Conference Proceedings – Speaker Transcript

Using plant population ecology to improve the effectiveness of both fire and weed management

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Link to Slides

I'd like to acknowledge the traditional owners of this land and this continent, who had a land management system thousands of years old that we're only just starting to appreciate. Personally, I come from the Sanders clan, from Devon and Somerset country, and I and my family would like to thank the traditional owners for putting up with us for the last 200 years. Not only did we disrupt their management system, but we made it far more difficult by bringing a range of other species with us.

Is our management working (Slide 3)? I would suggest we are having some local successes, but across the landscape, no, we are not winning yet. We have a great idea of the population ecology, thanks to the wonderful work of people like Charlie Morris, Peter Myerscough, Ross Bradstock, Tony Auld, David Morrison, David Keith, Doug Benson, and to the way this knowledge was operationalised by people like Bob Conroy. However, this is often applied on a short term horizon. We see a situation, we look at a fire regime, we apply it and that's the event. We need to go further than that.

This talk is about how to go a bit further. We have fire prescriptions, but they're primarily harm minimisation guidelines for intact native bushland, rather than dealing with the detailed management of complex disturbed landscapes with weeds (Slide 4).

How do we get there? As with the native species, we need a detailed understanding of the plant population ecology of weeds. The fire and weeds review described earlier at this conference is a great start. Populations respond to events and if we understand these responses, we can manage the population through managing the events. This talk is about that journey.

I'm going to go into some of the critical stages of the plant life cycle in a bit more detail (Slide 5 – 6). The progression between life stages may be fairly continuous and linear, or it might involve quite interrupted steps. That is very important to understand. In this slide (Slide 6) we

have wattles. We have a "surprise seedbank". This area was a grassy paddock in 2000, then we had a fire and we had an unexpected growth of wattles in the open area. Then we had another fire and we got a new generation of wattles in the open area. Then we found we had another surprise seedbank after we had a spot over from another fire. All of this was just populations responding to events.

Germination is a critical issue (Slide 7), it is the critical starting stage. Germination can be triggered by a range of factors (listed on Slide 7) for example:

- Cold (frost); seasonal temperature changes
- Moisture
- Mechanical or biological scarification
- Heat (esp. cracking seed coat)
- Light
- Smoke/combustion compounds
- Absence of chemical inhibitors.

Note that the last four of those factors are the likely outcomes of burning, while weed treatment may also stimulate germination.

The next stage, which is perhaps even more critical, is establishment (Slide 8). It is easily possible for seeds to germinate and then fail to reach light, due to obstructions or shading. This is the stage where most mortality is going to occur. The factors that affect establishment can be provided by both fire and weed treatment.

Plants need to reproduce (Slide 9), so flowering and fruiting is important. The time that it takes to reach flowering and fruiting is a critical element of fire thresholds, especially for obligate seeders.

Plants do move, often rapidly (Slide 10). We need to be very aware of this, because this can take us by surprise, and the distribution of seedbanks is an extremely important factor affecting the success or failure of our management.

One of the major issues that shaped our vegetation is the capacity to survive catastrophes (Slide 11). This ability requires the development of tissue for both protection and recovery, and the time that this takes is another important factor in setting fire thresholds. For example, a young *Banksia serrata* takes seven years to get sufficient bark depth to resist the next fire.

Another variation of the life cycle, which is really important for a lot of plants and particularly important when we're talking about weed management, is the vegetative life cycle (Slide 12). Once a plant reaches a particular age, it develops regenerative tissue. If there is a major impact on that plant, then the regenerative tissue can sprout and you get the plant back. As an example, here's a poplar that we cut down, the regenerative tissue has come back and you have more poplars.

Some plants go through this vegetative life cycle for centuries (Slide 13). A single plant can occupy very large areas and even hectares. *Acacia pubescens*, for example, was like this in some places when I first started working in western Sydney. You can't assume multiple stems are multiple plants, and most of western Sydney's larger trees are, in fact, re-sprouts. The vegetative cycle has saved them.

We can basically consider that there are three functionally separate plant populations (Slide 14). The one in the middle is the visible, above-ground plant population. The one on the right is the seedbank, it may be above ground, it may be below ground, it may be present at the moment or it may be still on the way. The one on the left is the regenerative plant parts, that might be the buds, the tubers, the root stocks, lignotubers, epicormic buds, etc.

The vast majority of our concentration on management is on population one, the visible plants. Quite often we don't think about the other two populations, even though the visible population is usually the minority. Those other two populations are the majority of the plants that are out there. They are difficult to reach, and they are quite often invisible to us.

The critical issue is 'how do we understand the distribution and the functioning of those other two populations and plan for what is going to happen'? We have to understand these transformations between the sub populations (Slide 15). If we don't understand and plan for them, we are only managing a minority of the plants, and our management is going to be compromised.

A few examples. Blackberry is very easy to transport, very hard to kill, because they have a great capacity for recovery (Slide 16). Transforming those hidden populations of root stocks by killing the visible blackberry makes the root stock visible to us when it re-sprouts. You can't just manage the visible blackberry. You need to ask 'how do we make the regenerative tissue visible and then how do we then manage that regenerative tissue'? Transforming a plant can also make them much harder to treat, as in this *Gleditsia* (Slide 16). There's actually a stump there that somebody cut and painted with good intentions. And as a result, we have a massive grove of *Gleditsia*, much harder to treat.

African Lovegrass has got a great recovery population, which is made of root masses. Fire can expose these populations and then they can be treated, as here at Scheyville (Slide 17). This area was burnt and the right hand side was sprayed within a week of the fire, while the left was sprayed about six to eight weeks later. Now, both of these populations are dead, but the Lovegrass structure is still influencing the growth of other plants on the left hand side.

The thick swards that you get from Lovegrass and other weeds are a major issue. The retention of a thick layer of leaf litter or dead plant matter may prevent other species recruiting (Slide 18). This is Lovegrass that has been poisoned. One year later it is still inhibiting other species. If you can lose that, then you make room for a lot of other species. In this case on the right hand side has been burnt and sprayed as part of a management program and, as a result, we

have other species appearing. In this case they were mostly weeds, because we didn't have much of a seedbank there at the start.

One of the issues, then, is what seedbanks are we going to awaken, what conditions do they need to establish, and do we want that to happen or not (Slide 19)? This (Slide 20) is unplanned deterioration following a typical fire. The first picture is *Coreopsis* on the edge of a road, there has been a fire which has burnt the groundcover layer away. There was a seedbank, which we didn't know about, and now that *Coreopsis* is established as a really thick, vigorous cover 20 metres into the bushland. In the right picture, the top half of this is a disturbed bank below a road. As a result of the fire, the seeds that have been falling downslope for a few years have now got the room to establish. The seeds have made it into the bush and they are establishing vigorously.

In the middle is an even more serious situation. An obligate seeder, *Banksia ericifolia*, was killed by fire, and is relying on seeds underneath it to regenerate. What we have is a really thick growth of inkweed underneath the *Banksia*. I don't think it is likely the *Banksia* seedlings are going to find their way through the Inkweed to regenerate.

I grew up believing that Crofton weed was something that only affected disturbed sites, that is where the original Crofton weed population was. There is now a nice population of Crofton weed in former intact bushland, because we've made those situations available.

I used to think that there was such a thing as bush in good condition that was fairly immune to invasion. But our management can create invasion opportunities (Slide 21). Every time we do a management action for fire or weeds, we are enabling population transitions - enabling the hidden populations to come out. This is a great opportunity for management, but it is a major problem if we ignore it. It is important to realise that most of our bush is increasingly fragmented and dissected by roads and these are nurseries for invasive species. One-dimensional treatment of these weed populations, (e.g. only spraying the visible parts) makes the situation worse.

This is a road that I have gone up quite often for many years, and the weeds on the side of the road have progressively got bigger, fiercer and nastier. Management is basically getting rid of the more susceptible weeds, and there are nastier, uglier ones coming to replace them.

How do we fix this? We need to look at the area we are managing (Slide 22). We need to look at the visible and the invisible populations. It is pretty straightforward. We already do it for the plants we know about and care about, but we need to include the weeds in this analysis. We need to assess not just the conservation value priorities but also the risk priorities. We have to look for opportunities, we have to look for risks and we need to plan a management campaign. We need to look at the likely distribution and size of the populations and rather than just saying 'let's do a management action', you actually need to consider what happens afterwards. And

what happens after that. And what happens after that. If you don't do these management campaigns, then we are going to keep going downhill.

Often we lack good knowledge, so we need to do adaptive management (Slide 23). In other words, we need to try things out, record what happens, acknowledge our successes and our failures, and distribute that information. The role of NCC in doing this is really significant and worth acknowledging. Our knowledge of grassy ecosystems in particular is still very basic and we need to keep trialling better methods of management.

To recap, our management influences a whole range of things that cause population transformations (Slide 24). The result, at the soil surface particularly, is absolutely critical to the future trajectories. Weeds will often alter soils from a naturally high carbon, low nitrogen condition to a high nitrogen, low carbon state, which then gives the weeds a significant advantage. We may need to repair this by actively adding carbon, we know that this works from some of the projects that Susan Prober and Charles Morris have been doing.

Here is an example of application (Slide 25). We have three generations of Queensland Blue Wattle. The original one arrived on a vehicle. There are not many of them there because there is very low germination in the absence of fire. That is pretty easy to treat. You can see the Queensland Blue Wattle and you go along and knock them out. But next time there's a fire, whether it's a hazard reduction burn or whether it's an unplanned wildfire, there are somewhere between 50 and 5000 seeds down the hill below, and they're all going to germinate. So, you need to not only get rid of the Queensland Blue Wattles you can see, but also map that area as an area that requires action as soon as that second population (the current seedbank) becomes visible to us. One of the issues here is that it's much easier to get rid of that first Queensland Blue Wattle when it first arrives, but strangely enough the presence of one single plant doesn't seem to excite us.

We use prescriptions to address the immediate issues, but we need to go to the next step of understanding the long term trajectories. As Ross said yesterday, we need to think about the long term outcomes that we're seeking. As John Hunter noted today, we may get long term fuel reduction by not burning, but instead getting a far more efficient carbon recycling system going.

Weed control is often far worse than just repeated hazard reduction (Slide 26), because weed control is often removing the visible vegetative population and then getting it straight back through transformation of the invisible populations or even getting something worse. While we are certainly doing management, we may not be achieving worthwhile change or even preserving current conditions.

I'm here to tell you that we need to get much, much better at this very soon (Slide 27). We don't have a lot of time: African Olive is on its way, it is already in the North Shore, Sydney Harbour, Berowra Valley, it is extensive in the Hunter, and it is just waiting for the next

disturbance, the next fire, the next opening, to come in. Bell Miners are coming with it. If we burn unconsciously, we are not considering these processes. We are providing the opportunity for the Olive, but conversely, fire actually provides one of the best opportunities for us to control it.

We need to think about pre- and post-fire action (Slide 28). We need to fully integrate weed management into fire planning. Every fire plan should have a weed assessment and a weed management plan. We need to also be much better at incorporating fires into weed management. We need to invest in high quality, weed resistant ground-cover layers along our bushland boundaries, and especially along service corridors to establish much more weed-proof areas.

Questions from audience

Question: I get the impression, Jonathan, and I'd like you to confirm it, that you're really seeing the pre-fire and post-fire weed management as the responsibility of the land manager who's carrying out the burn, and that it can't be left to some sort of community group. It's got to be done by people who are skilled in that work.

Jonathan: I think that's very much the case. We're not yet doing it adequately in National Parks, because we're still trying to understand this and we're still trying to understand how we integrate. We're moving in that direction, but we're a professional land management agency. How do you deal with that if you're an amateur landowner and so on? One of the major issues when I talk about African Olive, is the fact that the land managers might say, there's an African Olive, let's get rid of it. But there's an African Olive sitting in somebody's backyard in Cowan or Berowra Heights, and that's providing that invisible seedbank down the hill which is going to cause these major issues after the next fire. So we've also got to try and get much better landscape management of these things. Thank you.