

BELL MINER ASSOCIATED DIEBACK in the BORDER RANGES NORTH AND SOUTH BIODIVERSITY HOTSPOT - NSW SECTION.

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This review focuses on the extent and effect of Bell Miner Associated Dieback (BMAD) on the NSW section of the Border Ranges (North and South), one of Australia's 15 Biodiversity Hotspots and part of one of the world's 35 Biodiversity Hotspots. The region's forests are recognised as being of World Heritage value.

This review relies upon mapping of BMAD undertaken by the Forestry Corporation (DPI) in 2004 and the Forestry unit of the Department of Primary Industries (DPI) from 2015-17. The two DPI aerial visual sketch-mapping exercises were undertaken from a helicopter but map very different areas, which appears to be a methodological problem. To obtain a reasonable estimation both mappings were combined. Comparison with detailed mapping undertaken on the Richmond Range in 2005 shows that the recent mapping is only identifying 38% of the BMAD present, and that even when the two aerial visual sketch-mapping exercises are combined they still only identify 68% of BMAD, so while the DPI mapping has been relied upon herein as the only available regional mapping, the figures need to be considered very conservative.

Conclusions from this review of the two DPI Bell Miner Associated Dieback mapping exercises undertaken in the NSW section of the Border Ranges Biodiversity Hotspot, and the 2017 Government literature review, are:

- The most recent review confirms the basic process of initiating Bell Miner Associated Dieback (BMAD) as: logging opens up overstorey and disturbs understorey > invasion of lantana > proliferation of Bell Miners (Bellbirds) > proliferation of sap-sucking psyllids > sickening and death of eucalypts.
- Logging that initiates or promotes BMAD contravenes the basic principles of Ecologically Sustainable Forest Management.
- There has variously been some 37,000 hectares of forests mapped as affected by BMAD in the two DPI exercises in the Border Ranges region, with BMAD concentrated in the west of the region on the Richmond, Capeen, Tooloom, McPherson and Main Ranges, but extending to near the coast in Byron Shire.
- Around half the BMAD recently mapped north of Taree occurs in the Border Ranges, identifying it one of the worst dieback affected forest areas in Australia.
- Some 9% of the region's remnant forests have been mapped as BMAD affected, with this increasing to 27% of forests on State Forests.
- Around 1% of the older reserves created before 1995 are affected by BMAD, though this increases up to 16% of reserves that were being logged up until they were made into reserves in the forest reform process (mostly 1995-1999), and up to 29% of current State Forests (excluding plantations). BMAD clearly increases with logging history.
- There are 5 broad forest ecosystems with 20-43% of their extent affected. On State Forests 7 broad forest ecosystems have 40-56% of their extent affected,

- On State Forests BMAD affects 40% of the Endangered Ecological Community (EEC) Grey Box-Grey Gum Wet Sclerophyll Forest, 35% of the EEC White Gum Moist Forest and 31% of the EEC Lowland Rainforest:
- On State Forests BMAD affects 1,852ha (28%) of high and very high quality Koala habitat identified as occurring on State Forests,
- It is alarming that there have only been 3 monitored trials of BMAD treatments in north east NSW and that the outcomes for the two trials on State Forests have been largely suppressed and ignored.
- NEFA has been attempting to have BMAD addressed for 25 years, with concerted attempts over the past 9 years to have logging stopped in affected and susceptible public forests met by Government Agency obfuscation and inaction.

Recommendations from this review are:

1. Given the abundant evidence that logging is the primary cause of Bell Miner Associated Dieback, and that re-logging affected forests makes it worse, it is well past time that the logging of BMAD affected and susceptible forests is stopped and the process of restoration begun.
2. As the current aerial mapping is subjective and grossly understates the extent of BMAD it does not provide a reliable basis for identifying the current extent of BMAD or to be able to monitor changes over time, it is recommended that the worst BMAD affected areas be subject to objective and repeatable mapping using High Resolution Multi-spectral imagery and ALS Lidar to:
 - accurately identify the current extent of BMAD affected and susceptible forests
 - provide a baseline from which to assess changes over time
 - identify the variables affecting BMAD distribution
 - quantify the accuracy of current mapping and other remote sensing technologies
 - monitor the success of rehabilitation works.
3. It is estimated that it would now cost over \$12 million to rehabilitate the currently BMAD affected public forests of the Border Ranges Biodiversity Hotspot, requiring over \$600,000 per annum and a rehabilitation target of 1,300ha per annum for 20 years to repair the damage that logging has already done. Applying the user/polluter pay principle it is considered that the Forestry Corporation should be liable for the costs of repairing forests they have degraded, even when now in national parks.
4. In order to pay the annual cost of environmental repair across north-east NSW consideration should be given to imposing a "Dieback Repair Levy" of \$5 per cubic metre on the sale price of all hardwood sawlogs from north-east NSW's public native forests for the next 20 years.
5. It is reprehensible that despite the public monies spent on rehabilitation works on both public and private lands over the past 20 years that only three studies have monitored the outcomes of treatments on BMAD affected forests, and that for the two studies undertaken on the impacts of forestry operations the Forestry Corporation has been allowed to largely suppress and ignore the unfavourable results.
6. In order to better understand the causes of BMAD and assess the effectiveness and costs of rehabilitation, the highest priority has to be to undertake independent and transparent lantana (and other problem plant) removal trials, using manual methods that minimise disturbance, with clear objectives, monitoring and reporting requirements.

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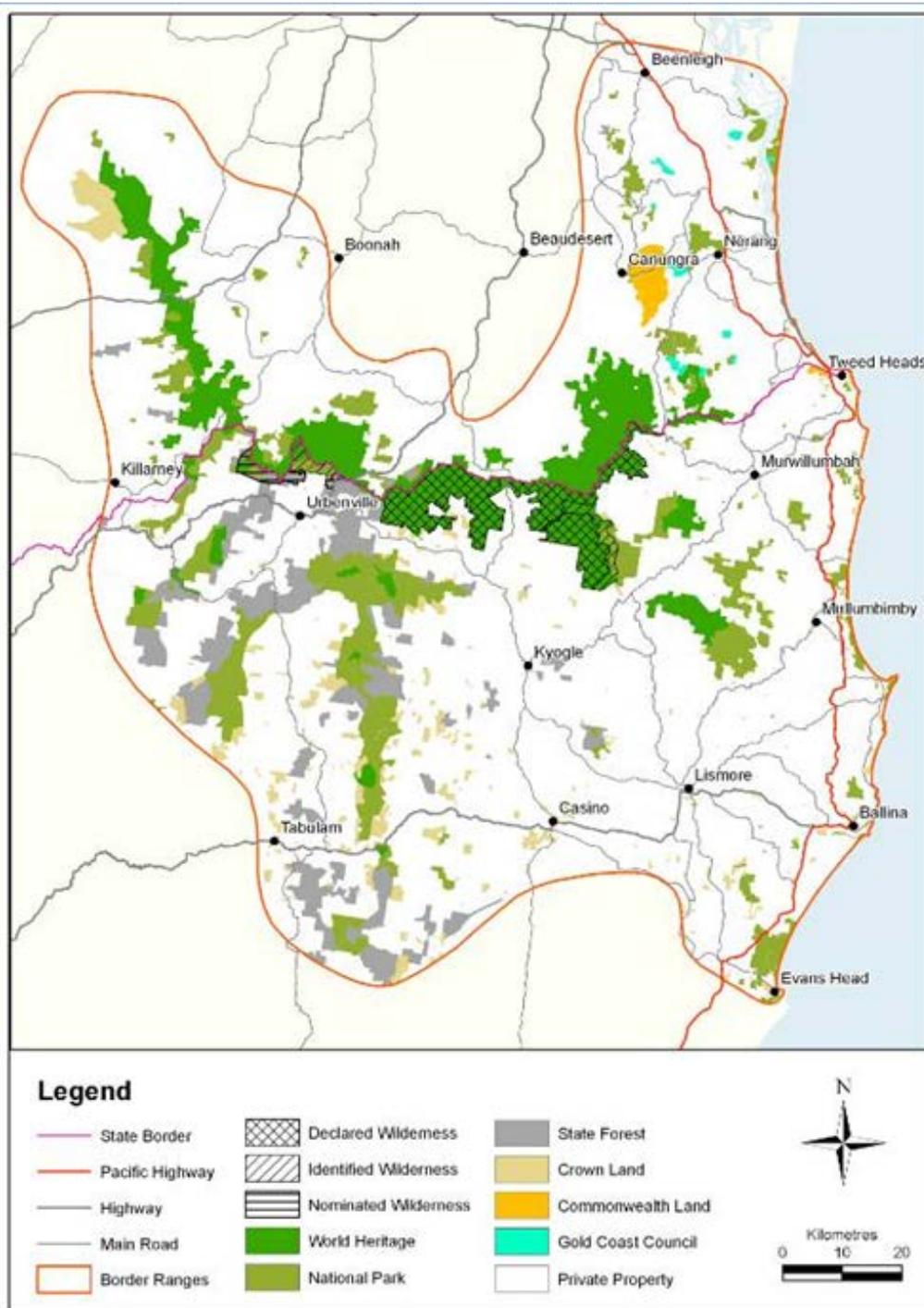
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Logging of BMAD affected forest in Yabbra State Forest 2009 - the forest was left to die.

Introduction

The Border Ranges region is centred on NSW-Queensland Border, encompassing the volcanic remnants from the 20-25-million year old Focal Peak and Mount Warning Volcanoes, which provide the dramatic mountains, cliffs and waterfalls that characterise the region. In NSW most of the volcanoes have been eroded away by the headwaters of the Richmond and Clarence Rivers, to expose the 135–200 million years old sedimentary rocks of the Clarence-Moreton Basin.



Border Ranges (North and South) Biodiversity Hotspot
from the Border Ranges Rainforest Biodiversity Management Plan.

Aboriginal settlement of the region dates back tens of thousands of years. European settlement dates from the 1840s. The larger NSW settlements now comprise Tweed Heads, Murwillumbah, Mullumbimby, Byron Bay, Ballina, Evans Head, Alstonville, Lismore, Casino and Kyogle.

The upper north east encompasses part one of one of Australia's 15 recognised biodiversity hotspots, the 'Border Ranges North and South (Queensland and New South Wales)'. Biodiversity hotspots are areas that support natural ecosystems that are largely intact and where native species and communities associated with these ecosystems are well represented. Areas with many endemic species where the levels of stress or future threat were considered to be high were identified by the Australian Government's [Threatened Species Scientific Committee](#) as hotspots. In relation to the Border Ranges North and South the Environment Australia website notes;

This sub-tropical and temperate hotspot is one of Australia's most diverse areas - and it is the most biologically diverse area in New South Wales and southern Queensland. It has a variety of significant habitats: subtropical rainforest, wet sclerophyll forest, mountain headlands, rocky outcrops and transition zones between forests.

These habitats support a huge variety of bird and macropod species. Many are rare or threatened: the Richmond Bird-wing Butterfly, Fleay's Frog, Hastings River Mouse, Long-nosed Potoroo, Spotted-tailed Quoll, Eastern Bristle Bird, Rufous Scrub-bird and the critically endangered Coxen's Fig parrot. Notable birds such as Albert's Lyrebird and the Paradise Riflebird make their home here, and in the south-east Queensland rainforests live a rich variety of primitive plant species, many of them similar to fossils from Gondwana.

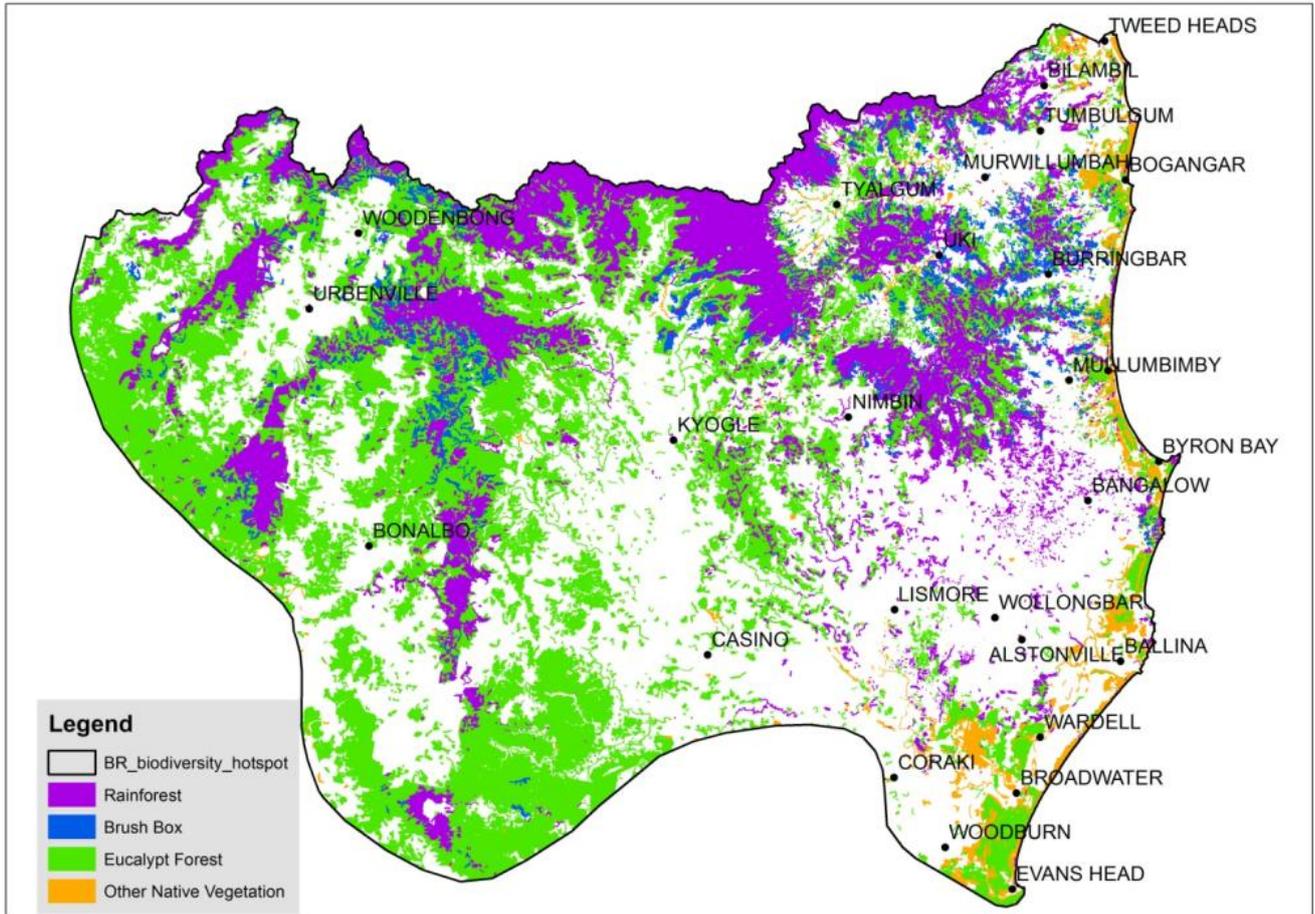
This region's high population growth, with associated urban and tourist developments along the coast, is a major cause of habitat loss and fragmentation. Although most remaining natural areas are protected, they are under considerable threat from weeds, fire and recreational use.

The forests of north-east NSW have been identified as part of one of the world's 35 biodiversity hotspots because of their exceptional species endemism (at least 1,500 endemic plant species, i.e., 0.5% of all known species) and habitat loss (70% or more of an area's primary vegetation cleared) (Williams *et.al.* 2011).

The rainforests of the region are recognised as being particularly significant for containing many endemic species and ecosystems, plants and animals of outstanding universal value, warranting their inclusion on the World Heritage List as the Gondwana Rainforests of Australia. Five broad rainforest forms are recognised: cool temperate, warm temperate, subtropical, dry and brush box. Many of the region's national parks are included in the Gondwana Rainforests of Australia World Heritage Area, with most of the reserves created after 1995 on the Tentative List awaiting addition to the World Heritage property.

The eucalypt forests too support a high diversity of species, making a significant contribution to the region's biodiversity, providing nectar, seeds, browse and hollows necessary for the survival of a large variety of animals. It is not until they are over a hundred years old that they begin to develop hollows essential as dens and nests for a wide variety of species, and not until they are over 200 years old that they provide the large hollows needed by gliders, owls and cockatoos. Eucalypts can live for 300-500 years, with some estimated to be over 1,000 years old. The eucalypt forests of the region have also been recognised as being of universal value and worthy of addition to the World Heritage List.

It is in the dynamic ecotones where eucalypts historically dominated a rainforest understorey in various stages of development that the effects of BMAD are most pronounced, with BMAD occurring where the rainforest understorey is replaced by lantana or viney tangles. The opening of the canopy in adjoining drier forests is encouraging lantana invasion and BMAD.



The predominant forest formations are rainforest, including Brush Box, and eucalypt forests. There are significant intergrades between them with eucalypt often present in the ecotones of rainforest and rainforest understories in eucalypt forests. It is in these wetter eucalypt forests where the effects of BMAD are most pronounced.

Three principal fauna groups are recognised, the Torresian group extending down from the tropical grassy savannah woodlands of northern Australia, the Bassian group extending up from the eucalypt-dominated forests of southern Australia, and the Tumbunan group, a relict of a once widespread group now largely restricted to two main core areas centred on the Border Ranges and the Herbert–Daintree uplands of north-east Queensland. The overlap of northern and southern faunas, combined with local endemic species, contribute to the region's outstanding biodiversity values.

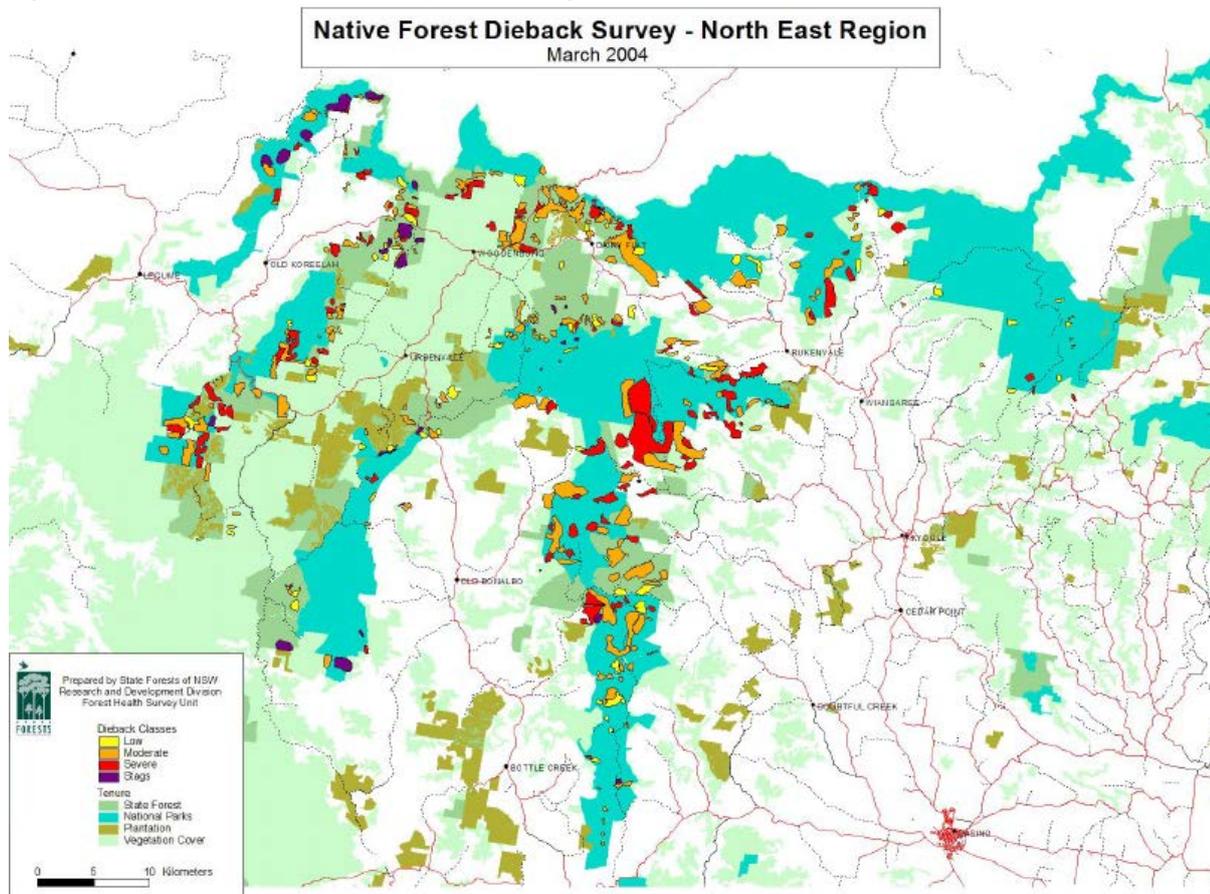
The NSW section of the Border Ranges North and South totals some 950,000ha, of which some 54% is currently cleared of native vegetation.

1. The Extent of BMAD.

Bell Miner Associated Dieback (BMAD) occurs when canopy trees are removed allowing lantana to dominate the understorey. The open canopy and dense lantana understorey allows Bell Miners (Bellbirds) to dominate the forest, chasing away most other animals. The Bell Miners "farm" tiny sap-sucking insects called psyllids that feed on eucalypt leaves, which proliferate and drain the life out of the eucalypts which sicken and eventually die. When BMAD is advanced it can be identified from the air by the dead and dying trees.

The Forestry Corporation/Department of Primary Industries have undertaken mapping of BMAD across most of the region in 2004 and 2018 by visual assessments from a helicopter (aerial visual sketch-mapping). These have all sorts of inherent biases, with BMAD affected trees more obvious during dry periods, and observations affected by flight paths and observer bias and fatigue, Both mapping exercises resulted in BMAD being identified in different areas.

In 2004 the Forestry Corporation identified almost 20,000 hectares of the approximately 100,000 hectares of apparently susceptible forest types in the western Border Ranges as being affected by dieback attributed to BMAD. The aerial visual sketch-mapping identified the following areas of severity classes: Low 2,205ha, Moderate 9,776ha, Severe 6,511ha, and Stags 1,382ha. The 2004 assessment was conservative as many areas known to be affected were missed, even when on the flight path (Jurskis and Walmsley 2012, Pugh 2014).



State Forests' (Carnegie 2004) 2004 mapping of BMAD in the western Border Ranges.

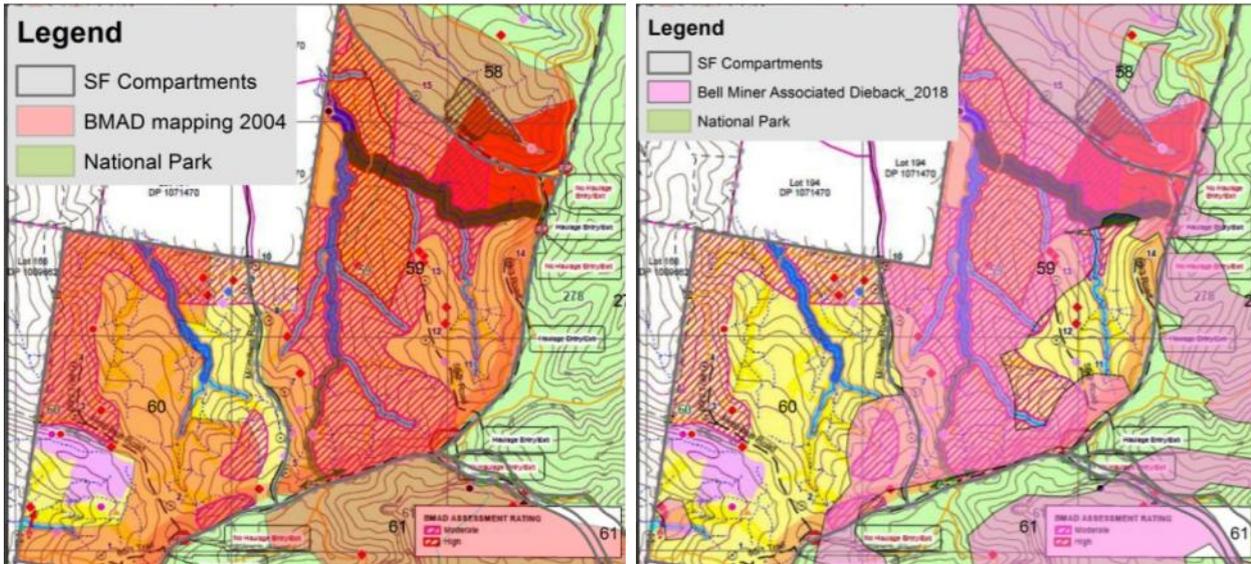
The 2018 aerial visual sketch-mapping (Silver and Carnegie 2017, and subsequent updates) is claimed to have covered some 1,250,000 hectares of forest north from Taree, with 44,777ha of BMAD mapped. Comprised of 17,005ha on State Forest, 12,822ha on National Park, 1,540 on Crown Land, 12,885ha on private property and 525ha on plantations. While DPI would not provide me with their shapefiles, I was provided with maps that I digitised (this introduces a source of error, though is not considered to significantly affect outcomes) and assessed in a GIS. This showed that the current mapping identifies some 22,000ha of the NSW section of the Border Ranges region as being affected by BMAD.

As half the dieback mapped north from Taree occurs in the Border Ranges region this highlights the seriousness and urgency of the problem, notably on the Richmond Range, Capeen Range, Tooloom Range, western McPherson Range and Main Range.

At face value, by comparing the two mappings it would seem that there has been no significant change in the extent of BMAD over the past 14 years, though this is contrary to what is seen on the ground. There is only an overlap of some 5,000ha (13%) between the two mappings which is an extraordinary mismatch, though as both mapping projects were undertaken by the same lead mapper the differences cannot be attributed solely to observer bias. Differences could be partially explained by annual fluctuations in perceived canopy health with weather conditions, though as 74% of the areas identified as severely affected in 2004 (i.e. *"consisted of many dead trees, severe thinning of crowns, low stocking rate of susceptible species and greatly increased mesophyllic ground story vegetation including weeds such as lantana"*) were mapped as having no dieback in 2018, it is hard to fathom how they could now have no visual evidence of dieback.



Severe BMAD affected forest in Donaldson SF (note the obvious dead trees), 9 years after "restoration" works.



The above mapping compares three different BMAD mappings for compartments 59 and 60 of Donaldson SF. The red hatched mapping was done by Forestry Corporation from ground based surveys in 2015 (which is probably the first time they have ever done it), it identifies 2 severity classes: moderate and high (low is excluded). **LEFT:** The orange overlay is the 2004 mapping which was mostly classed as moderately affected (i.e. discoloured foliage, severe thinning of tree canopy and a few dead trees), it reasonably encompasses mosy of the ground mapped areas, though also includes additional areas. **RIGHT:** The pink overlay is the 2018 mapping which misses large areas mapped from ground surveys (ie north and west in cmpt 60).

Given that BMAD affected forests are not recovering, and that many areas have been observed to have deteriorated (pers. obs.) it is considered that the only way to reconcile the divergent mapping is to combine it to identify overall extent. This gives a total area of 37,100 ha. This is considered to be conservative as it appears that the mapping is missing some areas and not picking up many areas with the early symptoms of dieback (dense lantana understories and large populations of Bell Miners), where trees are sickening but as yet without extensiver canopy damage. For transparency both the figures for the 2018 mapping and the additional areas (outside the 2018 mapping) mapped in 2004 are separated in reporting.

Though the evidence is that even combining the outputs of the aerial visual sketch-mapping grossly understates the true extent of BMAD affected forests. In 2005 (Stone *et.al.* 2005) a collaborative process by NSW Agencies used high resolution multi-spectral imagery (DMSI) to map BMAD across 30,000ha of the Richmond Range.

For the study 24 ground plots were assessed. which confirmed "*an apparent relative association between unhealthy eucalypt crown condition, higher site fertility (i.e. higher soil ammonium content and a low soil carbon to nitrogen ratio), high shrub cover, low tree crown cover and high bell miner density*".

For the entire 30,000 ha Richmond Range study area the results provided the following areas within each category.

Category	Percent area	Total area (ha)
Healthy sclerophyll tree crowns	30%	9,000
Mildly affected (slightly stressed) trees crowns *	20%	6,000
Moderately to severely BMAD affected trees	29%	8,700
Mesic vegetation including rainforest species and visible lantana (healthy)	7%	2,100
Non tree features (shadow, water, soil and grassland/pasture)	14%	4,200

The study notes *"We believe that the area classified as having healthy sclerophyll crowns is a slight under estimation while the area classified as slightly affected by Bell miner associated dieback may be a small over-estimation. This is due, in part, to the influence of the dry grassy understorey in the thinner Spotted gum stands which can influence the cumulative spectral response obtained by the DMSI. In addition, the classification process might also be detecting some of the ridge-top Spotted gum stands that may have been mildly stressed from drought at the time of image acquisition (August 2004)".*

This study provides the best data available to ground truth both the 2004 and 2018 mapping. It shows that both aerial visual sketch-mapping exercises grossly under-estimated the extent of BMAD. The Richmond Range study identified 14,700 ha (49%) as being affected by BMAD, compared to the 2018 aerial visual sketch-mapping only identifying 5,600 ha as affected within the same area, and even with the additional areas identified in the 2004 aerial mapping the combined total is just 10,000 ha (33%). So it appears that the aerial 2018 visual sketch-mapping is grossly under-estimating BMAD by some 62%, and that even when the two aerial visual sketch-mapping exercises are combined they still understate the extent of BMAD by some 32%.

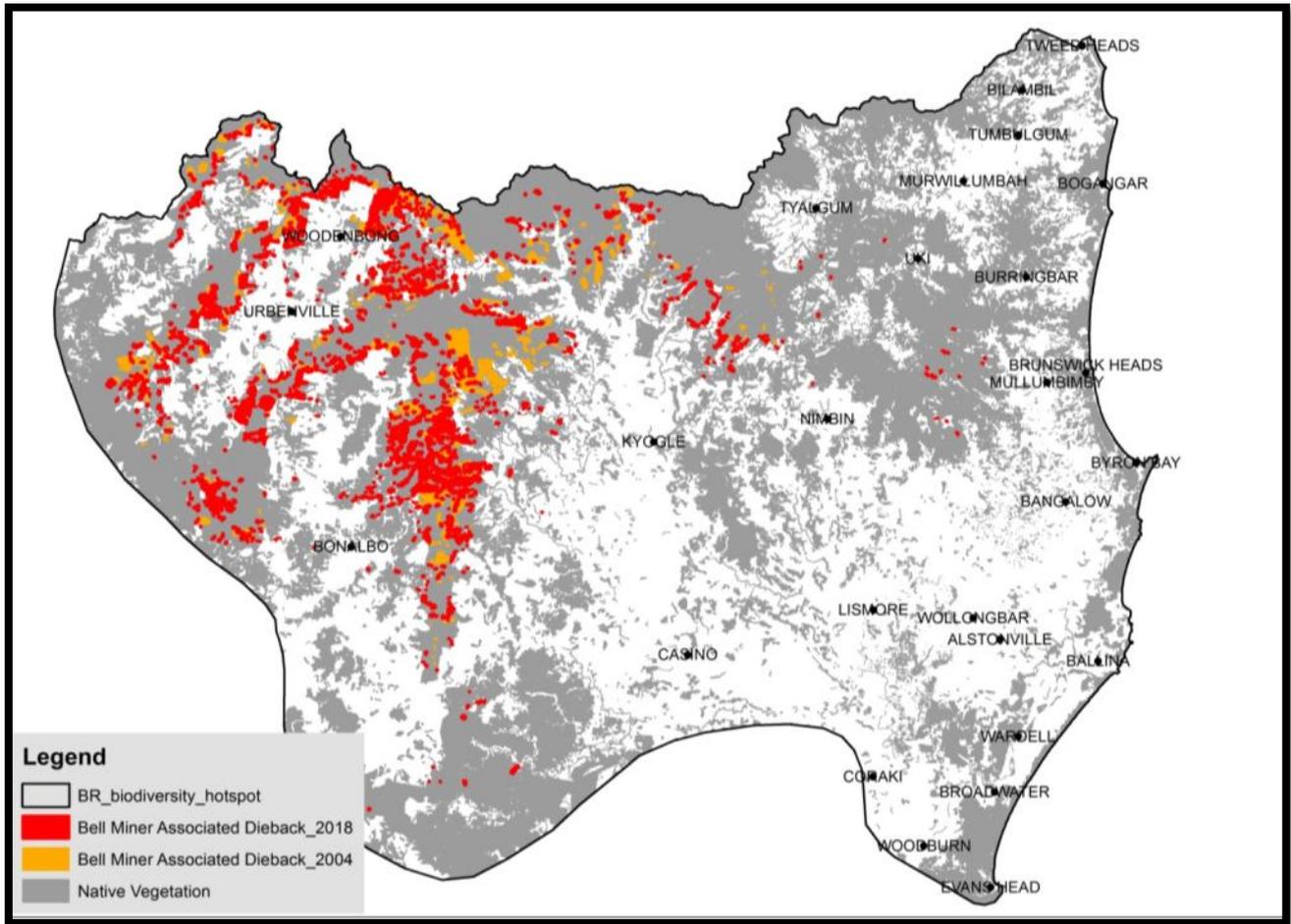
Without the mapped output from the Richmond Range project it is impossible to ascertain why the visual sketch-mapping is getting the mapping so wrong, though it is assumed that a large part of the problem is that it is only picking up the most severed dieback and missing the mildly affected stands.

The inability to use the aerial visual sketch-mapping to compare changes over time emphasises the folly of using non-repeatable subjective methods, and the stupidity of proposals to use this latest mapping as a benchmark to assess future changes.

The Office of Environment and Heritage (2014) 'Mitigating the effect of Bell Miner Associated Dieback (BMAD) on World Heritage' undertook an aerial BMAD mapping exercise in 2014 for the Border Ranges part of the World Heritage property, identifying that in NSW 13, 084 ha of eucalypt forests were mapped as the following;

- 1, 963 ha classified as healthy
- 6, 298 ha is classified as susceptible
- 4, 824 ha is classified as dieback affected.

Identifying 37% of eucalypt forests in the World Heritage area as dieback affected would be of concern except that this was based on the assumption that the whole of Wollumbin National Park is both eucalypt forest and entirely BMAD affected. Even a brief visit (or look at a rainforest map) would have shown this to be wrong. The OEH results are so unrealistic that they cannot be considered at all reliable.



Forestry's mapping of BMAD in the Border Ranges region. The map shows the area mapped in 2018 (red) with the additional areas mapped in 2004 (orange). It is considered that both need to be adopted to obtain a realistic assessment of BMAD distribution, though even then the mapping misses a number of areas known to be affected and does not recognise those areas in the early stages of BMAD.

While rapid aerial mapping of BMAD is relatively cheap and has its uses, it is obviously unreliable and useless for assessing changes over time. Decades and hundreds of thousands of dollars have been wasted as NSW Agencies stuff around pretending to do something about BMAD while actually doing very little. It is well past time that BMAD mapping was undertaken using objective, reliable and repeatable methods.

Haywood and Stone (2011) used High Resolution Multi-spectral imagery and ALS Lidar to identify both stands which are actually colonised by bell miners and stands which are susceptible to colonisation by bell miners. They considered that this produced reliable results. Such mapping would provide a rational basis for exploring the relationships between environmental variables and BMAD, to better assess BMAD and trends over time, quantifying the accuracy of the DPI mapping, and as an objective measure to assess the accuracy of other remote sensing technologies. It could be combined with earlier mapping and long-term monitoring plots to provide a rational basis for better identifying the nature and extent of the problem, and as a basis for monitoring and assessing trial rehabilitation methods. Though it seems that this is what the agencies are intentionally avoiding.

The two Forestry Corporation/Department of Primary Industries BMAD mapping projects have together identified some 9% of the Border Ranges region's forests as BMAD affected, with some 12,500 ha on National Parks and 13,400 ha on State Forests affected. In gross terms this represents 9% of National Parks and 20% of State Forests, though with the exclusion of plantations this increases to 29% of State Forests.

A major thrust of the Forestry Corporation and the EPA is to create the pretence that BMAD has nothing to do with forestry. One way of doing this is to claim that because BMAD occurs on National Parks, it can't have anything to do with logging. It is a convenient and effective excuse for inaction.

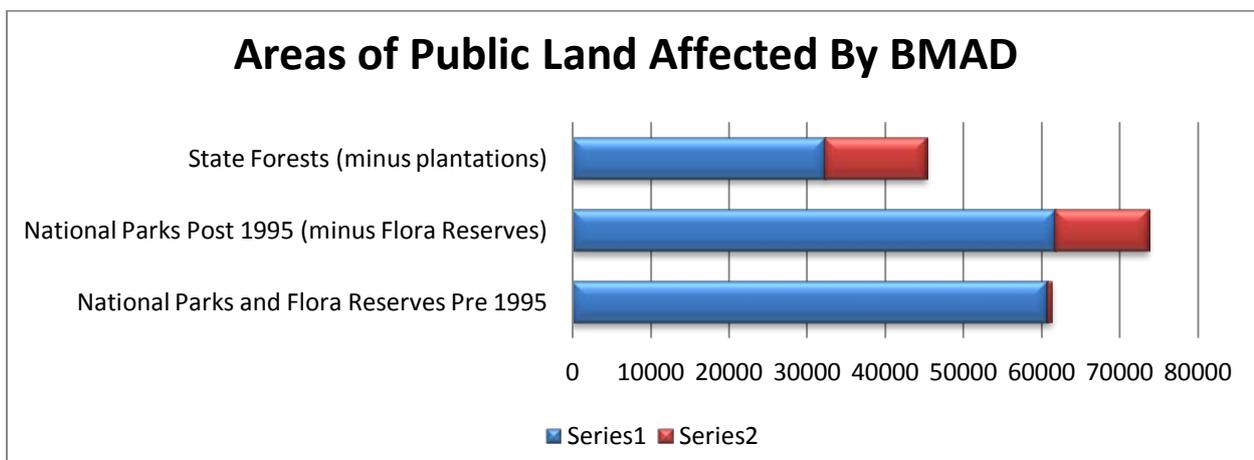
In 2015 NEFA took the then NSW Environment Minister, Mark Speakman, on a trip up the Richmond Range to show him BMAD. The area had been logged up until 1997 before being made into the Richmond Range National Park. We tried explaining to him that the forest was already degraded, with expanses of lantana and pockets of BMAD before it was made into a National Park, and that it had continued to degrade since. With the assistance of the EPA, Mark Speakman (4 November 2015) responded:

Bell Miner Associated Dieback

One of the key things you illustrated on our field trip on 29 August 2015 was the impact of BMAD on our native forests. I was interested and concerned to see how this process occurs and the disturbing changes to forest structure and composition that result. These changes pose threats to biodiversity and timber resources. I understand that BMAD spread is occurring across all tenures including state forest, national park and private land.

I acknowledge your recommendations on behalf of NEFA to cease logging in susceptible and affected forests, as outlined in the report 'For Whom the Bell Miners Toll', sent to the former Minister for the Environment Rob Stokes, on 12 August 2014. I understand that the causal factors of BMAD are complex, and that there is no consensus between subject matter experts about management options to control the spread of BMAD.

In order to properly consider the tenure claim, for this review a simple comparison was made of National Parks (and Flora Reserves) created before 1995, National Parks created after 1995 (mostly created from State Forests from 1995-1999 as part of the forest reform process) and current State Forests (excluding plantations). It is clear that most of the BMAD on National Parks is in parks that were being logged up until their creation as part of the forest reform process (post 1995).

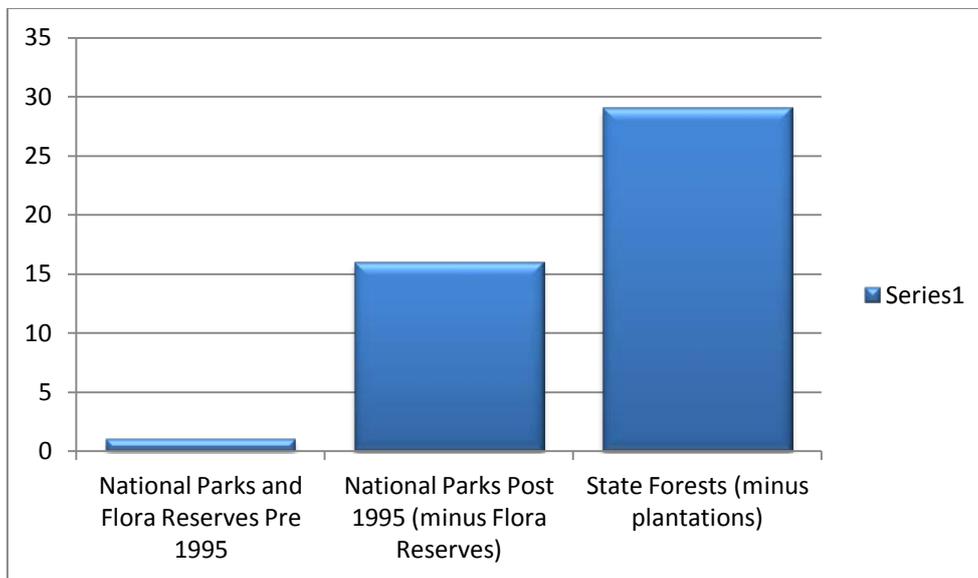


Series 1 (blue) are unaffected by BMAD and Series 2 (red) are affected by BMAD

While significant parts of the National Parks and Flora Reserves created before 1995 were subject to logging, the intensity and frequency being practiced then has resulted in a low 1% of these reserves being affected by BMAD.

By 1995 logging intensity and extent had significantly increased and there were already large areas of forests invaded by lantana and affected by BMAD. Many of the National Parks created in the forest reform process from 1995-1999 already had large areas of BMAD, though it is clear that it has continued to expand since, with 16% now affected.

Those native forests that remained as State Forests have been subject to increased logging intensities and the practice of removing all merchantable trees in BMAD affected forests, resulting in 29% of these forests now being affected by BMAD, with many more areas showing the early effects of BMAD.



Percentage of public tenures now affected by BMAD in the Border Ranges Region. Note the trends of increasing BMAD with increasing logging over time.

To explore this issue further, the logging history data available in 1998 for what was to become National Parks was reviewed. Logging history data was available for 58,700 ha of National Parks created after 1998. Some 8,100 ha of these forests are affected by BMAD, representing 65% of the 12,500 ha of BMAD mapped on National Parks. These data show that 89% of the BMAD in National Parks occurs in forests identified as logged, and while there appears to be an increasing trend of BMAD with logging over time this is not as pronounced as expected, with areas logged before 1970 now having significant BMAD.

Last Recorded Logging	Total Area (ha)	Dieback Area	
		(ha)	Percent
No history	12182	899	11.1
pre 70	4898	1320	16.3
70-79	14056	1862	23.0
80-89	12315	1726	21.3
90-98	15227	2297	28.3
TOTALS	58678	8103	

Logging History as at 1998 for forests later reserved as National Parks.

Proportionally less of the forests recorded as having no logging history are affected by dieback, with 7.4% of these forest affected compared to 15% of those forests logged after 1990 (the later increasing to 30% if just the western parks with most of the dieback are considered). Though it is apparent that significant parts of the areas with no logging history have in fact been logged, for example all Flora Reserves were identified as unlogged when significant parts had been logged and other areas with no logging history are identified as logged in the growth-stage mapping. There also appears to be an edge effect occurring.

It is clear that the extent of BMAD is related to forestry activities. While BMAD is increasing across all tenures due to logging legacies, it is apparent that, per hectare, those forests protected from logging some 20 years ago have almost half (55%) the BMAD than those that continued to be logged, and that those forests never logged or protected many decades ago only have some 3% of the BMAD found in currently logged forests, It is frightening to think what condition any forests left in the control of the Forestry Corporation will be like in another 20 years.



The aftermath of logging a BMAD affected forest, Yabbra State Forest 2009.

2. BMAD Impacts on Border Ranges Biota

For this review only a few examples of biological impacts are considered. These are only indicative of the profound impacts that the expanding BMAD is having on one of the world's biodiversity hotspots. Given the expanding habitat degradation, loss of food resources and tree hollows, creation of thick impenetrable understories, and the exclusion of most other diurnal animals by Bell Miners, lantana invasion and BMAD pose significant threats to the region's exceptional biodiversity.

The concerns are that BMAD is still expanding rapidly due to logging and the increasing severity of dry periods due to climate change. It needs to be stopped now and the long process of restoring the 37,000 ha already affected begun.

According to Office of Environment and Heritage vegetation mapping there are currently some 270,000ha of eucalypt dominated forest in the NSW section of the Border Ranges region, of which 18,100 ha was mapped as BMAD affected in 2018, with an additional 9,900 identified as affected in 2004. Taken together these represent some 10% of the region's eucalypt dominated forests. Some 41,000 of remnant eucalypt forests occur on State Forests (including in plantation areas), of these 7,600 was mapped as BMAD affected in 2018, with an additional 3,100 identified as affected in 2004, representing 27% of eucalypt forests on State Forests.

While rainforest species, including Brush Box, are not generally affected by BMAD, their ecosystems are where eucalypts form part of the canopy. There are 130,000ha of wet forests (117,000ha rainforest, 13,000ha Brush Box) in the region, of which the 2018 mapping shows 3,100ha affected by BMAD, with an additional 4,900ha identified in 2004. Taken together these represent some 6% of the region's wet forests (17% of Brush Box). There are 8,100ha of wet forests on State Forests (2,300ha Brush Box) of which 1,100ha was identified as BMAD affected in the 2018 mapping with an additional 1,300ha identified as affected in 2004, representing 30% of wet forests on State Forests (47% of Brush Box).

Based on the OEH vegetation mapping, overall some 9% of the region's forests have been mapped as BMAD affected, with this increasing to 27% of forests on State Forests. *(please note that the figures derived from the OEH mapping differ from those derived from reporting against tenure layers for a variety of reasons, such as the accuracy of the vegetation mapping and some plantations suffering from dieback)*

BMAD Affected Forest Ecosystems

Affected Forest Ecosystems	TOTAL	2018 BMAD Mapping		Additional 2004 BMAD Mapping	TOTAL BMAD	
	ha	ha	%	ha	HA	%
Clarence Lowlands Spotted Gum	27732	279	1.0	25	304	1.1
Coastal Flooded Gum	8951	971	10.8	696	1666	18.6
Dry Foothills Spotted Gum	258	16	6.3		16	6.3
Dry Heathy Blackbutt-Bloodwood	6176	17	0.3		17	0.3
Dry Heathy Sandstone Blackbutt	2759					
Dunns White Gum	689	202	29.3	65	267	38.8
Eastern Red Gums	1					

Escarpment Redgum	22321	2546	11.4	955	3502	15.7
Foothill Grey Gum-Ironbark-Spotted Gum	2941	21	0.7		21	0.7
Gorge Grey Box Total	1374	37	2.7	25	63	4.6
Grassy New England Blackbutt-Tallowwood-Blue Gum	659	34	5.1	163	197	29.9
Grey Box-Northern Grey Gum	5402	802	14.8	541	1342	24.8
Grey Box-Red Gum-Grey Ironbark	8267	662	8.0	122	784	9.5
Lowlands Grey Box	5138	177	3.4	42	219	4.3
Lowlands Scribbly Gum	938	2	0.2		2	0.2
Northern Grassy Sydney Blue Gum	2722	677	24.9	499	1176	43.2
Northern Moist Blackbutt	12793	8	0.1		8	0.1
Northern Ranges Dry Tallowwood	48068	2635	5.5	1860	4495	9.4
Northern Wet Tallowwood-Blue Gum	9445	1148	12.2	883	2032	21.5
Open Shrubby Brushbox-Tallowwood	6591	557	8.5	498	1055	16.0
Richmond Range Spotted Gum	23239	2528	10.9	826	3354	14.4
Richmond Range Spotted Gum-Box	8009	17	0.2		17	0.2
Rough-barked Apples	198	13	6.8		13	6.8
Sandstone Spotted Gum-Blackbutt	1160	1	0.1		1	0.1
Stringybark-Apple	6459	105	1.6	0	105	1.6
Wet Bloodwood-Tallowwood	40553	4658	11.5	2662	7320	18.1
Wet Flooded Gum-Tallowwood	3794	30	0.8	1	31	0.8
EUCALYPT FOREST SUBTOTAL	268449	18141	6.8	9865	28006	10.4
Dry Rainforest	4092	29	0.7	72	101	2.5
Northern Wet Brushbox	12975	1049	8.1	1190	2239	17.3
Sub-Tropical & Warm Temperate Rainforest	99529	1663	1.7	3336	4999	5.0
Sub-Tropical Rainforest	5809	94	1.6	147	241	4.1
Wet Bangalow-Brushbox	7054	257	3.6	102	359	5.1
WET FOREST SUBTOTAL	130028	3093	2.4	4846	7939	6.1
FOREST TOTAL	398477	21234	5.3	14711	35946	9.0

Note that sub-totals and totals for forests include non-affected forests not shown in tables

The worst affected ecosystems by BMAD at a regional scale are:

- Coastal Flooded Gum: 1,700ha affected by BMAD, representing 19% of extent.
- Escarpment Redgum: 3,500ha affected by BMAD, representing 16% of extent.
- Grey Box-Northern Grey Gum: 1,300ha affected by BMAD, representing 25% of extent.
- Northern Grassy Sydney Blue Gum: 1,200ha affected by BMAD, representing 43% of extent.
- Northern Ranges Dry Tallowwood: 4,500ha affected by BMAD, representing 9% of extent.
- Northern Wet Tallowwood-Blue Gum: 2,000ha affected by BMAD, representing 22% of extent.

- Open Shrubby Brushbox-Tallowwood:1,100ha affected by BMAD, representing 16% of extent.
- Richmond Range Spotted Gum: 3,400ha affected by BMAD, representing 14% of extent.
- Wet Bloodwood-Tallowwood: 7,300ha affected by BMAD, representing 18% of extent.
- Northern Wet Brushbox: 2,200ha affected by BMAD, representing 17% of extent.
- Sub-Tropical & Warm Temperate Rainforest: 5,000ha affected by BMAD,, representing 5% of extent.

It is obvious that State Forests are worst affected by BMAD, though this extends to many areas of State Forests added to the reserve system as a result of ALP pre-election promises and the RFA process in the late 1990s.

BMAD affected native forests State Forests

NAME	SF Total Area	BMAD 2018 Ha		BMAD Add 2004	TOTAL BMAD	
	ha	ha	%	ha	HA	%
Lowlands Grey Box	204	10	5.0	1	11	5.6
Clarence Lowlands Spotted Gum	1585	35	2.2	0	35	2.2
Coastal Flooded Gum	894	260	29.1	150	411	45.9
Dry Foothills Spotted Gum	160	16	10.2		16	10.2
Dry Heathy Blackbutt-Bloodwood	959	7	0.8		7	0.8
Dunns White Gum	192	69	36.2	2	72	37.3
Escarpment Redgum	2622	776	29.6	233	1009	38.5
Wet Bangalow-Brushbox	32	0	0.7	10	10	31.0
Gorge Grey Box	56	21	37.2	10	31	56.0
Grey Box-Red Gum-Grey Ironbark	1531	423	27.6	62	485	31.7
Grassy New England Blackbutt-Tallowwood-Blue Gum	88	8	8.9	28	36	40.2
Grey Box-Northern Grey Gum	2042	461	22.6	189	651	31.9
Northern Grassy Sydney Blue Gum	1060	311	29.4	257	568	53.6
Northern Ranges Dry Tallowwood	5219	838	16.1	414	1252	24.0
Northern Wet Tallowwood-Blue Gum	2550	450	17.6	263	712	27.9
Open Shrubby Brushbox-Tallowwood	459	52	11.3	31	83	18.0
Richmond Range Spotted Gum	4643	1390	29.9	538	1927	41.5
Richmond Range Spotted Gum-Box	5434	2	0.0		2	0.0
Stringybark-Apple	758	14	1.9	0	14	1.9
Wet Bloodwood-Tallowwood	7673	2401	31.3	956	3356	43.7
EUCALYPT FOREST SUB-	40963	7545	18.4	3144	10688	26.1

TOTALS						
Northern Wet Brushbox	2290	494	21.6	592	1086	47.4
Sub-Tropical Rainforest	250	20	8.2	14	34	13.6
Dry Rainforest	569	0	0.0	0	0	0.0
Sub-Tropical & Warm Temperate Rainforest	4948	569	11.5	707	1276	25.8
WET FOREST SUB-TOTALS	8057	1084	13.5	1312	2396	29.7
FOREST TOTALS	49020	8882	18.1	4502	13383	27.3

Note that sub-totals and totals for forests include non-affected forests not shown in tables

2.1. BMAD Impacts on Threatened Ecological Communities

Threatened Ecological Communities have only been mapped over State Forests by the EPA. There are four mapped Endangered Ecological Communities (EECs) occurring on State Forests in the region.

Grey Box-Grey Gum Wet Sclerophyll Forest: 2,918ha mapped, the 2018 mapping shows 615ha affected by BMAD, with the 2004 mapping showing an additional 543ha. Taken together these total 1158ha of BMAD, representing 40% of the total extent of this EEC on State Forests.

White Gum Moist Forest: 678 ha mapped, the 2018 mapping shows 172ha affected by BMAD, with the 2004 mapping showing an additional 66ha. Taken together these total 238ha of BMAD, representing 35% of the total extent of this EEC on State Forests in the region.

Lowland Rainforest: 2,926ha mapped, the 2018 mapping shows 442ha affected by BMAD, with the 2004 mapping showing an additional 466ha. Taken together these total 908ha of BMAD representing 31% of the extent of this EEC on State Forests in the region.

Subtropical Coastal Floodplain Forest: 159ha mapped. Occurs in Royal Camp State Forest where it has been significantly affected by BMAD in the headwaters of Sandy Creek. This BMAD was documented in NEFA's audit of Royal Camp State Forest, though was ignored by the EPA, and has been missed in DPI's mapping.

Note that the EEC White Gum Moist Forest to a large extent corresponds with the Forestry Corporation's Forest type 51 Dunns White Gum which was mapped long ago and was thus mapped in State forests which were converted to national parks. It is revealing that even on State Forests the EPA mapping doesn't pick up all Dunns White Gum. The OEH mapping identifies 689 ha of Dunns White Gum of which 39% has been mapped as affected by BMAD.



BMAD along Sandy Creek in the EEC Subtropical Coastal Floodplain Forest identified to the EPA in NEFA's Royal Camp Audit Report. The EPA response was to do nothing, aside from noting that "EPA officers determined that this area is susceptible to BMAD, noting presence of Bell Miners, active dieback in surrounding areas, lantana understorey". Five years later it wasn't even mapped.

2.2. BMAD Impacts on Koala

There are 6,358ha of mapped high and very high quality Koala habitat according to DPI's 2017 mapping occurring on State Forests in the Border Ranges region. The 2018 mapping shows 1,196ha as being affected by BMAD, with the 2004 mapping showing an additional 656ha as affected. Taken together these represent 1852ha (28%) of high and very high quality Koala habitat occurring on State Forests. There are 551 historical records of Koalas on State Forests, of which 121 occur in forests identified as BMAD affected in 2018, with an additional 31 records in additional BMAD areas identified in 2004. Taken together this gives 28% of historical Koala records on State Forests now being in areas affected by BMAD.

It is also evident that ecosystems with dominance by the favoured Koala feed trees Tallowwood or Grey Gum are particularly badly affected by BMAD, for example on State Forests 40% of Grassy New England Blackbutt-Tallowwood-Blue Gum and 44% of Wet Bloodwood-Tallowwood are affected by BMAD.

BMAD has multiple impacts on Koalas, those feed trees not logged sicken or die, dense lantana can hinder movement between trees and Bell Miners may aggressively mob Koalas to drive them from affected areas.

3. The Causes of BMAD

It has long been evident that the removal of canopy and extensive soil disturbance caused by logging is the principal cause of lantana invasion and the initiation of dieback. This is discussed on [NEFA's website](#) and in '[For Whom the Bell Miners Toll](#)' (Pugh 2014) so is not repeated here. This review focuses on the findings of the NSW Government's latest literature review of the causes of BMAD.

Following an inspection of BMAD on the Richmond Range with NEFA in 2015, the then Environment Minister Mark Speakman directed the NSW Office of Environment (OEH) to undertake a review of BMAD, leading to the establishment of a BMAD review Project Steering Committee, comprising representatives of the Office of Environment and Heritage, NSW Department of Industry – Lands, Environment Protection Authority, and Forestry Corporation of NSW.

The project steering committee sought to answer the following questions:

- What is the current extent of BMAD-affected land in NSW, and what areas are currently at risk of BMAD? (Q1)
- What are the options for systematic monitoring of BMAD status and trend across NSW? (Q2)
- What causative factors lead to BMAD? (Q3)
- What are the economic, social and ecological impacts of BMAD? (Q4)
- What are the most effective management interventions to control BMAD, prevent BMAD and restore healthy forest? (Q5)
- What are the costs of intervention? (Q6)
- What impact does landholding size (small private versus large public lands) have on developing treatment options for BMAD? (Q7)

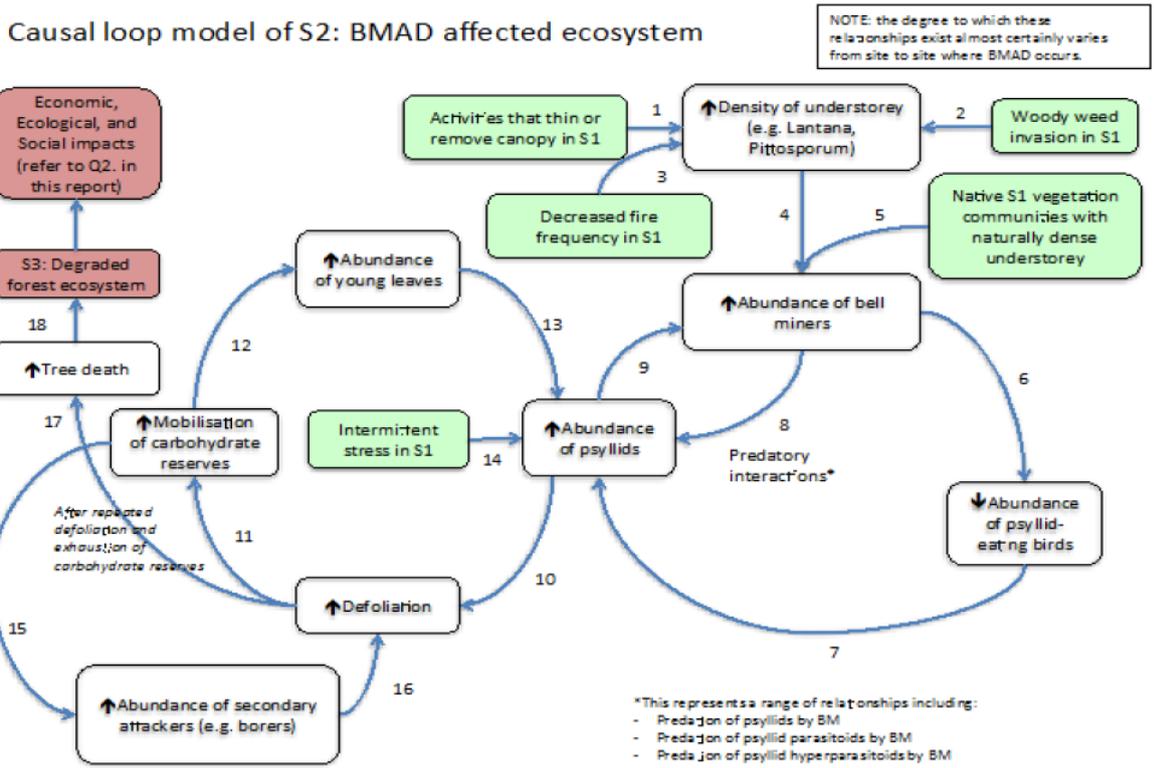
Once again the NSW Environmental Trust funded the project. And once again the Forestry Corporation have been allowed to run the process.

The BMAD mapping has been undertaken by the DPI forestry unit and the DPI have been allowed to co-author the "independent" literature review of the causes of BMAD (Silver and Carnegie 2017). The review confirms that over the last 20 years our knowledge of BMAD has made little progress while BMAD has been going gangbusters through our forests. There has been intentional obfuscation of the causes of BMAD, and the primary role of logging in causing it.

Yet again Silver and Carnegie (2017) found that the literature supports that logging is primary cause of dieback without clearly saying so. The process of BMAD has been identified for over 20 years, and the process is once again confirmed to be:

1. Reduction in density of overstorey canopy, or creation of gaps in the overstorey results in an increase in density of understorey plants, particularly the weed lantana ➤
2. Lantana outcompetes and suppresses native species, creating a dense understorey which is ideal for nesting by Bell Miners (Bellbirds) ➤
3. Aided by the open overstorey, Bell Miners aggressively mob other bird species (and predators and diurnal arboreal species) to exclude them from their territories ➤

4. The reduction in predators of the sap-sucking psyllids, coupled with the preferential feeding of Bell Miners on the psyllids sugary coatings (lerps) leaving the psyllids intact, enables populations of psyllids to proliferate ➤
5. Psyllids primarily feed on the leaves of eucalypt trees causing defoliation. The trees use their carbohydrate stores to produce new foliage with the young leaves even more attractive to psyllids ➤
6. Repeated defoliation depletes tree's carbohydrate stores, allowing for an increase in attack by secondary pests (such as wood-borers) and disease, and causing trees to sicken and die. Once a tree's carbohydrate stores are sufficiently depleted they may be unable to recover.



Silver and Carnegie's (2018) conceptual model of BMAD is their principal outcome, it once again identifies "activities that thin or remove canopy" (a.k.a. logging) as a primary instigator of BMAD, yet it also shows that there has been little progress since Stone (1999) developed a similar model 19 years ago.

It has once again been shown that the removal of trees and the disturbance of understoreies due to logging is the primary cause of BMAD. It is well past time that NSW Government agencies acknowledged this so that action can be taken to redress the problem.

The report identifies 20 case studies on BMAD intervention, though many are subjective assessments with no monitoring and it is not apparent that BMAD even existed at some sites. Silver and Carnegie (2017) comment:

Overall, the evidence base to identify effective BMAD interventions is of low quantity and poor quality. There have been very few studies conducted to a high standard and many are not conducted over a long enough time scale, often due to funding or institutional constraints. For this reason the review team could not remove cases based on the quality of evidence even though critical appraisal was conducted.

Of the 20 Case Studies reported on, only 11 related to north-east NSW. Of these only Case Studies 1, 2, and 4 included monitoring of BMAD treatments. Case Study 3 had methodological problems as lantana control was only undertaken in 50x50m plots and Case Study 11 was a scientific study limited to exclusion of eucalypt leaves from predation. Case Studies 5 and 6 reported favourable results but were subjective statements with no monitoring, The other 4 "Case Studies" (7, 8, 9, 10) provided no meaningful results or did not appear to relate to BMAD. That there are only three studies across the whole of north-east NSW than can be used to assess the effectiveness of intervention in BMAD affected sites is a disgraceful outcome for the millions spent on rehabilitation works on public and private lands in north-east NSW. The responsible agencies should be ashamed of themselves.

As part of the review process NEFA submitted our report *For Whom the Bell Miners Toll* (Pugh 2014), and in response to further enquires about documents we referred to, NEFA provided the partial Forestry Corporation (2015) monitoring results for BMAD trials in Donaldson (Case Study 2, see section 4.1 of this report) and Mount Lindesay State Forests (Case Study 1, see section 4.2), to which one of the authors replied "*Thanks very much for the report it will help in detailing those two case studies. I could not find that anywhere publicly available*". How can it be that despite \$117,000 of public funding the Forestry Corporation has been able to suppress the results of the only trials that were supposed to assess the relative affects of mechanical disturbance, burning and logging on BMAD, even from a multi-agency Steering Committee?

Silver and Carnegie (2017) (Case Studies 1 and 2) do not report on the 2015 results in their summary or take them into account in their literature review. I find it astounding that for Donaldson State Forest (see 4.1.) the report cites results and a student study undertaken some 7 months after treatments that NEFA (Pugh 2014) strongly criticised for their short time frames, while failing to mention the results over 8 years NEFA provided to the reviewers (Forestry Corporation 2015). To make matters worse, after being advised of the trials, the reviewers did not apparently attempt to obtain the full results from the Forestry Corporation, particularly as there should have been another 2 monitoring sessions by now to better understand the consequences of machinery, burning and logging in expanding BMAD. The lessons to be learned from Donaldson and Mt. Lindesay SFs have been ignored as they don't satisfy the agenda of the Government agencies.

Silver and Carnegie (2017) recommend that for any activity (a.k.a. logging and roading) that disturbs vegetation communities susceptible to BMAD:

R3(a): Disturbance of the canopy should be minimised where possible.

R3(b): Where the canopy is disturbed, rehabilitation should focus on re-establishment of a canopy as soon as possible to limit unnatural understorey density.

R3(c): Site rehabilitation should include ongoing management of invasive weeds, particularly those that minimise natural regeneration and can act as superior nesting sites for Bell miners.

In keeping with their obfuscation, as an outcome the Steering Committee predictably dropped these recommendations from a proposed shortlist. The intent is to "Monitor BMAD" and "Establish a BMAD research and development program", though "a research program on lantana control" was identified as a "low" priority. It is a recipe for another 20 years of procrastination to allow the Forestry Corporation to rampage through public forests leaving BMAD in their wake, a legacy for future generations to deal with.

4. Dealing With Dieback

NEFA have been vainly trying to have Bell Miner Associated Dieback dealt with in the Border Ranges region for over 25 years. This is discussed on [NEFA's website](#) and in '[For Whom the Bell Miners Toll](#)' (Pugh 2014) so is not repeated here. This review focuses on NEFA's on ground attempts to have BMAD dealt with in a responsible manner in the Border Ranges region based on field audits since 2009.

NEFA considers that BMAD is the antithesis of Ecologically Sustainable Forest Management (ESFM). In the Comprehensive Regional Assessment from 1995-1998 NEFA tried in vain to have BMAD taken into account, being assured that it would be dealt with in accordance with the Regional Forest Agreement (RFA) requirements for ESFM. The North East NSW RFA stipulates:

46. New South Wales confirms its commitment to the achievement of ESFM on Public and Private Land consistent with the principles of Ecologically Sustainable Forest Management at Attachment 14, and to the ongoing review and subsequent implementation of its legislation, policy, plans, Codes and Regional Prescriptions to ensure ESFM objectives can be achieved in a more efficient regulatory environment.

Attachment 14 to the North East NSW RFA details the Principles of Ecologically Sustainable Forest Management. It is apparent that the promotion of BMAD contravenes all the principles of EFSM, those of particular relevance include:

Principle 1: Maintain or increase the full suite of forest values for present and future generations across the NSW native forest estate

- The principle of intergenerational equity (that in meeting the needs of the present generation, the ability of the future generations to meet their own needs is not compromised) is embodied in this principle.*
- ...*
- Ensure the long-term maintenance of the full range of values of the NSW existing forest estate. The intention is to maintain or increase not only the full range of values, but also the magnitude or level at which those values are maintained or increased.*

Aims for values include

A Biodiversity

- Biological diversity of forests at the ecosystem, species and genetic levels where biological diversity includes natural patterns of ecosystems, species and gene pools in time and space.*

B The productive capacity and sustainability of forest ecosystems

- Maintain ecological processes within forests (such as the formation of soil, energy flows and the carbon, nutrient and water cycles, fauna and flora communities and their interactions).*
- Maintain or increase the ability of forest ecosystems to produce biomass whether utilised by society or as part of nutrient and energy cycles.*
- Ensure the deleterious effects of activities/disturbances which threaten forests, forest health or forest values are minimised.*

C Forest ecosystem health and vitality

- Reduce or avoid threats to forest ecosystems from introduced diseases, exotic plants and animals, unnatural regimes of fire or flooding, wind shear, land clearing and urbanisation.
- Promote good environmental practice in relation to pest management.
- Ensure the deleterious effects of activities/disturbances within forests, their scale and intensity, including their cumulative effects are minimised.
- Restore and maintain the suite of attributes (ecological condition, species composition and structure of native forests) where forest health and vitality have been degraded.

Principle 4 Apply precautionary principles for prevention of environmental degradation

The incorporation of the precautionary principle into decision making has been endorsed by State and Commonwealth Governments (Commonwealth of Australia 1992 p. 49, IGAE 1992) and is defined as ‘where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:

- *careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and*
- *an assessment of the risk-weighted consequences of various options.’*

Principle 5 Apply best available knowledge and adaptive management processes

ESFM would utilise the concept of adaptive management and continuous improvement based on best science and expert advice and targeted research on critical gaps in knowledge, monitoring or evaluation.

In keeping with the RFA the Integrated Forestry Operations Approval (IFOA) clause 2.7.1 requires that in carrying out forestry operations “SFNSW must give effect to the principles of ecologically sustainable forest management as set out in Chapter 3 of the document entitled, “ESFM Group Technical Framework”. The framework requires in part:

Principle 1 is: Maintain or increase the full suite of forest values for present and future generations across the NSW native forest estate. Relevant specific criteria are:

3.2.1.2 The productive capacity and sustainability of forest ecosystems

- *maintain ecological processes within forests (such as the formation of soil, energy flows and the carbon, nutrient and water cycles, fauna and flora communities and their interactions);*
- *maintain or increase the ability of forest ecosystems to produce biomass whether utilised by society or as part of nutrient and energy cycles;*
- *ensure the rate of removal of any forest products is consistent with ecologically sustainable levels;*
- *ensure the effects of activities/disturbances which threaten forests, forest health or forest values are without impact, or limited.*

3.2.1.3 Forest ecosystem health and vitality

- ...

- *ensure the effects of activities/disturbances within forests, their scale and intensity, including their cumulative effects are controlled and are benign;*
- *restore and maintain the suite of attributes (ecological condition, species composition and structure of native forests) where forest health and vitality have been degraded.*

The IFO (4.26) also requires:

SFNSW must ensure that the scale and intensity at which it carries out, or authorises the carrying out of, forest products operations in any part of the Upper North East Region, does not hinder the sustained ecological viability of the relevant species of tree, shrub or other vegetation within the part.

NEFA have been trying for years to get the Environmental Protection Authority and various Ministers to enforce the ESFM requirements and take action to stop the Forestry Corporation from targeting BMAD affected and susceptible stands for logging, and to rehabilitate areas after logging.

Within the Border Ranges BMAD has been specifically identified in NEFA reports and audits of logging in [Yabbra \(2009\)](#), [Royal Camp \(2012\)](#), [Koreelah \(2013\)](#), [Richmond Range \(2014\)](#), [Donaldson \(2014\)](#), [Cherry Tree \(2015\)](#) and [Sugarloaf \(2016\)](#) State Forests.

In response to plans to log a high quality stand, with patches of BMAD, in Donaldson State Forest, with widespread BMAD at lower elevations, NEFA ([Pugh 2014](#)) undertook a review of BMAD with particular reference to the Border Ranges. Two of the sites visited were where the Forestry Corporation had undertaken burning, mechanical and logging trials in BMAD affected forest, but had failed to monitor the outcomes in accordance with commitments.

Under the auspices of the Bell Miner Associated Dieback Working Group the then State Forests established management "trials" of BMAD in Donaldson State Forest in 2005 (see 4.1.) and Mt Lindesay State Forest in 2007 (see 4.2.), utilising some \$117,000 of Environmental Trust monies, with 120 monitoring plots established and commitments to 15 years monitoring. Only the initial 2 years results for Mount Lindesay were written up by the Forestry Corporation (St.Clair 2010), and it was only because of NEFA's complaints about the lack of monitoring and reporting (i.e. Pugh 2014) that the Forestry Corporation (2015) was forced to collate at least some results (though only a brief powerpoint presentation), claiming many of the records were missing.

It is no surprise that the Forestry Corporation tried to suppress the results (and still tries to) as the Donaldson Trials clearly show that the use of mechanical and fire treatments together resulted in 420% increases in lantana and 460% increases in Bell Miners after 8 years (FCNSW 2015), and the Mt. Lindesay trials found that logging increased lantana 145% and Bell Miners 104%, after 6 years (averaged across all plots, including those not affected by BMAD).

By 2009 it would have been very obvious to the Forestry Corporation that their trials had been an abject failure, so they started hitting BMAD areas as hard as they could, with the objective of removing all merchantable trees. In 2009 the Forestry Corporation returned to log BMAD affected and susceptible forests around their Donaldson trial area, leaving it to the discretion of the Harvesting Team Leader what treatment to apply.

In 2009 NEFA found horrendous logging of forests that had been affected by BMAD for 30 years in Yabbra State Forest (see 4.3), commenting:

Such logging can not be considered to be maintaining ecological processes, conducive to biomass production, to be ecologically sustainable, without (limited) impact, benign, restorative of forest health, or not to hinder the ecological viability of the natural vegetation. This is destroying the forest ecosystems and forest productivity. This logging is clearly not in accord with any of the principles of ecologically sustainable forest management as defined in the IFOA, and is clearly in breach of IFOA conditions 2.7.1 and 4.26.

NEFA's complaints resulted in the regulatory authorities issuing 6 Penalty Infringement Notices and 4 warnings for illegal logging, though they refused to take any action in relation to the logging of BMAD affected forests, the Department of Environment Climate Change and Water (DECCW - the forerunner of the EPA forest unit) responding (Simon Smith, DECCW, 19/5/2010):

DECCW notes your concerns regarding Bell Miner Associated Dieback (BMAD) and the principles of ecologically sustainable forest management. It is noted however that the NSW Scientific Committee's determination in relation to broad-scale canopy dieback associated with psyllids and Bell Miners "involves interactions between habitat fragmentation, logging, nutrient enrichment, altered fire regimes and weed-invasion". The Scientific Committee's determination also notes that "at present, no single cause explains this form of dieback. And it appears that 'Forest eucalypt associated with over-abundant psyllids and Bell Miners' cannot be arrested by controlling a single factor". An Inter-agency BMAD working group is working to improve knowledge on the interrelation of land management activities and the prevalence of BMAD.

...

As noted above, the NSW Scientific Committee's determination notes that there is inadequate information available to determine if Bell Miner populations and Bell Miner associated Dieback has been favoured by these logging and burning operations.

NEFA is perplexed as to how DECCW could reach such a conclusion when logging is clearly included as a causative factor. It is a perverse application of the precautionary principle.

NEFA took Forests NSW's CEO Nick Roberts on a site inspection in 2010, showing him a variety of the breaches and emphasising the parlous state of the forest and the already obvious lantana and regeneration problems. In Forests NSW's (2010) subsequent "Rehabilitation and Monitoring Plan, Compartments 162 and 163 Yabbara State Forest No 394" there was no mention what-so-ever of lantana or BMAD, and no proposals for rehabilitation. This plan was endorsed by DECCW.

Following NEFA's further complaint about the dying forest and inadequate regeneration, Nick Roberts, again inspected the forest on 13 December 2012 in company with NEFA. State Forests reluctantly agreed there was poor regeneration, and undertook to implement rehabilitation works to control weeds and plant trees in areas of poor regeneration. The Forestry Corporation subsequently prepared another plan. The January 2013 "Rehabilitation Plan 2013 Compartments (sic) 162&163 Yabbara State Forest Urbenville Management Area" states:

A follow up inspection by FNSW in December 2012 determined that some areas of the forest were not fully stocked with hardwood regrowth and that some areas of heavy weed burden persisted in the compartments.

The plan once again made no mention of BMAD and arbitrarily selected 6 areas for rehabilitation while excluding many BMAD areas on the grounds of affordability. The plan was never implemented and the forest abandoned to its fate.

As part of an audit report, in August 2012 NEFA complained that the Forestry Corporation were logging BMAD affected forests in Royal Camp State Forest and this was likely to aggravate both lantana and BMAD. It took a year for the EPA to respond, they recognised the presence of BMAD, stating "*No specific action taken but the broader issue is part of the EPA compliance priorities*".

In [NEFA's August 2014 submission](#) to the Upper House Inquiry "Performance of the NSW Environment Protection Authority (Inquiry) (vi) the regulation of forestry practices in Royal Camp State Forest" we raised the EPA's refusal to investigate the impact that logging would have on BMAD and their failure to raise the issue with the Forestry Corporation.

The EPA submission (29 August 2014) to the Inquiry states:

"In response to these matters, the EPA has included forest health issues, including this dieback as a compliance priority for EPA Crown forestry in 2013-14. The EPA will provide records of these observations to the Bell Miner Associated Dieback Working Group and the Forestry Corporation".

The Inquiry report (February 2015) states:

Potential exacerbation of bell miner associated dieback: The EPA considered the information tendered by NEFA regarding the presence of bell miners and susceptibility to the associated dieback in one area of forest. In response, the EPA has included forest health issues, including dieback, as a compliance priority for EPA Crown Forestry in 2013-14. The EPA will provide records of these observations to the Bell Miner Associated Dieback Working Group and the Forestry Corporation. It should be noted that NEFA observed that, in their view, this working group is unstaffed and powerless, with no power or ability to deal with such complaints.

On our initial site inspection of Koreelah State Forest in 2013 NEFA identified an area of Bell Miner Associated Dieback, part of an area which was mapped in the 2004 BMAD survey. On 12 May 2013 NEFA wrote to Mr Nick Roberts, Chief Executive Officer, Forestry Corporation of NSW, that:

As at Royal Camp the harvesting plan fails to recognise significant occurrences of Bell Miner Associated Dieback and proposes logging in and adjacent to affected areas with no special provisions to avoid aggravating the problem and facilitating its spread through adjacent stands. We observed an area of affected Blue Gum (with regrowth and lantana from previous logging), with numerous dead and dying trees, and a logging dump proposed to be constructed in the middle of it. I am particularly disappointed that you have allowed this to continue after we showed you the consequences in Yabbra SF.

On the 15 May 2013 Nick Roberts responded that:

The Integrated Forestry Operations Approval (IFOA, and specifically the TSL) does not prescribe any particular activity from harvesting areas affected by Bell Miner Associated Dieback (BMAD). FCNSW is of the opinion that infrequent disturbance, particularly by burning, is a primary cause of BMAD. The current harvesting operation, and any associated post-harvest burning and re-planting, provides a level of understorey disturbance to permit overstorey regeneration and regrowth of a more healthy forest.

NEFA subsequently undertook an audit, singling out one area of BMAD where a logging dump was proposed adjacent to a major stand of the Endangered Ecological Community White Gum Moist Forest as an area that should be protected. In November 2013 the EPA responded "*The EPA*

agrees that BMAD is a significant issue to ongoing forest health and has identified BMAD as a compliance priority", stating:

EPA officers have collated data from Koreelah State Forest and this information has been provided to the BMAD working group. This data will assist in continued research on BMAD. Such research will inform the development of strategic cross tenure BMAD landscape management actions in the future.

Accordingly I raised this issue at the BMAD Working Group meeting of 2 September 2015 (because OEH funding and support had been cut this was the first meeting of the Working Group since June 2013). When I asked whether any BMAD areas had been referred to the Working Group various members expressed surprise and claimed no knowledge of such a proposal, even the EPA representative at the meeting knew nothing about it. I agreed to write to the Chairman and detail the EPA claims (as identified above).

At the BMAD Working Group meeting the Forestry Corporation representatives made it very clear that they would resign from the Working Group if it attempted to consider logging because they did not agree with the Scientific Committee's identification of logging as a contributing factor to BMAD. The Chairman made it clear at the meeting that while people may express their views about logging, the Working Group will maintain its position of not taking any action in relation to logging.

The Chairman of the BMAD Working Group, Jim Morrison, (11 September 2015): responded to my letter (2 September 2015):

As chairman of the BMADWG I am unaware of any correspondence/information regarding observations of BMAD during compliance activities provided by the EPA to the BMADWG. I am also unaware of any specific complaints by NEFA regarding BMAD at Koreelah or Royal Camp SF's that have been passed on to the BMADWG from the EPA.

...

You are correct in assuming that the EPA have never referred any areas to the BMADWG in accordance with their compliance activities. You are also correct in assuming that BMADWG does not have the resources or ability to deal with such referrals.

The chair of the BMAD working group, along with NEFA, took the EPA's CEO Barry Buffier on a tour of BMAD rehabilitation sites in the Toonumbar valley in 2013.

In January 2014 NEFA undertook a brief assessment of Richmond Range State Forest (see 4.4), in compartments where the Forestry Corporation had identified BMAD in their harvesting plan, where we once again raised concerns about logging in BMAD affected and susceptible stands.

The EPA responded (Steve Hartley 16 April 2014):

The EPA also looked for signs of Bell Miner Associated Dieback and agrees that the understorey layers of the forest were impacted by dense lantana. EPA officers did not observe Bell Miner Associated Dieback, but clearly heard Bell Miners in the vicinity. It is clear such factors present a clear risk to the area's regeneration and future health. The EPA has notified FCNSW of these findings and will use this in our future regulatory work on this compliance priority.

As the Forestry Corporation were undertaking preparatory roadworks to commence logging in compartments 36 and 42 of Donaldson State Forest in May 2014 the North East Forest Alliance undertook a brief inspection (Initial Assessment, Donaldson State Forest), finding a number of stream breaches and relatively small patches of BMAD, recommending:

1. *Given the rampant Bell Miner Associated Dieback at lower elevations in compartments 43, 44, 45, 46, 47, 48 and 49, the abject failure of rehabilitation trials in compartments 44-49, the yet limited occurrences in compartments 36 and 42, and the high susceptibility of these forests to lantana invasion and BMAD that no logging should take place until:*
 - a. *The extent and severity of BMAD in compartments 36 and 42 is fully and accurately mapped;*
 - b. *The area of susceptible forest types is clearly delineated;*
 - c. *An explicit management and rehabilitation strategy is identified for affected and susceptible areas; and*
 - d. *Sufficient resources are available to immediately undertake and monitor required rehabilitation works.*

NEFA again wrote to Forestry Corporation CEO Nick Roberts (D. Pugh, 5 May 2014) stating:

It is unsurprising that all the evidence is that what occurred at Yabbra is an inevitable consequence of logging affected stands while refusing to undertake any rehabilitation works. It was a certain and intentional outcome. Surely you can't condone this as an inevitable consequence of your management? Hopefully a critical review of all trials undertaken will identify a workable management response and should be the highest priority for identifying management of BMAD sites.

Reliance on the evidence is that Brush Box and other hardier rainforest species are not vulnerable to dieback is an insufficient basis for the management of eucalypt dominated forests where they occur on sites that would not naturally be occupied by rainforest, and thus may not be able to support a forest dominated by rainforest over time. This is aside from the loss of native ecosystems

Could you please provide me with any other monitoring results you have from Donaldson or Mt Lindesay State Forests?

Will you declare a moratorium on logging BMAD affected and susceptible sites until a detailed and effective management response based on trial results is determined, applied and tested?

In response to a complaint about the proposed logging the EPA (Steve Hartley 1 August 2014) responded "*there is no mechanism in the existing forestry approvals to prevent or restrict harvesting in BMAD affected or potential areas*".

Given the EPA claim that it is up to the responsible Ministers to enforce the clauses of the IFOA relating to ESFM, rather than them, NEFA wrote to the then Environment Minister, Rob Stokes, on the 15 June 2014, attaching a detailed report "[For Whom the Bell Miners Toll](#)" (Pugh 2014) on BMAD, asking him to "*urgently intervene to stop what we consider to be unlawful logging of forests affected and susceptible to Bell Miner Associated Dieback (BMAD)*", commenting:

Our repeated attempts for the past 5 years to have the Environment Protection Authority stop logging of BMAD affected forests in what we consider to be a blatant contravention of the core principles of Ecologically Sustainable Forest Management (ESFM), and thus the Upper North East Integrated Forestry Operations Approval (IFOA) clauses 2.7.1 and 4.26, have been in vain. We also consider it a clear breach of one (1c) of the principal objectives the Forestry Act 2012, Section 6(2) of the Protection of the Environment Administration Act

1991 and the Forestry Corporation's ESFM Plans. These concerns are detailed in Section 4 of the attached report.

The EPA claim that it is up to the responsible Ministers to enforce the clauses of the IFOA rather than them. Thus our reason for writing to you.

In response to NEFA's (Pugh 2014) report the EPA (Barry Buffier 28 July 2014) replied on behalf of the Minister for the Environment, Rob Stokes:

I note your allegations that the EPA has not taken action on BMAD and has refused to enforce Integrated Forestry Operations Approvals (IFOA) requirements relating to Ecologically Sustainable Forest Management. Your report also asserts that the EPA is complicit in environmental crime. I reject these assertions. The EPA has and continues to take action on BMAD.

The EPA identified forest health as a key environmental compliance priority in the EPA's Crown Forestry Compliance Strategy for 2013/14. This included explicitly identifying BMAD as a compliance focus. By explicitly identifying BMAD in the Crown Forestry Compliance Strategy, the EPA has raised BMADs profile within the community, gathered information regarding its prevalence in audited areas and provided observations of BMAD affected forests directly to the BMAD Working Group. The EPA has also raised concerns about the potential impacts of logging in BMAD susceptible areas directly with the Forestry Corporation of NSW.

As previously discussed with EPA officers Gary Whytcross and Steve Hartley, the current coastal IFOAs include 'non-licence terms' that are open to interpretation and do not always deliver against their intended outcomes. Issues with the interpretation and enforcement of the IFOAs 'non-licence terms' are also clearly outlined in the IFOA discussion paper and are a focus for attention in the remake.

With the attachment stating:

BMADs causal factors are complex and its triggers are not known. Stopping logging in BMAD affected areas may be a viable management option, however, there is no agreement between subject matter experts that this should be pursued.

The EPA agrees that more information about the extent of BMAD is needed and that management interventions are needed to control this threat. There is no consensus across subject matter experts however about what those management actions should be. BMAD involves complex interactions between a number of biological factors and occurs across State forests, National Parks and private lands. There is also limited knowledge about BMADs causes and extent.

The EPA has requested FCNSW provide the information gathered through BMAD trials and management actions, including at Mount Lindesay and Yabbra State Forest. The EPA intends to review this information, seeking expert assistance where needed. This information also will be used to inform the remake of the coastal IFOAs.

On the 29 August 2015 NEFA took the then Environment Minister, Mark Speakman, on a brief tour of BMAD affected forests on the Richmond Range to show him the extent of the problem and provided him with background information. In response to his questions, on the 31 August 2015 NEFA wrote to the Environment Minister providing him with evidence linking logging and BMAD, asking him to intervene to enforce the IFOA by:

Placing all BMAD affected and susceptible areas under a logging moratorium until such time as appropriate management responses that restore ecosystem health and vitality are identified, trialled and proven to be effective.

Mark Speakman (4 November 2015) responded:

Bell Miner Associated Dieback

One of the key things you illustrated on our field trip on 29 August 2015 was the impact of BMAD on our native forests. I was interested and concerned to see how this process occurs and the disturbing changes to forest structure and composition that result. These changes pose threats to biodiversity and timber resources. I understand that BMAD spread is occurring across all tenures including state forest, national park and private land.

I acknowledge your recommendations on behalf of NEFA to cease logging in susceptible and affected forests, as outlined in the report 'For Whom the Bell Miners Toll', sent to the former Minister for the Environment Rob Stokes, on 12 August 2014. I understand that the causal factors of BMAD are complex, and that there is no consensus between subject matter experts about management options to control the spread of BMAD.

Improving the IFOAs

As BMAD is a land management issue, it appears that the most effective responses will be cross tenure and not necessarily delivered solely through the regulation of native forestry specifically. However, it is clear that the current Integrated Forestry Operations Approvals (IFOAs) do not reflect the threat posed by BMAD.

Under the current IFOAs, FCNSW must give effect to the principles of ecologically sustainable forest management when carrying out forestry operations, which includes a requirement to maintain or enhance the health and productivity of forests. The current coastal IFOAs include 'non-licence terms', of which ecologically sustainable forest management is one. Issues with the interpretation and enforcement of the IFOA 'non-licence terms' are also clearly outlined in the IFOA discussion paper and are a focus for attention in the remake.

He acknowledged that the EPA claimed to have only ever referred one case of BMAD to the BMAD Working Group - Koreelah State Forest. This had been an EPA "compliance priority" for two and a half years and this was the only action the EPA took to refer occurrences to the BMAD Working Group, and the Working Group denies even this was done. It is not apparent that the EPA ever sought to raise community awareness of the problem.

While the Minister did not stop the logging of BMAD affected and susceptible forests, to his credit he did direct the NSW Office of Environment (OEH) to undertake a review of BMAD, leading to the establishment of a BMAD review Project Steering Committee.

In March 2015 NEFA inspected Cherry Tree State Forest soon after logging had commenced. The Harvesting plan identifies that

Bell Miner Associated Die-back is a potential future forest health issue in some Flooded Gum and Grey Gum/Spotted Gum stands, particularly in the NE corner of Cpt. 359. Post-harvest burning and Eucalypt regeneration monitoring will be critical for this harvesting operation.

We identified one area of BMAD yet to be logged (where identified in the Harvesting Plan) and another area of BMAD adjacent to the logging area, finding most of the area proposed for logging surprisingly free of Bell Miners. We were concerned that Bell Miners would move through the forest along with the canopy opening and lantana promotion. NEFA considered "While all efforts should be made to avoid this, at the very least monitoring of their progress during the logging operation must be undertaken", accordingly recommending:

Existing Bell Miner Associated Dieback areas in the north east of compartment 359 (and all other occurrences) must be mapped, along with the current extent of Bell Miner colonies. The progress of Bell Miners as the logging progresses should be monitored.

Our attempts to have something done about the promotion of both lantana invasion and BMAD were apparently in vain because during our August visit we identified that the BMAD affected area had been heavily logged, with a significantly reduced overstorey, extensive lantana and high numbers of Bell Miners present.

In response to our final audit in December 2015 the EPA (December 2016) confirmed the presence of BMAD where we had identified, only proposing "*Bell Miner working group to be notified of locality*". By then the BMAD Working Group had long been disbanded.

In April 2016 the Forestry Corporation prepared a harvesting plan for compartments 59 and 60 of Donaldson State Forest. They had undertaken ground surveys to map moderate and severe BMAD, for the first time since the North East State Forests Harvesting Advisory Board had agreed that BMAD should be mapped ahead of all logging operations in the Border Ranges region. in 1997. Better late than never? The plan states:

- *Canopy health across the compartments varies from healthy to being severely affected by Bell Minor Associated Dieback (BMAD). BMAD assessment plots have been extensively placed throughout the compartments to stratify the severity of the dieback into nil/low, moderate and severe. Areas severely affected by dieback are excluded from harvesting as indicated on the operational map.*
- *In dieback affected areas, trees have a combination of characteristics including: having thin crowns, epicormic growth along branches, loss of seed bearing ability, discolouration of leaves and in severe cases total tree death. **Trees that are affected by dieback must be targeted for removal.***



BMAD affected forest logged against NEFA's entreaties in Cherry Tree State Forest in 2015.

It was in effect a prescription for clearfelling those areas moderately affected by BMAD. The logging was too much for the Githabul native title holders, in May 2016 they established a blockade of the logging operation and stopped the Forestry Corporation from logging anywhere on their lands (for now).

There is evidence is that BMAD can simply be controlled by removing lantana in a manner that does not create additional disturbance (see 4.5, also reported on by Silver and Carnegie (2017) as Case Study 4), provided it is subject to regular follow up works until natural regeneration is established. There are many private landowners across the region who can testify to this. There are problems where BMAD has been present long enough to deplete soil seed stores, particularly of eucalypts, meaning that replanting of some sites is required. There is a solution to the problem, if there is the will.

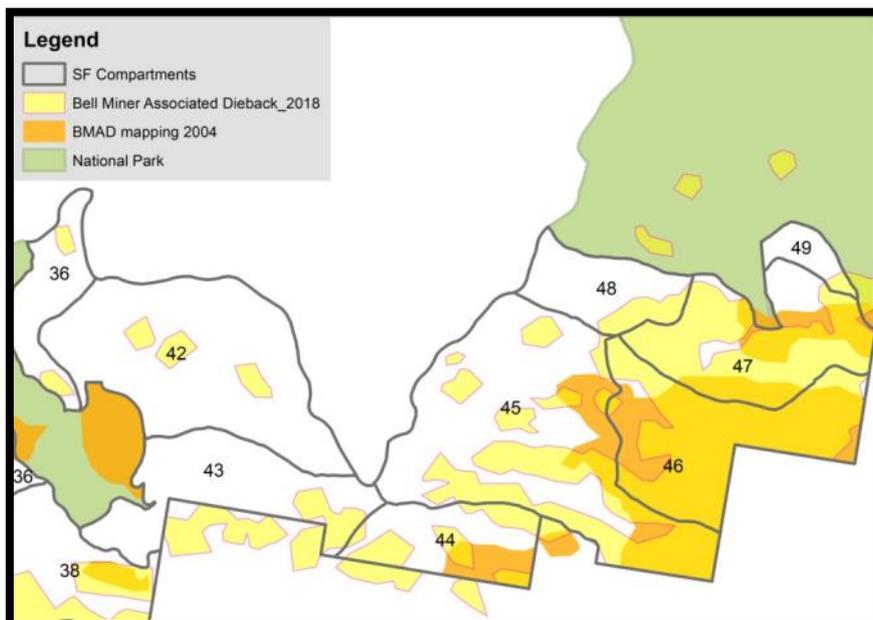
4.1. Donaldson Case Study

The Forestry Corporation prepared a Harvest & Rehabilitation Operational Management Plan for Compartments 44-49 of Donaldson State Forest on 17 October 2003. The forest was last logged in 1976-82 and had "*not been grazed or burnt for approximately 10 years*" (Shipman 2006).

In 2005 the BMAD Working Group determined to help fund trials of lantana control on Donaldson State Forest as one of three trials of using understorey control to redress BMAD (Pugh 2014). The trial was intended to:

- *Remove 25 hectares of dense shrub understorey in moist sclerophyll forest using dozer with follow-up spraying of herbicide.*
- *Remove 20 hectares of dense shrub understorey in grassy forest using dozer with follow-up regular low intensity fire.*
- *Remove 34 hectares of light to medium density shrub understorey in grassy forest using regular low intensity fire.*

The trial was meant to go for 15 years from November 2005 till 2020, with annual reports for first 3 yrs, then every 2 years thereafter. Costs were given as \$35,203 in kind and \$67,336 from the Environmental Trust via the BMAD working group.

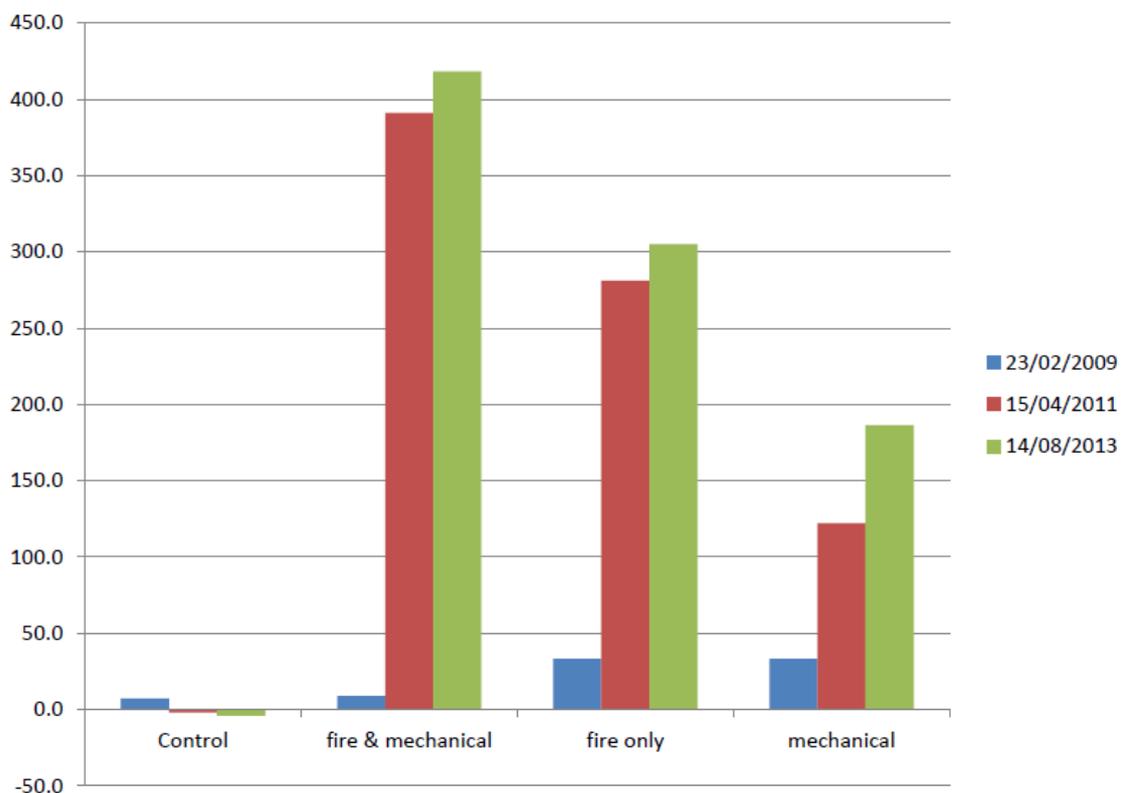


2004 and 2018 mapping of BMAD, Donaldson State Forest.

Shipman (2006) undertook intensive sampling of part of this area in compartment 46. Unfortunately the write up of results is poor, selective (i.e. native species other than eucalypts were classed as "weeds") and confusing. Shipman (2006) reports that "the prolific weed growth became a problem after fire", and that "There was patchy and generally poor regeneration of native forest eucalypts over the three treatments".

The Donaldson Trials clearly show dramatic increases over 8 years, with, for example, the combination of fire and mechanical treatments resulting in 420% increases in lantana, and 460% increases in Bell Miners after 8 years (FCNSW 2015).

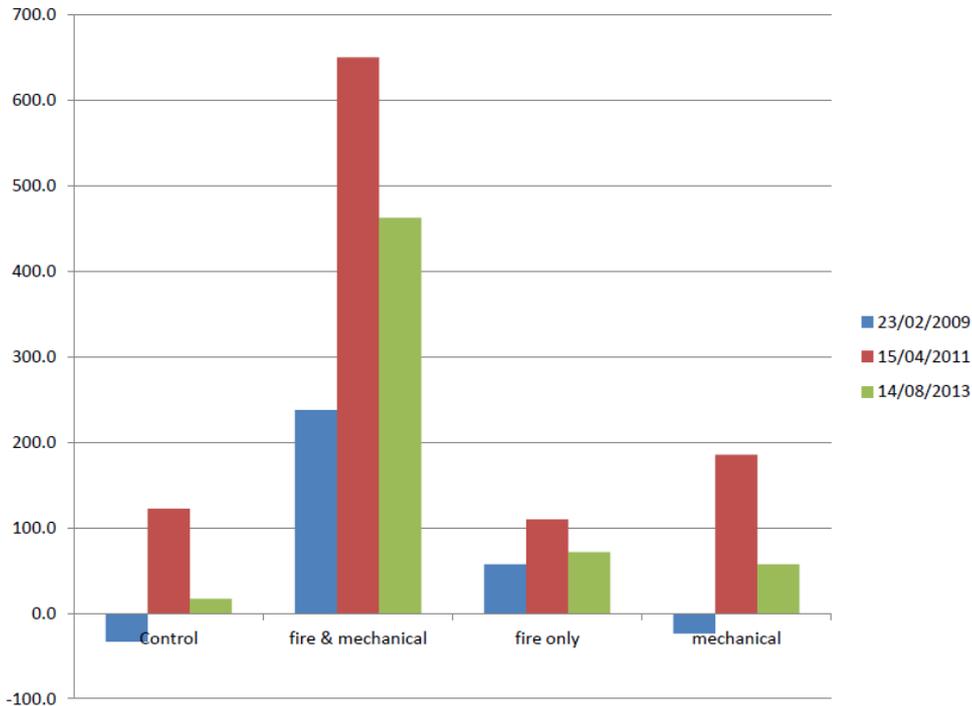
Lantana % change compared to original sample



The Forestry Corporation (2015) summarising:

- *Compromised experimental design reduces confidence in trial results*
- *Increase in Lantana especially in combined fire & mechanical treatment*
- *Bell Miner increase, but issues with data collection, inconsistent recording methods*
- *No regeneration or canopy health data*
- *Both treatments and control sites remain seriously unhealthy stand*

Bell Miner % change compared to original



The Forestry Corporation (2015) results for Donaldson State Forest.

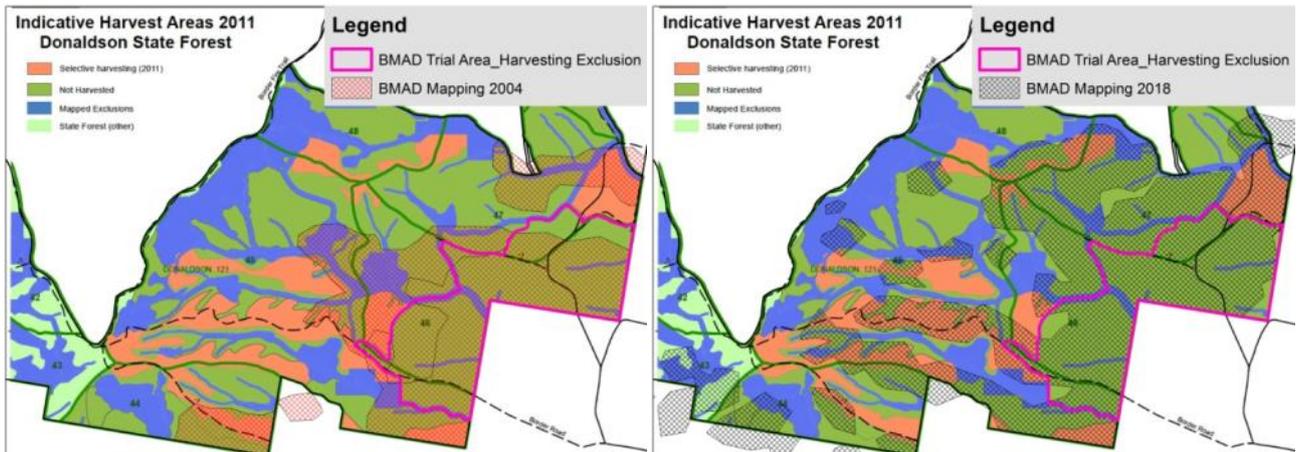
In 2011 the Forestry Corporation ignored the outcomes from their Donaldson trial, returning to Donaldson 44, 45, 46, 47, 48 and 49 in 2009. Logging commenced on 23 September 2009 and was suspended on 27 October 2009 presumably when the Forestry Corporation realised that they were logging in contravention of the requirements of the 2003 Harvest & Rehabilitation Operational Management Plan. A new Harvesting Plan was prepared in 2010, identifying:

Dieback is evident in various levels across parts of the harvest area. In affected areas the site is understocked and trees have thin crowns. There are numerous dead stags scattered across the harvest area. In affected areas understorey is predominately lantana under more open canopy and there is little healthy regrowth or potential for regrowth in the current state.

There was no mapping of BMAD. The trial area was to be excluded from logging, though elsewhere the intent was to "*Remove unhealthy merchantable trees*", with any treatment to be decided by the forester in charge:

Treatment

Treatment is to be developed on a site specific basis as operations progress by the Harvesting Team Leader and may involve a combination of harvesting, seed tree retention, mechanical disturbance, planting, weed control, and reintroduction of a low intensity fire regime. Treatments to be applied as required to obtain satisfactory regeneration event..



Comparison of BMAD mapping for 2004 (LEFT) and 2018 (RIGHT) overlaid on 2011 logging area (orange). While both mappings are of questionable veracity they indicate that the treatment of the trial area had no appreciable positive benefit on BMAD extent (and may have had a negative effect) and that the 2011 logging may have expanded the BMAD problem to higher elevations.

As the Forestry Corporation were undertaking preparatory roadworks to commence logging in compartments 36 and 42 of Donaldson State Forest in May 2014 the North East Forest Alliance undertook a brief inspection ([Initial Assessment, Donaldson State Forest](#)), finding a number of stream breaches and relatively small patches of BMAD, recommending:

2. *Given the rampant Bell Miner Associated Dieback at lower elevations in compartments 43, 44, 45, 46, 47, 48 and 49, the abject failure of rehabilitation trials in compartments 44-49, the yet limited occurrences in compartments 36 and 42, and the high susceptibility of these forests to lantana invasion and BMAD that no logging should take place until:*
 - a. *The extent and severity of BMAD in compartments 36 and 42 is fully and accurately mapped;*
 - b. *The area of susceptible forest types is clearly delineated;*
 - c. *An explicit management and rehabilitation strategy is identified for affected and susceptible areas; and*
 - d. *Sufficient resources are available to immediately undertake and monitor required rehabilitation works.*

NEFA followed this up with the report "[For Whom the Bell Miners Toll](#)" (Pugh 2014) on BMAD, which included a review of the BMAD trials in Donaldson and Mount Lindesay State Forests, emphasising the failure of the Forestry Corporation to undertake the required monitoring and reporting. Forcing the Forestry Corporation (2015) to belatedly compile their monitoring results into a brief report.

Part of the Donaldson trial area in compartments 45 and 46 was visited in May 2014, with the track forming the boundary of the Shipman (2006) area walked and visually assessed. NEFA (Pugh 2014) found:

Dense lantana growth meant that the area could not be readily assessed away from the track. The visual evidence is that, in this area at least, the trials utterly failed to control lantana, Bell Miners or BMAD. Lantana dominates the understorey, many trees are dead, most remaining eucalypts show evidence of BMAD (mostly severe), regeneration of eucalypts is patchy, wattles or lantana dominate large areas with few eucalypts. The Forest Red Gum stands at lower elevations seem to have been particularly severely affected with numerous dead and dying trees and little eucalypt regeneration.





ABOVE Photos of the BMAD trial area taken in May 2014.



ABOVE Photos of the 2011 logging adjacent to the BMAD trial area taken in May 2014.

In response to a complaint about the proposed logging from Jimmy Malecki the EPA (Steve Hartley 1 August 2014) responded:

Although the EPA is taking action on BMAD, it should be noted that there is no clear consensus between experts on the causes or viable treatments for this threat. BMAD involves complex interactions between a number of biological factors and occurs across state forests, national parks and private lands.

The EPA has raised the issue of BMAD with the Office of Environment and Heritage, the National Parks and Wildlife Service and the Forestry Corporation of NSW and will continue to work with these agencies where appropriate to develop cross tenure approaches to improve knowledge on this issue.

The EPA will continue to monitor the situation in Donaldson State Forest and has included the area in our forward native forestry audit program. However, as noted above, there is no mechanism in the existing forestry approvals to prevent or restrict harvesting in BMAD affected or potential areas.

The outcome was that the Forestry Corporation's logging schedules identified logging as current in compartments 36 and 42, later adding compartments 44-49, of Donaldson State Forest for years, though thankfully logging has not yet resumed.

4.2. Mount Lindesay Case Study

NEFA inspected compartment 276 and 279 of Mt Lindesay SF in 1997 when on the North East State Forest Harvesting Advisory Board (NESFHAB) in response to the Forestry Corporation's proposal to log the area. At that time the whole compartment was dominated by Bell Miners, particularly at lower elevations where BMAD was evident. Bell Miners had apparently been in the vicinity for a long time as the nearby "Bellbird Rest Area" was shown on the 1985 Second Edition of the Forestry Corporation's Forest Project Map.



BMAD in the vicinity of the now removed Bell Bird Rest Area, Compartment 276, May 2014

This area highlighted the issue of BMAD for the NESFHAB, leading to the preparation of "Discussion Paper: Psyllid/Bell Miner dieback area management" (Sharpe 1997) that proposed undertaking large scale rehabilitation of severely affected areas, and as part of the Harvesting Plan process mapping areas affected by BMAD (by class), identifying proposed management (including excluding logging from areas *"if it is decided that harvesting will further exacerbate the problem and that rehabilitation works are either impractical or unlikely to succeed"*) and details of specific remedial works. Unfortunately the Forestry Corporation blocked progress on this until the NESFHAB was disbanded and then abandoned it.

An outcome of the NESFHAB was a project to use Digital Multi-Spectral Video (DMSV) to quantify the extent and degree of canopy dieback in a 10,000 ha study area centred on Mount Lindesay, with the aim to be able to later use map comparisons *"to determine the stability of bellminer colonies, rate of spread of the dieback, make predictions on future spatial patterns and directions of the dieback across the landscape and confirm the stand risk criteria"*. In the end 5,000ha of State Forests was mapped using DMSV (all of Mt. Lindesay SF and compartments 34, 38, 55-58 of Donaldson SF), with 1:25,000 aerial photographs of all compartments and infra-red aerial photos of 8 compartments.

The Forestry Corporation established logging trials in BMAD in compartments 276 and 279 of Mt Lindesay State Forest in 2007 with over \$50,000 of Environmental Trust monies contributed through the BMAD Working Group as one of four trials of using understorey control to redress BMAD (Pugh 2014). It must have been apparent by then that the Donaldson trials failed. The forest had been variably logged, with the logging trials situated in a variety of forest types and a mixture of growth stages (disturbed oldgrowth, disturbed mature and young) mostly heavily logged from 1974-84, and the "control" mostly re-logged in 1996. The trials involved logging in combination with variable applications of mechanical disturbances, weed spraying, and burning, with some follow up weeding and planting. Objectives of the project were:

1. Lantana cover reduced to less than 15%
2. Increased health of retained trees
3. Decrease in abundance of bell miners (An indication of reduced habitat or food)
4. Maintenance of grassy understoreys
5. Restoration of severely degraded stands with natural regeneration, supplementary seeding and enrichment planting of native over-storey species
6. Integration of harvesting and rehabilitation

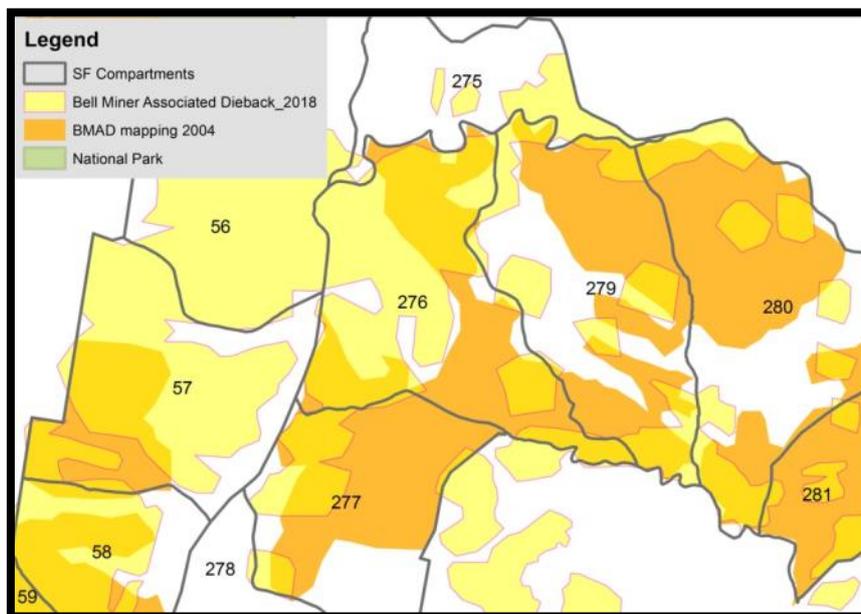
Forty plots were established in treated and 20 in control areas (logged in 1996 and suffering from dieback) with stratification based on broad forest types. Harvesting was conducted over the period May to September 2007. The results were apparently confounded by good rainfall leading to an improvement in tree health, a decline in lantana and a decline in Bell Miners on all plots, including the control. The results reported by St.Clair (2009) were only for the first two years, which can be summarised as:

- within 2 years Bell Miner numbers had recovered to pre-treatment levels relative to controls;
- Bell Miner numbers were related to lantana density;
- reductions in lantana cover was significant only in moderate and high intensity fire treatments, though lantana was showing significant recovery in the second year;
- the treatments did not improve the health of the retained trees relative to controls;
- Brush Box regeneration was two orders of magnitude greater than the eucalypts;
- regeneration of eucalypts was inadequate at most sites; and

- planting of eucalypt seedlings is vital to maintain a natural species composition in mixed stands.

The number of variables involved (such as 6 different forest types, numerous different canopy species, different understorey types, different disturbance histories and intensities, 4 disturbance types, lantana control, replanting etc) confounds meaningful interpretation of the results, particularly as there is "No recording of what has occurred where" (Forestry Corporation 2015). Undaunted St.Clair (2009) uses his short-term results and some convoluted logic to support his pre-determined position that the "removal of bell miners and poisoning or burning of lantana per se will not improve tree health. The phenomenon of linked lantana, psyllid and bell miner invasions is a consequence of poor tree health caused by deteriorating root function under changing soil conditions in the absence of fire as proposed by Jurskis (2005)". Based on this unsubstantiated and flawed assumption he goes on to make a variety of far reaching recommendations.

St.Clair (2009) does note "Whilst the cost of the project was significant, the opportunity cost of doing nothing is greater. The cost of rehabilitation was less than the likely loss of production if the forest continued to decline and die". St.Clair's (2009) estimated rehabilitation costs per hectare over 40 years ranged from \$200-2,500, though given the poor prognosis for much of his sites this may just reflect initial costs.



2004 and 2018 mapping of BMAD, Mt Lindesay State Forest.

NEFA (Pugh 2014) inspected the area and found:

For this review Hildebrand Road on the boundary between the compartment 276 and 279 was traversed in May 2014. BMAD was found to be widespread. The abundance of Bell Miners and lantana appeared to have markedly increased, and the structure of the forest deteriorated, since our 1997 assessment. There are numerous dead, dying and other BMAD affected trees, large areas have no or little overstorey, lantana dominates most of the understorey with large areas of wattles and patchy regeneration of eucalypts. As with Donaldson it is apparent that the full ramifications will become apparent over the next 15-25 years once the wattles begin to senesce and the regrowth reaches pole stage and begins to

show the effects of BMAD. It is evident that the objectives of the trial were not achieved and that the trials were once again an abject failure.

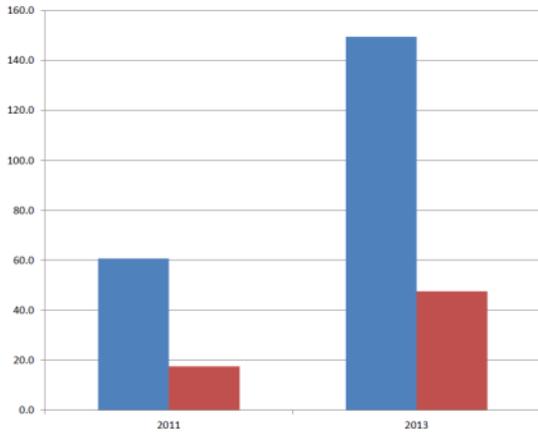


Photo of BMAD in Mount Lindsay taken in 2004.

For Mt. Lindsay over 6 years the Forestry Corporation (2015) found significant increases with a variety of treatments, including logging and burning: lantana 145%, Bell Miners 104%,

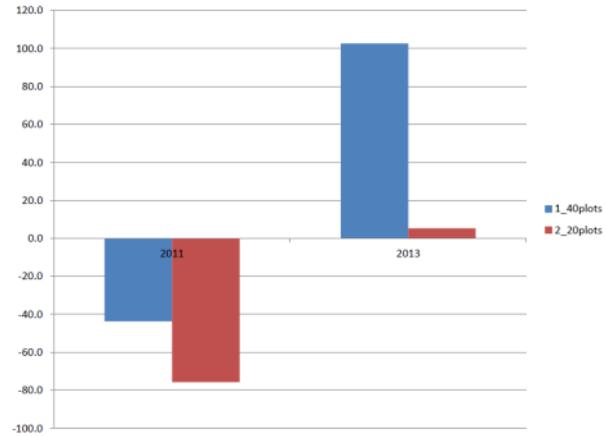
Mt Lindsay

Lantana % change compared to original



Mt Lindsay

Bell Miner % change compared to original

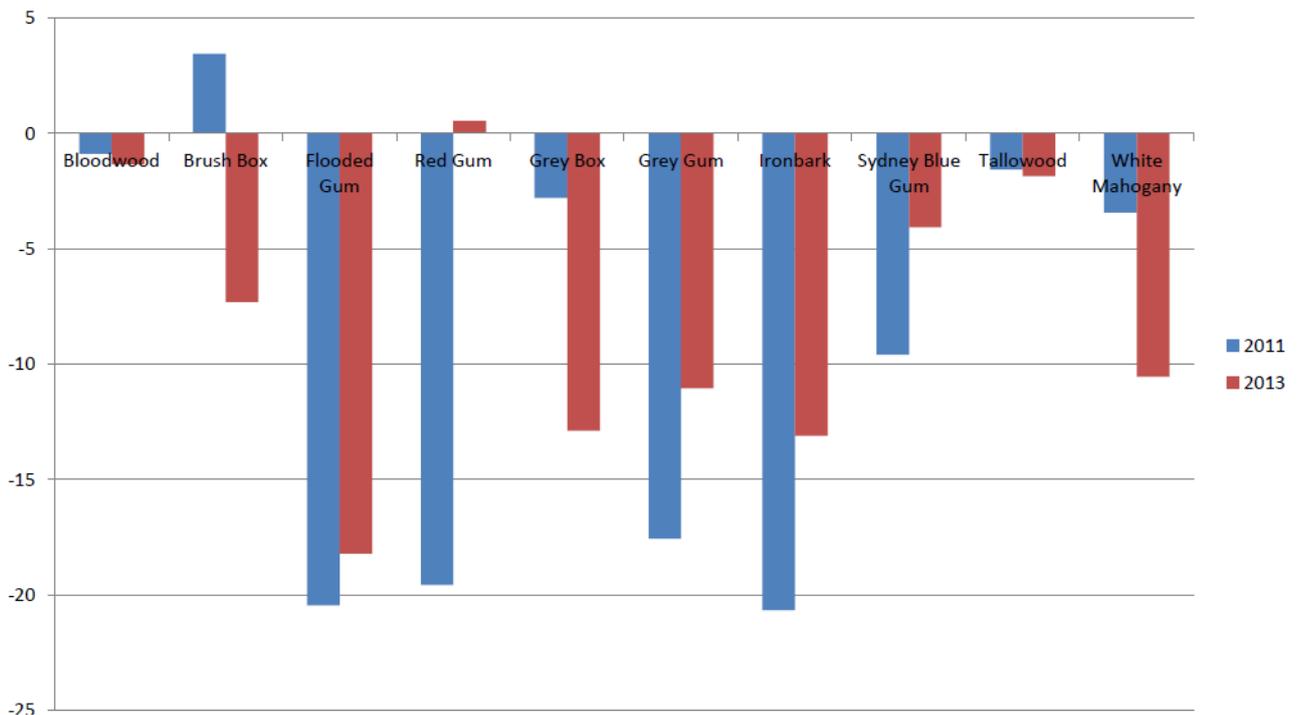


Forestry Corporation (2015) results for 2011 and 2013 reported for Mt. Lindsay State Forest. For these graphics blue represents the 40 trial plots and brown the 20 control plots.

The Forestry Corporation (2015) also report 10-20% declines in canopy health of Flooded Gum, Grey Box, Grey Gum, Ironbark and White Mahogany over the 6 years, which they consider "good".

Mt Lindsay

Canopy health % change compared to original by species



From Forestry Corporation (2015) showing significant declines in the health of most species following the trials.

Strangely the Forestry Corporation (2015) concluded these results showed:

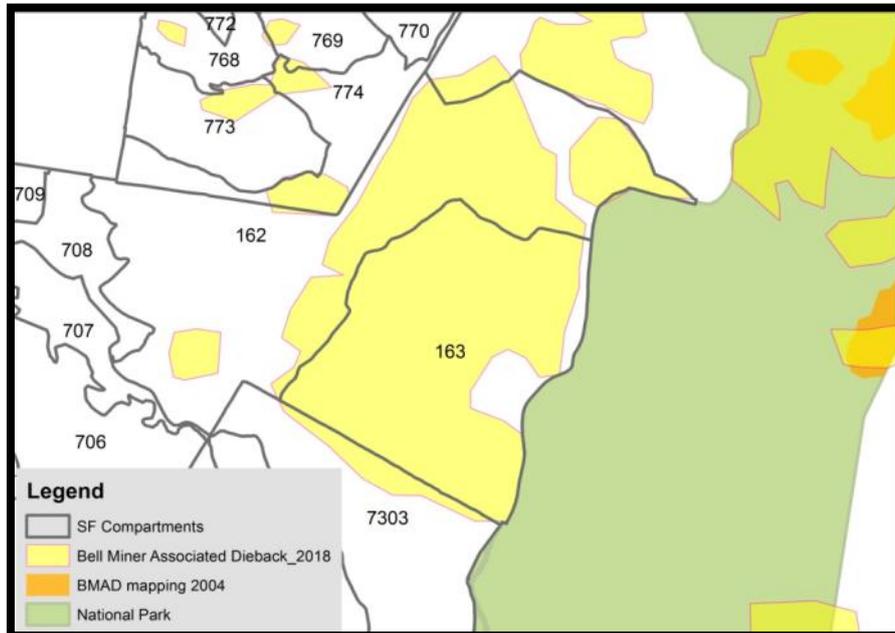
- *Variable change in Lantana*
- *Variable change in Bell Miner abundance*
- *Variable change in canopy health by species, some recovery may be evident*
- *Canopy health generally ok.*
- *Regeneration good in parts (particularly where planted) but no data has been collected on this yet*

This is a perverted interpretation of what are damning results, as when compared to the control none of the objectives the trial were realised: rather than a reduction in lantana by 15% there was a massive increase, rather than an increase in tree health most species deteriorated significantly, and rather than a decrease in Bell Miners there was a significant increase.

The full monitoring results from the trial should be released, along with the results from the last two monitoring periods. Though the Forestry Corporation appear intent on suppressing the outcomes from their trials.

4.3. Yabbra Case Study

Bell Miner Associated Dieback occurs in compartments 162 and 163 of Yabbra State Forest, and had been present since at least the early 1980s (pers. obs., Jurskis and Walmsley 2012). Despite BMAD being severe over an extensive area of compartment 163, and on the flight path of the Forestry Corporation's aerial survey, it was inexplicably missed in their 2004 BMAD mapping.



While the 2004 BMAD mapping inexplicably missed the existing BMAD in 2004, virtually the entire area logged in Compartments 162 and 163 in 2009 is now identified as BMAD in 2018 mapping.

The 2009 Harvesting Plan for compartments 162 and 163 of Yabbra SF (4.2) states:

Lantana & shrubby understorey is providing conditions suitable for occurrence of Bell Minor (sic) Associated Dieback (BMAD). A significant section of the harvest area has been adversely affected. There are many dead stems and the crowns of some of the remaining

trees are thin and appear unhealthy. BMAD affected areas will have unhealthy merchantable trees removed during this operation.

There was no mapping of dieback areas, no assessment of severity, no consideration of amelioration measures to apply in dieback areas, nothing. The Forestry Corporation had completed their Donaldson and Mount Lindesay trials so they knew what the outcome of this logging would be.

These compartments were logged in 2009 and audited by NEFA following logging ([Preliminary Audit of Compartments 162 and 163 Yabbra State Forest](#)). Given that most eucalypt trees in the worst affected areas were sick, the prescription that "*BMAD affected areas will have unhealthy merchantable trees removed during this operation*" resulted in the removal of most of the biggest and healthiest trees remaining in the dieback areas. Some retained trees were killed in the post logging burn and others by the added stress of the logging operation.

NEFA found that the Forestry Corporation made no attempt to delineate the area affected by dieback, logged most of the healthiest trees remaining, and had no intention to rehabilitate the severely degraded "forest" left behind. From our audit (Pugh 2009), we reported that:

Most remaining healthy trees were removed from forests affected by Bell Miner Associated Dieback (resultant from previous logging operations), having significant degrading impacts on forest health, ecosystem functioning and viability and forest productivity. Many retained affected trees had then succumbed to the hot post-harvest burn. This logging and "management" is clearly not in accord with any of the principles of ecologically sustainable forest management as defined in the IFOA (breaches IFOA conditions 2.7.1 and 4.26).

Bell Miner colony establishment was noted to be widespread throughout Compartments 162 and 163 and appeared to have been favoured by the logging and burning operations. It can be expected that the threatening process associated with colonies of this species (BMAD) will cause further deaths of trees, severely retard forest recovery and result in the loss of substantial areas of threatened species' habitat in the mid to long-term.





Logging of BMAD affected forests in Yabbra State Forest in 2009.

NEFA's complaints resulted in the regulatory authorities issuing 6 Penalty Infringement Notices and 4 warnings for illegal logging, though they refused to take any action in relation to the logging of BMAD affected forests, the Department of Environment Climate Change and Water (DECCW) responding (Simon Smith, 19/5/2010):

DECCW notes your concerns regarding Bell Miner Associated Dieback (BMAD) and the principles of ecologically sustainable forest management. It is noted however that the NSW Scientific Committee's determination in relation to broad-scale canopy dieback associated with psyllids and Bell Miners "involves interactions between habitat fragmentation, logging, nutrient enrichment, altered fire regimes and weed-invasion". The Scientific Committee's determination also notes that "at present, no single cause explains this form of dieback. And it appears that 'Forest eucalypt associated with over-abundant psyllids and Bell Miners' cannot be arrested by controlling a single factor". An Inter-agency BMAD working group is working to improve knowledge on the interrelation of land management activities and the prevalence of BMAD.

...

As noted above, the NSW Scientific Committee's determination notes that there is inadequate information available to determine if Bell Miner populations and Bell Miner associated Dieback has been favoured by these logging and burning operations.



Yabbra logging 2009.

Despite BMAD and lantana being emphasized in our audit, and on a site inspection with Forests NSW's CEO Nick Roberts in 2010 where he was shown the parlous nature of the forest and regeneration problems, in Forests NSW's (2010) subsequent "Rehabilitation and Monitoring Plan, Compartments 162 and 163 Yabbra State Forest No 394" there was no mention what-so-ever of the dieback issue, no delineation of problem areas, and no identification of rehabilitation measures relevant to the problem. There is no identification of problem and noxious weeds, not even a mention of Lantana. This plan was endorsed by DECCW.

Following NEFA's further complaint about the dying forest, Forestry Corporation's CEO Nick Roberts, Regional Manager Craig Busby, and Dean Kearney inspected the forest on 13 December 2012 in company with NEFA. On that inspection the Regional Manager kept referring to Brush Box regeneration as eucalypts, though the Forestry Corporation reluctantly agreed there was poor regeneration, and undertook to implement rehabilitation works to control weeds and plant trees in areas of poor regeneration.

The Forestry Corporation subsequently prepared another plan. The January 2013 "Rehabilitation Plan 2013 Compartments (sic) 162&163 Yabbra State Forest Urbenville Management Area" states:
A follow up inspection by FNSW in December 2012 determined that some areas of the forest were not fully stocked with hardwood regrowth and that some areas of heavy weed burden persisted in the compartments.

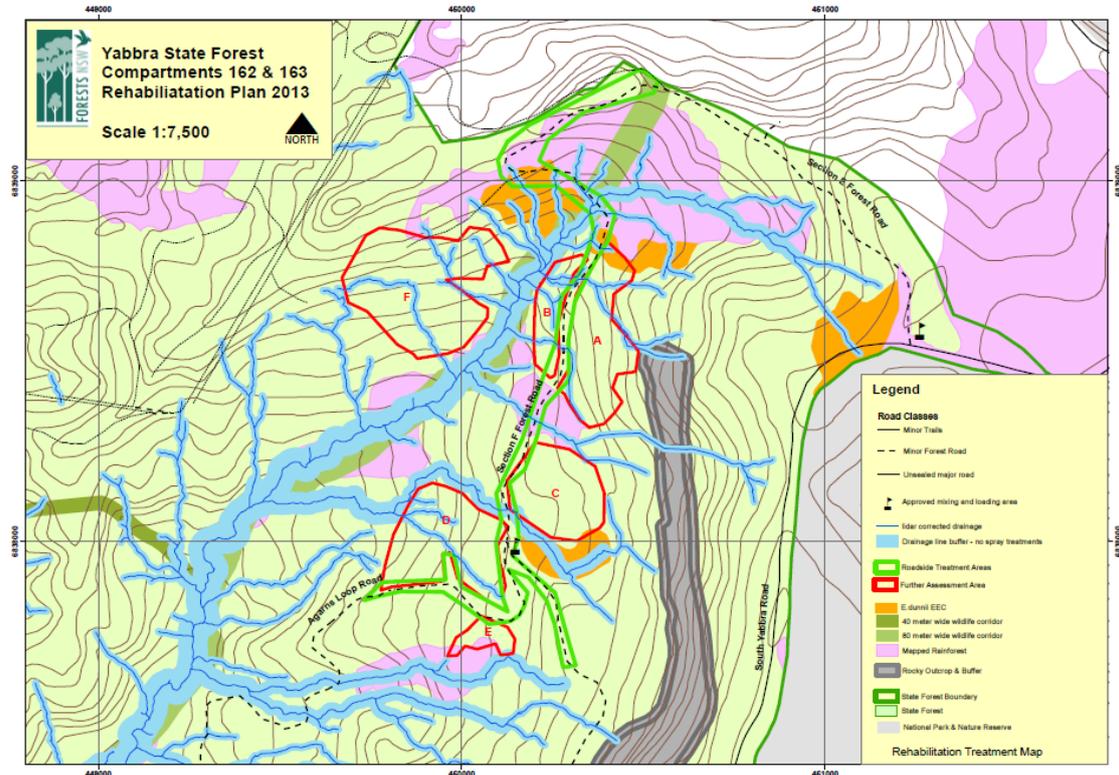
...

Roadside areas with large clumping lantana will be sprayed using high concentration, low volume technique (splatter gun). Occurrences of crofton weed, nodding thistle and moth vine will be also treated with spray application of herbicide. Areas for treatment will be marked in the field during January for herbicide application during late January – early February.



Yabba State Forest 3 years after logging in 2012.

In areas where overstorey canopy is sparse it was determined that traversing to identify understocked areas or areas with high weed loads would be undertaken. A treatment involving either back pack spraying or cut & spray of lantana stumps with enrichment planting with eucalypt species will be applied as determined appropriate. Detailed assessments will be undertaken during January with treatments applied as appropriate during late January – early February.



The Forestry Corporation’s rehabilitation plan identified 6 areas for rehabilitation work, though excluded large areas that were similarly degraded for budgetary reasons. There were a variety of deficiencies in the plan, most astoundingly that that there was no systematic assessment to identify all BMAD areas and that it totally ignored the issue of BMAD. NEFA said in response (Pugh 28/1/2013):

Bell Miner Associated Dieback is the principal process affecting these forests. BMAD will have the most significant affect on the success of regeneration. I am astounded that, as with Forests NSW’s Rehabilitation and Monitoring Plan, there is no mention or consideration of BMAD. I don’t understand how you can prepare a Rehabilitation Plan for the site without accounting for this influence. A plan that ignores the effects of BMAD is doomed to fail.

As well as recognising the widespread nature of Bell Miner Associated Dieback, it is essential to monitor Bell Miner populations and how they change as rehabilitation works and regeneration progress. If the works are not successful in controlling Bell Miners they are doomed to fail.

Dean Kearney responded (24/4/2013):

We have not focused on BMAD in this plan, as it has been prepared as an operational plan aimed at reducing weeds and establishing an stocking of appropriate tree species.

...

The designation of areas for detailed survey and remedial treatment identified in the plan reflects observations from field inspections, air-photo interpretation and consideration of the budget available to undertake any rehabilitation works. It is appropriate that operational plans be made with due consideration of all these factors...



BMAD affected forest excluded from Forestry Corporation's proposed 2013 rehabilitation areas on grounds of cost. Yabbra State Forest 2014.

The outcome was that the Forestry Corporation never undertook any rehabilitation works, so the only cost was the destruction of hundreds of hectares of forest.

4.4. Richmond Range Case Study

In 2005 (Stone *et.al.* 2005) a collaborative process by NSW Agencies used high resolution DMSI imagery to map BMAD across 30,000ha of the Richmond Range, including Richmond Range State Forest, identifying 49% of the forests as affected by BMAD, with 6,000 ha mildly affected and 8,700ha severely affected. Once again canopy removal was identified as a major cause.

The Forestry Corporation logged Compartment 329 of Richmond Range State Forest in 2010. The Harvesting Plan identifies areas around 3 log dumps as “Poor, severely affected by forest decline associated with Bell Miners (BMAD). Infestation of lantana widespread. This section will require a more intense regime of machine disturbance”, around 3 log dumps as “Moderately affected by BMAD. Lantana invasion of the midstorey is occurring”, and around 3 as “Good. Stand shows little sign of BMAD at this stage, mostly grassy and herbaceous understorey” (though with 2 log dumps cited twice for different severities). The 2005 (Stone *et.al.* 2005) mapping was not referred to or apparently used.

The silvicultural plan allocates logging intensity according to the degree of BMAD, with the worst affected areas targeted for the heaviest logging “Heavy STS, 50% BA removal”, noting “Heavy STS will result in higher BA removal in the area indicatively marked on the operational map. Machine disturbance will be more intense. The aim of this treatment is to create suitable conditions for seed regeneration and reduce Bell Minor (sic) habitat”.

Logging commenced in November 2010. A brief visit by NEFA in 2014 found that an area then described as “Good. Stand shows little sign of BMAD at this stage, mostly grassy and herbaceous understorey” is now suffering from BMAD.



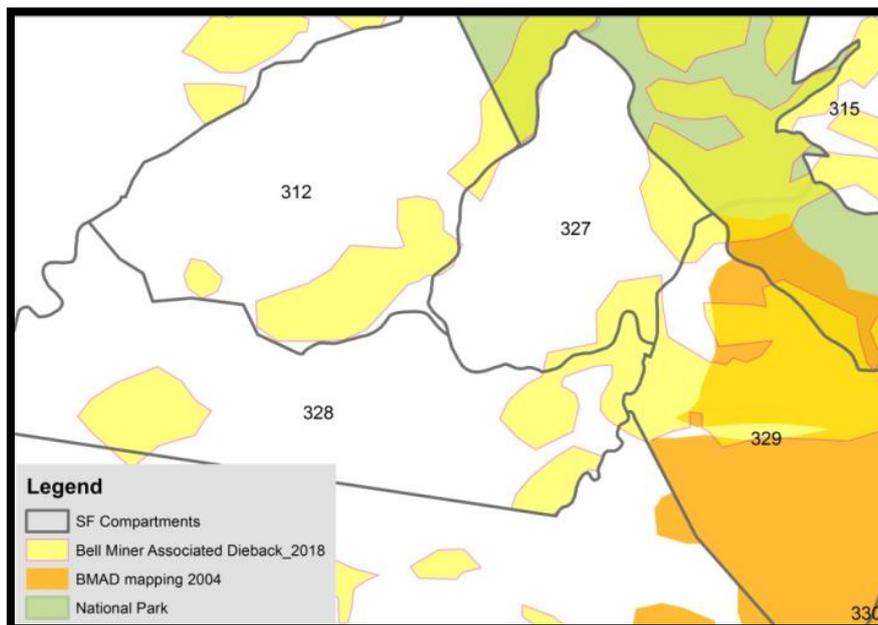
Forest identified in Richmond Range SF as “Good” with little sign of BMAD is now suffering from BMAD with numerous dead and sick trees following logging in 2010. Strangely this site has a grassy understorey.

The Forestry Corporation began logging in Compartments 327 and 328 of Richmond Range State Forest in 2014. The Harvesting Plan stating:

Generally moderate to good in Spotted Gum and Brushbox/Flooded Gum types becoming poorer to the south and lower slopes. The health of the stand is being affected by Bell Miner Associated Dieback (BMAD) especially in Red Gum/White Mahogany/Grey Gum Types and in Spotted Gum types where dense thickets of lantana exist.

The Harvesting Forester must assess BMAD areas after harvest and is responsible for ensuring that additional mechanical disturbance and planting is undertaken to achieve satisfactory regeneration.

NEFA undertook a brief inspection of logging in compartment 327 of Richmond Range State Forest in 2014 ([NEFA Complaint as Result of Brief Visit to Compartment 327 Richmond Range State Forest](#)) identifying a number of breaches, and again raising our concerns about BMAD, noting: *Bell Miner Associated Dieback is widespread in both compartments and all surrounding forests, including within the Richmond Range National Park as it has mostly been logged in this vicinity. Thousands of trees have already died in this vicinity and many thousands look in a parlous state. Bell Miners now dominate the avifauna over most of this part of the Richmond Range and have driven away most other diurnal bird species (including many threatened species), and, because of their aggressive mobbing, are likely to have affected populations of other species such as Koalas. The further opening up of the canopy and destruction of the rainforest understorey still present in some areas, will further facilitate the spread of lantana and increase dominance of the site by Bell Miners. The forest is already in a pitiful state and this logging will significantly exasperate the problem. The Forestry Corporation should be ashamed of themselves for stuffing up such important forests, and the EPA should be ashamed of themselves for facilitating such logging and ignoring the problem (despite pretending they will one day stop denying it and may even do something about it).*



2004 and 2018 mapping of BMAD, Richmond Range State Forest.

The EPA responding (Steve Hartley 16 April 2014):

The EPA also looked for signs of Bell Minor Associated Dieback and agrees that the understorey layers of the forest were impacted by dense lantana. EPA officers did not observe Bell Miner Associated Dieback, but clearly heard Bell Miners in the vicinity. It is clear such factors present a clear risk to the area's regeneration and future health. The EPA has notified FCNSW of these findings and will use this in our future regulatory work on this compliance priority.

Significant parts of the areas we specifically identified breaches in (and were thus visited by the EPA) are identified as being affected by BMAD in the 2018 BMAD mapping.

4.5. Creeks Bend

Landowners undertook lantana control on their property Creeks Bend in the Iron Pot Creek Valley as part of the BMAD Working Group trials. The aim was to remove 50% of 60 hectares of medium to dense Lantana using the splatter gun method. Somerville et. al. (2011) note:

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.

...

In 2005 before Lantana treatment commenced, Bell Miners were found throughout the forested areas, with only three small areas that 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 that had been filled with constant Bell Miner calls had become quiet.

...

The work on Creeks Bend since 2005, however, indicates that native forest badly degraded by BMAD 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. ... 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.

Somerville et. al. (2011) estimated the cost of their works as \$250 per hectare, noting "As techniques are refined, the cost per hectare is decreasing".

While the Forestry Corporation trials involving intensive disturbance have proven that their heavy handed approach only makes BMAD worse, the lantana control works on the private property at Creeks Bend provide strong evidence that a sustainable means of dealing with BMAD and restoring ecosystem health may be as simple as removing lantana in a manner that avoids intensive disturbance to native species and soils. Many other landholders have had similar results.

5. Conclusions

It is very disheartening to visit dying forests year after year as the Forestry Corporation target them for liquidation logging, removing all merchantable trees, and leaving seas of lantana with scattered dead and dying trees in their wake. In general they refuse to undertake rehabilitation, at best planting some token seedlings that they don't maintain. Their facilitation of the spread of lantana and dieback is ignored.

The wanton devastation of vast areas of forests and their wildlife has been underway for decades and is rapidly worsening, yet both those responsible for the environmental atrocities and those responsible for stopping them couldn't care less.

The evidence is clear that by opening up the overstorey and disturbing the understorey logging can facilitate the invasion and spread of lantana and thereby initiate and promote Bell Miner Associated Dieback (BMAD). Logging's legacy lasts well after the harvest, with lantana and BMAD still present and expanding in National Parks where logging was stopped over 20 years ago.

The current aerial mapping is subjective and unreliable, as shown by the limited (13%) correspondence between the 2004 and 2018 mapping. It clearly does not provide a reliable basis for identifying the current extent of BMAD or to be able to monitor changes over time. Haywood and Stone (2011) found using High Resolution Multi-spectral imagery and ALS Lidar reliably identified both stands which are actually colonised by bell miners and stands which are susceptible to colonisation by bell miners. The costs of such mapping are in the order of \$3 per hectare.

Given that the current aerial mapping is subjective and does not provide a reliable basis for identifying the current extent of BMAD or to be able to monitor changes over time, it is recommended that the worst BMAD affected areas be subject to objective and repeatable mapping using High Resolution Multi-spectral imagery and ALS Lidar to:

- accurately identify the current extent of BMAD affected and susceptible forests;
- provide a baseline from which to assess changes over time
- identify the variables affecting BMAD distribution
- quantify the accuracy of current mapping and other remote sensing technologies
- monitor the success of rehabilitation works

For the past 19 years forestry on public lands has been legally required by the Integrated Forestry Operations Approval (IFOA) to comply with the principles of Ecologically Sustainable Forest Management (ESFM). For the past 18 years the North East Regional Forest Agreement between the NSW and Commonwealth Governments has required forestry operations to be undertaken in accordance with the principles of ESFM. Over all this time the Forestry Corporation has been spreading BMAD through public forests despite its being the antithesis of ESFM. The EPA is the agency tasked with regulating forestry operations and yet has done nothing to stop this blatant contravention of the IFOA and the principles of ESFM. The EPA claim it is the responsibility of the Ministers to enforce the non-licence requirements of the IFOA, yet advise their Minister to do nothing.

It became obvious to me when exploring the western Border Ranges in the early 1980's that BMAD occurred on logged sites with lantana understoreys. Whenever I saw a patch of dead trees I would stop the car and sure enough I would hear the tinkling of Bell Miners. When Christine Stone (1995

1999) was tasked with assessing the extent and causes of BMAD for the then Forestry Commission she reached the conclusion that logging was one of the principal causes. When the NSW Scientific Committee listed BMAD as a Key Threatening Process in 2008 they considered it was initiated on sites "*where tree canopy cover has been reduced by 35 – 65 % and which contain a dense understorey, often of *Lantana camara**".

The Precautionary Principle is meant to underpin ESFM, requiring '*where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation*'. Contrary to this principle the Forestry Corporation have ignored their own research to adopt and apply a policy of maximising disturbance to BMAD affected stands. Meanwhile the EPA have adopted a reverse onus of proof, claiming that because there is a lack of agreement on the causes of BMAD that nothing should be done to prevent the environmental degradation that is occurring.

Because of these agencies' positions BMAD has been expanding through the forests of the Border Ranges at an alarming rate, leading to some 25,900 ha of State Forests and National Parks in the Border Ranges Biodiversity Hotspot now being variously mapped as affected by BMAD. The evidence is that BMAD is rapidly expanding on State Forests as affected stands are re-logged. We cannot afford to degrade any more forest, it is well past time it was stopped.

Given the abundant evidence that logging is the primary cause of Bell Miner Associated Dieback, and that re-logging affected forests makes it worse, it is well past time that the logging of BMAD affected and susceptible forests is stopped and the process of restoration begun.

On the basis of cost-recovery it is reasonable to expect the Forestry Corporation and sawmill owners to pay for the costs of repairing damage that has been incurred from past logging. There are various estimates of rehabilitation costs: St.Clair (2009) estimated rehabilitation costs per hectare over 40 years ranged from \$200-2,500; Somerville et. al. (2011) estimated the cost of their works as \$250 per hectare, noting "*As techniques are refined, the cost per hectare is decreasing*".

For discussion purposes, without accounting for past or future CPI, if it is assumed that the base cost is \$250 per hectare, with some 10% requiring replanting at the highest cost of \$2,500 per hectare, and if the target was to rehabilitate all currently affected forests over the next 20 years, for the Border Ranges this would require rehabilitating 1,300 hectares per annum at a cost of some \$617,500 per annum, and a total cost of \$12,350,000 over 20 years,

Given that around half the dieback recently mapped north from Taree occurs in the Border Ranges region, it would be reasonable to assume that the Border Ranges represent in the order of a third of the BMAD that exists in north east NSW, thus some \$1.85 million dollars per annum would be required over the next 20 years to repair BMAD affected forests.

Forestry Corporation's recent Expression of Interest identifies 185,000m³ of high quality sawlogs and 227,250m³ of low quality sawlogs available from north east NSW's forests per annum, therefore to recover the costs of rehabilitation from some 400,000m³ of sawlogs per annum would require a BMAD levy of \$4.60 per m³. Allowing for the likely under-estimated extent of BMAD and dwindling log supplies, a price of \$5 per m³ would be a more realistic starting point. Supply costs are put at \$60-90 per green metric tonne, so the averaged cost of \$75 per green metric tonne would equate to some \$90 per m³, giving a BMAD levy cost of 5.5%.

It is estimated that it would now cost over \$12 million to rehabilitate the currently BMAD affected public forests of the Border Ranges Biodiversity Hotspot, requiring over \$600,000 per annum and a rehabilitation target of 1,300ha per annum for 20 years to repair the damage that logging has already done. Applying the user/polluter pay principle it is considered that the Forestry Corporation should be liable for the costs of repairing forests they have degraded, even when now in national parks. In order to pay the annual cost of environmental repair across north-east NSW consideration should be given to imposing a "Dieback Repair Levy" of \$5.00 per cubic metre on the sale price of all hardwood sawlogs from north-east NSWs public native forests for the next 20 years.

Should there be a reduction in volumes of hardwood sawlogs a proportionate levy should be applied to softwood sawlogs.

The most urgent priority is to undertake and monitor lantana removal at a series of trial BMAD sites throughout north-east NSW as proposed by Silver and Carnegie (2017, recommendation 4.3) to both confirm the causal pathway and better refine and cost rehabilitation measures. As proposed, these trials need to be undertaken independently and transparently with clear objectives, monitoring and reporting requirements. As noted by Silver and Carnegie (2017):

Treatment must be manual removal of plants so that site disturbance can be minimised. This is essential as site disturbance will introduce confounding factors that may activate other causal pathways.

It is reprehensible that despite the public monies spent of rehabilitation works on both public and private lands over the past 20 years that only three studies have monitored the outcomes of treatments on BMAD affected forests, and that for the two studies undertaken on State forests the Forestry Corporation has been allowed to largely suppress and ignore the unfavourable results. In order to better understand the causes of BMAD and assess the effectiveness and costs of rehabilitation, the highest priority has to be to undertake independent and transparent lantana (and other problem plant) removal trials, using manual methods that minimise disturbance, with clear objectives, monitoring and reporting requirements.



Bell Miner

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