

Conference Proceedings – Speaker Transcript

Is re-introduction of burning necessary for threatened *Themeda* headland grassland EEC restoration: new evidence suggests caution

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First a bit of background (Slide 2). These *Themeda* grasslands occur all the way up and down the coast, from Queensland all the way to Tasmania, and they're listed as endangered in New South Wales. Some people believe that the only reason they exist is because Aboriginal people burnt the headlands regularly and fire is suggested as a fundamental tool to keep the grasslands healthy, and also to get rid of encroaching shrubs. Encroaching shrubs is considered to be one of the greatest threats to this community.

We looked at the Coffs Harbour region which is particularly diverse for these systems (Slide 3). Why we restricted ourselves to that is we were doing it unpaid, and we had a place down there, and so it was nice and easy. We looked at 18 headlands, and they don't cover a lot of country this *Themeda* grassland. At the moment it's probably around 15 hectares so there's not a lot of ground to look at. We put in 242 permanent plots that we're trying to visit every year for five years (Slide 4). We looked at as much as we could on these plots, we were on our hands and knees, we took a lot of measurements, and we also did three transects around each plot. Each plot was two by two metres, and the transects were to measure the shrub density around the plots, to look at what influence shrubs had to these grasslands.

Why would people want to reintroduce burning to the headlands? Well they're grassland and grasslands need to be burnt to keep their vigour. Also there was some work presented a couple of years ago at this last conference, down on the south coast, where they did burn quite regularly and they got this really good response from *Themeda*. It became super healthy and vigorous and quite tall, and some people have described this as *Themeda* on steroids. So they suggested you could burn these places every year. There's also the shrub problem, so let's burn them every three to six years because that'll keep the shrubs out. The shrubs are usually native species, banksia and

acacia, but there's also some weedy ones. In Cook's voyage he wrote down that they saw fires on the headlands as they were moving up, so some people believe that the Aboriginal people burnt these areas quite regularly.

But names have meaning (Slide 6), and this is something that's very important, and calling them a grassland does have conceptual implications. It does mean that people start to think they're a grassland, they should be burnt quite regularly. But at least in the Coffs Harbour region they're certainly not really grasslands. There's a couple of patches where grass is the main component and not much else, but when you really look at it they're quite something different, they're a mosaic of a lot of different types of systems, that all come under this concept of a threatened ecological community. And they're reacting to all different things, past fires, they're reacting to shrubs nearby, to soil depth, and even how much guano (bird dung) has been left behind on plants, particularly on the offshore islands. So along the whole coast maybe we should be looking at these as not always grasslands.

In the Coffs Harbour region you're probably better off calling them a prostrate healthy grassland, or a grassy prostrate heath (slide 7). In fact, when they were first described, some 45 years ago or so, that's exactly what they were called, and they're dominated by *Themeda* but they're interlaced with these prostrate shrubs. So think of a shrub that's about three to four metres tall, flatten it on the ground, spread it out, and that's what happens. These prostrate shrubs interlace with the grass. Most of these shrubs are threatened species such as *Pultenaea maritima*, *Zieria prostrata* or ecotypal variants that are likely to be described as new species or new sub-species in the near future.

Down on the south coast, when they burnt they got this super *Themeda*, and certainly in other demonstrations we've found that when you burn *Themeda* it can really respond well. But what does that mean? Using some of these graphs I'll give you a bit of an answer (Slide 8).

So this slide presents some of the reactions we're having on the north coast when you increase the *Themeda* biomass. When you start to make *Themeda* really vigorous and you make it dominate, you actually increase some of the herbs but all these threatened shrubs start to disappear and *Themeda* takes over. The *Pultenaea maritima*, like I said is a listed threatened species, and initially it kind of climbs up with the *Themeda*, but then as *Themeda* gets more dominant the *Pultenaea* disappears.

This is a statistical graph of what happens to species richness as *Themeda* biomass increases. These horizontal lines are increasing *Themeda* biomass, and these vertical red lines are the species richness, and as you can see, once you get to about this level here, the species richness as *Themeda* increases just drops away significantly.

But is a really vigorous *Themeda* always the outcome from a burn? We've had one burn so far out of our 242 plots we've actually structured across all these 18 headlands that are going to have

different types of burning regimes over this five year period (Slide 9). We've had one fire so far, a planned burn. After one year, this is the control plots, there's no statistical difference from one year to the next, but in the burnt one the *Themeda* never really recovered. It's still 50% below the biomass that we originally had for the burn. Down here, as the photo shows, are very open patches, and one of the problems with that is that if you have an extended time where *Themeda* really isn't getting back to its full vigour you leave spaces open. Those spaces can be open for some good things, some of those threatened shrubs, but they can also be open for any weedy species, and for the things that people are a bit scared of, the banksia and the acacia.

I think I might just go back to the last shot (Slide 8, photo). This is a burn that happened eight years ago. On one side are *Themeda* and *Pultenaea* growing happily together with a high diversity of other species. On the other side are just *Themeda* and *Viola* and not much else. This is eight years later, and the other species haven't been able to get back in. The *Themeda* can get so thick that it doesn't allow anything else, or as in the other example it might not really recover.

There's also an unplanned burn that happened on one headland. We've gone and looked at it every year, and four years later it's still in this very open tussock condition. So you can have a burn and it might increase the *Themeda* or it might not really come back, depending on the conditions that follow.

So there's a few fallacies of these *Themeda* threatened ecological communities and one of them is they're not really always a grassland (Slide 10). And they're full of these rare endemic shrubs and other ecotypes. But a lot of these shrubs are killed by fire, they're obligate seeders. Some of them are very long lived, they don't disperse very well, and they don't recruit very often. Now you are getting down to this issue that these shrubs don't occur anywhere else. They only occur on the headlands. And they can't have evolved under a frequent fire regime. You got a whole flora there, only on these headlands, that don't respond well to fire, they didn't evolve overnight. They must have evolved through a long time period of no fire.

What we do know is if we put frequent fire into these headlands we're going to have a much reduced species richness, we're going to reduce the landscape biodiversity, we're going to kill a lot of these threatened shrubs and knock them out of the system, so we have to think a little bit more carefully about whether fire needs to be introduced and whether we should continue to call these a grassland.

Just a small conceptual model (Slide 11): if we're burning constantly or quite frequently, we're only going to get *Themeda*, *Viola* and a bit of *Polymeria*, a very species poor kind of system. With lack of fire, these things still occur in patches, and you get this full gambit, quite a diversity of systems.

Woody shrub encroachment is one of the big issues that we have with this system, or that people believe is a big issue (Slide 12). Burning is listed as the main way of getting rid of these woody

shrubs. Woody shrubs are mainly native and in the Coffs Harbour region they had a little project, and they estimated that *Themeda* grassland (I'll still call it grassland at the moment) has been reduced by 57%. But one of the problems is that we don't know what it was like before 1943. Was it always that grassy or was it much more shrubby? Is shrub encroachment something new or is it cyclic and it happens every 50 or 80 years, builds up and drops back. We really don't know. Just because we're losing some of the grassland now, it doesn't mean that it's not returning back to what it was.

And is the woody shrub encroachment always bad (Slide 13)? Well one of the threatened species *Zieria prostrata* is listed as only occurring in this grassland. There are only 1,000 plants and they only occur on four headlands. But our research tends to indicate that it's actually an ecotonal specialist. This graph shows an increase in *Zieria prostrata* cover, in plots, and those arrows show an increase in the density of woody shrubs, at two metres, at four metres, and at eight metres. As you can see, it really likes being around shrubs. In fact, on this one it shows that again an increase in total shrub biomass, and *Zieria prostrata* just loves being around shrubs. It eventually gets knocked out once you get a proper *Banksia Acacia* woodland, but until you get to that point it's really thriving. So it's actually an ecotonal specialist, and if we start to get rid of the shrubs we're likely to do a lot of damage to this threatened species.

What about an overall effect of shrubs on these headlands (Slide 14)? What are they doing to the grasslands? One of the things the shrubs do is, once you start building up shrubs around this grassland, the *Themeda* starts to become less prominent and similarly with the *Pultenaea*. So having shrubs nearby actually decreases their over-dominance at a site. This is species richness, so as you get species richness per plot, as you increase shrubs within a two metre level that's the main factor that increases species richness in a plot. You have far more species in a plot if you have a shrub nearby. This is species evenness, so what species evenness does is it measures the abundance of all the species within a plot, so if you have a very uneven system you might have one or two species that over-dominate, and everything else only occurs once. In a nicely even system everything occurs at an equal abundance. And so having shrubs nearby tends to make the species within the plots all have a higher abundance.

This is looking at other measures of diversity (Slide 15): species richness per plot is only one measure of diversity and you shouldn't just rely on it. So we are looking at how many species are captured. If we put 52 random plots down within an area that doesn't have any shrubs nearby, you get a very low capture rate of species. If you have shrubs nearby I divided it up into no shrubs nearby within an eight metre radius, those that had between 100 and 200 metres of biomass of shrubs and those that had a much higher rate. For any plot that had a shrub nearby the species capture of the plot increases significantly. The total amount of species that can be held in the system is nearly double if you have a shrub nearby.

This other graph over here shows with no shrubs nearby the change in species between plots (which is the turnover), is very low. These are highly statistically significant results. Some people would call this beta diversity, which is another good thing in a landscape. The more shrubs you have nearby, the higher the level of turnover you have. That's a good thing for the landscape.

There is an important role of these *Banksia* and *Acacia* patches (Slide 16 & 17), and maybe we shouldn't be wholeheartedly burning them out of these systems. Yes, eventually, they may take over and form a woodland and maybe that's not a good thing, but it's also not a good thing to wholeheartedly think they're a threat, because one of the many things that these things do is protect. These headlands are very harsh environments, because they're exposed to many pressures. All the measures of diversity, alpha, beta, gamma diversity, everything is increased by having shrubs nearby on these grasslands, and so we shouldn't wholeheartedly get rid of them. If you burn constantly you're going to end up with this system, which has very low landscape diversity.

Questions from audience

Question: Did you monitor for macropod grazing? Because I know there are still quite substantial remnants of kangaroo and wallaby populations on those headlands.

John: That's part of the experimentation too. We've got exclusion plots set up, but I haven't got the results for those.

Question: Are you trialling any form of mowing or anything like that in areas where you probably don't have many macropods, but I don't know if that applies in that area?

John: Well some headlands have so many macropods that everything's counted at that level. And that's where we're doing a lot of the exclusion plots, so we don't need a mower because mower wouldn't cut anything, there's nothing left to cut. But surprisingly enough the shrubs and the grasslands, even though it's about that high, are still there. The only thing that seems to get knocked out is the *Pultenaea maritima*. The diversity on the headlands seems to remain no matter how intense the macropod grazing is.

Question: Andy Baker from Southern Cross University. Great talk, very interesting. So demonstrated that really frequent burning obviously has its issues for a lot of that diversity of shrubs and forbs, and conversely at the other end fire exclusion seems to be in some areas causing that encroachment. And up on the far north coast, north of the Clarence River, within 20 years of having fairly open diverse grassland, sometimes the banksia community comes in and forms not just patchy shrubs but complete closed forest, up to maybe ten metres. And that causes a complete displacement of all previous flora in the *Themeda* grassland, and presumably the fauna

as well. So my question is do you think potentially an intermediate approach might be something that's warranted? For example in Queensland, they recommend burning about every ten to 35 years, and also using a healthy indicator approach. So don't burn purely due to the numbers but if that sort of shrub diversity is starting to decline or the grassy health is starting to decline. Would you like to comment on that?

John: That's the ultimate answer - there's a point where *Banksia* and *Acacia* woodland replaces just like threatened littoral rainforest often takes over as well, and then you get a dichotomy: do we get rid of the one threatened community for another? I don't want to go into that. Yes, there's a point where the *Banksia* takes over, but where that is, and whether it'll happen every time, is the nuance that we have to tease out, but certainly the regular fire is something that I can't see ever really did happen for this system to have evolved the way it has, with the species it has, but there's some point, and I don't know where that is yet, it might be the 35 year mark, where maybe you do have to start implementing fire. We just have to wait for that answer.