Dryland Intermediate Outcome Newsletter #9
November 2010

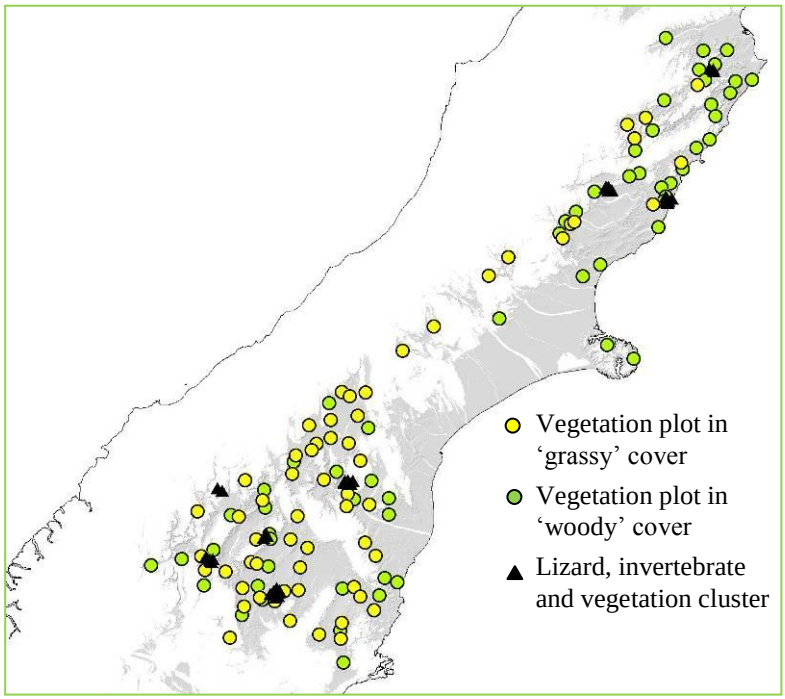
Hello everyone. The Dryland IO is well and truly into a summer field season again (whatever happened to the winter 'quiet time' for writing a newsletter?), and here's an update on what's been going on over the last busy year. Right now we find ourselves rich in data, and have a wealth of interesting analyses and writing to do. Several of our experiments in Strand 1 and some components of our biodiversity field surveys in Strand 2 have now run their courses. And the researchers are aware it's high time to get some of our results out as science papers – we'll continue to work on those through the summer. Meanwhile both field survey and experimental programmes continue, and these are keeping us busy in the field, glasshouse and lab. Our community and agency awareness work (Strand 3) also continues, and a most of the talks and presentations we have given in the course of this work are up on our website for you to browse and download.[1] This community and agency awareness work in particular is being affected by DOC's sinking funding, so we'll be leaning on and leveraging others' initiatives more and more for this aspect of the programme.

As usual, this newsletter reports highlights across our three strands of work. We start with the "Biodiversity of dryland woody communities" work in Strand 2.

Strand 2: Biodiversity of dryland woody communities

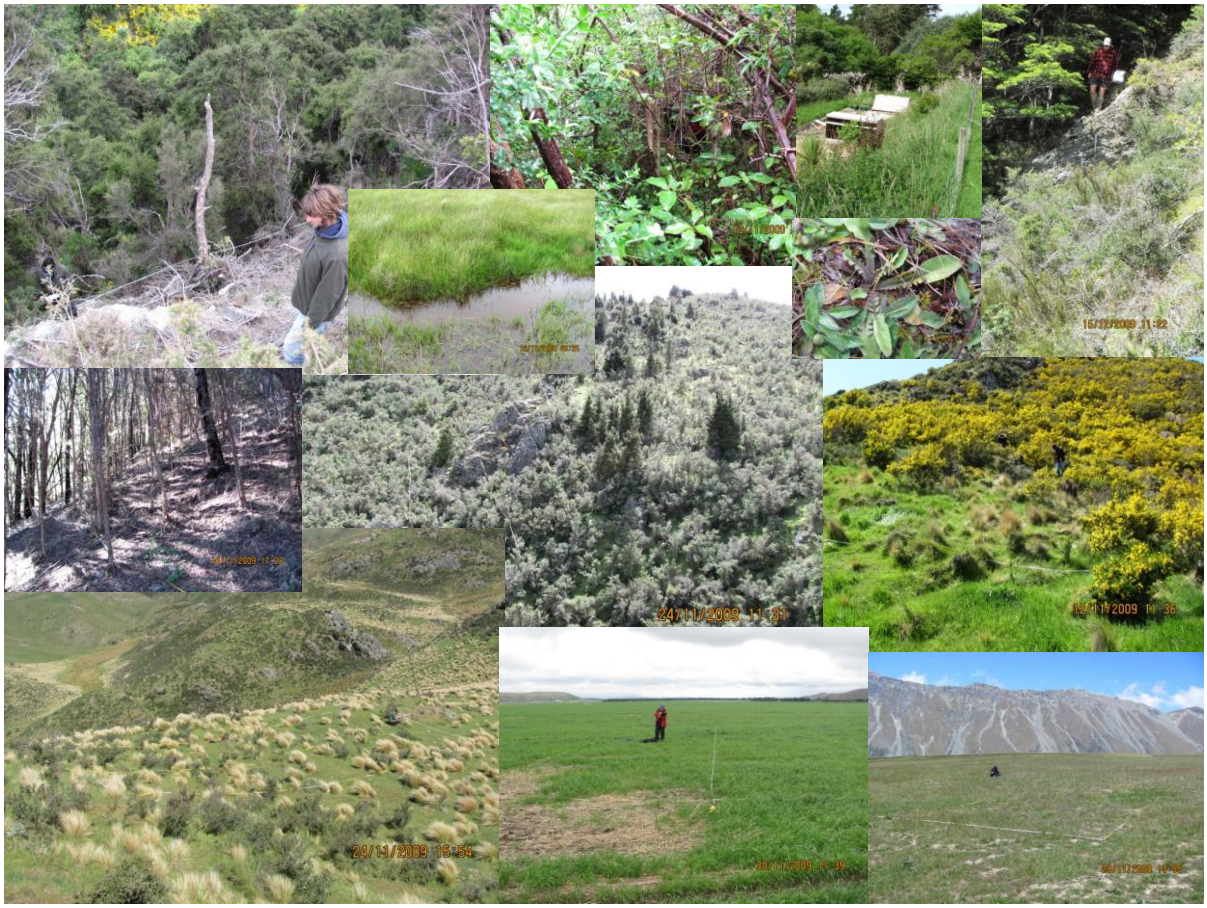
What do dryland woody (and grassy) communities contribute to biodiversity?

Our last newsletter mentioned that Kate Ladley, Dean Clarke, Max Crowe and Ella Hayman had just returned from an epic 6-week late-spring vegetation sampling trip asking 'How much native biodiversity remains in [dryland] land under indigenous cover'. They began sampling in the north-east (Marlborough) and worked southward to the Mackenzie Basin and the fringes of the Otago Lakes District. In those travels they sampled 74, 20 × 20 m vegetation plots and recorded 353 indigenous vascular plant species, 190 exotic plant species, plus 6 that could not be assigned to either indigenous or exotic.



The Spring 2009 survey was Year 1 of a 2-year study that aimed to sample the vegetation in two nominally 'grassy' and five nominally 'woody' LCDB2 classes across drylands in an unbiased way. 'Unbiased' means we sample precisely where our randomly located coordinates land within a target cover class, across both public and private land. Our plots have therefore included irrigated pasture, cut-over and standing plantations, backyards, and olive groves, along with some wonderfully rich indigenous-dominated communities.

[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"(without an 's'!) into the search box.



Above: Scenes from the CDRP-Dryland IO Spring 2009 survey of dryland vegetation

This winter, we analysed the data from the first survey year and wrote it up in a report for the CDRP (Cross-Departmenal Research Pool). The CDRP had co-funded this study for its implications for refining national biodiversity indicators based on the land cover database.[2] We found that the change in composition (turnover) of native species across plots was much higher than exotic species turnover (i.e. exotic plant species are more common but fewer in number and more generalist). Native dominance increased with tier height (communities were most invaded at ground level and more native-dominated the higher the tier). Our findings raise interesting questions about how such data might be used in refining a biodiversity indicator. Please contact us if you'd like a copy of the report.

The team commenced Year 2 of the survey in October, visiting 15 farms in Otago in the first of three planned trips. This was followed by a trip to the South Island's northern drylands to sample lizards and invertebrates as well as vegetation, at sites in the Hawkswood Range south of Kaikoura and the Amuri Range near Hanmer. At the end of the survey, we will have sought access to 120 vegetation-only plots, and eight clusters of plots at which lizards, invertebrates and vegetation are sampled (the clustering increases the efficiency of lizard and invertebrate sampling, which requires at least two site visits per site).

Deb Wilson, Susan Walker, Grant Norbury and Adrian Monks are working on analyses of data from our study of plants, birds, lizards and invertebrates across gradients of woodiness in Otago drylands. Again, we have a heap of data and we're going to need to split our findings into two or three overlapping papers. We hope to be in a position to present and discuss some of the results in our next newsletter.

[2] Walker, S., Wilson, D.J. and Ladley, K. 2010. How much indigenous biodiversity remains on land under indigenous vegetation? Report on completion of the first year of the field survey (Stage 5). Landcare Research Contract Report LC0910/189. Prepared for the Department of Conservation.

Above: Scenes from vegetation sampling on 15 farms in 2010 survey of dryland vegetation.

Strand 1: Succession to native woody communities

Rearing seedlings, seedlings and more seedlings for our ongoing and new experiments kept a big team of glasshouse workers busy again through spring, wondering if it would never end! But despite appearances, we have now wrapped up the suite of big Bendigo and Bendigo+® experiments described in earlier newsletters. Adrian is awaiting final weights and measures to start analysing the data from those trials in earnest. Here's what we can say so far.

Effects of herbivory, competition, water potassium, and shelter

It's pretty clear that herbivory and competition from grasses are equally bad news for woody seedlings. There may be some variation in the sensitivity of different species, but this is the big picture, and it confirms that some means to combat competition in the absence of grazing is needed to foster dryland woody succession. In the early years of the Bendigo trial, we tested to see whether supplementary water (irrigation at levels to simulate a good rainfall year) increased survival, and whether added potassium fertiliser increased seedling drought-resistance, and therefore survival. Neither made any perceptible difference.

Casual observation and ecological theory strongly suggest that in drylands, shelter is important to facilitate seedling establishment. Three experiments that manipulate shelter are looking at these effects on seeding establishment at present.

Two experiments are at the practical end of the spectrum. Our collaborative experiment at Ealing Springs with DOC Raukapuka Area Office and Canterbury Conservancy (see Newsletter #5) appears to show that leaving broom standing is the only treatment that favours native woody seedling establishment. So there is no need for spray or the big fossil fuel-guzzling root raking, crushing and mulching machines that were used in the other treatments!

The second practical shelter trial is new this spring: we're looking at the effects on the establishment of woody seedling of coarse woody debris (cut wilding pines) as shelter. We are planting out seedlings, and sowing seed, inside and outside of cut wilding pines at Medbury, Ashburton Lakes and Bendigo. Larry Burrows and Chris Morse could barely contain their 'Ho, ho, ho's as they delivered trees up and down drylands in their turbo-charged sleigh. Early indications are that post-planting mortality of seedlings has been very high outside of the trees. This is not very helpful at this stage of the experiment as we would have liked them to live long enough to be counted in our baseline survey!

The coarse woody debris experiment set up, Spring 2010

Our third shelter experiment (introduced in Newsletter #8) manipulates shade, lateral (wind) shelter, moisture, and organic matter at three sites, and is less practical and more focused on understanding what aspect of shelter matters to dryland woody seedlings and how much. We climbed a few technical learning curves last year when we first tried to limit soil moisture in the field, and we may decide to rerun those experiments next year with improved techniques once we've looked at our results. We will keep you posted.

Soils experiment findings

We've divided our findings from the big Lincoln pot experiment (see Newsletter #5) managed by Ellen Cieraad and Larry Burrows into two manuscripts that are likely to be the next papers off the blocks for the Dryland IO. In the first, we've compared six nitrogen-fixers ('Nfixers': native and exotic broom, gorse, matagouri, tree lupin, and kōwhai) with non-N-fixing shrubs ('others'). Under glasshouse conditions, N-fixers only outperformed non-Nfixing species when both soil N and moisture levels were low, and we think this reflects the economics of acquiring nitrogen via bacterial symbioses. These glasshouse results predicted that Nfixers should be more common in drier sites of lower fertility, and a random selection of plot data and field observations from New Zealand drylands supported this prediction.

Our second manuscript compares the performance (relative growth rate) of woody seedlings of native and exotic species, and asks whether exotic species are inevitably gruntier than natives. Our results suggest two dryland native woody species – scented tree daisy (*Olearia odorata*) and tauhinu (*Ozothamnus leptophyllus*) – have relative

Dryland *Olearia odorata* grey shrubland in Otago

growth rates matching the most aggressive exotic species under a wide range of soil moisture and fertility conditions. Tauhinu is already appreciated as a noted pioneer of native successions on the fringes of drylands (e.g. coastal Wellington and the Marlborough Sounds[3]), but like many heroic dryland woody battlers is less beloved further south, especially on pastoral land. Massey University's weed page warns that it is '*more difficult to flatten using machinery*' than some scrub species and '*not particularly susceptible to herbicides*'! The pioneering potential of scented tree daisy is less well known: but it can form a wonderful light-canopied native grey shrubland or woodland when conditions are right (as the photo from dryland Otago on the previous page shows).

We'll keep you posted on the progress of this work through the publication system.

Fate of dryland woody seedlings in grass swards

Over the past few years we have been measuring the accumulated biomass of dryland grass swards at 20 sites across a dryland rainfall gradient (introduced in Newsletter #5), with and without herbivory and fertiliser.

Last summer, Larry Burrows, Julia Wilson-Davey and French intern Alex Mathieu manipulated grass swards in a glasshouse experiment to investigat the above- and below-ground effects of grass sward competition on woody seedling establishment. Around last Christmas one-day-old seedlings were planted into the pots with grasses, and both with and without root tubes to keep the grass roots at bay. We harvested and weighed them in autumn. We've not formally analysed the data yet, but as the photographs on the right show, some of the effects were striking.

This spring we are rounding off that study with a reality test in the field: small native woody seedlings have been planted into the accumulated grass swards at our 20 field sites and we will measure their survival and growth this autumn.

Changes in dryland reserves over 16 years

Two largish dryland reserves were established in the early 1990s (the 800 ha Flat Top Hill Conservation Area in Central Otago, and the 1000 ha Tekapo Scientific Reserve). At that time, both areas were extremely degraded and denuded by stock grazing and high numbers of rabbits. Tussocks had virtually disappeared, bare soil covered extensive areas, and weeds dominated what vegetation remained (thyme and stonecrop on Flat Top Hill, mouse-eared hawkweed at Tekapo Scientific Reserve). Nevertheless, many diminutive indigenous herbs, and tiny relictual stands and individuals of native shrubs remained.

Importantly, these two reserves are probably the only two South Island dryland reserves that exist that (i) are of reasonable size (ii) aren't subject to ongoing or periodic stock grazing, and (iii) where feral grazing and prominent woody weeds such as wilding pines, broom and gorse have been controlled since their inception. Changes in Tekapo Scientific Reserve are especially pertinent because this is the only place in the Mackenzie

[3] See for example Fiona Carswell, Larry Burrows and Geoff Walls' report on managing for carbon *and* biodiversity gain at https://www.biodiversity.govt.nz/pdfs/biodiversity-carbon-gain-report.pdf

Basin where the potential for dryland ecosystem recovery can be assessed: it being the only reasonable area that has been under conservation management for any length of time.

The permanent plots in both reserves were recently monitored, 16 years after destocking, fencing and rabbit control. Last spring we helped DOC resample the permanent monitoring plots on Flat Top Hill Conservation Area, and have produced a report on the changes. We've recently also helped to analyse data collected at permanent monitoring plots in the Tekapo Scientific Reserve. Because of the extent of prior degradation and the location of the reserves in such extreme inland dryland environments, we expected the vegetation to still be in the very early stages of any recovery. We also hoped early indications of future trajectories would be starting to appear. In fact, striking vegetation changes occurred in both reserves, including encouraging ecological developments.[4]

However, this work has also highlighted inadequacies in the design of the permanent monitoring schemes established in the early 1990s, and in the sampling methods for capturing and documenting the unfolding changes. Through the coming summer and autumn, we plan to be involved in supplementary work in both reserves to strengthen the sampling design.

Strand 3: Community and agency awareness

Our work with agencies has continued to focus on territorial authorities, interacting and exchanging information on biodiversity values and threats with biodiversity protection programmes and their coordinators, and with key staff and councillors with biodiversity interests. We've also been trying to keep dryland protection needs top-of-mind as conservancies develop their conservation management strategies for the next 10 years. Talks to groups and agencies on conservation challenges in dryland environments, public field tours, and popular and media articles are other means we have used to raise awareness and appreciation of wider biodiversity issues in dryland environments. This week Grant helped coordinate Central Otago's first biodiversity forum with an impressive cast of speakers.

Events

The 'Future of the Mackenzie Basin' symposium hosted by the Environmental Defence Society, Forest & Bird, and the IUCN/ World Commission on Protected Areas (WCPA) will run from Friday 26 to Saturday 27 November 2010 at Twizel Events Centre (http://www.eds.org.nz/events/upcoming.cfm). The symposium is free, all are welcome, and it may be a crucial meeting for the future of dryland indigenous biodiversity in the Basin.

Many thanks!

We thank the Todhunter family of Cleardale Station for providing wilding pine trees for our coarse woody debris experiment, and the many landowners who granted access to their land. Students were again our mainstay: grateful thanks to Alex Ghaemaghamy, Aimee Pritchard and Rebecca Johnston, Max Crowe and Ella Hayman (part of our summer field sampling team again) and Alan Colligan for his help with seedling propagation and data entry. In the wet lab, Jessica Thorn, Katharina Tawiri-Suter and Elise Arnst helped Julia and Larry process the sward experiment. German interns Kathrin Bramke, Nicolas Bramke and Peter Zacharias have been wonderful versatile workers. Nick Head, Helen Braithwaite and Lorraine Cook from DOC and Jessica Thorn and Elise Arnst helped remeasure the experiment at Ealing Springs. John Barkla, Craig Wilson, Joy Comrie, Nick Head (DOC) and Marta Treskonova have been great collaborators. We would be in deep trouble without our peerless support people within LCR, especially Heather Russell, Christine Bezar, and Lara Nicholson.

[4] Walker S, Wilson C, Barkla J, Monks A 2010. Changes in the vegetation of sampling plots in Flat Top Hill Conservation Area from Spring 1993 to Spring 2009. Landcare Research Contract Report LC78, and Walker S 2010. Changes in the vegetation of sampling plots in Tekapo Scientific Reserve from 1993 to 2009. Landcare Research Contract Report LC30. Please ask us if you'd like acopy to read.