# Regenerating Native Forest Using Splatter Gun Techniques to Remove Lantana

By Susan Somerville, Wayne Somerville, and Rodney Coyle. (A version of this paper will be published in the journal *Ecological Management and Restoration* in 2011.)

*How does one farming couple repair 370 hectares of native forest severely infested with Lantana and affected by Bell Miner Associated Dieback (BMAD)? From declining forests with ailing trees, their forests are now vigorously regrowing and most trees recovering due to Lantana removal. Their use and improvement of the Splatter Gun Lantana treatment has resulted in forest regeneration. This raises the question of whether Lantana presence may be a critical element in a complex process of ecosystem breakdown.*

Susan and Wayne Somerville own and manage a previously logged rural property 'Creek's Bend'. Rodney Coyle (email: rodcoyle@hotmail.com ) is employed as the bush regeneration contractor on the property, treating Lantana with Splatter Gun technology, and contributing to monitoring of the works and listing of native flora.

This article was written to chronicle the development and early results of a novel technique to treat dense Lantana, a technique which is now being applied widely in native forest restoration in northern NSW.

Figure 1. Bell Miner Associated Dieback (BMAD) along Iron Pot Creek, Toonumbar Valley April 2009 (Photo Cliff Guy Productions). Bell Miner Associated Dieback has been listed as a Threatening Process in New South Wales and occurs through sclerophyll forests on public and private lands through a range of forest ecosystems in three states in eastern Australia. Landholders and agencies are currently trialling a range of treatments to break the cycle of decline and achieve forest recovery

## INTRODUCTION

In the 1970s, within the forests of the broader Toonumbar area west of Lismore in north-eastern NSW, there was little Lantana (*Lantana camara*). On the ridges, the drier eucalypt forests had grassy understoreys; further downslope, understoreys were shrubby; and in the wetter gullies, rainforests or rainforest elements were common. The native honeyeater Bell Miner (*Manorina melanophrys*) was present but not widespread.

By the 1990s, due mainly to previous logging disturbance, much of the forest understorey had been replaced by Lantana (50 to 90 per cent cover) and around the same time, Bell Miners became common throughout most of the forest. The hills rang with their incessant and penetrating calls from dawn until dusk; other birds were scarce; tree canopies were shrinking and some trees were dead. What has become known as Bell Miner Associated Dieback (BMAD) was rapidly spreading throughout the forests.

Currently, some 2,000 hectares of the Iron Pot Creek catchment and much of the Toonumbar valley forests have been invaded by Lantana and are BMAD affected (P. Flower, 2009) and it is evident that large swathes of forest trees are dying.

### Bell Miner Associated Dieback (BMAD)

Bell Miner Associated Dieback has been listed as a Threatening Process under the NSW *Threatened Species Conservation ACT, 199*5 (*TSC Act* 1995). It currently occurs through sclerophyll forests on public and private lands in New South Wales, Victoria and Queensland and is spreading through forest ecosystems in eastern Australia. Symptoms of BMAD in trees include dying or dead outer branches, and in severe cases high epicormic leaf production, discoloured leaves, and the death of the tree.

All the factors supporting BMAD are still not fully known but, the pattern of cause and effect has been described as a response to the disturbance of forest structure, where there is an open canopy, a sparse or absent mid-story and subsequently a well lit, dense, shrubby understorey. When the forest has tree species susceptible to attack by *Glycaspis* species of psyllid insects and the understorey becomes dominated by a single plant species such as the weed Lantana which supports nesting by the Bell Miner, the scene is set for increasing populations of psyllids and Bell Miners. The Bell Miner eats the sugary lerps coating covering the psyllid insect on eucalypt leaves, but it generally does not eat the psyllid itself. Due to the increased numbers of dominant Bell Miners in a disturbed forest, other birds that do eat the psyllid have been forced out of the area. The result is an over-abundance of psyllids which suck the sap from the leaves. This causes the tree to repeatedly defoliate, which eventually kills the tree, and ultimately, the forest (J Hunter, DECCW, pers. comm., www.bmad.com.au/index.html accessed 19/4/2011).

The NSW Scientific Committee's 2008 Final Determination of "Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners" or BMAD as a key Threatening Process estimates that 20% of 100,000 hectares of susceptible forest have been affected by this dieback, with about 30% of affected forest classed as severely damaged. It has been estimated that 2.5 million hectares of forest in New South Wales is at risk from BMAD.

The tree species most susceptible to dieback include Dunn's White Gum (*Eucalyptus dunnii*), Sydney Blue Gum, Flooded Gum (*E. grandis*), Grey Ironbark, Narrow Leaved White Mahogany (*E. acmenoides*) and Grey Gum.

There is also evidence that some normally non-susceptible dry sclerophyll types e.g Spotted Gum and Blackbutt (*E. pilularis*) may be affected when they occur alongside susceptible forest types. The potential impacts on conservation values include:

- Extreme degradation of forest ecosystems in World Heritage listed National Parks such as Border Ranges NP, Murray Scrub and Dome Mountain in Toonumbar NP, Bungdoozle and Cambridge Plateau in Richmond Range NP, Mt Nothofagus NP, Kooreelah NP, Mt Clunie NP and the Blue Mountains and Wollemi N.P.
- Major disruption in ecosystem function, and reduction in diversity and abundance of threatened flora and fauna species including Dunn's White Gum (*Eucalyptus dunni*), Yellow Bellied Glider (*Petaurus australis*), and Rufous Bettong (*Aepyprymnus rufescena*) across all land tenures,
- Increased weed invasion and associated displacement of native forest species.
- Impacts on forest productivity can be severe. Dieback defoliates the crown, ultimately leading to the death of standing trees. Not only do the standing trees die, but the lack of foliage and flowering and subsequent fruiting, reduce and eventually eliminate the seed production necessary for forest regeneration. Dense understorey development (primarily Lantana weed invasion in northern NSW and Cissus in the south) continues with little over-storey and reduced species competition. Reduced eucalypt flowering directly impacts on honey production and on bird species and populations that compete with Bell Miners.

The Bell Miner lives in large, complex social groups or colonies, which can number from eight to 200 birds (Higgins *et al*. 2001) Within each group there are subgroups consisting of several breeding pairs, but also including a number of birds who are not currently breeding. The nonbreeders help in providing food for the young in all the nests in the subgroup, even though they are not necessarily closely related to them. Bell Miners are sedentary and nest all year around, but mainly in June to November.

The bird nests in dense understorey from 2-5m above the ground (Stone, 2005). In the Creek's Bend forests the Lantana hedges provide the preferred vegetative structure for nesting. In other ecosystems, thickets of native vines which are structurally similar to Lantana hedges are also used by Bell Miners for nesting. They feed mainly on insects, especially psyllids and their lerps, from the foliage of eucalypts – but also eat nectar and manna. The birds defend their colony area communally and aggressively, excluding most other passerine species. They do this in order to protect their territory from other insect-eating birds that would eat the lerps on which they feed. (They will also "mob" humans when their territory is entered.) Predators of eggs and young include a range of carnivorous birds and snakes.

Psyllids are tiny invertebrates which feed on the leaf sap or phloem of certain host trees and construct a sugary coated shelter, or lerps, over their larvae to protect them from the elements. Psyllids species usually feed on a single plant species (monophagus) but can be oligophagus (feeding on a few similar species). *Glycaspis baileyi* is the main psyllid species associated with BMAD. *Glycaspis* psyllids live in large populations on Eucalypt species and females lay between 45 and 700 eggs on new Eucalypt foliage. The eggs hatch out within 10 to 20 days as nymphs. These nymphs then build their lerps and insert their stylet into the leaf to feed. The lerp is made of honey dew and sometimes a waxy secretion from the psyllid. The nymphs have five life stages under the lerp over one to two months and then emerge as winged adults, where they disperse among the tree canopies and the egg laying cycle begins again. (P. Meek, BMAD Working Group Technical Note 2, May 2007).

Whenever the local forests undergo increased psyllid infestations, the Bell Miner undergoes a population boom, placing further pressure on the trees. Some tree species die after a few attempts at re-sprouting foliage.

**The BMAD Working Group** is a voluntary body convened by a Northern Branch of the NSW National Parks and Wildlife Group (part of the Office of Environment and Heritage, previously Department of Environment and Climate Change) and supported by the North East Region of Forests NSW (part of the NSW Department of Primary Industries). The group, made up of scientists and representatives of government agencies, indigenous communities, industry groups, conservation groups and local landholders, is coordinating efforts to better manage BMAD.

The group has prepared and endorsed the Bell Miner Associated Dieback (BMAD) Strategy, which contains as an agreed suite of actions designed to address prevention, control and remediation of Bell Miner Associated Dieback in affected and potentially affected forests across all land tenures. Contact details of the Working Group and a copy of the Strategy can be obtained through the BMAD website: http://www.bmad.com.au/index.html

[For further information see the BMAD website' http://www.bmad.com.au/index.html]

**Creek's Bend**

Our 470 hectare property, Creek's Bend, offers a useful case study of the BMAD process and efforts to manage it. Creek's Bend consists of a series of steep ridges running from the Richmond Range in the west to the Iron Pot Creek in the east. The dry sclerophyll forest on the ridgetops is predominantly Grey Gum (*Eucalyptus propinqua*) - Grey Ironbark (*E. siderophloia*) forest with Spotted Gum (*Corymbia variegata*), Pink Bloodwood (*C. intermedia*) and Tallowwood (*E. microcorys*) as co-dominants. The wet sclerophyll forests and rainforests in the valley systems and gullies support Brush Box (*Lophostemon confertus*), Turpentine (*Syncarpia glomulifera*), Flooded Gum (*E. grandis*), Blue Gum (*E. saligna*), and many rainforest species.

The property is largely forested. About 100 ha of lowland pasture remains adjacent to the Iron Pot Creek for cattle and horse grazing. During the 1960s and 1970s, the previous owners selectively logged much of the forested area and low intensity grazing by cattle followed. When we purchased the property in 1980, cattle were excluded from the forests and the forests were left to regrow. However, their natural recovery was hampered by Lantana invasion. By the 1990s the Bell Miner had established large and persistent colonies on the property, and exploited for food the increasing populations of *Glycaspis* psyllids which were feeding on the eucalypts. Bell Miner Associated Dieback was evident and increasing.

In 2000, some 350 hectares of forest on Creek's Bend were infested with Lantana, with the weed spreading from previously logged areas to wetter gullies that had not been logged. Most of the forests' understoreys were composed of 25 % to 80% Lantana. A few small isolated areas dominated by Turpentine, rainforest or rainforest species, were free of Lantana. BMAD affected about 80% of the forests and was always associated with dense Lantana and high numbers of Bell Miners. There was only one small area of healthy intact forest. This was distinguished by having been only lightly logged and disturbed in the past.

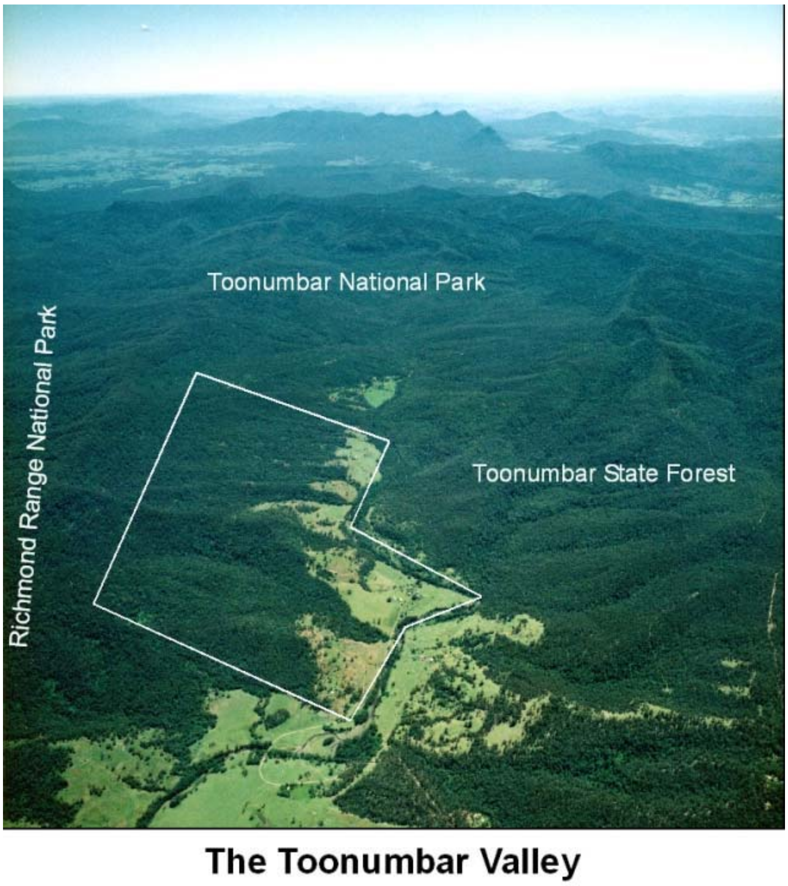



Fig 2. Location of the Creek's Bend property in the Toonumbar area of north coast NSW.

**Our response to the presence of BMAD on Creek's Bend**

Our observations and study of theories of BMAD proposed by researchers (the 'Stress theorem' (Jurskis, 2005a and 2005b) and the 'Disturbance theorem' (Stone, 1996, 2005) prompted us to develop a model of the pathogenic processes involved in BMAD (see Fig 3).

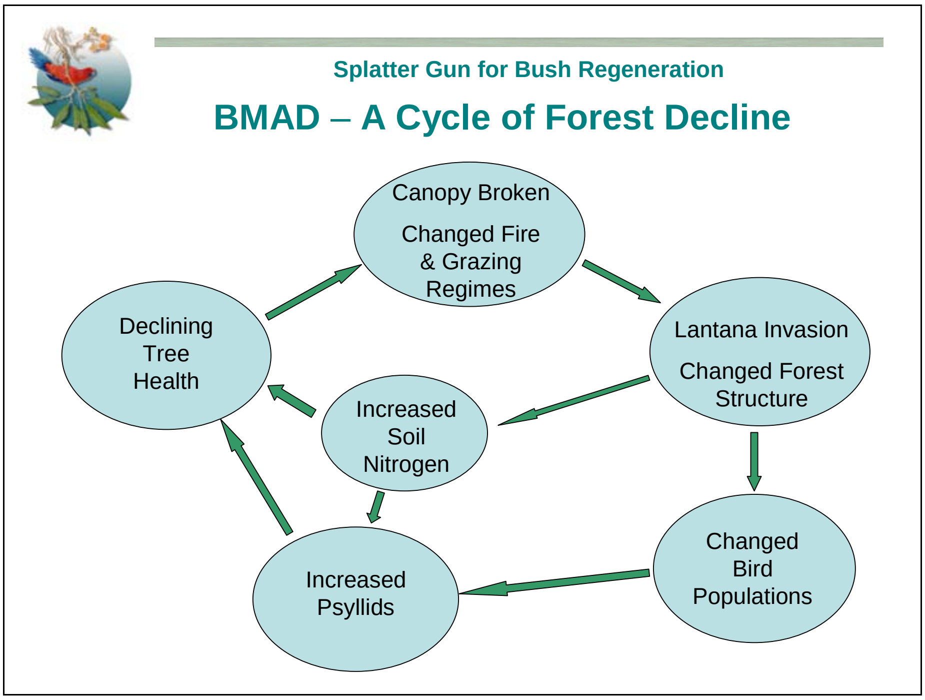



Fig 3. BMAD cycle of forest decline

Taking a Systems Theory and Adaptive Management approach, we hypothesised that the forests might heal themselves and natural balances be reinstated if one or more of the key factors that supported dieback was changed. Lantana was the obvious target for intervention. This Weed of National Significance has severe impacts on forest health and biodiversity and it is the only exotic factor in the model. Furthermore, it has been demonstrated elsewhere that removal of Lantana can be followed by regeneration of natives, if the recovery phase is subjected to repeated follow up weeding (Woodford 2000).

We set about testing the hypothesis that removing Lantana might play a vital role in breaking the BMAD cycle and allowing healthy regeneration of native forests to occur. We hoped that this work might help forest managers better respond to the appearance of BMAD in the future and ameliorate one of the major threats affecting the health of our eucalypt forests.

## TREATING LANTANA AND REGENERATING NATIVE UNDERSTOREYS

Lantana is a widely occurring weed along the east coast of Australia in a variety of situations and can be treated by a range of techniques including manual or mechanical removal, cut stump herbicide treatment, or overspraying with a range of herbicides with or without fire pre-treatment (Department of Natural Resources, Mines and Energy, 2004). Other techniques have also been developed for relatively flat land, such as flattening with a tractor followed by slashing and herbicide spraying of the regrowth (Woodford 2000).

There have also been numerous attempts at biological control programs for Lantana since 1914. A total of 31 agents have been introduced and 18 of those have established in the field. Five agents are damaging but only on a seasonal basis, and it is clear that Lantana is not adequately controlled by these agents (Queensland Government Department of Primary Industries and Fisheries, 2011). There is evidence that some biological control agents exist on our property but these have not significantly damaged the Lantana.

Due to the size of the area to be treated, the extent of the Lantana infestation and the steep and rugged terrain on our property, all of these techniques proved to be unsuitable and ineffective methods for Lantana removal. In an effort to find an alternative approach, we carried out a range of preliminary trials on Creek's Bend with what became known as the 'Splatter Gun'. These preliminary trials showed that we were able to treat Lantana without using a lot of herbicide mixture or causing significant off-target damage.

Encouraged by these early results, we developed a plan to undertake a program of works on Creek's Bend and grants were obtained from the Northern Rivers Catchment Management Authority in 2007 and 2009 to implement the program over a five year period. Works using the modified splatter gun technology commenced in 2006, progressing in a generally south to north direction on the property and are ongoing.

### Evolution of the Splatter Gun technique

As none of the commonly used techniques for removing Lantana, including mechanical removal or overspray with heavy equipment, could be readily applied to our steep and rugged site, we sought another solution. The answer to the problem was provided by John Hunter, then an Ecologist with NSW National Parks and Wildlife Service. At a 2005 Forum on BMAD at Southern Cross University, John related how his father had had great success treating Lantana in Queensland by 'squirting' small quantities of a glyphosate-water mixture onto plants.

The implications of this method of Lantana removal seemed profound as a low volume, high concentration approach offered efficiencies for treatment of Lantana in remote locations where carrying high volumes of water or using heavy machinery was impracticable.

Further investigation found that small, herbicide guns, about the size of a tree stem injector, had been used in the past by Queensland Forestry to treat small bushes of Lantana that grew in pine forests (John Hunter, 2006, pers. comm.). Because of the landscape scale task on Creek's Bend, we experimented with adapting a hand-operated cattle drench gun with the nozzle removed, to deliver the registered nine parts water to one part glyphosate (of 360g/l concentration) mix in a comparative trial supported by the National Parks and Wildlife Service and the BMAD Working Group. The method evolved and the drench gun was replaced by a NJ Phillips Forestry LPG powered gas gun and adapted nozzle. The nozzle on a 100 litre spray unit mounted on a 4WD vehicle was also adapted to deliver a splatter application.

**Current Technique** "Splatter Gun" (Fig 4) refers to the process of delivering discrete, tightly confined jets of a high concentration - low volume glyphosate mixture in a large droplet form. The herbicide is applied to Lantana hedges in parallel lines, spaced one to two metres apart, wetting only a minority of leaves on the plant. The effect is like that of a water pistol, not an overspray. (See video clip at http:/www.bmad.com.au).

A few millilitres of Protec, a canola based surfactant, was added to aid the herbicide mix sticking to and penetrating the Lantana foliage. A coloured spray marker dye was also added to enable the operator to see where the herbicide was being delivered and to aid in detecting spills or leaks.

Fig 4. The NJ Phillips Forestry Gas Gun has been specifically developed for the delivery of a stream of herbicide over extended distances.

As a result of these trials, we soon identified that the modified splatter gun technique - which showed little off-target damage and much improved delivery time and portability - might offer clear advantages in efficiency, effectiveness, and suitability for ecologically sensitive areas.

We found that we could deliver 100 litres of the nine parts water to one part glyphosate 360 (9:1) mix in 60 to 90 minutes using the 4WD spray unit. Using the backpack, our operator delivers between seven and ten litres of the 9:1 mix per hour, depending on the terrain and the density of the Lantana plants.

These early trials indicate that the modified splatter gun is exceptionally portable. An operator carrying a small backpack with five litres of 9:1 glyphosate mix and a hand held gas gun is able to treat Lantana as fast as he or she can walk, even in steep, rugged and isolated areas. The much reduced chemical run-off minimises collateral damage to other plants and encourages native species to regenerate through the dead Lantana. The focused nature of the herbicide jet makes it possible to surgically remove Lantana from around valuable plants and experienced users can just touch the trigger to deliver minimal, carefully directed doses to small Lantana plants.

Due to the landscape scale and ruggedness of terrain involved in the works, splatter gun operators on the ground found it more efficient to treat smaller areas within a valley or ridge system, let the Lantana die, and return to the site later to push through the dead thickets and proceed deeper into the area. Thus treatments would be done in sections, often starting from the most easily accessible areas and working toward the more inaccessible areas. This made it more efficient for the operator to create supply dumps of water and herbicide. The nature of the works is indicated by the following treatment maps. Work is done in different areas at different times, depending on the constraints of terrain and weather.

Because of the large size of the treatment area, the treatment needed to be staged. We found it most practical to reopen some previous logging tracks with a small 4WD tractor. These tracks usually contain dense, mature stands of Lantana which grow well in cleared areas. We then made side incursions with the tractor into solid Lantana hedges to allow access for the operators. The tracks were then treated with a small 4WD utility (Suzuki Sierra soft top) with a 100 litre spray unit with a Splatter Gun nozzle mounted on the back. The vehicle was driven by one operator with another walking behind, using the Splatter Gun nozzle. Both sides of the track were treated to a depth of between four and 20 metres, depending on terrain. About a month after this initial knockdown, a single operator would return with a Splatter Gun backpack and, working off the track, would treat the rest of the area. The operator used the parked 100 litre spray unit to refill the backpack from the track.

## DOCUMENTATION AND MONITORING METHODS

### *Vegetation*

A photographic record was kept ‘before, during and after’ treatments along with more formal photopoint monitoring at three locations. In addition, regular six monthly or annual observations of the treated sites were built into the program so we could understand the nature of the Lantana’s response to the initial treatment and to ensure that the follow-up treatments were delivered at appropriate times so that regeneration of natives could occur.

Records of works (i.e. locations, person hours, chemicals used and other details) were kept in daily record sheets to record information about areas as they are treated, and to help the landowners to plan and monitor the ongoing work. These data were then transferred to a computer spreadsheet, where the date of the treatment is hyperlinked to a directory that contains information the chemical data sheets, pre-and post treatment photos, pre-and post treatment audio sound recordings of Bell Miner calls, and other notes. Each entry of a treatment triggers a forward entry on a calendar to mark the appropriate follow-up for that area.

This record keeping allowed us to map the forest areas using a resilience-based bushland condition assessment system (McDonald 2008 pers. comm.), in which “0”, indicated “No degradation and excellent resilience”, to “6”, indicating “Extreme degradation and no resilience for the original vegetation community”. (Note that this system is based on condition of the native vegetation as well as weed status.)

### *Bell Miners*

In order to quantify changes in distribution of Bell Miners after treatment, we undertook monitoring of Bell Miner density from 2005 at variable time intervals along 100 metre transects. This was measured by visual and auditory sampling at five locations before and after Lantana removal. (Bell Miner colonies are easily detected as the birds make loud bell-like calls (“peep – tink” and distinct “chak chak” alarm calls (Morcombe, 2000).

The survey was conducted by the same single observer (Susan Somerville) in four 50m x 50m quadrats along each transect (two each side) at the five sites. Initially, Bell Miner numbers were estimated by sightings and calls. Later monitoring was reduced to a presence/absence determination on advice from the Scientific Reference Group advising the BMAD Working Group (Prof Harry Recher, pers. comm.), and movements of the Bell Miners were noted across areas of the property when they occurred. Bell Miner presence/absence continues to be monitored as the Lantana treatments continue and in more recently treated areas (not yet reported), audio recordings have been taken at photopoints in order to monitor Bell Miner movements in future.

## THE RESULTS OF OUR LANTANA TREATMENT

In terms of the delivery of herbicide, using the Splatter gun allowed us to treat about 300 hectares of degraded forest, including the necessary follow ups, within the five years the project has been in operation. We are currently systematically revisiting the total area with follow up treatments and are finding that we are treating Lantana at a progressively declining rate as the sites stabilize under native regrowth.

### *Effect on Lantana*

Our observations showed that, where the Lantana (which in our case is the Pink flowered variety – see Ensbey, 2008) was well hydrated and actively growing, it responded quickly to a 9:1 splatter gun treatment and defoliated and died in a few weeks (Fig 5). Where conditions were drier, Lantana was less responsive to herbicide. The splatter gun technique reliably killed individual plants and large hedges of Lantana with very little re-shooting from the base or roots. When re-shooting did occur it could be readily re-treated. Most regrowth of Lantana occurred from seed.

Fig 5. Although the plant physiological explanations are yet to be clarified, the application of low volume/high concentration herbicide at 1m spacings is highly effective and dramatically reduces the time and herbicide compared with conventional methods. This time series set of photos records the rapid process of Lantana decline over 29 days after treatment. (a) Site just after treatment (b) same site at 6 days after treatment (yellowing commencing), and (c) 21 days after treatment (no leaves remaining).

***Native and weed regrowth***

Our regular observations found that, in areas where the Lantana consists of isolated plants in an otherwise intact forest with good canopy density, the Lantana was slow to resprout from seed and was out-competed by the native understorey - no follow-up was necessary. In these areas, the Lantana has mostly been replaced by native seedlings rather than other weed species such as Tobacco Bush, Winter Senna, and Crofton Weed. In other areas containing up to 50% Lantana in the understorey, however, Lantana was able to re-colonise from seed and at least one follow-up treatment was necessary by 12 months after the initial knockdown to give the native plants an advantage over these weed species. In large degraded areas, such as old logging dumps, we observed strong competition between Lantana growing from seed and regenerating natives and it was necessary to continue to treat the Lantana (and other weed such as Crofton Weed) over a few follow-up visits, until some mid storey was developing to shade out the Lantana and prevent it from out-completing the natives and dominating the understorey again.

In drier areas on the ridges, we found that much of the regeneration involved a range of saplings and seedlings as well as vegetative expansion by forbs and grasses typical of the forest floor. All the species in Appendix 1 were found to be regenerating on the sites, and these species are typical of the broader community of Creek's Bend forests.

***Native canopies***

There is strong evidence that tree canopies on Creek's Bend have variously returned to health in areas with previously severe BMAD. This occurred only after the mid-storey and understorey diversity of these sites improved after Lantana removal. Prior to Lantana control we observed trees subjected to psyllid attack and producing epicormic growth several times until they finally died. Since Lantana has been controlled in these areas, while some younger and more damaged trees did not recover, many trees have gone beyond the epicormic growth response stage and are now re-forming healthy canopies. The most affected tree species remain the Grey Ironbark in the drier ecotones and Flooded Gum and Blue Gum in the moister areas. Where there is a dense population of Grey Ironbark, it appears that the psyllid populations remain high and the BMAD is most resistant to change.

Indeed, where we were previously able to show visitors samples of psyllids and psyllid-affected foliage from most trees, even saplings only a metre high, we now have to search much farther afield for samples of affected leaves.

***Mapped changes at property scale***

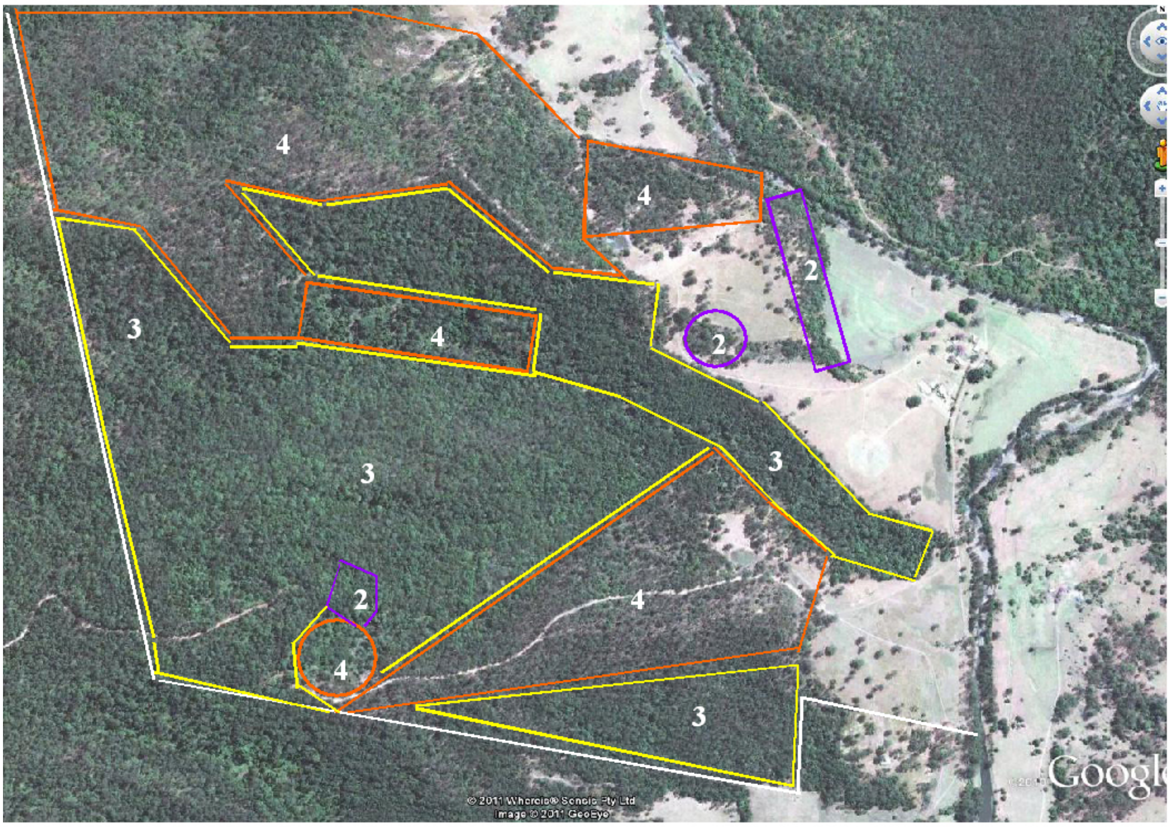
Substantial upward shifts in vegetation condition after Lantana treatment are shown in both Fig 6 and Table 1, which divide, for convenience, the two land portions which make up Creek’s Bend: The Lower Valley and the Upper Valley.

We estimate that in 2005, 2% of the forests of the property were in Class 1 or 2 (higher) condition at the commencement of the project, and 98% in Class 3 or 4 (lower) condition. In 2011, 50% of the property’s forests are in Class 1 or 2 condition and 50% in Class 3 or 4 condition. There is still about 25% of the area of the Upper Valley which has not yet been treated. This means that Condition Class 4 areas have substantially shifted to Class 3 condition and Class 3 areas have substantially shifted to Class 2 condition from 2005 to 2011. And we consider it fair to say that the treatment program, ensuring follow-up within a year at most sites, has achieved a distinct improvement in the condition of the vegetative communities on Creek’s Bend over the 5 years to date.

**Table 1: Condition class before and after Lantana treatment**

| **Sector of the Property** | **Class:** | **2005** | **2011** |
|---|---|---|---|
| **Lower Valley (243 hectares)** | 0 | | |
| | 1 | 0% | 2% |
| | 2 | 2% | 46% |
| | 3 | 50% | 50% |
| | 4 | 48% | 2% |
| | 5 | | |
| **Upper Valley (231 hectares)** | 0 | | |
| | 1 | 1% | 2% |
| | 2 | 1% | 50% |
| | 3 | 60% | 19% |
| | 4 | 38% | 4% |
| | 5 | | |
| Area still untreated: | | | 25% |

2005 Bushland Condition Assessment: Lower Valley Before Lantana Removal Interventions




2011 Bushland Condition Assessment: Lower Valley After Lantana Removal Interventions

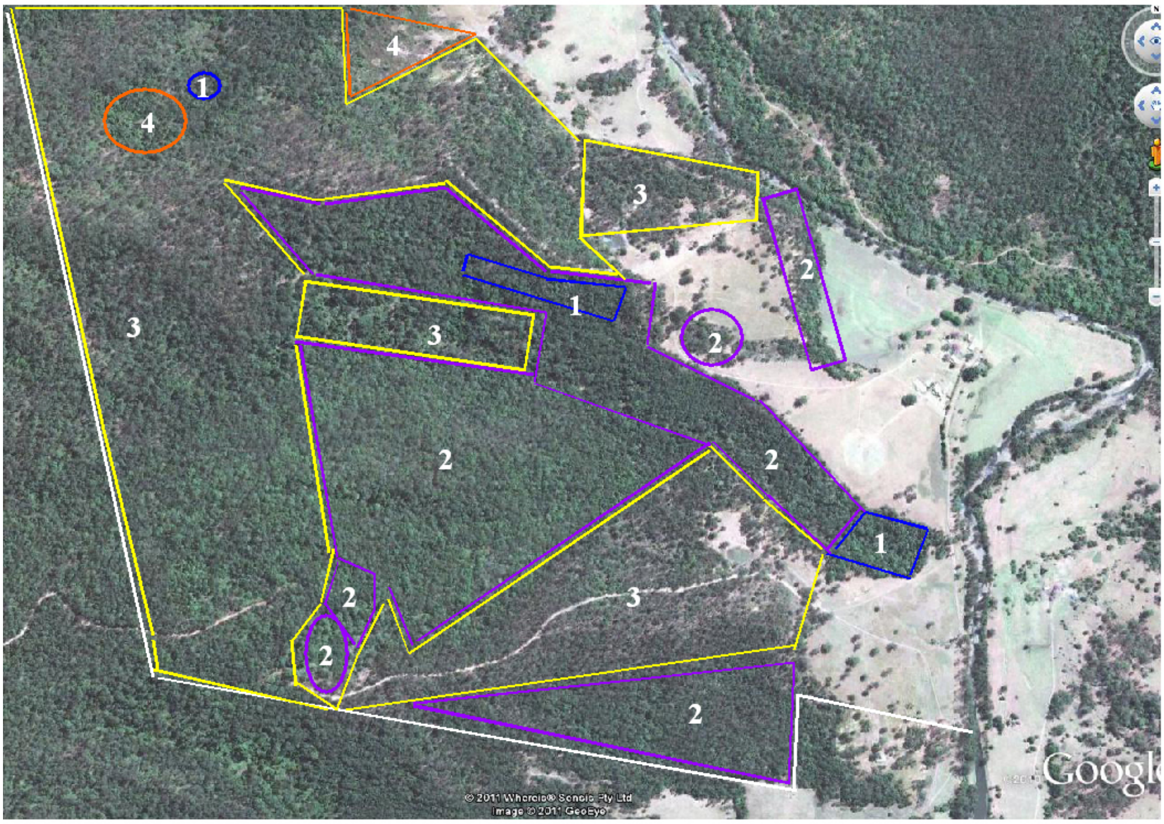



Fig 6. Mapping of condition classes in the Lower Valley at Creek's Bend at (a) 2005 (prior to treatment) and (b) 2011 (after and during treatment). The base photograph for (a) and (b) is the same Google Earth Photograph, dated 24 October 2009, and does not show changes in vegetation over time.

### *Changes to Bell Miner population and habitats*

In 2005 before Lantana treatment commenced, Bell Miners were found throughout the forested areas, with only three small areas which were Bell Miner free. Over time, we could see and hear that Bell Miners had moved from many areas of previously degraded forest after the Lantana was removed and forest structure and plant diversity improved. Areas of the forest which had been filled with constant Bell Miner calls had become quiet.

| Survey Date | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 |
|---|---|---|---|---|---|
| Oct-Nov 2005<br>(prior to treatment) | **23, 14, 29**<br>Mean = 22<br><br>Site then treated -<br>Feb 2006 (SG) | **18, 22**<br>Mean = 20 | **17, 27**<br>Mean = 22 | **25, 9, 16**<br>Mean = 17<br><br>Site then treated<br>- Feb 2006 (SG) | **22, 33**<br>Mean = 28<br><br>Site then treated<br>- Mar 2006 (SG) |
| June-July 2006<br>(after treatment) | **23, 38**<br>Mean = 31 | **19, 30**<br>Mean = 25<br><br>Site then treated -<br>July 2007 (F)<br>- Apr 2008 (SG) | **22, 30**<br>Mean = 26<br><br>Site then treated -<br>July 2007 (F)<br>- Apr 2008 (SG) | **13, 29**<br>Mean = 21<br><br>Site then treated<br>- Aug 2006 (SG)<br>- July 2007 (F)<br>- Apr 2008 (SG) | **34, 47**<br>Mean = 41<br><br>Site then treated<br>- Jul 2007 (F)<br>- Apr 2008 (SG) |
| April 2008 | **7** (all in 1 quadrat)<br><br>Site then treated<br>May 2010 (SG) | **0**<br><br><br>Site treated Feb<br>2011 (SG) | **5** (all in 1 quadrat)<br><br>Site then treated<br>June 2011(SG)<br>Jan 2011 (SG) | **4** (all in 1 quadrat)<br><br>Site then treated<br>Mar 2009 (SG)<br>Sep 2010 (SG) | **20** (in all quadrats)<br><br>Site then treated<br>Mar 2009 (SG)<br>May 2010(SG)<br>Aug 2010 (SG) |
| August 2011 | **0** | **0** | **0** | 14 (in all quadrats) | 19 (in all quadrats) |

Table 2. Numbers of Bell Miners Surveyed at five Sites before and after Lantana Treatments between 2005 and 2011.
[Note 1: Treatment "SG" denotes "Splatter Gun", while Treatment "F" denotes "a low intensity fire". Note 2: Sites 2 and 3 were used as untreated control sites for 9 months and were burnt in 2007].

Results from surveying Bell Miners ( show that high numbers of Bell Miners existed in all five monitored sites in November 2005 (Table 2) – but that, by April 2008 Bell Miner numbers at Sites 1, 2, and 3, had decreased substantially, and the birds were absent at these sites in August 2011. In contrast, Site 4 and Site 5 retained substantial numbers of Bell Miners, despite site 4 having dropped to low numbers in 2008.

## WHAT CAN THE RESULTS TELL US?

### *Vegetation response*

On Creeks Bend, Treated habitats with understoreys previously dominated by Lantana have, after 3-5 years, become much more structurally diverse, with a range of height classes of trees, shrubs and ferns; providing a number of habitats and shelter for other faunal species, especially other birds. But this was not a sudden process. The removal of Lantana across the landscape has occurred gradually over a few years, with the biodiversity and condition of the forest observably increasing as the Lantana dominance was observably decreasing. This left a changing understorey that has evidently provided a more protective habitat for understorey native fauna, reducing psyllid attack and allowing the gradual recovery of many of the tree canopies affected by dieback.

A PhD study is ongoing on the Creek's Bend property, monitoring two sites and measuring native regeneration occurring in these areas after Lantana removal. The results to date from that study indicate that very few introduced species occupied the plant community after herbicide treatment of Lantana and that the richness of the regenerating native plant community after herbicide was greater than that in untreated Lantana invaded areas (Yeates, A, 2011, unpub. data.). Final results from monitoring in one small area shows that control of Lantana using the splatter gun has been effective, with little off-target damage except possibly to the pioneer shrub Poison Peach (*Trema tomentosa*) which is very similar in appearance to Lantana (Yeates & Schooler 2011).

Hunter (2007) reports on a trial conducted in a 70 aerial ha area of native forest on Creek's Bend from October 2005 to June 2007. The report concluded that 90% of the Lantana treated with the Splatter Gun was killed and had not regrown. In its place, were successfully colonizing natives, including Cheese Tree (*Glochidion* sp.), Bleeding Heart (Homolanthus *populifolius*) , Red Cedar (*Toona ciliata*), Lilly Pilly (*Acmena smithii*) , Native Ginger (*Alipinia coerulea*) , ferns, bolly gums (*Litsea* spp., *Neolitsea* spp.), Celerywood and Rbbonwood (*Euroschinus falcatus*), among others. Hunter (2007) also noted changes in structure "with a mid-storey establishing, and a sparser understorey appearing under the thickening canopy, which is preventing the lantana from re-establishing" (Hunter 2007, p 7).

Hunter, Meek, and Billyard (2007), also reporting on the trial conducted on Creek's Bend, noted that: "*The overall effect appears to be a more diverse, multi-structured forest returning to the areas which were formerly a solid lantana understorey with a dying eucalypt upper storey. In the areas where the dying eucalypts may not recover appear to be evolving into a rainforest mid-storey"* (Hunter et al 2007, p 22).

<u>*Bird response*</u>

Bell Miners have moved away from some treated areas. We believe that this is a direct result of our treatments and that this has played a key role in vegetation recovery. That is, massive reduction of Bell Miner numbers occurred some years after Lantana treatment in three of the five monitored sites. This is likely to be due not only to the diverse native vegetation now in the understoreys of these sites but also to the fact that these three sites have no nearby Lantana in which Bell Miners could nest. Indeed, the retention of high numbers of Bell Miners in the regenerated sites 4 and 5 could be explained by the location of these sites either side of a large valley containing degraded, Lantana-infested forest that has only recently been initially treated. As such, this valley could have provided nearby nesting sites, allowing the Bell Miners to continue to defend sites 4 and 5 as feeding sites.

Our survey of Bell Miners, however, was relatively small and was conducted at different times of year; so further studies undertaken at similar times of year at a range of sites would be required to adequately test the decline of Bell Miner after vegetation treatment and recovery. In our view, however, it is unlikely that season would explain the decline of the birds on all the monitored sites without nearby Lantana as Bell Miner colonies are sedentary, and the colony members do not move far. Whole colonies may shift with changes in habitat, but not due to seasonal changes (P. McDonald, UNE, 2011, pers. comm.) Indeed, Bell Miners appear to persist throughout wet and dry years. The survey years 2005, 2006 and 2008 were all very dry years, while the final survey year when the birds had left the sites (2011) was a very wet year, when productivity increases would be expected in such prime habitat.

While we have no conclusive evidence as we have undertaken no formal comparisons of birds prior to and after treatment, we have certainly observed many other bird species in recovering areas compared to our observations of few birds other than Bell Miners in those areas dominated by Lantana. In particular we have noted King Parrot (*Alisterus scapularis*), Crimson Rosella (*Platycercus elegans*), Rainbow Lorikeet (*Trichoglossus haematodus*) Lewin's Honeyeater (*Meliphaga lewinii*), Laughing Kookaburra (*Dacelo novaeguineae*), Eastern Yellow Robin (*Eopsaltria australis*), Superb Fairy-wren (*Malurus cyaneus*), Rufous Fantail (*Rhipidura rufifrons*), Grey Fantail (*Rhipidura fuliginosa*), and ground dwelling birds (previously rarely seen) such as Log Runners (*Orthonyx temminckii*) and Brush Turkey (*Alectura lathami*).

## IMPLICATIONS OF THE RESULTS FOR MANAGEMENT

Our experiences and findings indicate that property-scale Lantana infestations can be effectively and efficiently treated minimal labour and cost using Splatter Gun technology. Over the previous five years, about 300 hectares of degraded forest on Creek's Bend have been treated by single operators on foot and/or two operators in a 4WD working along the tracks. Costs depend on such factors as terrain, accessibility, and severity of Lantana infestation but, on average, it has cost about $250 per hectare to do this form of Lantana removal on our property. As techniques are refined, the cost per hectare is decreasing.

Lantana follow up treatments are likely to be required for some years to come, albeit at a much reduced level once weed seedbanks are depleted. However, the level of native vegetation recovery is such that we are confident that time and continued effort over the next two to three years will see the reinstatement of stable, healthy forest across Creek's Bend. The removal of Lantana stimulates a variety of native species and treated areas have already begun to show marked improvement in forest structure and biodiversity. Native understoreys and midstoreys are reappearing and Bell Miners have moved from several areas of previously degraded forest.

In 2008, the NSW Scientific Committee, in their Notice of Final Determination of "Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners" as a Key Threatening Process, stated: "Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners' cannot be arrested by controlling a single factor" (Point 4). Furthermore, a review of the literature on BMAD concluded, "There is likely to be no single or simple management solution" (Wardell-Johnson et al. 2005).

Of course, determining the relative contributions of various pathogenic factors in a complex systemic condition such as BMAD will always be difficult if not impossible. It would take a huge research effort to separate out the individual roles that Lantana, psyllids, plant pathogens, soil nitrogen and chemistry, soil microbes, tree species, micro-climate, weather, fire, logging, grazing regimes, degree of disturbance, forest structure, flora and fauna diversity, and Bell Miners play in creating and supporting the pathological condition known as "BMAD".

The work on Creek's Bend since 2005, however, indicates that native forest badly degraded by Bell Miner Associated Dieback can show substantial levels of recovery and the return of complex structure and species biodiversity if the Lantana understorey is removed. This work adds weight to our initial hypothesis that the cycle of decline might be interrupted if one of the key factors, in this case the exotic weed Lantana, was removed. While we have not carried out experimental treatments to test this, the results are indicative of a process whereby changing one key factor, in this case Lantana, has resulted in systems-wide changes involving other key factors including reductions in Bell Miner populations in treated areas.

There may be a range of reasons why Bell Miners might move from sites, including decline of psyllids after widespread tree death or return to a previous territory (Ewen et al, 2003). However, our impression is that Bell Miner colonies can also leave an area about 12 months after it has been cleared of Lantana and forest regeneration is underway. This allows time after nesting site removal to impact on nesting behaviour and bird numbers. While this is as yet an untested hypothesis, we consider that our case provides sufficiently interesting indications to warrant formal experimentation into the efficacy and efficiency of using Splatter Gun technology to remove Lantana in the treatment of BMAD and for promoting improved biodiversity in Australian native forests. If further research confirms our findings, then the Splatter Gun method for removing Lantana could be widely used to address the severe threat posed by Lantana and BMAD to hundreds of thousands of hectares of native forests along the east coast of Australia, and worldwide.

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