

Dryland Intermediate Outcome Newsletter #3 December 2006

Here's a third 6-monthly update from the FRS&T-funded 'Dryland IO'. The last six months have been busy with hands-on work across the spectrum of our activities, including the set-up of two ecological experiments, compilation and analysis of datasets, research and methodology write-up, and work with agencies and communities to raise support for dryland biodiversity conservation on the ground. We describe some of these activities below.

We also ask for your input into the selection of a suite of monitored regional dryland flagship species, and advertise what promises to be a great restoration forum: NZERN's National Conference, **Restoring the Drylands** in Christchurch from 23-25 February 2007. We look forward to seeing you there (see <http://www.bush.org.nz/nzern/conference.html>)!

Strand 1: Succession to native woody communities

Before we can develop management-scale techniques to promote native woody succession, we need to better understand limitations to woody succession across the dryland zone—what these limitations are, where they occur, and how they operate. Key potential limitations to the re-establishment of dryland woody species are being investigated in two experiments:

1) **The Bendigo Experiment:** *The role of competition and herbivory in seedling establishment in the drylands: a pilot experiment at Bendigo, Central Otago.*

Competition (e.g. from exotic grass swards) and grazing are obvious candidate key limiting factors for dryland regeneration. Adrian Monks designed this 264-plot 'pilot' experiment (Is it so-called because only pilots can see the whole site at once, Adrian?) to measure the effects of competition, herbivory and water on germination, survival and growth of four dryland woody plant species. A split-plot design combines treatments of four species (*kanuka*, *Carmichaelia compacta*, *Ozothamnus leptophylla* or *Coprosma propinqua*) and no seed addition, and presence/absence of additional water (irrigation), herbivory (exclosures) and competition (using herbicide, trenching and hand weeding).

There were many logistic challenges and some very, very long days involved in setting up. Many thanks to a first-rate and tireless team.



Marcia, Richard, Adrian, Kate, Pete, Trent and Jana set up 264 mesh-enclosed, trenched, sprayed and/or irrigated subplots at Bendigo in Spring 2006.

By late Spring, setup was complete and seeds were sown. El Niño has responded to our insurance against drought-failure (i.e. irrigation) by supplying perhaps the highest-ever soil moisture levels across all treatments to date. Over 2–3 years, we will measure germination, survival and biomass accumulation, run trials to determine seed viability, calibrate plant numerical responses to grazing with an artificial herbivory trial, and undertake rabbit and possum spotlight counts. We hope results will shed light on some limitations to woody establishment, and form the basis of a general model of dryland seedling establishment. Logistic experience from Bendigo is sure to inform future experimental set-ups at other sites.

2) **The Soils Experiment:** *The role of soil chemistry and moisture levels on woody seedling growth in the drylands.*

Is soil chemistry potentially limiting for the re-establishment of dryland woody species? Larry Burrows and Ellen Cieraad are investigating the role of edaphic factors in woody plant growth. Seedlings of a suite of dryland woody species will be grown in pots of soil from seven South Island dryland sites (with similar annual moisture deficits but different soil types) in a Lincoln shade-house, at two different moisture levels, for about a year. Measurements of germination (and, in some species, non-germination!) rates, and of growth rates and biomass accretion in different species and soils will provide further life-history information about this little-researched segment of the flora, and contribute more parameters to our general model of dryland seedling establishment.

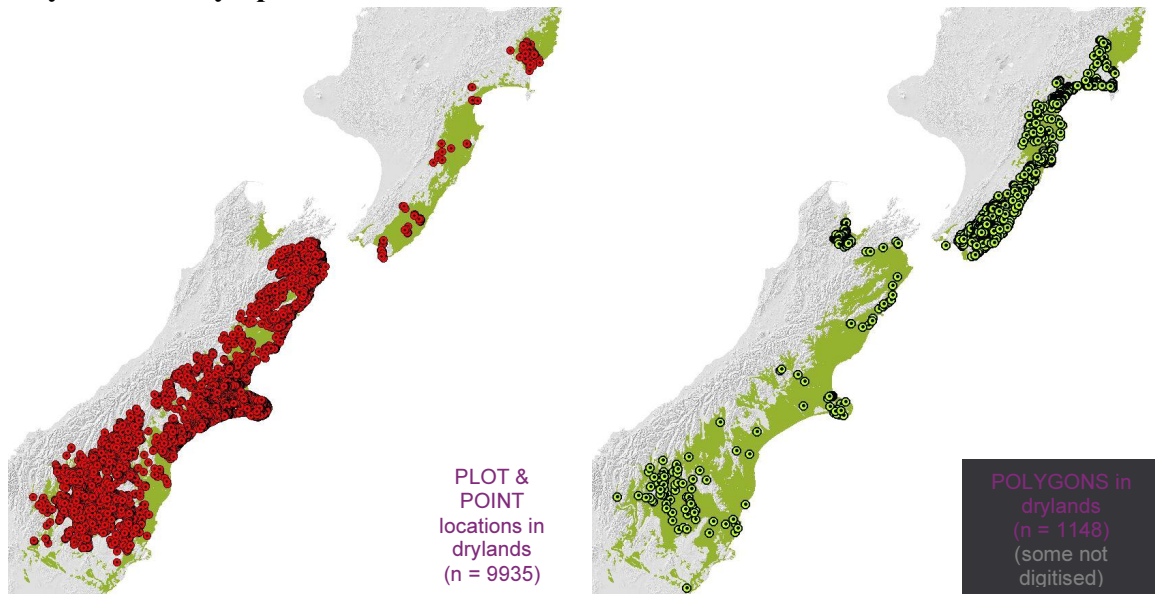


Ellen and Larry collecting and processing dryland soils, and growing seedlings for the soils experiment. Locations of the seven soil sites on the 400mm annual penman deficit ‘isohyet’ are mapped (lower left).

Which species where?

The dryland zone is large and diverse. A recurring question is “Which woody species are the best candidates to lead secondary succession in drylands and where?”. To begin to address this systematically, we built databases of dryland woody species locations and traits. Since my last Newsletter, we have completed the databases, compiled summary information, and have got underway with analyses.

Dryland Woody Species Distributions



Locations of dryland data plots, points, and polygon centroids in the Dryland Woody Species Distributions Database. Compiled summary data from the database (e.g. species rank by dryland zone) is available on request (walkers@landcareresearch.co.nz) and will be posted on our web page (...early next year, see below!).

Drawing on approx. 8500 dryland fixed-area plot records collated in the Distributions Database, Susan Walker and Robbie Price are producing maps of predicted distributions of woody species and associations across drylands. To distinguish species readily establishing in grasslands from those that preferentially colonise woody canopies, we're separating out different plot-richness classes (1–3, 4–6, 7–9, and ≥ 10 species) in the analyses. We'll also map relative density of the plots: this will indicate the relative certainty of predictions, and where supplementary plots are needed to refine them. We hope to have these analyses completed and results available to all by the end of the financial year.

Dryland Woody Species Traits

Understanding the link between plant traits and successful woody re-establishment in different dryland environments should help us to better predict which woody species will grow where in drylands, and may also reveal limitations to successful re-establishment operating across the dryland zone.

Height	Pollination agent	Seed size	Resprout after grazing/cutting	Age till flowering
Width	Dispersal agent	Seed bank type	N-fixation	Seed mass
Leaf longevity	Number of seeds/plant/crop	Spinosity	Shade tolerance	Palatability to animals
Sexual reproduction system	Years between crops	Toxicity	Fire tolerance	Frost tolerance

Twenty plant traits: our Dryland Woody Species Traits Database holds information on these traits for 300 common dryland woody species. Data are from published and unpublished literature and expert knowledge.

Our Traits Database compiles information on twenty plant traits (or attributes) that are likely to influence plant establishment, for about 300 of the most common native and exotic woody species in drylands. What we need to know is which traits (and/or trait groups) influence successful re-establishment, and where. To learn this, we linked our Traits and Distributions databases, and are starting to analyse trait spatial patterns, and relationships between traits and 'success' in seral woody communities. We will progress this analysis further next year.

Strand 2: Biodiversity of dryland woody communities

Answering the question “What are the benefits and drawbacks of woody succession for native biodiversity in drylands?” requires (1) development of new sampling and monitoring methods, and (2) their application in a field sampling programme across dryland woody communities. Methodology development and testing is going well, thanks to our continuing partnerships with DOC’s Grand and Otago Skink (GAOS) Recovery Programme and the dryland arm of the FRS&T-funded Multiple Pests Dynamics project, and generous assistance from Chris Jones and Marieke Lettink. Protocols for monitoring vegetation, common lizards, and invertebrates are now documented, and are implemented in the GAOS programme at Macraes Flat. We have analysed data, using newly-developed software and statistical methods, and written up the results of sampling undertaken so far. A report on the invertebrate monitoring protocol has been circulated. Deb Wilson, Robin Wiedemer and Ryan Clark have recently submitted a manuscript, detailing results and recommendations from the sampling of lizards with ACOs (Artificial Cover Objects), to *New Zealand Journal of Ecology*. A key result is that estimates of skink \hat{N} (population size), and first-day counts of skinks under ACOs, were significantly higher inside the mammal-proof fence at Macraes Flat compared with the experimental control. These achievements in Strand 2 reflect strong partnerships and great teamwork. Next, Deb and Grant Norbury will be initiating the field sampling programme, with a field-test early next year of stratified sampling of different biotic groups across a woodiness gradient in Central Otago.

Strand 3: Community and agency awareness

Grant Norbury spent last autumn consulting widely about how to build community and agency support for dryland biodiversity conservation. We circulated a report of those conversations (Norbury, G.; Walker, S. 2006: Building community and agency support for dryland biodiversity conservation: a review and strategy) which contains a refined list of 43 suggested actions for agencies and groups with biodiversity responsibilities in Drylands. “Improved public appreciation, translating into policy and operational initiatives that improve representation and management of dryland biodiversity” is going to require dedicated ownership and activity across drylands.

This year, in partnership with QEII, Grant is visiting less active agencies to discuss options and national funding opportunities available for non-regulatory approaches to biodiversity protection. He is also exploring corporate sponsorship opportunities for dryland flagships, and continuing a range of local, on-the-ground activities with individuals, agencies and ecological trusts to raise awareness and support for dryland conservation in Otago.

Dryland flagships

We have begun to assemble a list of dryland species that (1) are being used as flagships to rally support for dryland conservation (or potentially could be), *and* (2) that have some population data associated with them, and (3) could be used as regional indicators of changes in the security of dryland biodiversity over time. I have begun to discuss potential candidates with people working on species recovery projects around drylands. Flagships suggested so far (for which baseline population data exist), the region(s) covered, and principal agencies involved are: Lowland totara (Marlborough, MDC), *Muehlenbeckia astonii* (North & South Island Drylands, DOC), Canterbury Plains kowhai (ECan), Grand and Otago skinks, *Lepidium* species, and the dryland grasshopper *Sigauss childii* (Otago, DOC).



The list is still wide open and we will appreciate any comments and further suggestions! We would especially like to hear about dryland species recovery projects and datasets we may not be aware of. We'd like to highlight a number of flagship species projects on our web page.

Aligned proposals funded

Trent Bell's proposal for an online encyclopaedia of New Zealand lizards was funded by TFBIS in the mid-year bidding round. Well done again Trent! Envirolink Tools funding to transfer the Threatened Environments Classification add-on to LENZ (Land Environments of New Zealand) has been approved by FRS&T, and we anticipate starting working on this project from January with a Regional Council ecologist user group. Excellent news that Elaine Wright and Theo Stephens (DOC) won significant CDRP (Cross-Departmental Research Pool) funding for research focussed on interpreting terrestrial biodiversity indicators. Two projects ("How much indigenous biodiversity remains on 'land under indigenous vegetation?'" and "Does 'environmental representation' indicate species security?") will study common and rare components of mixed native-exotic communities that are widespread in drylands, and therefore align closely with Dryland IO Strand 2.

Proposals under development, and students working with us

Lowland dryland indigenous communities are being rapidly cleared for agriculture and urban development—at least, this is the *impression* gained when driving through drylands. The problem is, we have no reliable *data* revealing where, and how fast, loss is occurring! Objective tracking and quantification requires research to improve remote sensing techniques, so pasture 'improvement' can be reliably distinguished from soil moisture fluctuations. The Dryland IO is working with Drs. John Dymond and James Shepherd to finalise a funding proposal to the Miss E.L. Hellaby Indigenous Grasslands Research Trust for a PhD student to work in this area, with assistance from Landcare Research's Systematic Biodiversity Assessment Capability Fund. We are also developing a proposal for a PhD project to investigate facilitation and/or inhibition of native woody species by common exotic dryland shrubs (particularly sweet briar—*Rosa rubiginosa* and broom—*Cytisus scoparius*), in collaboration with Dr Katharine Dickinson (Otago University). I've already mentioned Deb Wilson's collaboration with Ryan Clark in Strand 2. Geoff Rogers (DOC RD&I, co-supervisor) and Susan Walker (advisor) are finalising a PhD proposal with Amadou Camara and Prof. Bastow Wilson (Otago University). Amadou proposes to investigate effects of shading on competitive interactions between declining dryland herbs and exotic species, in the presence and absence of grazing, using shaded field exclosures and glasshouse experiments. Two visiting students from Germany (Jana Gevers of Potsdam University, and Philipp Adler) have made great contributions to our dryland projects in the last few months.

Websites

Community data entry website launched

The New Zealand Biodiversity Recording Network (NZBRN: <http://www.nzbrn.org.nz>) is a web-based system to record and process natural history observations. Colin Meurk and others have developed NZBRN for New Zealand from a prize-winning Swedish Artportalen (species gateway) system, with funding from the Terrestrial & Freshwater Biodiversity Information System Fund

Welcome to New Zealand Biodiversity Recording Network (NZBRN)

 Report system for Birds
In co-operation with the Ornithological Society of New Zealand.
Opened summer 2006

 Report system for Vascular Plants
In co-operation with the New Zealand Botanical Society
Opened autumn 2006

(TFBIS). NZBRN has great potential to raise awareness of our natural history among the general public and schools. The system provides secure storage for biodiversity data outside institutional databases, enabling users to create their own databases, distribution maps, graphs, and species lists. Location data can be protected by clever privacy functions (vital to keep some of our fauna and flora safe).

Currently the NZBRN report system for birds is operational, and vascular plant and fungi systems will be launched soon. A lizard portal is under discussion. We would be delighted to hear from those who are using NZBRN, or planning to use it, in dryland projects.

A Dryland web page is coming!

In this newsletter, I was hoping to introduce a brand new Dryland page on the Landcare Research website, which will provide ready access to documents relating to our research and activities (newsletters, publications, reports, workplans, talks, etc). Alas, Manaaki Whenua's entire website is undergoing a revamp, and a Dryland page remains under construction. Our web page is now due *early in 2007*, and we'll post the link in Newsletter #4. Promise. With luck, the Dryland IO will be only three clicks from the front page of www.landcareresearch.co.nz, under [Collaborative research initiatives](#). Until then, please don't hesitate to contact me if you would like to receive data summaries from our distribution and trait databases, or other documents mentioned here or in earlier newsletters.

Upcoming conference presentations and talks

We are looking forward to gathering at and contributing to the NZERN National Conference, **Restoring the Drylands**, from 23-25 February 2007, Wai-ora Trust, 48 Watsons Rd, Harewood, Christchurch. See: <http://www.bush.org.nz/nzern/conference/2006Program.html>

Larry Burrows will present a paper on factors affecting dryland restoration, in an Arid Lands symposium at the Southern Connections conference in Adelaide in January. We expect Larry will return stimulated and informed by Southern Hemisphere experience.

Thanks!

Many thanks to Jan Clayton Greene, Simon Moore, Joy Comrie, Trudy Murdoch, Dave Murphy and Mike Tubbs of DOC for facilitating permits and for use of equipment. Rob Allan, Jim Ward, Tim Cameron, and Colin Nimmo kindly granted access to their properties for soil collection. Setting up the 1200-pot soil experiment proved a steep learning curve, and we were helped by John Wicken (Water Control Solutions - irrigation), Peter Keller (Opuha Nursery, Geraldine-seed & seedling source), Lester Davey (Matai Nurseries, Waimate-seedling source), and Joe Cartman (CCC Nursery-seed source). In Landcare Research, Stuart Oliver & David Purcell (nursery), Hugh Gourlay (auto-clave sterilisation), Ian Lynn (soil gathering, soil science advice), Allan Hewitt and Trevor Web (soil science advice), Tony McSeveny (bulk density and soil science advice), Graeme Rogers (irrigation), Jaggath Ekanayake & Celia Pruden (field capacity and permanent wilting point measurements), Peter Bellingham, Colin Meurk and Duane Peltzer (discussions on experimental set-up and more), and Ian Dickie (advice regarding mycorrhizae and fungi). Many thanks to Jake Overton for much assistance with species spatial modelling. Volunteers Jana Gevers and Philipp Adler invested long hours and much energy in the Bendigo and soils experiments, respectively- thank you both. Thanks (again) to James Reardon and the DOC GAOS team at Macraes Flat, and to DOC RD&I for continued support for work to build community and agency support for dryland biodiversity conservation.

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