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The Columbia Mountains Institute of Applied Ecology (CMI) hosts an annual Researchers' Forum where we gather members of the scientific community, Indigenous community members and representatives, stewardship groups, students, land managers, 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 in an informal atmosphere - everyone is invited to attend, mix, and mingle!

This event annually travels around the Columbia Mountains and Kootenay region. This year we gathered in Creston, BC where a number of topics discussed had direct connections to the Creston Valley Wildlife Management Area, and the Nature Conservancy of Canada's Frog Bear property. From large-scale connectivity programs like Kootenay Connect, on-the-ground stewardship projects for the endangered leopard frog and pollinators, and the extensive study and stewardship activities for at-risk bat species, the habitat enhancements and successes are inspiring. Projects taking place further afield were showcased and included promising technological research methods, restoration of riparian areas, invasive pike suppression, the reintroduction of sockeye salmon, and more. We also tuned in for the latest update on the modernization of the Columbia River Treaty, discussing how the recently secured 'agreement in principle' has the potential to support many of the initiatives presented throughout the two-day event.

Our time together started with some guiding and welcoming remarks by Robin Louie with the Yaquan Nukiy. In addition to an afternoon of well-articulated and engaging talks on day one, there were a number of fantastic posters featuring yet more ecological work pertaining to caribou and whitebark pine recovery efforts, successful water monitoring and tracking of water supply to better understand climate impact, and more. That night, an informal social around the fire provided a great way for conversations and networking to continue. The next morning was spent in the Duck Lake area of the Creston Valley Wildlife Management Area and the Nature Conservancy of Canada's Frog Bear property, also known as the Frog Bear conservation Corridor. We got a close look at the impressive array of bat maternity roosting structures, admired a leopard frog, and saw the myriad of habitat enhancement activities taking place in the area to benefit a variety of species.

A big **thank you** to everyone who took the time to share their work with us, bring their colleagues and students to the event, and for the important work you do. Thank you to Marc-André Beaucher and Kevin Bollefer who volunteered to emcee the forum. Thanks also to Isobel Phoebus, Catherine Craig, and Renae Mackas for the volunteer support – without you the event would not have run so smoothly.

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Oral presentations (in order they were presented)

1. Kootenay Connect: A regional network of ecological corridors connecting valley bottoms to mountain tops

Presenter: Marcy Mahr, Kootenay Connect Manager, Kootenay Conservation Program; marcy@kootenayconservation.ca

Co-Author: Michael Proctor, Transborder Grizzly Bear Project; mproctor@netidea.com

The biodiversity crisis is imperiling the web of life, being influenced by nature's ability to move and adjust to changing landscapes and climate conditions. There is a growing global movement to implement actions that increase the intactness of habitats and remove barriers to connectivity to support biological diversity and the ecological processes that species depend upon. Six years ago, the *Kootenay Connect Initiative* joined this movement by identifying 12 Ecological Corridors in the Kootenays that would enhance the region's biodiversity and increase landscape resilience to climate change and disruption. This talk explores how the *Kootenay Connect Initiative* and its federally funded Kootenay Connect Priority Places project, being coordinated by the Kootenay Conservation Program, is restoring a regional network of corridors connecting valley bottoms to uplands, biodiversity hotspots, protected areas, and climate refugia to benefit wildlife and ecosystems. The Creston Valley's Frog Bear Corridor is featured as a case study to illustrate how scientific research, conservation planning, diverse partnerships, and strategic land acquisition have led to specific solutions and on-the-ground actions including wetlands creation and restoration, improved water storage, habitat enhancement and creation of habitat features for species at risk, new wildlife-friendly fencing, and securing movement corridors to benefit multiple species at risk from grizzly bears to northern leopard frogs and bobolinks.

Resources

Kootenay Connect Corridors information, maps & videos:

kootenayconservation.ca/kootenay-connect/

2023 Summary Report: [*Kootenay Connect: Riparian Wildlife Corridors for Climate Change*](#)

KCP & CMI 2024 webinar series: "Wildlife Corridors and Ecological Connectivity":

<https://kootenayconservation.ca/winter-webinar-series/>

Kootenay conservation project aims to connect habitat for species at risk:

<https://thenarwhal.ca/species-at-risk-b-c-kootenays-wildlife-corridors-canada-nature-fund/>

National Program for Ecological Corridors:

<https://parks.canada.ca/nature/science/conservation/corridors-ecologiques-ecological-corridors>

IUCN Guidelines for conserving connectivity through ecological networks and corridors:

<https://portals.iucn.org/library/sites/library/files/documents/PAG-030-En.pdf>

Biographical notes

Marcy Mahr has been working on ecological connectivity and large landscape conservation throughout North America for much of the past 30 years. She has a M.Sc. in Plant Ecology and her love of plants has led her to assessing forest composition and structure, inventorying wetlands and riparian areas, and using GIS to classify habitat types. Her experience includes working for government, research institutes, conservation non-profits, and land trusts focused on understanding and conserving biodiversity, ecosystems, and wildlife corridors. Her contributions to advancing corridors and connectivity in the Greater Yellowstone Ecosystem, Montana's Flathead River to Lake, and Yellowstone to Yukon ecoregion continue to achieve conservation outcomes. Marcy is co-creator of the *Kootenay Connect Initiative* which has received national recognition for its inspiring vision of a regional network of wildlife corridors in the Kootenay region of BC. She is currently Kootenay Connect Manager of the Kootenay Conservation Program's Community-Nominated Priority Places project which has inspired over \$8 million in habitat enhancement and restoration investment in the past six years to benefit over 34 species at risk.

2. Mitigating loss of roosting habitats in the Columbia Basin – thinking outside the bat box

Presenter: Cori Lausen, Wildlife Conservation Society Canada, clausen@wcs.org

Co-Authors: Heather Gates, hgates@wcs.org, Wildlife Conservation Society Canada; Susan Dulc, dulcs18@mytru.ca, Thompson Rivers University; Susan Holroyd, sholroyd@wcs.org, Wildlife Conservation Society Canada.

Introduction

Threats to bats are unprecedented (Frick et al. 2020; Adams et al. 2024): increasing habitat loss; white-nose syndrome disease; the continued increase in wind turbine developments (Arnett et al. 2016); climate change including drought (e.g., Adams 2010, Amorim et al. 2015), wildfires (e.g., Low et al. 2024), and heat waves (e.g., Bideguren et al. 2019); insect declines (Wagner 2020), and more. As the primary consumer of night-time insects, and important natural pest control for industries such as agriculture and forestry, bat declines have been associated with increased use of pesticides and negative impacts on human health (Frank 2024).

Eighty-five percent of bat species in Canada are found in British Columbia (B.C.), where 15 species have been confirmed, and additional species suspected (Lausen et al. 2022). More than 70% of B.C.'s bat species regularly use trees for roosting, to raise young, and in some cases, also to hibernate (Lausen et al. 2022, de Freitas 2023). While there are two species (Hoary Bat, Eastern Red Bat) that roost among tree foliage, typically on tall trees, the other species use crevices and cavities that are prevalent in old trees and early stage snags. Old and mature forests provide far more crevice roosting opportunities than young forests which not only have trees with fewer defects, but typically restrict sufficient levels of solar insolation for maternity roosts, and thus do not support reproduction for most bats. Female bats optimize energy budgets through selecting appropriate roost microclimates, behavioural mechanisms such as forming colonies to influence microclimates, selecting roosts that passively rewarm a torpid bat, and physiologically strategic use of torpor (Lausen and Barclay 2003; Terrien et al. 2011; Willis and Brigham 2007). Bats switch roosts typically every one to two days and use dozens of trees to raise young (e.g., Olson and Barclay 2013).

Habitat loss is a major threat for bats in B.C. in particular as forests are harvested and land is developed. Three species of bats (Little Brown Myotis, Yuma Myotis, and Big Brown Bat) have adapted well to using human-built dwellings. For these species mitigating loss of forest and building roosts can theoretically be mitigated with other human-built structures including bat boxes and/or bat condos; however, concerns have

been raised over the use of these structures (e.g., Lausen et al. 2023; Rueegger 2016). Despite their widespread use for enhancement or replacement of lost roosts, most published evaluations have considered success of a bat box based on whether it was used by bats or not, rather than asking questions of bat welfare and fitness. Rising concern for overheating bat boxes in many places of the world (including B.C.), and mass mortality events in recent years, has brought the conservation use of these structures into question (Flaquer et al. 2014; Lausen et al. 2023). In 2019 we started monitoring bat boxes in the Creston and Okanagan areas, to compare to bats using building or building-like (i.e. bat condo) roosts. We also completed a literature review of bat boxes, and with colleagues, developed the Best Management Practices for Use of Bat Boxes in US and Canada.

As an alternative to using bat boxes, starting in 2020, we began constructing and evaluating human-made tree roosts. We created three types of structures to simulate old trees: Brandenbark™ (Copperhead Consulting, KY; Adams et al. 2015) wrapped around poles dug into the ground; Brandenbark™ wrapped around young trees; chainsaw-modified trees to create crevices and cavities (adapted from Griffiths et al. 2018).

Bat Box Best Management Practices (US-Canada)

We led the development of a peer-reviewed guidance document in collaboration with US Fish and Wildlife Service and Canadian Wildlife Health Cooperative: <https://ecos.fws.gov/ServCat/Reference/Profile/160034> (Holroyd et al. 2023). Results of on-the-ground research (S. Dulc, MSc thesis, unpublished data) underpinned some recommendations, including encouraging landowners to not evict bats due to the reproductive advantages that building roosts provide to endangered bat species (Lausen and Barclay 2006).

Main points that make this guidance document different from typical bat box guides are:

- i. One bat box is not enough to provision all roost microclimates that reproductive females need throughout the active season.
- ii. Roosts used by bats (natural or human-constructed) can overheat, so providing roosts in varying levels of full sun through to full shade, is the safest approach to providing suitable habitat for bats to choose from (Goldilocks Approach).
- iii. Boxes with multi-chambers (4 or more) are most suitable for maternity colonies of bats.

- iv. Exclusions of maternity colonies from buildings should be mitigated by construction of equivalent habitat to what was lost.
Bat boxes that are being used by bats at some point throughout the active season need to be maintained and should not be removed or altered.
Additional boxes need to be added in the vicinity if there are not sufficient alternative roosts.
- v. Because bat boxes are used by relatively few bat species, their use should be restricted to scenarios in which colonies of building-roosting bats are already established. This reduces likelihood of altering existing bat biodiversity.
- vi. Other artificial roost structures (e.g., BrandenBark™), should be considered to provide habitat for building-roosting bats *and* other bat species.

Tree-Roost Creations

As of October 2024, we have created a total of 183 'tree-like' roost structures for bats at 29 locations across B.C.'s Columbia Basin. Specifically this includes 35 BrandenBark™ poles, 85 BrandenBark™ trees, and 62 chainsaw modified trees. One additional pole with natural Doug Fir bark wrapped in layers was contributed by a private landowner.

We have partnered with Okanagan Nation Alliance, Creston Valley Wildlife Management Area, Min. of WLRS, Nature Conservancy Canada, B.C. Nature Trust, University of Northern British Columbia, The Land Conservancy, Valhalla Foundation for Ecology, Shuswap Band, Nupqu, and others including Kootenay Connect partners, to build and monitor these 'old tree' bat roost structures in the Columbia Basin.

Guano was collected throughout the active season from the wood-framed mesh traps at the base of the roost structures. Genetic analyses to date (samples as of fall 2023), have provided evidence of use of our roost creations by the following bat species: California Myotis, Long-legged Myotis, Long-eared Myotis, Little Brown Myotis, Yuma Myotis, Big Brown bat, Silver-haired bat, and possibly Fringed Myotis.

Recommendations

Given that ~70% of B.C.'s bats roost in old trees to raise young, and that bats now face unprecedented threats, one would logically conclude that saving old trees is a high priority for conserving bats. Mitigating roost loss is needed as a stop-gap measure until appropriate habitat restoration and protection can be achieved. Here we described artificial structures that can be used to replace some roosting habitat for bats. While we are learning valuable information about how these structures are used by bats, the scalability of this approach to sufficiently replace lost habitat is not clear given the cost

and labour-intensive nature of creating these roosts. Additional stop-gap roost replacement options need to be explored.

Appropriate habitat protection is needed to keep enough patches of old trees on the landscape to meet the varied roosting needs of the 10+ species of tree-roosting bat species in this province. In the Kootenay region, where most of our research and habitat mitigation has taken place, the only unit of habitat protection for bats has been the Wildlife Habitat Feature (WHF; Ministerial Order M213) facilitating retention of single trees, typically snags. Protection of intact patches of old growth and mature forest is urgently needed to keep bat biodiversity in B.C.

Biographical notes

Dr. Cori Lausen is the Director of Bat Conservation for the Western Bat Program of Wildlife Conservation Society Canada. Cori is a bat research and conservation biologist with an MSc and PhD on bats focusing on behaviour, physiology, and genetics. Cori has been researching bats in BC's Columbia Basin since 2008, and is the lead author of *Bats of British Columbia*, published by Royal BC Museum in 2022.

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3. Monitoring bat acoustic activity to estimate trends and migration patterns

Presenter: Jason Rae, Wildlife Conservation Society of Canada, Jrae@wcs.org

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Bat distributions and patterns of activity across BC have historically been poorly understood due in part to bats' nocturnal activity patterns, small size, inaccessible roosting locations, and the ease with which they evade capture. Delineating species' distributions and monitoring activity patterns across a broad area is made possible through recording of bat ultrasonic echolocation signals via acoustic detectors. Acoustic detectors are self-contained devices that record ultrasound bats make as they navigate the landscape.

Since 2008, Wildlife Conservation Society Canada's bat conservation program has used acoustic detectors to investigate bat activity across BC. Our first acoustic monitoring programs began in the Columbia Basin, but through strategic partnerships, we have expanded sampling across the province. Collaborators include naturalist groups, Indigenous partners, other non-profit organizations, and many biologists across the province. Our acoustics work spans five major projects: BatCaver, Winter Bat Ecology, North American Bat Monitoring (NABat) program, Bat Migration Monitoring, and Acoustic Workshops to Build Capacity for Indigenous-Led Bat Conservation.

BatCaver – We acoustically monitored over 150 caves and mines to survey for bats using these sites as hibernacula. Initial results indicate every low elevation cave and mine we have monitored has been used by bats at some point in winter.

Winter Bat Ecology – We have collected winter acoustic data from approximately 200 sites across BC with emphasis on Columbia Basin, but ranging as far north as Atlin. We have recorded bats flying during winter throughout southern BC, indicative of prevalence of hibernation habitat. The most widespread hibernate used by bats in winter seems to be rock crevices trees, though much work remains to be done to identify and describe features, and understand factors that result in winter bat flight. We are investigating environmental factors that correlate with bat activity outside hibernacula in the winter. While we have documented bat activity of multiple species in winter at many locations, at one

location in particular (Beasley), we completed a multi-year study of winter roosting ecology of the Silver-haired Bat. This work was done in collaboration with Thomas Hill of Fish and Wildlife Compensation Program and Dr. Erin Baerwald of University of Northern British Columbia, culminating in a Masters of Science thesis by Emily de Freitas. Silver-haired Bat is a species recently recommended for an Endangered designation in Canada (COSEWIC 2023). Although it was once believed to be migratory across its North American range, we now know that Silver-haired Bats hibernate in British Columbia and Alaska (Lausen et al. 2022; Blejwas et al. 2014). We determined that in BC this species hibernates in rock crevices, wood piles, trees, snags and some large cave-like mines. Data from radiotracked individuals suggest trees used in summer differ substantially from trees used in winter (de Freitas 2023), highlighting the urgent need for revisions of policy in the Kootenay region for what constitutes a bat hibernation feature, important for habitat protection (i.e. Wildlife Habitat Feature). We are using our science to inform forestry practices, including publishing information about appropriate timing of timber harvest for tree-hibernating bats, and roost tree retention for both winter hibernacula and summer tree roosts.

North American Bat Monitoring (NABat) – Since our project began in 2016, we have tripled the size of our network to collect data from over 60 10x10km sample sites (grid cells) across BC. Within each grid cell, 2 to 4 passive bat detectors were deployed for at least one week during the pre-volancy (pups not flying) time period of summer (late May to early July). Through this work we aim to fill gaps and identify changes in bat species distributions, investigate patterns and changes in habitat use, and assess patterns in species relative activity and abundance. Our annual trend analyses can serve as indicators of population declines by species and establish baseline relative abundance data prior to the impacts of devastating threats like white-nose syndrome. These data will facilitate and guide mitigation measures and recovery efforts and provide a benchmark for evaluating the effects of threats such as climate change, habitat destruction/restoration, development, mine closures, etc. In 2024, we have been working to pass leadership of our cross-border NABat network to Biodiversity Pathways by training a new team to continue coordinating this broad-scale monitoring in the future.

Migration Monitoring – We have recorded bat activity in the fall, winter, and spring at nearly 50 major riparian corridors and potential migration flyways to date. This information is locating and cataloging characteristics of bat migratory pathways, providing information on the timing of bat movements.

Acoustic Workshops to Build Capacity for Indigenous-Led Bat Conservation - Our most recent project developed a Workshop in partnership with the Sekw'el'was band in Lillooet in June 2024. This first workshop was attended by nearly 20 participants, building relationships between our program and the local communities. We continue to develop partnerships and future collaborative projects in that area. Following on the success of this first acoustic workshop, we have proposed a similar capacity-building model for the Kootenay region, starting in 2025, funding pending.

Our acoustic work has served to fill gaps in species distributions, establish reference points for relative species activity and abundance, identify patterns of winter activity and roost selection, and build capacity for future bat work in the province.

Biographical notes

Jason has been studying bats as part of the team at Wildlife Conservation Society for nearly 10 years. Throughout this time Jason has coordinated and expanded the North American Bat Monitoring Program in British Columbia into a broader regional Hub, including southeast Alaska. Jason has brought his expertise to the data analysis of large sets of acoustics data from across BC.

Literature cited

de Freitas, E. (2023). Winter Roosting Ecology of Silver-haired Bats (*Lasionycteris noctivagans*) in Southern British Columbia. MSc Thesis, University of Northern British Columbia. Available: <https://doi.org/10.24124/2023/59414>

4. Camas meadows as a model: Exploring pollination networks to identify keystone plants for restoration

Presenter: Valerie Huff, Kootenay Native Plant Society,
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Co-Authors: Brenda Beckwith, Rowan Rampton, Lincoln Best

The conservation of keystone plant-pollinator interactions is vital for biodiversity, resilience, ecosystem function and Sustainable Nature Based Solutions (Rafferty and Cosma 2024).¹ This talk highlights the role of camas meadows in supporting native bee populations through keystone plant-pollinator interactions. This talk presents findings from two years of research into these networks, emphasizing the importance of keystone plants in maintaining biodiversity and ecosystem resilience.

1. **Camas Meadows as Bee Biodiversity Hotspots:** Research conducted over two years in the West Kootenay documented interactions between over 100 plant species and more than 200 bee species, which accounted for about 40% of all bee species in British Columbia. This underscored camas meadows as significant hotspots for bee diversity.
2. **Identification of Keystone Plants:** Through analysis of plant-bee interaction networks²³, we identified 23 key plants that contributed to the strength and resilience of these networks, as well as to maintaining native bee diversity and abundance. The six primary network anchors were nodding onion, common camas, western spring beauty, yellow monkey-flower, silky lupine, and meadow death-camas. An additional 17 plants (yarrow, small-flowered blue-eyed Mary, Sutherland's larkspur, sticky cinquefoil, Scouler's hawkweed, swale desert-parsley, nine-leaved desert-parsley, nodding microseris, pink twink, narrow-leaved montia, small-leaved montia, yellow penstemon, common yampah, sagebrush buttercup, worm-leaved stonecrop, large-flowered triteleia, and American vetch) were found to be crucial for community stability and ecosystem function, supporting bee diversity and pollination services⁴.
3. **Comparison of Plant Lists:** A comparison between the identified keystone plants and an expert-recommended plant list from Pollinator Partnership Canada 5 revealed minimal overlap. Field research suggested that bees exhibited preferences for a wider range of plant families, the inclusion of annual plants, and a tendency to favor shorter plants, contrasting with the experts' selections. Both

lists can help inform selection of native plants for restoration in the context of local plant communities and pollinator interactions.

4. **Plantlife Corridors:** The concept of “Plantlife Corridors” was introduced, emphasizing the need for landscape connectivity for both pollinators and plants, much like wildlife corridors for animals. With camas meadows as a model, the focus is on protecting and enhancing existing habitats while increasing connectivity between them to sustain pollination networks across the landscape. Plantlife Corridors are crucial for promoting biodiversity, enabling gene flow, and increasing resilience against environmental changes, ensuring a healthier ecosystem for the future.

Conclusion

Our study reinforces the importance of conserving interactions within plant-pollinator networks rather than focusing on individual species. Plantlife corridors are proposed as a model to enhance landscape-level ecological health.

Biographical notes

Based in British Columbia, Valerie Huff works with the Kootenay Native Plant Society and leads the Pollination Pathway project, which aims to enhance ecological connectivity in fragmented landscapes. Valerie Huff has a strong background in community-based conservation, citizen science, and ecosystem restoration.

Literature

¹ Rafferty, N. E., & Cosma, C. T. (2024). *Sustainable nature-based solutions require establishment and maintenance of keystone plant-pollinator interactions*. *Journal of Ecology*, 00, 1–10. <https://doi.org/10.1111/1365-2745.14353>

² McGonigle, L. K., Williams, N. M., Lonsdorf, E., & Kremen, C. (2017). A Tool for Selecting Plants When Restoring Habitat for Pollinators. *Conservation Letters*, 10, 105-111. <https://doi.org/10.1111/conl.12261>

³ Rowan Rampton’s interactive network diagrams: Explore these on the KNPS website: <https://kootenaynativeplants.ca/our-work/camas/floral-relations-of-bees-in-camas-meadows/>

⁴ Rampton, R., V. Huff, L. Best, and BR Beckwith. 2023. Floral Relations of Native Bees in Camas Meadows. http://kootenaynativeplants.ca/final_col-f23_w3673_floralrelationsofbeesincamasmeadows-4/

⁵ Pollinator Partnership Canada. Selecting Plants for Pollinators: A guide for gardeners, farmers, and land managers in the Columbia Mountains and Highland Ecoregion. Available for download at: <https://pollinatorpartnership.ca/en/ecoregional-planting-guides>

5. Examining blister rust incidence in whitebark pine: why is Banff so different?

Presenter: Brendan Wilson, Selkirk Innovates, Selkirk College, West Kootenay and Boundary Region, bwilson@selkirk.ca

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Variation in the occurrence of white pine blister rust over the range of whitebark pine in the Canadian Rocky Mountains has long been a question of interest for land managers attempting restoration activities for whitebark pine. Past studies suggest that whitebark pine stands in Banff National Park (BNP) experience lower infection.

In this study, we asked four main questions regarding recent published levels of blister rust infection within BNP:

1. Was there a significant difference between blister rust infection rates in the populations of whitebark pine found within Banff National Park compared to the adjacent other national parks? 2. Were these estimates accurate? 3. Could patterns of blister rust infection be correlated with the proximity to Ribes species or other site variables? And 4. Could climate distribution models of the pine and Ribes spp. tell us something about the regional landscape patterns of blister rust infection.

We collected data on tree species populations, blister rust infection levels, environmental site conditions, and distance to nearest observed Ribes individuals at 17 different whitebark pine stands within Banff National Park during the summers of 2022-23. The blister rust levels were compared to a Canadian Rockies data set of blister rust infection from 2019. Regional spatial locations of whitebark pine and Ribes spp. were obtained from a Parks Canada Ecological Land Classification database allowing for the extraction of derived annual and seasonal variables down scaled for the plot locations from ClimateNA. We used Analysis of Variance on the 2019 data to determine that BNP was significantly lower in blister rust infection compared to the other surrounding national parks.

The results of a t-test between our study's blister rust levels at that of 2019 within BNP showed no significant difference. However, we also found that within BNP there was considerable variation - with higher levels than previously recorded in the southern

regions and much lower levels in the northern areas. Within our sample sites we used regression analyses to build a model showing distance to Ribes, average site slope, and elevation were important factors explaining the variation within rust levels.

Finally, we used Random Forests classification to build recent climate envelope models for both whitebark pine and Ribes spp. over the range of blister rust infection in BNP and the adjacent National Parks. This showed that there were some areas in the northern reaches of BNP where whitebark was expected and not Ribes spp. which corresponded to lowest infection values, whereas all the sites with higher infection were near areas where there was a greater probability of finding Ribes. Further work and management implications are discussed.

¹Selkirk Innovates, Selkirk College, West Kootenay & Boundary Region

²Parks Canada, Banff Field Unit

Biographical notes

Brendan Wilson is an instructor and research scientist in Selkirk College's School of Environment & Geomatics and Selkirk Innovates, where he has taught since 2001.

Originally from the Bow Valley in Alberta, Brendan has had a life-long interest in subalpine and timberline forest communities. He completed a B.Sc. Hons. in Applied Environmental Biology at the University of Technology in Sydney, where he examined the effect of selective harvesting on understory plant communities in an Australian subalpine forest. He completed his Ph.D. at the University of Alberta, studying regeneration dynamics of alpine larch.

Over the past 20 years Brendan and his students have worked on whitebark pine conservation, species at risk assessment, white pine blister rust monitoring, species distribution modelling, prescribed fire and forest fuel treatment work, and using remotely sensed imagery to aid with these projects.

Brendan currently teaches Ecosystem Management, Systems Ecology, Applied Research Methods, and Spatial Statistics.

6. Columbia Basin Water Monitoring Framework: From peaks to creeks

Presenter: Paige Thurston, Living Lakes Canada, paige@livinglakescanada.ca

Co-author: Nicole Trigg, Living Lakes Canada, nicole@livinglakescanada.ca

Data scarcity in the B.C. Columbia Basin region is compromising the ability to make informed watershed management decisions in consideration of climate change and other impacts. The CBWMF is a coordinated water and climate monitoring network initiated and operated by Living Lakes Canada throughout the Canadian Columbia Basin using an innovative methodology that addresses scientific data gaps in tandem with community concerns and priorities. These efforts are resulting in a nested, prioritized approach to hydroclimatic monitoring in an effort to advance watershed security in the region.

The CBWMF is monitoring 144 sites across the region, ranging from high elevation climate monitoring, snow surveys, and subalpine lake ecosystem studies to wetlands and groundwater in valley bottoms. This community-based network has increased hydrometric monitoring of tributaries by 112% and groundwater monitoring by 400% in the Basin. CBWMF data is housed in the Columbia Basin Water Hub, an open-source database with 50+ contributing organizations and over six million data points, created by Living Lakes as a centralized, easily accessible source of historical and current water data.

While longer-term data records are necessary for the identification and analysis of trends, near-term applications of the CBWMF data have already begun to develop since the network's pilot year in 2022. These include water supply monitoring in collaboration with several municipalities to inform climate action plans, community climate adaptation strategies such as water source mapping for wildfire suppression, and guiding sustainable water usage. Additionally, the data is informing restoration projects in several watersheds. Within the Creston area, the program includes several stream flow monitoring sites, including two operated by yaqan yu?kiy. Additionally, the program operates 5 groundwater observation wells in the area, recognizing the importance of groundwater supply for domestic, agricultural and ecosystem needs within the Creston Valley.

Through a series of Watershed Bulletins, Living Lakes is sharing findings and learnings from the program, as well as highlighting case studies of CBWMF data being used to support community climate adaptation and watershed security. The most recent bulletin

highlights the “Water Resources for Fire Suppression” project carried out in the Argenta area, and is available as a [flipbook](#) and [PDF](#).

Earlier in 2024, the CBWMF was featured as a water governance case study in a special issue of the peer-reviewed journal *Water International*:

Hartwig, K., Thurston, P., Smith, H., Carver, M., Utzig, G., MacDonald, R., Jollymore, A., & Trigg, N. (2024). Water security through community-directed monitoring in the Canadian Columbia Basin: democratizing watershed data. *Water International*, 49(3–4), 429–438. <https://doi.org/10.1080/02508060.2024.2321823>

Biographical Notes

Managing the CBWMF program, Paige focuses on bridging science with community engagement and leads a network of technical experts and community leaders, inspired by her dedication to enhancing hydrometric monitoring in the Columbia Basin. Paige holds a B.Sc. in Environmental Science and is currently completing a Masters in Natural Resources.

7. Columbia River Basin invasive northern pike suppression and monitoring

Presenter: Eleanor Duifhuis, Okanagan Nation Alliance, eduifhuis@syilx.org

Co-authors: Evan Smith, Okanagan Nation Alliance, esmith@syilx.org; Ross Zeleznik, Okanagan Nation Alliance rzeleznik@syilx.org

Northern pike have been introduced (legally and illegally) to systems outside of their native distribution for the purposes of sport fishing. When introduced, northern pike are known to have detrimental effects on native fish populations, including salmonids. In 2004, northern pike were first observed in the Pend d'Oreille River Box Canyon Reservoir in Pend Oreille County, Washington. This population is suspected to have seeded the population now established in the Lower Columbia River. From 2010 to 2023, over 1,000 northern pike have been removed from the Columbia River Basin through various projects. The Okanagan Nation Alliance (ONA) has conducted a targeted suppression program since 2018, focusing on populations in the Pend d'Oreille River the Lower Columbia River (downstream of HLK). Successful suppression methods include gillnetting, boat and backpack electrofishing, angling, fyke netting, seining, and minnow trapping.

Spring gillnet catch-per-unit-effort in the Columbia River has been comparable over the last six years (2018 – 2023); however, is markedly lower than when suppression began in 2014 (82% lower in 2023 compared to 2014). Northern pike have not been detected in the Pend d'Oreille River through the suppression program since 2021. Northern pike captured on this program have predated upon fish up to half of their own length, and have also been found with up to seven different fish in their stomachs. Identified stomach contents of individuals caught during this project include: kokanee, rainbow trout, mountain whitefish, sculpin, dace, northern pikeminnow, peamouth chub, redbside shiners, suckers, brook trout, lake whitefish, and yellow perch; non-fish prey items include: grasshoppers, aquatic sow bugs, wasps, flying ants, leeches, and other unidentified invertebrates.

Exploratory eDNA sampling occurs at 12 locations and includes Osoyoos Lake, Christina Lake, the Kettle River, the Arrow Lakes Reservoir (from Nakusp to the HLK Dam forebay), and the Kootenay River (downstream of Nelson). Alongside this monitoring and suppression program, the ONA coordinates an angler incentive program with prizes for members of the public who submit information on northern pike they've removed from the Columbia River Basin.

Biographical notes

Eleanor has been with the Okanagan Nation Alliance since 2018 and particularly focuses on invasive dreissenid mussels, juvenile white sturgeon, and the Murphy Creek rainbow trout spawning channel.

8. Riparian restoration effectiveness monitoring: Success on unnamed tributary

Presenter: Elise Urness, Ecofish Research Ltd.

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Abstract

The objective of riparian revegetation and effectiveness monitoring is to restore functional fish habitat through mitigation of short-term impacts (e.g., via sediment control) and creation of stable riparian habitat with established vegetation that will provide increasing riparian function (e.g., bank stability, nutrient and litter drop, temperature moderation, and large woody debris contributions) over time. In 2022, Ecofish Research Ltd. (Ecofish) provided a restoration plan to be implemented in and around a seasonal tributary in southeastern British Columbia to address immediate erosion and sediment control (ESC) concerns and to restore the riparian and instream conditions in the tributary channel. The restoration design included a revegetation prescription for a 30 m riparian buffer zone on either side of the tributary channel consistent with adjacent riparian habitats. The instream habitat restoration and ESC measures were implemented between October 31 to November 2, 2022; however, planting was delayed until the following spring. Ecofish conducted surveys in July 2023 to confirm site stability and conditions appropriate to proceed with riparian planting, oversaw planting activities and completed as-built riparian planting surveys, marking the end of the restoration plan implementation phase. The restoration plan prescribed five years of effectiveness monitoring (Table 1) including annual effectiveness monitoring of three components: channel stability, ESC effectiveness, and riparian revegetation.

In year one, channel armoring was observed to be stable and in good condition with no reportable shifting, slumping, collapse or sediment infilling. Hydraulic conditions have remained in alignment with the design, and there were no notable changes in channel morphology or identified risks to channel stability. Erosion and sediment control measures maintained stable site conditions to facilitate revegetation establishment, and the erosion control blanket was observed to be in the process of biodegrading favorably. Revegetation monitoring saw an estimated 97% survival rate from planting in June 2023 to the first monitoring visit in September 2023, and estimated to be upwards of 80% by September 2024 (Year 2). Three species of noxious weeds were observed, among other introduced herb species in July 2023. Following the 2023 (Year 1) monitoring visit,

the stream and riparian areas appear to be on a trajectory to meet the five-year restoration targets set in the restoration plan.

Introduction

In 2022, Ecofish Research Ltd. (Ecofish) provided a restoration plan to be implemented in and around a seasonal tributary in southeastern British Columbia following a washout during spring freshet. The plan was designed to address immediate erosion and sediment control (ESC) concerns and to restore the riparian and instream conditions in the tributary channel. To ensure the channel could accommodate the following spring freshet flows, the instream habitat restoration and ESC measures were implemented from October 31 to November 2, 2022. Due to the late timing of construction, implementation of the riparian revegetation component was delayed until the spring of 2023. Subsequently, Ecofish provided an Implementation Memo to describe the results obtained for early channel stability and ESC monitoring (conducted to confirm site stability and conditions appropriate to proceed with riparian planting) and as-built riparian planting surveys, marking the end of the restoration plan implementation phase. The restoration plan prescribed five years of effectiveness monitoring including annual effectiveness monitoring of three components: channel stability, ESC, and riparian revegetation. The purpose of this memorandum is to document the effectiveness of the three monitoring components as listed. Below is a summary of methods and results from monitoring in the first two years.

Figure 1. Looking downstream at restored stream channel with willow stakes.



Methods

Channel Stability Monitoring

The objective of ongoing effectiveness monitoring of channel stability is to monitor and measure the long-term changes to the instream habitat following the completion of the implementation phase with the aim of identifying and evaluating potential changes to the instream habitat that may indicate a change in channel morphology of concern such as a shift in rip-rap material or structural channel substrate.

The approach to channel stability monitoring consisted of a desktop review of site photographs by a Qualified Environmental Professional (QEP), with an on-site engineering site inspection contingent on the identification of potential issues warranting detailed assessment. Channel stability monitoring consisted of photo-point assessment of site conditions post-restoration implementation completion in spring 2023. Images taken were subsequently used by Ecofish to complete comparative photographic desktop assessments of overall site conditions to identify any potential changes in channel morphology that could pose a risk to channel stability (e.g., a shift in structural channel substrate).

Erosion and Sediment Control Monitoring

The objective of ESC effectiveness monitoring was to ensure effective ESC mitigation throughout the year with the intended outcome being achievement of stable site conditions. The installed ESC measures were inspected and photo-monitoring data were captured during two field visits and images taken were subsequently used to complete a desktop assessment of overall site conditions and the ongoing effectiveness of installed site ESC measures.

Riparian Effectiveness Monitoring Assessment

The objective of riparian revegetation is to restore functional riparian habitat through mitigation of short-term impacts (e.g., via sediment control) and creation of stable riparian habitat with established vegetation that will provide increasing riparian function (e.g., bank stability, nutrient and litter drop, temperature moderation, and large woody debris contributions) over time. The restoration plan included a revegetation prescription for a 30 m riparian buffer zone either side of the tributary, which was the area assumed to provide riparian functions to the tributary in previous assessments. Following restoration activities, the restoration plan outlines a 5-year annual monitoring and maintenance schedule to ensure success of the corrective measures. Annual effectiveness monitoring is planned for late summer every year.

Ecofish conducted effectiveness monitoring of the riparian revegetation of the tributary by using the following four methods:

1) Permanent Revegetation Monitoring Plots:

The density (stems per hectare) and survival of woody vegetation was used as the main metric and indicator of restored riparian habitat quality, function, and trajectory.

2) Percent Vegetation Cover Estimates:

Percent vegetation cover estimates are useful indicators of ground stabilization and siltation interception functions that are provided by grasses, forbs, and small shrubs and trees early in the revegetation process. These estimates are therefore used to indicate the success of initial ground stabilization treatments employed for the revegetation program

3) Ecosystem Description Plots (including coarse woody debris (CWD) transects):

Ecosystem Description Plots are used to document the general site conditions in the revegetated riparian area. Physical and biological ecosystem characteristics, including CWD (density and size of pieces), site position (e.g., aspect, mesoslope position, slope), ground cover (e.g., rocks, soil, water), soil characteristics (e.g., texture, colour, organics), and environmental constraints/filters (e.g., plant pathogens, wildlife forage, exposure, human) to revegetation were described and recorded within the revegetated area.

4) Photo-point Monitoring:

Photo-point monitoring, which involves comparison of photographs among years, allows qualitative evaluation of the condition of the revegetated riparian area and thereby can support interpretation of the results of the three quantitative methods.

5) Invasive Species Monitoring:

Invasive species may compromise the growth and survival of native species. Ground surveys were conducted to inventory invasive species presence/absence, distribution, and overall density across the riparian restoration area.

Results

Channel Stability Monitoring

The findings of the channel stability monitoring were as follows:

- Restored channel and drainage ditch armouring was stable and in good condition with no shifting, slumping, collapse, or sediment infilling noted.
- The culvert has retained a variable substrate following freshet and seasonal rain events, and hydraulic conditions remain in alignment with the design.
- No notable changes in channel morphology or identified risks to channel stability.

Overall, the constructed channel appears to have maintained its integrity. There have been no notable changes in channel morphology or identified risks to channel stability. Additionally, sediment recruitment and retention from natural sediment flushing flows and observed backwater effects was noted within the culvert and indicates that the system is functioning as per the restoration design.

Erosion and Sediment Control Monitoring

The findings of the ESC effectiveness monitoring were as follows:

- ESC measures maintained stable site conditions to facilitate planting and appear to have remained functional throughout effectiveness monitoring Year 1.
- The erosion control blanket (ECB) was observed to be in the process of biodegrading favourably.
- Minor erosion of soil cover on steep slopes leading into the roadside drainage ditch. These observations are being tracked through ongoing monitoring, and have not been a concern to warrant repair or changes.

Overall, ESC measures appear to have remained functional.

Riparian Revegetation Effectiveness Monitoring Assessment

The findings of the riparian effectiveness monitoring were as follows:

1) Permanent Revegetation Monitoring plots:

The estimated live vegetation density, for all six plots combined indicated a 97% survival rate over the first summer. Planted shrubs in the riparian area reached an 84% survival rate in year two, however the overall survival rate, including willow stakes was 79%. This was due to the extremely rocky substrate the that the willow stakes were planted in and along the streambed. The limited soil below the rip rap for the willows to establish roots combined with unseasonably hot and dry conditions resulted in a 0% willow stake survival observed within our permanent monitoring plot. The only willow stakes that did survive were planted in soil at the top of the bank, not in the rip rap. As standard techniques for

planting willow were unsuccessful, alternative approaches are being developed that are more appropriately tailored to the conditions of the site.

2) Percent Vegetation Cover Estimates:

Percent cover increased substantially since the as-built survey, from 4% in June 2023 to 16% in September 2023, and then to 47% in year two.

3) Ecosystem Description Plots (including CWD):

No notable change in characteristics used to describe the present ecosystem, nor notable changes in decay class, not enough time has yet passed to allow for observable decay

4) Photo-Point Monitoring:

See Figure 2 for representative comparison.

5) Invasive Species:

15 introduced species were detected in July 2023. Of these species, three noxious weeds were identified: (Canada thistle (*Cirsium arvense*), oxeye daisy (*Chrysanthemum leucanthemum*), and scentless chamomile (*Matricaria maritima*). In addition to these, a few more introduced species were observed in year 2, along with a 4th noxious species (Annual Sow thistle (*Sonchus oleraceus*)).

Figure 2. View of stream channel upstream from culvert in September 2023 (left), and July 2024 (right)



Closure

Following the 2024 (Year 2) monitoring visit, the stream and riparian areas appear to be on a trajectory to meet the five-year restoration targets set in the restoration plan. As summarized, no observations or measurements fell below targets for stability, cover or density; however, over-winter survival of the planted willow stakes did not meet survival targets. Our investigation of why the willow stakes were not effective along with recommendations for re-installation are in progress.

See table next page,

Table 1. Summary of 2023 (Year 1) results compared to monitoring metrics and targets defined in the restoration plan, with corrective actions required or recommended to achieve targets.

Component	Metric	Qualitative/ Quantitative	Methods and Analysis	Target	Status 2023 (Year 1)	Status 2024 (Year 2)	Corrective Action Required	Corrective Action Recommended
Instream Habitat Restoration	Photo- monitoring	Qualitative	Compare engineering observations and repeat photographs from fixed monitoring points in standard directions to as-built conditions and between years.	Physically stable channel	Stable - No evidence of changes in channel morphology or stability ¹	Stable - No evidence of changes in channel morphology or stability ¹	n/a	n/a
Erosion and Sediment Control	Photo- monitoring	Qualitative	Compare photographs from fixed monitoring points in standard directions to design/as-built survey conditions, and between years. Assessment of mitigation measure function and evidence of erosion.	Successful implementation of effective erosion and sediment control techniques; stable site conditions.	Stable - No evidence of erosion or sediment mobilization ¹	Stable - No evidence of erosion or sediment mobilization ¹	n/a	n/a
Riparian	Vegetation Cover (%)	Quantitative - estimate	Determine average % cover from estimated % cover of native and exotic species in ten quadrats (each 0.25 m ²). Compare % cover to target and trend between years.	80% cover	16% cover	47% cover ²	n/a	n/a
				Stable to increasing native plant composition (i.e., # of species), increasing total cover	Increasing	Increasing	n/a	n/a
	Woody Vegetation Density (stems/ha), Survival (%)	Quantitative - measure	Count number of stems in five 50 m ² plots; tally of dead and alive of each species. Calculate percent change in stem density (total and by species) from as-built conditions, and compare trend between years.	80% survival of original planted density of shrubs (or 80% of the number of stems planted)	97% overall (97% planted shrubs; 62% willow stakes ³)	79% overall (84% planted shrubs; 0% willow stakes ⁴)	Willow stake replacement ⁵	Watering during periods of drought in 2026 ⁶
				Stable to increasing # of native species; zero or decreasing invasive species.	Native species: Stable Invasive species: Increasing.	Native species: Stable Invasive species: Increasing ⁷	Manual removal of invasive species	n/a
Photo- monitoring	Qualitative	Compare vegetation status photographs from fixed monitoring points in standard directions to design/as-built survey conditions, and trend	Stable site conditions, improved vegetation success and continued succession.	Stable; some suppression of seeded grass under ECB	Stable	n/a	n/a	

¹ Stable based on current conditions; ongoing monitoring required to ensure long-term stability of the system.

² On trajectory to reach target by 2027 (Year 5).

³ Stakes showing signs of growth (leaves, buds) were considered alive. Those with no signs of growth were counted as dead, despite the potential for latent dormancy.

⁴ Within permanent monitoring plot. Total number of willow stakes observed to have any 2024 growth was 26 stakes out of ~1,000 stakes. Those without growth in 2024 were considered dead with no assumption of dormancy.

⁵ Details of willow stake replacement technique to improve future success to be detailed in the 2024 (Year 2) Annual Monitoring Report.

⁶ Periods of drought are considered as >4 weeks without significant rainfall.

⁷ Invasive species observed in revegetation area include Canada thistle, oxeye daisy, scentless chamomile, and annual sow thistle. Invasive species were observed to be suppressing shrub growth in some instances.

Biographical notes

Elise Urness is a Biologist in Training with the College of Applied Biologists. She completed her M.Sc. in Biology at Carleton University looking at populations and distributions of rare plant species. Focusing on Southern Ontario's remnant forest patches she used species distribution models and population estimation to prioritize species for conservation action. With over 10 years of experience working in the field, Elise has conducted a variety of technical work including species at risk surveys, habitat quality assessments, habitat restoration planning and implementation, and species identification. She has worked as a Lead Horticulturist/Botanist for Nupqu Resource Limited Partnership, in their Native Plants Division, where she was responsible for managing the seed collection program. Born and raised in BC, she has spent many years working in silviculture and reforestation as a tree planting foreman. Elise has also worked and volunteered for various ENGOs and Non-profits (A Rocha Canada, CPAWS, Museum of Nature Ottawa, Friends of Gatineau Park) in the area of environmental stewardship, conservation science, citizen science, education and community engagement. Elise now works for Ecofish Research Ltd as a senior environmental technician and field manager on various restoration monitoring projects most commonly within the mining and hydro power sectors.

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

Presenter: David Greaves, Selkirk College

Abstract

Fish habitat surveys are essential to understand, mitigate, and adapt to changing climates and other human-caused impacts to streams and fish populations. 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. There is a need to advance, optimize, and implement innovative workflows for processing UAV data to supplement traditional fisheries surveys. This study 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 and abundance. It explored multiple sensor payload data acquisition approaches, including LiDAR, RGB, long-wave infrared (thermal) and multispectral imaging. It compared the accuracy of the classified drone-based data products to field-verified fish habitat inventory metrics within three West Kootenay streams (Glade, Lemon and Norns Creek). Through use of a hybrid analysis approach of multiple sensor data types, including object-based image analysis, supervised and unsupervised classification, and raster spatial analysis techniques, classified stream habitat target feature maps were generated and associated with survey metrics, including how they compare with traditional ground-based approaches.

You can find the full publication for this work [here](#)

Biographical notes

David Greaves has a master's and bachelor's degree in Geographic Information Systems and Applications, as well as a diploma in Recreation, Fish, and Wildlife from Selkirk College. His master's project had a specific focus on using drones to identify stream channel characteristics for fish habitat. He is an advanced operations drone pilot, drone flight school instructor and flight reviewer, specialized in remotely piloted aircraft system mission management and airborne sensor-tech geospatial data acquisition. His research interests include remote sensing, drones, food security, fish and wildlife conservation, forestry, avalanche studies and sustainable rural development.

10. Bringing the salmon home – Evaluating the feasibility of sockeye salmon reintroduction to historic habitat in the Columbia River upstream of Grand Coulee Dam

Presenter: Patrick Zubick, Okanagan Nation Alliance and Columbia River Salmon Reintroduction Initiative, pzubick@syilx.org

Co-Authors: Michael Zimmer, Okanagan Nation Alliance, mzimmer@syilx.org; Ryan Benson, Okanagan Nation Alliance; Dan Stefanovic, Okanagan Nation Alliance; Misun Kang, Ktunaxa Nation Council; Ben Meunier, Ktunaxa Nation Council; Scott Cope, Shuswap Indian Band; Will Warnock, Ministry of Water, Lands, and Resource Stewardship

The Canadian reaches of the Columbia River were once home to at least three known sockeye salmon-rearing lakes. These sockeye were extirpated by the construction of the Grand Coulee Dam, but once comprised a major proportion of the sockeye salmon production in the Columbia River. Due to the tremendous cultural damage caused by the loss of salmon to the Indigenous Nations of the Upper Columbia, efforts have been undertaken to evaluate the feasibility of salmon reintroduction to the region. In the Canadian Reaches of the Upper Columbia River, these efforts have led to the formation of Bringing the Salmon Home: The Columbia River Salmon Reintroduction Initiative. This is a tri-nation tribal partnership of the Syilx Okanagan Nation, Secwépemc Nation, and the Ktunaxa Nation, along with the Province of British Columbia and Fisheries and Oceans Canada. Through this initiative, we hope to answer key questions surrounding reintroduction feasibility, including: (1) Do juvenile sockeye salmon survive their migration through the Columbia River from upstream of Grand Coulee Dam, and (2) How will adult sockeye salmon behave upon reintroduction to altered historic habitats. Here, we will present the preliminary results from studies led by the Okanagan Nation Alliance (ONA) and Bringing the Salmon Home performing releases of PIT-tagged sockeye fry and a study evaluating adult Sockeye salmon behaviour in the Upper Columbia River using acoustic-tagged adults. We will also outline the ongoing studies to continue evaluating the feasibility of reintroducing sockeye salmon to the Upper Columbia.

To begin addressing the first question we have released 22,423 PIT-tagged sockeye fry in 2023 and 34,970 in 2024. From these releases, we have detected fish from Rocky Reach Dam, through to the Columbia River Estuary indicating that sockeye smolts can complete their sea-ward migration from the Canadian Upper Columbia River. To address the second question, we have released 57 adult sockeye from the Okanagan population to the Arrow Lake Reservoir (ALR) at Syringa Creek boat launch in two

release groups (July 11 and Aug 30). Each fish was implanted with an acoustic tag and externally marked with a spaghetti tag for angler identification. We then tracked these fish using an acoustic array installed in the ALR. Fish were detected along the entire length of the reservoir, including one individual swimming to Arrowhead (~200 km from the release site).

Data analysis for both studies is on-going so results are pending, but we hope the data from these juveniles and adults will help us bring the salmon home, to an area where they have been excluded from for 80+ years.

Please follow our progress at [Welcome | CRSRI \(columbiariversalmon.ca\)](https://www.columbiariversalmon.ca).

Biographical notes

Patrick Zubick is a fisheries biologist with the Okanagan Nation Alliance working on various studies evaluating reintroduction feasibility of Pacific salmon to the blocked sections of the Canadian Columbia River. He received an M.Sc. under the supervision of Dr Scott Hinch in the Pacific Salmon Ecology and Conservation Lab at UBC Vancouver where he researched barrier culvert remediations and their impacts on Coho and Chinook salmon juveniles. Patrick was raised in Castlegar along the shores of the Columbia River and considers himself lucky to work on salmon reintroduction in his home town.

11. Modernizing the Columbia River Treaty: How does the Kootenay River fit in?

Presenter: Stewart Rood, University of Lethbridge, rood@uleth.ca

Co-Authors: Greg Utzig, Kutenai Nature Investigations, g13utzig@telus.net; Ben Muenier, Ktunaxa Nation Council, Ben.Meunier@ktunaxa.org

The Columbia River Treaty was ratified by Canada and the USA in 1964 and intended to coordinate development of the transboundary Columbia River system. The Treaty required the construction of three dams in British Columbia, Mica and Keenleyside on the Columbia River, and Duncan Dam on the Duncan River. The Treaty also allowed a fourth project, Libby Dam on the Kootenai River (American spelling) in Montana. The four dams created very large water storage reservoirs, Kinbasket, Arrow, Duncan, and Koochanusa, respectively, which were regulated for two objectives: flood risk management and hydropower generation. The reservoirs were annually filled and drawn down, which killed all vegetation and resulted in extensive, barren floodplain zones.

The initial Treaty term was to 2024, and negotiations for Treaty modernization commenced in 2018. These negotiations have been unique, with the involvement of Canada and the USA, British Columbia and American states, and representation from Canadian Indigenous Nations and American Tribes. With wider reconsideration, there is broad support for a third Treaty objective, ecosystem function (CRT-EFSC, 2022). This could complement Indigenous cultural values and socio-economic outcomes, including recreation and tourism. To enable the broadened objectives, an Agreement in Principle proposes to convert up to one-third of the coordinated storage to provide flexible storage to allow British Columbia to revise the dam operations for the environmental objectives, and to promote the restoration and reintroductions of anadromous salmon (BC-CRT, 2024)

Prospective operations for ecosystem enhancement could involve the two system components, rivers, and reservoirs. For rivers, Functional Flows would provide more normalized or natural regimes (Foster et al., 2018; Yarnell et al. 2020). These may include higher flows to restore geomorphic processes, as is safely feasible. The flow peaks would be followed by gradual recession, mimicking natural patterns, and sufficient flows would be sustained through the warm and dry summer intervals to support the native fish and riparian vegetation (MacDonald and Green, 2022).

For the reservoirs, the reservoir levels could be managed to promote Floodplain, Riparian and Wetland (FRW) habitats (Rood et al., 2022). An FRW regime could reduce the level, frequency, and duration of reservoir filling, which would allow vegetation colonization and community development in the upper drawdown bands. This might benefit cottonwood forests; riparian shrublands with willows; and riparian herbaceous associations, with sedges, horsetails, and other plants.

Through the past two decades, the two Treaty dams in the Kootenay River Basin have had operational regimes intended for ecosystem enhancement. The outcomes from those applications can provide guidance for future ecosystem enhancement regimes for the four Treaty projects, and especially those along the Columbia River.

Duncan Dam and Reservoir

A Functional Flow regime was implemented along the Duncan River from 2009 to 2018. Through a water use planning (WUP) process, sequential operational alternatives were considered, leading to the 'S73' regime that was intended to benefit fish and riparian cottonwood forests along the lower Duncan River (Polzin and Rood, 2019).

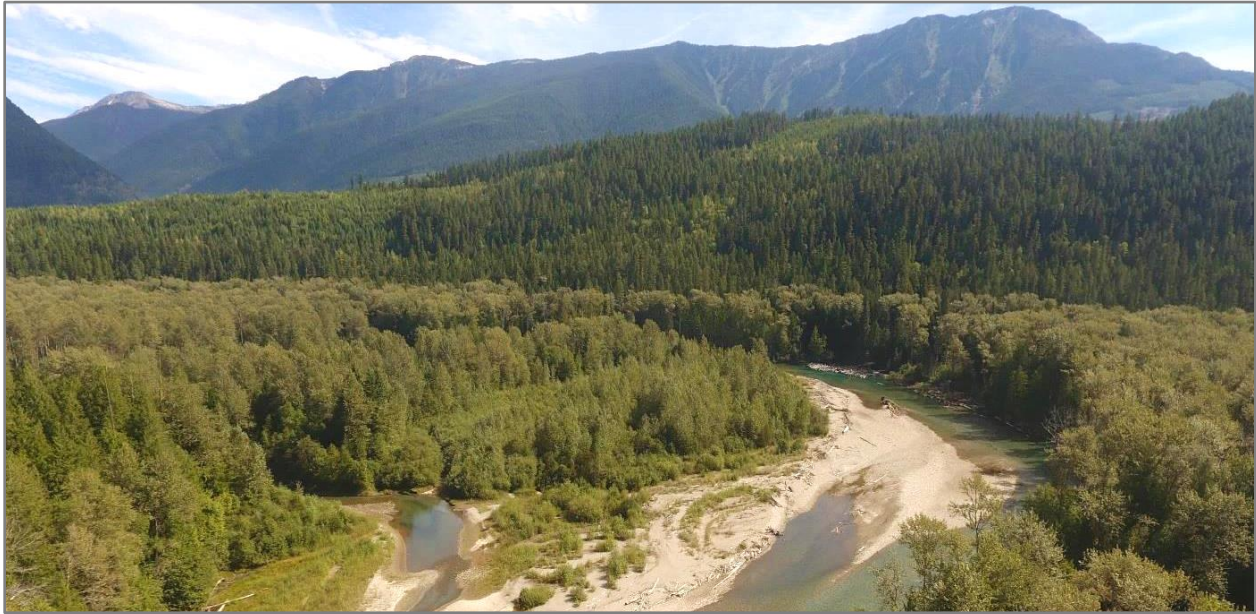
The S73 regime was delivered but there was apparently limited ecological benefit. This probably reflected recovery of the essential fluvial processes with the inflow from the unregulated Lardeau River downstream from the Duncan Dam (Polzin and Rood, 2019).

The change in the river flow regime required an elevated Duncan Reservoir regime. As predicted, this hindered the sparse vegetation in the upper drawdown zone, an outcome that supports the FRW concepts. Conversely, a future FRW regime with reduced upper reservoir inundation could promote vegetation on the alluvial fans and on the reservoir delta where the upper Duncan River outflows (Polzin et al., 2023).

Accompanying changes in the Treaty dam operations, there could be complementary measures for environmental conservation along the affected rivers and reservoirs. At storage reservoirs, there is often ecological expansion on the delta zones, with braided channels flanked by networks of riparian woodlands and wetlands. This is the case for Duncan Reservoir, and that delta zone may deserve protection.

Near and below the Duncan Dam, the valley and floodplain complex with the free-flowing Lardeau River, the regulated lower Duncan River, and the natural delta into Kootenay Lake provide an exceptionally rich ecological complex. This area could also deserve conservation measures and favorably, was recently assigned as a new *Kootenay Connect* focal area (Figure 1; <https://kootenayconservation.ca/kootenay-connect-duncan-lardeau/>).

Figure 1. Paralleling the dammed Duncan River, the Lardeau River (below) is relatively pristine, ecologically important, and worthy of protection.



Libby Dam and Kootenai Reservoir

Following the listing of the endemic Kootenai River White Sturgeon as endangered, Libby Dam operations were progressively changed from the 1990s. The first environmental flows provided an increased pulse to encourage sturgeon spawning. This was followed with more natural recession to provide a more holistic ecological flow regime, which benefitted the riparian as well as aquatic ecosystems (Rood et al., 2024). The outcome, Variable Discharge (*VarQ*), provides a Functional Flow regime, with different operations and flow patterns across wet versus dry years, based on snowpack accumulations and winter and spring rains.

The *VarQ* operational regime also altered the reservoir pattern. The annual fill objective was lowered by about 1.5 m (5 ft), which would be consistent with an FRW regime. This resulted in a commonly exposed band between the full pool elevation and the new fill objective, and this was rapidly colonized by riparian vegetation.

There were few new cottonwoods, but livestock grazing may have hindered their colonization on the favorable sites with shallow shoreline slopes. This emphasizes the influence of local land use, which also impacts the riparian ecosystems.

Accompanying *VarQ*, some willows and other shrubs colonized some of the delta zones from the inflowing streams. Similar to the case at Duncan Reservoir, the conservation of some of these delta zones would benefit ecological function. One candidate is Kikomun Creek, an ecologically rich spring-fed creek which supports a biodiverse delta zone and is a productive stream for fish spawning, including Kokanee salmon (Figure 2).

Figure 2. The delta zones where streams outflow into reservoirs are often ecologically enriched. Some delta zones may deserve protection such as that of Kikomun Creek, which flows into Koocanusa Reservoir (below). Kikomun Creek Provincial Park was established along with the Koocanusa Reservoir filling in 1972, but the namesake creek was not included within the park. It's conservation such as through Park expansion or with other measures could be worthwhile.



These ecological enhancement applications with the Duncan and Libby Dams provide guidance for dam operations to enhance ecosystem functions for the Mica and Keenleyside projects along the Columbia River. FRW regimes might promote vegetation development in the upper drawdown zones, including cottonwood forests and riparian shrub communities with willows. These provide deciduous woodlands that contribute rich habitats for diverse animals, including bugs, birds, bats, and bears.

There are limited remaining unimpounded river reaches below the Treaty dams on the Columbia River and correspondingly limited opportunities for the application of Functional Flows. The primary opportunity exists with the transboundary reach that extends from Keenleyside Dam downstream over the international border and into Roosevelt Reservoir, behind Grand Coulee Dam.

The proposed Treaty modernization following the Agreement in Principle could provide the essential flexibility in dam and reservoir management, to allow ecosystem enhancement. Associated strategies may include FRW regimes and Functional Flows for one or more of the four Treaty dams. Amplifying those ecosystem benefits, complementary management measures may include physical habitat enhancements, land use management, and other conservation measures.

Thus, the modernization of the Columbia River Treaty provides an opportunity to manage the major rivers of southeastern BC with broadened considerations for the ecological, Indigenous cultural, and socio-economic values. The Treaty modernization provides a second chance.

Biographical notes

The coauthors are environmental scientists with expertise in soils, plants, fish, river hydrology and ecology, and climate change. They have been studying the Columbia River Treaty rivers and reservoirs for two decades, in anticipation of the modernization of that Treaty. They were involved in the development and implementations of environmental flow regimes from the Duncan and Libby dams and have undertaken studies associated with the Keenleyside and Mica projects. They have been actively involved in the development of prospective FRW and Functional Flow applications and are members of the Joint Steering Team (JST) of the BC-CRT Team.

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Additional resources

BC Government – Columbia River Treaty site with a number of very informative postings: [Columbia River Treaty](#)

Indigenous perspective with the Ktunaxa Nation:

[Ktunaxa Nation celebrates milestone in Columbia River Treaty modernization : Ktunaxa Nation](#)

Wildsight - Graeme Lee Rowlands provides insight:

[Historic turning point for Columbia River, but what's next?](#)

Posters

12. Grafting as a conservation tool in whitebark pine recovery efforts

Presenter: Karli Graham, Geoterra

Co-Authors: Dana Charlton, TC Energy; Aaron Weaver, Geoterra; Gina Fryer, Geoterra; Randy Moody, Geoterra

Grafting scion from conifer species onto rootstock is a well-established method used in controlled breeding programs to conserve and propagate desirable traits, such as blister rust resistance in White Pine (Hunt, 2004; Sniezko et al., 2012). This method holds significant potential for the recovery of whitebark pine (*Pinus albicaulis*), a keystone species facing multiple threats (ECCC, 2017).

Field grafting offers a means of conserving genetic material from vulnerable plus trees until rust screening results are available, enabling their inclusion in seed orchards. Additionally, scion collection may be critical in situations where plus trees are threatened by mountain pine beetle infestations, wildfire, or require removal due to incidental activities.

In this study, whitebark pine scion material was collected in September 2021 from federal lands near Fernie, BC. In June 2022, the scions were grafted onto potted whitebark pine at the Kalamalka Forestry Centre in Vernon, BC, and onto seedlings at the Whitetail Mountain Study Site, 30 km west of Canal Flats, BC.

Preliminary results from the second year of monitoring will be presented, providing insights into the success of grafting as a conservation strategy for whitebark pine recovery.

[Click here to view the poster](#)

13. Summary of Nakusp maternity pen work to aid in mountain caribou recovery

Presenters: James Baxter, Sinixt Confederacy, james.baxter.fnw@colvilletribes.com

Co-Authors: Richard Whitney, Sinixt Confederacy; Francis Swan, Arrow Lakes Caribou Society; Aaron Reid Ministry of Water, Land and Resource Stewardship

The Central Selkirk Caribou Maternity Pen project was developed by the Arrow Lakes Caribou Society (ALCS) to support the recovery of the Central Selkirk herd (Nakusp herd) of Southern Mountain Woodland Caribou. The pen is located in the Kuskanax Creek drainage near the Nakusp Hot Springs, approximately 10 km northeast of the Village of Nakusp, B.C. The pen site was selected based on its elevation (875 m), variable terrain, suitable old cedar-hemlock forest, and accessibility. Pen construction began in fall 2019 and was fully completed in winter 2022 with the help of many volunteers, in-kind contributions, grant funding, and support from the Provincial Caribou Recovery Program. The maternity penning program began operating in 2022, and has continued in 2023 and 2024.

The primary objective of the maternity pen project is to have an increasing population growth rate ($\lambda > 1.0$) for each year of maternity penning. This objective will be achieved by meeting the following goals:

- Maintain or increase annual adult female survival: Maximizing the survival of adult females is key in increasing the population growth rate. The annual adult female survival objective of 0.85 was selected as the minimum, given the risks associated with maternity penning. The most recent census suggests there are 9-10 adult females in the Central Selkirk population. Because there are so few adult female caribou in the herd, capturing 75-100% of the adult females is critical to increase the chances of female survival and support population growth.
- Increase calf recruitment (Table 2): Meet or exceed 0.5 annual survival of pen-born calves and >15% annual calf recruitment at 10 months of age (age of recruitment). Calf recruitment from 2016 to 2021 averaged only 7.4% of the population (Reid 2021), well below the suggested 12% - 16% recruitment required for a stable population.

Field captures via helicopter occurred in 2022, 2023, and 2024, and are summarized below in Table 1 by year and capture location.

Capture is a difficult, high risk activity due to the complex mountainous terrain of caribou winter habitat. Typically, it takes place in late March or early April, depending on weather and snow conditions. A reconnaissance flight is flown several days prior to capture to determine the target animal locations and safe capture locations.

The capture team, consisting of pilots, animal wranglers, an avalanche tech, wildlife experts, veterinarians and volunteers, ensure caribou are safely captured and transported to the pen. Once in the pen, the sedated animals are assessed by veterinarians, vaccinated and collared before they are released.

Year	# Caribou Captured	Capture Locations
2022	7 adult females 1 female yearling	Lew Creek, Lardeau Range Halfway River, Nakusp Range Cape Horn Creek, Nakusp Range
2023	9 adult females from Central Selkirk herd 4 yearlings (10 months) – 3 females; 1 male 1 adult female from South Columbia herd	Lake Creek, Duncan Range South Trout Lake/Lardeau Range Mt Revelstoke
2024	7 adult females 2 young females (22 months) 1 female yearling (10 months)	Lew Creek, Lardeau Range Mt Jordan, Nakusp Range Kimbol Lake, Nakusp Range St Leon Creek, Nakusp Range

Table 1 – Field Capture Summary

Calving typically occurs around the end of May to mid June.

A wildlife veterinarian and veterinary technician are on staff during the calving period to perform neonatal examinations and provide any necessary veterinary intervention.

Each calf is assessed within 48 hours after birth and fitted with an ear tag. The neonatal exam includes determining sex, collecting a hair sample, weighing, checking the umbilicus for inflammation or abnormalities, and assessing the overall body condition and alertness of the calf.

The calf assessment is completed within three minutes of the chase initiation and the calf capture team ensure dams and calves reunite following the assessment.

Calves quickly gain weight (up to a kg/day) and adjust to the herd dynamic in the pen.

Year	# of Calves Born in the Pen	Survival to Release (%)	Survival to Recruitment (%)
2022	3 males/3 females	100	83
2023	7 males/1 female	100	undetermined
2024	4 males/2 females	83	undetermined

Table 2 - Calving Summary

Biographical notes

James Baxter is the Principal Biologist & Senior Manager for the Sinixt Confederacy out of Nelson, B.C. He has over 30 years for Natural Resource management experience in a variety of roles.

[Click here to view the poster](#)

14. Working towards northern leopard frog (*Lithobates pipiens*) recovery in Creston, BC

Presenter: Blaire Smith, Ministry of Water, Land and Resource Stewardship,
blaire.smith@gov.bc.ca

Co-Authors:

Irene Manley, Ministry of Water, Land and Resource Stewardship
Leigh Anne Isaac, Environmental Science Program, Thompson Rivers University &
Ministry of Water, Land and Resource Stewardship
Karl Larsen, Environmental Science Program, Thompson Rivers University

The northern leopard frog (*Lithobates pipiens*) is a wetland-dependent amphibian that has been adversely impacted by dam construction and operation due to the significant loss of wetland and riparian habitat within their historic range in the Columbia Basin. Although once widespread, the northern leopard frog suffered severe declines and by the mid-1990s was reduced to a single remnant population within the Creston Valley Wildlife Management Area (CVWMA). Since then, an ongoing recovery project has been guided by the BC Northern Leopard Frog Recovery Team (NLFRT) and is delivered by the Ministry of Water, Land and Resource Stewardship (WLRs) on behalf of the Fish and Wildlife Compensation Program. The project involves monitoring and stewardship of the population in the CVWMA, re-introduction activities across historic range, and facilitating scientific research.

Habitat Use and Movement Study

A recently initiated study investigates the habitat use and movement patterns of the northern leopard frog, in an agricultural landscape. We are identifying habitat use that may put migrating frogs in conflict with agricultural practices and are determining if this varies by life stage and/or sex. We predict that agricultural habitat use will vary by life-stage due to the difference in time that various life-stages spend in this suboptimal habitat (i.e. younger frogs will spend more time migrating through degraded agricultural areas). To test this, we will equip frogs with radio transmitters to track their terrestrial movements every 2-3 days and will monitor fine-scale movements during 24-hr focal monitoring. This will allow us to reveal whether movement patterns differ between adults (males and females) and juveniles, suggesting different habitat use by life-stages. As a result of this research, we will develop best management practices and harvest recommendations for land-managers to employ in agricultural areas that overlap with frog migration corridors.

Biographical notes

Blaire is a Wildlife Technologist with the Ministry of Water, Land and Resource Stewardship and she leads the northern leopard frog field program in Creston, BC. Blaire has worked in applied biology for the last ten years and has been involved in

northern leopard frog recovery in Creston, BC since 2018. Blaire is currently pursuing her M.Sc. in Environmental Science at Thompson Rivers University and is researching northern leopard frog habitat use and movement patterns.

[Click here to view the poster](#)

[Click here to see the recovery strategy for the Northern Leopard Frog, Rocky Mountain Population \(Canada\)](#)

15. Scouting cones by flying drones

Presenter: Brendan Wilson, Selkirk Innovates, Selkirk College, West Kootenay and Boundary Region

Co-Authors: Jamie Albino, Alana Block and Tom Perry, all with Selkirk Innovates, Selkirk College

In this pilot study, we explored the detection of whitebark pine cone clusters using moderately priced Remotely Piloted Aircraft Systems (RPAS) at a site in the Bonnington Range. Utilizing the DJI Mavic M3M (5-band multispectral) and M3T (thermal) RPAS, we found that cone clusters were particularly visible in the Near-Infrared (NIR) band of the multispectral imagery. Thermal imagery also revealed cone clusters, though with some limitations due to the hot ground surface, which did not contrast well with the clusters. This issue could potentially be mitigated by conducting flights at night or pre-sunrise. Additionally, flight height and Ground Sample Distance (GSD) considerations indicated that high-resolution products are necessary for visually detecting cone clusters in the imagery.

We propose a workflow designed to significantly reduce the effort required to count cone clusters in whitebark stands. This workflow involves workers accessing stands as easily as possible, followed by an RPAS mission from the access point. This approach minimizes the need to climb trees or traverse difficult habitats to check cone crops. RPAS missions can be programmed to inspect individual trees if their locations are known, and missions can be created on the fly in the field, provided a pre-loaded Digital Surface Model (DSM) or Digital Elevation Model (DEM) is available on the flight control system.

[Click to view poster here](#)

16. Columbia Basin Water Monitoring Framework: A coordinated monitoring network to support the tracking and understanding of climate impacts on water supply for communities and ecosystems

Presenter: Paige Thurston, Living Lakes Canada, paige@livinglakescanada.ca

Co-Authors: Nicole Trigg & Kai Smith, Living Lakes Canada

The Columbia Basin Water Monitoring Framework is a coordinated monitoring network developed to track how climate change and other impacts are affecting water supply for communities and ecosystems. CBWMF data is available to inform adaptive watershed management and freshwater stewardship strategies for Columbia Basin communities.

This poster highlights some of the data collected to date in the Slocan Valley, including Bonanza Creek which is monitored in partnership with the Slocan Lake Stewardship Society to support restoration and monitoring efforts within the Bonanza Biodiversity Corridor through the Kootenay Connect project.

[Click here to view poster](#)

Field trips

17. From bats to leopard frogs and much more, Creston Valley Wildlife Management Area and Nature Conservancy of Canada Frog Bear property, Creston BC



Hosted by:

Marc-Andre Beaucher, Creston Valley Wildlife Management Area;
Devon Moore, Ministry of Water Lands and Resource Stewardship, Kootenay
Bullfrog Control Program;
Cori Lausen Wildlife Conservation Society Canada, Director of Bat Conservation;
Jason Rae, Wildlife Conservation Society Canada; and
Marcy Mahr, Kootenay Connect.

Location:

Creston Valley Wildlife Management Area – Duck Lake and West Meadows Farm
Nature Conservancy of Canada – Frog Bear property.

Description:

Participants carpooled to Creston Valley Wildlife Management Area (CVWMA) Duck Lake site. The field trip commenced with a tour of a number of bat roosting and maternity artificial structures and the associated research conducted by Cori Lausen, Jason Rae and their team with the Wildlife Conservation Society of Canada. This included an opportunity to view the BrandenBark™ in action, something discussed the day before.

Following Cori and Jason’s tour, we moved on to see a recently constructed wetland where Marc-Andre Beaucher, Devon Moore, and Marcy Mahr discussed the northern leopard frog recovery project, American bullfrog monitoring and control, and the Kootenay Connect projects that have been implemented over a number of years. This portion of the field trip included a visit to a newly constructed channel where we discussed habitat restoration and enhancement for Species at Risk in the Creston Valley Wildlife Management Area. This portion of the field tour. We were lucky and saw some leopard frogs up close and personal!





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