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Living Lab Program for Climate Change and Conservation - Final Report

Project title:

Hydrological Modelling for Climate Resilience in Philips River Watershed

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Research findings

This is the first year of a five-year program, focused on equipment installation and initial data collection. Full research findings will emerge as DHSVM modeling and multi-season data analysis advance.

- **Equipment Procurement**: In the first year, we consulted with regional experts on suitable monitoring tools, reached out to several local vendors, obtained multiple quotes, and weighed different options for sensors, brands, models, and functions (e.g., evaluating durability, connectivity features like Bluetooth or satellite telemetry, power sources such as solar backups, and data security during high-flow events). This led to the final purchase of equipment, including BC Parks fully funded hydrometric stations (HOBO MX2001 non-vented water level loggers) and one partially funded Environment Canada-grade weather station (Sutron datalogger with comprehensive sensors).
- **Equipment Deployment**: The Philips Arm project encompasses two watersheds—the smaller, more accessible Fanny Bay watershed and the larger, harder-to-access Phillips River watershed. Taking advantage of Fanny Bay's easier access, we prioritized scouting and installing three hydrometric stations there first to learn the ropes on transportation logistics, equipment handling, and fieldwork challenges, which streamlined our approach for the more demanding Phillips River sites. We have also successfully installed two smaller-scale HOBO-grade weather stations in Philips Arm (not funded by BC Parks), with the Environment Canada station designed for the high-elevation rugged terrain and harsh environment of the mountains in the Phillips River watershed. Initial data confirms reliable capture of water levels, precipitation, and meteorological variables across elevations, addressing the historical data gap in this rain-on-snow system.

- **Preliminary Streamflow Observations**: Early rating curve development from multi-season visits shows variations in discharge influenced by snowmelt and rainfall, highlighting sensitivity to forest disturbances from past logging.
- **Baseline Climate Insights**: Initial weather data extensions reveal patterns in temperature and precipitation, setting the stage for simulations of future changes like altered snowmelt timing and increased flood/drought risks.

Methods summary

Site Selection for Monitoring Stations: Evaluate multiple locations based on stream channel representativeness, accessibility, proximity to key areas, and long-term monitoring potential.

Hydrometric Stations Installation and Operation: Purchase and install HOBO MX2001 water level loggers (non-vented with barometric sensors, Bluetooth for easy wireless data download, and onshore loggers for safety in floods). Prep sites by clearing plants, securing riverbanks, and building strong bases to handle bad weather. Anchor sensors (like pressure or ultrasonic types) to boulders in the stream and link them to protected data loggers for ongoing water depth tracking. Do regular upkeep every two months: check for issues and download the data.

Development of Discharge Rating Curves: Translate water depth data into streamflow discharge via site-specific rating curves for each of the hydrometric stations. Perform multiple on-site visits across seasons and flow ranges (low to high) to capture variations in channel geometry, floodplain flows, and roughness coefficients.

Weather Station Installation and Operation: Pick site based on how well it represents local microclimates and ease of access. Prep site by clearing vegetation, leveling the ground, and building sturdy foundations and fences; mount sensors at proper heights. Install HOBO datalogger with sensors for temperature, precipitation, humidity, wind speed/direction, and solar radiation.

Key outcomes for BC Parks

This is the first year of a five-year program, with efforts focused on equipment installation and initial data collection, and full outcomes will develop as data accumulates and DHSVM modeling advances. For conservation values, the project enhances ecosystem resilience by identifying climate-driven streamflow changes such as floods and droughts to protect fish habitats, while establishing long-term monitoring capacity via BC Parks-funded stations that aid habitat restoration and vulnerability mitigation from logging impacts. In terms of recreation values, it improves safety for activities like wildlife viewing by predicting flood and drought risks and maintaining trails and boating access, and it promotes sustainable experiences by ensuring resilient habitats for salmon observation along with educational programs on climate effects. Regarding cultural values, the research strengthens Indigenous-led stewardship by integrating Kwiakah traditional knowledge systems, fostering reconciliation via OCAP (Ownership, Control, Access, Possession) principles, and supporting co-management decisions that honor cultural priorities in land use and ecosystem protection.

Relevance to BC Parks management

As the first year of a five-year Kwiakah-led MITACS-funded program focused on equipment installation and initial data collection, this project addresses climate vulnerabilities by providing baseline data and models for streamflow changes in rain-on-snow systems, helping predict impacts on water resources, biodiversity such as salmon and overall ecosystem health from logging and climate variability. It informs decision-making by enabling vulnerability assessments, conservation strategies, habitat restoration, and resource allocation to enhance resilience in protected areas affected by industrial extraction. The initiative supports co-management by strengthening partnerships with Kwiakah First Nation through data sharing and the integration of traditional knowledge for regenerative forestry and long-term monitoring, with equipment ultimately owned by Kwiakah Forest Keepers. It facilitates conservancy expansion by aiding evaluations of hydrological and ecosystem risks associated with continued logging versus protection. Ultimately, it aligns with broader goals by contributing to sustainable management across BC's park system, including carbon dynamics, wildlife, and connectivity, in line with the Living Lab for Climate Change and Conservation Program.

Recommended Steps for Incorporating Findings

As data collection continues, BC Parks can start integrating preliminary insights by incorporating real-time streamflow and weather data from the stations into existing park dashboards for ongoing hydrological trend tracking, using model simulations (once available) to revise conservancy strategies that prioritize habitat restoration in flood/drought-prone areas, sharing findings via workshops or reports to enhance staff training on climate-resilient practices including risk assessments for extreme events, scheduling regular meetings with Kwiakah and researchers to apply insights to co-management decisions such as resource allocation or expansion proposals, and applying these to day-to-day operations by adjusting recreational guidelines (e.g., trail closures during predicted floods) and incorporating them into annual budgeting for adaptive infrastructure.

Project’s challenges/opportunities

This is the first year of a five-year program, focused on equipment installation and initial data collection. Full challenges and opportunities will evolve as data accumulates and DHSVM modeling advances.

Challenges/Lessons Learned

Accessing sites in the dense Great Bear Rainforest presented significant challenges due to remote and rugged terrain, requiring helicopter landings on stream sandbars when forest clearings proved impossible, which highlighted logistical hurdles and the necessity for adaptive fieldwork strategies. Environmental and wildlife interference further complicated efforts, with encounters with grizzly bears on trails and beaver dams washing out former logging roads-such as the notable "Beaver Dam" blockage-causing delays and teaching the importance of wildlife-aware planning and flexible routing. Tidal and weather variability added another layer of difficulty, as boats often got stranded on mudflats during low tides, necessitating manual pushing and underscoring the need for better timing and contingency plans in multi-modal transport for coastal fieldwork. Equipment maintenance in such isolated locations posed ongoing risks, including sensor displacement from high-flow events and the added costs and labor of helicopter visits for inspections and cleaning. Finally, data collection across seasons demanded multiple visits during varying flows to develop accurate rating curves, revealing challenges in capturing high-discharge events and channel changes, and informing the adoption of phased, patient data strategies.

Opportunities have also emerged from this foundational work. As a First Nation-initiated research project conducted entirely within Kwiakah First Nation traditional territory, with close collaboration on every step from design to implementation, it pioneers untouched sites by accessing likely human-unvisited areas via helicopter, opening unique data on pristine pockets amid logged landscapes and enabling finer-scale insights into climate resilience. Enhanced partnerships through this deep collaboration with Kwiakah First Nation build capacity for long-term monitoring and regenerative forestry, fostering reconciliation and shared knowledge. The BC Parks-funded stations create enduring tools for landscape-scale tracking, supporting conservancy expansion and adaptive management. Innovative modeling with early data sets the stage for DHSVM simulations of future scenarios, offering predictive tools for floods, droughts, and ecosystem recovery in protected areas. Broader applications mean insights from this rain-on-snow system can inform BC Parks' strategies across similar watersheds, promoting sustainable recreation, conservation, and cultural priorities.

Conclusions/next steps

The project has reached several key conclusions in its early phase. The successful purchase and deployment of hydrometric and weather stations has filled a critical data gap in this remote rain-on-snow watershed. Early data collection provides a reliable baseline for understanding forestry and climate impacts on streamflow, salmon habitat, and ecosystem health. A strong Kwiakah partnership, guided by OCAP principles, has integrated traditional knowledge and built long-term monitoring capacity owned by Kwiakah Forest Keepers. Overall, the project demonstrates how targeted investment in protected areas can support regenerative forestry and adaptive management amid past logging pressures.

Looking ahead, the next steps include continuing baseline data collection and maintenance through 2026 to strengthen the DHSVM model, running full climate-change scenario simulations and sharing results with Kwiakah, supporting Kwiakah's evaluation of future forest management scenarios, and planning for expanded collaboration in years 2–5, including deeper integration of wildlife, carbon, and cultural indicators.