Wise Up To Weeds!

What's Inside:

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Manaaki Whenua
Landcare Research

A Different Perspective on Weeds

The focus of work for Landcare Research plant ecologist Susan Walker over the last few years has been the maintenance and restoration of native woody biodiversity in rainshadow parts of the South Island east of the main divide. Susan views weeds from the standpoint of protecting, maintaining and restoring indigenous biodiversity, which can be fundamentally different from the agricultural perspective.

There have been great changes between prehuman and present day vegetation cover in New Zealand. "This is especially true for lowland environments and eastern South Island drylands. The rainshadow regions south of the main axial ranges of both islands contain a disproportionate number of New Zealand's most threatened species. Weed control here is critically important at a national level," Susan explained.

Two basic habitat types can be distinguished in eastern South Island drylands; non-forest and potential forest/shrubland habitats. Each type has its own weed threats and solutions. Examples of non-forest habitats include limestone/karst, crumbling cliffs, saline areas, braided riverbeds, ephemeral turfs, and lakeshores. "These are critical places for weed control since they are where a high proportion of our most threatened plants are," said Susan. Pasture development has been the overwhelming cause of the reduction in the extent of these habitats, but the weeds are a significant threat to the habitat that remains.

Other non-forest habitats are relatively resistant to most invaders, but not if outside influences alter the factors that sustain them. For example, ephemeral wetlands rely on long winter/spring water inundation, summer aridity and desiccation, and previously, heavy use by birds, for which sheep (but not cattle) may be a best surrogate. Few weeds can cope with these conditions, but pour on the nutrients and/or alter the moisture

Photo: Stu Thorn DOC

Olearia hectori, a native of the rugged drylands of Central Otago.

cycles, remove the surrogate grazing disturbance, and weeds can take over.

Susan has two suggestions for weed control in these special, often small ecosystems: "A first goal should be to spread weed control to ensure species populations survive across their genetic range. This might mean tackling some seriously degraded habitats at the fringes rather than focussing only on the best, most intact examples. Second, species survival will depend on ecosystem processes being maintained. Ecosystem-transforming weeds should be focussed on."

The forest and shrubland habitats are the extensive lowland and montane tussock grasslands of eastern South Island that were created by fire and maintained by a combination of fire and mammalian grazing.

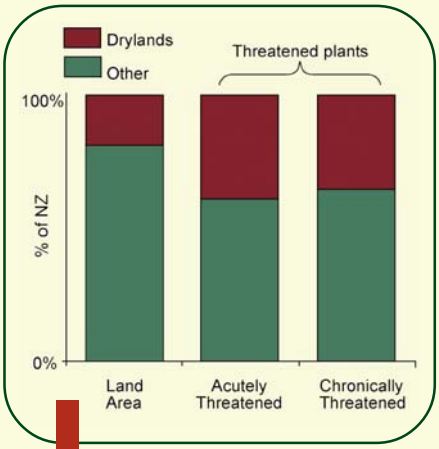
The main weed invaders here are perennial pasture grasses and forbs; tree and shrub invaders are relatively few. "Native dominance is decreasing in many places with continued pastoral use, and if we are to protect, maintain and restore these habitats we need to remove grazing and browsing animals, as well as make sure there is no burning."

Fear that the removal of grazing animals will cause an 'explosion' of weeds that will obliterate the remaining native plants is not always supported by evidence. For example, a long-term experiment on the Luggate Terraces in Central Otago involving nutrient replenishment and removal of grazing produced a boom in biomass, not only in exotic grasses, but also in native nitrogen-fixing shrubs, and the competitive exclusion of *Hieracium*. This is weed control achieved by in situ native plants. Removal of grazing in Flat Top Hill Reserve, in driest Cental Otago, has resulted in a boom of native shrubs. In this case thyme has apparently acted as a nurse by suppressing exotic grasses. In some wetter situations, the answer to exotic grass dominance may be a gradual phasing out of grazing combined with establishment of unpalatable, grass-suppressing native woody nurse species.

To control weeds in these forest and shrubland habitats biodiversity managers need to think long term and should:

- Control tall, densely shading ecosystem- transforming weeds
- Tackle sources, new and old
  - Broad-scale control of pines, sycamore and similar tall, long-lived invaders
  - Nip new infestations in the bud
- Live with and use nurse weeds but contain them where appropriate
- Find ways of enhancing weed-beating native woody vegetation succession, reintroduce seed sources by sowing seeds and planting, try different interventions and experiment!

Research to address ways of enhancing native woody vegetation will be one of the objectives in the Sustaining and Restoring Biodiversity programme for which Landcare Research recently secured FRST funding.



Drylands contain high proportions of NZ's most threatened species

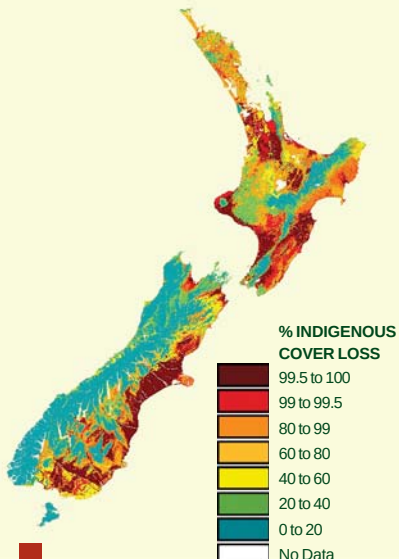
For further information see:

Walker, S.; Lee, W.G.; Rogers,G.M. 2003: The woody vegetation of Central Otago, New Zealand: its present and past distribution and future restoration needs. *Science for Conservation 226. Published by the Department of Conservation.*

Walker, S.; Lee, W. G.;Rogers, G.M. 2003: Post-pastoral succession in intermontane valleys and basins of eastern South Island, New Zealand. *Science for Conservation 227. Published by the Department of Conservation.*

Present situation:

Indigenous cover loss



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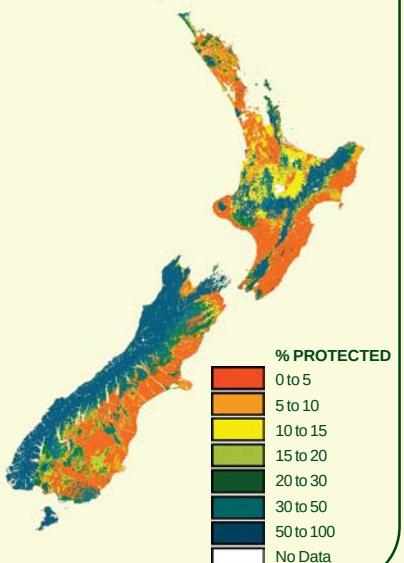

Little native cover left, and little of what's left protected, in NZ's eastern lowland/ montane zones

Understanding the Effects of an Invasive Woody Weed on Native Plants

Concerns about invasive species arise from the negative economic and biological effects they have on many ecosystems. The biological effects are most often documented for community structure, i.e. changes in species diversity or species composition. Despite the rapidly increasing literature on this topic, our knowledge of these impacts remains largely at the level of a collection of case studies. If we are to understand and manage invasions better, we need a general framework that can predict the kinds of impacts most likely to occur on community structure and ecosystem processes. If the invasion is to be controlled we also need to understand the degree to which effects are reversible and the time frame during which this is possible. To do this, a better understanding of the mechanisms that underlie community and ecosystem effects is necessary.

This is the challenge facing Duane Peltzer and colleagues from Landcare Research, Lincoln.

These researchers decided to investigate the effects of an invasive woody weed on the vegetation and soils of dry shrublands and forests in the eastern South Island. " More specifically, we are looking at the impacts of wilding pines (particularly *Pinus contorta*) on resource availability and comparing establishment and performance of native plant species." Duane went on, "Pine invasions are an excellent model system for developing a general framework to understand and manage the impacts of invaders. First, pines are widespread woody weeds that are expected to invade more than 210, 000 ha in the South Island in the next 15 years, and they are also a problem in other parts of the world. Second, pines are invading many kinds of habitats in New Zealand, and in dry shrublands are perceived to threaten native plant species including rare or endangered native plant species. They could transform the landscape from remnant shrubland and grassland communities into exotic forest. Finally, pine invasions are amenable to field removal experiments, which is the approach we used in this project to quantify the development and reversibility of impacts."

Understanding pine impacts at a local scale will help determine what these large-scale threats are likely to be. For example, pines may act as a nurse crop by facilitating native plant species at low densities, but they may competitively suppress native plants at higher densities or in drier sites, thus altering secondary succession differently along rainfall gradients.

The project will quantify the impacts of invasive woody plant species in the field, and is a first step towards understanding the larger scale, long-term implications of invasions, particularly by woody plants in herbaceous-dominated ecosystems that occur throughout New Zealand and elsewhere.

In the short term the results from this research will:

- Establish whether the Department of Conservation's strategy of wilding pine removal is also successful in minimising ecosystem consequences.
- Establish how DOC can manage already established wildings to restore invaded ecosystems to resemble indigenous ones.

How will the researchers do this?

The researchers will quantify the impacts of one of the most widespread and abundant invasive woody plants, *Pinus contorta,* on native abundance, species composition and resource availability by using pine removals in the field. "Removal experiments are a powerful tool for quantifying the effects of plants in ecosystems and species interactions in the field," Duane explained. "We use removal treatments to create a density gradient of wilding pines to determine their per-plant and per-unit biomass effects on variables of interest." Controls (i.e. unmanipulated plots) for this experimental design include patches under well-established stands of *Pinus contorta* (ca 32 yr old) and native mountain beech forest (*Nothofagus solandri* var. *cliffortoides*). These controls represent the baselines for invaded and uninvaded conditions for a conceptual model of invader species (Fig. 1).

Pinus contorta growing amongst manuka (*Leptospermum scoparium*) in a dry shrubland area.

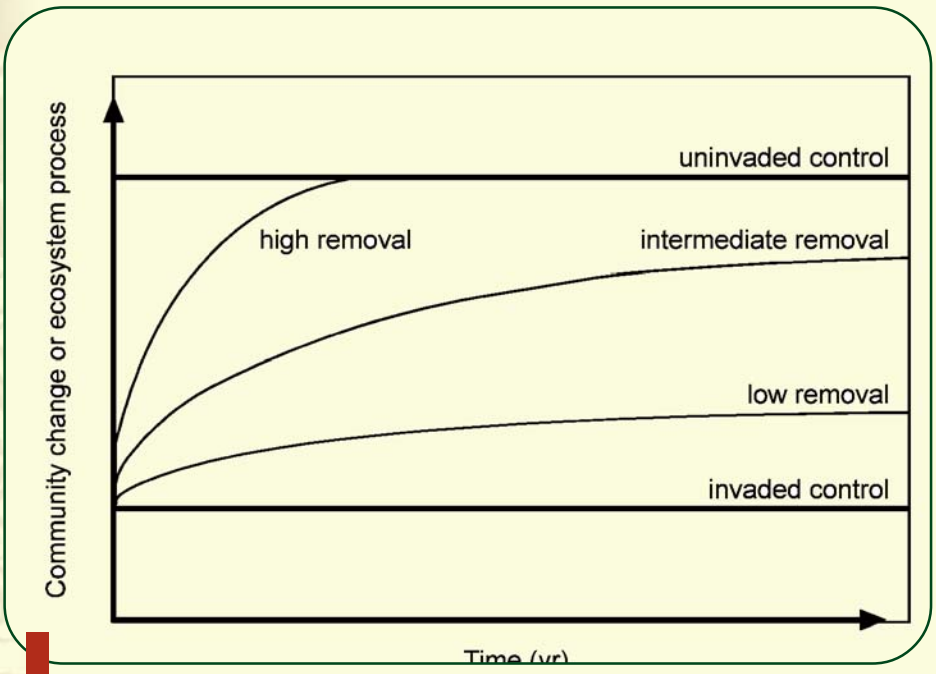

Figure 1. Conceptual summary of variation in community-level changes or ecosystem processes through time in uninvaded communities (top thick line) and invaded communities (lower thick line).

Careful comparisons among the removal treatments and unmanipulated controls will allow isolation of resource-based mechanisms of weed impacts, and determination of the time during which impacts can be reversed. For each manipulation starting with invaded conditions, the extent to which it becomes similar to the matched uninvaded site (distance on the y axis in Fig. 1) indicates the degree of reversibility of *Pinus* impacts. The time it takes for a given degree of similarity to occur (distance on the x axis in Fig. 1) indicates the time scale of reversibility. While there are expected to be substantial effects on the experimental treatments in the short term (i.e. <3 yr), it is also clear that reversibility of invasion effects may take much longer.

Plots were established at Craigieburn Forest Park near Arthur's Pass, to assess the experimental methodology in a site with known history. Craigieburn is on the wet end of a rainfall gradient for dryland ecosystems with extensive pine invasion, and according to Duane "we might expect to quantify weed impacts more rapidly in this system compared with sites at the drier end of the gradient." Varying percentages of *Pinus* stems were removed from plots, and data on plant abundance, soil nutrients, light availability and canopy structure were collected from all plots to provide baseline data against which to compare future changes in the plots. Seeds and planted seedlings of the two most common native plant species in the study area, *N. solandri* and *Leptospermum scoparium,* were added to a small part of each plot. The establishment of native plant species from seed, and the survival and growth of planted seedlings will be monitored.

Because of the time it takes to see the response of seeds and seedlings to pine removal, Duane says they will be running the "pine project" for at least another 5 years. "We are using these removal plots as a 'study system' to answer several questions. For example, we have started looking at which mycorrhizal fungi (the beneficial fungi on plant roots) are under pines compared with under mountain beech, and the role of these fungi in the regeneration of native and exotic plant species."

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