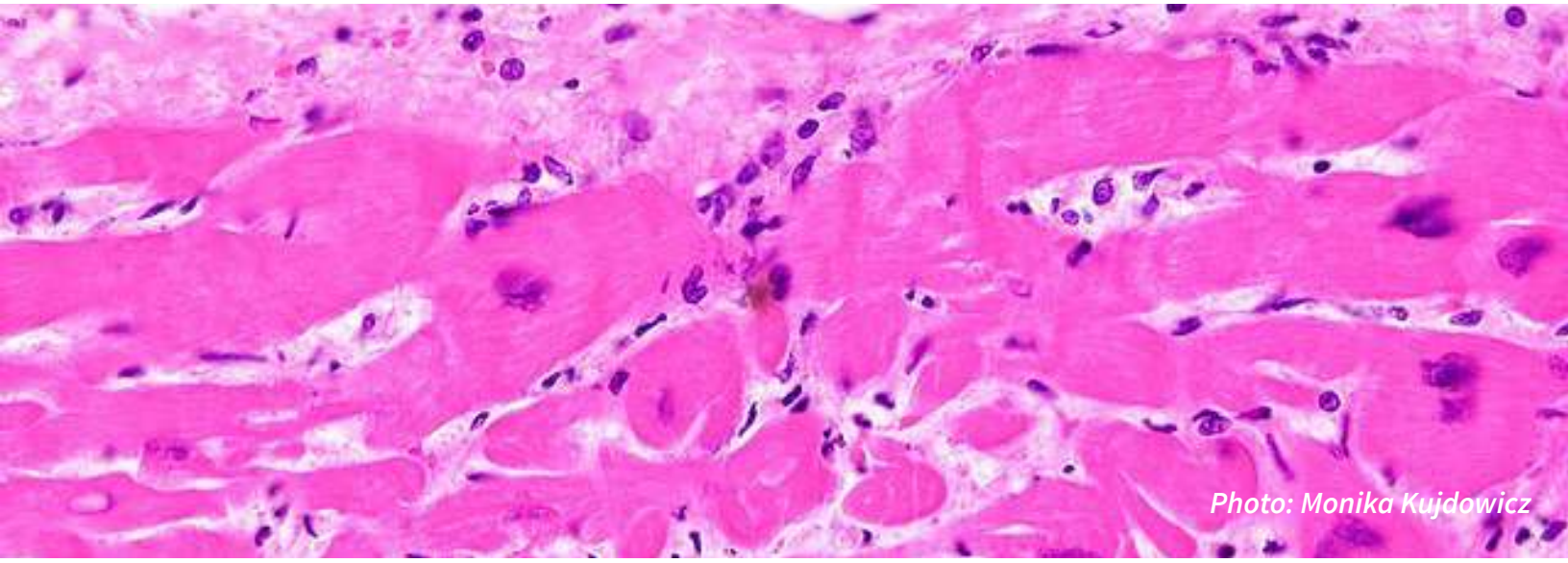


Photo: Monika Kujdowicz

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FIRST PLACE

Joanne Severe
University of Prince Edward Island

Mealtime in Child Care Centres: Exploring Educators' Feeding Practices

Joanne Severe[1], Jennifer Taylor, Jessie-Lee McIsaac, Misty Rossiter
[1]University of Prince Edward Island
Funding: Canadian Institutes of Health Research Project Grant
Supervisor: Misty Rossiter

Introduction: Educators play a key role in the development of children's eating behaviours in early learning settings. However, little is known about the mealtime environment and how educators approach food and feeding in child care centres.

Research statement/Objective: To understand the approach educators take to food and feeding by exploring the factors that influence feeding practices during mealtime in early learning settings.

Methods: Interviews and focus groups were conducted with 26 educators and 4 directors in 7 early learning and child care centres across Prince Edward Island and Nova Scotia. This qualitative descriptive study used an inductive thematic approach for data analysis.

Results: Three main themes emerged from the data: 1) interests during mealtime, 2) resources for feeding and 3) attitudes and beliefs around food and feeding. The findings revealed that educators had unique approaches, with a mix of more responsive and less responsive feeding practices during mealtime. Several educators stated that having a positive atmosphere, building relationships and communicating with the children were of value during mealtimes.

Discussion: The impact of limited observational learning, the importance of up-to-date feeding guidelines, as well as the value attributed to communication and a pleasant atmosphere, were key influencing factors of educators' mealtime practices.

Conclusion: Educators may benefit from workshops/training/programs focusing on responsive feeding practices and creating a supportive mealtime environment. Opportunities to support educators during mealtime, particularly around role modelling would also be valuable due to the important role of educators in shaping the feeding environment of young children.

SECOND PLACE

Sarah MacIsaac
St. Francis Xavier University

Sensory Characterization of a Commercial Apple Butter Fruit Spread, and Various Protein-enriched Texture Modified Variations

Sarah MacIsaac[1], Chantel Yakimets, Brighid Mackay, Madeleine Neuffer, Tylor Ralph, Kalli MacDonald, Lauren Viana, Ruth Harvie, Marcia English
[1]St. Francis Xavier University
Funding: National Research Council of Canada Industrial Research Assistance Program (NRCIRAP)
Supervisors: Marcia English, Ruth Harvie

Introduction: Dysphagia or swallowing difficulties is relatively common in older adults; its management can include texture modified foods (TMF) to ensure safe swallowing. However, TMFs are associated with lower energy and protein intake and poor sensory quality. The research aim was to develop a protein-enriched texture modified apple butter, to analyze the sensory properties and overall acceptability among participants with and without dysphagia.

Methods: In phase one, four variations of bench-top apple butter were made and enriched with pea protein and xanthan gum. Twelve panelists without dysphagia evaluated the sensory characteristics using a 9-point hedonic scale and a Check-All-That-Apply (CATA) questionnaire. In phase two, two variations of enriched bench apple butter were made. Twenty-four panelists living in Long Term Care, 12 with dysphagia and 12 without dysphagia, evaluated the apple butter samples. Acceptability was determined using 4-point graphic scales.

Results: All variations in phase one had similar overall liking and appearance and scored similarly for bolus-forming and thick puree textures. However, two variations were described as leaving a residue after swallowing. The preferred formulation contained 0.1% xanthan gum and 2.1% pea protein. In phase two, both variations had similar findings for both groups in appearance, aroma, taste, texture, and overall liking; one variation described as leaving small amounts of residue. The preferred formulation contained 0.1% xanthan gum and 1.1% pea protein.

Conclusion: Apple butter may be successfully developed as a protein enriched textured modified snack for individuals with and without dysphagia. Further research is required to optimize the formulations for improved consumer acceptability.

Science Atlantic Graduate Research Award

FIRST PLACE

Sathya Amarasena
Memorial University of Newfoundland

The Influence of Vitamin B6 Deficiency on Gut-mediated Brain Function and Behavior in Rats

Sathya Amarasena[1], Qi Yuan, Shyamchand Mayengbam
[1]Memorial University of Newfoundland
Funding: Natural Sciences and Engineering Research Council of Canada (NSERC), Memorial University of Newfoundland

Supervisor: Shyamchand Mayengbam

Introduction: Vitamin B6 is crucial for several metabolic pathways, including energy metabolism, cell signaling, and neurotransmitter biosynthesis. The intestinal microbiota also influences the production of gut-derived neuroactive compounds. We have shown that B6 deficiency alters gut microbiota and gut metabolites. However, the impact of B6 deficiency on the gut-mediated regulation of brain function is poorly understood.

Hypothesis: We hypothesize that B6 deficiency-induced alteration of the gut microbiome can modulate brain function and host behavior by altering gut-controlled neurotransmitter synthesis.

Methods: Sixty-four Sprague-Dawley rats (32F, 32M) were fed either an AIN-93G-based control (B6 7 mg/kg diet) or a vitamin B6 deficient (B6 0.07 mg/kg diet) diet for six weeks. In each diet group, half of the animals received a cocktail
of antibiotics through drinking water and weekly gavage, while the other half received regular water. During the 6th week, rats were subjected to behavioral experiments.

Results: The open field maze experiment showed that both Distance Traveled ($p<0.0001$) and Rearing Time ($p=0.0351$) were lower in MD-B6 deficient rats compared to the other groups. Similarly, in the elevated plus maze, MD-B6 deficient rats, specifically the females, exhibited significantly lower head dips ($p=0.028$) than the other rats. The sucrose preference test showed that MD-B6 optimum female rats had the lowest preference over 24 hours ($p=0.0183$).

Discussion: The microbiota-depleted, B6-deficient conditions show anxiety-like behavior in rats. However, future microbiome and metabolome analyses are required to unravel the underlying mechanisms.

Conclusion: Our study suggests that dietary vitamin B6 deficiency regulates host behavior through the microbiota-gut-brain axis.

Science Atlantic Graduate Research Award

SECOND PLACE

Megan White
Athabasca University

Exploring the Role of Compassion in 2S/LGBTQ+ Canadians' Eating Disorder Recovery Processes

Megan White[1], *Megan Aston, Phillip Joy*
[1]*Athabasca University*
Funding: Social Sciences and Humanities Research Council of Canada (SSHRC), Mount Saint Vincent University
Supervisor: Phillip Joy

Introduction: 2S/LGBTQ+ people experience higher rates of disordered eating than their cisheterosexual peers. They also face unique barriers to recovery from eating disorders (ED). Compassion has been shown to have positive impacts on patients' symptom resolution and emotional health. It is unclear how 2S/LGBTQ+ people experience compassion in ED treatment settings, indicating further study to understand its role and how it may be a method for improving delivery of ED recovery resources.

Research question: How do 2S/LGBTQ+ participants perceive the role of compassion in their ED recovery processes?

Objectives: To better understand participants' perceptions of compassion and its role in their ED recovery processes; to explore how compassion may be a way to improve the delivery of ED recovery resources for this population.

Methods: Semi-structured online interviews were conducted with 15 participants self identifying both as 2S/LGBTQ+ and as having experienced an ED. This qualitative research is guided by post-structuralist and queer theoretical frameworks.

Results: To be discussed in the presentation.

Discussion: This research situates compassion as a method for improving delivery of ED recovery resources for 2S/LGBTQ+ people and for changing heteronormative and homophobic views in ED treatment settings that negatively affect 2S/LGBTQ+ communities' wellbeing.

Conclusions: This research provides important insights on how 2S/LGBTQ+ participants perceive the role of compassion in their ED recovery processes. It also situates compassion as a method for improving the delivery of ED recovery resources for this population and to help change heteronormative and homophobic views within ED treatment settings.

Science Atlantic Graduate Research Award

THIRD PLACE

Ava Rasouli
Memorial University of Newfoundland

Dietary Vitamin B6 and the Pathophysiology of Non-alcoholic Fatty Liver Disease (NAFLD)

Ava Rasouli[1], Zack Clancy, Janet A. Brunton, Robert F. Bertolo
[1]Memorial University of Newfoundland
Funding: Memorial University of Newfoundland
Supervisor: Robert F. Bertolo

Introduction: Non-alcoholic fatty liver disease (NAFLD) is a multifactorial disorder affecting many people worldwide. Several studies have indicated the association between dietary micronutrients and the development of NAFLD. For instance, deficiency in vitamin B6 impairs one-carbon (1C) metabolism and triggers fat accumulation.

Objective: The objective of this study was to assess the effects of vitamin B6 supplementation on the progression of NAFLD through its role in 1C metabolism, expecting that micronutrient supplementation prevents or attenuates NAFLD manifestation.

Method: A total of thirty-two male C57BL/6J (B6) mice were fed either control (n=8), high-fat, high-sugar (HFHS, n=8), HFHS high in vitamin B6 (HFHS-HB6, n=8), HFHS low in vitamin B6 (HFHS-LB6, n=8) for eight weeks. Body weights were measured weekly, and urine and fecal samples were collected at three time points. Finally, blood and tissue samples were collected for biochemical analysis.

Results: The body weights of HFHS-LB6 mice were significantly lower compared to the control and HFHS mice ($P<0.001$). Percent liver weight was significantly higher in the HFHS-LB6 group ($P<0.001$) compared to the other groups. Jejunum ($P=0.031$) and Ileum ($P=0.013$) lengths were increased in the HFHS-LB6 group and HFHS groups, respectively, compared to the other groups. Liver triglyceride concentration was also significantly higher ($P=0.007$) in HFHS-LB6 group compared to the other groups.

Conclusions: This study suggests that dietary vitamin B6 supplementation does not prevent body weight gain but lowers liver triglyceride content. Other biochemical analyses will be conducted to determine the effects of vitamin B6 on the pathophysiology of NAFLD, including clinical markers and liver metabolites.

Science Atlantic Science Communication Award

FIRST PLACE

Varleen Kaur
Memorial University of Newfoundland

Assessing the Impact of Shift Work on Sleep, Activity, Energy Balance and Food Choice in Adults: The SWEAT Study

Varleen Kaur[1], Scott V. Harding
[1]Memorial University of Newfoundland
Funding: Memorial University of Newfoundland
Supervisor: Scott V. Harding

Introduction: Shift work is associated with adverse health outcomes such as poor sleep quality, cardiovascular disease, cancer and metabolic syndrome. Shift work-caused disrupted sleep can affect the behavioural regulation of energy intake and expenditure due to circadian rhythm alteration.

Objective: We want to explore some of the factors associated with the risk of adverse health outcomes in workers. We aim to compare lifestyle choices between day workers and shift workers.

Methods: This is a field-based observational study using subjective and objective assessments of sleep and physical activity and two 24-hour online dietary recalls in shift workers. Day (n=11) and night (n=13) workers were recruited and had their free-living sleep and physical activity tracked via accelerometry, and completed two online web-based 24-hour food recall, during a series of work shifts. Along with that, data on chronotype and stress level were also collected.

Results: Our initial analysis shows that there was no statistically significant difference between BMI and body fat% in the two categories. Energy and other macronutrient intakes were not different between the two groups. Day workers had better sleep quality compared to shift workers. Shift workers had a higher score for physical activity.

Conclusion: Future studies should focus on conducting a mixed methodology study with a larger sample size. These observations can help design behavioural interventions to optimize weight management in shift workers.

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Science Atlantic Undergraduate Research Award (Oral)

Rachel Binns
Mount Allison University

How Bright is the Bright Side? Measurement and Implications of Toxic Positivity for the Self and Others

Rachel Binns[1]
[1]*Mount Allison University*
Supervisors: Louise Wasylkiw and Andrew Inkpen

Toxic positivity refers to the belief that no matter how hard or difficult a situation is, people should maintain a positive outlook. The present research aimed to demonstrate that toxic positivity is a measurable construct through the development of the Binns Toxic Positivity Scale (BTPS). For Study One, a community sample (N=94) completed an initial set of 13 items to index toxic positivity. Factor analysis showed that items could be reduced to two subscales: Control and Positivity. Each subscale showed acceptable reliability, and correlations between the two subscales and emotion regulation strategies provided evidence of validity. Importantly, the subscales failed to correlate with optimism, indicating that the BTPS assesses a separate construct. In Study Two, results from a sample of undergraduates (N=142) showed that the revised Control and Positivity subscales were reliable. However, the evidence for validity was mixed. Specifically, the Control subscale was associated with more optimism, self-compassion, and better mental health, indicating that aspects of toxic positivity may have benefits for individuals. Of interest was the finding that participants who received toxic positivity feedback after reading an imaginary scenario of failure experienced more negative mood than participants who received compassionate feedback. This negative impact of toxic positivity on mood was moderated by individuals' level of self-compassion. Overall, findings illustrate that toxic positivity is a measurable construct, that scores relate to emotion regulation strategies, and that toxic positivity statements have negative impacts on others. Future research should focus on scale refinement and its utility.

Science Atlantic Undergraduate Research Award (Poster)

Akua Amankwah-Poku
St. Francis Xavier University

Comparing Factors that Influence Mental Health and Help-seeking in University Students in Canada and in Ghana

Akua Amankwah-Poku[1]
[1]*St. Francis Xavier University*
Supervisor: Erin Austen

Culture affects perceptions of mental illness (Krendl and Pescosolido, 2020). The present study compared mental health and help-seeking in 208 undergraduate university students from Canada and Ghana. A cross-sectional survey design was used to collect data on the variables sense of belonging, barriers to help-seeking, mental health/wellbeing, level of religiosity/spirituality and attitudes towards mental health. Reported rates of diagnoses of mental illness were higher among the Canadian (n=75, 54.5%) than Ghanaian (n=21, 25.6%) students. Results showed that both Canadian and Ghanaian students with a diagnosis of a mental illness had a lower sense of belonging, experienced more barriers to help-seeking, and reported more academic stress compared to students without a diagnosis. Further, Ghanaian students with a mental illness perceived more stigma than Canadian students. Ghanaian students also reported more academic stress, lower help-seeking, and higher religiosity than Canadian students. Students in both countries identified similar recommendations for things that they, their universities, professors, and peers could do to thrive academically, mentally, and socially.

Science Atlantic Science Communication Award (Oral)

Karla Kenny
Saint Mary's University

Oh, That's So Cringy! Exploring the Evolutionary Roots of Embarrassment

Karla Kenny[1], *Meylin Zink Yi*[1]
[1]*Saint Mary's University*
Supervisor: Maryanne Fisher

Embarrassment has been overlooked in the area of evolutionary psychology. We argue that it is inherent to being a social species, and may be caused, or felt, by one's own behaviour or by watching others. We propose four functions of embarrassment. First, it may serve as a social signal communicating a willingness to conform to social norms, or as a means to mitigate social threat by reducing the risk of negative social consequences, critical for group cohesion and survival. Second, it may have evolved as a mating strategy to appear likeable and humourous. Third, it may signal recognition of a mistake and a willingness to make amends, and fourth, it may be a form of self-regulation to help people manage emotional responses. Preliminary research on 60 participants shows the emergence of at least six contextual factors connected to embarrassment. They include the perception of other people's relational mistakes, perceived personal mistakes, the involvement of an authority figure, other people's perceived inappropriateness and the involvement of disability. We believe that by experiencing and responding to embarrassment in appropriate ways, individuals may be better equipped for navigating their complex social environment and relationships.

Science Atlantic Science Communication Award (Poster)

Noémie Thériault
Université de Moncton

Effects of Multimodal Distractors on Attention

Noémie Thériault[1]
[1]*Université de Moncton*
Supervisor: Frédéric Huppé-Gourgues

During Pavlovian conditioning, Sign-Tracker (ST), Goal-Tracker (GT) and Intermediate (IG) phenotypes emerge. These phenotypes are characterized by the degree to which they tend to attribute incentive salience to cues associated with rewards. Research has shown that these phenotypes also differ in other aspects. For example, in humans, STs tend to favor bottom-up attention, while GTs tend to favor top-down attention. Some researchers have found the same pattern in rodents. However, the evidence supporting this finding is limited. Therefore, it is hypothesized that if the addition of a distractor increases the difficulty of the task, then the performance of the rats will decrease when distractors are added compared to the absence of distractors. It is also hypothesized that if STs favor bottom-up attention and GTs favor top-down attention, then light and auditory distractors, will particularly affect the performance of STs in sustained attention tasks. The present study evaluates the signal detection performance of rats during four different sustained attention tasks with distractors. The sample consisted of 86 Long-Evans rats. Findings show a main effect of distractors, but no clear effect of phenotypes in detection performance. These result from adding distractors increases the difficulty of the task but negates that the performance of STs is more affected, suggesting that distinction between phenotypes in terms of attention capacity is less important than previously presented. This study nuances the current findings and highlights the importance of future studies to clarify the use of bottom-up attention phenotypes. Authors declare no conflicts of interest.

Karen Nicholson Award in Neuropsychology

Aidan Steeves
Mount Allison University

The Impact of Cognitive Style on Visuo-Haptic Object Identification

Aidan Steeves[1]
[1]*Mount Allison University*
Supervisor: Geneviève Desmarais

Haptic and visual object representations in memory rely on similar processes, equating to a multisensory memory trace that is accessible to both modalities. Past research examining the composition of this overlapping memory trace have found evidence for a visual as well as a verbal component. Therefore, the question remains: what is this shared memory trace between sight and touch composed of, and does this memory trace depend on the types of object encoded? The current study also examined whether this depends on individual differences in cognitive style, as one's preferred method for obtaining and applying information could explain the conflicting findings of past research. Participants first completed a self-report measure of cognitive style, followed by an object identification task that required them to learn to identify either simple or complex objects, either by sight or by touch. Two-thirds of participants simultaneously completed either a verbal or visuospatial distractor task. Participants learning to recognize complex objects produced more errors and required more blocks to reach criterion compared to those learning simple objects. Participants who completed the task without distraction displayed superior identification performance compared to those who experienced a visuospatial distractor, especially when identifying complex objects. Finally, we demonstrated that the information that composes this overlapping memory representation can be associated with one's cognitive style. However, the degree to which this occurs may depend on the types of objects being learned, as well as the modality in which encoding occurs.

Karen Nicholson (1971-2007) was a member of the Science Atlantic Psychology Committee whose research interest was in the neuropsychology of perception. She grew up in Lethbridge, Alberta. Karen's doctoral studies focused on the types of cues (shape, colour) that impact perception.

Karen's interest in the neuropsychology of perception was furthered during her postdoctoral work at Queen's University. She carried on to her own lab at Mount Allison University in 2002, where she worked as an Assistant Professor. Karen passed away in November 2007, after a courageous battle with cancer.

Karen is remembered as a committed teacher and a talented and energetic researcher.

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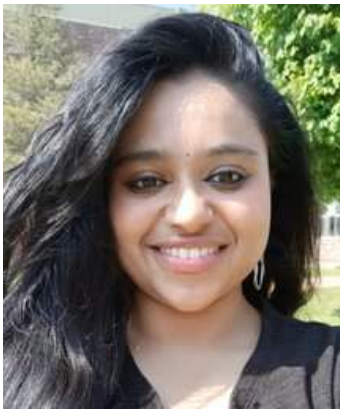
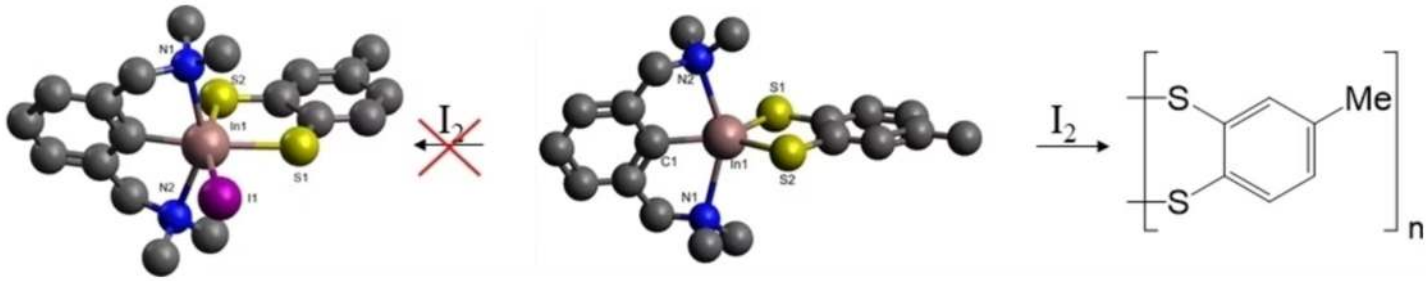


Padmapriya Srinivasan
Mount Allison University

Synthesis, Structure and Reactivity of Organoindium Benzenedithiolates

Padmapriya Srinivasan[1], Glen Briand[1], Gregory Sandala[1], Tanner George[2], Jason Masuda[2], Gregory MacNeil[3], Brian MacLean[4], Michael Mosher[1], Alexander Stockli[1], Rachel Vanderkloet[1], Charles Walsby[3]
[1]Mount Allison University, [2]Saint Mary's University, [3]Simon Fraser University, [4]St. Francis Xavier University

The establishment of the Twelve Principles of Green Chemistry, of which catalysis is a primary tenet, has led the path to reducing waste production in the chemical industry. However, industrially relevant catalysts typically incorporate expensive and toxic precious metals due to their favorable redox properties. Consequently, this has stimulated efforts of this study in finding an ideal green catalyst that would be cheap, stable, can undergo reversible redox reactions, and would have a favorable risk-reward profile for human health and the environment. Indium-based compounds are perfect candidates for such chemical processes because of their low toxicity, relatively low cost, and functional group tolerance of the metal center. Despite these advantages, indium is most stable in the +3 oxidation state and does not possess other readily accessible oxidation states. To mediate this, we are exploring the use of redox-active "non-innocent" ligands. Our recent work exploring the synthesis, reactivity, and computational studies of organometallic indium compounds incorporating redox-active 1,2-benzenedithiolate and 2-amidobenzenethiolate ligands will be presented.



Credit: Padmapriya Srinivasan

Science Atlantic Science Communication Award

Dreenan Shea
Dalhousie University

Metal Nitride/TiO_2 Composites for Plasmon-enhanced Photocatalytic Dye Degradation

Dreenan Shea[1], *Victoria White*[1], *Mita Dasog*[1]
[1]*Dalhousie University*

The current techniques for water treatment cannot effectively remove pollutants such as pesticides, dyes, and aromatic compounds. These can be removed via advanced oxidation process involving strong oxidants. This can increase the treatment costs and have residual oxidant in the water that needs to be removed. Photocatalysis has emerged as an effective alternative to degrade organic dyes and pollutants in water. Common photocatalytic practices involve the use of a semiconductor, such as TiO_2, as it is abundant, low cost, non-toxic and photochemically stable. However, the large bandgap of TiO_2 requires UV light to work effectively. To address this issue, plasmonic structures have served as a photosensitizer, to extend the absorbance of the photocatalyst into visible and near-IR regions. To-date gold and silver have been well investigated however, the high cost of gold and oxidative instability of silver make them difficult to incorporate in scaled-up applications. This presentation will highlight synthesis of plasmonic metal nitride/TiO_2 hybrids for photocatalytic Rhodamine B dye degradation using white light. The effect of various parameters such as catalyst loading, reaction volume, plasmonic material composition will be discussed.

Credit: Dreenan Shea

E. Gordon Young Award for Best Pedagogical Presentation

Sumayyah Chotoye
Saint Mary's University

Two-Dimensional Liquid Chromatography (2D-LC): A Novel Technique for the Analysis of Bisphenol Contaminants in Canned Food Items

Sumayyah Chotoye[1], *Christa Brosseau*[1]
[1]*Saint Mary's University*

Bisphenols (BPs) are chemicals prevalent in the manufacture of epoxy resins and polycarbonate plastics. For example, epoxy resin is used to line canned food items to prevent the can from corroding. Bisphenols, and BPA in particular, are known endocrine disruptors. Human exposure to BPA can have adverse effects on the reproductive and metabolic health. Given that ingestion of packaged food items constitutes the largest source of exposure to BPA, Health Canada has encouraged the phase-out of BPA in food contact materials. As a result, the food industry began replacing BPA with bisphenol analogues. Owing to the concerning toxicity of BPs to human health, it is essential to continuously identify and accurately monitor bisphenols that are unintentionally ingested, as a result of contaminated canned food items. This research proposes the first-ever use of a state-of-art technique, two-dimensional liquid chromatography (2D-LC), to identify and quantify BPA, BPB, BPF, BPS, BPZ, and BPAF in canned food items. To selectively and sensitively analyze the six targeted bisphenols, a multiple heart-cutting 2D-LC method was first developed. The coefficient of variation (CV) of peak areas and retention times for all analytes in both dimensions ranged from 0.050-2.960%. The recovery of the whole procedure was determined to be 67.41 ±0.05% in the first dimension, and 64.3 ±0.13% in the second dimension. Internal standard calibration curves were constructed for each analyte, using 4,4'-difluorobenzophenone as the internal standard. The coefficient of determination (R^2) for the least-squares regression of the internal standard calibration curves, ranged from 0.982-0.997. The limit of detection (LOD) values, determined in the second dimension for the analytes, ranged from 0.082-0.301 ppm. Finally, four canned food items were obtained by solid-liquid extraction, and surveyed for BPA, BPB, BPF, BPS, BPZ, and BPAF. The 2D separation space played a key role by allowing peaks of interest in the first dimension to further separate. BPF (0.093 ±0.351 ppm) and BPAF (2.656 ±0.442 ppm) were thus accurately detected in two separate samples, respectively.

Eldrid Gordon Young (1897-1976) was an internationally recognized scientist and the first Canadian to hold the title of biochemist. In 1924, Dr. Young moved to Atlantic Canada to lead the new Department of Biochemistry at Dalhousie University. In 1950, he stepped down to become the founding director of the Atlantic Regional Laboratory of the National Research Council, serving until his retirement in 1962.

CIC Undergraduate Award in Analytical Chemistry (Oral)

Miranda Amiro
Acadia University

Effect of Catnip (*Nepeta cataria* L.) Essential Oil on the Blacklegged Tick (*Ixodes scapularis*) Chemosensory System

Miranda Amiro[1], *Nicoletta Faraone*[1]
[1]*Acadia University*

Natural products provide a large reservoir of active ingredients that can be used for pest management. Essential oils are an interesting alternative to synthetic pesticides, because they are environmentally friendly and are safer products that can protect humans and animals against pest vectors such as ticks. Because of global warming, the rise in tick population has resulted in an increased risk for the transmission of vector borne diseases, such as Lyme disease which is vectored by the blacklegged tick (*Ixodes scapularis* Say), and an increase in demand for effective yet safe repellent products. Repellent activity of catnip (*Nepeta cataria* L.) essential oils (EOs) and the main chemical components were evaluated against *I. scapularis* adult female ticks. Seven varieties of catnip EOs were analyzed using GC-MS to determine their chemical compositions. Nepetalactone isomers (76.6 ±0.3% and 16.9 ±0.4% relative overall abundance) were detected in only one EO variety. These compounds were linked to the highly repellent action (100% repellency up to 8 hours post-exposure) exerted by the oil in repellent bioassays. The isolation of the nepetalactone isomers was performed through liquid chromatography, and chemical identity of the isomers was confirmed by GC-MS and NMR. Quantification (using a calibration curve and the internal standard method) of catnip EO main components (i.e., nepetalactone, L-menthone, alpha-pinene, and beta-caryophyllene) was performed through GC-MS. The concentration of the major isomer, (4aS, 7S, 7aS)-nepetalactone, was determined to be 80 ±10 wt% in the New Directions Aromatics Inc. catnip EO. The exposure of repellents and their impact on the tick chemosensory system was also investigated through electrophysiology. The electrophysiological response of adult tick females to a known attractant and host volatile (i.e., butyric acid), pre- and post-exposure to catnip EO, was recorded. Exposure was performed by fumigation assay, where it was found that pre-exposure to catnip EO significantly reduced tick response to butyric acid. Results of this study will contribute to better understanding the response of tick chemosensory system to different essential oil components and better select effective active ingredients for the development of repellent products.

The Chemical Institute of Canada comprises three constituent societies: the Canadian Society for Chemistry (CSC), the Canadian Society for Chemical Engineering (CSChE), and the Canadian Society for Chemical Technology (CSCT). Each CIC discipline division in the Atlantic region sponsors undergraduate and graduate awards at Science Atlantic ChemCon.

CIC Undergraduate Award in Analytical Chemistry (Poster)

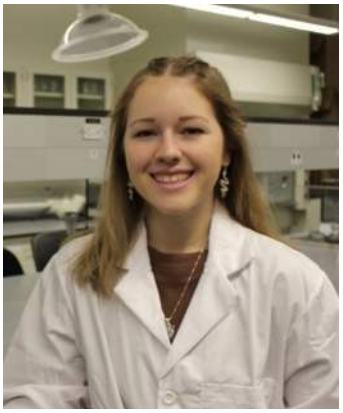
Zoë Lindensmith
Mount Allison University

Health Effects of Wildfire Aerosols: Transition-Metal Assisted Oxidative Stress Induced by Catechol and Nitrocatechol

Zoë Lindensmith[1], *Jenny Wong*[1]
[1]*Mount Allison University*

Exposure to atmospheric aerosol pollutants is a risk to human health, causing adverse effects in the pulmonary and cardiovascular systems. In particular, the increasing frequency of wildfires due to climate change causes growing concern for the health of individuals exposed to the aerosols generated in this process. One of the major organic compounds in fire aerosols is catechol, which accounts for 2.9-7.2% of smoke emitted from this process (Chet et al., 2018). Catechol is known to form complexes with iron (III) and copper (II), where iron (III) is reduced to iron (II) in the ligand-to-metal-charger transfer process, and reactive oxygen species (ROS) such as hydrogen peroxide (H_2O_2) and hydroxyl radical (•OH) can be produced. ROS cause cytotoxicity by inducing oxidative stress, which is defined as the imbalance between antioxidants and oxidants, and results in DNA damage, protein denaturation, and lipid peroxidation, among other harmful effects. Furthermore, catechol may react as it travels in the atmosphere to form nitrocatechol, which can also form complexes with iron and produce ROS. Therefore, the toxicity of fire aerosols may persist throughout the atmospheric lifetime of fire aerosols, where exposures to populations not in the proximity of the wildfire can occur. While both catechol and nitrocatechol are known to be cytotoxic, their relative toxicity and the effect of different conditions on their toxicity have not been characterized. This study examined the relationship between the chelated metal and R group identity on the toxicity of catechol, using ROS formation over time as an indicator of toxicity. At 37°C and pH 7 (i.e., intracellular conditions), the dichlorodihydrofluorescein (DCFH) assay was used to quantify H_2O_2, and coumarin-3-carboxylic acid (3-CCA) was used as an •OH probe to evaluate the production of ROS for the metal-catechol system. For catechol-metal where the ROS production was not observed, the potential of the reaction mixture to deplete a model antioxidant, dithiothreitol, was also examined. Preliminary results indicate catechol toxicity by oxidative stress when complexed with both iron and copper, though ROS were also formed in the absence of metals, indicating potential autooxidation of catechol. Comparatively minimal oxidative stress was observed from nitrocatechol. These results can help define the causes of wildfire aerosol toxicity and identify its most harmful components, as well as identify the scope of risk according to exposure proximity to the site of wildfires.

CIC Undergraduate Award in Inorganic Chemistry (Oral)



Jenna Lee Ralph
Memorial University of Newfoundland

Preparation and Characterization of Fluorinated UiO-67 Derivatives to Determine Effects on Gas Absorption

Jenna Lee Ralph[1], *Michael J. Katz*[1]
[1]*Memorial University of Newfoundland*

Metal Organic Framework (MOF) research is an area of inorganic chemistry that brings together metal ions/dimers/clusters (nodes) and organic anionic ligands (linkers) via Lewis Acid-Base interactions. MOFs often form highly porous structures that can be utilized in a variety of industries. We can control the properties of these materials with judicious modification of the linker (i.e., by installing different functional groups). One of the most common families of MOFs are the zirconium-cluster-based MOFs. While there are many classes of these MOFs,
the UiO (Universitetet i Oslo) sub-family is the most common due to the ease of synthesis and the stability of these MOFs to many different conditions. The most sensitive part of the UiO MOFs, especially as the linker length is increased to make more porous systems, is the coordinate bond between the node and linker. In some cases, long exposure to water vapour can cause the MOF to collapse. It is thus important to understand what features are necessary to improve the stability of these MOFs to water vapour. Previous research in the group has looked at attaching a variety of functional groups to the linker. The easiest way to introduce these groups almost exclusively installs them at the ortho position of the linker, which is distal to the node. In contrast to this, my project looked
at attaching hydrophobic fluorine groups to the meta position of the linker proximal to the node. It was our hope that in doing this, we would determine a reliable method of preventing water from interacting with the node. This thesis will discuss my work towards these goals.

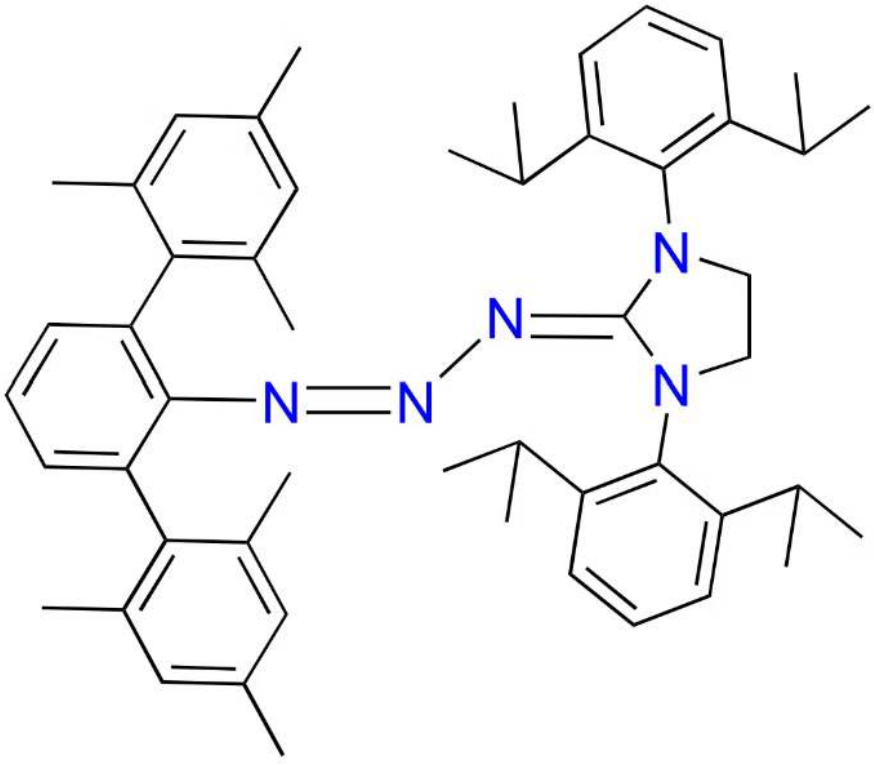
CIC Undergraduate Award in Inorganic Chemistry (Poster)

Thai Do
Saint Mary's University

A Bulky π-Conjugated Triazene Ligand and Related Group 11 Complexes

Thai Do[1]
[1]*Saint Mary's University*

A new bulky triazene ligand was prepared by the reaction between the bulky aryl azide, 2,6-bis(2,4,6-trimethylphenyl)phenyl azide and bulky N-heterocyclic carbene, N,N'-2,6-bis(diisopropylphenyl)-3,4-dihydroimidazol-2-ylidene. The bulkiness of the NHC-based π-conjugated triazene ligand increases the crowding around the N3 core, which hindered the potential ability of the ligand to act in a bidentate fashion. The triazene ligand was utilized as a neutral mono-dentate ligand, which results in strictly monomeric CuCl, AgOTf, and AuCl complexes owing to the steric bulk of the ligand.



Credit: Thai Do

CIC Undergraduate Award in Organic Chemistry (Oral)

Curran Layden
Acadia University

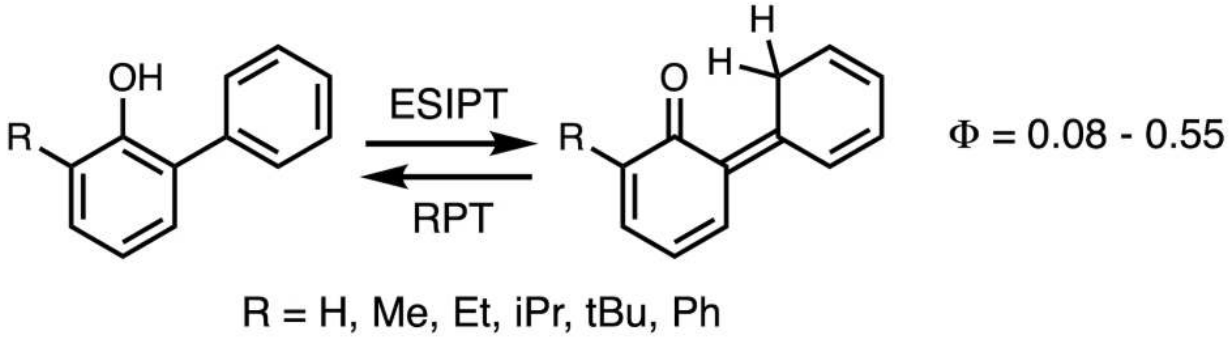
Excited State Intramolecular Proton Transfer in o-Alkyl Phenols

Curran Layden[1], Matt Lukeman[1], Noelle Tsimiklis[1]
[1]Acadia University

Excited State Intramolecular Proton Transfer (ESIPT) is a reaction in which an acidic hydrogen transfers to a basic site on the same molecule after absorbing light. The process is important for the function of sunscreens, photostabilizers, and laser dyes. In most examples, the acidic proton comes from a phenol OH group, and the basic atom is a heteroatom such as oxygen or nitrogen. Such examples of ESIPT are typically ultrafast, and the tautomer produced is usually short-lived, rapidly returning to starting material via reverse proton transfer.

We have been interested in examples of ESIPT to carbon atoms, since these form reactive quinone methide intermediates, which are important in synthesis and biology. In particular, we have focused our attention on hydroxybiaryls, where the 'basic' proton-accepting group is an aromatic carbon atom. We have been exploring strategies to increase the efficiency of such reactions, and found that introduction of an alkyl group (ortho to the phenol) can improve the reaction efficiency dramatically—by more than seven orders of magnitude.

In this presentation, we will describe the synthetic process used to make the derivative studied, which is based around a Suzuki coupling to make the biaryl bond. We will present the results of photochemical product studies, as well as UV-Vis and fluorescence spectroscopy. We will present an overall mechanistic overview to account for the dramatic efficiency improvements made possible by the o-alkyl substituents.



Credit: Curran Layden

CIC Undergraduate Award in Organic Chemistry (Poster)

Stuart Lawson
University of New Brunswick, Fredericton

Synthesis of Thieno-fused Heterocycles by Intramolecular Cyclizations

Stuart Lawson[1], *Sara Eisler*[1]
[1]*University of New Brunswick, Fredericton*

By controlling regioselectivity in synthetic routes, synthetic chemists gain insight to trends that can be applied to future synthetic targets. Through access to fused lactam targets, regioselective trends for intramolecular cyclization reactions have been uncovered. This is essential to understanding and predicting synthetic outcomes. Cyclization reactions between amide nucleophiles and alkyne electrophiles to produce thieno-fused lactams from one cyclization reaction have been studied with promising results; however, tandem cyclizations to access thieno-fused lactams have not been explored. Previous work on tandem cyclizations produced π-extended benzo-fused lactams and allowed insight into how regioselectivity of 7-endo- vs 6-exo-dig cyclization pathways could be controlled. Accessing thieno-fused lactams through a similar tandem cyclization was proposed for this project. Previous work provided insight into steric and electronic effects of a thiophene backbone, suggesting that tandem 6-endo/5-exo and 6-endo/6-endo pathways are both possible if substituted appropriately. This project investigates how 5-exo- and 6-endo-dig cyclization pathways can be controlled in tandem cyclization reactions of alkynyl amides with a thiophene backbone. By using an alkynyl amide building block approach, this presentation shows the synthesis of precursors to two targeted thieno-fused lactams. Progress has been made in this project by the synthesis of a key diyne building block required for the continuation of this synthetic pathway.

CIC Undergraduate Award in Physical, Theoretical, or Computational Chemistry (Oral)

Ailish Sullivan
Mount Saint Vincent University

Preliminary Investigation of Separate Potential Molecular Carriers for Two Different DIB Families

Ailish D. Sullivan[1], Emily R. Smith[1], Fraser M. Smith[2], Tiffany M. Fields[2], Tina A. Harriott[1], Daniel Majaess[1], Lou Massa[3], Chérif F. Matta[1,2,4,5]
[1]Mount Saint Vincent University, [2]Saint Mary's University, [3]City University of New York, [4]Université Laval, [5]Dalhousie University

Mary Lea Heger discovered the first diffuse interstellar bands (DIBs) at 5780 and 5797 Å over a century ago. Today more than 550 DIBs have been identified and yet their molecular sources remain unknown. An examination of highly correlated pairs of DIB equivalent widths (EWs) was used to propose two families of DIBs tied separately to 5780 and 5797 Å. Consistent correlations between EWs and optical reddening along with independent results using NIR reddening bolstered the existence of these families. Potential vibrational energies linked to offsets between pairs of DIBs within each family were evaluated. Thereafter, wavelengths associated with those vibrational energies were compared to spectra for approximately 16,000 molecules in the RASCALL (Rapid Approximate Spectral Calculations for ALL) database. The aim is to constrain functional groups or molecules which may be associated with Heger's lines. Preliminary results are discussed here along with current work being completed to test the robustness of these initial findings.

CIC Undergraduate Award in Physical, Theoretical, or Computational Chemistry (Poster)

Jillian Fougere
St. Francis Xavier University

Plasmonic Photocatalysis for Sustainable Phenol Generation

Jillian Fougere[1], *Geniece Hallett-Tapley*[1]
[1]*St. Francis Xavier University*

Phenols are widely used across medicinal and pharmaceutical chemistry as anti-oxidants, anti-allergic and anti-cancer agents, to name a few (Figure 1). Previous methods for synthesising phenols, such as hydrolysis of arene diazonium salts and Hock's process, involve harsh reaction conditions and highly reactive chemicals in activating the aryl halide precursor, unfavorable from an environmental perspective. One alternative over these more traditional routes is using light-activated pathways or photocatalysis—an avenue that has gained traction over the past decade to afford a more efficient and selective process.

Phenyl boronic acids (PBA) as possible phenol precursors is considered advantageous compared to more traditional diazonium and peroxide reagents. Photocatalytic activation of PBA to synthesize phenols has also shown promise. Work by Pitre and coworkers has illustrated efficient oxidative hydroxylation of PBA to phenol using a methylene blue dye sensitizer using visible light for 7 hours. Other metal-free catalysts, such as fullerene and carbazole-based materials, catalyzed PBA conversion to phenol in high yields, also using blue light. Copper nanoparticles supported on triazine covalent organic polymers have also shown success in converting PBA to phenol in as little as 10 minutes. In all three examples, materials were used to respond to lower energy blue light, but issues remain in regard to lengthy time requirements (for reaction or catalyst preparation) or limited recyclability of the catalysts. The proposed research will build on this prior, established work of synthesizing phenols from PBA using blue light, but will aim to optimize the reaction/catalyst preparation time, as well as catalyst recyclability using cuprous oxide (Cu_2O) nanoparticle doped metal oxides as a photocatalysts. Here, Cu_2O will respond to blue light, while use of a solid photocatalyst may improve recyclability and, therefore, decreased chemical waste associated with this process.

CIC Undergraduate Award in Material Chemistry (Oral)

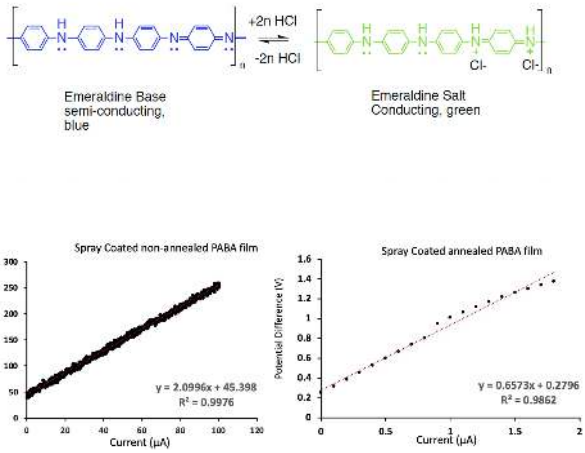
Mark Mikhail
Dalhousie University

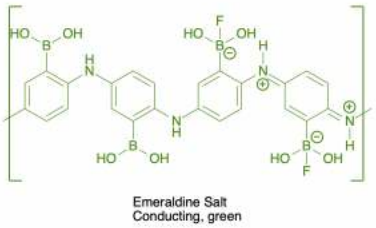
Synthesis and Optimization of Poly(anilineboronic acid) Conductive Ink for Printed Organic Electronics

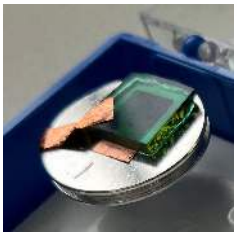
Mark Mikhail[1], *Michael Freund*[1]
[1]*Dalhousie University*

This study explores the use of poly(anilineboronic acid) (PABA) as an alternative to polyaniline in organic conducting ink for printed electronics. While organic inks offer cost-effective and large-scale production of electronic devices, polyaniline and other similar polymers suffer from low solubility, poor environmental stability, and loss of conductivity at high temperatures. To address these limitations, the boronic acid group of the substituted polyaniline derivative, PABA, improves the thermal stability and dispersibility in alcohols.

PABA was synthesized in methanol and analyzed its optical properties using UV-Vis spectroscopy. The film morphology of drop-cast, spin coat, and spray coat deposition methods were investigated using Scanning Electron Microscopy (SEM) imaging, and the annealed and non-annealed form of the films were also analyzed. A preliminary four-probe measurement was conducted to determine the sheet resistance and conductivity of PABA. Results indicate that spray coating of PABA in methanol on glass substrate forms the most uniform and continuous films compared to the other three deposition methods. Annealed films appear fused together, with pores present on the surface. Additionally, the sheet resistance of the non-annealed and annealed spray coat film on a printed circuit board were found to be 6.9 Ω/square and 2.27 MΩ/square, respectively. Furthermore, we found that PABA film fully disintegrated in 1% hydrogen peroxide over the period of one week. Overall, the tunable properties of PABA make it a promising candidate for use in thin-film transistors and other applications requiring organic conducting ink for printed electronics with the potential of reducing electronic waste given its disintegration.







Credit: Mark Mikhail

CIC Undergraduate Award in Material Chemistry (Poster)

Matthew Bremner
Mount Allison University

Determination of the Effect of Core Size on the Ligand Tilt Angle of Gold Nanoparticles

Matthew Bremner[1], Katherine Reiss, Annabelle Kilham, Samuel Whidden, M.-Vicki Meli
[1]Mount Allison University

Nanoparticles are becoming more and more popular as their application in many technologies' advances. For example, they have uses in medicine as drug carriers and even some consumer goods. Nanoparticles have different functions depending on their properties including their core element, size, shape, charge, and the ligand that is attached to them. These properties are all altered depending on how the particles are synthesized. Spherical gold nanoparticles with diameter of 4, 15, and 30 nm were all synthesized using variations of citrate reductions. The citrate stabilized particles were then all allowed to stir with mercaptoundecanoic acid to exchange with the citrate and form a fully packed ligand shell. Concentrations of the prepared particles were determined using UV-visible spectroscopy and their size was determined using transmission electron microscopy. The ligand density of these particles was determined using X-ray Photoelectron Spectroscopy. Tracking the shift of the λ_{max} upon full ligand exchange enabled the determination of ligand tilt on the nanoparticle surface for the three core sizes. We found that the ligand tilt decreases significantly with core size.

CIC Undergraduate Award in Macromolecules and Polymers Chemistry (Oral)

Suprio Chowdhury
Memorial University of Newfoundland

Progress Towards the Synthesis of (Z,Z)-[9](2,7)Pyrenophane-1,8-diene

Suprio Chowdhury[1], *Graham J. Bodwell*[1]
[1]*Memorial University of Newfoundland*

The Bodwell group has been actively working for more than two decades on the synthesis of a class of cyclophanes called the [n](2,7)pyrenophanes.[1] They consist of a polycyclic aromatic unit (pyrene) that is bridged at the 2 and 7 positions by an oligomethylene unit. The bridging causes the pyrene to be bent from the usual planar shape and the degree of bending increases as the chain length becomes shorter. This substantially changes the chemical and physical properties of the pyrene system in the pyrenophane.

The primary goal of this project was to synthesize (Z,Z)-[9](2,7)pyrenophane-1,8-diene, which features two cis-alkenes positioned at opposite ends of the bridge. The purpose of doing this was so that alkene chemistry could be utilized to introduce new functionality that could, in turn, ultimately be used to π-extend the aromatic system. This type of π-extension is known as contractive annulation.[2] Bridge atoms are used as "food" for the growth of the π system, so it results in the formation of a cyclophane with both a larger arene and a shorted bridge. Progress towards the synthesis of 2 will be presented.

Citations

(1) G. J. Bodwell, J. J. Fleming, M. R. Mannion, D. O. Miller, *J. Org. Chem.* 2000, *65*, 5360-5370.

(2) S. Biswas, C. S. Qiu, L. N. Dawe, Y. Zhao, G. J. Bodwell, *Angew. Chem. Int. Ed.* 2019, *58*, 9166-9170.

CIC Undergraduate Award in Macromolecules and Polymers Chemistry (Poster)

Jenna Hanrahan
Memorial University of Newfoundland

Is Maternal Exposure to Polyethylene Micro and Nanoplastics Causing Placental Dysfunction

Jenna Hanrahan[1]
[1]*Memorial University of Newfoundland*

Polyethylene has the highest annual production rate worldwide and is subject to degradation resulting in its breakdown in the environment to micro and nanoplastics (MPs and NPs). MPs have recently been discovered in the human placenta, raising concerns surrounding the impact of plastics on fetal health. In this study, we investigated the potential effects of maternal exposure to polyethylene plastic particles on placental function and metabolism. To do this, healthy, pregnant CD-1 mice were exposed to 10^6 ng/L of polyethylene MPs/NPs dissolved using a 0.1% biocompatible surfactant solution in filtered drinking water (n=12). Two control groups were incorporated into the study; a true control group that received filtered drinking water alone (n=11) and a surfactant control group that only received the 0.1% surfactant solution in water (n=12). Multiple measurements were taken on day 17.5 of gestation (one day before full term). These measurements include fetal and placental weights along with umbilical cord lengths. Additionally, high-frequency ultrasound biomicroscopy was used to image blood flow at the umbilical artery to evaluate placental function. Biological sex differences were explored to determine if the parameters being studied are sex dependent. We found that polyethylene delivered via drinking water did not impact fetal or placental weights. However, the polyethylene exposure did result in a significant increase of umbilical artery blood flow, suggesting placental dysfunction. This study improved our understanding of the impacts of plastic exposure on placental function and fetal development, ultimately improving our understanding of the effects plastic particles have on human health.

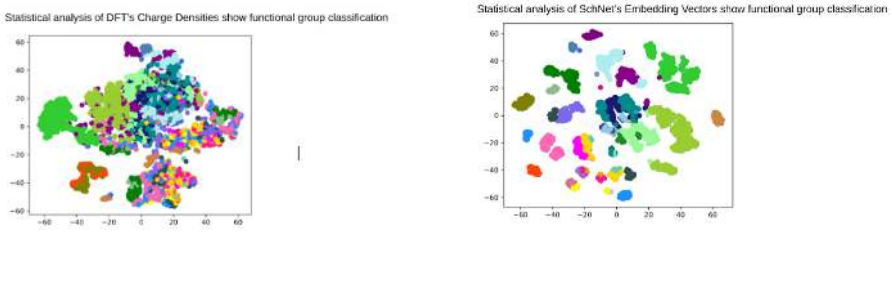
CATC Undergraduate Award in Theoretical Chemistry

Incé Husain
University of New Brunswick, Fredericton

SchNet and Density Functional Theory: Interpreting Molecular Representations Generated by Machine Learning Using Traditional Methods

Incé Husain[1], Amer El-Samman[1], Stijn De Baerdemacker[1]
[1]University of New Brunswick, Fredericton

With the rise of machine learning (ML) techniques for scientific prediction, computational chemists are interested in understanding how machine learning algorithms represent molecules. Specifically, there is interest in investigating whether ML-generated representations of molecules can be related to those used in computational techniques that are traditional to computational chemistry. In this study, this is examined by comparing machine learning representations of molecules to those used in Density Functional Theory (DFT) calculations. The neural network SchNet generates molecular representations in the form of 'embedding vectors', while DFT represents molecules by their spatial charge densities. These representations were visualized and statistically compared for molecules containing carbon, hydrogen, nitrogen, and oxygen. Results suggest that, although SchNet was trained on DFT datasets, it generates more specific molecular representations than DFT that adhere more strongly to traditional chemical understandings. Specifically, it was shown that SchNet's molecular representations classify functional groups more accurately than DFT, and that SchNet appears to capture traditional understandings of bonding character.



Credit: Incé Husain

The CATC Award is awarded to the top presenter(s) in computational and/or theoretical chemistry. The award is sponsored by the Canadian Association of Theoretical Chemists (CATC), who for over thirty years have represented the interests of both academic staff at Canadian universities and permanent staff in national laboratories whose focus is in computational and theoretical chemistry.

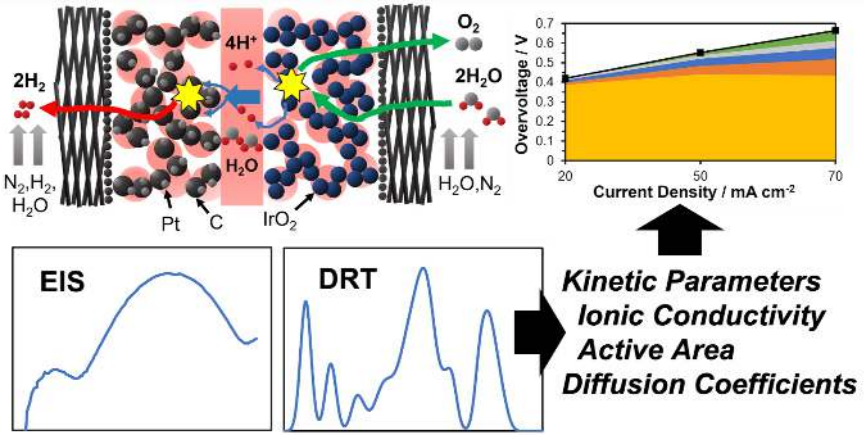
CIC Graduate Award in Analytical Chemistry (Oral)

Patrick Giesbrecht
Dalhousie University

Advanced Electrochemical Impedance Analyses for In Operando Mechanistic Insights of Water Electrolyzer Designs

Patrick Giesbrecht[1], *Michael Freund*[1]
[1]*Dalhousie University*

With the ever-growing climate crisis and global energy demands, the development of clean and sustainable energy and chemical frameworks are necessary to minimize man-made carbon-based emissions. One promising approach is by producing green hydrogen through renewable-coupled water electrolysis, providing a framework for sustainable chemical fuel and precursor production. Polymer electrolyte membrane-based water electrolyzers (PEMWEs) offer a compact design for water electrolysis, employing porous electrodes and an ionically conductive membrane that can operate with pure water. However, rapid, scalable development of PEMWEs requires the use of in operando methods to monitor changes to cell operation and stability throughout the cell lifetime. Electrochemical impedance spectroscopy (EIS) has been shown to be a powerful tool for rapid monitoring of changes to electrochemical cell operation based on changes to the cell impedance, where interpretation of the impedance is often challenging using conventional equivalent circuit modeling. Here, we use advanced EIS methods to analyze Nafion-based PEMWE operation and provide a breakdown of the different resistances impacting cell performance. Combining materials characterization of the cell components and EIS analyses of half-cell and full-cell configurations, we develop an equivalent circuit model for the cathode and anode operation that can provide series, charge transfer, ionic, contact, and mass transport resistances of each electrode. We use this model to determine kinetic parameters, active area, ionic conductivity, and diffusion coefficients for each electrode as a function of cell fabrication methods and operating conditions. The work presented here will show the versatility and limitations of EIS analysis of PEMWE designs as well as present key findings for improving performance and stability.



Credit: Patrick Giesbrecht

CIC Graduate Award in Analytical Chemistry (Poster)

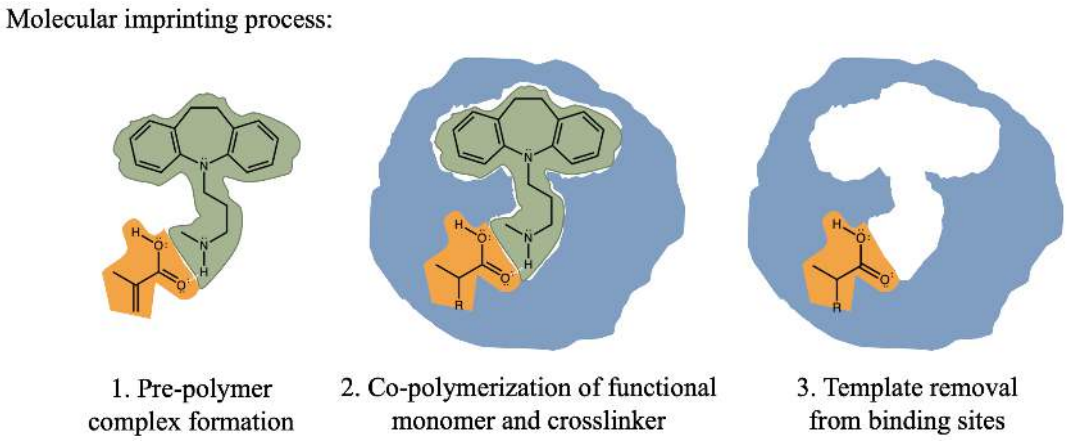
Sophia Parent
Memorial University of Newfoundland

Investigation of Pseudo-templates for Molecular Imprinting of Thin-polymer Films for Extraction of Tricyclic Antidepressants from Biological Samples

Sophia Parent[1], *Christina Bottaro*[1]
[1]*Memorial University of Newfoundland*

Molecularly imprinted polymers (MIPs) are synthetic polymers imprinted with a template molecule during polymerization to give rise to selective binding sites for target analyte(s). A MIP designed by our group to extract tricyclic antidepressants (TCAs) from human blood plasma used carboxybenzyl-protected desipramine (CBZ-desipramine) as the pseudo-template.[1] However, the amide bond in the CBZ-desipramine undergoes hydrolysis during either template extraction or instrumental analysis. Evidence of this process was detected in the data for desipramine, which had the poorest limit of quantitation (LOQ) compared to the other TCAs.[1]

This research is focused on the search for an improved pseudo-template for tricyclic antidepressant sample preparation from biological samples. ^{1}H-NMR spectroscopy was used to study the relative strengths of template-monomer complexes formed in MIP pre-polymer solutions, which are viewed as crucial to forming the desired selectivity.[2–4] Titration experiments were performed in $CDCl_3$. At room temperature, this method could not be used to observe the chemical shifts of the exchangeable protons directly. Chemical shifts were observed for the non-exchangeable protons due to changes in the chemical environment. However, an unknown effect of pH could have caused changes in the chemical shifts. Future work involves considering temperature and pH changes to determine relative template-monomer complex strengths.



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Citations

(1) Shahhoseini, F.; Langille, E. A.; Azizi, A.; Bottaro, C. S. Thin Film Molecularly Imprinted Polymer (TF-MIP), a Selective and Single-Use Extraction Device for High-Throughput Analysis of Biological Samples. *Analyst* **2021**, *146* (10), 3157–3168. https://doi.org/10.1039/d0an02228d.

(2) Sánchez-González, J.; Peña-Gallego , Á; Sanmartín, J.; Bermejo, A. M.; Bermejo-Barrera, P.; Moreda-Piñeiro, A. NMR Spectroscopy for Assessing Cocaine-Functional Monomer Interactions When Preparing Molecularly Imprinted Polymers. *Microchemical Journal* 2019, *147*, 813–817. https://doi.org/10.1016/j.microc.2019.03.088.

(3) Svenson, J.; Karlsson, J. G.; Nicholls, I. A. 1H Nuclear Magnetic Resonance Study of the Molecular Imprinting of (-)-Nicotine: Template Self-Association, a Molecular Basis for Cooperative Ligand Binding. *J Chromatogr A* 2004, *1024* (1– 2), 39–44. https://doi.org/10.1016/j.chroma.2003.09.064.

(4) Lu, Y.; Li, C.; Zhang, H.; Liu, X. Study on the Mechanism of Chiral Recognition with Molecularly Imprinted Polymers. *Anal Chim Acta* 2003, *489* (1), 33–43. https://doi.org/10.1016/S0003-2670(03)00708-6.

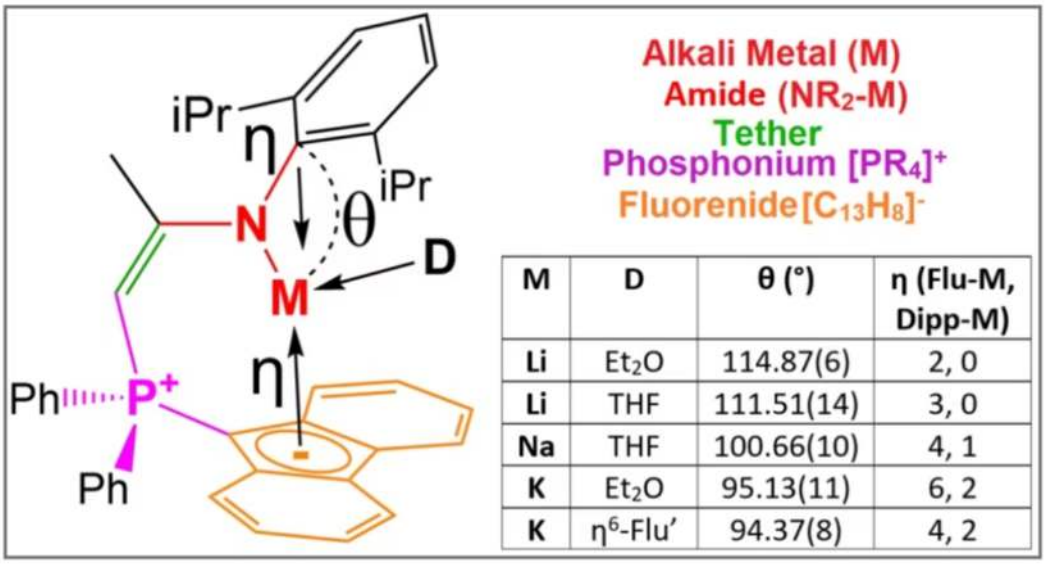
CIC Graduate Award in Inorganic Chemistry (Oral)

Tanner George
Saint Mary's University

Alkali Metal Amide Complexes with a Phosphonium Fluorenide Donor

Tanner George[1], *Jason Masuda*[1]
[1]*Saint Mary's University*

The purpose of this synthetic work was to design a novel ligand featuring an amide moeity coupled with an electron delocalized phosphonium fluorenide donor to utilize the variable donor ability of the polyaromatic fluorenide for future use as a component in catalytic cycles. Our original hypothesis was that this would encourage metal coordination that could accommodate a wide range of metal sizes and fill diverse coordination sphere requirements, and ideally, during catalytic cycles the fluctionality of the metal-fluorenide interaction could accomodate oxidative addition and reductive elimination. The preliminary steps were achieved through forming various lithium, sodium, and potassium complexes of each, highlighting a substantial shift in hapticity between the metal-fluorenide interactions and creating a basis for reactivity to form future organometallic complexes for testing efficacy in catalytic processes. In total, 5 new compounds are reported, with numerous crystal structures of various solvates of the free ligand in both (E) and (Z) conformations, lithium complexes with either coordinated diethyl ether or THF, and potassium complexes with coordinated diethyl ether and with cocrystallized hexane, with the coordination sphere of potassium instead filled via backside fluorenide donation resulting in a polymeric structure.



M	D	θ (°)	η (Flu-M, Dipp-M)
Li	Et_2O	114.87(6)	2, 0
Li	THF	111.51(14)	3, 0
Na	THF	100.66(10)	4, 1
K	Et_2O	95.13(11)	6, 2
K	η^6-Flu'	94.37(8)	4, 2

Credit: Tanner George

CIC Graduate Award in Inorganic Chemistry (Poster)

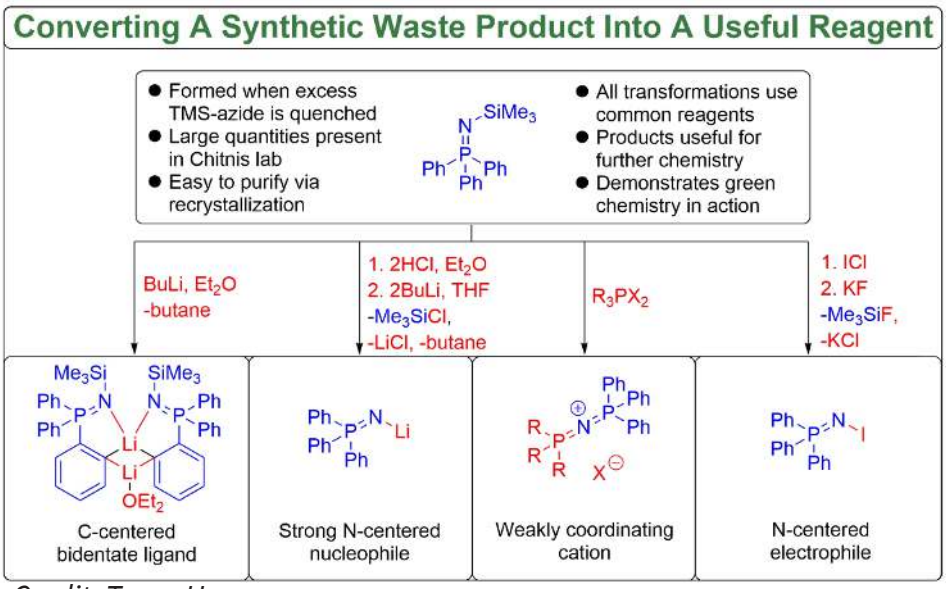
Toren Hynes
Dalhousie University

Converting a Synthetic Waste Product Into a Useful Reagent

Toren Hynes[1], Maxwell Lohar[1], Nicholas Murphy[1], Joseph P. Bedard[1], Karlee L. Bamford[1], Saurabh S. Chitnis[1]
[1]Dalhousie University

Synthetic chemistry has made major improvements to everyday life over the past century, yet the reactions used to make said products often produce by-products. In the laboratory, the most common option is to discard these by-products. Proper disposal, however, is often expensive and improper disposal may be harmful to the environment.

To avoid these pitfalls, industrial chemistry often attempts to reuse by-products instead. Doing so avoids the problem of disposal of by-products and, if the by-products can be easily turned into a synthetically useful chemical, it can help improve company profits. For this reason, the re-use of by-products is seen as one of the 12 principles of green chemistry. In this poster presentation, I will apply this concept on a laboratory scale and convert $Me_3SiNPPh_3$—a waste product from the Chitnis's group's polymer chemistry—into an N-centered electrophile, a ligand for main group chemistry, a stronger electrophile, and a weakly coordinating cation, using a combination of literature and novel methods. I hope that these reagents will prove useful for future chemistry in the Chitnis lab and that other research groups will be inspired to re-use some of their own waste products.



Credit: Toren Hynes

CIC Graduate Award in Organic Chemistry (Oral)

Zainab Bello
Dalhousie University

The On-resin Synthesis of Wewakazole B: an Oxazole-containing Peptide

Zainab Bello[1]
[1]*Dalhousie University*

Wewakazole B is a cyclic dodecapeptide first isolated from the cyanobacterium, *Moorea producens*, in the Red Sea.[1] This marine peptide contains heterocyclic 5-membered rings, termed oxazoles, that are known pharmacophores linked to anticancer and antifungal activity. Wewakazole B contains one oxazole and two methyloxazoles derived from cyclization of serine and threonine residues, in addition to nine natural amino acids. Initial studies have identified Wewakazole B mediated cytotoxicity in human H460 lung cancer and human MCF7 breast cancer cells however, the mode of action is unknown.[1] The cytotoxic potential of this peptide remains understudied due to the difficulty to isolate or synthesize Wewakazole B's unique structure in high yields. Four research groups have successfully carried out the total synthesis of this peptide using solution phase synthesis requiring several purification steps and ultimately resulting in low yields.[2,3,4,5] In this study we aim to streamline the synthesis of Wewakazole B using solid phase peptide synthesis techniques with the goal to minimize purification steps and increase overall yield. To achieve this, we explore the best approach to on-resin oxazole formation. Simplification of this synthetic pathway will allow us to explore metabolic stability and cytotoxicity of Wewakazole B and subsequent structural analogues.]

Citations

(1) J. A. V. Lopez, S. S. Al-Lihaibi, W. M. Alarif, A. Abdel-Lateff, Y. Nogata, K. Washio, M. Morikawa and T. Okino, *J. Nat. Prod.*, **2016**, *79*, 1213-1218.

(2) B. Long, J. Zhang, X. Wang, X.Tang, and Z. Wu, *Chem. Res. Chin. Univ.*, **2017**, *33*(6), 890-894.

(3) M. Inman, H. L. Dexter, and C. J. Moody, *Org. Let*. **2017** *19* (13), 3454-3457.

(4) B. Long, J. Zhang, X. Tang., and Z. Wu, *Org. Biomol. Chem.*, **2016**, *14*, 9712-9715.

(5) K. Nayani, and S.D.A. Hussaini, *Tetrahedron Letters*, **2017**, *58* (12), 1166-1169.

CIC Graduate Award in Organic Chemistry (Poster)

Nathan Gorey
University of New Brunswick, Fredericton

Modifying the Emission Properties of Organosulfur Fluorophores Through m-CPBA Oxidation

Nathan Gorey[1]
[1]*University of New Brunswick, Fredericton*

The ability to control and fine tune absorption and emission properties is critical for applications such as sensors, bio-markers and OLEDs. These compounds are known as fluorophores and posses some key characteristics. They have conjugated π-systems which generates small HOMO-LUMO gaps. This in turn allows these fluorophores to emit visible light upon excitation most commonly in the red to green portion of the visible light spectrum. However, a common issue for fluorophores is emission in the blue portion of the visible light spectrum because that emission of light requires a lot of energy and an unstable LUMO energy. This is a problem for fluorophores when employed in applications such as OLEDs because the blue emitting diodes require more energy and have a shorter lifespan compared to the red and green diodes resulting in a shorter battery life for the device and faster degradation over time. A common scaffold for fluorophore design are maleimides because they exhibit promising properties such as compact designs, high emissivity, large stokes shifts and facile modification. One common maleimide modification is the addition of sulfur functionalities because they exhibit strong emissions originating from their donor-acceptor architectures. A class of fluorophores that posses the characteristics discussed are thioaryl phthalimides (TAPs) which have low HOMO-LUMO gaps allowing them to fluoresce in the visible light spectrum mainly in the green colour range. The maleimide backbone in these fluorophores can be disubstituted with a range of coupling partners such as a benzothiophene boronic acid to achieve the desired TAP analogue. These TAP fluorophores have sulfur as part of their structures which can be oxidized by common oxidants such as m-CPBA into sulfone functionalities. Literature reports that sulfur oxidation can induce a blue shift in emission as well as generate high stability. Herein, the oxidation of a TAP fluorophore is performed to attempt to employ the discussed sulfone functionalities.

CIC Graduate Award in Physical, Theoretical, or Computational Chemistry (Oral)

MacAulay Harvey
Saint Mary's University

Investigating the Molecular Structure of Collagen Using Second Harmonic Generation Microscopy

MacAulay Harvey[1], Richard Cisek[1], Laurent Kreplak[2], Danielle Tokarz[1]
[1]Saint Mary's University, [2]Dalhousie University

Collagen is by far the most abundant protein within the human body making up ~30% of total body weight. The majority of collagen is found in the form of collagen fibrils which are nanoscale ropes that serve as the main load bearing element in most tissues in the human body. Damage to individual collagen fibril within tendons as a result of extreme loads or repetitive strain is thought to be the cause of tendinopathies, a class of disorder resulting in pain, reduced mobility, and in some cases permanent disability. In order to study the origins of this fibril damage we require an analytical technique with high sensitivity to collagen molecular structure under physiological conditions.

Polarization-resolved second harmonic generation microscopy (PSHG) is a microscopy technique which utilizes the natural frequency doubling properties of the collagen molecule as a contrast mechanism. This technique has had widespread use in quantifying collagen organization within collagenous tissues, but so far has not been applied to the study of individual collagen fibrils.

Here we present a new technique which utilizes PSHG to obtain structural information about the molecules within a collagen fibril using a much simpler experimental setup than has been previously used in PSHG measurements. Experiments are also performed on the effect of hydration on collagen fibril structure, and it is shown the helical pitch angle of the triple-helical collagen molecule can be extracted from PSHG data with accuracy similar to x-ray diffraction measurements. Finally preliminary work will be presented in which by applying an external magnetic field to individual collagen fibrils, we demonstrate the sensitivity of PSHG to conformational changes within the collagen molecule.

The work presented here will demonstrate the potential of PSHG as an analytical technique to study the origins of tendon damage at the nano scale, which may have long term implications in the prevention and treatment of tendinopathies.

CIC Graduate Award in Physical, Theoretical, or Computational Chemistry (Poster)

Julia Schmitt
St. Francis Xavier University

Polyhedral Gold Nanospecies as Efficient Photooxidation Catalysts

Julia Schmitt[1], *Geniece Hallett-Tapley*[1]
[1]*St. Francis Xavier University*

Environmentally sustainable materials and methods are an ever-growing aspiration in our society. Photocatalytic technology is considered as an efficient, stable, and environmentally friendly method in the field of environmental pollution control. One such reaction of interest is alcohol oxidations—commonly used in plastic, pharmaceutical and cosmetic synthesis. However, common methods tend to use harsh chemicals such as potassium permanganate or chromium trioxide. In this investigation, we will aim to explore the oxidation of various alcohols to their respective carbonyl products using heterogenous polyhedral gold catalysts, activated by low-energy red light. A series of variables will be examined to optimize this process including semiconductor composition, substrate concentration and structure, use of additive oxidative species and irradiation time. Finally, the recyclability of the heterogeneous catalyst will be examined to ensure the overall goal of sustainability is maintained.

CIC Graduate Award in Material Chemistry (Oral)

Tyler Saunders
Dalhousie University

Synthesis and Reactivity of New Phosphino(silyl) Nickel Complexes for Application in Alkene Hydrofunctionalization Catalysis

Tyler Saunders[1], *Laura Turculet*
[1]*Dalhousie University*

Research in the Turculet group targets the development of Earth-abundant 3d-transition metal complexes supported by multidentate (phosphino)silyl ligation for application in the catalytic hydrofunctionalization of unsaturated substrates such as alkenes, alkynes, and carbonyl derivatives.[1-3] In an effort to tune such catalysts and access increasingly reactive systems we have recently begun to explore the roles of coordinative unsaturation at the metal center and ancillary ligand steric features on reactivity. In this regard, this presentation will detail the synthesis of new phosphino(silyl) ligand derivatives and our investigation of Ni coordination chemistry. The utility of such phosphino(silyl) Ni species in hydroboration and hydrogenation catalysis of sterically hindered alkenes will also be described.

Citations

(1) Murphy, L. J.; Hollenhorst, H.; McDonald, R.; Ferguson, M. J.; Lumsden, M. D.; Turculet, L. *Organometallics* **2017**, *36*, 3709-3720.

(2) Murphy, L. J.; Ferguson, M. J.; McDonald, R.; Lumsden, M. D.; Turculet, L. *Organometallics* **2018**, *37*, 4814−4826.

(3) Hale, D.H.; Ferguson, M. J.; Turculet, L. *ACS Catal.* **2021**, *12*, 146-155.

CIC Graduate Award in Material Chemistry (Poster)

Nikita Harvey
Memorial University of Newfoundland

Maternal Exposure to Polystyrene Nanoplastics Impacts Developmental Milestones and Brain Structure in Mouse Offspring

Nikita Harvey[1], Grace Mercer[1], Darcie Stapleton[1], Katherine Steeves[1], Jenna Hanrahan[1], Megan Cui[1], Zahra Aghaei[1], Shoshana Spring[2], Paul Helm[3], Andre Simpson[4], Myrna Simpson[4], Christopher Macgowan[5,6], Ahmet Baschat[7], John Kingdom[8,9], John Sled[2,5,6,8], Karl Jobst[1], Lindsay Cahill[1]

[1]Memorial University of Newfoundland; [2]Mouse Imaging Centre, Hospital for Sick Children; [3]School of the Environment, University of Toronto; [4]Environmental NMR Centre and Department of Physical and Environmental Sciences, University of Toronto; [5]Translational Medicine, Hospital for Sick Children; [6]Department of Medical Biophysics, University of Toronto; [7]Johns Hopkins Center for Fetal Therapy, Department of Gynecology and Obstetrics, Johns Hopkins University; [8]Department of Obstetrics and Gynecology, University of Toronto; [9]Department of Obstetrics and Gynecology, Mount Sinai Hospital

Recently the presence of microplastics have been reported in human blood and the placenta raising concerns about their potential impacts on fetal development. Humans are primarily exposed to microplastics and nanoplastics (diameter <1 µm) by inhalation and ingestion of dust and through drinking water. Following exposure, nanoplastics could translocate from the lungs or gut into the bloodstream and other organs. In this study, we investigated how nanoplastics affect fetal growth, postnatal brain development, and brain metabolism using experimental mice.

Throughout gestation and lactation, pregnant CD-1 dams were exposed to 50 nm polystyrene nanoplastics in water (1000 µg/L, n=8). The control group consumed water without plastics (n=6). Pups were weighed weekly and monitored for the timing of developmental milestones. At weaning, a subset of the pups were sacrificed for 3D magnetic resonance imaging (MRI) to investigate neuroanatomical differences between the groups. A second subset of pups were sacrificed for metabolomics studies of the brain tissue using high-resolution magic angle spinning magnetic resonance spectroscopy. The mice exposed to nanoplastics had abnormal eye opening and focal differences in brain structure that were dependent on neonatal sex. This data motivates further studies to determine the levels of nanoplastics in the environment.

CIC Graduate Award in Macromolecules and Polymers Chemistry (Oral)

Lauren Grant
Saint Mary's University

Establishing a Microbial Connection Between L'Acadie Vineyard and Their Natural Wine

Lauren Grant[1], *Clarissa Sit*[1]
[1]*Saint Mary's University*

L'Acadie Vineyards, located in Wolfville, Nova Scotia, produces a natural wine from L'Acadie Blanc grapes. Natural wines are produced from spontaneously fermented organic grapes. In contrast to standard wines, no starter yeasts or other additives are used in the fermentation process. Instead, the fermentation relies on native yeast species present in the vineyard and on the grapes at the time of harvest. Spontaneous fermentation has been found to positively impact the sensory profile of wine when compared to conventional, inoculated wine fermentation. Natural wines are marketed for their greater terroir expression or connection to the vineyard. Terroir refers to how soil, climate, other geographical features, and the microbial community in the vineyard impact the wine. This research aims to establish a direct connection between vineyard microbes and L'Acadie Vineyard's natural wine. To do this, yeasts and bacteria have been isolated from vineyard grapes and are being identified by DNA sequencing. Results will be compared to metagenomic sequencing of wine lees, leftover organic material from the fermentation. Microbes isolated from the vineyard which are also present in the wine lees will be used to ferment grape juice for comparison to L'Acadie Vineyard's natural wine using an HPLC-QTOF. DNA and chemical analysis will be used to determine what vineyard microbes are impacting the natural wine fermentations and how they're impacting it.

CIC Graduate Award in Macromolecules and Polymers Chemistry (Poster)

Grace Mercer
Memorial University of Newfoundland

Identifying Placental Biomarkers of Preterm Birth Using NMR-based Metabolomics

Grace Mercer[1], Darcie Stapleton[1], Catherine Barrett[1], Rajshree Ghosh Biswas[2], William Wolff[2], Flavio Crizostomo Kock[2], Ronald Soong[2], André Simpson[2], Lindsay Cahill[1]

[1]Memorial University of Newfoundland, [2]University of Toronto

Introduction: Preterm birth (PTB) is one of the most common complications of pregnancy, affecting 8% of pregnancies in Canada. It is associated with high rates of infant morbidity and mortality as it accounts for two-thirds of infant deaths. While there are no effective methods to prevent PTB, interventions exist to prevent the sequelae associated with premature birth. However, over 50% of preterm deliveries are unpredicted and many people who are identified as high-risk for PTB go on to deliver at term. There is therefore a critical need to develop reliable methods for the prediction of PTB.

Methodology: Nine people with healthy term pregnancies and nine people with preterm pregnancies (<37 weeks' gestation) were recruited from Eastern Health (St. John's, Newfoundland; HREB 2021.015). Following delivery, placental tissue samples (1 cm^3) were snap-frozen in liquid nitrogen. Comprehensive multiphase NMR spectroscopy experiments of intact tissue were performed on a 500 MHz Bruker Avance III spectrometer (MAS=2.5kHz, temp=5°C). Data was analyzed using MestReNova and MetaboAnalyst.

Findings and Significance: Twenty-three low weight molecular metabolites were identified in the placental tissue using ^{1}H and ^{13}C literature values and correlations from a 2D ^{1}H-^{1}H COSY and a ^{1}H-^{13}C HSQC. The relative concentrations of valine, glutamate, and creatine were decreased in the PTB placentas compared to controls while alanine and glucose were elevated ($p<0.05$). This study shows the promise of potential biomarkers in the placenta for the early detection of metabolic abnormalities that lead to PTB. It has also provided insight into the biochemical pathways that are distributed by PTB and motivates a clinical study to test the predictive value of certain metabolites as early biomarkers of PTB.

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