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Living Lab Program for Climate Change and Conservation - Final Report

Project title: Climate change resilience and sensitivity of key wetland ecosystems in the Ancient Forest/Chun T'oh Whudujut Park

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Research findings

[Please include key quantitative and qualitative research accomplishments. Indicate any negative or positive results that were not anticipated. Bullets are acceptable]

- Water level data from 12 piezometers in the wetland have shown stable flow patterns throughout the snow free period. Horizontal groundwater velocity across the wetland falls within the range of 40-60 cm yr^{-1}, suggesting a residence time of up to 5000 years if horizontal groundwater flow were the primary transport process.
- Conversely, cross correlation between rainfall and water level find that water levels do react to rainfall an average of 20 hours following rainfall events indicating a short-term linkage between atmospheric processes and the groundwater.
- Preliminary analysis of stable water isotope data of water samples suggests however that if the shallow groundwater is indeed a mixture of seasonal snowmelt and rainfall, that rainfall only accounts for roughly 25 % of the mixture with snowmelt accounting for the remaining 75 % of the groundwater input.
- Groundwater chemistry was an important predictive variable for wetland community composition, with observed pH values ranging from 3.7 in extensive Sphagnum bogs, to 8.1, in a calcareous fen with upwelling springs.
- Analysis of herbarium samples collected in long-term wetland monitoring plots indicates that wetlands in the Ancient Forest area support 488 lichen and plant species. This includes 1 macroscopic green alga, 20 liverworts, 13 lichens, 93 mosses, and 361 vascular plant species.
- Species found in the studied wetlands that have special conservation significance for being regionally or globally rare, or rare regional endemics include *Carex lacustris* (not known in British Columbia outside the Robson Valley), *Castilleja purpurascens* (a regionally endemic species previously known from only a handful of populations close to the type locality), *Erythranthe sp*. A (known only from calcareous fens in the study area), Salix raupii (a rarely observed species throughout its global range), *Schistidium holmenianum* (a disjunct occurrence of a higher latitude species, the only population known in BC), and *Sphagnum cuspidatum* (previously known in western North America only from a few

observations near urban Vancouver deemed exotic, whereas the occurrences in the Robson Valley are undoubtedly native).

Methods summary

[Please be brief - bullets are acceptable]

- Water samples were collected from snowmelt, creeks, ponds and shallow groundwater were analysed for their stable water isotopic composition ($\delta^{18}O$ and $\delta^{2}H$).
- Water level loggers were installed in March 2019 and have continuously logged shallow groundwater tables, and surface ponding levels to present and are now being removed.
- Airborne laser scanning was used to generate a sub-decimeter scale digital elevation model of ~50% of the park, these data were used to facilitate mapping of the water table.
- We have established long term ecological monitoring (LTEM) plots in twenty-eight wetlands in three adjacent B.C. Provincial Parks in the Robson Valley: Ancient Forest/Chun T'oh Whudujut, Slim Creek, and Sugarbowl - Grizzly Den, and in the nearby large Sinclair Mills (Meteor Lake) wetland. With subplots that were set up in the larger wetlands, this resulted in a total of 54 replicate plots being established, a robust sample size for a regional installation. Water chemistry (pH and conductivity) was analyzed in 469 samples from a subset of 25 plots (spanning the range of major vegetation types) in summer 2021.
- All vascular plants, lichens, and bryophytes were enumerated within LTEM plots using a controlled intuitive wander method that directs allocation of field efforts to maximize species-capture. Voucher samples have been deposited with the Beatty Biodiversity Museum with data for rare species deposited with the B.C. Conservation Data Center.

Key outcomes for BC Parks

[e.g., what are the consequences of your research for park values/resources?, bullets are acceptable]

- Results from stable water isotope analysis and horizontal groundwater flow indicate an ecosystem reliant predominantly on the influx of snowmelt waters. This indicates that climate change is likely to alter the timing and elevation of peak water table for the wetland. Though the total annual amounts of precipitation are not expected to change markedly with climate change, the phase and timing of winter precipitation are. As a result, it is possible that the magnitude of snowmelt input to the wetland will likely change but it is yet to be determined whether this will be balanced out by increased spring rainfall.
- Although the Ancient Forest/Chun T'oh Whudujut Provincial Park and Protected area was established in 2016 primarily with the objective of protecting ancient western redcedar stands, the current Living Labs work suggests that another key focus for the management plan of this park (currently under development) will be the conservation of these provincially significant wetlands and their associated taxa in the park.
- Project surveys in the Meteor Lake wetland, an extensive wetland complex (> 2000 ha) immediately west of Sugarbowl - Grizzly Den Provincial Park, point to the high conservation value of this area. Our research findings were a major factor in the 2020 decision by the province to provide interim protection to this area under Section 16 of the Land Act, with planned inclusion as an ecologically valuable site in the Conservation Lands

Program (under the Strategic Plan for the Omineca Conservation Lands Program). This area remains vulnerable to any disruptions of hydrology from resource road construction or quarry activity on adjacent lands.

- Project biodiversity data are planned to be available in the online data repository for *Botany*, a National Research Council of Canada Journal, now with a planned 2021 submission of a journal manuscript outlining key project findings, including water chemistry findings from our 2020/21 fieldwork and analysis.
- A high resolution LIDAR dataset of the wetland area is available to be incorporated into an appropriate online database for public access.

Relevance to BC Parks management

[Provide any recommended steps BC Parks can take to incorporate your project's findings in our day to day management of the park system]

- Continue to promote climate change outreach opportunities.
- The UNBC climate station at the Ancient Forest Trail site provides key information to understanding changes in climate in the northern Columbia Mountains, both for B.C. Parks and for management of adjacent crown lands.
- Major wetlands in the three parks studied were previously unknown to science. Our findings suggest that they have major provincial significance, both as rare ecosystems in the region, for their diverse species assemblages, and for their role in sustaining ecological processes in the upper Fraser River watershed. Identified areas should be zoned to receive full protection from any disturbances that could impact biodiversity. This input is timely as B.C. Parks is currently working on their first management plan for the combined Slim Creek and Ancient Forest/Chun T'oh Whudujut Provincial Park and Protected areas. Project findings have been included in the newly drafted Ecosystem Overview Assessment for Slim Creek, Ancient Forest / Chun T'oh Whudujut Park and Protected Area, informing the public consultation process for the first park management plan.

Project's challenges/opportunities

[List challenges/lessons learned or opportunities here]

1. To better understand reliance of upslope groundwater flows, it is recommended to monitor water isotope compositions at known groundwater seeps within the cedar stands of the park as well as in the wetland. Understanding whether these seeps provide baseflow to the wetland water system will reveal how buffered the hydrology is from annual variability in snowpacks.
2. A major opportunity arising from the project is the incorporation of the new information on species biodiversity and rare ecosystems in the Ancient Forest/Chun T'oh Whudujut Park into the next generation of interpretive signs for the Ancient Forest Trail. Conversations about updating the Ancient Forest interpretive signs and incorporating features such as QR codes have been initiated with Natasha Ewing, Community Liaison Officer for the Northern Region.

3. A challenge for the project investigators and for the Living Labs program will be that of obtaining resources to conduct future reassessments in long-term plots to determine how climate change impacts play out.
4. A major limitation revealed by the project is the paucity of previous scientific surveys in wetlands of northern B.C., especially in the Robson Valley. The current project suggests the scientific importance of this area, however, many wetland complexes remain unvisited. Our preliminary survey at one wetland in the McGregor River valley, for instance, suggests that surface hydrology and species composition of some wetlands has already been seriously degraded by adjacent resource road construction. We are potentially losing species before we even have a chance to determine their presence.

Conclusions/next steps

Climate change impacts in provincial parks of the Robson Valley may be particularly severe, given the reliance of these ecosystems on winter snowpacks. There is an urgent need for better inter-agency cooperation and resource allocation (e.g. between B.C. Parks and FLNRORD re: the surrounding timber harvesting landbase) to ensure that effective knowledge creation and mitigation of these issues occurs.

References and links

[Optional - Provide any other links or information related to the project, including existing blogs, related publications, or other media]

Scientists Monitoring Impacts of Climate Change on Wetlands, August 12, 2019. https://engage.gov.bc.ca/bcparksblog/2019/08/12/scientists-monitoring-impacts-of-climate-change-on-wetlands/

Bezzola, A., and D. Coxson. 2019. Slim Creek, Ancient Forest / Chun T'oh Whudujut Park and Protected Area, Ecosystem Overview Assessment. Report submitted to B.C. Parks, March 14, 2019.

Morris, J.E., Déry, S.J., Coxson, D.S.: Determining the Influence of Spring Snowmelt on Wetlands of Ancient Forest/Chun T'oh Whudujut Provincial Park. Western Division of the Canadian Association of Geographers Annual Meeting, Prince George, B.C. 13 March 2020. Poster Presentation.

Checklist

- Have you submitted a short blog for BC Parks' website? Yes, in 2019
- Have you added any relevant Living Lab project data or reports to the BC Data warehouse and/or EcoCat? Please contact Jen Grant or Stephen Ban for assistance. No, other databases to be uses as outlined in report
- Invoice submitted? Will follow shortly