Proceeding Report of the Trent Graduate Students in Science Symposium

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1.0. Summary of the Symposium

The Trent Graduate Students in Science (TGSS) Symposium took place on March 9th, 2019 in Otonabee College at Trent University (Figure 1) from 8:30 AM to 5:30 PM. The purpose of this meeting was to bring together graduate researchers in a variety of different scientific disciplines to discuss the most recent scientific discoveries at Trent University and topics relevant to graduate studies as well as to facilitate networking and the practicing of presentation skills. Keynote speakers Dr. Raymond March and Dr. Douglas Evans used their own experiences and research to give insight into graduate studies and Jayme Stabler led a workshop on being an effective teaching assistant. Graduate students presented orally in morning and afternoon sessions (Session 1 and Session 2) in two concurrent presentation rooms (A and B) as well as in a short poster and ePoster presentation session midday. A summary of the TGSS Symposium is included in Figure 2. To facilitate the exchange of information in a multidisciplinary fashion, students in various scientific disciplines were dispersed throughout the sessions rather than grouped together. Each oral, poster and ePoster presentation was judged by a minimum of two judges. There was a total of 70 attendees, which included 28 graduate student presenters, 9 presentation judges and/or keynote speakers, and 5 members of the organizing committee. The organizing committee comprised of Erika L. Crowley, Kelly Wright, Novin Nezamololama, Verena Sesin and Amanda Stubbs (Figure 3).

Figure 1. Trent University in the fall of 2016. Photo by Erika L. Crowley.
<table>
<thead>
<tr>
<th>Time</th>
<th>Session 1A: OC 204</th>
<th>Session 1B: OC 206</th>
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<tr>
<td>10:00 AM</td>
<td>10:00 AM – 10:20 AM, Cassandra DeFrancesco</td>
<td>10:00 AM – 10:20 AM, Sasha Newar</td>
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<td>10:40 AM</td>
<td>10:40 AM – 11:00 AM, Jeremy Porquez</td>
<td>10:40 AM – 11:00 AM, Dayton Kelly</td>
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<td>11:00 AM</td>
<td>11:00 AM – 11:20 AM, Maegwin Bonar</td>
<td>11:00 AM – 11:20 AM, Kimber Munford</td>
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Teaching Assistant Workshop: Jayme Stabler
11:30 PM – 12:00 PM, OC 205

**Lunch**
12:00 PM – 12:45 PM, Gzowski College Dining Hall

**Poster Session**
12:45 PM – 1:30 PM, Otonabee College

Keynote Speaker: Dr. Douglas Evans
1:30 PM – 2:30 PM, OC 205

**Session 2**
2:30 PM - 4:00 PM

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<tr>
<th>Time</th>
<th>Session 2A: OC 204</th>
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<td>3:30 PM – 3:50 PM, Sandra Klemet-N’Guessan</td>
<td>3:30 PM – 3:50 PM, Meredith Kadjeski</td>
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Closing Remarks and Awards
5:00 PM – 5:30 PM, OC 205

**Figure 2.** The program in a glance for the TGSS Symposium in Otonabee College (OC).

**Figure 3.** The TGSS organizing committee Novin Nezamololama, Amanda Stubbs, Kelly Wright, Verena Sesin and Erika L. Crowley (left to right). Photo by Dr. Christina Davy.

### 2.0. Opening Address and Morning Keynote Presentation

The opening address and morning keynote presentation ran from 9:00 AM until 10:00 AM and was chaired by the organizing committee. The morning keynote presenter was Dr. Raymond E. March (Figure 4).

#### 2.1. Morning Keynote Presentation by Dr. Raymond E. March

Dr. March focused on the entrée to research through graduate studies. He examined the role of graduate students as apprentice
researchers and their development as highly qualified personnel. Dr. March asked, is this where you want to be? He explored the generation of ideas in attempt to meet the challenges of novelty in research and provided some examples of fruitful research that he has pursued together with further examples of research that, perhaps, should never have seen the light of day.

Figure 4. Morning keynote speaker Dr. Raymond E. March beginning his presentation on graduate research. Photo by Vereena Sesin.

3.0. Session 1A

Session 1A ran from 10:00 AM until 11:30 AM and was chaired by Amanda Stubbs. Graduate students presented their research for 15 minutes with 5 minutes of questions.

3.1. Factors affecting coloured dissolved organic matter properties from 2007-2017 in the Canada Basin, Arctic Ocean
Cassandra DeFrancesco* and Céline Guéguen
*Environmental and Life Sciences, Trent University, Peterborough ON

The Arctic Ocean is the smallest ocean in the world, making up 1% of the global ocean volume, but is the most “fresh” being supplied with ~11% of the global riverine freshwater. As global temperatures are rising due to greenhouse gas emissions (fossil fuel burning, deforestation, other anthropogenic activities), we are observing a loss of permanent, multiyear sea ice resulting in an ever-shrinking summer sea-ice coverage, thawing permafrost leading to increased input of organic carbon, and increased freshwater discharge. With decreasing sea ice coverage in the Arctic Ocean, it is expected that there will be an increase in terrestrial material to the Beaufort Sea and Canada Basin from surrounding rivers. Therefore, it is crucial to better understand the fate of terrestrial organic matter in the rapidly changing Arctic Ocean. Coloured dissolved organic matter (CDOM) will be measured for fluorophore components present as they are highly abundant in freshwater originating from soils, freshwater and rivers. Variables associated with CDOM will be compared with changes in sea ice extent to determine if there is an effect from environmental change. The goal of this research is to determine the temporal and spatial changes of water sources reaching the Arctic Ocean over a ten-year period from 2007-2017. The decline of sea ice may play a role, and this will be accounted for alongside changes in freshwater discharge. It is expected that more terrestrial components will appear in surface waters with little change in the deeper layers of the water column.

Keywords: Arctic Ocean, CDOM, Fluorescence, Sea Ice, Environmental Change

3.2. Fantastic beetles and where to find them in northern Ontario
Kaitlyn J. Fleming*, Jim Schaefer, Ken Abraham and David Beresford
*Environmental and Life Sciences, Trent University, Peterborough ON

Wildlife, specifically insects, in northern Ontario are incredibly understudied because it is difficult to sample them and access to the region is limited. Climate change and anthropogenic disturbance are two of the most significant environmental challenges threatening many species. To predict the impact these will have, it is first necessary to know what species are there now before we can see how it will change in the future. I am examining the effect abiotic factors have on current ground beetle biogeography and physiology in Ontario's Far North. With the
projected temperature increases associated with the current climate change models, as well as possible mining and development, habitat changes in Northern Ontario are inevitable. This research is the first to examine baseline distributions for 132 ground beetle species, including new range records, first Canadian, provincial, and territorial records, and invasive species in this area.

Keywords: Ground Beetles, Northern Ontario, Species Distribution

3.3. Generating bright chemical images with a CARS microscope and a technique called spectral surfing
Jeremy Porquez*, Ryan Cole, Joel Tabarangao and Aaron Slepkov
*Material Science, Trent University, Peterborough ON

Generating chemical images through a process called Raman scattering is a slow and tedious process. A coherent version, called coherent anti-Stokes Raman scattering (CARS), allows for chemical imaging that can potentially reach video-rate speeds. CARS microscopy is typically implemented using dual laser sources and can be expensive, potentially reaching more than three hundred thousand Canadian dollars to build. An economic way to implement CARS is through the use of broadband light source called a photonic crystal fiber. This can significantly lower the cost of the microscope by more than half. Unfortunately, the fiber is only able to generate light with limited brightness and wavelength range, thus limiting the generation of CARS chemical images to Raman modes greater than 1900 cm\(^{-1}\) when using an 800 nm pump laser. An experimental scheme called “spectral surfing” maximizes the power generated by the fiber through a dynamic power-tuning process. With spectral surfing, we find that the range of chemical imaging can be extended, from >1900 cm\(^{-1}\) to >350 cm\(^{-1}\), while also increasing the image brightness.

Keywords: Coherent, Anti-Stokes, Raman, Microscopy, Hyperspectroscopy

3.4. Genomic drivers of population level variation in migration directionality
Maegwin Bonar*, Spencer Anderson, Charles R. Anderson Jr., George Wittemyer, Joseph M. Northrup and Aaron B. A. Shafer
*Environmental and Life Sciences, Trent University, Peterborough ON

Migration, defined as the seasonal movement between home ranges, is critical to the life-history of many ungulate species. Migrations benefit ungulates by facilitating predator avoidance, increasing access to forage, and ultimately allowing for their persistence in variable environments. While the importance of migration is widely recognized, many ungulate species have experienced declines in migration behaviour due primarily to climate change and habitat loss. Conserving migratory range in ungulates is difficult and this is partially due to the variation in migration behaviour exhibited by individuals. While environmental factors primarily drive annual variation in migration, genetic or physiological drivers, likely account for residual variation among individuals within a population. If variation in migration behaviour has a genetic component, how might that affect a population’s ability to respond to and cope with climate change or anthropogenic disturbance? Our objectives were to: 1) quantify individual variation in directionality in mule deer during seasonal migrations; and 2) conduct genome wide scans to identify target genes that explain population level differences in directionality of migration. We used high resolution GPS data collected from 240 mule deer in Colorado from 2008-2015 to quantify migration behaviours and next generation sequencing techniques to assess genetic differences.

Keywords: Genomics, Migration, Behaviour
4.0. Session 1B

Session 1B ran from 10:00 AM until 11:30 AM and was chaired by Erika L. Crowley. Graduate students presented their research for 15 minutes with 5 minutes of questions.

4.1. The Hidden World of Flyers: Exploring Flying Squirrel Ultrasonic Vocalizations
Sasha Newar* and Jeff Bowman
*Environmental and Life Sciences, Trent University, Peterborough, ON

In recent years, the introduction of ultrasonic microphones has allowed for the improved acoustic monitoring of many mammalian species. Yet, our understanding of why mammals produce ultrasound vocalizations (USVs; calls exceeding 20 kHz) and the basic evolutionary drivers of high-frequency communication is not well informed. Generally, we know a broad range of mammals use USVs in a wide variety of adaptations. USVs serve two overarching purposes for mammals: social communication (the sharing of information between individuals) and individual communication (echolocation and echonavigation). The usage of USVs for social communication has been well documented in lab mice and rats and more recently in wild rodents. These calls have also been extensively reviewed in echolocating microbats and now echonavigation, a less complex acoustic tool, has been reported in shrews, blind mice, and a few megabats. Interestingly, flying squirrels are unique among most non-echolocating mammals as they are candidates for both social and individual communication. But while northern and southern flying squirrels have been successfully recorded using USVs, the purpose of high-frequency calls in these timid squirrels remains a mystery. I reveal the unseen behaviours of flying squirrels by using infrared cameras in conjunction with ultrasonic microphones so that acoustic behaviours can be associated. I’ve recorded individual squirrels in both T-mazes and captivity to non-invasively observe the actions associated with USV production and to determine if squirrels use USVs for social or individual communication. By documenting clear call behaviours, we will have novel insight into social behaviours in flying squirrels by using USVs.

Keywords: Flying Squirrels, Bioacoustics, Ultrasound, Behaviour

4.2. Curable Hybrid Materials for Corrosion Protection of Steel: Development and Application of UV Cured Methacryloxypropyltrimethoxysilane Derived Coatings
Kevin Scotland* and Andrew Vreugdenhil
*Material Science, Trent University, Peterborough ON

This work describes the synthesis and characterization of a UV crosslinked sol-gel comprised of 3-methylacryloxypropyltrimethoxysilane (MaTMS) and tetraethoxysilane (TEOS) using isopropanol as a co-solvent and stoichiometric amounts of HNO₃ (1 M) as the acid catalyst. MaTMS is often considered difficult to hydrolyze and keep solubilized. We have demonstrated that the use of isopropanol as the co-solvent and HNO₃ leads to rapid and complete hydrolysis of the material within 10 minutes of stirring at room temperature. Results show that the starting material is completely consumed within a few minutes compared to previously employed methods requiring up to 14 days of stirring. We also demonstrate that the use of this solvent/catalyst combination along with heating of the sol at 60 °C for 10 minutes leads to rapid and complete hydrolysis of the material within 10 minutes of stirring at room temperature. Results show that the starting material is completely consumed within a few minutes compared to previously employed methods requiring up to 14 days of stirring. We also demonstrate that the use of this solvent/catalyst combination along with heating of the sol at 60 °C for 10 minutes leads to extensive condensation and the formation of long open chain siloxane networks that can be readily crosslinked via a photo-initiated UV curing process with high efficacy. This results in a dense durable coating, that can provide corrosion protection for low carbon steel substrates for over 24 hours of immersion in dilute Harrison’s solution. This convenient and effective sol-gel material also functions as an excellent host for conductive polymer and oligomeric corrosion inhibitors, polypyrrole and polyaniline allowing
for further enhancement of the steel corrosion prevention provided by these systems.

Keywords: UV Cured, Sol-gel, Coatings, 3-methylacryloxypropytrimethoxysilane, Tetraethoxysilane

4.3. Mild Dehydration Protocol Impairs Lightweight Rowing Performance: Exploring Differences in Dehydration Technique
Dayton Kelly* and Liana Brown
*Psychology, Trent University, Peterborough ON

Dehydration is an acute weight loss technique used by lightweight rowers to become eligible for competition. While rowing allows a two-hour window between weigh-ins and racing that athletes can use to rehydrate, it is unclear what effect this procedure may have on performance. PURPOSE: To determine whether mild dehydration with rehydration, as a weight reduction strategy for lightweight rowers, compromises rowing performance. METHODS: Experienced rowers (N=14) twice performed a 2000 m rowing ergometer time trial and visuomotor battery: once euhydrated and once after mild dehydration (mean -1.68 ± .23% body mass reduction). Weight loss was achieved through a combination of 12-hour fluid restriction and subsequent sauna exposure. RESULTS: Participants were significantly slower on the 2000 m rowing trial in the dehydration condition than in the euhydration condition (2.44 ± 4.5 s, p<0.05). Hierarchical linear regression analyses revealed that these rowing performance decrements were better explained by dehydration achieved through fluid restriction (r²=.504, p<0.01) than by dehydration achieved in the sauna or total dehydration magnitude (r²=.025, n.s.). Hierarchical regression revealed that dehydration-related changes in visuomotor function were also explained by dehydration by fluid abstinence but not sauna exposure and were predictive of dehydration-related rowing performance decrements (r²=.310, p<0.01). CONCLUSION: These findings suggest that rowing time-trial performance can be negatively affected by relatively small changes in hydration status and that the technique by which dehydration is achieved is important. Performance losses were associated with fluid abstinence and not with sauna dehydration. Reduced motor control may explain declines in performance.

Keywords: Rowing, Dehydration, Motor Control

5.0. Teaching Assistant Workshop

The teaching assistant workshop ran from 11:30 AM until 12:00 PM and was chaired by Kelly Wright.

5.1. Teaching Assistant Workshop by Jayme Stabler

Jayme Stabler is a PhD candidate in the Materials Science program at Trent University. She has extensive experience working as a teaching assistant and has completed the teaching assistant training certificate. Recently, she was recruited to transform the first-year chemistry tutorial content and train the tutorial leaders. Jayme is highly respected by her students and has been voted the best third year teaching assistant in the Chemistry Department. In her years at Trent, she has been an influential mentor to several undergraduate thesis students. She used her wealth of knowledge to lead to an informative and lively discussion on how to be an effective teaching assistant.

6.0. Poster Presentation Session

The poster presentation session ran from 12:45 PM until 1:30 PM and was chaired by Verena Sesin. Graduate students presented their research.

6.1. Recycled media affects growth and causes changes in hormone profiles in microalgae
Cell growth mechanism has been a focus of numerous cell biology studies. Increasing the efficiency of growth and product yield are of interest not just to academia, but to industry as well. Rising in popularity is the use of microalgae in industry. It is possible to manipulate and track parameters pertaining to essential growth. The capacity of microalgae to grow using recycled materials could be carried out through industry collaboration. We have begun investigating the use of recycled materials with primary interest in the function of cytokinins (CK) -- a cell growth modifying phytohormone -- and its influence on biomass accumulation paired with monitoring of trace carbon sources, pH, glucose consumption, supernatant depletion, cell count, morphology, and gene expression, under organic and recycled conditions. Previous work with microalgae indicates that CKs act as growth regulators; however, little is known about their explicit roles among microalgal species. We seek to understand the role of CK in the complex mechanisms underlying microalgal growth, which may affect culture productivity and industrial waste footprint, by using microalgae recycled materials as a source for sustainable nutritious supplements. This research seeks to unlock the full potential of microalgae natural growth yield while expanding upon the roles of CKs in algal growth.

Keywords: Microalgae, Fermentation, Recycled Media, Cell Growth, Hormones

6.2. The Effect of Snow Depth on Wild Turkey Movement Patterns: An Analysis Using Least Cost Path Experiments

Jennifer Baici* and Jeff Bowman
*Environmental and Life Sciences, Trent University, Peterborough

Least-cost path modelling has been widely applied to study organism movement and gene flow through different landscapes. It is often used to identify wildlife movement corridors for the purposes of preserving critical habitat or mitigating human/wildlife conflict, such as road mortality. Using manipulative experiments and least-cost path modelling I will explore whether wild turkey winter movement patterns vary based on snow depth.

To identify turkey movement patterns, I have placed bait piles consisting of whole-kernel corn inside known turkey home ranges and used bait lines, also consisting of corn, to attract wild turkeys to the bait piles. Once the turkeys are aware of the bait’s location, I record the first organic (not along the bait line) path by backtracking each turkey’s tracks to the nearest woodlot or treeline. To generate different cost scenarios, the bait piles are strategically relocated within the experimental area every few weeks. Cost surfaces will be generated based on snow depth measurements collected in the field and other habitat variables including distance to obstructive cover.

If wild turkeys alter their movement patterns based on snow depth, I predict that a cost-distance model that assigns the highest cost to areas of deep snow and the lowest cost to areas with no snow will best predict wild turkey movement patterns. Understanding how snow depth impacts wild turkey winter mobility may allow us to predict population trends based on weather patterns and potential range expansions at northern latitudes.

Keywords: Least-cost Path, Turkey, Movement, Snow Depth

6.3. Expression optimization of auto-induced and isotope-labelled cytochrome bs from the parasitic Giardia intestinalis for NMR experiments

Erika Crowley* and Steven Rafferty
The protozoan parasite *Giardia intestinalis* does not synthesize heme and is devoid of many heme proteins common to eukaryotes, yet it expresses four members of the cytochrome *b* family. *Giardia* cytochromes *b* (gCYTB5s) have low reduction potentials and distinct subcellular locations, which is consistent with structural features and biological roles that differ markedly from their more thoroughly studied mammalian counterparts. Our goal is to determine the structure of gCYTB5-III, which unusually for proteins of this type is found solely in the nucleus. Heme proteins are especially interesting targets for NMR studies. In addition to multidimensional NMR experiments, 1H-1D and 1H-15N HSQC NMR spectra of CYTB5A compared well to those reported previously, while those of gCYTB5-III reveal significant differences in its heme-binding pocket, despite sharing a coordination environment from a pair of histidine residues. These results and additional multidimensional NMR experiments in progress can be extended to the other gCYTB5 isotypes and will expand our biochemical knowledge of the global parasite.

Keywords: *Giardia intestinalis*, Cytochrome *b*, Protein Nuclear Magnetic Resonance Spectroscopy, Expression Optimization, Isotope Labelling

### 6.4. Assessing the level of contaminants in lake catchments surrounding Iqaluit, Baffin Island

Rachel Brown* and Julian Aherne
*Environmental and Life Sciences, Trent University, Peterborough ON

The long-range transport and deposition of atmospheric contaminants onto Arctic ecosystems has caused great concern regarding their fate and environmental impacts. Contaminants, such as heavy metals and mercury, are a threat to human and environmental health due to their ability to bioaccumulate and biomagnify in Arctic flora and fauna. This poses a risk to northern communities, due to their reliance on traditional foods. Further, microplastics, which are plastic debris < 5 mm in size, are an emerging contaminant in the Arctic that have the ability to accumulate in lower trophic biota, e.g. zooplankton and fish. Lakes and ponds, which are recognized as ‘sentinels of change’ owing to their ability to reflect internal and external (catchment) processes, are one of the most common components of Arctic ecosystems. Quantifying pollutant loadings to Arctic lake catchments will further our understanding regarding the fate of atmospheric contaminates, and the potential for human exposure. The objective of this study was to assess the level of contaminants [arsenic (As), cadmium (Cd), mercury (Hg), lead (Pb), and microplastics] in lake catchments (*n*=20) surrounding the Iqaluit Region, Baffin Island. During September 2018, surface water and surface sediment were sampled from each lake, while vegetation [moss (*Hylocomium splendens* and *Pleurozium schreberi*), *Emetrum nigrum* (crowberry), *Vaccinium uliginosum* (blueberry), and *Rhododendron tomentosum* (Labrador tea)], and surface soils (0–10 cm depth) were sampled from their surrounding catchments. Microplastics were measured in surface waters, while As, Cd, Hg, and Pb were analyzed in surface waters, surface sediment, vegetation, and surface soils.

Keywords: Heavy Metals, Mercury, Arctic Lakes, Atmospheric Deposition, Vegetation
6.5. Integrating GPS and genetic data to inform wildlife management
Jesse F. Wolf*, Aaron B.A. Shafer and Krystal Dixon
*Environmental and Life Sciences, Trent University, Peterborough ON

In British Columbia, Canada (B.C.) the framework for preventing species from becoming at risk includes a ranking system to address conservation needs through specific, curated actions. The key approach to management strategies includes designating the populations and sub-populations into population management units (PMUs). PMUs are used to most effectively address the unique concerns, including specific situations regarding anthropogenic, environmental, and climatic factors, within each unit. The holistic process for designating PMUs not only relies on geographical predictors, but also on historical, biological, cultural, and legislative predictors. The more information integrated, the more informed and therefore, more effective population management practices become.

A species of concern in B.C. are mountain goats (*Oreamnos americanus; goats). Although the species has a large population size, they face threats throughout much of their B.C. range that has culminated in regional population size declines. B.C. goats in the Skeena region are managed by PMUs only informed by expert opinion and geographical parameters. This means that the current PMUs are not informed by biological data, and therefore may not be effectively structured for successful management. When biological data is introduced, subtle and difficult to observe changes in population structure can be reflected in subsequent PMU changes. This study will combine high-resolution GPS telemetry and genetic data to further explicate the relationship between landscape heterogeneity and genetic differentiation in B.C.’s goats. Initial results indicate that while these populations are geographically distinct from the rest of B.C.’s goats, they are genetically similar to goats located throughout B.C.

Keywords: Population Management, Mountain Goat, Genetic Relatedness, GPS

6.6. A Decadal Change in Mercury in Upland Irish Lakes
Sarah Nelson*, Julian Aherne and Holger Hintelmann
*Environmental and Life Sciences, Trent University, Peterborough ON

While mercury is a naturally occurring element, concentrations found in the atmosphere, surface waters and soils have increased as a result of human activities. Once in the environment, bacteria can convert elemental mercury into methylmercury, which can bioaccumulate and biomagnify in organisms. Methylmercury can cause significant impacts to human health, most notably causing harm to the nervous, digestive and immune systems. During the last decade there have been efforts to minimize anthropogenic sources of mercury. In 2013, the Minamata Convention on Mercury was adopted: a global treaty to protect human health and the environment from anthropogenic emissions of mercury.

A survey of 56 upland lake catchments in Ireland was conducted during summer 2017 to assess decadal changes in mercury. Water (n=56), soil (n=28), and sediment (n=24) samples were collected and analyzed for concentrations of total mercury (THg), and other chemical characteristics, including organic matter. The upland lakes are situated along the Western Irish coast and are primarily influenced by long range transport and atmospheric deposition of pollutants rather than local emissions. Average THg (± SD) were 6.0 ng/L ± 4.1, 236.4 ng/g ± 93.3, and 51.5 ng/g ± 50.2 for water, soil and sediment respectively. THg concentrations in water had the strongest relationship with SUVA-320, and THg in soil and sediment had a significant relationship with organic matter. Total
Hg concentrations were statistically higher during the 2017 survey in comparison to a previous survey conducted in 2008, despite decreased mercury emissions.

Keywords: Mercury, Organic Matter, Lake Chemistry

6.7. Heme Active Site Analysis of Flavohemoglobin of Giardia Intestinalis
Novin Nezamololama* and Steven Rafferty
*Environmental and Life Sciences, Trent University, Peterborough ON

The gastrointestinal parasite Giardia intestinalis is the causative agent of giardiasis or ‘Beaver fever’, a major contributor to diarrheal and intestinal infectious diseases worldwide with over 280 symptomatic infections annually. To date, Giardia is the only known protist to express a flavohemoglobin enzyme (gFlHb) that metabolizes the free radical nitric oxide to the less harmful nitrate in order to cope with nitrosative stress caused by the host antimicrobial defence mechanism. As gFlHb is the only enzyme that enables Giardia to counter nitrosative stress, it could be a novel pharmacological target since current antigiardial drugs show low efficacy and are associated with adverse effects such as alteration of the normal intestinal flora. We are particularly interested in imidazole-based compounds, as recent studies show that flavohemoglobins can be inhibited by antibiotics with this functional group that act as a ligand to the heme iron. In this framework, we studied the ligand binding properties of gFlHb towards imidazoles and compare those to Hmp, the flavohemoglobin of the commensal gastrointestinal tract microorganism E. coli. We used optical titrations to measure changes in the UV-visible spectrum of flavohemoglobin as ligands bind, and used isothermal titration calorimetry (ITC) to obtain information on the thermodynamics of ligand binding. Amongst the imidazoles examined, the bulky imidazole miconazole has the highest affinity for both gFlHb and Hmp ($K_d = 3-5 \mu M$).

Keywords: Giardia, Flavohemoglobin, Imidazole Derivatives, UV-Visible Spectroscopy, ITC

6.8. Roosting Network of the Eastern Wild Turkey at their Northern Range Edge
Elizabeth Pearce*, Jeff Bowman and Jennifer Baici
*Environmental and Life Sciences, Trent University, Peterborough ON

The use of communal roosts is common among many species, with benefits including decreased predation, increased thermoregulation benefits, and increased foraging efficiency. Past research on roosts focused on specifics at the roost, species of tree, height, characteristics that focused on the tree as a single unit. However, getting a big picture view of the network of roosts used can help to show patterns in the network and highlight important roost locations. The eastern wild turkey switches their roost site locations throughout the year which suggests that there is an interactive network of roosts. Our study site in Peterborough, ON, is at the wild turkeys northern range edge. One benefit of communal roosting is thermoregulation, and understanding how that impacts their roost locations may help to further understand their success as a reintroduced species, as well as a species at their northern range. Using a sample of wild turkeys (n=45) fitted with GPS tags, I am able to look at their night time locations and determine roost sites. With those roost sites, I’m then able to build a network with nodes being the roost sites, and the connections between the nodes being the turkeys switching between those roost sites. Using network analysis, I’m hoping to look at interaction data to address broader biological questions and help describe the network structure of the roosting system.

Keywords: Communal Roosting, Network Analysis

6.9. Atmospheric wet deposition of microfibers on the western periphery of Europe
Plastics particles <5 mm long called microplastics, have been found throughout marine, freshwater and terrestrial systems. There is growing concern of their environmental impacts given that they can absorb organic pollutants and trace metals. While our understanding of the sources and transport of microplastics has increased during the last decade, there have been limited studies on microplastics in atmospheric deposition. In this study, rainfall was collected from four ‘background’ precipitation chemistry stations under the EMEP network from June 2017 to May 2018. Daily rainfall samples were bulked by calendar month and analyzed for microfibers. Samples were vacuum filtered on to GF/C Whatman filters and microfibers were identified and counted using a stereomicroscope. Pictures each of microfibers were taken and measured using image processing software. A subsample of microplastics were further analyzed using Raman spectroscopy to identify the type of plastics. Annual deposition ranged from 16 to 29 microfibers per litre, resulting in a deposition of 64.5 to 102.0 microplastics/m 2 /day. The average microfibre length was 1.28 mm, resulting in a deposition of 37.6 m of microplastics/m 2 . Atmospheric deposition is an important vector for the transport of microfibres into remote locations.

Keywords: Precipitation Chemistry Monitoring Stations, Ireland, Microfibers, Microplastics, Rainfall

**6.10. Effects of macrophytes invasion on the movement and habitat selection of freshwater turtles in Southern Ontario, Canada**

S. Y. Jennifer Angoh*, Christina Davy and Joanna Freeland
*Environmental and Life Sciences, Trent University, Peterborough ON

Invasive species can have significant impacts on wildlife through severe habitat modification. The invasive graminoids *Phragmites australis* and *Typha x glauca* are spreading rapidly into Canadian wetlands and are considered threats to several species-at-risk (SAR). To test the hypothesis that these macrophytes alter habitat use and movement of freshwater turtles, we conducted mark-recapture surveys and radio-track Blanding’s turtles (*Emydoidea blandingii*) and spotted turtles (*Clemmys guttata*) across a mosaic of native marsh vegetation, cattail stands (*Typha spp.*), and both managed and unmanaged *P. australis* stands. Also, to determine if the temperature in invasive macrophytes stands and varying densities of these macrophytes influence freshwater turtles’ habitat selection, we used vegetation survey and temperature data recorded within individual turtle’s home ranges. Our results aim to inform evidence-based strategies that will balance the control of invasive plants with sustainable management of wetland SAR.

Keywords: Freshwater Turtles, Phragmites, Cattail, Invasion

**7.0. ePoster Presentation Session**

The ePoster Presentation Session ran from 12:45 PM until 1:30 PM and was chaired by Verena Sesin. Graduate students presented their research.

**7.1. Review of dermatologic conditions associated with giardiasis**

Erika L. Crowley* and Ashley O’Toole
*Environmental and Life Sciences, Trent University, Peterborough ON

*Giardia lamblia* is a worldwide freshwater pathogen responsible for the intestinal infection giardiasis. Patients infected with Giardia can present with or without gastroenterological manifestations but are often
asymptomatic. These patients can also present with a variety of other clinical manifestations, making it difficult to diagnose giardiasis and ultimately determine the connection between giardiasis and the alternate manifestation. Although not well understood, literature regarding dermatologic conditions that are associated with giardiasis is expanding. The current study aims to review case reports and case series of patients with dermatologic conditions that are associated with giardiasis. Giardia has been detected using either stool microscopy, immunofluorescence, or immunoenzymatic assays in the stool of patients with urticaria, bullous eosinophilic cellulitis, phrynoderma, atopic dermatitis, papulovesicular lesions and other dermatologic manifestations. In these cases, treatment with anti-giardial therapy such as metronidazole or secnidazole sodium often led to clearance of the dermatologic manifestation. Although not well understood, theories on the action of Giardia in dermatologic manifestation have been proposed and will be discussed in this review. Additional studies are required to gain a better understanding of the relationship between Giardia and dermatologic manifestation. Collaboration between specialists in dermatology and tropical medicine may be advantageous for these cases.

Keywords: Giardia lamblia, Giardiasis, Dermatology

7.2. Problem Solving as a path to comprehension: Understanding mathematical symbolism and notation
Seyeon Kim*, Marco Pollanen, Michael G. Reynolds and Wesley S. Burr
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The ability to read, write and manipulate complex mathematical expressions is assumed in most mathematical user interfaces for programs designed for authoring, collaboration and reasoning in mathematics. However little is actually known about how people cognitively process and integrate complex mathematical expressions. In our study, we explored the use of eye-tracking hardware as a tool for gaining insight into how people read and comprehend mathematical symbols and complex formula, tracking subjects pupillary focus on symbols as a guide to their attention and fixation. We studied two classes of subjects: mathematically “expert” and “non-expert”. Experts were students taken from a program of study involving mathematical sciences (e.g., mathematics, physics, and related fields) who had taken a minimum of five mathematics courses at the university level, while non-experts were students taken from other science programs which were less mathematically focused. Each subject was presented with a series of stimuli in the form of mathematical problems and their eyes and attention tracked as they worked through the problems mentally. We discuss the differences in the classes of subjects, between Expert and Non-Expert, and also break down further into comparisons between subjects who completed problems correctly and incorrectly.

Keywords: Eye-tracking, Mathematical Representations, Problem Identification, Symbolism, Mathematical Notation

8.0. Afternoon Keynote Presentation
The afternoon keynote presentation ran from 1:30 PM until 2:30 PM and was chaired by Verena Sesin.

8.1. Afternoon Keynote Presentation by Dr. Douglas Evans
In this presentation, Dr. Evans discussed potential areas of conflict that commonly arise between graduate students and their supervisors how to manage these conflicts. Many of the issues were drawn from his experience during his time as Dean of Graduate Studies at Trent University. In particular Dr. Evans focused on student’s versus supervisor’s expectations and
how to bring those expectations closer together to avoid conflicts.

9.0. Session 2A

Session 2A ran from 2:30 PM until 3:30 PM and was chaired by Novin Nezamololama. Graduate students presented their research for 15 minutes with 5 minutes of questions.

9.1. Industrial Recycling of Eggshell Membrane Waste

Jayme L. Stabler* and Andrew J. Vreugdenhil
*Material Science, Trent University, Peterborough ON

In order to eliminate a large industrial waste stream, research is being done to utilize eggshell and eggshell membrane waste which in turn impacts the environment in a positive way. This waste stream is made up of two main components, the inorganic shell and the organic membrane. The shell consists almost entirely of calcium carbonate and the membrane has a significant amount of collagen\(^1\) (35% w/w) and hyaluronic acid\(^2\) (5% w/w) along with many other components. Our work focuses on the isolation, purification and characterization of the collagen and hyaluronic components of the membrane. These two target biomolecules have significant value in the cosmetic, biomedical and nutraceutical industries as the chemical composition of membrane is very similar to the extracellular matrix in the human body.\(^3\) In our work, several extraction protocols have been developed and investigated for the isolation of collagen and hyaluronic acid. Characterization techniques include (define) HILIC chromatography mass spectrometry and IR for collagen and colourimetric assay, IR, NMR and rheology for hyaluronic acid. On going work focuses on the optimization of the extraction protocols for purity, function and scalability.


9.2. Sexting Prevalence and Experiences

Tasha Falconer* and Terry Humphreys
Psychology, Trent University, Peterborough ON

Sexting, the sending of sexually explicit text, picture or video messages, has primarily been studied in adolescents. Adult sexting prevalence and experience has not been thoroughly researched. The current study investigates the prevalence rates and information about who is sexting, when they are sexting, and how they are sexting. The design consists of a cross-sectional survey of undergraduate students and community members. The survey measured sexting behaviours, including frequency, what platforms are used, and who they are sexting with. The data demonstrates that the vast majority of adults are sexting and are doing so within the context of an intimate relationship.

Keywords: Sexting, Sexuality, Adults

9.3. Fiddler on the roost: Habitat selection and behaviour of Ontario insectivorous bat species

Laura Scott*, Jeff Bowman and Christina Davy
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The eastern small-footed bat (Myotis leibii) is a species native to North America. They are found in rocky habitats in Ontario and along the Appalachian Mountains. They are known for roosting on the ground under rock slabs or in rock crevices, however due to this cryptic behaviour, we know little about them. M. leibii, the little
brown bat (*Myotis lucifugus*), and the tricoloured bat (*Perimyotis subflavus*) are listed as endangered on the International Union for the Conservation of Nature’s red list. Since 2006 populations have declined up to 95% due to white-nose syndrome, a fungal disease that causes them to wake during hibernation and waste critical energy reserves. This in combination with the loss of critical habitat puts bat populations at risk.

To further our knowledge and understanding about this species’ habitat preferences, I ask: what are the ecological and evolutionary consequences of habitat selection for *M. leibii*? I will answer this by determining inter- and intra-species variation in personality using a modified open-field test. The open-field test is an experiment commonly used with rodents, in which behaviours displayed during the test can be correlated to personality traits. To account for bats being flying mammals, I built a 3-dimensional open-field test large enough for flight and crawling. Bats were tested for ~1 hour at night and during the day while being continuously video recorded. Behaviours such as exploration/avoidance and boldness/shyness were identified and recorded. I will explore the relationship between exhibited behaviours, ecological characteristics and morphology for each species.

Keywords: Personality, *Myotis leibii*, Habitat Selection

9.4. The effect of dissolved organic carbon on aquatic animal-mediated nutrient recycling

Sandra Klemet-N’Guessan* and Marguerite A. Xenopoulos

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Dissolved organic carbon (DOC) plays an important regulatory role on aquatic systems’ structure and processes. With climate change, DOC concentration is predicted to increase in many aquatic ecosystems which could in turn affect essential ecosystem services such as the role that aquatic animals play in mediating nutrient recycling. We evaluated the relationship between DOC and phosphorus (P) excretion rates, nitrogen (N) excretion rates, body P, N and carbon contents, and body mass across various vertebrate taxa in both lentic and lotic habitats. In lentic habitats, both vertebrates’ N and P excretion rates showed a non-linear relationship with DOC, such as in low DOC environments (<3.9 mg/L), N and P excretion rates increased, whereas in high DOC environments (>3.9mg/L), N and P excretion rates decreased. In lotic habitats, however, both vertebrates’ N and P excretion rates showed an asymptotic relationship with DOC, such as in low DOC environments (<1mg/L), N and P excretion rates were the highest, whereas in high DOC environments (>1mg/L), N and P excretion rates were consistently low. Considering the substantial increases in DOC concentrations in recent decades, there is a need in holistic and global perspectives on the cascading effects of rising DOC in lentic and lotic habitats for the design of management strategies that will help maintain aquatic ecosystems’ services.

Keywords: Dissolved Organic Carbon, Nutrient Recycling, Aquatic Animals, Global Change

10.0. Session 2B

Session 2B ran from 2:30 PM until 3:30 PM and was chaired by Kelly Wright. Graduate students presented their research for 15 minutes with 5 minutes of questions.

10.1. Mathematical reasoning: thoughts exposed via the eyes

Francis Quinby*, Wesley Burr, Michael Chan-Reynolds and Marco Pollanen

*Applied Modelling and Quantitative Methods Psychology, Trent University, Peterborough ON

Eye tracking technology allows researchers to track eye movements and fixations, which can provide insight into cognitive function
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During certain situations. This current research investigates how the use of a computer software interface affects the cognitive process of transcribing mathematics. Due to the vast number of complex symbols and notation present in the written representation of mathematics, it remains challenging for novice to intermediate users to create mathematical expressions using computer software. We believe that by utilizing eye tracking technology we will be able to reveal patterns which will help to determine how this barrier can be effectively overcome. In an experiment currently in progress, we are using a head-mounted eye tracker to examine how the transcription process changes when writing mathematical statements using pen and paper versus two computer programs which make use of different representative models for mathematical structure. The use of the eye tracker allows us to examine not only how long participants take to write the respective mathematical statement, but also how often they refer to the presented stimulus, which provides us with insight into how the interface interferes with an individual’s working memory. We used a 2 x 2 x 3 factorial experimental design to examine how expression length, complexity, and transcription tool effected our outcome variables as well as to determine if any significant interactions are present. My presentation will focus on the results of this experiment and the implications for the fields of software user experience, cognitive psychology, and mathematics education.

Keywords: Eye-tracking, Mathematics, User-experience, Education

10.2. Determining broad-scale migration pathways of an endangered bat species
Lauren Hooton*, Christina Davy and Erica Nol
*Environmental and Life Sciences, Trent University, Peterborough ON

Myotis lucifugus (little brown bats) are an Endangered species facing numerous threats, including mortality from wind turbines. They likely encounter the most turbines when they migrate between summer maternity sites and fall swarming (mating) sites, but the paths they take on these journeys have never been identified. I used the Motus Wildlife Tracking Network to track the movements of *M. lucifugus* across SW Ontario, both to and from swarming sites. I tagged 108 *M. lucifugus* with nanotag transmitters at 5 maternity roosts and 1 swarming site in southwestern Ontario in 2018. I will create maps of the most likely migration routes taken by the tagged bats, which will allow me to determine whether bats tagged at maternity sites are choosing different routes than bats tagged at swarming sites/hibernacula, whether these routes differ among the sexes, and whether there are specific migration corridors on the landscape. Ultimately, I will use these results to determine if turbine-related mortality risk is greater during regional migration than during regular foraging around roosts.

Keywords: Bats, Migration, Wind Energy, Species at Risk, Telemetry

10.3. CARS microscopy and supercontinuum generation
James Lee* and Aaron Slepkov
*Material Science, Trent University, Peterborough ON

Coherent anti-Stokes Raman spectroscopy (CARS) is a method for label-free, chemically specific imaging, which relies on synchronizing two laser pulses of different colours. An economical method of preparing two laser pulses utilizes the supercontinuum generation from a special optical fibre, from a single light source. In this talk, I will describe the operating principles of the CARS microscope, as well as how I study the characteristics of the supercontinuum generation from various fibres.

Keywords: Optics, Lasers, Microscopy, Supercontinuum Generation
11.0 Closing Remarks and Awards Ceremony

The closing remarks and awards ceremony ran from 5:00 PM until 5:30 PM and was chaired by the organizing committee. For the oral presentation competition, Maegwin Boner won 1st place, Jeremy Porquez won 2nd place and Jayme Stabler won 3rd place. For the poster and ePoster competition, Ryan Cole (abstract not included in this report) won 1st place, Elizabeth Pearce won 2nd place and Sarah Nelson won 3rd place. A photograph of the award winners is included in Figure 5.

Figure 5. The award winners Sarah Nelson, Ryan Cole, Maegwin Boner and Jeremy Porquez (left to right). Photo by Kelly Wright.

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Conflicts of Interest: None to declare.

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