Vive la résistance
Managing wilding conifer re-invasion

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2022-23 Annual research update

Vive la résistance: Achieving long-term success in managing wilding conifer invasions.

The goal for Vive la résistance (VLR) is to achieve one important impact for New Zealand: To optimise wilding conifer management for the long-term by minimising re-invasion and maximising the resilience to re-invasion of vulnerable landscapes.

Comparing serotinous cones with non-serotinous cones.

Research outcomes

The outcome of VLR is to enhance nationally coordinated wilding management with scientifically robust solutions that mitigate re-invasion of controlled but still vulnerable parts of our productive and conservation lands. Achieving this outcome starts with more targeted strategies to deploy enhanced control of primary infestations in conjunction with follow-up approaches that both overcome the invaders' resilience to control and increase natural resistance to re-invasion.

Since programme initiation in October 2021, excellent progress has been made in VLR building our experimental platforms and developing uptake and implementation pathways with the National Wilding Conifer Control Programme (NWCCP), the wider community (Wilding Pine Network; WPN) and with Ruawahia2BTrust (Iwi, Mount Tarawera).

Research progress: Quantifying re-invasion

The first phase of VLR has been dominated by establishing our novel trial network and sampling of post-control wilding infestations along a time, space and invasion level gradient – a global first attempt to collect unbiased population data to understand re-invasion of tree invaders. In summer 2022-23 we sampled 189 field plots across five regions in New Zealand with the largest control operations over the past five years. Preliminary analyses show that under the current control strategy eradication is difficult and re-invasion is occurring across the landscape.

Quantifying cone traits of *Pinus contorta* has indicated that New Zealand possibly hosts a unique invasive conifer, an intra-specific hybrid between coastal and inland sub-species' of *P. contorta* that produce larger cones and more viable seeds than the sub-species in their respective home ranges, traits that could contribute to the species' increased invasiveness in New Zealand.

Seeds germinating from a previously sprayed 7 yr old serotinous cone.

Comparing undeveloped samara (winged seed) with viable samara.

Tagged seedling in plot established to monitor re-invasion over time.

Understanding and preventing re-invasion

The establishment of our critical multi-factorial field trials testing the effect of "beyond-control" management practices (such as soil disturbance, competing vegetation, browsing) on re-invasion and identifying which management techniques increase re-invasion resistance is complete. Implemented at a DOC Stewardship area in East Pukaki these field trials will be a unique, national research asset with first results expected in 2024.

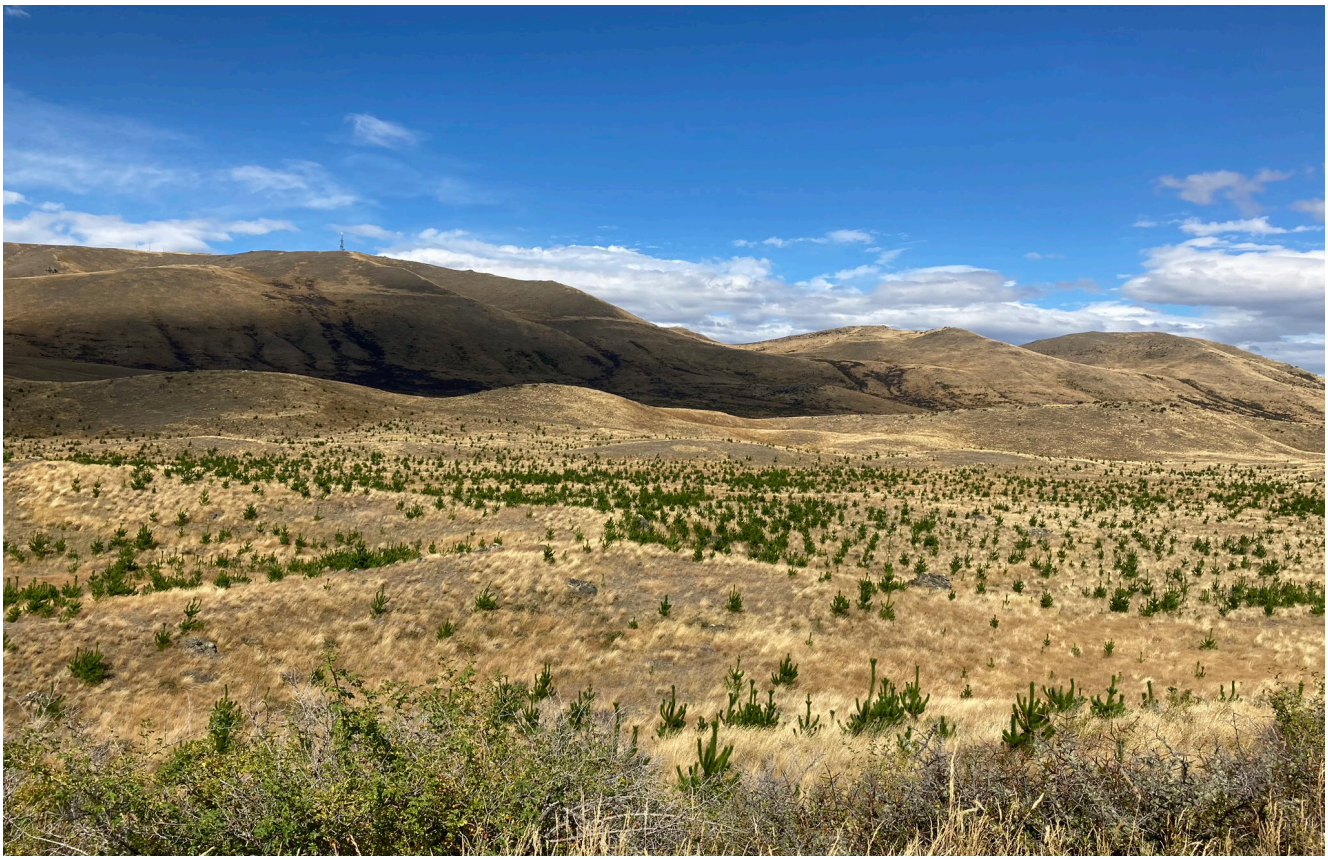
We are testing whether native plant species (trees, shrubs, and grasses) can be used to restore land and reduce reinvasion following control. Knowing that pine alters soils in ways that favour exotic species over natives, we are testing how wilding conifer shade tolerance is influenced by soil legacies. These results will inform predictive models that can be used to guide native plant restoration as a strategy to prevent re-invasion.

Trials to determine whether the widespread native fungus Harore (*Armillaria novae-zelandae*) can be used for reducing re-invasion post-control have also been initiated. Reintroducing the fungus will reduce fire risk associated with deadwood by increasing decomposition rates and help give native species a competitive edge when in competition with wildings. We have discussed initial concerns raised by the timber industry on using Harore with the Forest Biosecurity Council, noting that any introductions of the fungus will cause no change to pathogen risk in the broader landscape.

We have also established (and completed) several green-house and field trials investigating factors affecting seed germination and longevity as well as legacy effects of previously controlled *Pinus contorta* invasions on re-invasion by *P. contorta* and/or secondary invasion of other exotic tree species (*P. radiata*, *P. menziesii*, *S. giganteum* and *C. macrocarpa*).

Managing re-invasion

Working together with National eScience Infrastructure we have developed a semi-operational terrain sensitive Flow-Transport-Model (FTM) that predicts the dispersal of wilding seed. A case study has been published on the NeSI website (https://www.nesi.org.nz/case-studies/war-wildings) to demonstrate the model. Improvements in computational efficiency is enabling us to run complex scenarios for end-users 10 times faster than previously possible, via a user-friendly interface. This model will allow New Zealand to predict wilding spread with greater confidence.



Implementation of research

The immediate, tangible benefit of VLR is ongoing evidence-based operational/technical advice to support the NWCCP management operations:

- **Building on winning against wildings, we have implemented with the NWCCP a set of large-scale operational aerial spray trials testing a lower cost and more environmentally safe herbicide-application formula.** These operational trials have the potential to deliver effective control with a 25% reduction in cost and herbicide use.
- **We have co-developed with the NWCCP an evidence-based audit and quality assurance procedure for ground-based control operations to underpin planning of future operations by providing quantitative data on re-invasion.** A prototype standard operating procedure was trialled across six controlled sites in summer 22/23 and will likely be operational for the 2023-24 NWCCP control programme.
- **We have undertaken research to evaluate the suitability of readily-available satellite and aerial imagery to enable the NWCCP to cheaply and efficiently monitor emerging wilding infestations and re-invasions post-control.** The outcome is recommendations on a monitoring method that could reduce costs by 30%, compared to current practice (helicopter surveys).
- **VLR spray drift modelling expertise supported the development of new best practice guidelines to underpin environmentally safe aerial spraying operations carried out by the NWCCP.** The modelling supported the requirement for no-spray buffer zones around waterways to minimise herbicide contamination of surface water in sensitive catchments.
- **We have been collaborating with a commercial provider (SPS Automation), directly supporting the development of drone-based control for scattered infestations of wildings.**

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October 2023