2021 Undergraduate Research and Innovation Conference Program and Abstracts

Contents

Lightning Talks 4

Morgan Yeomans. *Female Sponsorship: The Unspoken Glass Ceiling in the Sports Industry for Female Athletes.* 4

Raven Moller. *The Neighbourhood Watch: Does the Proximity to Neighbours Influence Nest Success in Tree Swallows (*Tachycineta bicolor*)?* 4

Fanqi Wu. *Utilization of Chemically Treated Fly Ash as an Adsorbent for the Removal of Bisphenol S from the Environment.* 4

Gursharan Uppal. *Characterization of Bacterial Communities in Arctic Soil* 5

Aina Roenningen. *The Relationship Between Cognitive Decline, Inhibition and Anxiety* 5

Nicholas Coutu. Investigating the Potential for High-CBD Cannabis Sativa and Nitric Oxide to Modulate SARS-CoV-2 Spike-ACE2 Binding. 6

Taylor Griffin. *The Need for Multifaceted and Sustainable Management Strategies: Fire, Forestry and Range* 6

Lauren Okano. *Sensitive Detection of Parts-Per-Billion Levels of Nisin in Dairy Products by Capillary Electrophoresis* 7

Tatiana Mueller. *The Influence of Covid-19 on Sustainable Urban Food Systems: Recommendations for Kamloops, BC* 7

Alyssa Holt and Amy Moir. *Breaking the Cycle: The Implications of a Recovery House and Resource Hub for Women Experiencing Criminalization* 7

Amy Moir and Alyssa Holt. *Breaking the Cycle: The Implications of a Recovery House and Resource Hub for Women Experiencing Criminalization* 8

Riley Mager. *Investigating the Antimicrobial Properties of Cannabinoid Compounds* 9

Gurcharan Uppal. *Simultaneous Separation and Identification of Bisphenol Analogues by Capillary Electrophoresis* 9

Abu Nadeem. *Leachability Determination of Elements in Fly Ash as a Potential Fertilizer* 9

Morgan Rigelhof. *A Global Scale Analysis of Bergmanns Rule for All Extant Bat Species* 10

Posters 11

Keenan Baker. *Effects of Simulated Grazing on Fire-Treated Mine Tailings for Restoration* 11

Kelsey Stefanyk. *Turning Back the Clock: Dying Young at an Old Age* 11

Erin Thomsen. *Affects of Deep Ripping on Site Index Near 100 Mile House, British Columbia* 11

Lauren Letham. *Blindness* 12

Angela Ippolito. *The Effects of Biosolids on Antibiotic Resistance Gene Abundance and Diversity in Microbial Communities of Mine Tailing Reclamation Sites* 12

Aaron Veale. *Is Island Life Turning Birds into Giants? An Assessment of Foster's Rule Across All Birds* 13

Jessica Stromsmoe. *Tolerance for Law Violations and Social Projection* 13

Paula Sabaté Fàbregas. *The Impacts of Climate Change on Microbial Community Structure and Function in Antarctic Ecosystems* 13

Hailey Stevens, Emerson Hansen, and Madison Petonjic-Rogers. *Viewing a Local Flora Digitally.* 14

Jared Sonnleitner. *Longitudinal Shifts in the Migratory Routes of Western and Eastern, but not Mountain Bluebirds* 14

Gwendolyn Freeze and Nicholas Hilton. *The Impact of Sympathetic Nervous System Activity on Longitudinal Movements in the Carotid Artery of Young Healthy People* 15

Charlotte Hutchison. *Examining if the Ecogeographical Foster's Rule in Bat Species Can Predict The Size Differences Between Island and Mainland Bats.* 15

Hannah O'Neil. *Green Transportation: An Analysis of Sustainability and Cycling in Kamloops, With Recommendations and an Assessment of COVID-19 Impacts* 16

April Read. *Characterization of the Antimicrobial Secondary Metabolites Produced by the Cave Bacteria Streptomyces ICC1* 16

Gursharan Uppal. *Characterization of Bacterial Communities in Arctic Soil* 17

Fanqi Wu. *Utilization of Chemically Treated Fly Ash as an Adsorbent for the Removal of Bisphenol S from the Environment* 17

Raven Moller. *The Neighbourhood Watch: Does the Promixity to Neighbours Influence Nest Success in Tree Swallows (*Tachycineta bicolor*)?* 18

Elvira Mukharryamova. *Phase Transitions in the Nucleus.* 18

Lauren Okano. *Sensitive Detection of Parts-Per-Billion Levels of Nisin in Dairy Products by Capillary Electrophoresis* 19

Tatiana Mueller. *The Influence of Covid-19 on Sustainable Urban Food Systems: Recommendations for Kamloops, BC.* 19

Taylor Griffin. *The Need for Multifaceted and Sustainable Management Strategies: Fire, Forestry and Range* 19

Aina Roenningen. *The Relationship Between Cognitive Decline, Inhibition and Anxiety* 20

Elvira Mukharryamova. *In Pursuit of Phase Separation.* 20

Amy Moir and Alyssa Holt. *Women Helping Women: Analyzing the Incorporation of Lived Experience in Peer Support for Women Experiencing Criminalization* 21

Alyssa Holt and Amy Moir. *Breaking the Cycle: The Implications of a Recovery House and Resource Hub for Women Experiencing Criminalization.* 21

Riley Mager. *Investigating the Antimicrobial Properties of Cannabinoid Compounds* 22

Gurcharan Uppal. *Simultaneous Separation and Identification of Bisphenol Analogues by Capillary Electrophoresis* 22

Nesa White. *Traditional Ecological Knowledge in Canada.* 23

Shauntay Yung. *Empiricism Versus Rationalism: Understanding the Acquisition of Knowledge* 23

Morgan Rigelhof. *A Global Scale Analysis of Bergmanns Rule for All Extant Bat Species* 23

Abu Nadeem. *Leachability Determination of Elements in Fly Ash as a Potential Fertilizer* 23

Zahkary Barone. *Determination of Thymol in Mouthwash by Capillary Electrophoresis* 24

Gillian Spencer. *The Post-harvest Effects on the Growth of Lodgepole pine (*Pinus contorta var. latifolia*) on the Perimeter of Harvested Strips* 24

Nicholas Coutu. *Investigating the Potential for High-CBD Cannabis Sativa and Nitric Oxide to Modulate SARS-CoV-2 Spike-ACE2 Binding* 25

Lightning Talks

Morgan Yeomans. *Female Sponsorship: The Unspoken Glass Ceiling in the Sports Industry for Female Athletes.*

In the billion-dollar industry of sports, everyone has a front-row seat to what happens outside; however, not many get to see what happens behind the scenes; one of those things is sponsorship. Research within marketing and communications has shown that the sponsorship process works. Product endorsement by an athlete will increase the potential for market share while simultaneously providing the athlete with needed support. However, corporate sponsorship does not appear to be symmetrical across gender boundaries. This project hypothesized that women receive sponsorship opportunities of a lower magnitude when compared to men of similar professional stature. As a result of this bias, it is feasible that these barriers influence women's ability to succeed.

By not acknowledging the gender bias, the effectiveness of sponsorship as a marketing and communication tool is potentially compromised. Through qualitative research methods, elite athletes, corporate representatives and industry specialists were interviewed to investigate the glass ceiling that impacts female athletes. Identifying and understanding these biases will help raise awareness of the issues, better support women in sport, and ignite further research into the topic and industry.

Faculty advisors: Shannon Smyrl and Kellee Caton, Interdisciplinary Studies

Raven Moller. *The Neighbourhood Watch: Does the Proximity to Neighbours Influence Nest Success in Tree Swallows (*Tachycineta bicolor*)?*

Due to the nature of their habitat, tree swallows live in close proximity to other secondary cavity nesters, such as the mountain bluebird. While they do not compete for food or territory while brooding, neighbouring relationships can greatly impact the success of both birds. Literature suggests that neighbours can increase success through processes of reciprocal altruism in nest defence or decrease success through density-dependent competition. The goal of this study is to understand the impact that conspecific and heterospecific neighbours have on tree swallow reproductive success. The findings can be applied to habitat management to promote the highest possible success for tree swallows. For this study, I am using a series of bird boxes, inhabited by tree swallows and mountain bluebirds, throughout the Kamloops, BC area. I have compiled data on approximately 650 tree swallow nests and their neighbours over an 8 year period. Using a negative binomial linear mixed model analysis, I analyzed factors that related to reproductive success, such as the proportion of the nest that fledged, the number of eggs, nestlings, and fledgeling, and the occurrence of a fledged nest, in relation to the distance to the nearest conspecific and heterospecific neighbour and concentration of each type of neighbour in an area. The findings from these analyses may reveal changes in success due to neighbour proximity.

Faculty advisor: Matthew Reudink, Biological Sciences

Fanqi Wu. *Utilization of Chemically Treated Fly Ash as an Adsorbent for the Removal of Bisphenol S from the Environment.*

The utilization of fly ash as a potential adsorbent for the removal of environmental contaminant, bisphenol S, was demonstrated. In this study, the fly ash used is the wood residuals from biomass-fired power plants. The fly ash was obtained from the burning of wood chips, bark and wood fiber in biomass-fired power plants to generate electricity and process steam. These wood ash residuals that are produced are traditionally stored in onsite landfills or transported to permanent landfills at a significant

cost to the biomass industry. In addition, the disposal of fly ash from biomass power plants absorbs considerable amounts of water from fly ash ponds in the environment and cause numerous environmental problems. As a result, the continued storage of fly ash in the environment is not favorable and ways to find useful applications for it is gaining a lot of interest as it reduces the environmental and economic impacts of their disposal. Bisphenols such as bisphenol A and bisphenol S are found in plastics which are commonly used in our everyday lives and are therefore ubiquitous in the environment. These compounds have been found to be endocrine-disrupting chemicals and, in some cases, are carcinogenic. They are therefore acutely toxic to humans and other living organisms. In view of their adverse health effects, their removal in the environment is warranted. In this study we particularly investigated the potential of fly ash for adsorptive removal of bisphenol S (BPS) in the environment. To study the adsorption capability and characteristics of the fly ash for bisphenol S, the analytical technique of UV-visible spectrophotometry was utilized.

Faculty advisor: Kingsley Donkor, Chemistry

Gursharan Uppal. *Characterization of Bacterial Communities in Arctic Soil*

Environmental pollutants are found throughout the Arctic, but particularly in regions of recent human activity. These pollutants break down more slowly in the Arctic than in more temperate ecosystems as cold temperatures restrict microbial metabolism. Characterizing the microorganisms present in polluted Arctic soils will help us understand which microorganisms are involved in metabolizing these pollutants, and may help to inform strategies to remediate polluted sites. The aim of this project is to characterize and compare the composition of microbial communities in potentially contaminated Arctic soil samples. Soil samples were collected from several locations around Cambridge Bay, Nunavut in 2019. Total community DNA will be extracted from soil samples and the success of DNA extraction will be evaluated by agarose gel electrophoresis and quantification using the Qubit fluorometer. Polymerase chain reaction (PCR) targeting the bacterial 16sRNA gene will be completed on DNA extracts, and amplicons will be sequenced to characterize the bacterial community composition of samples. The sequence data will be processed in QIIME2 and statistical analyses comparing microbial community competition between samples will be completed in R. This research will provide information on the relative abundances of the types of bacteria present in samples from different contaminated Arctic soils. The results of the study will provide a baseline database of microbial diversity, and will improve our understanding of the diversity of the region and potential for microbial remediation of contaminated Arctic soils.

Faculty advisors: Eric Bottos and Jonathan Van Hamme, Biological Sciences

Aina Roenningen. *The Relationship Between Cognitive Decline, Inhibition and Anxiety*

Research studies have identified links between lower inhibitory attentional control and anxiety vulnerability. This is in accordance with the Attentional Control Theory, which suggests that stimulus-driven attentional mechanisms take over when high anxiety is exhibited.

We aim to examine how cognitive function and anxiety are correlated by investigating inhibitory control in older and younger adults with differing cognitive abilities and anxiety levels. We will recruit 30 younger (18-25 years of age) and 30 older adults (65 years of age or older) from Canada. Participants will complete three questionnaires; a Demographics questionnaire, the short version of the Depression and Anxiety Stress Scales (DASS) to control for depression, and the short version of the Stait-Trait Anxiety Inventory (STAI). Attentional control is tested using the Go/No-Go paradigm and the Posner Cueing task.

Both tasks include threatening animal images. Working memory is tested using a memory task that requires remembering a word list followed by a recognition task.

We hypothesize that highly anxious participants will show more errors in inhibition and working memory tasks than less anxious participants. Second, we hypothesize that highly anxious participants will show more inhibition errors in threat conditions compared with less anxious participants. Finally, we predict that the older adults will show weaker performance on all the tasks than younger participants, due to lower cognitive functioning. Anxiety's effects on cognitive functions have clinical implications because today's cognitive assessments might induce anxiety, thus leading to a possible misdiagnosis. Therefore, understanding the relationship between anxiety and cognition can help prevent misdiagnoses as well as improve identification of normal cognitive aging.

Faculty advisor: Claudia Gonzalez, Psychology

Nicholas Coutu. Investigating the Potential for High-CBD Cannabis Sativa and Nitric Oxide to Modulate SARS-CoV-2 Spike-ACE2 Binding.

A critical step of the SARS-CoV-2 infection is interaction between the SARS-CoV-2 Spike (S) protein's receptor binding domain on the surface of the viral particle and the ACE2 receptor on the surface of human cells. Thus, the identification of small molecules, antibodies, or other biological molecules that interfere with the formation of the S-ACE2 complex, could help to develop drugs to prevent or treat COVID-19.[1] High-CBD Cannabis treatments show modulation of ACE2 gene expression and ACE2 protein levels in human tissues, but it is unclear if the many cannabimimetic molecules also directly interact with the S-ACE2 binding or if it is merely due to the cannabinoid receptor mediated affects.[2] Additionally, NO likely causes conformational changes on surface glycoproteins that can interfere with host cell fusion, preventing infection and release of virions from already infected host cells, like neuraminidase inhibitors.[3] We will use a RayBio COVID-19 Spike-ACE2 binding assay kit, which is an in vitro enzyme-linked immunosorbent assay, to determine if cannabinoids and terpenes can interfere directly with the S-ACE2 binding, independent of cannabinoid receptors. Additionally, we will determine if NO interferes directly with the RBD of the Spike protein, and if there is a synergistic effect with a formulation of cannabinoids, terpenes, and NO, to give an enhanced interference.

Faculty advisors: Joanna Urban and John Church, Biological Sciences

Taylor Griffin. *The Need for Multifaceted and Sustainable Management Strategies: Fire, Forestry and Range*

As ninety-four percent of British Columbia is Crown land owned by the Provincial Government, there are considerable overlapping resource needs within the natural resource sector. As much of British Columbia's Crown land management is multifaceted, understanding the dynamic landscape is integral to sustainable ecosystem management. Additionally, British Columbia has historically received significant large-scale wildfire activity. Climate change is predicted to increase the frequency of these disturbance events moving forwards, making fire management even more vital. This study aims to understand how methods of fire fuel management influence range management activities on Crown land, such as forage production, in addition to creating a better understanding of the variables influenced by fire fuel management. As many cattle tenures within British Columbia directly overlap with forestry tenures, understanding the influences that the forest industry has on the cattle industry, and vice-versa, is important for proper inclusive ecosystem management. Forage availability is the main factor that influences the number of animals that can be put out on range, and this directly affects

ranching profits. This study specifically considers cattle; however, the importance of forage can be applied to any domesticated animal or wildlife. The results of this study will benefit the overall scientific development of multifaceted approaches towards resource management of our Crown land.

Faculty advisor: Rob Higgins, Natural Resource Science

Lauren Okano. *Sensitive Detection of Parts-Per-Billion Levels of Nisin in Dairy Products by Capillary Electrophoresis*

Nisin is a polycyclic antimicrobial peptide produced by the gram-positive bacteria, *Lactococcus lactis*. Due to its antimicrobial properties and low toxicity, nisin is commonly used in the food industry as a preservative in alcoholic beverages and foods such as meat and dairy. Nisin is currently the only lantibiotic that is FDA-approved for use as a biopreservative, however, changes in temperature, pH or interactions with other ingredients can cause nisin's activity to degrade overtime. For this reason, it is crucial to be able to quantify and monitor the stability of nisin throughout a product's shelf life. In this project, a technique called micellar electrokinetic chromatography (MEKC) will be employed to separate and quantify nisin in dairy products. An additional technique called large volume sample stacking technique (LVSS) will be investigated in order to improve the sensitivity of the method. The method will be optimized by testing parameters such as sample solvent composition, buffer pH, injection pressure, switch-polarity time and voltage. The results of this research will be compared to previous work using MEKC to detect nisin in dairy products. The successful development of this method will be useful to both food and beverage industries as it provides a simple and cost-effective way to monitor nisin levels in a wide variety of products including canned vegetables, fish, milk, cheese and wine..

Faculty advisor: Kingsley Donkor, Chemistry

Tatiana Mueller. *The Influence of Covid-19 on Sustainable Urban Food Systems: Recommendations for Kamloops, BC*

This poster outlines sustainable food production in Kamloops, possible improvements, the benefits of urban agriculture, and the impact of COVID-19 on urban agriculture, both globally and in Kamloops. This analysis involves a literature review and general observations. The research shows that while urban agriculture is realistic and highly beneficial to food security, cities such as Kamloops are still in the early stages. While community initiatives are increasing, there is still room for growth. Research and personal observations also show that although the presence of COVID-19 has had plenty of negative consequences, it may be a catalyst in urging cities towards more sustainable food systems. Recommendations include an increase in local food cultivation, processing, distribution, and sourcing. This research concludes that whereas Kamloops is developing as a more sustainable agricultural community, its full potential has not yet been reached.

Faculty advisor: Tom Waldichuk, Geography and Environmental Studies

Alyssa Holt and Amy Moir. *Breaking the Cycle: The Implications of a Recovery House and Resource Hub for Women Experiencing Criminalization*

This research project was conducted in affiliation with Thompson Rivers University (TRU) and the Kamloops and District Elizabeth Fry Society, as a part of the TRU community development research grant. The goal was to gain more in-depth insight into how recovery houses and resource hubs could help women who have been criminalized.

To begin, a literature review was conducted on women experiencing criminalization and their needs and concerns. Through this review, five main themes emerged. These were the overrepresentation of Indigenous women, the fragmentation of their healthcare experiences, the need to renegotiate their relationships, the challenges of community reintegration, and additional barriers such as employment and housing. Consideration is given to two subsets of this population, older women and transgender women. Consideration is also given to the impact that the COVID-19 pandemic has on women who have been criminalized.

Second, a literature review was conducted regarding recovery houses and the benefits and challenges associated with them.

Third, a literature review was conducted on the existence of resource hubs. Due to their limited nature, this review was expanded internationally.

The information acquired in these three sections was then compiled into a list of recommendations that mirror the five main themes of concern for women experiencing criminalization. The vision of the recovery house and the resource hub is to work collaboratively to address these five areas of a woman's life, to provide holistic care, and to ensure no woman falls through the gap.

Faculty advisor: Juliana West and Jennifer Murphy, Social Work

Amy Moir and Alyssa Holt. *Breaking the Cycle: The Implications of a Recovery House and Resource Hub for Women Experiencing Criminalization*

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Faculty advisor: Juliana West and Jennifer Murphy, Social Work

Riley Mager. *Investigating the Antimicrobial Properties of Cannabinoid Compounds*

As bacteria are rapidly developing resistance against existing drugs, cannabinoids present a novel and exciting opportunity as a potential new source of antibiotics. Cannabinoid compounds have become an epicenter of research in recent years with numerous studies elucidating the therapeutic uses of a few of the numerous compounds such as Cannabidiol (CBD) and Cannabigerol (CBG). This study seeks to investigate the antimicrobial properties of these two aforementioned compounds on a number of gram-negative and gram-positive microbes such as *Candida albicans*, *Streptococcus pyogenes* and *Pseudomonas aeruginosa*. Using spread plating methods, various concentrations and mixtures of CBD and CBG were applied to selected microbes in order to observe the effects (if any) on colony formation. Initial results have indicated a strong effect on gram-positive organisms and little to no effect on gram-negative organisms. These early results corroborate published literature reports. Ongoing work includes an investigation into the lipopolysaccharide (LPS) layer found on the gram-negative bacteria. Through enzymatic treatment, LPS layer removal will be facilitated, and testing performed to determine the role this layer plays in the observed decreased antimicrobial activity of these organisms.

Faculty advisors: Natasha Ramroop Singh and Joanna Urban, Biological Sciences

Gurcharan Uppal. *Simultaneous Separation and Identification of Bisphenol Analogues by Capillary Electrophoresis*

Bisphenols are a group of compounds containing two hydroxyphenyl functional groups joined together by a differently substituted bridging atom. Bisphenol A (BPA) is the best known of the bisphenol analogues. BPA is commonly used as the base chemical in polycarbonate plastic production; and has been found to leach out of different products in both acidic and basic conditions and most environmental matrices. BPA is an endocrine disrupting chemical (EDC) and due to BPA's toxic affects regulatory measures have been put into effect in an effort to limit the use of BPA. Commercialization of BPA-free products is increasing, with the substitution of BPA with its analogues. However, certain analogues have been shown to have nearly identical endocrine disrupting effects (BPS and BPF), while others cause increased concern due to their unstudied effects on health and the environment. The aim of this project is to optimize a method for the separation and identification of 13 bisphenol analogues (BPA, BPAF, BPB, BPBP, BPC, BPE, BPF, BPFL, BPG, BPM, BPP, BPS and BPZ) using the analytical technique of capillary electrophoresis (CE). This method can become a valuable resource in monitoring bisphenol contamination in food and the environment.

Faculty advisor: Kingsley Donkor, Chemistry

Abu Nadeem. *Leachability Determination of Elements in Fly Ash as a Potential Fertilizer*

When burning coal, the ash that is leftover is known as fly ash. For this research, the fly ash was supplied by a biomass company. Fly ash contains a range of elements that can be toxic or beneficial to the environment and soil—essentially having the potential to act as a fertilizer. Furthermore, leaching is a procedure that is used to extract elements from environmental samples. Leachability was simulated in this research by adding water to certain types of fly ash, and analyzing the samples after 1 to 4 weeks, to see if the concentrations of elements, or leachable recoveries, decreases with time or stays the same. In this study, the content and leachability of 11 elements will be determined: zinc (Zn), lead (Pb), chromium (Cr), copper (Cu), nickel (Ni), cobalt (Co), manganese (Mn), iron (Fe), magnesium (Mg), cadmium (Cd) and arsenic (As) using flame atomic absorption spectrometry (FAAS). The importance of this research is demonstrated by the potential of fly ash to be used as a fertilizer. To uncover the

leaching ability of the toxic elements and the beneficial elements in fly ash would determine the environmental impacts that this potential fertilizer has, and whether it is suitable for crops. In addition, fly ash being used as a fertilizer would increase the utilization of ash and can pose as a solution to the thousands of tons of ash being wasted yearly.

Faculty advisor: Kingsley Donkor, Chemistry

Morgan Rigelhof. *A Global Scale Analysis of Bergmann's Rule for All Extant Bat Species*

I will be presenting my findings on a global scale analysis on an ecogeographical rule called Bergmann's rule for all extant bats. Bergmann's rule involves the correlation between body size and latitudinal location of the species. The significance of understanding body size evolution is that it explains and influences an animal's life history. Understanding body size evolutionary trends impacts our ability to predict and protect biological diversity on a global scale. Studies of body size evolution and population structure are often critical components of endangered species conservation and management plans.

We have constructed our own phylogenetic tree to assess body size data collected over 4 months, and statistically analyzed the data to represent the correlations seen for Bergmann's rule in bats. This is not know to have been done before for a global analysis of bats.

Faculty advisor: Matthew Reudink and Sean Mahoney, Biological Sciences

Posters

Keenan Baker. *Effects of Simulated Grazing on Fire-Treated Mine Tailings for Restoration*

The alterations caused to the landscape while mining operations extract necessary materials are unavoidable but not completely permanent changes. Through dedication to the communities they border, mining companies have progressed the science of reclamation and are beginning to restore once wild places to more natural looking environments. In the early days of reclamation, aggressive agronomic vegetative species were used to establish vegetation cover to prevent erosion and act as the framework for eventual succession to a more natural pre-disturbed state. In practice on some sites, these agronomic species are becoming monocultures which are utilized by small mammals and ungulates but are not being displaced by planted native grasses to fully reclaim an area to its natural form. The use of prescribed burning to bring disturbance to a landscape and provide space for native grasses has had some positive results but more might be done to help these grasses become established more permanently. Herbicide works to reduce competition for nutrients and water uptake but without removing the dead material the leftover litter layer would still prevent small native grasses from obtaining light. I intend to look at the possibility of using simulated cattle grazing as a means of added disturbance to provide space for seeded native species to grow and eventually lead to early successional change to re-establish a pre-disturbed natural state on a dry tailing storage facility.

Faculty advisor: Wendy Gardner, Natural Resource Science

Kelsey Stefanyk. *Turning Back the Clock: Dying Young at an Old Age*

Aging, which impacts living organisms from yeast to humans, is characterized by the progressive decline in physiological integrity and function over time. This decline results in increased susceptibility to age-related diseases, and ultimately death. Researchers have identified nine molecular and cellular hallmarks of aging that contribute to the aging phenotype: Genomic instability, telomere attrition, epigenetic alterations, loss of proteostasis, deregulated nutrient sensing, mitochondrial dysfunction, cellular senescence, stem cell exhaustion, and altered intercellular communication. In addition to characterizing the aging process, researchers have also discovered manipulations of these hallmarks that introduce the possibility of living not just living longer, but living healthier for longer. The purpose of this literature review is to explore some of these possibilities, such as dietary restriction and several pharmaceutical interventions, in addition to examining the genetic aspects of aging.

Research in aging and longevity is an exciting new field. Humans are currently living longer than ever before. This increased lifespan, however, does not necessarily correspond to an increased healthspan. An aging population is one of the most significant challenges facing our healthcare system. Although there are ethical considerations, by increasing healthspan, illness in old age could be reduced, thereby improving individual quality of life while simultaneously alleviating strain on both the economy and healthcare system.

Faculty advisor: Don Nelson, Biological Sciences

Erin Thomsen. *Affects of Deep Ripping on Site Index Near 100 Mile House, British Columbia*

The objective of this study was to determine if site preparing a cut block using a winged subsoiler to deep rip the soil would impact the site index or growth of the site. This study was conducted South of 100 Mile House in the dry, cool interior Douglas-fir subzone, IDFdk3/01. Three blocks were sampled, each with 30 plots where the lodgepole pine (*Pinus contorta*) tree with the largest diameter at

1.3m was cut down and age and height were measured. The site index values determined using the growth intercept method were then compared to values recorded in 2006 and SIBEC, a program designed to estimate site index based on site series in British Columbia. Volume growth per year was measured based on annual ring width and compared between blocks. Site index was found in all three blocks to be greater than recorded in 2006, but less than predicted by SIBEC. Block C was notably lower than blocks A and B. Growth per year varied between blocks, block A increased and flattened off, Block B cycled over the years, and Block C increased steadily. Site index is a valuable measurement that can aid in determining growth and yield, funding allocation, and annual allowable cut. More research needs to be done through the different ecological zones where site preparation is commonly used to determine what impacts it has on the growth of the seedlings.

Faculty advisor: John Karakatsoulis, Natural Resource Science

Lauren Letham. *Blindness*

The purpose of this interdisciplinary directed studies was to examine how our familiarity with the places we inhabit blinds us to their beauty. Using artistic mapping and creative non-fiction, I explored my own *blindness* in the landscape I call home, Juniper Ridge. Through writing, I follow my mindset as I explored the natural history of a trail I walk weekly. As each season progressed, I realized that parts of the landscape I had once deemed lackluster hold a great amount of beauty and are worthy of my attention. Additionally, the production of an artistic map entitled *Close to Home*, allowed me to understand the Juniper Ridge area as a whole. By observing elements individually in the landscapes—the towering Douglas fir (*Pseudotsuga menziesii*) that coat the hillside in a rich green, the small wolf lichen (*Letharia vulpine*) that cling to those who have fallen, or the sweet bees (*Agapostemon*) that pollinate those flowers we love so dearly—I grew a deeper connection to the landscape and learned that all its pieces deserve our respect and attention. Collectively, the two parts of my project—creative writing and artistic mapping—dispersed the blindness cultivated through familiarity. My goal in sharing this work is to inspire others to find beauty in the over-looked places of their own lives.

Faculty advisor: Lyn Baldwin, Biological Sciences

Angela Ippolito. *The Effects of Biosolids on Antibiotic Resistance Gene Abundance and Diversity in Microbial Communities of Mine Tailing Reclamation Sites*

Mining requires chemical and mechanical methods to extract useful metals from the earth. Mine tailings are the material by-products of this process, and are usually placed into specific surface storage areas. The soil in these areas tend to contain sparse microbial communities and low nutrient content. Biosolids are a resource recovered from treatment of municipal wastewater. The final product is a material similar to soil that is rich in nutrients and organic matter. It can be used as an alternative to animal manures or chemical fertilizers. The production and use of biosolids in British Columbia are highly regulated and ongoing research continues to inform best practices for land application of biosolids. Some research suggests that biosolids and other soil amendments may promote the distribution and evolution of antibiotic resistance genes (ARGs) in soils and that antibiotics already present in biosolids may induce antibiotic resistance gene spread. In this study, we quantified the levels of 23 ARGs in soil microbial communities in existing copper mine tailings treated with varying levels of biosolids and those with no biosolids treatments. DNA was extracted from 57 tailing soil samples and ARGs were quantified using quantitative Polymerase Chain Reactions (qPCRs). Most ARGs were below detection across all samples. Three ARGs (ermC, ermB, and mefA) were detected in higher prevalence in

the biosolids treatments. The other four ARG targets (aadA1, veb, sfc1, and oxa54) were detected across biosolids and no biosolids treatments. The ARGs that were detected naturally occur in microbial communities. Thus, the increased prevalence in the biosolids treated samples may be related to the higher biomass that is established on those plots. Additional information acquired through further testing of the ARGs will help to improve understanding of potential risks associated with biosolids applications and inform policy on their future use in mine site remediation.

Faculty advisor: Eric Bottos and Jonathan Van Hamme, Biological Sciences

Aaron Veale. *Is Island Life Turning Birds into Giants? An Assessment of Foster's Rule Across All Birds*

The differences in the body sizes observed in island birds versus their closest mainland relatives have puzzled biologists for decades. First noted in other vertebrate groups by J. Foster, the general trend is usually summarized as small mainland species growing bigger on islands, while typically large mainland species are dwarfed. With many examples in both living and extinct fauna, the overall phenomenon became known as Foster's rule (synonymous with the island rule). This study aims to examine if members of the class Aves (the group that contains all modern birds) follow the general trends of Foster's rule and to what extent. One of the most diverse groups of vertebrates, birds are excellent colonizers of island habitats and can be found on most island systems. Using body mass, body length, and wingspan as a stand in for overall body size, data from over 9,000 extant species from around the world will be analyzed. The data will then be compiled and assessed using phylogenetic comparative techniques to account for evolutionary relationships of the main bird lineages.

Faculty advisor: Matthew Reudink, Biological Sciences

Jessica Stromsmoe. *Tolerance for Law Violations and Social Projection*

Tolerance to law violations (TLV) was measured in 60 male and female university students. In addition to this measure, engagement in social projection was assessed in 148 female students. Past researchers have found that people tend to project their attitudes on others, but less so on perceived 'outgroups'. TLV and social projection were measured using a questionnaire comprising of 10 TLV statements, each followed by an estimation question that measured the participants' engagement in social projection. Based on the gender differences in criminal behaviour, the masculation of criminality, and the male offender stereotype it is predicted that male students will have a greater tolerance for law violations than female students. Based on past research on in-group social projection, we hypothesize that female students will exhibit increased social projection when the target is described as sharing the same gender as the participant. Furthermore, similar to findings in a study conducted by Webster and Vermeulen (2011), we predict that if the target shares the same offender status as the participant (i.e. non- offender status) there will be greater social projection of TLV attitudes.

Faculty advisor: Sandra Vermeulen, Psychology

Paula Sabaté Fàbregas. *The Impacts of Climate Change on Microbial Community Structure and Function in Antarctic Ecosystems*

Antarctica, widely known for its extreme harsh environment, is currently undergoing changes caused by global warming. Rising temperatures are causing glaciers to retreat, precipitations to increase and ice shelves to collapse, drastically impacting Antarctic ecosystems. The purpose of this study is to review the available literature about the microbial communities inhabiting soils of Antarctica's McMurdo Dry Valleys, and better understand the potential impact of climate change on these

ecosystems. Understanding contemporary drivers of the structure and function of these microbial communities will help predict how they might respond to climate change in the future. Warming processes are likely to lead to increased soil microbial diversity across the region. Escalations in temperature increases the availability of liquid water, the key driver of microbial communities in soil ecosystems. Increases in moisture also allow for salts and nutrient mobilization, abiotic factors that limit many microbial species. The reviewed literature suggests that communities are shifting and are expected to shift towards more productive soil communities and more generalist species. Longer and warming growing seasons are expected to heighten microbial activity and biogeochemical cycling. Photosynthetic organisms are being found in regions where water was not previously available suggesting that relatively small changes can lead to community responses that may increase the propensity of the McMurdo Dry Valleys to become greener, putting at risk the unique and protected hyper-arid environment.

Faculty advisor: Eric Bottos, Biological Sciences

Hailey Stevens, Emerson Hansen, and Madison Petonjic-Rogers. *Viewing a Local Flora Digitally.*

In a world of increasing 'plant blindness,' many people, including university students, lack the background to recognize the native flora of a region. However, the availability of digital teaching and learning resources such as Moodle's H5P activities increases the usefulness of online learning for even such experiential topics as field botany. *Viewing local flora digitally* is a project to create an online resource that will outline the recognition characters of the most species-rich families found in the Interior of BC, as well as many of the most common flowering plant species. The objective of this project was threefold: (1) to build a digital resource, available to both future TRU students and the greater community, (2) foster our own knowledge and appreciation of the Kamloops flora, and (3) develop the skills to build digital education resources. By working collaboratively, we were able to cover 21 of the most species-rich flowering plant families. For each flowering plant family included, this resource has outlined the recognition characters, unique features, and provided local examples of the family. Information was incorporated into interactive H5P activities and summative quizzes that serve to engage the student and reinforce the content. The activities and quizzes built in Moodle have the potential to be transferred to a more public domain, through platforms such as WordPress. The events of the last year have shown the importance of online teaching and learning resources. Not only has this project allowed us to develop the necessary vocabulary and skills to recognize our local flora but has allowed us to contribute to a resource that can be used by future students and the public. The development of accessible science helps not only the university but the community in which TRU resides.

Faculty advisor: Lyn Baldwin, Biological Sciences

Jared Sonnleitner. *Longitudinal Shifts in the Migratory Routes of Western and Eastern, but not Mountain Bluebirds*

Both spatial and temporal shifts to the migrations of birds have become more common as climate change and habitat alterations have continued to impact habitats and the species dependent on them. Our ability to track these changes for individual species is limited by costs associated with current tracking technologies such as GPS and Geolocator technology. Our approach for this paper is to use eBird citizen science data collected over ten years to ask population level questions of three species of birds; Eastern (*S. sialis*), Western (*S. mexicana*) and Mountain (*S. currucoides*) bluebirds. Using a Generalized Additive Model (GAM) we were able to predict the mean centroid of all three species for

each Julian date from 2009 to 2018. We looked at the timing of both spring and fall migration, maximum breeding ground latitude as well as longitude of each species for each year. Using a regression analysis, we determined if there was a significant species year interaction for the response variable. From our analysis our most significant trend was that Eastern Bluebirds are shifting their longitude westward, Western Bluebirds are shifting their longitude eastward, while Mountain Bluebirds did not have any significant shift to their longitude.

Faculty advisor: Matt Reudink, Biological Sciences

Gwendolyn Freeze and Nicholas Hilton. *The Impact of Sympathetic Nervous System Activity on Longitudinal Movements in the Carotid Artery of Young Healthy People*

Arterial stiffness is a historically well-studied and reliable measurement used to assess vascular health and disease. However, recent research has emerged suggesting that arterial longitudinal wall motion is another key predictor in assessing cardiovascular disease and its associated risk factors. Arterial longitudinal wall motion is the oscillatory movement of the arterial wall in the anterograde (with blood flow) and retrograde (against blood flow) directions. Given its newly discovered application, it is imperative to understand the factors which contribute to the motion and their respective implications. One way to assess such factors is through activation of the sympathetic nervous system (SNS), also known as the 'fight or flight' reflex. The physiological responses are varied and often involve changes in blood vessel wall dynamics. In this study, we acutely manipulate SNS activity using a cold pressor and a post-exercise circulatory occlusion test and monitor various parameters like blood pressure and artery stiffness, which may influence the longitudinal motion. The goal of this study is to gain further insight into the determinants of arterial longitudinal wall motion and under what conditions its measurement might be compromised. In doing so, its potential use as a clinical tool in predicting vascular disease may be improved.

Faculty advisor: Mark Rakobowchuk, Biological Sciences

Charlotte Hutchison. *Examining if the Ecogeographical Foster's Rule in Bat Species Can Predict The Size Differences Between Island and Mainland Bats.*

In this study I will be examining Foster's rule as it applies to bats. Noticed by multiple scientists, there was a difference of body size on island and mainland animal species. Thought to be due to evolutionary factors, it was looked into, and in turn Foster's Rule was discovered. Foster's Rule, also known as the Island rule, is a rule in evolutionary biology regarding members of species becoming larger or smaller based on the amount of resources available to them in a given environment. The environmental conditions species on islands experience often create challenges or unique opportunities compared to those on the mainland. It can lead to dwarfism or gigantism. This theory was first brought to light by J. Bristol Foster (1964), originally proposed to occur and differ specific to taxa. Adjustments were made by Van Valen (1974), who coined the term Island rule. He generalized the rule to grade species on a scale based on body mass (Lomolino 1985). Early studies focused on this phenomenon in mammals. Recent research has expanded the field, including work done in birds by a Thompson Rivers University student (Veale 2020). My primary question is if size differences observed on island and mainland bat species can support the theory. According to Lomolino (1985), there is evidence to support this theory in bat species. This was done on a very small scale, so I would like to build upon this research and test Foster's rule in bats using a larger dataset, worldwide. Based on current publications, I predict

that my research will produce support for Foster's rule, with island bats having larger body masses than those residing on the mainland.

Faculty advisor: Matthew Reudink, Biological Sciences

Hannah O'Neil. *Green Transportation: An Analysis of Sustainability and Cycling in Kamloops, With Recommendations and an Assessment of COVID-19 Impacts*

Kamloops presents itself as a sustainable community that is dedicated to reducing its environmental footprint. Sustainability includes green transportation options, such as cycling: a low emission form of transportation. The objective of this poster is to evaluate Kamloops' current sustainability by examining available biking infrastructure. Connections between good biking infrastructure and urban sustainability are discussed, as are people's reasons for biking. Recommendations to increase Kamloops' sustainability by encouraging cycling are also proposed. The methodology used for this project is a literature review and observations. Tentative results are that Kamloops is lacking in safe and connected bike routes that encourage more people to use biking as a method of transportation. Bike routes are usually only well connected in small concentrated areas, without many connections in between. The principal conclusion is that the current bike routes do not present the level of safety and convenience necessary to encourage cyclists, so urban sustainability is minimized.

Keywords & Terms: cycling, urban environmental sustainability, bike routes, cycling infrastructure, City of Kamloops

Faculty advisor: Tom Waldichuk, Geography and Environmental Sciences

April Read. *Characterization of the Antimicrobial Secondary Metabolites Produced by the Cave Bacteria Streptomyces ICC1*

The progression of antibiotic-resistant microorganisms has hindered the therapeutic efficiency of various commercially available pharmaceuticals. Therefore, an overwhelming demand for novel treatment presents itself; the likelihood of multi-resistant microbes surpassing the development of antibiotics escalates in a coevolutionary race between humans and bacteria. Researchers have turned to extreme environments as valuable sources of microbial capability, particularly in the production of pharmaceutically significant metabolites. Specifically, the unique conditions of caves, including high humidity, relatively low but stable temperatures, and low nutrients, create a highly selective environment. Energy-starved conditions of caves encourage competition among its microbial community, promoting metabolite production including antibiotics and hydrolytic enzymes, which inhibit growth of their cohabitants.

Streptomyces is one of the most abundant microbial genera in cave environments. The characteristic most notable of *Streptomyces* is its' ability to produce bioactive secondary metabolites—such as antifungals, antivirals, antitumorales, anti-hypertensives, immunosuppressants, and especially antibiotics. Through this Honours research, secondary metabolites produced by the cave-dwelling *Streptomyces* sp. ICC1 strain have been examined; a strain which is prevalent in the isolated environment of the Iron Curtain Cave in Chilliwack, British Columbia. Secondary metabolites secreted by *Streptomyces* sp. ICC1 have shown antimicrobial properties, evidently effective against both multi-drug resistant strains and common laboratory strains of *Escherichia coli* and *Staphylococcus aureus*. Since antimicrobial activity has been established, the next step is the metabolite containing solution will be

purified and separated by high performance liquid chromatography techniques. Each peak from the HPLC will be tested for antimicrobial activity. NMR will help elucidate the structure of each active peak that was identified in the HPLC. The determination of the structure will help us hypothesize a mechanism of action.

Faculty advisors: Heidi Huttunen-Hennelly, Naowarat Cheeptham, Donkor Kingsley, Eric Bottos, and Dipesh Prema, Biological Sciences

Gursharan Uppal. *Characterization of Bacterial Communities in Arctic Soil*

Environmental pollutants are found throughout the Arctic, but particularly in regions of recent human activity. These pollutants break down more slowly in the Arctic than in more temperate ecosystems as cold temperatures restrict microbial metabolism. Characterizing the microorganisms present in polluted Arctic soils will help us understand which microorganisms are involved in metabolizing these pollutants, and may help to inform strategies to remediate polluted sites. The aim of this project is to characterize and compare the composition of microbial communities in potentially contaminated Arctic soil samples. Soil samples were collected from several locations around Cambridge Bay, Nunavut in 2019. Total community DNA will be extracted from soil samples and the success of DNA extraction will be evaluated by agarose gel electrophoresis and quantification using the Qubit fluorometer. Polymerase chain reaction (PCR) targeting the bacterial 16sRNA gene will be completed on DNA extracts, and amplicons will be sequenced to characterize the bacterial community composition of samples. The sequence data will be processed in QIIME2 and statistical analyses comparing microbial community competition between samples will be completed in R. This research will provide information on the relative abundances of the types of bacteria present in samples from different contaminated Arctic soils. The results of the study will provide a baseline database of microbial diversity, and will improve our understanding of the diversity of the region and potential for microbial remediation of contaminated Arctic soils.

Faculty advisors: Eric Bottos and Jonathan Van Hamme, Biological Sciences

Fanqi Wu. *Utilization of Chemically Treated Fly Ash as an Adsorbent for the Removal of Bisphenol S from the Environment*

The utilization of fly ash as a potential adsorbent for the removal of environmental contaminant, bisphenol S, was demonstrated. In this study, the fly ash used is the wood residuals from biomass-fired power plants. The fly ash was obtained from the burning of wood chips, bark and wood fiber in biomass-fired power plants to generate electricity and process steam. These wood ash residuals that are produced are traditionally stored in onsite landfills or transported to permanent landfills at a significant cost to the biomass industry. In addition, the disposal of fly ash from biomass power plants absorbs considerable amounts of water from fly ash ponds in the environment and cause numerous environmental problems. As a result, the continued storage of fly ash in the environment is not favorable and ways to find useful applications for it is gaining a lot of interest as it reduces the environmental and economic impacts of their disposal. Bisphenols such as bisphenol A and bisphenol S are found in plastics which are commonly used in our everyday lives and are therefore ubiquitous in the environment. These compounds have been found to be endocrine-disrupting chemicals and, in some cases, are carcinogenic. They are therefore acutely toxic to humans and other living organisms. In view of their adverse health effects, their removal in the environment is warranted. In this study we particularly investigated the potential of fly ash for adsorptive removal of bisphenol S (BPS) in the

environment. To study the adsorption capability and characteristics of the fly ash for bisphenol S, the analytical technique of UV-visible spectrophotometry was utilized.

Faculty advisors: Kingsley Donkor, Chemistry

Raven Moller. *The Neighbourhood Watch: Does the Proximity to Neighbours Influence Nest Success in Tree Swallows (*Tachycineta bicolor*)?*

Due to the nature of their habitat, tree swallows live in close proximity to other secondary cavity nesters, such as the mountain bluebird. While they do not compete for food or territory while brooding, neighbouring relationships can greatly impact the success of both birds. Literature suggests that neighbours can increase success through processes of reciprocal altruism in nest defence or decrease success through density-dependent competition. The goal of this study is to understand the impact that conspecific and heterospecific neighbours have on tree swallow reproductive success. The findings can be applied to habitat management to promote the highest possible success for tree swallows. For this study, I am using a series of bird boxes, inhabited by tree swallows and mountain bluebirds, throughout the Kamloops, BC area. I have compiled data on approximately 650 tree swallow nests and their neighbours over an 8 year period. Using a negative binomial linear mixed model analysis, I analyzed factors that related to reproductive success, such as the proportion of the nest that fledged, the number of eggs, nestlings, and fledgeling, and the occurrence of a fledged nest, in relation to the distance to the nearest conspecific and heterospecific neighbour and concentration of each type of neighbour in an area. The findings from these analyses may reveal changes in success due to neighbour proximity.

Faculty advisor: Matthew Reudink, Biological Sciences

Elvira Mukharryamova. *Phase Transitions in the Nucleus.*

Eukaryotic cells organize some of its cellular components into membrane-less compartments through a process called liquid-to-liquid phase separation (LLPS). LLPS-driven compartments, also referred to as biomolecular condensates, emerge from transient interactions between intrinsically disordered proteins (IDPs) and other biomolecules, primarily RNA and DNA. Self-associating IDPs are key regulators of LLPS as they lack a 3-dimensional protein structure due to the abundance of charged, hydrophilic amino acids within its linear protein sequence. This compositional bias enables IDPs to maintain multiple weak interactions that result in selective localization of free-floating cytoplasmic molecules. Under preferable physical conditions, the localized molecules transition from dilute to molecule-rich phase forming a chemically unique gel-like condensate capable of performing biological functions.

Biomolecular condensates are prevalent inside the nucleus of eukaryotic cells and range in size from relatively large nucleoli to tiny nuclear speckles. The advances in recent research showed that phase separated states hold a central role in nucleus organization and functionalization; however, the intricacies of this topic are yet to be explored. In this literature review and the accompanying poster, three instances of biological phase transitions inside the nucleus, including heterochromatin gene regulation, transcriptional regulation by RNA polymerase II and ribosome assembly, will be discussed in detail. Specifically, we interpret the molecular mechanisms and biophysical aspects that form, segregate and localize LLPS condensates in the nuclear space to perform each of three nuclear functions. The purpose of this review is to summarize the existing information on the topic area and build a comprehensive understanding of the complex concept by presenting the information in a structured and coherent manner.

Faculty advisor: Don Nelson, Biological Sciences

Lauren Okano. *Sensitive Detection of Parts-Per-Billion Levels of Nisin in Dairy Products by Capillary Electrophoresis*

Nisin is a polycyclic antimicrobial peptide produced by the gram-positive bacteria, *Lactococcus lactis*. Due to its antimicrobial properties and low toxicity, nisin is commonly used in the food industry as a preservative in alcoholic beverages and foods such as meat and dairy. Nisin is currently the only lantibiotic that is FDA-approved for use as a biopreservative, however, changes in temperature, pH or interactions with other ingredients can cause nisin's activity to degrade overtime. For this reason, it is crucial to be able to quantify and monitor the stability of nisin throughout a product's shelf life. In this project, a technique called micellar electrokinetic chromatography (MEKC) will be employed to separate and quantify nisin in dairy products. An additional technique called large volume sample stacking technique (LVSS) will be investigated in order to improve the sensitivity of the method. The method will be optimized by testing parameters such as sample solvent composition, buffer pH, injection pressure, switch-polarity time and voltage. The results of this research will be compared to previous work using MEKC to detect nisin in dairy products. The successful development of this method will be useful to both food and beverage industries as it provides a simple and cost-effective way to monitor nisin levels in a wide variety of products including canned vegetables, fish, milk, cheese and wine.

Faculty advisor: Kingsley Donkor, Chemistry

Tatiana Mueller. *The Influence of Covid-19 on Sustainable Urban Food Systems: Recommendations for Kamloops, BC.*

This poster outlines sustainable food production in Kamloops, possible improvements, the benefits of urban agriculture, and the impact of COVID-19 on urban agriculture, both globally and in Kamloops. This analysis involves a literature review and general observations. The research shows that while urban agriculture is realistic and highly beneficial to food security, cities such as Kamloops are still in the early stages. While community initiatives are increasing, there is still room for growth. Research and personal observations also show that although the presence of COVID-19 has had plenty of negative consequences, it may be a catalyst in urging cities towards more sustainable food systems. Recommendations include an increase in local food cultivation, processing, distribution, and sourcing. This research concludes that whereas Kamloops is developing as a more sustainable agricultural community, its full potential has not yet been reached.

Faculty advisor: Tom Waldichuk, Geography and Environmental Studies

Taylor Griffin. *The Need for Multifaceted and Sustainable Management Strategies: Fire, Forestry and Range*

As ninety-four percent of British Columbia is Crown land owned by the Provincial Government, there are considerable overlapping resource needs within the natural resource sector. As much of British Columbia's Crown land management is multifaceted, understanding the dynamic landscape is integral to sustainable ecosystem management. Additionally, British Columbia has historically received significant large-scale wildfire activity. Climate change is predicted to increase the frequency of these disturbance events moving forwards, making fire management even more vital. This study aims to understand how methods of fire fuel management influence range management activities on Crown land, such as forage production, in addition to creating a better understanding of the variables influenced by fire fuel management. As many cattle tenures within British Columbia directly overlap

with forestry tenures, understanding the influences that the forest industry has on the cattle industry, and vice-versa, is important for proper inclusive ecosystem management. Forage availability is the main factor that influences the number of animals that can be put out on range, and this directly affects ranching profits. This study specifically considers cattle; however, the importance of forage can be applied to any domesticated animal or wildlife. The results of this study will benefit the overall scientific development of multifaceted approaches towards resource management of our Crown land.

Faculty advisor: Rob Higgins, Natural Resource Science

Aina Roenningen. *The Relationship Between Cognitive Decline, Inhibition and Anxiety*

Research studies have identified links between lower inhibitory attentional control and anxiety vulnerability. This is in accordance with the Attentional Control Theory, which suggests that stimulus-driven attentional mechanisms take over when high anxiety is exhibited.

We aim to examine how cognitive function and anxiety are correlated by investigating inhibitory control in older and younger adults with differing cognitive abilities and anxiety levels. We will recruit 30 younger (18-25 years of age) and 30 older adults (65 years of age or older) from Canada. Participants will complete three questionnaires; a Demographics questionnaire, the short version of the Depression and Anxiety Stress Scales (DASS) to control for depression, and the short version of the Stait-Trait Anxiety Inventory (STAI). Attentional control is tested using the Go/No-Go paradigm and the Posner Cueing task. Both tasks include threatening animal images. Working memory is tested using a memory task that requires remembering a word list followed by a recognition task.

We hypothesize that highly anxious participants will show more errors in inhibition and working memory tasks than less anxious participants. Second, we hypothesize that highly anxious participants will show more inhibition errors in threat conditions compared with less anxious participants. Finally, we predict that the older adults will show weaker performance on all the tasks than younger participants, due to lower cognitive functioning. Anxiety's effects on cognitive functions have clinical implications because today's cognitive assessments might induce anxiety, thus leading to a possible misdiagnosis. Therefore, understanding the relationship between anxiety and cognition can help prevent misdiagnoses as well as improve identification of normal cognitive aging.

Faculty advisor: Claudia Gonzalez, Psychology

Elvira Mukharryamova. *In Pursuit of Phase Separation.*

According to Anfinsen's structure-function postulate, the ability of linear chains of amino acids to fold into a 3-D structure governs protein's function. Therefore, the subsequent recognition of intrinsically disordered proteins (IDPs) that fail to form a stable conformation, but yet preserve its biological function, became a 'mysterious' phenomenon in protein science. Disorder-based functionality of IDPs is thought to be associated with the amino acid compositional bias, which deprives the protein of its ability to fold but enables it to maintain multivalent interactions with other molecules. IDPs were shown to participate in regulatory processes such as post translational modifications, transport, and regulation of gene expression by compartmentalizing molecules intracellularly through the process of liquid-to-liquid phase separation (LLPS). Recent discoveries have experimentally shown IDPs as being key regulators of phase separation in vitro and in vivo over the years; however, the molecular processes that govern IDPs to form phase separated droplets in eukaryotic cells remain largely unknown. The purpose of this research work was to establish a relationship between the amino acid composition and natively

unfolded conformation of IDPs. Hence, the bioinformatic analysis of intrinsically disordered proteins in *Drosophila melanogaster* was performed to examine the distribution of disordered content and the amino acid compositional bias. Genetic line diagrams and a primer design strategy for the selected proteins were completed as part of the future work analysis. The findings of bioinformatic screening along with the future laboratory experiment will contribute to our understanding of molecular principles behind IDR-driven phase separation and its application in human disease.

Faculty advisor: Don Nelson, Biological Sciences

Amy Moir and Alyssa Holt. *Women Helping Women: Analyzing the Incorporation of Lived Experience in Peer Support for Women Experiencing Criminalization*

There is little research centering on the experiences of women who have been criminalized and utilize their experience in their work or volunteer roles with women currently experiencing criminalization. This research applies an intersectional feminist and anti-oppressive/anti- privilege framework to explore how these women support other women, especially during times of COVID-19 affected services. Research demonstrates that women living with criminalization experience oppressive social relations and structural violence. The weakened social safety net and lack of community-based support force women into cycles of incarceration and homelessness. Peer support of women with shared lived experience is known to effectively support women to escape the incarceration cycle. Using purposeful sampling, approximately 35 women-serving agencies will be invited to circulate an online survey regarding the use and impact of peer mentorship. The agencies are also being asked to forward a recruitment poster to their employees, volunteers, and potential contacts for interviews. Potential peer mentor participants will be invited to participate in a 30 - 45 minute semi-structured interview via Zoom (maximum of six participants). The results of this research will provide valuable new knowledge detailing the experiences of women who transition from prison to a social service role. The results can inform social work practice in supporting women experiencing criminalization and identify areas needing further research.

Faculty advisors: Jennifer Murphy and Juliana West, Social Work

Alyssa Holt and Amy Moir. *Breaking the Cycle: The Implications of a Recovery House and Resource Hub for Women Experiencing Criminalization.*

This research project was conducted in affiliation with Thompson Rivers University (TRU) and the Kamloops and District Elizabeth Fry Society, as a part of the TRU community development research grant. The goal was to gain more in-depth insight into how recovery houses and resource hubs could help women who have been criminalized.

To begin, a literature review was conducted on women experiencing criminalization and their needs and concerns. Through this review, five main themes emerged. These were the overrepresentation of Indigenous women, the fragmentation of their healthcare experiences, the need to renegotiate their relationships, the challenges of community reintegration, and additional barriers such as employment and housing. Consideration is given to two subsets of this population, older women and transgender women. Consideration is also given to the impact that the COVID-19 pandemic has on women who have been criminalized.

Second, a literature review was conducted regarding recovery houses and the benefits and challenges associated with them.

Third, a literature review was conducted on the existence of resource hubs. Due to their limited nature, this review was expanded internationally.

The information acquired in these three sections was then compiled into a list of recommendations that mirror the five main themes of concern for women experiencing criminalization. The vision of the recovery house and the resource hub is to work collaboratively to address these five areas of a woman's life, to provide holistic care, and to ensure no woman falls through the gap.

The full Community Report summarized in this poster can be viewed at https://tru.arcabc.ca/islandora/object/tru%3A5406

Faculty advisors: Juliana West and Jennifer Murphy, Social Work

Riley Mager. *Investigating the Antimicrobial Properties of Cannabinoid Compounds*

As bacteria are rapidly developing resistance against existing drugs, cannabinoids present a novel and exciting opportunity as a potential new source of antibiotics. Cannabinoid compounds have become an epicenter of research in recent years with numerous studies elucidating the therapeutic uses of a few of the numerous compounds such as Cannabidiol (CBD) and Cannabigerol (CBG). This study seeks to investigate the antimicrobial properties of these two aforementioned compounds on a number of gram-negative and gram-positive microbes such as *Candida albicans*, *Streptococcus pyogenes* and *Pseudomonas aeruginosa*. Using spread plating methods, various concentrations and mixtures of CBD and CBG were applied to selected microbes in order to observe the effects (if any) on colony formation. Initial results have indicated a strong effect on gram-positive organisms and little to no effect on gram-negative organisms. These early results corroborate published literature reports. Ongoing work includes an investigation into the lipopolysaccharide (LPS) layer found on the gram-negative bacteria. Through enzymatic treatment, LPS layer removal will be facilitated, and testing performed to determine the role this layer plays in the observed decreased antimicrobial activity of these organisms.

Faculty advisors: Natasha Ramroop Singh and Joanna Urban, Biological Sciences

Gurcharan Uppal. *Simultaneous Separation and Identification of Bisphenol Analogues by Capillary Electrophoresis*

Bisphenols are a group of compounds containing two hydroxyphenyl functional groups joined together by a differently substituted bridging atom. Bisphenol A (BPA) is the best known of the bisphenol analogues. BPA is commonly used as the base chemical in polycarbonate plastic production; and has been found to leach out of different products in both acidic and basic conditions and most environmental matrices. BPA is an endocrine disrupting chemical (EDC) and due to BPA's toxic affects regulatory measures have been put into effect in an effort to limit the use of BPA. Commercialization of BPA-free products is increasing, with the substitution of BPA with its analogues. However, certain analogues have been shown to have nearly identical endocrine disrupting effects (BPS and BPF), while others cause increased concern due to their unstudied effects on health and the environment. The aim of this project is to optimize a method for the separation and identification of 13 bisphenol analogues (BPA, BPAF, BPB, BPBP, BPC, BPE, BPF, BPFL, BPG, BPM, BPP, BPS and BPZ) using the analytical technique of capillary electrophoresis (CE). This method can become a valuable resource in monitoring bisphenol contamination in food and the environment.

Faculty advisor: Kingsley Donkor, Chemistry

Nesa White. *Traditional Ecological Knowledge in Canada.*

Traditional Ecological Knowledge (TEK) is becoming more prominent in land management programs in Canada. While it was largely dismissed for quite some time since colonization began in Canada, it is increasingly valued for its integral understanding and accurate knowledge of local ecosystems. Canadian land management regimes were selected as case studies in order to broaden understanding of how TEK is used in modern land management scenarios. Discussion elaborates on other uses of TEK aside from land management and how further research and documentation of TEK could benefit ecosystems and humans in the face of a changing climate, declining biodiversity, threatened and endangered species, and increasing intensity and incidences of wildfire.

Faculty advisor: John Karakatsoulis, Natural Resource Science

Shauntay Yung. *Empiricism Versus Rationalism: Understanding the Acquisition of Knowledge*

Theories of knowledge, certainty, and skepticism in philosophy are of particular importance to learning, as these theories quite literally explain how we are able to perceive the world around us. Two specific theories have been identified as strong arguments in philosophy, the first is termed 'Empiricism' and the second 'Rationalism'. Using both materials provided in this course, as well as some external arguments that have been considered by Max Hocutt, Tom Stoneham, John Turri and Wesley Buckwalter, the arguments of Locke, Berkeley, and Hume in regard to anti-skepticism, and Descartes' skeptical, rationalist argument will be compared and contrasted. In this paper, I will consider the three empiricist conceptions on knowledge posed in Locke's 'Representational Theory of Perception', Berkeley's 'Idealist Theory of Knowledge', and Hume's 'Problem of Induction', and how these perspectives relate and differ to one another, then I will consider Descartes' rationalist approach illustrated in his Meditations. In addition, I will conclude by stating my opinion of these different theories and whether I believe Rationalism or Empiricism to be better, as well as why I consider one theory to be stronger than the others.

Faculty advisor: Jenna Woodrow, Philosophy

Morgan Rigelhof. *A Global Scale Analysis of Bergmanns Rule for All Extant Bat Species*

I will be presenting my findings on a global scale analysis on an ecogeographical rule called Bergmann's rule for all extant bats. Bergmann's rule involves the correlation between body size and latitudinal location of the species. The significance of understanding body size evolution is that it explains and influences an animal's life history. Understanding body size evolutionary trends impacts our ability to predict and protect biological diversity on a global scale. Studies of body size evolution and population structure are often critical components of endangered species conservation and management plans.

We have constructed our own phylogenetic tree to assess body size data collected over 4 months, and statistically analyzed the data to represent the correlations seen for Bergmann's rule in bats. This is not know to have been done before for a global analysis of bats.

Faculty advisors: Matthew Reudink and Sean Mahoney, Biological Sciences

Abu Nadeem. *Leachability Determination of Elements in Fly Ash as a Potential Fertilizer*

When burning coal, the ash that is leftover is known as fly ash. For this research, the fly ash was supplied by a biomass company. Fly ash contains a range of elements that can be toxic or beneficial to

the environment and soil—essentially having the potential to act as a fertilizer. Furthermore, leaching is a procedure that is used to extract elements from environmental samples. Leachability was simulated in this research by adding water to certain types of fly ash, and analyzing the samples after 1 to 4 weeks, to see if the concentrations of elements, or leachable recoveries, decreases with time or stays the same. In this study, the content and leachability of 11 elements will be determined: zinc (Zn), lead (Pb), chromium (Cr), copper (Cu), nickel (Ni), cobalt (Co), manganese (Mn), iron (Fe), magnesium (Mg), cadmium (Cd) and arsenic (As) using flame atomic absorption spectrometry (FAAS). The importance of this research is demonstrated by the potential of fly ash to be used as a fertilizer. To uncover the leaching ability of the toxic elements and the beneficial elements in fly ash would determine the environmental impacts that this potential fertilizer has, and whether it is suitable for crops. In addition, fly ash being used as a fertilizer would increase the utilization of ash and can pose as a solution to the thousands of tons of ash being wasted yearly.

Faculty advisor: Kingsley Donkor, Chemistry

Zahkary Barone. *Determination of Thymol in Mouthwash by Capillary Electrophoresis*

Thymol is a natural monoterpene phenol derivative of p-cymene found in oil of thyme and extracted from various plants which has strong antiseptic properties. Thymol is listed as a medical ingredient in mouthwash and some toothpastes as it contains active antiseptic ingredients. Many brands of mouthwash state that thymol fights tooth decay and infections, and it was found that mouthwash containing thymol was effective at preventing the initiation of dental caries—a pathological process of destruction of tooth structure by microorganisms. Thymols antibacterial activity is caused by inhibiting growth and lactate production and by decreasing cellular glucose uptake. This study was conducted to separate and quantify the amount of thymol ($C_{10}H_{14}O$) present in mouthwash by capillary electrophoresis (CE), and to compare the results obtained to the manufacturers claim. Nine samples of mouthwash from four companies (Listerine, Crest, Equate, and Life) were measured to determine their concentration of thymol. Quantifying the amount of thymol contained in mouthwash could aid in ensuring the appropriate amount is present to effectively prevent dental decay. CE was chosen as it is an extremely sensitive instrument that is proficient at separating analytes. Analytes are separated according to ionic mobility via an applied voltage; an ions mobility depends on its size, charge and viscosity. Data is collected as electropherograms which plot the absorbance of the analytes against their migration time which allows for the quantification of the amount of thymol present in the samples.

Faculty advisor: Kingsley Donkor, Chemistry

Gillian Spencer. *The Post-harvest Effects on the Growth of Lodgepole pine (*Pinus contorta var. latifolia*) on the Perimeter of Harvested Strips*

Lodgepole pine (*Pinus contorta var. latifolia*) was harvested by Tolko on a site near Kelowna, located in the Montane Spruce biogeoclimatic zone, in 2018 using a strip-selection method leaving tree reserves. Previously, the area was harvested in 1975 and planted with Lodgepole pine. Each block consists of strips that are 10, 15, and 20 m widths, and all varying lengths. Two blocks were used in this project, one with strips laid out North to South and one with strips laid out East to West. This research determines if growth of trees on the edges have been stimulated by the canopy opening, and whether varying strip widths and orientations have an effect. Growth was determined by measuring diameter at breast height (DBH) and tree height for volume and by measuring annual growth using tree cores. These measurements will be compared to measurements taken pre-harvest in January 2017. Given the

relatively increased light availability in trees that are South-facing and in 20 m strips, it was predicted that those trees will have the most growth since harvest. The results of this study could alter silviculture plans made by foresters to include trees on the edge of openings and potentially increase their harvest volume.

Faculty advisors: Lauchlan Fraser and John Karakatsoulis, Natural Resource Science

Nicholas Coutu. *Investigating the Potential for High-CBD Cannabis Sativa and Nitric Oxide to Modulate SARS-CoV-2 Spike-ACE2 Binding*

A critical step of the SARS-CoV-2 infection is interaction between the SARS-CoV-2 Spike (S) protein's receptor binding domain on the surface of the viral particle and the ACE2 receptor on the surface of human cells. Thus, the identification of small molecules, antibodies, or other biological molecules that interfere with the formation of the S-ACE2 complex, could help to develop drugs to prevent or treat COVID-19.[1] High-CBD Cannabis treatments show modulation of ACE2 gene expression and ACE2 protein levels in human tissues, but it is unclear if the many cannabimimetic molecules also directly interact with the S-ACE2 binding or if it is merely due to the cannabinoid receptor mediated affects.[2] Additionally, NO likely causes conformational changes on surface glycoproteins that can interfere with host cell fusion, preventing infection and release of virions from already infected host cells, like neuraminidase inhibitors.[3] We will use a RayBio COVID-19 Spike-ACE2 binding assay kit, which is an in vitro enzyme-linked immunosorbent assay, to determine if cannabinoids and terpenes can interfere directly with the S-ACE2 binding, independent of cannabinoid receptors. Additionally, we will determine if NO interferes directly with the RBD of the Spike protein, and if there is a synergistic effect with a formulation of cannabinoids, terpenes, and NO, to give an enhanced interference.

Faculty advisors: Joanna Urban and John Church, Biological Sciences