COLUMBIA MOUNTAINS INSTITUTE of Applied Ecology

Forum Summary

CMI Annual Researchers' Forum

October 26-27, 2023

Nelson Rod & Gun Club Hall & various field sites

Nelson, BC

PHOTO: Skyeler Folkes

Many thanks to Masse Environmental Consultants and Columbia Power for your financial support.

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COLUMBIA POWER

The Columbia Mountains Institute of Applied Ecology (CMI) hosts an annual event where we gather members of the scientific community, Indigenous community members and representatives, stewardship groups, students, and interested individuals to provide updates on ecological projects taking place in southeastern British Columbia – everything from field trials, new restoration projects and their associated community initiatives, to ecosystem monitoring and research, etc. These updates cover a wide range of topics and species – unlike our conferences which have clearly defined themes. This is an informal atmosphere and everyone is invited to attend, mix, and mingle!

This event travels around the Columbia Mountains area and this year our Researchers' Forum took place in Nelson, BC. This year's gathering highlighted aquatics work in the region, alongside a variety of other ecological projects. The presentations and a social took place on Thu Oct 26th, and two field trips were planned for Fri Oct 27th. (A third field trip had been planned, but was cancelled due to the weather.) This year just over 115 people gathered around eleven talks, ten posters, one field trip, and a bunch of networking!

A big **thank you** to everyone who took the time to share their work with us and for the important work you do. Thank you to Marc-André Beaucher, Catherine Craig and Doris Hausleitner who volunteered to emcee the forum. Thanks also to Kendal Benesh, Pete Tarleton, Renae Mackas, Jacqui Van Horne, and Brendan Wilson for their volunteer support.

Contents

Oral presentations (in order they were presented)

1. From drones to data: Advancing fisheries research through collaboration and geospatial technology

Presenters: Skyeler Folkes, GIS and Emerging Technology Leads, Okanagan Nation Alliance, sfolks@sylix.org
Bruno-Charles Busseau, Selkirk College School of Environment and Geomatics, bbusseau@selkirk.ca
David Greaves, Selkirk College and Selkirk Innovates, dgreaves@selkirk.ca

Co-Authors: Rena Vandenbos, Selkirk College and Selkirk Innovates

Negative human impacts and climate change have emphasized the need to facilitate rapid climate and economic adaptation efforts to safeguard aquatic resources. Technology skill development and access to cutting-edge equipment have begun to play a crucial role in the preservation of fisheries and aquatic resources. The integration of geospatial technology opens avenues for the creation of swift, replicable, quantifiable survey methodologies, facilitates more efficient processing and analysis of landscape-scale data, and reduces the overall cost of data collection.

Over the past few years, Selkirk Innovates and the Okanagan Nation Alliance have engaged in collaborative efforts on multiple innovative fisheries projects that incorporate geospatial technology. The Okanagan Nation Alliance is a not-for-profit tribal organization that works for the member bands of the Okanagan Nation. The fisheries department mandate is the conservation and preservation of fisheries and aquatic resources within the traditional territories of the Syilx people, incorporating leading and advanced technologies where possible. Selkirk Innovates is a leader in applied research related to geospatial technologies and natural resource management. The GIS and Natural Resources Lab at Selkirk Innovates provides critical infrastructure, student internships and applied research expertise to support this research. Together we are developing fisheries intelligence research methods utilizing drones to further develop conservation and restoration works currently underway. Several examples of this work include:

1. The *Thermal Refugia Project* where we are leveraging drone-based thermal imaging technology to map thermal refuge habitats in Kootenay and Okanagan streams;
2. The *Multi-sensor Approach to Classification of Juvenile Freshwater Fish Habitat Inventory using Unmanned Aerial Vehicles Project* where we are refining drone-based data acquisition methods and exploring the use of hybrid sensor data to

design workflow and processing pipelines for habitat mapping and stream metrics mensuration;
3. The *Fish and Redd Enumeration Project* where we are investigating automation techniques to enumerate fish and redds using multi-sensor approach; and
4. The *Exploration of Surface Flow Rates* project where we are determining the feasibility of using drone imagery to measure stream flow rates within a river for the purpose of identifying spawning habitat and determining optimal stream flows required for Salmonids to spawn and rear young.

Understanding and studying fish habitats are vital not only for ecological balance but also for preserving cultural heritage and sustaining regional economies, as these fisheries play pivotal roles in Indigenous traditions and the local economy. These research projects function under a greater purpose to support collaborative relationship building and knowledge sharing opportunities. Building partnerships that focus on solving community development challenges through student learning has proven to strengthen diversity, inclusion, and Indigenous reconciliation. Our approach is grounded in the understanding that innovation requires a diversity of perspectives.

Biographical notes

Skyeler Folks is from the frog clan, wilp (house) Nikateen of the Gitxsan Nation on his mother's side, and English on his fathers. Skyeler lives within the Penticton Creek watershed with his two boys and partner. Skyeler has been gratefully living and working in Syilx territory since 2003 where he completed his BSc in Freshwater Science, and Earth and Environmental Science at UBCO. Since working with ONA Skyeler has been working on incorporating advanced technologies into natural resource projects. From fisheries and stock assessment to riparian, forestry, and wildlife management applications, Skyeler is now the lead of the geospatial team at ONA utilizing thermal, LiDAR and photogrammetry workflows in projects within Syilx territory.

Bruno-Charles Busseau, AKA B-C, is a geographer, specialized in snow remote sensing. He completed a B.A. in geography and environmental studies from the University of Ottawa and a M.Sc. in geography applied to remote sensing from Sherbrooke University. His research used remote sensing and in-situ measurements to characterize snow accumulation and snow melt in Northern Quebec. He has since worked in the forestry and agricultural industry as a GIS Analyst and Data Scientist. B-C joined Selkirk College in February 2020 as a research assistant working on various projects using remote sensing and LiDAR technologies. He has now moved on to work in the Wine industry as a remote sensing researcher but is still an instructor with the school of environment and geomatics. B-C moved to British Columbia with his family in 2017 to get closer to the mountains. He is an avid skier, rock climber and mountain biker.

David Greaves is a master's candidate in Vancouver Island University’s GIS Applications program, has a bachelor's degree in Geographic Information Systems and a diploma in Recreation, Fish, and Wildlife from Selkirk College. He is an experienced advanced operations drone pilot, instructor, and flight reviewer, specialized in remotely piloted aircraft system mission management and airborne sensor-tech data acquisition. He has proven experience in leading field operations, project safety, public relations, hardware management and a unique ability to apply technology to business processes. His research interests include remote sensing, drones, food security, fish and wildlife conservation, forestry, avalanche studies and sustainable rural development. David is active in the Castlegar community serving as President of the Kootenay Food Strategy Society responsible for the Castlegardens community garden space. He resides with his wife and six children in Castlegar and enjoys skiing, biking, horticulture, photography, and videography.

2. The importance of Kootenay Lake habitat for Kootenay(i) White Sturgeon

Presenter: Sarah Stephenson, Sturgeon Restoration Specialist for BC Ministry of Water, Land and Resource Stewardship, Sarah.Stephenson@gov.bc.ca

Kootenay/i White Sturgeon are federally listed as endangered in both USA and Canada, residing in the Kootenay River and Lake, ranging through Montana, Idaho, and BC. The importance of the Kootenay Lake portion of the range in BC has become increasingly clear as we learn about habitat use of the remaining wild fish as well as the growth trends of the hatchery juvenile and subadults. This transboundary population has had virtually no recruitment since the construction of Libby Dam in 1972. The wild population of the entire transboundary population is mainly comprised of aging wild adults (n=~1700) and the juvenile and sub-adult population (n=~15,000) are hatchery origin individuals from supplementation that began in 1991. Long term acoustic telemetry data sets are an important monitoring tool for a species that lives over 100 years and females can take more than 35 years to reach sexual maturity. This study focused on the wild female spawning portion of the population; 192 females were tagged with the longest life acoustic tag available (10-year battery life) and tracking data was summarized from 2003-2022. Regardless of where the adults reside outside of spawning, all spawning occurs in a 15 km stretch of river in Idaho. The time spent on the spawn reach by females was mid-May to mid-June, the median time spent on the spawn reach overall years was 22 days. The time between spawns varied between two to seven years (median=3 years); however, this is likely an underestimate of spawn periodicity as some females only had one spawn event recorded and periodicity could extend beyond the life of the tag. Outside of spawning, most females resided in Kootenay Lake. The benefits of residing in Kootenay Lake versus the lower productive river habitat was investigated by looking at spawn periodicity and growth of the fish. There was no relationship between time spent in the lake and spawn periodicity nor a clear relationship with growth (fork length). Growth rates are challenging to monitor with adult White Sturgeon because annual growth in the Kootenay system was only ~2 cm/year, the average time between encounters was 7 years and 30% of fish were only recaptured once. Measurement error between captures therefore tended to drown out any potential relationships. However, from other studies in the Kootenay drainage looking at younger hatchery origin individuals, growth is significantly higher in the lake portion of the range versus the river. Long-term monitoring will continue for this population, tracking growth and habitat use of both the wild and hatchery components of the population. Understanding the high use of Kootenay Lake is important for understanding population dynamics, informing modelling assumptions and sampling needs, all to optimize recovery and stocking targets in a highly altered ecosystem.

Biographical notes

Sarah Stephenson is a fish biologist who has worked with White Sturgeon for 15 years, primarily with the Kootenay and Columbia populations. Sarah has led field programs for sturgeon programs in the US and BC and although she is mostly office based these days, her favorite days are still when she is out working on the water with fish, especially sturgeon. Currently, Sarah is in a role with the BC Ministry of Water, Land and Resource Stewardship supporting sturgeon programs throughout BC, including leading engagement with First Nations and stakeholders for the BC Fraser River White Sturgeon Plan.

3. Columbia River Sturgeon substrate placement and monitoring

Presenters: Andre Zimmermann, Principal Geoscientist, Northwest Hydraulic Consultants Ltd., azimmermann@nhcweb.com
Steve McAdam, Hydro Impacts/Sturgeon Specialist, BC Ministry of Land and Water Resource Stewardship, Steve.McAdam@gov.bc.ca
James Crossman, Senior Environmental Coordinator, Fish and Aquatics, Environment, BC Hydro, James.Crossman@bchydro.com

Natural juvenile production of Columbia River white sturgeon has been below replacement levels for decades due to persistent recruitment failure. The apparent cause of recruitment failure is historical substrate alterations at spawning sites that decreases the quality of interstitial habitats, and thereby limits survival of eggs and larvae. Substrate restoration was conducted in tailrace of the Arrow Lakes Hydro generating station aimed to improve substrate quality at one of three spawning sites in the Canadian portion of the transboundary reach. Selection of the area and composition of restored substrates was based on expert input leading to a finalized design to place substrate over an area of 5,800 square meters. Between October 2022 and April 2023 material was placed to a depth of two times the largest particles size (i.e. 0.60 m), and the composition of the rock provided a mix of larger material (maximum size = 0.30 m diameter) to provide substrate retention and smaller material (minimum size = 0.10 m) to provide suitable interstitial habitat. Long term monitoring of subsurface substrate conditions is a key challenge that was addressed by placing temperature monitoring grids within the placed substrate. Grids placed at three locations monitoring infilling based on the principle that heat transmission differs when interstitial habitats are filled with water or sand. A heater element is turned on periodically and the resulting rise in temperature is an index of how much sediment has filled the interstitial habitat. Monitoring to date indicates a limited amount of infilling may have occurred at depth in upstream portion of the placed material (See here for more; user: public/ pass nhcwater!). While the placement of the substrate is simple in concept, the implementation of the design required a substantial commitment by the project cooperators. Furthermore, the installation of a system capable of monitoring the lifespan of the placed material is unique. Monitoring enables a true quantification of this habitat-based recovery effort.

Biographical notes
Andre Zimmermann grew up in Nelson and first work in the aquatic habitat field in 1997 at Timberland Consultants during the FRBC Habitat Restoration Program. Today Andre is a Principal Geomorphologist in North Vancouver and specializing in channel stability, hydrology, complex data collection systems, and analysis of large time-series datasets.

A self-professed data geek, Andre takes pleasure in solving difficult data acquisition problems that require the use of a wide variety of commercial and custom-designed instruments for application across the full spectrum of field and laboratory settings. André is an adjunct faculty member in the Department of Geography at UBC, where he collaborates with students on applied research projects.

4. The impacts of declining kokanee abundance on grizzly bear observations at the Lardeau River

Presenter: Sage Raymond, University of Alberta, Thompson Rivers University, rraymon1@ualberta.ca

Co-Authors: Julius Strauss, Wild Bear Lodge Ltd
Nancy Flood, Thompson Rivers University

Salmon (*Oncorhynchus* spp.) are an important food source for Grizzly Bear (*Ursus arctos*), but many salmon populations are declining. While most research on Grizzly Bear–salmon interactions occurs in coastal ecosystems, declining salmon may also affect Grizzly Bears in inland ecosystems where salmon are also an important part of their diet. We document changes in the number and distribution of observations of Grizzly Bears and changing Kokanee (i.e., landlocked Sockeye Salmon, *Oncorhynchus nerka*) abundance at an inland river. We hypothesized that reduced abundance of Kokanee would limit the number of Grizzly Bear observations at the river. We compared Kokanee abundance and Grizzly Bear observations (n = 535) between 2012 and 2019 at the Lardeau River, British Columbia, Canada. We used a generalized linear mixed model to test if the number of bear observations changed as a function of Kokanee abundance among four river reaches during eight consecutive years of study. Kokanee abundance was a strong statistical predictor of Grizzly Bear observations (β = 0.52, P = 0.001, CI = 0.12–0.87), and Kokanee abundance and reach explained 73% of the variance. Our results suggest that reduced Kokanee abundance also reduces Grizzly Bear presence, likely because bears seek out other, more available food sources, away from Kokanee spawning habitat. This pattern could limit ecosystem services provided by Grizzly Bears adjacent to spawning areas and it could have implications for bear management and conservation.

See here for published article.

Biographical notes

Sage has been working with wildlife in various capacities for the last 10 years. She has a diploma in recreation, fish, and wildlife from Selkirk College and a bachelor's degree in science from Thompson Rivers University. Sage is currently a PhD student at the University of Alberta, studying conflict between people and urban-adapted coyotes. She worked as a bear-viewing and wilderness guide in the Kootenays for 6 years. Sage also studies and teaches wildlife track and sign identification and is the first certified track and sign specialist in Canada (trackercertification.com).

5. Wetland mapping across British Columbia

Presenter: Cora Skaien, Ministry of Water, Land and Resource Stewardship and BC Conservation Data Centre, Cora.skaien@gov.bc.ca

Co-Authors: Deepa Filatow, BC Ministry of Water, Land and Resource Stewardship and Terrestrial Ecosystem Inventory
Gillian Munroe, BC Ministry of Water, Land and Resource Stewardship and Terrestrial Ecosystem Inventory; Erin Roberts, Canadian Wildlife Service
Jason Straka, BC Ministry of Water, Land and Resource Stewardship and BC Conservation Data Centre

Wetlands host numerous at-risk species and offer several ecological benefits, such as habitat for animals including waterfowl and mammals, and the potential for long-term carbon storage. In this presentation, I highlight some key goals of the Province of British Columbia related to wetland mapping, modelling and status rankings. I showcase recent wetland mapping work completed in the East Kootenays and Northern BC, and prior wetland modelling in the Williston Drainage Basin. The Williston Wetlands Predictive Model was 86.7% accurate in predicting wetlands across the landscape (3-category; wetland, upland, water), with potential to predict further to wetland class (e.g., marsh, fen, swamp, bog, shallow open water, flood plains, etc.). This project acts as a demonstration of what we can do in other areas of the province, including some of the additional pilot areas surveyed in 2023. The ultimate goal is to enhance province-wide data on wetlands that builds off of the Freshwater Atlas (FWA) and other data. Additionally, within the Conservation Data Centre (CDC), we use the field data collected to map wetland Site Associations as Element Occurrences (EO) that are used to assess the conservation status ranking of different ecosystems to classify as S1-S5, and into red, blue and yellow-listed ecosystems. The EO mapping and status ranking processes requires expertise from qualified professionals, with an RFQ issued periodically. The BC government is partnering with other organizations and universities to accomplish our goals and have an internal 'wetlands working group'. An example of a collaboration currently underway is a project in which university students are working on creating data derivatives from SPOT 1.5-m resolution satellite imagery that can be made publicly available by the province. We want to know, "what derivatives would help people's research?". Another upcoming collaboration pertains to carbon sequestration modelling in collaboration with the federal government, in which we are seeking additional interested collaborators for submitting data on peat depth measurements and for modelling. Individuals or groups who would like to submit wetland data to be included in the BC Government database, or suggest collaborations, can e-mail wetlands@gov.bc.ca

Relevant Links:

1. LMH 52
2. Freshwater Atlas (FWA)
3. Williston Wetlands Explorer Tool

4. Submitting data to TEI
5. Submitting data to CDC
6. CDC Element Occurrence information
7. CDC Status Assessment Rankings
8. CDC iMap
9. BC Species and Ecosystem Explorer
10. Helpful webinar for CDC iMap and BC Species and Ecosystem Explorer

Relevant contacts:

1. CDC to inquire for data or RFQs: cdcdata@gov.bc.ca
2. TEI group to request BAPID or more information on data submissions: TEI_Mail@gov.bc.ca
3. Wetland-specific inquiries: wetlands@gov.bc.ca

Biographical notes

Cora is a wetland vegetation ecologist for the Conservation Data Centre within the Government of British Columbia's Knowledge Management Branch. She focuses on inventory, classification, status ranking and modelling of wetlands across BC. Prior to this role, she was an ecological modelling specialist where she collaborated on producing models aimed at predicting wildfire locations and intensity across BC over the next 100 years, huckleberry production in logged areas for grizzly bears, and other projects. She also is involved in wildfire rehabilitation research within the West Kootenays and helping to reduce human-wildlife conflict through her role as a Community Coordinator with WildSafeBC. She also continues working on projects looking at recovery of ecosystems with reduction in herbivore density, mainly on the coast and throughout the Gulf Islands, continuing themes from her PhD work. Cora happily resides in the Slocan Valley with her 2 dogs and 2 cats.

6. Geology, aquifer, and water study of the Slocan Valley

Presenter: Richard Johnson, P.Eng., Slocan Lake Research Centre,
richard.slrc@gmail.com

A geology-aquifer-water study has been initiated for the Slocan River Valley. It is in response to the need for an integrated study to update the aquifer mapping which is currently out of date and to service the needs of residents with water source questions and on-the-ground work being done that needs hydrogeological input.

Government maps of the Slocan Valley need to be updated using the latest water and geological knowledge. The post-glacial geology of the valley is the framework that dictated the formation of the aquifers. The water quality and quantity data that has been collected and is currently being collected contributes to the knowledgebase. An integrated study will bring these disciplines together. The goal is to create a user-friendly ongoing knowledge base for the community that can easily be accessed on-line with in-person support.

Biographical notes
Richard is a professional engineer working on ethnohydrogeological problems. His work has included finger-printing water, teaching water analysis interpretation, doing hydrogeological studies and teaching people how to use the QGIS mapping program in their studies. He works with numerous non-profit societies in the Upper Columbia River Basin.

7. Ecosystem values & the dynamics of decision making

Presenter: Wendy King, Slocan Lake Stewardship Society, wkconsul@telusplanet.net

As the world, climate and environment around us rapidly changes, conservation organizations, indigenous communities and regulatory authorities are facing continued pressure to improve not only the effectiveness of conservation and restoration implementations, techniques and methodologies, but a defined need to reduce the timeline from visioning to on-the-ground lifecycles. The Slocan Lake Stewardship Society (SLSS) has taken an innovative approach in an attempt to reduce that timeline and move from ecosystem value recognition to defined priorities for conservation. This presentation will provide insight on maturing your practices to support multiple and complex views for priority setting, use of multi-faceted teams, leveraging knowledge and hardening strategic plans. SLSS will draw from their recent experience on a series of projects in the Bonanza Biodiversity Corridor over the past 4 years and highlight how that approach is now being applied and extended into the Slocan River Valley.

Biographical notes
After retiring from a long and diverse career in the industrial and corporate worlds, Wendy brings her business development and strategic expertise to the table in the crafting of pragmatic and flexible approaches to successfully deliver projects, initiatives and programs. Wendy King initially got involved in conservation work in the Slocan Watershed shortly after permanently moving to the area and becoming active on various trail and recreational societies in the area. Several years later, Wendy leads SLSS in expanding their strategic focus and building a network of working partners.

8. Managing human activities around wolverine reproductive dens

Presenter: Andrea Kortello, Grylloblatta Ecological Consulting, kortello@yahoo.com

Co-Authors: Doris Hausleitner, Seepanee Ecological Consulting, Dhausleitner@selkirk.ca
Mirjam Barrueto, PhD. Candidate, University of Calgary, mirjam.barrueto@ucalgary.ca
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John Krebs, Ministry of Forests, Lands, Natural Resource Operations and Rural Development, John.krebs@gov.bc.ca

Wolverines den in deep snow associated with boulders or woody debris at or below treeline in montane western North America. They have naturally low reproductive rates, a fidelity to denning areas and a sensitivity to disturbance during the reproductive period. Identifying dens and denning habitat is important for conservation and management but few dens have been located in North America. We used citizen science, aerial surveys, remote cameras and camera integrated bait stations to identify wolverine dens and reproductive activity in the West Kootenays. We synthesized existing information on wolverine denning areas to provide guidance on managing human activity to minimize disturbance to breeding females. Denning areas can be identified by a concentration of tracks over multiple weeks from 15 January to 15 May and latrine piles indicate prolonged use associated with denning. Reproductive females may use a series of nearby dens, and rely on provisions cached in the surrounding areas, hence activities should be avoided within a 4 km radius during the denning period. When activities can't be avoided completely, best practices are to limit groups and concentrate movement on existing trails or roads. Wolverines are sensitive to disturbance at a very low intensity of use and are at greatest risk when movement is dispersed and unpredictable. Mechanized use is more disruptive to reproductive females, as it can occur across a larger spatial footprint.

Biographical notes

Andrea Kortello is based in Nelson. She has been pursuing the elusive wolverine for the last decade. Her interests are in conservation ecology, and she has worked with provincial and federal agencies on projects spanning fire ecology, aquatic insects and large carnivores. She has recently joined Poisson Consulting.

9. Harvest retention of endangered Whitebark Pine

Presenter: Michael P. Murray, Ministry of Forests, michael.murray@gov.bc.ca

The long-term retention of endangered mature whitebark pine trees can ensure that ecological values are better protected. Despite well-intended efforts, harvest retention is challenged by windfall events. Before this study, survivorship of whitebark pine retained within commercial harvests had not been examined. We investigated the fate of residual trees to infer some preliminary recommendations. Our objectives were to describe the temporal attrition of retained mature whitebark pine trees and to identify factors that likely promote survivorship during the critical initial post-harvest period.

The probability of mortality of retained whitebark pine trees is best explained by a combination of tree characteristics, slope/aspect, and the number of surrounding retained trees. We found a strong increase in survivorship, with greater tree crown length accompanied by decreasing tree height. Thus, the probability of post-harvest mortality was higher for taller trees with shorter crowns and lower for shorter trees with long crowns. In examining the importance of neighbor trees, a survivorship probability greater than 50% required a minimum of 7.5 retained neighbor trees with tree height radial distance. For trees that did not survive, we found the vast majority of downed stems oriented in a northeasterly direction from root collar to crown indicating the strongest winds experienced at the sites arrived from southwesterly directions. Interestingly, there were opposite effects depending on the tree lesion type (cankers vs. rodent wounding). Any rodent damage indicated higher survivorship. With one or more blister rust cankers, there would be less than a 50% chance of survival.

Results indicate that most trees fell during storm conditions. We suggest that winter storms and approaching fronts of coastal low-pressure systems are the most significant drivers of blowdown for whitebark pine stands in the southern interior region. For at least one harvest site (Lavington), a majority of trees were blown over while alive. Although cankered mature trees can survive for decades, if *Cronartium ribicola* remains in the host, chronic stress may interfere with physiological mechanisms that contribute to windfirmness. Our results are consistent with the vast majority of retention studies, indicating that higher retention levels favor positive survivorship rates. There are likely additional factors that favor retention survivorship – that we did not examine. These may include pre-harvest stem density, soil (texture, depth, moisture), and rooting structure.

For southeast British Columbia and the adjacent Kootenai Region of the USA, we recommend harvest practitioners carefully retain whitebark pine. To increase likelihood of survival, we recommend practitioners retain:

- A minimum of eight neighboring trees within the target tree's height radius.
- Trees with longer crown lengths and lower frequencies of disease cankers.
- Trees of average height.
- Ovate patches of retention oriented on a southwest-to-northeast azimuth

Paper links

- Harvest Retention Survivorship

- Retain Whitebark Pine

Biographical notes
Michael Murray is a Regional Forest Pathologist based in Nelson, BC. He received his Ph.D. in whitebark pine fire ecology and forest health from the University of Idaho. Michael initiated Canada's disease resistance program for whitebark pine. Other interests include climate driven tree declines and ameliorating armillaria root disease. Michael is a founding board member of Canada's Whitebark Pine Ecosystem Foundation.

10. Species distribution modeling to inform seed provenance approaches that create climate change resilience in *Camassia quamash* (common camas) populations throughout the Lower Columbia region of the West Kootenays in British Columbia

Presenter: Tannah M. Ernst, Kootenay Native Plant Society, t.ernst@kootenaynativeplants.ca

Co-Authors: Valerie Huff & Bren Beckwith, Kootenay Native Plant Society

The inability of native plant populations to adapt to a rapidly changing climate will negatively impact plant-pollination networks and threaten the overall resilience of ecosystems in the Lower Columbia Region, a subregion of the West Kootenays. Supporting many species of native pollinators, *Camassia quamash* (common camas) plays a crucial role in propping up the plant-pollinator networks of this area. Introducing climate resilience into these ecosystems requires intimate knowledge of how these species ranges will respond so that all restoration and seed provenance approaches can be tailored to the needs of the species.

The objectives of this study include creating maps of camas in their current and projected distribution throughout the Columbia Plateau (SDM study area), and the range response in the Lower Columbia Region (restoration study area). I also analyzed to identify the best seed provenance approach based on the range response of camas. All data preparation and model setting steps were performed using RStudio. The distribution of camas was modeled under current and projected climate conditions with MaxEnt using presence-only species occurrence data. The environmental variables used in the current and projected distribution models and their explanatory contribution are (in order from greatest contribution to least): precipitation in the spring (35.5%), annual heat moisture index (17.9%), elevation (15.3%), average temperature in the summer (9.7%), relative humidity (8.6%), mean annual temperature (8.4%), and precipitation in the summer (4.5%). The selection process for the variables was based on their relevance to camas environmental requirements and lack of overt correlation amongst each other. The distribution output from MaxEnt was symbolized using ArcGIS Pro, and further analyzed with ArcGIS Pro's Raster Calculator to create the range response in the Lower Columbia Region.

The study found that under projected conditions, highly suitable areas of camas habitat contracted, with general patterns of expansion moving both upslope and in northern directions for populations in both Canada and the United States. In addition to this, the populations along the valley bottoms in the Lower Columbia Region were predicted to

respond to climate change by contracting from lower elevations and expanding to sites uphill.

Biographical notes

Tannah M. Ernst is a recent graduate from Selkirk College Geomatic Information Systems (GIS) BSc and Integrated Environmental Planning (IEP) programs and volunteers with the Ymir Watershed Action Group. Since 2020 Tannah has worked with the Kootenay Native Plant Society (KNPS) as a student research assistant for Native Bees and their Floral Relations, Wild-Seed Sourcing, Native Bee Baseline Surveys, and as their Mapping and Restoration Technician. In March of 2023 she completed her GIS BSc thesis, supported by KNPS, on modeling climate suitability for Camas in the Columbia Plateau. Current projects with KNPS include long term climate suitability models under various climate projection scenarios; wild-seed sourcing and restoration initiatives for KNPS' long-term Pollination Pathway Climate Adaptation Initiative (PPCAI) project; and Ymir Watershed initiatives.

11. Myxomycetes of British Columbia

Presenters: Ryan Durand, M.Sc., R.P.Bio., EcoLogic Consultants Ltd.,
rdurand@ecologicconsultants.com
Tyson Ehlers, B.Sc., R.P.Bio., Masse Environmental Ltd.,
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For the last three years we have been working on an inventory of the myxomycetes (slime moulds) of British Columbia. Over that time, we have documented roughly 240 species (of the approximately 1,200 known globally), including several dozen species not previously known to occur in the province, several new species for Canada or North America, and Tyson Ehlers is in the process of describing a new genus that is endemic to the Slocan Valley. While we have been actively collecting and describing species from across BC, the majority of our effort has been within the west Kootenay. Of particular interest is a group known as the nivicolous slime moulds which mainly develop at (or just under) the melting snow line. In August of this year, slime moulds were added to the BC Conservation Data Centre's database, including initial conservation assessments resulting in multiple blue-listed species.

Our presentation included a brief introduction to the diversity of these tiny, but very photogenic species and where they can be found.

Biographical notes
Ryan Durand is an ecologist from the Slocan Valley with EcoLogic Consultants. For the last 25 years he has worked throughout western Canada and the arctic on a wide range of ecosystem mapping, classification and inventory projects, with a focus on wetlands and rare species. He is working with a small group of like-minded myxo obsessed researchers on an inventory of all the slime moulds of BC to develop a guide book for the province.

Tyson Ehlers is an ecologist and biologist from the Slocan Valley specializing in mycology. Like many who spend their time looking for mushrooms, slime moulds (myxomycetes) inevitably caught his eye. Somehow this passing interest became an obsession and for the past several years Tyson has devoted his time to the slime. He has been collecting and learning about slime moulds and collaborating with other BC myxo-enthusiasts to produce a baseline inventory and guidebook for the slime moulds of BC.

Posters

12. Tree frogs in the Kootenays: A new species in BC?

Presenter: Ian Adams, Larix Ecological Consulting, ian44adams@gmail.com
Co-Authors: Leigh Anne Issac, BC Ministry of Water, Land and Resource Stewardship, leighanne.isaac@gov.bc.ca

Background

Evidence suggests that British Columbia may support an additional species of treefrog, aka chorus frogs. To date, treefrogs in southern BC have been recognized as **Northern Pacific Treefrog**, *Pseudacris regilla*, (sometimes classified as Genus *Hyliola* or *Hyla*). Increasing evidence support treefrogs in the southeastern part of the province are a separate species: **Sierra Treefrog**, *P. sierra*. However, this is still debated (see 4) and with treefrog phylogenetics remaining an area of uncertainty, the BC Conservation Data Centre considers all treefrogs in BC to be *P. regilla*. NatureServe also does not recognize *P. sierra* to occur in BC or Washington, but places it in Idaho and Montana. Conversely, NatureServe recognizes *P. regilla* in BC, Washington and Montana but not Idaho. However, both Idaho and Montana Natural Heritage Programs, analogous to BC CDC, recognize *P. sierra* but not *P. regilla* as occurring in these states. They recognize *P. sierra* in counties adjacent to the US-Canada border). In sum, there is strong evidence for treefrogs east of the Kettle River valley being assigned to *P. sierra.* The situation farther north of the US border is unclear.

Project

We are working on a project to collect treefrog tissue samples across the southern BC interior to submit for genetic sampling and determine:

A) Is there evidence for two species of treefrogs in southern British Columbia?

And, if yes,

B) Where does the fracture zone occur between *P. regilla* and *P. sierra*?

How You Can Help

We are looking to collate information on where *Pseudacris* sp. occur and breed in the southern BC interior.

- If you know of a pond where treefrogs breed, we'd like to know more about it including location and time of breeding by local treefrogs.
- If you are willing to collect tissues from this pond, we'd like to have your help.
- If you know of a pond where treefrogs breed but aren't able to collect, we'd still like to know about the pond.

If you can help, please email your information including: **Name**, **email address**, phone number (optional), and **location of pond(s)** to us at one of the emails above

We will send you more information on how to differentiate among tadpole species that may also occur in the pond including: Columbia Spotted Frog, Great Basin Spadefoot, Western Toad, Long-toed Salamander, and others.

Biological notes
Ian Adams is a wildlife biologist based in Cranbrook with over 25 years of experience in a variety of capacities, including a past Director and President with CMI. He is currently the Key Biodiversity Area coordinator for British Columbia with Wildlife Conservation Society Canada as well as dabbling in a range of other projects, such as teasing apart treefrog species in southeastern BC.

Click here to view the poster

13. CLEAR (Collective for Lower Elk Aquifer Restoration

Presenter: Karen Bergman, CLEAR

CLEAR is a volunteer community water and environmental stewardship group. We are a registered BC Society as of February, 2023.

Our mission: To restore, preserve and protect Elko and Baynes Lake aquifers., surface water and eco-systems that rely on the Elk River, for the benefit of the natural environment and the people who live, work and recreate here, for generations to come.

We formed initially to address critically low water levels in our area in 2022. Some kettle lakes were dry and others reduced to puddles. Aquatic and semi aquatic habitats were reduced or gone. Some domestic wells dried up.

Our area has had recurring low water concerns for decades related to changes to Elko Hydro Dam operations on the Elk River. The Dam began operating in 1925. Recent new geology and water quality evidence demonstrates the hydrological link between the Elk River and our aquifers.

Restoring reliable water quantity and quality is a start. Water and environmental stewardship is going to become more important given changes in climate, population growth, developmental pressures, changes in Elk River water use upstream and cumulative environmental effects.

We are honored to have Yaq̓it ʔa·knuqƛi 'it (Tobacco Plains) membership on our board. We recognize we are on the traditional lands of the Yaq̓it ʔa·knuqƛi 'it and they are the original stewards.

CLEAR completed an Environmental Screening Report in 2023. Link: https://data.cbwaterhub.ca/organization/collective-for-lower-elk-aquifer-restoration

CLEAR is contracting with MacHydro to develop a long term water monitoring framework in 2023/24.

See here for CLEAR's Facebook page

Biographical notes

Karen Bergman (BSc, MBA) is the co-founder and co-chair of CLEAR (Collective for Lower Elk Aquifer Restoration). She has lived in Baynes Lake since 2011 after retiring from a public service career in policy for several governments and many departments! She believes a caring, strong community that takes action makes the world a better place for all living things.

Click here to view the poster

14. Exploring drone-enabled fish detection and behaviour monitoring for salmonids

Presenters: Ethan Castilloux, Selkirk Innovates, Ecastilloux@selkirk.ca
Bruno-Charles Busseau, Selkirk College, bbusseau@selkirk.ca

Co-authors: David Greaves, Selkirk College and Selkirk Innovates, dgreaves@selkirk.ca
Rena Vandenbos, Selkirk College and Selkirk Innovates, Rvandenbos@selkirk.ca
Riley Kenning, Selkirk Innovates, rrkenning@gmail.com

Fish and spawning bed ("redd") enumeration are important components of traditional fisheries studies and typically involve field-based techniques that rely on visual observation and manual counting through snorkel surveys, fish tagging, or boat surveys. Recently, advancements in geospatial technology have allowed for semi-automated approaches to these types of studies. In 2022, Selkirk Innovates partnered with the Okanagan Nation Alliance to explore the feasibility of using drones alongside traditional methods for fish and redd enumeration.

The investigation into semi-automated fish detection leveraged TensorFlow Object Detection (TFOD) with a machine learning Convolutional Neural Network (CNN). Model and parameter optimization were achieved through a comprehensive exploration of various image sizes, labeling methods, training/testing image ratios, step counts, and pre-trained models. Preliminary findings show accurate fish object detection using these techniques. The research with redd enumeration involved the use of multispectral imagery and object-based image analysis (OBIA). Initial results have demonstrated the potential of utilizing specific wavelengths and multiband indices to detect sediment disturbances and algae removal during the formation of redds. Further experimentation remains imperative to refine accuracy and fully harness the technology's potential in fisheries management.

These novel approaches hold significant promise for enhancing our capacity to monitor and assess fish populations, especially in environments where traditional enumeration methods may present limitations. By leveraging advanced imaging technology and analysis, our goal is to contribute insights into the reproductive behavior and habitat preferences of salmonids, better understand and focus conservation efforts.

Biographical notes
Originally from the Comox Valley and Vancouver, he moved to the Kootenays to study in the School of Environment and Geomatics at Selkirk College. Ethan completed the

Recreation, Fisheries and Wildlife Technology program with honours in 2021, and graduated from the Advanced Diploma in Geographic Information Systems in 2022. Currently, he is engaged with two prominent organizations: the Okanagan Nation Alliance, where he works as a Fisheries Technician within their traditional territory and concurrently with Selkirk College in Castlegar B.C as a Geospatial Research Intern. In his role at the college, Ethan is exploring ground-breaking applications of remote sensing and GIS technologies within the realm of fisheries, striving to merge his expertise with a profound passion for fish, wildlife, land management, and conservation.

Click here to view the poster

15. A multi-sensor approach to classification of juvenile freshwater fish habitat inventory using UAVs

Presenter: David Greaves, dgreaves@selkirk.ca,Selkirk College and Selkirk Innovates
Co-authors: Rena Vandenbos, Rvandenbos@selkirk.ca, Selkirk College and Selkirk Innovates

Fish habitat surveys are essential to understand, mitigate, and adapt to changing climates and other human-caused impacts to streams and fish. Unmanned aerial vehicles (UAVs) and related technologies are being successfully used to improve traditional fisheries assessment methods and can provide rapid, high-resolution, and cost-effective data, allowing for more comprehensive and timely monitoring of aquatic ecosystems. Considering this newly emerging research area, there is a need to advance, optimize, and implement innovative workflows for processing UAV data to supplement traditional fisheries surveys.
Here we focused on the development of UAV-based data product analysis techniques and workflows to identify channel width, wetted edge, stream gradient, temperature, and large woody debris presence. We explored multiple sensor payload data acquisition approaches, including LiDAR, RGB, long-wave infrared and multispectral imaging at three West Kootenay streams (Glade, Lemon and Norns Creeks). Using object-based image analysis, supervised and unsupervised classification, and raster spatial analysis techniques, we aim to generate classified stream habitat target feature maps with associated survey metrics, including how they compare with traditional ground-based approaches.
Multiple stakeholders have expressed keen interest in this technology. By establishing swift, reproducible, and quantifiable survey methods, we can enhance our capacity to fulfill conservation objectives. Additionally, addressing the challenges of cost and safety, the automation and efficiency of data collection will enable smaller budgets to accomplish comprehensive surveys. This data, in turn, can play a pivotal role in enhancing the management of hydroelectric facilities, both operationally and environmentally, yielding substantial benefits.

Click to view poster here

Biological notes
David is a master's candidate in Vancouver Island University's GIS Applications program, has a bachelor's degree in Geographic Information Systems and a diploma in Recreation, Fish, and Wildlife from Selkirk College. He is an experienced advanced operations drone pilot, instructor, and flight reviewer, specialized in remotely piloted aircraft system mission management and airborne sensor-tech data acquisition. He has proven experience in leading field operations, project safety, public relations, hardware management and a unique ability to apply technology to business processes. His

research interests include remote sensing, drones, food security, fish and wildlife conservation, forestry, avalanche studies and sustainable rural development.

David is active in the Castlegar community serving as President of the Kootenay Food Strategy Society responsible for the Castlegardens community garden space. He resides with his wife and six children in Castlegar and enjoys skiing, biking, horticulture, photography, and videography.

16. Presenters: Ethan Exploring the use of UAV thermal imagery to map thermal refugia in the West Kootenays

Presenter: Emma Lognon, Selkirk Innovates, elognon@selkirk.ca
Co-authors: David Greaves, dgreaves@selkirk.ca,Selkirk College and Selkirk Innovates
Rena Vandenbos, Rvandenbos@selkirk.ca, Selkirk College and Selkirk Innovates

Fish, particularly salmonids, in the West Kootenays region depend on specific temperature ranges for various life stages. With climate change, finding thermal refuge in both winter and summer months becomes crucial. Thermal imagery helps locate temperature gradients, refuge sizes, and optimal temperatures for these species. The Columbia Headwaters Aquatic Restoration Secwepemc Strategy (CHARS) aim to restore and recover habitat for Westslope Cutthroat (*Oncorhynchus clarkii lewisi*) and White sturgeon (*Acipenser transmontanus*), which are both Species at Risk, along with keystone species such as Bull trout (*Salvelinus confluentus*), burbot (*Lota lota*), kokanee (*Oncorhynchus nerka*), and Chinook (*Oncorhynchus tshawytscha*). These species require specific temperature ranges for embryo growth and juvenile growth with upper thermal tolerance for migrating adults. To aid restoration efforts, this project leverages thermal imagery to map cold and warm water patches during critical life stages of these species.

In 2023, thermal and visible light imagery was collected by drone for Lemon and Norns Creeks in the Columbia River Basin. These images were converted to radiometric values and orthomosaics were used to delineate the stream course. Object-based and pixel-based classification methods will be used to identify cold-water patches and then filter for minimum patch size. Results aim to confirm the reliability of thermal imagery for temperature values, distinguish cold patches from ambient stream temperature, and provide insights for restoration in similar topographic streams. Due to declining historical salmon runs, stakeholders are motivated restore habitats for future use. Thermal imagery can pinpoint areas of concern in Kootenay and Okanagan streams.

Biological notes
Emma (she/her) is a student currently working on a Bachelor of Science in Geographic Information Systems at Selkirk College after completing a diploma in Recreation, Fish and Wildlife and an advanced diploma in GIS. Emma has been working towards a career using geospatial techniques to inform restoration, conservation and management of our wildlife and fisheries. As a Butterfly Intern with the Kootenay Native Plant Society (KNPS), she gained experience conducting applied research on butterflies and the plants that support them. With this research, Emma has helped implement restoration work in the West Kootenays to support these species. She is continuing this approach in her current work as a Geospatial Research Intern with Selkirk Innovates, working with researchers, to leverage remote sensing techniques to understand fisheries ecosystems

and inform habitat restoration for keystone species in the Columbia River basin. As an avid outdoor enthusiast, Emma is connected to the land and strives to use her background in ecological and geospatial research and outdoor recreation to aid in the protection and stewardship of our lands, waters, and the creatures that inhabit them.

Click here to view poster

17. Seasonal changes to upwelling groundwater in shore-spawning Kokanee Salmon habitat in the West Arm of Kootenay Lake

Presenters: Natasha Neumann, BC Ministry of Forests and University of British Columbia, natasha.neumann@gov.bc.ca
Cameron Spooner, University of British Columbia Okanagan, cgspoon@student.ubc.ca
Ed Hornibrook, University of British Columbia Okanagan, ed.hornibrook@ubc.ca

A small population of Kokanee Salmon spawn in areas of upwelling groundwater along the shoreline of the West Arm of Kootenay Lake. Lake drawdown during the October to April egg and alevin development period results in stranding of fry above the waterline. In 2020, the Friends of Kootenay Lake Stewardship Society installed gravel beds deeper in the water column at McDonald's Landing Regional Park to enhance the amount of available spawning habitat and increase survivorship of this unique population. For two over-winter seasons, groundwater flow patterns were directly and indirectly monitored to assess the efficacy of this habitat enhancement during periods of normal reservoir level management.

A multi-technique approach was adopted to gain a fulsome picture of surface water – groundwater interactions. Vertical lakebed temperature profiles were measured continuously and used to estimate groundwater upwelling rates in transects perpendicular and parallel to the shoreline. Seepage meters were installed in the spawning gravels and measured approximately monthly. Water samples were collected from precipitation, the lake, Duhamel Creek, the lakebed and a deep groundwater source, and analysed for stable isotope and radon concentrations. These data provide information on the mixing of surface water and groundwater within the spawning habitat. Preliminary results indicate that high lake levels in the fall following spawning reduced groundwater upwelling, while lowering of lake levels in late winter/early spring increased upwelling. Understanding the relationship between lake level and groundwater upwelling rates and the impacts on egg and alevin development in the deeper habitat will help inform future enhancement projects.

Biographical notes
Natasha is the Research Hydrologist for BC Ministry of Forests in the Kootenay Boundary Region. Her research interests include surface water – groundwater interactions, snow accumulation and melt processes, drought and meteorological monitoring. Natasha is based in Nelson and loves working and playing in the diverse climates and landscapes in the Boundary, Kootenays and Columbia.

Click here to view the poster

18. Climate change mitigation in the Columbia Wetlands

Presenter: Darcie Quamme, Integrated Ecological Research (IER), dlquamme@gmail.com
Co-Authors: Dr. Suzanne Bayley, University of Alberta, Emeritus, the Columbia Wetland Stewardship Partners (CWSP), sbayley@ualberta.ca
Catriona Leven, CWSP/University of Waterloo, Rooney Lab, catriona.leven@uwaterloo.ca
John Boulanger, IER, boulange@ecological.bc.ca
Jessica Holden, CWSP, Living Lakes Canada (LLC), jessica.holden@livinglakescanada.ca

Metabarcoding of macroinvertebrates, fish and diatoms are currently being used to investigate climate change vulnerability of wetlands and restoration effectiveness in a large-scale study of ecological health in the Columbia Basin, British Columbia, Canada. Exciting new work focusses on evaluating wetland habitats in the Columbia Wetlands and bench lands of Columbia Valley along with hydrological monitoring to prioritize vulnerable wetlands (Bayley et al 2021). This project aims to restore ecosystem functions of the wetlands to conserve Species at Risk (SARA) dependent on these wetlands. Techniques include the use of beaver dam analogues in collaboration with Dr. Suzanne Bayley, University of Alberta, Emeritus, the Columbia Wetland Stewardship Partners, Living Lakes Canada and the STREAM project. The genomics work is being carried out in collaborative monitoring of submerged aquatic vegetation, migratory birds, and other species at risk.

Macroinvertebrates are less mobile than many wildlife species and their DNA can be used to quantify localized restoration actions and community changes from restoration actions. We have successfully used eDNA metabarcoding and/or traditional taxonomy (125 samples) when combined with other wetland assessment methods to examine how macroinvertebrates recover as water levels are re-established at restoration sites post restoration. To date we have identified 497 wetland species of invertebrates in the Columbia Basin wetlands using eDNA methods as part of the STREAM project (Rpt. 57). In addition, genomics will be tested for fish and diatoms to evaluate possible use of these species as a component of wetland effectiveness monitoring.

This project will:

1. Help evaluate decision making and plans to move forward with wetland restoration.
2. Provide inference to wildlife populations and Species At Risk which may be difficult to assess directly because of appropriate scale and population

movements while macroinvertebrates integrate localized conditions. (Quamme et al. 2020 and 2022)

3. Track ecological lift by examining the rate at which wetland macroinvertebrate taxa and richness increase over time following reestablishment of natural drainage patterns. Quamme et al. 2016, Quamme et al. 2018.
4. To identify actions that encourage the development of a diverse macroinvertebrate community providing a base for higher trophic levels in wetland ecosystems.

Biographical notes

Darcie successfully brings together government agencies, industry and non-profits at a regional, provincial and national levels in projects such as private landowner enhancement, and development of protocols to prioritize and evaluate and monitor wetland and stream restoration. Darcie has authored over 50 papers providing guidance and prescription to industry, government and non-profits in aquatic assessment, habitat enhancement and evaluations of suspended sediment, sediment quality, and soil evaluations.

Click here to view the poster

19. An update on assessing the impacts of wildfire on food availability and use of forests by wildlife

Presenters: Cora Skaien, Ministry of Water, Land and Resource Stewardship, cora.skaien@gov.bc.ca
Richard Johnson, Arrow Lakes Environmental Stewardship Society
Co-author: Adrian Leslie, Nature Conservancy of Canada

This is an update on the ongoing work we are doing in which we further explore the impacts of wildfire on fuel loads, plant species cover and diversity, and use by wildlife. To accomplish this, we compare the occupancy rate of different animal species in areas impacted by fires of low, moderate and high severity burns that occurred in 2018 and 2021, both in Englemann Spruce-Subalpine Fir (ESSF) areas within the West Kootenays. Preliminary results obtained through the use of wildlife cameras show a clear reduction in occupancy and use by mammals in areas with high severity burns, and frequent use in areas with low severity burning or no burning. Key species assessed include deer species, elk, bears, wolverine, porcupine and other carnivore species. We also discuss the future use of remote sensing and Machine Learning in assessing and predicting wildfire recovery from remote sensing data. Although many plans exist to assess the impacts of soil instability on water quality in these areas, we do not yet have the data to present on this element.

Click here for a map showing Mid-Columbia Kootenay Wildfires from 1917-2022 on the Kootenay Lake side and click here for a map showing Mid-Columbia Kootenay Wildfires from 1917-2022 on the Arrow Lake side.

Biographical notes
Cora is a wetland vegetation ecologist for the Conservation Data Centre within the Government of British Columbia's Knowledge Management Branch. She focuses on inventory, classification, status ranking and modelling of wetlands across BC. Prior to this role, she was an ecological modelling specialist where she collaborated on producing models aimed at predicting wildfire locations and intensity across BC over the next 100 years, huckleberry production in logged areas for grizzly bears, and other projects. She also is involved in wildfire rehabilitation research within the West Kootenays and helping to reduce human-wildlife conflict through her role as a Community Coordinator with WildSafeBC. She also continues working on projects looking at recovery of ecosystems with reduction in herbivore density, mainly on the coast and throughout the Gulf Islands, continuing themes from her PhD work. Cora happily resides in the Slocan Valley with her 2 dogs and 2 cats.

Click here to view the poster

20. Water monitoring for watershed security in the Canadian Columbia Basin – Year Two

Presenter: Richard Johnson, Arrow Lakes Environmental Stewardship Society
Authors: Paige Thurston and Nicole Trigg, Living Lakes Canada

Climate change is a global issue, yet many challenges related to climate-impacted water sustainability are regionally specific and thus require localized solutions. Moreover, community buy-in and improved data accessibility can increase capacity for source water protection.

In this context, Living Lakes Canada (LLC) is implementing a community-informed regional water monitoring network in the Canadian Columbia Basin (CCB) guided by the Columbia Basin Water Monitoring Framework (CBWMF). Click here to view a poster of CBWMF.

The transboundary Columbia River Basin is a highly regulated, snow-dominated hydrologic system, with glaciers contributing an average of 12% of annual water yield. Glacial ice in eastern British Columbia is expected to decline 90% by 2100, in all emission scenarios except RCP 2.6 (Clarke et al., 2015). Indeed, April 1st snow-water equivalent has already declined significantly in the Canadian Rockies, the easternmost mountain range in the CCB. The timing of snowmelt contributions to streamflow has also changed, with a shift toward earlier snowmelt runoff peaks.

These changes in the hydrologic cycle directly impact communities and ecosystems within the CCB. The region's human population is projected to increase by 7% by 2041 (Selkirk Innovates, 2022), and with it, the demand for domestic water and agricultural production. At the same time, seasonal water supply will change – summer water deficits associated with warmer and drier conditions are already occurring in eastern British Columbia.

As a transboundary basin, water supply and peak flow timing changes in the CCB could have major impacts on the United States. The Canadian portion of the Columbia River system contributes approximately 50% of the river's total summer runoff which feeds US hydroelectric dams and fills critical reservoirs. For example, the Columbia River flows through Washington State, which produces nearly 30% of US net electricity generation through hydroelectricity.

Along with the impacts to humans, changes in flow impact anadromous salmon through disruption of migration routes and spawning habitat, while increased temperatures

reduce the quality of habitat and impacts on other biota such as migratory waterbirds are also likely. Thus, a changing climate will challenge water security and require innovative management in attempts to satisfy conflicting needs for humans and ecosystems in the near future. Understanding local water priorities can help water managers balance these needs.

Adequate data are required to quantify the impacts of climate change on CCB freshwater sources. As of 2017, the CCB had lost half of its government-run hydrometric stations (Carver, 2017). These reductions increase the uncertainty in understanding water availability which could result in economic losses. Of the hydrometric stations operating in the CCB, many are on larger systems and used to monitor stream flow for hydropower and flood control (Carver et al., 2020; Moore et al., 2020), while many residential water licences are on smaller systems that are typically unmonitored (Carver, 2017). Any hope of implementing adaptive management of freshwater to cope with uncertainties of climate change requires reliable monitoring of water flows across the spectrum of stream sizes that characterize the CCB.

This presentation will consist of an update on the CBWMF project which was introduced at last year's CMI Researchers Forum while the project was still in its pilot year. Developments in 2023 include expansion into two new hydrologic regions, robust community engagement, new monitoring site selection, and pilot year memos outlining results of the data collected to date within the context of climate extremes experienced in 2023.

Biographical notes
Richard Johnson is a geological engineer who has worked in the petroleum industry for over thirty years prior to moving to the Slocan Valley in 2007. He has over thirty years of experience teaching courses to students, he is one of the founders of the Slocan Wetland Assessment and Monitoring Project (SWAMP) and after many years on the board of the Columbia Basin Watershed Network he continues to serve on their science committee who offer an annual mapping program with Selkirk College. Richard continues to perform hydrogeological studies, aquifer mapping, satellite image interpretation, and teach QGIS

Click here to view a poster of CBWMF

21. Can we use drones to identify whitebark pine in mature forests?

Presenter: Marcus Friesen, Selkirk Innovates, mfriesen@selkirk.ca
Co-Authors: Jamie Albino, Selkirk Innovate, james.patrick.albino@gmail.com
Jessica Cahill, Selkirk College, jessicacahill@edu.selkirk.ca
David Grieves, Selkirk College and Selkirk Innovates, dgreaves@selkirk.ca
Brendan Wilson, Selkirk College and Selkirk Innovates, bwilson@selkirk.ca

Remotely Piloted Autonomous Vehicles (RPAS), or drone use has increased dramatically in forest measurements, including biomass estimation, tree species classification, and regeneration estimation. In this project we are testing a variety of sensor types to aid the inventory and assessment of the high elevation endangered tree species, whitebark pine. In this poster we present our efforts to remotely identify mature whitebark individuals using 10 band multispectral data and machine learning in the upper Grohman Creek area, northwest of Nelson, BC. Our preliminary results using a Random Forest classifier on a small sample size separated Engelmann spruce, subalpine fir and whitebark pine with overall accuracy of >70%.

Biographical notes
Marcus Friesen grew up in Hope British Columbia. After graduating Highschool he went on to gain a Diploma in Biblical Studies from Columbia Bible College, a Bachelor of Arts in the field of Anthropology with a focus on Archaeology from Kwantlen Polytechnic University. He most recently he graduated with a Bachelors in Geographic Information Systems (GIS) from Selkirk College. He currently works for Selkirk Innovates as a GIS and Forestry research intern.

Click here to view the poster

22. Water data options in British Columbia

Presenter: Andre Zimmermann, Northwest Hydraulic Consultants,
azimmermann@nhcweb.com
Co-Authors: Frank Weber, BC Hydro
Robert Williams, Ministry of Environment and Climate Change Strategy,
frank.weber@bchydro.com

Over the last five years there has been a number of new initiatives in BC and the Columbia Basin that relate to the availability and sharing of water data. This presentation will touch on:

- New automated snow monitoring stations in the Columbia Basin and what they record and how the data can be accessed. These stations represent a modernization of the historic snow course surveys and an expansion of the existing network.
- The provincial data catalog and associated access to real-time and historical groundwater, surface water and snow data. The different means of accessing the data will be explored.
- The integration of third-party snow, groundwater and hydrometric data in the provincial network: who, why and how of third-party water data.

Biographical notes
Andre Zimmermann grew up in Nelson and first work in the aquatic habitat field in 1997 at Timberland Consultants during the FRBC Habitat Restoration Program. Today Andre is a Principal Geomorphologist in North Vancouver and specializing in channel stability, hydrology, complex data collection systems, and analysis of large time-series datasets. A self-professed data geek, Andre takes pleasure in solving difficult data acquisition problems that require the use of a wide variety of commercial and custom-designed instruments for application across the full spectrum of field and laboratory settings. André is an adjunct faculty member in the Department of Geography at UBC, where he collaborates with students on applied research projects.

Click here to view the poster

Field trips

23. Sunshine Bay Regional Park wetland restoration in Harrop, BC

Hosted by: Oleksandra Dmitrienko, Friends of Kootenay Lake
oleksandra@friendsofkootenaylake.ca

Location:
Sunshine Bay Regional Park in Harrop – across Kootenay Lake via a short cable ferry. Approx 45min from Nelson. See location pin drop here.

Description:
Development of Kootenay Lake's valley bottoms and moderation of its natural flood cycles have significantly reduced the extent of wetlands and wetland-dependent species within the Kootenay Lake Basin. Local hydroelectric-influenced habitat loss is greatest for obligate or frequent wetland users such as amphibians, waterfowl, songbirds, bats,

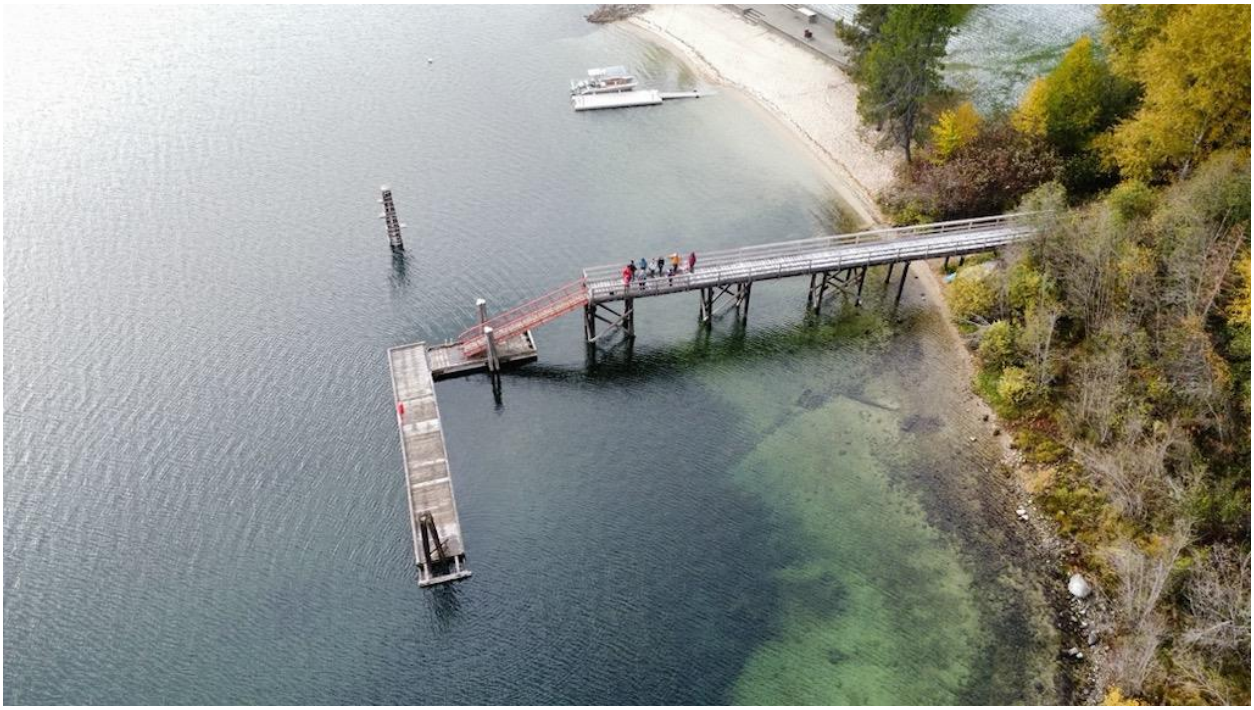
and aerial insectivores (Utzig and Schmidt, 2011). The proposed restoration site in Harrop, BC's Sunshine Bay Regional Park is a Kootenay Lake floodwater-fed ephemeral wetland that represents a small, degraded portion of its historic extent prior to damming and land privatization. Higher rates of evaporation and water loss, visible ditching, cattle grazing, and invasive species overgrowth have severely reduced habitat values. This is problematic, given the wetland provides habitat for 45 animal species, including breeding western toad, and the following provincially blue-listed species: western painted turtle and great blue heron (McKenzie and Dulisse, 2011).

The project will combat known and projected habitat and population risks for western toads that breed onsite, create critical refuge for wetland users that have limited habitat options in Kootenay Lake's west arm, and ensure a diverse habitat that is more resilient to climate threats. The current project scales up the 2022 restoration of an adjacent pond within the wetland complex. The 2022 project addressed a critical population sink for western toads and has achieved all outlined goals to date. However, the extent of this restored wetland is small. It is critical that the wetland area be expanded to increase productive habitat, not only for breeding western toads, but for a diversity of wildlife species. The current project is a direct conservation action that aims to restore and protect at least 0.53 ha of degraded wetland habitat in Sunshine Bay Regional Park by restoring one large wetland basin located just south from the initial restoration site, combating invasive reed canary grass monoculture, and installing habitat features for amphibians, reptiles and birds.

Project partners:
Project partners include Columbia Wetlands Stewardship Partners, Lake Windermere District Rod and Gun Club, Living Lakes Canada, Golden Rod and Gun Club, Trout Unlimited Canada, province of BC, Selkirk College, numerous other partners and local landowners.

PHOTO: Marc André Beaucher

24. Groundwater and Kokanee at McDonald's Landing Regional Park



Hosted by: Natasha Neumann, BC Ministry of Forests and University of British Columbia, natasha.neumann@gov.bc.ca
Skyeler Folkes, GIS and Emerging Technology Leads, Okanagan Nation Alliance, SFolks@syilx.org
Greg Utzig, Friends of Kootenay Lake, g13utzig@telus.net

Location:
McDonalds Landing Regional Park, 3127 Highway 3A (NE of Nelson).

Description:
There is a small population of Kokanee Salmon in Kootenay Lake that spawn along the lake shore instead of in the tributary streams. These shorespawners use areas where groundwater is upwelling into the lake. Unfortunately, as the reservoir level is drawn down over the winter some fry are stranded and perish above the water line. In 2020, to compensate for these losses, the Friends of Kootenay Lake Stewardship Society (FOKLSS) installed gravels deeper in the water to attract salmon to spawn lower in the water column where they would not be dewatered. During this field trip we'll talk about some of the research and monitoring that is underway by Okanagan Nation Alliance Fisheries Department, BC Ministry of Forests, FOKLSS, University of British Columbia

Okanagan, and the Friends of Kootenay Lake at this site to assess groundwater flow patterns and the impacts of reservoir levels.

PHOTO: Skyeler Folkes

Continue the conversation on any or all our channels

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