March 16, 2026

Living Lab Program for Climate Change and Conservation - Final Report

BC Parks LIVING LAB

Project title: Five-Year Post-Wildfire Impacts on Invasive Species at Skaha Bluffs Park

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Research findings

The overall objectives for this project were to

1. Conduct surveys of priority invasive species in Skaha Bluffs Park
2. Determine Karrikin-levels in soils five years post-fire
3. Identify effective/bioactive levels of karrikins on invasive and endemic plant species at Skaha Bluffs Park

Key Finding 1A. Community composition is modified with fire severity, with overall species richness increased after low – medium fire severity

A total of 45 sites were sampled in spring and summer 2025 (Figure 1). Community composition varied significantly across fire severity classes ($p = 0.003$) and landcover types ($p = 0.011$; Table 1). Looking at total species richness per site (total number of species) we found that low-medium severity burn sites had higher species richness compared to control and high burn sites.

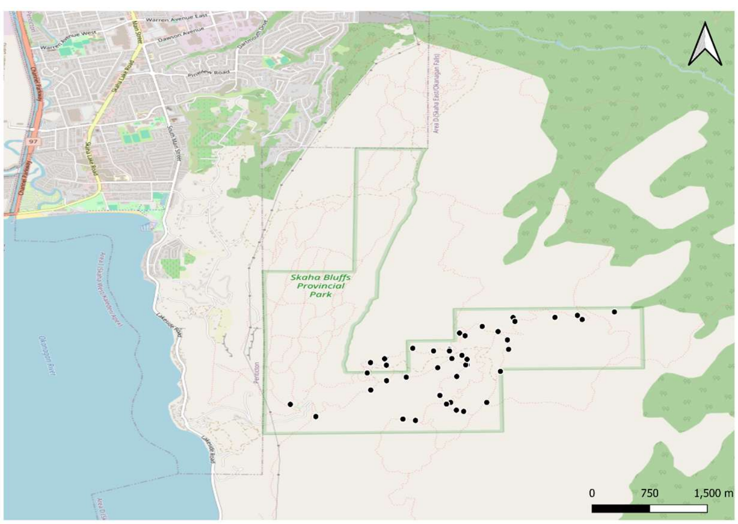

Figure 1. *Sites sampled in 2025*

Table 1. *PERMANOVA results testing the effects of fire severity class, landcover class, elevation, and their interaction on plant community composition (sequential sums of squares). Significant terms (p < 0.05) are in bold.*

TERM	DF	SUM OF SQUARES	R^2	F	PR(>F)
FIRE SEVERITY CLASS	3	1.2137	0.1347	1.6968	**0.0030**
LANDCOVER CLASS	5	1.6832	0.1869	1.4120	**0.0110**
ELEVATION	1	0.2187	0.0243	0.9172	0.5699
SEVERITY × LANDCOVER INTERACTION	7	2.0771	0.2306	1.2446	0.0551
RESIDUAL	16	3.8148	0.4235	—	—
TOTAL	32	9.0075	1.0000	—	—

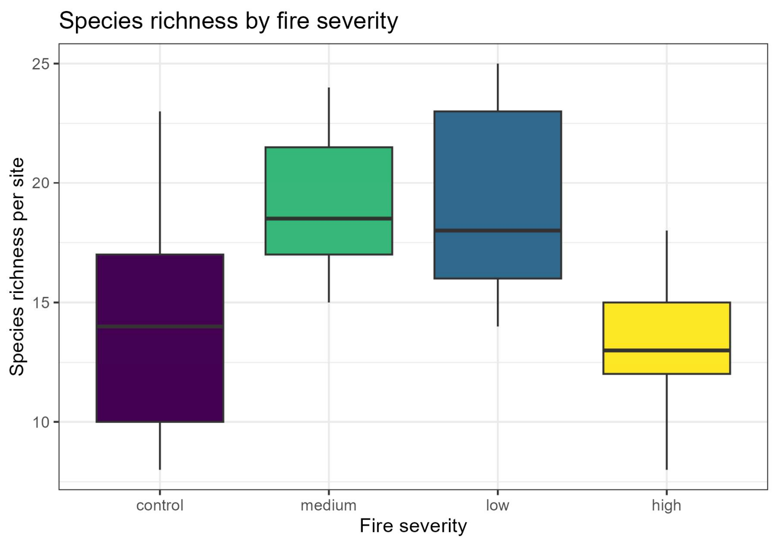

Figure 2. Boxplot of site-level species richness (number of species per site) across fire severity classes. Boxes indicate interquartile range (IQR), horizontal line is the median, and whiskers extend to 1.5 × IQR

Key Finding 1B. Native and invasive species abundance are significantly correlated with wildfire severity even 5 years post-fire

Bluebunch Wheatgrass (*Pseudoroegneria spicata*)

Bluebunch Wheatgrass was present at 63% of sites, being primarily present in open grassland sites, as was expected. Species coverage significantly decreased with increasing fire severity (p = 0.011).

Cheatgrass (*Bromus tectorum*)
Cheatgrass was present at 71% of sites. Cheatgrass was not significantly influenced by landcover type or fire severity. Qualitatively it was most abundant at medium-severity open sites (15%), with lower coverage in forested and riparian habitats (<5%). Cheatgrass was nearly absent from medium-severity forests (<1%) and riparian sites.

Sulphur cinquefoil (*Potentilla recta*)
Sulphur cinquefoil was recorded at 37% of sites. While fire severity did not have a significant

effect on sulphur cinquefoil abundance, it was qualitatively least common at high-severity sites (17%). In part the patchiness of coverage at most sites means that this species is being re-analyzed for presence/absence data as percent coverage is not as reliable a metric for the species.

Pinegrass (*Calamagrostis rubescens*)

Pine Grass was included as a fourth species of interest due to it near ubiquitous presence across sites (present in 91%). Pinegrass coverage increased with fire severity. While generally more present at open and forested sites, we did find a significant interaction between landcover and fire severity with medium fire severity riparian sites having a more than 2-fold increase in pinegrass (13%) cover compared to control and low severity sites (< 5%).

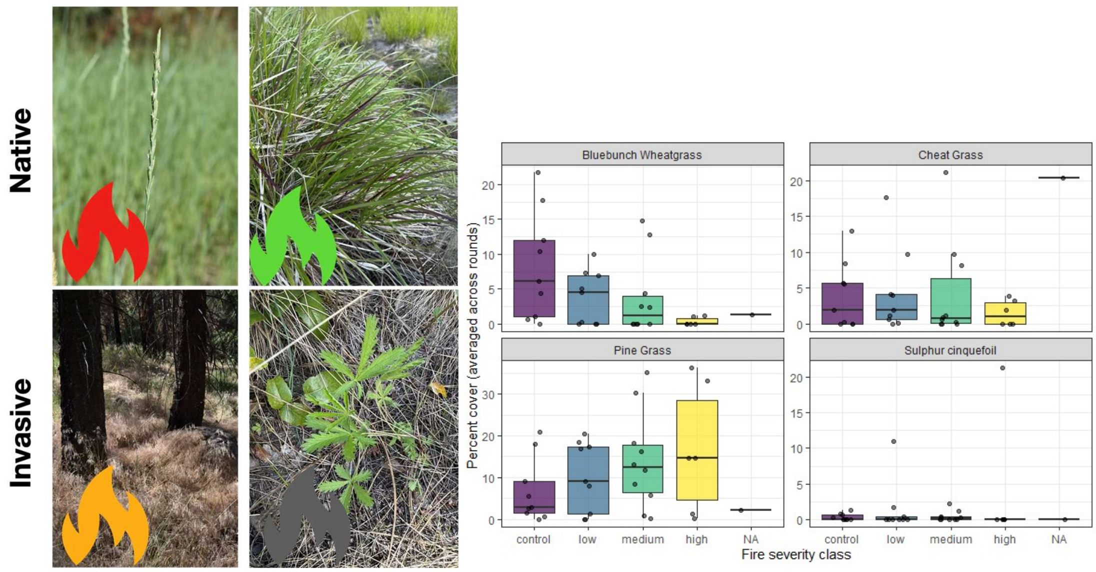

Figure 3. Left summary of response of target species (top: bluebunch wheatgrass, pinegrass; bottom: cheat grass, sulphur cinquefoil) with red indicating a negative response, green positive response, grey no response and orange a mixed response. This is mirrored in the boxplots of percent cover for focal species across fire severity classes. Values represent means per site, averaged across two sampling rounds.

Key Finding 2. Karrikins were still present in soils even 5 years post fire and are significantly correlated with plant community composition.

In 2022 KAR3 was the most abundant species across sites samples (Figure 4), however, we observed a shift towards higher abundance of KAR1 in 2025. Of our four priority species, only pinegrass was positively associated with karrikin concentration in soils at sites 5 years post-fire (Figure 5). Looking at overall plant community composition, we see that presence of karrikins is associated with increased species richness across sites (Figure 6) with several native species being overrepresented at sites with karrikin in soils including heart leaf arnica (*Arnica cordifolia*), *Antennaria* species, giant red painbrush (*Castilleja miniata*), columbia lily (*Lilium columbianum*)(Figure 7). The species most increased in abundance at sites where karrikins are present included our target species pinegrass as well as others include fireweed (Chameanerion angustifolium), snowberry (Symphoricarpos albos) and Oregon grape (*Berberis aquifolium*). We will be completing spatial analysis similar to 2022 data once we have complete karrikin analysis to better understand relationships between fire severity, karrikin contents of soils and community composition.

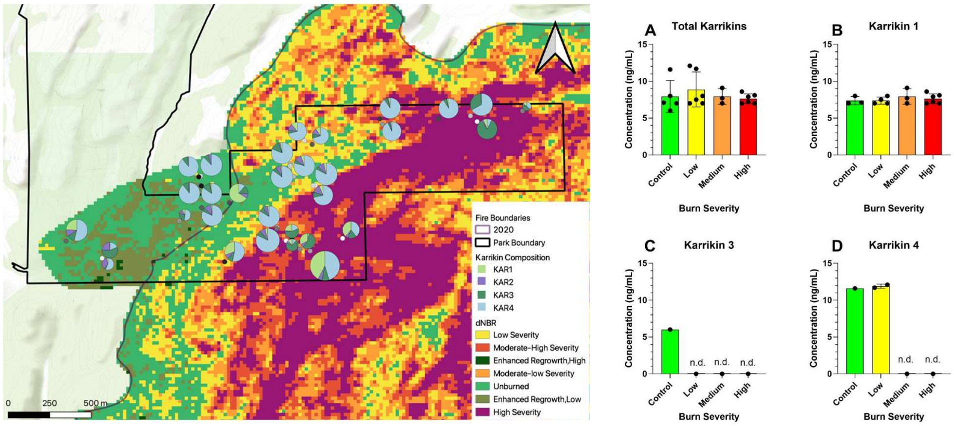

Figure 4. LEFT: Soil karrikin concentration overlayed with normalized burn recovery (dNBR) for 2020 to 2022. Pie chart size represented total abundance of karrikins at each site while slices represent composition (KAR 1 – 4). RIGHT: Soil karrikin concentrations by burn severity, note that KAR 2 was not detected at any sites, KAR 3 at 1 control site only and KAR 4 at 3 sites only.

Figure 5. Mean percent cover of target species by karrikin (all KAR species) presence at sites

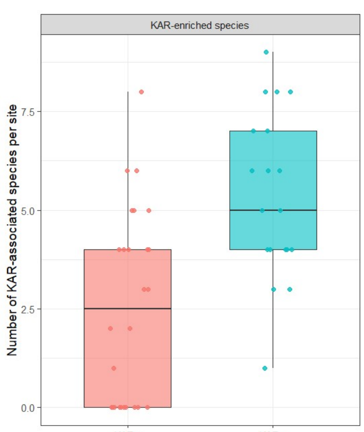

Figure 6. Species richness by karrikin presence.

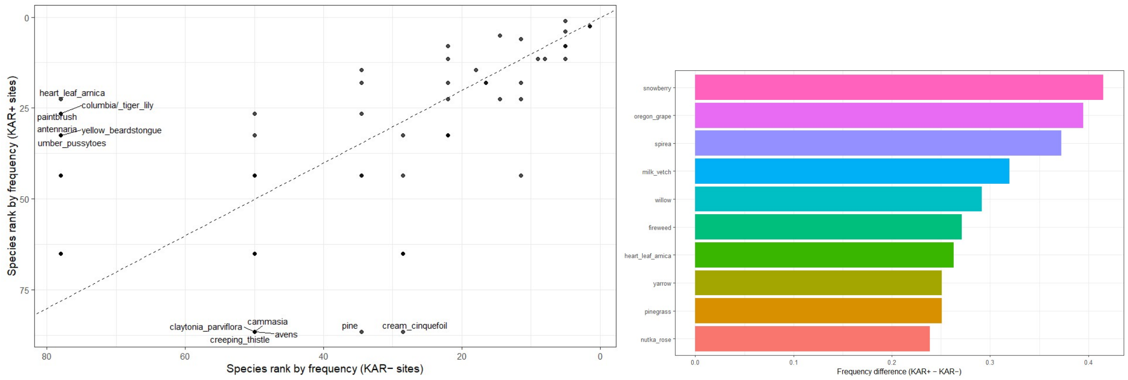

Figure 7. Left: species ranks based on occurrence frequency in KAR– sites (x-axis) plotted against ranks in KAR+ sites (y-axis). The dashed diagonal line represents a 1:1 relationship, where species occupy the same relative rank in both site classes.Species positioned close to the diagonal exhibit similar relative prominence across KAR– and KAR+ sites, whereas species deviating from the diagonal exhibit shifts in rank order between site classes. Right: Top 10 species most frequently present at karrikin positive sites as compared to negative sites

Key Finding 3. Native and invasive species respond differently to germination in the presence of isolated karrikins

While our seed germination data is still preliminary, initial results (3 weeks) indicate that sulphur cinquefoil seed germination is not significantly affected by the presence of karrikins with almost 100 % of all seeds across all treatments germinated after 4 weeks, similar to the response to fire severity that we observed in our vegetation surveys. The two grasses included in the study, however, had more significant responses to karrikin treatment. Bluebunch wheatgrass which was had a negative response to increasing fire severity, as we would expect, interestingly had differential responses to karrikin species, with karrikin 1 inhibiting early germination, but karrikin 11 promoting seed germination. This will be interesting to see if the pattern persists and to look at KAR 11 data once available. Interesting early results in cheat grass have found that KAR 2 is inhibiting cheat grass seed germination. We still have yet to complete seed viability testing and complete the minimum 6 week germination period which may change the results. If current trends persist, this may be one avenue for future seeding management, but more data is required.

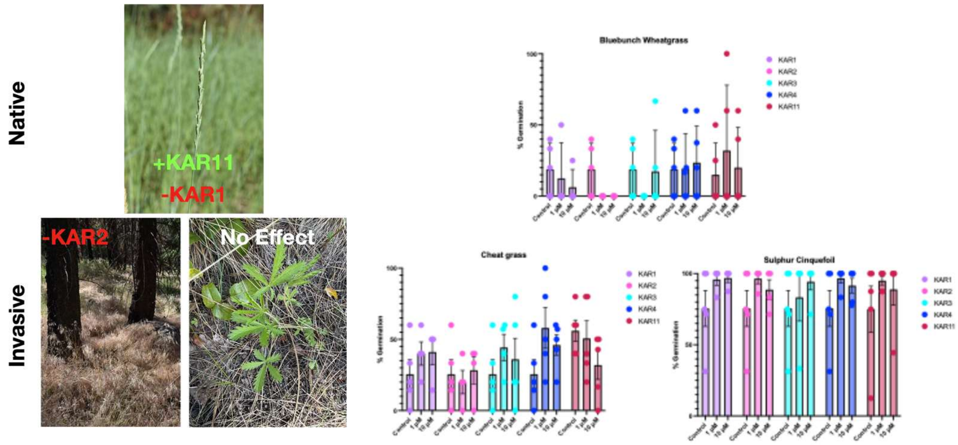

Figure 8. :LEFT: Summary of seed germination responses to karrikin exposure. RIGHT: Germination results, uncorrected for viability after 4 weeks, data is displayed as mean with standard error.

Methods summary

Objective 1. Vegetation Surveys & Soil Sampling

Vegetation surveys were completed at 45 sites across Skaha Bluffs Provincial Park from May – July 2025. Each site was visited once in Spring (May) and once in Summer (late June/July). At each site fire severity was assessed based on scorch height, to be confirmed with fire polygons and satellite mapping in later work flows. Landcover (open, forest or riparian) was also recorded. At each site all species present were recorded, and presence/absence was used for all downstream analysis. For the two priority invasive species: cheat grass and sulphur cinquefoil and two native species blue bunch wheat grass (priority native species) and pinegrass (commonly present native species) vegetation density was measured across 3 x 10 m transect lines. Percent species coverage was recorded at 4 x 0.5 m^2 quadrats along each line and average coverage used for all downstream analysis.

For one transect line at each site soil samples were taken at 2 m intervals along the transect at a depth of 0 – 15 cm (1” diameter) and collected in paper bags. Samples were stored at – 20 °C until analysis.

Objective 2. Karrikin analysis (in progress)

Field collected soil samples were sifted (#8 sieve) to remove plant materials and debris. For initial analysis half of each of the transect subsamples were combined as a site pooled sample and were extracted with a sequential acid (4 % acetic acid) base (1 N sodium hydroxide) extraction, 30 min each with shaking followed by a rinse. Extracts were combined and then concentrated and cleaned via solid phase extraction using 3 mg Oasis HLB Cartridges (Waters), rinsed with 10 % methanol and eluted in 100 % methanol prior to separation and analysis via ultra performance liquid chromatography (UHPLC) mass spectrometry (MS; Bruker Elute+ UHPLC with Bruker Impact II MS with VIP HESI ionization) following methods validated in the BERRI Lab. Karrikins 1 – 4 were identified and quantified through peak integration and comparison (retention time and spectra) to authentic standards using standard curves. Due to a delay in KAR11 standard shipping from the manufacturer quantification of this analyte is still to be completed. For a subset of samples analysis will be repeated for individual unpooled samples to assess intra-site variability. These experiments are in progress.

Objective 3. Seed Germination Assays (in progress)

Seeds from the three priority study species sulphur cinquefoil, blue bunch wheatgrass and cheat grass were collected at the same time as vegetation surveys in summer 2025 and stored at 4 °C for ~ 6 months for cold stratification. Seeds were processed and cleaned in the lab and sterilized with a solution of 20 % bleach with 1 % head and shoulders for 20 min prior to plating on water agar (8 g /L) in 60 mm petri dishes. A minimum of 5 seeds were started per plate and 5 plates per treatement. Treatments were tested using a completely random design and included five karrikin species (KAR 1 – 4, 11) at 0, 1 or 10 µM concentrations. Controls were included with water agar only, ethanol or methanol (the latter two being solvents for the karrikins). Seeds were incubated under low light in a growth room with daily temperatures of 24 °C (day) 16 °C (night) and percent germination was recorded weekly. Note that these experiments are still ongoing.

Key outcomes for BC Parks

- Low to medium severity burns similar to prescribed burns have increased species diversity after 5 years, increase presence of pinegrass, while the two invasive species do not have a strong response to fire severity.
- Soil karrikin concentrations and chemical diversity shifts over time, but are persistent with the most common species.
- Soil karrikin levels are correlated with the presence of some native species, including fire associated species and may contribute to post-fire community composition
- Seeds from native and invasive species included in the study respond differently to karrikin exposure during germination. **Preliminary** results suggest that native species may be more responsive to some karrikins.

Relevance to BC Parks management

- Use of low to medium severity burns to increase native species abundance are supported in BC Parks
- If karrikin responses persist, the use of karrikins or karrikin containing products like smoke extracts (smoke paper, smoke water) may be considered for incorporation in seeding mixes to support native seed germination, suppress native species establishment. However, further data collection is still needed.

Project’s challenges/opportunities

The soil analysis method for karrikin analysis has been a major undertaking in the lab to achieve reliable quantitative analysis, with delays due to requirements for custom synthesis for some of the standards that were previously available. however, now that this method is established we have capacity to generate the remaining necessary karrikin data to complete the project. A final report is anticipated by end of calendar year 2026.

Conclusions/next steps

We are completing germination and karrikin soil analysis studies. Information on Karrikin 11 and final germination data will be important in determining potential viability of karrikins in managing cheat grass germination.

Based on the results it will be interesting to update our satellite vegetation recovery data completed as part of the 2 year study, to look for correlations across recovery times.