

Dryland Intermediate Outcome Newsletter #8

December 2009

Hello everyone. Here's a brief pre-summer-break update on what we've been doing in the Dryland IO since May. Last newsletter we highlighted work in Strand 2 (Biodiversity of dryland woody communities). This one, as promised, gives an update on the mushrooming experimental programme which has kept everyone even busier than before. We'll also mention relevant new research initiatives and some of our work in raising awareness and informing people about pressures on dryland biodiversity and what can be done to protect it. Things have been just hectic round here! Remember all our newsletters and most of our recent talks and documents are on our website to browse and download.¹

Strand 1: Succession to native woody communities

Our Newsletter #6 (October 2008) gave an overview of our experimental programme, and some more of the roll-out is described here. This spring, we almost bit off more than we could chew in our experimental strand of work having to plant many thousands of woody seedlings out in two field experiments arrayed across eight dryland sites. And that's not counting ongoing work on the Ealing Springs experiment (next newsletter!), and our sward experiment which entered its glasshouse-experiment phase at Lincoln (described below).

To understand what controls the establishment of woody seedlings in drylands, we have switched from field sowing (which initially failed miserably) to a two-pronged approach. The first prong is to understand germination (see later, under **Germination ecology of dryland woody seedlings**). The second prong asks what influences survival of seedlings in field conditions. We've been learning on both fronts.

Some had noticed that our plans for planting out seedlings this spring were a little ambitious. But "no worries!" we told ourselves ... we always get such poor germination that there won't be *that* many to plant out. We were WRONG! We'd reckoned without the magic of cool moist stratification, the new ability of our recently reclad glasshouse to suck in the Dunedin winter sun, and the green fingers of Dean Clarke and many helpers.

By Oct 5 it was all go with a vast number of seedlings on board. An amazing effort by two teams was needed; one team started at the northernmost site in the Clarence Reserve (Marlborough), and the other at the Aldinga Reserve (Central Otago). The eight team members met up at Tekapo and together finished off planting the final site. That night, a meal at the pub was enjoyed, and tales told of sleet, snow, paper clips and sore fingers. All in all, a grand total of 22,500 seedlings were planted, with each one's location marked with a coloured paper clip. The field and glasshouse teams deserved their beer, and the overambitious scientists celebrated that not one of them got lynched by an exasperated field tech in the process (let's not mention any names, eh Adrian?).



A seedling's eye view of the one of eight dryland experimental sites, spring 2009

¹ http://www.landcareresearch.co.nz/research/obi_documents.asp?Objective_ID=kfk490gk40fvlo4n238bvskg or just go to the Landcare Research public website and type "Dryland" into the search box at top right.

Bendigo⁺® : an update

This is the last year that we will be running the competition and herbivory experiment that began at Bendigo (Central Otago) and spread to Tekapo (Mackenzie Basin) and Mt Barker (Canterbury) last year (earning the natty “plus” trademark), and this year also to Aldinga (Central Otago) and the Clarence (Molesworth, in Marlborough).

The trademark denotes our tests of the interacting effects of herbivory and competition – two major drivers of vegetation processes in drylands. At Bendigo (the original; see Newsletters #5 & #6), we discovered that few (if any) woody seedlings survived without fencing, or without weeding, or without both. The first expansion to Tekapo and Mt Barker was to test whether these results held up across a rainfall gradient from dry (Bendigo) to moist (Tekapo and especially Mt Barker). They didn't!

Survival of seedling initially was higher in the treatments with sward competition at Mt Barker and Tekapo, than at Bendigo, where it has been very much lower. These results hinted that a competing sward may increase early survival at some sites – at least until the same sward chokes off the seedlings through competition! Hence we've added two more Bendigo⁺® sites at the extremes of the moisture gradient), hoping to separate out site-specific effects from the effect of the moisture gradient.

We're increasing the number of species of 'common' dryland pioneer shrubs we're testing across the sites (including *Olearia odorata* and *Discaria toumatou* this year – which we've proud to have recently learned to germinate!). Practice in set-up also makes perfect. I'm assured none of our newer, scaled down and totally efficient set-ups can be clearly seen on Google Earth (unlike Bendigo the original)!

The shelter experiment

The second set-up was another experiment at three sites (Bendigo – again! – in Central Otago, Ashburton Lakes in South Canterbury, and Medbury in North Canterbury). The experiment is designed to look at the role of shelter in seedling establishment. Shade, lateral shelter, moisture, and organic matter are being manipulated. Students, including volunteer Cory Olesen (Santa Barbara, California, US), Otago University summer student Lisa Dobbie, and Annika Korsten (from Germany) have been a wonderful help to the Landcare Research people operating out of Dunedin, Alexandra and Lincoln.



Setting up and sampling the shelter experiment at Ashburton Lakes, spring 2009

Maintaining the field experiments

All the experiments that are being run with these thousands of seedlings need regular maintenance. After planting, the teams go out and monitor seedling survival and do the first height measurement and a biomass harvest that becomes the baseline for growth. In another 4 weeks, we run a weeding trip to ensure the no-competition sites stay weed free. In the summer, there's a further trip to assess survival and then the final harvest in May. Even though many seedlings don't survive the treatments and only a small number of seedlings are collected from each species, it results in a couple of weeks in the lab processing the seedlings for above- and below-ground biomass.

The list of people who have been involved in these field trips is getting pretty long! Kate Ladley (below) comments:

"I think everyone would agree the highlights of these trips are the sites. We get to work in fantastic places like Bendigo, Tekapo, Ashburton Lakes, and Clarence. The weather can be interesting, I'm not often rained on, but snow is common..."



Germination ecology of dryland woody seedlings

Last summer, Otago University student Heather Tiffin worked with Adrian Monks (and without him!) to build our understanding of the limits to woody seedling germination and to help with our experiments where seedlings are required. She started with a literature review to discover what's already known (about viability, flowering time, seeding time, pollination type, dormancy and tricks to break it, seed mass, crop size variation, and seed type) then did some experimental work to fill in the gaps. Heather developed and used protocols to measure the viability of several dryland species, and tested the effects of 6 weeks' cool moist stratification, fire (on seeds on the surface vs buried) asking "is germination in our hard-

seeded dryland species triggered by fire?”), extreme temperatures, light pulses (mimicking soil disturbance) and temperature fluctuations in the dark (which mimic seed depth sensing). Heather and Adrian plan further experiments (and a paper as soon as time allows...).

Thyme experiment

Ella Hayman (Hons student, University of Otago) will be working with us this year looking at inhibition of woody species germination by thyme litter. The leaves of thyme contain volatile carbon-based compounds that have been shown to inhibit germination and growth of competitors in Europe. The effects on New Zealand species are unknown and we are looking forward to seeing Ella's results.

The sward experiment Part II

At Lincoln, Larry Burrows, with much help from Julia Wilson-Davey and French intern Alex Mathieu, has been setting up an experiment to understand the above- and below-ground effects on woody seedling establishment of competition from grass swards. The grasses have been growing spectacularly well and Larry, Julia and Alex expect to be planting one-day-old seedlings into the pots before Christmas.

This work is part of our sward study in the field where we have been measuring the accumulated biomass through time at more than 20 sites (introduced in Newsletter #5) with and without herbivory and fertiliser. In spring 2010 we intend to sow seed and/or seedlings into these sward field plots.

Secondary dryland woody vegetation patterns: a new paper

A very multi-authored paper by the team has just been published in the *New Zealand Journal of Botany* (it doesn't feel 'new' to its authors who worked on it for some time!). The paper ('**Secondary woody vegetation patterns in New Zealand's South Island dryland zone**') describes the predicted potential distributions of woody species and succession pathways in seral woody communities across South Island drylands (see also 'Which species where?' in Dryland Newsletter #4, and its foreshadowing in Newsletter #6). The paper combines the Dryland Woody Species Distributions Database, preliminary analysis of the Dryland Woody Traits Database (see Dryland Newsletter #2 for descriptions of both) and environmental data.

The paper describes predicted woody species assemblages that may emerge through woody succession over time and in different dryland zones. Our predictions are uncertain and imperfect, of course, in part because some species can't be distinguished from old plot records (e.g. *Olearia* species such as *odorata*, *lineata* and *bullata* have all been called *O. virgata* in the past) and others were too rarely recorded for their distributions to be modelled. Plot data were rare in many places. Nevertheless, some intuitive trends emerge, with simple, robust species like *Discaria toumatou* predicted to lead the early seral stages, and more diverse and divergent assemblages to emerge later. Because of data limitations, we end with three hypotheses, rather than firm conclusions. You can download the paper², or if that fails, just email one of us to send you a pdf.

Strand 3: Community and agency awareness

What happens after a strategy is written? The Biodiversity Advice Fund has recently announced an additional two years' support for the Canterbury Regional Biodiversity Coordinator, to implement the Canterbury Biodiversity Strategy. The Dryland IO has made presentations at Steering Group meetings to representatives of central and local government

² <http://www.royalsociety.org.nz/Site/publish/Journals/nzjb/2009/029.aspx>

agencies and groups (e.g. Forest and Bird) that have adopted or maintain an interest in the Canterbury Biodiversity Strategy. The group meets regularly to oversee and assist in facilitating implementation of the Strategy, and you can register for the Canterbury Biodiversity email newsletter about initiatives, funding sources, field days and other events, and other relevant information (<http://www.canterburybiodiversity.org.nz/newsletter-event-register.html>).

The Mackenzie Basin: Proposals to irrigate another 25,000 ha of the Mackenzie Basin pose the biggest and most immediate threat to Canterbury’s dryland biodiversity. The Canterbury Biodiversity Strategy specifically acknowledges (p. 29) that these inland environments are undergoing some of the most rapid changes in land use within the region, and an increasing priority for action to protect them as important indigenous habitats for Canterbury’s biodiversity. Furthermore, many of the areas proposed for irrigation meet all the significance criteria of the Canterbury Regional Policy Statement. It’s the decline of these habitats and species that the Intermediate Outcome is all about reversing, and we’re charged with working with contracted partner agencies to do just that.

When evidence was to be presented on the effects of these proposals on terrestrial plants and animals and their habitats, there was little sign that the Canterbury Biodiversity Strategy was considered (or of input from the Steering Group), and our formal partners (DOC, QEII, councils) appeared unable to engage. It was a depressing illustration of how councils struggle to reconcile their development and biodiversity maintenance roles, and how agencies are unwilling to act on their mandates. This is why in October–November Susan Walker agreed to present expert evidence before the ECan hearing committee for a citizen’s group – the Mackenzie Guardians³ – who were submitting against the proposals. Susan’s evidence and other submissions and evidence can be found at the link⁴ below. It’s encouraging to see media and public awareness and concern over this development growing!

New releases: We repeatedly mention COET as a flagship awareness-raising project for dryland biodiversity and make no apologies – they deserve it! Grant Norbury wrote recently:

“We had a great day on Nov 28 releasing 12 Otago skinks to the Mokomoko Dryland Sanctuary. The weather was perfect, the crowd enthused and keen, the speeches short, sweet and informative, the food delicious, and the skinks got out of those plastic containers as soon as they could! A day to remember... it’s so rewarding seeing these lovely creatures crawling over our local schist outcrops once again. This is just the beginning of community-driven dryland ecosystem restoration on our doorstep...”



³ <http://mackenzieguardians.co.nz/>. See their video at

<http://mackenzieguardians.co.nz/youtube-view-for-love-of-the-mackenzie-country/>

⁴ <http://www.ecan.govt.nz/get-involved/consent-projects/waitaki-consents/upper-waitaki/Pages/submitter-evidence.aspx#mackenzie>

Strand 2: Biodiversity of dryland woody communities

What do dryland woody (and grassy) communities contribute to biodiversity?

Today Kate Ladley, Dean Clarke, Max Crowe and Ella Hayman return safely from the third of three epic late-spring vegetation sampling trips asking ‘How much native biodiversity remains in [dryland] land under indigenous cover’. It’s been a big effort, not least from Richard Clayton who made countless phone calls to landowners, and willing assistance from many people in several agencies and communities. More in the next newsletter.

New aligned projects funded and off the starting blocks

Last newsletter we briefly described a Sustainable Farming Fund application led by farmer Jim Morris of Ben Avon Station, that proposes to quantify potential carbon sequestration by native vegetation (both shrubby and non-woody) and soils across a spectrum of high country land uses. Larry Burrows, Fiona Carswell and Susan Walker assisted Jim in scoping the proposed work and writing the application. Excellent news! The project was funded and recently got off the ground with a field day and good publicity for this potential alternative to land use intensification in the Mackenzie Basin and drylands generally.

We’re also pleased to say that FRST confirmed funding for a continuation of the dryland multipest project (described in Newsletter #7) in July. The name of the new umbrella programme is **Invasive mammal pests’ impacts on biodiversity**. The dryland component of the research is now to be led by Grant Norbury, with the Dryland IO’s Deb Wilson playing a key role; Andrea Byrom and Roger Pech will continue to be much involved. The research will help managers decide ‘where’ and ‘when’ to apply pest control, based on knowledge of the ecology and dynamics of pests and their impacts on dryland native species. It adds much value to the dryland IO and we look forward to continuing to work alongside them.

We are still seeking students to work with us! We are still looking for more help with seed ecology, and we’re also keen to hear from a prospective PhD student who would consider working with us on succession pathways in drylands after primary shrub establishment (a really fun project with heaps of fieldwork!). So if you know of a keen and thoughtful ecology student looking for a challenge (and preferably thinking of an MSc or PhD in one of these areas) in the next few years, please put them in touch or let us know. We are able to contribute co-supervision, fees and resources for the right student. Contact Adrian Monks (monksa@landcareresearch.co.nz) or Susan Walker (walkers@landcareresearch.co.nz)

Thanks! The team once again thanks Nick Ledgard (Ensis) for his help with Mt Barker logistics, and Nick Head, Wendy Sullivan, Greg Johnstone and Steve Harraway from DOC, who helped with the Ealing Springs experiment remeasurement in October. Student helpers from home and abroad continue to be a mainstay of our work; we thank Ella Hayman, Max Crowe, Katharina Schulz, Cyril Frazao, Lisa Dobbie, Simon Burrows, Annika Korsten, and Fiona Sanford. Steph Hicks and Beatrice Lee also spent many hours pricking out our seedlings. Susan Walker has numerous people to thank for help and encouragement in the preparation of evidence on the Mackenzie Basin; in particular, Waikato University PhD student Emily Weeks – who is mapping grassland loss in eastern South Island – and her co-supervisors James Shepherd and John Dymond, who helped with the estimates of recent loss in the region. Di Lucas, Anne Steven, Ian Lynn, Peter Johnson, Bill Lee and DOC’s Nick Head, Iain Gover, Warren Chinn, Geoff Rogers and Joy Comrie all contributed key information and guidance. And we have many wonderfully helpful people to thank for assisting us to gain CDRP sampling access – we will do this thoroughly in our next newsletter!