

# Living Lab Program for Climate Change and Conservation - Final Report



## Project title:

Waterfall Sprayzones in Wells Gray Provincial Park: Biodiversity Hotspots and Potential Refugia in a Changing Climate

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## Research findings

The six Wells Gray waterfalls inventoried in 2023 and 2024 (Are, Dawson, Moul, Rainbow, Triple Decker, and Sticta falls) and their adjacent (typically) upstream (control) habitats supported 1174 species of plants and cryptogams, i.e., 254 vascular plants, 582 lichens, 240 mosses, and 98 hepatics. Of these, 994 species occurred in waterfall sprayzones, versus only 624 species in our comparison sites. Intriguingly, 550 species were recorded exclusively in sprayzones, including 45 vascular plants, 319 lichens, 129 mosses, and 57 hepatics versus only 179 species in the comparison sites, i.e., 70 vascular plants, 77 lichens, 27 mosses, and 5 hepatics. Thus, not only did the sprayzone sites yield half again as many species as the comparison sites, they also supported more than three times as many exclusive species.

Overall species richness was higher for sprayzones than for comparison areas in all cases excepting Triple Decker Falls. The differences in species richness were especially striking for cryptogams (lichens and bryophytes), which at Dawson Falls were 4.4 times more diverse within sprayzones than outside of them. Differences in cryptogam species richness was also notably higher at four of the other waterfalls: 2.1 times at Are Falls, 1.6 times at Sticta Falls, 1.5 times at Moul Falls, and 3.6 and 2.2 times for the two comparisons at Rainbow Falls,. By contrast, vascular plant richness often shows an opposite trend, with diversity in the comparison areas exceeding that in the sprayzones in Are, Dawson, Moul and Triple Decker Falls.

Even more striking is the occurrence of rare or otherwise noteworthy species, which are many times more numerous in the sprayzones than in the comparison sites. Among the species recorded in the project that are rare in British Columbia, many of them are accorded conservation status (Blue or Red) by the British Columbia Conservation Data Centre (BC-CDC 2024). Of the species deemed rare in BC, 72 occurred in sprayzones as compared with only 8 species outside the sprayzones (66 of the 72 exclusively in sprayzones). Of the 21 species recorded in our study that are primarily coastal in their geographic distribution and rare in interior regions, 18 were found only in sprayzones and only 1 only in comparison areas. Perhaps even more remarkable in this context is our finding that 58 of the sprayzone species could not be named to species and, at least in some cases, are presumably new to science.

Specimens from biodiversity assessments will be available for review pending deposit and processing at the UBC herbarium, while photographs and voice recorder files are available upon request. A complete list of species identified is available on request.

A major influence on this floristic diversity in areas of sprayzone influence is microclimate amelioration. Climate data from Are Falls showed a marked sprayzone influence on streamside climate with mid-day (maximum) sprayzone temperatures up to 10°C cooler on hot summer days than in adjacent upland habitats. The inner sprayzone (immediately adjacent to the waterfall) was consistently the coolest site midday, typically 2-3 °C cooler than the outer sprayzone station. This data points to the importance of waterfall spray zones as climate refugia.

Observation of physical habitats adjacent to Are, Dawson, Helmcken, Moul, Rainbow, Spahats, Sticta, and Triple Decker Falls show quite different impacts of human use, correlated with the intensity of visitor use. Are Falls being the least disturbed site, with streamside vegetation and adjacent upland forest showing little human influence. Streamside habitats at Rainbow and Sticta Falls were also largely undisturbed by human impacts, both having only limited areas designated for visitor viewpoints, and most of the rest of the areas of the sprayzones being too difficult to traverse for most visitors to attempt a more exploratory scramble.

Dawson Falls, as a major visitor destination (see cover photograph), showed localized trampling of streamside vegetation, mainly in areas immediately adjacent (both upslope and down to the river shore) to access trails and viewing platforms. This included breakage of canopy twigs and loss of bryophyte and lichen cover in potentially species-rich streamside habitats.

The north rim of the Helmcken Falls chasm is the site of a popular tourist viewpoint. The human footprint at this viewpoint is readily observed, with heavily used trails, fencing, and a viewing platform. The south rim of the Helmcken Falls chasm is not developed for tourist visitation and relatively little tourist activity occurred there until recent years, when ice climbing has increased in popularity. At several points along the south rim, trees and shrubs have been cut, branches sawn off, and precipice-edge ground vegetation completely removed. These impacts to the sprayzone vegetation on the south rim are presumably due to the presence of numerous rope ties and exit points at the termini of ice climbing routes.

## Methods summary

In 2023, we inventoried four waterfalls for their plants, lichens, mosses and hepatics within and immediately adjacent to Wells Gray Park, i.e., Are Falls (Philip Creek), Dawson Falls, Moul Falls, and Rainbow Falls. These inventories were amplified by parallel studies of two additional waterfalls in 2024, namely, Sticta Falls and Triple Decker Falls. Two additional waterfalls – Helmcken and Spahats – were assessed for their previously known flora but were rejected for further inventory due to significant damage to their canyon rims by tourist activity, as well as safety risks and other difficulties involved in working in their canyon-bottom sprayzones.

Waterfall vegetation assessments followed methodologies outlined in the British Columbia Resource Inventory Standards Committee (RISC) Standards. This methodology employs a “controlled intuitive meander” approach, in which field effort is allocated to all microhabitats present within each waterfall sprayzone. Survey routes were therefore not plot- or transect-oriented, but emphasized habitats with potential for maximum species richness, consistent with the goal to compile a comprehensive species list for each waterfall sprayzone.

For each of these focal microhabitats, our search effort was determined by a species-area accumulation slope, such that search effort continues only as long as it yields additional species.

Once no additional species were located within a defined search area, assessment efforts were shifted to the next selected microhabitat. To compare floristic inventory results of waterfall spray ecosystems against adjacent riparian habitat each inventory was paired with a second inventory conducted in a roughly equivalent area outside the area of waterfall influence (following the same intuitive search method as described above); where possible, this second inventory was conducted in streamside forests immediately above the waterfall.

Temperature and relative humidity (RH) at Are Falls were measured using a Hobo 12-bit Temperature/ Relative Humidity Smart Sensor installed in an unspirated radiation shield. Incident precipitation was measured using a Hobo tipping bucket rain gauge (0.2 mm resolution), while the duration of periods of both incident and occult precipitation (condensation of mist and fog on foliage) was measured using Hobo Leaf Wetness Smart Sensors installed at a 45° orientation from vertical.

### **Key outcomes for BC Parks**

[e.g., what are the consequences of your research for park values (conservation, recreation, and/or cultural)?, bullets are acceptable]

Our project results confirm that waterfalls in Wells Gray Provincial Park have major importance, not only as high profile visitor attractions within the park, but as floristic hotspots for regional biodiversity. Due to their ability to create zones of cooler and moist microclimate conditions waterfall sprayzones are likely to play an increasingly important role as biodiversity refugia in the face of climate change.

### **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]

Field work in connection with the present study suggests that human disturbance does not at presently threaten species richness within or adjacent to the sprayzones of any of the six waterfalls inventoried in detail that are within or adjacent to Wells Gray Park (Are, Dawson, Moul, Rainbow, Triple Decker, and Sticta falls), though some species may be threatened if they occur only adjacent to foot-traffic areas. However, the conspicuous damage to the Helmcken north and south Rim, the Spahats north rim, and Triple Decker Falls give testimony to the need to manage tourism activity to limit the intensity and areal scope of damage from visitation.

We would note that our project provided detailed assessments for only six of the forty-one listed waterfalls in Wells Gray Park. Although other waterfalls in Wells Gray are likely to display the same species enrichment in their sprayzones, they may support other combinations of unique and/or rare species. Continued floristic assessments of waterfall sprayzones in Wells Gray (existing and new sites) is recommended, both as a baseline against which future climate change impacts can be assessed, and as an indicator of potential changes in visitor impacts.

### **Project's challenges/opportunities**

Ideally, species assessments for each waterfall comparison zone would have been made in the zone immediately upstream and in the contiguous downstream sprayzone. Unfortunately, this was not possible in all cases owing to the presence of subsidiary cataracts immediately upstream, each with

its own sprayzone, or to upstream private land. Thus, the comparison zone for Triple Decker Falls was positioned at some distance downstream (the upstream area is intersected by a major road and private properties, and the intervening area downstream is impacted by numerous windfallen and flood-carried trees and the streambanks there are unstable). For Moul Falls, the comparison zone was situated some distance upstream along a low-grade span of the creek. Due to upstream cataracts, the Rainbow Falls comparison area had to be situated immediately downstream along the short span of the creek between Rainbow Falls and Azure Lake. In order to mitigate any residual sprayzone effects on this later comparison area, and because the comparison area presents only uniformly shrubby fringe habitat, we established a second comparison area along the adjacent shore of Azure Lake.

Due to multiple climate station failures at Are Falls in 2023 (treefall onto a climate station and other sensor failures due to extended operation in very wet environments) we focused environmental monitoring efforts in 2024 on climate station work, installing 7 separate climate stations to provide redundancy at different sites (1 station located at the Are fall inner mist zone, 2 at the Are Falls outer mist zone, 2 at the Are falls upland site, and 2 at the Edgewood Blue upland site). With this shift in emphasis we did not conduct water chemistry measurements, but we believe the microclimate measurements from the spray zones are the more important environmental variable.

## Conclusions/next steps

Wells Gray Park, our study area, falls within the traditional territory of the Simpcw (North Thompson) and Tsq'escenemc (Canim Lake) First Nations. We have discussed our proposal and preliminary research findings with members of Simpcw and have since been in conversation with Mandy Ross, Intermediate Biologist, with the Simpcw Resources Group, who is leading discussions on this proposed research with the Simpcw. Our preliminary plans are to host a community workshop at Wells Gray in 2025 to share project findings and strategize on meeting future community needs. We anticipate that our findings will prove helpful to coming generations of Indigenous Peoples faced with managing their traditional territory in a time of deepening climate change.

## References and links

Project results are being submitted for publication in the journal *Botany* in spring 2025 and if accepted will be available as an open-access publication.

## 2024 Financial Summary.

Direct project expenditures:

Total project expenditures in 2025 were \$15,000.00. The main project expenditure was biodiversity assessments by Curtis Björk and Trevor Goward (\$12,600 to Enlivened Consulting). In 2024 this covered assessments at Sticta Falls and Triple Decker Falls as well as site visits for tourism impacts at Helmcken and Spahats Falls. \$1650.00 of project funds was spent on travel (Coxson UNBC) for site visits to Wells Gray Park. UNBC overhead constituted the remaining charge (\$750.00).

In-Kind and other expenditures.

Looking at the overall project, this scope of taxonomic identification represents a significant in-kind contribution (ca. \$10,000.00) to the research by Enlivened. Additional direct project expenses were incurred for climate station data loggers and sensors (\$2869.00), these contributions coming from other UNBC research funds.