Horses for courses: restoring grassland diversity on public and private land in the ACT and surrounds: lessons learnt over a seven-year journey [+]

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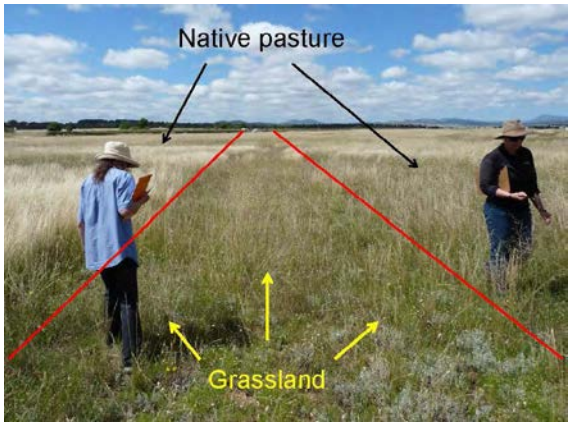
Abstract: Over the last seven years Greening Australia in the Capital Region has broadened its focus from native trees and shrubs to include grasslands and the grassy component of grassy woodlands. We have partnered in many restoration projects across a range of land tenures including landfills, quarries, reserves, airports, travelling stock routes and paddocks. While adopting many of the techniques pioneered by our colleagues in the Grassy Groundcover Research Project (GGRP) in Victoria, we have also faced a suite of somewhat unique challenges in our local environment and situation. As a result, new seed production areas, nursery techniques and seeding machines have been developed, trialled and refined. The level of intervention and techniques applied to each site are dictated by the site condition, management funds available and long-term goals. From intensive nutrient reduction techniques through to hand-planting, the suite of tools in our grassland restoration tool kit is discussed.

Greening Australia is a national organisation, and this talk is about the local part of it in the ACT region, including my personal experience and that of my colleagues.

Our work with grasslands is a team effort and it is new to us. I spent the first two or three years of my career as 'the tree guy': I would go onto farms and grow trees. Now the whole organisation is moving to restoring grasslands and the grassy components of woodlands, and this move has been a seven-year journey not only for me but also the organisation as a whole.

This photo (right) shows the beginning of the journey. It is a plot that has been mown. Is it grassland? Is it native pasture? Is it exotic? We did not really know. It was a plot of grass that had recently been cut. We had little idea how it would react with the addition of water, or sun, or anything else.

About 20–30 m away (photo below) is a very similar landscape. Here we can see very tall grass on the left, very tall grass on the right and a strip right down the middle. According to Alison Rowell who had been monitoring this site for several years, the strips to left and right are native pasture and the strip in the middle is Natural Temperate Grassland. It has a thinner cover of native grasses and an abundance of wildflowers.



The question is: why is there this strip of Natural Temperate Grassland right through the middle of this native pasture? This was where we started on our journey of coming to grips with soil fertility. What happens beneath the ground really drives what happens on top of the ground. In this case, that narrow strip was an old roadway; it had been graded using a road grader, the top soil had been removed and the incredibly low fertility was favouring the wildflowers over the grass growth. We have now adopted the phrase: 'Bulldozing for biodiversity'. I wonder if it will catch on?

One of the first things that I wanted to do was to come to grips with soil fertility and its role in driving vegetation structure. Using Alison's map of vegetation classes across the site, I took a series of soil cores, sent them off to be analysed and then tried to see if there was a link between soil fertility and grassland condition. As it turned out, there is a beautiful link between soil nitrogen and which species are growing. Where the nitrate rating was 4–7 mg/kg, we had an exotic pasture (diagram, right). In the middle zone, where nitrate measured 3.4 mg/kg or so, there was 'native pasture' dominated by native grasses. It has a couple of common forbs, but no spectacular diversity. Where the soil nitrate concentration was 0–2 mg/kg, we found a fantastic wildflower diversity. For scientists such as Josh Dorrough and Sue McIntyre, this is nothing new. They have written papers and produced beautiful graphics depicting this situation. However, for us to see it for ourselves was really valuable. We learnt our first lesson – that soil fertility matters, and a soil test could prevent many costly mistakes. Soil testing for fertility is now a fundamental part of our grasslands restoration toolkit and it is usually the first thing we do.

Veg Condition	Nitrate (mg/kg)
Exotic pasture	7.1
Exotic pasture	4.4
Native pasture	3.4
Grassland	1.8
Grassland	0.6

At our low fertility sites, increasing the diversity of species has been relatively straightforward (photos, right). We have modified our tree seeder by taking the disc off the front. Fluffy seeds now are mixed with sand in one of the seed boxes. Lily seed and other larger seeds go through the seed box that is usually used for *Acacia* seed. We have used this seeder for single runs in Golden Sun Moth and Grassland Earless Dragon habitat, where we had very strict instruction not to disc soil out of the way. To start with it was trial and error, doing a single row and then revisiting the engineers for a couple of modifications, then another row, and so on – we had no idea if this was going to work. Six months later, we were down on our hands and knees, an inch from the ground, looking. ... Little lilies were popping up! Little daisies were popping up! All sorts of things were emerging! I was very excited.

One of the criticisms made about sowing strips of grassland is that they are strips; they are linear. However, within two or three years with the right conditions on these low fertility sites, the plants are now self-seeding and are essentially naturalised. There is a little bit of a line down the middle but there is recruitment on either side of that and we will see more recruitment like that in 5–10 years.

These low fertility sites are also suitable for tube stock or transplants of already grown plants. The photos at right show a trial planting of mature plants of *Lepidium*, a threatened species. We used tubestock to understand if we

have created the necessary conditions for these mature plants to naturalise and set their own seed. The lower photos of the set (previous page) show that the trial seems to have worked reasonably well. It is a fairly laborious method, but if you have passionate volunteers or willing staff then it can succeed.

We are also working with low fertility sites at some of the local landfills and quarries. In the photos here (right) the site is a landfill, full of ACT waste. It had been capped with clay and the managers wanted it sown to native species. They saw benefits in terms of lower weed management problems in the long run. Trees and shrubs would crack the clay and introduce other problems. This has been a really good exercise, taking our seeding practice up to the next scale. Many rural tips are now due for closure having been downsized into waste transfer stations, and we are having discussions with a number of local councils about restoring these sites with native grasses and native wildflowers. Restored landfill sites will be used by the community. There is a feeling of ownership with these sites, and I think including the wildflowers will enhance that. I hope that instead of a landfill we shall have a thriving grassland system here that is attractive to look at, along with a sense of ownership.

High and moderate fertility sites

In high fertility sites, there can be 1.5 m-high growth of Fescue and various other exotic pasture grasses (composite image at right). At far right is an African Lovegrass + thistle combination. From Greening Australia experience in Victoria we have learnt that if we use a grader to scrape off the topsoil to create the right soil conditions and then sow native species into that, in a relatively short period of time – say 4–5 months – there will be germination of Wallaby Grass and some Kangaroo Grass, some native Plantains starting to flower, some Yam Daisies, some Bluebells (photo immediately right). By 12 months' time this high fertility weedy mess will become an absolute showpiece.

Between the two extremes there is moderate fertility soil which we often call native pasture (top images next page). It has a backbone of native species without the diversity. In one of our projects we are trying to increase the grassland quality in these moderate sites. In wet conditions these sites can grow a lot of grass, and the normal management regime is to slash it without removal. That creates a very thick layer of thatch and dead material, up to several inches thick, which largely suppresses the germination of grassland forbs, lilies and other species. Our second lesson has been that this biomass must be managed.


To create conditions suitable for interesting species we need to get rid of that litter layer (left photo of pair at right), and to do that we have brought in a commercial de-thatching unit which rips up the thatch and brings it to the surface of the pasture. To remove that altogether we have tried several methods. Initially we just sucked it up in a mower, and from one 20 m x 20 m plot we collected an enormous trailer load – a vast volume – of dead grass material. The 'downside' on some of these moderate fertility sites is that opening up the grass sward allows weed invasion (photo, right) – which is very disheartening.

However, we carried on, and continued to mow these sites and remove the grass after every cut. We borrowed a forage harvester from Bush Heritage Australia which enabled us to mow and remove the grass continuously (4-photo composite, right). Now, after doing this for three years, we are starting to record lower soil nitrate concentrations. That means we are mining the fertility out of the soil by continually removing nutrients contained in the grass. Fewer weeds are invading because the soil is becoming less hospitable to exotic growth. However, it is still a more difficult prospect to restore moderate sites like this than those with lower nutrient status.




Lesson number three has been that not all our machinery works in the same way. We have tried out many different machines, trying to find the most efficient way of taking the grass off the site. The machine in the single photo (right) is essentially a giant vacuum cleaner, and on an airport that level of dust was not acceptable!

Our fourth lesson has been that we need to have patience. We direct-seeded some lilies, and up they came. Those who know anything about lilies know that at the first sign of a rise in temperature they retreat back underground to a little tuber. The following year they emerge again and may grow a bit more and retreat. We have sown Bulbine Lilies, and two and half years after sowing the tubers are now 1.5 cm long (photo with pen, right). So, we might be looking at possibly 5 or even 10 years before this turns into a flowering plant, which is probably not uncommon. Most Australian shrubs and trees are very long-lived. From what I understand, grassland plants are exactly the same. Many of them live for 30 or even 50 years, so they do not need to grow particularly vigorously. They just need a very fail-safe growing strategy.



The final lesson we have learnt is that to restore grassland sites at large scale you need dedicated seed production. We have set up seed production sites in Victoria and in Aranda in the north of Canberra, and they are really spectacular (e.g. photo composite, right). We successfully produce Chocolate Lilies (top left photo), Hoary Sunray (top right), *Convolvulus* (Australian Bindweed) and other species. This facility is really a testament to the work of Stephen, my colleague, who has worked tirelessly over the last 2–3 years building these production sites, with the help of volunteers. They give us the volumes of seed needed to restore grasslands on a large scale.

Some comments on management

Overall, our management is site specific. One of the best ongoing management tools is biomass control, and this is a common situation with grasslands. In some instances we cannot use burning for that, such as at the airport, and in that situation we also cannot use livestock to keep that balance of grasses and wildflowers. This is why we are using a mechanical version of burning or grazing, if you like, by cutting all the material and taking it all off site.

For weeds, there has to be ongoing management. Many of our sites are very near to areas of perennial grassy weeds: Serrated Tussock, Chilean Needlegrass, African Lovegrass. Therefore there has to be at least an annual weed management program, just to prevent those species from invading.

For fertility management, I suggest the method depends on the site. If the site has been heavily improved (fertilised), then lowering fertility only by slashing and removal could take a prohibitively long time. If the site has moderately high fertility, where there are some native species and some exotic species, then our early results show that after three years of mowing about three times a year we are starting to see a drop in soil nitrogen concentration as I said above. The phosphorus concentrations are already very low. With a regular program of biomass removal, there does not seem to be any reason for the soil fertility to increase.

Management of biomass could affect the grassland fauna if we are not careful. The depth-setting of the machine is important. The de-thatcher should literally just touch the soil surface so it is not actually disturbing the soil but only hitting the top and fluffing up all the fallen grass so we can collect it. There should be very little root disturbance so as to avoid damage to the Golden Sun Moth. I do not know the specific requirements to avoid disturbing the Grassland Earless Dragon, but we time our operations based on advice from Alison Rowell, to avoid potential breeding times or critical times.

In summary, in some respects the low fertility and the high fertility sites are 'easily' managed (I use that term in jest). However, the moderate fertility sites, the ones that have an existing base of native plants, that might be providing habitat for the Golden Sun Moth for example, or the Grassland Earless Dragon, or have a suite of other values preventing us reducing the nutrients as we can do in a paddock of Fescue or African Lovegrass – these are the sites that have proved most challenging.

Overall, Greening Australia is still learning about grassland restoration. We have to find out more about how to control weed invasion. We are impatient: everyone wants to see results. I think a realistic timeframe for treatments, and also of growth patterns, might be 3–5 years. Seed production areas are essential. Slightly counter-intuitively, grasslands seem ideally suited

to reclaiming quarries, tips and landfills, and these sites give us opportunities to build new patches of 1, 2, 3 and 10 hectares.

I would like to acknowledge the many people and groups (list at right) who have supported and advised us – in Victoria and in Canberra. Thank you.

Graham Fifield is a senior project manager at Greening Australia Capital Region with seven years' experience in environmental rehabilitation. During this time he has delivered a range of incentive funding projects on private and public land. Graham has worked extensively across the Southern Tablelands, South West Slopes and Central West regions of NSW. He has visited projects in other states and understands many of the regional challenges facing the industry. Graham has recently finished a three-year program of grassland restoration trials and has been involved with sowing grasses, herbs and forbs.

Acknowledgements

- Canberra Airport
- ACT Government
- Federal Government
- Bush Heritage Australia
- Australian National Botanic Gardens
- Alison Rowell
- Peter Saunders (BHA)
- Greening Australia staff
- GA Volunteers
- FOG
- Rod White & Paul Gibson-Roy

[+] This record of the talk given at the forum has been checked by the presenter, but not peer-reviewed. To find out more, contact the presenter, via their institution or by email to: info@fog.org.au/.