24th annual

Northern Research Day

27 February 2020

PRESENTED BY THE CIRCUMPOLAR STUDENTS ASSOCIATION

Welcome to Northern Research Day 2020!

The Circumpolar Students' Association extends a warm welcome to the conference attendees for the 24th annual Northern Research Day. Our mission is to bring students together from diverse disciplines and backgrounds to connect and converse with a network of peers. Northern Research Day is a forum for exchange of ideas and an opportunity to present in a stress-free, welcoming environment. We are excited to highlight the research undertaken by students at the University of Alberta whose work focuses on the North, and provide opportunity to stimulate discussion regarding complex issues in the North. We thank UAlberta North for their generous support in bringing our keynote speaker, Dahti Tsetso, from Fort Simpson, NT.

About UAlberta North

UAlberta North is an office dedicated to building relationships with northern partners, making research connections, supporting opportunities for students, and helping to amplify Northern voices, especially Indigenous voices. The office administers Northern Scientific Training Program Awards and U of A Northern Research Awards, along with community reporting awards, travel grants and scholarships - totaling $200,000 per year - as well as the Engage North summer program.

About the Digital Scholarship Centre

The Digital Scholarship Centre is a research space located on the second floor of the Cameron Science & Technology Library on the North Campus of the University of Alberta. Northern Research Day 2020 will take place in the Visualization Lab and Multipurpose Room. Tours of the space will be offered during the morning coffee break.

Remote Connection

We are providing a webinar connection to facilitate remote participation. If you are unable to attend in person, please join us via this LINK or you can also dial in using your phone: +1 (647) 497-9373.

Acknowledgement

We wish to acknowledge that the land on which we gather is Treaty 6 Territory, traditional lands of First Nations and Metis people. The lands discussed at this conference are traditional meeting grounds and home for First Nations, Metis, Inuit, and many other First Peoples of Canada and other circumpolar countries. We acknowledge the benefits conferred to us, aim to make these benefits mutual, and aspire to conduct our research in an inclusive manner that empowers First Nations, Metis, Inuit, and all First Peoples of Canada and other circumpolar countries.

Code of Conduct

All participants, attendees, and organizers are treated with respect and consideration, valuing a diversity of views and opinions. Communication should be considerate, respectful, and collaborating; critiques should address ideas rather than individuals. Unacceptable behaviour includes verbal comments related to gender, sexual orientation, disability, physical appearance, body size, race, religion, and national origin. Harassment, bullying, intimidation, and discrimination are not tolerated.

Time	Event
8:45 AM	**Registration & Badge pick-up**
9:00 AM	**Opening Remarks**
9:15 AM	**Charvanaa Dhoonmoon** - Investigating mechanisms of nutrient export from tidewater glaciers and their effects on primary productivity in the Canadian Arctic
9:30 AM	**Karling Roberts** - The seasonal dynamics of fish isotope niches depends on species, community composition, and habitat structure
9:45 AM	**Samantha Blais** - Denying Reality: Mega-Dams in Manitoba's North
10:00 AM	**Tina Wasilik** - An early childhood vocational education program for Inuit women in Nunavut, Canada
10:15 AM	**April Robin Martinig** - Going the distance: the local vacancy game and how it changes dispersal
10:30AM	**Coffee Break + Digital Scholarship Centre Tours**
11:00AM	**McKenzie Kuhn** - Using a methane specific landcover model to estimate pan-arctic methane emissions
11:15 AM	**Kasia Staniszewska** - Thaw slumps in continuous permafrost contribute minor amounts of mercury to downstream environments in the Old Crow River, Yukon
11:30 AM	**Makenzie MacKay** - Once you've been to one community, you've been to one community: Exploring community renewable energy in the Inuvialuit Settlement Region
11:45 AM	**Casey Buchanan** - Isotopic variations of hillslope active layer waters and upper permafrost ice in the Blackstone River Valley, Yukon Territory
12:00 PM	**Lunch + Poster Presentations**
1:00 PM	**Keynote Presentation: Dahti Tsetso**
2:00 PM	**Christopher Schulze** - Effects of wildfire and permafrost thaw on nitrous oxide fluxes from boreal peatlands in Western Canada
2:15 PM	**Elizabeth Dowdell** - Will the caribou be reclaimed? Traditional Knowledge and mine reclamation in Northern Canada
2:30 PM	**Zachary G. MacDonald** - Assessment of present and historical gene flow among Rocky Mountain Apollo (Parnassius smintheus) metapopulations
2:45 PM	**Coffee Break**
3:00 PM	**Kristine Wray** - Making a place for Indigenous fishing livelihoods: Navigating cross-scale institutions in Great Slave Lake commercial fisheries management
3:15 PM	**Lee Hecker** - Latitudinal plasticity in American bison (Bison bison) diets
3:30 PM	**Angelo Thomas Filicetti** - Linear disturbances and restoration of woodland caribou habitat: the billion-dollar conservation dilemma for woodland caribou survival
3:45 PM	**Baily McCulloch** - The new top dogs? Mesopredator response to wolf removal in a changing landscape
4:00 PM	**Closing Remarks**

Keynote Presentation: Dahti Tsetso

Dahti Tsetso is the Director of Lands & Resources for Dehcho First Nations (DFN). Through her work with DFN, Dahti is working with their ten member communities to develop a Regional Stewardship Program known as Dehcho K'ehodi (meaning 'Taking care of the Dehcho' in Dehcho Dene Zhatie). This Stewardship Program seeks to implement conservation from the Dene perspective and is actively working to establish a Dehcho Guardian Program in close collaboration with the community-based water monitoring program, known as Dehcho-AAROM. Recently, Dahti led negotiations on the establishment of a new Indigenous-led Protected Area known as Edehzhie, which was finalized in July 2018. Dahti holds a Bachelor of Science and a Bachelor of Arts from the University of Alberta, and is also a graduate of the University of Victoria's Indigenous Language Revitalization Program. Dahti is active in language revitalization efforts in the Dehcho region. She has led numerous language-revitalization projects; including a language-promotion button campaign, a social-media page to support and encourage language learning, and various land-based language programs for youth. Dahti currently lives in Fort Simpson, NT with her husband and three children.

Oral Presentations

Investigating mechanisms of nutrient export from tidewater glaciers and their effects on primary productivity in the Canadian Arctic

Presenter: *Charvanaa Dhoonmoon, PhD Candidate, Earth and Atmospheric Sciences*

Authors: *Charvanaa Dhoonmoon, Maria Cavaco, Megan Roberts, Patrick Williams, Stephanie Waterman, David Burgess, Erin Bertrand, and Maya Bhatia*

Glaciers can play an active role in the carbon cycle by increasing supply of limiting nutrients to the ocean surface, thereby regulating marine primary productivity (PP). Tidewater glaciers may supply nutrients to phytoplankton in the marine euphotic zone via two mechanisms: 1) direct addition of nutrients by glacial discharge to the ocean surface, and; 2) upwelling of nutrient-rich deep seawater to the surface driven by submarine meltwater discharge. Glacial melt rates are rising in the Canadian Arctic Archipelago (CAA) due to climate change, potentially boosting nutrient fluxes to ocean surfaces. Nutrient export by CAA tidewater glaciers may play a role in sustaining Arctic PP, which supports polar marine ecosystems and hunting activities of northern Indigenous communities. However, these meltwater and nutrient fluxes remain understudied. Further characterization is needed to elucidate the mechanisms by which tidewater glaciers supply nutrients to marine ecosystems and their impacts on PP. By collaborating with the Hamlet of Grise Fiord, we will examine mechanisms of nutrient export from Jones Sound tidewater glaciers. We hypothesize that a combination of direct addition and nutrient upwelling sustains PP in the CAA. We will incubate marine phytoplankton collected from Jones Sound with glacial meltwater and/or deep seawater as nutrient sources. Subsamples taken daily from the incubations will be analyzed via a suite of biochemical techniques to assess how each nutrient source impacts PP. Incubation results will be compared to in-situ observations. Our results will illuminate biogeochemical impacts of increasing meltwater fluxes on the marine ecosystems that support local Indigenous communities.

The seasonal dynamics of fish isotope niches depends on species, community composition, and habitat structure

Presenter: *Karling Roberts, PhD Candidate, Renewable Resources*

Authors: *Karling Roberts and Mark Poesch*

Habitat offsets compensate for damages to natural habitat caused by socio-economic development projects with habitat construction or restoration. Offsets are being used more frequently in more parts of the world, however, large uncertainties remain surrounding the ability of constructed or restored habitats to support desired ecosystem functions. To address this uncertainty, comparisons between the isotopic niches from three natural lakes and one constructed lake, a habitat offset, in the oil sands region of Alberta during summer and winter seasons were performed. We investigate: 1) whether fish isotope niches vary in size, carbon 13 values or nitrogen 15 values between seasons 2) whether these changes are consistent between lakes, and 3) whether a constructed lake displays similar seasonal patterns to natural lakes. Fish carbon 13 values were consistent across seasons in all lakes, suggesting that baseline resources supporting fish production is consistent year-round. Fish nitrogen 15 values increased in the winter in fishes from deep lakes, but not in fishes from a shallow lake that does not support piscivorous species. This suggests that some fishes switch to higher trophic level prey items in the winter, but this is not an option for all species in all types of lakes. Whether the size of a fish's isotope niche changed between seasons and whether it became smaller or larger in the winter was highly variable between species and lakes. This suggests that resource availability for fishes in the winter is complex, and does not vary seasonally in a consistent and easily predictable manner.

Denying Reality: Mega-Dams in Manitoba's North

Presenter: *Samantha Blais, PhD Candidate, History*

Author: *Samantha Blais*

Hydroelectric development in Canada's north is widely recognized as having caused irreversible ecological change and environmental damage with negative impacts for northern Indigenous peoples. Yet, the public health of Indigenous communities that have suffered collateral damage from development remains unacknowledged (Reading and Wien, 2009; Martin and Hoffman, 2008). Fox Lake Cree Nation, Tataskweyak Cree Nation, O-Pipon-Na-Piwin Cree Nation, Misipawistik Cree Nation, and Pimicikamak Cree Nation have all been publicly vocal about their experience with hydroelectric development, but to little effect. One Pimicikamak trapper who lives about twenty kilometers from the Jenpeg generating station in northern Manitoba, Ed McKay, noted the impacts in his interview with CBC News in 2015. He stated, "Once everything is gone, what are we going to eat? Are we going to eat money, or plastic cards?" In the interview, McKay argued that the hydroelectric dam had damaged the land and poisoned the water throughout the Pimicikamak traditional areas because of floods, which have killed the animals and plants. I will explore the real costs of the so-called "clean" hydroelectricity in northern Manitoba. In particular, I will examine the ways in which Manitoba Hydro and hydroelectric development has threatened the sustainability of Indigenous livelihoods in northern Manitoba from 1954. Through oral histories, interview transcripts, and personal conversations with people from the impacted communities, I will illustrate the ways hydroelectric development has destroyed the environment, the traditional economy, and lifestyles of these indigenous communities that contributes to the continuing public health crisis.

An early childhood vocational education program for Inuit women in Nunavut, Canada

Presenter: *Tina Wasilik, PhD Candidate, Department of Secondary Education*

Author: *Tina Wasilik*

The founders and directors of the 2016 Early Childhood Education (ECE) vocational program have won a one million-dollar Arctic Inspiration Prize award that rewards northern projects committed to addressing the causes rather than the symptoms of issues facing the Arctic (Oudshoorn, 2019). The 2016 ECE vocational program is a two-year post-secondary accredited diploma that prepares learners with the knowledge and skills to develop and deliver Inuit-focused ECE that offers education rooted in the traditional child-rearing practices that are responsive to the needs of each Nunavut community. My proposed methodology is Indigenous Research Methods, which emphasizes accountability that allows relationships to form in storytelling (Wilson, 2008). Indigenous storytelling allows traditional Indigenous knowledge to be shared in ways that signifies relationships between people, the natural world, and their lived and ancestral experiences (Archibald, 2008; Kovach, 2009). My proposed research will focus on the stories of the research collaborators' lived experiences in the 2016 ECE vocational program. Indigenous Research Methods align with the Inuit Qaujimajatuqangit principles which are based on embracing all aspects of traditional Inuit culture, including values, worldview, language, social organization, knowledge, life skills, perceptions and expectations (Nunavut Department of Education, 2007). As this methodology aligns with Inuit cultural values, the data gathered from this approach will be applied to strengthen these values within the post-secondary ECE curriculum delivery across Nunavut communities.

Going the distance: the local vacancy game and how it changes dispersal

Presenter: *April Robin Martinig, PhD Candidate, Biological Sciences*

Authors: *April Robin Martinig, Jeffrey E. Lane, Andrew G. McAdam, Ben Dantzer, and Stan Boutin*

All offspring that reach the age of independence from their parents face a decision as to where they will establish their own breeding site. Dispersal, the movement from a natal site to new site, is characteristic of juveniles and virtually all species make a dispersal movement at some stage in their life cycle. Territorial species face a unique situation where they are typically unable to occupy the natal site and must disperse. Using four years of telemetry data that includes the timing and location of settlement for 193 juvenile North American red squirrels, we asked whether dispersal distance was affected by the availability of vacant territories. We hypothesized that local competition for space would be the main driver of dispersal distance, with juveniles having shorter dispersal distances when there were more vacancies nearby (spatial) and available (temporal).

Using a methane specific landcover model to estimate pan-arctic methane emissions

Presenter: *McKenzie Kuhn, PhD Candidate, Renewable Resources*

Authors: *McKenzie Kuhn, David Olefeldt, Mikael Hovemyr, Gustaf Hugelius, Ruth Varner, Merritt Turetsky, Claire Treat, Guido Grosse, Ted Schuur, Katey Walter Anthony, A. David McGuire, Martin Wik , Jennifer Watts, and David Bastviken*

Bottom-up estimates of methane (CH_4) emissions from the arctic and sub-arctic are 2-3 times higher than top-down inversion model estimates and include high uncertainties. Lakes alone are estimated to emit ~16 Tg C a year, ~70% of the total natural CH_4 estimate for the north. Uncertainties and the likely overestimate of bottom-up emissions largely stem from relying on upscaling land cover classes that are too coarse in resolution. For example, using one flux value for all wetlands or lakes likely over-estimates total emissions. General bias to conduct field studies on lakes that are high emitters of CH_4 may also skew the “average” flux values attributed to lakes for upscaling. Furthermore, we have poor constraints on the spatial extent of wetlands and small lakes in the north. Different definitions of wetlands across Arctic countries and low-resolution maps lead to “double counting” of CH_4 emissions from wetlands and lakes. In this study we use a CH_4 specific land cover model, which addresses double counting, and detailed land cover classes to produce a more constrained estimate of bottom-up CH_4 emissions from the pan-Arctic region. To model the empirical relationships between land cover classes and CH_4, we use the most recent CH_4 emission database, including new empirical flux measurements from lakes in the previously unstudied Taiga Plains region of Canada. We expect the results of our study to provide a more constrained estimate of bottom up estimates across the circumpolar region.

Thaw slumps in continuous permafrost contribute minor amounts of mercury to downstream environments in the Old Crow River, Yukon

Presenter: *Kasia Staniszewska, Master's Candidate, Earth and Atmospheric Sciences*

Authors: *Kasia J. Staniszewska, Colin A. Cooke, and Alberto V. Reyes*

Permafrost soils are a significant reservoir of legacy mercury. Anthropogenic climate warming, which is amplified at high latitudes relative to the global mean, is leading to ground warming and local degradation of permafrost across the Arctic. It has been suggested that degrading permafrost is releasing legacy contaminants to downstream environments through thaw slumps and other thermokarst features, with uncertain consequences for water quality. Thaw slumps are landscape features which occur where ice-rich ground thaw leads to slope collapse. We collected slump sediment and associated upstream-, downstream-, and rill-water samples at four slumps along Old Crow River, YT, which is underlain by continuous permafrost. Sediment-mercury concentrations were low, ranging from 45–115 µg/kg. At two slumps, rill water mercury concentrations reached 23 ng/L and 213 ng/L, at or above the Canadian Environmental Water Quality Guideline of 26 ng/L. However, mercury concentrations in downstream water samples were not significantly higher than in upstream samples. Although mercury concentrations in rill-water discharge were moderately-high, discharge was extremely low and therefore the load (volume over time) of mercury released by slumps is insignificant at the scale of this large watershed. Although concentrations of mercury in permafrost are high, the overall environmental impact of permafrost degradation must be viewed in the context of contaminant loads and exports, and rates of physical permafrost degradation.

Once you've been to one community, you've been to one community: Exploring community renewable energy in the Inuvialuit Settlement Region

Presenter: *Makenzie MacKay, Master's Candidate, Resource Economics and Environmental Sociology*

Authors: *Makenzie MacKay and Brenda Parlee*

Canada's Northwest Territories see some of the highest heating and electricity costs among all Arctic Nations. Most communities in the NWT, especially those that live in more Northern and remote locations, rely on fossil fuels imported from the South. Associated shipping costs are high and the far transportation distance creates risk that the supply chain will be disrupted, leaving the community without energy. Community Renewable Energy (CRE) is proposed as a way to create energy systems that are more equitable and meet community needs. This research works in collaboration with the communities of Inuvik and Tuktoyaktuk, NT. The principles of Community-Based Participatory Research were followed at every stage of the project. Together we decided to explore the research question, What is the state of Community Renewable Energy in Canada's Northwest Territories and how can an energy transition be realistically facilitated? Through semi-structured interviews with 23 Elders, community members, and energy stakeholders, we seek to answer the question of how to best meet the energy needs of the region. A qualitative "conventional content analysis" highlighted 6 key themes: motivation, decision-making, energy policy, uniqueness of the North, projects prioritized, and "who benefits?". Findings were approved by community members at verification workshops. We find that while CRE is not feasible right now there are meaningful initiatives underway. Small-scale and northern-specific energy solutions are most appropriate and beneficial. Meaningfully incorporating community voices is key for the long-term success of the energy system as well as being respectful of Inuvialuit self-government efforts.

Isotopic variations of hillslope active layer waters and upper permafrost ice in the Blackstone River Valley, Yukon Territory

Presenter: *Casey Buchanan, Master's Candidate, Earth and Atmospheric Sciences*

Authors: *C.A. Buchanan, D.G. Froese, T. Porter, and J. Kavanaugh*

Stable isotope (δ18O, δ2H) signatures of permafrost ground ice provide a proxy for historic air temperature variations. This relationship arises from the strong temperature dependence of δ18O and δ2H in precipitation. Precipitation that infiltrates the active layer – the horizon which undergoes an annual freeze-thaw cycle – becomes incorporated into the upper permafrost ice as the soil surface aggrades. However, mechanisms which potentially modify the δ18O and δ2H values of meteoric waters during their residence within the active layer and during the freezing process are not well understood. This study seeks to answer three questions: 1) how do δ18O and δ2H in active layer waters vary across topography and hydrological regime, 2) what mechanisms give rise to these variations, and 3) how closely do δ18O and δ2H values of upper permafrost ice reflect that of late-summer active layer waters? To test these questions, June ground ice samples and September active layer waters were collected in 2019 along two catenas within the Ogilvie Mountains, Yukon Territory. The isotopic values of active layer waters and upper permafrost ice co-varied with respect to topographic position, likely due to the progressive influence of evapotranspiration and water mixing on these waters during downslope migration. Furthermore, although upper permafrost ice was consistently more enriched than September active layer waters, this enrichment was much less than predicted by the Rayleigh fractionation model commonly employed in cryofractionation calculations in the active layer. Ultimately, these findings will help paleoclimate researchers account for isotopic modification in paleotemperature calculations.

Effects of wildfire and permafrost thaw on nitrous oxide fluxes from boreal peatlands

Presenter: *Christopher Schulze, PhD Candidate, Renewable Resources*

Authors: *Christopher Schulze, Carolina Voigt, Oliver Sonnentag, Guillermo Hernandez Ramirez, Lauren Thompson, McKenzie Kuhn, Liam Heffernan, and David Olefeldt*

Increasing temperatures in the Taiga Plains in northwestern Canada cause more frequent and intense disturbances in boreal permafrost peatlands which threatens the stability of those globally significant stores of carbon and nitrogen. Resulting increased rates of permafrost thaw affect the greenhouse gas balance of peatlands through a higher frequency and severity of wildfires and the development of thermokarst features where the ice-rich permafrost ground collapses into water-saturated bogs or lakes. The developing landforms are characterized by differences in soil temperature and moisture conditions, thaw depth, pore water chemistry and vegetation composition. While the consequences of these transformations for the two carbon-based greenhouse gases, carbon dioxide and methane, have been investigated intensively, the effects of wildfire and thermokarst on nitrous oxide fluxes from permafrost peatlands are poorly understood. In this study, we carry out flux measurements applying both, ground-mounted and floating, closed static dark chambers to detect differences in soil greenhouse gas exchange from selected post-fire and thermokarst stages compared to intact permafrost peat plateaus. Additionally, we monitor porewater chemistry to reveal the interaction between surface fluxes and belowground nutrient cycling. We expect higher nitrous oxide emissions in burned compared to thermokarst-affected areas, due to the larger disruption in vegetation growth post-fire vs. post-thaw, whereas anaerobic conditions in thermokarst bogs and ponds may further inhibit nitrous oxide emissions. The results of this study will help us understand which of the two disturbance types intensified by increasingly warmer temperatures has a larger impact on the nitrous oxide fluxes of northern permafrost peatlands.

Will the caribou be reclaimed? Traditional Knowledge and mine reclamation in Northern Canada

Presenter: *Elizabeth Dowdell, Master's Candidate, Resource Economics and Environmental Sociology*

Author: *Elizabeth Dowdell*

For decades, northern Canada has been home to extractive resource projects like mining and oilsands that have created serious and lasting environmental and social impacts for local and Indigenous communities living in the North. 'Reclamation' is the term used in laws, assessments, and guidelines to ensure these impacts are remedied. The inclusion of Traditional Knowledge in the process is required by law. However, these documents are vague and allow for multiple interpretations of what reclamation means and how Traditional Knowledge is to be included. This has led to contested meanings and practices of reclamation. In this study, I explore how stakeholders and practitioners in the reclamation industry (government, industry, scientists, NGOs, communities) interpret and understand the meaning of reclamation, and what dimensions (ecological, social, cultural, economic) or scales (geographic, temporal) of Traditional Knowledge are put into practice through the treatment of a complex component (caribou). I use a systematic literature review of existing studies and semi-structured interviews with stakeholders and practitioners to explore the meanings and practice of reclamation in extractive resource sectors in the Yukon, Northwest Territories, and Alberta. Reflecting on the meaning and practice of reclamation reveals underlying assumptions. This creates space to think differently about reclamation and identify opportunities to shift or challenge the status quo towards more meaningful and sustainable ways.

Assessment of present and historical gene flow among Rocky Mountain Apollo (Parnassius smintheus) metapopulations

Presenter: *Zachary G. MacDonald, PhD Candidate, Renewable Resources*

Authors: *Zachary G. MacDonald, Greg A. Breed, John H. Acorn, Scott E. Nielsen, and Felix A. H. Sperling*

Throughout mountainous regions in northwestern North America, metapopulations of the Rocky Mountain Apollo butterfly (Parnassius smintheus) occur in isolated patches of alpine meadow habitat. Research on P. smintheus in southern Canada suggests that gene flow within metapopulations may decrease with climate change, as habitat suitability between isolated alpine meadows declines and populations track their climatic niche up mountain slopes. However, northern metapopulations, currently recognized as a distinct subspecies, P. smintheus yukonsesis, have had distinct evolutionary histories since the late Pleistocene. We hypothesise that this subspecies likely differs from more southerly Canadian subspecies, P. smintheus smintheus and P. smintheus magnus, both in terms of their ecology and responses to environmental and habitat changes. In this study, we aim to i) quantify the extent and determinants of gene flow within and among northern P. smintheus metapopulations, and ii) assess whether these metapopulations are indeed genetically, morphologically, and ecologically distinct from more southerly metapopulations. Throughout the summer of 2019, we collected ~300 adult P. smintheus across northwestern Canada. We plan use next-generation genotyping by sequencing (specifically, ddRADseq) to obtain thousands of single nucleotide polymorphisms across the P. smintheus nuclear genome. Habitat suitability models will be built to generate resistance-based distances between isolated subpopulations. Together, these data will be used to quantify effects of spatial separation, topography, arrangements of suitable habitat, and environmental conditions on gene flow, and to assess determinants of genetic divergence between northern and southern metapopulations. This information will be integral to alpine butterfly conservation planning under continued climate change.

Making a place for Indigenous fishing livelihoods: Navigating cross-scale institutions in Great Slave Lake commercial fisheries management

Presenter: *Kristine Wray, PhD Candidate, Resource Economics and Environmental Sociology*

Author: *Kristine Wray*

The Dene communities surrounding the Great Slave Lake have managed their use of fishery resources for many generations. However, the opening of the commercial fishery by the federal government in 1945 radically changed community access to fish resources. Control over lake resources shifted as a result of the international demand for fish and the assumption of management by the federal government. The territorial government is currently interested in revitalizing the commercial fishery. In this context, the Dene communities have expressed interest in the formation of a new approach to fisheries management, featuring an increased ability to participate and to contribute their Traditional Knowledge. This project explores what kind of co-management structure can support the sustainability of Indigenous fishing livelihoods in the context of a commercial fishery. Objective One: To generate an oral history of the Great Slave Lake region from the pre-contact Dene fishery to the present, with the intention of understanding the effect of commercialization on Indigenous fishing livelihoods. Objective Two: Investigate contemporary fishing livelihoods, based on both local knowledge of the ecology of the lake as well as values and norms (rules-in-use) of stewardship. Objective Three: Explore the role and significance of Dene knowledge and participation in the evolving fishery co-management structures. The research will advance understanding of multi-scale fisheries management scenarios using multi-scale and co-management theories. The study has been developed collaboratively with the Kátł'odeeche First Nation and the Akaitcho Territory Government. Decolonizing and Indigenous research methodologies inform the research. Qualitative semi-structured interviews are the main tool for data collection. This research will improve our understanding of the relationships between management decisions and fishing livelihoods, and by doing so, will contribute to fishery management efforts going forward.

Latitudinal plasticity in American bison (Bison bison) diets

Presenter: *Lee Hecker, PhD Candidate, Renewable Resources*

Authors: *Lee J. Hecker, Sean C. P. Coogan, Mark A. Edwards, and Scott E. Nielsen*

In niche theory, diet is a trait frequently used to place species along a continuum from specialists to generalists. Recently, a multidimensional approach to investigating species niches has been developed to also incorporate dietary nutrition. We have applied concepts of multidimensional nutritional niche theory to examine the dietary patterns of a widespread megaherbivore, American bison (Bison bison), including their: 1) food exploitation niche (i.e., the functional forage groups consumed); 2) food composition niche (i.e., the macronutrient composition of foods consumed); and 3) realized macronutrient niches (i.e., the macronutrients in diets) of American bison subpopulations. Additionally, we sought to explore changes in these nutritional niches seasonally and geographically. We reviewed 29 peer-reviewed publications, government reports, conference proceedings, and graduate theses reporting the dietary composition of bison in North America. We found that bison diets were dominated by graminoids throughout the year, but that the food exploitation niche expanded during the growing season with an increased consumption of forbs and browse items. The realized macronutrient niche for bison was similarly dominated by carbohydrates, and expanded in the growing season, with bison consuming more lipids and proteins. We also found a slight, but significant, increase in the consumption of browse items, lipids, and proteins with increasing latitude. We suggest that managers exploring bison reintroductions or translocations consider not just the foods that dominate bison diets (i.e., graminoids), but also supplementary browse items that offer higher proportions of proteins and lipids, which may be functionally important at northern latitudes.

Linear disturbances and restoration of woodland caribou habitat: the billion-dollar conservation dilemma for woodland caribou survival

Presenter: *Angelo Thomas Filicetti, PhD Candidate, Renewable Resources*

Authors: *Angelo T. Filicetti and Scott E. Nielsen*

Alberta's forests are highly fragmented by linear disturbances, particularly seismic lines, linear features (3–12 m wide) cleared of trees for the purpose of petroleum exploration. Many seismic lines have failed to be reforested 50 years post-disturbance, commonly within the preferred habitat for threatened woodland caribou. The mechanized creation of seismic lines simplifies microtopography and depresses the soil surface leading to failures in tree recruitment. These linear features act as pathways for other vertebrates to enter caribou habitat and ultimately increasing caribou predation. Methods to reforest seismic lines are expensive (>$12,000/km) and do not account for wildfires which can destroy restoration investments (planted trees), yet also initiate early seral conditions that favor long-term recovery. We investigated, across multiple studies, the restoration of seismic lines through tree recovery with mechanical site preparations and wildfires. Overall, recent mechanical site preparations have been successful in recruiting trees in the short-term, yet wildfires pose a cost-effective long-term solution for most forest types with the exception of fens. We also relate limitations to restoration with microtopography, depth to water table, and life history traits of boreal trees. We also demonstrate that restoration of seismic lines may not inhibit animal use and in some conditions promote lichens on seismic lines thus acting as a potential attractant for caribou. We suggest that passive restoration of seismic lines can be expected post-fire and therefore active restoration, through silviculture and tree planting, should be applied strategically with considerations of wildfire frequency to save limited restoration dollars.

The new top dogs? Mesopredator response to wolf removal in a changing landscape

Presenter: *Baily McCulloch, Master's Candidate, Biological Sciences*

Authors: *Baily McCulloch, Melanie Dickie, Robert Serrouya, and Stan Boutin*

As apex predators disappear worldwide, their role in structuring systems facing rapid anthropogenic change is a critical avenue of study. The absence of apex predators can have complex ecological consequences, such as mesopredator release – an increase in the number of smaller predators. Although global increases in mesopredator range and abundance are a current conservation concern, it is uncertain whether this effect is driven primarily by apex predator loss, or by a changing landscape becoming more friendly to mesopredators; these factors have previously been challenging to test simultaneously. The wolf control program in Alberta provides a natural experiment to study mesopredator release, while neighbouring Saskatchewan offers a less human-modified baseline compared to Alberta, where industrial activity has left a heavy human footprint. Using a network of camera traps across Alberta and Saskatchewan, established by the Alberta Biodiversity Monitoring Institute, paired with an emerging method for estimating the density of unmarked species, we compare mesopredator densities across different levels of wolf control and human disturbance. At a larger scale, we investigate the relative effect of apex predator presence and anthropogenic disturbance – as well as abiotic factors associated with climate change – on mesopredator occupancy and range, to advance our understanding of the effects of the loss of apex predators and the increasing human footprint on the world's predator systems. We demonstrate that anthropogenic landscape change is associated with a larger change in mesopredator density than the top-down effect of apex predator loss.

Poster Presentations

Zombie soil carbon: revival of aged soil organic carbon in the contemporary carbon cycle of extracted peatlands

Presenter: *Rebecca Frei, Master's Candidate, Renewable Resources*

Authors: *Rebecca J. Frei, Miranda Hunter, David Olefeldt, Claudia Czimczik, Cristian Estop-Aragones, and Maria Strack*

Peat is harvested for horticultural use and is a multi-million-dollar industry in Canada. To prepare for harvesting, peatlands are drained and have all surface vegetation removed, effectively stripping away the modern peat layer. Because peatlands are critical carbon (C) sinks and regulators of global climate, it is important to understand how peatland harvesting affects ecosystem C balance and presents a unique opportunity to constrain the contribution of aged peat for C export laterally (e.g. hydrological export of dissolved organic C (DOC)) and vertically (greenhouse gas emissions of CO2 and CH4). In this study, we used radiocarbon analysis of DOC and gaseous emissions of CO2 and CH4 to understand the contribution of aged peat to the ecosystem C balance. We hypothesized that the aged peat will play a major role in vertical and horizontal C fluxes because it is easily degradable and mobilized via hydrological alteration of the peatland catchment. Using chamber flux measurements, DOC characterization, continuous water level data, and radiocarbon analysis in three harvested peatlands in western Canada we measured vertical and horizontal C fluxes and the approximate age of C for each flux on the peat surface and in the drainage channels. We found that aged C played a significant role in both the gaseous and dissolved C emissions in the harvested peatlands which has implications for rapid loss of C to the atmosphere and downstream ecosystems because of peatland disturbance. We conclude that harvested peatlands provide an ideal setting for radiocarbon analysis to understand the fate of aged peat in the face of human land use and climate change.

Susceptibility of Boreal Plains shallow lakes to terrestrialization

Presenter: *Brooke Hehr, Undergraduate student, Renewable Resources*

Authors: *Brooke Hehr and David Olefeldt*

Terrestrialization of shallow lakes is often referred to as being a gradual, autogenic process, however the lateral expansion of vegetation can also be influenced by hydrologic variability driven by allogenic processes related to climate, lake, and landscape characteristics. While research to assess terrestrialization processes are often accompanied by remote sensing technology, few have utilized freely available surface water datasets to evaluate long-term changes in lake extent in the Boreal Plains of Western Canada. We investigated how surface water detections from the Global Surface Water Explorer Yearly History dataset compare to actual water level measurements taken from Boreal Plains shallow lakes in order to (1) examine the presence of surface water in Boreal Plains shallow lakes between 1984–2018 and to (2) compare lake extents to actual water level measurements taken from 1998–2018 to assess the validity of the Yearly History dataset. Here, we extracted annual water history pixel values (0 for no data, 1 for no water present, 2 for seasonal water, and 3 for permanent water) for 33 study lakes in the Utikuma Research Study Area. Preliminary results suggest that the dataset correlates well with actual water level measurements for larger lakes, while smaller lakes show some randomness. This study may provide insight into how the Global Surface Water Explorer Yearly History dataset can be utilized to assess terrestrialization processes, as well as its associated limitations. Next steps include determining lake and landscape drivers influencing water level changes and creating a terrestrialization "susceptibility index" for each study lake.

Community-Based Research: Lessons from the North

Presenter: *Skylar Leili Lipman, Master's Candidate, Resource Economics and Environmental Sociology*

Author: *Skylar Leili Lipman*

"The global Indigenous have a rich and varied history of traditional customs as well as modern relations with settler peoples. This varied history of relations with settlers has led to a multitude of approaches to conflict resolution, ranging from peaceful negotiations to acts of violence to invisibilization; surely not all approaches are created equally. I draw lessons from abroad and discuss their potential applicability to the weak acknowledgement of and collaboration with the members of Graton Rancheria in central California. Given the richness of case studies concerning community-based initiatives of land management in the North and Canada's close relationship with the United States, I review a number of Canadian cooperative organizations, initiatives, and projects that carry out community-based research. I then synthesize common themes to determine "what works" and what needs improvement, using community benefits and ecological health as common pillars around which to analyze each case study. I conclude with a discussion of these lessons learned from the North and how they might be applied to benefit Graton Rancheria.

Not all permafrost-DOM are equal: Investigating biodegradation and composition across the Western Canadian Arctic

Presenter: *Erin MacDonald, Master's Candidate, Biological Sciences*

Authors: *Erin MacDonald, Suzanne Tank, Ryan Hutchins, Steve Kokelj, Duane Froese, and Brian Lanoil*

As temperatures increase, carbon that was previously sequestered in permafrost soils can enter contemporary biogeochemical cycles and become subject to microbial decomposition (biodegradation), releasing carbon dioxide and methane. Biodegradation can occur along the soil-aquatic continuum, transporting and processing carbon within dissolved organic matter (DOM). Though not all DOM is equally susceptible to biodegradation, little is known. To investigate biodegradability, we leached DOM from three stratigraphic layers within the headwall of retrogressive thaw slumps. We measured oxygen consumption to determine biodegradation rates of leachates and found that the relict active layer leachates had the greatest consumption of oxygen (39.3% ±3.89), followed by Pleistocene tills (35.4% ±1.83), and the lowest consumption in active layer leachates (19.3% ±1.97). Overall, oxygen consumption was correlated to initial OC concentrations and was driven by composition, nutrients, and select metals. We also completed a detailed characterization of DOM from a variety of permafrost end-members and landscapes across a latitudinal gradient. Using FTICR-MS, we found variation in DOM among end-member types, which were influenced by landscape but unaffected by latitude. Though there was a high degree of overlap, the compounds unique to one single end-member show variation in saturation and oxygenation, where permafrost end-members include compounds considered to be more biolabile. Together, these results demonstrate that DOM leached from permafrost reflects the heterogeneity at stratigraphic, landscape and regional scales, which should be included for future estimates of carbon release following permafrost thaw.

Landscape controls on water quality in Northern Alberta

Presenter: *Julia Orlova, PhD Candidate, Renewable Resources*

Authors: *Julia Orlova, Taylor Cyr, and David Olefeldt*

Heterogeneous landscapes created by variations in relief and surficial geology in northern Alberta result in highly variable and often unpredictable surface water quality and quantity. Natural variations can be exacerbated by climate change and industrial development. Understanding these variations is critical for protecting the aquatic ecosystems and our drinking water sources. Studies carried out in different forested regions show that runoff as well as the export of solutes (e.g., nutrients and organic matter) from catchments depend on a number of factors, such as climate, presence of wetlands, geology, hydrologic connectivity, land use. However, there is limited information that links catchment characteristics to stream flow and water quality in northern Alberta. Our study is conducted at the Utikuma Region Study Area (URSA), a research site established north of Slave Lake, within the Boreal Plains ecozone. URSA is representative of the boreal Alberta, a region with substantial industrial development, where many people rely on surface water as their drinking water source. In 2018-2019, we measured flows and various water quality parameters (e.g. DOC, TN, NO_3^-, PO_4^{3-}) at 15 streams that drain catchments with different characteristics. Catchment areas for each stream were delineated, and proportions of different land cover and surficial geology types were estimated for each catchment. The relationship between catchment characteristics, stream flow and water quality were examined. The results of this study show the importance of landscapes in controlling water chemistry and availability in streams, and help better understand and anticipate natural variations in surface water quality and quantity.

Rural resources and political power: Understanding incentive structures, local agency, and oil development in the Northwest Territories and Alaska

Presenter: *Kelsey Schober, Master's Candidate, Political Science*

Author: *Kelsey Schober*

Much of the Arctic relies on oil. Ironically, oil – and the burning of fossil fuels – currently threatens Arctic communities, homes, and ways of life. However, increasing amounts of research ignore this seeming contradiction at the community level, choosing instead to focus on federal actions related to oil development. My research seeks to understand whether impacted communities in the Arctic have any say in the future of their engagement with oil, or whether these decisions have already been made by an intricate web of structural incentives, political pressures, and broader power dynamics within governing bodies. What does the pressure to say 'yes' to oil look like in the North American Arctic – and from where does that 'yes' come? My research will answer this question with a two-pronged approach. First, I will construct a framework that delineates structural incentives for oil at the state/territorial level of the Northwest Territories and Alaska. Through a literature review and document analysis, I will synthesize how state/territorial governments are incentivized to say 'yes' to oil development, regardless of the interests of their region. Second, I will undertake a comparative case study between Inuvik (NWT) and Utqiagvik (AK), communities chosen due to their importance as regional hubs for oil, as well as current political climates in which oil faces an ambiguous future due to much-anticipated lease sales (AK) and a federal drilling moratorium (NWT). There, I will conduct semi-structured interviews with political leaders, key Indigenous organizations, and residents. These interviews will seek to better understand political efficacy by observing how the pressure to say 'yes' manifests itself in everyday conversations and perspectives. Ultimately, these case studies will ground my research in examples that can illustrate broader trends in incentive structures, as well as the implications these structures hold for power dynamics in the Arctic.

No evidence of elevated methylmercury downstream of thawing permafrost peatlands

Presenter: *Lauren Thompson, Master's Candidate, Renewable Resources*

Authors: *Lauren Thompson, McKenzie Kuhn, Ryan Hutchins, and David Olefeldt*

Mercury levels in streams and ponds may be sensitive to permafrost thaw driven by climate warming. Permafrost peatland ecosystems have sequestered vast mercury stores from atmospheric deposition and subsequent binding to soil organic matter which may be released through thaw and transformed by microbes to neurotoxic methylmercury. This methylmercury can be transported downstream, bound to dissolved organic carbon. Here, we examined whether methylmercury concentrations are elevated in streams and ponds due to permafrost thaw of boreal peatlands in the Boreal and Taiga Plains of western Canada. We collected water samples from 47 streams and 25 ponds on a 1700 km latitudinal transect to compare permafrost free (56°N), rapidly thawing discontinuous permafrost (59 - 63°N), and continuous permafrost sites (67 - 68°N). Methylmercury and mercury concentrations varied regionally, but were not significantly higher in discontinuous permafrost regions. Small peatland catchments with reducing conditions and aromatic dissolved organic carbon had higher methylmercury concentrations across the transect, regardless of permafrost extent. Our results suggest that in the Boreal and Taiga Plains, mercury released from permafrost and subsequently produced methylmercury do not currently elevate ponds and streams above baseline concentrations.

Exploring Demonstrative Space in Norton Sound Kotlik Yugtun: or how many words are there for there in Yup'ik?

Presenter: *Nicholas Toler, PhD Candidate, Linguistics*

Author: *Nicholas Toler*

Demonstratives, or pointing words, are used to locate and draw attention to objects or places in physical space by creating frames of reference centered on the speaker's location (Levinson 2003). In English, the pronominal demonstrative this references objects close to the speaker while that references objects further away from the speaker. Demonstratives almost universally, however, are used for a wide variety of information indexation tasks from object reference to temporal reference such as now and then, and also discourse reference (Diessel 1999). Central Alaskan Yup'ik, an Eskimo-Aleut language, is regarded as having the world's largest and most complex spatial demonstrative system comprising 30 basic words (Miyaoka 2012). But how does this extensive system actually get utilized in day-to-day speech, and how does it get translated beyond the spatial domain? My fieldwork documenting the highly endangered Norton Sound Kotlik (NSK) dialect is a long term and ongoing process which has focused on the creation of a large set of naturalistic recordings. I record village Elders telling stories, discussing their past, and speaking of the Yup'ik Yuuyaraq or 'The people's way of living.' This presentation discusses my ongoing documentation with the NSK dialect by examining how and which demonstratives surface in spontaneous speech, and how they're being used in the narrative event.

Variability of dissolved organic matter quality within a thawing permafrost peatland catchment: Implications for the methylation of mercury

Presenter: *Erik Umbach, Undergraduate student, Renewable Resources*

Authors: *Erik Umbach, Lauren Thompson, and David Olefeldt*

Climate warming is causing permafrost thaw in the subarctic of northwestern Canada. Peatlands dominate this region that are composed of fens, bogs, lakes, which have thermokarst versions formed from permafrost thaw, and peat plateaus underlain with permafrost. As permafrost thaws, mercury (Hg) bound in organic matter can be released. Depending on physiochemical factors, Hg can undergo methylation into methylmercury (MeHg), a neurotoxin. The quality of dissolved organic matter (DOM) present is a major factor controlling transport, methylation, and removal of Hg from peatlands. This study focused on one characteristic peatland catchment near Wrigley, NWT and aimed to determine how DOM quality and other biogeochemical parameters vary with catchment position and landscape feature. Quantifying these parameters helps predict the potential outcome of Hg within the peatland complex. The catchment was divided into five landscape features where filtered water samples were collected for analyses of pH, electrical conductivity, optical properties to characterize DOM, and sampled for total Hg and MeHg. Quality of the DOM, based on inferred molecular weight (MW), varied as expected within the landscape features. Fen and lake features had the lowest MW, conducive to methylation. Peat plateau and thermokarst features had the highest MW, associated with transport. Fen features also presented the highest concentrations of MeHg and ratio of MeHg/Hg. The connections between landscape features, DOM quality, and Hg concentrations confirmed the findings of previous research. Consequently, our results conclude a link between the landscape features in a thawing permafrost peatland catchment and different Hg methylation conditions.

From ice to ocean: Tracking the composition, fate, and impact of submarine glacial discharge in the nearshore coastal ocean in the Canadian Arctic Archipelago

Presenter: *Patrick Williams, Master's Candidate, Earth and Atmospheric Science*

Authors: *Patrick Williams, Megan Roberts, Stephanie Waterman, David Burgess, Charvanaa Dhoonmoon, Erin Bertrand, and Maya Bhatia*

As glaciers melt, erosion, chemical weathering, biological reactions, and hydrologic fluxes transform and export entrained sediments and dissolved species to the ocean. This runoff may influence biological productivity in nearshore ecosystems by supplying essential nutrients and carbon. To better understand the relationship between glacial melt and downstream productivity, we conducted an ice-to-ocean study of a large marine-terminating glacier in a previously uncharacterized Arctic region, the Canadian Arctic Archipelago. We present data from ice and meltwater collected on the glacier surface and margins in the spring and summer, in conjunction with marine measurements spanning the submarine discharge plume within 1 to 25-km of the glacier terminus. We track biogeochemical properties of glacial runoff and its fate in the ocean by characterizing the downstream evolution of its sediment, carbon, nutrient, and biological community composition. Profiles of temperature, salinity, turbidity, and chlorophyll provide broad-scale physical and biological oceanographic context and insight into meltwater plume extent and dynamics. Finally, an array of time-lapse cameras as well as historical satellite, meteorological, and global positioning station data are used to constrain the seasonal evolution of the glacier drainage system and its relationship to plume development at the terminus, placing our measurements in the broader seasonal context. Results from this ice-to-ocean study will help to clarify current uncertainties regarding the source, fate and biological impact of glacially-derived nutrients and carbon in the ocean, providing important insight into how Arctic coastal productivity will be impacted by future climate warming.